**Bootstrapped Confidence Intervals for the Mean and the Median: SAS**

These can be obtained with SPSS, SAS, and R, as well as with other programs.

Here is an example using SAS. Download [Bootstrap\_Mean-Median.sa](http://core.ecu.edu/psyc/wuenschk/SAS/Bootstrap_Mean-Median.sas)s and run it. Here is the output. Within the program are several explanatory comments. Read them.

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| Standard Confidence Interval for Median Using Burchill's Code |

| **Obs** | **ci** | **Diff** | **median** |
| --- | --- | --- | --- |
| **1** | Upper | 19 | 23 |
| **2** | Lower | 31 | 23 |

This CI was obtained with a method that assumes the sampling distribution is normal.

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| Confidence Intervals for Quartiles from Proc Univariate |

The UNIVARIATE Procedure

Variable: Diff

| **Moments** | | | |
| --- | --- | --- | --- |
| **N** | 15 | **Sum Weights** | 15 |
| **Mean** | 20.3333333 | **Sum Observations** | 305 |
| **Std Deviation** | 12.9265323 | **Variance** | 167.095238 |
| **Skewness** | -1.0852178 | **Kurtosis** | 0.05767632 |
| **Uncorrected SS** | 8541 | **Corrected SS** | 2339.33333 |
| **Coeff Variation** | 63.5731098 | **Std Error Mean** | 3.3376163 |

| **Basic Statistical Measures** | | | |
| --- | --- | --- | --- |
| **Location** | | **Variability** | |
| **Mean** | 20.33333 | **Std Deviation** | 12.92653 |
| **Median** | 23.00000 | **Variance** | 167.09524 |
| **Mode** | 32.00000 | **Range** | 38.00000 |
|  |  | **Interquartile Range** | 15.00000 |

| **Tests for Location: Mu0=0** | | | | |
| --- | --- | --- | --- | --- |
| **Test** | **Statistic** | | **p Value** | |
| **Student's t** | **t** | 6.092172 | **Pr > |t|** | <.0001 |
| **Sign** | **M** | 5.5 | **Pr >= |M|** | 0.0074 |
| **Signed Rank** | **S** | 55 | **Pr >= |S|** | 0.0006 |

With all three procedures in the table above (the latter two being nonparametric) we concluded the scores differ significantly between the two conditions.

| **Quantile** | **Estimate** |  | | | |
| --- | --- | --- | --- | --- | --- |
| **95% Confidence Limits Assuming Normality** | | **95% Confidence Limits Distribution Free** | |
| **100% Max** | 33 |  |  |  |  |
| **99%** | 33 | 40.6489 | 69.74415 | . | . |
| **95%** | 33 | 33.5948 | 56.49407 | 32 | 33 |
| **90%** | 32 | 29.6483 | 49.60256 | 32 | 33 |
| **75% Q3** | 32 | 22.5002 | 38.56384 | 23 | 33 |
| **50% Median** | 23 | 13.1749 | 27.49181 | 17 | 32 |
| **25% Q1** | 17 | 2.1028 | 18.16651 | -5 | 23 |
| **10%** | -4 | -8.9359 | 11.01833 | -5 | 17 |
| **5%** | -5 | -15.8274 | 7.07184 | -5 | 2 |
| **1%** | -5 | -29.0775 | 0.01773 | . | . |
| **0% Min** | -5 |  |  |  |  |

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| Mean and Confidence Interval (95 %) using Proc Means for Diff |

The MEANS Procedure

| **Analysis Variable : Diff** | | | | | |
| --- | --- | --- | --- | --- | --- |
| **Mean** | **Lower 95% CL for Mean** | **Upper 95% CL for Mean** | **Maximum** | **Minimum** | **N** |
| 20.3333333 | 13.1748583 | 27.4918083 | 33.0000000 | -5.0000000 | 15 |

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| Standard upper and lower confidence intervals for Mean and Median using Bootstrap |
| Data = Diffs Variable=Diff CI=95 |

| **Obs** | **Mean Diff** | **Median Diff** | **the 2.5000 percentile, l\_Mean** | **the 97.5000 percentile, l\_Mean** | **the 2.5000 percentile, l\_median** | **the 97.5000 percentile, l\_median** |
| --- | --- | --- | --- | --- | --- | --- |
| **1** | 20.3333 | 23 | 14.6 | 26.2667 | 19 | 31 |

|  |
| --- |
| Bias Reduced upper and lower confidence intervals for Mean and Median using Bootstrap |
| Data = Diffs Variable=Diff CI=95 |

| **Obs** | **Mean Diff** | **Median Diff** | **Lower Mean** | **Upper Mean** | **Lower Median** | **Upper Median** |
| --- | --- | --- | --- | --- | --- | --- |
| **1** | 20.3333 | 23 | 14.3170 | 26.3497 | 15.7749 | 30.2251 |

Since the confidence interval for the difference scores excludes zero, we conclude that the scores differ significantly between the two conditions.

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