Applied Statistics for Management and Economics

Course Number:
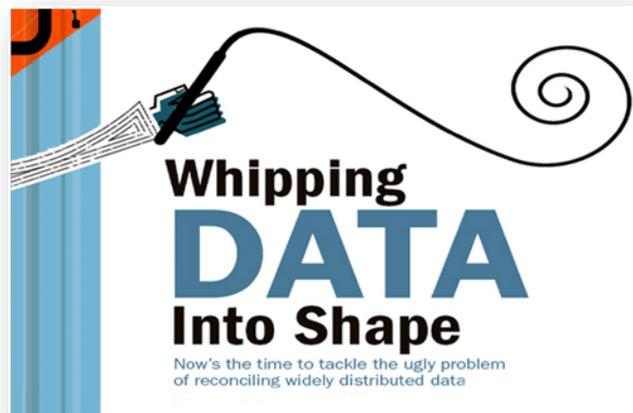BUS 2340; ECN 2340
 4 Credits
Course Time:
MWF 1:35 p.m. – 2:20 p.m. (Section 1)
Office Hours: MW 3:00 p.m.—5:30 p.m. and by appointment.

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Course Approach

"It's easy to lie with statistics, but it's hard to tell the truth without them."
Andrejs Dunkels

The analysis of data and information is a noble and important pursuit. This is a research course that asks you to analyze and report on data to reduce uncertainty in decision-making. The course also offers an opportunity for you to create a piece of "Signature Work" (Association of American Colleges and Universities 2016) as a semester project.

Whipping **DATA** Into Shape
Now's the time to tackle the ugly problem of reconciling widely distributed data

The purpose of this course is to learn statistical concepts and processes involved in using creating and analyzing data using personal computers and web applications. This process will take two separate and parallel methods.

- The lecture/discussion portion of the class is designed to increase your knowledge of data science, statistical methods, data visualization, data handling, and the theoretical and research base that surrounds these concepts and technologies. The lecture/discussion is designed to stimulate thought about data, data visualization, and statistical assertions using spatial and non-spatial databases. We will use these techniques to explore and explain ideas in our world.

- The research portion of the course is designed to help you learn and integrate basic statistical knowledge and skills, handle and analyze data, apply elements of visualization design and enhance your computer skills to produce statistical statements and visualizations. Students will be expected to develop knowledge and expertise in data selection, compilation, display, design, graphic skills, and desktop mapping production techniques. Students will have the opportunity to comment on each other's work. Students are expected to attend all class and lab sessions.
  - The most important challenge for undergraduate education in business and social science is to integrate a culture of research into the curriculum. As the pace of discovery continues to accelerate, teaching approaches that present a static pool of information are increasingly limited. In contrast, students who learn the logic of experimental design and data analysis are better prepared to assimilate new information and are more likely to be active participants in the future.
  –adapted from PKAL F21 Statement, 2002.

- This class is not about "learning how to use SPSS and Excel." Rather it is about learning the concepts behind analyzing data. There are other types of software on the market—using the same statistical concepts, but with different commands and algorithms. When you complete this course, you should be able to think about statistical concepts and apply them to a variety of software packages. Ideally you will walk away from the class with an ability to:
    - "To summarize huge quantities of data. To make better decisions. To answer important social questions. To recognize patterns that can refine how we do everything from selling diapers to catching "criminals. To evaluate the effectiveness of policies, programs, drugs, medical procedures, and other innovations. And to spot the scoundrels who use these very same powerful tools for nefarious ends." Charles Wheelan

Statistics is the science of learning from data and using statistical information to reduce (but not eliminate) uncertainty in decision-making. It rare that you will have a data set without errors and without uncertainty. Part of statistics is dealing with that uncertainty. Statistical analysis and data visualization is an essential element of Business analytics as well as a variety of other disciplines (Environmental Science, History, Political Science, Geography, Economics, Biology, and many more). Although there are thousands of statistical questions we can look at, we will focus on the four of the biggest questions:

- **Which is bigger (or different) and how do you know?**
- **Are these things related and how do you know?**
- **Is what you observed what you expected and how do you know?**
- **How good is your estimate and how do you know?**

If the projects in this course coincide with your own research and course work, it is possible to make some of the assignments complement your other academic work. Consult the instructor for approval if your project that falls outside the written course requirements.

Learning Outcomes from this Course

1. Students will apply sampling techniques through the extraction of data subset from a large database for analysis.
    - Without data, there can be no applied statistics. Therefore, students should be able to obtain data.
2. Students will determine descriptive measures of central tendency and dispersion for data sets and explain what they mean.
    - Computing and understanding these numerical descriptive statistics is a necessary foundation for any more advanced statistical work. For some simply problems, descriptive statistics is all that people use.
3. Students will use data visualization techniques to explain their findings.
    - Data visualization is becoming its own discipline beyond traditional graphical descriptive statistics and this class will focus on those traditional tools since, like numerical descriptive statistics, they are a necessary foundation for advanced statistics and, sometimes, are all that has needed to address a problem.

4. Students will demonstrate mastery of the hardware and software required to complete the course.
    - There is nothing wrong with using calculators, tables, and formulas for statistical work but it is nearly impossible to do so with large datasets and modern applied statistics requires competency with at least one computer-based tool. In this class Microsoft Excel® will be the primary tool used.
5. Students will explain the concepts of estimation and confidence intervals and use them to determine whether the sample size of their data sets is adequate to measure a statistical outcome.
    - This directly covers the big question "How good is your estimate and how do you know?" We rarely know any quantity with absolute certainty so we need to understand how statistical estimation works.
6. Students will demonstrate understanding of the concept of probability by interpreting p-values in the context of a statistical test of significance.
    - While p-values are relevant for all statistical tests, we will start with single-sample tests to address the question "Is what you observed what you expected and how do you know?"
7. Students will set up statistical questions and execute statistical tests for differences, similarities, correlations, and the general linear model and explain what they mean (parametric and non-parametric).
    - These are the statistical tools used to address "Which is bigger and how do you know?" and "Are these things related and how do you know?"
8. Students will determine whether their data set requires a parametric or non-parametric statistical test.
    - Now we are back to …. data. Obtaining data (Objective 1) is the beginning, but you also need to know what to do with data after you get it and different types of data require different types of analysis.

Course Material

Required Material:
- Salkind, N. J. 2017. Statistics for People Who (Think They) Hate Statistics. 6th Edition.
- A Windows® version of Excel® (2010 or higher). Although you can use other versions of Excel to complete the coursework, there are differences between versions which may make the work more difficult for you and will require you to go through more complex steps to solve your problems. A version of Excel is available for free on (nearly) all public computers on campus. You may also get a one-year license for office 365 though the Library computer center. See https://www.carthage.edu/live/news/4252-get-ms-office-365-for-free and contact Carol Sabbar for the license.
- A copy of SPSS (Statistical Package for the Social Sciences. SPSS is advanced statistical analysis software that is now available to all Carthage students and faculty via a download under the Technology and Support tab. Click on the Software & Resources heading on the Hedberg Library website. The software can be downloaded after entering your Carthage credentials. After downloading, you must take your computer to the Library Information Desk to have the license key entered into your device to activate the software. Faculty may email help@carthage.edu for the key. The software is also available on select computers around campus. Please see the Software & Resources page for more information. We will use this software near mid semester. You may find it useful early in the semester so get it early.

- A copy of Tableau software. This is available for free for students. You need to register and download a copy from: http://www.tableau.com/academic/students
- If you do not own a computer or your computer lacks the capability of performing the required operations, all of the work in this course can be completed on the computers in the library, and computing labs. If your computer malfunctions unexpectedly, this is how you will complete the homework on time.
- On occasion additional books and readings may be assigned and left on reserve or on e-Learning.

Recommended (Optional) Material:

Occasionally students have found these items useful. They are not necessary for success in the course, but they have proven valuable to some students.
- "After market" manuals that give additional "tips" on using software. Local bookstores will stock after-market manuals for most of the other software we will use in this course.
- Online videos and tutorials
- A thumb/jump/usb external storage cartridge or drive

Evaluation and Assignments

- **Grades**: Course grades are based on the following assignment/exam values in the table below. Incomplete grades are given on rare occasions based on illness or uncontrollable factors, and need instructor approval. Grading standards are based on the grading system listed in the *Carthage College Catalog* (https://www.carthage.edu/academics/catalog/). Students are expected to conform and adhere to the College's code of academic conduct that can be found at: http://www.carthage.edu/campus-life/code/academic-concerns/. Your instructor has also posted a complementary guideline on e-learning.

  This course will use something called "specifications grading." This system clarifies expectations for students and puts them in more control of their semester grade. Semester grades are linked more directly to learning outcomes and many assignments are graded fail/pass/superior pass (i.e. whether or not it meets the specifications). Passing the assignment demonstrates sufficient mastery of the associated learning objective. With clarified expectations, students can aim for whatever grade they want. Superior passes are for work that goes beyond the specifications of the assignment. It shows initiative or adds substantive academic value to the assignment product beyond what is asked for. We will talk more about this when assignments are given.

  Specifications grading has a set of specifications (i.e. "specs") for each assignment. Any work that meets all of the specs passes. Falling short on any aspect of the specs fails. This is much more like the real world:
  - You either make the sale or not.
  - You show up for the interview or you do not get the job.
  - Either your computer program works as required or it does not.
  - … You get the idea.

  On the other hand, the real world sometimes allows second chances. You might need to make four calls on a client before landing the sale. However, that is not free. The extra time and effort costs you something. This is why I allow late work to come in. It is the

same as when I have a contract that pays me $10,000 for having the entire project complete by July 1. If I cannot get it done by July 15, the company still wants the work, but they may only pay me $7500.

To earn a "D":
- You must earn at least a 70% average on the chapter quizzes. Earning a 70% across all of the quizzes demonstrates a baseline conceptual understanding of material spanning all eight learning outcomes.
- You must complete the portfolio assignment.

To earn a "C":
- You must complete all of the "D" work and pass 70% of the lab assignments and case studies. Each lab assignment will be graded fail/pass/superior pass. Students who do not pass a lab the first time may resubmit it in a revised and acceptable form. The number of assignments may vary, but assume that there may be about six or seven lab/case study assignments. That means a "C" will require the successful completion of four or five assignments.
- Completing these lab assignments will demonstrate an adequate understanding of the associated learning objectives.

To earn a "B":
- You must complete all of the "C" work and successfully complete pass 80% of the lab and case study assignments (in and out of class). Each lab assignment will be graded fail/pass/superior pass. Students who do not pass a lab the first time may resubmit it in a revised and acceptable form. The number of assignments may vary, but assume that there may be about six or seven lab/case study assignments. That means a "B" will require the successful completion of five or six assignments. You must also successfully complete the Semester Project, but you have chosen to do a project I give you rather than setting up the project and data yourself (more about this when we discuss the final project). Semester projects will require you to complete original research using secondary data. Successfully completing a project will demonstrate both your ability on all eight learning objectives and your ability to integrate them. I will allow students to group up for semester projects. Of course, that means that students are aiming for an "A" of a "B" in the course.
- Completing these lab assignments and the final project will demonstrate a very good understanding of the learning objectives.

To earn an "A":
- You must complete all of the "B" work. You must complete 90% of the lab and case study assignments with passing grades. You must complete a semester project where you acquire data and set up the research question with only minor consultation with the instructor (few if any of you have the expertise to do this completely on your own. Semester projects will require you to complete original research using secondary data. Successfully completing a project will demonstrate both your ability on all eight learning objectives and your ability to integrate them. I will allow students to group up for semester projects. Of course, that means that students are aiming for an "A" or a "B" in the course.
- Completing all this work to specifications constitutes a superior understanding of the learning outcomes for the course.

Note: The quiz standard is the same for all four grades. While I encourage you to give quizzes your "best" effort, there is little marginal learning in pushing your mastery beyond the 70% standard. Once you put forth whatever effort you need to meet that standard, additional effort should be focused on other aspects of the course where we will focus more closely on the concepts as they will appear in your professional lives.

If all specifications for an A are completed, the percentage value breakdown is as follows:

Graded Categories	Percentage
Labs, Case Problems (in-class and out of class) and In-class Quizzes	50%
MindTap Quizzes and Assignments	20%
Semester Paper and Large Format Poster	25%
Digital Professional Portfolio	5%
Class Participation	5%
Total	**100%**

- **Lab and Case Problems**—The lab and case problems ask you to integrate the lectures, assigned reading, and other material. These problems provide the practical experience to enhance your theoretical understanding of statistics. All lab and case assignments are due at the specific time assigned or at the beginning of the class or lab period assigned. Late assignments will be docked according to the late work policy. Graded exercises are generally returned to students as soon as possible following their due date. Late exercises will be graded at the convenience of the instructor (warning—sometimes this can be a long time). It is in your best interest to begin assignments early (this comes as advice from others who have taken this course from me).
- **Quizzes**—This prepares you for the more serious work in the course that includes actual data acquisition, data description, data analysis, and interpretation. The material is fairly rote and should be completed before the class period when we apply it.
- **Semester Paper and Large Format Poster Project**—You will build a statistical research problem and outcome as your semester project. You will write this up as a paper. You will also construct a large-format poster describing your project in words, maps, graphs, and photographs that form a "visual essay." The poster will be submitted digitally, but should be a format that could be printed at a professional printing outlet. You will present the poster at the end of the semester. A formal assignment sheet will be distributed later.
- **Digital Professional Portfolio**—During the semester you should be compiling your work into a digital portfolio. This is not designed to be an onerous task. The portfolio will not require you to make any new material; rather this is a "gathering reflective exercise." This is to be a document that you use as a resource later on for employment interviews. It will allow you to demonstrate to potential employers and internship sites what you know and what you can do. It should not simply be a collection of "stuff" but a description of what you have learned and the skills you have acquired because of the work you have completed. The best advice in preparing your portfolio is to place a separate "clean copy" of your each of your assignments in a master document. Each assignment should also include a short description of the project and the skills you gained in the process. There should also be a

cover sheet explaining your skills and abilities. A formal assignment sheet will be distributed later.

- **Late work, Assignments and Penalties**—all assignments are due on the day stated in the assignment—no exceptions so do not ask (it is part of specifications grading). If no specific time of day is specified—it may be turned in at any time during the 24 hour time period for that day. Late work is accepted by the instructor. You may turn in late work up until **May 7, 2017**. The penalty for late work is a 1% deduction from the grade earned per day late. With specifications grading—you still get a "pass" but the lateness is noted. One late assignment is unlikely to affect your semester grade. Several of them probably will lower your grade up to a full grade over the semester.

  In-class work and quizzes cannot be made up—however the instructor will drop the lowest 10% of your in-class assignments and quizzes. This usually allows you to have an illness, physician's appointment, required external event, family emergency, or internship interview without penalty.

  Any piece of work without a name on it will have 5% deducted from the grade.

Notes on Technology

Our class is fortunate to have access to quality hardware, software, and internet applications. These applications allow the course to be taught very differently than it was just a few years ago. The following are notes that need to be made explicit:

- I do not expect that you begin this class with significant computer skills. You were not born speaking R or C nor do I expect you are writing Java and Python scripts. I do expect that when you will finish the class, you will have a variety of skills that you can apply and refine in the future. I expect you will confront the technology and work with it. **I expect you to ask me questions.** No question is a silly question including: "How do I turn this on?"
- It is o.k. and a COMMON EXPERIENCE to feel overwhelmed early on in the semester in this course. **I know that**. I know that you need a lot of technical support early on. I will provide that for you. Please keep in touch via e-mail, phone, text, or just drop by my office!
- I do have some expectations that align with department expectations about skills with Microsoft Excel. These align with a course on Lynda.com (free access to Carthage students) called Excel 2013 Essential Training with Dennis Taylor. You are expected to be able to perform the types of Excel operations in this course. If you have yet to learn these, you can take the course for free through Carthage's Lynda.com license.
- Students' major error in this course is worrying if they are asking questions that are too simple. If it is a question about the material—it does not matter how simple it is, it only matters that you have a question and that it is answered.
- Previous students said that they only got brave enough to ask questions about in the 10th or 12th week of class. They said they should have been asking questions early in the semester and things would have gone much smoother at the end.
- Previous students have told me that I should emphasize how important an early start on the projects is. Although I have always told students to start their projects right away, this has seldom happened. Later in the semester, I would appreciate your telling me how I can make this more apparent to students at the beginning of the semester.
- The College has invested in a Course Management System (CMS) called e-learning. E-learning helps us create course site that better serves our needs. Your instructor has used web pages in courses for several years, but e-learning offers some unique features that will

explore in the coming weeks. You will log onto the course through the College portal. To reduce errors and better respond to you this semester, all my sections will use the same site for class.

- We will also be using the publisher's website for our background work. MindTap will allow you to read the text, do practice homework, and take online quizzes.
- The exercises and problems assigned in this course assume that you are using a Windows 7 or later interface along with updated web browsers. There is no prohibition in using Linux, UNIX, or Apple interfaces—however since I do not work with them regularly, my ability to provide tech support may be limited.
- If something isn't working on the Internet, the problem is often solved by using another browser. I recommend having at least 3 of the following browsers on your computer (Firefox, Chrome, Opera, Internet Explorer, Safari).
- Although technology solves many problems, it can also create them. Your instructor **expects** problems to occur. It is your responsibility to ask questions and seek solutions. No question is too basic or too simple. It is not out of bounds to call the instructor at his home before 9:00 p.m.
- Think about using Skype and screen share for computer problems.

Other Information

- Your excellent attendance is assumed. The absent student has the same responsibilities as those who were present. It is assumed that if you are away, there is an adult reason and that you will let me know. An email is appreciated.
- Your instructor assumes that not every word that drops from his mouth is crystal-clear—questions in class are expected and welcome. Visits to his office to clarify materials and assignments are encouraged.
- The instructor reserves the right to alter the course schedule and syllabus. These updates will appear as announcements in e-learning or general e-mails to the class.
- The College expects faculty to maintain active scholarly lives. As part of my scholarly work, I am often invited to travel to schools and conferences for consulting and speaking engagements. I will adjust your workload when I am away so my absence is not an issue. I am usually available for consultation via email, Skype or Google Hangout.
- The instructor reserves the right correct clerical errors on the assignments, syllabus, or the e-learning system.
- I calculate grades at the end of the semester using excel. When students ask me for intermediate grades, I tell them: Any intermediate grade I give you will be suspect because so much depends on the last couple weeks of work in the class. You can figure this out from posted grades in e-leaning. I also do not use the "auto-calculation" feature in e-leaning. It often produces a false impression that a student is failing or doing well when the opposite is true.
- The instructor assumes you are using your Carthage e-mail as your primary academic e-mail address. If this is not the case, it is your responsibility that messages sent through e-learning to your Carthage e-mail is properly forwarded to your primary academic e-mail account. In other words: not using your Carthage e-mail account is not an excuse for a missed assignment or update.
- The results of data analysis often counters my long held beliefs and sometimes makes me uncomfortable. I expect the same will happen for you.
- If you use a non-Carthage e-mail to contact me you run the risk of being caught in the College's spam filter—this is your problem and not mine. It may be two or three weeks

before I check the spam filter—students have had messages languish there for weeks or be auto-deleted.

- Although it is fine to text and email the instructor with questions, some questions are too complex to answer effectively by text or email. If my response to you is "call me," you should contact me on my cell phone. If you receive a text response of "160" it means the question is too complex for texting and you should call me directly.
- All wireless and electronic devices must be shut down or in silent mode during the class period unless prior arrangements have been made with the instructor. We will use your wireless devices in class—so bring them with you.
- No portion of class may be electronically recorded by any device without prior approval from the instructor.
- Please address any special needs or accommodations with the instructor at the beginning of the semester. You will also need to have documentation on file with Diane Schowalter in the Advising Center (x5802). This information will be kept confidential.

Class Schedule, Readings and Labs

Class Schedule, Readings and Labs

Date	Topic	Reading and Activity
Week 1 **2/1/17** **Wednesday**	Introduction to the Course Building the Ideas about Statistics, Data, Visualization and Decision Making in Uncertainty The Big 4 questions • Which is bigger? • Are these things related? • Is what you observed what you expected? • How good is your estimate?	Read the Syllabus
Friday	**Descriptive Statistics** **The middle** **Variation and dispersion** **Decision Making in Uncertainty**	Introduction Salkind Chapter 1 The Death of Data Journalism: http://www.nytimes.com/2015/06/20/upshot/death-to-data-journalism.html?rref=upshot&_r=1&abt=0002&abg=0
Week 2 **2/6/17** **Monday**	**More Descriptive Statistics** **Data Summaries** **Visualizations and Effective Description of Data**	Salkind Chapter 2 & 3

Date	Topic	Reading and Activity
Wednesday	More Descriptive Statistics Data Summaries Visualizations and Effective Description of Data	Salkind Chapter 4 Think Like a Statistician http://flowingdata.com/2010/03/04/think-like-a-statistician-without-the-math/ Ideas for visualizing data http://flowingdata.com Case Study: Reading the output for central tendency and dispersion Writing up the data Writing about dispersion and variability Assignment: Downloading Data for Descriptive Statistics Assignment http://grorac.com/StatisticsResources/IntroToCI.html
Friday	**More Descriptive Statistics Data Summaries Visualizations and Effective Description of Data**	
Week 3 2/13/17	Hypothesis Testing Null Hypothesis Alternative Hypothesis Samples and Populations	Salkind Chapter 7
Wednesday	**Probability and Significance Z-scores Normal Curves Hypothesis Testing**	**Salkind Chapter 8**
Friday	**Probability and Significance** **Z-scores Normal Curves Hypothesis Testing**	**Salkind Chapter 9**

Date	Topic	Reading and Activity
Week 4 2/20/17 Monday	Estimation and Confidence Intervals I	http://grorac.com/StatisticsResources/IntroToCI.html
Wednesday	Estimation and Confidence Intervals II	Salkind Chapter 10
Friday	Finding Differences between 2 things (t-tests, z-tests, rank sum W, Mann-Whitney)	Salkind Chapter 11
Week 5 2/27/17 Monday	Finding Differences between 2 things (t-tests, z-tests, rank sum W, Mann-Whitney)	Salkind Chapter 12
Wednesday	Finding Differences between 3 or more things (ANOVA and Kruskal-Wallis)	Chapter 13
Friday	Finding Differences between 3 or more things (ANOVA and Kruskal-Wallis)	Chapter 14
Week 6 3/6/17 Monday	Correlations and Causality I (Pearson's and Spearman's) Understanding correlation outputs Writing about correlations	Correlation and Causality Salkind Chapter 5 (http://www.ted.com/talks/michael_specter_the_danger_of_science_denial) Spurious Correlations http://tylervigen.com/
Wednesday	Regression Analysis I (Single and multiple)	Salkind Chapter 15
Friday	Regression Analysis II (Single and multiple)	Salkind Chapter 16
Week 7 3/13/17 Monday	Regression Analysis III (Single and multiple)	
Wednesday	It's Not Normal and why you should think of non-parametric techniques	Chi-Square Kolmogorov-Smirnov And other non-parametric Salkind—Chapter 17

Date	Topic	Reading and Activity
Friday	There is more to know	Salkind—Chapter 18
Spring Break Week 3/20/17	**Spring Break**	**Spring Break**
Week 8 3/27/17 **Monday**	Bringing the Tools Together for Cases Applying the Tools	Case Study
Wednesday	Applying the Tools	Case Study
Friday	Applying the Tools	Case Study
Week 9 4/3/17 **Monday**	Applying the Tools	Case Study
Wednesday	Applying the Tools	Case Study
Friday	Applying the Tools	Case Study
Week 10 4/10/17 **Monday**	Applying the Tools	Case Study
Wednesday	Applying the Tools	Case Study
Friday	**Good Friday—No Class**	**Good Friday—No Class**
Week 11 4/17/17 **Monday**	**Easter Monday—No Class**	**Easter Monday—No Class**
Wednesday		
Friday	Applying the Tools	Case Study
Week 12 4/24/17 **Monday**	Applying the Tools	Case Study
Wednesday	Applying the Tools	Case Study
Friday	Applying the Tools	Case Study

Date	Topic	Reading and Activity
Week 13 5/1/17 **Monday**	Applying the Tools	Case Study
Wednesday	Applying the Tools	Case Study
Friday	Applying the Tools	Case Study
	All Late work and resubmits are Due May 7	
Week 14 5/8/17 **Monday**	Applying the Tools	Case Study
Wednesday	Applying the Tools	Case Study
Friday	Applying the Tools	Case Study
Final Exam Monday 5/15/17 1:00 pm to 3:00 pm	**Final Research Poster Presentations**	

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