ANOVA (Analysis of Variance) is a statistical technique used to compare means across two or more groups to determine if there are any statistically significant differences among them. It's often used when you have more than two groups and want to understand whether the differences in the means are due to genuine effects or just random variation. Here's an example of how to use ANOVA:

Scenario: Imagine you are conducting an experiment to compare the effectiveness of three different fertilizers (A, B, and C) on the growth of plants. You have randomly assigned 30 plants to each fertilizer group and measured their heights after one month.

Step-by-step process:

Step 1: Hypotheses

Null Hypothesis (H_0): There is no significant difference in the mean plant heights among the three fertilizer groups. ($\mu A = \mu B = \mu C$)
Alternative Hypothesis (H_1): There is a significant difference in the mean plant heights among at least one pair of fertilizer groups.
Step 2: Data Collection

Measure the heights of 30 plants in each fertilizer group (A, B, and C).
Step 3: Compute Means and Variance
Calculate the sample means and sample variances for each group:

Group A Mean: μA
Group B Mean: μB
Group C Mean: μC
Group A Variance: $\sigma^2 A$
Group B Variance: $\sigma^2 B$
Group C Variance: $\sigma^2 C$
Step 4: Compute ANOVA
Perform the ANOVA calculations to obtain the F-statistic and p-value:

Calculate the "between-group" variability (explained variability):

MSB (Mean Squares Between) = SSbetween / (k - 1)
where k is the number of groups.
Calculate the "within-group" variability (unexplained variability):

MSW (Mean Squares Within) = SSw / (n - k)
where n is the total number of observations and k is the number of groups.

Compute the F-statistic:

F = MSB / MSW
Determine the degrees of freedom (df) for between-groups and within-groups:

df_between = k - 1
df_within = n - k
Look up the critical F-value from a table or use statistical software based on your desired significance level and degrees of freedom.

Step 5: Compare with Critical Value and p-value

If the calculated F-value is greater than the critical F-value, you reject the null hypothesis. Alternatively, if the p-value associated with the F-statistic is less than your chosen significance level (e.g., 0.05), you reject the null hypothesis.
Step 6: Conclusion

If you reject the null hypothesis, it indicates that at least one pair of fertilizer groups has significantly different mean plant heights. You can then perform post hoc tests (like Tukey's HSD) to determine which specific groups differ from each other. Remember, ANOVA tells you if there's a statistically significant difference among groups, but it doesn't tell you which specific group(s) are different from each other. For that, you might need additional tests or methods.