**Quantitative Methods**

**Final Examination PAD 503**

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Question One:

Definition: A ***flipped classroom*** is an ***instructional strategy*** and a ***type of blended*** ***learning*** that ***reverses*** the traditional learning environment by ***delivering instructional content***, often online, outside of the classroom. It moves activities, including those that may have traditionally been considered homework, into the classroom

TRANSCRIPT:

Good evening Class this is a simplified version explaining ***Parametric Test*** One Way ANOVA.

It is my objective to make a new subject both ***Palatable*** and ***Enjoyable*** to learning Process.

**Slide 1**. On our First Slide, you have the description of the test itself. The slide describes the test formal Identification and then its variables. Noting that ANOVA divides case into two or more mutually exclusive levels, or groups. Which is an advantage over the T-Test.

For simplification we will deal with just two Variations:

**Slide 2 : Dependent Variable**: Your dependent variable should be measured at the interval or ratio level (i.e., they are continuous). Examples of variables that meet this criterion include revision time (measured in hours), intelligence (measured using IQ score), exam performance (measured from 0 to 100), weight (measured in kg), and so forth.

**Independent Variable:** Your independent variable should consist of two or more categorical, independent groups. Typically, a one-way ANOVA is used when you have three or more categorical, independent groups, but it can be used for just two groups (but an independent-samples t-test is more commonly used for two groups). Example independent variables that meet this criterion include ethnicity (e.g., 3 groups: Caucasian, African American and Hispanic), physical activity level (e.g., 4 groups: sedentary, low, moderate and high), profession (e.g., 5 groups: surgeon, doctor, nurse, dentist, therapist), and so forth.

**Slide 3:** Data Set Up: Your Data should include at least two Variables represented in the Columns.

**Slide 4**: Shows Data table in three portions: Medication Exercise and Diet. A researcher wishes to try three different techniques to lower the blood pressure of individuals diagnosed with high blood pressure.

Goup1 Takes Medication. Group, 2 Exercises, Group 3 Follows a special diet

What is useful to reduce the blood pressure is the **Alpha Level of Significance**

**Slide 5:** Describes the Common uses as shown on the slide:

Field Studies , Experiments, Quasi experiments

One way ANOVA is commonly Used in the following:

Statistical differences among the means of two or more **Images, Intervention & change scores.**

**Slide 6: Data Requirements: What exact is used to SET UP the Data**

The data

**Slide 7:** Continuing with the data requirements explaining, Random, Non Normal Homogeneity of variances.

**Slide 8**: Data Requirements: When the normality, homogeneity of variances, or outliers’ assumptions for One-Way ANOVA are not met, you may want to run the **non-parametric**

Kruskal-Wallis test instead.

**Slide 9:** Hypothesis is confirmatory data analysis which is testable on the bases of observing a process of Set Up for Random Variables. The On Way ANOVA is considered an Omnibus “All test.

**Slide 10:** Test Statistics Steps are illustrating in calculating the ANOVA

**Slide 11:** Anagrams Descriptions of the ANOVA

**Slide 12:** Test Statistics Continued: In ANOVA we must find the Value of **“F”**

**MSR =** The regression mean square ***over***

**MSE** = The mean square error

**F Test** originates from the statistician **Ronald A. Fisher**

**Slide 13:** One Way ANOVA Questionswhich ask about Homogeneity of Variety

We look at in Two words Homo = The Same and Geneity = Structure or Composition

What are the similarities in the variables. This slide ask the student to dissect the words and understand the origin of the meaning.

**Slide 14:** References

1. **Describe** *why to use that test* **over another statistical test available**

**Why ANOVA** *is better statistical test***:**

**Answer**: The point of conducting an experiment is to find a significant effect between the stimuli being tested. To do this various statistical test are used, the 2 being discussed in this blog will be the ANOVA and the T-test. In a psychology experiment an independent variable and dependent variable are the stimuli being manipulated and the behavior being measured. Statistical tests are carried out to confirm if the behavior occurring is more than chance.

**The** *T-test compares the means between 2 samples and is simple to conduct***, but if there are** *more than 2 conditions* **in an experiment an ANOVA is required.** *The fact the ANOVA can test more than one treatment is a major advantage over other statistical analysis such as the t-test***, it opens many testing capabilities, but it certainly doesn’t help with mathematical headaches. It is important to know that when looking at the analysis of variance an IV is called a factor, the treatment conditions or groups in an experiment are called the levels of the factor. ANOVA’s uses an** *F-ratio* **as its** *significance statistic**which is variance* **because it is impossible to calculate the sample means difference with more than two samples.**

**The ANOVA** *is an important test because it enables us to see for example how effective two different types of treatments are and how durable they are.* **Effectively an ANOVA can tell us how well a treatment work, how long it lasts and how budget friendly it will be an example being intensive early behavioral intervention (EIBI) for autistic children which lasts a long time with a lot hour, has amazing results but costs a lot of money. *The ANOVA can tell us if another therapy can do the same task in shorter amount of time and therefore costing less and making the treatment more accessible*. Conducting this test would also help establish concurrent validity for the therapy against EIBI. The F-ratio tells the researcher how big of a difference there is between the conditions and the effect is more than just chance. ANOVA test assumes three things:**

The population sample must be normal

The observations must be independent in each sample

The population the samples are selected from have equal variance a.k.a. homogeneity of variance.

These requirements are the same for a paired and a repeated measures t-test and these measured are solved in the same way for the t-test and the ANOVA. The population sample is assumed to be normal anyway, the independent samples isachieved with the design ofthe experiment, if the variance is not correct then normally more data (participants) is needed in the experiment.

In conclusion it is necessary to use the ANOVA when the design of a study has more than 2 condition to compare. The t-test is simple and less daunting especially when you see a 2x4x5 factorial ANOVA is needed, but the risk of committing a type I error is not worth it. The time you spent conducting the experiment only to have it declared obsolete because the right statistical test wasn’t conducted would be a waste of time and resources, statistical tests should be used correctly for this reason.

**Part 1C: Create 2 test questions/problems using your chosen statistical test.**

Question: What is the parametric test **Chi Square**? Explain the process

Question2: What is the parametric test **T Square** Test and explain the process

Question 3: What is the parametric Test **ANOVA** and explain the process.

**Part 2 . Provide at least one** *example* **on** *how to perform the test***.**

**Examples of how to perform ANOVA:**

**Formulas:**

**Chi-Square Test:**

chi-squared test is used to determine whether there is a significant difference between the expected frequencies and the observed frequencies in one or more categories. Chi is a greek letter ***χ***. So, Chi square is written as ***χ*2**.

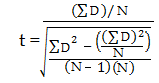
This is the formula for Chi-Square:

chi square formula chisquare = sum (O-E)^2 / E

**T-Test**

The t test (also called Student’s T Test) compares two averages (means) and tells you if they are different from each other. The t test also tells you how significant the differences are.

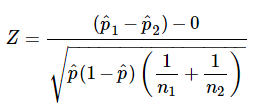
Formula to calculate the t-score:

[](https://www.statisticshowto.datasciencecentral.com/wp-content/uploads/2014/12/paired-t-test-example.png)

**Z-Test**

A Z-test is a type of hypothesis test. It tell us if it’s probably true, or probably not true. A Z test, is used when our data is approximately normally distributed**.**

 Z test statistic formula:

[](https://www.statisticshowto.datasciencecentral.com/wp-content/uploads/2014/02/two-proprtion-z-test.png)

**ANOVA TEST**

ANOVA is a statistical technique that assesses potential differences in a scale-level dependent variable by a nominal-level variable having 2 or more categories.

  The assumptions in ANOVA are

                        Normal distribution of data

                        Independent simple random samples

                        Constant variance

**Hypotheses**

*H*0: all means are equal

*HA*: not all means are equal

**Statistical Test**

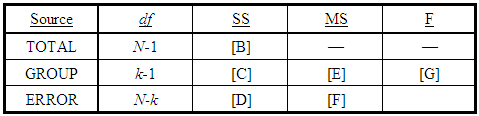
            Test statistic and distribution

            The ANOVA test statistic is the variance ratio, V.R., which is distributed as F with the appropriate number of numerator degrees of freedom and denominator degrees of freedom at the chosen a level.

https://www.kean.edu/~fosborne/bstat/px/ANOVAeq1.gif

A big value of F means to reject the null hypothesis.  A small value means not to reject.

*Sample ANOVA table.*



            The ANOVA table has columns for degrees of freedom (*df*), sums of squares (SS), mean squares (MS) and the variance ratio (F).  These values are found using a series of calculations.

            For degrees of freedom, *N* and *k* are used in the following formulas.

                        TOTAL *df* = *N* - 1

                        GROUP *df* = *k* - 1

                        ERROR *df* = *N - k*

            The error term reflects how much each individual measurement differs from the population mean of its group.

Steps for ANOVA calculations

            [A]       Calculate the correction factor

https://www.kean.edu/~fosborne/bstat/px/ANOVAeqA.gif

            [B]       Calculate the Sum of Squares Total value (SS Total)

                        SS Total = Sx2 - CF

            [C]       Calculate the SS Group value

https://www.kean.edu/~fosborne/bstat/px/ANOVAeqC.gif

            [D]       Calculate the SS Error value

                        SS Error = SS Total - SS Group

            [E]       Calculate MS Group value

https://www.kean.edu/~fosborne/bstat/px/ANOVAeqE.gif

            [F]       Calculate MS Error value

https://www.kean.edu/~fosborne/bstat/px/ANOVAeqF.gif

            [G]       Calculate F value (V.R.)

https://www.kean.edu/~fosborne/bstat/px/ANOVAeqG.gif

            All of the above equations are used in the ANOVA calculations.

**Correlation and Regression**

Correlation is used to give information about the relationship between two variables x and y.  When the regression equation is calculated, the correlation results indicate the nature and the strength of the relationship.

Equation for correlation:

http://archive.bio.ed.ac.uk/jdeacon/statistics/image298.gif

http://archive.bio.ed.ac.uk/jdeacon/statistics/image299.gif

http://archive.bio.ed.ac.uk/jdeacon/statistics/image314.gif

Correlation coefficient r,

http://archive.bio.ed.ac.uk/jdeacon/statistics/image301.gif

Equation for regression:

Regression equation for y on x is: y = bx + a, where b is slope and a is the intercept.

http://archive.bio.ed.ac.uk/jdeacon/statistics/image302.gif

a = http://archive.bio.ed.ac.uk/jdeacon/statistics/mage297.gif- bhttp://archive.bio.ed.ac.uk/jdeacon/statistics/image152.gif

|  |  |  |  |
| --- | --- | --- | --- |
| **QUESTION NO. 3**  Two physicians examined results of 50 randomized, double-blind, placebo-controlled trial | | | |
| examining whether patients with chronic fatigue syndrome (CFS) improved | | | |
| 6 weeks after treatment with intramuscular magnesium. The group who received the magnesium | | | |
| were compared to a group who received a placebo and outcome was feeling better. | | | |
| Physician A believed 15 patients received magnesium as opposed to placebo. Physician B believed | | | |
| 20 patients received magnesium as opposed to placebo. They both agreed on 9 patient cases having received magnesium as opposed to placebo. **What is the Chi square result?** | | | |
|  |  |  |  |
| Treatment |  | Outcome |  |
|  | **Physician B - Magnesium** | **Physician B - Placebo** | Total |
| **Physician A - Magnesium** | ***9*** | ***6*** | 15 |
| **Physician A - Placebo** | ***11*** | ***24*** | ***35*** |
| Total | 20 | ***30*** | **50** |

|  |  |  |  |
| --- | --- | --- | --- |
| Treatment |  | Outcome |  |
|  | **Physician B - Magnesium** | **Physician B - Placebo** | Total |
| **Physician A - Magnesium** | ***(15\*20)/50*** | ***(15\*30)/50*** | 15 |
| **Physician A - Placebo** | ***(35\*20)/50*** | ***(35\*30)/50*** | ***35*** |
| Total | 20 | ***30*** | **50** |

|  |  |  |  |
| --- | --- | --- | --- |
| Treatment |  | Outcome |  |
|  | **Physician B - Magnesium** | **Physician B - Placebo** | Total |
| **Physician A - Magnesium** | ***6*** | ***9*** | 15 |
| **Physician A - Placebo** | ***14*** | ***21*** | ***35*** |
| Total | 20 | ***30*** | **50** |

|  |  |  |  |
| --- | --- | --- | --- |
| Treatment |  | Outcome |  |
|  | **Physician B - Magnesium** | **Physician B - Placebo** | Total |
| **Physician A - Magnesium** | ***{(9-6)^2}/6*** | ***{(6-9)^2}/9*** | 15 |
| **Physician A - Placebo** | ***{(11-14)^2}/14*** | ***{(24-21)^2}/21*** | ***35*** |
| Total | 20 | ***30*** | **50** |

|  |  |  |  |
| --- | --- | --- | --- |
| Treatment |  | Outcome |  |
|  | **Physician B - Magnesium** | **Physician B - Placebo** | Total |
| **Physician A - Magnesium** | ***1.5*** | ***1*** | 15 |
| **Physician A - Placebo** | ***0.64*** | ***0.43*** | ***35*** |
| Total | 20 | ***30*** | **50** |

**Chi square,**

***χ* 2 = 1.5 + 1 + 0.64 + 0.43 = 3.57**

1. **A researcher at SRVMC wishes to try three different techniques to lower the blood pressure of individuals diagnosed with high blood pressure.  The subjects are randomly assigned to three groups**.

**Group 1 takes medication**

**Group 2 exercises**

**Group 3 follows a special diet.**

**After four weeks, the reduction in each person’s blood pressure is recorded.  At an alpha level of significance of 0.05, the researchers now must test the claim that there is no difference among the means.**

|  |  |  |
| --- | --- | --- |
| **Medication** | **Exercise** | **Diet** |
| **10** | **6** | **5** |
| **12** | **8** | **9** |
| **9** | **3** | **12** |
| **15** | **0** | **8** |
| **13** | **2** | **4** |

**Solution:**

* **Step 1.** Set up hypotheses and determine level of significance

H0: μ1 = μ2 = μ3 H1: Means are not all equal                            α=0.05

* **Step 2.** Select the appropriate test statistic.

The test statistic is the F statistic for ANOVA, F=MSB/MSE.

* **Step 3.** Set up decision rule.

In order to determine the critical value of F we need degrees of freedom,

df1=k-1 and df2=N-k.

In this example, df1=k-1=3-1=2 and

df2=N-k=15-3=12.

* **Step 4.** Compute the test statistic.

To organize our computations we will complete the ANOVA table. In order to compute the sums of squares we must first compute the sample means for each group and the overall mean.

|  |  |  |
| --- | --- | --- |
| **Medication** | **Exercise** | **Diet** |
| n1=5 | n2=5 | n3=5 |
| = (10 + 12 + 9 + 15 + 13)/5 = 59/5 = 11.8 | = (6+8+3+0+2)/5 = 19/5 = 3.8 | = (5+9+12+8+4)/5 = 38/5 = 7.6 |

 If we pool all N=15 observations, the overall mean is (11.8+3.8+7.6)/3 = (23.2)/3 = 7.73

We can now compute:

http://sphweb.bumc.bu.edu/otlt/MPH-Modules/BS/BS704_HypothesisTesting-ANOVA/lessonimages/equation_image63.gif

Substituting:

Finally, SSB = 82.8245 + 77.2245 + 0.0845 = 160.1335

**Next,**

**http://sphweb.bumc.bu.edu/otlt/MPH-Modules/BS/BS704_HypothesisTesting-ANOVA/lessonimages/equation_image66.gif**

SSE requires computing the squared differences between each observation and its group mean. We will compute SSE in parts. For the participants with Medication:

|  |  |  |
| --- | --- | --- |
| **Medication** | **(X – 11.8)** | **(X – 11.8)2** |
| 10 | -1.8 | 3.24 |
| 12 | 0.2 | 0.04 |
| 9 | -2.8 | 7.84 |
| 15 | 3.2 | 10.24 |
| 13 | 1.2 | 1.44 |
| Total | 0 | 22.8 |

**Thus, = 22.8**

**For participants with exercise:**

|  |  |  |
| --- | --- | --- |
| **Exercise** | **(X - 3.8)** | **(X - 3.8)2** |
| 6 | 2.2 | 4.84 |
| 8 | 4.2 | 17.64 |
| 3 | -0.8 | 0.64 |
| 0 | -3.8 | 14.44 |
| 2 | -1.8 | 3.24 |
| Total | 0 | 40.8 |

**Thus,** = **40.8**

**For participants with Diet:**

|  |  |  |
| --- | --- | --- |
| **Diet** | **(X - 7.6)** | **(X - 7.6)2** |
| 5 | -2.6 | 6.76 |
| 9 | 1.4 | 1.96 |
| 12 | 4.4 | 19.36 |
| 8 | 0.4 | 0.16 |
| 4 | -3.6 | 12.96 |
| Total | 0 | 41.2 |

**Thus, = 41.2**

**= 22.8 + 40.8 + 41.2 = 104.8**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Source of Variation** | **Sums of Squares (SS)** | **Degrees of freedom (df)** | **Mean Squares (MS)** | **F** |
| Between groups | 160.1335 | 2 | 80.06675 | 9.1682 |
| Error or Residual | 104.8 | 12 | 8.733 |  |
| Total | 264.9335 | 14 |  |  |

We can now construct the **ANOVA table**.

**Number 5.**

**You have collected the following data:**

**7 9 15 10 2**

**If you randomly select one of these numbers, what is the probability the number (X) will be....**

**a. equal to 9?**

**b. less than 10?**

**c. greater than 2?**

**Solution: There are 5 numbers or data collected and we need to choose one of the randomly.**

**Probability of number (9) = 1/5 = 0.2**

**Probability of number (10) = 1/5 = 0.2**

**Probability of number (2) = 1/5 = 0.2**

**Number 6.**

**This is a standard deviation question. You must choose four numbers from the whole numbers 0 to 20, with repeats allowed (you may use the number more than once).**

**a. Choose four numbers that have the smallest possible standard deviation.**

**b. Choose four numbers that have the largest possible standard deviation.**

**c. Is there more than one choice possible in either a or b? Explain.**

**Solution:**

**(a) Pick any four numbers all the same: e.g., (4,4,4,4) or (6,6,6,6). Choosing all of the numbers the same (e.g., 5, 5, 5, 5) produces the smallest possible standard deviation, 0.**

**(b) (0,0,20,20). The four numbers 0, 0, 20, 20, have the largest possible standard deviation, because they are as far as possible from their mean (i.e.,X ̅ = 10).**

**(c) There is more than one possible answer for (a) but not for (b). As mentioned, there is more than one choice in (a), but there is only one in (b)**

**Number 7.** Integrity/honour code statements: Initial (type) statement if accurate.

**Gwendolyn Phillips de Ashborough,** I certify that I read the course syllabus, posted lectures, examples, and notes provided by the instructor.

**Gwendolyn Phillips de Ashborough,** I certify that I have given this course 100% of my effort when attempting to review the lectures, examples, notes, and completing the assigned problem sets.

**Gwendolyn Phillips de Ashborough,** I certify that I have submitted my own individual work for all assignments.