

American United of Technology
Faculty of Applied Sciences
STA 315 – Probability & Statistics
CRN 10120

Semester: Spring 2019

Credit Hours: 3 Credits (Two 75 minutes Lectures)

Course Instructor Information: Dr. Mouhamad Ibrahim

Office: Admin Bldg, 2nd Floor, Room AD 203

Email: mouhamad.ibrahim@aut.edu

Phone:

Office Hours: To be announced on Moodle

Lecture Timings: TR 10- 11:15 am

Classroom: AG113

Catalog Description of the course:

Basic statistical techniques emphasizing engineering and science applications. Topics covered include graphical and numerical data summary techniques, population models, probability theory, probability distributions, mathematical expectation, sampling distributions, estimation, hypothesis testing, simple regression, statistical quality control.

Prerequisite by course: MATH 102: Calculus II and co-Calculus III

(MAT 203)

Prerequisite by topic:

Functions and graphs; Trigonometric functions; Logarithmic and exponential functions; Derivatives; Techniques of integration.

Textbook:

Probability & Statistics for Engineers & Scientists, 9th Edition, R. E. Walpole, R. H. Myers, S. L. Myers, and K. Ye, Prentice Hall, 2011

You may have free online access to it from Moodle.

References: Textbook will be placed on Moodle in pdf version.

Course Learning Outcomes

Upon successful completion of this course, **students will be familiar with basic rules of probability** and will be able to use them in modeling uncertainty in obtaining and recording data. They **will be able to utilize graphical and numerical summaries** of data in understanding data generating processes. They **will understand the logic of statistical inference** and will be able to apply common inferential procedures.

Students will be exposed to the computational aspects of statistics through the **use of calculators**,

spreadsheet programs or special purpose data analysis packages.

Upon successful completion of the course, students should be able to

1. use set-theoretic notation to describe events and compute probabilities,
2. use basic combinatorial techniques to calculate probabilities,
3. compute and interpret conditional probability,
4. test for independence of events or of random variables,
5. find either the distribution function or the density (mass) function of a given random variable and compute its expectation and variance,
6. identify the types of random variables involved in a given problem and calculate relevant probabilities, compute probabilities, expectations, covariances, and correlations of jointly distributed random variables,
7. explain practical implications of expectation and variance and how they predict the shapes of distribution and density (mass) functions of a random variable,
8. find probability information of a random variable which is defined as a function of another or several other random variables,
9. represent given data graphically and compute descriptive statistics,
10. describe an appropriate statistical model for the given data and compute population parameters using appropriate estimators,
11. compute the bias of an estimator,
12. construct linear regression models,
13. estimate population parameters using the maximum likelihood estimator and confidence intervals.

Added-value outcome skills:

1. Plan data collection, turn data into information and achieve action.
2. Apply the statistical methods taught in real life situations.
3. Communicate statistical information in oral and written form.
4. Use computer and graphical techniques.
5. Plan, analyze and interpret the results of experiments.

Specific Learning Objectives

Probability

Students completing the course will be able to:

- Use basic counting techniques (multiplication rule, combinations, and permutations) to compute probability and odds.
- Use Minitab to run basic simulations of probabilistic scenarios.
- Compute conditional probabilities directly and using Bayes' theorem, and check for independence of events.
- Set up and work with discrete random variables. In particular, understand the Bernoulli, binomial, geometric and Poisson distributions.
- Work with continuous random variables. In particular, know the properties of uniform, normal and exponential distributions.
- Know what expectation and variance mean and be able to compute them.
- Understand the law of large numbers and the central limit theorem.
- Use available resources (the internet or books) to learn about and use other distributions as they arise.

Statistics

Students completing the course will be able to:

- Create and interpret scatter plots and histograms.
- Understand the difference between probability and likelihood functions, and find the maximum likelihood estimate for a model parameter.
- Find credible intervals for parameter estimates.
- Use null hypothesis significance testing (NHST) to test the significance of results, and understand and compute the p-value for these tests.
- Use specific significance tests including, z-test t-test (one and two sample), chi-squared test.
- Find confidence intervals for parameter estimates.
- Compute and interpret simple linear regression between two variables.
- Set up a least squares fit of data to a model.

Course Outline

Week(s)	Unit Contents	Unit Objective
1	Chapter1: Introduction to statistics and data analysis: An overview of statistical terminology.	<p>We familiarize the student with statistical terminology. We introduce the concepts of discrete and continuous data. Then, we introduce the techniques for summarizing data.</p> <p>Exploring Univariate Data</p> <ul style="list-style-type: none">• Types of data• Mean and Median• Standard Deviation and Variance• Range, IQR and Finding Outliers• Graphs and Describing Distributions
2-3	Chapter 2: Probability: Definition of a sample space, events, complements, intersection, exclusive events, union of events, Venn diagrams, probability, additive rules, multiplicative rules, conditional probability, Bayes' rule.	<p>The student will learn how to compute probability.</p> <ul style="list-style-type: none">• Counting Techniques, Combinations and Permutations• Sets and Venn Diagrams• Basic Probability Models• General Probability Rules

4	Chapter 3: Random Variable & Probability Distributions: The concept of a random variable, discrete, continuous & empirical distributions.	<p>Understand the concept of a random variable and their different types. Many applications are used in the illustration.</p> <p>Discrete Distributions:</p> <ul style="list-style-type: none"> • Random Variables • Binomial Distributions • Geometric Distributions <p>Continuous Distributions:</p> <ul style="list-style-type: none"> • Density Curves • The Normal Distribution • Standard Normal Calculations • Sampling Distribution of \bar{x} and \hat{p}
5-6	Chapter 4: Mathematical Expectation: Mean of a random variable, Variance and co-variance, Chebyshev's theorem.	Show how to compute the mean and variance of a random variable as well as the covariance/correlation among two variables.
7-8	Chapter 5: Discrete Probability Distributions: Hypergeometric distributions and their Discrete, Uniform, Binomial, Poisson & probability.	The student will learn when and how to model random variables using the discrete uniform, Binomial, Poisson or Hypergeometric Distribution & how to compute the chances of certain events from such distributions.
9-10	Chapter 6: Continuous Probability Distributions: Probability density function, Normal distribution & probability.	Familiarize students with distributions needed to make inferences and to model certain random variables.
11-12	Chapter 8: Sampling Distributions.	Show students how statistics computed vary from one sample to another and what are the features of such variations in terms of mean, variance, and distribution.

13	Chapter 9: Estimation Problems.	<p>Acquaint the student with concepts of estimation in statistics.</p> <p>Margins of Error and Estimates</p> <ul style="list-style-type: none"> • Confidence Interval for a Proportion • Confidence Interval for the Difference of Two Proportions • Confidence Interval for a Mean • Confidence Interval for the Difference of Two Means
14	Chapter 10: Hypothesis testing.	<p>Familiarize students with procedures that lead to the acceptance or rejection of statistical hypotheses.</p> <p>Tests of Significance</p> <ul style="list-style-type: none"> • Inference for the Mean of a Population • Sample Proportions • Inference for a Population Proportion • Comparing Two Means • Comparing Two Proportions • Goodness of Fit Test • Two-way Tables
15	Chapter 11: Simple Linear Regression and Correlation	<ul style="list-style-type: none"> • Confidence Intervals • Test for Slope of Regression Lines • Scatter Plots • Correlation • The Least Squares Regression Line • Residuals • Non-Linear Models • Relations in Categorical Data
15	Review	

Grading Policy:

Class Attendance & participation	5 %
Homework Quizzes	20 %
Test 1	20 %
Test 2	20 %
Final Exam	35 %

Lecture expectations: Class attendance and participation is essential to student success. Come to class prepared: Before attending a lecture, read thoroughly (from your book and class notes on Moodle) the material covered in the previous lecture and solve the related homework problems. During the lecture, we will discuss problems, work in groups sometimes, and analyze concepts. Ask questions, and participate in the discussion!

Students are required to have a calculator. A graphing calculator is not necessary. Use of laptop in class is helpful.

Students are required to have a notebook in class all the times.

Class Attendance:

Class attendance will be taken at the beginning of class. A student will receive an "AW" after 7 absences from class.

Students coming late will not be allowed extra time for class quiz which will be applied during the first 10 minutes of class.

Homework:

Weekly homework assignments will be posted on Moodle, and are due a week later. There will be a 10-min class quiz each week on a homework problem.

You are encouraged to work in groups on homework. However, you must be the sole author of all work turned in unless specified otherwise by the assignment. You must identify explicitly all individuals with whom you worked. You must also list explicitly any outside sources employed, including websites.

The best way to succeed in learning the class material is by fully working and understanding the assigned problems.

Homework Quizzes:

Weekly quizzes will be given in the first 10 minutes of the class section. These quizzes will be graded as if they were exam questions. The quiz questions are related to homework assignments. No notes will be allowed during quizzes. Missed quizzes cannot be made up. The lowest grade in the quizzes will be dropped when computing your final grade to accommodate emergencies.

Reading: You are expected to do the reading from the appropriate sections BEFORE coming to the class meeting in which the topic is scheduled.

Exercises: You are expected to work the assigned exercises after the corresponding material is presented in class, and BEFORE the next class meeting (lecture).

Computer Software:

To facilitate the understanding of concepts and methods in probability and statistics, we are going to incorporate the use of Minitab and Excel in this course. The instructor will provide help for Minitab only.

Use of Technology:

Calculator and Laptops– Students will be expected to use either a laptop computer or a basic graphing calculator for homework and classroom exercises. **You may use a calculator for each test, but you will be required to show all work for the tests** and if you rely on a sophisticated graphing calculator for solutions, you will get zero credit. You are here to learn calculus and the calculator may be used only as an aid.

Students will not be permitted to use computers on any unit test or the Final Exam.

Cellphones and other technology – Students will not be permitted to use cellphones or any other technology (including smart watches) on any unit tests or the Final Exam. Cellphones should be silenced and stored away during class.

Extra help:

- You are encouraged to get extra help whenever you need it. The instructor has posted office hours and you are welcome to go for any course-related questions and help.
- You are also welcome to send questions to your instructor via e-mail at any time.

Policy on Cheating: Cheating is a very serious offense and will not be tolerated. Copying home works, or any other form of illegal help, will be dealt according to university academic conduct policy.

Course Policies (based on AUT policies and procedures as per Catalogue)

- a. **Punctuality:** You must be in class exactly on time.
- b. **Homework:** Assignments will be given at the end of each section.
- c. **Moodle:** It is where the course PDF/PPT files will be posted.
- d. **Office hours:** MF: 2:00- 3:00 & TR: 11:00-12:00.
- e. **Makeup exam policy:** No makeup exams.
- f. **Grading policy:** Exam 1(20%), exam 2 (20%), HW quizzes/Attendance & participation (20%), final exam (40%).

Student Class Attendance Policy

"Students are expected to attend all classes and laboratory sessions on regular basis and on time. The maximum number of absence hours permitted in a course, whether authorized or not, is three (3) hours per credit. For example, a student is allowed to be absent up to 9 hours per semester (6 classes) in a 3-credit course without directly jeopardizing his/her grade in the course. If a student's number of absence hours in a course exceeds the maximum allowed limit then the student will automatically receive the failing grade ("FW") in the course."

Academic Dishonesty (including Cheating and Plagiarism)

AUT endeavors to uphold Academic Integrity. Cheating, Plagiarism or other infractions will not be tolerated in this course. Read University policy on Plagiarism. Read class hand-outs on Plagiarism. Cheating and plagiarism is defined and addressed in several lectures. There is NO excuse for not knowing the policy. lack of knowledge will not serve as an excuse. Hint: "recycling" your own work constitutes plagiarism.