

Math 114 – Review for Exam III – Chapter 9 – Statistics

For Exam III you should understand the following concepts and be able to do problems like the examples shown.

- (1.) **Random/Unbiased Sample** – To ensure you have a random or unbiased sample you need to make sure that every member of the population has an equal chance of being included in the sample. A biased sample favors some parts of the population over others.
- (2.) **Frequency Charts** – A frequency chart shows the distribution of data into classes or intervals. The classes or intervals are constructed so that each data value falls into exactly one class.

For example the list below shows One-way Commuting Distances (in miles) for 60 workers in downtown Dallas.

13,7,12,6,34,14,47,25,45,2,13,26,10,8,1,14,41,10,3,21,8,13,28,24,16,19,4,7,36,37,20,15,16,15,17,31,17,3,11,46,24,8,40,17,18,12,27,16,4,14,23,9,29,12,2,6,12,18,9,16

To construct a frequency chart for this data first you need to define your class width.

$$\text{Class Width} = \frac{\text{Largest Data value} - \text{Smallest Data Value}}{\text{Desired number of classes}}$$

So if I wanted 6 classes for my chart the class width would be equal to:
Class Width = $(47-1)/6 = 7.7$ (use 8), Now construct the frequency chart by using the defined classes and listing the number of commuting distances within that specific class.

Class Intervals(miles)	Frequency
1-8	14
9-16	21
17-24	11
25-32	6
33-40	4
41-48	4

From this chart you can make a **histogram and a frequency polygon**

(3.) Computing the Mean, Median, and Mode

a. Definitions

Mean = Sum of all data points/Number of data points

Median = the middle value of data that is listed in increasing or decreasing order

Mode – the most frequent value in a set of data

b. Calculating Mean, Median, & Mode for a set of data

Find the mean, mode, and median for the following quiz scores:

2,4,4,6,7,8,5,3,7,9,10, 8,9,4,11

First list data in increasing order:2,3,4,4,4,5,6,7,7,8,8,9,9,10,11

Mean = $97/15 = 6.5$

Median = $(n + 1)/2$, where n = number of data points

Median = $(15+1)/2 = 8^{\text{th}}$ data point = 7 (**must use data listed in increasing or decreasing order!**)

- OR -

Median = list the data in order, cross them off from each end, and find the middle number

Mode = 4

c. Calculating Mean, Median, & Mode for grouped data – for this example let's use a modified version of the one-way commute data.

Class Intervals(miles)	Frequency (f_i)	Midpoint (m_i)	f_m
1-9	14	5	70
10-18	21	14	294
19-27	11	23	253
28-36	6	32	192
37-45	4	41	164
46-54	5	50	250
Totals	61		1223

$$\text{Mean} = \frac{\sum f_i m_i}{n} = 1223 / 61 = 20$$

Median = $(\text{number of data points} + 1) / 2 = (61+1) / 2 = 31$ – Use the 31st score (midpoint)= 14

Mode = Most frequent data point = 14 (midpoint)

(4.) Calculating Sample Mean, Sample Variance, Sample Standard Deviation

You should know how to use the following equations for a sample of data:

$$\text{Sample Mean} = \bar{x} = \frac{\sum x}{n}$$

$$\text{Sample Variance} = S^2 = \frac{\sum (x - \bar{x})^2}{(n-1)}$$

$$\text{Sample Standard Deviation} = S = \sqrt{S^2}$$

where x = data point in sample & n = the number of data points in sample

(5.) Calculating Population Mean, Population Variance, Population Deviation

You should know how to use the following equations for data for an entire population:

$$\text{Population Mean} = \mu = \frac{\sum x}{N}$$

$$\text{Population Variance} = \sigma^2 = \frac{\sum (x - \mu)^2}{N}$$

$$\text{Population Standard Deviation} = \sigma = \sqrt{\sigma^2}$$

Where: N= the number of data in the entire population, x = data point in population

(6.) Normal Distribution

You should understand the properties of Normal Distribution (Section 9.3) including how to calculate a Z score.

$$Z = \frac{x - \mu}{\sigma} = (\text{Difference between } x \text{ and } \mu) / \text{Standard Deviation}$$

where:

x = Original data point

μ = Mean of the original data

σ = Standard Deviation of the original data

(7.) Empirical Rule (68, 95, 99.7%)

know that in a standard normal distribution 68% of the data lies within one standard deviation of the mean, 95% of the data lie within two standard deviations of the mean, and 99.7% of the data lie within 3 standard deviations of the mean

Sample Problems

1. The following list of data represents highway fuel consumption in miles per gallon (mpg) for a random sample of 30 cars. Construct a grouped frequency table, histogram and frequency polygon for this data using five equal interval lengths and starting with the interval 13-20.

30,27,22,25,24,35,35,33,52,49,20,23,24,25,30,18,20,25,27,24,24,27,26,25,24,13,13,
21,28,37

2. Using the following frequency chart for ages of senators in the 95th Congress, calculate the mean, median and mode. Hint: you will need to calculate the midpoint for each class.

Age (yrs)	Frequency
30-39	6
40-49	26
50-59	35
60-69	21
70-79	10
80-90	2

3. The Pro Football Encyclopedia gave the following ages for a random sample of football players. Calculate the mean, median and mode.

24,23,25,23,30,29,28,26,33,29,24,37,25,23,22,27,28,25,31,29,25,22,31,29,22,28,27,
26,23,21

4. A reporter for the *Honolulu Star-Bulletin* was doing a news article about car theft in Honolulu. For a given 10-day period, the police reported the following number of car thefts;

9,6,10,8,10,8,4,8,3,8

Calculate the mean, mode, and median.

5. What is the mode for the following group of numbers:

1,2,3,4,5,8,9,10,12,13

6. Given the following grades for an entire class:

Hint: Is this a sample or a population?

73, 99, 67, 67, 82, 86, 94, 87, 86, 82, 81, 67, 91, 73, and 50

Find the range: _____ Find the variance: _____ Find the standard deviation: _____

7. Given the following prices of a random sample of used homes (in thousands):

Hint: Is this a sample or a population?

190,144,140,110,140,140,115,100,70,100,80,200,140,120,100,120,150

Find the range, variance, and standard deviation

8. Normal Distribution Curve:

What percentage of area under the normal curve lies:

- a. to the left of μ
 - b. between $\mu - \sigma$ and $\mu + \sigma$
 - c. between $\mu - 3\sigma$ and $\mu + 3\sigma$
9. Assuming that the heights of college women are normally distributed, with a mean of 65 inches and standard deviation of 2.5 inches answer the following questions.
- a. What percentage of women are taller than 65 inches?

 - b. What percentage of women are shorter than 65 inches?

 - c. What percentage of women are between 62.5 inches and 67.5 inches?

 - d. What percentage of women are between 60 inches and 70 inches?
10. Using the given population mean and standard deviation calculate the Z-score for x.
- a. $\mu=14, \sigma=3, x=20$

 - b. $\mu=140, \sigma=15, x=125$

 - c. $\mu=32, \sigma=13, x=10$

11. Using the given Normal Distribution Curve and assuming that the scores for the final exam in Math 114 are normally distributed with a mean of 75 and a standard deviation of 10 answer the following questions.

- a. What percentage of students score above 75?
- b. What percentage of students scored below 75?
- c. What percentage of students scored between 65 and 85?
- d. What percentage of students scored between 55 and 95?
- e. If 65 is passing , what percentage of students passed the exam?
- f. If the top 15% of the students get A's, what is the cut-off score for an A?

12. Given the following z-scores on a standard normal distribution find the percent of the total area under the standard normal curve.

- a. area to the left of $z = 1.45$
- b. area to the right of $z = -0.13$
- c. area between $z = 1.37$ and $z = 2.98$

13. Ashley earned an 89 on her History midterm and an 81 on her Math midterm. In the History class the mean score was an 82 with a standard deviation of 5. In the Math class the mean score was 76 with a standard deviation of 3.

- a. Convert each score to a standard z-score.

History _____ Math _____

- b. On which test did she do better compared to the rest of the class? Explain.