

Introduction to Statistics

MAT 1360

Winter 2012

Statistics is...“the most important science in the world, for upon it depends the practical application of every other science and of every art. The one science essential to all political and social administration, all education, all organization based on experience, for it only gives the results of our experience.”

– Florence Nightingale

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University and Departmental Mission: Seattle Pacific University seeks to be a premier Christian university fully committed to engaging the culture and changing the world by graduating people of competence and character, becoming people of wisdom, and modeling grace-filled community. The mathematics department at Seattle Pacific University seeks to provide excellent instruction to enable our students to be competent in the mathematics required for their chosen fields, and to share our expertise with the community through service and leadership. Hence, common goals for students in mathematics courses include 1) becoming competent in the topics covered in the course, 2) demonstrating skills and attitudes which contribute to professional, ethical behavior, 3) the ability to communicate mathematically, in both written and verbal form, and 4) learning to appreciate the beauty and utility of mathematics.

Course Goals: The aim of this course is to develop critical reasoning skills necessary to understand our quantitative world. The focus of the course is the process of learning how to ask appropriate questions, how to collect data effectively, how to summarize, interpret, and draw conclusions from that data, and how to understand the limitations of statistical inference. Students should gain an understanding of fundamental statistical concepts, including randomization, estimation, confidence, testing, and significance.

Learning Objectives: By the end of the course, you should be able to:

- describe and critique various methods of data collection and experimental design;
- construct, analyze, and interpret verbal, numerical, and graphical summaries of data;
- perform basic probability computations and articulate the role that probability plays in statistical inference;
- apply the central limit theorem and explain the role that it plays in statistics;
- construct, analyze, and interpret confidence intervals for proportions and means;
- conduct and interpret tests of hypotheses in a wide variety of contexts;
- use linear regression and the correlation coefficient to analyze the relationship between two variables and to predict the value of the dependent variable;
- approach and solve practical problems and analyze genuine data using statistical reasoning;
- use a computer and Minitab to analyze data and to solve statistical problems; and
- communicate the results of statistical analyses through graphical and verbal means.

Course Prerequisites: Mathematics Placement Level B. You are expected to be able to perform mathematically at the level of basic high school algebra. Here are some examples of important prerequisite knowledge:

1. You should be able to calculate 3% of 700.
2. You should be able to decide which is greater: $6/81$ or 0.5% .
3. $78/91$ is equal to what percent?
4. How do we describe all numbers greater than or equal to $1/7$? You should be able to use both interval and inequality notation.
5. Solve for x if $y = 42$ in the equation $y = -\frac{5}{4}x + 2$, and find the slope and y-intercept of this line.
6. Solve for n in the equation: $1.5 = \sqrt{\frac{(.98)(.02)}{n}}$ and for σ or μ in the equation: $\frac{x - \mu}{\sigma} = -.46$.
7. Basic familiarity with descriptive statistics, including numerical summaries such as means and medians and graphical summaries such as histograms, bar graphs, and boxplots.
8. Please see me immediately if you have questions about these concepts! These kinds of skills are critical for success in this course!

Course Overview

What is Statistics? *Statistics* is the science of collecting and analyzing data for the purpose of drawing conclusions and making decisions. There are three main topics of statistics: *data collection*, *descriptive statistics*, and *inferential statistics*. One of the primary goals of statistics is *inferential statistics*, which can be defined as drawing conclusions and/or making decisions concerning a large population based only on data about a *sample* from the population. When trying to draw conclusions about an entire population based only on a sample, it is essential that the sample be *representative* of the population. Poorly collected data can lead to misleading (if not completely meaningless) conclusions. As a result, proper *data collection* is a fundamental concern. Once data has been collected, it needs to be organized, summarized, and effectively presented in both graphical and numerical forms in order to facilitate understanding of the data. These methods are known collectively as *descriptive statistics*. We will study all three areas of statistics in some detail in this course.

Statistics involves the analysis of genuine data. Statistics is very applicable in everyday life and in most fields of academic endeavor. Throughout this course, you will analyze genuine data from a wide variety of applications. Some of these data sets involve information that you will collect about yourselves and your peers; others will come from sources such as almanacs, journals, magazines, newspapers, and books. The contexts for these data will span a wide variety of subject matter; most should be of interest to a general audience.

Statistics is not number-crunching. Contrary to its popular perception, statistics involves much more than numerical computations. This is not a traditional mathematics course – the main emphasis of the course will be on understanding statistical concepts and on interpreting and communicating the results of statistical analyses, *not* on mathematical computations. In other words, you will be expected to learn to construct and analyze numerical *arguments*. In contrast to most math courses, we will be using phrases such as "there is strong evidence that ..." and "the data suggest that ..." rather than "the exact answer is ..." and "it is therefore proven that ...". To alleviate the computational burden, we will often use the computer program Minitab or other software to perform calculations and produce visual displays. Technology can also help present ideas in a visual, interactive environment, allowing you to more easily understand the concepts and their properties.

Statistics is a way of thinking. Learning a new way of thinking requires serious effort on the part of the student. Statistics cannot be learned simply by listening to lectures or reading a book; you must actively engage with the material. This course will ask you to think critically and to defend your arguments. You will be asked to make guesses, collect data, draw conclusions, write summaries, discuss findings, explore alternatives, investigate scenarios, etc. You must have an open and active mind in order to complete these tasks; in other words, **you must accept responsibility for your own learning**. To be successful in this course, for every hour spent in the classroom, a typical student should expect to need to spend approximately two hours outside of class reading, studying, and working on homework. As your instructor, I view my role as providing you with contexts and opportunities which facilitate the learning process and lead you on the path toward understanding statistics. Please call on me to help you with this learning in whatever ways I can.

Textbook and Course Materials:

Textbook: *Intro Stats*, 3rd Edition/Technology Update, by Richard De Veaux, Paul Velleman, and David Bock.

Statistical Software: We will make very substantial use of the statistical software package Minitab (version 16) to perform calculations, create graphics for analyzing data, and conduct computer simulations of random phenomena. Minitab is available for your use in all public computer labs on campus, including labs in OMH and the library. Use of Minitab will be required for most homework assignments throughout the quarter and will also be required on exams. If you wish to use Minitab on your own computer, you can purchase a license at <http://www.onthehub.com/minitab/>. You can get a temporary license for Minitab 16 which will expire at the end of the academic year for \$29.99, or you can buy a permanent license for \$99.99. In addition to Minitab, we will make use of a variety of Java applets and other software tools freely available over the internet.

Classroom Response System: We will make use of the TurningPoint Response System to collect data from students in the class, conduct polls, collect results from in-class activities and exercises, and administer online quizzes in class. This system will use smart phones and/or the computers in the classroom and will provide instant results in class. You will be required to purchase a three-month license for the system for \$10.

Office Hours: My regular office hours will be 8:30-9:20 MWF in OMH 209. You are strongly encouraged to drop by my office to ask questions, discuss problems, and just to get to know me better. If you are unable to meet with me during my scheduled office hours, I am available at other times by appointment. I also maintain an "open door" policy at my office – any time that my door is open you are welcome to drop in to talk to me, even if it is not during my scheduled office hours. I will typically be around for much of the afternoon on MWF, and I will often be available on Thursdays as well. I will not be on campus at all on Tuesdays, so please plan accordingly.

Tutoring: Free tutoring for this course is available through the Mathematics Study Center, which is located between OMH 139 and OMH 143. Additional details and a schedule will be provided during the first week of class.

Grading and Course Expectations

Attendance and Class Participation: Unless you have an acceptable excuse *and* make special arrangements with me *before* class begins, you are expected to attend class every day, arrive on time, and remain until class is over. During class, you are expected to actively participate in all activities and to work *only* on statistics – texting, doing work for other classes, surfing the internet, checking e-mail, or chatting about your weekend social activities will be considered equivalent to being absent for the day’s class. Attendance and class participation will count as a part of your course grade.

If you will be absent from class, you must contact me *before* class begins (in person or by phone or e-mail) to make arrangements for the day. Failure to do so will reduce your attendance/class participation grade and will result in a grade of zero for any exam or quiz given in class that day.

NOTE: Things such as oversleeping or lack of preparation are NOT acceptable excuses. Acceptable excuses include illness, a death in your family, and official SPU athletics trips. If requested, *you are responsible for providing me with documentation of your excuse.*

Homework: The only way to truly learn statistics and mathematics is to work as many exercises as possible. You cannot learn to do mathematics by watching someone else do mathematics or listening to someone else talk about mathematics – you must actually do it yourself and practice, practice, practice. Furthermore, the material each class period builds on what came before, so it is essential to keep up with the work every day. As a result, there will be homework assignments given virtually every class period which will often be collected at the next class meeting. All assignments will be posted on the course website; however, you are also responsible for all announcements made in class (whether or not they are posted on the web). Most assignments require the use of Minitab, so you will need to plan to have access to a computer with Minitab when doing your homework.

General homework policies:

- Homework must be turned in by 11:00 (the start of the class period) on the day it is due; **late homework will not be accepted for any reason (and homework is considered late at 11:01)**. If you have an excused absence and make arrangements with me *before* class starts, the homework score will be dropped.
- You are strongly encouraged to come to my office to ask me questions about the homework.
- You are also encouraged to work with other students on the homework, but unless otherwise indicated for a particular assignment, you must individually write up and turn in your own solutions.
- *You are required to list on your paper all other individuals that you worked with or that gave you assistance with the homework* – failure to do so will be considered cheating (turning in someone else’s work as your own).
- Homework must be neat and easily readable or you will receive NO credit.
- You must show all of your work—a correct answer with no justification will also be worth NO credit.
- When explanations are called for on the homework, you should respond in complete sentences with proper grammar, spelling, and punctuation.
- Not all homework exercises will be graded, but solutions for exercises which are not graded will be posted on the course webpage.
- Your lowest homework score will be dropped from your final grade.

Exams: There will be two midterm exams and a cumulative final exam. All exams will be open book. Use of computer software will be required as a part of the exams. Tentative dates for the exams are listed in the schedule at the end of this syllabus, *but those dates are subject to change.*

Quizzes: There will be frequent quizzes, many of which may be administered online outside of regular class time. The online quizzes will often cover reading assignments which have not yet been discussed in class. Quiz scores will count toward your homework/quiz grade.

Course Grades: Homework assignments and quizzes will be worth a combined total of 25% of your course grade. Each midterm exam will be worth 20% of the course grade and the final exam will count for 25%. Attendance and class participation will determine the remaining 10% of the grade. Course grades will be based on the following scale:

	93-100%	A	90-92%	A-	
87-89%	B+	83-86%	B	80-82%	B-
77-79%	C+	73-76%	C	70-72%	C-
67-69%	D+	60-66%	D	Below 60%	E

A grade of I (incomplete) is only given for on-academic reasons such as a severe illness that prevents you from completing the course. You must have a passing grade on the material that you have completed in order to receive an incomplete.

Academic Integrity: The current edition of the SPU Undergraduate Catalog describes the University's commitment to academic integrity, which is breached by academic dishonesty of various kinds. Examples of academic dishonesty include copying another's work on an exam, bringing concealed answers to an exam, turning in another person's work as your own, committing plagiarism, assisting another student in cheating, or lying to the instructor. The *minimum* penalty for academic dishonesty in any form will be a zero for the assignment or exam in question; in severe cases, academic dishonesty will result in a failing grade for the course. In addition, all students have an obligation to make efforts to prevent other students from cheating and to report incidents of cheating or plagiarism.

Additional Notes:

E-mail: All SPU students have an SPU e-mail address. I will occasionally make use of these SPU e-mail addresses to send information to all members of the class, so you should check your e-mail regularly. If you do not use your SPU e-mail account, there is a utility available through Banner to set up your SPU e-mail account to forward messages to some other e-mail address. I strongly recommend doing this so that you do not miss any important messages.

Please note that while it can be a great tool for quick communication, *e-mail is rarely a good substitute for face-to-face conversations and is very poorly suited for answering mathematical questions.* When you come to my office to ask me questions, I engage you in a discussion about the problem, ask questions about what ideas you have for approaching the problem, explore various possible approaches (and what goes wrong with some of them), etc. In the process, I can usually find out precisely where your difficulties lie and help you to learn how to get past them. Such a conversation is impossible by e-mail. Furthermore, typing and e-mailing mathematical symbols is very time consuming, and the resulting equations in the e-mail often come out garbled (or even completely missing).

Students with Disabilities: In accordance with Section 504 of the Rehabilitation Act of 1973 and the Americans with Disabilities Act of 1990, students with specific disabilities that qualify for academic accommodations need to contact Disabled Student Services in the Center for Learning. Disabled Student Services in turn will send a Disability Verification Letter to me indicating what accommodations have been approved. *Once you have done this, you should also make an appointment to meet with me as early as possible in the quarter to discuss the details of how we will implement the accommodations in this course.*

Inclement Weather: SPU maintains an Emergency Closure Hotline (206-281-2800). In the event of inclement weather or an emergency that might close the university, please call the Hotline for the most up-to-date closure information or check the SPU website. Both will be updated before 6:00 a.m.

Emergency Procedure: Please note the emergency procedures posted in the classroom and note all emergency exits. In case of an emergency (fire, earthquake, hazardous material spillage, bomb threat, etc.), the class will evacuate the building and gather in the Alumni Center parking lot outside Otto Miller Hall. Please try to stay together so that we can check that everyone has made it safely out of the building.

"... statistical techniques are tools of thought, and not substitutes for thought."

– Abraham Kaplan

"It is easy to lie with statistics, but it is easier to lie without them."

– Frederick Mosteller

"The conception of chance enters into the very first steps of scientific activity in virtue of the fact that no observation is absolutely correct. I think chance is a more fundamental conception than causality; for whether in a concrete case, a cause-effect relation holds or not can only be judged by applying the laws of chance to the observation."

– Max Born

"While nothing is more uncertain than the duration of a single life, nothing is more certain than the average duration of a thousand lives."

– Elizur Wright

"In God we trust, all others bring data."

– William Edwards Deming

(Attribution to Deming is ironically not supported by data)

Tentative Class Schedule

The table below provides a tentative listing of topics that we will cover from the textbook *Intro Stats*. There will also be other supplementary topics covered in class which are not listed here. A more detailed schedule of homework assignments, due dates, and material covered will be posted on the course webpage. The exact dates on which we cover material will almost certainly vary somewhat from the list below. Also, topics may be added or removed at any time.

Date	Topics Covered
1/4	Chapter 1: Stats Starts Here; Chapter 2: Data
1/6	Chapter 3: Displaying & Describing Categorical Data
1/9	Introduction to Statistical Inference
1/11	Chapter 4: Displaying & Summarizing Quantitative Data
1/13	Chapter 5: Understanding & Comparing Distributions
1/16	No class – Martin Luther King Jr. Birthday
1/18	Chapter 6: The Standard Deviation as a Ruler & the Normal Model
1/20	Chapter 11: Understanding Randomness
1/23	Chapter 12: Sample Surveys
1/25	Chapter 13: Experiments and Observational Studies
1/27	Exam #1
1/30	Chapter 14: From Randomness to Probability
2/1	Chapter 15: Probability Rules!
2/3	Chapter 18: Sampling Distribution Models
2/6	More on Sampling Distributions
2/8	Chapter 19: Confidence Intervals for Proportions
2/10	More on Confidence Intervals
2/13	Chapter 20: Testing Hypotheses about Proportions
2/15	More on Hypothesis Testing
2/17	Chapter 21: More About Tests
2/20	No class – Presidents' Day
2/22	Chapter 22: Comparing Two Proportions
2/24	Chapter 23: Inferences About Means
2/27	Chapter 24: Comparing Means
2/29	Review and more on Inference
3/2	Exam #2
3/5	Chapter 7: Scatterplots, Association, and Correlation
3/7	Chapter 8: Linear Regression
3/9	Chapter 9: Regression Wisdom
3/12	Review
3/14	Final exam, 10:30-12:30

Modifications to the course requirements can be made at any time. It is *your* responsibility to know all course requirements as described here or announced in class.