

**CARTHAGE COLLEGE**  
**MATH 3050—THEORY OF STATISTICS**

Spring Semester—Feb 1—May 17, 2017

Allen J. Klingenberg, Ph. D

Associate Professor of Mathematics

Office Phone: 262.551.5804

**Cell Phone: 262.308.4502**

**Email: [aklingenberg@carthage.edu](mailto:aklingenberg@carthage.edu)**

**Email: [akling2003@yahoo.com](mailto:akling2003@yahoo.com)**

**Office Hours: MWF 7:15-7:55 and MWF**  
**9:15-10:15 AM or by Appointment in Straz 176**  
 Room Straz 255

### Course Description

Mathematics 3050—Theory Statistics is a survey of statistical methods from the perspective of how these methods are implemented in real life situations using both excel and the college/textbook provided statistical software package. This course is divided into Three Units. Unit I includes: data collection and analysis involving continuous and discrete distributions, sampling theory, confidence intervals and estimation theory, and hypothesis testing of both parametric and non-parametric data. Unit II covers Joint Distributions/Order statistics, Covariance, Bivariate Normal distribution, Linear Combinations, Linear Regression Analysis and Correlation, Multiple Linear Regression Models, Multiple Regression Models and hypothesis testing and confidence intervals in Multiple Regression Models and ANOVA (one and multiple factorial designs). Unit III covers Design of Experiments involving completely randomized one factor and multi-factor designs, including random effect models, randomized complete block design, factorial design, blocking and confounding, and fractional replications. It also covers Time Series Models and Forecasting, Linear time Series Models, Moving Average and Auto-regressive Models, Exponential Smoothing, Estimation, Data Analysis, Index Numbers, and Forecasting with Time Series Models, Forecasting Errors and Confidence Intervals, ARIMA, and application of time series statistics to significant real-world data. **Students will be assessed on their demonstration of knowledge and application of these statistical concepts and their ability to apply this understanding in real life contexts.**

### Required Text Books

Statistical Techniques in Business and Economics (15<sup>th</sup> Edition), Lind, Marchal, & Wathen, McGraw-Hill Irwin, 2012 Obviously most Mathematics and Business majors have TI 83s or better which are more than adequate.

### Course Goals

By the end of the course, students will be able to demonstrate the following:

1. Use technical writing and apply descriptive and inferential statistical applications in a 10-20 page research project paper written in APA style with five chapters and testing two or more hypotheses using the five step hypothesis testing process.  
Assessment: Presentation of a 10 minute summary report using technology summarizing the five chapter paper and submission of the paper which will be assessed using an eight point rubric based on a five point Likert Scale with five items related to the content and three items related to the written presentation.
2. Use of Excel or Mathematica Statistic package in data analysis of data sets.  
Assessment: The cumulative final examination will include questions and real life situations which require use of these statistical programs.

3. Use of probability theory in solving real life and academic mathematical problems involving the normal probability distribution, binomial distribution, Poisson distribution, and hyper geometric distribution.

Assessment: The cumulative final examination will involve real life and mathematical problems which require the application of these probability topics in solving the problems and or questions.

4. Application of statistical inference techniques in hypotheses testing involving population and multi population samples using both z and t tests.

Assessment: The cumulative final examination will include real life problems which require the use of these techniques while applying the five step hypothesis testing process to solve these problems.

5. Use of either the one-way or two-way analysis of variance tests to solve real life problems presented involving two or more samples of data.

Assessment: The cumulative final examination will involve problems which require the student to demonstrate the application and interpretation of using ANOVA tests and their data outputs.

6. Using Correlation and Regression Analysis programs to solve real life and mathematical data sets.

Assessment: The cumulative final examination will include real life problems requiring the student to apply and interpret Correlation and Regression Analysis results from provided data sets.

7. Selection and application of appropriate non-parametric statistical analysis tests to provided data sets.

Assessment: The cumulative final examination will include real life problems and data sets which require the selection of an appropriate non-parametric test to analysis the data presented.

8. Applying time series forecasting, linear time series model and applying various indexing models to data sets to solve problems and questions in a real life situation.

Assessment: The cumulative final examination will include problems and data sets which require the student to select the appropriate analysis strategy and apply it to the data presented.

### Course Requirements

Attendance: Attendance is expected. Students should e-mail the instructor before missing a class. Students are responsible for all material presented, and all assigned material must be handed in as scheduled for full credit unless the student is officially on College Business/Activities (Athletics, Drama Production, etc). Work from the missed classes will have to be made up. **Unexcused absences will impact the final grade with three unexcused absences reducing the final letter grade by one-half of a letter grade and six unexcused absences resulting in a one full letter grade reduction.** It is the student's responsibility to contact the instructor on any matters of attendance, to request an excused absence.

Reading and Problem Assignments: There will be one or more reading assignments each week along with assigned exercise problems to be completed and kept in a three ring binder, your Statistics Portfolio. **Students are expected to read the assignments prior to class and complete the required problems or written assignment prior to class meetings. It is expected that the student will be ready to discuss and demonstrate the material. Students are expected to apply critical thinking principles to the course readings, writing assignments and problems assigned.** In addition to the assignments, there will be supplemental homework handouts and assignments that must be completed.

**Writing Assignments: There will be a writing assignment due most weeks. Students are to apply critical thinking in all problems, worksheets, and written analysis assignments.** Note: All assignments are due as scheduled and any late assignments will be reduced by a full grade point unless approval is given prior to class.

**General Information:** Your success in this class depends upon attending and participating in all classes. This is a 4-credit course and will require a significant amount of homework and out of class project work. Assistance is available both during office hours and by the college's math tutors. Feel free to stop by, e-mail or telephone me to discuss any concerns or questions you might have. I expect students to come with questions about homework or projects during office hours or the tutoring sessions, and not wait until the next class meeting. You are encouraged to form study groups to discuss homework and project assignments together, as well as study for exams and quizzes. Quizzes and in-class portions of exams will be non-collaborative and closed book/notes.

**Grading: Your final grade will be based on completion of the following Course assignments:**

- Homework: Weekly assignments to be done in pencil or by computer and corrected with a red ink pen and kept organized in your Three Ring Portfolio.
- Three Exams. These exams of approximately one hour will cover material presented in weekly assignments, class discussions, and lectures to that point in the course.
- Final Exam per College Schedule during the week of May.15, 2017
- Specific writing projects on application of the statistical concepts covered in the daily assignments to published statistical displays and or sets of data. These analysis projects are to be kept in your portfolio.
- Development of a "research project applying statistical inference techniques" of at least 8 pages in length.
- Demonstration of the skill of identifying statistical abuse in data presentations and analysis.
- Demonstration of hypotheses testing in regression models and using time series linear models.
- Attendance and class participation

The percentage or points to be received for each assignment are listed below.

### COURSE GRADING PERCENTAGE ALLOCATION:

Class Participation—weekly assignments	5%
Three exams	30%
Final Exam	20%
Written Research Project	15%
Presentation of Research Project	5 %
Written Assignments including	
• Five one page statistical abuse examples	25%
• Two to three page analysis of a research study	
• Case analysis	

**Tutoring is available in the Math Lab (DSC) Sunday through Thursday, 6:00 PM to 10:00 PM.**

Grade	Grading System
A	95-100
A-	90-95
B+	88-89
B	85-87
B-	80-84
C+	78-79
C	75-77
C-	71-74
D+	68-70
D	65-67
D-	60-64
F	Below a 60

### COLLEGE POLICIES AND PROCEDURES

**Incomplete Policy: In rare circumstances a student may need to request an incomplete in this class. Incomplete grades are granted because of extraordinary circumstances. It is the student's responsibility to initiate this process. Failure to initiate the Carthage College "incomplete policy" as published in the Student Handbook, can result in a grade of "F." See the student handbook for further details.**

College Policies and Procedures: Students are to review the Student Handbook for all policies and procedures.

Disclaimer: Instructors often use student papers as examples. If you do not wish to have your paper(s) used as an example, or would wish to have your name removed before using your work, please let your instructor know.

***Note: Course content and syllabus problems/project schedule may vary from this outline to meet the needs of this particular group of students. The instructor will explain the rationale for any variance as it occurs.***

## Unit I

### Week One

#### Objectives:

- Overview of course and requirements
- Collection of Information
- Review of Descriptive Statistics
  - Measures of Central Tendency-Mean, Median, Mode, Midrange
  - Measures of Dispersion-Range, Variance, Standard Deviation
- Data Collection and use of Excel, SPSS and Minitab
- The Art of Statistical Deception

**Assignments Due for week 1:** *Read chapters one and two in the text. For each chapter, do problems assigned and worksheets provided. For the week's writing project provide an example of statistical abuse written in third person using the following outline Title and Source of article, chart, graph, etc.; summary of item chosen; identify the statistical abuse(s); and analysis of abuse. (One page)*

### Week Two

#### Objectives:

- Graphic Presentation of Data Strategies
- Graphs, Pareto Diagrams, Dot Plots, Stem-And-Leaf
- Frequency Distribution & Histograms
- Review of Inferential Statistics

**Assignments Due for week 2:** *Read chapters three and four and do assigned problems and worksheets provided. Find your second example of statistical abuse and write a one-page analysis.*

### Week Three

#### Objectives:

- Continued review of Inferential Statistics
- Statistical Inferences
- Nature of Estimation
- Estimation of Mean, ( $\sigma$  Known)

- Hypothesis Testing—Null and Alternative Hypothesis
- Hypothesis Testing—Probability Value Approach versus Classical Approach
- Independent and Dependent Samples
- Inferences Concerning Mean Difference Using Two Independent Samples
- Inferences Concerning Mean Difference Using Two Dependent Samples
- Inferences Concerning Proportions
- Inferences Concerning Ratio of Variances

**Assignments Due for week 3:** *Read chapters ten and eleven and do problems and worksheets provided. Test one on chapters 1-4.*

#### **Week Four**

##### **Objectives:**

- Exam One
- Nonparametric Statistics
- Chi-square Applications

**Assignments Due for week 4:** *Read chapter 17 and complete problems and worksheets provided. Prepare your third statistical abuse Analysis and research the literature for a research study that uses a Chi-square application and do a one page written analysis.*

#### **Week Five**

##### **Objectives:**

- Sign Test
- Wilcoxon Rank Sum Test
- Wilcoxon Signed-Rank Test
- Kruskal-Willis Test
- Rank Order Correlation

**Assignments due for week 5:** *Read Chapter 18 and do the assigned problems for each nonparametric test and worksheets provided. Prepare your fourth statistical abuse one-page analysis. Exam 2 is scheduled for Next week.*

## **Unit II**

#### **Week Six**

##### **Objectives:**

- Exam 2
- Distribution of two Random Variables
- Covariance
- Bivariate Normal Distribution
- Linear Combinations

**Assignment Due for week 6:** *Read Chapter 3 in Business Statistics and complete problems and worksheets provided*

## Week Seven

### Objectives:

- Linear Regression
- Properties of Estimators
- Hypothesis Testing and Confidence Intervals
- Predictions
- Adequacy of Linear Regression Model
- Transformations
- Correlation

**Assignment Due for week 7:** *Study and read Chapter 13 and complete the problems and worksheets provided. Complete your fifth statistical abuse paper.*

## Spring Break

## Week Eight

### Objectives:

- Multiple Regression Model
- Least Square Estimate of Parameters
- Hypothesis Tests and Confidence Intervals
- Prediction
- Select Topic for Mini Research Study.

**Assignments due for week 8:** Study and read Chapter 14 and do problems and worksheets provided. Submit a one page outline of your mini research project you are planning to complete.

## Week Nine

### Objectives:

- Multiple Regression
- Checking Model Adequacy
- Model Building
- Multicollinearity
- ANOVA (one and multi-factor)

Assignments due for week 9: ***Read and study Chapter 12 and 14 do the problems and worksheets provided. Also complete a flow chart or Gantt chart describing how you will complete your mini research project.***

## Week Ten

### Objectives:

- Design of Experiments with ANOVA
- Completely Randomized One Factor Experiments
- Randomized Complete Block Design
- Designing experiments with Several factors
- Test 3

**Assignments due for week 10:** *Read and study research design handout. Find two or three articles, which involve hypotheses testing related to your mini research project. Write a one- page analysis of one of these articles.*

## Unit III

### Week Eleven

#### Objectives:

- Time Series Forecasting
- Linear Time Series Models
- Moving Average, Autoregressive and ARIMA Models
- Components of time series
- Calculate moving average and linear trend equations
- Calculate a trend equation for nonlinear trend
- Applying trend equations to forecast future time periods and adjusted forecasts

**Assignment due for week 11:** Read chapter 16 and complete problems and worksheets provided. Find a research article where Time Series was used and write a one-page summary. Turn in a one-page status report on the progress you are making with your research project.

### Week Twelve

#### Objectives:

- Time Series Continued
- Estimation, data analysis and forecasting with time series
- Forecasting errors
- Confidence Intervals
- Exponential Smoothing
- Decomposition

**Assignments due for week 12:** *Study and read Chapter 16 in the text and do problems and the worksheet print outs provided. Students must sign up for their 10-15 minute presentations on their research project on Wed. and Friday of this week.*

### Week Thirteen

#### Objectives:

- Describe the term *index* and key terminology
- Differences between weighted and an unweighted index
- Construct and Interpret a Laspeyres, Paache, Fisher Ideal and value index  
Calculate and interpret a set of seasonal indexes
- Deseasonalize data using seasonal indexes.
- Review for Final Exam
- Student Project Presentations

**Assignment for week 14:** Read and study handout on time series and forecasting models and complete instructor handouts on this topic. Complete Review Test. Review for final Exam.

### Week Fourteen

**Review and Complete Final Exam per College Schedule**



# Have a Great Summer Break!

<b>Dates</b>	<b>Readings</b>	<b>Written Assignments</b>	<b>Presentations</b>	<b>Activities</b>
<b>Week 1</b>	Chapters 1 and 2	Study Guide: chapters 1 and 2 worksheets		
<b>Week 2</b>	Chapters 3 and 4	Study Guide: chapters 3 and 4 Worksheets		Abuse article one du
<b>Week 3</b>	Chapters 5 and 6	Study Guide: chapters 5 and 6 Worksheets		
<b>Week 4</b>	Chapters 7 and 8	Study Guide: chapters 7 and 8 Worksheets		Midterm (over chapt
<b>Week5</b>	Chapter 9	Study Guide: chapter 9 Worksheet		Abuse article two du

