# Lesson 3: Hypothesis Tests Concerning the Variance and Nonparametric Inference

## Hypothesis Tests for the Variance of a Normally Distributed Population

Hypothesis tests for testing the variance of a normally distributed population tests for testing the variance of a normally distributed population involve the use of the chi-square distribution.

Three important features of the chi-square distribution are:

- It is asymmetrical.
- It is bounded by zero. Chi-square values cannot be negative.
- It approaches the normal distribution in shape as the degrees of freedom increase.

## Hypothesis Tests for the Variance of a Normally Distributed Population

### Example

Test the accuracy of a claim made by ZX Associates that the investment strategies they follow result in standard deviation of monthly returns of 5%. Use the 5% level of significance. ZX performance data for the last 25 months has a standard deviation of 5.2%.

Hypotheses related to the equality of the variance of two populations are tested with an **F-test**. This test is used under the assumptions that:

- The populations from which samples are drawn are normally distributed.
- The samples are independent.

### Tests for the Equality of the Variance of Two Populations

Features of the F-distribution

- It is skewed to the right
- It is bounded by zero on the left
- It is defined by two separate degrees of freedom

The rejection region for any F-test, whether it be one-tailed or two-tailed, always lies in the right tail. This unique feature makes the F-test different from all the other hypothesis tests that we have performed.

## Tests for the Equality of the Variance of Two Populations

### Example

Susan is examining the earnings of two companies. She is of the opinion that the earnings of Company A are more volatile than those of Company B. She obtains earnings data for the past 31 years for Company A, and for the past 41 years for Company B. She finds that the sample standard deviation of Company A's earnings is $4.40 and that of Company B's earnings is $3.90. Determine whether the earnings of Company A have a greater standard deviation than those of Company B at the 5% level of significance.

A **parametric test** has at least one of the following two characteristics:

- It is concerned with parameters, or defining features of a distribution.
- It makes a definite set of assumptions.

A **non-parametric test** is not concerned with a parameter, and makes only a minimal set of assumptions regarding the population. Nonparametric tests are used when:

- The researcher is concerned about quantities other than the parameters of the distribution.
- The assumptions made by parametric tests cannot be supported.
- When the data available is ranked. For example, non-parametric methods are widely used for studying populations such as movie reviews, which receive one to five stars based on people's preferences.

Often the results of parametric and non-parametric tests are both presented. This allows the reader to gauge how sensitive the conclusions are to the assumptions underlying the parametric tests. If the assumptions made under the parametric test are met, the use of parametric tests is preferred because they usually offer more crisp and reliable conclusions.