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Normality Tests

Key Learning Points

1. Describe the importance of testing for normality.
2. Explain how to complete a normality test.
3. Utilize normality tests in improvement projects.

What is a Normality Test?

A normal distribution is the traditional name for a probability distribution with a bell-shaped curve. The peak is always in the middle and the curve is always symmetrical. In a normal distribution, the mean, median, and mode are all the same.

A normality test is used to determine if a particular data set conforms to the normal distribution. Many statistical tests are only appropriate for normally distributed data.

Normality Test Method

1. State the null and alternative hypotheses.
2. Use the appropriate graphical tool to evaluate the data. *
3. Use Minitab to test for normality.

*If sample sizes are small, it is often difficult to graphically evaluate normality.

Step 1: State the Null and Alternative Hypotheses

H_o: The data are normally distributed.
H_a: The data are not normally distributed.

Step 2: Use The Appropriate Graphical Tool to Evaluate the Data

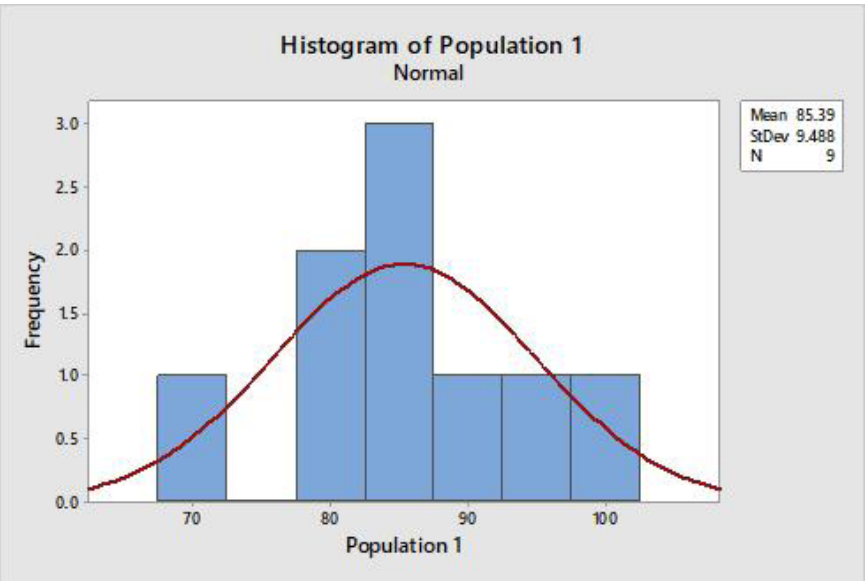
Histograms are most frequently used to graphically evaluate normality. If a histograms curve reflects a the shape of a bell, the data are likely normal.

Remember, if you have a small data set, it will be difficult to evaluate normality using a histogram.

Histogram

To create a histogram in Minitab:

- **Minitab: Graph > Histogram**
  - Select "With Fit"



This histogram is a close match to the bell-shaped curve. It is likely normally distributed.

Step 3: Use Minitab to Test for Normality

Minitab allows you to quickly test for normality, even when there is too little data to effectively make an effective graphical evaluation.

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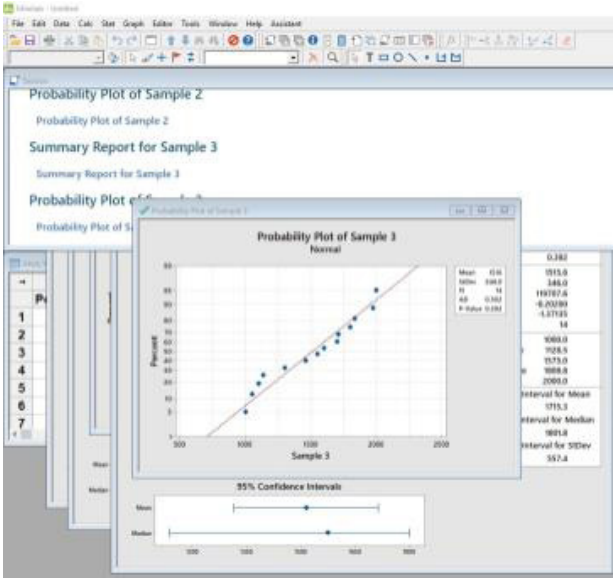


Method 1: Normality Test and Probability Plot

To test for normality in Minitab:

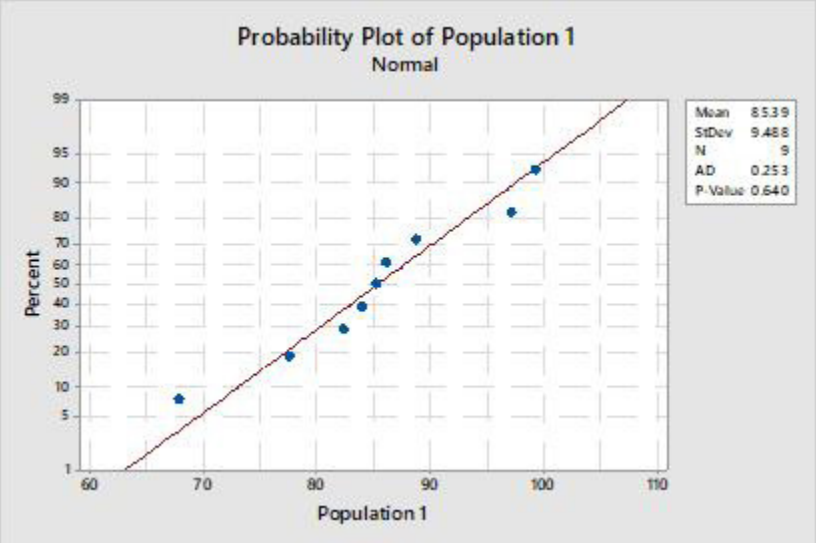
- **Minitab: Stat > Basic Statistics > Normality Test**
  - Enter your data into the column(s)
  - Select the columns containing the data
  - Choose the Anderson-Darling Normality Test
  - Run the test

The Probability Plot is used to graphically display the probability that data may be treated as normal. Points falling reasonably close to the reference line indicate that the data follow a normal distribution. For the test:

P-Value ≤ α: Reject Ho

P-Value > α: Fail to reject Ho

Results



Note the P-Value in the summary to the right of the plot. Because the P-Value (0.640) is greater than the alpha level of 0.05, you fail to reject the null hypothesis. In other words, the data may be treated as Normal. The points fall reasonably close to the reference line indicating that the data follow a normal distribution.

Method 2: Graphical Summary

- Alternative test for normality in Minitab:
- **Minitab: Stat > Basic Statistics > Graphical Summary**
  - Enter your data into the column(s)
  - Select the columns containing the data
  - Set confidence level at 95%

This method creates a summary of your data, including a histogram showing the curve, as well as the Anderson-Darling normality test results.

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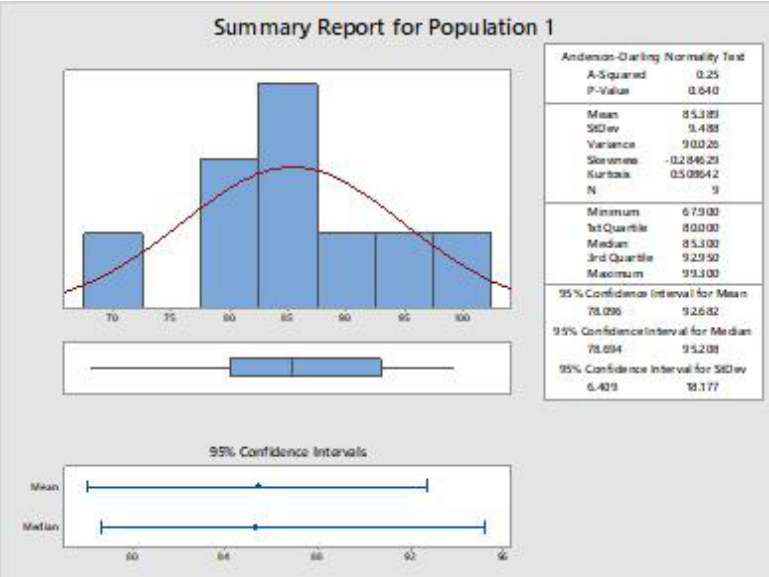
Results



The Graphical Summary displays a histogram with normal curve, summary statistics, and the Anderson-Darling Normality Test. The P-Value (0.640) is greater than the alpha level of 0.05. The data may be treated as Normal.

When Should Normality Tests Be Used?

- Normality tests are mainly used to verify assumptions for hypothesis tests.
- If normality is rejected, some hypothesis tests would be inappropriate.
- The ultimate goal of statistical methods is to predict performance in the broader population of data. Knowing the correct probability distribution is paramount to this endeavor.

Pitfalls to Avoid

- Be sure to use the p-value to determine the ultimate outcome of your hypothesis test. Minitab will always superimpose a normal curve. Your eyes may deceive you.
- With very small sample sizes, it is hard to reject normality with the Anderson-Darling test..
- With very large samples, the A-D test can falsely reject normality.

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