HEC-FDA
Version 1.4, September 2014
Release Notes

Since the last release of the HEC-FDA software (Version 1.2.5a, October 2010), there have been a number of modifications to the software as listed below. Also, this release creates a command prompt window that must be closed as described below.

Installation

Version 1.2.5a of HEC-FDA installed to the following directory: *C:\Program Files (x86)\HEC\HEC-FDA\1.2.5a*. Version 1.4 (September 2014) installs to the following directory: *C:\Program Files (x86)\HEC\HEC-FDA\1.4*.

The sample data sets are also copied to this directory as a self-extracting zip file called "ExampleStudies.exe". If a user wants to run the sample data sets and the user does not have system admin rights, the user must extract the data from *C:\Program Files (x86)\HEC\HEC-FDA\1.4\Example Studies.exe* into a directory where the user has access. For example, the user might choose to create the directory *C:\data\HEC-FDA\1.4\Example Studies* and extract the sample data sets into that directory. To do this, simply double click on the file "Example Studies.exe" and provide the appropriate directory.

Additional HEC-FDA Version 1.4 - The default release of HEC-FDA Version 1.4 is optimized for interface stability, but at a cost for computational speed. A second version of the software (*fda-performance.exe*) is provided which is optimized for computational speed over interface stability. If you are interested in using this additional version, please review the document "fda-performance.readme.txt" which is provided with the install package.

Running HEC-FDA

When HEC-FDA runs, a command prompt (DOS) window that contains Galaxy debug messages opens (Figure 1). Under previous Windows operating systems, this window automatically closed when HEC-FDA stopped running. Under Windows 7, the user will have to close this window manually. Galaxy is the commercial library that was used to create the HEC-FDA GUI.

Using Data from a Previous Version of HEC-FDA

HEC-FDA Version 1.4 can directly import studies created in Versions 1.2.4, 1.2.5, and 1.2.5a. However, once imported into Version 1.4, the study database will be converted to a new format and will no longer be compatible with earlier versions of the program. Studies created in Version 1.2 will first have to be converted to Version 1.2.5a before

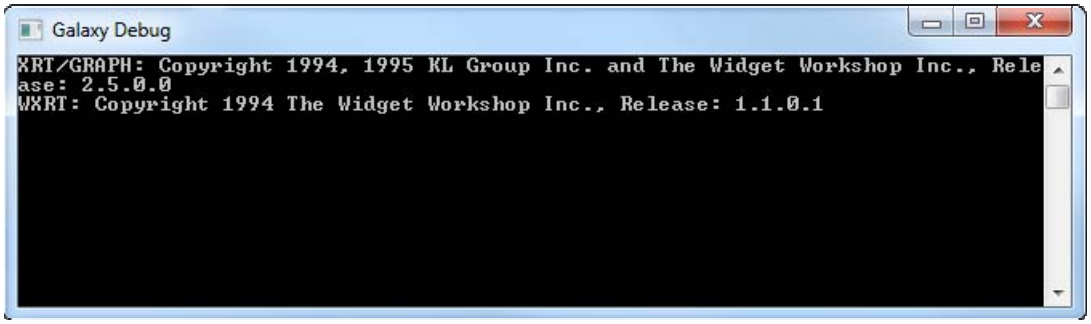

Figure 1. Galaxy Debug Messages

they can be imported into Version 1.4. There is no direct conversion from a Version 1.2 database to a Version 1.4 database. To convert a study, just open the study in HEC-FDA. A notice will be posted that the database is compatible with an older version of the program, as shown in Figure 2, and ask if the user wants to convert the database. Be sure to backup the study database before conversion.

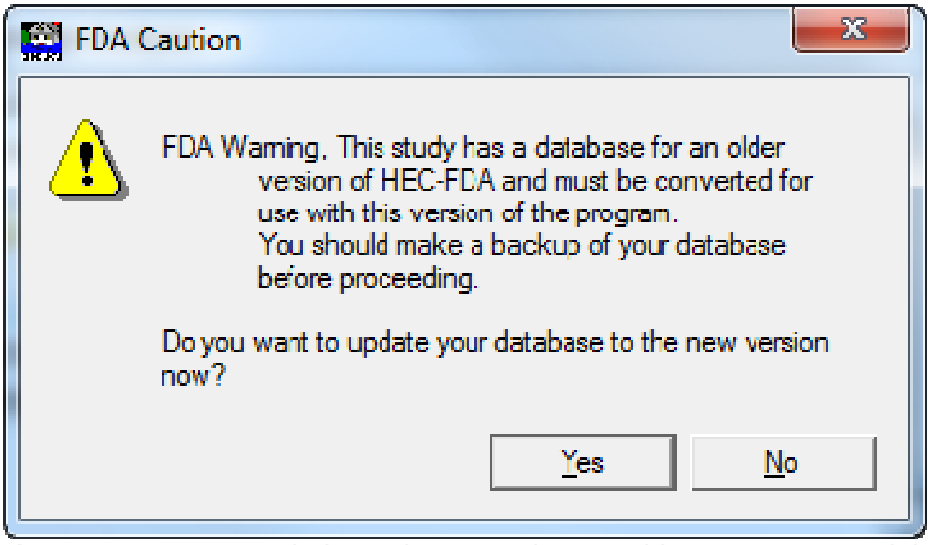

Figure 2. Message Window When Opening an Older HEC-FDA Model

Program Modifications

There have been many changes to HEC-FDA since Version 1.2.5a. The two major areas of change are:

1) introduction of a new method for computing uncertainty about graphical probability curves, which can affect results, and

2) rewriting of the database software, including switching all memo fields in the database (with the exception of the water surface profiles) from binary to tab-delimited text format so the user can visualize and edit the data.

The first major change concerned the methodology for computing uncertainty about graphical probability curves. A change was needed because the existing order statistics methodology gave inconsistent results when comparing change in output parameters as

a function of the Equivalent Length of Record. Version 1.4 of HEC-FDA utilizes the "Less Simple Method" which provides a solution to the problem while calculating reasonable confidence limits about graphical curves.

The second major change was the re-writing of the underlying HEC-FDA database. The changes now allow users to edit data outside of HEC-FDA by cutting and pasting between a spreadsheet and the memo field using dBASE or MS Access.

The following sections summarize all software changes functional area:

Expected annual damage calculations including calculation of uncertainty about graphical probability curves:

1. Changed diagnostic output that is written to text files for greater clarity.

2. Fixed various minor bugs.

3. Replaced the explicit order statistics method with the "less simple" approximation of that method for calculating uncertainty about graphical probability curves.

4. Modified EAD (expected annual damage) calculations when a geotechnical curve (fragility curve) is present. In Versions 1.2.4 and 1.2.5, the points in the geotechnical failure curve controlled the calculation points. In Version 1.4, internally-generated calculation points are used, assuring that more points are used for greater curve definition.

5. Added checks to prevent divide-by-zero calculation in interpolation routines. This prevents some computational aborts.

6. Made several modifications in output, including initializing the DFSIM array to zero so that if there is no damage, zeroes are printed in results tables (it was previously reporting false numbers).

The changes to the stage-aggregated damage calculations include some related to the changed database code and others related to enhancements or bugs fixes:

1. Changed a lot of the formatting of the source code for clarity.

2. Modified the code that stores computed stage-aggregated damage functions. HEC-FDA now attempts to replace stage-damage results if already existing, rather than continually deleting results and appending new results with new ID’s. This maintains clarity internally to the database and economizes on the need for new internal identifiers.

3. Enhanced the computed stage-aggregated damage naming scheme. If a record is new, HEC-FDA generates the function name from the

plan/year/reach /category so that it is recognizable when editing the file with dBASE.

4. Increased the function names from 16 to 32 characters which will allow greater flexibility in naming functions, structures, etc.

5. Modified the calculation for the range in stages needed for calculating stage-aggregated damage, including cases when negative stages are used. Previously, the stage range did not always go low enough to capture all the damage.

6. Changed the import/export routines to handle longer function names.

7. Changed the import/export routines to additionally import/export frequency curves, rating curves, and levee data.

8. Made numerous changes for compatibility with new database code.

9. Modified import/export to manage two lists of exceedance probabilities: 1) default, and 2) current
10.
11. Changed the way structures are filtered for computing stage-aggregated damage to take advantage of the database library query capability for more robust filtering.

The database code for HEC-FDA was completely rewritten to facilitate conversion from the older database of Version 1.2.5a and to support storing data in tab-delimited text format in memo fields. The changes include:

1. Added miscellaneous utility methods to enhance internal database management.

2. Added a class to update the database from Version 1.2.5 to 1.4.

3. Made major changes to database code for new database format where data written to memo fields is written in tab-delimited format (rather than binary format). This excludes the water surface profiles for efficiency reasons. Also made changes for additional fields such as date, sort key, etc. For example, there is a date stamp in every record that records the last date/time that a record was stored in the database.

4. Modified the error distribution class to correct some problems with triangular distributions when used for the stage-discharge rating curve.

5. Modified the code to store exceedance probabilities with the water surface profile object, making it possible to have different probabilities for different water surface profile sets.

6. Internally, removed the event type from the water surface profile class. Instead, the profile is accessed by integer index or exceedance probability. This was done for internal programming reasons.

7. Modified the analysis years to be treated like plans, reaches, etc. using internal ID's rather than integer year number. Allows the user to change years while maintaining integrity of database.

8. Renamed several of the database files so that they are consistent and recognizable by the user.

9. Increased the function names from 16 to 32 characters to add flexibility in user naming schemes.

HEC-FDA Graphical User Interface Modifications:

Results reports are written to the tab-delimited file Fda_Results.txt for import into spreadsheets and inclusion in reports. To access the reports from a different software package such as Excel, the user will first have to close the study from within HEC-FDA.

1. Made many modifications so that the GUI could access new database code.
2.
3. Modified the "add record" mode to append a blank record and update the record navigator so that it would properly display the current record location.
4.
5. Corrected problem with triangular distribution in depth-damage functions when used with the stage-discharge function.
6.
7. User can now edit the "Without" plan. The user can internally change the pointer from the without plan to some other plan. It requires the use of dBASE or MS Access.
8.

Notes about HEC-FDA Computations

This section contains notes about HEC-FDA Version 1.4 computations that are not included in the User's Manual.

Difference in Results between Versions 1.2.5a and 1.4

As noted, Version 1.4 contains a revised method of computing uncertainty about graphical probability curves (either discharge-probability or stage-probability) and it means that, for those cases, computational results are different when comparing results from Versions 1.2.5a and 1.4. It cannot be generalized that results will change

consistently (e.g. the EAD will always be higher, the AEP (annual exceedance probability) will always be lower, the 1% CNP (conditional non-exceedance probability or assurance) will always be lower, etc.). Table 1 displays a comparison of results generated by the two versions of HEC-FDA for the without-project plan across a range of studies. As can be seen from this sample, Version 1.4 results are not consistently higher or lower when compared to Version 1.2.5a results.

Table 1. Comparison of Results from Versions 1.2.5a and 1.4, Change in Percent

FDA Version 1.4 Comparison										
		Expected Annual Damage			Annual Exceedance Probability			Conditional Non-Exceedance Probability for 1% Event		
Study	Plan	V1.2.5a	V1.4	Difference %	V1.2.5a	V1.4	Difference %	V1.2.5a	V1.4	Difference %
Anacostia	Without	645	933	44.6	0.00540	0.00840	55.6	0.8506	0.7200	(15.4)
ArTest	Without	245,576	250,030	1.8	0.02077	0.02050	(1.3)	0.3261	0.3414	4.7
BearWs5s	Without	971	958	(1.3)	0.86070	0.86014	(0.1)	0.0000	0.0000	-
BearWs5s_SF09_GIT	Without	608	597	(1.9)	0.86069	0.86120	0.1	0.0000	0.0000	-
ClearCrkMain	Without	21,759	21,695	(0.3)	0.57199	0.70850	23.9	0.0039	0.0045	14.3
Colorado	Without	6,637	3,241	(51.2)	0.07532	0.05800	(23.0)	0.2246	0.0345	(84.6)
Dallas Floodway	Without	8,426	10,286	22.1	0.00137	0.00140	2.2	0.9999	0.9913	(0.9)
Des Plaines	Without	19,470	19,843	1.9	0.00511	0.00550	7.6	0.8219	0.8138	(1.0)
Kansas City	Without	26,567	30,763	15.8	0.00448	0.00520	16.1	0.8849	0.8277	(6.5)
Yuba	Without	15,762	14,238	(9.7)	0.03777	0.03430	(9.2)	0.7844	0.8362	6.6
Chester	Without	79	79	0.0	0.06390	0.06390	0.0	0.0003	0.0003	0.0

Potential Overestimation of Uncertainty at the Upper End of a Graphical Probability Curve

HEC-FDA Version 1.4 may overestimate uncertainty at the upper end of a graphical probability curve under certain circumstances, as described herein. Version 1.4 uses the "Less Simple Method" to calculate uncertainty about a graphical probability curve with the constraint that the variance does not increase beyond the 1% quantile, but instead is held constant for 1% and higher quantiles. This constraint is included because the "Less Simple Method" produces uncertainty that can be much larger than in HEC-FDA Version 1.2.5. Some of this increase is due to a previous underestimation of uncertainty, and some is due to the lack of hydrologic reality in the computation of uncertainty.

While this added constraint improves results for most frequency curves, a drawback is seen with frequency curves that flatten beyond the 1% quantile. In such cases, the expected decrease in uncertainty in the flat region does not occur because the 1% quantile variance is held constant. This causes the uncertainty values to be overestimated in the flat region of the frequency curve beyond the 1% quantile. This effect is illustrated in the following example at location "BFFL".

Figure 3 depicts the stage-probability curve and the unadjusted confidence bands of plus or minus 2 standard deviations at BFFL. The stage-probability curve has a steep section followed by a flat section beyond the 0.5% quantile.

Figure 4 depicts both the calculated and adjusted standard error for BFFL based on 15 years of equivalent annual record. The solid line represents the initial calculation and the dashed line represents the adjustment made in HEC-FDA Version 1.4, which is to

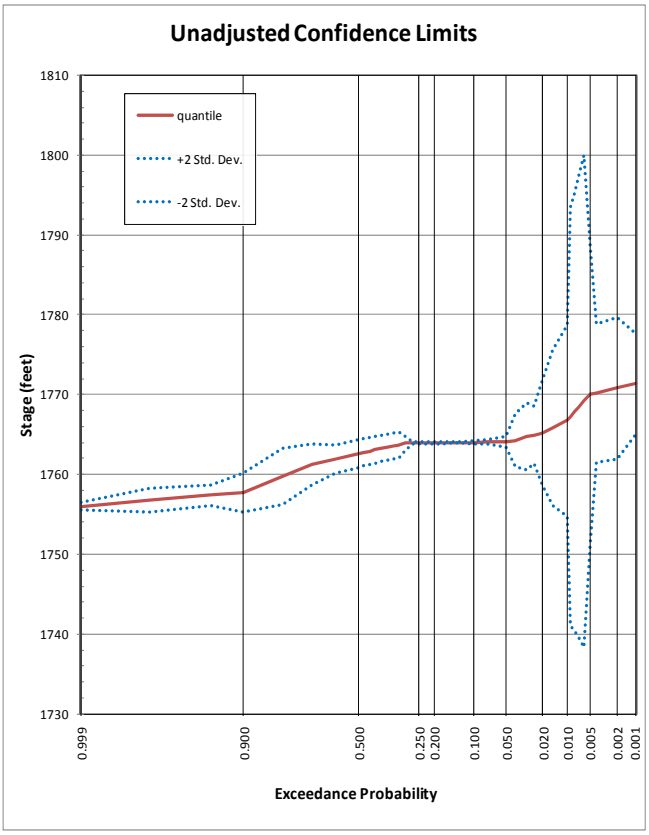

Figure 3. Unadjusted Confidence Limits

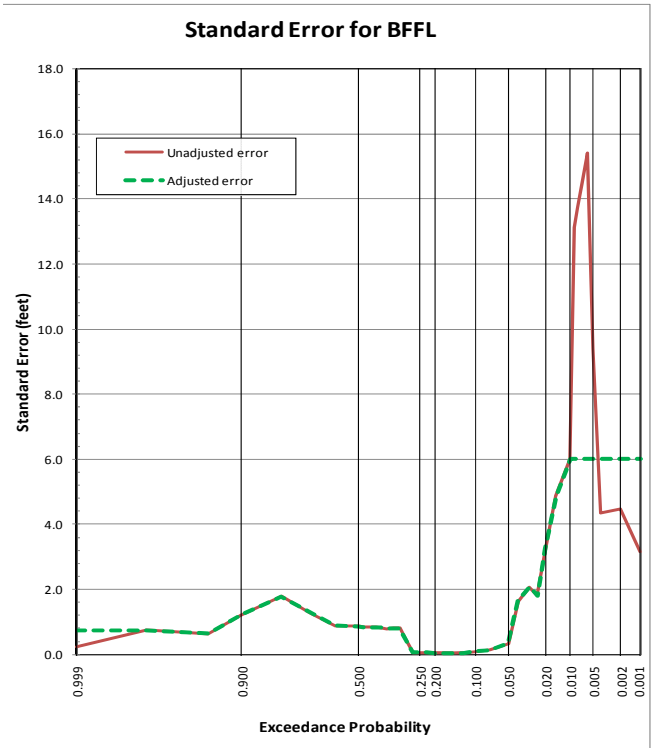

Figure 4. Calculated and Adjusted Standard Error

hold the standard error constant before the 99% quantile and after the 1% quantile. In this case, the adjustment results in an underestimation of the standard error between the 0.01 and 0.005 exceedance probabilities and an overestimation beyond the 0.005 exceedance probability.

Figure 5 depicts the curve and confidence bands at BFFL after the adjustment is applied to the standard error, and it is held constant beyond the 0.99 and 0.01

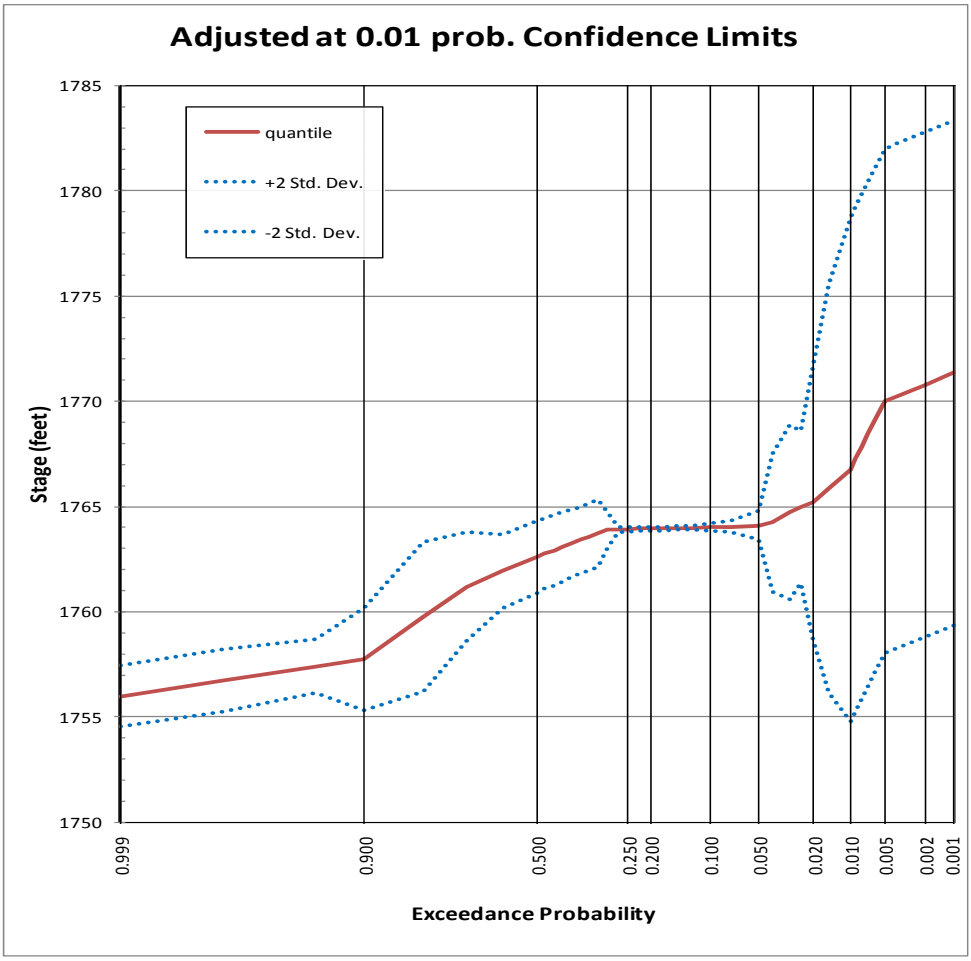

Figure 5. Adjusted Confidence Limits

exceedance probabilities. The standard error depicted in Figure 3 cannot be used as-is, however, because it doesn't produce a monotonically increasing confidence band and therefore won't produce monotonically increasing stage-probability replicates. A second adjustment is made to ensure the confidence bands edges are monotonically increasing.

Figure 6 depicts two confidence bands: 1) The original calculated confidence band (blue dotted line) and 2) the final adjusted confidence band (green dashed line). The final confidence band was derived by first adjusting it by fixing the standard error at the 0.99 and 0.01 exceedance probabilities and then modifying the standard errors so that they produced a monotonically increasing confidence band edges.

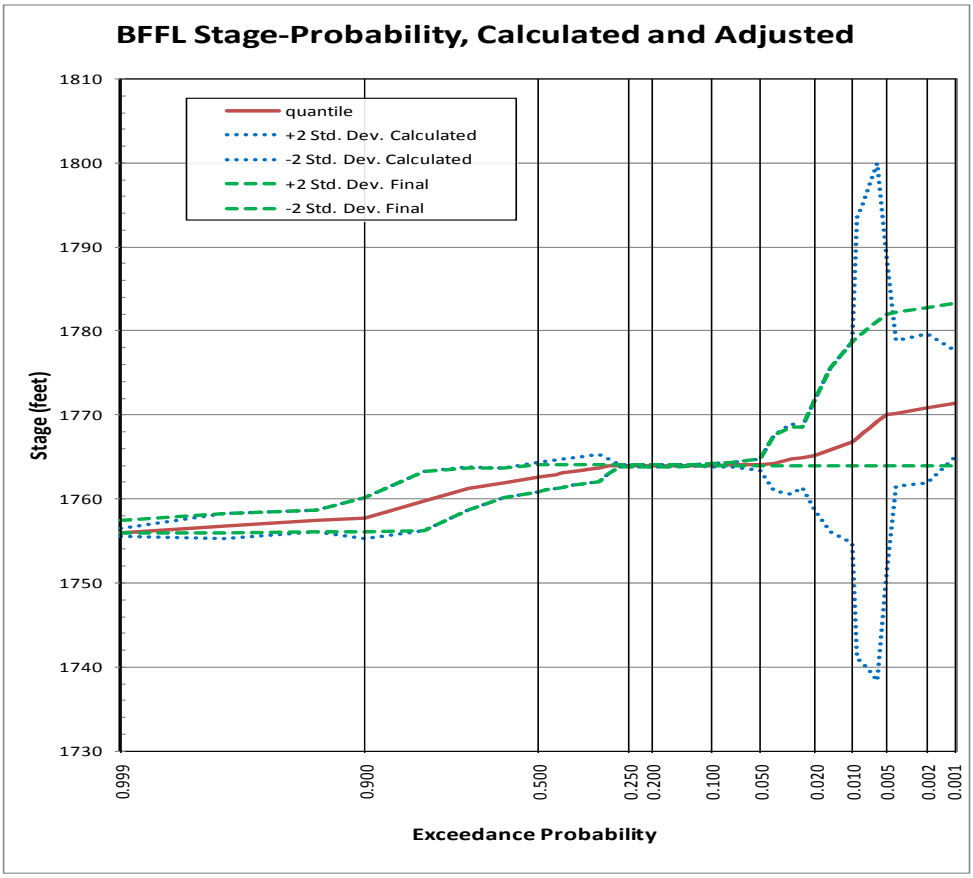

Figure 6. Comparison of Calculated and Final Adjusted Confidence Limits

In cases similar to BFFL with a flat section at the high end of the curve, the calculated standard errors and confidence bands can be reviewed by examining the last two tables in the text file fdalog.out. The user would first open a study and display the probability function. Examples of these files are shown in Table 2 and Table 3. The user can then compare the adjusted and unadjusted standard errors and resulting confidence bounds to evaluate whether the uncertainty is overestimated at the upper end of the curve.

If the user wants to select a different point on the curve at which the standard error is held constant instead of the 1% quantile, the database can be modified using dBASE or Microsoft Access to change the default value. Please contact HEC for more information on this process.

Table 2

Computed Standard Error						
nonexceed			Std Err	Std Err	Quantile	Quantile
i	prob	quantile	Adjusted	Un Adjust	+1sd	+1sd UnAdj
1	.0010	1755.992	.73646	.23394	1756.729	1756.226
2	.0100	1756.735	.73646	.73646	1757.471	1757.471
3	.0500	1757.397	.63487	.63487	1758.032	1758.032
4	.1000	1757.750	1.21743	1.21743	1758.967	1758.967
5	.2000	1759.755	1.78155	1.78155	1761.536	1761.536
6	.3000	1761.200	1.28324	1.28324	1762.483	1762.483
7	.4000	1761.924	.88545	.88545	1762.809	1762.809
8	.5000	1762.600	.86474	.86474	1763.465	1763.465
9	.5250	1762.761	.83136	.83136	1763.592	1763.592
10	.5500	1762.922	.83325	.83325	1763.756	1763.756
11	.5750	1763.085	.83638	.83638	1763.922	1763.922
12	.6000	1763.250	.81311	.81311	1764.063	1764.063
13	.6250	1763.407	.79132	.79132	1764.198	1764.198
14	.6500	1763.567	.79797	.79797	1764.365	1764.365
15	.6750	1763.731	.80662	.80662	1764.537	1764.537
16	.7000	1763.900	.42840	.42840	1764.328	1764.328
17	.7250	1763.912	.05460	.05460	1763.966	1763.966
18	.7500	1763.924	.05541	.05541	1763.979	1763.979
19	.7750	1763.936	.05659	.05659	1763.993	1763.993
20	.8000	1763.950	.04993	.04993	1764.000	1764.000
21	.8250	1763.961	.04359	.04359	1764.004	1764.004
22	.8500	1763.972	.04524	.04524	1764.017	1764.017
23	.8750	1763.985	.04753	.04753	1764.033	1764.033
24	.9000	1764.000	.09039	.09039	1764.090	1764.090
25	.9250	1764.043	.13598	.13598	1764.179	1764.179
26	.9500	1764.100	.33208	.33208	1764.432	1764.432
27	.9600	1764.250	1.64444	1.64444	1765.894	1765.894
28	.9700	1764.750	2.07287	2.07287	1766.823	1766.823
29	.9750	1764.956	1.81381	1.81381	1766.770	1766.770
30	.9800	1765.200	3.27325	3.27325	1768.473	1768.473
31	.9850	1765.861	4.86479	4.86479	1770.726	1770.726
32	.9900	1766.750	5.99508	5.99508	1772.745	1772.745
33	.9910	1767.262	5.99508	13.11364	1773.257	1780.375
34	.9920	1767.826	5.99508	13.73030	1773.821	1781.556
35	.9930	1768.455	5.99508	14.47488	1774.451	1782.930
36	.9940	1769.170	5.99508	15.39887	1775.166	1784.569
37	.9950	1770.000	5.99508	9.39165	1775.995	1779.392
38	.9960	1770.202	5.99508	4.34617	1776.197	1774.548
39	.9980	1770.800	5.99508	4.45810	1776.795	1775.258
40	.9990	1771.361	5.99508	9.55792	1777.356	1780.919
41	.9999	1773.025	5.99508	3.02411	1779.020	1776.049

Table 3

confidence limits stage frequency

freq	stage	-two	-one	+one	+two	sferr	sc1Raw	sc2Raw	sc3Raw	sc4Raw
.9990	1755.99	1755.99	1755.26	1756.73	1757.47	.73646	1754.52	1755.26	1756.73	1757.47
.9900	1756.73	1755.99	1756.00	1757.47	1758.21	.73646	1755.26	1756.00	1757.47	1758.21
.9500	1757.40	1756.13	1756.76	1758.03	1758.67	.63487	1756.13	1756.76	1758.03	1758.67
.9000	1757.75	1756.13	1756.94	1758.97	1760.18	1.21743	1755.32	1756.53	1758.97	1760.18
.8000	1759.75	1756.19	1757.97	1761.54	1763.32	1.78155	1756.19	1757.97	1761.54	1763.32
.7000	1761.20	1758.63	1759.92	1762.45	1763.69	1.28324	1758.63	1759.92	1762.48	1763.77
.6000	1761.92	1760.15	1761.04	1762.81	1763.69	.88545	1760.15	1761.04	1762.81	1763.69
.5000	1762.60	1760.87	1761.74	1763.31	1764.02	.86474	1760.87	1761.74	1763.46	1764.33
.4750	1762.76	1761.10	1761.93	1763.39	1764.02	.83136	1761.10	1761.93	1763.59	1764.42
.4500	1762.92	1761.26	1762.09	1763.47	1764.02	.83325	1761.26	1762.09	1763.76	1764.59
.4250	1763.09	1761.41	1762.25	1763.55	1764.02	.83638	1761.41	1762.25	1763.92	1764.76
.4000	1763.25	1761.62	1762.44	1763.63	1764.02	.81311	1761.62	1762.44	1764.06	1764.88
.3750	1763.41	1761.82	1762.62	1763.71	1764.02	.79132	1761.82	1762.62	1764.20	1764.99
.3500	1763.57	1761.97	1762.77	1763.79	1764.02	.79797	1761.97	1762.77	1764.36	1765.16
.3250	1763.73	1762.12	1762.92	1763.88	1764.02	.80662	1762.12	1762.92	1764.54	1765.34
.3000	1763.90	1763.04	1763.47	1763.96	1764.02	.42840	1763.04	1763.47	1764.33	1764.76
.2750	1763.91	1763.80	1763.86	1763.97	1764.02	.05460	1763.80	1763.86	1763.97	1764.02
.2500	1763.92	1763.81	1763.87	1763.98	1764.03	.05541	1763.81	1763.87	1763.98	1764.03
.2250	1763.94	1763.82	1763.88	1763.99	1764.05	.05659	1763.82	1763.88	1763.99	1764.05
.2000	1763.95	1763.85	1763.90	1764.00	1764.05	.04993	1763.85	1763.90	1764.00	1764.05
.1750	1763.96	1763.87	1763.92	1764.00	1764.05	.04359	1763.87	1763.92	1764.00	1764.05
.1500	1763.97	1763.88	1763.93	1764.02	1764.06	.04524	1763.88	1763.93	1764.02	1764.06
.1250	1763.99	1763.89	1763.94	1764.03	1764.08	.04753	1763.89	1763.94	1764.03	1764.08
.1000	1764.00	1763.89	1763.95	1764.09	1764.18	.09039	1763.82	1763.91	1764.09	1764.18
.0750	1764.04	1763.89	1763.97	1764.18	1764.32	.13598	1763.77	1763.91	1764.18	1764.32
.0500	1764.10	1763.89	1764.00	1764.43	1764.76	.33208	1763.44	1763.77	1764.43	1764.76
.0400	1764.25	1763.89	1764.07	1765.89	1767.54	1.64444	1760.96	1762.61	1765.89	1767.54
.0300	1764.75	1763.89	1764.32	1766.67	1768.58	2.07287	1760.60	1762.68	1766.82	1768.90
.0250	1764.96	1763.89	1764.42	1766.77	1768.58	1.81381	1761.33	1763.14	1766.77	1768.58
.0200	1765.20	1763.89	1764.55	1768.47	1771.75	3.27325	1758.65	1761.93	1768.47	1771.75
.0150	1765.86	1763.89	1764.88	1770.73	1775.59	4.86479	1756.13	1761.00	1770.73	1775.59
.0100	1766.75	1763.89	1765.32	1772.75	1778.74	5.99508	1754.76	1760.75	1772.75	1778.74
.0090	1767.26	1763.89	1765.58	1773.26	1779.25	5.99508	1755.27	1761.27	1773.26	1779.25
.0080	1767.83	1763.89	1765.86	1773.82	1779.82	5.99508	1755.84	1761.83	1773.82	1779.82
.0070	1768.46	1763.89	1766.17	1774.45	1780.45	5.99508	1756.47	1762.46	1774.45	1780.45
.0060	1769.17	1763.89	1766.53	1775.17	1781.16	5.99508	1757.18	1763.18	1775.17	1781.16
.0050	1770.00	1763.89	1766.95	1776.00	1781.99	5.99508	1758.01	1764.00	1776.00	1781.99
.0040	1770.20	1763.89	1767.05	1776.20	1782.19	5.99508	1758.21	1764.21	1776.20	1782.19
.0020	1770.80	1763.89	1767.35	1776.80	1782.79	5.99508	1758.81	1764.80	1776.80	1782.79
.0010	1771.36	1763.89	1767.63	1777.36	1783.35	5.99508	1759.37	1765.37	1777.36	1783.35