

Seneca Army Depot Activity

MEC Risk Assessment for OD Grounds, Rev. 1

MUNITIONS AND EXPLOSIVES OF CONCERN RISK ASSESSMENT AND ALTERNATIVES ANALYSIS

FOR

OPEN DETONATION GROUNDS

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Contract Number W912DY-08-D-0003 Task Order No. 0013 EPA Site ID# NY0213820830 NY Site ID# 8-50-006

Revision 1 November 2018



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C.1 BACKGROUND

C.1.1 A qualitative risk assessment was conducted to evaluate explosive hazards to human receptors. A risk from explosive hazards exists at an MRS if there is a complete MEC exposure pathway, consisting of a receptor that can come near or into contact with MEC and interact with the item in a manner that might result in its detonation. For this reason, the risk depends upon the presence of three critical elements, all of which must be present for a risk to exist from explosive hazards (i.e., there is no risk if any one of these three elements is absent). These three critical elements are:

- (1) A source of MEC (i.e., an explosively hazardous item);
- (2) A receptor (i.e., a person); and
- (3) The *potential for harmful outcome resulting from interaction between the MEC source and the receptor* (i.e., the possibility a receptor encounters the MEC item and causes energy to be imparted on it resulting in an unintentional detonation).

C.1.2 The qualitative risk assessment technique presented here follows the "Decision Logic to Assess Risks Associated with Explosive Hazards, and to Develop RAOs for MRSs" (USACE, 2017), hereafter referred to as the "Decision Logic to Assess Risks." The Decision Logic to Assess Risks provides an assessment of the explosive hazards associated with MEC at an MRS by analyzing MRS-specific conditions and human issues that affect the likelihood that a MEC accident will occur. The Decision Logic to Assess Risks focuses on risks to human receptors and does not directly address environmental or ecological concerns that might be associated with MEC. The Decision Logic to Assess Risks is described in a final study paper that was established as interim guidance by USACE on January 3, 2017 for a two-year trial period. The method uses input data based on historical documentation, field observations, and results of previous studies and removal actions. Most importantly, the Decision Logic to Assess Risks provides a means to evaluate site-specific factors with regard to explosive hazards at an MRS and differentiate acceptable versus unacceptable conditions.

C.1.3 The risk assessment presented below was conducted to evaluate the baseline conditions for the MRS regarding risks associated with explosive hazards and to evaluate the changes to the risks that would result from implementation of the response alternatives presented in the FS Report. This baseline risk assessment provides the basis for the evaluation and implementation of effective management response alternatives for mitigating unacceptable risks. The risk assessment also supports hazard communication among stakeholders by organizing MRS information in a consistent manner for the hazard management decision-making process.

C.2 ADDRESSING MULTIPLE RISK SCENARIOS

C.2.1 The Decision Logic to Assess Risks is applied to all portions of an MRS. However, the MEC-related characteristics of discrete areas within an MRS may differ regarding the munitions types and quantities, land uses, receptors, and other factors. If these factors differ significantly, the qualitative risks associated with explosive hazards in the discrete areas are also likely to vary. For example, the characteristics of a range impact area and its safety fan are likely to differ regarding the amount of MEC potentially present or different land use activities may exist that create differing potentials for MEC interaction with human receptors within a large maneuver area. Additionally, the current and future land uses at an MRS or part of an MRS may differ, which

might also affect the qualitative risks associated with explosive hazards. Finally, different levels of risk may also result in different response alternatives being appropriate for these discrete areas.

C.2.2 For these reasons, there may be multiple possible risk scenarios within the MRS and it may be appropriate to evaluate them separately. In such cases, two or more distinct risk scenarios may be identified, each of which will be the subject of a separate application of the Decision Logic to Assess Risks. However, if a project site is likely to be the subject of only one response alternative (e.g., the MRS is small), it may be evaluated using a single risk scenario despite the potential for differing risk-related characteristics. In this event, the most conservative input factors (see below) should be selected for purposes of the Decision Logic to Assess Risks. A determination regarding risk scenarios is made for each MRS subject to the risk assessment.

C.3 OVERVIEW OF INPUT FACTORS FOR DECISION LOGIC TO ASSESS RISKS FROM EXPLOSIVE HAZARDS

C.3.1 The Decision Logic to Assess Risks (USACE, 2017) uses three matrices (Matrices 1 through 3) to support the risk evaluation for each risk scenario. To complete the baseline risk assessment for the explosive hazards under each risk scenario, input factors for the three matrices are reviewed and suitable categories are selected based on historical documentation and data results. These matrices are related to the three critical elements noted previously and are:

- Likelihood of Encounter (Matrix 1), which is based on the input factors:
 - Amount of MEC (i.e., how much MEC is there at the site?).
 - *Accessibility* (i.e., how likely are human receptors to contact MEC at the site based on access conditions and frequency of use?).
- Severity of Incident (Matrix 2), which is based on the input factors:
 - Likelihood of encounter (see first bullet above).
 - Severity Associated with Detonation of Specific Munitions (i.e., if someone encounters MEC and it detonates, how many people might be injured and how seriously?).
- Likelihood of Detonation (Matrix 3), which is based on the input factors:
 - *Sensitivity/Susceptibility to Detonation* (i.e., how sensitive is the fuzing of the MEC?).
 - *Likelihood to Impart Energy on an Item* (i.e., what are the activities involved that might result in human receptors encountering MEC at the site?).

C.3.2 A fourth matrix (Matrix 4) combines the results of the other matrices to differentiate acceptable versus unacceptable conditions regarding risk from explosive hazards.

- Matrix 4: Acceptable and Unacceptable Site Conditions, which is based on the:
 - o Severity of Incident (i.e., output of Matrix 2).
 - *Likelihood of Detonation* (i.e., output of Matrix 3).

C.3.3 The four risk matrices and the input factors required to complete the risk assessment are described below, though more complete details and explanations are provided in the Decision Logic to Assess Risks (USACE, 2017).

C.3.4 *Matrix 1, Likelihood of Encounter*: This is dependent on two input factors, the *amount of MEC* items known or suspected to exist, and *access conditions* (e.g., accessibility and

frequency of use). "Amount of MEC" is determined using site specific characterization data or anticipated or completed results of a remedial action. Although the scale emphasizes the results of distribution, the selection may also include consideration of available historical information, such as former uses. "Access Conditions" are selected based on considerations of the access and frequency of use for the MRS. The selection considers "Accessibility" (i.e., how easily human receptors can gain access to the area), but also considers other relevant conditions, such as topography, terrain, specific land use, and specific potential receptors via defined pathways to establish access conditions as a frequency of use. Matrix 1 is shown in **Table C.1**.

			A	Access Conditions	s (frequency of	use)
	(An	Likelihood of Encounter nount of MEC versus Access Conditions)	Regular (e.g., daily use, open access)	Often (e.g., less regular or periodic use, some access)	Intermittent (e.g., some irregular use, or limited access)	Rare (e.g., very limited use, access prevented)
	I	MEC are visible on surface and detected in subsurface	Frequent	Frequent	Likely	Occasional
	п	MEC are known (i.e., <i>confirmed</i>) or suspected (e.g., <i>MD indicative of MEC is identified</i>) to be present on surface and in subsurface	Frequent	Likely	Occasional	Seldom
	ш	 There is physical evidence of MEC, or MEC concentration (e.g., MEC/acre) is below a project-specific threshold that supports this selection 	Likely	Occasional	Seldom	Unlikely
Amount of MEC	IV	 MEC presence is based on isolated historical discoveries (e.g., Explosive Ordnance Disposal report) prior to investigation, or A DERP response action has been conducted to physically remove MEC and known or suspected MEC remains to support this selection (e.g., surface MEC removal where subsurface MEC has not been addressed), or MEC concentration (e.g., MEC/acre) is below a project-specific threshold that supports this selection 	Occasional	Seldom	Unlikely	Unlikely
	V	 MEC presence is suspected based on historical evidence of munitions use only, or A DERP response action has been conducted to physically remove surface and subsurface MEC (evidence some residual hazard remains to support this selection), or MEC concentration (e.g., MEC/acre) is below a project-specific threshold that supports this selection 	Seldom	Seldom	Unlikely	Unlikely
	VI	 Investigation of the area did not identify evidence of MEC presence, or A DERP response action has been conducted that will achieve unrestricted use/unlimited exposure (UU/UE) 	Unlikely	Unlikely	Unlikely	Unlikely

Table C.1 Decision Logic to Assess Risks, Matrix 1: Likelihood of Encounter

C.3.5 *Matrix 2, Severity of Incident*: This factor relates "Likelihood of Encounter" from Matrix 1 (see above) to the severity of an unintentional detonation. Unlike the two factors affecting the likelihood of encounter in Matrix 1, the "Severity" factor in Matrix 2 is a static characteristic of each of the munitions known or suspected to exist at the site. Matrix 2 is shown in **Table C.2**.

	Foundation of Fundational Insident		Likelihood	of Encounter (fro	m Matrix 1)	
	May result in one or more injuries requiring emergency medical treatment, without hospitalization Minor: May result in one or more injuries requiring first aid or medical treatment, without hospitalization Improbable:	Frequent	Likely	Occasional	Seldom	Unlikely
ed with is Items	May result in one or more deaths, permanent total or partial disability,	A	A	В	В	D
Associated wit Munitions Item	May result in one or more injuries requiring emergency medical	В	В	В	С	D
Severity A Specific M	May result in one or more injuries requiring first aid or medical	в	С	С	С	D
	Improbable: No injury anticipated	D	D	D	D	D

 Table C.2

 Decision Logic to Assess Risks, Matrix 2: Severity of Incident

C.3.6 *Matrix 3, Likelihood of Detonation*: This factor relates the sensitivity of site specific munitions items to the likelihood of energy being imparted on an item, such that the interaction results in detonation (i.e., a MEC incident). MEC sensitivity and the likelihood for energy imparted during an encounter are both specific to the CSM. The "sensitivity" of a munitions item is inherent to the known or suspected munitions present at the site. The "likelihood to impart energy" is selected based on the known activities at the site that may cause an interaction that results in energy being imparted on a munitions item by human activity. Matrix 3 is shown in **Table C.3**.

 Table C.3

 Decision Logic to Assess Risks, Matrix 3: Likelihood of Detonation

		Likelihood t	Likelihood to Impart Energy on an Item				
()	Likelihood of Detonation Aunitions Sensitivity versus hood of Energy to be Imparted)	High (e.g., areas planned for development, or seasonally tilled)	Modest (e.g., undeveloped wildlife refuge, parks)	Inconsequential (e.g., not anticipated, prevented, mitigated)			
ibility	High (e.g., classified as sensitive)	I	1	3			
ivity: Susceptionity to Detonation	Moderate (e.g., HE or pyrotechnics)	1	2	3			
sensitivity: to Det	Low (e.g., propellant or bulk secondary explosives)	I	3	3			
Sen	Not Sensitive	2	3	3			

C.3.7 Matrix 4, Acceptable and Unacceptable Site Conditions: The final matrix represents the overall risk for the site and differentiates "acceptable" from "unacceptable" conditions. This is determined based on the likelihood of an encounter (Matrix 1), with consideration given to the severity of the incident (Matrix 2), combined with the likelihood of an interaction that results in detonation (Matrix 3). For example, a result of "A" from Matrix 2 and "3" from Matrix 3 indicates "Unacceptable" site conditions for risks when cross-referenced on Matrix 4. The overall risk for this selection is driven by a "frequent" or "likely" encounter (Matrix 1) with a potentially catastrophic munitions item (Matrix 2), even though the likelihood of a detonation (Matrix 3) is low ("3") based on sensitivity and likelihood to impart energy on the item. Matrix 4 is shown in **Table C.4**.

Acceptable and		Result from Matrix 2						
	eptable onditions	A	В	С	D			
3 .	1	Unacceptable	Unacceptable	Unacceptable	Acceptable			
rix [2	Unacceptable	Unacceptable	Acceptable	Acceptable			
Matr	3	Unacceptable	Acceptable	Acceptable	Acceptable			

 Table C.4

 Decision Logic to Assess Risks, Matrix 4: Acceptable and Unacceptable Site Conditions

C.3.8 At the end of characterization, the result from Matrix 4 is used to differentiate unacceptable from acceptable risk conditions. If an acceptable risk scenario is identified and concurred by the project team and stakeholders, then it may be possible to recommend no further action to address explosive hazards at the site. Where an unacceptable risk scenario is identified as the baseline condition, a remedial response is required to address risks from explosive hazards. In these situations, the matrices is used as part of the FS to identify remedial responses that will ultimately achieve acceptable conditions. A summary of this process is depicted in **Figure C.1**.

C.4 BASELINE RISK SCENARIOS

C.4.1 Description of Risk Scenarios - OD Ground MRS

C.4.1.1 *Overview*: A qualitative baseline risk assessment of hazards posed by MEC was developed for OD Hill by reviewing each of the input factors for the Decision Logic to Assess Risks described in Subchapter C.3 above. Historical data available from prior studies were used to determine the appropriate categories for each input factor. Selection of these categories for the OD Hill is discussed in the following paragraphs.

C.4.1.2 *Risk Scenarios*: The CSM for the OD Grounds MRS identifies two separate areas related to MEC contamination and planned future remediation: "OD Hill," and the "Kickout Area." Potential contamination related to UXO and DMM was identified in both the OD Hill and Kickout Area of the OD Grounds MRS. However, the amount of contamination related to UXO and DMM is higher for the OD Hill than the Kickout Area of the OD Grounds MRS and this is likely to influence the relative explosives hazards in both areas. For this reason, separate baseline risk scenarios will be evaluated for the OD Hill and Kickout Area.

C.4.1.3 Additionally, it is the ultimate goal of the Army to transfer the property containing the OD Grounds MRS out of DOD control; therefore, it is also anticipated that the land uses and associated receptors will change between the current use conditions at the property (i.e., under DOD control), and the planned future property use (as a Conservation/Recreation Area). For this reason, baseline risk scenarios will be evaluated for both current and future conditions at both the OD Hill and Kickout Area.

C.4.2 Baseline Decision Logic to Assess Risks from Explosive Hazards - OD Hill Area

C.4.2.1 Matrix 1, Likelihood of Encounter: Based on the CSM, MEC in the form of UXO and DMM are almost certain to exist subsurface and can be suspected to be present on the surface at the OD Hill. Therefore, the "Amount of MEC" for the OD Hill is determined to be "Category II". A "Category I" rating is not considered appropriate for this area because the surface of the OD Hill has been cleared during previous investigations; therefore, no MEC is anticipated to be visible on the surface. The OD Grounds MRS is located on a closed installation and Army operations at the site have ceased. A fence is present around the property containing the MRS, however, the fence is not monitored. Hunting is performed in the area. The deer hunting season begins in mid-November and ends during the second week of December. Based on these land uses, the "Access Conditions" for the OD Hill is determined to be "Intermittent" (i.e., some irregular use, or limited access) under current conditions with a possible change to "Often" (i.e., less regular or periodic use, some access) in the future during planned use as a conservation/recreation area. Evaluating these input factors on Matrix 1 results in a "Likelihood of Encounter" of "Occasional" for current and "Likely" for future conditions at the OD Hill.

C.4.2.2 *Matrix 2, Severity of Incident*: Evidence of UXO/DMM presence at the OD Hill included 2.36" High Explosive Anti-Tank (HEAT) Rocket Warhead (UXO), 75mm, 57mm, and 40mm projectiles (UXO), and M72 LAW Rocket Warheads (UXO). A MEC incident involving any of these munitions may result in one or more deaths, permanent total or partial disability, or hospitalization, and so the "Severity Associated with Specific Munitions Items" is determined to be "*Catastrophic/Critical*" for the OD Hill. The "Likelihood of Encounter" from Matrix 1 (see above) was determined to be "*Occasional*" for current use, and "*Likely*" for future use. Evaluating these input factors on Matrix 2 results in a "Severity of Incident" of "*B*" for current use, and a "Severity of Incident" of "*A*" for future use.

C.4.2.3 Matrix 3, Likelihood of Detonation: As described above, evidence of UXO/DMM presence at the OD Hill included 2.36" HEAT Rocket Warhead (UXO). The "Sensitivity: Susceptibility to Detonation" for the OD Hill is determined to be "High" based on the presence of HEAT munitions. The "Likelihood to Impart Energy on an Item" for the OD Hill is determined to be "Inconsequential" under current site conditions for three reasons: (1) intrusive activities are currently restricted to those following appropriate safety protocols; (2) the only allowed activity that could impart energy to UXO or DMM is walking over the site, but the previously completed surface clearance has removed all UXO and DMM that might have been susceptible to detonation via walking activities; and (3) current site access procedures include UXO safety education which stress the 3Rs. If the land is transferred without use restrictions in place, future land use could include plowing/tilling of food plots as part of the habitat development at the conservation/recreation area; therefore, the "Likelihood to Impart Energy on an Item" for the OD Hill must be conservatively assumed to be "High" under future site conditions. Based on the categories described above, the "Likelihood of Detonation" for the OD Hill is determined to be "3" under current conditions and "1" under future conditions.

C.4.2.4 *Matrix 4, Acceptable and Unacceptable Site Conditions*: As described above, the "**Severity of Incident**" (Matrix 2) for OD Hill was determined to be "*B*" for current use, and a "*A*" for future use while the "**Likelihood of Detonation**" (Matrix 3) was determined to be "*3*" under current conditions and "*1*" under future conditions. Evaluating the inputs of "*B-3*" and "*A-1*" on Matrix 4 indicates the overall risk from explosive hazards is "*Acceptable*" at the OD Hill under current conditions but is "Unacceptable" under future conditions. **Exhibits C.1 and C.2** summarize the matrix inputs and outputs for the OD Hill current and future conditions risk scenario, respectively.

C.4.3 Baseline Decision Logic to Assess Risks from Explosive Hazards - Kickout Area

C.4.3.1 *Matrix 1, Likelihood of Encounter*: Based on the CSM, MEC in the form of UXO and DMM have been confirmed on the surface and subsurface at the Kickout Area. Therefore, the "Amount of MEC" for the Kickout Area is determined to be "*Category I*". A "*Category I*" rating is appropriate for this area because the surface has not been completely cleared; and UXO/DMM have been confirmed on the surface during prior actions. The OD Grounds MRS is located on a closed installation and Army operations at the site have ceased. A fence is present around the property containing the MRS, however, the fence is not monitored. Hunting is performed in the area. The deer hunting season begins in mid-November and ends during the second week of December. Based on these land uses, the "Access Conditions" for the Kickout Area is determined to be "*Intermittent*" (i.e., some irregular use, or limited access) under current conditions with a change to "*Often*" (i.e., less regular or periodic use, some access) in the future during planned use as a conservation/recreation area. Evaluating these input factors on Matrix 1 results in a "Likelihood of Encounter" of "*Likely*" for current and "*Frequent*" for future conditions at the Kickout Area.

C.4.3.2 *Matrix 2, Severity of Incident*: Many different types of UXO/DMM items have been identified at the Kickout Area including a 75mm HE projectile, 2.75-inch rockets, 106mm HEAT projectiles along with MD from munitions types including bombs, grenades, mines, mortars, rockets, projectiles, and fuzes. A MEC incident involving many of these munitions may result in one or more deaths, permanent total or partial disability, or hospitalization, and so the "Severity Associated with Specific Munitions Items" is determined to be "*Catastrophic/Critical*" for the Kickout Area. The "Likelihood of Encounter" from Matrix 1 (see above) was determined to be "*Likely*" for current use, and "*Frequent*" for future use. Evaluating these input factors on Matrix 2 results in a "Severity of Incident" of "A" for current use and for future use.

C.4.3.3 *Matrix 3, Likelihood of Detonation:* As described above, evidence of UXO/DMM presence at the Kickout Area included 106mm HEAT projectiles. The "Sensitivity: Susceptibility to Detonation" for the Kickout Area is determined to be "*High*" based on the presence of HEAT munitions. The "Likelihood to Impart Energy on an Item" for the Kickout Area is determined to be "*Modest*" under current site conditions, because while intrusive or high energy activities are restricted to those following appropriate safety protocols, items may remain on the surface where receptors may impart energy on the item. A rating of "*Modest*" is typically selected for undeveloped wildlife refuges and parks. Future land use would include plowing/tilling of food plots as part of the habitat development at the conservation/recreation area; therefore, the "Likelihood to Impart Energy on an Item" for the Kickout Area is determined to be "*High*" under future site conditions. Based on the categories described above, the "Likelihood of Detonation" for the OD Hill is determined to be "*3*" under current conditions and "*1*" under future conditions.

C.4.3.4 *Matrix 4, Acceptable and Unacceptable Site Conditions*: As described above, the "Severity of Incident" (Matrix 2) for Kickout Area was determined to be "A" for both current and future use while the "Likelihood of Detonation" (Matrix 3) was determined to be "3" under current conditions and "1" under future conditions. Evaluating the inputs of "A-3" and "A-1" on Matrix 4 indicates the overall risk from explosive hazards is "Unacceptable" at the Kickout Area under current and future conditions. Exhibits C.3 and C.4 summarize the matrix inputs and outputs for the Kickout Area under current and future conditions risk scenario, respectively.

C.4.4 Summary of Results for OD Ground MRS

C.4.4.1 A summary of the results for the subareas and use scenarios at the OD Grounds MRS are presented in **Table C.5**. As described in the previous subchapters, the evaluation conducted using the Decision Logic to Assess Risks indicates the overall risk from explosive hazards is "*Acceptable*" at the OD Hill and "*Unacceptable*" in the kickout area under current conditions. The main difference between the OD Hill area and the Kickout Area is that in the OD Hill Area no MEC are expected on the surface while MEC are expected on the surface in the Kickout Area. The indicated overall risk from explosive hazards is "*unacceptable*" in both the OD Hill and the Kickout Area under the anticipated future land use conditions.

MRS/Area	Risk Scenario	UXO and DMM	Receptors	Exposure Pathways	Baseline Risk Condition (Matrix 4)	Risks from Explosive Hazards
OD Hill	Current conditions	UXO and DMM likely To many munitions types to list.	<i>Current</i> : Site workers	Potentially Complete	В-3	Acceptable
	Future conditions	UXO and DMM likely To many munitions types to list.	<i>Future:</i> Site workers, site visitors, and possible plowing of feed plots by site workers	Potentially Complete	A-1	Unacceptable
Kickout Area	Current conditions	UXO and DMM likely To many munitions types to list.	<i>Current</i> : Site workers	Potentially Complete	A-3	Unacceptable
	Future conditions	UXO and DMM likely To many munitions types to list.	<i>Future:</i> Site workers, site visitors, and possible plowing of feed plots by site workers	Potentially Complete	A-1	Unacceptable

 Table C.5

 Decision Logic to Assess Risks, Summary of Results for OD Grounds Current and Future Conditions

Exhibit C.1 Summary of Decision Logic Evaluation Results for the OD Hill Area Current Use Conditions Risk Scenario Seneca Army Depot Activity, Open Detonation Grounds

Likelihood of Encounter (Amount of MEC versus Access Conditions)			Access Conditions	s (frequency of use)	
		Regular	Often	Intermittent	Rare
	Category I (Most)	Frequent	Frequent	Likely	Occasional
EC	Category II	Frequent	Likely	Occasional	Seldom
01 MEC	Category III	Likely	Occasional	Seldom	Unlikely
AIBOUDE	Category IV	Occasional	Seldom	Unlikely	Unlikely
AIR	Category V	Seldom	Seldom	Unlikely	Unlikely
	Category VI (Least)	Unlikely	Unlikely	Unlikely	Unlikely

Matrix 2: Severity of Incident

	Severity of Explosive Incident	Likelihood of Encounter (from Matrix 1)					
	(Severity vs. Likelihood of Encounter)	Frequent	Likely	Occasional	Seldom	Unlikely	
	Catastrophic/Critical	A	А	В	В	D	
verity	Modest	В	В	В	С	D	
Seve	Minor	В	С	С	С	D	
	Improbable	D	D	D	D	D	

Matrix 3: Likelihood of Detonation

Likelihood of Detonation (Sensitivity vs. Likelihood to Impart Energy)		Likelihood to Impart Energy on an Item				
		High	Modest	Inconsequential		
-	High	1	1	3		
livity	Moderate	1	2	3		
Sensitivity	Low	1	3	3		
	Not Sensitive	2	3	3		

Matrix 4: Acceptable and Unacceptable Site Conditions

	Result from Matrix 2					
Acceptable and	Unacceptable Site Conditions	A	В	С	D	
	1	Unacceptable	Unacceptable	Unacceptable	Acceptable	
Matrix	2	Unacceptable	Unacceptable	Acceptable	Acceptable	
M	3	Unacceptable	Acceptable	Acceptable	Acceptable	

Exhibit C.2 Summary of Decision Logic Evaluation Results for the OD Hill Area Future Use Conditions Risk Scenario Seneca Army Depot Activity, Open Detonation Grounds

Likelihood of Encounter (Amount of MEC versus Access Conditions)			Access Conditions	(frequency of use)	
		Regular	Often	Intermittent	Rare
	Category I (Most)	Frequent	Frequent	Likely	Occasional
g	Category II	Frequent	Likely	Occasional	Seldom
OI MEC	Category III	Likely	Occasional	Seldom	Unlikely
ALINOULL	Category IV	Occasional	Seldom	Unlikely	Unlikely
W	Category V	Seldom	Seldom	Unlikely	Unlikely
	Category VI (Least)	Unlikely	Unlikely	Unlikely	Unlikely

Matrix 2: Severity of Incident

	Severity of Explosive Incident	Likelihood of Encounter (from Matrix 1)						
	(Severity vs. Likelihood of Encounter)	Frequent	Likely	Occasional	Seldom	Unlikely		
	Catastrophic/Critical	A	А	В	В	D		
erity	Modest	В	В	В	С	D		
Seve	Minor	В	С	С	С	D		
	Improbable	D	D	D	D	D		

Matrix 3: Likelihood of Detonation

_	Likelihood of Detonation	Likelihood to Impart Energy on an Item					
(Ser	nsitivity vs. Likelihood to Impart Energy)			Inconsequential			
	High	1 1 1 1 1	1	3			
tivity	Moderate	I	2	3			
Sensitivity	Low	1	3	3			
	Not Sensitive	2		3			

Matrix 4: Acceptable and Unacceptable Site Conditions

		Result from Matrix 2							
Accepta	ble and Unacceptable Site Conditions	Α	В	С	D				
ош 3	1	Unacceptable	Unacceptable	Unacceptable	Acceptable				
1 <u>2</u> ,2	2	Unacceptable	Unacceptable	Acceptable	Acceptable				
Result Matr	3	Unacceptable	Acceptable	Acceptable	Acceptable				

Exhibit C.3 Summary of Decision Logic Evaluation Results for the Kickout Area Current Use Conditions Risk Scenario Seneca Army Depot Activity, Open Detonation Grounds

	Likelihood of Encounter		_		
(Amount of MEC versus Access Conditions)		Regular	Often	Intermittent	Rare
EC.	Category I (Most)	Frequent	Frequent	Likely	Occasional
	Category II	Frequent	Likely	Occasional	Seldom
U MEC	Category III	Likely	Occasional	Seldom	Unlikely
ount	Category IV	Occasional	Seldom	Unlikely	Unlikely
Amount	Category V	Seldom	Seldom	Unlikely	Unlikely
	Category VI (Least)	Unlikely	Unlikely	Unlikely	Unlikely

Matrix 2: Severity of Incident

	Severity of Explosive Incident		Likelihood of Encounter (from Matrix 1)						
	(Severity vs. Likelihood of Encounter)	Frequent	Likely	Occasional	Seldom	Unlikely			
	Catastrophic/Critical	A	A	В	В	D			
erruy	Modest	В	В	В	С	D			
Seve	Minor	В	С	С	С	D			
	Improbable	D	D	D	D	D			

Matrix 3: Likelihood of Detonation

	Likelihood of Detonation	Likelihood to Impart Energy on an Item				
(Ser	nsitivity vs. Likelihood to Impart Energy)			Inconsequential		
1.1	High	1	1	3		
livity	Moderate	1	2	3		
Sensitivity	Low	1	3	3		
	Not Sensitive	2	3	3		

Matrix 4: Acceptable and Unacceptable Site Conditions

		Result from Matrix 2						
Acceptable and	Unacceptable Site Conditions	A	В	С	D			
10m	1	Unacceptable	Unacceptable	Unacceptable	Acceptable			
÷	2	Unacceptable	Unacceptable	Acceptable	Acceptable			
Matri	3	Unacceptable	Acceptable	Acceptable	Acceptable			

Exhibit C.4 Summary of Decision Logic Evaluation Results for the Kickout Area Future Use Conditions Risk Scenario Seneca Army Depot Activity, Open Detonation Grounds

			Access Conditions	(frequency of use)	
(An	Likelihood of Encounter nount of MEC versus Access Conditions)	Regular	Often	Intermittent	Rare
	Category I (Most)	Frequent	Frequent	Likely	Occasional
с С	Category II	Frequent	Likely	Occasional	Seldom
of MEC	Category III	Likely	Occasional	Seldom	Unlikely
Amount (Category IV	Occasional	Seldom	Unlikely	Unlikely
	Category V	Seldom	Seldom	Unlikely	Unlikely
	Category VI (Least)	Unlikely	Unlikely	Unlikely	Unlikely

Matrix 2: Severity of Incident

	Severity of Explosive Incident		Likelihood of Encounter (from Matrix 1)						
	(Severity vs. Likelihood of Encounter)	Frequent	Likely	Occasional	Seldom	Unlikely			
	Catastrophic/Critical	Λ	А	В	В	D			
erity	Modest	В	В	В	С	D			
Seve	Minor	В	С	С	С	D			
	Improbable	D	D	D	D	D			

Matrix 3: Likelihood of Detonation

	Likelihood of Detonation	Like	Likelihood to Impart Energy on an Item					
(Ser	asitivity vs. Likelihood to Impart Energy)	High	Modest	Inconsequential				
	High	a di sa basarina	1	3				
tivity	Moderate	ſ	2	3				
Sensitivity	Low	1	3	3				
¢1	Not Sensitive	2		3				

Matrix 4: Acceptable and Unacceptable Site Conditions

			Result from	m Matrix 2	
Accepta	hle and Unacceptable Site Conditions	A	В	С	D
from ix 3	1	Unacceptable	Unacceptable	Unacceptable	Acceptable
ult fr atrix	2	Chacceptable	Unacceptable	Acceptable	Acceptable
Result Matri	3	Unacceptable	Acceptable	Acceptable	Acceptable

C.5 ALTERNATIVE RISK SCENARIOS FOR THE OD GROUND MRS

C.5.1 Description of Alternatives – OD Grounds MRS

In addition to providing a technique to evaluate baseline MEC risks, the Decision Logic to Assess Risks (USACE, 2017) matrices may be used to evaluate the anticipated MEC risk conditions that would remain following implementation of a remedial action. This is done by evaluating how the assumptions made regarding the future conditions at the site would change from the baseline conditions using the three matrices (Matrices 1 through 3) to support the risk evaluation for each hypothetical future risk scenario.

The land use at the OD Grounds MRS is anticipated to change with a land transfer out of DOD control following implementation of an appropriate remedial action alternative. Therefore, the comparison of the anticipated risk scenario of each potential remedial action alternative will use the future land use risk scenario as the baseline condition. This analysis will evaluate each potential remedial action alternative to determine if implementation would achieve acceptable MEC risk conditions base on the planned future land use.

The remedial action alternates considered at the OD Ground MRS are described in detail in the FS Report. The following alternatives were retained for analysis in the FS Report and were therefore evaluated as part of this Risk Assessment.

- Alternative 1: No Action
- Alternative 3: Consolidate and cap with surface and subsurface clearance to 2 feet bgs outside the cap and LUCs
- Alternative 4: Excavate OD Hill to grade and perform surface/subsurface clearance to 2 feet bgs over site, and LUCs; and
- Alternative 5: Excavate entire site to 1 foot below grade and perform surface/subsurface clearance to 2 feet bgs

This Risk Assessment will focus on describing the specific aspect of each alternative that will change the assumptions presented in the Decision Logic to Assess Risks (USACE, 2017) categories. **Figure C.1** shows a diagram summarizing the structure of the MEC Risk Evaluation. Within the Decision Logic to Assess Risks the following five risk factors are evaluated base on site conditions (note that only three will change based on implementation of a remedial action):

- Amount of MEC (i.e., how much MEC is there at the site?).
 - This element may change due to physical removal of MEC during a remedial action.
- *Access Conditions* (i.e., how likely are human receptors to contact MEC at the site based on accessibility and frequency of use?).

- This element may change through the implementation of LUCs or barriers that alter future use of the site.
- Severity Associated with Detonation of Specific Munitions (i.e., if someone encounters MEC and it detonates, how many people might be injured and how seriously?).
 - This element does not change based on implementation of any of the alternatives because all may leave deep-buried UXO or DMM that, if unintentionally detonated by an uninformed future user, could result in severe or catastrophic harm.
- Sensitivity/Susceptibility to Detonation (i.e., how sensitive is the fuzing of the MEC?).
 - This element does not change based on implementation of any of the alternatives because all may leave deep-buried UXO or DMM that might have sensitive fuzing.
- *Likelihood to Impart Energy on an Item* (i.e., what are the activities involved that might result in human receptors encountering MEC at the site?).
 - This element may change if remedial actions are implemented that affect behavioral modifications or changes that will affect the likelihood or ability of imparting energy on a munitions item.

Table C.6 presents a summary of the appropriate input factors selected to complete the Decision Logic to Assess MEC Risk for each of the five alternatives evaluated in the FS. As noted above, only three input factors are influenced by implementation of a remedial action (*Amount of MEC, Access Conditions*, and *Likelihood to Impart Energy on an Item*). Alternative 1, the no action alternative, assumes no remedial action element are implemented, therefore this alternative would not change any input factors from the baseline future risk conditions. Alternative 2 is implementation of LUCs only. This alternative would not change the amount of MEC or access conditions (LUCs under Alternative 2 do not restrict access or activities). The Likelihood to impart energy would be changed from high to modest due to the influence of educational awareness which would change behavior to reduce the likelihood that a person would impart energy on an MEC item. Evaluation of Alternative 2 shows the following implementation of Remedial Action Alternative 2 would not achieve acceptable MEC risk conditions.

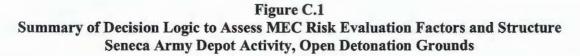
For each of Alternatives 3, 4 and 5. the *Amount of MEC* rating will change to Category V in both the OD Hill and the Kickout Area following implementation of the remedial action. The Category V rating applies to sites where "A DERP response action has been conducted to physically remote surface and subsurface MEC". If Alternative 3 were implemented MEC would not be physically removed from the subsurface at the OD Hill; however, the MEC remaining on site would be secured under a cap. Because the cap will include 18 inches of clean soil over the top of any remaining MEC, this alternative is considered equivalent to a surface and subsurface MEC removal. And has been scored as if surface and subsurface response action were complete.

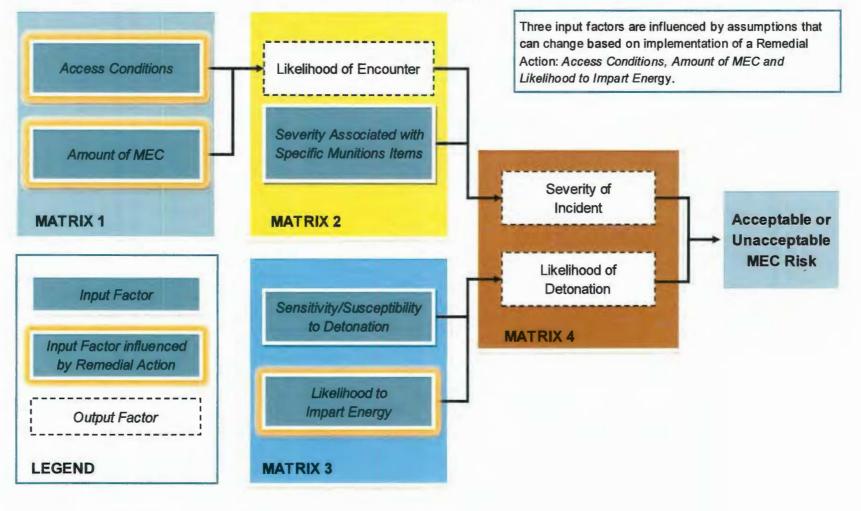
A surface and subsurface MEC removal would be conducted within the Kickout Area under Alternative 3 so this area is also scored as Category V. Both the Kickout Area and the OD Hill under Alternatives 4 and 5 would include a surface and subsurface MEC removal; therefore, Category V for *Amount of MEC* is appropriate for both the OD Hill and Kickout Area under each of these alternatives.

At the OD Ground MRS the future site use conditions are well known. As such the remedial alternatives evaluated in the FS were developed to achieve acceptable use conditions based on planned future use. Access Conditions used in the Future Risk Use Conditions are consistent with the future use under all of the alternative scenarios. The access conditions in all cases is "Often (e.g., less regular or periodic use, some access)". The intended future land use is for conservation/recreation; while driving tours may visit the site daily, persons accessing the site on foot where access with MEC could occur would be only periodic.

Under the future use risk conditions, the Likelihood to Impart Energy on an Item was rated as "High (e.g., areas planned for development, or seasonally tilled)." This category was selected because future land use would include plowing/tilling of food plots as part of the habitat development at the conservation/recreation area and MEC are anticipated to be present at the depths that would be impacted by tilling and intrusive activity. Under Alternatives 4 and 5 surface and subsurface MEC removal will be conducted to depths appropriate to meet the RAOs in both the Kickout Area and OD Hill. In both areas after remedial action implementation under Alternatives 4 and 5 it would no longer be expected that seasonal tilling or other allowed intrusive activities would result in interaction with subsurface MEC. In these cases, the Likelihood to Impart Energy on an Item has been rated as Inconsequential because interaction is no longer anticipated as the intrusive depth no longer overlaps with the depth interval where MEC might exist. LUCs will further mitigate any unforeseen interactions with MEC by teaching land users to obey the 3Rs of explosive safety in the unlikely event they discover UXO or DMM. Under Alternative 3 the Kickout area has the same remedial action as under Alternative 4 and in the OD Hill intrusive activity restrictions in the cap would prevent interaction with MEC that may remain below the cap. Therefore, Alternative 3 is also scored as Inconsequential (e.g., not anticipated, prevented, mitigated) for the same reasons described above for Alternatives 4 and 5.

Exhibits C.5 and C.6 summarize the matrix inputs and outputs for Alternative 2 within the OD Hill and Kickout Area, respectively. **Exhibit C.7** summarizes the matrix inputs and outputs for the Kickout Area and OD Hill for post remedial action conditions following implementation of Alternatives 3, 4 or 5.





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Table C.6 Analysis of Alternatives using the Decision Logic to Assess MEC Risk Seneca Army Depot Activity, Open Detonation Grounds

		(Water)		1000 C		Marris 3		Matrix 4	
Risk Scenario	Access Conditions	Amount of MEC	Likelihood of Encounter	Severity Associated with Specific Munitions items	Sensitivity Susceptibility to Detonation	Likelihood to Impart Energy	Likelihood of Detonation	Severity of Incident	Rating
Future Baseline - OD Hill	Often	Category II	Likely	Catastrophic/Critical	High	High	1	A	Unacceptable
Future Baseline - Kickout	Often	Category I (Most)	Frequent	Catastrophic/Critical	High	High	1	A	Unacceptable

Alternative 1 No Action

Alternative 1 would results in no change from the Future Baseline Conditions Risk Scenario

Alternative 2 LUCs only

Alternative 2 - OD Hill	Often	Category II	Likely	Catastrophic/Critical	High	Modest	2	A	Unacceptable
Alternative 2 - Kickout	Often	Category I (Most)	Frequent	Catastrophic/Critical	High	Modest	2	A	Unacceptable
Rationale	LUCs would not prevent access	This alternative does not remove MEC.	-	-	-	Educational Awareness will reduce the likelihood that people will impart energy on an item		-	

Alternative 3

Alternative 3 - OD Hill	Often	Category V	Seldom	Catastrophic/Critical	High	Inconsequential	3	В	Acceptable
Alternative 3 - Kickout	Often	Category V	Seldom	Catastrophic/Critical	High	Inconsequential	3	В	Acceptable
Rationale	LUCs would not prevent access	The cap at the OD Hill would be equivalent to a surface and subsurface MEC removal. Surface and subsurface MEC removal would be conducted in the kickout area.		-	-	Removal depth below anticipated intrusive depth.		-	-

Alternative 4

Alternative 4 - OD Hill	Often	Category V	Seldom	Catastrophic/Critical	High	Inconsequential	3	В	Acceptable
Alternative 4 - Kickout	Often	Category V	Seldom	Catastrophic/Critical	High	Inconsequential	3	В	Acceptable
Rationale	LUCs would not prevent access	Surface and subsurface MEC removal would be conducted in the OD Hill and kickout area.	-	-	-	Removal depth below anticipated intrusive depth.	-	-	-

Alternative 5

Alternative 5 - OD Hill	Often	Category V	Seldom	Catastrophic/Critical	High	Inconsequential	3	В	Acceptable
Alternative 5 - Kickout	Often	Category V	Seldom	Catastrophic/Critical	High	Inconsequential	3	В	Acceptable
Rationale	LUCs would not prevent access	Surface and subsurface MEC removal would be conducted in the OD Hill and kickout area.		-	-	Removal depth below anticipated intrusive depth.	-	-	-

Exhibit C.5 Summary of Decision Logic Evaluation Results for the OD Hill Area Alternative 2 Use Conditions Risk Scenario Seneca Army Depot Activity, Open Detonation Grounds

	Likelihood of Encounter	Access Conditions (frequency of use)					
(A	mount of MEC versus Access Conditions)			Intermittent	Rare		
	Category I (Most)	Frequent	Frequent	Likely	Occasional		
ដ	Category II	Frequent	Likely	Occasional	Seldom		
of MEC	Category III	Likely	Occasional	Seldom	Unlikely		
Amount	Category IV	Occasional	Seldom	Unlikely	Unlikely		
Аш	Category V	Seldom	Seldom	Unlikely	Unlikely		
	Category VI (Least)	Unlikely	Unlikely	Unlikely	Unlikely		

Matrix 2: Severity of Incident

	Severity of Explosive Incident		Likelihood of Encounter (from Matrix 1)							
	(Severity vs. Likelihood of Encounter)	Frequent	Likely	Occasional	Seldom	Unlikely				
	Catastrophic/Critical	A	Α	В	В	D				
rity	Modest	В	в	В	С	D				
Seve	Minor	В	С	С	С	D				
	Improbable	D	D	D	D	D				

Matrix 3: Likelihood of Detonation

	Likelihood of Detonation	Like	Likelihood to Impart Energy on an Item					
(Se	nsitivity vs. Likelihood to Impart Energy)	High	Modest	Inconsequential				
	High	1	1	3				
tivity	Moderate	1	2	3				
Sensitivity	Low	1	3	3				
•,	Not Sensitive	2		3				

Matrix 4: Acceptable and Unacceptable Site Conditions

		Result from Matrix 2				
Acceptable and	Unacceptable Site Conditions	А	В	с	D	
E ۳	1	Unacceptable	Unacceptable	Unacceptable	Acceptable	
atrix atrix	2	Unacceptable	Unacceptable	Acceptable	Acceptable	
Res	3	Unacceptable	Acceptable	Acceptable	Acceptable	

Exhibit C.6 Summary of Decision Logic Evaluation Results for the Kickout Area Alternative 2 Use Conditions Risk Scenario Seneca Army Depot Activity, Open Detonation Grounds

	Likelihood of Encounter	Access Conditions (frequency of use)					
(Ar	mount of MEC versus Access Conditions)	Regular	Often	Intermittent	Rare		
1	Category I (Most)	Frequent	Frequent	Likely	Occasional		
	Category II	Frequent	Likely	Occasional	Seldom		
OT M	Category III	Likely	Occasional	Seldom	Unlikely		
Amount of MEC	Category IV	Occasional	Seldom	Unlikely	Unlikely		
AIT	Category V	Seldom	Seldom	Unlikely	Unlikely		
	Category VI (Least)	Unlikely	Unlikely	Unlikely	Unlikely		

Matrix 2: Severity of Incident

	Severity of Explosive Incident	Likelihood of Encounter (from Matrix 1)						
	(Severity vs. Likelihood of Encounter)	Frequent	Likely	Occasional	Seldom	Unlikely		
	Catastrophic/Critical	A	А	В	В	D		
/erity	Modest	В	В	В	С	D		
Seve	Minor	В	С	С	С	D		
	Improbable	D	D	D	D	D		

Matrix 3: Likelihood of Detonation

	Likelihood of Detonation	Like	elihood to Impart Energy on a	in Item	
(Se	ensitivity vs. Likelihood to Impart Energy)	High	Modest	Inconsequential	
	High	1		3	
tivity	Moderate	1	2	3	
Sensitivity	Low	1	3	3	
	Not Sensitive	2		3	

Matrix 4: Acceptable and Unacceptable Site Conditions

			Result from	m Matrix 2	
Acceptable and	d Unacceptable Site Conditions	A	В	с	D
trom ix 3	1	Unacceptable	Unacceptable	Unacceptable	Acceptable
Matrix	2	Unacceptable	Unacceptable	Acceptable	Acceptable
Matri	3	Unacceptable	Acceptable	Acceptable	Acceptable

Exhibit C.7 Summary of Decision Logic Evaluation Results for the OD Hill and Kickout Area Alternative 3, 4 and 5 Use Conditions Risk Scenario Seneca Army Depot Activity, Open Detonation Grounds

	Mat	rix 1: Likelihood	of Encounter		
	Likelihood of Encounter		Access Conditions	(frequency of use)	
(Ar	nount of MEC versus Access Conditions)	Regular	Often	Intermittent	Rare
	Category I (Most)	Frequent	Frequent	Likely	Occasional
MEC	Category II	Frequent	Likely	Occasional	Seldom
of	Category III	Likely	Occasional	Seldom	Unlikely
Amount	Category IV	Occasional	Seldom	Unlikely	Unlikely
Am	Category V	Seldom	Seldom	Unlikely	Unlikely
	Category VI (Least)	Unlikely	Unlikely	Unlikely	Unlikely

Matrix 2: Severity of Incident

	Severity of Explosive Incident	Likelihood of Encounter (from Matrix 1)							
	(Severity vs. Likelihood of Encounter)	Frequent	Likely	Occasional	Seldom	Unlikely			
	Catastrophic/Critical	A	А	В	В	D			
erity	Modest	В	В	В	С	D			
Seve	Minor	В	С	С	С	D			
	Improbable	D	D	D	D	D			

Matrix 3: Likelihood of Detonation

	Likelihood of Detonation	Likelihood to Impart Energy on an Item					
(Se	nsitivity vs. Likelihood to impart Energy)			Inconsequential			
	High	1	1	3			
tivity	Moderate	I	2	3			
Sensi	Low	1	3	3			
	Not Sensitive	2	3	3			

Matrix 4: Acceptable and Unacceptable Site Conditions

			Result from	n Matrix 2	
Acceptab	le and Unacceptable Site Conditions	A	В	с	D
mo mo	1	Unacceptable	Unacceptable	Unacceptable	Acceptable
.⊈.≍ ⊏	2	Unacceptable	Unacceptable	Acceptable	Acceptable
Matri	3	Unacceptable	Acceptable	Acceptable	Acceptable

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APPENDIX D

DETAILED COST ESTIMATE

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		Alt 1	Alt 2	Alt 3		Alt 4	Alt 5
	Title:	No Action	LUCs Only	Cap with MPPI Removal	EH	Partial Excavation with MPPEH Removal	Full Excavation with MPPEH Removal
	Description:	No Action	LUCs Only	Consolidate and Cap v Surface and Subsurfa Clearance to 2 feet bgs o the cap and LUCs	ice p	xcavate OD Hill to grade and perform surface/subsurface clearance to 2 feet bgs over site, and LUCs	Excavate entire site to 1 foot below grade and perform surface/subsurface clearance to 2 feet bgs (total of 3 feet removal)
	Total Cost:	\$0	\$271,680	\$18,494,249		\$13,546,296	\$69,120,588
	Estimated Field Durration:	0 Days	10 Days	42 Months		40 Months	115 Months
	No Action	\$0	-	-		-	
Controls	LUCs	-	\$ 271,680	\$ 27	71,680 \$	271,680	\$ 271,680
Support Tasks	Grubbing and Vegetation Clearance with UXO Technician Support	-		\$ 1,08	31,240 \$	1,081,240	\$ 1,081,240
Sup	Site Re-grading and Re-vegetation	-	-	\$ 1,04	\$1,267	1,041,267	\$ 2,597,402
_	Annual Groundwater Sampling at Landfill Inspection and Reporting			\$ 4,50	00,000		
TIM	Land Fill Maintenance			\$ 90	00,000	1010	
	Post RA Groundwater Confirmation Sampling				\$	400,000	\$ 400,000
noval	Consolidate High Metal Content Soil at OD Hill and Cover with Engineered Cap. Remove Visible MPPEH During Earthwork.	-		\$ 3,27	78,595	-	-
/Ren	Install Slurry Wall around Cap		-	\$ 35	53,378		-
lioi	Backfill with clean soil			\$ 1,23	39,206	-	
MEC Dete	Excavate, Clear soil of MPPEH, and Return as Fill or Haz waste off-site disposal after Surface/Subsurface Clearance	-		-	\$	4,757,118	\$ 61,137,485
	Surface/Subsurface Clearance	-	-	\$ 5,60	3,882 \$	5,819,991	\$ 3,457,780
ing	Work Planning			\$ 15	50,000 \$	100,000	\$ 100,000
Reporing	Final Reporting	-	-	\$ 7	75,000 \$	75,000	\$ 75,000

\mabos07fs01\pttProjects\Huntaville Cont W912DY-08-D-0003\TC#13 - OD Grounde RI-FS\Documents\FS\03 - Final FS\Ver4_040318\cost\Draft FS Cost Book_083018.xisx

lt 2	LUCs Only					
Year	Capital Cost (\$)	Annual O&M Costs (\$)	Periodic Costs (\$)	Total Cost + 0% Tax(\$)	Discount Factor at 0.6%	Present Value at 3%
0	\$42,468.00	\$4,000		\$46,468.00	1.00	\$46,468.00
1	\$0.00	\$4,000		\$4,000.00	0.99	\$3,976.14
2	\$0.00	\$4,000		\$4,000.00	0.99	\$3,952.43
3	\$0.00	\$4,000		\$4,000.00	0.98	\$3,928.86
4	\$0.00	\$4,000	\$18,202	\$22,202.06	0.98	\$21,677.11
5	\$0.00	\$4,000		\$4,000.00	0.97	\$3,882.13
6	\$0.00	\$4,000		\$4,000.00	0.96	\$3,858.98
7	\$0.00	\$4,000		\$4,000.00	0.96	\$3,835.96
8	\$0.00	\$4,000		\$4,000.00	0.95	\$3,813.08
9	\$0.00	\$4,000	\$18,202	\$22,202.06	0.95	\$21,038.34
10	\$0.00	\$4,000		\$4,000.00	0.94	\$3,767.73
11	\$0.00	\$4,000		\$4,000.00	0.94	\$3,745.26
12	\$0.00	\$4,000		\$4,000.00	0.93	\$3,722.92
13	\$0.00	\$4,000		\$4,000.00	0.93	\$3,700.72
14	\$0.00	\$4,000	\$18,202	\$22,202.06	0.92	\$20,418.39
15	\$0.00	\$4,000		\$4,000.00	0.91	\$3,656.71
16	\$0.00	\$4,000		\$4,000.00	0.91	\$3,634.90
17	\$0.00	\$4,000		\$4,000.00	0.90	\$3,613.22
18	\$0.00	\$4,000		\$4,000.00	0.90	\$3,591.67
19	\$0.00	\$4,000	\$18,202	\$22,202.06	0.89	\$19,816.71
20	\$0.00	\$4,000		\$4,000.00	0.89	\$3,548.95
21	\$0.00	\$4,000		\$4,000.00	0.88	\$3,527.79
22	\$0.00	\$4,000		\$4,000.00	0.88	\$3,506.75
23	\$0.00	\$4,000		\$4,000.00	0.87	\$3,485.83
24	\$0.00	\$4,000	\$18,202	\$22,202.06	0.87	\$19,232.77
25	\$0.00	\$4,000		\$4,000.00	0.86	\$3,444.38
26	\$0.00	\$4,000		\$4,000.00	0.86	\$3,423.83
27	\$0.00	\$4,000		\$4,000.00	0.85	\$3,403.41
28	\$0.00	\$4,000		\$4,000.00	0.85	\$3,383.11
29	\$0.00	\$4,000	\$18,202	\$22,202.06	0.84	\$18,666.02
Total	\$42,468	\$120,000	\$109,213	\$271,680		\$251,722
					t + 0% Tax(\$)	\$271,680
					of TPV Range	\$163,619
				Upper end	of TPV Range	\$377,583



dt 3	Cap with MPPEH Re	moval				
Year	Capital Cost (\$)	Annual O&M Costs (\$)	Periodic Costs (\$)	Total Cost + 0% Tax(\$)	Discount Factor at 0.6%	Present Value at 3%
0	\$3,675,724.76	\$154,000		\$3,829,724.76	1.00	\$3,829,724.76
1	\$3,675,724.76	\$154,000.00		\$3,829,724.76	0.99	\$3,806,883.46
2	\$3,675,724.76	\$154,000.00		\$3,829,724.76	0.99	\$3,784,178.39
3	\$1,837,862.38	\$154,000.00		\$1,991,862.38	0.98	\$1,956,434.84
4	\$0.00	\$154,000.00	\$18,202	\$172,202.06	0.98	\$168,130.47
5	\$0.00	\$154,000.00		\$154,000.00	0.97	\$149,462.01
6	\$0.00	\$154,000.00		\$154,000.00	0.96	\$148,570.59
7	\$0.00	\$154,000.00		\$154,000.00	0.96	\$147,684.48
8	\$0.00	\$154,000.00		\$154,000.00	0.95	\$146,803.66
9	\$0.00	\$154,000.00	\$318,202	\$472,202.06	0.95	\$447,451.59
10	\$0.00	\$154,000.00		\$154,000.00	0.94	\$145,057.74
11	\$0.00	\$154,000.00		\$154,000.00	0.94	\$144,192.59
12	\$0.00	\$154,000.00	Section and the	\$154,000.00	0.93	\$143,332.59
13	\$0.00	\$154,000.00		\$154,000.00	0.93	\$142,477.72
14	\$0.00	\$154,000.00	\$18,202	\$172,202.06	0.92	\$158,367.70
15	\$0.00	\$154,000.00		\$154,000.00	0.91	\$140,783.26
16	\$0.00	\$154,000.00		\$154,000.00	0.91	\$139,943.60
17	\$0.00	\$154,000.00		\$154,000.00	0.90	\$139,108.94
18	\$0.00	\$154,000.00		\$154,000.00	0.90	\$138,279.27
19	\$0.00	\$154,000.00	\$318,202	\$472,202.06	0.89	\$421,469.59
20	\$0.00	\$154,000.00		\$154,000.00	0.89	\$136,634.73
21	\$0.00	\$154,000.00		\$154,000.00	0.88	\$135,819.81
22	\$0.00	\$154,000.00		\$154,000.00	0.88	\$135,009.75
23	\$0.00	\$154,000.00		\$154,000.00	0.87	\$134,204.53
24	\$0.00	\$154,000.00	\$18,202	\$172,202.06	0.87	\$149,171.83
25	\$0.00	\$154,000.00		\$154,000.00	0.86	\$132,608.45
26	\$0.00	\$154,000.00		\$154,000.00	0.86	\$131,817.55
27	\$0.00	\$154,000.00		\$154,000.00	0.85	\$131,031.36
28	\$0.00	\$154,000.00		\$154,000.00	0.85	\$130,249.86
29	\$0.00	\$154,000.00	\$318,202	\$472,202.06	0.84	\$396,996.28
Total	\$12,865,037	\$4,620,000	\$1,009,213	\$18,494,249		\$17,911,881
					t + 0% Tax(\$)	\$18,494,249
				Lower end	of TPV Range	\$11,642,723
				Upper end	of TPV Range	\$26,867,822

lt 4	Partial Excavation wi	th MPPEH Removal				
Year	Capital Cost (\$)	Annual O&M Costs (\$)	Periodic Costs (\$)	Total Cost + 0% Tax(\$)	Discount Factor at 0.6%	Present Value at 3%
0	\$3,995,125.20	\$4,000		\$3,999,125.20	1.00	\$3,999,125.20
1	\$3,995,125.20	\$4,000.00		\$3,999,125.20	0.99	\$3,975,273.56
2	\$3,995,125.20	\$4,000.00		\$3,999,125.20	0.99	\$3,951,564.17
3	\$1,331,708.40	\$4,000.00		\$1,335,708.40	0.98	\$1,311,951.30
4	\$0.00	\$4,000.00	\$18,202	\$22,202.06	0.98	\$21,677.11
5	\$0.00	\$4,000.00		\$4,000.00	0.97	\$3,882.13
6	\$0.00	\$4,000.00		\$4,000.00	0.96	\$3,858.98
7	\$0.00	\$4,000.00		\$4,000.00	0.96	\$3,835.96
8	\$0.00	\$4,000.00		\$4,000.00	0.95	\$3,813.08
9	\$0.00	\$4,000.00	\$18,202	\$22,202.06	0.95	\$21,038.34
10	\$0.00	\$4,000.00		\$4,000.00	0.94	\$3,767.73
11	\$0.00	\$4,000.00		\$4,000.00	0.94	\$3,745.26
12	\$0.00	\$4,000.00		\$4,000.00	0.93	\$3,722.92
13	\$0.00	\$4,000.00		\$4,000.00	0.93	\$3,700.72
14	\$0.00	\$4,000.00	\$18,202	\$22,202.06	0.92	\$20,418.39
15	\$0.00	\$4,000.00		\$4,000.00	0.91	\$3,656.71
16	\$0.00	\$4,000.00		\$4,000.00	0.91	\$3,634.90
17	\$0.00	\$4,000.00		\$4,000.00	0.90	\$3,613.22
18	\$0.00	\$4,000.00		\$4,000.00	0.90	\$3,591.67
19	\$0.00	\$4,000.00	\$18,202	\$22,202.06	0.89	\$19,816.71
20	\$0.00	\$4,000.00		\$4,000.00	0.89	\$3,548.95
21	\$0.00	\$4,000.00		\$4,000.00	0.88	\$3,527.79
22	\$0.00	\$4,000.00		\$4,000.00	0.88	\$3,506.75
23	\$0.00	\$4,000.00		\$4,000.00	0.87	\$3,485.83
24	\$0.00	\$4,000.00	\$18,202	\$22,202.06	0.87	\$19,232.77
25	\$0.00	\$4,000.00		\$4,000.00	0.86	\$3,444.38
26	\$0.00	\$4,000.00		\$4,000.00	0.86	\$3,423.83
27	\$0.00	\$4,000.00		\$4,000.00	0.85	\$3,403.41
28	\$0.00	\$4,000.00		\$4,000.00	0.85	\$3,383.11
29	\$0.00	\$4,000.00	\$18,202	\$22,202.06	0.84	\$18,666.02
Total	\$13,317,084	\$120,000	\$109,213	\$13,546,296		\$13,431,311
				Total Cos	t + 0% Tax(\$)	\$13,546,296
				Lower end	of TPV Range	\$8,730,352
				Upper end	of TPV Range	\$20,146,966

dt 5	Full Excavation with	MPPEH Removal			and the second se	
Year	Capital Cost (\$)	Annual O&M Costs (\$)	Periodic Costs (\$)	Total Cost + 0% Tax(\$)	Discount Factor at 0.6%	Present Value at 3%
0	\$7,188,665.23	\$4,000.00		\$7,192,665.23	1.00	\$7,192,665.23
1	\$7,188,665.23	\$4,000.00		\$7,192,665.23	0.99	\$7,149,766.63
2	\$7,188,665.23	\$4,000.00		\$7,192,665.23	0.99	\$7,107,123.89
3	\$7,188,665.23	\$4,000.00		\$7,192,665.23	0.99	\$7,064,735.48
4	\$7,188,665.23	\$4,000.00	\$18,202	\$7,210,867.29	0.98	\$7,040,371.56
5	\$7,188,665.23	\$4,000.00	\$10,202	\$7,192,665.23	0.98	\$6,980,715.58
6	\$7,188,665.23	\$4,000.00		\$7,192,665.23	0.96	\$6,939,081.10
7	\$7,188,665.23	\$4,000.00		\$7,192,665.23	0.96	\$6,897,694.93
8	\$7,188,665.23	\$4,000.00		\$7,192,665.23	0.95	\$6,856,555.60
9	\$4,193,388.05	\$4,000.00	\$18,202	\$4,215,590.11	0.95	\$3,994,629.92
10	\$0.00	\$4,000.00	\$10,202	\$4,000.00	0.93	the second se
10	\$0.00				0.94	\$3,767.73
12	\$0.00	\$4,000.00		\$4,000.00	0.94	\$3,745.26 \$3,722.92
13	\$0.00			\$4,000.00	0.93	
13	\$0.00	\$4,000.00	£10.000	\$4,000.00		\$3,700.72
14	\$0.00	4	\$18,202	\$22,202.06	0.92	\$20,418.39
16	\$0.00	\$4,000.00		\$4,000.00	0.91	\$3,656.71
10		\$4,000.00		\$4,000.00		\$3,634.90
	\$0.00	\$4,000.00		\$4,000.00	0.90	\$3,613.22
18	\$0.00	\$4,000.00	010.000	\$4,000.00	0.90	\$3,591.67
19	\$0.00	\$4,000.00	\$18,202	\$22,202.06	0.89	\$19,816.71
20	\$0.00	\$4,000.00		\$4,000.00	0.89	\$3,548.95
21	\$0.00	\$4,000.00		\$4,000.00	0.88	\$3,527.79
22	\$0.00	\$4,000.00		\$4,000.00	0.88	\$3,506.75
23	\$0.00	\$4,000.00		\$4,000.00	0.87	\$3,485.83
24	\$0.00	\$4,000.00	\$18,202	\$22,202.06	0.87	\$19,232.77
25	\$0.00	\$4,000.00		\$4,000.00	0.86	\$3,444.38
26	\$0.00	\$4,000.00		\$4,000.00	0.86	\$3,423.83
27	\$0.00	\$4,000.00		\$4,000.00	0.85	\$3,403.41
28	\$0.00	\$4,000.00		\$4,000.00	0.85	\$3,383.11
29	\$0.00	\$4,000.00	\$18,202	\$22,202.06	0.84	\$18,666.02
Total	\$68,891,375	\$120,000	\$109,213	\$69,120,588		\$67,358,631
				Total Cost	+ 0% Tax(\$)	\$69,120,588
				Lower end	of TPV Range	\$43,783,110
				Upper end	of TPV Range	\$101,037,947

Table: 1.1_LUCs and 4K per year annual inspections Element: LUCs Date: July 31, 2018 Contract: W912DY-08-D-0003 Task Order 0013 Document: FS Report for OD Grounds MRA Site: Seneca Army Depot Activity, Romulus, New York

Implementation elements include:	Imp	ementation	elements	include:
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Airfare: HSV-SYR plus webfee (1 week notice)

Printing (color on gloss white per sheet)

Truck Rental (week)

\\m

- 1 LUCs RD Plan
- 2 Environmental Easement
- 3 5-year Reviews
- 4 Educational Awareness

1 LUCs RD Plan	1	Jnit U	nit Cost			
Project Manager	hour	24 \$	146.00			
Engineer II	hour	40 \$	97.00			
Scientist I	hour	140 \$	72.00			
Administrative (Home Office)	hour	16 \$	62.00			
		\$	19,896.00			
2 Environmental Easement						
Project Manager	hour	15 \$	146.00			
Engineer II	hour	\$	97.00			
Scientist I	hour	30 \$	72.00			
Administrative (Home Office)	hour	34 \$	62.00			
		ş	10,936.00			
3 5-year Reviews				Hrs per Review Tota	al Reviews Tota	l Hours
Project Manager	hour	A1 \$	146.00	8	6	48
Engineer II	hour	888 \$	97.00	64	6	384 include planning time (16), site visit (16), and reporting (24) for each review
Scientist 1	hour	884 \$	72.00	64	6	384 include planning time (16), site visit (16), and reporting (24) for each review
Administrative (Home Office)	hour		62.00	16	6	96 planning and reporting
Newspaper ad	each	\$	100.00	1	6	6 one per review

each	\$	2,268.00
day	24 \$	44.25
day	12 \$	59.00
night	24 \$	116.39
	\$	109,212.36
hour	5	146.00
hour	30 \$	97.00
hour	#0 \$	72.00
hour	## \$	62.00
	day night hour hour hour	day as \$ day 12 \$ night 23 \$ hour 15 \$ hour 15 \$

RT

weekly

each

146.00	Manage task
97.00	Review prepared material
72.00	Develop materials and assist distribution

2

1

1

4

2

4

Assumptions

62.00 12 for general prep assistance, 20 for finding addresses and mailing

6

6

6

6

6

6

06301.8.xist

12 2 per review (2 people)

12 2 per review (2 people) 24 4 per review (2 people 2 nights)

24 4 per review (2 people 2 travel days)

6 one per review

6 half per review

\$ 0.40 500 pamphiets

848.75

400.00

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\$ 11,636.00



 Table:
 2.1_Veg_Clear

 Element:
 Grubbing and Vegetation Clearance with UXO Technician Support

Date: July 31, 2018

Contract: W912DY-08-D-0003 Task Order 0013

1 2

- Document: FS Report for OD Grounds MRA
- Site: Seneca Army Depot Activity, Romulus, New York

						Assumpti	ons	
	Implementation elements include:							
1	Vegetation Removal Subcontractor							
2	UXO Escort							
					production - 1 acre	/day for light and me	edium and .5 for heavy	544.1 crew days
	1 Vegetation Removal Subcontractor		Unit U	Init Cost	Production = 0.5 ac	res/crew/day for he	avy (141.05) and 1 acre/crew/day medium and light over (201.5+60.45) = 806 crew days. Assume 4 crews and 137 work day	137 days
	Project Manager	hour	70	\$ 146.00	2 hrs per week dura	ation of 203 work da	ys or 51 weeks	35 weeks
	Scientist I	hour	105	\$ 72.00	3 hrs per week dura	ation of 203 work da	ys or 51 weeks	4 crews
	Brush Clearing - Heavy	acre	141.05	\$ 3,500.00	35%	141.05	Percentage of total site acres and acres	
	Brush Clearing - Medium	acre	60.45	\$ 2,400.00	15%	60.45	Percentage of total site acres and acres	
	Brush Clearing - Light	acre	201.5	\$ 500.00	50%	201.5	Percentage of total site acres and acres	
	Brush Contractor Mob/Demob (Personnel and Eq	uipment) each	16	\$ 750.00	2 Mobs and 2 Dem	obs per crew due to		
				\$ 769,285.00				
	2 UXO Escort							137 days
	Project Manager	hou	17.5	\$ 146.00	Staff Management	0.5 hr per week.		35 weeks
	Scientist I	hour	35	\$ 72.00	Coordination 1 hr p	er week		4 crews
	UXO Tech II w/8% HPD	hour	5480				3 acres = 806 crew days. Assume 4 crews and 203 work days	
				A 344 AFF 00				

\$ 311,955.00

Table: 2.2_Site_Restoration Element: Site Re-grading and Re-vegetation Date: July 31, 2018 Contract: W912DY-08-D-0003 Task Order 0013 Document: FS Report for OD Grounds MRA Site: Seneca Army Depot Activity, Romulus, New York

Implementation elements include: Regrading

1 2

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Reseeding/Restoration

1 Regrading

UOM Units Project Manager hour Scientist I hour Grading 18.03026087 S acre Brush Contractor Mob/Demob (Personnel and Equipment) each

2 Reseeding/Restoration

Project Manager	hour	
Scientist I	hour	Sec. 1
UXO Tech II w/8% HPD	hour	18 19 19
Brush Contractor Mob/Demob (Personnel and Equipment)	each	
Seeding	acre	1.0

	hour	17	\$ 146.00
	hour	34	\$ 72.00
	hour	2700	\$ 56.00
t)	each	4	\$ 750.00
	acre	403	\$ 2,000.00

4 4 6 6 6				
146.00	2 hrs per week duration			2 weeks
72.00	3 hrs per week duration			2 crews
4,000.00	100%	403	Percentage of total site acres and acres	
750.00	1 Mob and 1 Demob due to	duration per crew		
76,137.04				

Production = 1.5 acres/crew/day for 403 acres = 267 crew days. Assume 2 crews and 134 work days

	Production = 1.5 acres/crew/day for 403 acres = 267	crew days. Assume 2 crews and 134 work days	135 days			
00	Staff Management 0.5 hr per week.		34 weeks			
00	Coordination 1 hr per week					
00	Production = 0.5 acres/crew/day for 403 acres = 806	crew days. Assume 4 crews and 203 work days				
00	1 Mob and 1 Demob due to duration per crew					
00	100% 403 Perc	entage of total site acres and acres				

\$ 965,130.00

U nit Cost

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Si

15

Assumptions



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7 days

2.2_5ite_Restoration Table: Element: Site Re-grading and Re-vegetation Date: July 31, 2018 Contract: W912DY-08-D-0003 Task Order 0013 Document: FS Report for OD Grounds MRA Site: Seneca Army Depot Activity, Romulus, New York

Implementation elements include:

1 Regrading

2 **Reseeding/Restoration**

1 Regrading

Regrading	UOM	Units	Unit Cost	
Project Manager	hour	68	\$	
Scientist 1	hour	102	\$	
Grading	acre	403	\$	
Brush Contractor Mob/Demob (Personnel and Equipment)	each	4	S	
			A	

Unit	Cost	Production = 1.5 acres	/crew/day for 44	03 acres = 267 crew days. Assume 2 crews and 134 work days	135 days
8 \$	146.00	2 hrs per week duratio	n		34 weeks
2 \$	72.00	3 hrs per week duratio	n		2 crews
3 \$	4,000.00	195%	403	Percentage of total site acres and acres	
4 \$	750.00	1 Mob and 1 De mob d			
¢;	1,632,272.00				

2 Reseeding/Restoration

Project Manager	hour	17	\$
Scientist I	hour	34	\$
UXO Tech II w/8% HPD	hour	2700	\$
Brush Contractor Mob/Demob (Personnel and Equipment)	each	4	\$
Seeding	acre	403	\$

	Production = 1.5 acres/	crew/day for	403 acres = 267 crew days. Assume 2 crews and 134 work days	135 days				
146.00	Staff Management 0.5 hr per week.							
72.00	Coordination 1 hr per week							
56.00	Production – এন্স acres/crew/day for 403 acres = 806 crew days. Assume 4 crews and 203 work days							
750.00	1 Mob and1 De mob due to duration per crew							
2,000.00	100%	403	Percentage of total site acres and acres					

\$ 965,130.00

Assumptions

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Table: 3.1_Cap Element: Consolidate

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Element: Consolidate High Metal Content Soil at OD Hill and Cover with Engineered Cap. Remove Visible MPPEH During Earthwork.

Date: July 31, 2018

Contract: W912DY-08-D-0003 Task Order 0013

- Document: FS Report for OD Grounds MRA
- Site: Seneca Army Depot Activity, Romulus, New York

				Assu	Imptions					
Implementation elements include: Mob/Demob Earthworks Confirmation and Borrow Area Sampling Cap Construction Borrow Earthwork										
Task	Counts	Units	Production	Units	Teams	Work Days	Work Weeks (4 day)	Per Diem Days/person	Persons	Total Staff
<u>Alt 3</u>										
Mob/Demob Earthworks Confirmation and Borrow Area Sampling Cap Construction Borrow Earthwork	1 34907 12 9154 9154	persons CY Samples CY CY	0.5 200 1 300 300	round trips per day CY/day/team day/day/team CY/day/team CY/day/team	1 2 1 2 2 2	2 88 12 16 16	0.5 22 3 4 4	3.5 154 21 28 28	7 6 1 6 6	SUXOS, Safety, UXO QC, Excavation Sub, Tech II Escort, Engineer III SUXOS, Safety, UXO QC, Excavation Sub, Tech II Escort, Engineer III 1 Geo SUXOS, Safety, UXO QC, Excavation Sub, Tech II Escort, Engineer III SUXOS, Safety, UXO QC, Excavation Sub, Tech II Escort, Engineer III
1 Mob/Demob Senior UXO Supervisor UXO Quality Control Specialist UXO Safety Offer UXO Tech II	hour hour hour hour		16 \$ 78	.00 .00 .00						

	Senior UXO Supervisor	hour	16	÷	an en 1
	JXO Quality Control Specialist	hour			82.00
	JXO Safety Officer		16		73.00
	JXO Tech II	hour	16		78.00
		hour	32		52.00
	ngineer III	hour	16		125.00
	roject Manager	hour .	16		146.00
	Misc Field Supplies (batteries, fire extinguishers, cameras)		4	\$	2,268.00
	Conex Delivery and Pickup	each	4	\$	1,392.00
	Office Trailer Mob/Demob	each	1	\$	2,162.00
	Airfare: HSV-SYR plus webfee (1 week notice)	RT	7	Ś	848.75
	vi&iE Travel Day (75%)	day	14		44.25
1	odging + 13% SYR Tax	night	14	\$	116.39
				\$	34,720.21
_	Earthworks				
:	Senior UXO Supervisor	hour	880	\$	82.00
1	JXO Quality Control Specialist	hour	880	\$	73.00
1	JXO Safety Officer	hour	880	Ś	78.00
- 1	JXO Tech II	hour	1760	Ś	52.00
1	Ingineer III	hour	880	Ś	125.00
1	Project Manager	hour	88	Ś	146.00
- 1	Misc Field Supplies (batteries, fire extinguishers, cameras)	each	2	Ś	2,268.00
	Armor an Excavator	each	2	ŝ	16,000.00
	Armor a Dozer	each	2	Ś	24,000.00
	Armor a Haul Truck	each	2	ŝ	6,000.00
1	C-200 Excavator	day	176	Ś	1,360.00
	Dozer	day	176		900.00
1	Haul Truck	dav	176		800.00
	Operator	dav.	176		1,145.00
1	Perdiem	day	176		145.00
i	Pickup Truck Rental	/week	110		300.00
	Radio - 2 way (set of 10)	/month	5.5		725.30
	anitation	/month	5.5		725.30
	Full Day Per Diem (Lodging, 13% Tax + M&IE)	dav			
	an Day rei Diem (Louging, 13% Fax + Molt)	uay	924	\$	175.39

\$ 1,481,202.36

1 of 2 /2018

 Table:
 3.1_Cap

 Element:
 Consolidate High Metal Content Soil at OD Hill and Cover with Engineered Cap. Remove Visible MPPEH During Earthwork.

Date: July 31, 2018

Contract: W912DY-08-D-0003 Task Order 0013

Document: F5 Report for OD Grounds MRA

Site: Seneca Army Depot Activity, Romulus, New York

2 Confirmation and Barrow Asso Samalian			
3 Confirmation and Borrow Area Sampling		Unit	Unit Cost
Scientist II	hour	120	
GPS Handheld	/week	3	\$ 300.00
Misc Field Supplies (batteries, fire extinguishers, cameras)	each		\$ 2,268.00
Pickup Truck Rental	/week	3	
Full Day Per Diem (Lodging, 13% Tax + M&IE)	day	21	
FED Exp Package (50 lbs)	each	6	
Soil Sample Set	each	12	\$ 170.00
			\$ 24,117.87
4 Cap Construction			
Senior UXO Supervisor	hour	160	\$ 82.00
UXO Quality Control Specialist	hour	160	\$ 73.00
UXO Safety Officer	hour	160	\$ 78.00
UXO Tech II	hour	320	\$ 52.00
Project Manager	hour	16	
Engineer III	hour	160	
Misc Field Supplies (batteries, fire extinguishers, cameras)			
		2	
Armor an Excavator	each	2	
Armor a Dozer	each	2	
Armor a Haul Truck	each	2	\$ 6,000.00
Pickup Truck Rental	/week	24	\$ 300.00
Radio - 2 way (set of 10)	/month	1	\$ 725.30
Sanitation	/month	1	\$ 78.70
Full Day Per Diem (Lodging, 13% Tax + M&IE)	day	168	\$ 175.39
Solid Waste Landfill Cap with HDPE	acre	4	\$ 300,000.00
			\$ 1,410,261.52
5 Borrow Earthwork			
Senior UXO Supervisor	hour	160	\$ 82.00
UXO Quality Control Specialist	hour	160	\$ 73.00
UXO Safety Officer	hour	160	\$ 78.00
UXO Tech II	hour	320	\$ 52.00
Project Manager	hour	16	\$ 146.00
Misc Field Supplies (batteries, fire extinguishers, cameras)	each	2	\$ 2,268.00
Armor an Excavator	each	2	
Armor a Dozer	each		
Armor a Haul Truck	each	2	
PC-200 Excavator	day	32	
Dozer	day	32	
Haul Truck	day	32	\$ 800.00
Operator	day	32	
Perdiem	day		\$ 146.00
Pickup Truck Rental	/week		\$ 300.00
Radio - 2 way (set of 10)	/month	1 1	
Sanitation	/month	1	
Full Day Per Diem (Lodging, 13% Tax + M&IE)	day	168	
			\$ 328,293.52

Table:	3.2_Slurry
Element:	Install Slurry Wall around Cap
Date:	July 31, 2018
Contract:	W912DY-08-D-0003 Task Order 0013
Document:	FS Report for OD Grounds MRA
Site:	Seneca Army Depot Activity, Romulus, New York

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Site.	Selects Army Depot Activity, Romaids, New Pork												
							Asur	nptions					
	Implementation elements include:						- addition	inpriorita.					
1	Mob/Demob												
2	Earthworks												
3	Slurry Wall Installation												
4	Well Installation												
5	Design												
	Task	Counts	Units	Prod	uction	Units	Teams	Work Day	vs	Work	Per Diem	Persons	Total Staff
											Days/person		
										(4 day)			
	Alt 3												
	Mob/Demob	1	1 persons		0.5	round trips per		1	2	0.5	3.5	; 3	Comparison State Trade II Frances Franks and Michael State II
	Earthworks		1 CY		300	CY/day/team			3	0.5	5.25		Excavation Sub, Tech II Escort, Engineer III, Scientist II
	Siurry Wall Installation		2 square feet		100	ft2/day/team			19	4.75	33.25		SUXOS, Safety, UXO QC, Excavation Sub, Tech il Escort, Engineer III, Scientist II SUXOS, Safety, UXO QC, Excavation Sub, Tech il Escort, Engineer III, Scientist II
	Well Installation		0 wells	•	1	well/day/team			10	2.5	17.5		SUXOS, Safety, UXO QC, Excavation Sub, Tech II Escort, Engineer III, Scientist II SUXOS, Safety, UXO QC, Excavation Sub, Tech II Escort, Scientist II
					-	wen/ any/ cea		*	10	2.5	17.5	, ,	SONOS, Salety, ONO QC, Excavation Sub, Tech II Escort, Scientist II
	1 Mob/Demob		Unit	Unit	Cost								
	UXO Tech II	hour		16 \$	52.00	1							
	Engineer III	hour		16 \$	125.00								
	Scientist II	hour		16 \$	85.00								
	Project Manager	hour		16 \$	146.00								
	Misc Field Supplies (batteries, fire extinguishers, cameras)	each		1\$	2,268.00								
	Airfare: HSV-SYR plus webfee (1 week notice)	RT	1	4 \$	848.75								
	M&IE Travel Day (75%)	day	1	8\$	44.25								
	Lodging + 13% SYR Tax	night	1	8\$	116.39								
				\$	13,476.12								
	2 Earthworks												
	Senior UXO Supervisor	hour	1	30 \$	82.00								
	UXO Quality Control Specialist	hour		30 \$	73.00								
	UXO Safety Officer	hour		30 \$	78.00								
	UXO Tech II	hour	1	30 \$	52.00								
	Engineer III	hour		30 \$	125.00								
	Scientist II	hour		30 \$	85.00								
	Project Manager	hour		3\$	146.00								
	Armor an Excavator PC-200 Excavator	each		1 \$	16,000.00								
		day		3 \$	1,360.00								
	Operator Perdiem	day		3\$	1,145.00								
	Pickup Truck Rental	day /week		3\$ 3\$	146.00 300.00								
	Radio - 2 way (set of 10)	/week /month		3 \$ 375 \$	725.30								
	Sanitation	/month		375 \$	725.30								
	Full Day Per Diem (Lodging, 13% Tax + M&iE)	day		1.5 \$	175.39								
		,	1 5	1.J V	210.00								
				Ś	45,816.54								
				+									
	Senior UXO Supervisor	hour	1 1	.90 Ś	82.00								
	UXO Quality Control Specialist	hour		90 \$	73.00								
	UXO Safety Officer	hour		90 \$	78.00								
	UXO Tech II	hour		90 \$	52.00								
	Engineer III	hour		.90 \$	125.00								
	Scientist II	hour		.90 \$	85.00								
	Project Manager	hour		19 \$	146.00								
	GPS Handheld	/week		.75 \$	300.00								
	Pickup Truck Rentai	/week		.75 \$	300.00								
	Full Day Per Diem (Lodging, 13% Tax + M&IE)	day		9.5 \$	175.39								
	Siurry Wall Install	square for	ot 18	312 \$	20.00								

20.00 \$ 170,904.31

Table: 3.2_Slurry

Element: Install Slurry Wall around Cap

Date: July 31, 2018

Contract: W912DY-08-D-0003 Task Order 0013 Document: FS Report for OD Grounds MRA

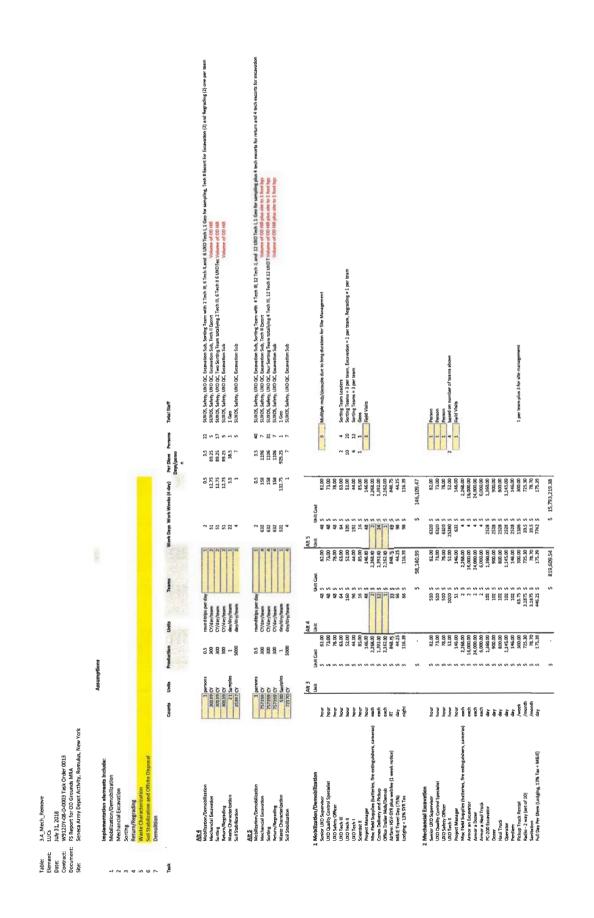
Site: Seneca Army Depot Activity, Romulus, New York

Unit Unit Cost Senior UXO Supervisor 100 \$ 82.00 hour UXO Quality Control Specialist hour 100 \$ 73.00 UXO Safety Officer hour 100 Ş 78,00 UXO Tech II 100 \$ hour 52.00 Project Manager hour 10 \$ 146.00 Scientist II 100 \$ 85.00 hour Misc Field Supplies (batteries, fire extinguishers, cameras) each 4 Ş 2,268.00 PC-200 Excavator day 12.5 Ş 1,360.00 used as replacement for drilling rig cost. Radio - 2 way (set of 10) 0.625 \$ 0.625 \$ /month 725.30 Sanitation /month 78,70 Full Day Per Diem (Lodging, 13% Tax + M&IE) 87.5 \$ 175.39 day each Drums for MD storage FED Exp Package (50 lbs) 10 \$ 111.11 as cost for IDW drums each 5\$ 309.78 Soil Sample Set each 14 \$ 170.00 \$ 85,421.13 Project Manager hour 20 \$ 146.00 Engineer III hour 160 \$ 125.00 Scientist II hour 160 Ş 85.00 Administrative (Home Office) 20 \$ hour 62.00 \$ 37,760.00

Table:3.3_BackfillElement:Backfill with clean soilDate:July 31, 2018Contract:W912DY-08-D-0003 Task Order 0013Document:FS Report for OD Grounds MRASite:Seneca Army Depot Activity, Romulus, New York

		As	ssum	ptions		
Implementation elements include:						
Regrading						
Fill Material						
Project Manager Scientist I Grading		Units Un 8 \$ 12 \$ 18.03026087 \$ 2 \$	nit Co	ost 146.00 72.00 4,000.00 750.00	Production = 1.5 acres/crew/day for 18 acres = 13 crew days. 2 hrs per week duration 3 hrs per week duration The Area outside the OD Hill that is contaminated. 1 Mob and 1 Demob due to duration per crew	13 days 4 weeks 1 crews
2 Fill Material Clean Backfill Material	сү	\$ 29089 \$	5	75,653.04 40.00		
	Regrading Fill Material 1 Regrading Project Manager Scientist I Grading Brush Contractor Mob/Demob (Personnel and Equipment) 2 Fill Material	Regrading UOM Fill Material bur Project Manager hour Scientist I hour Grading acre Brush Contractor Mob/Demob (Personnel and Equipment) each 2 Fill Material	Implementation elements include: Regrading Fill Material 1 Regrading UOM Project Manager hour Scientist I hour Grading acre Brush Contractor Mob/Demob (Personnel and Equipment) each 2 Fill Material S	Implementation elements include: Regrading Fill Material 1 Regrading Project Manager Scientist I Grading Brush Contractor Mob/Demob (Personnel and Equipment) each \$ 2 Fill Material Clean Backfill Material	Regrading Fill Material UOM Units Unit Cost 1 Regrading Project Manager Scientist I Grading Brush Contractor Mob/Demob (Personnel and Equipment) Units Units Unit Cost 8 \$ 146.00 9 acre 18.03026087 \$ 4,000.00 9 5 75,053.04 \$ 75,653.04	Implementation elements include: Regrading Regrading Fill Material 1 Regrading Project Manager hour Scientist I hour Grading UM Brush Contractor Mob/Demob (Personnel and Equipment) each V 29089 Y 29089 Y 29089

\\mab



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Tabler	3.0	him

 Table:
 3.4_Mech_Remove

 Element:
 LUGs

 Date:
 July 31, 2013

 Contract:
 W912DV080-D0003 Tesk Order 0013

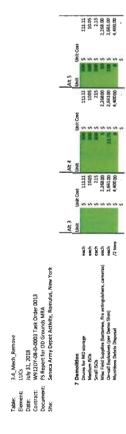
 Document:
 FS Report for 000 Grounds MRA

 Ske:
 Seneca Army Depot Activity, Romulus, New York

		AR 3		Alt 4			Alt 5	1	
3 Sorting		Unit	Unit Cost	Unit		it Cost		lit Cost	
Senior LICO Supervisor	hour	1	\$ 82.00		510 \$				1 1 Person
UXO Quality Control Specialist	hour	+	\$ 73.00		510 \$		6320 \$		1 1 Penson
UXO Safety Officer	hour		S 78.00		510 5				1 1 Person
UXO Tech Iti	how		\$ 63.00		1020 5	63.00			2 4 Sorting Team Leeders
UXO Tech II	hour	1	\$ 52.00		3060 5	52.00	75840 \$	52.00	6 12 Sorting Teams = 3 per team
UXO Tech I	hour		\$ 44.00		3060 \$	44.00	75840 \$	44.00	6 12 Sorting Teams = 3 per team
Scientist II	hour	1	\$ 85.00		510 S	85.00	6320 \$	85.00	1 1 Geos
Project Manager	hour		\$ 145.00		16 5	146.00	16 \$	146.00	1 1 Field Visits
Project Menamer	hour	+	\$ 146.00		51 S		632 5		1 hr per day Office Time
Misc Field Supplies (betteries, fire extinguishers, comeras)	sach		5 2,268.00		2 5		4 5		1 per baam
Sifting Operation Build Out	such		\$ 20,000.00		2 5	20.000.00	4 4 4		2 per tolen
Armor an Exceptor	each		5 16.000.00		2 5		4 5		
PC-200 Excertator	day		5 1,360.00		102 5	1,360.00	2528 5	1.360.00	1 per taem
Operator	day								1 per toom
Perdiem		1			102 5	1,145.00	2528 \$		1 per team
Pickup Truck Rental	day				102 5		2528 \$		1 per team
	/week		\$ 300.00		114.75 S	300.00	2370 \$		3 per team plus 3 for Site Management
Radio - 2 way (ant of 10)	/month		\$ 725.30		3.1875 \$		39.5 \$		
Generator	/week		\$ 600.00		51 S		158 \$	600.00	2 per beam
Generator Mob/Demob	each		\$ 85.00		4 5	85.00	8 5	85.00	2 per team per week
Full Day Per Diem (Lodging, 1.3% Tax + M&JE)	day		\$ 175.39	1	1517.25 \$	175.39	34286 \$	175.39	
			s -		s	1,210,707.37	\$	24,680,998,89	
4 Return/Regrading				1					
Senior UXO Supervisor	how		\$ 82.00		510 \$		6320 \$		8 Person
UKO Quality Control Specialist	hour		\$ 73.00		510 S	73.00	6320 \$		Person
UXO Safety Officer	how		\$ 78.00	1	510 \$		6320 \$		Fernan
UXO Tech II	hour		S 52.00		1020 S	52.00	25280 S	S2.00	2 4 based on number of terms above
Project Manager	hour		5 146.00		51 S	146.00	632 5	146.00	Field Michael
Misc Field Supplies (batteries, Bre extinguishers, cameres)	each		\$ 2,268.00		2 5	2,268.00	4 5	2,268.00	Lange differential
Armor an Excavator	each		\$ 15,000.00		2 5		4 5	16.000.00	
Armor a Dozer	each	1	\$ 24,000,00		2 5		4 5		
Armor a Mard Truck	each	1	\$ 6,000.00		2 5	6,000.00	4 5		
PC-200 Excevetor	dev	1	\$ 1,360.00		102 5				
Doper		1	\$ 900.00				2528 \$		
Heut Truck	day				102 S		2528 \$		
	day	1	5 800.00		102 \$		2528 \$		
Operator	day	1	\$ 1,145.00		102 \$		2528 \$		
Pordiem	day	1	\$ 146.00		102 \$		2528 5		
Pickup Truck Rental	/week	1	\$ 300.00		63.75 \$		1106 \$	300.00	1 per team plus 3 for site management
Radio - 2 way (set of 10)	/month		5 725.30		3,1875 \$	725.30	39.5 \$	725.30	
Sanitation	/month	1	\$ 78,70		3.1875 5	78.70	39.5 \$		
Full Day Per Diem (Lodging, 13% Tax + M&JE)	day		\$ 175.39		446.25 \$	175.39	7742 5	175.39	
5 Waste Characterization			ş .		\$	819,609.54	ş	15,793,219.38	
Scientist II		1	\$ 85.00						
GPS Handheid	hour	1			220 \$				
	Aweek		\$ 300.00	-	5.5 \$			300,00	
Misc Field Supplies (batteries, ilre extinguishers, cameras)	each	1	5 2,268.00	_	5 \$	2,268.00		2,268.00	
Pickup Truck Rental	Aweek		\$ 300,00		5.5 \$	300.00	132.75 \$		
Full Day Per Diem (Lodging, 13% Tax + M&/E)	day		\$ 175.39		38.5 \$		929.25 \$		
FED Exp Package (50 lbs)	each		\$ 309,78		11 \$		265.5 \$		
Soll Sample Set	each		\$ 170.00		21 5	170.00	530 \$	170.00	
			5 -		5	40,282.62	5	870,889.52	
6 Soil Stabilization and Offsite Disposal									
Engineer II	hour		\$ 97.00		40 S	97.00	40 5	97.00	
Scientist !	hour	1	\$ 72.00		40 5		40 5	72.00	Alt 4 volume portion of OD Hill
Senior UIIIO Supervisor	hour	1	5 82.00		40 \$		40 5		Person Alt 5 volume Portion of OD Hill and 1 foot inside 500 foot radi
UIO Quality Control Specialist	hour	1	5 73.00		40 5	73.00	40 5		Person Art 5 volume Portion of OD Hill and 1 toot inside 500 toot rad Person Person
LIKO Safety Officer	hour	1	\$ 78.00		40 \$		40 5		1 Penion 1 Penion
LIXO Tech II	hour	1	5 52.00		80 \$		160 5		
Project Manager	hour	1	5 52.00						2 4 based on number of teams above
After Dald for alles the stand of the other d		1			4 5	146.00	4 5		1 Field Visits
Misc Field Supplies (betteries, fire extinguishers, cameras) Armor an Excentor	such	1	\$ 2,268.00		2 5		4 \$		
Armor an excavator	each	1	5 16,000.00		2 5		4 5		
	such		\$ 24,000.00		2 5		4 5		
Armor a Haul Truck	each	1	\$ 6,000.00		2 5		4 5		
PC-200 Excevator	day	1	\$ 1,360.00		8 5		16 5		
Dozer	day	1	\$ 900.00	1	85	900.00	16 5	900.00	
Haul Truck	day		\$ 800.00	1	8 5		16 5		
Operator	day	1	\$ 1,145.00		8 5		16 5		
Partiern	day		\$ 146.00		8 5		16 5		
Pickup Truck Rental	Aurork	1	\$ 300.00		5 \$		7 5		
Radio - 2 way (set of 10)	/month		\$ 725.30		0.25 \$	725.30	0.75 5		
Sanitation	/month	1							
Full Day Per Diem (Lodging, 13% Tax + M&IE)	dav	1	\$ 78.70 \$ 175.39		0.25 \$		0,25 5		
His Lay Per Liern (Longing, 1.75 1at + Mile) Administrative (Home Office)									
Transport and Disposel to a non-haterdous class 2 landfill	hour		\$ 62.00		20 \$		20 5		CY of soil Density g/cm3 Tons/CY
Transport and Disposal to a non-haterdous class 2 landfill Soil Sample Set	Ton		\$ 42.00		5396.65715 \$			42.00	28,000 57,089 1.5 1.26
over the share the	each		\$ 170.00	-	5	170.00		170.00	
		1	\$ -	1	\$	1,651,307.25	5	3,337,737.24	

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Page 2 of 3 7/31/2018



mabod07401/pit/PicketS/Venrov/like Cont W9120Y-08-0-00031/T0#13 - OD Grounds Ri-F5/Documents/F5/D3 - Final F5/Ven4_040318/ixoar/Dinit F5 Cast Book_053018.uk

Table: 3.5_DGM_Intrusive Element: LUCs					
Date: July 31, 2018					
Contract: W912DY-08-D-0003 Task Order 0013					
Document: F\$ Report for OD Grounds MRA					
Site: Seneca Army Depot Activity, Romulus, New York					
ATEL AND A MARKED			Assumptions		
Implementation elements include: 1. Mobilization/Demobilization					
2 Dynamic Data Collection					
3 Cued Data Collection					
4 Intrusive 5 IVS Setup					
5 IVS Setup					
Task	Counts Units Product	on Units Teams	Work Days Work Weeks (4 day) Per Diem Pers	ions Total Staff	
			Days/		
			person		
Alta					
Mobilization/Demobilization	1 persons 353 Acres	0.5 round trips per day 1 acres/day/team	2 0.5 2 118 29.5 206.5	25 SUXOS, Safety, UXO QC, Geo Laed, 3 Geos, 3 UXO Tech II (geo), 2 UXO Tech III, 10 SUXOS, Safety, UXO QC, Geo Lead, 3 Geos, 3 UXO Tech II	4 UXO Tech II, and 4 UXO Tech I Total number of MRS Acres minus Footprint of cap
Cued Data Collection	141,484 anomalies	275 targets/day/team	258 64.5 451.5	8 SUXOS, Safety, UXO OC, Geo Lead, 2 Geos, 2 UXO Tech II	See Compliation Report Calos for rates.
Intrusive IVS	28,297 TOI 3 Days	125 TOI/day/team	76 19 133 3 0.75 5.25	19 SUXOS, Safety, UXO OC, 1 Geo, 2 UXO Tech III, 4 UXO Tech II, and 4 UXO Tech I 5 SUXOS, Safety, UXO OC, 2 Geo	This is assumed at 80% reduction due to small items
	eil rin An		a 0.75 5.25	a aunus, aeety, UXU IL, 2 980	
Att 4 Mobilization/Demobilization					
Dynamic Data Collection	2 persons 403 Acres	0.5 round trips per day 1 acres/day/team	2 0,5 3,5 135 33,75 236,25	18 SUXOS, Safety, UXO QC, Geo Luzid, 3 Geos, 3 UXO Tech II (geo), 2 UXO Tech III, 10 SUXOS, Safety, UXO QC, Geo Lead, 3 Geos, 3 UXO Tech II	3 UXO Tech II, and 3 UXO Tech I Full acres of site
Gued Data Collection	343,494 anomalies 38,297 TOI	275 torgets/day/team 125 TOI/day/team	258 64.5 451.5	8 SUXOS, Safety, UXO OC, Geo Lead, 3 Geos, 3 UXO Tech II	Highest number, will include OD hill area without excevation of 1 foot.
IVS	2 Days	1 day/day/team	76 19 133 3 0.75 5.25	19 SUXOS, Safety, UXO QC, 1 Geo 5 SUXOS, Safety, UXO QC, 2 Geo	This is asserted at 80% reduction due to small items
Alts					
Mobilization/Demobilization	1 persons	0.5 round trips per day	2 0.5 3.5	18 SUXOS, Safety, UXO QC, Geo Lead, 3 Geos, 3 UXO Tech II (geo), 2 UXO Tech III,	3 UKO Tech II. and 3 UKO Tech I
Dynamic Data Collection Cued Data Collection	408 Acres	1 screa/day/team	135 33.75 236.25	10 SUXOS, Safety, UXO QC, Geo Lead, 3 Geos, 3 UXO Tech II	Full acres of alter
Intrusive	57,217 anormalies	275 targets/day/taam 125 TOI/day/taam	105 26.25 183.75 31 7.75 54.25	8 SUXOS, Safety, UXO QC, Geo Lead, 3 Geos, 3 UXO Tech II 19 SUXOS, Safety, UXO QC, 1 Geo	Should sature 97% remove) outside center, and 60% in center This is assumed at 60% reduction due to small items
IVS	3 Days	1 day/day/beem	3 0.75 5.25	5 5UXOS, Safety, UXO QC, 2 Geo	
	Alt 3	Alt 4	Alt 5		
1. Mobilization/Demobilization Senior UICO Supervisor	Unit Unit Cos hour 48 S	t Unit Unit Cost 82.00 48 S 82.00	Unit Unit Cost 48 S \$2.00		
UNO Quality Control Specialist	hour 48 \$	73.00 48 5 73.00	48 5 73.00	1 Multiple mob/demote due to long duration	
LIXO Safety Officer	hour 48 \$ hour 48 \$	78.00 48 5 78.00 63.00 48 5 63.00	48 \$ 78.00 48 \$ 63.00	3 Intrusive team leaders	
UXO Tech II	hour 144 S	52.00 144 5 52.00	144 \$ 52.00	3 Intrusive team enders 9 3 for Geo and 4 for intrusive, not the same due to overlap of teaks	
UXO Tech I Scientist II	hour 96 \$	44.00 96 \$ 44,00 85.00 48 \$ 85.00		6 4 for intrusive 3 Geos	
Scientist III	hour 16 S	115.00 16 5 115.00	16 \$ 115.00	1 Geo Laad	
Project Managar Misc Field Supplies (Setteries, fire actinguishers, corneras)	hour 64 S	146.00 64 5 146.00 2,268.00 2 5 2,268.00		4 Field Visits	
Conex Delivery and Pickup	each 2 S	1,392.00 2 5 1,392.00	2 \$ 1,392.00		
Office Trailer Mob/Demob Airfare: HSV-SYR plus weblee (1 week notice)	ench 3 \$ RT 25 \$	2,162.00 1 \$ 2,162.00 848.75 25 \$ 848.75	1 \$ 2,162.00 25 \$ 848.75		
Milu'E Travel Day (75%)	day 70 \$	44.25 70 \$ 44.25	70 \$ 44.25		
Lodging + 13% SYR Tax	night 70 S	116.39 70 \$ 116.39 83,129.55 \$ 83,129.55			
2 Dynamic Data Collection		5 65,123.55	5 65,125.35		
Service UICO Supervisor UICO Quality Control Specialist	hour 1180 \$	82.00 1350 \$ 82.00	1350 \$ 82.00	1 Person	
UXO Safety Officer	hour 1180 S hour 1180 S	73.00 1350 \$ 73.00 78.00 1350 \$ 78.00	1350 5 78.00	1 Person 3 Person	
Scientist II Scientist III	hour 3540 \$ hour 1180 \$	85.00 4050 5 85.00 115.00 1350 5 115.00	4050 \$ 85.00	based on number of taents above	
Project Manager Misc Field Supplies (batteries, fire entinguishers, cameras)	hour 118 \$ each 2 \$	145.00 135 \$ 146.00 2,268.00 2 \$ 2,268.00	135 \$ 146.00	• P013001	
G P\$ Handheld	/wweek 29.5 \$	300.00 33.75 \$ 300.00	33.75 \$ 300.00		
GPS - RTK Base Station GPS Network Rover Univ	/week 29.5 \$ /week 88.5 \$	400.00 33.75 \$ 400.00 450.00 101.25 \$ 450.00		1 per team	
Geophysical Survey Instruments	/week 88.5 \$	560.00 101.25 \$ 560.00	101.25 \$ 560.00	1 per team	
Mobilization - Geophysical Instrumentation (80 lbs) Pickup Truck Rental	each 6 \$ /waek 83.5 \$	150.00 6 5 150.00 300.00 101.25 5 300.00		2 per team 1 per team	
Radio - 2 way (set of 10)	/month 7.375 \$	725.30 8.4375 \$ 725.30	8.4375 \$ 725.30	e pres Miller	
		23.75 33.75 \$ 23.75 78.70 8.4375 \$ 78.70			
Computer Senitation	/week 29,5 \$ /month 7,375 \$				
Sanitation Gator	/month 7,375 \$ /month 7,375 \$	908.00 8.4375 \$ 908.00	8.4375 \$ 908.00	1 towed toems	
Sanitation	/month 7,375 \$ /month 7,375 \$ esch 2 \$	908.00 8.4375 \$ 908.00 80.00 2 \$ 80.00	2 5 80.00	1 bowed teams	
Senitatop Getor Getor Mob/Demob Generator Generator Kolc/Demob	/month 7,375 \$ /month 7,375 \$ esch 23,5 \$ week 29,5 \$ esch 21,5 \$	908.00 8.4375 \$ 908,00 80,00 2 \$ 80,00 600,00 33.75 \$ 600,00 83,00 2 \$ 85,00	2 S 80.00 33.75 S 600.00 2 S 85.00		
Sanitation Gator Gator Mod/Demoib Generator Generator Mod/Demoib Tractor/MddRisteer Tractor/MddRisteer	/month 7.375 \$ /month 7.375 \$ each 23.5 \$ /week 29.5 \$	908.00 8.4375 \$ 908.00 80.00 2 \$ 80.00 600.00 33.75 \$ 600.00	2 5 80.00 33.75 5 600.00 2 5 85.00 67.5 5 953.00	3) towed teams	
Sanhaton Gator Gator Mod/Demob Generator Mod/Demob Tractor/Akdistee	/month 7.375 \$ /month 7.375 \$ eech 23.5 \$ /week 23.5 \$ esch 23.5 \$ esch 32 \$ /week 59 \$	908.00 8.4375 \$ 908.00 80.00 2 \$ 80.00 600.00 33.75 \$ 600.00 85.00 2 \$ 85.00 953.00 67.5 \$ 953.00	2 5 80.00 33.75 5 600.00 2 5 85.00 67.5 5 953.00 2 2 5 85.00		
Sanitation Gator Gator Mob/Demob Generator Generator Mob/Demob Tractor/MkBtoer Tractor/Mbb/Demob	/month 7.375 5 ./month 7.375 5	908.00 8.4375 908.00 80.00 2 \$ 80.00 600.00 33.75 \$ 600.00 85.00 2 \$ 85.00 953.00 67.5 \$ 933.00 85.00 2 \$ 85.00	2 5 80.00 33.75 6 00.00 2 5 85.00 67.5 953.00 2 2 5 85.00 2362.5 175.39 175.39		

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mior UXO Supervisor	hour	2580 \$	82.00	2580 \$	82.00	1050 \$	82.00	R Person
KO Quality Control Specialist	hour	2580 \$	73.00	2580 \$	73.00	1050 \$	73.00	1 Person
to Safety Officer	hour	2580 \$	78.00	2580 S	78.00	1050 5	78.00	3. Person
KO Tech B	hour	5160 \$	52.00	5160 \$	52.00	2100 \$	52.00	based on number of teams above
lentist II	hour	5160 S	85.00	5160 \$	85.00	2100 \$	85.00	based on number of teams above
cientist III	hour	2580 \$	115.00	2580 \$	115.00	1050 \$	115.00	1 Person
oject Manager	hour	258 \$	146.00	258 \$	146.00	105 \$	146.00	
lisc Field Supplies (betteries, fire extinguishers, cameras)	each	# \$	2,268.00	2 \$	2,268.00	2 \$	2,268.00	
PS Handheid	/www.k	64.5 \$	300.00	64.5 \$	300.00	26.25 \$	300.00	
PS - RTK Base Station	/week	64,5 S	400.00	64.5 S	400.00	26.25 \$	400.00	
PS Network Rover Only	/www.k	129 \$	450.00	129 \$	450.00	52.5 \$	450.00	1 per team
exphysical Survey Instruments	/week	129 \$	560.00	129 \$	560.00	52.5 \$	560.00	1 per team
lobilization - Geophysical Instrumentation (80 lbs)	each	4 \$	150.00	4 5	150.00	4 5	150.00	2 per team
ckup Truck Rental	/waek	129 \$	300.00	129 \$	300.00	S2.5 5	300.00	1 per team
adio - 2 way (set of 10)	/month	16.125 \$	725.30	16.125 S	725.30	6.5625 5	725.30	
omputer	/www.ek	64.5 S	23.75	64.5 S	23.75	26.25 \$	23.75	
an its tion	/month	16.125 \$	78.70	16.125 S	78,70	6.5625 \$	78.70	
enerator	/week	64.5 S	600.00	64.5 S	600.00	26.25 \$	600.00	
enerator Mob/Demob	each	2 5	85.00	2 5	85.00	2 5	85.00	
ractor/skkdstaer	/www.k	129 S	953.00	129 \$	953.00	52.5 \$	953.00	2 AGC curd teams
actor Mob/Demob	each	S IE	85.00		85.00			Auc. cued deams
all Day Per Diem (Lodging, 13% Tax + Milute)	day	3612 \$	175.39	2 \$ 3612 \$	175.39	2 \$ 1470 \$	85.00	
n ory en own (Lodging, 134 (a) + waite)	OBY	2015 2	1/5.39	3612 5	175.39	14/0 5	175.39	
rtrusive		\$	2,671,686.06	\$	2,671,686.06	s	1,090,561,49	
mior UICO Supervisor	hour	760 \$	82.00	760 S	82.00	310 S	\$2.00	1 Person
XO Quality Control Specialist	hour	750 \$	73.00	760 5	73.00	310 5	73.00	
XO Safety Officer	hour	760 5	78.00	760 \$	78.00			2 Person
XO Tech III	hour	2280 \$				310 5	78.00	1. Person
XO Tech II			63.00	2280 S	63.00	930 \$	63.00	1 per team
	hour	4560 \$	52.00	4560 \$	52.00	1860 5	52.00	Z per taam
XO Tech I	hour	4560 \$	44.00	4560 \$	44.00	1860 \$	44.00	2 per laarn
roject Marunger	hour	228 \$	146.00	228 \$	146.00	93 \$	146.00	
Osc Field Supplies (batteries, fire extinguishers, cameras)	each		2,268.00	2 5	2,268.00	2 5	2,268.00	
P5 Handheid	/week	19 \$	300.00	19 \$	300.00	7.75 \$	300.00	
PS Netwark Rover Only	/week	57 \$	450.00	57 \$	450.00	23.25 \$	450.00	
eophysical Survey Instruments	/week	57 \$	\$60.00	57 \$	560.00	23.25 \$	560.00	
lobilization - Geophysical Instrumentation (80 lbs)	each	· · · · · · · · · · · · · · · · · · ·	150.00	6 S	150.00	6 5	150.00	
ckup Trisck Rental	/www.k	57 \$	300.00	57 \$	300.00	23.25 \$	300.00	
adio - 2 way (set of 10)	/month	4.75 5	725.30	4.75 S	725.30	1.9375 S	725.30	
itation	/month	475 \$	78.70	4.75 S	78.70	1.9375 \$	78.70	
all Day Per Diem (Lodging, 13% Tax + M&IE)	day	2527 \$	175.39	2527 \$	175.39	1030.75 \$	175.39	
		s	1,324,603,53	5	1.324.603.53	S	543.517.49	
/S Setup			1,324,603.53	5	1,324,603.53		543,517.49	
mior UI(O Supervisor	hour	30 \$	82.00	30 S	1,324,603.53 82.00	30 S	543,517.49 82.00	I Person
	hour					30 S	82.00	
mlor UNO Supervisor NO Quality Control Specialist		30 \$	82.00 73.00	30 S 30 S	82.00 73.00	30 S 30 S	82.00 73.00	1. Person
mior UI(O Supervisor	hour	30 \$ 30 \$ 30 \$	82.00 73.00 78.00	30 \$ 30 \$ 30 \$	82.00 73.00 78.00	30 S 30 S 30 S	82.00 73.00 78.00	A Person B Person
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onlor UKO Supervisor KO Quality Control Specialist XO Safety Officer XO Tech III KO Tech II	hour hour hour	30 \$ 30 \$ 30 \$ 30 \$ 30 \$	82.00 73.00 78.00 63.00 52.00	30 \$ 30 \$ 30 \$ 30 \$ 30 \$	82.00 73.00 78.00 63.00 52.00	30 S 30 S 30 S 30 S 30 S	82.00 73.00 78.00 63.00 52.00	Person Person Person Berson based on number of transs ab based on number of transs ab
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nele UEO Segarahor KO Galilly Control Specialist 20 Safety Offlour 20 Safety Offlour 20 Tech II 20 Seattle Statum 25 Seattle Statum 25 Seattle Statum 25 Seattle Statum 26 Seattle Statum 20 Seattle S	hour hour hour hour hour hour esch /week /week /week /week esch /week	30 \$ 30 \$ 30 \$ 30 \$ 30 \$ 30 \$ 30 \$ 30 \$	82.00 73.00 78.00 63.00 52.00 44.00 2.268.00 300.00 400.00 400.00 450.00 566.00 150.00	30 \$ 30 \$ 30 \$ 30 \$ 30 \$ 30 \$ 30 \$ 30 \$	82.00 73.00 78.00 63.00 52.00 44.00 146.00 2,288.00 300.00 450.00 560.00 150.00 130.00	30 S 30 S 30 S 30 S 30 S 30 S 3 S 30 S 3 S 2 S 0.75 S 0.75 S 0.75 S 0.75 S 0.75 S	82.00 78.00 63.00 52.00 44.00 2.268.00 300.00 400.00 580.00 150.00 150.00	Person Person Person Besed on number of basis ab based on number of trains ab
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Inde UED Sugarvisor ND Safety Colliser ND Safety Officer ND Safety Officer ND Safety Officer ND Tech II In Feld Supplier Safety Officer PS Handhold PS Handhold PS Handhold PS Handhold PS Handhold PS Handhold PS Handhold Name Naver Othy Handhold PS Handhold Safety New Name And Safety Officer Handhold PS Handhold Safety New Name And Safety Officer Handhold PS Handhold Safety New Name And Safety Officer Handhold PS Handhold PS Handhold PS Handhold Name Name Name Name Name Name Name Name Name Name Name Name Name	hour hour hour hour hour hour esch /week esch /week esch /week esch /week esch /week esch /week esch /week esch /week /month /mo	30 \$ 30 \$	82.00 73.00 78.00 32.00 44.00 1.46.00 2.86.00 460.00 460.00 460.00 725.30 725.30 725.30 906.00 600.00	30 \$ 30 \$ 30 \$ 30 \$ 30 \$ 30 \$ 30 \$ 30 \$	82,00 73,00 73,00 53,00 54,00 146,00 146,00 460,00 460,00 460,00 150,00 725,30 300,00 725,30 73,75 908,00 80,00 80,00 80,00	30 5 30 5 30 5 30 5 30 5 30 5 30 5 30 5	52.00 73.00 52.00 52.00 346.00 3246.00 300.00 400.00 400.00 560.00 725.30 300.00 725.30 906.00 80.00 600.00	Person Person Person Besed on number of basis ab based on number of trains ab
nole UID Sugarvisor No Sality Context Specialist 20 Sality of Rear 8 20 Sality of Rear 8 20 Sality of Rear 9 20 Sality of Rear	hour hour hour hour hour hour esch /week /week /week /week /week /month week /month each	30 \$ 30 \$ 30 \$ 30 \$ 30 \$ 30 \$ 30 \$ 30 \$	17.00 71.00 61.00 52.00 44.00 300.00 450.00 450.00 550.00 550.00 755.30 735.30 735.30 735.30 735.30 735.30 735.30 860.00 600.00 65.00	30 S 30 S	82,00 73,60 63,00 44,00 2,266,00 450,00 450,00 450,00 450,00 560,00 350,00 350,00 350,00 350,00 350,00 373,30 23,73 78,70 808,00 80,00 80,00 850,00 850,00	30 \$ 30 \$ 30 \$ 30 \$ 30 \$ 30 \$ 30 \$ 30 \$	82.00 78.00 83.00 52.00 44.00 2,268.00 300.00 450.00 450.00 560.00 560.00 725.30 21.75 78.70 908.00 80.00 80.00 850.00 850.00	Person Person Person Berson based on number of transs ab based on number of transs ab
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//mebas07401/pht/Projects/Viuntsville Cont W912DY-08-D-0003/TO#13 - OD Grounds RI-PS/Documents/P5/GB - Rnel P5/Vent_040318/cost/Draft P5 Cost Book_063018.ster

Table: 3.5_DGM_intrusive Element: LUCs Date: July 31, 2018 Contract: W9120V-080-0003 Task Order 0013 Document: FS Report for OD Grounds MRA Sike: Seneca Army Depot Activity, Romulus, New York

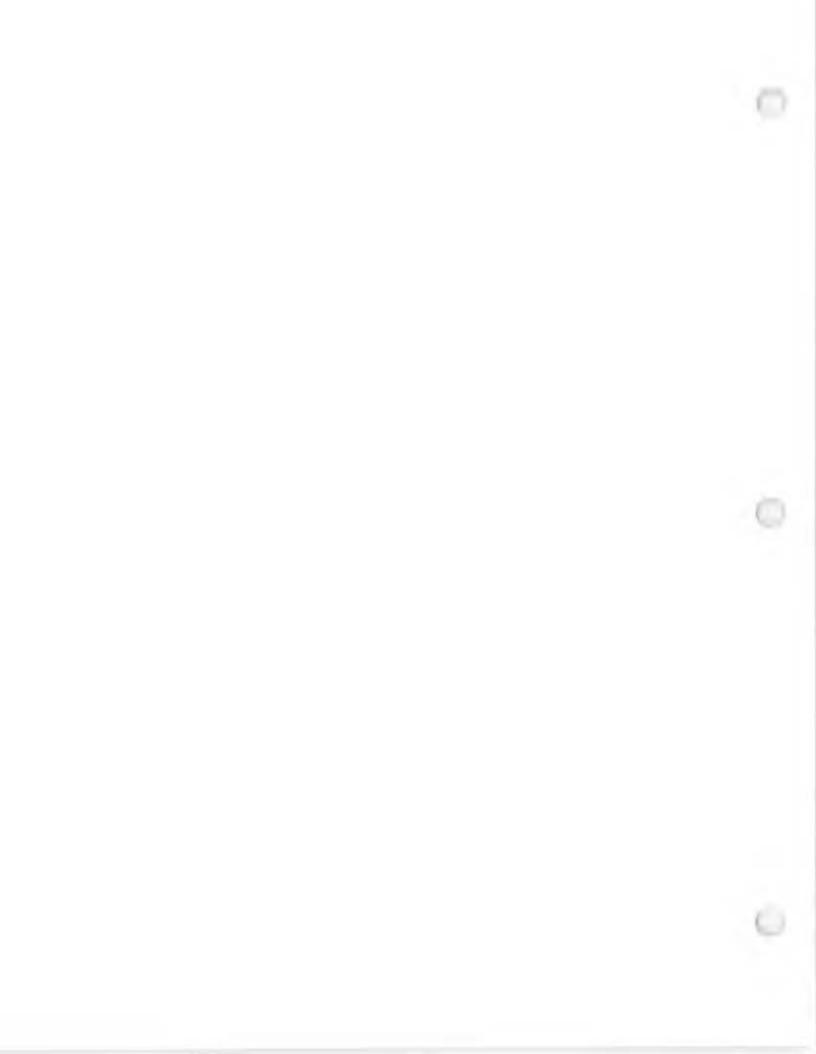
Page 2 of 2 7/31/2018

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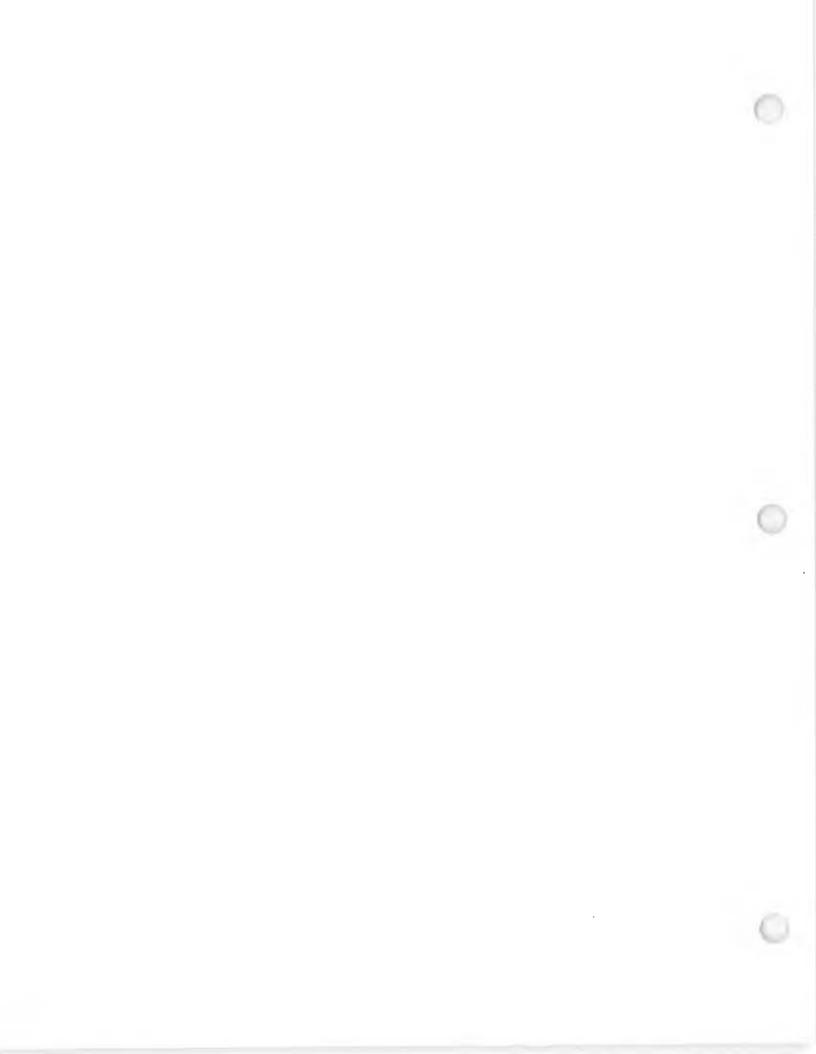
14,

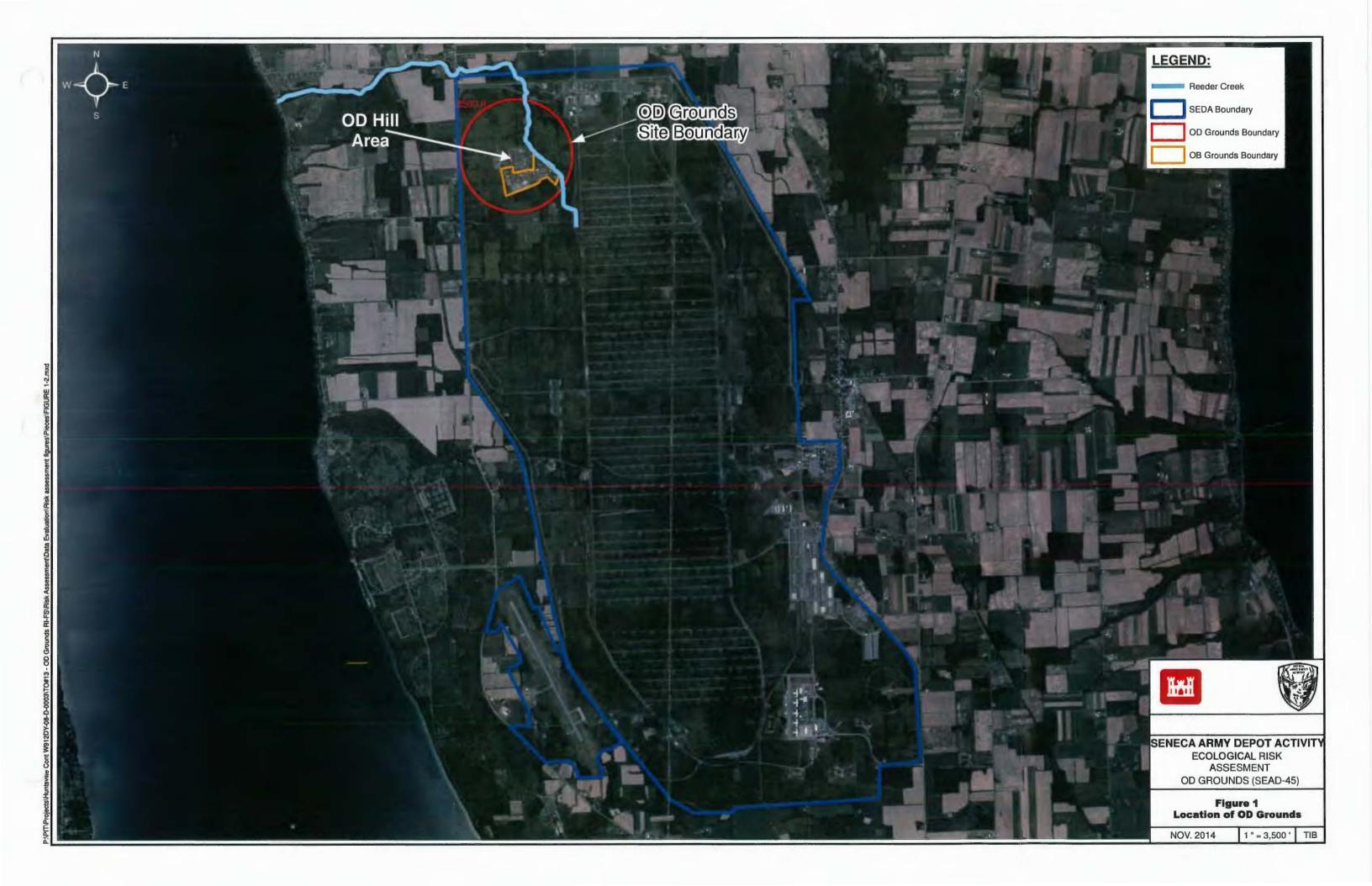
APPENDIX E COMPILATION OF PREVIOUS INVESTIGATIONS AND STUDIES

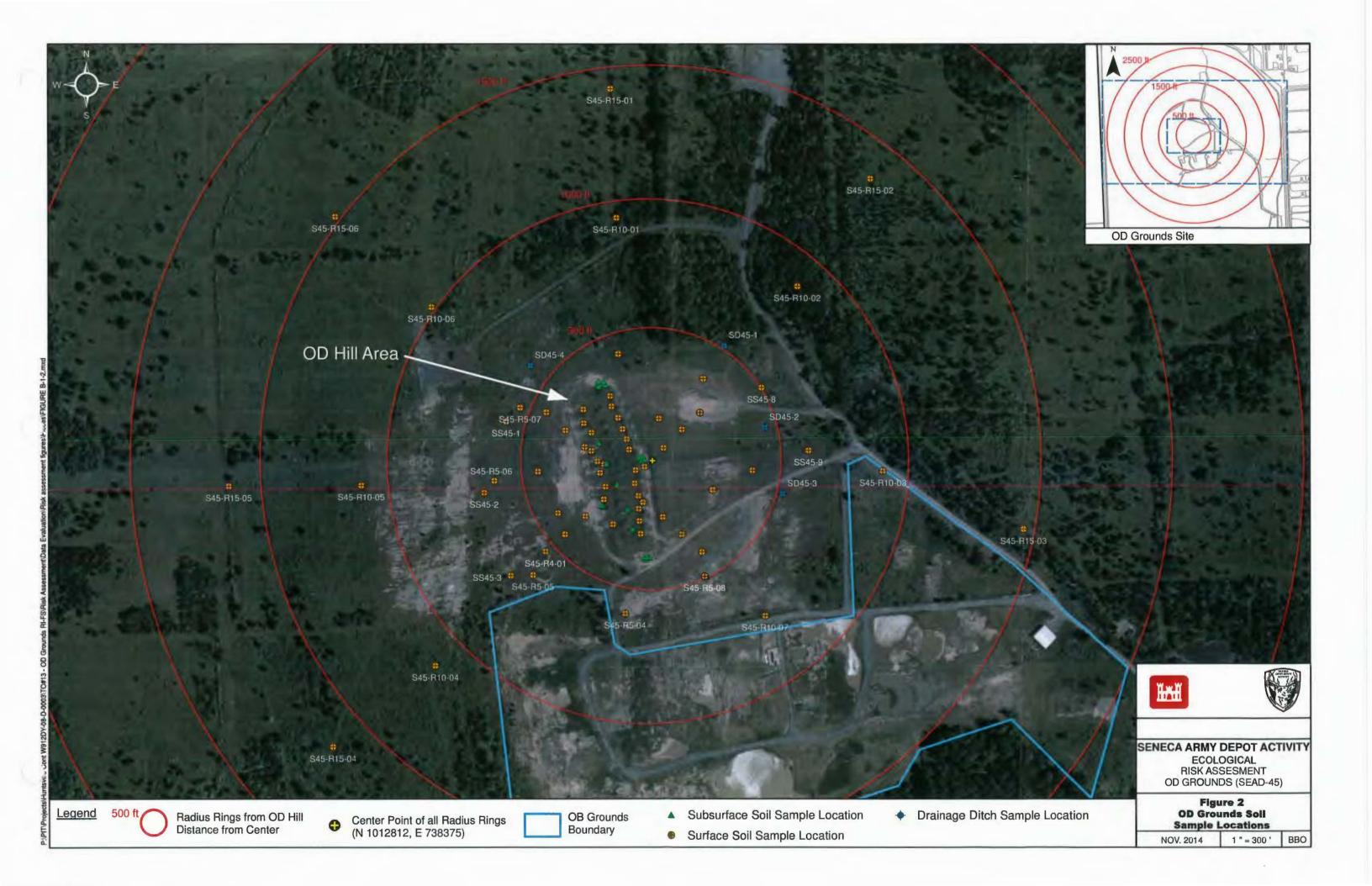
1



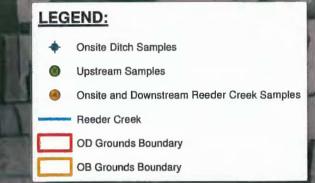
Appendix C2 Munitions and Explosives of Concern Risk Assessment (MEC RA) and Alternatives Analysis















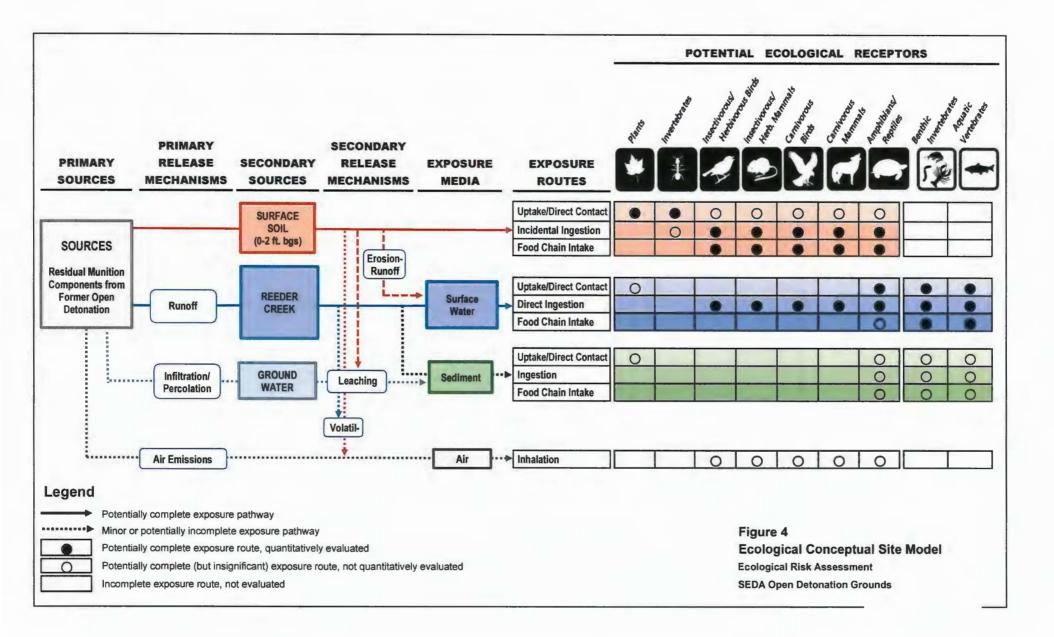
SENECA ARMY DEPOT ACTIVITY HUMAN HEALTH RISK ASSESMENT OD GROUNDS (SEAD-45)

 Figure 3

 OD Grounds Surface

 Water Sample Locations

 NOV. 2014
 1 "= 2,000 '
 TIB



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ATTACHMENT A

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	Lognormal GOF 1		
Shapiro Wilk Test Statistic	0.773	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk P Value	6.041E-11	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.205	Lilliefers Lognormal GOF Test	
5% Lilliefors Critical Value	0,119	Data Not Lognormal at 5% Significance Level	-
Data Not L	ognormal at 5% Sig	nificance Level	
	Lognormal Statist	les	
Minimum of Logged Data	8.684	Mean of logged Data	9.792
Maximum of Logged Data	10.46	SD of logged Data	0.23
	ming Lognormal Di		
95% H-ÚCL		90% Chebyshev (MVUE) UCL	
95% Chebyshev (MVUE) UCL		97.5% Chebyshev (MVUE) UCL	21973
99% Chebyshev (MVUE) UCL	24110		
	tric Distribution Free		
Deta do not fo	niow a Discernible I	Distribution (0.05)	_
	ametric Distribution		
95% CLT UCL		95% Jackknife UCL	19295
	19267	95% Bootstrap-t UCL	19584
95% Hall's Bootstrap UCL	19929	95% Percentile Bootstrap UCL	19257
95% BCA Bootstrap UCL	19489		-
90% Chebyshev(Mean, Sd) UCL	20047	95% Chebyshev(Mean, Sd) UCL	20818
97.5% Chebyshev(Mean, Sd) UCL	21888	99% Chebyshev(Mean, Sd) UCL	23989
	man and a stand as		
	Suggested UCL to	Use	
95% Student's-t UCL	19295	or 95% Modified-t UCL	19319
95% Student's-t UCL			19319
	19295		19319
Note: Suggestions regarding the selection of a 95%	19295 UCL are provided t	or 95% Madified-t UCL	19319
Note: Suggestions regarding the selection of a 95% Recommendations are bas	19295 UCL are provided t ed upon data size, d	or 95% Modified-t UCL o help the user to select the most appropriate 95% UCL.	19319
Note: Suggestions regarding the selection of a 95% Recommendations are bas These recommendations are based upon the resul	19295 UCL are provided t ed upon data size, a ts of the simulation	or 95% Modified-t UCL o help the user to select the most appropriate 95% UCL. Iata distribution, and skewness.	19319
Note: Suggestions regarding the selection of a 95% Recommendations are bas These recommendations are based upon the resul	19295 UCL are provided t ed upon data size, a ts of the simulation	or 95% Modified-t UCL o help the user to select the most appropriate 95% UCL. fata distribution, and skewness. studies summarized in Singh, Malchie, and Lee (2006).	19319
Note: Suggestions regarding the selection of a 95% Recommendations are bas These recommendations are based upon the resul	19295 UCL are provided t ed upon data size, a ts of the simulation	or 95% Modified-t UCL o help the user to select the most appropriate 95% UCL. fata distribution, and skewness. studies summarized in Singh, Malchie, and Lee (2006).	19319
Note: Suggestions regarding the selection of a 95% Recommendations are bas These recommendations are based upon the resul However, simulations results will not cover all Real W	19295 UCL are provided t ed upon data size, a ts of the simulation	or 95% Modified-t UCL o help the user to select the most appropriate 95% UCL. fata distribution, and skewness. studies summarized in Singh, Malchie, and Lee (2006).	19319
Note: Suggestions regarding the selection of a 95% Recommendations are bas These recommendations are based upon the resul	19295 UCL are provided t ed upon data size, a ts of the simulation	or 95% Modified-t UCL o help the user to select the most appropriate 95% UCL. fata distribution, and skewness. studies summarized in Singh, Malchie, and Lee (2006).	19319
Note: Suggestions regarding the selection of a 95% Recommendations are bas These recommendations are based upon the resul However, simulations results will not cover all Real W	19295 UCL are provided t ed upon data size, a ts of the simulation	or 95% Modified+ UCL o help the user to select the most appropriate 95% UCL tata distribution, and skewness. studies summarized in Singh, Malchle, and Lee (2006). dditional insight the user may want to consult a statistician.	19319
Note: Suggestions regarding the selection of a 95% Recommendations are bas These recommendations are based upon the resul However, simulations results will not cover all Real W	19295 UCL are provided t ed upon data size, e ts of the simulation orld data sets; for a	or 95% Modified+ UCL o help the user to select the most appropriate 95% UCL tata distribution, and skewness. studies summarized in Singh, Malchle, and Lee (2006). dditional insight the user may want to consult a statistician.	41
Note: Suggestions regarding the selection of a 95% Recommendations are bas These recommendations are based upon the result However, simulations results will not cover all Real W	19295 UCL are provided t ed upon data size, e ts of the simulation orld data sets; for ar	or 95% Modified+ UCL o help the user to select the most appropriate 95% UCL, stata distribution, and skewness, studies summarized in Singh, Malchle, and Lee (2006). ddltional insight the user may want to consult a statistician,	
Note: Suggestions regarding the selection of a 95% Recommendations are bas These recommendations are based upon the result However, simulations results will not cover all Real W	19295 UCL are provided t ed upon data size, e ts of the simulation orld data sets; for ar	or 95% Modified+ UCL o help the user to select the most appropriate 95% UCL, tata distribution, and skewness. studies summarized in Singh, Malchle, and Lee (2006). dilfional insight the user may want to consult a statistician, Mumber of Distinct Observations	41
Note: Suggestions regarding the selection of a 95% Recommendations are bas These recommendations are based upon the resul However, simulations results will not cover all Real W ony Total Number of Observations	19295 UCL are provided t ed upon data size, ts of the simulation orld data sets; for ar General Statistic 55	or 95% Modified-t UCL o help the user to select the most appropriate 95% UCL. data distribution, and skewness. studies summarized in Singh, Maichle, and Lee (2006). didtional insight the user may want to consult a statistician, didtional insight the user may want to consult a statistician, Number of Distinct Observations Number of Missing Observations	41
Note: Suggestions regarding the selection of a 95% Recommendations are bas These recommendations are based upon the resul However, simulations results will not cover all Real W ony Total Number of Observations Minimum	19295 UCL are provided ti dupon data size, i ts of the simulation orld data sets; for ar General Statistic 55 0.09	or 95% Modified-t UCL o help the user to select the most appropriate 95% UCL. data distribution, and skewness. studies summarized in Singh, Maichle, and Lee (2006). diltional insight the user may want to consult a statistician, diltional insight the user may want to consult a statistician, Mumber of Distinct Observations Number of Distinct Observations Mean	41 0 1.925 0.26
Note: Suggestions regarding the selection of a 95% Recommendations are bas These recommendations are based upon the result However, simulations results will not cover all Real W ony Total Number of Observations Minimum Maximum	19295 UCL are provided t ed upon data size, ts of the simulation orld data sets; for ar General Statistic 55 0.09 13.4	or 95% Modified+ UCL o help the user to select the most appropriate 95% UCL tata distribution, and skewness. studies summarized in Singh, Malchle, and Lee (2006). dditional insight the user may want to consult a statistician. dditional insight the user may want to consult a statistician. Mumber of Distinct Observations Number of Missing Observations Mean Median	41 0 1.925
Note: Suggestions regarding the selection of a 95% Recommendations are bas These recommendations are based upon the result However, simulations results will not cover all Real W ony Total Number of Observations Minimum Maximum SD	19295 UCL are provided t ed upon data size, ts of the simulation orld data sets; for ar General Statistic 55 0.09 13.4 3.564	or 95% Modified+ UCL o help the user to select the most appropriate 95% UCL, stata distribution, and skewness. studies summarized in Singh, Maichile, and Lee (2006). dditional insight the user may want to consult a statistician. dditional insight the user may want to consult a statistician dditional insight the user may want to consult a statistician. Median Median Std, Error of Mean	41 0 1.923 0.26 0.48
Note: Suggestions regarding the selection of a 95% Recommendations are bas These recommendations are based upon the result However, simulations results will not cover all Real W ony Total Number of Observations Minimum Maximum SD	19295 UCL are provided t ed upon data size, ts of the simulation orld data sets; for ar General Statistic 55 0.09 13.4 3.564	or 95% Modified-t UCL o help the user to select the most appropriate 95% UCL. data distribution, and skewness. studies summarized in Singh, Maichle, and Lee (2006). diffonel insight the user may want to consult a statistican, diffonel insight the user may want to consult a statistican, Mumber of Distinct Observations Number of Missing Observations Mean Median Std. Error of Mean Std. Error of Mean	41 0 1.923 0.26 0.48
Note: Suggestions regarding the selection of a 95% Recommendations are base These recommendations are based upon the result However, simulations results will not cover all Real W ony Total Number of Observations Minimum Maximum SD	19295 UCL are provided t ed upon data size, edupon data size, is of the simulation orld data sets; for an orld	or 95% Modified-t UCL o help the user to select the most appropriate 95% UCL. data distribution, and skewness. studies summarized in Singh, Maichle, and Lee (2006). diffonel insight the user may want to consult a statistican, diffonel insight the user may want to consult a statistican, Mumber of Distinct Observations Number of Missing Observations Mean Median Std. Error of Mean Std. Error of Mean	41 0 1.923 0.26 0.48
Note: Suggestions regarding the selection of a 95% Recommendations are bas These recommendations are based upon the resul However, simulations results will not cover all Real W ony Total Number of Observations Minimum Maximum SD Coefficient of Variation	19295 UCL are provided ti ed upon data size, is of the simulation orld data sets; for ar General Statistic 55 0.09 13.4 3.564 1.848 Narmal GOF Tee	or 95% Modified+ UCL o help the user to select the most appropriate 95% UCL tata distribution, and skewness. studies summarized in Singh, Matchle, and Lee (2006). dditional insight the user may want to consult a statistician. dditional insight the user may want to consult a statistician. Mumber of Distinct Observations Number of Missing Observations Mean Std. Error of Mean Skewness	41 0 1.923 0.26 0.48
Note: Suggestions regarding the selection of a 95% Recommendations are bas These recommendations are based upon the result However, simulations results will not cover all Real W ony Total Number of Observations Minimum Maximum SD Coefficient of Variation	19295 UCL are provided th ed upon data size, ts of the simulation orid data sets; for are General Statistic 55 0.09 13.4 3.564 1.848 Narmal GOF Tee 0.552	or 95% Modified+ UCL o help the user to select the most appropriate 95% UCL. stata distribution, and skewness. studies summarized in Singh, Maichle, and Lee (2006). dditional insight the user may want to consult a statistician. dditional insight the user may want to consult a statistician. Mumber of Distinct Observations Number of Missing Observations Median Std. Error of Mean Skewness at Shapiro Wilk GOF Teet	41 0 1.923 0.26 0.48
Note: Suggestions regarding the selection of a 95% Recommendations are base These recommendations are based upon the resul However, simulations results will not cover all Real W ony Total Number of Observations Minimum Maximum SD Coefficient of Variation Shapiro Wilk Test Statistic 5% Shapiro Wilk P Value	19295 UCL are provided t ed upon data size, ts of the simulation orld data sets; for ar General Statistic 55 0.09 13.4 3.564 1.848 Normal GOF Tee 0.552 0	or 95% Modified+t UCL o help the user to select the most appropriate 95% UCL, stata distribution, and skewness. studies summarized in Singh, Malchle, and Lee (2006). dditional insight the user may want to consult a statistician. dditional insight the user may want to consult a statistician dditional insight the user may want to consult a statistician. Median Number of Distinct Observations Number of Missing Observations Median Std. Error of Mean Skewness t Shapiro Wilk GOF Test Data Not Normal at 5% Significance Level	41 0 1.925 0.26 0.481

	arounds – OD Hill Activity (SEDA) isk Assessment	Army Depot /	Seneca		
	red Full Data Sets	tics for Uncenso	UCL Statis		
				User Oals stad Oatland	
			ProUCL 5, 17/25/2018 6:5	User Selected Options Date/Time of Computation	
_			Surfsoil_ProUCL_temp.xl	From File	
			OFF	Full Precision	
			95%	Confidence Coefficient	
_			2000	mber of Bootstrap Operations	
				um	
-	inites	General Stat			
3 37	Number of Distinct Observations	55	Number of Observations	Tota	
s 0	Number of Missing Observations				
18346	Mean	5910	Minimum		
17800	Median	35000	Maximum		
567.2	Std. Error of Mean	4206	SD		
1.88	Skewness	0.229	Coefficient of Variation		
	Task	Normal GOF			
_	Shapiro Wilk GOF Test	0.755	Shapiro Wilk Test Statistic		
	Data Not Normal at 5% Significance Level		5% Shapiro Wilk P Value		
	Lillefors GOF Test	0.237	Lilliefors Test Statistic		
	Data Not Normal at 5% Significance Level	0.119	5% Lilliefors Critical Value		
		Normal at 5% S	Data Not		
	95% UCLs (Adjusted for Skewness)	suming Normal I	As mei UCL	95% Ma	
10/33	95% Adjusted-CLT UCL (Chen-1995)	19295	95% Student's-t UCL	00 / 10	
	95% Modified-t UCL (Johnson-1978)	102.00			
-				-	
		Gamme GOF			
	Anderson-Darling Gamma GOF Test	4.081	A-D Test Statistic		
9	Data Not Gamma Distributed at 5% Significance Leve	0.749	5% A-D Critical Value		
	Kolmogorov-Smirnov Gamma GOF Test	0.208	K-S Test Statistic 5% K-S Critical Value		
.61	Data Not Gamma Distributed at 5% Significance Leve 5% Significance Level				
		Gamma Stat			
	k star (bias corrected MLE)	20.42	k hat (MLE)		
	Theta star (bias corrected MLE)	898.3	Theta hat (MLE)		
	nu star (bias corrected)	2246	nu hat (MLE)		
	MLE Sd (bias corrected)	18346	LE Mean (bias corrected)	М	
	Approximate Chi Square Value (0.05) Adjusted Chi Square Value	0,0456	sted Level of Significance	e	
2016	Adjusted Chi Square Value	0,0400	Stor Level of Signatcance	Adju	
	Distribution	uming Gamma i	Ан		
	95% Adjusted Gamma UCL (use when n<50)	10010	1101 /use where as a 500	95% Approximate Gamma	

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Note: Suggestions regarding the selection of a 95%			
		e, data distribution, and skewness.	
		on studies summarized in Singh, Malchle, and Lee (2006).	
However, simulations results will not cover all Real W	orld data sets; for	r additional insight the user may want to consult a statistician,	
mic	A had a de la contra de la contra de		
	General State	stics	
Total Number of Observations	55	Number of Distinct Observations	25
		Number of Missing Observations	0
Minimum	4	Mean	5.578
Maximum	12.4	Median	5.2
SD	1.462	Std. Error of Mean	0.197
Coefficient of Variation	0.262	Skewness	3,036
	Normal GOF	Test	
Shapiro Wilk Test Statistic	0,687	Shapiro Wilk GOF Test	
5% Shapiro Wilk P Value	1.277E-14	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.258	Lillefors GOF Test	_
5% Lillefors Critical Value	0.119	Data Not Normal at 5% Significance Level	
Data Not	Normal at 5% Si	gnificance Level	
As	euming Normal D	Nation	
95% Normal UCL		95% UCLs (Adjusted for Skewness)	_
95% Student's-t UCL	5,908	95% Adjusted-CLT UCL (Chen-1995)	5.98
		95% Modified-t UCL (Johnson-1978)	5.92
	Gamma GOF	Teat	
A. D. Taux Ossilation			
A-D Test Statistic 5% A-D Critical Value	3.425	Anderson-Darling Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.749	Kolmoporov-Smirnov Gamma GOF Test	
		-	
5% K-S Critical Value Data Not Game	0.12 na Distributed at :	Data Not Gamma Distributed at 5% Significance Level 5% Significance Level	
		-	_
	Gamma Stati		
k hat (MLE)	20.59	k star (blas corrected MLE)	19.48
Theta hat (MLE)	0.271	Theta star (blas corrected MLE)	0.28
nu hat (MLE)	2265	nu star (bias corrected)	2142
MLE Mean (bias corrected)	5.578	MLE Sd (bias corrected)	1.26
		Approximate Chi Square Value (0.05)	2036
Adjusted Level of Significance	0,0456	Adjusted Chi Square Value	2033
As	suming Gamma I	Distribution	
95% Approximate Gamma UCL (use when n>=50))	5.87	95% Adjusted Gamma UCL (use when n<50)	5.87
	Lognormal GO	FTest	
Shapiro Wilk Test Statistic	0.828	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk P Value	2.3344E-8	Data Not Lognormal at 5% Significance Level	
Lillefors Test Statistic	0.209	Lillefors Lognormal GOF Test	_
5% Lilliefors Critical Value	0.119	Data Not Lognormal at 5% Significance Level	

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rap UCL	2.693	1	
Sd) UCL	4.024	-	
Sd) UCL			
		1	
		1	
		1	

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7/25/201	В

95% Normal UCL		95% UCLs (Adjusted for Skewmens)	
95% Student's-t UCL	2.733	95% Adjusted-CLT UCL (Chen-1995)	2.86
5576 5000125-1 002	2.133	95% Modified-t UCL (Johnson-1978)	2.75
		·····	
	Gamma GOF		
A-D Test Statistic 5% A-D Critical Value	5,953 0,817	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value K-S Test Statistic	0.817	Data Not Gamma Distributed at 5% Significance Level Kolmosorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.239	Data Not Gamma Distributed at 5% Significance Level	_
		% Significance Level	-
	Gamma Statis		
k hat (MLE)	0.491	k star (blas corrected MLE)	0.47
Theta hat (MLE)	3.928	Theta star (bias corrected MLE)	4.04
nu hat (MLE)	54.01	nu star (bias corrected)	52.4
MLE Mean (blas corrected)	1.929	MLE Sd (bias corrected)	2.79
		Approximate Chi Square Value (0.05)	36.7
Adjusted Level of Significance	0.0456	Adjusted Chi Square Value	36,4
Aar	uming Gamma D	Istribution	-
95% Approximate Gamma UCL (use when n>=50))	2.748	95% Adjusted Gamma UCL (use when n<50)	2.77
	Lognormal GO	Test	
Shapiro Wilk Test Statistic	0.829	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk P Value		Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0,194	Lillefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.119	Data Not Lognormal at 5% Significance Level	_
		ignificance Lavel	
	Lognormal Stat	lettos	
Minimum of Logged Data	-2.408	Mean of logged Data	-0.64
Maximum of Logged Data	2.595	SD of logged Data	1.48
	2.000		
		Pd - L - R	
	aming Lognormal		
95% H-UCL	2.938	90% Chebyshev (MVUE) UCL	
95% H-UCL 95% Chebyshev (MVUE) UCL	2.938 3.326		
95% H-UCL	2.938	90% Chebyshev (MVUE) UCL	
95% H-UCL 95% Chebyshev (MVUE) UCL 99% Chebyshev (MVUE) UCL	2.938 3.326 5.624	90% Chebyshev (MVUE) UCL	
95% H-UCL 95% Chebyshev (MVUE) UCL 99% Chebyshev (MVUE) UCL Nonperame	2.938 3.326 5.624 Aric Distribution F	90% Chebyshev (MVUE) UCL 97.5% Chebyshev (MVUE) UCL	
95% H-UCL 95% Chebyshev (MVUE) UCL 99% Chebyshev (MVUE) UCL 99% Chebyshev (MVUE) UCL Nonperame Data do not fi	2.938 3.326 5.624 Aric Distribution F	90% Chebyshev (MVUE) UCL 97.5% Chebyshev (MVUE) UCL ree UCL Statistics a Distribution (0.05)	
95% H-UCL 95% Chebyshev (MVUE) UCL 99% Chebyshev (MVUE) UCL 99% Chebyshev (MVUE) UCL Nonperame Data do not fi	2.938 3.326 5.624 Artic Distribution F Discernibi	90% Chebyshev (MVUE) UCL 97.5% Chebyshev (MVUE) UCL ree UCL Statistics a Distribution (0.05)	4.10
95% H-UCL 95% Chebyshev (MVUE) UCL 99% Chebyshev (MVUE) UCL Nonparame Data do not fi Nonparame	2.938 3.326 5.624 Aric Distribution F Silow a Discernibil remetric Distribution	90% Chebyshev (MVUE) UCL 97.5% Chebyshev (MVUE) UCL ree UCL Statistics a Distribution (0.05) on Free UCLs	2.76 4.10 2.73 2.90
95% H-UCL 95% Chebyshev (MVUE) UCL 99% Chebyshev (MVUE) UCL Nonparame Data do not fi Norpar 95% CLT UCL	2.938 3.326 5.624 Attic Distribution F bolicw a Discernibut ametric Distribut 2.719	90% Chebyshev (MVUE) UCL 97.5% Chebyshev (MVUE) UCL ree UCL Statistics 9 Distribution (0.05) on Free UCLs 95% Jackknife UCL	2.73
95% H-UCL 95% Chebyshev (MVUE) UCL 99% Chebyshev (MVUE) UCL Nonparame Data do not f Nonpa 95% CLT UCL 95% Standard Bootstrap UCL	2.938 3.326 5.624 kric Distribution F color a Discernibl americic Distribut 2.719 2.706	90% Chebyshev (MVUE) UCL 97.5% Chebyshev (MVUE) UCL 97.5% Chebyshev (MVUE) UCL es UCL Statistics 9 Distribution (0.05) 90 Free UCLs 95% Jackknife UCL 95% Bootstrap-t UCL	4.10 2.73 2.90
95% H-UCL 95% Chebyshev (MVUE) UCL 95% Chebyshev (MVUE) UCL 95% Chebyshev (MVUE) UCL Nonparame Data do not f Nonpa 95% CLT UCL 95% Standard Bootstrap UCL 95% Hall's Bootstrap UCL	2.938 3.326 5.624 tric Distribution F collow a Discernible collow a Discernible collow a Discernible collow a Discernible 2.719 2.706 2.79	90% Chebyshev (MVUE) UCL 97.5% Chebyshev (MVUE) UCL 97.5% Chebyshev (MVUE) UCL es UCL Statistics 9 Distribution (0.05) 90 Free UCLs 95% Jackknife UCL 95% Bootstrap-t UCL	4.10 2.73 2.90 2.69
95% H-UCL 95% Chebyshev (MVUE) UCL 95% Chebyshev (MVUE) UCL 95% Chebyshev (MVUE) UCL Nonperame Data do not fi Nonper 95% CLT UCL 95% Standard Bootstrap UCL 95% Halfs Bootstrap UCL	2.938 3.326 5.624 etric Distribution F etric Distribution F etric Distribution F etric Distribution 2.719 2.706 2.79 2.836	90% Chebyshev (MVUE) UCL 97.5% Chebyshev (MVUE) UCL 97.5% Chebyshev (MVUE) UCL estimation (MVUE) UCL 95% Jackknife UCL 95% Jackknife UCL 95% Bootstrap-t UCL 95% Percentile Bootstrap UCL	4.10 2.73 2.90
95% H-UCL 95% Chebyshev (MVUE) UCL 99% Chebyshev (MVUE) UCL 99% Chebyshev (MVUE) UCL Nonparame Data do not 95% CLT UCL 95% Standard Bootstrap UCL 95% Halfs Bootstrap UCL 95% BCA Bootstrap UCL 95% Chebyshev(Mean, Sd) UCL	2.938 3.326 5.624 4ric Distribution F ollow a Discernibl 2.719 2.706 2.79 2.836 3.37	90% Chebyshev (MVUE) UCL 97.5% Chebyshev (MVUE) UCL 97.5% Chebyshev (MVUE) UCL end 95% Chebyshev (Mount) UCL 95% Dootstrap+t UCL 95% Chebyshev (Mean, Sd) UCL 99% Chebyshev (Mean, Sd) UCL	4.10 2.73 2.90 2.69 4.00

5% A-D Critical Value	0.75	Data Not Gamma Distributed at 5% Significance Level	-
K-S Test Statistic	0.165	Kolmogorov-Smirnov Gemma GOF Test	
5% K-S Critical Value	0.12	Data Not Gamma Distributed at 5% Significance Level	
-	me Distributed at	5% Significance Level	
	Gemme Stat		
k hat (MLE)	9,97	k star (blas corrected MLE)	9,43
Theta hat (MLE)	17.88	Theta star (blas corrected MLE)	18.89
nu hat (MLE)	1097	nu star (bias corrected)	1038
MLE Mean (blas corrected)	178.2	MLE Sd (bias corrected) Approximate Chi Square Value (0,05)	964.4
Adjusted Level of Significance	0.0456	Adjusted Chi Square Value	962.5
Aa	suming Gemma		
95% Approximate Gamma UCL (use when n>=50))	191.9	95% Adjusted Gamma UCL (use when n<50)	192,3
	Lognormal GO	F Test	
Shapiro Wilk Test Statistic	-	Shaptro Wilk Lognormal GOF Test	
5% Shapiro Wilk P Value	8.2731E-9	Data Not Lognormal at 5% Significance Level	
Lillefors Test Statistic	0.172	Lillefore Lognormal GOF Test	_
5% Lilliefors Critical Value	0.119	Data Not Lognormal at 5% Significance Level	
Data Not I	ognormal at 5%	Significance Level	
	Lognormal Sta	ndictics	
Minimum of Logged Data	3.329	Mean of logged Data	5.13
Maximum of Logged Data	5.9	SD of logged Data	0.35
Aas	uming Lognormal	Distribution	
95% H-UCL	196,1	90% Chebyshev (MVUE) UCL	206,5
95% Chebyshev (MVUE) UCL	218.5	97.5% Chebyshev (MVUE) UCL	235,1
99% Chebyshev (MVUE) UCL	267.7		
Nonparame	stric Distribution I	Free UCL Statistics	-
		le Distribution (0.05)	
Monne	remetric Distribut	Non Erma 11Cl a	
95% CLT UCL		95% Jackknife UCL	190.4
95% Standard Bootstrap UCL	190.4	95% Bootstrap-t UCL	192
95% Hall's Bootstrap UCL	193.3	95% Percentile Bootstrap UCL	190
95% BCA Bootstrap UCL	191.1		
90% Chebyshev(Mean, Sd) UCL	200	95% Chebyshev(Mean, Sd) UCL	209.8
97.5% Chebyshev(Mean, Sd) UCL	223.5	99% Chebyshev(Mean, Sd) UCL	250.4
	Character (110)	An I lan	
95% Student's-t UCL	Suggested UCL 190,4	or 95% Modified-t UCL	190,5
No. and the second seco		ed to help the user to select the most appropriate 95% UCL.	
		co, unu uloulouloul, and skewness.	
Recommendations are ba		ion studies summarized in Singh, Maichle, and Lee (2006).	
Recommendations are bat These recommendations are based upon the resu	ults of the simulat	ion studies summarized in Singh, Maichle, and Lee (2006). or additional insight the user may want to consult a statistician.	-
Recommendations are bat These recommendations are based upon the resu	ults of the simulat		
Recommendations are bat These recommendations are based upon the resu	ults of the simulat		

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	C8	Lognormal Statistics	
1.694	Mean of logged Data	1.386	Minimum of Logged Data
0.208	SD of logged Data	2.518	Maximum of Logged Data
_	theten	ming Lognormal Distribu	Anne
6.033	90% Chebyshev (MVUE) UCL	5,84	95% H-UCL
6,543	97.5% Chebyshev (MVUE) UCL	6.247	95% Chebyshev (MVUE) UCL
		7.127	99% Chebyshev (MVUE) UCL
	UCL Statistics	tric Distribution Free UCI	Noncaratinal
		Now a Discernible Distric	
5.908	Free UCLs 95% Jackknife UCL	ametric Distribution Free 5.902	95% CLT UCL
6.07	95% Jackknile UCL 95% Bootstrap-t UCL	5.896	95% Standard Bootstrap UCL
5.91	95% Percentile Bootstrap UCL	6.404	95% Standard Bootstrap UCL 95% Hall's Bootstrap UCL
5.91	35% Percentije Bootstrap UCL	5,993	95% BCA Bootstrap UCL
6,43	95% Chebyshev(Mean, Sd) UCL	6,169	90% Chebyshev(Mean, Sd) UCL
7.539	99% Chebyshev(Mean, Sd) UCL	6.809	97.5% Chebyshev(Mean, Sd) UCL
7,538	33% Chebyshev(Mean, 30) UCL	0.009	ST.5 % Chebysnev(mean, Su) CCL
	Jao	Suggested UCL to Use	
	or 95% Modified-t UCL	C 000	95% Student's-t UCL
	bis 55% modified 4 OCL bis ball the user to select the most appropriate 95% UCL, lata distribution, and skewness. studies summarized in Singh, Malchie, and Lee (2006), iditional insight the user may want to consult a statistician.	ed upon data size, data o ts of the simulation studi	Note: Suggestions regarding the selection of a 95% Recommendations are bas These recommendations are based upon the result
	b help the user to select the most appropriate 95% UCL lata distribution, and skewness. trudies summarized in Singh, Maichle, and Lee (2006). Iditional Insight the user may want to consult a statistician.	UCL are provided to hel ed upon data size, data d ts of the simulation studi orld data sets; for additio	Note: Suggestions regarding the selection of a 95% Recommendations are bas These recommendations are based upon the result
	b help the user to select the most appropriate 95% UCL lata distribution, and skewness. studies summarized in Singh, Malchle, and Lee (2006). Iditional insight the user may want to consult a statistician.	UCL are provided to hel ed upon data size, data d ts of the simulation studi orld data sets; for additio	Note: Suggestions regarding the selection of a 95% Recommendations are bas These recommendations are based upon the resul However, simulations results will not cover all Reel W
45	b help the user to select the most appropriate 95% UCL, ata distribution, and skewness, studies summarized in Singh, Maichle, and Lee (2006), iditional insight the user may want to consult a statistician. Number of Distinct Observations	UCL are provided to hel ed upon data size, data d ts of the simulation studi orld data sets; for additio	Note: Suggestions regarding the selection of a 95% Recommendations are bas These recommendations are based upon the result
45 0	b help the user to select the most appropriate 95% UCL, ata distribution, and skewness. studies summarized in Singh, Maichle, and Lee (2006), iditional Insight the user may want to consult a statistician. Number of Distinct Observations Number of Missing Observations	UCL are provided to hel ded upon data size, data ts of the simulation studi orid data sets; for additio	Note: Suggestions regarding the selection of a 95% Recommendations are bas These recommendations are based upon the result However, simulations results will not cover all Reel W Total Number of Observations
45 0 178,2	b help the user to select the most appropriate 95% UCL, ata distribution, and skewness. studies summarized in Singh, Maichle, and Lee (2006). Iditional Insight the user may want to consult a statistician. Number of Distinct Observations Number of Missing Observations Mean	UCL are provided to hel ed upon data size, data ts of the simulation studi orid data sets; for addition General Statistics 55 27.9	Note: Suggestions regarding the selection of a 95% Recommendations are bas These recommendations are based upon the result However, simulations results will not cover all Real W Total Number of Observations Minimum
45 0 178.2 170	b help the user to select the most appropriate 95% UCL, late distribution, and skewness. studies summarized in Singh, Maichle, and Lee (2006), iditional insight the user may want to consult a statistician. Number of Distinct Observations Number of Distinct Observations Mean Median	UCL are provided to hel ed upon data size, data de ts of the simulation studi orid data sets; for additio	Note: Suggestions regarding the selection of a 95% Recommendations are bas These recommendations are based upon the resul However, simulations results will not cover all Real W Total Number of Observations Total Number of Observations Minimum
45 0 178,2 170 7,248	b help the user to select the most appropriate 95% UCL, ata distribution, and skewness. studies summarized in Singh, Maichle, and Lee (2006). Iditional Insight the user may want to consult a statistician. Number of Distinct Observations Number of Missing Observations Mean	UCL are provided to hel ed upon data size, data ts of the simulation studi orid data sets; for addition General Statistics 55 27.9	Note: Suggestions regarding the selection of a 95% Recommendations are bas These recommendations are based upon the result However, simulations results will not cover all Real W Total Number of Observations Minimum
45 0 178,2 170 7,248	b help the user to select the most appropriate 95% UCL, ata distribution, and skewness. studies summarized in Singh, Maichle, and Lee (2006). didtional Insight the user may want to consult a statistician. Number of Distinct Observations Number of Missing Observations Mean Median Std, Error of Mean Skewness	UCL are provided to hel ed upon data size, data ts of the simulation studie orid data sets; for addition General Statistics 55 27.9 365 53.75 0.302	Note: Suggestions regarding the selection of a 95% Recommendations are base These recommendations are based upon the result However, simulations results will not cover all Real W Total Number of Observations Minimum Maximum SD
45 0 178,2 170 7,248	b help the user to select the most appropriate 95% UCL, ata distribution, and skewness. studies summarized in Singh, Maichle, and Lee (2006). iditional Insight the user may want to consult a statistician. Number of Distinct Observations Number of Missing Observations Mean Median Std. Error of Mean Skewness	UCL are provided to hel ed upon data size, data ts of the simulation studi orid data sets; for additio General Statistics 55 27.9 365 53.75 0.302 Normal QOF Test	Note: Suggestions regarding the selection of a 95% Recommendations are bas These recommendations are based upon the result However, simulations results will not cover all Real W Total Number of Observations Minimum Maximum SD Coefficient of Variation
45 0 178,2 170 7,248	help the user to select the most appropriate 95% UCL, ata distribution, and skewness. studies summarized in Singh, Maichle, and Lee (2006). didional Insight the user may want to consult a statistician. Number of Distinct Observations Number of Distinct Observations Median Stat, Error of Mean Skewness t Shaphro Wilk QOF Teet	UCL are provided to held de upon data size, data to of the simulation studie ord data sets; for addition data sets; for additi	Note: Suggestions regarding the selection of a 95% Recommendations are base These recommendations are based upon the result However, simulations results will not cover all Real W Total Number of Observations Total Number of Observations Minimum Maximum Sp Coefficient of Variation Shapiro Wilk Test Statistic
45 0 178,2 170 7,248	b help the user to select the most appropriate 95% UCL, ata distribution, and skewness, studies summarized in Singh, Maichle, and Lee (2006), didtional Insight the user may want to consult a statistician. Number of Distinct Observations Number of Distinct Observations Meetian Std. Error of Mean Std. Error of Mean Std. Error of Mean Staphro Wilk GOF Test Data Not Normal at 5% Significance Level	UCL are provided to hely ed upon data size, data ta of the simulation studie orid data sets; for additio General Statistics 55 27.9 365 53.75 0.302 Normal QOF Test 0.911 3.8416E-4	Note: Suggestions regarding the selection of a 95% Recommendations are base These recommendations are based upon the result However, simulations results will not cover all Real W Total Number of Observations Minimum Maximum Sp Coefficient of Variation Shapiro Wilk Test Statistic 5% Shapiro Wilk P Value
45 0 178,2 170 7,248	b help the user to select the most appropriate 95% UCL, ata distribution, and skewness. studies summarized in Singh, Maichle, and Lee (2006), iditional insight the user may want to consult a statistician. Number of Distinct Observations Number of Distinct Observations Mean Std. Error of Mean Std. Error of Mean Skewness t	UCL are provided to hel ed upon data size, data ts of the simulation studie orid data sets; for addition General Statistics 55 27.9 365 53.75 0.302 Normal GOF Test 0.911 3.8416E-4 0.196	Note: Suggestions regarding the selection of a 95% Recommendations are base These recommendations are based upon the result However, simulations results will not cover all Reel W Total Number of Observations Total Number of Observations Minimum Maximum SD Coefficient of Variation Shapiro Wilk Test Statistic 5% Shapiro Wilk P Value Lilliefors Test Statistic
45 0 178,2 170 7,248	b help the user to select the most appropriate 95% UCL, ata distribution, and skewness. studies summarized in Singh, Maichle, and Lee (2006), iditional Insight the user may want to consult a statistician. Number of Distinct Observations Number of Distinct Observations Nean Median Std, Error of Mean Std, Error of Mean Skewness t Shapiro Wilk GOF Test Data Not Normal at 5% Significance Level Lilliators GOF Test Data Not Normal at 5% Significance Level	UCL are provided to hel ed upon data size, data ts of the simulation studie orid data sets; for addition General Statistics 55 27.9 365 53.75 0.302 Normal QOF Test 0.911 3.8416E-4 0.196 0.119	Note: Suggestions regarding the selection of a 95% Recommendations are bas These recommendations are based upon the result However, simulations results will not cover all Real W Total Number of Observations Total Number of Observations Minimum Maximum SD Coefficient of Variation Shapiro Wilk Test Statistic 5% Shapiro Wilk P Value Lilliefors Test Statistic
45 0 178,2 170 7,248	b help the user to select the most appropriate 95% UCL, ata distribution, and skewness. studies summarized in Singh, Maichle, and Lee (2006), iditional Insight the user may want to consult a statistician. Number of Distinct Observations Number of Distinct Observations Nean Median Std, Error of Mean Std, Error of Mean Skewness t Shapiro Wilk GOF Test Data Not Normal at 5% Significance Level Lilliators GOF Test Data Not Normal at 5% Significance Level	UCL are provided to hel ed upon data size, data ts of the simulation studie orid data sets; for addition General Statistics 55 27.9 365 53.75 0.302 Normal GOF Test 0.911 3.8416E-4 0.196	Note: Suggestions regarding the selection of a 95% Recommendations are bas These recommendations are based upon the result However, simulations results will not cover all Real W Total Number of Observations Total Number of Observations Minimum Maximum SD Coefficient of Variation Shapiro Wilk Test Statistic 5% Shapiro Wilk P Value Lilliefors Test Statistic
45 0 178,2 170 7,248	b help the user to select the most appropriate 95% UCL, ata distribution, and skewness. studies summarized in Singh, Maichle, and Lee (2006), didional insight the user may want to consult a statistician. Number of Distinct Observations Number of Distinct Observations Median Std. Error of Mean Std. Error of Mean Std. Error of Mean Skewness t Shaptro Wilk GOF Test Data Not Normal at 5% Significance Level Lilliefore GOF Test Data Not Normal at 5% Significance Level Icance Level	UCL are provided to hel ed upon data size, data ts of the simulation studie orid data sets; for addition General Statistics 55 27.9 365 53.75 0.302 Normal QOF Test 0.911 3.8416E-4 0.196 0.119	Note: Suggestions regarding the selection of a 95% Recommendations are base These recommendations are based upon the result However, simulations results will not cover all Reel W Total Number of Observations Minimum Maximum SD Coefficient of Variation Shapiro Wilk Test Statistic 5% Shapiro Wilk P Value Lillefors Test Statistic 5% Lillefors Critical Value Date Not
45 0 178.2 170 7.248 0.912	b help the user to select the most appropriate 95% UCL, ata distribution, and skewness. studies summarized in Singh, Maichle, and Lee (2006), diftional insight the user may want to consult a statistician. Number of Distinct Observations Number of Distinct Observations Mean Median Std. Error of Mean Std. Error of Mea	UCL are provided to hel of upon data size, data ts of the simulation studie orid data sets; for addition General Statistics 55 27.9 365 53.75 0.302 Normal GOF Test 0.911 3.8416E-4 0.196 0.119 Normal at 5% Significant suming Normal Distribution	Note: Suggestions regarding the selection of a 95% Recommendations are bas These recommendations are based upon the result However, simulations results will not cover all Reel W Total Number of Observations Minimum Maximum SD Coefficient of Variation Shapiro Wilk Test Statistic 5% Shapiro Wilk P Value Lilliefors Test Statistic 5% Lilliefors Critical Value Data Not
45 0 178.2 170 7.244 0.912	b help the user to select the most appropriate 95% UCL ata distribution, and skewness. studies summarized in Singh, Maichle, and Lee (2006). didtional Insight the user may want to consult a statistician. Number of Distinct Observations Number of Distinct Observations Mean Median Std, Error of Mean Std, Error of Mean Skewness to Shapiro Wilk GOP Test Data Not Normal at 5% Significance Level Lillietors GOP Test Data Not Normal at 5% Significance Level Lillietors GOP Test Data Not Normal at 5% Significance Level Station S% UCLs (Adjusted for Skewness) 95% Adjusted-CLT UCL (Chen-1995)	UCL are provided to held de upon data size, data ta of the simulation studie orid data sets; for addition data sets; for addition sets; for additi	Note: Suggestions regarding the selection of a 95% Recommendations are base These recommendations are based upon the result However, simulations results will not cover all Reel W Total Number of Observations Minimum Maximum SD Coefficient of Variation Shapiro Wilk Test Statistic 5% Shapiro Wilk P Value Lillefors Test Statistic 5% Lillefors Critical Value Date Not
45 0 178.2 170 0.912	b help the user to select the most appropriate 95% UCL ata distribution, and skewness. studies summarized in Singh, Maichle, and Lee (2006), iditional Insight the user may want to consult a statistician. Number of Distinct Observations Number of Distinct Observations Mean Median Std, Error of Mean Std, Error of Mean Skewness t Shapiro Wilk GOF Test Data Not Normal at 5% Significance Level Lillietors GOF Test Data Not Normal at 5% Significance Level Lillietors GOF Test Data Not Normal at 5% Significance Level Lillietors GOF Test Data Not Normal at 5% Significance Level Station S5% UCLs (Adjusted for Skewness) 95% Adjusted-CLT UCL (Chen-1995)	UCL are provided to hel of upon data size, data ts of the simulation studie orid data sets; for addition General Statistics 55 27.9 365 53.75 0.302 Normal GOF Test 0.911 3.8416E-4 0.196 0.119 Normal at 5% Significant suming Normal Distribution	Note: Suggestions regarding the selection of a 95% Recommendations are bas These recommendations are based upon the result However, simulations results will not cover all Reel W Total Number of Observations Minimum Maximum SD Coefficient of Variation Shapiro Wilk Test Statistic 5% Shapiro Wilk P Value Lilliefors Test Statistic 5% Lilliefors Critical Value Data Not
45 0 178.2 170 7.244 0.912	b help the user to select the most appropriate 95% UCL, ata distribution, and skewness. studies summarized in Singh, Maichle, and Lee (2006), didional Insight the user may want to consult a statistician. Number of Distinct Observations Number of Distinct Observations Mean Median Std, Error of Mean Std, Error of Mean Std, Error of Mean Std, Error of Mean Std, Error of Mean Stewness t Shapiro Wilk GOF Test Data Not Normal at 5% Significance Level Lilliefore GOF Test Data Not Normal at 5% Significance Level Cance Level Station 95% UCLs (Adjusted for Skewness) 95% Adjusted-CLT UCL (Johnson-1978)	UCL are provided to hel of upon data size, data ts of the simulation studie orid data sets; for addition General Statistics 55 27.9 365 53.75 0.302 Normal GOF Test 0.911 3.8416E-4 0.196 0.119 Normal at 5% Significant suming Normal Distribution	Note: Suggestions regarding the selection of a 95% Recommendations are bas These recommendations are based upon the result However, simulations results will not cover all Reel W Total Number of Observations Minimum Maximum SD Coefficient of Variation Shapiro Wilk Test Statistic 5% Shapiro Wilk P Value Lilliefors Test Statistic 5% Lilliefors Critical Value Data Not

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99% Chebyshev (MVUE) UCL	0,949		
Nonparameti	ic Distribution Fr	ree UCL Statistics	
Data do not foi	low a Discemible	Distribution (0.05)	
Nonpara	metric Distributio	on Free UCLs	
95% CLT UCL	0.814	95% Jackknife UCL	0.814
95% Standard Bootstrap UCL	0.813	95% Bootstrap-t UCL	0.819
95% Hall's Bootstrap UCL	0.832	95% Percentile Bootstrap UCL	0.814
95% BCA Bootstrap UCL	0.817		
90% Chebyshev(Mean, Sd) UCL	0.837	95% Chebyshev(Mean, Sd) UCL	0.859
97.5% Chebyshev(Mean, Sd) UCL	0.891	99% Chebyshev(Mean, Sd) UCL	0,953
	Suggested UCL 1	he I laa	
95% Student's-t UCL	0.814	or 95% Modified-t UCL	0.815
Note: Suggestions regarding the selection of a 95%	JCL are provide	d to help the user to select the most appropriate 95% UCL.	
Recommendations are base	d upon data size	e, data distribution, and skewness.	
These recommendations are based upon the result	s of the simulatio	n studies summarized in Singh, Malchie, and Lee (2006).	
		additional insight the user may want to consult a statistician.	
	_		
n			
		-	_
Total Number of Observations	General State	Number of Distinct Observations	42
Total Number of Observations	55		42
		Number of Missing Observations	
Minimum	0.46	Mean	7.02
Maximum	23,6	Median	7.4
SD	3.806	Std. Error of Mean	0.51
Coefficient of Variation	0,542	Skewness	1.4
	Normal GOF	Test	
	Normal GOP	1 ear	
Shapiro Wilk Test Statistic	0.872	Shapiro Wilk GOF Test	
Shapiro Wilk Test Statistic 5% Shapiro Wilk P Value 3	0.872		
	0.872	Shapiro Wilk GOF Test	
5% Shapiro Wilk P Value 3 Lilliefors Test Statistic 5% Lilliefors Critical Value	0.872 .5672E-6 0.167 0.119	Shapiro Wilk GOF Test Data Not Normal at 5% Significance Level Lillefors GOF Test Data Not Normal at 5% Significance Level	
5% Shapiro Wilk P Value 3 Lilliefors Test Statistic 5% Lilliefors Critical Value	0.872 .5672E-6 0.167	Shapiro Wilk GOF Test Data Not Normal at 5% Significance Level Lillefors GOF Test Data Not Normal at 5% Significance Level	
5% Shapiro Wilk P Value 3 Lilliefors Test Statistic 5% Lilliefors Critical Value Deta Not	0.872 .5672E-6 0.167 0.119	Shapiro Wilk GOF Test Data Not Normal at 5% Significance Level Lillefors GOF Test Data Not Normal at 5% Significance Level gnificance Level	
5% Shapiro Wilk P Value 3 Lilliefors Test Statistic 5% Lilliefors Critical Value Deta Not	0.872 .5672E-6 0.167 0.119 Normal at 5% Sig	Shapiro Wilk GOF Test Data Not Normal at 5% Significance Level Lillefors GOF Test Data Not Normal at 5% Significance Level gnificance Level	
5% Shapiro Wilk P Value 3 Lilliefors Test Statistic 5% Lilliefors Critical Value Data Not 1	0.872 .5672E-6 0.167 0.119 Normal at 5% Sig	Shapiro Wilk GOF Test Data Not Normal at 5% Significance Level Lillefors GOF Test Data Not Normal at 5% Significance Level gnificance Level	7.97
5% Shapiro Wilk P Value 3 Lilliefors Test Statistic 5% Lilliefors Critical Value Deta Not 85% Normal UCL	0.872 .5672E-6 0.167 0.119 Normal at 5% Sk	Shapiro Wilk GOF Test Data Not Normal at 5% Significance Level Lilliefors GOF Test Data Not Normal at 5% Significance Level gnffcance Level Istribution 95% UCLs (Adjusted for Sixemess)	
5% Shapiro Wilk P Value 3 Lilliefors Test Statistic 5% Lilliefors Critical Value Deta Not 85% Normal UCL	0.872 .5672E-6 0.167 0.119 Normal at 5% Skg uming Normal D 7.882	Shapiro Wilk GOF Test Data Not Normal at 5% Significance Level Lillefors GOF Test Data Not Normal at 5% Significance Level antificance Level stribution 5% UCLs (Adjusted for Sixwmess) 95% Adjusted-CLT UCL (Chen-1995) 95% Modified-t UCL (Johnson-1978)	
5% Shapiro Wilk P Value 3 Lilliefors Test Statistic 5% Lilliefors Critical Value Data Not 1 Ase 95% Normai UCL 95% Student's-t UCL	0.872 .5672E-6 0.167 0.119 Normal at 5% Skg varing Normal D 7.882 Gemma GOF	Shapiro Wilk GOF Test Data Not Normal at 5% Significance Level Liliertors GOF Test Data Not Normal at 5% Significance Level gnificance Level istribution \$5% UCLs (Adjusted for Siewnee) \$5% Adjusted-CLT UCL (Chen-1995) \$5% Modified-t UCL (Johnson-1978) Test	
5% Shapiro Wilk P Value 3 Lilliefors Test Statistic 5% Lilliefors Criticol Value Deta Not 85% Normal UCL 95% Student's-t UCL A-D Test Statistic	0.872 .5672E-6 0.167 0.119 Wormal at 5% Sk Wining Normal D 7.882 Gamma GOF 3.185	Shapiro Wilk GOF Test Data Not Normal at 5% Significance Level Liliertors GOF Test Data Not Normal at 5% Significance Level gnificance Level stribution	
5% Shapiro Wilk P Value 3 Lilliefors Test Statistic 5% Lilliefors Critical Value Data Not 85% Normal UCL 95% Student's-t UCL A-D Test Statistic 5% A-D Critical Value	0.872 .5672E-6 0.167 0.119 Normal at 5% Sk uning Normal D 7.882 Gemme GOF 3.185 0.76	Shapiro Wilk GOF Test Data Not Normal at 5% Significance Level Lilleitors GOF Test Data Not Normal at 5% Significance Level gnificance Level istribution 95% UCLs (Adjusted for Sixwmese) 95% Adjusted-CLT UCL (Chen-1995) 95% Modified-t UCL (Johnson-1978) Test Anderson-Darling Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level	
5% Shapiro Wilk P Value 3 Lilliefors Test Statistic 5% Lilliefors Critical Value Data Not 95% Normal UCL 95% Student's-t UCL 4-D Test Statistic 5% A-D Critical Value K-S Test Statistic	0.872 .5672E-6 0.167 0.119 Normal 15% Sk wring Normal D 7.882 Gamma GOF 3.185 0.76 0.794	Shapiro Wilk GOF Test Data Not Normal at 5% Significance Level Lillerious GOF Test Data Not Normal at 5% Significance Level gnificance Level stribution 95% Adjusted-CLT UCL (Chen-1995) 95% Adjusted-CLT UCL (Chen-1978) Test Anderson-Darling Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level Kolmogorov-Smirnov Gamma GOF Test	
5% Shapiro Wilk P Value 3 Lilliefors Test Statistic 5% Lilliefors Critical Value Deta Not 1 495% Normai UCL 95% Student's-t UCL 95% Student's-t UCL 5% A-D Test Statistic 5% A-D Critical Value K-S Test Statistic	0.872 .5672E-6 0.167 0.119 Normal at 5% Skg uming Normal D 7.882 Gamma GOF 3.185 0.76 0.194 0.121	Shapiro Wilk GOF Test Data Not Normal at 5% Significance Level Lilleitors GOF Test Data Not Normal at 5% Significance Level gnificance Level istribution 95% UCLs (Adjusted for Sixwmese) 95% Adjusted-CLT UCL (Chen-1995) 95% Modified-t UCL (Johnson-1978) Test Anderson-Darling Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level	7.97
5% Shapiro Wilk P Value 3 Lilliefors Test Statistic 5% Lilliefors Critical Value Deta Not 1 495% Normai UCL 95% Student's-t UCL 95% Student's-t UCL 5% A-D Test Statistic 5% A-D Critical Value K-S Test Statistic	0.872 .5672E-6 0.167 0.119 Normal at 5% Skg uming Normal D 7.882 Gamma GOF 3.185 0.76 0.194 0.121	Shapiro Wilk GOF Test Data Not Normal at 5% Significance Level Lillefors GOF Test Data Not Normal at 5% Significance Level anificance Level stribution 95% Adjusted-CLT UCL (Chen-1995) 95% Adjusted-UCL (Johnson-1978) 95% Modified-t UCL (Johnson-1978) 7est Anderson-Darling Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level Kolmogorov-Smirnov Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level	
5% Shapiro Wilk P Value 3 Lilliefors: Test Statistic 5% Lilliefors: Critical Value Data Not 1 495% Normai UCL 95% Student's-t UCL 95% Student's-t UCL 5% A-D Test Statistic 5% A-D Critical Value K-S Test Statistic	0.872 .5672E-6 0.167 0.119 Normal at 5% Skg uming Normal D 7.882 Gamma GOF 3.185 0.76 0.194 0.121	Shapiro Wilk GOF Test Data Not Normal at 5% Significance Level Lilierions GOF Test Data Not Normal at 5% Significance Level gnificance Level stribution 95% UCLs (Adjusted for Skewnese) 95% Adjusted-CLT UCL (Chen-1995) 95% Modified-t UCL (Johnson-1978) 7est Anderson-Darling Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level Kotmogorov-Smirnov Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level 5% Significance Level	

	General Statis	les	
Total Number of Observations	55	Number of Distinct Observations	28
		Number of Missing Observations	0
Minimum	0.43	Mean	0.786
Maximum	1.4	Median	0.79
SD	0,124	Std. Error of Mean	0,0167
Coefficient of Variation	0.158	Skewness	1.765
	Normal GOF 1	Cent	
Shapiro Wilk Test Statistic	0.829	Shapiro Wilk GOF Test	
5% Shapiro Wilk P Value		Data Not Normal at 5% Significance Level	
Lillefors Test Statistic	0.167	Liliefors GOF Test	
5% Lilliefors Critical Value	0.119	Data Not Normal at 5% Significance Level	
	Normal at 5% Sig		
Provide 1 April			
Aar 95% Normal UCL	uming Normal Di	etribution 95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	0.814	95% Adjusted-CLT UCL (Chen-1995)	0,818
55% Students-LOCE	0.014	95% Modified-t UCL (Johnson-1978)	0.815
A-D Test Statistic	Camma GOF	Test Anderson-Darling Gamma GOF Test	_
5% A-D Critical Value	0,748	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0,149	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.149	Data Not Gamma Distributed at 5% Significance Level	
	a Distributed at 5	5% Significance Level	
	Gamme Statis	den	
k hat (MLE)	43.58	k star (bias corrected MLE)	41.22
Theta hat (MLE)	0.018	Theta star (blas corrected MLE)	0.0191
nu hat (MLE)	4794	nu star (bias corrected MCE)	4534
MLE Mean (bias corrected)	0.786	MLE Sd (blas corrected)	0,122
MLE Mean (Mas conected)	0.760	Approximate Chi Square Value (0.05)	4378
Adjusted Level of Significance	0.0456		4376
Adjusted Level of Significance	0.0450	Adjusted Chi Square Value	4374
	mine Commo D	Astibution	
	0.814	95% Adjusted Gamma UCL (use when n<50)	0.815
			0.815
	0.814		0.815
% Approximate Gamma UCL (use when n>=50))	0.814 Lognormal GOF 0.873	- Test	0.815
% Approximate Gamma UCL (use when n>=50)) Shapiro Wilk Test Statistic	0.814 Lognormal GOF 0.873	Test Shapko Wik Lognormal GOF Test	0.815
% Approximate Gamma UCL (use when n>≔50)) Shapiro Wilk Test Statistic 5% Shapiro Wilk P Value	0.814 Lognormal GOF 0.873 4.3362E-6	Test Shaphro Wilk Lognormal GOF Test Data Not Lognormal at 5% Significance Level	0.815
% Approximate Gamma UCL (use when n>=50)) Shapiro Wilk Test Statistic 5% Shapiro Wilk P Value Lilliefors Test Statistic 5% Lilliefors Critical Value	0.814 Lognormal GOF 0.873 4.3362E-6 0.146	Test Shepko Wik Lognormal GOF Test Data Not Lognormal at 5% Significance Level Liliefors Lognormal GOF Test Data Not Lognormal at 5% Significance Level	0.815
% Approximate Gamma UCL (use when n>=50)) Shapiro Wilk Test Statistic 5% Shapiro Wilk P Value Lilliefors Test Statistic 5% Lilliefors Critical Value	0.814 Lognormal GOF 0.873 4.3362E-6 0.146 0.119	Test Shepho Wilk Lognormal GOF Test Data Not Lognormal at 5% Significance Level Lillefore Lognormal GOF Test Data Not Lognormal at 5% Significance Level Significance Level	0.815
% Approximate Gamma UCL (use when n>=50)) Shapiro Wilk Test Statistic 5% Shapiro Wilk P Value Lilliefors Test Statistic 5% Lilliefors Critical Value	0.814 Lognormal GOF 0.873 4.3362E-6 0.146 0.119 ognormal at 5% S	Test Shepho Wilk Lognormal GOF Test Data Not Lognormal at 5% Significance Level Lillefore Lognormal GOF Test Data Not Lognormal at 5% Significance Level Significance Level	-0.252
% Approximate Gamma UCL (use when n>=50)) Shapiro Wilk Test Statistic 5% Shapiro Wilk P Value Lilliefors Test Statistic 5% Lilliefors Critical Value Data Not L	0.814 Lognormal GOF 0.873 4.3362E-6 0.146 0.119 0.119 Dognormal at 5% S Lognormal Stat	Frest Shepho Wilk Lognormal GOF Test Data Not Lognormal at 5% Significance Level Lillefors Lognormal GOF Test Data Not Lognormal at 5% Significance Level Significance Level	
% Approximate Gamma UCL (use when n>=50)) Shapiro Wilk Test Statistic 5% Shapiro Wilk P Value Lilliefors Test Statistic 5% Lilliefors Critical Value Data Not L Minimum of Logged Data Maximum of Logged Data	0.814 Lognormal GOF 0.873 4.3362E-6 0.146 0.119 ognormal at 5% S Lognormal at 5% S Lognormal Stat -0.844 0.336	Test Shepiro Wik Lognormal GOF Test Data Not Lognormal at 5% Significance Level Liliefors Lognormal GOF Test Data Not Lognormal at 5% Significance Level Significance Level Significance Level Significance Lavel Significance Lavel Significance Significance Level Significance Significance Level Significance Significance Level Significance Signi	-0.252
% Approximate Gamma UCL (use when n>=50)) Shapiro Wilk Test Statistic 5% Shapiro Wilk P Value Lillefors Test Statistic 5% Lillefors Critical Value Deta Not L Minimum of Logged Data Maximum of Logged Data	0.814 Lognormal GOF 0.873 4.3362E-6 0.116 0.119 ognormal at 5% S Lognormal Stat -0.844	Test Shepiro Wik Lognormal GOF Test Data Not Lognormal at 5% Significance Level Liliefors Lognormal GOF Test Data Not Lognormal at 5% Significance Level Significance Level Significance Level Significance Lavel Significance Lavel Significance Significance Level Significance Significance Level Significance Significance Level Significance Signi	-0.252

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Coefficient of Variation	1,874	Skewness	5.081
	Normal GOF	Test	
Shapiro Wilk Test Statistic	0.244	Shapiro Wilk GOF Test	
5% Shapiro Wilk P Value	0	Data Not Normal at 5% Significance Level	
Lillefors Test Statistic	0,469	Lillelors GOF Test	
5% Lilliefors Critical Value	0.119	Data Not Normal at 5% Significance Level	
Data Not	Normal at 5% Sk	gnificance Level	
Ase	uming Normal D	Netribution	
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	62.81	95% Adjusted-CLT UCL (Chen-1995)	70,66
		95% Modified-t UCL (Johnson-1978)	64.08
	Gamma GOF		
A-D Test Statistic	14.58	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.768	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.425	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.122	Data Not Gamma Distributed at 5% Significance Level	
Dets Not Gemm	a Distributed at :	5% Significance Level	_
	Germme Stat	alica	_
k hat (MLE)	1.534	k star (blas corrected MLE)	1.463
Theta hat (MLE)	28.78	Theta star (bias corrected MLE)	30,19
nu hat (MLE)	168.7	nu star (bias corrected)	160.8
MLE Mean (blas corrected)	44.14	MLE Sd (bias corrected)	36.5
MEE Mean (bias conected)	94.14	Approximate Chi Square Value (0.05)	132.5
Adjusted Level of Significance	0.0456	Adjusted Chi Square Value	131.8
			10110
Ase	uming Gamma I	Distribution	
95% Approximate Gamma UCL (use when n>=50))	53.57	95% Adjusted Gamma UCL (use when n<50)	53.85
	Lognormal GO	FTest	_
Shapiro Wilk Test Statistic	0.468	Shapiro Wilk Lognormal GOF Teat	
5% Shapiro Wilk P Value	0	Data Not Lognormal at 5% Significance Level	
Lillefors Test Statistic	0.355	Lillefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.119	Data Not Lognormal at 5% Significance Level	
Data Not Lo	gnormal at 5% s	Significance Level	
	Lognormal Sta	Hation	
Minimum of Logged Data	2.361	Mean of logged Data	3,42
Maximum of Logged Data	6.182	SD of logged Data	0.56
		and a state of the	
	ming Lognormal		
95% H-UCL	41.88	90% Chebyshev (MVUE) UCL	44.74
95% Chebyshev (MVUE) UCL	48.71	97.5% Chebyshev (MVUE) UCL	54.21
99% Chebyshev (MVUE) UCL	65.02		
Nonparamet	ric Distribution F	Free UCL Statistics	
Data do not fo	low a Discernib	le Distribution (0.05)	
Nonper	metric Distribut	ion Free UCLs	

Theta hat (MLE)	2.677	Theta star (blas corrected MLE)	2.817
nu hat (MLE)	288.6	nu star (bias corrected)	274.2
MLE Mean (blas corrected)	7.023	MLE Sd (bias corrected)	4,448
with mean (bias corrected)	1.025	Approximate Chi Square Value (0.05)	236.9
Adjusted Level of Significance	0.0456	Adjusted Chi Square Value	235.9
Adjusted Level of Significance	0.0456	Adjusted Chi Square Value	235,9
Aar	uming Gamma Di	etribution	
95% Approximate Gamma UCL (use when n>=50))	8.131	95% Adjusted Gamma UCL (use when n<50)	8,163
	Lognormal GOF	Test	
Shapiro Wilk Test Statistic	0.8	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk P Value		Data Not Lognormal at 5% Significance Level	_
Lillefors Test Statistic	0.233	Liliefore Lognormal GOF Test	
5% Ulliefors Critical Value	0,235		_
	ognormal at 5% Si	Data Not Lognormal at 5% Significance Level	
	ognormal at 0 % de		
	Lognormal Stati	etics	-
Minimum of Logged Data	-0.777	Mean of logged Data	1.747
Maximum of Logged Data	3.161	SD of logged Data	0.763
95% H-UCL	9,532		40.01
		90% Chebyshev (MVUE) UCL	10.24
95% Chebyshev (MVUE) UCL 99% Chebyshev (MVUE) UCL	11.43	97.5% Chebyshev (MVUE) UCL	13,07
	1010		
	ntic Distribution Fr		100
Data do not f	oliow a Discernible	Distribution (0.05)	
	rametric Distributio		
95% CLT UCL	7.867	95% Jackknife UCL	7.882
95% Standard Bootstrap UCL	7.869	95% Bootstrap-t UCL	
			0100
95% Hall's Bootstrap UCL	8.175	95% Percentile Bootstrap UCL	0100
95% BCA Bootstrap UCL	7.956	95% Percentile Bootstrap UCL	0100
95% BCA Bootstrap UCL 90% Chebyshev(Mean, Sd) UCL			0100
95% BCA Bootstrap UCL	7.956	95% Percentile Bootstrap UCL	9.26
95% BCA Bootstrap UCL 90% Chebyshev(Mean, Sd) UCL	7.956 8.563 10.23	95% Percentile Bootstrap UCL 95% Chebyshev(Mean, Sd) UCL 99% Chebyshev(Mean, Sd) UCL	9.26
95% BCA Bootstrap UCL 90% Chebyshev(Mean, Sd) UCL	7.956 8.563	95% Percentile Bootstrap UCL 95% Chebyshev(Mean, Sd) UCL 99% Chebyshev(Mean, Sd) UCL	9.26
95% BCA Bootstrap UCL 90% Chebyshev(Mean, Sd) UCL 97.5% Chebyshev(Mean, Sd) UCL 95% Chebyshev (Mean, Sd) UCL	7.956 8.563 10.23 Suggested UCL to 9.26	95% Percentile Bootstrap UCL 95% Chebyshev(Mean, Sd) UCL 99% Chebyshev(Mean, Sd) UCL 99% Chebyshev(Mean, Sd) UCL	9.26
95% BCA Bootstrap UCL 90% Chebyshev(Mean, Sd) UCL 97.5% Chebyshev(Mean, Sd) UCL 95% Chebyshev (Mean, Sd) UCL 95% Chebyshev (Mean, Sd) UCL Note: Suggestions regarding the selection of a 95%	7.956 8.563 10.23 Suggested UCL to 9.26 6 UCL are provided	95% Percentile Bootstrap UCL 95% Chebyshev(Mean, Sd) UCL 99% Chebyshev(Mean, Sd) UCL o Use	9.26
95% BCA Bootstrap UCL 90% Chebyshev(Mean, Sd) UCL 97.5% Chebyshev(Mean, Sd) UCL 95% Chebyshev (Mean, Sd) UCL Note: Suggestions regarding the selection of a 95% Recommendations are bas	7.956 8.563 10.23 Suggested UCL to 9.26 6 UCL are provided sed upon data size	95% Percentile Bootstrap UCL 95% Chebyshev(Mean, Sd) UCL 99% Chebyshev(Mean, Sd) UCL o Use 1 to help the user to select the most appropriate 95% UCL , data distribution, and skewness.	9.26
95% BCA Bootstrap UCL 90% Chebyshev(Mean, Sd) UCL 97.5% Chebyshev(Mean, Sd) UCL 95% Chebyshev (Mean, Sd) UCL 95% Chebyshev (Mean, Sd) UCL Note: Suggestions regarding the selection of a 95% Recommendations are based upon the resu	7.956 8.563 10.23 Suggested UCL & 9.26 & UCL are provided sed upon data size Its of the simulation	95% Percentile Bootstrap UCL 95% Chebyshev(Mean, Sd) UCL 99% Chebyshev(Mean, Sd) UCL o Use 1 to help the user to select the most appropriate 95% UCL, data distribution, and skewness. n studies summarized in Singh, Malchle, and Lee (2006).	9.26
95% BCA Bootstrap UCL 90% Chebyshev(Mean, Sd) UCL 97.5% Chebyshev(Mean, Sd) UCL 95% Chebyshev (Mean, Sd) UCL 95% Chebyshev (Mean, Sd) UCL Note: Suggestions regarding the selection of a 95% Recommendations are based upon the resu	7.956 8.563 10.23 Suggested UCL & 9.26 & UCL are provided sed upon data size Its of the simulation	95% Percentile Bootstrap UCL 95% Chebyshev(Mean, Sd) UCL 99% Chebyshev(Mean, Sd) UCL o Use 1 to help the user to select the most appropriate 95% UCL , data distribution, and skewness.	9.26
95% BCA Bootstrap UCL 90% Chebyshev(Mean, Sd) UCL 97.5% Chebyshev(Mean, Sd) UCL 95% Chebyshev (Mean, Sd) UCL 95% Chebyshev (Mean, Sd) UCL Note: Suggestions regarding the selection of a 95% Recommendations are based upon the resu	7.956 8.563 10.23 Suggested UCL & 9.26 & UCL are provided sed upon data size Its of the simulation	95% Percentile Bootstrap UCL 95% Chebyshev(Mean, Sd) UCL 99% Chebyshev(Mean, Sd) UCL o Use 1 to help the user to select the most appropriate 95% UCL, data distribution, and skewness. n studies summarized in Singh, Malchle, and Lee (2006).	8.00 ⁻ 7.857 9.26 12,13
95% BCA Bootstrap UCL 90% Chebyshev(Mean, Sd) UCL 97.5% Chebyshev(Mean, Sd) UCL 95% Chebyshev (Mean, Sd) UCL 95% Chebyshev (Mean, Sd) UCL Note: Suggestions regarding the selection of a 95% Recommendations are based upon the resu	7.956 8.563 10.23 Suggested UCL & 9.26 & UCL are provided sed upon data size Its of the simulation	95% Percentile Bootstrap UCL 95% Chebyshev(Mean, Sd) UCL 99% Chebyshev(Mean, Sd) UCL o Use 1 to help the user to select the most appropriate 95% UCL, data distribution, and skewness. n studies summarized in Singh, Malchle, and Lee (2006).	9.26
95% BCA Bootstrap UCL 90% Chebyshev(Mean, Sd) UCL 97.5% Chebyshev(Mean, Sd) UCL 95% Chebyshev(Mean, Sd) UCL 95% Chebyshev (Mean, Sd) UCL Note: Suggestions regarding the selection of a 95% Recommendations are based These recommendations are based upon the resu However, simulations results will not cover all Real W	7.956 8.563 10.23 Suggested UCL to 9.26 UCL are provided sed upon data size bits of the simulatio forld data sets; for	95% Percentile Bootstrap UCL 95% Chebyshev(Mean, Sd) UCL 99% Chebyshev(Mean, Sd) UCL o Use d to help the user to select the most appropriate 95% UCL, data distribution, and skewness. In studies summarized in Singh, Malchle, and Lee (2006). additional insight the user may want to consult a statistician.	9.26
95% BCA Bootstrap UCL 90% Chebyshev(Mean, Sd) UCL 97.5% Chebyshev(Mean, Sd) UCL 95% Chebyshev(Mean, Sd) UCL 95% Chebyshev (Mean, Sd) UCL Note: Suggestions regarding the selection of a 95% Recommendations are based These recommendations are based upon the resu However, simulations results will not cover all Real W	7.956 8.563 10.23 Suggested UCL to 9.26 UCL are provided seed upon data size sed upon data size General Sizates	95% Percentile Bootstrap UCL 95% Chebyshev(Mean, Sd) UCL 99% Chebyshev(Mean, Sd) UCL o Use 1 to help the user to select the most appropriate 95% UCL, data distribution, and skewness. In studies summarized in Singh, Malchle, and Lee (2006). additional insight the user may want to consult a statistician.	9.26
95% BCA Bootstrap UCL 90% Chebyshev(Mean, Sd) UCL 97.5% Chebyshev(Mean, Sd) UCL 95% Chebyshev(Mean, Sd) UCL 95% Chebyshev (Mean, Sd) UCL Note: Suggestions regarding the selection of a 95% Recommendations are based These recommendations are based upon the resu However, simulations results will not cover all Real W	7.956 8.563 10.23 Suggested UCL to 9.26 UCL are provided sed upon data size bits of the simulatio forld data sets; for	95% Percentile Bootstrap UCL 95% Chebyshev(Mean, Sd) UCL 99% Chebyshev(Mean, Sd) UCL o Use i to help the user to select the most appropriate 95% UCL, data distribution, and skewness. In studies summarized in Singh, Maichle, and Lee (2006), additional insight the user may want to consult a statistician.	7.857 9.26 12.13
95% BCA Bootstrap UCL 90% Chebyshev(Mean, Sd) UCL 97.5% Chebyshev(Mean, Sd) UCL 95% Chebyshev(Mean, Sd) UCL 95% Chebyshev (Mean, Sd) UCL Note: Suggestions regarding the selection of a 95% Recommendations are based Recommendations are based upon the resu However, simulations results will not cover all Real W nium	7.956 8.563 10.23 Suggested UCL to 9.26 UCL are provided sed upon data size its of the simulation fordid data sets; for General Statist 55	95% Percentile Bootstrap UCL 95% Chebyshev(Mean, Sd) UCL 99% Chebyshev(Mean, Sd) UCL o Use i to help the user to select the most appropriate 95% UCL , data distribution, and skewness. n studies summarized in Singh, Maichle, and Lee (2006). additional insight the user may want to consult a statistician. dice Number of Distinct Observations Number of Missing Observations	7.857 9.26 12.13
95% BCA Bootstrap UCL 90% Chebyshev(Mean, Sd) UCL 97.5% Chebyshev(Mean, Sd) UCL 95% Chebyshev(Mean, Sd) UCL 95% Chebyshev (Mean, Sd) UCL Note: Suggestions regarding the selection of a 95% Recommendations are based These recommendations are based upon the resu However, simulations results will not cover all Real W	7.956 8.563 10.23 Suggested UCL to 9.26 UCL are provided seed upon data size sed upon data size General Sizates	95% Percentile Bootstrap UCL 95% Chebyshev(Mean, Sd) UCL 99% Chebyshev(Mean, Sd) UCL o Use i to help the user to select the most appropriate 95% UCL, data distribution, and skewness. In studies summarized in Singh, Maichle, and Lee (2006), additional insight the user may want to consult a statistician.	7.857 9.26 12.13

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95% Approximate Gamma UCL (use when n>=50))	12.81	95% Adjusted Gamma UCL (use when n<50)	12.83
	Lognormal GOF	Test	
Shapiro Wilk Test Statistic	0.859	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk P Value	7.8543E-7	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.176	Lillefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.119	Data Not Lognormal at 5% Significance Level	
Data Not L	ognormal at 5% Si	gnificance Level	
	Lognormal Stati		
Minimum of Logged Data	2.197	Mean of logged Data	2.497
Maximum of Logged Data	3.19	SD of logged Data	0.163
Aan	uning Lognormal D	Natribution	
95% H-UCL	12.79	90% Chebyshev (MVUE) UCL	13.12
95% Chebyshev (MVUE) UCL	13.49	97.5% Chebyshev (MVUE) UCL	14
99% Chebyshev (MVUE) UCL	15.01		
		······	A A .
	tric Distribution Fr		
Darta do noch	ollow a Discernible	Destruction (0.05)	
Nonpe	rametric Distributio	n Free UCLa	
95% CLT UCL	12.85	95% Jackknife UCL	12.86
95% Standard Bootstrap UCL	12.85	95% Bootstrap-t UCL	13.14
95% Hall's Bootstrap UCL	13.78	95% Percentile Bootstrap UCL	12.86
95% BCA Bootstrap UCL	13.09		TREFORD
90% Chebyshev(Mean, Sd) UCL	13.28	95% Chebyshev(Mean, Sd) UCL	13.72
97.5% Chebyshev(Mean, Sd) UCL	14.32	99% Chebyshev(Mean, Sd) UCL	15,5
	Suggested UCL to	o Llee	
95% Student's-t UCL	12.86	or 95% Modified-t UCL	12.88
Note: Connections segarilize the asterious of a 050	1101 and provide a	to help the user to select the most appropriate 95% UCL.	
	•	, data distribution, and skewness.	ALL - AL
		n studies summarized in Singh, Malchle, and Lee (2006).	
However, simulations results will not cover all Real W			
However, simulations results will not cover all Real V			_
However, simulations results will not cover all Real V			
	General Statis		
			52
er Total Number of Observations	General Statis	lice	0
er Total Number of Observations Minimum	General Statist 55 31.5	ice Number of Distinct Observations Number of Missing Observations Mean	0
er Total Number of Observations Minimum Maximum	General Statis 55 31.5 4180	ics Number of Distinct Observations Number of Missing Observations Mean Median	0 458.4 411
er Total Number of Observations Minimum Maximum SD	General Statist 55 31.5 4180 556.1	tcs Number of Distinct Observations Number of Missing Observations Mean Median Std. Error of Mean	0 458.4 411 74,98
er Total Number of Observations Minimum Maximum	General Statis 55 31.5 4180	ics Number of Distinct Observations Number of Missing Observations Mean Median	0 458.4 411 74,98
er Total Number of Observations Minimum Maximum SD	General Statist 55 31.5 4180 556.1 1.213	Ice Number of Distinct Observations Number of Missing Observations Mean Median Std. Error of Mean Std. error of Mean Std. wwness	0 458.4 411
of Total Number of Observations Minimum Maximum SD Coefficient of Variation	General Statist 55 31.5 4180 556.1	fce Number of Distinct Observations Number of Missing Observations Mean Median Std. Error of Mean Skewness	0 458.4 411 74,98
er Total Number of Observations Minimum Maximum SD Coefficient of Variation Shapiro Wilk Test Statistic	General Statis 55 31.5 4180 556.1 1.213	tcs Number of Distinct Observations Number of Missing Observations Mean Median Std. Error of Mean Std. Error of Mean Skewness est Stepiro Wilk GOF Test	0 458.4 411 74,98
of Total Number of Observations Minimum Maximum SD Coefficient of Variation	General Statist 55 31.5 4180 556.1 1.213 Normal GOF T 0,477 0,477	ice Number of Distinct Observations Number of Missing Observations Mean Median Std. Error of Mean Skewness	0 458.4 411 74,98

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95% Standard Bootstrap UCL	62.67	95% Bootstrap-t UCL	329.4
95% Hall's Bootstrap UCL	208.2	95% Percentile Bootstrap UCL	61.49
95% BCA Bootstrap UCL	76.4		
90% Chebyshev(Mean, Sd) UCL	77.61	95% Chebyshev(Mean, Sd) UCL	92.77
97.5% Chebyshev(Mean, Sd) UCL	113,8	99% Chebyshev(Mean, Sd) UCL	155,1
	Suggested UC	2. to Use	
95% Chebyshev (Mean, Sd) UCL	92.77		
Note: Suggestions reporting the collection of a 058	4 LICI are provi	ded to help the user to select the most appropriate 95% UCL.	
		size, data distribution, and skewness.	
		ation studies summarized in Singh, Maichle, and Lee (2006).	
		for additional insight the user may want to consult a statistician.	
	10110 0818 8818,	To additional magne are user may wate to consult a statistician.	_
	_		_
it .			
	General St		
Total Number of Observations	55	Number of Distinct Observations	33
		Number of Missing Observations	0
Minimum		Mean	12.33
Maximum	24.3	Median	12.2
SD	2.366	Std, Error of Mean	0,319
Coefficient of Variation	0.192	Skewness	2,974
	Normal GO	DF Tast	
Shapiro Wilk Test Statistic		Shapiro Wilk GOF Test	
5% Shapiro Wilk P Value		Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic		Lillefore GOF Test	
5% Lillefors Critical Value		Data Not Normal at 5% Significance Level	
		Significance Level	
	seuming Norma		
95% Normal UCL	1	95% UCLs (Adjusted for Skewnees)	
95% Student's-t UCL	12,86	95% Adjusted-CLT UCL (Chen-1995)	12.99
		95% Modified-t UCL (Johnson-1978)	12.88
	Gamma GO	DF Test	
A-D Test Statistic		Anderson-Darling Gamma GOF Test	
5% A-D Critical Value		Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic		Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.12	Data Not Gamma Distributed at 5% Significance Leve	
Data Not Gam	me Distributed :	at 5% Significance Level	
	Germme St	zitelics	
k hat (MLE)	35.09	k star (bias corrected MLE)	33.19
Theta hat (MLE)	0.351	Theta star (bias corrected MLE)	0.371
nu hat (MLE)	3860	nu star (blas corrected)	3651
MLE Mean (bias corrected)		MLE Sd (bias corrected)	2.139
	-	Approximate Chi Square Value (0.05)	3512
		Approximate Crit Square value (0.031)	
Adjusted Level of Significance	0.0456	Adjusted Chi Square Value	3508

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95% Chebyshev (Mean, Sd) UCL	785.2		
Note: Suggestions regarding the selection of a 050	LICI are provide	d to help the user to select the most appropriate 95% UCL.	
		e, data distribution, and skewness.	
		on studies summarized in Singh, Maichle, and Lee (2006).	
However, simulations results will not cover all Real V	/orld data sets; fo	r additional insight the user may want to consult a statistician.	
	General Stati		_
Total Number of Observations	55	Number of Distinct Observations	42
		Number of Missing Observations	0
Minimum	7600	Mean	28815
Maximum	75700	Median	26700
SD	9107	Std. Error of Mean	1228
Coefficient of Variation	0.316	Skewness	3,06
	Normal GOF	Test	
Shapiro Wilk Test Statistic	0.652	Shapiro Wilk GOF Test	
5% Shapiro Wilk P Value	4.441E-16	Data Not Normal at 5% Significance Level	-
Lilliefors Test Statistic	0.285	Lillefore GOF Test	-
5% Lillefors Critical Value	0.119	Data Not Normal at 5% Significance Level	
Data No	Normal at 5% Sk	antificance Level	
95% Normal UCL		95% UCLs (Adjusted for Skewnees)	
95% Student's-t UCL	20970		
	30870	95% Adjusted-CLT UCL (Chen-1995)	31377
		95% Adjusted-CLT UCL (Chen-1995) 95% Modified-t UCL (Johnson-1978)	
	Gamma GOF	95% Modified-t UCL (Johnson-1978)	
A-D Test Statistic		95% Modified-t UCL (Johnson-1978)	
A-D Test Statistic 5% A-D Critical Value	Gamma GOF	95% Modified-t UCL (Johnson-1978)	30954
	Gemme GOF	95% Modified-t UCL (Johnson-1978) Test Andereon-Darling Gamma GOF Test	30954
5% A-D Critical Value	Gamma GOF 5.633 0.75	95% Modified-t UCL (Johnson-1978) Test Anderson-Darling Gamma GOF Test Data Not Gamma Distributed at 5% Significance Leve	30954
5% A-D Critical Value K-S Test Statistic 5% K-S Critical Value	Gamma GOF 5.633 0.75 0.241 0.12	95% Modified-t UCL (Johnson-1978) Test Anderson-Darling Gamma GOF Test Data Not Gamma Distributed at 5% Significance Leve Kolmogorov-Smirnov Gamma GOF Test	30954
5% A-D Critical Value K-S Test Statistic 5% K-S Critical Value	Gamma GOF 5.633 0.75 0.241 0.12	95% Modified-t UCL (Johnson-1978) Test Anderson-Darling Gamma GOF Test Data Not Gamma Distributed at 5% Significance Leve Kolmogorov-Smirnov Gamma GOF Test Data Not Gamma Distributed at 5% Significance Leve	30954
5% A-D Critical Value K-S Test Statistic 5% K-S Critical Value	Gamma GOF 5.633 0.75 0.241 0.12	95% Modified t UCL (Johnson-1978) Test Anderson-Darling Gamma GOF Test Data Not Gamma Distributed at 5% Significance Leve Kolmogorov-Smirnov Gamma GOF Test Data Not Gamma Distributed at 5% Significance Leve 5% Significance Level	30954
5% A-D Critical Value K-S Test Statistic 5% K-S Critical Value	Gamma GOF 5.633 0.75 0.241 0.12 ma Distributed at	95% Modified t UCL (Johnson-1978) Test Anderson-Darling Gamma GOF Test Data Not Gamma Distributed at 5% Significance Leve Kolmogorov-Smirnov Gamma GOF Test Data Not Gamma Distributed at 5% Significance Leve 5% Significance Level	30954
5% A-D Critical Value K-S Test Statistic 5% K-S Critical Value Deta Not Gami	Germme GOF 5.633 0.75 0.241 0.12 me Distributed et Germme Statis	95% Modified-t UCL (Johnson-1978) Test Anderson-Darling Gamma GOF Test Data Not Gamma Distributed at 5% Significance Leve Kolmogorov-Smirnov Gamma GOF Test Data Not Gamma Distributed at 5% Significance Leve 5% Significance Level e8ce	30954
5% A-D Critical Value K-S Test Statistic 5% K-S Critical Value Deta Not Gam k hat (MLE)	Gemma GOF 5.633 0.75 0.241 0.12 ma Distributed at Gemma Stati 13.07	95% Modified-t UCL (Johnson-1978) Test Anderson-Darling Gamma GOF Test Data Not Gamma Distributed at 5% Significance Leve Kolmogorov-Smirnov Gamma GOF Test Data Not Gamma Distributed at 5% Significance Leve 5% Significance Level stics k star (bias corrected MLE)	30954
5% A-D Critical Value K-S Test Statistic 5% K-S Critical Value Deta Not Gerni k hat (MLE) Theta hat (MLE)	Germma GOF 5,633	95% Modified-t UCL (Johnson-1978) Test Anderson-Darling Gamma GOF Test Data Not Gamma Distributed at 5% Significance Leve Kolmogorov-Smirnov Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level 5% Significa	30954 { { 1 12.3 2329
5% A-D Critical Value K-S Test Statistic 5% K-S Critical Value Deta Not Gern k hat (MLE) Theta hat (MLE) nu hat (MLE)	Germma GOF 5,633	95% Modified-t UCL (Johnson-1978) Test Anderson-Darling Gamma GOF Test Data Not Gamma Distributed at 5% Significance Leve Kolmogorov-Smirnov Gamma GOF Test Data Not Gamma Distributed at 5% Significance Leve 5% Significance Level effice k star (bias corrected MLE) Theta star (bias corrected MLE) nu star (bias corrected)	30954 (1 12.3 2329 1361
5% A-D Critical Value K-S Test Statistic 5% K-S Critical Value Data Not Gami k hat (MLE) Theta hat (MLE) nu hat (MLE) MLE Mean (bias corrected)	Gamma GOF 5,633	95% Modified-t UCL (Johnson-1976) Test Anderson-Darling Gamma GOF Test Data Not Gamma Distributed at 5% Significance Leve Kolmogorov-Smirnov Gamma GOF Test Data Not Gamma Distributed at 5% Significance Leve 5% Significance Level stics k star (bias corrected MLE) Theta star (bias corrected MLE) nu star (bias corrected) MLE Sd (bias corrected)	30954 1 12.3 2329 1361 8193
5% A-D Critical Value K-S Test Statistic 5% K-S Critical Value Deta Not Gern k hat (MLE) Theta hat (MLE) nu hat (MLE)	Gamma GOF 5.633 0.75 0.241 0.12 ma Distributed at 13.07 2204 14.38 28815 28815	95% Modified-t UCL (Johnson-1978) Test Anderson-Darling Gamma GOF Test Data Not Gamma Distributed at 5% Significance Leve Kolmogorov-Smirnov Gamma GOF Test Data Not Gamma Distributed at 5% Significance Leve 5% Significance Levei stice k star (bias corrected MLE) Theta star (bias corrected MLE) nu star (bias corrected MLE) Nu Sta (bias corrected) MLE 54 (bias corrected) Approximate Chi Square Value (0.05)	30954 4 1 12.3 2329 1361 8193 1276
5% A-D Critical Value K-S Test Statistic 5% K-S Critical Value Deta Not Gerni k hat (MLE) Theta hat (MLE) nu hat (MLE) MLE Mean (bias corrected) Adjusted Level of Significance	Germme GOF 5.633 0.75 0.241 0.241 0.12 ma Distributed at 1 Germme Stati 13.07 2204 1438 28815 0.0456	95% Modified-t UCL (Johnson-1978) Test Anderson-Darling Gamma GOF Test Data Not Gamma Distributed at 5% Significance Leve Kolmogorov-Smirnov Gamma GOF Test Data Not Gamma Distributed at 5% Significance Leve 5% Significance Level 5% Significan	30954 4 1 12.3 2329 1361 8193 1276
5% A-D Critical Value K-S Test Statistic 5% K-S Critical Value Deta Not Gerni k hat (MLE) Theta hat (MLE) nu hat (MLE) MLE Mean (bias corrected) Adjusted Level of Significance	Gamma GOF 5.633 0.75 0.241 0.241 0.12 ma Distributed at 1 Gamma Stati 13.07 2204 1438 28815 0.0456 scaning Gamma Ga	95% Modified-t UCL (Johnson-1978) Test Anderson-Darling Gamma GOF Test Data Not Gamma Distributed at 5% Significance Leve Kolmogorov-Smirnov Gamma GOF Test Data Not Gamma Distributed at 5% Significance Leve 5% Significance Level stice k star (bias corrected MLE) Theta star (bias corrected MLE) Nu star (bias corrected) MLE Sd (bias corrected) Approximate Chi Square Value (0.05) Adjusted Chi Square Value Distribution	30954 4 1 2.3 2329 1361 8193 1276 1274
5% A-D Critical Value K-S Test Statistic 5% K-S Critical Value Deta Not Gerni k hat (MLE) Theta hat (MLE) nu hat (MLE) MLE Mean (bias corrected) Adjusted Level of Significance	Gamma GOF 5.633 0.75 0.241 0.241 0.12 ma Distributed at 1 Gamma Stati 13.07 2204 1438 28815 0.0456 scaning Gamma Ga	95% Modified-t UCL (Johnson-1978) Test Anderson-Darling Gamma GOF Test Data Not Gamma Distributed at 5% Significance Leve Kolmogorov-Smirnov Gamma GOF Test Data Not Gamma Distributed at 5% Significance Leve 5% Significance Level 5% Significan	30954 4 1 2.3 2329 1361 8193 1276 1274
5% A-D Critical Value K-S Test Statistic 5% K-S Critical Value Deta Not Gerni k hat (MLE) Theta hat (MLE) nu hat (MLE) MLE Mean (bias corrected) Adjusted Level of Significance	Gamma GOF 5,633 0.75 0.75 0.241 0.12 ma Distributed at 1 Gamma Statistical Statis Statistical Statistical Statistical Statistical Statis	95% Modified-t UCL (Johnson-1978) Test Anderson-Darling Gamma GOF Test Data Not Gamma Distributed at 5% Significance Leve Kolmogorov-Smirnov Gamma GOF Test Data Not Gamma Distributed at 5% Significance Leve s% Significance Level stcs k star (bias corrected MLE) Theta star (bias corrected MLE) Theta star (bias corrected MLE) Nu star (bias corrected MLE) Approximate Chi Square Value Distribution 95% Adjusted Gamma UCL (use when n<50)	30954 4 1 2.3 2329 1361 8193 1276 1274
5% A-D Critical Value K-S Test Statistic 5% K-S Critical Value Deta Not Gerru k hat (MLE) Theta hat (MLE) nu hat (MLE) MLE Mean (bias corrected) Adjusted Level of Significance Adjusted Level of Significance Adjusted Level of Significance	Gamma GOF 5.633 0.75 0.241 0.12 ma Distributed at Gamma Statis 13.07 2204 1438 28815 0.0456 suming Gamma I 30726 Lognormal GO	95% Modified-t UCL (Johnson-1978) Test Anderson-Darling Gamma GOF Test Data Not Gamma Distributed at 5% Significance Leve Kolmogorov-Smirrov Gamma GOF Test Data Not Gamma Distributed at 5% Significance Leve 5% Significance Level effice k star (bias corrected MLE) Theta star (bias corrected MLE) Nu star (bias corrected MLE) Nu star (bias corrected MLE) Approximate Chi Square Value Approximate Chi Square Value Distribution 95% Adjusted Gamma UCL (use when n<50) F Test	30954 4 1 2.3 2329 1361 8193 1276 1274
5% A-D Critical Value K-S Test Statistic 5% K-S Critical Value Deta Not Gam k hat (MLE) Theta hat (MLE) nu hat (MLE) MLE Mean (bias corrected) Adjusted Level of Significance Adjusted Level of Significance Shapiro Wilk Test Statistic	Gamma GOF 5.633 0.75 0.241 0.12 ma Distributed at 1 Gamma Statis 13.07 2204 1438 28815 0.0456 suming Gamma G 30726 Lognormal GO 0.736	95% Modified-t UCL (Johnson-1978) Test Anderson-Darling Gamma GOF Test Data Not Gamma Distributed at 5% Significance Leve Kolmogorov-Smirnov Gamma GOF Test Data Not Gamma Distributed at 5% Significance Leve 5% Significance Levei estcs k star (bias corrected MLE) Theta star (bias corrected MLE) MLE 3d (bias corrected) Approximate Chi Square Value (0.05) Adjusted Chi Square Value Distribution 95% Adjusted Gamma UCL (use when n<50) F Test Shapiro Wilk Lognormal GOF Test	30954 4 1 2329 1361 8193 1276 1274
5% A-D Critical Value K-S Test Statistic 5% K-S Critical Value Deta Not Gami k hat (MLE) Theta hat (MLE) nu hat (MLE) MLE Mean (bias corrected) Adjusted Level of Significance Adjusted Level of Significance Stapiro Wilk Test Statistic 5% Shapiro Wilk P Value	Gamma GOF 5.633 0.75 0.241 0.241 0.12 ma Distributed at 1 Gamma Stati 13.07 2204 14.38 28815 0.0456 euming Gamma GO 30725 Lagnormal GO 0.736 1.505E-12 1.505E-12	95% Modified-t UCL (Johnson-1978) Test Anderson-Darling Gamma GOF Test Data Not Gamma Distributed at 5% Significance Leve Kolmogorov-Smirnov Gamma GOF Test Data Not Gamma Distributed at 5% Significance Leve S% Significance Level effice k star (bias corrected MLE) Theta star (bias corrected MLE) Theta star (bias corrected MLE) MLE Sd (bias corrected) Approximate Chi Square Value (0.05) Adjusted Chi Square Value Detribution 95% Adjusted Gamma UCL (use when n<50) F Test Shapiro Wilk Lognormal GOF Test Data Not Lognormal at 5% Significance Level	30954 4 1 2329 1361 8193 1276 1274
5% A-D Critical Value K-S Test Statistic 5% K-S Critical Value Deta Not Gam k hat (MLE) Theta hat (MLE) nu hat (MLE) MLE Mean (bias corrected) Adjusted Level of Significance Adjusted Level of Significance Shapiro Wilk Test Statistic	Gamma GOF 5.633 0.75 0.241 0.12 ma Distributed at 1 Gamma Statis 13.07 2204 1438 28815 0.0456 suming Gamma G 30726 Lognormal GO 0.736	95% Modified-t UCL (Johnson-1978) Test Anderson-Darling Gamma GOF Test Data Not Gamma Distributed at 5% Significance Leve Kolmogorov-Smirnov Gamma GOF Test Data Not Gamma Distributed at 5% Significance Leve 5% Significance Levei estcs k star (bias corrected MLE) Theta star (bias corrected MLE) MLE 3d (bias corrected) Approximate Chi Square Value (0.05) Adjusted Chi Square Value Distribution 95% Adjusted Gamma UCL (use when n<50) F Test Shapiro Wilk Lognormal GOF Test	12.33 12.33 1361 1361 1276 1274

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		6 Significance Level	
Aar	uming Norm	al Distribution	
95% Normel UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	583,9	95% Adjusted-CLT UCL (Chen-1995)	643,7
		95% Modified-t UCL (Johnson-1978)	593.5
	Gemme G	DE Test	
A-D Test Statistic	2.06	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.768	Data Not Gamma Distributed at 5% Significance Level	_
K-S Test Statistic	0.173	Kolmogorov-Smirnov Gamma GOF Test	_
5% K-S Critical Value	0.122	Data Not Gamma Distributed at 5% Significance Level	
		i at 5% Significance Level	_
	Gemme		
k hat (MLE)	1.537	k star (bias corrected MLE)	1.46
Theta hat (MLE)	298,2	Theta star (blas corrected MLE)	312,8
nu hat (MLE)	169.1	nu star (bias corrected)	161.2
MLE Mean (bias corrected)	458.4	MLE Sd (bias corrected)	378.7
		Approximate Chi Square Value (0.05)	132.8
Adjusted Level of Significance	0.0456	Adjusted Chi Square Value	132.1
Ase	uming Game	na Distribution	
95% Approximate Gamma UCL (use when n>=50))	556.2	95% Adjusted Gamma UCL (use when n<50)	559.1
	Lognormei	GOF Test	
Shapiro Wilk Test Statistic	0.875	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk P Value	4.9394E-6	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.175	Lillefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.119	Data Not Lognormal at 5% Significance Level	
Data Not Lo	ognormal at 5	596 Significance Lavel	
	Lognormal	Otudation	
Minimum of Logged Data	3.45	Mean of logged Data	5.76
Maximum of Logged Data	8.338	SD of logged Data	0.90
Maximum of Logged Data	0.000	SD 010gged Data	0.00
		mel Distribution	_
95% H-UCL		90% Chebyshev (MVUE) UCL	679
95% Chebyshev (MVUE) UCL	770.3	97.5% Chebyshev (MVUE) UCL	897
99% Chebyshev (MVUE) UCL	1146		
Nonparame	tric Distributi	on Free UCL Statistics	
		mible Distribution (0.05)	
		ibution Free UCLs	-
95% CLT UCL	581.7	95% Jackknife UCL	583.9
95% Standard Bootstrap UCL	578.4	95% Bootstrap-t UCL	727.4
95% Hall's Bootstrap UCL	1093	95% Percentile Bootstrap UCL	592.6
95% BCA Bootstrap UCL	686		
		95% Chebyshev(Mean, Sd) UCL	785.2
90% Chebyshev(Mean, Sd) UCL 97,5% Chebyshev(Mean, Sd) UCL	683,3 926,7	99% Chebyshev(Mean, Sd) UCL	1204

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	Gamma GOF		
A-D Test Statistic	3.287	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.757	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.213	Kolmogorov-Smirnov Gamma GOF Test	_
5% K-S Critical Value	0.121	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gam	na Distributed at	5% Significance Level	
	Gamma Stat	stica	
k hat (MLE)	3.221	k star (bias corrected MLE)	3.057
Theta hat (MLE)	20.91	Theta star (bias corrected MLE)	22.03
nu hat (MLE)	354.3	nu star (bias corrected)	336,3
MLE Mean (blas corrected)	67.35	MLE Sd (bias corrected)	38.52
		Approximate Chi Square Value (0.05)	294,8
Adjusted Level of Significance	0.0456	Adjusted Chi Square Value	293.8
As	ruming Gemme I	Distribution	
	76.83	95% Adjusted Gamma UCL (use when n<50)	77.1
	Lognormat GO		
Shapiro Wilk Test Statistic	0.896	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk P Value	0.188	Data Not Lognormal at 5% Significance Level	
Lillefors Test Statistic		Lillefors Lognormal GOF Test	
5% Lillefors Critical Value Data Not L	0,119 opportual at 5%	Data Not Lognormal at 5% Significance Level	_
	Lognormal Sta	tistics	
Minimum of Logged Data	2.477	Mean of logged Data	4.04
Maximum of Logged Data	5.864	SD of logged Data	0.54
Ann	uming Lognormal	Distribution	
95% H-UCL	76.76	90% Chebyshev (MVUE) UCL	81.94
95% Chebyshev (MVUE) UCL	89.02	97.5% Chebyshev (MVUE) UCL	98.85
99% Chebyshev (MVUE) UCL	118.1		
Management	at - Distingtion	Tree UCL Statistics	
		le Distribution (0.05)	
Nonpa 95% CLT UCL	78.74	ton Free UCLs 95% Jackknife UCL	78.94
95% Standard Bootstrap UCL	78.5	95% Bootstrap-t UCL	88.57
95% Hall's Bootstrap UCL	132.7	95% Percentile Bootstrap UCL	79.77
95% BCA Bootstrap UCL	82.33	55 % Percentine Bootstrap UCL	/3.//
90% Chebyshev(Mean, Sd) UCL	88.12	95% Chebyshev(Mean, Sd) UCL	97.53
	110.6	95% Chebyshev(Mean, Sd) UCL 99% Chebyshev(Mean, Sd) UCL	136.2
97.5% Chebyshev(Mean, Sd) UCL			
97.5% Chebyshev(Mean, Sd) UCL			
	Suggested UCL	, to Use	_
97.5% Chebyshev(Mean, Sd) UCL 95% Chebyshev (Mean, Sd) UCL	Suggested UCL 97.53	, to Use	
95% Chebyshev (Mean, Sd) UCL Note: Suggestions regarding the selection of a 95%	97.53 6 UCL are provid	ed to help the user to select the most appropriate 95% UCL.	
95% Chebyshev (Mean, Sd) UCL Note: Suggestions regarding the selection of a 95% Recommendations are ba	97.53 6 UCL are provid sed upon data siz		

	Lognormal Statist	(C))	
Minimum of Logged Data	8.936	Mean of logged Data	10.23
Maximum of Logged Data	11.23	SD of logged Data	0.279
Ann	uming Lognormal Dir	stribution	
95% H-UCL		90% Chebyshev (MVUE) UCL	32109
95% Chebyshev (MVUE) UCL	33607		35687
99% Chebyshev (MVUE) UCL			
Negagerage	tric Distribution Free	101 Otuliation	
	ollow a Discernible D		
Montrol	rametric Distribution	Sme LICLe	
95% CLT UCL		95% Jackknife UCL	30870
95% Standard Bootstrap UCL			32195
	34219	95% Bootstrap UCL	
	31435	23% Percentite Dootstrap UCL	50281
	32498	95% Chebyshev(Mean, Sd) UCL	24167
		99% Chebyshev(Mean, Sd) UCL	
	00400		41000
	Suggested UCL to		
95% Student's-t UCL	30870	or 95% Modified-t UCL	30954
Recommendations are bas These recommendations are based upon the resu	sed upon data size, o lits of the simulation	to help the user to select the most appropriate 95% UCL, data distribution, and skewness. studies summarized in Singh, Maichie, and Lee (2006). dditional insight the user may want to consult a statistician.	
Recommendations are bas These recommendations are based upon the resu	sed upon data size, o lits of the simulation	data distribution, and skewness. studies summarized in Singh, Maichie, and Lee (2006).	
Recommendations are bas These recommendations are based upon the resu	sed upon data size, o lits of the simulation	data distribution, and skewness. studies summarized in Singh, Maichie, and Lee (2006).	
Recommendations are bas These recommendations are based upon the resu However, simulations results will not cover all Real W	sed upon data size, i lits of the simulation Vorid data sets; for a General Statistic	data distribution, and skewness. studies summarized in Singh, Malchie, and Lee (2006). dditional insight the user may want to consult a statistician.	
Recommendations are based upon the resu	sed upon data size, lits of the simulation Vorld data sets; for a	data distribution, and skewness. studies summarized in Singh, Malchie, and Lee (2006). dditional insight the user may want to consult a statistician. dditional insight the user may want to consult a statistician.	54
Recommendations are bas These recommendations are based upon the resu However, simulations results will not cover all Real W Total Number of Observations	sed upon data size, its of the simulation Vorid data sets; for a General Statistic 55	data distribution, and skewness. studies summarized in Singh, Malchie, and Lee (2006). dditional insight the user may want to consult a statistician. Se Number of Distinct Observations Number of Missing Observations	54 0
Recommendations are bas These recommendations are based upon the resu However, simulations results will not cover all Real V Total Number of Observations Minimum	sed upon data sizo, jits of the simulation Yorld data sets; for a General Statistic 55 11.9	data distribution, and skewness. studies summarized in Singh, Malchle, and Lee (2006). dditional insight the user may want to consult a statistician. dditional insight the user may want to consult a statistician. Number of Distinct Observations Number of Missing Observations Mean	54 0 67.35
Recommendations are based upon the resu These recommendations are based upon the resu However, simulations results will not cover all Real V Total Number of Observations Minimum Maximum	Sed upon data size, its of the simulation Vorid data sets; for a General Statistic 55 11.9 352	data distribution, and skewness. studies summarized in Singh, Malchie, and Lee (2006). dditional insight the user may want to consult a statistician. dditional insight the user may want to consult a statistician. Number of Distinct Observations Number of Missing Observations Mean Mean	54 0 67.35 59.9
Recommendations are based upon the resu These recommendations are based upon the resu However, simulations results will not cover all Real W Total Number of Observations Minimum Maximum SD	General Statistics	data distribution, and skewmess. studies summarized in Singh, Malchie, and Lee (2006). dditional insight the user may want to consult a statistician. dditional insight the user may want to consult a statistician. Number of Distinct Observations Number of Distinct Observations Mean Median Std. Error of Mean	54 0 67.35 59.9 6.924
Recommendations are based upon the resu These recommendations are based upon the resu However, simulations results will not cover all Real V Total Number of Observations Minimum Maximum	Sed upon data size, its of the simulation Vorid data sets; for a General Statistic 55 11.9 352	data distribution, and skewness. studies summarized in Singh, Malchie, and Lee (2006). dditional insight the user may want to consult a statistician. dditional insight the user may want to consult a statistician. Number of Distinct Observations Number of Missing Observations Mean Mean	54 0 67.35 59.9
Recommendations are based upon the resu These recommendations are based upon the resu However, simulations results will not cover all Real V Total Number of Observations Minimum Maximum SD Coefficient of Variation	General Statistic 11: of the simulation Vorid data sets; for a General Statistic 5: 11.9 3:52 5:1.35 0.762 Normal QOF Te	data distribution, and skewness. studies summarized in Singh, Malchie, and Lee (2006). dditional insight the user may want to consult a statistician. dditional insight the user may want to consult a statistician. Number of Distinct Observations Number of Missing Observations Mean Median Std. Error of Mean Skewness	54 0 67.35 59.9 6.924
Recommendations are bas These recommendations are based upon the resu However, simulations results will not cover all Real W Total Number of Observations Minimum Maximum SD Coefficient of Variation Shapiro Wilk Test Statistic	General Statistic SS General Statistic SS 11.9 352 51.35 0.762 Normal GOF Te 0.592	data distribution, and skewness. studies summarized in Singh, Malchie, and Lee (2006). dditional insight the user may want to consult a statistician. dditional insight the user may want to consult a statistician. Number of Distinct Observations Number of Missing Observations Mean Median Std. Error of Mean Std. Error of Mean Std. Staphro Wilk GOF Teet	54 0 67.35 59.9 6.924
Recommendations are based upon the resu These recommendations are based upon the resu However, simulations results will not cover all Real W Total Number of Observations Total Number of Observations Minimum Maximum SD Coefficient of Variation Shapiro Wilk Test Statistic 5% Shapiro Wilk P Value	General Statistics General Statistics 55 11.9 352 51.35 0.762 Normal GOF Te 0.592 0	data distribution, and skewmess. studies summarized in Singh, Malchie, and Lee (2006). dditional insight the user may want to consult a statistician. dditional insight the user may want to consult a statistician. Number of Distinct Observations Number of Missing Observations Mean Median Std. Error of Mean Std. Error of Mean Skewmess st Shapiro Wilk GOF Test Data Not Normal at 5% Significance Level	54 0 67.35 59.9 6.924
Recommendations are based upon the resu These recommendations are based upon the resu However, simulations results will not cover all Real V Total Number of Observations Minimum Maximum SD Coefficient of Variation Shapiro Wilk Test Statistic 5% Shapiro Wilk P Value Lilliefors Test Statistic	Seed upon data size, its of the simulation Vorid data sets; for a Oeneral Stat/set 55 11.9 352 51.35 0.762 Normal GOF Te 0 0 0.298	data distribution, and skewness. studies summarized in Singh, Malchle, and Lee (2006). dditional insight the user may want to consult a statistician. dditional insight the user may want to consult a statistician. Number of Distinct Observations Number of Missing Observations Mean Median Std. Error of Mean Std. Error of Mean Std. Error of Mean Skewness et Shapiro Wilk GOF Test Data Not Normal at 5% Significance Level Lillebra GOF Test	54 0 67.35 59.9 6.924
Recommendations are based upon the resu These recommendations are based upon the resu However, simulations results will not cover all Real V Total Number of Observations Minimum Maximum SD Coefficient of Variation Shapiro Wilk Test Statistic 5% Shapiro Wilk P Value Lilliefors Test Statistic 5% Lilliefors Critical Value	Seed upon data size, its of the simulation Vortid data sets; for a General Stat/stdf 55 11.9 352 51.35 0.762 Normal GOF Te 0.592 0 0.298 0.119	data distribution, and skewness. studies summarized in Singh, Malchie, and Lee (2006). dditional insight the user may want to consult a statistician. dditional insight the user may want to consult a statistician. Number of Distinct Observations Number of Distinct Observations Number of Missing Observations Mean Median Std. Error of Mean Std. Error of Mean Std. Shapiro Wilk GOF Test Data Not Normal at 5% Significance Level Lilliefors GOF Test Data Not Normal at 5% Significance Level	54 0 67.35 59.9 6.924
Recommendations are based upon the resu These recommendations are based upon the resu However, simulations results will not cover all Real V Total Number of Observations Minimum Maximum SD Coefficient of Variation Shapiro Wilk Test Statistic 5% Shapiro Wilk P Value Lilliefors Test Statistic 5% Lilliefors Critical Value	Seed upon data size, its of the simulation Vorid data sets; for a Oeneral Stat/set 55 11.9 352 51.35 0.762 Normal GOF Te 0 0 0.298	data distribution, and skewness. studies summarized in Singh, Malchie, and Lee (2006). dditional insight the user may want to consult a statistician. dditional insight the user may want to consult a statistician. Number of Distinct Observations Number of Distinct Observations Number of Missing Observations Mean Median Std. Error of Mean Std. Error of Mean Std. Shapiro Wilk GOF Test Data Not Normal at 5% Significance Level Lilliefors GOF Test Data Not Normal at 5% Significance Level	54 0 67.35 59.9 6.924
Recommendations are bas These recommendations are based upon the resu However, simulations results will not cover all Real V Total Number of Observations Minimum Maximum SD Coefficient of Variation Shapiro Wilk Test Statistic 5% Shapiro Wilk Test Statistic 5% Lilliefors Test Statistic 5% Lilliefors Critical Value Data Not	Seed upon data size, its of the simulation Vortid data sets; for a General Stat/stat 55 11.9 352 51.35 0.762 Normal GOF Te 0.592 0 0.298 0.119	data distribution, and skewness. studies summarized in Singh, Malchle, and Lee (2006). dditional insight the user may want to consult a statistician. dditional insight the user may want to consult a statistician. Number of Distinct Observations Number of Distinct Observations Number of Missing Observations Mean Median Std. Error of Mean Std. Error of Mean Std. Error of Mean Skewness at Shapiro Wilk GOF Test Data Not Normal at 5% Significance Level Lillefora GOF Test Data Not Normal at 5% Significance Level Itlaetone Level Itlaetone Level	54 0 67.35 59.9 6.924
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Recommendations are bas These recommendations are based upon the resu However, simulations results will not cover all Real V Total Number of Observations Minimum Maximum SD Coefficient of Variation Shapiro Wilk Test Statistic 5% Shapiro Wilk P Value Lillefors Test Statistic 5% Lillefors Critical Value Data Not	Sed upon data size, its of the simulation Vorid data sets; for a Openeral Statistic 55 11.9 352 51.35 0.762 Normal GOF Te 0.592 0 0.298 0.119 Normal at 5% Sign	data distribution, and skewness. studies summarized in Singh, Malchle, and Lee (2006). dditional insight the user may want to consult a statistician. dditional insight the user may want to consult a statistician. Number of Distinct Observations Number of Distinct Observations Number of Missing Observations Mean Median Std. Error of Mean Std. Error of Mean Std. Error of Mean Skewness at Shapiro Wilk GOF Test Data Not Normal at 5% Significance Level Lillefora GOF Test Data Not Normal at 5% Significance Level Itlaetone Level Itlaetone Level	54 0 67.35 59.9 6.924

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649.7		628.5	95% H-UCL
706,3	97.5% Chebyshev (MVUE) UCL	673.4	95% Chebyshev (MVUE) UCL
		770.9	99% Chebyshev (MVUÉ) UCL
	Free UCL Statistics		
	button at 5% Significance Level	acemible Distribu	Data appear to follow a D
	4		
627.7		627.1	95% CLT UCL
632.1		627.1	95% Standard Bootstrap UCL
627.6		635.2	95% Hall's Bootstrap UCL
027.0	33% Percentile Bootstrap OCL	631.9	95% BCA Bootstrap UCL
675.9	95% Chebyshev(Mean, Sd) UCL	651.5	90% Chebyshev(Mean, Sd) UCL
776.4		709.8	97.5% Chebyshev(Mean, Sd) UCL
770.4	55 % Citebysitev(mean, 30) CCC	703.0	ST.5 % Chebyshev(Mean, 30) CCL
_	to line	Suggested UCL 1	
		627.7	95% Approximate Gamma UCL
	n	027.7	3578 Approximate Gamma CCL
-	nal) distribution passing one of the GOF test	note (a ci norma	When a data set follows an approvi
_	ribution (e.g., gamma) passing both GOF tests in ProUCL		
_	noution (e.g., gamma) passing both GOP tests in ProUCL	sed upon a distric	when applicable, it is suggested to use a UCL ba
_	ed to help the user to select the most appropriate 95% UCL,		
	ze, data distribution, and skewness.		
	don studies summarized in Singh, Maichle, and Lee (2006).		
	con scuales summanzed in singh, maicrile, and Lee (2009). or additional insight the user may want to consult a statistician.		
	or additional insight the user may want to consult a statistician.		
40	or additional insight the user may want to consult a statistician.	orld data sets; for	
40	or additional insight the user may want to consult a statistician.	orid data sets; for General Statis	However, simulations results will not cover all Real W
0	or additional insight the user may want to consult a statistician.	orid data sets; for General Statis	However, simulations results will not cover all Real W
0	or additional insight the user may want to consult a statistician. Setics Number of Distinct Observations Number of Missing Observations	General Statis	However, simulations results will not cover all Real W
0 3.199 3.4	or additional insight the user may want to consult a statistician. Setice Number of Distinct Observations Number of Missing Observations Mean	General Statis 55 0.03	However, simulations results will not cover all Real W Total Number of Observations Minimum
0 3.199 3.4 0.245	or additional insight the user may want to consult a statistician. Selice Number of Distinct Observations Number of Missing Observations Mean Median	General Statis 55 0.03 7	However, simulations results will not cover all Real W Total Number of Observations Minimum Maximum
0 3.199 3.4 0.245	or additional insight the user may want to consult a statistician. Setice Number of Distinct Observations Number of Missing Observations Mean Median Std, Error of Mean	General Statis 55 0.03 7 1.814	However, simulations results will not cover all Real W Total Number of Observations Minimum Maximum SD
0 3.199 3.4 0.245	or additional insight the user may want to consult a statistician. Setics Number of Distinct Observations Number of Missing Observations Mean Median Stid, Error of Mean Skewness Teet	General State 55 0.03 7 1.814 0.567 Normel GOF T	However, simulations results will not cover all Real W Total Number of Observations Minimum Maximum SD Coefficient of Variation
0 3.199 3.4 0.245	or additional insight the user may want to consult a statistician. Setics Number of Distinct Observations Number of Missing Observations Mean Median Std. Error of Mean Skewness	General Static 55 0.03 7 1.814 0.567	However, simulations results will not cover all Real W Total Number of Observations Minimum Maximum SD
0 3.199 3.4 0.245	or additional insight the user may want to consult a statistician. Setics Number of Distinct Observations Number of Missing Observations Mean Median Stid, Error of Mean Skewness Teet	General State 55 0.03 7 1.814 0.567 Normel GOF T	However, simulations results will not cover all Real W Total Number of Observations Minimum Maximum SD Coefficient of Variation
0 3.199 3.4 0.245	or additional insight the user may want to consult a statistician.	General Statis 55 0.03 7 1.814 0.567 Normel GOF T 0.963	However, simulations results will not cover all Real W Total Number of Observations Minimum Maximum SD Coefficient of Variation Shapiro Wilk Test Statistic
0 3.199 3.4 0.245	or additional insight the user may want to consult a statistician.	General Statle 55 0.03 7 1.814 0.567 Normel GOF T 0.963 0.174	However, simulations results will not cover all Real W Total Number of Observations Minimum Maximum SD Coefficient of Variation Shapiro Wilk Test Statistic 5% Shapiro Wilk P Value
0 3.199 3.4 0.245	or additional insight the user may want to consult a statistician.	General Statis 55 0.03 7 1.814 0.567 Normal GOF T 0.963 0.174 0.0568 0.119	However, simulations results will not cover all Real W Total Number of Observations Minimum Maximum SD Coefficient of Variation Shapiro Wilk Test Statistic 5% Shapiro Wilk P Vatue Lillefors Test Statistic 5% Lillefors Critical Value
0 3.199 3.4 0.245	or additional insight the user may want to consult a statistician.	General Statie 55 0.03 7 1.814 0.567 Normal GOF T 0.963 0.174 0.0568 0.119 Normal at 5% S	However, simulations results will not cover all Real W Total Number of Observations Minimum Maximum SD Coefficient of Variation Shapiro Wilk Test Statistic 5% Shapiro Wilk P Value Lillefors Test Statistic 5% Lillefors Critical Value Data appear
0 3.199 3.4 0.245	or additional insight the user may want to consult a statistician.	General Statis 55 0.03 7 1.814 0.567 Normal GOF T 0.963 0.174 0.0568 0.119	However, simulations results will not cover all Real W Total Number of Observations Minimum Maximum SD Coefficient of Variation Shapiro Wilk Test Statistic 5% Shapiro Wilk P Value Lillefors Test Statistic 5% Lillefors Critical Value Data appea
0 3.199 3.4 0.245 0.139	or additional insight the user may want to consult a statistician.	General Statls 55 0.03 7 1.814 0.567 Normel GOF T 0.963 0.174 0.0568 0.119 r Normal at 5% S	However, simulations results will not cover all Real W Total Number of Observations Minimum Maximum SD Coefficient of Variation Shapiro Wilk Test Statistic S% Shapiro Wilk Test Statistic S% Lilliefors Test Statistic S% Lilliefors Critical Value Data appea Aar 95% Normal UCL
0 3.199 3.4 0.245 0.139	or additional insight the user may want to consult a statistician. Satics Number of Distinct Observations Number of Missing Observations Mean Median Std. Error of Mean Skewness Test Shapiro Wilk GOF Test Data appear Normal at 5% Significance Level Lilistons GOF Test Data appear Normal at 5% Significance Level Significance Level Significance Level Significance Level Significance Level Distribution S5% UCLs (Acjusted for Steameae) 95% Adjusted-CLT UCL (Chen-1995)	General Statie 55 0.03 7 1.814 0.567 Normal GOF T 0.963 0.174 0.0568 0.119 Normal at 5% S	However, simulations results will not cover all Real W Total Number of Observations Minimum Maximum SD Coefficient of Variation Shapiro Wilk Test Statistic 5% Shapiro Wilk P Value Lillefors Test Statistic 5% Lillefors Critical Value Data appea
0 3.199 3.4 0.245 0.139	or additional insight the user may want to consult a statistician.	General Statls 55 0.03 7 1.814 0.567 Normel GOF T 0.963 0.174 0.0568 0.119 r Normal at 5% S	However, simulations results will not cover all Real W Total Number of Observations Minimum Maximum SD Coefficient of Variation Shapiro Wilk Test Statistic S% Shapiro Wilk Test Statistic S% Lilliefors Test Statistic S% Lilliefors Critical Value Data appea Aar 95% Normal UCL
0 3.199 3.4 0.245 0.139	or additional insight the user may want to consult a statistician.	General Statie 55 0.03 7 1.814 0.567 Normel GOF T 0.963 0.174 0.5588 0.119 r Normel at 5% S saming Normel DE 3.608	However, simulations results will not cover all Real W Total Number of Observations Minimum Maximum SD Coefficient of Variation Shapiro Wilk Test Statistic S% Shapiro Wilk Test Statistic S% Lilliefors Test Statistic S% Lilliefors Critical Value Data appea Aar 95% Normal UCL
0 3.199 3.4 0.245 0.139	or additional insight the user may want to consult a statistician.	General Static 55 0.03 7 1.814 0.567 Normal GOF T 0.963 0.174 0.0568 0.119 r Normal at 5% S uming Normal Di 3.608	However, simulations results will not cover all Real W Total Number of Observations Minimum Maximum SD Coefficient of Variation Shapiro Wilk Test Statistic 5% Shapiro Wilk P Value Lilliefors Test Statistic 5% Lilliofors Critical Value Data appea Aar 95% Normal UCL 95% Studente-t UCL
0 3.199 3.4 0.245 0.139	or additional insight the user may want to consult a statistician.	General Statls 55 0.03 7 1.814 0.567 Normel GOF T 0.963 0.174 0.9568 0.119 r Normal at 5% S uming Normal DI 3.608 2.093	However, simulations results will not cover all Real W Total Number of Observations Minimum Maximum SD Coefficient of Variation Shapiro Wilk Test Statistic S% Shapiro Wilk P Value Lillefors Test Statistic S% Lilliofors Critical Value Data appea Aar 95% Normal UCL 95% Student's-t UCL
0	or additional insight the user may want to consult a statistician.	General Static 55 0.03 7 1.814 0.567 Normal GOF T 0.963 0.174 0.0568 0.119 r Normal at 5% S uming Normal Di 3.608	However, simulations results will not cover all Real W Total Number of Observations Minimum Maximum SD Coefficient of Variation Shapiro Wilk Test Statistic 5% Shapiro Wilk P Value Lilliefors Test Statistic 5% Lilliefors Critical Value Data appear Aar 95% Normal UCL 95% Students-t UCL

	General St	atistics	
Total Number of Observations	55	Number of Distinct Observations	47
		Number of Missing Observations	0
Minimum	336	Mean	597,6
Maximum	1080	Median	582
SD	133.2	Std. Error of Mean	17.97
Coefficient of Variation	0.223	Skewness	1.313
	Normal GC	F Test	
Shapiro Wilk Test Statistic	0.894	Shapiro Wilk GOF Test	-
5% Shapiro Wilk P Value	4.9241E-5	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.133	Lillefors GOF Test	_
5% Lillietors Critical Value	0.119	Data Not Normal at 5% Significance Level	_
Data Not	Normal at 5%	Significance Level	
As	suming Norma	Distribution	
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	627.7	95% Adjusted-CLT UCL (Chen-1995)	630.5
		95% Modified-t UCL (Johnson-1978)	628.2
	Gamma Go	DF Test	_
A-D Test Statistic	1.096	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.748	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.109	Kolmogorov-Smirnov Gamma GOF Test	-
5% K-S Critical Value	0.12	Detected data appear Gamma Distributed at 5% Significance	Lovol
		Induction at 5% Significance Level	Lavel
	Germine St		
k hat (MLE)	22.12	k star (bias corrected MLE)	20.93
Theta hat (MLE)	27.02	Theta star (bias corrected MLE)	28,56
nu hat (MLE)	2433		2302
MLE Mean (blas corrected)	597,6	MLE Sd (blas corrected)	130,6
			2191
Adjusted Level of Significance	0.0456	Adjusted Chi Square Value	2188
Aa	uming Gemm	a Distribution	
95% Approximate Gamma UCL (use when n>=50)	627.7	95% Adjusted Gamma UCL (use when n<50)	628,5
	Lognormal G	OF Test	-
Shapiro Wilk Test Statistic	0.947	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk P Value	0.0305	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.115	Lillefors Lognormal GOF Test	_
5% Lilliefors Critical Value	0.119	Data appear Lognormal at 5% Significance Level	-
Deta appear Approx	dmate Lognon	nel at 5% Significance Level	
	Lognormal S	bilitica	_
Minimum of Logged Data	5,817	Mean of logged Data	6,37
Maximum of Logged Data	6,985	SD of logged Data	0.214

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55	Number of Distinct Observations	44
		0
23.8		39.7
		39.6
		0.945
0,177	Skewness	1,423
		_
	•	
suming Normal D		_
41.28		41,44
	95% Modified-t UCL (Johnson-1978)	41.31
Gamma GOF	Test	-
1.989	Anderson-Darling Gamma GOF Test	
0.748	Data Not Gamma Distributed at 5% Significance Level	
0.17	Kolmogorov-Smirnov Gamma GOF Test	
0.12	Data Not Gamma Distributed at 5% Significance Level	
ne Desnoued at a	5% Significance Level	
Gamma Statis	atics .	_
35.36	k star (bias corrected MLE)	33.45
		1.18
		3679
39.7		6.86
		3539
0.0456	Adjusted Chi Square Value	3536
euming Gamma D	Distribution	_
41.27	95% Adjusted Gamma UCL (use when n<50)	41,3
Lognormal GOI	FTest	_
0.921	Shapiro Wilk Lognormal GOF Test	
0.0014	Data Not Lognormal at 5% Significance Level	
0.161	Lillefors Lognormal GOF Test	
0.119	Data Not Lognormal at 5% Significance Level	
ognormal at 5% S	Significance Level	
Loonormal Ste	tistics	
		3.66
4.215	SD of logged Data	0.16
uming Lognormal		10.0
uming Lognormal 41.29 43.64	Distribution 90% Chebyshev (MVUE) UCL 97.5% Chebyshev (MVUE) UCL	42.4
	23.8 67.7 7.01 0.177 0.177 0.872 3.5532E-6 0.195 0.119 Normal at 5% St auming Normal D 41.28 41.28 0.119 41.28 0.119 0.119 1.889 0.748 0.77 0.12 ma Distributed at 3 3890 39.7 0.0456 auming Gamme I 41.27 Lognormal at 5% St Lognormal at 5% St	Number of Missing Observations 23.8 Mean 67.7 Median 7.01 Stat. Error of Mean 0.177 Skewness Normal GOF Test Skewness 0.872 Shapko Wilk GOF Test 0.872 Shapko Wilk GOF Test 0.195 Lillefors GOF Test 0.195 Lillefors GOF Test 0.195 Lillefors GOF Test 0.119 Data Not Normal at 5% Significance Level Rormal GOF Test Significance Level suming Normal Distribution 95% UCLa (Adjusted-CLT UCL (Chen-1995) 41.28 95% Adjusted-CLT UCL (Chen-1995) 0.748 Data Not Gamma Distributed at 5% Significance Level 0.748 Data Not Gamma Distributed at 5% Significance Level 0.17 Kohnegerov-Smirnov Gamma GOF Test 0.12 Data Not Gamma Distributed at 5% Significance Level Oarnma Statistics 35.36 k star (blas corrected MLE) 1.123 Theta star (blas corrected MLE) 3.890 nu star (blas corrected MLE) 3.9.7 Adjusted Chi Square Value 0

Page 20 o	f	5	6
7/25/2	0	11	8

5% K-S Critical Value	0.122	Data Not Gamma Distributed at 5% Significance Level	_
Deta Not Gernn	a Distributed at	5% Significance Level	
	Gamma Stat	and an	
k hat (MLE)	1.647	k star (blas corrected MLE)	1.57
Theta hat (MLE)	1.942	Theta star (blas corrected MLE)	2.03
nu hat (MLE)	181.2	nu star (blas corrected)	172.6
MLE Mean (bias corrected)	3,199	MLE Sd (bias corrected)	2.55
	01100	Approximate Chi Square Value (0.05)	143.3
Adjusted Level of Significance	0.0456	Adjusted Chi Square Value	142.5
An	wining Germa	Distribution	
95% Approximate Gamma UCL (use when n>=50))	3.855	95% Adjusted Gamma UCL (use when n<50)	3,87
	Lognormal GO	DF Teet	
Shapiro Wilk Test Statistic	0.745	Shapiro Wilk Logrormal GOF Test	
5% Shapiro Wilk P Value	3.681E-12	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.201	Liliefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.119	Data Not Lognormal at 5% Significance Level	
Data Not L	ognormal at 5%	Significance Level	
	-		
	Lognormal St	and ca	
Minimum of Logged Data	-3.507	Mean of logged Data	0.83
Maximum of Logged Data	1.946	SD of logged Data	1.12
		1	
Алы	uming Lognorme	I Distribution	
95% H-UCL	6.346	90% Chebyshev (MVUE) UCL	6.60
95% Chebyshev (MVUE) UCL	7.676	97.5% Chebyshev (MVUE) UCL	9,16
99% Chebyshev (MVUE) UCL	12.08		
Nonparame	tric Distribution	Free UCL Statistics	
Data appear to follow a D	Jiscemible Distri	Ibution at 5% Significance Level	
Norpa	rametric Distribu	tion Free UCLs	
95% CLT UCL	3.601	95% Jackknife UCL	3,60
95% Standard Bootstrap UCL	3.591	95% Bootstrap-t UCL	3,60
95% Hall's Bootstrap UCL	3.607	95% Percentile Bootstrap UCL	3.60
95% BCA Bootstrap UCL	3.62		
90% Chebyshev(Mean, Sd) UCL	3.932	95% Chebyshev(Mean, Sd) UCL	4.26
97.5% Chebyshev(Mean, Sd) UCL	4.726	99% Chebyshev(Mean, Sd) UCL	5,63
	Suggested UC	L to Use	
95% Student's-t UCL	3.608		_
		ded to help the user to select the most appropriate 95% UCL.	
		ize, data distribution, and skewness.	
	its of the simular	tion studies summarized in Singh, Maichle, and Lee (2006).	
These recommendations are based upon the resu		for additional insight the user may want to consult a statistician.	
These recommendations are based upon the resu	Vorid data sets; 1		
These recommendations are based upon the resu	Vorid data sets; 1		
These recommendations are based upon the resu	Vorid data sets; f		

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MLE Mean (bias corrected)	0.471	MLE Sd (bias corrected)	0,26
			308.1
Adjusted Level of Significance	0.0456		307
			_
	uming Gamma Dis		
95% Approximate Gamma UCL (use when n>=50))	0.536	95% Adjusted Gamma UCL (use when n<50)	0.53
	Lognormal GOF	lest	
Shapiro Wilk Test Statistic	0.94	Shapiro Wilk Lognormal GOF Test	-
5% Shapiro Wilk P Value	0.0131	Data Not Lognormal at 5% Significance Level	-
Lilliefors Test Statistic	0.13	Lilliefors Lognormel GOF Test	
5% Lilliefors Critical Value	0,119	Data Not Lognormal at 5% Significance Level	
Data Not Lo	gnormal at 5% Sig		
	Lognormal Statis		
Minimum of Logged Data	-1.715	Mean of logged Data	-0.909
Maximum of Logged Data	0.531	SD of logged Data	0.53
Assu	ming Lognormal D	stribution	
95% H-UCL	0.535	90% Chebyshev (MVUE) UCL	0.57
95% Chebyshev (MVUE) UCL	0.619	97.5% Chebyshev (MVUE) UCL	0.68
99% Chebyshev (MVUE) UCL	0.818	, , , , , , , , , , , , , , , , , , , ,	
	tric Distribution Fre		
Data do not fo	Now a Discernible	Distribution (0.05)	
Nonpar	ametric Distribution	Free UCLs	-
95% CLT UCL	0.54	95% Jackknife UCL	0,54
95% Standard Bootstrap UCL	0.542	95% Bootstrap-t UCL	0.56
95% Hall's Bootstrap UCL	0.581	95% Percentile Bootstrap UCL	0.54
95% BCA Bootstrap UCL	0.557		
90% Chebyshev(Mean, Sd) UCL	0.598	95% Chebyshev(Mean, Sd) UCL	0.65
97.5% Chebyshev(Mean, Sd) UCL	0.734	99% Chebyshev(Mean, Sd) UCL	0.89
	1		
	Suggested UCL to	Use	
95% Chebyshev (Mean, Sd) UCL	0.655		_
Note: Suggestions regarding the selection of a 95%	UCL are provided	to help the user to select the most appropriate 95% UCL.	-
		data distribution, and skewness.	_
		studies summarized in Singh, Maichle, and Lee (2006).	
		dditional insight the user may want to consult a statistician.	
			-
			_
		58	
	General Statisti		
Total Number of Observations	General Statisti 55	Number of Distinct Observations	35
Total Number of Observations		Number of Distinct Observations Number of Missing Observations	35 0
Total Number of Observations Minimum			0
Minimum	55	Number of Missing Observations	~~
	0.04	Number of Missing Observations Mean	0

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Pedripelantia	ric Distribution P	Free UCL Statietics	
		e Distribution (0.05)	
	_		
Nonper	metric Distribut	Ion Free UCLs	
95% CLT UCL	41.25	95% Jackknife UCL	41.28
95% Standard Bootstrap UCL	41.22	95% Bootstrap-t UCL	41.62
95% Hall's Bootstrap UCL	41.81	95% Percentile Bootstrap UCL	41.21
95% BCA Bootstrap UCL	41.55		
90% Chebyshev(Mean, Sd) UCL	42.53	95% Chebyshev(Mean, Sd) UCL	43.82
97.5% Chebyshev(Mean, Sd) UCL	45.6	99% Chebyshev(Mean, Sd) UCL	49.1
	Suggested UCL	to Ues	
95% Student's-t UCL	41.28	or 95% Modified-t UCL	41.31
Note: Suggestions regarding the selection of a 95%	UCL are provide	ed to help the user to select the most appropriate 95% UCL.	
Recommendations are bas	ed upon data siz	e, data distribution, and skewness,	
		on studies summarized in Singh, Maichle, and Lee (2006).	-
		or additional insight the user may want to consult a statistician.	
			_
m			
a))			-
	General Stati	intica	
Total Number of Observations	55	Number of Distinct Observations	34
Total realized of Observatoris	55	Number of Missing Observations	0
Minimum	0.18	Mean	0.471
Maximum	1.7	Median	0.4
SD	0.313	Std, Error of Mean	0.0421
Coefficient of Variation	0.663	Skewness	2.365
Coefficient of Venesion	0,003	CCDIIMDAC	2.300
	Normal GOF	Tent	-
01 1 1400 W . 0. 0. 0. 0	0.752	Shapiro Wilk GOF Test	
Shapiro Wilk Test Statistic			
Shapiro Wilk Test Statistic 5% Shapiro Wilk P Value (.947E-12	Data Not Normal at 5% Significance Level	
	0.241	Data Not Normal at 5% Significance Level	
5% Shapiro Wilk P Value 6			
5% Shapiro Wilk P Value Lillefors Test Statistic 5% Lillefors Critical Value	0.241 0.119	Lilliefors GOF Test	
5% Shapiro Wilk P Value Lilllefors Test Statistic 5% Lilllefors Critical Value Data Not	0.241 0.119 Normal at 5% Si	Lilliefors GOF Test Data Not Normal at 5% Significance Level Ignificance Level	
5% Shapiro Wilk P Value Lilliefors Test Statistic 5% Lilliefors Critical Value Data Not	0.241 0.119	Lilliefors GOF Test Data Not Normal at 5% Significance Level Ignificance Level	
5% Shapiro Wilk P Value Lilliofors Test Statistic 5% Lilliofors Critical Value Data Not Am 95% Normal UCL	0.241 0.119 Normal at 5% Si suming Normal D	Lillefore GOF Teet Data Not Normal at 5% Significance Level ignificance Level Detribution 85% UCLs (Adjusted for Skewness)	
5% Shapiro Wilk P Value Lilliefors Test Statistic 5% Lilliefors Critical Value Data Not	0.241 0.119 Normal at 5% Si	Lilliefore GOF Teet Data Not Normal at 5% Significance Level ignificance Level Detribution 95% UCLs (Adjusted for Skewmess) 95% Adjusted-CLT UCL (Chen-1995)	0.555
5% Shapiro Wilk P Value Lilliofors Test Statistic 5% Lilliofors Critical Value Data Not Am 95% Normal UCL	0.241 0.119 Normal at 5% Si suming Normal D	Lillefore GOF Teet Data Not Normal at 5% Significance Level ignificance Level Detribution 85% UCLs (Adjusted for Skewness)	0.555
5% Shapiro Wilk P Value Lilliofors Test Statistic 5% Lilliofors Critical Value Data Not Am 95% Normal UCL	0.241 0.119 Normal at 5% SI uming Normal D 0.542	Lilliefore GOF Test Data Not Normal at 5% Significance Level ignificance Level Distribution 85% UCLs (Adjusted for Skewnees) 95% Adjusted-CLT UCL (Chen-1995) 95% Modified-t UCL (Johnson-1978)	
5% Shapiro Wilk P Value Lilliefors Test Statistic 5% Lilliefors Critical Value Data Not Ass 95% Normal UCL 95% Student's-t UCL	0.241 0.119 Normal at 5% SI uming Normal D 0.542 Gamma GOF	Lillefore GOF Test Data Not Normal at 5% Significance Level ignificance Level Steribution 85% UCLs (Adjusted for Skewness) 95% Adjusted-CLT UCL (Chen-1995) 95% Modified-t UCL (Johnson-1978) Test	
5% Shapiro Wilk P Value Lilliefors Test Statistic 5% Utiliefors Critical Value Data Not 95% Normal UCL 95% Student's-t UCL A-D Test Statistic	0.241 0.119 Normal at 5% SI uming Normal D 0.542 Gamma GOF 1.312	Lillefore GOF Teet Data Not Normal at 5% Significance Level ignificance Level Setribution 95% UCLs (Adjusted for Skewness) 95% Adjusted-CLT UCL (Chen-1995) 95% Modified-t UCL (Johnson-1978) Test Anderson-Darling Gamma GOF Teet	
5% Shapiro Wilk P Value Lilliefors Test Statistic 5% Utiliefors Critical Value Data Not Ast 95% Normail UCL 95% Student's-t UCL A-D Test Statistic 5% A-D Critical Value	0.241 0.119 Normal at 5% SI 0.542 Gamma GOF 1.312 0.756	Lilliefore GOF Teet Data Not Normal at 5% Significance Level ignificance Level Detribution 95% UCLs (Adjusted for Skewmess) 95% Adjusted-CLT UCL (Chen-1995) 95% Modified-t UCL (Johnson-1978) Teet Anderson-Dating Gamma GOF Teet Data Not Gamma Distributed at 5% Significance Level	
5% Shapiro Wilk P Value Lilliefors Test Statistic 5% Lilliefors Critical Value Data Not 95% Normal UCL 95% Student's-t UCL 95% Student's-t UCL A-D Test Statistic 5% A-D Critical Value K-S Test Statistic	0.241 0.119 Normal at 5% SI uming Normal I 0.542 0.542 0.556 0.756 0.772	Lilliefore GOF Teet Data Not Normal at 5% Significance Level ignificance Level Detribution 95% UCLs (Adjusted for Skewness) 95% Adjusted-CLT UCL (Chen-1995) 95% Modified-t UCL (Johnson-1978) 75et Anderson-Darling Gamma GOF Teet Data Not Gamma Distributed at 5% Significance Level Kolmogorov-Smirnov Gamma GOF Teet	
5% Shapiro Wilk P Value Lilliefors Test Statistic 5% Lilliefors Critical Value Data Not 85% Normal UCL 95% Student's-t UCL 95% Student's-t UCL 5% A-D Test Statistic 5% A-D Critical Value K-S Test Statistic 5% K-S Critical Value	0.241 0.119 Normal at 5% SI 0.542 0.542 0.542 0.542 0.756 0.172 0.172	Lillefore GOF Test Data Not Normal at 5% Significance Level ignificance Level Set/Eurore Level Data Not Gamma Distributed at 5% Significance Level Set/Eurore L	
5% Shapiro Wilk P Value Lilliefors Test Statistic 5% Lilliefors Critical Value Data Not 85% Normal UCL 95% Student's-t UCL 95% Student's-t UCL 5% A-D Test Statistic 5% A-D Critical Value K-S Test Statistic 5% K-S Critical Value	0.241 0.119 Normal at 5% SI 0.542 0.542 0.542 0.542 0.756 0.172 0.172	Lilliefore GOF Teet Data Not Normal at 5% Significance Level ignificance Level Detribution 95% UCLs (Adjusted for Skewness) 95% Adjusted-CLT UCL (Chen-1995) 95% Modified-t UCL (Johnson-1978) 75et Anderson-Darling Gamma GOF Teet Data Not Gamma Distributed at 5% Significance Level Kolmogorov-Smirnov Gamma GOF Teet	
5% Shapiro Wilk P Value Lilliefors Test Statistic 5% Lilliefors Critical Value Data Not 85% Normal UCL 95% Student's-t UCL 95% Student's-t UCL 5% A-D Test Statistic 5% A-D Critical Value K-S Test Statistic 5% K-S Critical Value	0.241 0.119 Normal at 5% St uning Normal D 0.542 0.542 0.542 0.542 0.756 0.172 0.121 0.121 0.121 0.121	Lillefore GOF Teet Data Not Normal at 5% Significance Level ignificance Level S5% UCLs (Adjusted for Skewnees) 95% Adjusted-CLT UCL (Chen-1995) 95% Modified-t UCL (Johnson-1978) 55% Modified-t UCL (Johnson-1978) Test Anderson-Darling Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level Kolmogrov-Smirnov Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level 5% Significance Level	
5% Shapiro Wilk P Value Lilliefors Test Statistic 5% Utiliefors Critical Value Data Not 95% Normal UCL 95% Student's-t UCL 95% Student's-t UCL 5% A-D Critical Value K-S Test Statistic 5% K-S Critical Value Data Not Gammer	0.241 0.119 Normal at 5% St uming Normal D 0.542 0.542 0.542 0.542 0.542 0.556 0.172 0.121 0.121 0.121 0.121 0.121 0.121 0.121 0.121 0.121	Lillefore GOF Teet Data Not Normal at 5% Significance Level ignificance Level 95% UCLs (Adjusted for Stewmess) 95% Adjusted-CLT UCL (Chen-1995) 95% Modified-t UCL (Johnson-1978) 55% Modified-t UCL (Johnson-1978) Test Anderson-Darling Gamma GOF Teet Data Not Gamma Distributed at 5% Significance Level Kolmogorov-Smirnov Gamma GOF Teet Data Not Gamma Distributed at 5% Significance Level 5% Significance Level Interso	0.544
5% Shapiro Wilk P Value Lilliefors Test Statistic 5% Lilliefors Critical Value Data Not 85% Normal UCL 95% Student's-t UCL 95% Student's-t UCL 5% A-D Test Statistic 5% A-D Critical Value K-S Test Statistic 5% K-S Critical Value	0.241 0.119 Normal at 5% St uning Normal D 0.542 0.542 0.542 0.542 0.756 0.172 0.121 0.121 0.121 0.121	Lillefore GOF Teet Data Not Normal at 5% Significance Level ignificance Level S5% UCLs (Adjusted for Skewness) 95% Adjusted-CLT UCL (Chen-1995) 95% Adjusted-CLT UCL (Chen-1995) 95% Modified-t UCL (Johnson-1978) Test Anderson-Darling Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level Kolmogrov-Smirnov Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level 5% Significance Level	

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95% BCA Bootstrap UCL	3,234		
90% Chebyshev(Mean, Sd) UCL	3.488	95% Chebyshev(Mean, Sd) UCL	3.79
97,5% Chebyshev(Mean, Sd) UCL	4.21	99% Chebyshev(Mean, Sd) UCL	5.034
	Suggested U	CL to Use	-
95% Chebyshev (Mean, Sd) UCL	3.79		
Note: Successions recarding the selection of a 95%	UCL are prov	ided to help the user to select the most appropriate 95% UCL.	
		size, data distribution, and skewness.	
		lation studies summarized in Singh, Maichle, and Lee (2006).	_
		; for additional insight the user may want to consult a statistician.	
Tothe data and the	General S		
Total Number of Observations	55	Number of Distinct Observations	23
	0.08	Number of Missing Observations	0
Minimum		Mean	0.209
Maximum	0.38	Median	0.19
SD	0.078	Std. Error of Mean	0.0105
Coefficient of Variation	0.373	Skewness	0.512
	Normal G	DE Test	
Shapiro Wilk Test Statistic	0.939	Shapiro Wilk GOF Test	
5% Shapiro Wilk P Value	0.0111	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.183	Lillefore GOF Test	
5% Lilliefors Critical Value	0.119	Data Not Normal at 5% Significance Level	
		Significance Level	
		organicance care	
As	ruming Norm	al Distribution	
95% Normal UCL		95% UCLs (Adjusted for Skawness)	
95% Student's-t UCL	0.227	95% Adjusted-CLT UCL (Chen-1995)	0.227
		95% Modified-t UCL (Johnson-1978)	0.227
	Gemma G	OF Test	
A-D Test Statistic	0.545	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.752	Detected data appear Gamma Distributed at 5% Significance	Level
K-S Test Statistic	0.134	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.12	Data Not Gamma Distributed at 5% Significance Level	
	r. Gamma Di	stribution at 5% Significance Level	
	Gamma S	tatistics	
k hat (MLE)	7.257	k star (bias corrected MLE)	6.873
Theta hat (MLE)	0.0288	Theta star (bias corrected MLE)	0.0304
nu hat (MLE)	798,3	nu star (bias corrected)	756
MLE Mean (bias corrected)	0.209	MLE Sd (bias corrected)	0,0798
		Approximate Chi Square Value (0.05)	693.2
Adjusted Level of Significance	0.0456	Adjusted Chi Square Value	691.6
Ass 95% Approximate Gamma UCL (use when n>=50)	0,228	ne Distribution 95% Adjusted Gamma UCL (use when n<50)	0,229

Gamma UCL (use when n<50)	0.2
	Page

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	Normal GOF	Test	
Shapiro Wilk Test Statistic	0.935	Shapiro Wilk GOF Test	
5% Shapiro Wilk P Value	0.0071	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.128	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.119	Data Not Normal at 5% Significance Level	
Data Not	Normal at 5% Sk	gnificance Level	
Are	uming Normal D	Notethan Man	
95% Normal UCL	Authing rearmail L	95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	3.193	95% Adjusted-CLT UCL (Chen-1995)	3.203
35% Studen 34 00L	3.133	95% Modified-t UCL (Johnson-1978)	3,196
			0.100
	Gamma GOF	Test	
A-D Test Statistic	3.755	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.768	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.226	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.122	Data Not Gamma Distributed at 5% Significance Level	_
Data Not Gamm	a Distributed at	5% Significance Level	
	Gamma Stati	wice .	
k hat (MLE)	1.49	k star (bias corrected MLE)	1.42
Theta hat (MLE)	1.893	Theta star (bias corrected MLE)	1.98
nu hat (MLE)	163.9	nu star (bias corrected)	156.3
MLE Mean (bias corrected)	2.821	MLE Sd (bias corrected)	2,36
		Approximate Chi Square Value (0.05)	128,4
Adjusted Level of Significance	0.0456	Adjusted Chi Square Value	127.7
	suming Gamma I		
95% Approximate Gamma UCL (use when n>=50))	3.434	95% Adjusted Gamma UCL (use when n<50)	3,45
	Lognormal GO	E Test	
Shapiro Wilk Test Statistic	0.735		
		Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk P Value	and the second se	Data Not Lognormal at 5% Significance Level	
5% Shapiro Wilk P Value Littlefors Test Statistic	0.269	Lilliefors Lognormal GOF Test	
5% Shapiro Wilk P Value Liffiefors Test Statistic 5% Liffiefors Critical Value	0.269 0.119	Lillietors Lognormal GOF Test Data Not Lognormal at 5% Significance Level	
5% Shapiro Wilk P Value Lilliefors Test Statistic 5% Lilliefors Critical Value	0.269 0.119	Lilliefors Lognormal GOF Test	
5% Shapiro Wilk P Value Liffiefors Test Statistic 5% Liffiefors Critical Value	0.269 0.119	Lillefors Lognormal GOF Test Data Not Lognormal at 5% Significance Level Significance Level	
5% Shapiro Wilk P Value Liffiefors Test Statistic 5% Liffiefors Critical Value	0.269 0.119 ognormal at 5% 4	Lillefors Lognormal GOF Test Data Not Lognormal at 5% Significance Level Significance Level	0,66
5% Shapiro Wilk P Valus Lilliefors Test Statistic 5% Lilliefors Critical Value Data Not L	0.269 0.119 ognormal at 5% s	Lilletors Lognormal GOF Test Data Not Lognormal at 5% Significance Level Significance Level	
5% Shapiro Wilk P Value Lilliefors Test Statistic 5% Lilliefors Critical Value Data Not L Minimum of Logged Data Maximum of Logged Data	0.269 0.119 ognormal at 5% s Lognormal Sta -3.219 2.163	Lilletors Lognormal GOF Test Data Not Lognormal at 5% Significance Level Significance Level Itistice Mean of logged Data SD of logged Data	
5% Shapiro Wilk P Value Lilliefors Test Statistic 5% Lilliefors Critical Value Data Not L Minimum of Logged Data Maximum of Logged Data	0.269 0.119 ognormal at 5% 4 Lognormal Sta -3.219 2.163 aming Lognormal	Lilletors Lognormal GOF Test Data Not Lognormal at 5% Significance Level Significance Level Mean of logged Data SD of logged Data I Distribution	1,18
5% Shapiro Wilk P Value Lilliefors Test Statistic 5% Lilliefors Critical Value Data Not L Minimum of Logged Data Maximum of Logged Data Asso 25% H-UCL	0.269 0.119 ognormal at 5% s Lognormal Sta -3.219 2.163 aming Lognormal 5.943	Lilletors Lognormal GOF Test Data Not Lognormal at 5% Significance Level Significance Level Itistice Mean of logged Data SD of logged Data I Distribution 90% Chebyshev (MVUE) UCL	6.10
5% Shapiro Wilk P Value Lilliefors Test Statistic 5% Lilliefors Critical Value Data Not L Minimum of Logged Data Maximum of Logged Data Associate 95% H-UCL 95% Chebyshev (MVUE) UCL	0.269 0.119 ognormal at 5% 4 -3.219 2.163 aming Lognormal 5.943 7.138	Lilletors Lognormal GOF Test Data Not Lognormal at 5% Significance Level Significance Level Mean of logged Data SD of logged Data I Distribution	6.10
5% Shapiro Wilk P Value Lilliefors Test Statistic 5% Lilliefors Critical Value Data Not L Minimum of Logged Data Maximum of Logged Data Asso 25% H-UCL	0.269 0.119 ognormal at 5% s Lognormal Sta -3.219 2.163 aming Lognormal 5.943	Lilletors Lognormal GOF Test Data Not Lognormal at 5% Significance Level Significance Level Itistice Mean of logged Data SD of logged Data I Distribution 90% Chebyshev (MVUE) UCL	6.10
5% Shapiro Wilk P Value Lilliefors Test Statistic 5% Lilliefors Critical Value Data Not L Minimum of Logged Data Maximum of Logged Data 95% H-UCL 95% Chebyshev (MVUE) UCL 99% Chebyshev (MVUE) UCL	0.269 0.119 ognormal at 5% s Lognormal at 5% s -3.219 2.163 aming Lognormal 5.943 7.138 11.37	Lilletors Lognormal GOF Test Data Not Lognormal at 5% Significance Level Significance Level Itistice Mean of logged Data SD of logged Data i Distribution 90% Chebyshev (MVUE) UCL 97.5% Chebyshev (MVUE) UCL	6.10
5% Shapiro Wilk P Value Lilliefors Test Statistic 5% Lilliefors Critical Value Data Not L Minimum of Logged Data Maximum of Logged Data S5% H-UCL 95% Chebyshev (MVUE) UCL 95% Chebyshev (MVUE) UCL Nonparame	0.269 0.119 0.000 0.119 0.11 0.11	Lilletors Lognormal GOF Test Data Not Lognormal at 5% Significance Level Significance Level significance Level Mean of logged Data SD of logged Data Distribution 90% Chebyshev (MVUE) UCL 97.5% Chebyshev (MVUE) UCL Free UCL Statistics	6.10
5% Shapiro Wilk P Value Lilliefors Test Statistic 5% Lilliefors Critical Value Data Not L Minimum of Logged Data Maximum of Logged Data S5% H-UCL 95% Chebyshev (MVUE) UCL 99% Chebyshev (MVUE) UCL Nonparame	0.269 0.119 0.000 0.119 0.11 0.11	Lilletors Lognormal GOF Test Data Not Lognormal at 5% Significance Level Significance Level Itistice Mean of logged Data SD of logged Data i Distribution 90% Chebyshev (MVUE) UCL 97.5% Chebyshev (MVUE) UCL	6.10
5% Shapiro Wilk P Value Lilliefors Test Statistic 5% Lilliefors Critical Value Data Not L Minimum of Logged Data Maximum of Logged Data Maximum of Logged Data 95% H-UCL 95% Chebyshev (MVUE) UCL 99% Chebyshev (MVUE) UCL 99% Chebyshev (MVUE) UCL Nonparama Data do not fit	0.269 0.119 0.000 0.119 0.11 0.11	Lilletors Lognormal GOF Test Data Not Lognormal at 5% Significance Level Significance Level Mean of logged Data SD of logged Data I Distribution 90% Chebyshev (MVUE) UCL 97.5% Chebyshev (MVUE) UCL Free UCL Statistics ke Distribution (0.05)	6.10
5% Shapiro Wilk P Value Lilliefors Test Statistic 5% Lilliefors Critical Value Data Not L Minimum of Logged Data Maximum of Logged Data Maximum of Logged Data 95% H-UCL 95% Chebyshev (MVUE) UCL 99% Chebyshev (MVUE) UCL 99% Chebyshev (MVUE) UCL Nonparama Data do not fit	0.269 0.119 0.309 0.119 0.309 0.119 0.309 0.3219 2.163 3.3219 2.163 3.943 7.138 11.37 Artic Distribution F oliow a Discardo	Lilletors Lognormal GOF Test Data Not Lognormal at 5% Significance Level Significance Level Mean of logged Data SD of logged Data I Distribution 90% Chebyshev (MVUE) UCL 97.5% Chebyshev (MVUE) UCL Free UCL Statistics ke Distribution (0.05)	0.66 1,18 6.10 8.56 3.19
5% Shapiro Wilk P Value Lilliefors Test Statistic 5% Lilliefors Critical Value Date Not L Minimum of Logged Data Maximum of Logged Data Maximum of Logged Data Maximum of Logged Data Sign H-UCL 95% Chebyshev (MVUE) UCL 95% Chebyshev (MVUE) UCL 99% Chebyshev (MVUE) UCL Nonparame Data do not fit Nonpara	0.269 0.119 0.319 0.319 0.319 0.319 0.3219 2.163 aming Lognormal 5.943 7.138 11.37 bitic Distribution f follow a Discernib	Lilletors Lognormal GOF Test Data Not Lognormal at 5% Significance Level Significance Level Identification Identification 90% Chebyshev (MVUE) UCL 97.5% Chebyshev (MVUE) UCL Free UCL Statistics ide Distribution (0.05) iden Free UCLs	1.18 6.10 8.56

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5% Lilliefors Critical Value	0.119	Data Not Normal at 5% Significance Level	
Data Not	Normal at 5% Sk	mificance Level	
	euming Normel D		
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	30.84	95% Adjusted-CLT UCL (Chen-1995)	31.11
		95% Modified-t UCL (Johnson-1978)	30.88
	Gamme GOF	Test	
A-D Test Statistic	3.497	Anderson-Darling Gamma GOF Test	-
5% A-D Critical Value	0.748	Data Not Gamma Distributed at 5% Significance Level	-
K-S Test Statistic	0,198	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0,12	Data Not Gamma Distributed at 5% Significance Level	
Data Not Gamm	na Distributed at I	5% Significance Level	
	Gemme Stati		
k hat (MLE)	32.56	k star (blas corrected MLE)	30.79
Theta hat (MLE)	0.907	Theta star (blas corrected MLE)	0,959
nu hat (MLE)	3581	nu star (blas corrected)	3387
MLE Mean (bias corrected)	29.54	MLE Sd (blas corrected)	5.324
		Approximate Chi Square Value (0.05)	3253
Adjusted Level of Significance	0.0456	Adjusted Chi Square Value	3250
As	suming Gamma L	Distribution	
95% Approximate Gamma UCL (use when n>=50))	30.76	95% Adjusted Gamma UCL (use when n<50)	30.8
	Lognormal GO	ETast	_
Shapiro Wilk Test Statistic	0.831	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk P Value		Data Not Lognormal at 5% Significance Level	
Lillefors Test Statistic	0.188	Lillefors Lognormal GOF Test	
5% Lilliefors Critical Value	0,119	Data Not Lognormal at 5% Significance Level	
		Significance Level	
			-
	Lognormal Sta	tistics	
Minimum of Logged Data	2.809	Mean of logged Data	3.37
Maximum of Logged Data	3,983	SD of logged Data	0.17
Aaa	uning Lognormal	Distribution	
95% H-UCL		90% Chebyshev (MVUE) UCL	31,58
95% Chebyshev (MVUE) UCL	32.51	97.5% Chebyshev (MVUE) UCL	33,81
99% Chebyshev (MVUE) UCL	36.36		
	dele Distribution F	ree UCL Statistics	
Nonseram			
	ollow a Discernib	le Distribution (0.05)	
Data do not f	ollow a Discernib		_
Data do not f Nonpa		Ion Free UCLs	30,84
Data do not f Nonpe 95% CLT UCL	ollow a Discernib rametric Distribut	ion Free UCLa 95% Jackknife UCL	
Data do not f Nonpa	rametric Distribut 30.82	lon Free UCLs 95% Jackknife UCL 95% Bootstrap-t UCL	31.52
Data do not f Nonpa 95% CLT UCL 95% Standard Bootstrap UCL	rametric Distribut 30,82 30,81	ion Free UCLa 95% Jackknife UCL	30.84 31.52 30.84
Data do net f Nonpa 95% CLT UCL 95% Standard Bootstrap UCL 95% Hall's Bootstrap UCL	ametric Distribut 30.82 30.81 32.89	lon Free UCLs 95% Jackknife UCL 95% Bootstrap-t UCL	31.52

Lognormal GOF Test Shapiro Wilk Test Statistic 0.959 Shapiro Wilk Lognormal GOF Test 5% Shapiro Wilk P Value 0.112 Data appear Lognormal at 5% Significance Level Lilliefors Test Statistic 0.109 Lillefors Lognormal GOF Test 5% Littlefors Critical Value 0.119 Data appear Lognormal at 5% Significance Level Data appear Lognormal at 5% Significance Level Lognormal Statistics Minimum of Logged Data -2.526 Mean of logged Data -1.635 Maximum of Logged Data -0.968 SD of logged Data 0.386 Assuming Lognormal Distribution 95% H-UCL 0.231 90% Chebyshev (MVUE) UCL 0.243 95% Chebyshev (MVUE) UCL 0.259 97.5% Chebyshev (MVUE) UCL 0.28 99% Chebyshev (MVUE) UCL 0.321 Nonparametric Distribution Free UCL Statistics Data appear to follow a Discernible Distribution at 5% Significance Level Nonparametric Distribution Free UCLs 95% CLT UCL 0.226 95% Jackknife UCL 0.227 95% Standard Bootstrap UCL 0,226 95% Bootstrap-t UCL 0.228 95% Hall's Bootstrap UCL 0.227 95% Percentile Bootstrap UCL 0.226 95% BCA Bootstrap UCL 0.226 90% Chebyshev(Mean, Sd) UCL 0.241 95% Chebyshev(Mean, Sd) UCL 0.255 97.5% Chebyshev(Mean, Sd) UCL 0.275 99% Chebyshev(Mean, Sd) UCL 0.314 Suggested UCL to Use 95% Approximate Gamma UCL 0.228 When a data set follows an approximate (e.g., normal) distribution passing one of the GOF test When applicable, it is suggested to use a UCL based upon a distribution (e.g., gamma) passing both GOF tests in ProUCL Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness, These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006). However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician. Vanadium General Statistics Total Number of Observations 55 Number of Distinct Observations 43 Number of Missing Observations 0 Mean 29.54 Minimum 16.6 Maximum 53,7 Median 28,7 SD 5,744 Std. Error of Mean 0.775 Coefficient of Variation 0.194 Skewness 2.577 Normal GOF Test Shapiro Wilk Test Statistic 0.723 Shapiro Wilk GOF Test 5% Shapiro Wilk P Value 3,997E-13 Data Not Normal at 5% Significance Level Lilliefors Test Statistic 0.231 Lillefors GOF Test

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5% Lilliefors Critical Value	0.119	Data Not Lognormal at 5% Significance Level	
Data Not L	ognormal at 5% Sig	nificance Level	-
	Lognormal Statis	tics	_
Minimum of Logged Data	4.202	Mean of logged Data	5.716
Maximum of Logged Data	7.208	SD of logged Data	0.547
Assu	ming Lognormal D	latibution	
95% H-UCL	406.7	90% Chebyshev (MVUE) UCL	434.2
95% Chebyshev (MVUE) UCL	471.6	97.5% Chebyshev (MVUE) UCL	523.5
99% Chebyshev (MVUE) UCL	625,4		
Nonparame	tric Distribution Fre	e UCL Statistics	
Data do not fe	blow a Discernible	Distribution (0.05)	
Nonpar	ametric Distributio	n Free UCLs	
95% CLT UCL	391,6	95% Jackknife UCL	392.4
95% Standard Bootstrap UCL	391.8	95% Bootstrap-t UCL	413,6
95% Hall's Bootstrap UCL	487.1	95% Percentile Bootstrap UCL	390.7
95% BCA Bootstrap UCL	404.2		
90% Chebyshev(Mean, Sd) UCL	428	95% Chebyshev(Mean, Sd) UCL	464.4
97,5% Chebyshev(Mean, Sd) UCL	515	99% Chebyshev(Mean, Sd) UCL	614.3
	Suggested UCL to	u Ues	
95% Chebyshev (Mean, Sd) UCL	464.4		
Note: Suggestions regarding the selection of a 95%	UCL are provided	to help the user to select the most appropriate 95% UCL.	
	ed upon data size	data distribution, and skewness.	
Recommendations are bas	ou should ante outof		

	Suggested UCL1		30.88
95% Student's-t UCL	30.84	or 95% Modified-t UCL	30,88
ote: Suggestions regarding the selection of a 95%	UCL are provide	d to help the user to select the most appropriate 95% UCL.	
Recommendations are base	ed upon data size	e, data distribution, and skewness.	
These recommendations are based upon the result	ts of the simulatio	on studies summarized in Singh, Maichle, and Lee (2006).	
vever, simulations results will not cover all Real Wo	orld data sets; for	additional insight the user may want to consult a statistician.	
Total Number of Observations	General Statis		49
Total Number of Observations	55	Number of Distinct Observations	49
8.81-1	66.8	Number of Missing Observations Mean	347.5
Minimum	1350	Median	347,5
Maximum	1350		26.82
Coefficient of Variation	0.572	Std. Error of Mean Skewness	26.82
Coefficient of Vanation	0.572	Skewness	2,870
	Normal GOF	Test	_
Shapiro Wilk Test Statistic	0.706	Shapiro Wilk GOF Test	
5% Shapiro Wilk P Value 8		Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.248	Lillefors GOF Test	
5% Littlefors Critical Value	0.119	Data Not Normal at 5% Significance Level	
	Normal at 5% Sk		
Âm	uming Normal D	intribution.	
95% Normal UCL	earing roomans		
05% Student's t IICI	202 4	95% OCLs (Adjusted for Skewness)	402.7
95% Student's-t UCL	392.4	95% Adjusted-CLT UCL (Chen-1995)	402.7
95% Student's-t UCL	392.4		402.7 394.1
95% Student's-t UCL		95% Adjusted-CLT UCL (Chen-1995) 95% Modified-t UCL (Johnson-1978)	
	Gamma GOF	95% Adjusted-CLT UCL (Chen-1995) 95% Modified-t UCL, (Johnson-1978)	
A-D Test Statistic	Gamma GOF 3,899	95% Adjusted-CLT UCL (Chen-1995) 95% Modified-t UCL, (Johnson-1978) Test Anderson-Darling Gamma GOF Test	394,1
A-D Test Statistic 5% A-D Critical Value	Gamme GOF 3.899 0.754	95% Adjusted-CLT UCL (Chen-1995) 95% Modified-t UCL (Johnson-1978) Test Anderson-Darting Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level	394,1
A-D Test Statistic 5% A-D Critical Value K-S Test Statistic	Gemme GOF 3.899 0.754 0.223	95% Adjusted-CLT UCL (Chen-1995) 95% Modified-t UCL (Johnson-1978) Test Anderson-Darting Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level Kolmogorov-Smitnov Gamma GOF Test	394,1
A-D Test Statistic 5% A-D Critical Value K-S Test Statistic 5% K-S Critical Value	Gamma GOF 3.899 0.754 0.223 0.12	95% Adjusted-CLT UCL (Chen-1995) 95% Modified-t UCL (Johnson-1978) Test Anderson-Darting Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level Kolmogorov-Smirnov Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level	394,1
A-D Test Statistic 5% A-D Critical Value K-S Test Statistic 5% K-S Critical Value	Gamma GOF 3.899 0.754 0.223 0.12	95% Adjusted-CLT UCL (Chen-1995) 95% Modified-t UCL (Johnson-1978) Test Anderson-Darting Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level Kolmogorov-Smitnov Gamma GOF Test	394,1
A-D Test Statistic 5% A-D Critical Value K-S Test Statistic 5% K-S Critical Value	Gamma GOF 3.899 0.754 0.223 0.12 na Distributed at 1	95% Adjusted-CLT UCL (Chen-1995) 95% Modified-t UCL (Johnson-1978) Test Anderson-Darfing Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level Kolmogorov-Smfrov Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level 5% Significance Level	394,1
A-D Test Statistic 5% A-D Critical Value K-S Test Statistic 5% K-S Critical Value	Gamma GOF 3.899 0.754 0.223 0.12	95% Adjusted-CLT UCL (Chen-1995) 95% Modified-t UCL (Johnson-1978) Test Anderson-Darfing Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level Kolmogorov-Smfrov Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level 5% Significance Level	394.1
A-D Test Statistic 5% A-D Critical Value K-S Test Statistic 5% K-S Critical Value Deta Not Garrer k hat (MLE)	Gamma GOF 3.899 0.754 0.223 0.12 ne Distributed at 1 Gemma Stati	95% Adjusted-CLT UCL (Chen-1995) 95% Modified-t UCL (Johnson-1978) Test Anderson-Darting Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level Kolmogorov-Smirnov Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level 5% Significance Level stics k star (bias corrected MLE)	394.1
A-D Test Statistic 5% A-D Critical Value K-S Test Statistic 5% K-S Critical Value Deta Not Gamm	Gamma GOF 3.899 0.754 0.223 0.12 na Distributed at 1 Gamma Station 3.863	95% Adjusted-CLT UCL (Chen-1995) 95% Modified-t UCL (Johnson-1978) Test Anderson-Darling Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level Kolmogorov-Smirnov Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level 5% Significance Level	394.1
A-D Test Statistic 5% A-D Critical Value K-S Test Statistic 5% K-S Critical Value Deta Not Garrer k hat (MLE) Theta hat (MLE)	Gamma GOF 3.899 0.754 0.223 0.12 ne Distributed at 1 Gamma Statis 3.863 89,96	95% Adjusted-CLT UCL (Chen-1995) 95% Modified-t UCL (Johnson-1978) Test Anderson-Darling Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level Kolmogorov-Smirnov Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level 5% Significance Level 8% star (bias corrected MLE) Theta star (bias corrected MLE)	394.1 3.66 94.83
A-D Test Statistic 5% A-D Critical Value K-S Test Statistic 5% K-S Critical Value Deta Not Germ k hat (MLE) Theta hat (MLE) nu hat (MLE)	Germme GOF 3.899 0.754 0.223 0.12 ne Distributed at 1 Germme State 3.863 89.95 424.9	95% Adjusted-CLT UCL (Chen-1995) 95% Modified-t UCL (Johnson-1978) Test Anderson-Darting Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level Kolmogorov-Smirnov Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level 5% Significance Level stoce k star (bias corrected MLE) Theta star (bias corrected MLE) nu star (bias corrected)	394,1 3.66 94,83 403.1
A-D Test Statistic 5% A-D Critical Value K-S Test Statistic 5% K-S Critical Value Data Not Garner k hat (MLE) Theta hat (MLE) nu hat (MLE) MLE Mean (bias corrected)	Germme GOF 3.899 0.754 0.223 0.12 ne Distributed at 1 Germme State 3.863 89.95 424.9	95% Adjusted-CLT UCL (Chen-1995) 95% Modified-t UCL (Chen-1995) 7test Anderson-Darting Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level Kolmogorov-Smirnov Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level 5% Significance Level stice k star (bias corrected MLE) Theta star (bias corrected MLE) nu star (bias corrected MLE) nu star (bias corrected MLE) MLE 54 (bias corrected) MLE 54 (bias corrected)	394,1 3.663 94.83 403.1 181.5
A-D Test Statistic 5% A-D Critical Value K-S Test Statistic 5% K-S Critical Value Deta Not Germ k hat (MLE) Theta hat (MLE) nu hat (MLE)	Germme GOF 3.899 0.754 0.223 0.12 me Distributed at 1 Germme Stati 3.863 89.96 424.9 347.5	95% Adjusted-CLT UCL (Chen-1995) 95% Modified-t UCL (Johnson-1978) Test Anderson-Darting Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level Kotmogorov-Smitnov Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level 5% Significance Level etics k star (bias corrected MLE) Intet astar (bias corrected MLE) nu star (bias corrected) MLE Sd (bias corrected)	394,1 3.66 94.83 403.1 181.5 357.6
A-D Test Statistic 5% A-D Critical Value K-S Test Statistic 5% K-S Critical Value Deta Not Gamer k hat (MLE) Theta hat (MLE) nu hat (MLE) MLE Mean (bias corrected) Adjusted Level of Significance	Germme GOF 3.899 0.754 0.223 0.12 me Distributed at 1 Germme Stati 3.863 89.96 424.9 347.5	95% Adjusted-CLT UCL (Chen-1995) 95% Modified-t UCL (Johnson-1978) Test Anderson-Darting Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level Kolmogorov-Smirnov Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level 5% Significance Level etcs k star (bias corrected MLE) Theta star (bias corrected MLE) nu star (bias corrected) MLE Sd (bias corrected) Approximate Chi Square Value (0.05) Adjusted Chi Square Value	394,1 3.66 94.83 403.1 181.5 357.6
A-D Test Statistic 5% A-D Critical Value K-S Test Statistic 5% K-S Critical Value Deta Not Gamer k hat (MLE) Theta hat (MLE) nu hat (MLE) MLE Mean (bias corrected) Adjusted Level of Significance	Germme GOF 3.899 0.754 0.223 0.12 me Distributed at 1 Germme State 3.863 89.96 424.9 347.5 0.0456	95% Adjusted-CLT UCL (Chen-1995) 95% Modified-t UCL (Johnson-1978) Test Anderson-Darting Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level Kolmogorov-Smirnov Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level 5% Significance Level etcs k star (bias corrected MLE) Theta star (bias corrected MLE) nu star (bias corrected) MLE Sd (bias corrected) Approximate Chi Square Value (0.05) Adjusted Chi Square Value	394,1 3.66 94.83 403.1 181.5 357.6
A-D Test Statistic 5% A-D Critical Value K-S Test Statistic 5% K-S Critical Value Deta Not Gerrer k hat (MLE) Theta hat (MLE) nu hat (MLE) MLE Mean (bias corrected) Adjusted Level of Significance	Germme GOF 3.899 0.754 0.223 0.12 na Distributed at 3 3.863 89.96 424.9 347.5 0.0456	95% Adjusted-CLT UCL (Chen-1995) 95% Modified-t UCL (Chen-1995) 95% Modified-t UCL (Johnson-1978) Test Anderson-Darfing Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level Kohrogorov-Smirnov Garrma GOF Test Data Not Gamma Distributed at 5% Significance Level 5% Significance Level etics k star (bias corrected MLE) Theta star (bias corrected MLE) nu star (bias corrected MLE) nu star (bias corrected) MLE 5d (bias corrected) Approximate Chi Square Value (0.05) Adjusted Chi Square Value	394,1 3.66 94,83 403,1 181,5 357,6 356,4
A-D Test Statistic 5% A-D Critical Value K-S Test Statistic 5% K-S Critical Value Deta Not Gerrer k hat (MLE) Theta hat (MLE) nu hat (MLE) MLE Mean (bias corrected) Adjusted Level of Significance	Germme GOF 3.899 0.754 0.223 0.12 na Distributed at 3 3.863 89.96 424.9 347.5 0.0456	95% Adjusted-CLT UCL (Chen-1995) 95% Modified-t UCL (Johnson-1978) Test Anderson-Darting Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level Kolmogorov-Smirnov Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level 5% Significance Level etce k star (bias corrected MLE) Theta star (bias corrected MLE) nu star (bias corrected MLE) nu star (bias corrected MLE) MLE 54 (bias corrected) MLE 54 (bias corrected) Approximate Chi Square Value Distribution 95% Adjusted Gamma UCL (use when n<50)	394,1 3.66 94,83 403,1 181,5 357,6 356,4
A-D Test Statistic 5% A-D Critical Value K-S Test Statistic 5% K-S Critical Value Deta Not Gerrer k hat (MLE) Theta hat (MLE) nu hat (MLE) MLE Mean (bias corrected) Adjusted Level of Significance	Germme GOF 3.899 0.754 0.223 0.12 me Distributed at 1 Germme Statt 3.863 89.96 424.9 347.5 0.0456	95% Adjusted-CLT UCL (Chen-1995) 95% Modified-t UCL (Johnson-1978) Test Anderson-Darting Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level Kolmogorov-Smirnov Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level 5% Significance Level etce k star (bias corrected MLE) Theta star (bias corrected MLE) nu star (bias corrected MLE) nu star (bias corrected MLE) MLE 54 (bias corrected) MLE 54 (bias corrected) Approximate Chi Square Value Distribution 95% Adjusted Gamma UCL (use when n<50)	394.1 3.666 94.83 403.1 181.5 357.6 356.4
A-D Test Statistic 5% A-D Critical Value K-S Test Statistic 5% K-S Critical Value Deta Not Gamm k hat (MLE) Theta hat (MLE) nu hat (MLE) MLE Mean (bias corrected) Adjusted Level of Significance Adjusted Level of Significance S% Approximate Gamma UCL (use when n>=50))	Germme GOF 3.899 0.754 0.754 0.223 0.12 1 me Distributed at 3 3.863 89.96 424.9 347.5 0.0456 suming Germma IG 391.8 Lognormal GO 0.834	95% Adjusted-CLT UCL (Chen-1995) 95% Modified-t UCL (Johnson-1978) Test Anderson-Darting Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level Kotmogorov-Smirnov Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level 5% Significance Level etics k star (bias corrected MLE) Theta star (bias corrected MLE) nu star (bias corrected) MLE Sd (bias corrected) Approximate Chi Square Value Distribution 95% Adjusted Gamma UCL (use when n<50) F Test	394.1 3.666 94.83 403.1 181.5 357.6 356.4
A-D Test Statistic 5% A-D Critical Value K-S Test Statistic 5% K-S Critical Value Deta Not Gamer k hat (MLE) Theta hat (MLE) nu hat (MLE) MLE Mean (bias corrected) Adjusted Level of Significance Adjusted Level of Significance Mas Shapiro Wilk Test Statistic	Germme GOF 3.899 0.754 0.754 0.223 0.12 1 me Distributed at 3 3.863 89.96 424.9 347.5 0.0456 suming Germma IG 391.8 Lognormal GO 0.834	95% Adjusted-CLT UCL (Chen-1995) 95% Modified-t UCL (Johnson-1978) Test Anderson-Darfing Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level Kolmogorov-Smfnov Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level 5% Significance Level etics k star (bias corrected MLE) Theta star (bias corrected MLE) Nut Star (bias corrected MLE) Nut Star (bias corrected MLE) Approximate Chi Square Value (0.05) Adjusted Chi Square Value Distribution 95% Adjusted Gamma UCL (use when n<50) F Test	394.1 3.666 94.83 403.1 181.5 357.6 356.4

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	Lognormal GOF	Test	
Shapiro Wilk Test Statistic	0.984	Shapiro Wilk Lognormal GOF Teet	
5% Shapiro Wilk Critical Value	0.918	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.093	Lillefors Lognormal GOF Test	_
5% Lilliefors Critical Value	0.173	Data appear Lognormal at 5% Significance Level	_
Data appear	Lognormal at 5%	Significance Level	
Minimum of Logged Data	9,561	Mean of logged Data	9.83
Maximum of Logged Data	10.13	SD of logged Data	9.83
Maximum of Logged Data	10.13	SD of logged Data	0.13
Assu	ming Lognormal I	Distribution	
95% H-UCL	19822	90% Chebyshev (MVUE) UCL	20424
95% Chebyshev (MVUE) UCL	21112	97.5% Chebyshev (MVUE) UCL	22067
99% Chebyshev (MVUE) UCL	23943	•	
Nonserana	tric Distribution Fr	an LICI Statistics	
		tion at 5% Significance Level	
	ametric Distributio		
95% CLT UCL		95% Jackknite UCL	
95% Standard Bootstrap UCL		95% Bootstrap-t UCL	19771
95% Hall's Bootstrap UCL		95% Percentile Bootstrap UCL	19688
95% BCA Bootstrap UCL			
90% Chebyshev(Mean, Sd) UCL		95% Chebyshev(Mean, Sd) UCL	
97.5% Chebyshev(Mean, Sd) UCL	22037	99% Chebyshev(Mean, Sd) UCL	23896
	Suggested UCL t	o Line	
95% Student's-t UCL			
95% Student's-t UCL	19762		
95% Studente-t UCL Note: Suggestions regarding the selection of a 95%	19762 UCL are provided	to help the user to select the most appropriate 95% UCL.	
95% Student's-t UCL Note: Suggestions regarding the selection of a 95% Recommendations are bas	19762 UCL are provided ed upon data size	to help the user to select the most appropriate 95% UCL, data distribution, and skewness.	
95% Student's-t UCL Note: Suggestions regarding the selection of a 95% Recommendations are bas These recommendations are based upon the result	19762 UCL are provided ed upon data size ts of the simulatio	to help the user to select the most appropriate 95% UCL, data distribution, and skewness. n studies summarized in Singh, Malchie, and Lee (2006).	
95% Student's-t UCL Note: Suggestions regarding the selection of a 95% Recommendations are bas These recommendations are based upon the result	19762 UCL are provided ed upon data size ts of the simulatio	to help the user to select the most appropriate 95% UCL, data distribution, and skewness.	
95% Student's-t UCL Note: Suggestions regarding the selection of a 95% Recommendations are bas These recommendations are based upon the result	19762 UCL are provided ed upon data size ts of the simulatio	to help the user to select the most appropriate 95% UCL, data distribution, and skewness. n studies summarized in Singh, Malchie, and Lee (2006).	
95% Student's-t UCL Note: Suggestions regarding the selection of a 95% Recommendations are bas These recommendations are based upon the result	19762 UCL are provided ed upon data size ts of the simulatio	to help the user to select the most appropriate 95% UCL, data distribution, and skewness. n studies summarized in Singh, Malchie, and Lee (2006).	
95% Student's-t UCL Note: Suggestions regarding the selection of a 95% Recommendations are bas These recommendations are based upon the result	19762 UCL are provided ed upon data size ts of the simulatio	to help the user to select the most appropriate 95% UCL, data distribution, and skewness. n studies summarized in Singh, Malchie, and Lee (2006).	
95% Student's-t UCL Note: Suggestions regarding the selection of a 95% Recommendations are bas These recommendations are based upon the result	19762 UCL are provided ed upon data size ts of the simulatio orld data sets; for	I to help the user to select the most appropriate 95% UCL, , data distribution, and skewness. n studies summarized in Singh, Malchle, and Lee (2006). additional insight the user may want to consult a statistician.	
95% Student's-t UCL Note: Suggestions regarding the selection of a 95% Recommendations are bas These recommendations are based upon the result	19762 UCL are provided ed upon data size ts of the simulatio	I to help the user to select the most appropriate 95% UCL, , data distribution, and skewness. n studies summarized in Singh, Malchle, and Lee (2006). additional insight the user may want to consult a statistician.	19
95% Student's-t UCL Note: Suggestions regarding the selection of a 95% Recommendations are bas These recommendations are based upon the result However, simulations results will not cover all Real We	19762 UCL are provided ed upon data size ts of the simulatio orid data sets; for General Statist	I to help the user to select the most appropriate 95% UCL, data distribution, and skewness. n studies summarized in Singh, Malchie, and Lee (2006). additional insight the user may want to consult a statistician.	
95% Student's-t UCL Note: Suggestions regarding the selection of a 95% Recommendations are bas These recommendations are based upon the result However, simulations results will not cover all Real We	19762 UCL are provided ed upon data size ts of the simulatio orid data sets; for General Statist	I to help the user to select the most appropriate 95% UCL, data distribution, and skewness. In studies summarized in Singh, Malchle, and Lee (2006). additional insight the user may want to consult a statistician. Idea Number of Distinct Observations Number of Missing Observations	19 0
95% Student's-t UCL Note: Suggestions regarding the selection of a 95% Recommendations are base These recommendations are based upon the result However, simulations results will not cover all Real We Total Number of Observations	19762 UCL are provided ed upon data size ts of the simulatio orid data sets; for General Statist 25	i to help the user to select the most appropriate 95% UCL, data distribution, and skewness. In studies summarized in Singh, Malchle, and Lee (2006). additional insight the user may want to consult a statistician. defined the user may want to consult a statistician. Number of Distinct Observations Number of Missing Observations Mean	19 0 3.12
95% Student's-t UCL Note: Suggestions regarding the selection of a 95% Recommendations are bas These recommendations are based upon the result However, simulations results will not cover all Real We Total Number of Observations Minimum	19762 UCL are provided ed upon data size is of the simulatio orid data sets; for General Statist 25 0.09 11.7	I to help the user to select the most appropriate 95% UCL, data distribution, and skewness. etudies summarized in Singh, Malchle, and Lee (2006). additional insight the user may want to consult a statistician. Ice Number of Distinct Observations Number of Missing Observations Mean Median	19 0 3.12 0.18
95% Student's-t UCL Note: Suggestions regarding the selection of a 95% Recommendations are bass These recommendations are based upon the result However, simulations results will not cover all Real With Total Number of Observations Minimum Maximum	19762 UCL are provided ed upon data size ts of the simulatio orid data sets; for General Statist 25 0.09	i to help the user to select the most appropriate 95% UCL, data distribution, and skewness. In studies summarized in Singh, Malchle, and Lee (2006). additional insight the user may want to consult a statistician. defined the user may want to consult a statistician. Number of Distinct Observations Number of Missing Observations Mean	19 0 3.12 0.18 0.90
95% Student's-t UCL Note: Suggestions regarding the selection of a 95% Recommendations are base These recommendations are based upon the result However, simulations results will not cover all Real We Total Number of Observations Minimum Maximum SD	19762 UCL are provided ed upon data size ts of the simulatio orid data sets; for General Statist 25 0.09 11.7 4.54 1.454	i to help the user to select the most appropriate 95% UCL, data distribution, and skewness. n studies summarized in Singh, Maichle, and Lee (2006). additional insight the user may want to consult a statistician. additional insight the user may want to consult a statistician. Idea Number of Distinct Observations Number of Distinct Observations Mean Median Std. Error of Mean Skewness	19 0 3.12 0.18 0.90
95% Student's-t UCL Note: Suggestions regarding the selection of a 95% Recommendations are bas These recommendations are based upon the result However, simulations results will not cover all Real W Total Number of Observations Total Number of Observations Minimum Maximum SD Coefficient of Variation	19762 UCL are provided ed upon data size to of the simulatio orid data sets; for General Statistic 25 0.09 11.7 4.54 1.454 Normal GOF T	I to help the user to select the most appropriate 95% UCL, data distribution, and skewness. netudies summarized in Singh, Malchle, and Lee (2006). additional insight the user may want to consult a statistician. des Number of Distinct Observations Number of Missing Observations Mean Median Std. Error of Mean Skewness	19 0 3.12 0.18 0.90
95% Student's-t UCL Note: Suggestions regarding the selection of a 95% Recommendations are base These recommendations are based upon the result However, simulations results will not cover all Real W Total Number of Observations Total Number of Observations Minimum Maximum SD Coefficient of Variation	19762 UCL are provided ed upon data size ts of the elimulatio orid data sets; for General Statist 25 0,009 11.7 4.54 1.454 Normal GOF T 0.663	I to halp the user to select the most appropriate 95% UCL, data distribution, and skewness. etudies summarized in Singh, Meichle, and Lee (2006), additional insight the user may want to consult a statistician. Number of Distinct Observations Number of Distinct Observations Number of Missing Observations Mean Median Std. Error of Mean Std. Error of Mean Std. Error of Mean	19 0 3.12 0.18 0.90
95% Student's-t UCL Note: Suggestions regarding the selection of a 95% Recommendations are base These recommendations are based upon the result However, simulations results will not cover all Real We Total Number of Observations Total Number of Observations Minimum Maximum SD Coefficient of Variation Shapiro Wilk Test Statistic 5% Shapiro Wilk Critical Value	19762 UCL are providee ed upon data size to of the elimulatio orid data sets; for Ceneral Statist 25 0.09 11.7 4.54 1.454 1.454 Normal GOF T 0.665 0.918	I to help the user to select the most appropriate 95% UCL, data distribution, and skewness. etudies summarized in Singh, Meichle, and Lee (2006), additional insight the user may want to consult a statistician. Sca Number of Distinct Observations Number of Distinct Observations Mean Meating Std. Error of Mean Std. Er	19 0 3.12 0.18 0.90
95% Student's-t UCL Note: Suggestions regarding the selection of a 95% Recommendations are base These recommendations are based upon the result However, simulations results will not cover all Real W Total Number of Observations Total Number of Observations Minimum Maximum SD Coefficient of Variation	19762 UCL are provided ed upon data size ts of the elimulatio orid data sets; for General Statist 25 0,009 11.7 4.54 1.454 Normal GOF T 0.663	I to halp the user to select the most appropriate 95% UCL, data distribution, and skewness. etudies summarized in Singh, Meichle, and Lee (2006), additional insight the user may want to consult a statistician. Number of Distinct Observations Number of Distinct Observations Number of Missing Observations Mean Median Std. Error of Mean Std. Error of Mean Std. Error of Mean	19

	Seneca	Army Depo	rounds – Kickout Area at Activity (SEDA) Risk Assessment	
	UCL Statis	tics for Data S	Sets with Non-Detects	
User Selected Options				
Date/Time of Computation	ProUCL 5.17/25/2018 12:			
From File	Surfsoil_ProUCL_temp.xl	\$		
Full Precision	OFF			
Confidence Coefficient Number of Bootstrap Operations	95% 2000			
Number of Bootstrap Operations	2000			
Juminum		_		
		General S	tatistics	
Tota	al Number of Observations	25	Number of Distinct Observations	22
			Number of Missing Observations	0
	Minimum	14200	Mean	18904
	Maximum		Median	18900
		2509	Std. Error of Mean	501.7
	Coefficient of Variation	0.133	Skewness	0.24
		Normal G	OF Test	
	Shapiro Wilk Test Statistic	0.985	Shapiro Wilk GOF Test	_
5%	Shapiro Wilk Critical Value	0.918	Data appear Normal at 5% Significance Level	
	Lilliefors Test Statistic	0.0689	Lilliefors GOF Test	
	5% Littlefors Critical Value	0.173	Data appear Normal at 5% Significance Level	
	Data appe	er Normal at 5	% Significance Level	_
		suming Norm	al Distribution	
95% No	Imal UCL		95% UCLs (Adjusted for Skewness)	
	95% Student's-t UCL	19762	95% Adjusted-CLT UCL (Chen-1995)	
			95% Modified-t UCL (Johnson-1978)	19766
		Gamma G	OF Test	
1 4 pt	A-D Test Statistic	0.14	Anderson-Darling Gamma GOF Test	
	5% A-D Critical Value	0.742	Detected data appear Gamma Distributed at 5% Significance	e Level
	K-S Test Statistic	0.0842	Kolmogorov-Smirnov Gamma GOF Test	
	5% K-S Critical Value	0.174	Detected data appear Gamma Distributed at 5% Significance	e Level
	Detected data appear	Gamma Distr	Ibuted at 5% Significance Level	_
		Gamma S	intistics	
	k hat (MLE)		k star (bias corrected MLE)	51.95
	Theta hat (MLE)	320.4	Theta star (bias corrected MLE)	363.9
	nu hat (MLE)		nu star (blas corrected)	2597
A	ILE Mean (bias corrected)	18904	MLE Sd (bias corrected)	2623
A .di.	isted Level of Significance	0.0395	Approximate Chi Square Value (0.05)	2480
Adju	IPIER FEASI OF SIGNALCEUCE	0.0395	Adjusted Chi Square Value	2472
				_
	As a UCL (use when n>=50))	euming Gemm	na Distribution	

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Recommendations are bas	ed upon data size	a, data distribution, and skewness.	
These recommendations are based upon the result	ts of the simulation	on studies summarized in Singh, Malchle, and Lee (2006).	
However, simulations results will not cover all Real W	orld data sets; for	radditional insight the user may want to consult a statistician.	
	General Statis	sice	
Total Number of Observations	25	Number of Distinct Observations	18
		Number of Missing Observations	0
Minimum	3.9	Mean	5.73
Maximum	16,1	Median	5,1
SD	2.332	Std. Error of Mean	0.46
Coefficient of Variation	0.407	Skewness	3.95
	Normal GOF	Test	
Shapiro Wilk Test Statistic	0,524	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.918	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.305	Lilliefors GOF Test	
5% Lilliefors Critical Value	0.173	Data Not Normal at 5% Significance Level	
Data Not	Normal at 5% Sk	gnificance Level	
Aa	uming Normal D	Istibution	
95% Normal UCL		95% UCLs (Adjusted for Skewness)	_
95% Student's-t UCL	6.53	95% Adjusted-CLT UCL (Chen-1995)	6.89
		95% Modified-t UCL (Johnson-1978)	6.59
	Gamma GOF	Test	
A-D Test Statistic	2.759	Anderson-Datiling Gamma GOF Test	
5% A-D Critical Value	0.745	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.274	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.174	Data Not Gamma Distributed at 5% Significance Level	
Data Not Garran	n Distributed at	5% Significance Lavel	
	Gamma Stati	ation	
k hat (MLE)	11.02	k star (bias corrected MLE)	9.72
Theta hat (MLE)	0.52	Theta star (bias corrected MLE)	0.58
nu hat (MLE)	551	nu star (blas corrected)	486.2
MLE Mean (bias corrected)	5,732	MLE Sd (blas corrected)	1.83
, , , , , , , , , , , , , , , , , , , ,		Approximate Chi Square Value (0.05)	436.1
Adjusted Level of Significance	0.0395	Adjusted Chi Square Value	432.9
A	uming Gemme I	Nethurlion	
95% Approximate Gamma UCL (use when n>=50))	6.391	95% Adjusted Gamma UCL (use when n<50)	6.43
	Lamonal CO		
Shapiro Wilk Test Statistic	Lognormal GO	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.918	Data Not Lognormal at 5% Significance Level	
5% Shapiro Wilk Chucal Value	0.918	Linte Not Lognormal at 5% Significance Level	
5% Lillefors Critical Value	0,253	Data Not Lognormal at 5% Significance Level	

Assuming Normal Distribution 85% Normal UCL 95% UCLs (Adjusted for Skewness) 95% Student's-t UCL 4.675 95% Adjusted-CLT UCL (Chen-1995) 4.826 95% Modified-t UCL (Johnson-1978) 4.708 Gamma GOF Test A-D Test Statistic 2.681 Anderson-Darling Gemma GOF Test 5% A-D Critical Value 0.829 Data Not Gamma Distributed at 5% Significance Level K-S Test Statistic 0.28 Kolmogorov-Smirnov Gamma GOF Test 5% K-S Critical Value 0.187 Data Not Gamma Distributed at 5% Significance Level Data Not Gamma Distributed at 5% Significance Level Gamma Statistics k hat (MLE) 0.403 k star (bias corrected MLE) 0.381 Theta hat (MLE) 7.755 Theta star (bias corrected MLE) 8.195 nu hat (MLE) 20.13 nu star (bias corrected) 19.04 MLE Mean (bias corrected) 3.122 MLE Sd (bias corrected) 5.058 Approximate Chi Square Value (0.05) 10.15 Adjusted Level of Significance 0.0395 Adjusted Chi Square Value 9.708 Assuming Germa Distribution 95% Approximate Gamma UCL (use when n>=50)) 5,857 95% Adjusted Gamma UCL (use when n<50) 6.124 Lognormal GOF Test Shapiro Wilk Test Statistic 0.779 Shapiro Wilk Lognormal GOF Test 5% Shapiro Wilk Critical Value 0.918 Data Not Lognormal at 5% Significance Level Lillefors Test Statistic 0.251 Lillefors Lognormal GOF Test 5% Lilliefors Critical Value 0,173 Data Not Lognormal at 5% Significance Level Data Not Lognormal at 5% Significance Level Lognormal Statistics Minimum of Logged Data -2.408 Mean of logged Data -0.495 Maximum of Logged Data 2.46 SD of logged Data 1,978 Assuming Lognormal Distribution 95% H-UCL 21.16 90% Chebyshev (MVUE) UCL 9.001 95% Chebyshev (MVUE) UCL 11.47 97.5% Chebyshev (MVUE) UCL 14.9 99% Chebyshev (MVUE) UCL 21.63 Nonperametric Distribution Free UCL Statistics Data do not follow a Discemble Distribution (0.05) Nonparametric Distribution Free UCLs 95% Jackknife UCL 4.675 95% CLT UCL 4.615 95% Standard Bootstrap UCL 4.615 95% Bootstrap-t UCL 4.954 95% Hall's Bootstrap UCL 4,585 95% Percentile Bootstrap UCL 4.63 95% BCA Bootstrap UCL 4.826 90% Chebyshev(Mean, Sd) UCL 5.845 95% Chebyshev(Mean, Sd) UCL 7.079 97.5% Chebyshev(Mean, Sd) UCL 8.792 99% Chebyshev(Mean, Sd) UCL 12.16 Suggested UCL to Use 95% Chebyshev (Mean, Sd) UCL 7.079

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5% A-D Critical Value	0.746	Detected data appear Gamma Distributed at 5% Significance	Level
K-S Test Statistic	0.13	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.175	Detected data appear Gamma Distributed at 5% Significance	Level
Detected data appear	Gamma Dietr	Ibuted at 5% Significance Level	
	Gamma S	Statistics.	
k hat (MLE)	7.846	k star (bias corrected MLE)	6.93
Theta hat (MLE)	19.36	Theta star (blas corrected MLE)	21.92
nu hat (MLE)	392.3	nu star (bias corrected)	346.6
MLE Mean (blas corrected)	151.9	MLE Sd (bias corrected)	57.7
		Approximate Chi Square Value (0.05)	304.4
Adjusted Level of Significance	0,0395	Adjusted Chi Square Value	301.7
Aa	suming Gamm	, Distribution	
95% Approximate Gamma UCL (use when n>=50))	172.9	95% Adjusted Gamma UCL (use when n<50)	174.5
	Lognormal	GOF Test	_
Shapiro Wilk Test Statistic	0,965	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.918	Data appear Lognormal at 5% Significance Level	
Lillefors Test Statistic	0.141	Littlefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.173	Data appear Lognormal at 5% Significance Level	
Data appear	Lognormel at	5% Significance Level	
	Lognormal	Statietics	
Minimum of Logged Data	4.015	Mean of logged Data	4.95
Maximum of Logged Data	5.659	SD of logged Data	0.37
Ann	mine Lormon	mei Distribution	
95% H-UCL	175.7	90% Chebyshev (MVUE) UCL	186.8
95% Chebyshev (MVUE) UCL	202.5	97,5% Chebyshev (MVUE) UCL	224.4
99% Chebyshev (MVUE) UCL	267.3		_
Nonparame	tric Distributio	on Free UCL Statistics	
		stibution at 5% Significance Level	
Manta	analda Diatri	button Free UCLs	
95% CLT UCL		95% Jackknife UCL	171.3
95% Standard Bootstrap UCL	170.5	95% Bootstrap-t UCL	174.4
95% Hall's Bootstrap UCL	172.9	95% Percentile Bootstrap UCL	171.1
95% BCA Bootstrap UCL	172,2		
90% Chebyshev(Mean, Sd) UCL	185.8	95% Chebyshev(Mean, Sd) UCL	201.2
97.5% Chebyshev(Mean, Sd) UCL	222.5	99% Chebyshev(Mean, Sd) UCL	264.4
	Suggested U	ICL to Use	_
	171.3		
95% Student's-t UCL			_
	UCL are pro	vided to help the user to select the most appropriate 95% UCL	
Note: Suggestions regarding the selection of a 95%		vided to help the user to select the most appropriate 95% UCL. size, data distribution, and skewness.	
Note: Suggestions regarding the selection of a 95% Recommendations are bat	sed upon data		
Note: Suggestions regarding the selection of a 95% Recommendations are based upon the resu	sed upon data	size, data distribution, and skewness. Ilation studies summarized in Singh, Maichle, and Lee (2006).	-
Note: Suggestions regarding the selection of a 95% Recommendations are based upon the resu	sed upon data	size, data distribution, and skewness.	

	Lognormel Statis	tice	
640-1	-		
Minimum of Logged Data	1.361	Mean of logged Data	1.7
Maximum of Logged Data	2.779	SD of logged Data	0.2
Assu	ming Lognormal D	latribution	-
95% H-UCL	6,283	90% Chebyshev (MVUE) UCL	6,6
95% Chebyshev (MVUE) UCL	7.046	97.5% Chebyshev (MVUE) UCL	7.6
99% Chebyshev (MVUE) UCL	8.805		
Noneremat	ric Distribution Fre	a ICI Statistics	
	llow a Discernible		
	ametric Distribution		
95% CLT UCL	6.499	95% Jackknife UCL	6.5
95% Standard Bootstrap UCL	6.459	95% Bootstrap-t UCL	7.7
95% Half's Bootstrap UCL	9.447	95% Percentile Bootstrap UCL	6,5
95% BCA Bootstrap UCL	7,076		
90% Chebyshev(Mean, Sd) UCL	7.131	95% Chebyshev(Mean, Sd) UCL	7.7
97.5% Chebyshev(Mean, Sd) UCL	8.645	99% Chebyshev(Mean, Sd) UCL	10.
		164	
95% Student's-t UCL	Suggested UCL to 6.53	or 95% Modified-t UCL	6.5
95% Student S-L OCL	6,53	or 95% Modified-CUCL	0.3
These recommendations are based upon the result	ts of the simulation	data distribution, and skewness. studies summarized in Singh, Maichle, and Lee (2006). additional insight the user may want to consult a statistician.	-
These recommendations are based upon the result However, simulations results will not cover all Real We	ts of the simulation	studies summarized in Singh, Maichle, and Lee (2006).	
These recommendations are based upon the result However, simulations results will not cover all Real We	ts of the simulation	studies summarized in Singh, Maichle, and Lee (2005). additional insight the user may want to consult a statistician.	
These recommendations are based upon the result	ts of the simulation orld data sets; for a	studies summarized in Singh, Maichle, and Lee (2006). additional insight the user may want to consult a statistician.	23
These recommendations are based upon the result However, simulations results will not cover all Real We	ts of the simulation orld data sets; for a General Statient	i studies summarized in Singh, Maichle, and Lee (2006). additional Insight the user may want to consult a statistician. Insight the user may want to consult a statistician.	
These recommendations are based upon the result However, simulations results will not cover all Real We furm Total Number of Observations	ts of the simulation orld data sets; for a General Station 25	a studies summarized in Singh, Maichle, and Lee (2006). additional Insight the user may want to consult a statistician. Insight the user may want to consult a statistician. Number of Distinct Observations Number of Missing Observations	D
These recommendations are based upon the result However, simulations results will not cover all Real We furm Total Number of Observations Minimum	General Statient 25 55,4	studies summarized in Singh, Maichle, and Lee (2005). additional Insight the user may want to consult a statistician. Ica Number of Distinct Observations Number of Missing Observations Mean	0
These recommendations are based upon the result However, simulations results will not cover all Real We fum Total Number of Observations Minimum Maximum	General Statistics S5.4 287	studies summarized in Singh, Maichle, and Lee (2005). additional Insight the user may want to consult a statistician. Ica Number of Distinct Observations Number of Missing Observations Mean Median	0 151. 140
These recommendations are based upon the result However, simulations results will not cover all Real We furm Total Number of Observations Minimum	General Statient 25 55,4	studies summarized in Singh, Maichle, and Lee (2005). additional Insight the user may want to consult a statistician. Ica Number of Distinct Observations Number of Missing Observations Mean	0 151. 140 11.
These recommendations are based upon the result However, simulations results will not cover all Real We furm Total Number of Observations Minimum Maximum SD	General States 25 55.4 287 56.54	studies summarized in Singh, Maichle, and Lee (2005). additional Insight the user may want to consult a statistician. Ica Number of Distinct Observations Number of Missing Observations Mean Mean Std, Error of Mean	0 151. 140 11.
These recommendations are based upon the result However, simulations results will not cover all Real We furm Total Number of Observations Minimum Maximum SD Coefficient of Variation	General Statistics Ceneral Statistics 25 55,4 287 56,54 0,372 Normal GOF Te	studies summarized in Singh, Maichle, and Lee (2005). additional Insight the user may want to consult a statistician. Insight the user may want to consult a statistician. Number of Distinct Observations Number of Missing Observations Mean Median Std. Error of Mean Skewness	0 151. 140 11.
These recommendations are based upon the result However, simulations results will not cover all Real We furm Total Number of Observations Minimum Maximum SD Coefficient of Variation Shapiro Wilk Test Statistic	General Statist 25 55.4 287 56.54 0.372 Normal GOF To 0.926	studies summarized in Singh, Maichle, and Lee (2005). additional Insight the user may want to consult a statistician. defined to consult a statistician. Number of Distinct Observations Number of Missing Observations Mean Median Std. Error of Mean Std. Error of Mean Std. Error of Mean Std. Error of Mean Skewness	0 151. 140 11.
These recommendations are based upon the result However, simulations results will not cover all Real We furm Total Number of Observations Minimum Maximum SD Coefficient of Variation Shapiro Wilk Test Statistic 5% Shapiro Wilk Critical Value	General Statistic 25 55.4 287 56.54 0.372 Normal GOF Te 0.926 0.918	a studies summarized in Singh, Maichle, and Lee (2005). additional Insight the user may want to consult a statistician. definitional Insight the user may want to consult a statistician. Number of Distinct Observations Number of Distinct Observations Number of Missing Observations Median Std. Error of Mean Skewness	0 151. 140 11.
These recommendations are based upon the result However, simulations results will not cover all Real We furm Total Number of Observations Minimum Maximum SD Coefficient of Variation Shapiro Wilk Test Statistic	General Statist 25 55.4 287 56.54 0.372 Normal GOF To 0.926	studies summarized in Singh, Maichle, and Lee (2005). additional Insight the user may want to consult a statistician. defined to consult a statistician. Number of Distinct Observations Number of Missing Observations Mean Median Std. Error of Mean Std. Error of Mean Std. Error of Mean Std. Error of Mean Skewness	0 151. 140 11.
These recommendations are based upon the result However, simulations results will not cover all Real We furm Total Number of Observations Minimum Maximum SD Coefficient of Variation Shapiro Wilk Test Statistic S% Shapiro Wilk Critical Value	General Statistic 25 55.4 287 56.54 0.372 Normal GOF Te 0.926 0.918	a studies summarized in Singh, Maichle, and Lee (2005). additional Insight the user may want to consult a statistician. definitional Insight the user may want to consult a statistician. Number of Distinct Observations Number of Distinct Observations Number of Missing Observations Median Std. Error of Mean Skewness	0 151. 140 11.
These recommendations are based upon the result However, simulations results will not cover all Real We furm Total Number of Observations Minimum Maximum SD Coefficient of Variation Shapiro Wilk Test Statistic 5% Shapiro Wilk Critical Value Lilliefors Test Statistic 5% Utiliefors Critical Value	General Statistic 25 55.4 287 56.54 0.372 Normal GOF Tr 0.926 0.918 0.137	studies summarized in Singh, Maichle, and Lee (2005). additional Insight the user may want to consult a statistician. difference of Distinct Observations Number of Distinct Observations Number of Missing Observations Median Std. Error of Mean Std. Error of Mean Std. Error of Mean Skewmess set Shapiro Wilk GOF Test Data appear Normal at 5% Significance Level Lillefore GOF Test Data appear Normal at 5% Significance Level	0 151. 140 11.
These recommendations are based upon the result However, simulations results will not cover all Real We frum Total Number of Observations Minimum Maximum SD Coefficient of Variation Shapiro Wilk Test Statistic 5% Shapiro Wilk Critical Value Lilliefors Test Statistic 5% Utiliefors Critical Value Data eppeer	General Statistic 25 55.4 287 56.54 0.372 Normal GOF Te 0.926 0.137 0.173	atudies summarized in Singh, Maichle, and Lee (2005). additional Insight the user may want to consult a statistician. additional Insight the user may want to consult a statistician. Ca Number of Distinct Observations Number of Distinct Observations Number of Missing Observations Mean Median Stat. Error of Mean Stat. Error of Mean St	0 151.1 140 11.1
These recommendations are based upon the result However, simulations results will not cover all Real We frum Total Number of Observations Minimum Maximum SD Coefficient of Variation Shapiro Wilk Test Statistic 5% Shapiro Wilk Critical Value Lilliefors Test Statistic 5% Utiliefors Critical Value Data eppeer	General Statistic 25 55,4 287 56,54 0,372 Normal GOF Tr 0,926 0,918 0,173 r Normal at 5% St	a studies summarized in Singh, Maichle, and Lee (2005). additional Insight the user may want to consult a statistician. additional Insight the user may want to consult a statistician. additional Insight the user may want to consult a statistician. Insight the user may want to consult a statistician. Insight the user may want to consult a statistician. Number of Distinct Observations Number of Distinct Observations Number of Missing Observations Median Median Median Std. Error of Mean Std. Error of Mean Std. Error of Mean Skewness Insight the user may want to statistic operations Insight the user may want to consult a statistician. Insight the user may want to consult a statistician. Insight the user may want to consult a statistic operations Insight the user may want to consult a statistic operations Insight the user may want to consult a statistic operations Insight the user may want to consult a statistic operations Insight the user may want to consult a statistic operation of the statistic operations Insight the user may want to consult a statistic operations Insight the user may want to consult a statistic operations Insight the user may want to consult a statistic operations Insight the user may want to consult a statistic operations Insight the user may want to consult a statistic operations Insight the user may want to consult a statistic operation operations Insight the user may want to consult a statistic operations Insight the user may want to consult a statistic operations Insight the user may want to consult a statistic operations Insight the user may want to consult a statistic operations Insight the user may want to consult a statistic operation operations Insight the user may want to consult a statistic operations Insight the user may want to consult a statistic operation operations Insight the user may want to consult a statistic operation operations Insight the user may want to consult a statistic operation operations Insight the user may want to consult a	0 151.1 140 11.1
These recommendations are based upon the result However, simulations results will not cover all Real We form Total Number of Observations Minimum Maximum SD Coefficient of Variation Shapiro Wilk Test Statistic 5% Shapiro Wilk Critical Value Lilliefors Test Statistic 5% Utiliefors Critical Value Data appear Ast	General Statistics of the simulation or id data sets; for a General Statistics 25 55.4 287 56.54 0.372 756.54 0.372 756.54 0.372 756.54 0.372 756.54 0.372 756.54 0.372 756.55 0.926 0.918 0.137	studies summarized in Singh, Maichle, and Lee (2005). additional Insight the user may want to consult a statistician. additional Insight the user may want to consult a statistician. Insight the user may want to consult a statistic to the user may also be used as the user may also be user may also be used as the user may also be use	0 151.1 140 11.1 0.8
These recommendations are based upon the result However, simulations results will not cover all Real We film Total Number of Observations Minimum Maximum SD Coefficient of Variation Shapiro Wilk Test Statistic 5% Shapiro Wilk Critical Value Lilliefors Test Statistic 5% Utiliefors Critical Value Data appear	General Statistic 25 55,4 287 56,54 0,372 Normal GOF Tr 0,926 0,918 0,173 r Normal at 5% St	a studies summarized in Singh, Maichle, and Lee (2005). additional Insight the user may want to consult a statistician. additional Insight the user may want to consult a statistician. additional Insight the user may want to consult a statistician. Insight the user may want to consult a statistician. Insight the user may want to consult a statistician. Number of Distinct Observations Number of Distinct Observations Number of Missing Observations Median Median Median Std. Error of Mean Std. Error of Mean Std. Error of Mean Skewness Insight the user may want to statistic operations Insight the user may want to consult a statistician. Insight the user may want to consult a statistician. Insight the user may want to consult a statistic operations Insight the user may want to consult a statistic operations Insight the user may want to consult a statistic operations Insight the user may want to consult a statistic operations Insight the user may want to consult a statistic operation of the statistic operations Insight the user may want to consult a statistic operations Insight the user may want to consult a statistic operations Insight the user may want to consult a statistic operations Insight the user may want to consult a statistic operations Insight the user may want to consult a statistic operations Insight the user may want to consult a statistic operation operations Insight the user may want to consult a statistic operations Insight the user may want to consult a statistic operations Insight the user may want to consult a statistic operations Insight the user may want to consult a statistic operations Insight the user may want to consult a statistic operations Insight the user may want to consult a statistic operations Insight the user may want to consult a statistic operations Insight the user may want to consult a statistic operations Insight the user may want to consult a statistic operations Insight the user may want to consult a statistic operations Insight the user	0 151. 140 11.
These recommendations are based upon the result However, simulations results will not cover all Real We furm Total Number of Observations Minimum Maximum SD Coefficient of Variation Shapiro Wilk Test Statistic 5% Shapiro Wilk Critical Value Lilliefors Test Statistic 5% Utiliefors Critical Value Data appear Ast	General Statistics of the simulation or id data sets; for a General Statistics 25 55.4 287 56.54 0.372 756.54 0.372 756.54 0.372 756.54 0.372 756.54 0.372 756.54 0.372 756.55 0.926 0.918 0.137	studies summarized in Singh, Maichle, and Lee (2005). additional Insight the user may want to consult a statistician. additional Insight the user may want to consult a statistician. Insight the user may want to consult a statistician. Insight the user may want to consult a statistician. Insight the user may want to consult a statistician. Number of Distinct Observations Number of Distinct Observations Mean Median Std. Error of Mean Std. Error of Mean Std. Error of Mean Std. Error of Mean Skewness Std. Error of Mean Skewness	0 151. 140 11. 0.8
These recommendations are based upon the result However, simulations results will not cover all Real We furm Total Number of Observations Minimum Maximum SD Coefficient of Variation Shapiro Wilk Test Statistic 5% Shapiro Wilk Critical Value Lilliefors Test Statistic 5% Utiliefors Critical Value Data appear Ast	General Statistics of the simulation or id data sets; for a General Statistics 25 55.4 287 56.54 0.372 756.54 0.372 756.54 0.372 756.54 0.372 756.54 0.372 756.54 0.372 756.55 0.926 0.918 0.137	a studies summarized in Singh, Maichle, and Lee (2005). additional Insight the user may want to consult a statistician. additional Insight the user may want to consult a statistician. additional Insight the user may want to consult a statistician. Issuer of Distinct Observations Number of Distinct Observations Mean Median Std. Error of Mean Std. Erro	0 151. 140 11. 0.8

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99% Chebyshev (MVUE) UCL	1,021		
SS & Chebyshov (MVOE) UCL	1,021		
Nonparametr	c Distribution Fr	ee UCL Statistics	
Data appear to follow a Di	cemible Distribu	ulion at 5% Significance Level	-
MARA	metric Distributio		
95% CLT UCL	0.85	95% Jackknife UCL	0.851
95% Standard Bootstrap UCL	0.85	95% Bootstrap-t UCL	0.851
95% Stantiard Bootstrap UCL	0.853	95% Percentile Bootstrap UCL	
95% BCA Bootstrap UCL	0.853	95% Percentile Bootstrap UCL	0.851
90% Chebyshev(Mean, Sd) UCL	0.85	95% Chebyshev(Mean, Sd) UCL	0.905
97.5% Chebyshev(Mean, Sd) UCL	0.944	99% Chebyshev(Mean, Sd) UCL	1.019
1	Suggested UCL 1	tee	-
95% Student's-t UCL	0.851		_
Note: Suggestions regarding the selection of a 95%	UCL are provide	d to help the user to select the most appropriate 95% UCL	
		e, data distribution, and skewness.	
These recommendations are based upon the result	s of the simulatio	on studies summarized in Singh, Malchie, and Lee (2006).	
However, simulations results will not cover all Real Wo	rid data sets: for	additional insight the user may want to consult a statistician.	_
	General Statis		
Total Number of Observations	25	Number of Distinct Observations	21
		Number of Missing Observations	0
Minimum	0.62	Mean	3,25
Maximum	25.6	Median	1.6
SD	5.04	Std. Error of Mean	1.00
Coefficient of Variation	1.551	Skewness	3.95
	Normal GOF	Feet	
Shapiro Wilk Test Statistic	0.493	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0,918		
ore on april of the on a day	01010	Data Not Normal at 5% Significance Level	
Lillefors Test Statistic	0.301	Data Not Normal at 5% Significance Level	
Lillefors Test Statistic 5% Lillefors Critical Value	0.301	Lillefors GOF Test Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic 5% Lilliefors Critical Value Deta Not	0.301	Lillevions GOF Test Data Not Normal at 5% Significance Level gnificance Level	
Lilliefors Test Statistic 5% Lilliefors Critical Value Deta Not	0.301 0.173 Normal at 5% Sig	Lillevions GOF Test Data Not Normal at 5% Significance Level gnificance Level	
Lilliefors Test Statistic 5% Lilliefors Critical Value Deta Not	0.301 0.173 Normal at 5% Sig	Lillivions GOF Test Data Not Normal at 5% Significance Level gnificance Level Astribution 95% UCLs (Adjusted for Skewnees)	5.76
Lilliofors Test Statistic 5% Lilliofors Critical Value Data Not Ass 95% Normal UCL	0.301 0.173 Normal at 5% Sig suming Normal D	Lillivions GOF Test Data Not Normal at 5% Significance Level gnificance Lavel Istribution	
Lilliofors Test Statistic 5% Lilliofors Critical Value Data Not Ass 95% Normal UCL	0.301 0.173 Normal at 5% Sig suming Normal D 4.975	Lilleviors GOF Test Data Not Normal at 5% Significance Level antificance Level Netribution 95% UCLs (Adjusted for Sikewnees) 95% Adjusted-CLT UCL (Chen-1995) 95% Modified-t UCL (Johnson-1978)	
Lilliefors Test Statistic 5% Lilliefors Critical Value Data Not 95% Normal UCL 95% Student's-t UCL	0.301 0.173 Normal at 5% Sig auming Normal D 4.975 Gamma QOF	Lillivions GOF Test Data Not Normal at 5% Significance Level gntficance Level Mstribution 95% UCLs (Adjusted for Sikewneee) S5% Adjusted-CLT UCL (Chen-1995) 95% Modified-t UCL (Johnson-1978) Test	
Lilliofors Test Statistic 5% Lilliofors Critical Value Data Not 95% Normal UCL 95% Studen1%-t UCL A-D Test Statistic	0.301 0.173 Normal at 5% Sig suming Normal D 4.975 Gamma QOF 1.893	Lillevions GOF Test Data Not Normal at 5% Significance Level gntficance Level stribution 95% UCLs (Adjusted for Skewnees) 95% Adjusted-CLT UCL (Chen-1995) 95% Modified-t UCL (Johnson-1978) Test Anderson-Darling Gamma GOF Test	
Lilliefors Test Statistic 5% Lilliefors Critical Value Data Not 95% Normal UCL 95% Students-t UCL 4-D Test Statistic 5% A-D Critical Value	0.301 0.173 Normal at 5% Sig suming Normal D 4.975 Gamma QOF 1.893 0.77	Lillevions GOF Test Data Not Normal at 5% Significance Level antificance Level stribution 95% UCLa (Adjusted for Skrewnees) 95% Adjusted-CLT UCL (Chen-1995) 95% Modified-t UCL (Johnson-1978) Test Anderson-Darifng Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level	
Lilliofors Test Statistic 5% Lilliofors Critical Value Data Not 95% Normal UCL 95% Students-t UCL A-D Test Statistic	0.301 0.173 Normal at 5% Sig suming Normal D 4.975 Gamma QOF 1.893	Lillevions GOF Test Data Not Normal at 5% Significance Level gntficance Level stribution 95% UCLs (Adjusted for Skewnees) 95% Adjusted-CLT UCL (Chen-1995) 95% Modified-t UCL (Johnson-1978) Test Anderson-Darling Gamma GOF Test	
Lilliefors Test Statistic 5% Lilliefors Critical Value Data Not 95% Normal UCL 95% Student's-t UCL 95% Student's-t UCL 5% A-D Test Statistic 5% A-D Critical Value K-S Test Statistic 5% K-S Critical Value	0.301 0.173 Normal at 5% Sig suming Normal D 4.975 Gamma QOF 1.893 0.77 0.238 0.179	Lillevions GOF Test Data Not Normal at 5% Significance Level antificance Level stribution 95% UCLa (Adjusted for Sixewneee) 95% Adjusted-CLT UCL (Chen-1995) 95% Modified-t UCL (Johnson-1978) Test Anderson-Darling Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level Kolmogorov-Smirnov Gamma GOF Test	5.76
Lilliefors Test Statistic 5% Lilliefors Critical Value Data Not 95% Normal UCL 95% Student's-t UCL 5% A-D Test Statistic 5% A-D Critical Value K-S Test Statistic 5% K-S Critical Value	0.301 0.173 Normal at 5% Sk uming Normal D 4.975 Gamma GOF 1.893 0.77 0.238 0.77 0.238 0.79 bistributed at 5	Lillevions GOF Test Data Not Normal at 5% Significance Level gntficance Level stribution 95% UCLa (Adjusted for Skewnees) 95% Adjusted-CLT UCL (Chen-1995) 95% Modified-t UCL (Johnson-1978) Test Anderson-Darting Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level Kolmogorov-Smitnov Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level 5% Significance Level	
Lilliefors Test Statistic 5% Lilliefors Critical Value Date Not 95% Normal UCL 95% Student's-t UCL 5% A-D Test Statistic 5% A-D Critical Value K-S Test Statistic 5% K-S Critical Value	0.301 0.173 Normal at 5% Sig suming Normal D 4.975 Gamma QOF 1.893 0.77 0.238 0.179	Lillevions GOF Test Data Not Normal at 5% Significance Level gntficance Level stribution 95% UCLa (Adjusted for Skewnees) 95% Adjusted-CLT UCL (Chen-1995) 95% Modified-t UCL (Johnson-1978) Test Anderson-Darting Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level Kolmogorov-Smitnov Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level 5% Significance Level	

	tatistics	General St	
16	Number of Distinct Observations	25	Total Number of Observations
0	Number of Missing Observations		
0,816	Mean	0.62	Minimum
0.8	Median	1	Maximum
0.0204	Std. Error of Mean	0.102	SD
0.172	Skewness	0.125	Coefficient of Variation
_		Normal GC	
	Shapiro Wilk GOF Test	0.96	Shapiro Wilk Test Statistic
	Data appear Normal at 5% Significance Level	0.918	5% Shapiro Wilk Critical Value
	Lillefors GOF Test	0.107	Litiefors Test Statistic
_	Data appear Normal at 5% Significance Level	0.173	5% Lilliefors Critical Value
	5% Significance Level	r Normal at 5	Large appea
_	al Distribution	uming Norma	
	95% UCLs (Adjusted for Skewness)		95% Normal UCL
0.851	95% Adjusted-CLT UCL (Chen-1995)	0.851	95% Student's-t UCL
0.851	95% Modified-t UCL (Johnson-1978)		
	NOF Test	Gemme Ge	
	Anderson-Darling Gamma GOF Test	0.311	A-D Test Statistic
Level	Detected data appear Gamma Distributed at 5% Significance	0.742	5% A-D Critical Value
	Kolmogorov-Smirnov Gamma GOF Teet	0.101	K-S Test Statistic
Level	Detected data appear Gamma Distributed at 5% Significance ributed at 5% Significance Level	_	5% K-S Critical Value
Level 58.45	tbutad at 5% Significance Level		5% K-S Critical Value
	ributad at 5% Significance Level	Gemme Distri Gemme S	5% K-S Critical Value Detected data appear
58,45	Ibuted et 5% Significance Level Statistics k star (bias corrected MLE) Theta star (bias corrected MLE)	Germe Distri Germe St 66.39	5% K-S Critical Value Detected data appear k hat (MLE)
58.45 0.014 2923	Ibuted et 5% Significance Level Statistics k star (bias corrected MLE) Theta star (bias corrected MLE)	Gemme Distri Gemme S 66.39 0.0123	5% K-S Critical Value Detected data appear k hat (MLE) Theta hat (MLE)
58.45 0.014 2923	tButted at 5% Significance Level Statistics k star (bias corrected MLE) Theta star (bias corrected MLE) nu star (bias corrected) MLE Sd (bias corrected)	Gemme Distri Gemme S 66,39 0.0123 3320	5% K-S Critical Value Detected data appear k hat (MLE) Theta hat (MLE) nu hat (MLE)
58.45 0.014 2923 0.107	tbutted at 5% Significance Level Statistics k star (bias corrected MLE) Theta star (bias corrected MLE) nu star (bias corrected) MLE Sd (bias corrected) MLE Sd (bias corrected) Approximate Chi Square Value (0.05)	Gemme Distri Gemme S 66,39 0.0123 3320	5% K-S Critical Value Detected data appear k hat (MLE) Theta hat (MLE) nu hat (MLE)
58.45 0.014 2923 0.107 2798	Ibuted at 5% Significance Level Statistics k star (bias corrected MLE) Theta star (bias corrected MLE) nu star (bias corrected MLE) nu star (bias corrected) MLE S4 (bias corrected) Approximate Chi Square Value (0.05) Adjusted Chi Square Value	Gemme Distri Gemme Si 66.39 0.0123 3320 0.816 0.0395	5% K-S Critical Value Detected data appear k hat (MLE) Theta hat (MLE) nu hat (MLE) MLE Mean (bias corrected) Adjusted Level of Significance
58.45 0.014 2923 0.107 2798 2790	tbuted at 5% Significance Level Statistics k star (bias corrected MLE) Theta star (bias corrected MLE) nu star (bias corrected) MLE Sd (bias corrected) MLE Sd (bias corrected) Approximate Chi Square Value (0.05) Adjusted Chi Square Value me Distribution	Gamma Distri Gamma Si 66.39 0.0123 3320 0.816 0.0395	5% K-S Critical Value Detected data appear k hat (MLE) Theta hat (MLE) nu hat (MLE) MLE Mean (bias corrected) Adjusted Level of Significance Aa
58.45 0.014 2923 0.107 2798 2790	Ibuted at 5% Significance Level Statistics k star (bias corrected MLE) Theta star (bias corrected MLE) nu star (bias corrected MLE) nu star (bias corrected) MLE S4 (bias corrected) Approximate Chi Square Value (0.05) Adjusted Chi Square Value	Gemme Distri Gemme Si 66.39 0.0123 3320 0.816 0.0395	5% K-S Critical Value Detected data appear k hat (MLE) Theta hat (MLE) nu hat (MLE) MLE Mean (bias corrected) Adjusted Level of Significance
58.45 0.014 2923 0.107 2798 2790	Ibuted at 5% Significance Level Statistics k star (bias corrected MLE) Theta star (bias corrected MLE) nu star (bias corrected) MLE Sd (bias corrected) Approximate Chi Square Value (0.05) Adjusted Chi Square Value 95% Adjusted Gamma UCL (use when n<50) GOF Test	German State German St 66.39 0.0123 3320 0.816 0.0395 uming German 0.853 Lognomed G	5% K-S Critical Value Detected data appear k hat (MLE) Theta hat (MLE) nu hat (MLE) MLE Mean (bias corrected) Adjusted Level of Significance Adjusted Level of Significance Adjusted Level of Significance
58.45 0.014 2923 0.107 2798 2790	Ibutied at 5% Significance Level Statistics k star (bias corrected MLE) Thota star (bias corrected MLE) nu star (bias corrected MLE) nu star (bias corrected) MLE Sd (bias corrected) MLE Sd (bias corrected) Approximate Chi Square Value (0.05) Adjusted Chi Square Value ma Distribution 95% Adjusted Gamma UCL (use when n<50) GOF Test Shapiro Wilk Lognormal GOF Test	Gamma District Gamma St 66.39 0.0123 3320 0.816 0.0395 uming Gamma 0.853 Lognormal G 0.964	5% K-S Critical Value Detected data appear k hat (MLE) Thete hat (MLE) nu hat (MLE) MLE Mean (bias corrected) Adjusted Level of Significance Stapproximate Gamma UCL (use when n>=50)) Shapiro Wilk Test Statistic
58.45 0.014 2923 0.107 2798 2790	Ibuted at 5% Significance Level Statistics k star (bias corrected MLE) Theta star (bias corrected MLE) nu star (bias corrected MLE) nu star (bias corrected) MLE Sd (bias corrected) MLE Sd (bias corrected) Approximate Chi Square Value (0.05) Adjusted Chi Square Value (0.05) Adjusted Chi Square Value 95% Adjusted Gamma UCL (use when n<50) GOF Test Shaptro WIX: Lognormal GOF Test Data appear Lognormal at 5% Significance Level	Gamma Diat Gamma Si 66.39 0.0123 3320 0.816 0.0395 Uming Gamm 0.853 Lognormal 0.964 0.918	5% K-S Critical Value Detected data appear k hat (MLE) Theta hat (MLE) nu hat (MLE) MLE Mean (bias corrected) Adjusted Level of Significance Shaptroximate Gamma UCL (use when n>=50)) Shaptro Wilk Test Statistic 5% Shaptro Wilk Critical Value
58.45 0.014 2923 0.107 2798 2790	Ibuted at 5% Significance Level Statistica k star (bias corrected MLE) Theta star (bias corrected MLE) nu star (bias corrected MLE) nu star (bias corrected) MLE Sd (bias corrected) MLE Sd (bias corrected) MLE Sd (bias corrected) Approximate Chi Square Value (0.05) Adjusted Chi Square Value (0.05) Adj	Germme Dietri Germme Si 66,39 0.0123 3320 0.816 0.0395 uming Germin 0.853 Lognormel (0.964 0.913	5% K-S Critical Value Detected data appear k hat (MLE) Theta hat (MLE) nu hat (MLE) MLE Mean (bias corrected) Adjusted Level of Significance Adjusted Level of Significance Shapiro Wilk Test Statistic 5% Shapiro Wilk Critical Value Lilliofors Test Statistic
58.45 0.014 2923 0.107 2798 2790	Ibuted at 5% Significance Level Statistics k star (blas corrected MLE) Theta star (blas corrected MLE) nu star (blas corrected MLE) Nu star (blas corrected) MLE Sd (blas corrected) Approximate Chi Square Value (0.05) Adjusted Chi Square Value (0.05) Adjusted Chi Square Value Bistribution 95% Adjusted Gamma UCL (use when n<50) GOF Test Data appear Lognormal at 5% Significance Level Lillefors Lognormal at 5% Significance Level Data appear Lognormal at 5% Significance Level	Germme Diet Germme S 66.39 0.0123 3320 0.816 0.0395 uming Germ 0.853 Lognormal (0.964 0.918 0.11 0.173	5% K-S Critical Value Detected data appear k hat (MLE) Theta hat (MLE) nu hat (MLE) MLE Mean (blas corrected) Adjusted Level of Significance Adjusted Level of Significance Stapproximate Gamma UCL (use when n>=50)) Shapiro Wilk Test Statistic 5% Shapiro Wilk Critical Value Lilliofors Test Statistic 5% Ulliefors Critical Value
58.45 0.014 2923 0.107 2798 2790	Ibuted at 5% Significance Level Statistica k star (bias corrected MLE) Theta star (bias corrected MLE) nu star (bias corrected MLE) nu star (bias corrected) MLE Sd (bias corrected) MLE Sd (bias corrected) MLE Sd (bias corrected) Approximate Chi Square Value (0.05) Adjusted Chi Square Value (0.05) Adj	Germme Diet Germme S 66.39 0.0123 3320 0.816 0.0395 uming Germ 0.853 Lognormal (0.964 0.918 0.11 0.173	5% K-S Critical Value Detected data appear k hat (MLE) Theta hat (MLE) nu hat (MLE) MLE Mean (blas corrected) Adjusted Level of Significance Adjusted Level of Significance Shapiro Wilk Test Statistic 5% Shapiro Wilk Critical Value Lilliofors Test Statistic 5% Ulliefors Critical Value
58.45 0.014 2923 0.107 2798 2790 0.855	Ibuted at 5% Significance Level Statistics k star (bias corrected MLE) Theta star (bias corrected MLE) nu star (bias corrected MLE) nu star (bias corrected) MLE Sd (bias corrected) Approximate Chi Square Value (0.05) Adjusted Chi Square (0.05)	Germme Dietr Germme S 66.39 0.0123 3320 0.816 0.0395 0.816 0.0395 0.853 Lognormal et Lognormal et	5% K-S Critical Value Detected data appear k hat (MLE) Theta hat (MLE) nu hat (MLE) MLE Mean (bias corrected) Adjusted Level of Significance Adjusted Level of Significance Shapiro Wilk Test Statistic 5% Shapiro Wilk Test Statistic 5% Shapiro Wilk Critical Value Lilliefors Test Statistic 5% Lilliefors Critical Value Data appear
58.45 0.014 2923 0.107 2798 2790 0.855	Ibutied at 5% Significance Level Statistics k star (bias corrected MLE) Theta star (bias corrected MLE) nu star (bias corrected MLE) nu star (bias corrected MLE) NLE Sd (bias corrected) Approximate Chi Square Value (0.05) Adjusted Chi Square (0.05) Adj	Germme Steel Germme Steel 66.39 0.0123 3320 0.816 0.0395 uming Germ 0.853 Lognormel C 0.984 0.918 0.11 0.173 Lognormal at Lognormal at -0.478	5% K-S Critical Value Detected data appear k hat (MLE) Theta hat (MLE) Theta hat (MLE) nu hat (MLE) MLE Mean (bias corrected) Adjusted Level of Significance Adjusted Level of Significance Adjusted Level of Significance Shapiro Wilk Test Statistic 5% Shapiro Wilk Test Statistic 5% Shapiro Wilk Critical Value Lilliofors Test Statistic 5% Lilliefors Critical Value Dets appear Minimum of Logged Data
58.45 0.014 2923 0.107 2798 2790 0.855	Ibuted at 5% Significance Level Statistics k star (bias corrected MLE) Theta star (bias corrected MLE) nu star (bias corrected MLE) nu star (bias corrected) MLE Sd (bias corrected) Approximate Chi Square Value (0.05) Adjusted Chi Square (0.05)	Germme Dietr Germme S 66.39 0.0123 3320 0.816 0.0395 0.816 0.0395 0.853 Lognormal et Lognormal et	5% K-S Critical Value Detected data appear k hat (MLE) Theta hat (MLE) nu hat (MLE) MLE Mean (bias corrected) Adjusted Level of Significance Adjusted Level of Significance Shapiro Wilk Test Statistic 5% Shapiro Wilk Test Statistic 5% Shapiro Wilk Critical Value Lilliefors Test Statistic 5% Utiliefors Critical Value Deta appear
58.45 0.014 2923 0.102 2798 2790 0.855	Ibutied at 5% Significance Level Statistics k star (bias corrected MLE) Theta star (bias corrected MLE) nu star (bias corrected MLE) nu star (bias corrected MLE) NLE Sd (bias corrected) Approximate Chi Square Value (0.05) Adjusted Chi Square (0.05) Adj	Germme Steel Germme Steel 66.39 0.0123 3320 0.816 0.0395 uming Germ 0.853 Lognormal d 0.918 0.11 0.173 Lognormal at Lognormal d	5% K-S Critical Value Detected data appear k hat (MLE) Theta hat (MLE) nu hat (MLE) MLE Mean (bias corrected) Adjusted Level of Significance Adjusted Level of Significance Shapiro Wilk Test Statistic 5% Approximate Gemma UCL (use when n>=50)) Shapiro Wilk Test Statistic 5% Shapiro Wilk Critical Value Lillifors Test Statistic 5% Lillifors Test Statistic 5% Lillifors Test Statistic 5% Lillifors Test Statistic 5% Lillifors Critical Value Data appear Minimum of Logged Data
58.45 0.014 2923 0.107 2798 2790 0.855	Ibuiled at 5% Significance Level Studietics k star (bias corrected MLE) Theta star (bias corrected MLE) Theta star (bias corrected MLE) nu star (bias corrected MLE) Nu star (bias corrected) MLE Sd (bias corrected) Approximate Chi Square Value (0.05) Adjusted Chi Square Value (0.05) Adjusted Chi Square Value (0.05) Adjusted Chi Square Value star Obstribution 95% Adjusted Gamma UCL (use when n<50) GOF Test Shapiro Wilk Lognormal GOF Test Data appear Lognormal at 5% Significance Level Lillefors Lognormal at 5% Significance Level t 5% Significance Level Statistics Mean of logged Data SD of logged Data	Germme Steel Germme Steel 66.39 0.0123 3320 0.816 0.0395 uming Germ 0.853 Lognormal d 0.918 0.11 0.173 Lognormal at Lognormal d	5% K-S Critical Value Detected data appear k hat (MLE) Theta hat (MLE) nu hat (MLE) MLE Mean (bias corrected) Adjusted Level of Significance Adjusted Level of Significance Shapiro Wilk Test Statistic 5% Approximate Gemma UCL (use when n>=50)) Shapiro Wilk Test Statistic 5% Shapiro Wilk Critical Value Lillifors Critical Value S% Lillifors Test Statistic 5% Lillifors Test Statistic 5% Lillifors Critical Value Data appear Minimum of Logged Data Maximum of Logged Data

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Coefficient of Variation	0.138	Skewness	1.198
	Normal G	057	
Shapiro Wilk Test Statistic	0.912	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.912	Data Not Normal at 5% Significance Level	
Lillefors Test Statistic	0.0924		
5% Lilliefors Critical Value	0.0924	Data appear Normal at 5% Significance Level	
		nal at 5% Significance Level	_
Count of Source Solution	Conditioning 140411		-
	suming Norm	al Distribution	
95% Normal UCL		95% UCLs (Adjusted for Skewmens)	
95% Student's-t UCL	28.72	95% Adjusted-CLT UCL (Chen-1995)	28.87
		95% Modified-t UCL (Johnson-1978)	28.76
	Gamma G	OF Test	
A-D Test Statistic	0.36	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.742	Detected data appear Gamma Distributed at 5% Significance	Level
K-S Test Statistic	0,101	Kolmogorov-Smirnov Gamma GOF Test	LOVOI
5% K-S Critical Value	0.174	Detected data appear Gamma Distributed at 5% Significance	Level
Detected data appear	Gemme Dist	fbuted at 5% Significance Level	
k hat (MLE)	Germme S 58.61	k star (blas corrected MLE)	51.61
Theta hat (MLE)	0.468	Theta star (bias corrected MLE)	0.53
	2931		2580
nu hat (MLE)		nu star (bias corrected)	3.81
MLE Mean (bias corrected)	27.43	MLE Sd (bias corrected)	
Adjusted Level of Significance	0.0395	Approximate Chi Square Value (0.05) Adjusted Chi Square Value	2463
			2100
As	ruming Gam	na Distribution	
95% Approximate Gamma UCL (use when n>=50))	28.73	95% Adjusted Gamma UCL (use when n<50)	28.82
	Lognormal	GOF Test	
Shapiro Wilk Test Statistic	0.948	Shapiro Wilk Lognormal GOF Test	_
5% Shapiro Wilk Critical Value	0,918	Data appear Lognormal at 5% Significance Level	
Lillefors Test Statistic	0.0971	Lillefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.173	Data appear Lognormal at 5% Significance Level	_
	Lognormal at	t 5% Significance Level	
	1	Charles and the second s	
Minimum of Logged Data	Lognormal 3,109	Sametics Mean of logged Data	3,30
Maximum of Logged Data	3.671	SD of logged Data	0.13
maximum or Logger Data	0.071	SD OF OG 200 Date	0.10
Ass	ming Lognor	mel Distribution	
95% H-UCL	28.73	90% Chebyshev (MVUE) UCL	29.59
95% Chebyshev (MVUE) UCL	30.57	97.5% Chebyshev (MVUE) UCL	31,94
99% Chebyshev (MVUE) UCL	34.62		
	the Distribut	on Free UCL Statistics	-
Nonnersme			
Nonparame Data appear to follow a I	Necemible Di	Internation at 234 Significance Flakes	
Data appear to follow a I			_
Data appear to follow a I		Ibution Free UCLs 95% Jackknife UCL	28.72

Theta hat (MLE)	2.84	Theta star (bias corrected MLE)	3.144
nu hat (MLE)	57.22	nu star (bias corrected)	51.69
MLE Mean (blas corrected).	3.25	MLE Sd (bias corrected)	3,197
MLE Mean (bias confected)	3.20		36.18
A dissent i and a film to any	0.0395	Approximate Chi Square Value (0.05)	
Adjusted Level of Significance	0.0395	Adjusted Chi Square Value	35,29
Ast	uming Gamme Di	stribution	
95% Approximate Gamma UCL (use when n>=50))	4.644	95% Adjusted Gamma UCL (use when n<50)	4.761
	Lognormal GOF	Teat	_
Shapiro Wilk Test Statistic	0.891	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.918	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.196	Lilletons Lognormal GOF Test	
5% Littlefors Critical Value	0.130	Data Not Lognormal at 5% Significance Level	_
	ognormal at 5% Sk		
Destroit	Senormal at 576 Se		
	Lognormal Statis	itics	
Minimum of Logged Data	-0.478	Mean of logged Data	0,682
Maximum of Logged Data	3.243	SD of logged Data	0.872
Aan	ming Lognamus P	Nambility of a se	
95% H-UCL	4,383	90% Chebyshav (MVUE) UCL	4,479
95% Chebyshev (MVUE) UCL	5.224	97.5% Chebyshev (MVUE) UCL	6.258
99% Chebyshev (MVUE) UCL	8,289		
Nonparame	tric Distribution Fre	a LICI Statistics	
Data do not fo	liow a Discernible	Distribution (0.05)	-
		Distribution (0.05)	
Nonper	ametric Distributio	Distribution (0.05) In Free UCLs	
Nonper 95% CLT UCL	ametric Distributio 4,909	Distribution (0.05) n Free UCLs 95% Jackknife UCL	4.975
Nonper 95% CLT UCL 95% Standard Bootstrap UCL	ametric Distributio 4,909 4,852	Distribution (0.05) n Free UCLs 95% Jackknife UCL 95% Bootstrap-(UCL	8.118
Nonper 95% CLT UCL 95% Standard Bootstrap UCL 95% Hall's Bootstrap UCL	ametric Distributio 4,909 4,852 10,96	Distribution (0.05) n Free UCLs 95% Jackknife UCL	
Nonper 95% CLT UCL 95% Standard Bootstrap UCL	ametric Distributio 4,909 4,852 10,96 5,953	Distribution (0.05) n Free UCLs 95% Jackknife UCL 95% Bootstrap-(UCL	8.118
Nonper 95% CLT UCL 95% Standard Bootstrap UCL 95% Hall's Bootstrap UCL	ametric Distributio 4,909 4,852 10,96	Distribution (0.05) n Free UCLs 95% Jackknife UCL 95% Bootstrap-(UCL	8.118
Nonpar 95% CLT UCL 95% Standard Bootstrap UCL 95% Hall's Bootstrap UCL 95% BCA Bootstrap UCL	ametric Distributio 4,909 4,852 10,96 5,953	Diletribution (0.05) n Free UCLs 95% Jackknife UCL 95% Bootstrap-t UCL 95% Percentile Bootstrap UCL	8.118
Nonpar 95% CLT UCL 95% Standard Bootstrap UCL 95% Hall's Bootstrap UCL 95% BCA Bootstrap UCL 95% BCA Bootstrap UCL	ametric Distributio 4.909 4.852 10.96 5.953 6.275	Dieffbution (0.05) A Free UCLs 95% Jackknife UCL 95% Bootstrap-t UCL 95% Percentile Bootstrap UCL 95% Chebyshev(Mean, Sd) UCL 99% Chebyshev(Mean, Sd) UCL	8.118 4.956 7.645
Nonpar 95% CLT UCL 95% Standard Bootstrap UCL 95% Hall's Bootstrap UCL 95% BCA Bootstrap UCL 95% BCA Bootstrap UCL	ametric Distributio 4.909 4.852 10.96 5.953 6.275 9.546	Dieffbution (0.05) A Free UCLs 95% Jackknife UCL 95% Bootstrap-t UCL 95% Percentile Bootstrap UCL 95% Chebyshev(Mean, Sd) UCL 99% Chebyshev(Mean, Sd) UCL	8.118 4.956 7.645
Nonpar 95% CLT UCL 95% Standard Bootstrap UCL 95% Hall Bootstrap UCL 95% BCA Bootstrap UCL 90% Chebyshev(Mean, Sd) UCL 97.5% Chebyshev(Mean, Sd) UCL 95% Chebyshev (Mean, Sd) UCL	ametric Distributio 4.909 4.852 10.96 5.953 6.275 9.546 Suggested UCL to 7.645	Dieffbution (0.05) A Free UCLs 95% Jackknife UCL 95% Bootstrap-t UCL 95% Percentile Bootstrap UCL 95% Chebyshev(Mean, Sd) UCL 99% Chebyshev(Mean, Sd) UCL	8.118 4.956 7.645
Nonpar 95% CLT UCL 95% Standard Bootstrap UCL 95% Hall's Bootstrap UCL 95% CAB Sotstrap UCL 90% Chebyshev(Mean, Sd) UCL 97,5% Chebyshev(Mean, Sd) UCL 95% Chebyshev (Mean, Sd) UCL 95% Chebyshev (Mean, Sd) UCL	ametric Distributio 4.909 4.852 10.96 5.953 6.275 9.546 Suggested UCL to 7.645 UCL are provided	Dietribution (0.05) In Free UCLs 95% Bootstrap-t UCL 95% Percentile Bootstrap UCL 95% Chebyshev(Mean, Sd) UCL 98% Chebyshev(Mean, Sd) UCL 98% Chebyshev(Mean, Sd) UCL 10 Use	8.118 4.956 7.645
Nonpar 95% CLT UCL 95% Standard Bootstrap UCL 95% Hall's Bootstrap UCL 95% BCA Bootstrap UCL 95% Chebyshev(Mean, Sd) UCL 97.5% Chebyshev(Mean, Sd) UCL 95% Chebyshev (Mean, Sd) UCL 95% Chebyshev (Mean, Sd) UCL Note: Suggestions regarding the selection of a 95% Recommendations are base	ametric Distributio 4.909 4.852 10.96 5.953 6.275 9.546 Suggested UCL to 7.645 UCL are provided and upon data size.	Dieffbution (0.05) In Free UCLs 95% Bootstrap-UCL 95% Percentile Bootstrap-UCL 95% Chebyshev(Mean, Sd) UCL 98% Che	8.118 4.956 7.645
Nonpar 95% CLT UCL 95% Standard Bootstrap UCL 95% Hall's Bootstrap UCL 95% BGA Bootstrap UCL 95% BCA Bootstrap UCL 95% Chebyshev(Mean, Sd) UCL 97.5% Chebyshev(Mean, Sd) UCL 95% Chebyshev (Mean, Sd) UCL 95% Chebyshev (Mean, Sd) UCL 95% Chebyshev (Mean, Sd) UCL 95% Chebyshev (Mean, Sd) UCL	ametric Distributio 4.909 4.852 10.96 5.953 6.275 9.546 Suggested UCL to 7.645 UCL are provided dupon data size, its of the simulation	Dietribution (0.05) In Free UCLs 95% Bootstrap-LUCL 95% Bootstrap-LUCL 95% Percentile Bootstrap-UCL 95% Chebyshev(Mean, Sd) UCL 99% Chebyshev(Mean, Sd) UCL 99% Chebyshev(Mean, Sd) UCL 10 help the user to select the most appropriate 95% UCL, data distribution, and skewness. In studies summarized in Singh, Maichle, and Lee (2006).	8.118 4.956 7.645
Nonpar 95% CLT UCL 95% Standard Bootstrap UCL 95% Hall's Bootstrap UCL 95% BGA Bootstrap UCL 95% BCA Bootstrap UCL 95% Chebyshev(Mean, Sd) UCL 97.5% Chebyshev(Mean, Sd) UCL 95% Chebyshev (Mean, Sd) UCL 95% Chebyshev (Mean, Sd) UCL 95% Chebyshev (Mean, Sd) UCL 95% Chebyshev (Mean, Sd) UCL	ametric Distributio 4.909 4.852 10.96 5.953 6.275 9.546 Suggested UCL to 7.645 UCL are provided dupon data size, its of the simulation	Dieffbution (0.05) In Free UCLs 95% Bootstrap-UCL 95% Percentile Bootstrap-UCL 95% Chebyshev(Mean, Sd) UCL 98% Che	8.118 4.956 7.645
Nonpar 95% CLT UCL 95% Standard Bootstrap UCL 95% Hall's Bootstrap UCL 95% BGA Bootstrap UCL 95% BCA Bootstrap UCL 95% Chebyshev(Mean, Sd) UCL 97.5% Chebyshev(Mean, Sd) UCL 95% Chebyshev (Mean, Sd) UCL 95% Chebyshev (Mean, Sd) UCL 95% Chebyshev (Mean, Sd) UCL 95% Chebyshev (Mean, Sd) UCL	ametric Distributio 4.909 4.852 10.96 5.953 6.275 9.546 Suggested UCL to 7.645 UCL are provided dupon data size, its of the simulation	Dietribution (0.05) In Free UCLs 95% Bootstrap-LUCL 95% Bootstrap-LUCL 95% Percentile Bootstrap-UCL 95% Chebyshev(Mean, Sd) UCL 99% Chebyshev(Mean, Sd) UCL 99% Chebyshev(Mean, Sd) UCL 10 help the user to select the most appropriate 95% UCL, data distribution, and skewness. In studies summarized in Singh, Maichle, and Lee (2006).	8.118 4.956 7.645
Nonpar 95% CLT UCL 95% Standard Bootstrap UCL 95% Hall's Bootstrap UCL 95% BGA Bootstrap UCL 95% BCA Bootstrap UCL 95% Chebyshev(Mean, Sd) UCL 97.5% Chebyshev(Mean, Sd) UCL 95% Chebyshev (Mean, Sd) UCL 95% Chebyshev (Mean, Sd) UCL 95% Chebyshev (Mean, Sd) UCL 95% Chebyshev (Mean, Sd) UCL	ametric Distributio 4.909 4.852 10.96 5.953 6.275 9.546 Suggested UCL to 7.645 UCL are provided dupon data size, its of the simulation	Dietribution (0.05) In Free UCLs 95% Bootstrap-LUCL 95% Bootstrap-LUCL 95% Percentile Bootstrap-UCL 95% Chebyshev(Mean, Sd) UCL 99% Chebyshev(Mean, Sd) UCL 99% Chebyshev(Mean, Sd) UCL 10 help the user to select the most appropriate 95% UCL, data distribution, and skewness. In studies summarized in Singh, Maichle, and Lee (2006).	8.118 4.956 7.645
Nonpar 95% CLT UCL 95% Standard Bootstrap UCL 95% Hall's Bootstrap UCL 95% Chebyshev(Mean, Sd) UCL 97.5% Chebyshev(Mean, Sd) UCL 97.5% Chebyshev(Mean, Sd) UCL 95% Chebyshev (Mean, Sd) UCL 95% Chebyshev (Mean, Sd) UCL Note: Suggestions regarding the selection of a 95% Recommendations are base These recommendations are based upon the resu However, simulations results will not cover all Real W	Annelic Distribution 4.852 10.96 5.953 6.275 9.546 Suggested UCL to 7.645 UCL are provided dupon data size, for fordid data sets; for	Dieffbution (0.05) In Free UCLs 95% Bootstrap-UCL 95% Bootstrap-UCL 95% Chebyshev(Mean, Sd) UCL 95% Chebyshev(Mean, Sd) UCL 99% Chebyshev(Mean, Sd) UCL 99% Chebyshev(Mean, Sd) UCL 5 Use 1 to help the user to select the most appropriate 95% UCL, data distribution, and skewness. In studies summarized in Singh, Maichle, and Lee (2006). additional insight the user may want to consult a statistician.	8.118 4.956 7.645
Nonpar 95% CLT UCL 95% Standard Bootstrap UCL 95% Hall's Bootstrap UCL 95% Chebyshev(Mean, Sd) UCL 97.5% Chebyshev(Mean, Sd) UCL 97.5% Chebyshev(Mean, Sd) UCL 95% Chebyshev (Mean, Sd) UCL 95% Chebyshev (Mean, Sd) UCL Note: Suggestions regarding the selection of a 95% Recommendations are base These recommendations are based upon the resu However, simulations results will not cover all Real W	ametric Distributio 4.909 4.852 10.96 5.953 6.275 9.546 Suggested UCL to 7.645 UCL are provided dupon data size, its of the simulation	Dieffbution (0.05) n Free UCLs 95% Bootstrap-t UCL 95% Percentile Bootstrap UCL 95% Chebyshev(Mean, Sd) UCL 99% Chebyshev(Mean, Sd) UCL 99% Chebyshev(Mean, Sd) UCL 99% Chebyshev(Mean, Sd) UCL bues to help the user to select the most appropriate 95% UCL. data distribution, and skewness. to help the user to select the most appropriate 95% UCL. data distribution, and skewness. dational insight the user may want to consult a statistician.	8.118 4.956 7.645
Nonper 95% CLT UCL 95% Standard Bootstrap UCL 95% Hall's Bootstrap UCL 95% BAB Bootstrap UCL 95% Chebyshev(Mean, Sd) UCL 97.5% Chebyshev(Mean, Sd) UCL 95% Chebyshev(Mean, Sd) UCL 95% Chebyshev (Mean, Sd) UCL Note: Suggestions regarding the selection of a 95% Recommendations are based These recommendations are based upon the result However, simulations results will not cover all Real W	ametric Distributio 4.909 4.852 10.96 5.953 6.275 9.546 Suggested UCL to 7.645 UCL are provided upon data size. Is of the simulation ford data sets; for General Statist	Dieffbution (0.05) n Free UCLs 95% Bootstrap-t UCL 95% Percentile Bootstrap UCL 95% Chebyshev(Mean, Sd) UCL 95% Chebyshev(Mean, Sd) UCL 98% Chebyshev(Mean,	8.118 4.956 7.645 13.28
Nonpar 95% CLT UCL 95% Standard Bootstrap UCL 95% Hall's Bootstrap UCL 95% Hall's Bootstrap UCL 95% Chebyshev(Mean, Sd) UCL 97.5% Chebyshev(Mean, Sd) UCL 95% Chebyshev(Mean, Sd) UCL 95% Chebyshev (Mean, Sd) UCL 95% Cheb	A .909 4.909 4.852 10.96 5.953 6.275 9.546 Suggested UCL to 7.645 UCL are provided upon data size. Its of the simulation fordi data sets: for General Statist 25	Dieffbution (0.05) In Free UCLs 95% Jackknife UCL 95% Bootstrap-t UCL 95% Percentile Bootstrap-t UCL 95% Chebyshev(Mean, Sd) UCL 99% Chebyshev(Mean, Sd) UCL 99% Chebyshev(Mean, Sd) UCL 90% Chebyshev(Mean, Sd) ULL 90% Chebyshev(Mean, Sd) ULL 90% Chebyshev(Mean, Sd) ULL 90% Chebyshev(Mean, Sd) UL	8.118 4.956 7.645 13.28
Nonper 95% CLT UCL 95% Standard Bootstrap UCL 95% Hall's Bootstrap UCL 95% BAB Bootstrap UCL 95% Chebyshev(Mean, Sd) UCL 97.5% Chebyshev(Mean, Sd) UCL 95% Chebyshev(Mean, Sd) UCL 95% Chebyshev (Mean, Sd) UCL Note: Suggestions regarding the selection of a 95% Recommendations are based These recommendations are based upon the result However, simulations results will not cover all Real W	ametric Distributio 4.909 4.852 10.96 5.953 6.275 9.546 Suggested UCL to 7.645 UCL are provided upon data size. Is of the simulation ford data sets; for General Statist	Dieffbution (0.05) n Free UCLs 95% Bootstrap-t UCL 95% Percentile Bootstrap UCL 95% Chebyshev(Mean, Sd) UCL 95% Chebyshev(Mean, Sd) UCL 98% Chebyshev(Mean,	8.118 4.956 7.645 13.28

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Adjusted Level of Significance	0.0395	Adjusted Chi Square Value	457.2
Ase	uming Gemma Dis	tribution	
95% Approximate Gamma UCL (use when n>=50))	13.7	95% Adjusted Gamma UCL (use when n<50)	13.8
	Lognormal GOF 1		
Shapiro Wilk Test Statistic	0.85	Shapiro Wilk Lognormal GOF Tent	
5% Shapiro Wilk Critical Value	0.918	Data Not Lognormal at 5% Significance Level	
Lillefors Test Statistic 5% Lillefors Critical Value	0.184	Liliefors Lognormal GOF Test	
	gnormal at 5% Sig	Data Not Lognormal at 5% Significance Level	
Lotter I for Lo	gnormen er o ve org	Intrance Later	
	Lognormal Statis	des	
Minimum of Logged Date	2.041	Mean of logged Data	2.468
Maximum of Logged Data	3.288	SD of logged Data	0.281
· · · · · · · · · · · · · · · · · · ·		+	
Assir	ming Lognormal D	Istribution	
95% H-UCL	13.6	90% Chebyshev (MVUE) UCL	14.34
95% Chebyshev (MVUE) UCL	15.29	97.5% Chebyshev (MVUE) UCL	16.6
99% Chebyshev (MVUE) UCL	19.19		
Nonparamet	ric Distribution Fre	e UCL Statistics	
Data do not fo	low a Discernible	Distribution (0.05)	
	ametric Distribution		
95% CLT UCL	13.75	95% Jackknife UCL	13.81
95% Standard Bootstrap UCL	13.74	95% Bootstrap-t UCL	15.6
95% Hall's Bootstrap UCL	22.22	95% Percentile Bootstrap UCL	13.86
95% BCA Bootstrap UCL	14.09	off of the state of the state	40.40
90% Chebyshev(Mean, Sd) UCL	14.94 17.77	95% Chebyshev(Mean, Sd) UCL 99% Chebyshev(Mean, Sd) UCL	16.12
97.5% Chebyshev(Mean, Sd) UCL	17.77	99% Chebysnev(Mean, Sd) OCL	21
	Suggested UCL to	line	
95% Student's-t UCL	13.81	or 95% Modified-t UCL	13,88
5575 54455115-1 552	10.01		
Note: Suggestions regarding the selection of a 95%	UCL are provided	to help the user to select the most appropriate 95% UCL.	
		data distribution, and skewness.	
These recommendations are based upon the result	ts of the simulation	studies summarized in Singh, Maichle, and Lee (2006).	
However, simulations results will not cover all Real W	orld data sets; for a	additional insight the user may want to consult a statistician.	
Wr.			
	General Statist		05
Total Number of Observations	25	Number of Distinct Observations	25
Minimum	20	Number of Missing Observations Mean	0
	323	Mean Median	100,1
Maximum SD	323 89.3	Median Std. Error of Mean	17.86
SD Coefficient of Variation	0,892	Std. Error of Mean Skewness	17.86
	0,032	Skewness	1.17.
	Normal GOF T	est	

95% Standard Bootstrap UCL	28.65	95% Bootstrap-t UCL	28,96
95% Hall's Bootstrap UCL	29.26	95% Percentile Bootstrap UCL	28.72
95% BCA Bootstrap UCL	28.84		
90% Chebyshev(Mean, Sd) UCL	29.7	95% Chebyshev(Mean, Sd) UCL	30.73
97.5% Chebyshev(Mean, Sd) UCL	32,16	99% Chebyshev(Mean, Sd) UCL	34,97
	Suggested UCL	to Use	
95% Student's-t UCL	28.72		
When a data set follows an approxit	nate (e.g. norma	al) distribution passing one of the GOF test	
	the second se	bution (e.g., gamma) passing both GOF tests in ProUCL	
Note: Suggestions regarding the selection of a 95%	UCL are provide	d to help the user to select the most appropriate 95% UCL	
		s, data distribution, and skewness.	_
		on studies summarized in Singh, Maichle, and Lee (2006).	
lowever simulations results will not cover all Real W	orid data sets: for	r additional insight the user may want to consult a statistician.	
	General State		
Total Number of Observations	25	Number of Distinct Observations	22
		Number of Missing Observations	0
Minimum	7.7	Mean	12.32
Maximum	26.8	Median	11.2
	4.361	Std. Error of Mean	0.872
Coefficient of Variation	0.354	Skewness	2.455
	Normal GOF	Test	
Shapiro Wilk Test Statistic	0.701	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.918	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.26	Lilliefora GOF Test	
5% Lillefors Critical Value	0.173	Data Not Normal at 5% Significance Level	
Data Not	Normal at 5% Si	gnificance Level	
	uming Normel D	Distribution	_
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
	uming Normel D	95% UCLs (Adjusted for Skewness) 95% Adjusted-CLT UCL (Chen-1995)	14.21
95% Normal UCL		95% UCLs (Adjusted for Skewness)	14.21 13.88
95% Normal UCL 95% Studente-t UCL	13.81 Gerama GOF	95% UCLs (Adjusted for Skowness) 95% Adjusted-CLT UCL (Chen-1995) 95% Modified-t UCL (Johnson-1978) Test	
95% Normal UCL 95% Studenfe-t UCL A-D Test Statistic	13.81 Gamma GOF 1.577	95% UCLs (Adjusted for Skowness) 95% Adjusted-CLT UCL (Chen-1995) 95% Modified-t UCL (Johnson-1978) Test Anderson-Darling Gamma GOF Test	13.88
95% Normal UCL 95% Student's-t UCL A-D Test Statistic 5% A-D Critical Value	13.81 Gamma GOF 1.577 0.745	95% UCLs (Adjusted for Skowness) 95% Adjusted-CLT UCL (Chen-1995) 95% Modified-t UCL (Johnson-1978) Test Anderson-Darling Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level	13.88
95% Normal UCL 95% Student's-t UCL A-D Test Statistic 5% A-D Critical Value K-S Test Statistic	13.81 Gamma GOF 1.577 0.745 0.209	95% UCLs (Adjusted for Skøwness) 95% Adjusted-CLT UCL (Chen-1995) 95% Modified-t UCL (Johnson-1978) Test Anderson-Darling Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level Kolmogorov-Smirnov Gamma GOF Test	13.88
95% Normal UCL 95% Student's-t UCL A-D Test Statistic 5% A-D Critical Value K-S Test Statistic 5% K-S Critical Value	13.81 Gamma GOF 1.577 0.745 0.209 0.174	95% UCLs (Adjusted for Skøwness) 95% Adjusted-CLT UCL (Chen-1995) 95% Modified-t UCL (Johnson-1978) Test Anderson-Darling Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level Kolmogorov-Smirnov Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level	13.88
95% Normal UCL 95% Student's-t UCL A-D Test Statistic 5% A-D Critical Value K-S Test Statistic 5% K-S Critical Value	13.81 Gamma GOF 1.577 0.745 0.209 0.174	95% UCLs (Adjusted for Skøwness) 95% Adjusted-CLT UCL (Chen-1995) 95% Modified-t UCL (Johnson-1978) Test Anderson-Darling Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level Kolmogorov-Smirnov Gamma GOF Test	13.88
95% Normal UCL 95% Student's-t UCL A-D Test Statistic 5% A-D Critical Value K-S Test Statistic 5% K-S Critical Value	13.81 Gamma GOF 1.577 0.745 0.209 0.174	95% UCLs (Adjusted for Skownees) 95% Adjusted-CLT UCL (Chen-1995) 35% Modified-t UCL (Johnson-1978) Test Anderson-Darling Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level Kolmogorow-Smirnov Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level 5% Significance Level	13.88
95% Normal UCL 95% Studente-t UCL A-D Test Statistic 5% A-D Critical Value K-S Test Statistic 5% K-S Critical Value Data Not Game k hat (MLE)	Image: 13.81 Generating GOF 1.577 0.745 0.209 0.174 te Distributed at .	95% UCLs (Adjusted-for Skowness) 95% Adjusted-CLT UCL (Chen-1995) 95% Modified-t UCL (Johnson-1978) Test Anderson-Darling Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level Kolmogorov-Smirnov Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level Significance Level stics k star (bias corrected MLE)	13.88
95% Normal UCL 95% Student*+ UCL A-D Test Statistic 5% A-D Critical Value K-S Test Statistic 5% K-S Critical Value Data Not Gamma k hat (MLE) Theta hat (MLE)	Camma GOF 1.577 0.745 0.209 0.174 te Distributed at Gamma Stati 11.61 1.062	95% UCLs (Adjusted-for Skowness) 95% Adjusted-CLT UCL (Chen-1995) 95% Modified-t UCL (Johnson-1978) Test Anderson-Darling Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level Kolmogorov-Smirnov Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level S% Significance Level stics	13.88 10.24 1.203
95% Normal UCL 95% Studente-t UCL A-D Test Statistic 5% A-D Critical Value K-S Test Statistic 5% K-S Critical Value Data Not Game k hat (MLE)	Osmma GOF 1.577 0.745 0.209 0.174 va Distributed at Gamma Stati 11.61	95% UCLs (Adjusted-for Skowness) 95% Adjusted-CLT UCL (Chen-1995) 95% Modified-t UCL (Johnson-1978) Test Anderson-Darling Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level Kolmogorov-Smirnov Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level Significance Level stics k star (bias corrected MLE)	13.88
95% Normal UCL 95% Student's-t UCL A-D Test Statistic 5% A-D Critical Value K-S Test Statistic 5% K-S Critical Value Data Not Gamm k hat (MLE) Theta hat (MLE)	Camma GOF 1.577 0.745 0.209 0.174 te Distributed at Gamma Stati 11.61 1.062	95% UCLs (Adjusted-for Skowness) 95% Adjusted-CLT UCL (Chen-1995) 95% Modified-t UCL (Johnson-1978) Test Anderson-Darling Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level Kolmogorov-Smirnov Gamma GOF Test Data Not Gamma Distributed at 5% Significance Level S% Significance Level stics	13.88 10.24 1.203

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97.5% Chebyshev(Mean, Sd) UCL	211.7	99% Chebyshev(Mean, Sd) UCL	277.9
	Suggested UCL	An I fan	
		10 Use	_
95% Adjusted Gamma UCL	139.6		_
When a data set follows an approx	imate (e.g., norm	al) distribution passing one of the GOF test	
When applicable, it is suggested to use a UCL b	ased upon a dist	ribution (e.g., gamma) passing both GOF tests in ProUCL	
		ed to help the user to select the most appropriate 95% UCL.	
		ze, data distribution, and skewness. Ion studies summarized in Singh, Maichle, and Lee (2006).	_
		or additional insight the user may want to consult a statistician.	
	_		-
			_
Total Number of Observations	General Stat		
Total Number of Observations	25	Number of Distinct Observations Number of Missing Observations	23
Minimum	20400	Number of Missing Observations Mean	
Maximum		Median	
SD	10639	Std, Error of Mean	2128
Coefficient of Variation	0.375	Skewness	3,93
	Normal GOF		_
Shapiro Wilk Test Statistic 5% Shapiro Wilk Critical Value		Shapiro Wilk GOF Test Data Not Normal at 5% Significance Level	
Lillefors Test Statistic		Lillefors GOF Text	
5% Lilliefors Critical Value	0,173	Data Not Normal at 5% Significance Level	
Data No	t Normal at 5% S		
	euming Normal I		
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	31992	95% Adjusted-CLT UCL (Chen-1995)	
		95% Modified-t UCL (Johnson-1978)	322/1
	Gamma GOF	Teet	
A-D Test Statistic	2.025	Andereon-Darling Gamma GOF Test	_
5% A-D Critical Value	0.744	Data Not Gamma Distributed at 5% Significance Level	1
K-S Test Statistic		Kolmogorov-Smirnov Gemme GOF Test	
		Data Not Gamma Distributed at 5% Significance Level	1
5% K-S Critical Value		5% Significance Level	
	ma Distributed at		
	Gemme Stat		
Data Not Gam	Gemme Stat	istics	11.02
	Gemme Stat		11.02
Deta Not Gem k hat (MLE)	Gemme Stat 12,49 2269	istics k star (bias corrected MLE)	
Deta Not Gam k hat (MLE) Theta hat (MLE)	Germma Stat 12.49 2269 624.7	stics k star (bias corrected MLE) Theta star (bias corrected MLE) nu star (bias corrected) MLE Sd (bias corrected)	2573 551 8540
beta Not Gam k hat (MLE) Theta hat (MLE) nu hat (MLE) MLE Mean (bias corrected)	Germme Stat 12,49 2269 624,7 28352	tetce k star (bias corrected MLE) Theta star (bias corrected MLE) nu star (bias corrected) MLE Sd (bias corrected) Approximate Chi Square Value (0.05)	2573 551 8540 497.6
Deta Not Gem k hat (MLE) Theta hat (MLE) nu hat (MLE)	Germme Stat 12,49 2269 624,7 28352	stics k star (bias corrected MLE) Theta star (bias corrected MLE) nu star (bias corrected) MLE Sd (bias corrected)	551 8540
Deta Not Gem k hat (MLE) Theta hat (MLE) nu hat (MLE) MLE Mean (bias corrected) Adjusted Level of Significance	Germme Stat 12,49 2269 624,7 28352	k star (bias corrected MLE) Theta star (bias corrected MLE) nu star (bias corrected) MLE Sd (bias corrected) MLE Sd (bias corrected) Approximate Chi Square Value Adjusted Chi Square Value	2573 551 8540 497.6

5% Shapiro Wilk Critical Value	0.918	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.218	Litilefors GOF Test	
5% Lilliefors Critical Value	0.173	Data Not Normal at 5% Significance Level	
Data Not	Normal at 5%	Significance Level	
	uming Norma	al Distribution	
95% Normal UCL	Normally rearran	95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	130.7		134
3376 30001134 002	150.7	95% Adjusted-CLT UCL (Chen-1995)	
		95% Modified-t UCL (Johnson-1978)	131.4
	Gamma Go	DF Test	_
A-D Test Statistic	0.829	Anderson-Darling Gemma GOF Test	
5% A-D Critical Value	0.762	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.148	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.178	Detected data appear Gamma Distributed at 5% Significance	Level
Detected data follow App	r. Gemme Dis	tribution at 5% Significance Level	
	Gamma Si		
k hat (MLE)	1.483	k star (blas corrected MLE)	1.332
Theta hat (MLE)	67.53	Theta star (bias corrected MLE)	75.2
nu hat (MLE)	74.14	nu star (bias corrected)	66.58
MLE Mean (blas corrected)	100.1	MLE Sd (bias corrected)	86,78
		Approximate Chi Square Value (0.05)	48.8
Adjusted Level of Significance	0.0395	Adjusted Chi Square Value	47,76
		BLAS 4	
A# 5% Approximate Gamma UCL (use when n>=50)	136.6	95% Adjusted Gamma UCL (use when n<50)	139.6
			100.0
	Lognormal G	aOF Test	
Shapiro Wilk Test Statistic	0,928	Shapiro Wilk Lognormal GOF Text	
5% Shapiro Wilk Critical Value	0.918	Data appear Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.116	Lillefore Lognormal GOF Test	
5% Lilliefors Critical Value	0.173	Data appear Lognormal at 5% Significance Level	_
Data appear	Lognormal at	5% Significance Level	
	1		
Minimum of Logged Data	Lognormal S	Mean of logged Data	4.233
Maximum of Logged Data	5.778	SD of logged Data	0.886
maximum or cogget bata	5.776	SD of logged Data	0.000
Aasa	ming Lognom	nal Distribution	
95% H-UCL	156.2	90% Chebyshev (MVUE) UCL	159
95% Chebyshev (MVUE) UCL	185.8	97.5% Chebyshev (MVUE) UCL	222.9
99% Chebyshev (MVUE) UCL	295.9		
Nonparame	tric Distributio	n Free UCL Statistics	_
Data appear to follow a D	iscemible Dis	tribution at 5% Significance Level	
		bution Free UCLs	
95% CLT UCL		95% Jackknife UCL	130.7
	100.0	95% Bootstrap-t UCL	138
95% Standard Bootstrap UCL	128.9		
95% Standard Bootstrap UCL 95% Half's Bootstrap UCL	133.5	95% Percentile Bootstrap UCL	129.9
95% Standard Bootstrap UCL			

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/100	uming Normal D	Distribution	
95% Normal UCL		95% UCLs (Adjusted for Skewnees)	
95% Student's-t UCL	66.19	95% Adjusted-CLT UCL (Chen-1995)	70.25
		95% Modified-t UCL (Johnson-1978)	66.93
	Gamma GOF	Test	
A-D Test Statistic	1.463	Anderson-Darling Gemme GOF Test	-
5% A-D Critical Value	0.76	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.21	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0,177	Data Not Gamma Distributed at 5% Significance Level	
	a Distributed at	5% Significance Level	
k hat (MLE)	Gemma Stat	k star (bias corrected MLE)	1.46
K hat (MLE) Theta hat (MLE)	29.93	Theta star (bias corrected MLE)	33.4
	29.93		
nu hat (MLE)		nu star (blas corrected)	73.38
MLE Mean (blas corrected)	49.02	MLE Sd (bias corrected)	40.46
Address 11 - 1 - 1 - 1	0.000-	Approximate Chi Square Value (0.05)	54.65
Adjusted Level of Significance	0.0395	Adjusted Chl Square Value	53.55
Ase	uming Gamma I	Distribution	
95% Approximate Gamma UCL (use when n>=50))	65.81	95% Adjusted Gamma UCL (use when n<50)	67.16
	Lognormel GO	IT Tank	_
Shapiro Wilk Test Statistic	0.91	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.918	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.177	Lillefore Lognormal GOF Teet	
5% Lilliefors Critical Value	0.177	Data Not Lognormal at 5% Significance Level	
		Significance Level	
	Lognormal Sta	tistics	
Minimum of Logged Data	2,485	Mean of logged Data	3.55
Maximum of Logged Data	5,288	SD of logged Data	0.77
Aceu	ming Lognorma	Distribution	
95% H-UCL	66,79	90% Chebyshev (MVUE) UCL	69.7
95% Chebyshev (MVUE) UCL	80.35	97.5% Chebyshev (MVUE) UCL	95.0
99% Chebyshev (MVUE) UCL	123.9		
	No Dist il uni	Free UCL Statistics	
		Ne Distribution (0.05)	_
		tion Free UCLs	
			66,1
95% CLT UCL	65.53	95% Jackknife UCL	
95% CLT UCL 95% Standard Bootstrap UCL	65.53 65.12	95% Bootstrap-t UCL	82.1
95% CLT UCL 95% Standard Bootstrap UCL 95% Hait's Bootstrap UCL	65.53 65.12 76.59		82.1- 67.7
95% CLT UCL 95% Standard Bootstrap UCL 95% Half's Bootstrap UCL 95% BCA Bootstrap UCL	65.53 65.12 76.59 71.19	95% Bootstrap-1 UCL 95% Percentile Bootstrap UCL	67.7
95% CLT UCL 95% Standard Bootstrap UCL 95% Hall's Bootstrap UCL 95% BCA Bootstrap UCL 90% Chebyshev(Mean, Sd) UCL	65.53 65.12 76.59 71.19 79.13	95% Bootstrap-t UCL 95% Percentile Bootstrap UCL 95% Chebyshev(Mean, Sd) UCL	67.7 92.7
95% CLT UCL 95% Standard Bootstrap UCL 95% Half's Bootstrap UCL 95% BCA Bootstrap UCL	65.53 65.12 76.59 71.19	95% Bootstrap-1 UCL 95% Percentile Bootstrap UCL	
95% CLT UCL 95% Standard Bootstrap UCL 95% Half's Bootstrap UCL 95% BCA Bootstrap UCL 90% Chebyshev(Mean, Sd) UCL	65.53 65.12 76.59 71.19 79.13	95% Bootstrap-t UCL 95% Percentile Bootstrap UCL 95% Chebyshev(Mean, Sd) UCL 99% Chebyshev(Mean, Sd) UCL	67.7 92.7

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	Lognormal GOF	Test		
Shapiro Wilk Test Statistic	0.754	Shapiro Wilk Lognormal GOF Test		
5% Shapiro Wilk Critical Value	0.918	Data Not Lognormal at 5% Significance Level		
Lilliefors Test Statistic	0.174	Lillefors Lognormal GOF Test		
5% Littlefors Critical Value	0.173	Data Not Lognormal at 5% Significance Level		
Data Not L	ognormal at 5% Si	gnificance Level		_
	Lognormal State			
Minimum of Logged Data	9.923	Mean of logged Data	10.21	
Maximum of Logged Data	11,23	SD of logged Data	0,259	
	ming Lognormal D			
95% H-UCL		90% Chebyshev (MVUE) UCL		
95% Chebyshev (MVUE) UCL 99% Chebyshev (MVUE) UCL		97.5% Chebyshev (MVUE) UCL	37323	
99% Chebyshev (MVUE) UCL	42/85			
Management	tric Distribution Fr	to LICI Chatleting		
	oliow a Discernible			
Data do fiot a		Disensoration (0.05)		
Nonna	ametric Distributio	n Free LICI a		-
95% CLT UCL		95% Jackknife UCL	31992	
95% Standard Bootstrap UCL		95% Bootstrap-t UCL	36557	 _
95% Hall's Bootstrap UCL		95% Percentile Bootstrap UCL	32332	 _
95% BCA Bootstrap UCL	34608			
90% Chebyshev(Mean, Sd) UCL		95% Chebyshev(Mean, Sd) UCL	37627	
97.5% Chebyshev(Mean, Sd) UCL		99% Chebyshev(Mean, Sd) UCL	49523	
	Suggested UCL to	o Use		
95% Student's-t UCL		ar 95% Modified-t UCL	32271	
Note: Suggestions regarding the selection of a 95%	UCL are provided	to help the user to select the most appropriate 95% UCL.		
Recommendations are bas	sed upon data size	data distribution, and skewness.		
These recommendations are based upon the resu	its of the simulation	n studies summarized in Singh, Maichle, and Lee (2006).		
owever, simulations results will not cover all Real W	/orld data sets; for	additional insight the user may want to consult a statistician		
	General Statis			
	25	Number of Distinct Observations	25	
Total Number of Observations		Number of Missing Observations	0	
Minimum	12	Mean	49.02	
Minimum Maximum	198	Mean Median	26.6	
Minimum Maximum SD	198 50,19	Mean Median Std. Error of Mean	26.6 10.04	
Minimum Maximum	198	Mean Median	26.6	
Minimum Maximum SD	198 50.19 1.024	Mean Median Std. Error of Mean Skowness	26.6 10.04	
Minimum Maximum SD Coefficient of Variation	198 50,19 1.024 Normal GOF T	Mean Median Std. Error of Mean Skowness	26.6 10.04	
Minimum Maximum SD Coefficient of Variation Shapiro Wilk Teat Statistic	198 50.19 1.024 Normal GOF T 0.673	Mean Median Std. Error of Mean Skowness Sext Shapiro Wilk QOF Test	26.6 10.04	
Minimum Maximum SD Coefficient of Variation Shapiro Wilk Test Statistic 5% Shapiro Wilk Critical Value	198 50,19 1.024 Normal GOF T 0.673 0,918	Mean Median Std, Error of Mean Skøwness Stapiro Wilk GOF Test Data Not Normal at 5% Significance Level	26.6 10.04	
Minimum Maximum SD Coefficient of Variation Shapiro Wilk Teat Statistic	198 50.19 1.024 Normal GOF T 0.673 0.918 0.267	Mean Median Std. Error of Mean Skowness Sext Shapiro Wilk QOF Test	26.6 10.04	

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Lead

	Lognormal	Statistics	
Minimum of Logged Data	5.545	Mean of logged Data	6.42
Maximum of Logged Data	8.525	SD of logged Data	0.578
Asse	ming Lognon	mel Distribution	-
95% H-UCL		90% Chebyshev (MVUE) UCL	989.5
95% Chebyshev (MVUE) UCL	1109	97,5% Chebyshev (MVUE) UCL	1276
99% Chebyshev (MVUE) UCL	1603		12.10
		on Free UCL Statistics atribution at 5% Significance Level	
			-
		button Free UCLs	
95% CLT UCL	1088	95% Jackknife UCL	1100
95% Standard Bootstrap UCL	1083	95% Bootstrap-t UCL	1796
95% Hall's Bootstrap UCL	2204	95% Percentile Bootstrap UCL	1139
95% BCA Bootstrap UCL	1313		
90% Chebyshev(Mean, Sd) UCL	1337	95% Chebyshev(Mean, Sd) UCL	1586
97.5% Chebyshev(Mean. Sd) UCL	1932	99% Chebyshev(Mean, Sd) UCL	2612
	Suggested U	ICL to Use	_
95% H-UCL			
			_
Recommendations are bas These recommendations are based upon the resu	ed upon data ts of the simu	vided to help the user to select the most appropriate 95% UCL size, data distribution, and skewness. Ilation studies summarized in Singh, Malchle, and Lee (2006). ;; for additional insight the user may want to consult a statistician.	
Recommendations are bas These recommendations are based upon the resu However, simulations results will not cover all Real V ProUCL computes and output	ed upon data its of the simu orld data sets s H-statistic b	size, data distribution, and skewness. Ilation studies summarized in Singh, Maichle, and Lee (2006), ;; for additional insight the user may want to consult a statistician. seeed UCLs for historical reasons only.	
Recommendations are bas These recommendations are based upon the resu However, simulations results will not cover all Real V ProUCL computes and output H-statistic often results in unstable (both high and	ed upon data ts of the simu orld data sets s H-statistic t d low) values	size, data distribution, and skewness. Iation studies summarized in Singh, Maichle, and Lee (2006). ;; for additional insight the user may want to consult a statistician. vased UCLs for historical reasons only. of UCLB5 as shown in examples in the Technical Guide.	
Recommendations are bas These recommendations are based upon the resu However, simulations results will not cover all Real W ProUCL computes and output H-statistic often results in unstable (both high an It is therefore recommende	ed upon data its of the simu orid data sets a H-statistic b d iow) values d to avoid the	size, data distribution, and skewness. Ilation studies summarized in Singh, Maichle, and Lee (2006), ;; for additional insight the user may want to consult a statistician. seeed UCLs for historical reasons only.	
Recommendations are bas These recommendations are based upon the resu However, simulations results will not cover all Real W ProUCL computes and output H-statistic often results in unstable (both high an It is therefore recommende	ed upon data its of the simu orid data sets a H-statistic b d iow) values d to avoid the	size, data distribution, and skawness. Ilation studies summarized in Singh, Malchie, and Lee (2006). ;; for additional insight the user may want to consult a statistician. pased UCLs for hietorical reasons only. of UCLS5 as shown in examples in the Technical Guide. use of H-statistic based 95% UCLs.	
Recommendations are bas These recommendations are based upon the resu However, simulations results will not cover all Real W ProUCL computes and output H-statistic often results in unstable (both high an It is therefore recommende	ed upon data its of the simu orid data sets a H-statistic b d iow) values d to avoid the	size, data distribution, and skawness. Ilation studies summarized in Singh, Malchie, and Lee (2006). ;; for additional insight the user may want to consult a statistician. pased UCLs for hietorical reasons only. of UCLS5 as shown in examples in the Technical Guide. use of H-statistic based 95% UCLs.	
Recommendations are bas These recommendations are based upon the resu However, simulations results will not cover all Real W ProUCL computes and output H-statistic often results in unstable (both high an It is therefore recommende	ed upon data its of the simu orid data sets a H-statistic b d iow) values d to avoid the	size, data distribution, and skawness. Ilation studies summarized in Singh, Malchie, and Lee (2006). ;; for additional insight the user may want to consult a statistician. pased UCLs for hietorical reasons only. of UCLS5 as shown in examples in the Technical Guide. use of H-statistic based 95% UCLs.	
Recommendations are bas These recommendations are based upon the resu However, simulations results will not cover all Real W ProUCL computes and output H-statistic often results in unstable (both Ngh an It is therefore recommende Use of nonparametric methods are preferred to comp	ed upon data its of the simu orld data sets s H-statistic b d tow) values d to avoid the ute UCL95 for General S	size, data distribution, and skawness. Ilation studies summarized in Singh, Maichle, and Lee (2006). ;; for additional insight the user may want to consult a statistician. vesed UCLs for historical reasons only. of UCLS5 as shown in examples in the Technical Guide. use of H-statistic based 95% UCLs. rekeived data sets which do not follow a gamma distribution. Ratistice	
Recommendations are bas These recommendations are based upon the resu However, simulations results will not cover all Real W ProUCL computes and output H-statistic often results in unstable (both high an It is therefore recommende	ed upon data ts of the simu orld data sets s H-statistic b d to avoid the ute UCL95 for	size, data distribution, and skewness. Ilation studies summarized in Singh, Maichle, and Lee (2006). ;; for additional insight the user may want to consult a statistician. vesed UCLs for historical reasons only. of UCLS as shown in examples in the Technical Guide. use of H-statistic based 95% UCLs. released data sets which do not follow a gamma distribution. Statistics Number of Distinct Observations	19
Recommendations are based upon the resu These recommendations are based upon the resu However, simulations results will not cover all Real W ProUCL computes and output H-statistic often results in unstable (both high and It is therefore recommende Use of nonparametric methods are preferred to comp Total Number of Observations	ed upon data ts of the elmu orid data sets a H-statistic b a H-statistic b d low) values d lo avoid the use UCLS5 for General S 25	size, data distribution, and skewness. Iation studies summarized in Singh, Maichle, and Lee (2006). ;; for additional insight the user may want to consult a statistician, vesed UCLs for historical reasons only. of UCL95 as shown in examples in the Technical Guide. use of H-testifies based 95% UCLs. rekeved data sets which do not follow a gamma distribution. Ratistice Number of Distinct Observations Number of Missing Observations	0
Recommendations are based upon the resu These recommendations are based upon the resu However, simulations results will not cover all Real V ProUCL computes and output H-statistic often results in unstable (both high an It is therefore recommende Use of nonparametric methods are preferred to comp Total Number of Observations Minimum	ed upon data ts of the elmu orid data sets a H-statistic b a H-statistic b d low) values d lo avoid the use UCL95 for General S 25 0,06	size, data distribution, and skawness. Iation studies summarized in Singh, Maichle, and Lee (2006). ;; for additional insight the user may want to consult a statistician. passed UCLs for historical reasons only. of UCL95 as shown in examples in the Technical Guide. use of H-statistic based 85% UCLs. released data sets which do not follow a gamma distribution. Statistics Number of Distinct Observations Number of Missing Observations Mean	0
Recommendations are based upon the result These recommendations are based upon the result However, simulations results will not cover all Real Vu ProUCL computes and output H-statistic often results in unstable (both high an It is therefore recommende Use of nonparametric methods are preferred to comp Total Number of Observations Minimum	ed upon data ts of the simu orid data sets a H-statistic b d low) values d to avoid the use UCLSS for General S 25 0.06 4.4	size, data distribution, and skewness. Iation studies summarized in Singh, Malchle, and Lee (2006). ;; for additional insight the user may want to consult a statistician. Desed UCLs for historical reseans only. of UCLS5 as shown in summples in the Technical Guide. use of H-statistic based 95% UCLs. reserved data sets which do not follow a gamma distribution. Ratesics Number of Distinct Observations Number of Missing Observations Mean Median	0 0.75 0.38
Recommendations are based upon the resu These recommendations are based upon the resu However, simulations results will not cover all Real V ProUCL computes and output H-statistic often results in unstable (both high an It is therefore recommende Use of nonparametric methods are preferred to comp Total Number of Observations Minimum	ed upon data ts of the elmu orid data sets a H-statistic b a H-statistic b d low) values d lo avoid the use UCL95 for General S 25 0,06	size, data distribution, and skawness. Iation studies summarized in Singh, Maichle, and Lee (2006). ;; for additional insight the user may want to consult a statistician. passed UCLs for historical reasons only. of UCL95 as shown in examples in the Technical Guide. use of H-statistic based 85% UCLs. released data sets which do not follow a gamma distribution. Statistics Number of Distinct Observations Number of Missing Observations Mean	0 0.75 0.38 0.19
Recommendations are based upon the result These recommendations are based upon the result However, simulations results will not cover all Real W ProUCL computes and output H-statistic often results in unstable (both high an It is therefore recommende Use of nonparametric methods are preferred to comp Total Number of Observations Minimum Maximum	ed upon data ts of the simu orid data sets a H-strittetic L 4 low) values d to avoid the d to avoid the UCLS5 for 0.06 4.4 0.954 1.265	size, data distribution, and skewness. Ilation studies summarized in Singh, Maichle, and Lee (2006). ;; for additional insight the user may want to consult a statistician. passed UCLs for historical reasons only. of UCL95 as shown in examples in the Technical Guide. use of H-testifiesc based 95% UCLs. reasoned data sets which do not follow a gamma distribution. Ratistice Number of Distinct Observations Number of Distinct Observations Mean Median Std. Error of Mean Skewness	0 0.75 0.38 0.19
Recommendations are based upon the result These recommendations are based upon the result However, simulations results will not cover all Real V ProUCL computes and output H-statistic often results in unstable (both high and It is therefore recommende Use of nonparametric methods are preferred to comp Total Number of Observations Minimum Maximum SD Coefficient of Variation	ed upon data ts of the simu orid data sets as H-statistic Li dow) values d to avoid the use UCLSS for 0.06 4.4 0.954 1.265	size, data distribution, and skewness. Iation studies summarized in Singh, Maichle, and Lee (2006). ;; for additional insight the user may want to consult a statistician. passed UCLs for historical reasons only. of UCL95 as shown in examples in the Technical Guide. use of H-testifisic based 85% UCLs. reasonad data sets which do not follow a gamma distribution. Ratifietics Number of Distinct Observations Number of Missing Observations Mean Median Std. Error of Mean Skewness OF Teet	0 0.75 0.38 0.19
Recommendations are based upon the result These recommendations are based upon the result However, simulations results will not cover all Real Vu ProUCL computes and output H-statistic often results in unstable (both high an It is therefore recommende Use of nonparametric methods are preferred to comp Total Number of Observations Minimum Maximum SD Coefficient of Variation	ed upon data ts of the simu orid data sets a H-statistic b d low) values d to avoid the tate UCLSS for General S 25 0.06 4.4 0.954 1.265 Normal G 0.694	size, data distribution, and skewness. Ilation studies summarized in Singh, Malchle, and Lee (2006), ;; for additional insight the user may want to consult a statistician. Desed UCLs for historical reseans only. of UCLS5 as shown in scamples in the Technical Guide. use of H-testific based 95% UCLs. reserved data sets which do not follow a gamma distribution. Ratestice Number of Distinct Observations Maan Median Std. Error of Mean Std. Error of Mean Std. Error of Mean Std. Error of Mean Std. Error of Mean	
Recommendations are based upon the result These recommendations are based upon the result However, simulations results will not cover all Real W ProUCL computes and output H-statistic often results in unstable (both high and It is therefore recommende Use of nonparametric methods are preferred to comp Total Number of Observations Minimum Maximum SD Coefficient of Variation Shapiro Wilk Test Statistic 5% Shapiro Wilk Critical Value	ed upon data ts of the simu orid data sets a H-strittetic h I low) values d to avoid the ute UCL95 for d to avoid the UCL95 for d to avoid the ute UCL95 for d to avoid the d to av	size, data distribution, and skawness. Iation studies summarized in Singh, Maichle, and Lee (2006). s; for additional insight the user may want to consult a statistician. vesed UCLs for historical reasons only. of UCL95 as shown in examples in the Technical Guide. use of H-testistic based 95% UCLs. rekewed data sets which do not follow a gamma distribution. Ratistics Number of Distinct Observations Number of Distinct Observations Mean Median Std. Error of Mean Std. Error of Mean Std. Error of Mean Std. Brosses OF Teet Data Not Normal at 5% Significance Level	0 0.75 0.38 0.19
Recommendations are based upon the resu These recommendations are based upon the resu However, simulations results will not cover all Real W ProUCL computes and output H-statistic often results in unstable (both high and It is therefore recommende Use of nonparametric methods are preferred to comp Total Number of Observations Minimum Maximum SD Coefficient of Variation Shapiro Wilk Test Statistic 5% Shapiro Wilk Critical Value Lilliefors Test Statistic	ed upon data ts of the simu orid data sets as H-statistic L 5 low) values d to avoid the uto UCLS5 for Ceneral S 25 0.06 4.4 0.954 1.265 Normal CP 0.618 0.918 0.918	size, data distribution, and skewness. lation studies summarized in Singh, Maichle, and Lee (2006). ;; for additional insight the user may want to consult a statistician, vesed UCLs for hietorical reasons only. of UCL95 as shown in examples in the Technical Guide. use of H-testifie's based 95% UCLs. released data sets which do not follow a gamma distribution. Ratistice Number of Distinct Observations Number of Missing Observations Mean Median Std. Error of Mean Std. Er	0 0.75 0.38 0.19
Recommendations are based upon the resu These recommendations are based upon the resu However, simulations results will not cover all Real V ProUCL computes and output H-statistic often results in unstable (both high and It is therefore recommende Use of nonparametric methods are preferred to comp Total Number of Observations Minimum Maximum SD Coefficient of Variation Shapiro Wilk Critical Value Lillefors Test Statistic 5% Lillefors Critical Value	ed upon data ts of the simu orid data sets a H-strittetic L 5 low) values d to avoid the tab UCLS5 for 0.06 4.4 0.954 1.265 Normal G 0.694 0.694 0.233 0.213	size, data distribution, and skewness. Iation studies summarized in Singh, Maichle, and Lee (2006), ;; for additional insight the user may want to consult a statistician, based UCLs for historical reasons only. of UCL95 as shown in examples in the Technical Guide. use of H-testifie's based 95% UCLs. reasoned data sets which do not follow a gamma distribution. Ratistice Number of Distinct Observations Number of Distinct Observations Mean Median Std. Error of Mean Skewness OF Test Data Not Normal at 5% Significance Level Lillefors GOP Test Data Not Normal at 5% Significance Level	0 0.75 0.38 0.19
Recommendations are based upon the resu These recommendations are based upon the resu However, simulations results will not cover all Real V ProUCL computes and output H-statistic often results in unstable (both high and It is therefore recommende Use of nonparametric methods are preferred to comp Total Number of Observations Minimum Maximum SD Coefficient of Variation Shapiro Wilk Critical Value Lillefors Test Statistic 5% Lillefors Critical Value	ed upon data ts of the simu orid data sets a H-strittetic L 5 low) values d to avoid the tab UCLS5 for 0.06 4.4 0.954 1.265 Normal G 0.694 0.694 0.233 0.213	size, data distribution, and skewness. lation studies summarized in Singh, Maichle, and Lee (2006). ;; for additional insight the user may want to consult a statistician, vesed UCLs for hietorical reasons only. of UCL95 as shown in examples in the Technical Guide. use of H-testifie's based 95% UCLs. released data sets which do not follow a gamma distribution. Ratistice Number of Distinct Observations Number of Missing Observations Mean Median Std. Error of Mean Std. Er	0 0.75 0.38 0.19

Note: Currentiene comprise the coloritor of a OE0		and the hole the unset of a state of the most supported by DEV (10)	
		ed to help the user to select the most appropriate 95% UCL. ze, data distribution, and skewness.	
		ion studies summarized in Singh, Maichle, and Lee (2006).	
		or additional insight the user may want to consult a statistician.	_
However, simulations results will not cover all Real vi	Aond data sets; ro	or additional insight the user may want to consult a statistician,	
anganese			
	General Stat	ietics	
Total Number of Observations	25	Number of Distinct Observations	24
		Number of Missing Observations	0
Minimum	256	Mean	786
Maximum	5040	Median	562
SD	917.8	Std. Error of Mean	183.6
Coefficient of Variation	1.168	Skewness	4.47
	Normal GOF	Test	
Shapiro Wilk Test Statistic	0.429	Shapiro Wilk GOF Test	-
5% Shapiro Wilk Critical Value	0.918	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic.	0.306	Liflefors GOF Test	
5% Littlefors Critical Value	0.173	Data Not Normal at 5% Significance Level	
Data Not	Normal at 5% S	ignificance Level	
	euming Normal I	Natellisetian	
95% Normal UCL	enumb reation t	95% UCLs (Adjusted for Skewness)	_
95% Student's-t UCL	1100	95% Adjusted-CLT UCL (Chen-1995)	1263
35% Students-COCL	1100	95% Modified-t UCL (Johnson-1978)	11203
		35 % Modified CCE (Sofilisor 1978)	112/
	Gamma GOF	Test	
A-D Test Statistic	2.156	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.755	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.218	Kolmogorov-Smirnov Gemme GOF Test	2.5
5% K-S Critical Value	0.177	Data Not Gamma Distributed at 5% Significance Level	1
Data Not Gam	ne Distributed at	5% Significance Level	
	Gamma Stat	letica	
k hat (MLE)	2.232	k star (blas corrected MLE)	1.99
Theta hat (MLE)	352.1	Theta star (bias corrected MLE)	394.8
nu hat (MLE)	111.6	nu star (blas corrected)	99.54
MLE Mean (bias corrected)	786	MLE Sd (blas corrected)	557,1
		Approximate Chi Square Value (0.05)	77.52
Adjusted Level of Significance	0.0395	Adjusted Chi Square Value	76.2
A=	suming Gamma I	Distribution	-
95% Approximate Gamma UCL (use when n>=50))	-	95% Adjusted Gamma UCL (use when n<50)	1027
Observices 18.00 mm - do. st. of	Lognormal GO		
Shapiro Wilk Test Statistic	0.838	Shaptro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.918	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.17	Litilefors Lognormal GOF Test	
5% Lilliefors Critical Value	0,173	Data appear Lognormal at 5% Significance Level	

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		size, data distribution, and skewness.	
		ation studies summarized in Singh, Maichle, and Lee (2006).	
However, simulations results will not cover all Real Wo	orid data sets;	for additional insight the user may want to consult a statistician.	-
	General St	atistics	
Total Number of Observations	25	Number of Distinct Observations	22
		Number of Missing Observations	0
Minimum	21.4	Mean	35.39
Maximum	52.1	Median	33.4
SD	9.049	Std. Error of Mean	1.81
Coefficient of Variation	0.256	Skewness	0.15
	Normal GO	DF Test	
Shapiro Wilk Test Statistic	0.956	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0,918	Data appear Normal at 5% Significance Level	
Lilliefors Test Statistic	0.132	Lillefors GOF Test	
5% Lilliefors Critical Value	0.173	Data appear Normal at 5% Significance Level	
Data appea	r Normal at 5	% Significance Lavel	
	ruming Norma		
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	38.49	95% Adjusted-CLT UCL (Chen-1995)	38.43
		95% Modified-t UCL (Johnson-1978)	38.5
	Gamma G	OF Test	_
A-D Test Statistic	0.367	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.744	Detected data appear Gamma Distributed at 5% Significance	Level
K-S Test Statistic	0.121	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.174	Detected data appear Gamma Distributed at 5% Significance	Level
Detected data appear	Gemma Dietri	buted at 5% Significance Level	
	Gamma S	biblics	
k hat (MLE)	15.53	k star (bias corrected Mi_E)	13.69
Theta hat (MLE)	2.279	Theta star (bias corrected MLE)	2.58
nu hat (MLE)	776.4	nu star (bias corrected)	684.6
MLE Mean (blas corrected)	35,39	MLE Sd (blas corrected)	9.56
		Approximate Chi Square Value (0.05)	624.9
Adjusted Level of Significance	0,0395	Adjusted Chi Square Value	621
A	umba Garrie	ne Distribution	
95% Approximate Gamma UCL (use when n>=50))	38.77	95% Adjusted Gamma UCL (use when n<50)	39.02
,	-		
	Lognormal		
Shapiro Wilk Test Statistic	0.955	Shapiro Wilk Lognormal GOF Text	_
5% Shapiro Wilk Critical Value	0.918	Data appear Lognormal at 5% Significance Level	
Lillefors Test Statistic	0.125	Lilliefors Lognormai GOF Test	
5% Lilliefors Critical Value	0.173	Data appear Lognormal at 5% Significance Level	
	I a manual - *	5% Significance Level	

95% Normai UCL 95% UCLs (Adjusted for Skewness) 95% Student's-t UCL 1.081 95% Adjusted-CLT UCL (Chen-1995) 1.177 95% Modified-t UCL (Johnson-1978) 1.098 Gamma GOF Test A-D Test Statistic 0.49 Anderson-Darling Gamma GOF Test 5% A-D Critical Value 0.774 Detected data appear Gamma Distributed at 5% Significance Level K-S Test Statistic 0.145 Kolmogorov-Smirnov German GOF Test 5% K-S Critical Value 0.18 Detected data appear Gamma Distributed at 5% Significance Level Detected data appear Gamma Distributed at 5% Significance Level Gamma Statistics k hat (MLE) 0.966 k star (bias corrected MLE) 0,876 Theta hat (MLE) 0.781 Theta star (bias corrected MLE) 0.861 nu hat (MLE) 48.28 nu star (bias corrected) 43.82 MLE Mean (bias corrected) 0.754 MLE Sd (bias corrected) 0.806 Approximate Chi Square Value (0.05) 29.64 Adjusted Level of Significance 0.0395 Adjusted Chi Square Value 28.85 Assuming Gamma Distribution 95% Approximate Gamma UCL (use when n>=50) 1.115 95% Adjusted Gamma UCL (use when n<50) 1.146 Lognormal GOF Test Shapiro Wilk Test Statistic 0.975 Shapiro Wilk Lognormal GOF Text 5% Shapiro Wilk Critical Value 0.918 Data appear Lognormal at 5% Significance Level Lilliefors Test Statistic 0.0957 Lillefors Lognormal GOF Test 5% Lilliefors Critical Value 0.173 Data appear Lognormal at 5% Significance Level Deta appear Lognormal at 5% Significance Level Lognormal Statistics Minimum of Logged Data -2.813 Mean of logged Data -0.882 Maximum of Logged Data 1.482 SD of logged Data 1.13 Assuming Lognormal Distribution 95% H-UCL 1.448 90% Chebyshev (MVUE) UCL 1.347 95% Chebyshev (MVUE) UCL 1.616 97.5% Chebyshev (MVUE) UCL 1.99 99% Chebyshev (MVUE) UCL 2.723 Nonparametric Distribution Free UCL Statistics Data appear to follow a Discernible Distribution at 5% Significance Level Nonperametric Distribution Free UCLs 95% CLT UCL 1.068 95% Jackknife UCL 1.081 95% Standard Bootstrap UCL 1.062 95% Bootstrap-t UCL 1.29 95% Half's Bootstrap UCL 2.353 95% Percentile Bootstrap UCL 1.066 95% BCA Bootstrap UCL 1.17 90% Chebyshev(Mean, Sd) UCL 1.327 95% Chebyshev(Mean, Sd) UCL 1.586 97.5% Chebyshev(Mean, Sd) UCL 1.946 99% Chebyshev(Mean, Sd) UCL 2.653 Suggested UCL to Use 95% Adjusted Gamma UCL 1.146 Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL.

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Deta Not Gamma D k hat (MLE) k hat (MLE) Theta hat (MLE) MLE Mean (blas corrected) Adjusted Level of Significance Adjusted Level of Significance S% Approximate Gamma UCL (use when n>=50)) Lo Shapiro Wilk Test Statistic	German Statisti 4.437 0.0751 21.8 0.0333 0.0395 0.0395 0.397 0.397 0.397 0.918	k star (blas corrected MLE) Theta star (blas corrected MLE) nu star (blas corrected MLE) MLE Sd (blas corrected) MLE Sd (blas corrected) Approximate Cht Square Value (0.05) Adjusted Cht Square Value ethbution 95% Adjusted Gamma UCL (use when n<50)	3.931 0.0844 196.5 0.168 165.1 163.1
k hat (MLE) 4 Theta hat (MLE) 4 nu hat (MLE) 22 MLE Mean (blas corrected) (Adjusted Level of Significance 0 Adjusted Level of Significance 0 Adjusted Level of Significance 0 Shapiro Wilk Test Statistic (German Statisti 4.437 0.0751 21.8 0.0333 0.0395 0.0395 0.397 0.397 0.397 0.918	ice k star (bias corrected MLE) Theta star (bias corrected MLE) nu star (bias corrected) MLE 54 (bias corrected) MLE 54 (bias corrected) Approximate Chi Square Value (0.05) Adjusted Chi Square Value etitbution 95% Adjusted Gamma UCL (use when n<50) Test	0.0844 196.5 0.168 165.1 163.1
k hat (MLE) 4 Theta hat (MLE) 0 nu hat (MLE) 22 MLE Mean (bias corrected) (Adjusted Level of Significance 0 Adjusted Level of Significance 0 5% Approximate Gamma UCL (use when n>=50)) (Shapiro Wilk Test Statistic (4.437 0.0751 21.8 0.333 0.0395 0.397 0.397 0.397 0.79 0.918	k star (blas corrected MLE) Theta star (blas corrected MLE) nu star (blas corrected MLE) nu star (blas corrected) MLE Sd (blas corrected) Approximate Chi Square Value (0.5) Adjusted Chi Square Value stribution 95% Adjusted Gamma UCL (use when n<50) Test	0.084 196.5 0.168 165.1 163.1
k hat (MLE) 4 Theta hat (MLE) 0 nu hat (MLE) 22 MLE Mean (bias corrected) (Adjusted Level of Significance 0 Adjusted Level of Significance 0 5% Approximate Gamma UCL (use when n>=50)) (Shapiro Wilk Test Statistic (4.437 0.0751 21.8 0.333 0.0395 0.397 0.397 0.397 0.79 0.918	k star (blas corrected MLE) Theta star (blas corrected MLE) nu star (blas corrected MLE) nu star (blas corrected) MLE Sd (blas corrected) Approximate Chi Square Value (0.5) Adjusted Chi Square Value stribution 95% Adjusted Gamma UCL (use when n<50) Test	0.084 196.5 0.168 165.1 163.1
Theta hat (MLE) 0 nu hat (MLE) 22 MLE Mean (blas corrected) 0 Adjusted Level of Significance 0 S% Approximate Gamma UCL (use when n>=50)) 0 Lo Shapiro Wlik Test Statistic	0.0751 21.8 0.333 0.0395 0.397 0.397 0.397 0.397 0.397 0.979 0.918	Theta star (bias corrected MLE) nu star (bias corrected) MLE Sd (bias corrected) Approximate Chi Square Value (0.05) Adjusted Chi Square Value stribution 95% Adjusted Gamma UCL (use when n<50) Test	0.084 196.5 0.168 165.1 163.1
nu hat (MLE) 22 MLE Mean (blas corrected) (Adjusted Level of Significance 0 Adjusted Level of Significance 0 Aesumi 5% Approximate Gamma UCL (use when n>=50)) (Lo Shapiro Wilk Test Statistic (21.8 0.333 0.0395 0.395 0.397 0.397 0.79 0.918	nu star (bias corrected) MLE Sd (bias corrected) Approximate Chi Square Value (0.05) Adjusted Chi Square Value stribution 95% Adjusted Gamma UCL (use when n<50) Test	196.5 0.168 165.1 163.1
MLE Mean (blas corrected) C Adjusted Level of Significance O Adjusted Level of Significance O 5% Approximate Gamma UCL (use when n>=50)) C Lo Lo Shapiro Wlik Test Statistic C	0.333 0.0395 Ing Gemme Di 0.397 Ognormal GOF 0.79 0.918	MLE Sd (blas corrected) Approximate Chi Square Value (0.05) Adjusted Chi Square Value stribution 95% Adjusted Gamma UCL (use when n<50) Test	0.168 165.1 163.1
Adjusted Level of Significance 0 Aesumi 5% Approximate Gamma UCL (use when n>=50)) Lo Shapiro Wilk Test Statistic (0.0395 Ing Gemme Di 0.397 ognormal GOF 0.79 0.918	Approximate Chi Square Value (0.05) Adjusted Chi Square Value ethtution 95% Adjusted Gamma UCL (use when n<50) Test	165.1 163.1
Assum 5% Approximate Gamma UCL (use when n>=50)) (Lo Shapiro Wilk Test Statistic (ognormal GOF 0.79 0.79 0.918	Adjusted Chi Square Value attitution 95% Adjusted Gamma UCL (use when n<50) Test	
Assum 5% Approximate Gamma UCL (use when n>=50)) (Lo Shapiro Wilk Test Statistic (ognormal GOF 0.79 0.79 0.918	atribution 95% Adjusted Gamma UCL (use when n<50)	
5% Approximate Gamma UCL (use when n>=50)) (Lo Shapiro Wilk Test Statistic (0.397 ognormal GOF 0.79 0.918	95% Adjusted Gamma UCL (use when n<50)	0.401
5% Approximate Gamma UCL (use when n>=50)) (Lo Shapiro Wilk Test Statistic (0.397 ognormal GOF 0.79 0.918	95% Adjusted Gamma UCL (use when n<50)	0.401
Shapiro Wilk Test Statistic	0.79		
Shapiro Wilk Test Statistic	0.79		
	0.918	Shapiro Wik Lognormal GOF Test	
ere enapse come enabel come		Data Not Lognormal at 5% Significance Level	_
	0.271	Lillefore Lognormal GOF Test	
	0.173	Data Not Lognormal at 5% Significance Level	
Data Not Logno	ormal at 5% Sk	gnificance Level	
	ognormal Statis		
Minimum of Logged Data -1	1.715	Mean of logged Data	-1.216
Maximum of Logged Data -0.	.0834	SD of logged Data	0.446
Assumin	ng Lognormal D	Distribution	
95% H-UCL	0.39	90% Chebyshev (MVUE) UCL	0.416
95% Chebyshev (MVUE) UCL	0.457	97.5% Chebyshev (MVUE) UCL	0.514
99% Chebyshev (MVUE) UCL	0.625		
		ee UCL Statistics	_
Data do not follow	r a Discernible	Distribution (0.05)	
	eiric Distributio		
0070 021 002	0.4	95% Jackknife UCL	0.402
	0.399	95% Bootstrap-t UCL	0.453
our renting between been	0.42	95% Percentile Bootstrap UCL	0.403
	0.418		
	0.455	95% Chebyshev(Mean, Sd) UCL	0.51
97,5% Chebyshev(Mean, Sd) UCL	0,586	99% Chebyshev(Mean, Sd) UCL	0.736
Star	ggested UCL to	o Uae	
	0.402	or 95% Modified-t UCL	0.405
Note: Suggestions regarding the selection of a 95% LIC	L are provided	to help the user to select the most appropriate 95% UCL.	
		, data distribution, and skewness.	
		n studies summarized In Singh, Maichle, and Lee (2006).	_
wever, simulations results will not cover all Real World	uata sets; for a	additional insight the user may want to consult a statistician.	
17187 - 17181			_

Minimum of Logged Data 3.063 Mean of logged Data 3.534 Maximum of Logged Data 3.953 SD of logged Data 0.263 Assuming Lognormal Distribution 95% H-UCL 39.05 90% Chebyshev (MVUE) UCL 41.08 95% Chebyshev (MVUE) UCL 43.65 97.5% Chebyshev (MVUE) UCL 47.21 99% Chebyshev (MVUE) UCL 54.2 Nonparametric Distribution Free UCL Statistics Data appear to follow a Discernible Distribution at 5% Significance Level Nonperametric Distribution Free UCLs 95% CLT UCL 38,37 95% Jackknife UCL 38.49 95% Standard Bootstrap UCL 38.33 95% Bootstrap-t UCL 38.44 95% Hall's Bootstrap UCL 38.46 95% Percentile Bootstrap UCL 38.29 95% BCA Bootstrap UCL 38.29 90% Chebyshev(Mean, Sd) UCL 40.82 95% Chebyshev(Mean, Sd) UCL 43.28 97.5% Chebyshev(Mean, Sd) UCL 46.69 99% Chebyshev(Mean, Sd) UCL 53.4 Suggested UCL to Use 95% Student's-t UCL 38.49 Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. Recommendations are based upon data size, data distribution, and skewness. These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006). However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statistician. Selenium **General Statistics** Total Number of Observations 25 Number of Distinct Observations 15 Number of Missing Observations 0 Mean 0,333 Minimum 0.18 Maximum 0.92 Median 0.26 Std. Error of Mean 0.0405 SD 0.203 Skewness 2.193 Coefficient of Variation 0.608 Normal GOF Test Shapiro Wilk Test Statistic 0.646 Shapiro Wilk GOF Test 5% Shapiro Wilk Critical Value 0.918 Data Not Normal at 5% Significance Level Lilliefors Test Statistic 0.325 Lillefors GOF Test 5% Lilliefors Critical Value 0.173 Data Not Normal at 5% Significance Level Data Not Normal at 5% Significance Level Assuming Normal Distribution 95% UCLs (Adjusted for Skewnees) 95% Normal UCL 95% Student's-t UCL 0.402 95% Adjusted-CLT UCL (Chen-1995) 0.419 95% Modified-t UCL (Johnson-1978) 0.405 Gamme GOF Test A-D Test Statistic 2.653 Anderson-Darling Gemma GOF Test 5% A-D Critical Value 0.748 Data Not Gamma Distributed at 5% Significance Level

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A1	la Distrikutio		
		ree UCL Statistics e Distribution (0.05)	
	IOW & Discotling	e Distribution (0.05)	
Nonpara	metric Distribut	on Free UCLs	
95% CLT UCL	1.109	95% Jackknife UCL	1,122
95% Standard Bootstrap UCL	1.107	95% Bootstrap-t UCL	1,133
95% Hall's Bootstrap UCL	1.133	95% Percentile Bootstrap UCL	1.124
95% BCA Bootstrap UCL	1.122		
90% Chebyshev(Mean, Sd) UCL	1.359	95% Chebyshev(Mean, Sd) UCL	1.61
97,5% Chebyshev(Mean, Sd) UCL	1.958	99% Chebyshev(Mean, Sd) UCL	2.641
	Suggested UCL	to Use	_
95% Chebyshev (Mean, Sd) UCL	1.61		_
		d to help the user to select the most appropriate 95% UCL.	
		e, data distribution, and skewness.	
		on studies summarized in Singh, Malchle, and Lee (2006).	
However, simulations results will not cover all Real Wo	orld data sets; fo	r additional insight the user may want to consult a statistician.	
lium			
	General Stati		
Total Number of Observations	25	Number of Distinct Observations	18
	20	Number of Missing Observations	0
Minimum	0.09	Mean	0.43
Maximum	2.6	Median	0.2
SD	0.716	Std. Error of Mean	0.14
Coefficient of Variation	1,649	Skewness	2.52
			-
	Normal GOF		
Shapiro Wilk Test Statistic	0.498	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.918	Data Not Normal at 5% Significance Level	
Lillefors Test Statistic	0.41	Lillefors GOF Test	
5% Lillefors Critical Value	0,173	Data Not Normal at 5% Significance Level	
Data Not	Normal at 5% S	ignificance Lavel	
Ası	uming Normal I	Distribution	
95% Normal UCL		95% UCLs (Adjusted for Skewmens)	
95% Student's-t UCL	0,679	95% Adjusted-CLT UCL (Chen-1995)	0.74
		95% Modified-t UCL (Johnson-1978)	0.69
	Gamma GOF	Test	
A-D Test Statistic	3.398	Anderson-Darting Gamma GOF Test	
5% A-D Critical Value	0.779	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.311	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0,18	Data Not Gamma Distributed at 5% Significance Level	-
Data Not Gamm	a Distributed at	5% Significance Level	
	Germe Stat	tanca.	
			0.77
k hat (MLE) Theta hat (MLE)	0.869	k star (bias corrected MLE) Theta star (bias corrected MLE)	0.79

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	General Statis	ites .	
Total Number of Observations	25	Number of Distinct Observations	15
		Number of Missing Observations	0
Minimum	0.06	Mean	0.80
Maximum	3,1	Median	0.18
SD	0.922	Std. Error of Mean	0.18
Coefficient of Variation	1.144	Skewness	0.98
	Numerica Contra		
01 - 1 - 1400 - 2 - 4 04 - 4 - 4	Normal GOF	Shaptro Wilk GOF Test	
Shapiro Wilk Test Statistic			
5% Shapiro Wilk Critical Value	0.918	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic		Lillefors GOF Test	_
5% Littlefors Critical Value	0.173	Data Not Normal at 5% Significance Level	
Deta Not	Normal at 5% Sk	gnificence Level	
Aar	uming Normal D	Istribution	
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	1.122	95% Adjusted-CLT UCL (Chen-1995)	1.1
		95% Modified-t UCL (Johnson-1978)	1.
			-
	Gemma GOF	Test	_
A-D Test Statistic	1.865	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.79	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.231	Kolmogorov-Smirnov Gamma GOF Test	
5% K-S Critical Value	0.182	Data Not Gamma Distributed at 5% Significance Level	
	A	-	
k hat (MLE)	Gemme Stati	k star (bias corrected MLE)	0.6
Theta hat (MLE)	1.188	Theta star (bias corrected MLE)	1.
nu hat (MLE)	33.92	nu star (bias corrected)	31
MLE Mean (bias corrected)	0.806	MLE Sd (bias corrected)	1.0
		Approximate Chi Square Value (0.05)	19
Adjusted Level of Significance	0.0395	Adjusted Chi Square Value	18
		·····	
95% Approximate Gamma UCL (use when n>=50))	uming Gamma I 1,294	95% Adjusted Gamma UCL (use when n<50)	12
	l	······································	-
	Lognormai GO		
Shapiro Wilk Test Statistic	0.834	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.918	Data Not Lognormal at 5% Significance Level	
Lilliefors Test Statistic	0.225	Lillefors Lognormal GOF Test	
5% Lilliefors Critical Value	0,173	Data Not Lognormal at 5% Significance Level	
Dete Not L	ognormal at 5% :	Significance Lavel	
	Lognormal Sta	datics	-
Minimum of Logged Data	-2.813	Mean of logged Data	-1.1
Maximum of Logged Data	1.131	SD of logged Data	1.
Ann	iming Lognormal	Distribution	
95% H-UCL	2.485	90% Chebyshev (MVUE) UCL	1
95% Chebyshev (MVUE) UCL	2.465	97.5% Chebyshev (MVUE) UCL	2
99% Chebyshev (MVUE) UCL	4.096		diay 1
32 YO CHEDYSHEY (MYYOC) OCL	4.000		

	Normal GC	DF Teet	
Shapiro Wilk Test Statistic	0.98	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.918	Data appear Normal at 5% Significance Level	
Littlefors Test Statistic	0.0788	Lillefors GOF Test	
5% Lilliefors Critical Value	0.173	Data appear Normal at 5% Significance Level	
Data apper	r Normal at 5	% Significance Level	
			_
	suming Norma		
95% Normal UCL		95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	32.61	95% Adjusted-CLT UCL (Chen-1995)	32.59
		95% Modified-t UCL (Johnson-1978)	32,62
	Gamma G	OF Test	_
A-D Test Statistic	0.189	Anderson-Darling Gamma GOF Test	
5% A-D Critical Value	0.189		
		Detected data appear Gamma Distributed at 5% Significance	Level
K-S Test Statistic 5% K-S Critical Value	0.0861	Kolmogorov-Smirnov Gamma GOF Test	
		Detected data appear Gamma Distributed at 5% Significance buted at 5% Significance Level	Level
Constant onto appear		Dated at 5 % organicalities Larter	
	Gemme S	atistics	
k hat (MLE)	41.78	k star (bias corrected MLE)	36.79
Theta hat (MLE)	0,741	Theta star (bias corrected MLE)	0.84
nu hat (MLE)	2089		1840
MLE Mean (bias corrected)	30,94	MLE Sd (blas corrected)	5.10
	00.01		1741
Adjusted Level of Significance	0.0395		1734
	uming Gamm		
95% Approximate Gamma UCL (use when n>=50))	32.69	95% Adjusted Gamma UCL (use when n<50)	32,82
	Lognormal	OF Test	
Shapiro Wilk Test Statistic	0.981	Shapiro Wilk Lognormal GOF Test	_
5% Shapiro Wilk Critical Value	0.918	Data appear Lognormal at 5% Significance Level	
Lillefors Test Statistic	0.0833	Lillefors Lognormal GOF Test	
5% Lillefors Critical Value	0.0833	Data appear Lognormal at 5% Significance Level	
		5% Significance Level	
	Colling and		
	Lognormal	Statistics	
Minimum of Logged Data	3.114	Mean of logged Data	3.42
Maximum of Logged Data	3.735	SD of logged Data	0,15
	-		
95% H-UCL	32.75	90% Chebyshev (MVUE) UCL	33.9
95% Chebyshev (MVUE) UCL	32.75	90% Chebyshev (MVUE) UCL 97,5% Chebyshev (MVUE) UCL	33.9
95% Chebyshev (MVUE) UCL 99% Chebyshev (MVUE) UCL	35,24	97.5% Chebysnev (MVUE) UCL	37.11
22 % Chabyanav (MVOE) OCL	-10.70		
Nonperame	tric Distributio	n Free UCL Statistics	
	iscemible Dis	tribution at 5% Significance Level	
Data appear to follow a D			
	matric Distri	Notion Eres 11/1 a	_
	ametric Distri	button Free UCLs 95% Jackknife UCL	32.61

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a) -1.5	95% Adjusted Gamma UCL (use when n<50) Test Shapiro Wilk Lognormal QOF Test Data Not Lognormal at 5% Significance Level Lillietors Lognormal GOF Test Data Not Lognormal at 5% Significance Level milicance Level	43.45 0.434 0.0395 xuming Gemma 0.656 Lognormal G 0.777 0.918 0.206 0.173 ognormal at 59	nu hat (MLE) MLE Meen (bias corrected) Adjusted Level of Significance 95% Approximate Gamma UCL (use when n>=50) Shapiro Wilk Test Statistic 5% Shapiro Wilk Test Statistic 5% Shapiro Wilk Test Statistic 5% Ullifotors Test Statistic 5% Lillifotors Critical Value
b) 26.1 e 25.4 0) 0.6	Approximate Chi Square Value (0.05) Adjusted Chi Square Value tribution 95% Adjusted Gamma UCL (use when n<50) Feet Shepiro Wilk Lognormal GOF Teet Data Not Lognormal at 5% Significance Level Lilliefore Lognormal GOF Teet Data Not Lognormal at 5% Significance Level milicance Level	0.0395 suming Germine 0.656 Lognermei G 0.777 0.918 0.206 0.173	Adjusted Level of Significance Asso 95% Approximate Gamma UCL (use when n>=50)) Shapiro Wilk Test Statistic 5% Shapiro Wilk Critical Value Lilliefors Test Statistic
a -1.5	Adjusted Chi Square Value strbution 95% Adjusted Gamma UCL (use when n<50) Fest Shapiro Wilk Lognormal GOF Test Data Not Lognormal at 5% Significance Level Lilliefore Lognormal at 5% Significance Level pata Not Lognormal at 5% Significance Level milicance Level	Lognormal G 0.656 Lognormal G 0.777 0.918 0.206 0.173	Asso 95% Approximate Gamma UCL (use when n>=50)) Shapiro Wilk Test Statistic 5% Shapiro Wilk Critical Value Lilliefors Test Statistic
a) -1.5	tribution S5% Adjusted Gamma UCL (use when n<50) Stapiro Wilk Lognormal QOF Test Data Not Lognormal at 5% Significance Level Lillisetors Lognormal QOF Test Data Not Lognormal at 5% Significance Level milicance Level	Lognormal G 0.656 Lognormal G 0.777 0.918 0.206 0.173	Asso 95% Approximate Gamma UCL (use when n>=50)) Shapiro Wilk Test Statistic 5% Shapiro Wilk Critical Value Lilliefors Test Statistic
a -1.5	95% Adjusted Gamma UCL (use when n<50) Test Shapiro Wilk Lognormal QOF Test Data Not Lognormal at 5% Significance Level Lillietors Lognormal GOF Test Data Not Lognormal at 5% Significance Level milicance Level	0.656 Lognormal G 0.777 0.918 0.206 0.173	95% Approximate Gamma UCL (use when n>=50)) Shapiro Wilk Test Statistic 5% Shapiro Wilk Critical Value Lilliefors Test Statistic
a -1.5	Test Shapiro Wilk Lognormal QOF Test Data Not Lognormal at 5% Significance Level Lilitetors Lognormal QOF Test Data Not Lognormal at 5% Significance Level milicance Level	Lognormal G 0.777 0.918 0.206 0.173	Shapiro Wilk Test Statistic 5% Shapiro Wilk Critical Value Lilliefors Test Statistic
	Shapiro Wilk Lognormal QOF Test Data Not Lognormal at 5% Significance Level Lillefors Lognormal QOF Test Data Not Lognormal at 5% Significance Level milicance Level	0.777 0.918 0.206 0.173	5% Shapiro Wilk Critical Value Lilifefors Test Statistic
	Shapiro Wilk Lognormal QOF Test Data Not Lognormal at 5% Significance Level Lillefors Lognormal QOF Test Data Not Lognormal at 5% Significance Level milicance Level	0.777 0.918 0.206 0.173	5% Shapiro Wilk Critical Value Lilifefors Test Statistic
	Data Not Lognormal at 5% Significance Level Lilliefore Lognormal GOF Test Data Not Lognormal at 5% Significance Level nificance Level	0.918 0.206 0.173	5% Shapiro Wilk Critical Value Lilifefors Test Statistic
	LIBefors Lognormal GOF Test Data Not Lognormal at 5% Significance Level nificance Level	0.206	Lilifiefors Test Statistic
	Data Not Lognormal at 5% Significance Level milicance Level	0.173	
	nificance Level		
			Data Not Lo
	lice		
		Lognormal S	
a 0.9	Mean of logged Data	-2.408	Minimum of Logged Data
	SD of logged Data	0,956	Maximum of Logged Data
_	attibution	ming Lognorm	Asses
L 0.5	90% Chebyshev (MVUE) UCL	0.594	95% H-UCL
	97.5% Chebyshev (MVUE) UCL	0.693	95% Chebyshev (MVUE) UCL
L 0,0	ST.5% Chebyshev (MVOE) OCL	1.132	99% Chebyshev (MVUE) UCL
		1.132	35% CHEDYSHEV (MVOL) OCL
	e UCL Statistica	ric Distribution	Noncercement
_			
_		Non a Discont	
	Energia	amable Diately	Manager
L 0.6			
L 0.8	95% Bootstrap-t UCL	0.669	95% Standard Bootstrap UCL
- 0.0			
L 1.0	B5% Chabuchau(Maan Sd) LICI		
	99% Chebyshev(Mean, Sd) UCL	1.328	97.5% Chebyshev(Mean, Sd) UCL
1			
1	Use	Suggested UC	
1	Uso	Suggested UC 1.058	95% Chebyshev (Mean, Sd) UCL
1	Use	1.058	95% Chebyshev (Mean, Sd) UCL
1		1.058 UCL are provi	95% Chebyshev (Mean, Sd) UCL Note: Suggestions regarding the selection of a 95%
1	to help the user to select the most appropriate 95% UCL, data distribution, and skewness.	1.058 UCL are provi	95% Chebyshev (Mean, Sd) UCL Note: Suggestions regarding the selection of a 95% Recommendations are base
1	to help the user to select the most appropriate 95% UCL.	1.058 UCL are provi sed upon data s its of the simula	95% Chebyshev (Mean, Sd) UCL Note: Suggestions regarding the selection of a 95% Recommendations are base These recommendations are based upon the result
L	95% Jackknife UCL 95% Bootstrap-t UCL 95% Percentile Bootstrap UCL 95% Chebyshev(Mean, Sd) UCL	ametric Distrib 0,669 0,669 0,624 0,758 0,863	Data do not foi Nonpert 95% CLT UCL 95% Standard Bootstrap UCL 95% Hall's Bootstrap UCL 95% BCA Bootstrap UCL 95% BCA Bootstrap UCL

Pa

	Lognormal GOF	Test	
Shapiro Wilk Test Statistic	0.907	Shapiro Wilk Lognormal GOF Test	
5% Shapiro Wilk Critical Value	0.918	Data Not Lognormal at 5% Significance Level	_
Lilliefors Test Statistic	0.147	Lillefors Lognormal GOF Test	
5% Lilliefors Critical Value	0.173	Data appear Lognormal at 5% Significance Level	
Data appear Approx	imete Lognormal	at 5% Significance Level	****
	1	Laboration of the second se	
	Lognormal Stat		
Minimum of Logged Data	4.331	Mean of logged Data	5.00
Maximum of Logged Data	5.948	SD of logged Data	0.50
Assu	ming Lognormal I	Distribution	
95% H-UCL	207.1	90% Chebyshev (MVUE) UCL	221.3
95% Chebyshev (MVUE) UCL	245.5	97.5% Chebyshev (MVUE) UCL	279
99% Chebyshev (MVUE) UCL	344.9		-
		ree UCL Statistics	
Data appear to recow a D	secenticite Discric	ution at 5% Significance Level	_
	ametric Distributi		
95% CLT UCL	200,9	95% Jackknife UCL	202.2
95% Standard Bootstrap UCL	200	95% Bootstrap-t UCL	209.3
95% Hall's Bootstrap UCL	201.9	95% Percentile Bootstrap UCL	201.2
95% BCA Bootstrap UCL	202.2		
95% BCA Bootstrap UCL 90% Chebyshev(Mean, Sd) UCL	202.2 226.8	95% Chebyshev(Mean, Sd) UCL	252.7
95% BCA Bootstrap UCL	202.2		
95% BCA Bootstrap UCL 90% Chebyshev(Mean, Sd) UCL	202.2 226.8	95% Chebyshev(Mean, Sd) UCL 99% Chebyshev(Mean, Sd) UCL	252.7
95% BCA Bootstrap UCL 90% Chebyshev(Mean, Sd) UCL	202.2 226.8 288.7	95% Chebyshev(Mean, Sd) UCL 99% Chebyshev(Mean, Sd) UCL	252.7
95% BCA Bootstrap UCL 90% Chebyshev(Mean, Sd) UCL 97.5% Chebyshev(Mean, Sd) UCL	202.2 226.8 288.7 Suggested UCL	95% Chebyshev(Mean, Sd) UCL 99% Chebyshev(Mean, Sd) UCL	252.7
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95% Hall's Bootstrap UCL	32.7	95% Percentile Bootstrap UCL	32,5
95% BCA Bootstrap UCL	32.72		
90% Chebyshev(Mean, Sd) UCL	33.87	95% Chebyshev(Mean, Sd) UCL	35.19
97.5% Chebyshev(Mean, Sd) UCL	37.03	99% Chebyshev(Mean, Sd) UCL	40.64
	Suggested UCL	de l lans	
050/ 04-14-14-1101		10 COM	
95% Student's-t UCL	32.61		
Note: Suggestions regarding the selection of a 95%	UCL are provid	ed to help the user to select the most appropriate 95% UCL.	
		te, data distribution, and skewness.	
		ion studies summarized in Singh, Malchle, and Lee (2006).	
However, simulations results will not cover all Real V	orld data sets; fo	or additional insight the user may want to consult a statistician.	
nc			
	General Stat		
Total Number of Observations	25	Number of Distinct Observations	23
		Number of Missing Observations	0
Minimum	76	Mean	169.6
Maximum	383		130
SD	95,43	Std. Error of Mean	19.09
Coefficient of Variation	0.563	Skewness	1.113
	Normal GOF	Test	
Shapiro Wilk Test Statistic	0.822	Shapiro Wilk GOF Test	
5% Shapiro Wilk Critical Value	0.918	Data Not Normal at 5% Significance Level	
Lilliefors Test Statistic	0.229	Lillefors GOF Test	
5% Lillefors Critical Value	0.173	Data Not Normal at 5% Significance Level	
		ignificance Level	
		-	
95% Normai UCL	euming Normal	Distribution 95% UCLs (Adjusted for Skewness)	
95% Student's-t UCL	202.2	95% Adjusted-CLT UCL (Chen-1995)	205.5
95% Students-CUCL	404.4	95% Adjusted-CL1 OCL (Chen-1995) 95% Modified-t UCL (Johnson-1978)	205,5
A-D Test Statistic	Gemme GOI	F Test Anderson-Derling Gamma GOF Test	
5% A-D Critical Value	0.749	Data Not Gamma Distributed at 5% Significance Level	
K-S Test Statistic	0.178	Kolmogorov-Smirnov Gamma GOF Text	
5% K-S Critical Value	0.175	Data Not Gamma Distributed at 5% Significance Level	
5% K-S Checal Value			
Data Not Gam	on Distributed at	5% Skonicence Level	
Data Not Gama	na Distributed at	5% Significance Level	
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k hat (MLE)	Gamma Sta 3.941	tetics k star (bias corrected MLE)	
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k hat (MLE) Theta hat (MLE) nu hat (MLE) MLE Mean (bias corrected) Adjusted Level of Significance	Gemme Stat 3.941 43.02 197 169.6	Istics k star (bias corrected MLE) Theta star (bias corrected MLE) nu star (bias corrected) MLE Sd (bias corrected) Approximate Chi Square Value (0.05) Adjusted Chi Square Value	48.52 174.7 90.7 145.2

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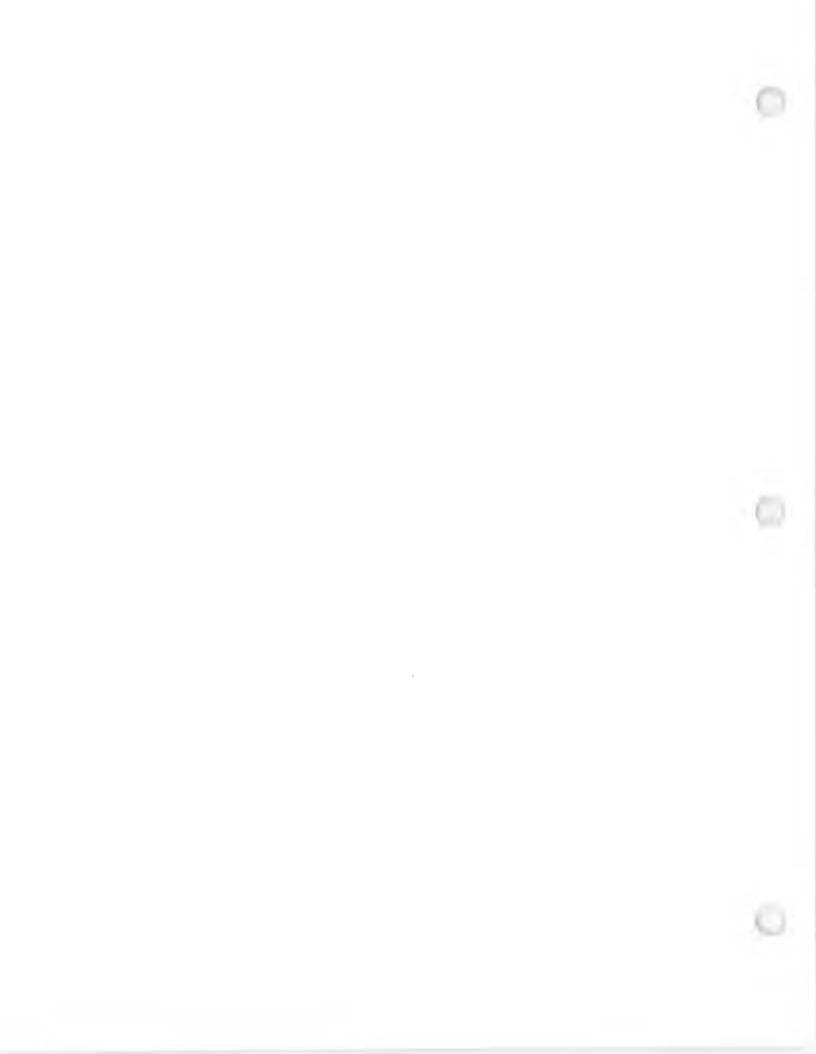
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APPENDIX C1 AND C2

C1: MUNITIONS AND EXPLOSIVES OF CONCERN HAZARD ASSESSMENT (MEC HA)

C2: MUNITIONS AND EXPLOSIVES OF CONCERN RISK ASSESSMENT (MEC RA) AND ALTERNATIVES ANALYSIS

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Appendix C1 Munitions and Explosives of Concern Hazard Assessment (MEC HA)



MUNITIONS AND EXPLOSIVES OF CONCERN HAZARD ASSESSMENT FOR

OPEN DETONATION GROUNDS

SENECA ARMY DEPOT ACTIVITY ROMULUS, SENECA COUNTY, NEW YORK

Prepared for:

U.S. Army Engineering and Support Center, Huntsville



and SENECA ARMY DEPOT ACTIVITY ROMULUS, NEW YORK

Prepared by:

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Contract Number W912DY-08-D-0003 Task Order No. 0013 EPA Site ID# NY0213820830 NY Site ID# 8-50-006

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C.1 EXECUTIVE SUMMARY

Parsons was tasked by the U.S. Army Corps of Engineers (USACE), Huntsville District, under Contract No. W912DY-08-D-0003, Task Order No. 0013 to prepare a munitions and explosives of concern (MEC) hazard assessment (HA) for the Open Detonation (OD) Grounds, also known as SEAD-45, located at the Seneca Army Depot Activity (SEDA or the Depot) in Romulus, New York. The purpose of this MEC HA is to assess qualitatively the potential explosive hazards to human receptors associated with complete MEC exposure pathways at the OD Grounds munitions response site (MRS). This appendix contains a detailed description of the MEC HA conducted for the OD Grounds, including the information and assumptions used for this assessment.

The MEC HA method was developed by the Technical Working Group for Hazard Assessment, which included representatives from the Department of Defense (DoD), the U.S. Department of the Interior, the United State Environmental Protection Agency (USEPA), and various states and tribes. The method provides an assessment of the acute explosive hazards associated with remaining MEC at an MRS by analyzing site-specific conditions and human issues that affect the likelihood that a MEC accident will occur (Subchapter C.5). Under the MEC HA method, the potential MEC hazards are evaluated qualitatively for each MRS by evaluating site conditions and assigning related "input factors" that generate a total MEC HA score between 125 and 1,000, with the upper limit representing the maximum level of explosive hazard (Subchapters C.7 and C.8).

This MEC HA divides the OD Grounds into two areas for assessment purposes based on differing anticipated explosive hazard characteristics (Subchapter C.6). Previous investigations indicate the density of potential MEC is highest at the center of the OD Grounds, in the vicinity of the OD Hill where the demolition activities took place and areas in the immediate vicinity that received most of the "kick-outs" from those activities. This area is referred to as the "OD Hill area" in this MEC HA. The second assessment area includes areas further away from the OD Hill that received kick-outs, but in lower densities. This second assessment area is referred to as the "Kickout Area" in this MEC HA. The locations of these two assessment areas are shown on Figure 1-2 in the Feasibility Study (FS) Report.

A qualitative baseline evaluation of the potential MEC hazards posed was conducted by reviewing each of the MEC HA input factors for the OD Hill and Kickout areas (Subchapter C.9). Having generated baseline MEC HA scores for each assessment area, different remedial alternatives were further evaluated using the MEC HA method to compare how they might reduce the explosive hazards in each area (Subchapter C.10). The remedial alternatives evaluated were (1) the No Action Alternative, (2) LUCs only, including groundwater restriction, (3) Consolidate and Cap with Surface and Subsurface Clearance Outside the Cap and LUCs, (4) Excavate OD Hill and perform surface/subsurface clearance over the entire site, and LUCs, and (5) Excavate entire site to 1 foot below grade and perform surface/subsurface clearance. These are referred to here and, in the FS, as Remedial Alternatives 1, 2, 3, 4, and 5 respectively. Remedial Alternative 1, the no action alternative, is the baseline scenario for this MEC HA.

The results of the MEC HA conducted for both assessment areas are shown in Table C.8 (Subchapter C.9). For the OD Hill area, the baseline score (the no action alternative) results in a MEC HA score of 865. Remedial Alternative 2 (LUCs only, including groundwater use restriction) results in a

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MEC HA score of 865, identical to the baseline. The Hazard Level remained at 1 ('highest potential explosive hazard conditions') for Alternative 2. Remedial Alternative 3 (consolidate and cap with surface and subsurface clearance outside the cap, followed by implementation of LUCs), Remedial Alternative 4 (excavate OD Hill to grade and perform surface/subsurface clearance over site and LUCs), and Remedial Alternative 5 (excavate entire site to 1 foot below grade and perform surface/subsurface clearance) were also evaluated for the OD Hill area, and result in a MEC HA score of 470. The reduction in MEC HA score from 865 to 470 for Alternatives 3, 4, and 5, reduces the corresponding Hazard Level rating from 1 ('highest potential explosive hazard conditions') to 4 ('low potential explosive hazard conditions'). Based on these results, there is no significant difference between these three remedial alternatives with respect to reduction of explosive hazards at the OD Hill area.

For the Kickout area, the baseline score (the no action alternative) results in a MEC HA score of 715. Alternative 2 results in no change in MEC HA score and Hazard Level from the baseline evaluation. Remedial Alternatives 3, 4 and 5 result in a MEC HA score of 445. This reduction in MEC HA score for Alternatives 3, 4, and 5 reduces the corresponding Hazard Level rating from 3 ('moderate potential explosive hazard conditions') to 4 ('low potential explosive hazard conditions'). Based on these results, there is no significant difference between Alternatives 3, 4, and 5 with respect to reduction of explosive hazards at the Kickout area.

The remaining sections of this appendix provide information on the site history, current and future land use, the MEC HA input and output factors, the details of the baseline MEC HA evaluation, the remedial action alternatives, and the adjusted MEC HA scores resulting from the implementation of these remedial action alternatives.

C.2 SITE HISTORY AND PREVIOUS DISCOVERIES

Since its inception in 1941, SEDA's military mission included receipt, storage, distribution, maintenance, and demilitarization of conventional ammunition, explosives, and special weapons.

The OD Grounds located in the northwestern corner of the Depot and is designated as SEAD-45. The site is largely meadow with some wooded and heavily brushed areas. Reeder Creek runs through the OD Grounds. Access is possible via a paved road that enters the area from the southeast and roughly parallels the path of Reeder Creek along its western bank. The unnamed access road branches off North-South Baseline Road near Building 2104, which is located in the southeastern corner of the OD Grounds.

The OD Grounds were used to destroy munitions resulting from SEDA's military mission. Operations at the OD Grounds began circa 1941 when the Depot was first constructed and continued at regular intervals until circa 2000 when the military mission of the Depot ceased. Detonations were conducted on an approximately 30-foot high man-made hill constructed to buffer the intensity of planned detonations (the 'OD Hill'). Detonations occurred intermittently since the Depot closed as part of continuing munitions response activities being performed at the Depot. During operations, off specification munitions were placed in an excavated opening in the side of the OD Hill with additional demolition material, covered with a minimum of 8 feet of soil, and detonated remotely. After demolition was completed, explosively displaced

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portions of the mound were reconstructed by moving displaced and native soils back into the central earthen mound.

These historic operations resulted in MEC, material potentially presenting an explosive hazard (MPPEH), and munitions debris (MD) being expelled ("kicked out") from the OD Hill to the surrounding area. Investigations indicate the highest MPPEH densities are in the vicinity of the OD Hill, which is to be expected as this area contains both the former detonation location and the areas that would have received most "kick outs". Densities of "kick-outs" from the demolition operations decrease moving away from the demolition operations.

C.3 MEC POTENTIALLY PRESENT ONSITE

Several characterization efforts and investigations for MPPEH have been conducted at the OD Grounds and are summarized in the FS document. Based on historical data, previous investigations and removal actions, the MPPEH present at the site is summarized in Subchapter C.5.

C.4 CURRENT AND FUTURE LAND USE

The OD Grounds are currently closed. The planned future use for the area that encompasses the OD Grounds is projected to be a "Conservation/Recreation Area". For the remedial alternatives considered in this MEC HA, it is assumed LUCs will be implemented that will restrict the area to non-intrusive recreational activities such as hiking, with no camping allowed. The LUCs will also restrict access to groundwater, prohibit digging or any intrusive activities, and prohibit the use of the site for residential or day care uses.

C.5 EXPLOSIVE HAZARDS AND HAZARD ASSESSMENT

An explosive hazard exists at a site if there is a potentially complete MEC exposure pathway. A complete MEC exposure pathway is present any time a receptor can come near or into contact with MEC and interact with the item in a manner that might result in its detonation. There are three elements of a complete MEC exposure pathway: (1) a source of MEC, (2) a receptor, and (3) the potential for interaction between the MEC source and the receptor. <u>All three</u> of these elements must be present for a potentially complete MEC exposure pathway to exist.

Based on the findings of previous investigations, MPPEH remains or has the potential to remain within the OD Grounds area. Known or suspected munitions include 81mm HE mortars, 60mm illumination mortars, 75mm HE projectiles, 75mm HEAT projectiles, 57 mm HE projectiles, 40mm practice projectiles, 37mm HE projectiles, 20mm HEI projectiles, 3.5-inch HEAT rockets, sub-caliber aircraft rockets, 4-lb. fragmentation bombs (Butterfly), 40mm HE grenades, antitank rifle grenades, fragmentation hand grenades, riot hand grenades, bomb nose fuzes, bomb tail fuzes, point detonating fuzes, base detonating fuzes, parachute flares, and illuminating ground signals.

The qualitative hazard assessment technique presented here follows the MEC HA method, which provides an assessment of the acute explosive hazards associated with remaining MEC at a MRS by analyzing site-specific conditions and human issues that affect the likelihood that a MEC accident will

occur. The MEC HA method focuses on hazards to human receptors and does not directly address environmental or ecological concerns that might be associated with MEC. The process for conducting the MEC HA is described in the MEC HA interim guidance document (USEPA, 2008) and uses input data based on historical documentation, field observations, and the results of previous studies and removal actions. The MEC HA interim guidance was developed by the Technical Working Group for Hazard Assessment, which included representatives from the DoD, the U.S. Department of the Interior, the USEPA, and various states and tribes. The DoD has encouraged use of this method on a trial basis (DoD 2009).

The MEC HA method reflects the basic difference between assessing acute hazards from exposure to MEC and assessing chronic environmental risks from exposure to potential contaminants, such as munitions constituents (MC). An explosive hazard can result in immediate injury or death; therefore, risks from explosive hazards are evaluated either as being present or not present. If the potential for an encounter with MEC exists, then the potential that the encounter may result in injury or death also exists. This MEC HA was conducted to evaluate the baseline conditions for the site with regard to explosive hazards. These baseline evaluations provide the basis for the evaluation and implementation of effective management response alternatives in a FS for this property. The MEC HA also supports hazard communication among stakeholders by organizing site information in a consistent manner for the hazard management decision-making process. However, the MEC HA does not provide a quantitative assessment of MEC hazards and is not used to determine whether or not further action is necessary at a site.

C.6 DEFINING THE AREAS TO BE ASSESSED

A MEC HA is focused on each MRS at a site. However, the MEC-related characteristics of discrete areas within an MRS may differ with regard to the ordnance types and quantities, land uses, receptors, and other factors. If these factors vary significantly, the qualitative MEC hazards associated with the discrete areas are likely to differ. For example, the characteristics of a range impact area and its safety fan are likely to differ with regard to the amount of MEC potentially present or different land use activities may exist that create differing potentials for MEC interaction with human receptors within a large maneuver area.

Different MEC hazards may result in different response alternatives being appropriate for these discrete areas; consequently, an MRS may be subdivided into two or more distinct "assessment areas," each of which will be the subject of a separate MEC HA for purposes of hazard assessment and subsequent response alternative evaluation. However, if an MRS is likely to be the subject of only one response alternative (e.g., the MRS is small), the MRS may be evaluated as a single assessment area, despite the potential for differing MEC-related characteristics. In this event, the most conservative MEC HA input factors (see below) are selected for purposes of the MEC HA.

Based on the history of the site and the results of previous investigations, the area at and in the immediate vicinity of the OD Hill (within 1,000 feet), where demolition activities were previously conducted, are known to exhibit higher densities of MPPEH than the surrounding areas (e.g., the Kickout area). Due to these differing MEC-related characteristics, the OD Grounds is divided into two areas for assessment purposes: the OD Hill area and the Kickout area.

The OD Hill area, includes the OD Hill where detonations occurred, and the area in the immediate vicinity (within 1,000 feet) that received most of the kick-outs from those detonations. The Kickout area (more than 1,000 feet from the OD Hill) received lower quantities of kick-outs and therefore has a lower potential for MPPEH to be present. Separate MEC HA scores are calculated for each of these assessment areas. The two areas are shown on Figure 1-2 of the FS Report.

OVERVIEW OF MEC HA INPUT FACTORS C.7

Under the MEC HA method, the potential MEC hazards are evaluated qualitatively for each MRS or assessment area by evaluating three primary factors. These primary factors are related to the three critical elements noted previously are:

- Severity: the potential consequences of the effect on a human receptor should a MEC item • detonate;
- Accessibility: the likelihood that a human receptor will come into contact with a MEC item; and
- Sensitivity: the likelihood that a MEC item will detonate if a human receptor interacts with the • item.

To complete the baseline MEC HA for each MRS/assessment area, the input factors are reviewed and suitable categories (baseline, surface MEC cleanup, or subsurface MEC cleanup) are selected based on historical documentation and field observations. The input factors for the MEC HA method are highlighted below (USEPA, 2008):

Energetic Material Type: This factor describes the general type of energetic material associated with the munition(s) known or suspected to be present within the MRS or assessment area. The six possible categories for this factor, ranging from the most to least potentially hazardous, are 'high explosives and low explosive fillers in fragmenting rounds,' 'white phosphorus (WP),' 'pyrotechnics,' 'propellants,' 'spotting charges,' and 'incendiaries.' The category selected for each MRS or assessment area is based on the energetic material with the greatest potential explosive hazard known or suspected to be present.

Location of Additional Human Receptors: Human receptors other than the individual who causes a detonation may be exposed to overpressure and/or fragmentation hazards from the detonation of MEC. This factor describes whether or not there are additional human receptors located within the MRS/assessment area or within the explosive safety quantity-distance (ESQD) arc surrounding the MRS/assessment area. The two possible categories for this factor are "inside the MRS or inside the ESQD arc surrounding the MRS" and "outside the ESOD arc."

Site Accessibility: The site accessibility factor describes how easily human receptors can gain access to the MRS or assessment area and takes into account the various barriers to entry that might be present. The four possible categories of site accessibility range from "full accessibility" (i.e., a site with no barriers to entry) to "very limited accessibility" (i.e., a site with guarded chain link fences or terrain that requires special skills and equipment to access). This factor differs from the Potential Contact Hours factor (see below) and does not include or account for LUCs that might restrict site access. The effects of LUCs are assessed in the FS alternatives assessment.

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Potential Contact Hours: This factor accounts for the amount of time receptors spend within the MRS or assessment area during which they might come into contact with MEC and intentionally or unintentionally cause a detonation. Both the number of receptors and the amount of time each receptor spends in the MRS/assessment area are used to calculate the total "receptor-hours/year." This total is calculated for all activities that might result in potential MEC interaction and there are four possible categories, ranging from "many hours" (≥ 1,000,000 receptor-hours/year) to "very few hours" (< 10,000 receptor-hours/year).

Amount of MEC: This input factor describes the relative quantity of MEC anticipated to remain within the MRS or assessment area as a result of past munitions-related activities. For example, a greater quantity of MEC would be expected to be present in a former target area than at a former firing point. The nine possible categories for this factor, from the largest to the least anticipated amount of MEC, range from "target area" and "Open Burning/Open Detonation (OB/OD) area," through "burial pit" and "firing point," to "storage" and "explosives-related industrial facility."

Minimum MEC Depth Relative to the Maximum Receptor Intrusive Depth: This factor indicates whether the MEC in the MRS or assessment area are located at depths that might be reached by the anticipated human receptor activities. For the baseline MEC HA, the four possible categories concern whether or not MEC are located at the surface and in the subsurface within the MRS or assessment area, or whether MEC are present in the subsurface only, and whether or not the receptor intrusive depth overlaps with this MEC location.

Migration Potential: The migration potential factor addresses the likelihood that MEC in the MRS or assessment area might migrate by natural processes (e.g., erosion or frost heave) thereby increasing the chance of subsequent exposure to potential human receptors. The two possible categories for this factor are "possible" and "unlikely."

MEC Classification: This factor accounts for how easily a human receptor might cause a detonation of the MEC and relates directly to the MEC sensitivity. The six possible categories for this factor, ranging from the highest to lowest sensitivity (and explosive hazard) are "sensitive unexploded ordnance (UXO)," "other UXO," fuzed sensitive discarded military munitions (DMM)," "fuzed DMM," "unfuzed DMM," and "bulk explosives." The selection of category for each MRS or assessment area is made using the MEC with the highest potential sensitivity known or suspected to be present and, where uncertainty exists, conservative assumptions are made and documented. For example, UXO is always assumed to be present within a known target area, whether or not the investigation uncovers UXO at the site.

MEC Size: This factor indicates how easy it is for a typical human receptor to move the MEC item(s) present within the MRS or assessment area. For example, an individual is considerably more likely to pick up or accidentally kick a hand grenade than a 200-lb. bomb. The basic assumption used in this category is that MEC weighing 90-lbs or more is unlikely to be moved without the use of special equipment. Based on this assumption, the two possible categories for this factor are "small" (i.e., items weighing less than 90lbs.) and "large" (items weighing 90-lbs. or more). The selection of category for each MRS or assessment area is based on the MEC known or suspected to be present with the highest potential to be moved (i.e., the smallest item).

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Each category for each of the MEC HA input factors has an assigned score that relates to the relative contributions of the different input factors to the overall MEC hazard. These scores were developed by the Technical Working Group for HA. These factors and their associated scores for the baseline condition and after cleanup conditions are provided in Table C.1a. The detailed technical basis for the scores assigned is provided in the MEC HA interim guidance document (USEPA, 2008).

C.8 OVERVIEW OF MEC HA OUTPUT FACTORS

Once the categories and scores for all input factors are defined for each MRS or assessment area at the site, the related scores for each category are totaled to calculate an overall MEC HA score for each MRS/assessment area. The total maximum possible MEC HA score for an MRS/assessment area ranges from 125 - 1,000. The MEC HA method identified the associated hazard levels for these scores, which range from 1 to 4. A Hazard Level of 1 indicates the highest potential explosive hazard conditions and a hazard level of 4 indicates low potential explosive hazard conditions. The basis for these hazard levels is detailed in the MEC HA interim guidance document (USEPA, 2008). The total MEC HA scores and associated hazard levels are *qualitative references only* and should <u>not</u> be interpreted as quantitative measures of explosive hazard or as the sole basis for determining whether or not further action is necessary at a site. A summary of the hazard levels and their related MEC HA scores is presented in Table C.2.

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nput Factor Input Factor Category		Baseline Score	Score After Subsurface Cleanup	
Energetic Material	HE and Low Explosive Fillers in Fragmenting Rounds	100	100	
Туре	White Phosphorus	70	70	
	Pyrotechnic	60	60	
	Propellant	50	50	
	Spotting Charge	40	40	
	Incendiary	30	30	
Location of Additional Human Receptors	Inside the MRS or inside the ESQD arc surrounding the MRS	30	30	
	Outside of the ESQD arc	0	0	
Site Accessibility	Full Accessibility	80	80	
	Moderate Accessibility	55	55	
	Limited Accessibility	15	15	
	Very Limited Accessibility	5	5	
Potential Contact	Many Hours	120	30	
Hours	Some Hours	70	20	
	Few Hours	40	10	
	Very Few Hours	15	5	
Amount of MEC	Target Area	180	30	
	Open Burning/Open Detonation (OB/OD) Area	180	30	
	Function Test Range	165	25	
	Burial Pit	140	10	
	Maneuver Areas	115	5	
	Firing Points	75	5	
	Safety Buffer Areas	30	5	
	Storage	25	5	
	Explosive-Related Industrial Facility	10	5	

 Table C.1a

 Summary of MEC HA Input Factors and Associated Baseline Scores

Input Factor	Input Factor Category	Baseline Score	Score After Subsurface Cleanup
Minimum MEC Depth vs. Maximum Intrusive Depth	Baseline Condition : MEC located on surface and in subsurface; After Cleanup : intrusive depth overlaps with minimum MEC depth	240	95
	Baseline Condition : MEC located on surface and in subsurface; After Cleanup : intrusive depth <i>does not</i> overlap with minimum MEC depth	240	25
	Baseline Condition : MEC located only in subsurface; Baseline Condition or After Cleanup : intrusive depth overlaps with minimum MEC depth	150	95
	Baseline Condition : MEC located only in subsurface; Baseline Condition or After Cleanup : intrusive depth <i>does not</i> overlap with minimum MEC depth	50	25
Migration Potential	Possible	30	10
	Unlikely	10	10
MEC Classification	Sensitive UXO	180	180
	UXO	110	110
	Fuzed Sensitive DMM	105	105
	Fuzed DMM	55	55
	Unfuzed DMM	45	45
	Bulk Explosives	45	45
MEC Size	Small	40	40
	Large	0	0

 Table C.1a, cont'd.

 Summary of MEC HA Input Factors and Associated Baseline Scores

Source: MEC HA interim guidance document (USEPA, 2008)

NOTE: For Alternative 3 (Consolidate and cap with surface and subsurface clearance to 2 feet bgs outside the cap and LUCs), the installation of a cap is functionally equivalent to a subsurface clearance for MEC HA purposes as it places a barrier of clean soil between the receptors and the ground surface.

Scores for the categories are in multiples of five, with a total maximum possible score for all factors of 1,000 and a minimum possible score of 125. These MEC HA scores are *qualitative references only* and should <u>not</u> be interpreted as quantitative measures of explosive hazard. A summary of the maximum possible scores and their related weights with regard to the overall MEC HA score are shown in Table C.1b.

Explosive Hazard Component			Weights
Severity	Energetic Material Type	100	10%
	Location of Additional Human Receptors	30	3%
	Component Total	130	13%
Accessibility	essibility Site Accessibility		8%
	Total Contact Hours	120	12%
	Amount of MEC	180	18%
	Minimum MEC Depth vs. Maximum Intrusive Depth	240	24%
	Migration Potential	30	3%
	Component Total	650	65%
Sensitivity	MEC Classification	180	18%
	MEC Size	40	4%
	Component Total	220	22%
	Maximum Total Score	1,000	100%

Table C.1b Summary of MEC HA Scoring

Source: MEC HA interim guidance document (USEPA, 2008)

Table C.2			
Hazard Level	Scoring	Rankings	Table

Hazard Level	Maximum MEC HA Score	Minimum MEC HA Score	Associated Relative Explosive Hazard
1	1,000	840	Highest potential explosive hazard conditions
2	835	725	High potential explosive hazard conditions
3	720	530	Moderate potential explosive hazard conditions
4	525	125	Low potential explosive hazard conditions

Source: MEC HA interim guidance document (USEPA, 2008).

C.9 BASELINE MEC HAZARD EVALUATION

A qualitative baseline evaluation of the potential MEC hazards posed was conducted by reviewing each of the MEC HA input factors described above for the two assessment areas, the OD Hill and Kickout areas. Historical and field investigation data were used to determine the appropriate categories for each MEC HA input factor (see Subchapter C.7).

Based on the site history and previous investigations, the OD Grounds was the location of an area used to destroy munitions by detonation in support of the Army mission. The site is currently closed, although hunting is performed. Numerous MPPEH items including mortars, large or medium caliber projectiles, rockets, bombs, grenades, and fuzes have been removed from this site, some of which were configured with explosives, explosive bursters, and/or fuzes. All of the MPPEH items found were described as UXO based on the terminology used during the time of the investigation.

Assessment Area Definition: The assessment areas that are the subject of the MEC HA for the OD Grounds are the OD Hill and Kickout areas. The primary differences between these two assessment areas are the potential amount of MEC and contact hours in each one; most other site characteristics are identical for each assessment area.

Energetic Material Type: The MEC items known or suspected to be present within the OD Grounds include mortars, large or medium caliber projectiles, rockets, bombs, grenades, and fuzes. Items with various fillers have been found, and some of these items contain high explosives or are fragmenting rounds. The energetic material type selected for both assessment areas is determined to be 'high explosives and low explosive filler in fragmenting rounds', which is the most potentially hazardous of the available selections.

Location of Additional Human Receptors: The MEC item anticipated to be present within the OD Grounds that is considered to be the most hazardous, based on Hazardous Fragment Distance (HFD), is the Mortar, 81mm, HE, M374. For this item, the HFD is 239 feet. On this basis, the ESQD used for this MEC HA is 239 feet for both the OD Hill and Kickout areas. Although receptors are present in both assessment areas, there are no locations within the ESQD of either assessment area where people will congregate. Based on this information, the location of additional human receptors for the OD Hill and Kickout assessment areas is assessed to be 'outside the ESQD arc.'

Site Accessibility: The Current Site Conditions for both assessment areas assumes that no fence is present to limit access. Based on this information, both the OD Hill and Kickout assessment areas are classified as having 'full accessibility' under the Current Site Conditions scenario.

Potential Contact Hours: As described above, the Current Site Conditions for the OD Grounds MRS assumes the site is located at a closed military installation, and the OD Grounds are closed. Hunting is performed in the area. The deer hunting season begins in mid-November and ends during the second week of December.

• Under this scenario for both the OD Hill and the Kickout area, 10 hunters are assumed to hunt in the area, with each spending an average of 12 hours per day, 16 days per year, for a total of 192 hours per year per receptor. Based on this information, the total potential contact hours for the assessment area are calculated to be 1,920 receptor-hours/year, which corresponds to a

classification of 'very few hours' (less than 10,000 receptor-hours/year) for the OD Hill assessment area.

Amount of MEC: The potential for MEC presence varies within the OD Grounds MRS.

- In the OD Hill assessment area, the primary cause of MPPEH presence is munitions disposal by open detonation. For this reason, a classification of 'OB/OD Area' is considered appropriate for purposes of this MEC HA.
- In the Kickout assessment area, which is outside the former OD area and is not where disposal
 activities were conducted, the presence of MPPEH is the result of potential kick-outs only. For this
 reason, a MEC HA classification of "Safety Buffer Area" is considered appropriate for purposes of
 this MEC HA.

Minimum MEC Depth Relative to the Maximum Receptor Intrusive Depth: At the OD Grounds MRS, MPPEH has been found on the ground surface and to depths of 36 inches bgs. There are currently no intrusive activities performed in this area so the maximum receptor intrusive depth at the site is assumed to be 0 inches. Based on this information, for the OD Hill and the Kickout areas, the minimum MEC depth relative to the maximum receptor intrusive depth for the assessment area is assessed to be 'MEC located surface and subsurface – intrusive depth overlaps with minimum MEC depth'.

Migration Potential: The site conditions at the OD Grounds are currently largely meadow with some wooded and, heavily brushed areas. The primary natural process that can result in the migration or exposure of MEC items that might be present at the OD Grounds is erosion. Natural erosion of soil over time by the wind or by water (surface water or precipitation) can result in the exposure of MEC below grade by the removal of the overlying soil. In some cases, if soil is unstable and the erosive force is sufficient to act on items(s) the size of the MEC present, this process can result in the movement of MEC from its original position to another location (typically somewhere downstream of the wash). This is not anticipated to be the case at the OD Grounds as no visual indication of this occurring on-site has been observed.

MEC Classification: As described previously, the MPPEH items known or suspected to be present at the OD Grounds MRS include mortars, large or medium caliber projectiles, rockets, bombs, grenades, and fuzes. Some of these items also contain high explosive anti-tank (HEAT) fillers. Mortars, hand grenades, and HEAT munitions are all classified as 'special case' items in the MEC HA guidance. Because UXO items have been found in both assessment areas during prior investigations and because MEC found would be the result of munitions disposal, it is assumed that UXO might be present. Therefore, according to the criteria listed in the MEC HA method, the MEC classification for MPPEH items that might remain at the site is 'Sensitive UXO.'

MEC Size: The MEC items known or suspected to be present within both assessment areas of the OD Grounds MRS include mortars, large or medium caliber projectiles, rockets, bombs, grenades, and fuzes. Based on the criteria defined in the MEC HA method, because many of the munitions known or suspected to be present weigh less than 90 pounds, the MEC size for the site is classified as having the highest potential to be moved or 'small' for purposes of this MEC HA.

MEC HA Baseline Results: The two assessment areas within the OD Grounds MRS, were evaluated separately. The primary differences between the two evaluations were the "Amount of MEC" and "Potential Contact Hours" classifications. The OD Hill assessment area was classified as an "OB/OD Area", while the Kickout assessment area was classified as a "Safety Buffer Area." Total receptor contact hours differed between the two assessment areas, though the classification for both areas was "very few hours." The resulting MEC HA scores are summarized below:

- The OD Hill assessment area has a total MEC HA score of 865 under the current site conditions, which equates to a Hazard Level of 1 (Table C.3). This hazard level indicates an area with 'Highest potential explosive hazard conditions' (USEPA, 2008).
- The Kickout assessment area has a total MEC HA score of 715 under the current site conditions, which equates to a Hazard Level of 3 (Table C.3). This hazard level indicates an area with 'moderate potential explosive hazard conditions' (USEPA, 2008).

This information provides the baseline for the assessment of response alternatives presented in Subchapter C.10.

Note that the total MEC HA score and the associated hazard level are *qualitative references only* and should <u>not</u> be interpreted as quantitative measures of explosive hazard. Also, this MEC HA does <u>not</u> address or otherwise evaluate potential risks related to munitions constituents posed by that might be present at the site.

Table C.3
Summary of MEC HA Baseline Scores
OD Hill and Kickout Assessment Areas
Current Site Conditions

Explosive Hazard	Input Factors	Category Selected for	Score ^{(1), (2)} (Max. Score)			
Component	input ractors	MRS/Area	OD Hill	Kickout 100 (<i>100</i>)		
Severity Accessibility	Energetic Material Type	High explosives and low explosive filler in fragmenting rounds	100 (<i>100</i>)			
	Location of Additional Human Receptors	Outside of the ESQD arc	0 (30)	0 (<i>30</i>)		
Accessibility	Site Accessibility	Full accessibility	80 (<i>80</i>)	80 (<i>80</i>)		
	Total Contact Hours	Very few hours	15 (<i>120</i>)	15 (<i>120</i>)		
	Amount of MEC	OB/OD Area (180) Safety Buffer Area (30)	180 (<i>180</i>)	30 (<i>180</i>)		
	Minimum MEC Depth vs. Maximum Intrusive Depth	MEC located in surface and subsurface; max. intrusive depth overlaps min. MEC depth	240 (<i>240</i>)	240 (<i>240</i>)		
	Migration Potential	Unlikely	10 (<i>30</i>)	10 (<i>30</i>)		
Sensitivity	MEC Classification	Sensitive UXO	180 (<i>180</i>)	180 (<i>180</i>)		
	MEC Size	40 (<i>40</i>)	40 (<i>40</i>)			
Total MEC HA S	core ⁽²⁾		845 (1,000)	695 (1,000)		
MEC HA Hazard	Level		1(3)	3(4)		

- Scores assigned for each factor as listed and described in MEC HA interim guidance document (USEPA, 2008). The maximum possible MEC HA score is listed in parentheses beneath the assigned score(s) for reference purposes.
- (2) The scores for the input factors are based on the baseline condition.
- (3) A MEC HA Hazard Level of 1 indicates an area with "Highest potential explosive hazard conditions".
- (4) A MEC HA Hazard Level of 3 indicates an area with "Moderate potential explosive hazard conditions".

C.10 EVALUATION OF POTENTIAL REMEDIAL ACTIONS

In addition to providing a technique to evaluate baseline MEC hazards, the MEC HA method also establishes a process to evaluate qualitatively the hazard mitigation that would be achieved by remedial actions. This process is based on assumptions made regarding the effects of a given remedial response (e.g., LUCs, surface cleanup, subsurface cleanup), coupled with modified scores for MEC HA input factors, to evaluate how the MEC HA score might be reduced following implementation of the response. The primary purpose of this process is to support the evaluation of response alternatives conducted during an FS; i.e., this evaluation should not be used as the sole basis upon which to recommend a remedial response. As with the baseline score, these total MEC HA scores and the associated hazard levels are *qualitative references only* and should <u>not</u> be interpreted as quantitative measures of explosive hazard.

Four potential remedial scenarios are evaluated against the baseline in this MEC HA: Alternatives 2, 3, 4, and 5. Alternative 1, the no action alternative, is equivalent to the baseline scenario for this MEC HA. Future land use under all these scenarios is assumed to be non-intrusive recreational land use (e.g., hiking, no camping). A brief description of Alternatives 2, 3, 4, and 5 is provided in the following subchapters, together with the associated modifications to the MEC HA score. More detailed descriptions of these remedial alternatives are provided in Chapter 4 of the FS report.

Alternative 2 would include LUCs only, including a groundwater use restriction. Under this scenario, activities at the property would be changed to non-intrusive conservation/recreational use (hiking, no camping) and LUCs.

Alternative 3 would involve consolidating the soil around OD Hill and installing a cap over the consolidated soil. The net effect of installing the cap is considered equivalent to a subsurface MEC clearance to a depth of 1.5 feet. This alternative would also include completing a surface and subsurface clearance to 2 feet bgs outside the cap and implementing LUCs. LUCs will prohibit residential land use and use for playgrounds and prohibit intrusive activities. Under this scenario, activities at the property would be change to non-intrusive conservation/recreational use (hiking, no camping).

Alternative 4 would involve excavating OD Hill to grade and performing mechanical separation to remove MPPEH from the excavated soil, performing surface/subsurface clearance to 2 feet bgs over the site, and then implementing LUCs. LUCs will prohibit residential land use and use for playgrounds, prohibit intrusive activities, and prohibit access to or use of groundwater. Under this scenario, activities at the property would change to conservation/recreational use (hiking, no camping).

Alternative 5 would involve excavating the entire site to 1 foot below grade and performing mechanical separation to remove MPPEH from the excavated soil. Following the excavation to 1 foot below grade, a surface/subsurface clearance would be performed to achieve a post excavation clearance depth of 3 feet bgs. LUCs will prohibit residential land use and use for playgrounds, prohibit digging, and prohibit access to or use of groundwater. Under this scenario, activities at the property would change to conservation/recreational use (hiking, no camping).

All remedial alternatives considered in this MEC HA reflect a scenario under which the property is remediated and can revert to restricted public use. Under all alternatives, the LUCs would prohibit intrusive

activities, prohibit access to or use of groundwater, and prohibit future land uses other than non-intrusive recreation (e.g., no residential or day care use).

C.10.1 OD Hill Area

All remedial alternatives were considered for the OD Hill Assessment Area. For Alternative 2, input assumptions and related MEC HA scores are unchanged from the baseline evaluation. Accounting for the lack of score modifications resulting from Remedial Alternative 2, the total MEC HA score remained at 845 and the Hazard Level rating remained at 1 ("highest potential explosive hazard conditions"). The MEC HA scores for Alternative 2 are shown in Table C.4.

Alternatives 3, 4, and 5 modify the input assumptions for the assessment area with regard to *potential contact hours, amount of MEC, minimum MEC depth vs. maximum intrusive depth, and migration potential.* All other input assumptions and related MEC HA scores for these three scenarios are unchanged. In accordance with USEPA (2008) guidance, the scores assigned for these categories under the baseline condition are reduced to reflect subsurface MEC clearance to either 1.5 feet bgs (Remedial Alternative 3), estimated 2 feet bgs (Remedial Alternative 4) or estimated 3 feet bgs (Remedial Alternative 5). Alternative 3 would also include a cap that would cover the surface of the assessment area, increasing the minimum MEC depth. Therefore, in Alternatives 3, 4, and 5, after cleanup, activities do not overlap with MEC location. Consequently, human receptors are no longer as likely to come into contact with MEC in the assessment area. The modified assumptions and their effect on the associated MEC HA input factors are addressed together in the following sections.

MRS Definition: Unchanged from baseline evaluation.

Energetic Material Type: Unchanged from baseline evaluation.

Location of Additional Human Receptors: Unchanged from baseline evaluation.

Site Accessibility: Unchanged from baseline evaluation.

Potential Contact Hours: As described above, the future land use scenario considered for the OD Hill once a remedial response has been implemented assumes the future use of conservation/recreation, which includes hiking but no camping. Though it is not anticipated that the OD Grounds will become a hiking destination, for the purposes of this evaluation, this MEC HA conservatively assumes that 2,000 people visit the area each year and each person is assumed to spend an average of 4 hours on the site, for a total of 8,000 hours per year. No intrusive activities are permitted or expected to occur. Based on this information, the total potential contact hours for the assessment area under the future scenario are calculated to be 8,000 receptor-hours/year. This value corresponds to a classification of 'very few hours' (less than 10,000 receptor-hours/year). Even though the potential contact hours classification does not change, the MEC HA scores for Alternatives 3, 4, and 5 are reduced from 15 to 5 for this input factor, because the remedial action (surface clearance or cap installation) is equivalent to a subsurface MEC clearance of 1.5 feet.

November 2018 P:\PIT\Projects\Huntsville Cont W912DY-08-D-0003\TO#13 - OD Grounds R1-FS\Documents\FS\03 - Final FS\Ver6_113018\Appendices\Appendic C - MEC RA\OD_Grounds_MEC_HA_112718.docx Amount of MEC: The potential MEC presence at the OD Hill assessment area is the result of open detonation; therefore, the classification of 'OB/OD Area' is selected. However, for Alternatives 3, 4, and 5, the MEC HA associated scores for this input factor are reduced from 180 to 30 due to the remedial action (surface clearance or cap installation) which is equivalent to a subsurface MEC clearance of 1.5 feet.

Minimum MEC Depth Relative to the Maximum Receptor Intrusive Depth: The maximum receptor intrusive depth at the site is anticipated to be 0 feet with a future land use of non-intrusive conservation/recreation (hiking, no camping) and LUCs that restrict intrusive activity. To change the minimum MEC depth, Alternative 3 would install a cap over the assessment area and Alternatives 4 and 5 would conduct subsurface clearance to a depth of 2 feet bgs. As a result of the remedial actions, the minimum MEC depth would change to 1.5 feet (Remedial Alternative 3) and 2 feet (Remedial Alternative 4), and 3 feet (Remedial Alternative 5). The maximum intrusive depth for these three scenarios would no longer overlap with the minimum MEC depth. The input parameter would change to 'MEC located only in subsurface – intrusive depth *does not* overlap with minimum MEC depth'. This approach has the result of reducing the score for this input factor from 240 to 25 for Alternatives 3, 4, and 5.

Migration Potential: Unchanged from the baseline evaluation.

MEC Classification: Unchanged from baseline evaluation.

MEC Size: Unchanged from baseline evaluation.

MEC HA Results: Accounting for these score modifications resulting from either Remedial Alternative 3, 4, or 5 and a land use change to non-intrusive conservation/recreational (hiking, no camping), the total MEC HA score for the OD Hill assessment area would be reduced from 845 to 470. This reduction in the MEC HA score reduces the corresponding Hazard Level rating from 1 ('highest potential explosive hazard conditions') to 4 ('low potential explosive hazard conditions') for these three remedial alternatives. The revised MEC HA scores for Alternatives 3, 4, and 5 are shown in Table C.5.

Table C.4Summary of MEC HA ScoreRemedial Alternative 2OD Hill Assessment Area

Explosive Hazard Component	Input Factors	Input Factors Category Selected for Area				
Severity	Energetic Material Type	High explosives and low explosive filler in fragmenting rounds	100 (100)			
•	Location of Additional Human Receptors	Outside of the ESQD arc	0 (30)			
Accessibility	Site Accessibility	Full accessibility	80 (80)			
	Total Contact Hours	Very few hours	15 (120)			
	Amount of MEC	OB/OD Area	180 (180)			
	Minimum MEC Depth vs. Maximum Intrusive Depth	MEC located only in subsurface; max. intrusive depth <u>does not</u> overlap with min. MEC depth	240 (240)			
	Migration Potential	Unlikely	10 (30)			
Sensitivity	MEC Classification	Sensitive UXO	180 (180)			
	MEC Size	40 (40)				
Total MEC HA Scor	e		845 (1,000)			
MEC HA Hazard Le	vel		1 (2)			

(1) Categories and/or scores that change from the baseline because of the assumed future scenario are shown in **bold italics**.

(2) A MEC HA Hazard Level of 1 indicates an area with "Highest potential explosive hazard conditions" (USEPA, 2008).

Table C.5
Summary of MEC HA Score
Remedial Alternative 3, 4, and 5
OD Hill Assessment Area

Explosive Hazard Component	onent Input Factors Category Selected for Area				
Severity	Energetic Material Type	High explosives and low explosive filler in fragmenting rounds	100 (<i>100</i>)		
	Location of Additional Human Receptors	Outside of the ESQD arc	0 (<i>30</i>)		
Accessibility	Site Accessibility	Full accessibility	80 (80)		
	Total Contact Hours	Very few hours	5 (120)		
	Amount of MEC	OB/OD Area	30 (180)		
	Minimum MEC Depth vs. Maximum Intrusive Depth	MEC located only in subsurface; max. intrusive depth <u>does not</u> overlap with min. MEC depth	25 (240)		
	Migration Potential	Unlikely	10 (30)		
Sensitivity	MEC Classification	Sensitive UXO	180 (<i>180</i>)		
	MEC Size	40 (<i>40</i>)			
Total MEC HA Scor	e	1	470 (<i>1,000</i>)		
MEC HA Hazard Le	vel		4 (3)		

- (1) Scores assigned for each factor for Alternative 3 are considered equivalent to subsurface cleanup and are scored under a "subsurface cleanup" scenario as listed and described in USEPA (2008). The maximum possible MEC HA score is listed in parentheses beneath the assigned score(s) for reference purposes.
- (2) Categories and/or scores that change from the baseline as a result of the assumed future scenario are shown in *bold italics*.
- (3) A MEC HA Hazard Level of 4 indicates an area with "Low potential explosive hazard conditions" (USEPA, 2008).

C.10.2 Kickout Area

Alternatives 2, 3, 4, and 5 were also considered for the Kickout Area. For Alternative 2, input assumptions and related MEC HA scores are unchanged from the baseline evaluation. Accounting for the lack in score modifications resulting from Remedial Alternative 2, the total MEC HA score for the Kickout Area remained at 695 and the Hazard Level rating remained at 3 ('moderate potential explosive hazard conditions'). The revised MEC HA scores for the Kickout assessment area are shown in Table C.6.

Alternatives 3, 4, and 5 modified the input assumptions for this assessment area with regard to *potential* contact hours, amount of MEC, minimum MEC depth vs. maximum intrusive depth, and migration potential. All other input assumptions and related MEC HA scores for these three scenarios are unchanged. In accordance with USEPA (2008) guidance, the scores assigned for these categories under the baseline condition are reduced to reflect subsurface MEC clearance to either an estimated 2 feet bgs (Remedial Alternatives 3 and 4) or an estimated 3 feet bgs (Remedial Alternative 5). After cleanup, activities do not overlap with MEC location. Consequently, human receptors are no longer as likely to come into contact with MEC in the assessment area. The modified assumptions and their effect on the associated MEC HA input factors are described below.

MRS Definition: Unchanged from baseline evaluation.

Energetic Material Type: Unchanged from baseline evaluation.

Location of Additional Human Receptors: Unchanged from baseline evaluation.

Site Accessibility: Unchanged from baseline evaluation.

Potential Contact Hours: As described above, the future land use scenario considered for the Kickout assessment area after a remedial response has been implemented assumes the future use of conservation/recreation, which includes hiking but no camping. Though it is not anticipated that the OD Grounds will become a hiking destination, for the purposes of this evaluation, this MEC HA conservatively assumes that 2,000 people visit the area each year and each person is assumed to spend an average of 4 hours on the site, for a total of 8,000 hours per year. No intrusive activities are permitted or expected to occur. Based on this information, the total potential contact hours for the assessment area under the future scenario are calculated to be 8,000 receptor-hours/year. This value corresponds to a classification of 'very few hours' (less than 10,000 receptor-hours/year). Even though the potential contact hours classification does not change, the MEC HA scores for Alternatives 3, 4, and 5 are reduced from 15 to 5 for this input factor, due to the remedial action (subsurface clearance) (USEPA, 2008).

Amount of MEC: The potential MEC presence in the Kickout assessment area is the result of kick-outs from open detonation, but with no actual detonation occurring in the area. Therefore, the MEC HA classification of 'Safety Buffer Area' is selected. However, the MEC HA associated scores for Alternatives 3, 4, and 5 for this input factor are reduced from 30 to 5 due to the remedial action (subsurface clearance) (USEPA, 2008).

Minimum MEC Depth Relative to the Maximum Receptor Intrusive Depth: The maximum receptor intrusive depth at the site is anticipated to be 0 feet with a future land use of non-intrusive

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conservation/recreation (hiking, no camping) and LUCs that restrict intrusive activity. As a result of the remedial action (subsurface clearance), the minimum MEC depth would change to either 2 feet bgs (Remedial Alternatives 3 and 4) or 3 feet bgs (Remedial Alternative 5). The maximum intrusive depth would no longer overlap with the minimum MEC depth. The input parameter would change to 'MEC located only in subsurface – intrusive depth *does not* overlap with minimum MEC depth'. This approach has the result of reducing the scores for this input factor from 240 to 25.

Migration Potential: Unchanged from baseline evaluation.

MEC Classification: Unchanged from baseline evaluation.

MEC Size: Unchanged from baseline evaluation.

MEC HA Results: Accounting for these score modifications resulting from Remedial Alternatives 3, 4, and 5, the total MEC HA score for the Kickout assessment area would be reduced from 695 to 445 under these three remedial alternatives. This reduction in MEC HA score reduces the corresponding Hazard Level rating from 3 ('moderate potential explosive hazard conditions') to 4 ('low potential explosive hazard conditions'). The revised MEC HA scores for the Kickout assessment area are shown in Table C.7.

Table C.6 Summary of MEC HA Score Remedial Alternative 2 Kickout Assessment Area

Explosive Hazard Component	Input Factors	Category Selected for Area	Score ⁽¹⁾⁽²⁾ (Max. Score) Alt 2	
Severity	Energetic Material Type	High explosives and low explosive filler in fragmenting rounds	100 (100)	
	Location of Additional Human Receptors	Outside of the ESQD arc	0 (30)	
Accessibility	Site Accessibility	Full accessibility	80 (80)	
	Total Contact Hours	Very few hours	15 (120)	
	Amount of MEC	Safety Buffer Area	30 (180)	
	Minimum MEC Depth vs. Maximum Intrusive Depth	MEC located only in subsurface; max. intrusive depth does not overlap with min. MEC depth	240 (240)	
	Migration Potential	Unlikely	10 (30)	
Sensitivity	MEC Classification	Sensitive UXO	180 (180)	
	MEC Size	40 (40)		
Total MEC HA Scor	e		695 (1,000)	
MEC HA Hazard Le	vel		3 (2)	

(1) Categories and/or scores that change from the baseline because of the assumed future scenario are shown in bold italics.

(2) A MEC HA Hazard Level of 3 indicates an area with "Moderate potential explosive hazard conditions" (USEPA, 2008).

Table C.7 Summary of MEC HA Score Remedial Alternative 3, 4, and 5 Kickout Assessment Area

Explosive Hazard Component	Input Factors	Category Selected for Area	Score ⁽¹⁾⁽²⁾ (<i>Max. Score</i>) Alt 3, Alt 4, and Alt 5	
Severity	Energetic Material Type	High explosives and low explosive filler in fragmenting rounds	100 (100)	
	Location of Additional Human Receptors	Outside of the ESQD arc	0 (30)	
Accessibility	Site Accessibility	Full accessibility	80 <i>(80)</i>	
	Total Contact Hours	Very few hours	5 (120)	
	Amount of MEC	Safety Buffer Area	5 (180)	
	Minimum MEC Depth vs. Maximum Intrusive Depth	MEC located only in subsurface; max. intrusive depth does not overlap with min. MEC depth	25 (240)	
	Migration Potential	Unlikely	10 (30)	
Sensitivity	MEC Classification	Sensitive UXO	180 (180)	
	MEC Size	40 (40)		
Total MEC HA Scor	e	· · · · · · · · · · · · · · · · · · ·	445 (1,000)	
MEC HA Hazard Le	vel		4 (3)	

- (1) Scores assigned for each factor are scored under a "subsurface cleanup" scenario as listed and described in USEPA (2008). The maximum possible MEC HA score is listed in parentheses beneath the assigned score(s) for reference purposes.
- (2) Categories and/or scores that change from the baseline because of the assumed future scenario are shown in bold italics.
- (3) A MEC HA Hazard Level of 4 indicates an area with "Low potential explosive hazard conditions" (USEPA, 2008).

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C.11 DISCUSSION OF RESULTS

A summary of the results of the MEC HAs conducted for the baseline and possible future remedial alternatives at the OD Grounds is presented in Table C.8. For the OD Hill area, the baseline score (the no action alternative) results in a MEC HA score of 845 and a Hazard Level of 1 ('highest potential explosive hazard conditions'). As shown in the table, Remedial Alternative 2 results in a MEC HA score of 845, same as the baseline. Remedial Alternative 3, 4, and 5 all result in the same MEC HA score of 470 for the OD Hill assessment area. Based on this result, remedial alternatives 3, 4, and 5, if implemented, would significantly reduce the MEC hazards at the site (from 'highest potential explosive hazard conditions'). There would be no differences between these remedial alternatives with regard to reduction explosive hazards at the OD Hill area. The revised MEC HA scores for all the alternatives are shown in Table C.8.

For the Kickout area, the baseline score (the no action alternative) results in a MEC HA score of 695 and a Hazard Level of 3 ('moderate potential explosive hazard conditions'). For Remedial Alternative 2, the MEC HA score and Hazard Level remained unchanged from the baseline evaluation. Alternatives 3, 4, and 5 result in the same MEC HA score of 445. Based on this result, the remedial alternative 3, 4, or 5, if implemented, would reduce the MEC hazards at the site (from 'moderate potential explosive hazard conditions' to 'low potential explosive hazard conditions'). The revised MEC HA score for this alternative is shown in Table C.8.

Based on these results, there is no significant difference between the remedial alternatives 3, 4, and 5 with respect to reduction of explosive hazards at the OD Hill area. As has been noted before, these total MEC HA scores and the associated hazard levels are *qualitative references only* and should <u>not</u> be interpreted as quantitative measures of explosive hazard, nor should the results of this evaluation be used as the sole basis on which to recommend a remedial response. Also, this MEC HA does <u>not</u> address or otherwise evaluate potential risks related to MC that might be present at the site.

Scenario Description	Assessment Area	Energetic Material Type	Location of Additional Human Receptors	Site Accessibility	Total Contact Hours	Amount of MEC	Minimum MEC Depth vs. Maximum Intrusive Depth	Migration Potential	MEC Classification	MEC Size	Total MEC HA Score (125-1,000)	MEC HA Hazard Level
Maximum MEC HA Score		100	30	80	120	180	240	30	180	40	1,000	1
BASELINE SCENARIO: Current Conditions/No Action Alternative Current Site Conditions No Public Use	OD Hill	100 HE or fragmenting rounds	0 Outside MRS or ESQD arc	80 Full accessibility	15 Very few hours	180 OB/OD Area	240 MEC located surface and subsurface; max, intrusive depth overlaps min. MEC depth	10 Unlikely	180 Sensitive UXO	40 Small	845	1
	Kickout	100 HE or fragmenting rounds	0 Outside MRS or ESQD arc	80 Full accessibility	15 Very few hours	30 Safety Buffer Area	240 MEC located surface and subsurface: max. intrusive depth overlaps min. MEC depth	10 Unlikely	180 Sensitive UXO	40 Small	695	3
REMEDIAL ACTION Alternative - 2: LUCs Only, including groundwater restriction. Future Use: Restricted Recreational	OD Hill	100 HE or fragmenting rounds	0 Outside MRS or ESQD arc	80 Full accessibility	15 Very few hours	180 OB/OD Area	240 MEC located surface and subsurface: max, intrusive depth overlaps min. MEC depth	10 Unlikely	180 Sensitive UXO	40 Small	845	I
	Kickout	100 HE or fragmenting rounds	0 Outside MRS or ESQD arc	80 Full accessibility	15 Very few hours	30 Safety Buffer Area	240 MEC located surface and subsurface: max, intrusive depth overlaps min. MEC depth	10 Unlikely	180 Sensitive UXO	40 Small	695	3
REMEDIAL ACTION Alternative - 3: Consolidate and Cap with Surface and Subsurface Clearance Outside the Cap and LUCs. Future Use: Restricted Recreational	OD Hill	100 HE or fragmenting rounds	0 Outside MRS or ESQD arc	80 Full accessibility	5 Very few hours	30 OB/OD Area	25 MEC located only in subsurface; max. intrusive depth does not overlap with min. MEC depth	10 Unlikely	180 Sensitive UXO	40 Small	470	Ł
	Kickout	100 HE or fragmenting rounds	0 Outside MRS or ESQD arc	80 Full accessibility	5 Very few hours	\$ Safety Buffer Area	25 MEC located only in subsurface; max. intrusive depth does not overlap with min. MEC depth	10 Unlikely	180 Sensitive UXO	40 Small	445	4

Table C.8 Summary of MEC IIA Results for All Evaluated Scenarios and Assessment Areas OD Grounds

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Seneca Army Depot Activity

MEC Hazard Assessment for OD Grounds

Scenario Description	Assessment Area	Energetic Material Type	Location of Additional Human Receptors	Site Accessibility	Total Contact Hours	Amount of MEC	Minimum MEC Depth vs. Maximum Intrusive Depth	Migration Potential	MEC Classification	MEC Size	Total MEC HA Score (125-1,000)	MEC HA Hazard Leve (1-4)
REMEDIAL ACTION Alternative – 4: Excavate OD Hill to grade and perform surface/subsurface clearance over the entire site, and LUCs. Future Use: Restricted Recreational	OD Hill	100 HE or fragmenting rounds	0 Outside MRS or ESQD arc	80 Full accessibility	5 Very few hours	30 OB/OD Area	25 MEC lost subsurface; max. intrusive depth does not overlap with min. MEC depth	10 Unlikely	180 Sensitive UXO	40 Smail	470	4
	Kickout	100 HE or fragmenting rounds	0 Outside MRS or ESQD arc	80 Full accessibility	5 Very few hours	5 Safety Buffer Area	25 MEC located only in subsurface; max. intrusive depth does not overlap with min. MEC depth	10 Unlikely	180 Sensitive UXO	40 Small	445	4
REMEDIAL ACTION Alternative 5: Excavate entire site to 1 foot below grade and perform surface/subsurface clearance. Future Use: Restricted Recreational	OD Hill	100 HE or fragmenting rounds	0 Outside MRS or ESQD arc	80 Full accessibility	5 Very few hours	30 OB/OD Area	25 MEC located only in subsurface; max. intrusive depth does not overlap with min. MEC depth	10 Unlikely	180 Sensitive UXO	40 Small	470	4
	Kickout	100 HE or fragmenting rounds	0 Outside MRS or ESQD arc	80 Full accessibility	5 Very few hours	5 Safety Buffer Area	25 MEC located only in subsurface; max. intrusive depth does not overlap with min. MEC depth	10 Unlikely	180 Sensitive UXO	40 Small	445	4

(1) For these remedial actions, scores are assigned for each factor assuming a 'subsurface cleanup' scenario as listed and described in the MEC HA interim guidance document (USEPA, 2008). The installation of a cap is considered equivalent to a subsurface cleanance.

(2) Categories and/or scores that change from the baseline as a result of the assumed future scenario are shown in bold Italics.

C.12 GLOSSARY OF TERMS

- Discarded Military Munitions (DMM): Military munitions that have been abandoned without proper disposal or removed from storage in a military magazine or other storage area for the purpose of disposal. The term does not include unexploded ordnance, military munitions that are being held for future use or planned disposal, or military munitions that have been properly disposed of consistent with applicable environmental laws and regulations (10 U.S.C. 2710(e)(2)).
- Munitions and Explosives of Concern (MEC): This term, which distinguishes specific categories of military munitions that may pose unique explosives safety risks, means: (a) Unexploded Ordnance (UXO), as defined in 10 U.S.C. 101 (e)(5); (b) Discarded Military Munitions (DMM), as defined in 10 U.S.C. 2710(e)(2), or (c) Munitions constituents (e.g., TNT, RDX) present in high enough concentrations to pose an explosive hazard.
- Munitions Potentially Presenting an Explosive Hazard (MPPEH): Material that, prior to determination of its explosives safety status, potentially contains explosives or munitions (e.g., munitions containers and packaging material; munitions debris remaining after munitions use, demilitarization, or disposal; and range-related debris); or potentially contains a high enough concentration of explosives such that the material presents an explosive hazard (e.g., equipment, drainage systems, holding tanks, piping, or ventilation ducts that were associated with munitions production, demilitarization or disposal operations). Excluded from MPPEH are munitions within the DoD established munitions management system and other hazardous items that may present explosion hazards (e.g., gasoline cans, compressed gas cylinders) that are not munitions and are not intended for use as munitions.
- Unexploded Ordnance (UXO): Military munitions that: (a) Have been primed, fuzed, armed, or otherwise prepared for action; (b) Have been fired, dropped, launched, projected or placed in such a manner as to constitute a hazard to operations, installations, personnel, or material; and (c) Remain unexploded either by malfunction, design, or any other cause (10 U.S.C. 101 (e)(5)).

C.13 REFERENCES

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