Multivariate data analysis is primarily a mathematical approach to decision making. It has many applications, including problems in engineering, traffic management, biology, economics ,marketing, and even ethics and behavioral psychology. It can quantify how changes in one or more areas of a complex problem will affect an outcome over time, and indicate whether those changes will alleviate or exacerbate a problem.

Suppose you have 100 patients for a medical study. You measure 10 different body characteristics (e.g. height, weight, LDL cholesterol, etc) and then monitor each patient for 20 different symptoms over the next 2 years. You would use multivariate analysis to see which groups of body characteristics correlate with which sets of symptoms. In this case you have to use multivariate data analysis. For example, you may find that the combination (5\*weight +LDL) correlates strongly with (2\*high insulin + 3\*hypertension). You will end up getting factors (i.e., linear combinations) of explanatory variables and predicted variables that you will be paring up.

Marketers use multivariate advertising to determine the best way of advertising a product to consumers, based on a wide range of consumer characteristics such as age, income, gender, background, industry and interests. Marketers in the multivariate testing process most commonly use experiments in ad preference. Basically, marketers use this form of testing to create a number of advertisements and conduct tests on those ads. These tests help determine the best method of advertising a product for each market. Basically, marketers convert information to numbers and create charts based on these numbers. A straight line, or linearity, on such a chart indicates a solid trend that connects a series of varies to a constant or dependent value. Linearity allows marketers to understand how consumer habits relate to the consumer, and therefore how to create an ad that speaks directly to a consumer base. Specificity in ads revolves around giving the consumer what works for them or convinces them to buy. Multivariate testing helps marketers arrive at this information.

There are different test procedures:

* For a continuous variable, use the **two-sample t-test**for the difference in means.
* For a flag variable, use the **two-sample Z-test** for the difference in proportions.
* For a multinomial variable, use the test for the **homogeneity of proportions.**
* The **Goodness-of-Fit Test** is used to test the distribution of a single variable. In essence it compares the observed values with what we would expect.

**ANOVA (Analysis of variance)** provides a [statistical test](https://en.wikipedia.org/wiki/Statistical_test) of whether or not the [means](https://en.wikipedia.org/wiki/Mean) of several groups are equal, and therefore generalizes the [*t*-test](https://en.wikipedia.org/wiki/Student%27s_t-test#Independent_two-sample_t-test) to more than two groups. ANOVA is useful for comparing (testing) three or more means (groups or variables) for [statistical significance](https://en.wikipedia.org/wiki/Statistical_significance).

As a summary we can see that this part of statistics is extensively used in different fields of our progressive society such as

* Quality control and quality assurance across a range of industries such as food and beverage, paint, pharmaceuticals, chemicals, energy, telecommunications, etc
* Research and development
* Consumer and market research
* Process optimization and process control