

# Radiological Data Assessment Guidance for Emergency Response Job Aid: Assess an Area Against an Action Level

This job aid has been developed to guide readers through performing statistical testing for data quality assessment using Visual Sample Plan<sup>1</sup>. More information about data quality assessment can be found in the Radiological Data Assessment Guidance for Emergency Response<sup>2</sup> document on CBRN Responder.

**Use Case:** Determine whether a specified area has suspected contamination or radiation levels that can be said to below an incident action level (threshold). One example is assessing whether an affected area should be considered a radiologically controlled area when comparing measured values to an action level. This test is described in Section 5.2.5 of the Radiological Data Assessment Guidance for Emergency Response<sup>2</sup>.

### **Assumptions:**

- The test area should contain terrain that is roughly homogeneous throughout the area.
- Data collected is representative of the area being assessed.
- The area being assessed does not include regions known to have drastically different contamination or radiation levels, such as hot spots.
- This test is performed on data collected over time in various locations in which conditions have not significantly changed.
- The data have all already been transformed into the same units.
- The data contains no outliers that would indicate potential hotspots.
- The reader has already successfully installed VSP on their computer. VSP is currently only compatible with Windows operating systems.
- This test requires at least four measurement values.

If any of the assumptions above are not true for your particular situation or data, this test may not be appropriate. Consult EPA guidance QA/G-9 "Practical Methods for Data Analysis" for more information<sup>3</sup>.

Throughout this job aid, markers such as "(A)" indicate a highlight in the next VSP screenshot after the marker.

- 1. Launch the Upper Tolerance Limit (UTL) dialog in VSP: Follow the steps below to launch the design dialog to import data and perform the test.
  - 1.1. In the top-left menu bar, click on (A) "Sampling Goals".
  - 1.2. In the pop-up drop-down menu, hover over each item in order from (B) to (C):

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<sup>&</sup>lt;sup>1</sup> <u>https://www.pnnl.gov/projects/visual-sample-plan</u>

<sup>&</sup>lt;sup>2</sup> <u>https://www.cbrnresponder.net/app/index#resources/documents/download/2308</u>

<sup>&</sup>lt;sup>3</sup> https://www.epa.gov/sites/default/files/2015-06/documents/g9-final.pdf

- (B) "Show That at Least Some High % of the Sampling Area is Acceptable"
- (C) "Using quantitative measurements from an unknown distribution  $\dots$  "
- 1.3. Click on "Using quantitative measurements from an unknown distribution ... "to launch the Nonparametric Upper Tolerance Limit test in a new dialog that will pop up.

Wisual Sample Plan - [VS	sampl1]
File Map A Sar	mpling Goals Tools Options Room View Window Help
	Compare Average to Fixed Threshold 📔 🏩 🖉 🔛 🔲
	Compare Average to Reference Average
Laver Control	Estimate the Mean
Settings	Construct Confidence Interval on Mean
🖻 🏊 Background Imag	Locate Hot Spots (Contiguous Areas of Contamination)
Imac B Map Lines () B	Show That at Least Some High % of the Sampling Area is Acceptable Vising presence / absence measurements
🖃 🔽 💙 Default Mi	Discover Unacceptable Areas With High Confidence Using quantitative measurements that follow a normal distribution
View Settings	Combined Average and Individual Measurement Criteria C Using quantitative measurements from an unknown distribution
	Detect a Trend Sing presence / absence measurements for different strata
	Identify Sampling Redundancy
	Add Sampling Locations to Reduce Spatial Uncertainty
POP-	Nonparametric Upper Tolerance Limit          Nonparametric Upper Tolerance Limit       Sample Placement       Costs       Data Analysis         Decision Rule:       If the Upper Tolerance Limit (UTL) is > or = to the action level, conclude that the decision unit is contaminated; otherwise the decision unit is not contaminated.       Specify Parameter To Calculate         Iwart to: <ul> <li>Calculate the number of samples required.</li> <li>Calculate the achieved confidence based on a fixed number of samples.</li> <li>Calculate the fraction of the population that could be concluded to be below the action level with a specified level of confidence, given a fixed number of samples.</li> <li>Specify Confidence Level and Fraction of Population</li> <li>Iwart at least</li> <li>% confidence that at least</li> <li>% of the values in the population are below the action level of confidence based on a fixed number of samples.</li> <li>Specify Confidence Level and Fraction of Population</li> <li>Iwart at least</li> <li>% confidence that at least</li> <li>% of the values in the population are below the action level of units.</li> <li>Image samples are required to achieve the specified parameters.</li> </ul>
	OK Cancel Apply Help

- 2. **Specify the percent confidence, fraction of population, and the action level**: Follow the steps below to set the necessary test parameters.
  - 2.1. Specify the established (F) **action level**. For example, 2 mR/hr is a commonly-used limit.
  - 2.2. Specify the (D) **percent confidence** and the (E) **fraction of the population** such that there is enough reason to consider an area as a radiologically controlled

area. The maximum possible value to specify for either parameter is 99.99%, and the lowest possible value is 50.00%.

- 2.3. VSP will calculate how many samples are needed to perform the UTL test. The higher the percent confidence and faction of the population, the more samples are needed.
- 2.4. The three radio buttons in the Specify Parameter To Calculate section allow different parameters of interest to be calculated. For example, if a fixed level of confidence is required and a known number of data values have been collected, selecting the third radio button will allow the confidence and the number of data values in order to calculate the fraction of the population that can be confidently determined to be below a particular level.

Monparametric Upper Tolerance Limit	-		×
Nonparametric Upper Tolerance Limit Sample Placement Costs Data Analysis			
Decision Rule: If the Upper Tolerance Limit (UTL) is > or = to the action level, conclude that the decision unit is contaminated; otherwise the decision unit is not contaminated.			
Specify Parameter To Calculate			
I want to:			
<ul> <li>Calculate the number of samples required.</li> </ul>			
C Calculate the achieved confidence based on a fixed number of samples.			
C Calculate the fraction of the population that could be concluded to be below the action level with a specified level of confidence, given a fixed number of samples.			
Specify Confidence Level and Fraction of Population			
I want at I D 95.00 % confidence that at least 95.00 % E			
of the values in the population are below the action level of 2 units.			
59 samples are required to achieve the specified parameters.			
If the maximum of the 59 sample values (the nonparametric UTL) is less than the action level, then you will be able to conclude with 95% confidence that at least 95% of the values in the population are less than the action level and therefore that the decision unit is uncontaminated.			
OK Cancel A	pply	He	lp

- 3. **Prepare your data to be loaded into VSP**: Follow the steps below to prepare to load your data into VSP.
  - 3.1. Open your data in Excel (recommended) or a text editor.
  - 3.2. **Note on format**: VSP does not accept comma delimited data, only tab delimited. Ensure that the data is in a columnar format (i.e., tab delimited).
  - 3.3. Select and copy the rows to be imported into VSP. The test can still be computed if there are missing data, extra columns, or no specific order to columns or rows, but ensure that there is a column for (G) the **sample values**.

Excel	Text Editor (tab delimited)	
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E102 - E × ✓ Jr mR/hr A B C D 1 1 Field Surveys	K Cut	80 34.22395798 -81.32447429 0.686 mR/hr 81 34.2996044 -81.29445804 0.241 mR/hr 82 34.20617741 -81.3303797 1.751 mR/hr 83 34.20864528 -81.34602137 1.463 mR/hr
2 I D Latitude Longitude Standardized Assessment Standardiz 3 1 34.20371408 -81.3269 G 1.872 mR/hr	red 🛱 Paste Options: din	84         34.2708307         -81.26920918         1.662         mR/hr           85         34.21632017         -81.30959097         0.535         mR/hr           86         34.2147         Undo         mR/hr
4         2         34,28319619         -81.34451         1.713         mR/hr           5         3         34,20471323         -81.34897514         1.708         mR/hr           6         4         34,2559794         -81.29468931         1.77         mR/hr           7         5         34,2022703         -81.34485063         0.367         mR/hr	Paste Special Jnsert Delete	87         34.24369         mR/hr           88         34.27312         Cut         mR/hr           89         34.22927         Copy         mR/hr
8         6         34.25106509         -81.29393635         0.47         mR/hr           9         7         34.26577362         -81.29705318         0.393         mR/hr           10         8         34.29625422         -81.28706515         1.924         mR/hr           11         9         34.29783439         -81.2872461         0.147         mR/hr	Clear Contents	90         34.28514         Paste         mR/hr           91         34.23905         Delete         mR/hr           92         34.23121         Select All         mR/hr
12         10         34.23083772         -81.2540599         0.124         mR/hr           13         11         34.26556261         -81.33985872         1.32         mR/hr           14         12         34.23822238         -81.26029159         1.948         mR/hr           15         13         34.27887766         -81.31604379         1.479         mR/hr	Eliter     Sort     Sort	93         34, 21/9         Detect nin         mR/hr           94         34, 25525         Right to left Reading order         mR/hr           95         34, 29161         Show Unicode control characters         mR/hr           96         34, 29845         Show Unicode control characters         mR/hr
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23         21         34.24406659         -81.34010925         0.352         mR/hr           24         22         34.23102216         -81.25179093         1.123         mR/hr	Pick From Drop-down List	

- 4. Load the data into VSP: Follow the steps below to load your data into VSP.
  - 4.1. In the **"Nonparametric Upper Tolerance Limit**" dialog, click on the **"Data Analysis**" tab. Ensure the **"Data Entry**" sub tab is open. If not, click on it.
  - 4.2. Click on the (H) "**Paste**" button.

Nonparametric	: Upper Tolerance	e Limit					$\times$
Nonparametric Upp	er Tolerance Limit	Sample Pla	cement	Costs Data /	Analysis		
Data Entry Su	mmary Statistics	Tests   Plots					
H Paste	Paste new data	a from the clip	board	Сору	Copy the data to the	dipboard	
Import	Import new dat	ta from a file		Delete All	Delete all existing sam	ples and data	
Manual	Manually enter	new data		Columns	Configure which colum	nns to display	
Filter Data	Use filters to cr	eate a subset	of the da	ta			_
Anal	yte	Value	Ref	Surv			_
			Tran	nsform Data	Apply a transform to all da	ata values	

- 4.3. In the new pop-up dialog, preview the pasted data and ensure it matches what was copied in step 3.3. For example, in the data loaded below, 100 samples measuring gamma radiation (mR/hr) were collected in Jenkinsville, Arkansas, USA.
- 4.4. Click on the column headers to map the appropriate columns to **Value**.
- 4.5. Check the box "**Ignore header row during import**" if copied data has a header row.
- 4.6. Press OK to import data.
- 4.7. Ensure the data has been imported as expected. If data has been imported incorrectly and needs to be reimported, click on the (I) "**Delete All**" button and follow steps **4.1 4.6** again.

## POP-UP

#### ndd Data

☐ Ignore header row during import

1           2           3           4           5           6           7           8           9           10           11           12           13           14           15           16           17           18           19           20           21           22           23   parametric Upper Entry Summ Paste Import Manual ilter Data  Analyt An	Upper Toleran r Tolerance Lim mary Statistics Paste new da Import new da	84.20371408 84.20371408 84.20371408 84.28319619 84.20471323 84.25595794 84.25595794 84.25505650 84.296577362 84.296556261 84.29783439 94.23083772 84.26556261 84.238296562 84.24181295 84.22480857 84.22860857 84.22360857 84.2236589 84.23792396 84.23792396 84.23746512 84.240659 84.2302216 84.23351677     nce Limit nit   Sample Placer   Tests   Plots    ta from the clipboa ata from a file se new data	-81.32693069 -81.34453514 -81.34897514 -81.29468931 -81.34485063 -81.29393635 -81.29705318 -81.28002645 -81.2872461 -81.2540599 -81.33985872 -81.26029159 -81.33929038 -81.26029159 -81.33929038 -81.26029159 -81.33929038 -81.26014304 -81.27084343 -81.33561663 -81.34903708 -81.3401925 -81.3401925 -81.25179093 -81.28011322 -81.2801132 -81.280112 -81.280112 -81.280112 -81.280112 -81.280112 -81.280112 -81.28	1.872 1.713 1.708 1.7 0.367 0.47 0.393 1.924 0.147 0.124 1.32 1.948 1.479 0.02 0.996 0.91 1.835 1.296 0.182 1.631 0.352 1.123 0.223 .223	mR/hr mR/hr	Cancel
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7         8           9         10           11         12           13         14           15         16           17         18           19         20           21         22           23         21           22         23           parametric Upper         Entry           Entry         Sumr           Paste         Import           Manual         ilter Data           Iter Data         Analyt           3         Analyt           3         Analyt           4         Analyt           5         Analyt           7         Analyt           8         Analyt	Upper Toleran r Tolerance Lim many Statistics Paste new da Import new da	94.26577362 34.29625422 34.29783439 34.23083772 34.26556261 34.23822238 34.27487706 34.28296562 34.24181295 34.22808577 34.22502755 34.225808577 34.22502755 34.22502755 34.22502755 34.22302755 34.23746512 34.23746512 34.24406659 34.23102216 34.25351677 Tests   Plots   Tests   Plots   Ita from the clipboal ata from a file ata from a file	-81.29705318 -81.28002645 -81.2872461 -81.2540599 -81.33985872 -81.26029159 -81.33929038 -81.26014304 -81.22084343 -81.3261663 -81.34973708 -81.3401925 -81.3401925 -81.25179093 -81.25179093 -81.28011322 -81.2801132 -81.2801132 -81.2801132 -81.2801132 -81.2801132 -81.2801132 -81.2801132 -81.2801132 -81.2801132 -81.2801132 -81.2801132 -81.280112 -81.28	0.393 1.924 0.147 0.124 1.32 1.948 1.479 0.02 0.996 0.91 1.835 1.296 0.182 1.631 0.352 1.123 0.723 	mR/hr mR/hr	Cancel
8         9           10         11           12         13           14         15           16         17           18         19           20         21           22         23           parametric Upper           Entry         Sumr           Paste         Import           Manual         ilter Data           1         Analyt           3         Analyt           5         Analyt           5         Analyt           7         Analyt           8         Analyt	Upper Toleran r Tolerance Lim mary Statistics Paste new da Import new da	94.29625422 34.29783439 34.20783439 34.26556261 34.23822238 34.27487706 34.2826562 34.24181295 34.22860857 34.22502755 34.22502755 34.23502755 34.23746512 34.23746512 34.23102216 34.23102216 34.25351677 Tests   Plots   Tests   Plots   ta from the clipboa ata from a file se new data	-81.28002645 -81.2872461 -81.2540599 -81.33985872 -81.26029159 -81.31604379 -81.33929038 -81.26014304 -81.26154416 -81.27084343 -81.34973708 -81.34973708 -81.34027785 -81.34010925 -81.25179093 -81.280111322 -81.28011322 -81.2801132 -81.280112 -81.280112 -81.280112 -81.280112 -81.280112 -81.280112 -81.28012 -81.280112 -81.280112 -81.280112 -81.280112 -81.2	1.924 0.147 0.124 1.32 1.948 1.479 0.02 0.996 0.91 1.835 1.296 0.182 1.631 0.352 1.123 0.223	mR/hr mR/hr	Cancel
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10           11           12           13           14           15           16           17           18           19           20           21           22           23	Upper Toleran r Tolerance Lim mary Statistics Paste new da Import new da	34.23083772 34.26556261 34.23822238 34.27487706 34.28296562 34.24181295 34.22860857 34.22860857 34.22502755 34.22502755 34.23746512 34.2406659 34.23102216 34.25351677 A	-81.2540599 -81.33985872 -81.26029159 -81.31604379 -81.33929038 -81.26014304 -81.26014304 -81.27084343 -81.33561663 -81.34973708 -81.34017785 -81.34017785 -81.34017925 -81.25179093 -81.25179093 -81.28011322	0.124 1.32 1.948 1.479 0.02 0.996 0.91 1.835 1.296 0.182 1.631 0.352 1.123 0.723 	mR/hr mR/hr	Cancel
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12           13           14           15           16           17           18           19           20           21           22           23	Upper Toleran r Tolerance Lim mary Statistics Paste new da Import new da	123622236           14.27487706           34.28296562           34.28296562           34.28296562           34.24181295           34.228296357           34.22860857           34.232860857           34.2329652           34.2310255           34.27392396           34.27392396           34.2740512           34.2406659           34.23102216           34.25351677           ate Climit           nit         Sample Placer           Tests         Plots           ate from the clipboa           ate from a file           ar new data	-61.2604379 -81.31604379 -81.33929038 -81.26014304 -81.26154416 -81.27084343 -81.33561663 -81.34973708 -81.34017925 -81.34017925 -81.25179093 -81.25179093 -81.25179093 -81.26011322	1.946 1.479 0.02 0.996 0.91 1.835 1.296 0.182 1.631 0.352 1.123 0.223 0.223	mR/hr mR/hr mR/hr mR/hr mR/hr mR/hr mR/hr mR/hr mR/hr mR/hr mR/hr mR/hr mR/hr mR/hr mR/hr arphr mR/hr	Cancel
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15 16 17 18 19 20 21 22 23 Parametric U ametric Upper Entry Sumr Paste Import Manual ilter Data Analyt 3 Analyt 5 Analyt 6 Analyt 8 Analyt 8 Analyt	Upper Toleran r Tolerance Lim mary Statistics Paste new da Import new da	94.24181295 34.22860857 34.22502755 34.2056589 34.27392396 34.27392396 34.2746512 34.24406659 34.2216 34.2216 34.25351677 Tests   Plots   Ita from the clipboa ata from a file ar new data	-81.26014304 -81.26154416 -81.27084343 -81.33561663 -81.34973708 -81.34010925 -81.34010925 -81.25179093 -81.25179093 -81.26011322 March Costs Data A	0.996 0.91 1.835 1.296 0.182 1.631 0.352 1.123 0.223	mR/hr mR/hr mR/hr mR/hr mR/hr mR/hr mR/hr mR/hr mR/hr Mr OK	Cancel
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				ppiy a transform to a	an uata values	

- 5. **Perform the test:** The name of the statistical test used here is called the "Upper Tolerance Limit" (UTL) test. Follow the steps below to perform this test in VSP.
  - 5.1. Click on the "Tests" tab on the Nonparametric Upper Tolerance Limit dialog.

×

5.2. View the test results in the section of the Tests tab under the "**Nonparametric Upper Tolerance Limit**" section. (J) is the percent confidence and (H) is the percent of the area that the test applies to.

Monparametric Upper Tolerance Limit
Nonparametric Upper Tolerance Limit   Sample Placement   Costs Data Analysis
Data Entry Summary Statistics Tests Plots
Analyte 1  All Data
Normal Distribution Test
Lilliefors Significance Level: 5%
Data are sufficient to conclude with
Critical Value: 0.11535 pot pormally distributed
not normally also bacca
-Nonparametric Upper Tolerance Limit
Nonparametric UTL = 1.948 J Achieved Confidence: 95.15%
Because the data do not appear to be normal, the nonparametric UTL is recommended Conclude site is dean. ((More than 95% H is population <= Action Level of 2 mR/hr)
Parametric Upper Tolerance Limit
Parametric UTL = 2.1682 Conclude site is dirty
(Less than 95% of the population Not recommended because the data <= Action Level of 2 mR/hr)
do not appear to be normal
UCLs and Normality Tests Provided Courtesy of ProUCL

- 5.3. Use the UTL value provided in VSP to appropriately state the statistical conclusion that can be drawn from this test.
  - 5.3.1. The calculated UTL can be described as follows: "Given *n* measurements, we can be *C* percent confident that *P* percent of the area is below the UTL". In the example above, there were 59 measurements (indicated when the data is loaded). The conclusion statement would thus read "Given <u>59</u> measurements, we can be <u>95.15</u> percent confident that <u>95</u> percent of the area is below the UTL".