Submitted by: Lynda Lee Osborne
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# Quant II? Really???

As we venture into the realm of mean comparisons in statistical analysis, some of you may be shuddering in your boots as to the thought of such an inquiry. After all, you're probably just kicking up your heels at the thought of successfully completing your Quant I course! But, listening to your inner researcher, you can't help but wonder about how you might pursue more advanced levels of research if you don't have a solid foundation in more advanced statistics. If it's one thing you've learned in Quant I it's that moving on to higher levels of statistical study endows a researcher with tools to make keener, more fluid, more relevant (and hopefully, more accurate) observations of phenomena which can be measured using quantitative statistics. So, despite your reservations, you convince yourself to continue in your quest to become that well-prepared academic investigator by packing your researcher bag with tools like ANOVA, repeated measures, regression analysis, and chi squared techniques.

What's that jibberish, you say? Why, all of the wonderful analyses you'll have the pleasure of exploring in Quantitative Methods for Research II. Yes, I said it. And, yes…you can do it. So that I don't bore you, I shall introduce you to these new tools one at a time. Let us begin with one of my favorite tools for comparing group means, the analysis of variance (ANOVA).

We've already discussed in Quant I how subject comparisons can be made using the t-test and z-test. The ANOVA extends our realm of application by allowing researchers to compare more than two *group* means under a variety of circumstances. Working with the analysis of variance as a statistical tool will greatly facilitate the type of conclusions you may draw using inferential statistics.

There are several types of ANOVA used in inferential statistical analysis – the one-way ANOVA, factorial ANOVA, repeated measures, and multivariate ANOVA.

Each brand of this statistical tool proves useful depending on what type of study is being conducted. The one-way ANOVA compares means of one group across diverse independent variables, while the factorial ANOVA compares means of two or more groups across a set of two or more independent variables. For the moment, we shall briefly explore the relevance of the one-way and factorial ANOVA tools using exemplars to illustrate practical applications of each.

Perhaps there is a researcher who wants to compare the performance outcomes on an exam for students in a class who studied in three different ways – 10 hours straight (cramming), 2 hours per day for 5 days (gradual), or not at all. If groupings are designated via random sampling, then a one-way analysis of variance can be used to compare student scores. A one-way ANOVA is based on a single factor, in this case "study type". It tests group differences based on only one variable. Using the ANOVA helps to reduce type I error because it can compare multiple groups on a single variable at once. The test renders an F statistic which indicates whether the group means differed by a statistically significant margin. When comparing more than two groups using an ANOVA, a post-hoc test can also be run in order to determine which groups differed from the others. The researcher may then be able to infer (ergo why we call it inferential statistics) from the statistical data obtained which of the study methods is more effective than the other. However, with statistical analysis, it is always important to take a variety of factors into account to increase power and generalizability, such as sample size, demographic, testing conditions, methods used, method delivery, cultural differences, age, motivation, etc.

Now, consider that the same researcher above wants to go further and compare performance outcomes on an exam for students in a class who studied in three different ways AND who were grouped according to their achievement scores on a previous exam (above 80, between 70 – 80, below 70). In this case, factorial ANOVA can be used to compare mean scores of each of the groups in relationship to each of the two variables (study type and previous score range). This tool is also useful for determining interaction effects among the treatment types. From the statistical data gathered in this 3X3 analysis,

the researcher may be able to make inferences about what effect study type AND previous score has on testing outcomes.

Both the one-way and factorial ANOVA's are statistical tools used to compare means of groups as they vary across circumstances or group differences. They both use alpha designations to determine error levels. Both rely on a set of assumptions which include: independence of cases, homogeneity of variances (or homoscedasticity), and distribution normality. Each ANOVA type comes in quite handy in the observation of groups and in investigating questions about how groups may differ. Should your appetite be whetted for more on the usefulness of advanced statistical tools, I invite you to bite the bullet and register for Quantitative II. You can do it!

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