MTH 265 – Statistics for Scientists and Engineers **EXAM I REVIEW**

Your exam is Tuesday, January 30th. This exam will not involve just calculations. I will test you on concepts. How do statistics behave? How do formulas work? How do we interpret statistics? This is where the reading (and re-reading) becomes very important. Expect calculation questions as well as true/false and short answer questions. All odd and even assigned problems are good test questions, so make sure you've done them all.

CHAPTER 1

1.1 Sampling

- Be able to define a population given information about a sample. Read page 3 and then look at problem 1 in the problem set.
- Be able to determine whether a population is tangible or conceptual. When might you be dealing with a conceptual population? Read pages 5 and 6.
- Be able to explain why simple random samples always differ from the population in some ways.
- What does it mean if items in a sample are independent?

1.2 Summary Statistics

- Be able calculate a sample mean, sample variation, sample standard deviation by hand. Looking closely at how they are calculated gives insight into how they are interpreted.
- How are the sample mean, sample variance, and sample standard deviation affected if a constant is added to each value in a data set or if a constant is multiplied to each value in a data set?
- Be able to find the median, mode, range, percentiles, and quartiles of a sample.
- Know what it means for a value to be a certain quartile or percentile.
- Why do we tend to use the sample standard deviation rather than the sample variance? Page 12.
- Why do we divide by n-1 when calculating the sample standard deviation and variance? Page 13.

1.3 Histograms and Box Plots

- Be able to construct a frequency histogram or answer questions about one that I give you.
- Be able to discuss a histogram according to skewness or symmetry.
- Be able to calculate and use the first quartile, second quartile, third quartile, and inner quartile range to construct a box plot for a set of data.
- Know how long to draw the "whiskers" for the box plot and what makes a data value an outlier.
- Know how a box plot separates the data into four parts and know what **percentage** of data falls into each of the four parts.
- If I give you a completed box plot, be able to identify all important aspects of the box plot and answer questions about it.

CHAPTER 2

2.1 Correlation Coefficient

- We discussed the formula for the correlation coefficient and noted how it works. Carefully read pages 38, 39, and 40. Be able to intelligently discuss this important statistic.
- If the correlation coefficient is 0 does that mean there is no association at all? There could be a strong association that is curved. Read carefully the bottom of page 41.
- What does the correlation coefficient measure? Read pages 41 and 42.
- Why do we say correlation is not causation? Read page 43.
- Be able to discuss confounding. I showed an extreme confounding example in class. There are examples in your book on pages 44 to 46. You also worked on problems 7 and 8 in your homework.

2.2 Least Squares Line

- Know the new vocabulary: least-squares coefficients, fitted value, and residuals.
- Be able to identify residuals on a scatter plot that contains the least-squared regression line.
- How is the Least-Squares Regression Line created? Read pages 49 and 50.
- Be able to use your calculator to generate the regression line or use the formulas on page 53 if I give you information as was done in problem 4.
- Be able to answer questions about your regression line as in any homework problem.

2.3 Features and Limitations of the Least-Squares Line

- What is extrapolation and what are the dangers of extrapolating?
- Should we use the least-squares line on curved data?
- How do we measure how good the line fits the data? Be able to discuss the coefficient of determination. How is it calculated and what does it measure? Read carefully page 59 and 60. Be able to identify parts from a scatter plot. Your second project focused on the coefficient of determination, so I assume you can discuss this statistic well.

CHAPTER 3

3.1 Probability Basic Ideas

- Be able to list the sample space for an experiment and calculate probabilities.
- Know how to construct new events using intersection, union, or the complement.
- Know when events are mutually exclusive.
- Be able to calculate the probability of an event or the complement of an event.

3.2 Conditional Probability and Independence

- We discussed how the sample space changes when we find conditional probabilities. Be able to find conditional probabilities.
- Be able to use Venn Diagrams to visualize probability.
- When events are independent, how do we find the probability that both events occur?
- We used independent events, union, and intersection to discuss reliability problems. Be able to calculate such probabilities.

3.3 Random Variables

- What is a random variable and how do you tell if it is discrete or continuous?
- Be able to explain what a probability distribution (probability mass function) is for a discrete random variable.
- Be able to find the probability distribution and the cumulative distribution function for a discrete random variable for a given experiment.
- Be able to find the probability of event occurring for a discrete random variable for a given experiment. Be able to create a probability histogram for a random variable.
- Be able to find the mean (expected value), variance, and standard deviation for a discrete random variable from a given experiment. See pages 91 to 93
- What is the expected value of a random variable?
- Be able to explain what a probability distribution (probability density function) is for a continuous random variable. See page 96.
- Be able to use calculus to find probabilities of events for continuous random variables.
- Be able to use calculus to find the cumulative distribution function for a continuous random variable. See pages 98 and 99.
- Be able to use calculus to find the mean and variance for a continuous random variable. See pages 100 and 101.