

Class members provided following questions that will be discussed in class.

Question: I don't really get the conceptual meaning of interaction in ANOVA. In HSTA 558, we had learned interaction in linear regression and I felt it was not that hard to interpret it through coefficient. I run the dataset we discussed last Thur using linear model, trying to see if I can have more clear idea through comparing the output between the anova table and coefficient. Now I am more confused.

Ans. Interaction takes many forms, and generally involves complexities that can make interpretations of results of studies hard to interpret. If you find this complicated, then you are probably beginning to understand!

Question: Why do we want to have a quadratic fitted model in ANOVA? I remember when I learn regression, I plot the distribution of X and Y and the relationship between X and Y, whether linear or quadratic is more intuitive.

Ans. I will discuss ...again!

- As the F test is non-directional, do we have to assume for practical purposes that difference would be directional, ie researchers seem to think that $h_0 > h_1$, and that a $h_0 \neq h_1$ result from the implies that $h_0 > h_1$

Ans: (partial)

Please DON'T write, $h_0 > h_1$, etc. These are LABELS for hypotheses, not values of parameters. It is true that F is non-directional, and t is bi-directional. And any researcher will want to LOOK AT the means for the groups, and if they are found to be statistically different, learning which is high or low, etc. will be central to one's interpretation.

- How many distributions can we use this test for? Many distributions are based off of one or two parameters, that change along with the mean. Binomial, exponential, poisson, beta, and gamma are just some examples of distributions where if two functions have different means they have different variances.

Ans: ANOVA is used as a DATA ANALYTIC METHOD; you are speaking about theoretical distributions. One NEVER knows in real apps anything more than what the 'data look like.' Don't think about theoretical distributions as if they GAVE USE DATA. They do not. Transformations are used to help make real data meet the assumptions that underpin ANOVA inferential statistics. Read the Elemental Graphics paper AND the key references on this point for details.

- The 2w anova graphic for our example still seems foreign to me. I'm not sure what the two factors are keeping track of. For whatever reason, my R output for granova.2w is different than the one given in class (class doesn't have 'cell counts reordered' the same way I do, the aov.summary is way more in depth and descriptive in class compared to the one I have).

Comment: in looking at your results, I see nothing that I would not expect to see; and for $n = 1$ per cell, the info. Is exactly what you should expect to see. Look again please.

Please DON'T say, "The confidence interval was significant, or not" BAD LANGUAGE!

Can you explain the use of fitted means in the two way ANOVA?

How do you factor group sizes into contrast coefficients?

How is it possible to have outliers in ranked data? *yes*

How does the transformation of values into their reciprocals homogenize group variances?

Can you explain orthogonality?

1. For the `gronova.ds` function, in my figure the y-axis (axis) is the control groups and the x-axis (axis) is the treatment group (t & mean(d) go negative). But in most example (section 5.2, bloodlead, etc) and most people's home work the set is reverse to mine. I don't see any problem for now, but I'm not sure if there be any problem or trouble if we going future steps for the analysis? Shall we keep the t & mean(d) positive (always let $x > y$) for any future analysis?

Not a problem. Just reverse columns of input matrix, e.g., `xx[,2:1]`

2. After we run `gronova.2w`, is there any way we can save the picture as .gif file or any other form as a animation graphic in R? **YES, I HAVE MANY EXAMPLES. I'LL TRY TO POST ONE OR TWO.**

1. In dependent sample analyses, if we detect a few outliers which show effects contrary to the mean difference between treatment and control groups, how can we tell whether it's due to unreliable outcome measures or because of covariate differences that are associated with individual differences? Suppose two causes work together to result in clusters, outliers or trends across blocks, how to find out the major interpretation?

2. Most examples using dependent sample analyses have relative small sample size. Does increase in sample size affect the validity and efficiency of dependent sample graphic produced by R code "`granova.ds`"? ***ANS. I don't really understand this.***

Questions about dependent sample: if we want to compare our whole class's scores of midterm and final, is it a kind of dependent sample? ***Ans. No, but idea is close. Will discuss.***

In one way ANOVA, we know $\text{dif}(\text{total}) = \text{dif}(\text{within}) + \text{dif}(\text{between})$, $\text{MS}(\text{betw}) = 2\sigma + n * 2\sigma$, $\text{MS}(\text{within}) = 2\sigma$, $F = \text{MS}(\text{betw}) / \text{MS}(\text{within})$. Can you explain more about how to calculate $\text{MS}(\text{betw})$ and $\text{MS}(\text{within})$? *See my ANOVA + Contrasts pdf. But most importantly, read the Elemental Graphics pdf where computation is discussed in detail.*

1. In One-way ANOVA, when will jittering be needed and how to control the amount the jittering? ***Read the help file for .1w; see arg jj.***

2. In Two-way ANOVA, why does “quadratic” (power of 2) model be used to describe the interaction term instead of power of 1 term? How to spell out the quadratic model? ***I’ll either discuss in class (likely) or address this later if needed.***

1. How should we use and interpret the F-statistic? In what analyses would it be necessary? What is meant by MS(treatment) and MS(interaction) as on the wiki? *I have posted a pdf on Relations Among Distributions by my colleague Prof. Bruce Dudek in Psychology here. P. 7 spells out relation between t and F.*

2. How should the graph resulting from granova.2w be understood? When points line up vertically, is it true that factor A and factor B for those points are all the same? In the graph I created, the points appear to be continuously moving along factor A, but in some of the graphs we have seen, the points only appear at various points along A.

1. Besides the visual detection of the “irregularity” of data which could possibly suggest “covariate differences” of certain variables among subjects, is there any way to more precisely pinpoint the variables that are having the most prominent effect? How does multicollinearity come into play in the situation when there are “covariate differences”?

2. If resources permit, is a complete factorial design the most reliable design in terms of making statistical inferences?

1. How can we fix data if the correlation between two factors is high when we do

two way ANOVA analysis? ***I don’t understand the question. Data are not to be ‘fixed’ although often we want to transform data.***

2. In one way anova analysis, one assumption is that the two groups have equal variance on the dependent variable. If this assumption is violated, what shall we do?

Seek a transformation, as in Elemental Graphics paper, that reduces this effect.

Based on the readings, especially the one--*Enhancing Dependent Sample Analyses with Graphics*, I learned that there are 4 types of dependent sample designs. The one you asked us to do is paradigm 2a. In this article, it is specified that in paradigm 2a, subjects should also **be matched** on the basis of prior information. In my experiment, subjects are assigned to blocks based on their scores on the mental-skill scale. However, they also differ on other factors that might influence the response measure. How should we take

into account this issue? That is, how homogeneity within blocks is achieved? In my understanding, this homogeneity should be based on as many as dimensions as possible, not just on one factor (such as pre-experimental A1c measures). □

Statistically, how ANOVA based on dependent sample differs from ANOVA based on independent samples? I understand that methods of visualization under these two situations are different, but the way difference between groups is calculated *should be the same*. (?---NO, not true) If not the same, how each is done?

Difference scores are central here; 2w anova setup makes clear that the test statistic for the experimental effect uses the INTERACTION MS in the denominator!

1. While I was browsing through the literature of experiments regarding obesity, I encountered another way of analysis besides independent samples and dependent (paired) samples. That is meta-analysis. I later found that that “it is a technique which is used to analyze the results of a number of different studies and is often used for comparing the effectiveness of treatments.” According to this contention I assume that it is a technique concerning the “effectiveness” of treatments. So my question is that how it is different from what we have learned and are we going to learn a little bit about meta-analysis concerning comparison of means?

Ans. We are far away from such a question here; I shall try to sketch my view in class.

2. So far what I have learned over the years is that in order to compare the scores between two groups we need to compare the means. I think I also have a remote memory of having read something about using other techniques besides using the means to compare. Is that the case? If so, I would like to learn a little more about that.

Ans: that is what ANOVA is generally concerned with. We only introduce ANOVA in the course. See all the functions in granova, and the Elemental Graphics paper for many details that concern this. Bootstrapping will also become relevant for parts of this.

1) For bootstrapping I thought that do to The Central Limit Theorem the samples would have means closer to “normal distribution” even if the population they were sampled from was not normal, yet the Bootstrap methods chapter says “the distribution is centered close to the mean of the original sample”?

This will become clear as we work through bootstrapping as next topic.

2) If you reject at 0.05 and a 95% CI has 0.95 probability of containing the true value of μ , I know 0.05 is related to type I error rates can you elucidate the connection between CI's and error rates? ***Ans. We first need to distinguish between hypothesis tests and significance tests. Then it should become clear, quickly.***