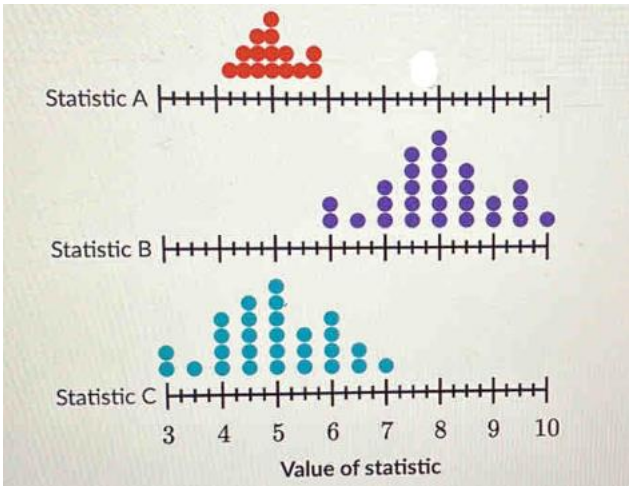
Chapter 12 Review Session 17: 4/16/25

Theorem

- The Logic of ANOVA
  - ANOVA is a test that compares individual samples to each other AND observes the variation within each individual sample.
    - When comparing individual samples to each other, we call that _____ (____)
    - When observing the variation within each individual sample, we call that _____ (____)



- Everything ANOVA (Table and Testing by Hand)
  - The _____ is the interest that is measured in an experiment.
    - This is also known as the _____.
  - The _____ is what is effected by the _____.
    - This is also known as the _____.
  - _____ in an experiment are the levels in the _____.

Factor (Variable)					
Residual (Error)					

  - Considerations

        - There are ___ treatments which act as our _____
            - These treatments are under ____ category
        - The overall sample size (___) for ____ are distributed for each ___
        - Each ___ also has a _____ & _____
            - To find the _____:

        - The hypotheses
            - Null:
            - Alternative:
    - Formulas
        - The Sum of Squares
            - Between (_____)

            - Within (_____)

        - The degrees of freedom
            - Between (_____)

            - Within (_____)

        - The Mean Squares
            - Between (_____)

            - Within (_____)

        - Test Statistic

        - P-value

        - Total Sum or Squares (May or may not be asked to find this)

        - Total Degrees of Freedom (May or may not be asked to find this)

    - Decision & Interpretation
        - Rejecting (_____)

      At ____% level of significance, there is _____ evidence to support that at least one of the treatment means differ.

        - Failing to Reject (_____)

      At ____% level of significance, there is _____ evidence to support that at least one of the treatment means differ.

- ANOVA F-Test on the Calculator
    - You will need the data/list for each treatment
        - Input into the calculator

    - Then you go to the ANOVA function

        - Output Terms to know
            - F is the ___
            - P is the _____
            - Factor stats (df, SS, and MS) is the _____ values
            - Error stats (df, SS, and MS) is the _____ values

- Ignore Sxp!!!

- Post-Hoc Analysis
  - Only used when you _____ in the ANOVA test!
  - This analysis looks at determining which treatment is different from the others, if possible for the particular scenario.
  - This class focuses on the _____ method and the _____ method.
    - We use _____ for _____ sample sizes between treatments.
    - We use _____ for _____ sample sizes between treatments.
  - Both methods are _____ comparisons.
    - I.e. If there are 3 treatments Post-Hoc looks at:
  - This means the hypotheses look like:
    - Null:
    - Alternative:
  - For Post-Hoc, you will be given an R table with each treatment comparison written out. You will not be expected to calculate for each comparison!
  - Decision & Interpretation (Overall)
    - Rejecting (_____)
      - Means that _____
    - Failing to Reject (_____)
      - Means that _____
    - Thus, we say:

    At ___% level of significance, we could say that treatment(s) _____ are different from treatment(s) _____.

Practice

1. Ella, a beauty CEO, is performing an experiment comparing the time it takes (in minutes) for different face mask formulas to dry to determine which face mask is best for quick use. Use the table below to answer the questions, keeping in mind that we are testing against a 5% significance level.

Formula A	Formula B	Formula C
2.35	3.58	1.25
1.55	3.05	1.90
2.05	2.98	2
3	4	3.05
2.88	2.89	1.5
1.90	3.43	2.80
3.05		1.45
2.75		

a. Identify the Factor, Levels, and response variables.

b. State the ANOVA Hypotheses.

c. Fill in the ANOVA table.

	SS	Df	MS	TS	p-value
Factor (Variable)					
Residual (Error)					

d. What is the decision?

e. Choose the appropriate interpretation.

- ❑ At 5% level of significance, there is sufficient evidence to support that at least one of the treatment means differ.
- ❑ At 5% level of significance, there is insufficient evidence to support that at least one of the treatment means differ.

f. Would we move onto Post-Hoc? If yes, continue.

g. Write the Post-Hoc Hypotheses.

h. Analyze the R output below.

	diff	lwr.ci	upr.ci	pval
Formula B - Formula A	1.08	-1.455499	3.6154988	0.8149
Formula C - Formula A	-1.42	-3.955499	1.1154988	0.4616
Formula C - Formula B	-2.50	-4.814583	-0.1854169	0.0322 *

i. Interpret the scenario.

2. Steven, a pharmacist, is trying to determine which ADHD medication is most effective out of the 4 most common types. To do so, the pharmacist asks 7 people for each medication how effective they would rate it. Use the statistics below to answer the questions, keeping in mind that we are testing against a 1% significance level.

Medication	Mean Score	Standard Deviation	Sample Size
#1	5.43	1.72	7
#2	4.14	1.35	7
#3	6.29	1.11	7
#4	6	1.41	7

a. Identify the Factor, Levels, and response variables.

b. State the ANOVA Hypotheses.

c. Fill in the ANOVA table.

	SS	Df	MS	TS	p-value
Factor (Variable)					

Residual (Error)				

d. What is the decision?

e. Choose the appropriate interpretation.

- ❑ At 1% level of significance, there is sufficient evidence to support that at least one of the treatment means differ.
- ❑ At 1% level of significance, there is insufficient evidence to support that at least one of the treatment means differ.

f. Would we move onto Post-Hoc? If yes, continue.

g. Write the Post-Hoc Hypotheses.

h. Analyze the R output below.

	diff	lwr	upr	p adj
2-1	0.36250000	0.12528287	0.59971713	0.0010358
3-1	0.07833333	-0.15888380	0.31555047	0.8143113
4-1	0.22000000	-0.01721713	0.45721713	0.0778376
3-2	-0.28416667	-0.52138380	-0.04694953	0.0131752
4-2	-0.14250000	-0.37971713	0.09471713	0.3869986
4-3	0.14166667	-0.09555047	0.37888380	0.3921830

i. Interpret the scenario.