**Exercise 9.71**

A manufacturer of car batteries claims that the batteries will last, on average, 3 years with a variance of 1 year. If 5 of these batteries have lifetimes of 1.9, 2.4, 3.0, 3.5, and 4.2 years, construct a 95% conﬁdence interval for and decide if the manufacturer’s claim that is valid. Assume the population of battery lives to be approximately normally distributed.

**Solution**

First, we must calculate the mean of the sample. This can be done with the usual formula:

Using this, we then calculate the sample variance, also with the usual formula:

With a sample of five items, there are four degrees of freedom. To determine the confidence interval, we use the following equation to solve for :

We then calculate the value for :

Looking at a table, we can determine the values for and with four degrees of freedom:

Plugging all these values into the equation above, we get:

Therefore, the 95% confidence intervale for is . Because this interval contains 1, the manufacture’s claim that appears to be valid.

**Exercise 16.3**

A food inspector examined 16 jars of a certain brand of jam to determine the percent of foreign im-purities. The following data were recorded:

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| 2.4 | 2.3 | 3.1 | 2.2 | 2.3 | 1.2 | 1.0 | 2.4 |
| 1.7 | 1.1 | 4.2 | 1.9 | 1.7 | 3.6 | 1.6 | 2.3 |

Using the normal approximation to the binomial distribution, perform a sign test at the 0.05 level of significance to test the null hypothesis that the median percent of impurities in this brand of jam is 2.5% against the alternative that the median percent of impurities is not 2.5%.

**Solution**

First, we’ll explicitly state the null and alternate hypotheses.

Next we begin the sign test by assigning values above 2.5 as a “+” and value below 2.5 as a “-“:

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 2.4 | 2.3 | 3.1 | 2.2 | 2.3 | 1.2 | 1.0 | 2.4 | 1.7 | 1.1 | 4.2 | 1.9 | 1.7 | 3.6 | 1.6 | 2.3 |
| - | - | + | - | - | - | - | - | - | - | + | - | - | + | - | - |

In order to use the normal approximation to the binomial distribution, we then must calculate μ and σ using the following equations:

There are no values equal to 2.5 in the dataset, so n is equal to 16. Additionally, both p and q are equal to 0.5 in this test. Plugging into the above equations yield:

The z value can be found with the following equation:

From the sign test above, x equals 3. Plugging the values into the equation above yields:

To find the P-value, we use the following equation:

This value is less than the significance value of 0.05, therefore, we reject .

**Summary**

In the first exercise we determined the 95% confidence interval for and determined whether a claimed value was supported by the collected sample. In the second exercise, we utilized a sign test to test the validity of a claimed value for the population median.