

Introduction to Applied Statistics

EMEN 5005 / APPM 4570 / APPM 5570

Course Syllabus & Content Outline

Dr. Jeffrey T. Luftig

W. Edwards Deming Professor of Management
Engineering Management Program, College of Engineering
&
Adjunct Faculty, Department of Applied Mathematics

1. Course Description

Covers foundations for statistical reasoning and statistical applications. Topics include descriptive statistics, introduction to probability, random variables, discrete and continuous probability distributions, sampling theory and sampling distributions, statistical inference (point and interval estimation and hypothesis testing), and simple regression.

2. Course Goals and Objectives

As a result of successfully completing this course, the student will possess a basic understanding of descriptive and inferential statistics, and their practical use in making decisions in business and industry. Emphasis will be placed on application versus theory, with examples and case studies drawn from actual data bases obtained from companies such as Anheuser-Busch, ALCOA, Ford Motor Company, Applied Magnetics, Molex, Earthgrains, FASCO/BTR, the Inland Steel Company, and other firms across the world.

After successfully completing this course, the student will be capable of:

- (a) properly classifying, statistically describing, and illustrating all forms of data;
- (b) understanding and utilizing probability rules and theory to formulate answers to common business/industrial/engineering decisions;
- (c) applying his or her understanding of data and probability to generate and understand common probability distributions, and make decisions based upon each distribution;

- (d) generating and mathematically describing common Random Sampling Distributions (RSDs), and applying each in order to solve problems and make decisions;
- (e) utilizing Random Sampling Distribution theory to conduct basic hypothesis tests to assess assumptions (one and two sample independent and dependent tests) related to proportions, counts, and measures of central tendency, dispersion, and shape in order to make accurate and cost-effective decisions;
- (f) utilizing computer-based statistical software to perform the tasks required as described by items (a) through (f), which will result in an understanding of the use and applications of this content, by minimizing time requirements associated with performing simple mathematical calculations; and, time-permitting
- (g) describing common measures of correlation and association, and performing simple regression analysis.

3. Instructor

Dr. Jeffrey T. Luftig
Room 414 – College of Engineering
Office Hours : Tuesday & Thursday, 9:00 – 11:00 AM
Additional Hours by Appointment / Arrangement
E-mail : Jeffrey.Luftig@colorado.edu
Office Phone : 303-492-1591

4. Textbook / References / Software

The recommended textbook for this course is *Probability and Statistics for Engineering and the Sciences*; 6th (or latest) Edition; Jay L. Devore; Thomson Publishing Company; 2004. As an alternative, a basic statistics text can be obtained on loan for the semester from the instructor.

Additional references / reading materials will be identified if additional resources are required by the student; however, it is anticipated that the material resident on the ECollege course website will be sufficient to support the class lectures.

The course will make significant use of the software package: *MVPStats*. Some applications will also be reviewed using SPSSPc for Windows. **Students are strongly encouraged to purchase the MVPStats software for their own personal use**, particularly if they intend to continue the Managing Applied Research Certificate sequence (EMEN 5900, EMEN 5610, and EMEN 5620). If you do decide to purchase

MVPStats, be sure to do so from the following link:

<https://mmm1921.dulles19-verio.com/mvppro/store/studentorder>

which will take you to a page where the software can be purchased for a reduced rate as compared to standard pricing (\$65.00 versus \$400.00).

*Note that both the mid-term and final examinations will be computer-based, and will **heavily** employ the MVPStats software.* Whether you purchase the software or not, you **MUST** become familiar with its use and applications.

5. The Course Website

All students must register on the web at [XXXXXXXXXXXXXXXXXXXX](#) for access to eCompanion (look for the *register* link). ALL of the lectures and materials used in this course are contained on this website. Additionally, all communication associated with this course will take place via the e-mail function on the course website; students will be responsible for checking their e-mail frequently enough to be knowledgeable about the information sent by the instructor to them using this utility throughout the semester.

A Note on e-Mail Addresses

When you register on ECollege, you can set your e-mail address to be sent from the course website to any address you choose. I know it can be a hassle to check multiple e-mail locations on a daily / regular basis, but may I suggest that you use your CU e-mail address for this purpose (e.g. [firstname.lastname@colorado.edu](#)). If you do not know your assigned CU address, contact ITS (dial 5-HELP from any on-campus phone) and they will provide it to you. The reason I mention this is because in the past, I have sent e-mails to students with attachments of interest as the course proceeds. In some cases, where students have used their work e-mail address, the e-mail goes through but the attachment is blocked. In some rare cases, fire-walled work systems, when blocking an attachment, block the associated e-mail as well, and provide no indication to the student that anything was sent out by me and subsequently blocked. It is *your* responsibility to be cognizant of any information sent via the course website by me, so it might be useful to use either a CU or at least personal e-mail address that will not present this sort of possibility.

Additional information associated with the use of the ECollege website and accessing videos of the lectures are available on the ECollege website, under the **Course Home** section, in the Content Item labeled '**Instructions**'.

6. Course Structure / Approach

The course topic outline which follows identifies the lecture topics which will be presented throughout the semester in order to allow the student to achieve the goals and objectives of the course. For each topic, the corresponding chapters/sections of the textbook are identified, and it will be the student's responsibility to:

- (a) have read the assigned material *before* viewing the corresponding lecture; and
- (b) attend each lecture and participate in the class session (on-campus students);
OR review each lecture in a timely fashion and e-mail any questions you may have to the course TA (distance students).

It should be noted that the textbook is intended to *supplement*, but *not supplant*, the lecture content. As a result, completion of the reading assignments and viewing the class lectures are *both* required in order to achieve a complete mastery of the course content. The student is additionally cautioned that the material builds upon itself; for example, hypothesis testing cannot be understood if Random Sampling Distribution theory is a mystery.

The course requirements are as follows:

- (1) At the end of each of the initial content areas (i.e. Lectures), a self-review problem(s) will be provided. Occasionally, data associated with this self-review problem will also be provided. It will be the responsibility of each student to individually complete this self-review problem(s). These problems are intended to provide the student with an opportunity to assure a mastery of the content presented, and set the stage for the subject matter to be presented in the next lecture. Where data are provided, the student should note that they are working with data drawn from actual examples from business and industry. *These problems will not be submitted and graded*, but the student is cautioned that the successful completion of these exercises is key to understanding the material taught. Further, these examples will bear **close** resemblance to the problems found on the course examinations; and therefore constitute 'practice problems' for the tests.
- (2) During the semester, 3 Content Area Exercises (CAEs) will be completed by each student. These Exercises may be completed by each student working alone, or may be completed by students collaborating / working in teams. The due date for each Exercise to be completed will be one week from the last lecture viewed in which the content required to complete the Exercise has been delivered. The ECollege website will clearly indicate when each Exercise should be completed, and the Instructor will announce the due date in class. All of the Exercises (and their associated data sets) are

available on the course web site from the beginning of the semester.

The Exercise submissions should be prepared in a professional manner, and submitted in *.pdf format via the ECollege Drop box associated with that particular assignment ('CutePDF Writer' is available for free if you do not have a pdf file conversion utility). The Answer Sheets to be employed for all of the assignments are also resident on the course website. Each student will submit a completed Exercise Answer Sheet in the dropbox provided on the website, even if working with other students in a team format. The names of all students working on a Team to complete the Exercise should appear on all of the individual Answer Sheets.

The Exercise Answers will be assessed as 'Satisfactory' or 'Unsatisfactory' (i.e. Pass/Fail) *and will not be included in the calculation of the final grade*. Students should note that these Exercises are intended to prepare them for the ability to successfully complete the three Examinations which are required for this course.

Now, here is something that may be different than what you may have experienced in other classes.

My ultimate objective for this class is your success in mastering the material, and performing well on the three exams. I have years of data which suggest that the completion of the CAEs are key to achieving this objective. Therefore, while the Exercises will be graded P/F, each student must submit evidence of a serious effort to complete each CAE as a prerequisite to receiving and completing the Examination associated with that content area. Students who do not submit a CAE for a particular content area, or who do not submit work reflecting a serious effort at completing this requirement, will not receive the exam for that content area and will receive an 'F' for that exam.

- (3) Three Examinations, covering the content reviewed to that date in the required reading and course lectures. These examinations will be taken and submitted one week after the CAEs associated with that content has been submitted and evaluated, and after the student receives the correct answers to the Exercise. For example, the student will receive Lecture 1 – Frequency Distributions, then Lecture 2 – Descriptive Statistics, then complete the first two self-reviews, then view Lecture 3 – Probability and complete the probability self-review, then view Lecture 4 – Probability Distributions, and complete the self-reviews associated with that PowerPoint lecture material. Then, Content Area Exercise #1 (which covers the first four Lectures) will be completed and submitted. After the Exercise has been evaluated and the answers returned, the student will

have one week to complete and submit Examination #1, which covers the material covered to that point.

All examinations are open-book, open-notes, and should be completed with (preferably) MVPStats (if the student wishes to use alternative software, it is completely the student's responsibility to assure that the alternative software package generates all of the answers to the problems taught, with equivalent answers. Answers generated by MVPStats and/or SPSSPc will be assumed to be 'correct' versus different answers generated with any other software). See section 8 for the submission sequence associated with all of the assignments and examinations.

Unlike the Self-Reviews and Content Area Exercises, **the Examinations MUST be completed by each student, individually**. Specifically, all examinations submitted must be the product of only the student submitting that examination, in conformance with generally accepted standards associated with Academic Honesty. The [CU Honor Code website](#) provides and explanation of these standards; as well as the Pledge each student will be asked to sign (type) at the end of each examination Answer Sheet. If you at any time have any questions regarding what is and is not appropriate in this area, make certain to speak with the Instructor. *Exams submitted by any student, assisted or written in part or in whole by any other individual, shall be considered to constitute fraud under the University Honor Code, and will result in the assignment of an 'F' for the entire course.*

The Examinations MUST be submitted via the dropboxes provided for that purpose on the ECollege course website. No other method of submission is acceptable. For example, submissions of examination answer sheets as e-mail attachments will be neither accepted nor even opened. Any submission other than via the course website dropbox will be treated as if the exam was never submitted.

The final grade for the course will be assigned on the basis of the following weighting:

- Examination #1	33.33%
- Examination #2	33.33%
- Examination #3	33.34%

Each exam is assigned a letter grade and GPA value (A+ is possible), which is converted by the ECollege Gradebook into a percentage which is equivalent to the GPA value earned against the value of an 'A'. For example, a B is equivalent to a GPA value of 3.0. This value is divided by the value of an 'A' of 4.0, and converted into a value of 75%. B+ equals 3.3, and is converted into an 82.5%. An A+ would be 4.3/4 or

107.5%. To generate your final grade, ECollege multiplies each percentage by its weight, and generates a final cumulative percentage (fcp). You can determine your final grade by comparing your final cumulative percentage to the following table:

Final Weighted Percentage Earned - Low	Final Weighted Percentage Earned - High	Final Course Grade Equivalent
96.250	107.500	A
87.500	96.249	A-
78.750	87.499	B+
71.250	78.749	B
62.500	71.249	B-
53.750	62.499	C+
46.250	53.749	C
37.500	46.249	C-
28.750	37.499	D+
21.250	28.749	D
17.500	21.249	D-
< 17.50		F

For example, assume that a student received the following grades:

Exam 1	B+ = 3.3
Exam 2	A- = 3.7
Exam 3	B+ = 3.3

The final cumulative percentage (fcp) generated by ECollege would be:

$$\begin{aligned}
 \text{fcp} &= ((33.33)(3.3/4.00)) + ((33.33)(3.7/4.00)) + ((33.34)(3.3/4.0)) \\
 &= 27.497 + 30.830 + 27.505 \\
 &= 85.832
 \end{aligned}$$

Converting the fcp to a letter grade using the previous table, the final grade earned would be a B+.

7. Additional Course Clarifications Recommended for Inclusion by the Office of Undergraduate Education and the Engineering Management Program at the University of Colorado – Boulder

- a. If you qualify for accommodations because of a disability, please submit a letter to me from Disability Services in a timely manner so that your needs may be addressed. Disability Services determines accommodations based on documented disabilities. Contact: 303-492-8671, Willard 322, or <http://www.Colorado.EDU/disabilityservices>

- b. Campus policy regarding religious observances requires that faculty make every effort to reasonably and fairly deal with all students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance. In this class, my expectation is that each student will review the policy details (http://www.colorado.edu/policies/fac_relig.html) and religious holiday calendar (<http://www.interfaithcalendar.org/>) during the first week of class, and by the end of the second week of class notify the instructor via e-mail as to what dates the student anticipates they will not be in class, and the religious holiday they will be observing.

- c. Students and faculty each have responsibility for maintaining an appropriate learning environment. Students who fail to adhere to behavioral standards may be subject to discipline. Faculty have the professional responsibility to treat students with understanding, dignity and respect, to guide classroom discussion and to set reasonable limits on the manner in which students express opinions. Policies regarding classroom behavior may be reviewed at:

<http://www.colorado.edu/policies/classbehavior.html>

http://www.colorado.edu/studentaffairs/judicialaffairs/code.html#student_code

- d. All students of the University of Colorado at Boulder are responsible for knowing and adhering to the academic integrity policy of this institution. Violations of this policy may include: cheating, plagiarism, aid of academic dishonesty, fabrication, lying, bribery, and threatening behavior. All incidents of academic misconduct shall be reported to the Honor Code Council (honor@colorado.edu; 303-725-2273). Students who are found to be in violation of the academic integrity policy will be subject to both academic sanctions from the faculty member and non-academic sanctions (including but not limited to university probation, suspension, or expulsion). Additional information on the Honor Code can be found at:

<http://www.colorado.edu/policies/honor.html>

and at

<http://www.colorado.edu/academics/honorcode/>

- e. The University of Colorado Policy on Sexual Harassment applies to all students, staff and faculty. Sexual harassment is unwelcome sexual attention. It can involve intimidation, threats, coercion, or promises or create an environment that is hostile or offensive. Harassment may occur between members of the same or opposite gender and between any combination of members in the campus community: students, faculty, staff, and administrators. Harassment can occur anywhere on campus, including the classroom, the workplace, or a residence hall. Any student, staff or faculty member who believes s/he has been sexually harassed should contact the Office of Sexual Harassment (OSH) at 303-492-2127 or the Office of Judicial Affairs at 303-492-5550. Information about the OSH and the campus resources available to assist individuals who believe they have been sexually harassed can be obtained at:

<http://www.colorado.edu/sexualharassment/>

- f. Appropriate Classroom Laptop Use

Although having a laptop in class opens up new learning possibilities for students, sometimes students utilize it in ways that are inappropriate. It is easy for your laptop to become a distraction to you and to those around you. Therefore, please refrain from instant messaging, e-mailing, surfing the Internet, playing games, writing papers, doing homework, etc. during class time. Acceptable uses include taking notes, following along with the instructor on PowerPoint, and other directed class activities, as well as working on assigned in-class activities, projects, and discussions that require laptop use.

8. Lectures, Assigned Reading, Assignment and Examination Submission Sequence

Lecture Topic	Textbook Assignment
<p>Introduction to the Course & Course Requirements</p> <ul style="list-style-type: none"> * Syllabus * Content Outline * Assignments * Examinations * Suggested Support References <p>Introduction to the Instructor</p> <ul style="list-style-type: none"> * Background & Experience * Case Study Sources 	None!
<p>Introduction to Statistics</p> <p>Displaying Data : Frequency Distributions</p> <ul style="list-style-type: none"> - Ungrouped, Relative, and Grouped Frequency Distributions - Illustrating Frequency Distributions : Polygons and Histograms <p>Descriptive Statistics</p> <ul style="list-style-type: none"> - Measurement Scales : Continuous (Ratio and Interval) and Discrete (Ordinal and Nominal) - Descriptive Measures of Frequency Distributions : Measures of Central Tendency, Dispersion, and Shape (Skewness and Kurtosis) <p>Computer Applications and Approaches to Calculations</p>	Chapter 1
<p>Introduction to Probability</p> <ul style="list-style-type: none"> - Basic Definitions - Type of Probability - Rules / Conditions of Probability - Conditions Under Statistical Independence and Dependence 	Chapter 2
<p>Probability Distributions</p> <ul style="list-style-type: none"> - Definitions and Configurations - Random Variables : Discrete and Continuous - Discrete Probability Distributions <ul style="list-style-type: none"> * the Binomial Distribution * the Hypergeometric Distribution * the Poisson Distribution <p>Computer Applications</p>	Chapter 3

Lecture Topic	Textbook Assignment
<p>Probability Distributions (continued)</p> <ul style="list-style-type: none"> - Continuous Probability Distributions <ul style="list-style-type: none"> * The Normal Distribution * The Exponential Distribution * Other Continuous Distributions/Families (Log-Normal, Weibull, Johnson, Beta, Gamma) - Testing for Normality (Introduction) <p>Computer Applications</p>	<p>Chapter 4</p> <p>Optional Reading: <i>How to Test Normality & Other Distributional Assumptions</i>, S. Shapiro, American Society for Quality Control, 1980</p>
<p>Content Area Exercise # 1</p> <p>Examination # 1 Due 1 Week After Exercise #1 Due Date</p>	<p>N.A.</p>
<p>Sampling Methods and Random Sampling Distribution Theory</p> <ul style="list-style-type: none"> - Populations & Samples - Types of Sampling - Sampling Distributions and Statistical Inference - Observations and Assumptions Related to Sampling Distributions; the Central Limit Theorem - Estimation and Estimators: Criteria for 'Good' Estimators - Point and Interval Estimation - Confidence Levels and Intervals <p>Computer Applications</p>	<p>Chapter 5</p> <p>Chapters 6 & 7</p>
<p>Introduction to Hypothesis Testing</p> <ul style="list-style-type: none"> - Basic Assumptions and Concepts - Testing Hypotheses - The Significance Level and Risk - One and Two Tailed Tests - Error (Type I and II) and Power - Calculating Type II Error and Power - Calculating Appropriate Sample Sizes - Type I and II Error, Power, Sample Size, and Effective Decision-Making in Business and Industry: Risk vs Cost/Value Analysis 	<p>Chapter 8</p> <p>Optional Reading:</p> <p>“Improving Your Hypothesis Testing: Type II Error & Power”, Luftig & Norton, <i>Journal of Studies in Technical Careers</i>, Vol. IV, No. 1, Winter, 1982 (Lecture 7 Support Materials – ECollege Website)</p> <p>“Improving Your Hypothesis Testing: Determining Sample Sizes”, Luftig & Norton, <i>Journal of Studies in Technical Careers</i>, Vol. IV, No. 2, Spring, 1982 (Lecture 7 Support Materials – ECollege Website)</p>

Lecture Topic				Textbook Assignment
Content Area Exercise # 2 Examination # 2 Due 1 Week After Exercise #2 Due Date				N.A.
Hypothesis Testing: One Sample Tests - Testing for Differences in the Mean (the One Sample Normal & t) - Testing for Differences in Variance (the Chi-Square test) - Testing for Differences in Proportions (the One Sample Binomial and Approximate Tests for r and p) - Testing for Normality (Anderson-Darling, Moment Tests) Computer Applications				Chapter 8
Hypothesis Testing: Two Sample Tests				Chapter 9
Parameters	Means	Variances	Proportions	
Condition				
Independence	- Normal (z) - t-test - Approximate Test	- F-test	- Two Sample Binomial & Approximate Tests	
Dependence	- Repeated Measures t-test - Two Sample t-Test	- Matched Pairs t-test	- McNemar's Test	
Computer Applications				
Content Area Exercise # 3 Examination # 3 Due 1 Week After Exercise #3 Due Date				N.A.
Introduction to Correlation and Association - The Pearson r: Calculations and Interpretation - Hypothesis Tests for Differences in Correlation (One Sample t & Approximate Test; Two Sample Independent and Dependent Tests) - Other Measures of Correlation and Association Computer Applications Introduction to Simple Regression Analysis				Chapter 12

9. Required & Recommended Resources

- * Textbook (not required during lectures)
- * Calculator *with Statistical Functions* (e.g. TI 30) – *Required during lectures*
- * Personal Computer – *Recommended during Lectures*
- * Software: MVPStats (**primary software package for course**)