Course Module
Stephen F. Austin State University
MTH 220-030 Introduction to Statistics - Honors
Math 210 10:00-10:50AM MWF

Instructor
Robert (Bob) Henderson
Department: Mathematics & Statistics; Office: Math 344
E-mail: hendersork@sfasu.edu
Phone: Office: (936) 468-1540; Cell: (936) 615-7796
BA in Math & History – Trinity University, San Antonio, TX (1978)
MS in Mathematical Statistics – Southern Methodist University, Dallas, TX (1980)
PhD in Mathematical Statistics – Southern Methodist University, Dallas, TX (1982)
MBA – University of Delaware, Newark, DE (1988)
Worked in industry for 27 years: ~6 years with DuPont as internal consultant for a variety of businesses and staff groups; then ~21 years in the semiconductor business, most with a supplier of a key enabling material for semiconductor production; and later with Samsung working primarily with engineers in process control efforts. The entire 27 years included many training delivery, as well as course development activities related to basic statistics, experimental design, and process control systems. Fall 2009 was first semester working at SFA.

Teaching Hours – 8-8:50AM & 10-11:50AM MWF; 2:3:15PM TR, 3:30-5PM W
Office Hours – 9-10AM MWF, 2-3:30PM MW, 10-AM-12PM TR, and by appointment

Course Goals
Statistics is a subject that has a tendency to evoke emotions for students. These emotions can run from fear and loathing to apathy, and there are the occasional students who are excited about the subject. However, the latter is generally not the norm. One of the goals of the course will be to change any primary negative emotion associated with statistics to one of at least respect for the subject, if not excitement, and, of course to nurture even greater enthusiasm for anyone already interested in the subject.

There is substantial evidence that statistics can be challenging for many students. Traditionally, a significant barrier to having students embrace learning about statistics has been the relatively large number of formulas involved. These are not going to go away, and there are many of them in the course material; however, it is NOT going to be a goal of this course for the student to memorize formulas. Students will have access to formulas for all work and exams, just as you would in any future employment.

My experience is that much of the challenge for many people with the subject of statistics is that the subject often requires us to think about things differently than we have before encountering this subject. Statistics is a subject that requires admission of ignorance which takes a certain level of humility, security, and self-esteem to do. Fortunately, it does not require an admission of complete and total ignorance, and certainly no one enrolled here at SFA would ever be so described. However, it does require admission of ignorance about a specific question or set of questions which are sufficiently important that effort to reduce our ignorance related to this question (or these questions) is deemed to be of some value.
In order to reduce the level of ignorance, often an experiment is run, an observational study is conducted, or a survey of some sort is initiated, all of which generate data related to the question(s) of interest. With the presence of data, there is always that lurking discipline of statistics, which is simply the art of extracting meaningful information from data.

Unfortunately, what you will find out in this course is that there are many ways to do this and that rarely, if ever, will one approach provide the exact answer(s) to the original question(s). This can make the study and use of statistics frustrating for some. However, if the process of collecting, analyzing, and interpreting the relevant data is done well, then knowledge will be improved and the level of ignorance will be reduced. If done poorly, then the level of ignorance may actually be increased. Consequently, a second goal of this course is to provide the student with the knowledge necessary to understand when a statistical endeavor has been done well, and how such studies, even the well executed ones, may be lacking.

This course is titled “Introduction to Statistics”, and this is what it is – an introduction. You will not leave this course as a world-class statistician. I have a PhD in statistics and over 27 years working with data and statistics in industry and do not consider myself a world-class statistician. However, the desire is for each of you to leave this class with respect for the discipline of statistics (and perhaps some with a level of excitement about the subject), as well as an understanding of its limitations. In addition, you will acquire the background to be able to work with professional statisticians as a subject matter expert, including being able to more easily converse with a professional statistician, and ask pertinent questions about the approaches and assumptions being made in their efforts to help you address your question(s) of interest. Another take-away from this course would ideally be a healthy perspective on what can and cannot be learned from a specific set of data and or a statistical report attempting to summarize that data.

Text
None

Computer Access/Skills
It will be helpful to have access to a spreadsheet program such as Excel, as well as some skills in using the features of such software. Many plots, analyses, and calculations can be done relatively simply via Excel, and almost every workplace will furnish a copy of this software (or something similar) to their employees. Hence, gaining some experience in using it will likely be helpful beyond this course. In addition, it will likely be helpful to download the university version of the JMP software (available on My SFA) for work later in the semester.

Prerequisites
Students will be expected to have some basic math skills (enough to obtain an acceptable score on the Math element in the SAT or ACT), and some facility with college-level algebra will be helpful. Any familiarity with calculus would be an additional plus, but it certainly is not required.

Course Rationale
Data surrounds us from all media: radio, TV computer, etc. Data can be collected, summarized, and interpreted as statistics. Decisions are often based on data and statistical summarizations of data. To help us better understand and live in our world, it is helpful to know something about statistics.
Across the domains of human knowledge, information is becoming more quantitative. A basic understanding of statistics is necessary to make some sense out of all the data. The use of statistics has increased in the workplace. Market research, analysis of business trends, manufacturing, and quality assurance all make use of statistical analysis. Statistics are also used both correctly and incorrectly in matters of political and public debate to achieve desired results without deliberately falsifying the data.

The course is designed to introduce the statistical methodology that might be encountered in any of the above situations or others. It is hoped that with this knowledge, the student will have some appreciation for how to critically evaluate the actual information conveyed by some of the more standard types of statistical analyses.

**Course Overview**

Weeks 1-2: Introduction  
Weeks 2-4: Case 1A – Small Sample Proportion (Binomial Distribution)  
Weeks 4-6: Case 1B – Large Sample Proportion (Normal Distribution, Confidence Intervals)  
Weeks 6-8: Case 2A – Small Sample Population Mean (Descriptive Statistics, t Distribution)  
Weeks 8-10: Case 2B – Large Sample Population Mean (Central Limit Theorem)  
Weeks 10-12: Case 3A – Two Sample Means  
Weeks 12-14: Case 4A – Correlation & Regression  
Weeks 14-15: Case 5A – Two Sample Proportions

**Course Student Learning Objectives**  
The ideas it would be expected a MTH 220 student to successfully address at the time of course completion include:

1) Data from real-world processes exhibits variation. The strongest form of model for this variation is a distribution. As such, distributions, including those of frequent application are of importance in statistics.

2) Because the exact distribution of a population of values is rarely known, statistical science relies on sampling in order to investigate the distribution and its features.

3) We estimate the distribution of a population, or more often, specific features of populations (parameters) with appropriate and corresponding features from a sample (statistics).

4) Knowledge gained from a sample is imperfect. It is not possible to make definitive claims about populations from taking samples. It is, however, possible to provide (non-definitive) claims about populations with margins of error attached.

5) Non-definitive claims about populations can be sufficient for decision making.

6) Claims about populations must be made in recognition that the collected sample is one of many that were possible. As such, statistics vary from sample to sample and therefore have distributions themselves. The most important statistic whose distribution deserves study is the average or proportion (which is merely an average in disguise) of a sample.
7) Investigating the distribution of a statistic leads to the ability to create a margin of error to be provided along with any statistical estimate (confidence interval). This margin of error is intimately tied to two things: the amount of variation present and the size of sample taken.

8) Investigating the distribution of a statistic under an assumption about a parameter leads to a null distribution. The null distribution has information in it that allows an experimenter to assess how common it would be to observe the value of the statistic seen in the sample (p-value). The p-value facilitates a decision regarding the validity of the assumption.

9) Samples should be taken in a way that is representative of the population. Data from the sample should be summarized, described, graphed – generally - communicated in efficient, reliable ways.

10) Data can be of different types. As such, the way we describe and utilize data depends on this type. Descriptive statistic techniques and inferential statistics procedures are intimately tied to data types. (students will be exposed to continuous and categorical data, to univariate and bivariate data and to statistical methods for each type)

Departmental Course Syllabus Link:
http://www2.sfasu/math/courses/syllabi/MTH220Syllabus.pdf

About Assignments
In preparing assignments, please be sure to include your name at the top of each page. The problems should be in order with all work shown. Since odd numbered problem solutions are recorded in the back of the text, no credit will be given for the correct answer when no work is shown, and/or no information is supplied related to how answers were obtained. Since the grading will primarily be focused on the steps and/or approaches used to reach a final solution, neatness will count. If the steps cannot be followed, or it is unclear how a specific step is reached in a given problem solution, then points will be lost.

Of the problems assigned for homework, it is highly likely only 1 or 2 will be chosen at random to be evaluated for each homework result. There will be approximately bi-weekly homework assignments, and your best ~70-90% of scores will be used in the calculation of the homework grade.

There will be approximately 7 quizzes assigned throughout the course, and again, there will often be multiple problems assigned for each take-home quiz, but only 1 or 2 problems chosen at random to be graded for each specific quiz result. The best 5 or 6 of the quiz scores will be used in the calculation of the quiz grade.

There will be 4 projects for this course. At least two of these will be group projects; the other two can be individual or group projects. If a group project, then groups will be no larger than 4 students. Generally, the best 3 of the 4 project scores are used to calculate an overall project score.
Grading
Final grade will be determined based on the following proportions:

- Homework: 10%
- Take-Home Quizzes: 15%
- Projects: 45%
- Exams: Max of (Mid-Term, Wtd Avg of HW & Quizzes) 10%
- Final: 20%

Homework (off-line) and quizzes will be collected at the beginning of the session for which they are due. Students wishing to retain homework to study from are asked to make a copy of their homework on their own prior to turning it in. Homework will be checked and returned as quickly as possible. The final will be comprehensive.

Attendance
While certainly not mandatory, attendance is highly encouraged. Since homework and quizzes account for over half of the grade, and one or the other will be due at the beginning of many class sessions (and the policy is to not accept late homework or quizzes), it will serve the student to regularly attend the class. If you know you are going to have to miss a class, then either arrange to send your homework with a classmate, or bring it by my office prior to the class.

Academic Integrity
It is the responsibility of the student to abstain from cheating. Dishonesty of any kind with respect to examinations, written assignments [completed] in or out of class, alteration of records, or illegal possession of current examinations or keys to examinations shall be considered cheating. Courtesy and honesty require that any ideas or materials borrowed from another must be fully acknowledged. Offering the work of another as one’s own is plagiarism. The subject matter of ideas thus taken from another may range from a few sentences or paragraphs to entire articles copied from books, periodicals, or the writing of other students. The offering of materials assembled or collected by others in the form of projects or collections without acknowledgment is also considered plagiarism. Any student who fails to give credit for ideas or materials taken from another is guilty of plagiarism.

Definition of Academic Dishonesty

Academic dishonesty includes both cheating and plagiarism. Cheating includes but is not limited to (1) using or attempting to use unauthorized materials to aid in achieving a better grade on a component of a class; (2) the falsification or invention of any information, including citations, on an assigned exercise; and/or (3) helping or attempting to help another in an act of cheating or plagiarism. Plagiarism is presenting the words or ideas of another person as if they were your own. Examples of plagiarism are (1) submitting an assignment as if it were one’s own work when, in fact, it is at least partly the work of another; (2) submitting a work that has been purchased or otherwise obtained from an Internet source or another source; and (3) incorporating the words or ideas of an author into one’s paper without giving the author due credit. (from SFA on-line Student Handbook)
A full description of university procedures and penalties in response to cheating and plagiarism can be found in the on-line Student Handbook in the Academic Integrity section at http://www.sfasu.edu/policies/academic_integrity.asp.

All of the above is the official policy of the school; however, the ultimate defender of academic integrity is each individual student. In this class, it might be helpful to work in small groups on the problems. Sharing ideas and helping each other with approaches to understand and solve the problems is not considered cheating or plagiarism. Copying someone else’s homework results verbatim (or nearly so) is considered to be cheating (be warned that these situations are generally easy to identify, and both parties will be subject to the respective penalties). You are encouraged to discuss the problems with others outside the classroom, but you are all considered adults, and until you provide evidence to the contrary, will be relied upon to set appropriate boundaries in how you work with others through the duration of this class.

Withheld Grades
Ordinarily, at the discretion of the instructor of record and with the approval of the academic chair/director, a grade of WH will be assigned only if the student cannot complete the course work because of unavoidable circumstances. Students must complete the work within one calendar year from the end of the semester in which they receive a WH, or the grade automatically becomes an F. If students register for the same course in future terms, the WH will automatically become an F and will be counted as a repeated course for the purpose of computing the grade point average.

Students with Disabilities
In accordance with University policy, students with disabilities who need accommodations are expected to initiate a meeting with the professor immediately upon registering with Disability Services to discuss how accommodations included on the Special Accommodation Request form will be provided. Students with disabilities who may have special needs and have not requested support services should seek assistance through Disability Services. The Office of Disability Services (ODS) is located in the Human Services Building, room 325, and can be contacted by phone at 468-3004 / 468-1004 (TDD). Failure to request services in a timely manner may delay appropriate accommodations. For additional information, go to http://www.sfasu.edu/disabilityservices/.

Acceptable Student Behavior
Classroom behavior should not interfere with the instructor’s ability to conduct the class or the ability of other students to learn from the instructional program (see the Student Conduct Code, policy D-34.1). Unacceptable or disruptive behavior will not be tolerated. Students who disrupt the learning environment may be asked to leave class and may be subject to judicial, academic or other penalties. This prohibition applies to all instructional forums, including electronic, classroom, labs, discussion groups, field trips, etc. The instructor shall have full discretion over what behavior is appropriate/inappropriate in the classroom. Students who do not attend class regularly or who perform poorly on class projects/exams may be referred to the Early Alert Program. This program provides students with recommendations for resources or other assistance that is available to help SFA students succeed.
Course description: Probability, random variables, mean and variance, binomial distribution, normal distribution, statistical inference and linear regression.

Core Objectives (CO):
1. Critical Thinking [CO 1]: to include creative thinking, innovation, inquiry, and analysis, evaluation and synthesis of information
2. Communication Skills [CO 2]: to include effective development, interpretation and expression of ideas through written, oral and visual communication
3. Empirical and Quantitative Skills [CO 3]: to include the manipulation and analysis of numerical data or observable facts resulting in informed conclusions

Credit hours: 3

The following is an excerpt from SFA Policy 5.4:
The federal definition of a credit hour is an amount of work represented in intended learning outcomes and verified by evidence of student achievement that is an institutionally established equivalency that reasonably approximates:

1. Not less than one hour of classroom or direct faculty instruction and a minimum of two hours out-of-class student work each week for approximately fifteen weeks for one semester or trimester hour of credit, or 10 to 12 weeks for one quarter hour of credit, or the equivalent amount of work over a different amount of time, or;

2. At least an equivalent amount of work as outlined in item 1 above for other academic activities as established by the institution including laboratory work, internships, practica, studio work, and other academic work leading to the award of credit hours.

To this end, all students in courses offered by the Department of Mathematics and Statistics that wish to be successful should plan to spend a minimum of two hours outside of class for every credit hour associated with this course. Expected activities to be completed in the time outside of class include reviewing notes from previous class meetings, reading assigned course resources, completing all assigned exercises and projects, and performing periodic assessment preparation.

Course Prerequisites and Corequisites: See general course prerequisites.

General Education Core Curriculum: This course has been selected to be part of SFA’s core curriculum. The Texas Higher Education Coordinating Board has identified six objectives for all core courses: Critical Thinking Skills, Communication Skills, Empirical and Quantitative Skills, Teamwork, Personal Responsibility, and Social Responsibility. SFA is committed to the improvement of its general education core curriculum by regular assessment of student performance on these six objectives. Assessment of these objectives at SFA will be based on student work from all core curriculum courses. This student work will be collected in D2L, the assessment management system selected by SFA to collect student work for core assessment.

The chart below indicates the core objectives identified by SFA to be assessed in this course. The instructor of each section of the course will provide the assignment(s) that will be used to assess the objectives as well as the date(s) by which the assignments must be completed and uploaded in D2L.

<table>
<thead>
<tr>
<th>Core Objective</th>
<th>Definition</th>
<th>Course Assignment Title</th>
<th>Date Due in D2L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Critical Thinking Skills</td>
<td>To include creative thinking, innovation, inquiry, and analysis, evaluation and synthesis of information.</td>
<td>The instructor of each section will determine the assignment for this assessment.</td>
<td>Only assessed in fall of odd years. (See instructor for due date(s).)</td>
</tr>
</tbody>
</table>
Course outline:

- **Descriptive Statistics [CO 1, 2, 3]**
  - Graphical Display of Data
  - Measures of location
  - Measures of Dispersion
  - 10%

- **Probability [CO 1, 2, 3]**
  - Classical Probability
  - Probability Laws (Rules)
  - Counting Techniques
  - 20%

- **Probability Distributions [CO 1, 2, 3]**
  - Random Variables
  - Discrete Distributions
    - Binomial Distribution
    - Hypergeometric Distribution
  - Continuous Distributions
    - Uniform Distribution
    - Normal Distribution
  - 20%

- **Sampling Distributions [CO 1, 2, 3]**
  - Random Samples
  - Central Limit Theorem
  - 10%

- **Statistical Inference [CO 1, 2, 3]**
  - Estimation
    - Point Estimation
    - Interval Estimation
  - Hypothesis Testing
  - 30%

- **Linear Regression [CO 1, 2, 3]**
  - 5%

Explicit instruction in Critical Thinking, Communication and Empirical and Quantitative Reasoning is in addition to implicit instruction, modeling and practice that occur daily in the discussion of limits and continuity, derivatives and antiderivatives, applications of derivatives and definite integration. This explicit instruction includes explanation of solving mathematical problems by thinking critically, communicating logically ordered solutions with complete and correct notation, and applying empirical or quantitative skills as appropriate to the problem.

5%

**Academic Integrity**

Academic integrity is a responsibility of all university faculty and students. Faculty members promote academic integrity in multiple ways including instruction on the components of academic honesty, as well as abiding by university policy on penalties for cheating and plagiarism.

The penalty for a student found cheating on any part of an assignment, quiz, or exam in this class will range from a grade of zero on the work to a grade of F in the course, and may result in additional, more severe disciplinary measures. A student who allows another to copy his work and the student copying the work are both guilty of cheating. Do your own work. Do not show your completed work to others. Do not allow others to copy your work.

**Definition of Academic Dishonesty (SFA policy 4.1):**

Academic dishonesty includes both cheating and plagiarism. Cheating includes, but is not limited to:

- using or attempting to use unauthorized materials on any class assignment or exam;
- falsifying or inventing of any information, including citations, on an assignment;
- helping or attempting to help other student(s) in an act of cheating or plagiarism.

sfasu.edu/math
Plagiarism is presenting the words or ideas of another person as if they were one’s own. Examples of plagiarism include, but are not limited to:

- submitting an assignment as one’s own work when it is at least partly the work of another person;
- submitting a work that has been purchased or otherwise obtained from the Internet or another source;
- incorporating the words or ideas of an author into one’s paper or presentation without giving the author credit.

**Withheld Grades Semester Grades (SFA Policy 5.5)**

Ordinarily, at the discretion of the instructor of record and with the approval of the academic chair/director, a grade of WH will be assigned only if the student cannot complete the course work because of unavoidable circumstances. Students must complete the work within one calendar year from the end of the semester in which they receive a WH, or the grade automatically becomes an F. If students register for the same course in future terms the WH will automatically become an F and will be counted as a repeated course for the purpose of computing the grade point average. The circumstances precipitating the request must have occurred after the last day in which a student could withdraw from a course. Students requesting a WH must be passing the course with a minimum projected grade of C.

**Students with Disabilities**

To obtain disability related accommodations, alternate formats and/or auxiliary aids, students with disabilities must contact the Office of Disability Services (ODS), Human Services Building, and Room 325, 468-3004 / 468-1004 (TDD) as early as possible in the semester. Once verified, ODS will notify the course instructor and outline the accommodation and/or auxiliary aids to be provided. Failure to request services in a timely manner may delay your accommodations. For additional information, go to [http://www.sfasu.edu/disabilityservices](http://www.sfasu.edu/disabilityservices).

**Acceptable Student Behavior**

Classroom behavior should not interfere with the instructor’s ability to conduct the class or the ability of other students to learn from the instructional program (see the [Student Conduct Code, policy 10.4](http://www.sfasu.edu/math)). Unacceptable or disruptive behavior will not be tolerated. Students who disrupt the learning environment may be asked to leave class and may be subject to judicial, academic or other penalties. This prohibition applies to all instructional forums, including electronic, classroom, labs, discussion groups, field trips, etc. The instructor shall have full discretion over what behavior is appropriate/inappropriate in the classroom. Students who do not attend class regularly or who perform poorly on class projects/exams may be referred to the Early Alert Program. This program provides students with recommendations for resources or other assistance that is available to help SFA students succeed.

**Student Learning Outcomes (SLO):** At the end of MTH 220, a student who has studied and learned the material should be able to:

1. Exhibit an understanding of basic probability rules and concepts [CO:1,3]
2. Demonstrate an understanding of different probability models and ways they are used in statistical inference. [CO: 1, 2, 3]
3. Demonstrate an understanding of point estimation of population parameters. [PLO: 1,3]
4. Demonstrate an understanding of interval estimation about population parameters and inference that can be drawn from such techniques. [CO: 1,3]
5. Demonstrate an understanding of hypothesis testing concerning population parameters and inference that can be drawn from such techniques. [CO:1,3]

*There are no specific program learning outcomes for this major addressed in this course. It is a general education core curriculum course and/or a service course.*

*Date of document: 01/11/2019*