Notes:

Test of Equal Variance in Minitab

Key Learning Points

1. Describe the importance of testing for equal variance.
2. Explain how to test for equal variance.
3. Utilize testing for equal variance in improvement projects.

Why Test for Equal Variance?

A test for equal variance is used to determine whether the variances of two or more groups differ. This test asks "Is there a significant difference in the variability of outputs? (Is there a real difference between σ^2_{pop1} and σ^2_{pop2}?" This test requires the use of the F-test statistic.

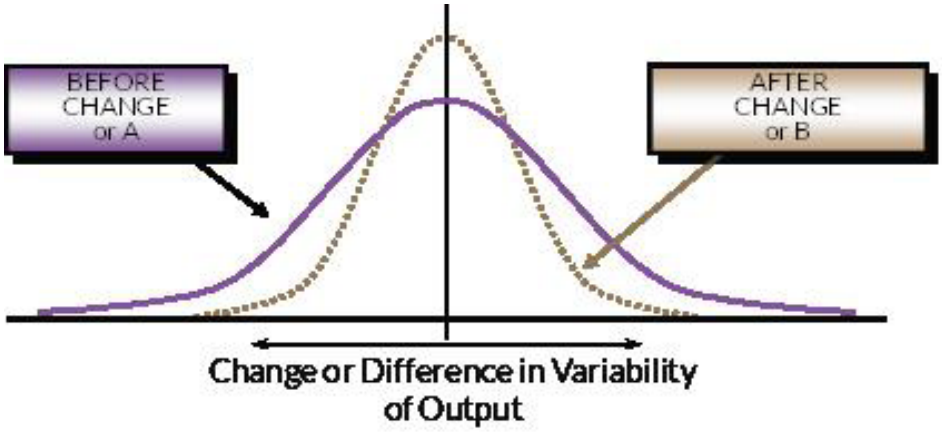
Requirements

You must have at least one categorical factor and a continuous response.

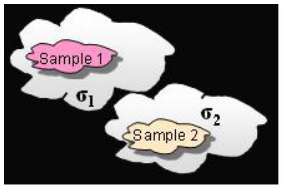
Variability of Outputs

Is there a significant difference in the variability of outputs?

All Rights Reserved, Juran Institute, Inc.



Are Variances the "Same" or "Different"?



OR

1. Calculate F_{calc} such that $F_{calc} > 1$
   a. Fcalc = $s2^2/s1^2$ (or) $F^{calc} = s1^2/s2^2$
2. Compare to F^{crit} (for $\alpha = 0.05$)
3. If $F_{calc} > F^{crit}$, then reject H_o

For this calculation, the larger variance is put in the numerator (s1, s2). Most text-books only give critical F statistics that are greater than 1.

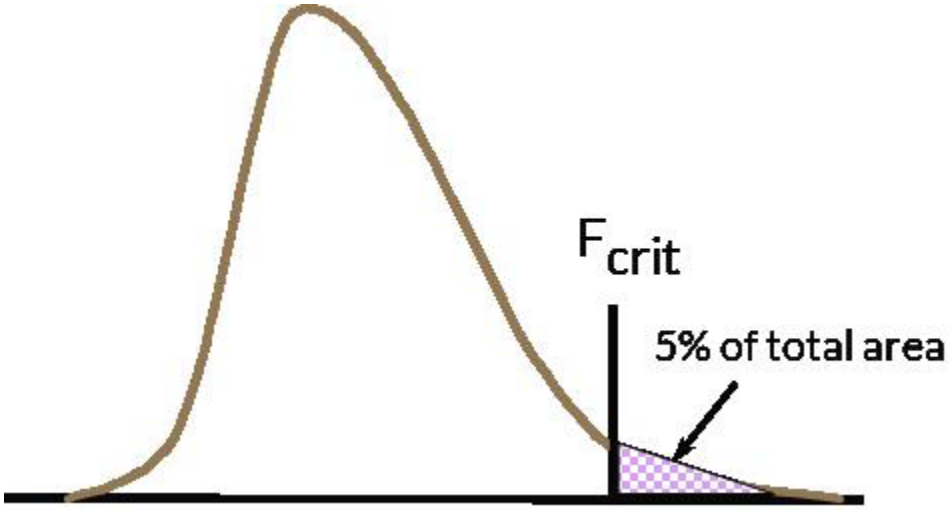
Notes:

All Rights Reserved, Juran Institute, Inc.

F-Distribution

To know the critical F-Value, look it up in a table. The value depends upon the alpha level, and the degrees of freedom (df) for both factors (denominator and numerator). Degrees of freedom for each factor equals n-1, where n is the sample size for the factor.

When the calculated F-Statistic exceeds the critical F (at $\alpha = 0.05$), the P-Value will be less than 0.05. Fcalc > Fcritical or P-Value indicate that the two variances are different.



Test Method

1. Test data for normality.
2. If data is normal use:
   a. F-Test for 2 Samples
   b. Bartlett's Test for 2 or More Samples
3. If data is not normal use Levene's Test for 2 or more samples.

Practical Problem

Suppose you have a process that has been modified. You want to see if you have "significantly" improved the yield of the process (measured in kilograms) with these modifications before you spend significant time and resources modifying the rest. After sampling the yield, how do you determine if there is a "real" difference between the two yields?

Step 1: Test for Normality

First you must determine if the data are normally distributed.
H_o: Data are Normal
H_a: Data are Not Normal

Notes:

All Rights Reserved, Juran Institute, Inc.

P-value > alpha, fail to reject H_o. The data are normal.

Step 2: Test for Equal Variances

Since the data from both processes are normal, you can test for equal variances using an F-Test.

H_o: $\sigma_1 / \sigma_1 = 1$
H_a: $\sigma_1 / \sigma_1 \neq 1$

Since the P-Value (0.505) > α, you can fail to reject the null hypothesis and conclude that the variances in the two sets of data are equal.

Step 3: Make Practical Conclusion

Since we fail to reject Ho, we conclude there is no real difference between the variation in Process A and Process B. The change did not improve process variation.

When Should Tests for Equal Variance Be Used?

Use a test for equal variance to determine significant differences in variation between two or more groups. This test is often used to verify assumptions for other hypothesis tests.

Pitfalls to Avoid

This test can be used with normal and non-normal data.

Notes:

All Rights Reserved, Juran Institute, Inc.