Mthsc 309 Material Covered: (Fall 2013)

Chapter 1: Statistics, Data, and Statistical Thinking

Section 1.1 – The Science of Statistics

- Define Statistics
- Section 1.2 Types of Statistical Applications in Business
 - Descriptive statistics
 - Inferential statistics
- Section 1.3 Fundamental Elements of Statistics
 - Experimental Units
 - Population
 - Variable
 - Census
 - Sample
 - Statistical Inference
 - Reliability
 - Four Elements of Descriptive Statistical Problems
 - The population or sample of interest
 - \circ $\,$ One or more variables that are to be investigated
 - Tables, graphs, or numerical summary tools
 - Identification of patterns in the data
 - Five Elements of Inferential Statistics Problems
 - The population of interest
 - One or more variable that are to be investigated
 - The sample of population units
 - The inference about the population based on information contained in the sample
 - A measure of reliability for the inference
- Section 1.5 Types of Data
 - Quantitative Data
 - Qualitative Data
- Section 1.6 Collecting Data
 - Data from a published source
 - Data from a designed experiment
 - Data from a survey
 - Data collected observationally
 - Representative Sample
 - Random Sample
- Section 1.7 The Role of Statistics in Managerial Decision Making
 - Selection bias
 - Nonresponse bias
 - Measurement error

Chapter 2a: Methods for Describing Sets of Data

Section 2.1 – Describing Qualitative Data

- Frequency Table
 - o Class
 - o Class frequency

- o Class relative frequency
- o Class percentage
- Bar graphs
- Pie chart
- Pareto diagram
- Section 2.2 Graphical Methods for Describing Quantitative Data
 - Dot plots
 - Stem-and-leaf displays
 - Histograms
 - Class intervals
- Section 2.4 Numerical Measures of Central Tendency
 - Mean
 - Median
 - Skewness
 - o Detecting skewness by comparing the mean and median
 - Mode
- Section 2.5 Numerical Measures of Variability
 - Range
 - Standard Deviation
 - Variance

Chapter 2b: Methods for Describing Sets of Data (Cont.)

Section 2.6 – Interpreting the Standard Deviation

- Chebyshev's Rule
- The Empirical Rule
- Section 2.7 Numerical Measures of Relative Standing
 - Percentile
 - Z-score
- Section 2.8 Methods for Detecting Outliers: Box Plots and z-Scores
 - Outliers
 - Boxplots
 - Lower quartile, middle quartile, upper quartile, interquartile range, inner fences, outer fences
- Section 2.9 Graphing Bivariate Relationships
 - Scatterplot
- Section 2.10 The Time Series Plot
 - Time Series Plot
- Section 2.11 Distorting the Truth with Descriptive Techniques
 - Graphical Distortions
 - Misleading Numerical Descriptive Statistics

Chapter 3 – Probability

Section 3.1 – Events, Sample Spaces, and Probability

- Experiment
- Sample Point
- Sample Space
- Combinations
- Section 3.2 Unions and Intersections

- Union
- Intersection
- Two-Way Table
- Section 3.3 Complementary Events
 - Complement
- Section 3.4 The Additive Rule and Mutually Exclusive Events
 - Additive Rule
 - Mutually Exclusive
- Section 3.5 Conditional Probability
 - Conditional probability
- Section 3.6 The Multiplicative Rule and Independent Events
 - Multiplicative Rule
 - Independent Events, Dependent Events
- Section 3.7 Random Sampling
 - Random number generators
 - Random number table

Exam 1

Chapter 4a: Random Variables and Probability Distributions

Section 4.1 – Two Types of Random Variables

- Discrete
 - Continuous
- Section 4.2 Probability Distributions for Discrete Random Variables
 - Discrete Probability Distribution
 - o Mean
 - \circ Variance
 - o Standard deviation
- Section 4.3 Binomial Distribution
 - Characteristics of Binomial Experiment
 - o *n* identical trials
 - o only two possible outcomes on each trial (success and failure)
 - the probability of success remains the same from trial to trial (p)
 - o trials are independent
 - binomial random variable *x* is the number of successes in *n* trials
 - binomial formula
 - o mean
 - o variance
 - $\circ \quad \text{standard deviation} \quad$
- Section 4.4 Other Discrete Distributions: Poisson
 - Characteristics of Poisson Random Variable
 - Count the number of times a certain event occurs during a given unit of time
 - \circ $\;$ Probability that an event occurs is a given unit of time $\;$
 - \circ $\;$ The number of events that occur in one unit of time are independent
 - Mean is lambda

Chapter 4b: Random Variables and Probability Distributions (cont.)

- Section 4.5 Probability Distributions for Continuous Random Variables
 - Probability Density Function
- Section 4.6 Normal Distribution
 - Standard Normal Distribution
 - Steps for finding normal probability
 - Sketch normal distribution, indicate mean, and shade the area corresponding to the probability you want
 - Convert boundaries to z-scores
 - Use Table, or Excel to find area corresponding probability wanted
- Section 4.7 Descriptive Methods for Assessing Normality
 - Determining whether the data are approx. normal
 - o Construct either histogram or stem and leaf
 - o Check Empirical Rule
 - Check (IQR/s) is approx equal 1.3
 - Construct a normal probability plot (points fall approximately on straight line)
- Section 4.9 Other Continuous Distributions: Uniform and Exponential
 - Uniform Probability Distribution
 - Exponential Distribution
- Section 4.10 Sampling Distributions
- Section 4.11 Sampling Distribution of a Sample Mean and the Central Limit Theorem
 - Mean of sampling distribution of sample mean
 - Standard deviation of sampling distribution of sample mean
 - Central Limit Theorem
- Chapter 5: Inferences Based on a Single Sample

Section 5.1 – Identifying and Estimating the Target Parameter

- Point estimate
- Confidence interval
- Section 5.2 Confidence Interval for a Population Mean: Normal z statistic
 - Confidence level
 - Conditions Required for a Large Sample Confidence interval for μ
 - Random sample from target population
 - o Sample size is large
 - Interpretation of a Confidence Interval for a Population Mean
- Section 5.3 Confidence interval for a population Mean: Student's t-Statistic
 - T-statistic (degrees of freedom)
 - Conditions Required for a Valid Small-Sample Confidence
 - Random sample from target population
 - Population has a relative frequency distribution that is approximately normal
- Section 5.4 Large Sample Confidence Interval for a Population Proportion
 - Sampling Distribution of proportion
 - o Mean
 - Standard deviation
 - Large samples
 - Large Sample Confidence Interval for proportion
 - o Random sample

o Large sample

Adjusted Confidence Interval for a Population Proportion

Section 5.5 – Determining the Sample Size

- Estimating the Population Mean
- Estimating the Population Proportion

Section 5.6 – SKIP

Exam 2

Chapter 6a: Inferences Based on a Single Sample

Section 6.1 – The Elements of a Test of Hypothesis

- Null hypothesis
- Alternative hypothesis
- Test statistic
- Type I Error
- Rejection Region
- Type II Error
- Level of significance
- Section 6.2 Formulating Hypotheses and Setting Up the Rejection Region
 - One tailed statistical test
 - Two tailed statistical test
- Section 6.3 Test of Hypothesis about a Population Mean: Normal z Statistic
 - Large Sample Test of Hypothesis about μ
 - Conclusions about Hypothesis Test
- Section 6.4 Observed Significance Levels: p-values
 - Steps for Calculating the p-value for a Test of Hypothesis
 - o Determine test statistic
 - One tail versus two tail
- Section 6.5 Test of Hypothesis about a Population Mean: Student's t-Statistic
 - Conditions Required for a Valid Small Sample Hypothesis Test for $\boldsymbol{\mu}$
 - o Random sample
 - Population from which the sample is selected has a distribution that is approximately normal

Chapter 6b: Inferences Based on a Single Sample (cont.)

Section 6.6 – Large-Sample Test of Hypothesis about a Population Proportion

- Conditions Required for a Valid Large-Sample Hypothesis Test for p
 - o Random sample
 - Sample size *n* is large
- Section 6.7 SKIP

Section 6.8 – Test of Hypothesis about a Population Variance

- Conditions Required for a Valid Hypothesis Test for s²
 - Random sample from target population
 - Population from which the sample is selected has a distribution that is approximately normal

Chapter 10: Simple Linear Regression

Section 10.1 – Probabilistic Models

- General Form of Probabilistic Model
- Straight line model
- Regression analysis
- Steps to Developing a Model
 - \circ Hypothesis the deterministic component of the model that relates the mean
 - \circ Use the sample data to estimate unknown parameters in the model
 - Specify the probability distribution of the random error term and estimate the standard deviation of this distribution
 - Evaluate usefulness of the model
 - \circ ~ Use model for prediction, estimation, and other purposes
- Section 10.2 Fitting the Model: The Least Squares Approach
 - Scatterplot
 - Errors of prediction
 - Least squares regression line (least squares)
 - Interpretation of slope and y-intercept
- Section 10.3 Model Assumptions
 - Mean of probability distribution of $\varepsilon = 0$
 - Variance of population distribution of $\boldsymbol{\epsilon}$ is constant for all values of \boldsymbol{x}
 - Probability distribution of ε is normal
 - The values of ε are independent

Section 10.4 – Assessing the Utility of the Model: Making Inferences about the slope

- Sampling distribution of slope
- Test for Slope
- Confidence interval for Slope
- Section 10.5 The Coefficients of Correlation and Determination
 - Coefficient of correlation
 - Coefficient of determination
- Section 10.6 Using the Model for Estimation and Prediction
 - Sampling Errors for the Estimator of the Mean of y and the Predictor of an individual new value of y
 - Confidence interval for Mean Value of y
- Section 10.7 A Complete Example

Exam 3 Final Exam