MTH 23.5 LECTURE NOTES (Ojakian)

Topic 1: Introduction to Statistics

OUTLINE

References (**Algebra Book**: None; **Statistics Book**: 1.1, 1.2, 1.3, 1.4)

1. Introduction to Statistics
2. Random Samples
3. Experimental Design

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1. Introductory Example
   (a) Who is going to win the presidential race in November 2024?
      i. Democrat: Kamala Harris (current V.P.)
      ii. Republican: Donald Trump (former president)
   (b) How might you predict the outcome?
2. Basic Terminology of Statistics

   Do survey: Commute time? Fast Food?

   Use survey as example for below terminology. Use Example 1.2 (Section 1.1, page 8).

   (a) Individual:
   (b) Variable:
   (c) Data:
   (d) Quantitative/Numerical versus Qualitative/Categorical Variable:
   (e) Population versus Sample ("census" versus "representative sample"): Have a "criteria" for being in the population ...
   (f) Parameter versus Statistic:
   (g) Summarizing data: mode, "middle", max, min, range, counting, proportion, mean
   (h) Examples
      i. Example 1.3 (Section 1.1, page 9).
      ii.

      PROBLEM 1. *Discuss how the mean commute time for our class can be viewed as a parameter or a statistic.*
3. Ok, let's remember our numbers! ...: Number Line.

   Definition 1. *The **number line** is a horizontal line going infinitely far to the right and left with the following properties:*

   (a) Zero is in "middle"
   (b) Positive numbers to right of zero

(c) *Negative numbers to left of zero*

(d) *Left is smaller. Right is larger.*

(e) *Discuss:* $<$ *and* $>$ *and* $\leq$ *and* $\geq$.

PROBLEM 2. *Draw the number line and place the following numbers on it (largest, smallest?):*

$$0,\ 4,\ -5,\ -8,\ 1/2,\ -1/2,\ 11.75,\ -7.75,\ 11\frac{1}{3},\ -3\frac{3}{4}$$

4. Types of Numbers

Definition 2. *A* ***real number*** *is any number on the Number Line.*

Definition 3. *An* ***integer*** *is a whole number, which is positive, negative, or 0.*

PROBLEM 3. *Which of the following numbers are integers:* $9,\ 5/4,\ 4/5,\ 10.4,\ 10,\ -19,\ 0.7,\ 0$

5. Back to Statistics! ...

(a) Level of Measurement: Nominal (or qualitative/categorical), Ordinal, Interval, Ratio (Section 1.3, page 26).
Example: Temperature, Height, Generation, ...

PROBLEM 4. *From* ***Statistics Book*** *(7th Edition) do Sec 1.1 - Prob 11*

(b) More Examples.

PROBLEM 5. *From* ***Statistics Book*** *(7th Edition)) do Section 1.1 - Probs 7, 9. Also determine the level of measurement for each problem.*

6. What is Statistics and What is this course?

(a) The Field of Statistics:

(b) Descriptive versus Inferential Statistics:

(c) Us: Statistics and Background Math/Algebra

PROBLEM 6. *From* ***Statistics Book*** *(7th Edition) Section 1.1, do Problem 15.*

7. Random Samples

(a) Simple Random Sample:

i. Example 1.13 (Section 1.2, page 23)

ii.

PROBLEM 7. *From* ***Statistics Book*** *(7th Edition) Section 1.2 do Problem 8.*

(b) Sampling Error versus Non-Sampling Error:

(c) Another Example:

i. I have 35 sheets of paper (each numbered 1 - 10), repetitions allowed. You want to guess what the mean is ...

ii. To guess the population mean, take a random sample of size 4 and find the sample mean. Two volunteers!

8. Experimental Design

(a) Observation versus Experiment:

PROBLEM 8. *From* ***Statistics Book*** *(7th Edition) Section 1.3 do Problem 7.*

(b) Aspects of an Experiment.

i. Control Group versus Treatment Group:
ii. Completely Randomized Experiment:
iii. Placebo Effect:
iv. Double-blind:

(c)

PROBLEM 9. *From* ***Statistics Book*** *(7th Edition) Section 1.3 do Problem 9. Also, specify the control group and how to make the study double-blind (if possible).*