One Sample Tests

OpenStat provides the ability to perform tests of hypotheses based on a single sample. Typically the user is interested in testing the hypothesis that

1. a sample mean does not differ from a specified hypothesized mean,
2. a sample proportion does not differ from a specified population proportion,
3. a sample correlation does not differ from a specified population correlation, or
4. a sample variance does not differ from a specified population variance.

The One Sample Test for means, proportions, correlations and variances is started by selecting the Comparisons option under the Statistics menu and moving the mouse to the One Sample Tests option which you then click with the left mouse button. If you do this you will then see the specification form for your comparison as seen below. In this form there is a button corresponding to each of the above type of comparison. You click the one of your choice. There are also text boxes in which you enter the sample statistics for your test and select the confidence level desired for the test. We will illustrate each test. In the first one we will test the hypothesis that
a sample mean of 105 does not differ from a hypothesized population mean of 100. The standard deviation is estimated to be 15 and our sample size is 20.

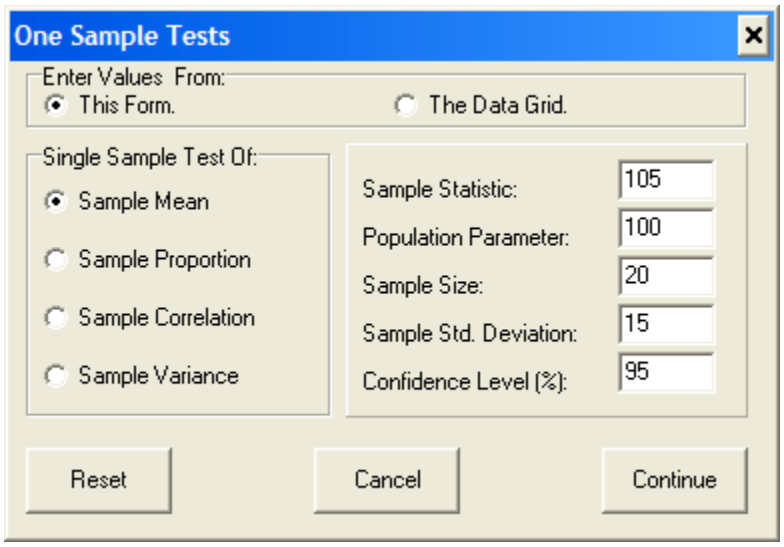

Figure 1 Single Sample Tests Dialog For a Sample Mean

When we click the Continue button on the form we then obtain our results in an output form as shown below:

```
ANALYSIS OF A SAMPLE MEAN

Sample Mean = 105.000
Population Mean = 100.000
Sample Size = 20
Standard error of Mean =  3.354
t test statistic =  1.491 with probability  0.152
t value required for rejection =  2.093
Confidence Interval = (97.979,112.021)
```

We notice that our sample mean is "captured" in the 95 percent confidence interval and this would lead us to accept the null hypothesis that the sample is not different from that expected by chance alone from a population with mean 100.

Now let us perform a test of a sample proportion. Assume we have an elective high school course in Spanish I. We notice that the proportion of 30 students in the class that are female is only 0.4 (12 students) yet the population of high school students in composed of 50% male and 50% female. Is the proportion of females enrolled in the class representative of a random sample from the population? To test the hypothesis that the proportion of .4 does not differ from the population proportion of .5 we click the proportion button of the form and enter our sample data as shown below:

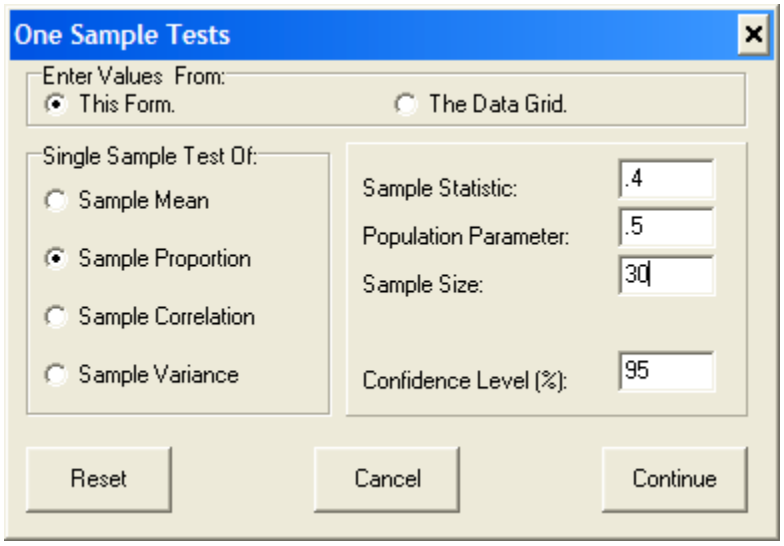

Figure 2 One Sample Test for a Proportion

When we click the Continue button we see the results as shown below:

```
ANALYSIS OF A SAMPLE PROPORTION

Sample Proportion =  0.400
Population Proportion =  0.500
Sample Size = 30
Standard error of proportion =  0.091
z test statistic = -1.095 with probability > P =  0.863
z value required for rejection =  1.645
Confidence Interval = ( 0.221, 0.579)
```

We note that the z statistic obtained for our sample has a fairly high probability of occurring by chance when drawn from a population with a proportion of .5 so we are again led to accept the null hypothesis.

Now let us test a hypothesis concerning a sample correlation. Assume our Spanish teacher from the previous example has given two examinations to the 30 students enrolled in the course. The first is a standardized Spanish aptitude test and the second is a mid-term examination in the course. The teacher observes a correlation of 0.45 between the two examinations. In reading the literature which accompanies the standardized aptitude test the teacher notices that the validation study reported a correlation of 0.72 between the test and midterm examination scores in a very large sample of students. The teacher wonders if her observed correlation differs from that of the validation study. We enter our data in the Single Sample form as follows:

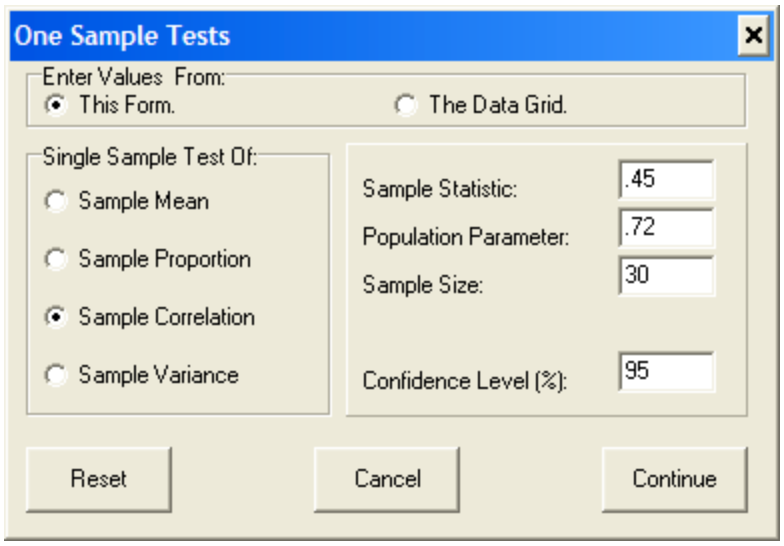

Figure 3 One Sample Correlation Test

When the Continue button is pressed we obtain on the output form the following results:

```
ANALYSIS OF A SAMPLE CORRELATION

Sample Correlation =  0.450
Population Correlation =  0.720
Sample Size = 30
z Transform of sample correlation =  0.485
z Transform of population correlation =  0.908
Standard error of transform =  0.192
z test statistic = -2.198 with probability  0.014
z value required for rejection =  1.960
Confidence Interval for sample correlation = ( 0.107, 0.697)
```

Observing the small probability of the sample z statistic used to complete the test and noting that the population correlation is not in the 95% confidence interval for the sample statistic, our teacher reasonably rejects the null hypothesis of no difference and concludes that her correlation is significantly lower than that observed in the validation study reported in the test manual.

It occurs to our teacher in the above example that perhaps her Spanish students are from a more homogeneous population than that of the validation study reported in the standardized Spanish aptitude test. If that were the case, the correlation she observed might well be attenuated due to the differences in variances. In her class of thirty students she observed a sample variance of 25 while the validation study for the instrument reported
a variance of 36. Let's examine the test for the hypothesis that her sample variance does not differ significantly from the "population" value. Again we invoke the One Sample Test from the Comparisons option of the Statistics menu and complete the form as shown below:

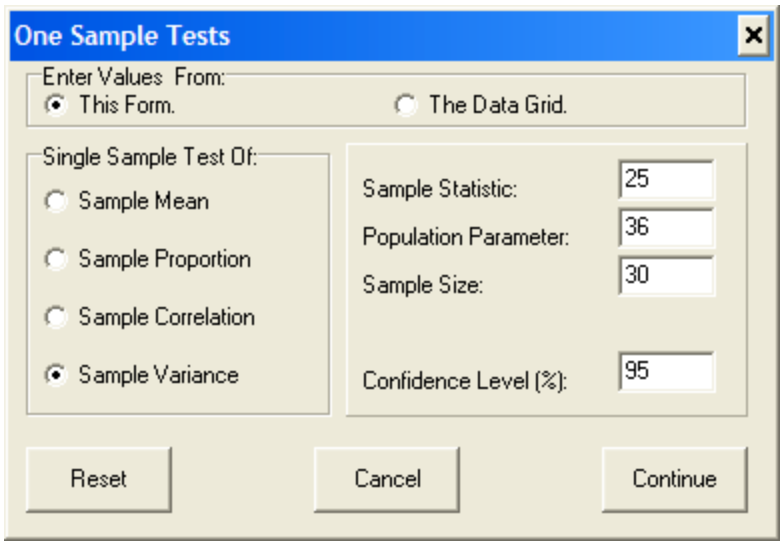

Figure 4 One Sample Variance Test

Upon clicking the Continue button our teacher obtains the following results in the output form:

```
ANALYSIS OF A SAMPLE VARIANCE

Sample Variance = 25.000
Population Variance = 36.000
Sample Size = 30
Chi-square statistic = 20.139 with probability > chisquare =  0.889 and
D.F. = 29
Chi-square value required for rejection = 16.035
Chi-square Confidence Interval = (45.725,16.035)
Variance Confidence Interval = (15.856,45.215)
```

The chi-square statistic obtained leads our teacher to accept the hypothesis of no difference between her sample variance and the population variance. Note that the population variance is clearly within the 95% confidence interval for the sample variance.