1. Course Description

Combines intermediate and advanced statistical methods with practical research applications and computer software. Addresses commonly used statistical models such as Simple and Multiple Regression Analysis, GLMs, the Analysis of Variance, Data Mining and the use of CHAID, as well as the analysis of Fractional Factorial Designs for the solution of common business and industrial research problems. The statistical models are implemented and interpreted in the context of actual data sets using available statistical software. Prerequisites: EMEN 5900 & 5610; or APPM 5580 & 7400a; or the equivalent, with the permission of the instructor.

2. Course Goals and Objectives

This course is intended to serve as the fourth course in a four-course sequence in Managing Applied Research in Technology. As the final course in this sequence, more advanced statistical methods than those presented in EMEN 5610 will be investigated. At the conclusion of this course, the student should possess the ability to perform required statistical analyses for any univariate (single Criterion Measure) application in a business / industrial setting.

Specifically, at the conclusion of this course, the student will be capable of performing the following analyses / tasks:

- Perform Simple, Multiple, and Nonlinear Regression Analyses, including the analysis of all underlying assumptions associated with these models;
- Performing all of the above analyses, as associated with nominal and ordinal data applications/measurements;
- Designing cost-effective and efficient Fractional Factorial Designs; and
- Combining Fractional and Full Factorial Designs with Simple and Multiple Regression applications and CHAID and other decision tree analysis methods for the purpose of Data Mining
In order to master these techniques, data generated from a series of research studies drawn from contemporary business and industrial applications as well as textbook examples will be employed. The industrial examples have been extracted from actual studies conducted for firms such as Anheuser-Busch; the Earthgrains company; ALCOA, and ALCOA of Australia; Molex, and Molex-Singapore; the Applied Magnetics Corporation; the Inland Steel company; Ford Motor Company; Motorola - Semi-Conductor Division; and the Oregon Saw Chain company.

As a result of successfully completing the four course sequence associated with the MART Certificate, the student will be capable of performing a vast array of activities in business and industry utilizing the principles and tools of applied statistical methods and experimental design techniques. Specifically, when faced with a statement of a problem in either a production or administrative setting, in the context of a product or a service, the student will be capable of:

(a) properly classifying the problem/issue as a candidate for the Problem-Solving Strategy versus the Quality Improvement (i.e. Variability Reduction) Strategy;

(b) describing an appropriate (most efficient in balancing power and cost) research design to respond to the statement of the problem;

(c) developing a high-power, cost-effective experimental design to test the required hypotheses which will guard against threats to External and Internal Validity;

(d) designing the appropriate sampling plan in relation to the experiment, including the calculation of a defensible sample size, and selecting replications, or repetitions, or both in the conduct of the design;

(e) explaining the methods which must be utilized to conduct and control the execution of the study in the business and industrial environment;

(f) designing an appropriate plan for the statistical analysis of the data, taking internal and external customer issues, as well as cost and profitability, into account; then

(g) executing the analytical plan and correctly answering the research questions posed; and finally

(h) preparing and presenting the results of the study in a professionally acceptable format for decision-making purposes at the highest level of an organization.
The analyses taught by the instructor, and utilized by the student, in this course will require the assessment of criterion measures evaluated on nominal, ordinal, and continuous data scales (in some cases, all within a single research study). Further, the underlying assumptions related to each statistical test and its interpretation will be thoroughly reviewed.

3. Rationale

The application and use of applied statistical methods in business and industry today does not take place within a vacuum. The engineering manager in contemporary business organizations plays a vital role in the enhancement of profitability through focused cost reduction, quality improvement, problem-solving, and increasing asset utilization efforts. As part of a cross-functional team, it is the engineering manager that is depended upon to create those conditions within which disciplined and controlled studies may take place, and where generated (versus collected or gathered) data may be interpreted and disseminated for decision-making purposes.

Within this context, statistics, and the statistical analysis of data, is primarily a tool; not an objective. In this regard, applied statistics should be learned in the same way; that is, as a tool employed within a larger strategy for the purposes that will be found in the business environment. The student will find that all of the following research questions:

1. What is the quality of the telephone response rate among the inside sales group, and is there a day-of-the-week or time-of-day effect(s)?

2. What temperature setting, feed rate, and atmosphere condition should be used for our new heat treat furnace to maximize quality, and yet minimize cost?

3. How much magnesium and manganese should be included in the aluminum alloy used for our customers making soft drink cans in Singapore so as to minimize our costs, but increase their production rates with no consumer complaints?

4. What is the superior inside spray formulation to use if we wish to control off-taste in beer?

5. Which of the 67 possible variables affecting plugging on the caster must be controlled, and at what targets, in order to realize an additional profit of $33,000,000.00 per year?

may all be answered through controlled and designed experimentation followed by appropriate statistical analyses (in some of the cases above, the same statistical tests), but that the focus and purpose of the activity is **not** to obtain \( t \), \( F \), \( \chi^2 \) values and their associated p-values, **but to correctly answer the research question(s) at**
the lowest possible cost. Additionally, some of the studies required to answer these research questions may cost a company tens or hundreds of thousands of dollars to execute and you only get one chance at the experiment, and there are no 'do-overs'. Therefore, threats to the internal validity, and subsequent external validity, of the design employed must be understood by the engineering manager (researcher). Statistical methods may often be robust against certain violations of underlying assumptions, but no test statistic known can save the engineering manager from a flawed experimental design. This is of particular concern when one notes that performing research in many industrial situations is nothing like conducting experiments in a laboratory, classroom, or at the end of a chapter in a textbook. Most continuous distributions encountered are not normal; many planned sample sizes are not realized; subjects or test units are often lost; data turns up missing; gauges are modified in mid-study. Knowing how to adjust and control for all of these types of occurrences can make the difference between a successful research effort and a catastrophic event.

Finally, the contemporary engineering manager must manage and/or conduct all research and statistical analyses mindful of the fact that obtaining a correct answer in business and industry today is not enough if that answer is not associated with a set of conditions or outcomes that may be achieved at the lowest possible cost, and highest profit, to the organization implementing the solution. Concurrent with this observation is the realization that no solution will be implemented by upper-level management (particularly the high risk variety) if the engineering manager cannot present the results of his/her analysis in such a way so as to convince those who do not understand the difference between alpha and beta (i.e. Type I and II error), much less the revelations offered by Levene’s Improved Test for homogeneity of dispersion versus variance, why a particular solution is the right one. It is the researcher's responsibility to translate the analysis conducted from the universal language used to discuss variability (i.e. statistics) into the language of business (dollars). This also is a skill set possessed by the successful engineering manager.

Given the rationale presented, this course was originally organized by Dr. Jeffrey Luftig to maximize the probability that the student who successfully learns this content material will be able to operate in the manner described above. Each case study presented will require the student to select an appropriate investigative strategy, select an appropriate statistical analysis plan (mindful of the nature of the data available, and the underlying assumptions associated with the test involved), correctly execute the analytical plan, and make recommendations for further research / action in a format consistent with the presentation of such data in a business environment. Each case study has been carefully selected so as to make certain that the student will have covered a significant number of diverse statistical analyses by the end of the course.
4. Instructor

Dr. Ray L. Littlejohn
Office: ECOT 414
Office Phone: 303-492-2034 or 720-515-6066
e-mail: Ray.Littlejohn@colorado.edu
Office Hours: Tuesday 3:00 PM – 5:00 PM
Friday 10:00 AM – 4:00 PM
Friday 2:00 PM – 4:00 PM

5. Course Website

I will use D2L to administer all functions associated with this course. You are responsible for checking the course website on a regular basis so you may stay current with all aspects of the course as we progress through the semester.

A Note on e-Mail Addresses

The official means of communication for this course, which is consistent with university policy, is through the use of your university email address, which is usually (e.g. firstname.lastname@colorado.edu). You are responsible for monitoring (either directly or through a forwarding system) to be able to receive communication concerning the course. You are cautioned about using a work or other personal email address with regard to this course. You can easily forward your “colordo.edu” email address to other email services if you must do so.

Class attendance and Class Videos

Class attendance either in person (for Campus students) or remotely by BlueJeans links (for Distance Students). All class sessions will be recorded and the videos will be posted and available for on line viewing or for downloading and off-line viewing. You are encouraged to take advantage of the course videos. And, for distance students, you will be able to, and are encouraged to attend class through a Live BlueJeans link. All you have to have is an internet connection and a web cam. Detailed instructions are available on the course website for enabling and accessing the class session via BlueJeans. So, follow those instructions.

6. Textbook / References / Software

After careful review, the instructor has determined that no single text can adequately comprise a resource for all of the topics we will review in this course. Instead, the instructor will provide students with extensive handouts and support material on the course website. If support texts are desired, a useful text would be Design of Experiments in Quality Engineering, by Jeffrey Luftig & Victoria Jordan, McGraw-Hill Publishing Company, 1998. A textbook that is also recommended highly as a compendium of statistical tests is the Handbook of Parametric and Non-Parametric Statistical Procedures by David Sheskin, published by CRC Press. These materials were part of the material for EMEN 5900 and any/all EMEN 5900 materials well be made available if you still need them, just let me know.
Some of the other textbooks which may be used as references for some or most of the material reviewed in this course (these are only sample references; this is not intended to constitute a collectively exhaustive list) include the following publications:

- **Box & Draper** *Evolutionary Operation*, John Wiley & Sons
- **Box, Hunter, and Hunter** *Statistics for Experimenters*, John Wiley & Sons
- **Campbell & Stanley** *Experimental & Quasi-Experimental Designs for Research*, Rand McNally College Publishing Co. A PDF version of this book can be made available to you.
- **Daniel, C.** *Applications of Statistics to Experimental Design*, John Wiley & Sons
- **Draper & Smith** *Applied Regression Analysis*, John Wiley & Sons
- **Dowdley & Wearden** *Statistics for Research*, John Wiley & Sons
- **Hicks, C.** *Fundamental Concepts in the Design of Experiments*, Holt, Rinehart, and Winston
- **Luftig, J.** *Special Techniques for the Analysis of Unreplicated Fractional Factorial Designs*, Luftig & Warren International
- **Siegel & Castellan** *Nonparametric Statistics for the Behavioral Sciences*, McGraw-Hill
- **Agresti, Alan** *An Introduction to Categorical Data Analysis*, John Wiley & Sons.
**Software**

For all of the statistical analyses presented and conducted, the student will make use of an extensive array of computer software. The primary software programs utilized in this course will be SPSS for Windows, PHAST-TM (or the web based StatOStar) and MVPStats (which all students should already own from the prerequisite courses). These programs are also resident and available for use by students in the computer labs on the second floor of the Engineering Building.

All students enrolled in this course should already possess MVPStats. If you have not purchased this program in previous courses, you should download the software from the following URL:


This URL will allow you to purchase the software for $65.00 versus the normal price to the ‘public’ of $395.00; through an agreement with the software producer.

The second program we will use extensively, which is installed on many of the computers in the Engineering building, will be SPSS for Windows. SPSS is available from a number of sources, with rates that vary widely. **DO NOT purchase the Student Version.** It is a limited version that does not include all of the modules you will need, and handles data files of limited size. The Graduate Version/Pack is the minimum system you will require. The Standard Graduate Version/Pack can be purchased from a number of sites. The Graduate Version/Pack is available with a perpetual license at JourneyEd: http://www.journeyed.com/. The SPSS Graduate Version can also be leased for a 6 or 12 month period from: http://www.e-academy.com/. Perhaps the best, most reliable and convenient, and least expensive option for acquiring SPSS is through the OIT department here on campus. They provide discounted prices for student licenses when the software is required for a course as it is in this case. I will provide a course list with your names on it to OIT to assure you can get the software at the discounted prices. Relevant information can be obtained from:

OIT Site Licensing
sitelic@colorado.edu -- 303.492.8995
license info: http://www.colorado.edu/oit/licenses

Other programs/routines which we will employ in this course will include: CHAID and CRT an integral part of SPSS and Design Array, PHStat (an EXCEL add-in), Schaub Regression (another Excel-based program) and ANOVA TM (these last four will be provided to you) along with various other Excel Workbooks for special purposes. In those cases were possible, these packages will be provided by the instructor to the students, and subsequently utilized in assignments and projects. For now, the primary emphasis should be on obtaining SPSS and MVPstats. We will work on getting the other software programs as we go along and specific arrangements have been made.
7. Course Structure / Approach

The course topic outline which follows identifies the proposed and tentative lecture topics (some topics may be added or dropped based upon student input and projects of interest which may arise during the semester) 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 covered, it will be the student’s responsibility to:

(a) have read any assigned material identified by the instructor before the corresponding lecture is attended or viewed; and

(b) attend or view the lecture, and participate in classroom discussions of the material presented (on-campus students)

OR

review the lecture, and post questions associated with the content on the NB website (distance students); and

(c) complete all homework, mini and/or binary assignments following each lecture in which they are assigned. These assignments are designed to allow the student to confirm that the content presented in any given lecture has been learned and mastered, before material of increased complexity is presented in subsequent lectures.

The course requirements are as follows:

(1) Each student will individually complete and electronically submit all homework, minis and binary assignments. The 7 homework assignments in this course are equally weighted, and the number of assignments submitted will be a function of how much content is ultimately covered. The assignments MUST be submitted via the dropbox utility on the course website in the proper format. No other form of submission will be accepted.
(2) Students will be assigned to teams, and each team will be provided with a research problem and associated data set(s) from an actual business application. It will be the team's responsibility to:

(a) Perform all correct and appropriate statistical analyses required to answer the research question(s);

(b) Prepare a report suitable for presentation to a Chief Executive Officer and management team in business or industry; and

(c) Provide a presentation to the class on the methods utilized, techniques employed, and the results obtained. The members of each team will receive the same grade for the final project.

8. Grading & Final Course Grade Calculations

There will be 3 major types of graded work that will constitute the final course grade: I) Homework Assignments (there will be 7 major homework assignments, each equally weighted and scored on a 100-point basis and each one worth 10%, for a total of 70% of the total course grade), II) Minis Smaller, selected, simpler homework assignments referred to as Minis. These will be “binaries on Steroids” they will be scored and in total will make up 10% of your final course grade. The number (J) of Minis will vary depending on the topic and their timing. The value of each one will be 10%/J percent each. III) a Term Team Project which will be required, and will worth 20% of the course grade. IV) Binary Assignments (little assignments scored as 0 or 1 based on acceptability which will be used to introduce or reinforce key topics or concepts. Binaries will be the only source of Extra Credit for this course, and as in previous courses will be used as “border busters”, the little nudge that some may need to get into the next higher grade category. The total worth of binaries will be .5% of the final course grade, and their value will NOT be counted as part of the total possible values. The composition of the Final Weighted Total score (on a 100-point basis) will be determined as follows:

- Homework Assignments (7 at 10% each) 70%
- Minis (J total, 10/J each) 10%
- Team Project (1 at 20%) 20%
- Binaries (Extra Credit, max of .5%) ---

For purposes of illustration, the final grade will be calculated by assigning the weighted averages of the scores received as follows. Assume the following summary information:
Graded Item       % Item Ave
Homework (7 assignments @ 10% each)   70%      .880
Minis (J minis @ 10% / J each)    10%      .930
Team Term Project (1 @ 20%)    20%      .930
Binaries (% of N complete, max .5%)  0.5%     0.???

Example 1: Without any Binaries:
Final Weighted Total Grade = (.880)(70) + (.930)(10) + (.930)(20) + (.05)(0)
= 61.6 + 9.3 + 18.6
= 89.5
This FWT Score, when compared to the following table would yield a B+.

Example 2: With all Binaries:
Final Weighted Total Grade = (.880)(70) + (.930)(10) + (.930)(20) + (.05)(1)
= 61.6 + 9.3 + 18.6 + 0.5
= 90.0
This FWT Score, when compared to the following table would yield an A-.

So, Binaries really are Border Busters!

<table>
<thead>
<tr>
<th>Final Weighted Total Points - Low</th>
<th>Final Weighted Total Points - High</th>
<th>Final Course Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>93.33</td>
<td>100.000</td>
<td>A</td>
</tr>
<tr>
<td>90.00</td>
<td>93.32</td>
<td>A-</td>
</tr>
<tr>
<td>86.67</td>
<td>89.99</td>
<td>B+</td>
</tr>
<tr>
<td>83.33</td>
<td>86.66</td>
<td>B</td>
</tr>
<tr>
<td>80.00</td>
<td>83.32</td>
<td>B-</td>
</tr>
<tr>
<td>75.00</td>
<td>79.99</td>
<td>C+</td>
</tr>
<tr>
<td>70.00</td>
<td>74.99</td>
<td>C</td>
</tr>
<tr>
<td>65.00</td>
<td>69.99</td>
<td>C-</td>
</tr>
<tr>
<td>60.00</td>
<td>64.99</td>
<td>D+</td>
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<td>55.00</td>
<td>59.99</td>
<td>D</td>
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<tr>
<td>50.00</td>
<td>54.99</td>
<td>D-</td>
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<tr>
<td>&lt; 50.00</td>
<td></td>
<td>F</td>
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**D2L Gradebook**

Each submission will be assigned a proportion score (earned points/highest student points earned) which will be weighted accordingly. Cumulative standing (FCP for Final Cumulative Percentage in the D2L Gradebook) will be provided on an ongoing basis. Weighting will be checked intermittently to assure that the cumulative
information is an accurate assessment of your standing in the class on an ongoing basis.

All assignments are expected to be completed 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 for each major course requirement submitted. 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. It is expected that there will be collaboration on the Team Project. However, may discuss among yourselves issues associated with homework assignments, but you should not copy another’s work and present it as your own. Work on homework, minis, and binaries should be your own. I’d prefer you ask me if you have questions rather than ask one another. However, in the spirit of group think and group ideas, we will use a PDF annotation tool called Note Bene (NB), provided by MIT so you can post questions, comments, and responses to every content document we will use in the course (which will be posted on NB). There is additional information on the Course D2L site concerning NB, so check it out there.
# 9. Lecture Topics & Associated Discussion Points
*(See Course Schedule and Calendar for specific details.)*

<table>
<thead>
<tr>
<th>Primary Lecture Topic</th>
<th>Case Studies / Reference Material</th>
<th>Statistical Tests Reviewed &amp; Discussion Points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Introduction to the Course &amp; Course Requirements  * Syllabus  * Content Outline  * Individual Homework Assignments / Term Project  * Suggested Support References</td>
<td>N.A.</td>
<td>N.A.</td>
</tr>
<tr>
<td><strong>Fast Review of Critical Material from EMEN 5610 / APPM 7400a</strong>  (Posted on the Course Website – Unit 1 Module)</td>
<td>Posted Materials and Handouts Provided by the Instructor</td>
<td>- Updated Lecture Presentation: 3-Way ANOVA – Model I – Fully Crossed Analyses  - Updated Lecture Presentation: 3-Way ANOVA – Model III – Fully Crossed Analysis  - Homework Assignment # 9 (Final Assignment): Review of Correct Solutions  - 5610 Term Project Solution</td>
</tr>
<tr>
<td><strong>Measures of Relationship: Indices of Association and Correlation</strong>  Lecture Presentation Handout (pdf file) Provided by the Instructor  Measures of Relationship Flow Chart  Likert Scales and Data Analysis Article  Ordinate Values for the Normal Curve at Values of $z$  Small Sample Size Critical Values for the $\rho_{SP}$ (Posted on the Course Website – Relationships Unit Tab)</td>
<td></td>
<td>An overview of the major indices and tests associated with measures of relationship for Nominal, Ordinal, and Continuous variables; including:  * Contingency Table Analysis; Phi, C, V  * Youden’s J-Index of Predictive Efficiency  * Cohen’s Kappa  * Kendall’s Coefficient of Concordance  * Spearman’s Rank Correlation Coefficient  * The Biserial and Point-Biserial Coefficients of Correlation</td>
</tr>
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| **An Overview of Simple Linear Regression and Correlation** | Lecture Presentation Handout (assorted pdf files) Provided by the Instructor  
Appendix B-9  
*Multiple Regression: Procedure REGRESSION*  
SPSS Guide (Out of Print)  
Durbin-Watson Tables of Critical Values (Posted on the Course Website – Simple Regrsn Unit Tab) | * Using Simple Regression to Describe a Linear Relationship  
* Testing Inferences About the Population Regression Line, the Intercept (β₀), and Slope (β₁), and the Underlying Assumptions of the Model  
* Assessing the Fit of the Regression Line – Using the ANOVA Table  
* The Coefficients of Correlation, Determination, and Alienation  
* Generating and Interpreting Confidence and Prediction Limits  
* Testing The Basic Assumptions of the Model  
  - Linearity  
  - Homoscedasticity  
  - Normality  
  - Independence of Errors (Serial Correlation)  
* Residual Analysis and Corrections for Model Violations  
* Detecting the Presence of ‘Outliers’ on the X and Y Dimension  
* Detecting the Presence of High Leverage and Influential Measures  
* Using MVPStats and SPSS for Simple Linear Regression Analyses.  
* Models to include nominal and ordinal response variables, as well as Nominal, Ordinal, and Continuous predictor or explanatory variables, Poisson Regression, and the relationship between t tests for means and tests for correlation and slope coefficients.  
* Will introduce Logistic Regression and log-linear models. |
<p>| <strong>An Overview of other bivariate Regression Models</strong> | Lecture Presentation Handout (assorted pdf files) Provided by the Instructor | |</p>
<table>
<thead>
<tr>
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<th>Statistical Tests Reviewed &amp; Discussion Points</th>
</tr>
</thead>
</table>
| *Introduction to Multiple Regression Analysis* | Lecture Presentation Handout (assorted pdf files) Provided by the Instructor  
Appendix B-9  
*Multiple Regression: Procedure REGRESSION*  
SPSS Guide (Out of Print)  
Durbin-Watson Tables of Critical Values (Posted on the Course Website – Simple and Mult. Regrtn Unit Tabs) | *Underlying Theory & Assumptions – Linear Models*  
*Testing Inferences About the Regression Coefficients*  
*Assessing the Fit of the Regression Line; the ANOVA Table, the Coefficient of Determination and the Multiple Correlation Coefficient, Part and Partial Correlation Coefficients*  
*Full & Reduced Models; Forward and Backward Regression Approaches*  
*Learning testing procedures for Model Comparisons using SPSS*  
*Prediction Using the Multiple Regression Model*  
*Testing The Basic Assumptions of the Model*  
  - Linearity  
  - Homoscedasticity  
  - Normality  
  - Independence of Errors (Serial Correlation)  
*Residual Analysis and Corrections for Model Violations*  
*Multicollinearity*  
*Detecting the Presence of ‘Outliers’ on the X and Y Dimension*  
*Detecting the Presence of High Leverage and Influential Measures*  
*Creating Dummy Variables for Nominal Variables*  
*Testing for Interaction Effects in Multiple Regression Analyses*  
*Lagging Variables in Time Series Analyses*  
*Generating Output with SPSS* |
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<th>Case Studies / Reference Material</th>
<th>Statistical Tests Reviewed &amp; Discussion Points</th>
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</thead>
</table>
| **Introduction to Other Regression models** | Lecture Presentation Handout (assorted pdf file) Provided by the Instructor (Posted on the Course Website – Non-Lnr Unit Tab) | * Show how ANOVA is directly related to Multiple Regression,  
  * Introduce the concept of Multivariate Multiple Regression and Canonical Correlation as the basis Introducing Multinomial Response variables extending Logistic Regression concepts.  
  * Fitting Curvilinear Relationships  
    - Polynomial Regression & 2nd Order Models  
    - Reciprocal Transformation of the X Variable  
    - Log Transformation of the X Variable  
    - Log Transformations of Both the X and Y Variables  
  * Non-Linear Regression and Model-Fitting Using MVPStats. |
| **Introduction to Non-Linear Regression Analysis** | Lecture Presentation Handout (assorted pdf file) Provided by the Instructor | |
| **Introduction to Data Mining** | Lecture Presentation Handout (assorted pdf file) Provided by the Instructor  
Multiple Mining Case Studies for Design and Review (Posted on the Course Website – Data Mining Unit Tab) | * In Introduction to Data Mining, Happenstance Data Analysis, and Associated Statistical Procedures for the Identification of Potentially Critical Factors and Interactions  
* CHAID and associated analytical procedures  
* Combining CHAID and other Classification and Regression Tree analyses with factorial designs, ANOVA, and multiple regression analysis to identify critical, significant, and trivial factors and variables |
<table>
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</tr>
</thead>
</table>
| *Introduction to *Fractional Factorial Designs & Considerations Related To Conducting Screening Experiments* | Lecture Presentation Handout (assorted pdf files) Provided by the Instructor  
Conducting Effective Screening Experiments  
A Procedure for a Statistical Start-Up of New and Existing Production Systems  
Methods for the Analysis of Unreplicated Fractional Factorials  
AET Selection Flow Chart for Data Analysis in Fractional Designs  
Plackett-Burman Designs (Nelson)  
Multiple Fractional Factorial Case Studies for Design and Review (Posted on the Course Website – Screening DOE Unit Tab) | * The Fractional Factorial Design - Basic Theory  
* Developing High(er) Resolution Designs  
* Extending the Latin Square : Orthogonal Arrays  
* Special Techniques for the Analysis of Unreplicated Fractional Factorial Designs; including the Use of Lenth’s Procedure for Dispersion Analysis  
* Setting Up Screening Experiments in Real Life: Guidelines and Recommendations for the Engineering Manager  
* The Engineering Log & It's Post-Hoc Use in Error Term Analysis  
* Developing of Extreme Screening Designs: Plackett-Burman Matrices and other Fully Saturated Design Approaches |
10. **Syllabus addendum – Spring, 2015**

PROGRAM & UNIVERSITY PROVISIONS AND REQUIREMENTS

a. **General Environment**

Students and faculty each have responsibility for maintaining an appropriate learning environment. Those who fail to adhere to such behavioral standards may be subject to discipline. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with differences of race, color, culture, religion, creed, politics, veteran’s status, sexual orientation, gender, gender identity and gender expression, age, disability, and nationalities. Class rosters are provided to the instructor with the student’s legal name. I will gladly honor your request to address you by an alternate name or gender pronoun. Please advise me of this preference early in the semester so that I may make appropriate changes to my records. See policies at [http://www.colorado.edu/policies/classbehavior.html](http://www.colorado.edu/policies/classbehavior.html) and at [http://www.colorado.edu/studentaffairs/judicialaffairs/code.html#student_code](http://www.colorado.edu/studentaffairs/judicialaffairs/code.html#student_code)

b. **Access to Streaming Video**

The lecture videos are now available for viewing by all students registered for each class; whether they are on-campus or distance students. This change was made to improve the quality of the educational experience for all students, enabling any student to review each lecture as many times as needed to master the material. If you have difficulties accessing the video, FIRST check Technical Help / FAQ at: [https://cuengineeringonline.colorado.edu/distance-delivery/technical-help-faq](https://cuengineeringonline.colorado.edu/distance-delivery/technical-help-faq) If you are still experiencing difficulties, please contact: caete@colorado.edu One of CAETE’s experienced technicians will then assist you.

c. **Class Attendance for On-Campus Students**

Unfortunately, some on-campus students have used the availability of the lecture videos to stop attending classes, and rely instead on the videos to learn the material. In the opinion of the faculty, this choice often results in a significant reduction in the quality of the educational experience for both on-campus and distance students; therefore, EMP has established the following policy for all on-campus students registering for an EMEN course:

Class attendance for all on-campus students is expected and required. Unexcused absences may incur a penalty against the student’s final grade.

d. **Recording of EMP classes**

Please note that students attending EMP classes live, whether on-campus or via teleconferencing, may be recorded.
c. **Academic Integrity, Plagiarism, and the EMP Honor Code Quiz**

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). Information on the CU Honor Code can be found at [http://www.colorado.edu/policies/honor.html](http://www.colorado.edu/policies/honor.html)

The faculty of the Engineering Management Program (EMP) believe that a culture of integrity is essential to both the long-term, personal success of our students and to the economies and countries in which they live and work. Therefore, EMP has created an Honor Code Violation Policy that specifies a program-specific, academic consequence for a second violation of the CU Honor Code:

**EMP HONOR CODE VIOLATION POLICY**

Any and all violations of the CU Honor Code in EMP classes will be reported to the Honor Code Council. As per CU’s policy, the faculty member will determine the academic sanction for an offense. The CU Honor Code Council will determine any additional, non-academic sanctions. This portion of EMP’s policy is a restatement of the Honor Code policy approved by the CU Board of Regents.

A second violation of the CU Honor Code by any Engineering Management graduate student will result in the academic sanction of dismissal from the Engineering Management graduate program.

The development of the Internet has provided students with historically unparalleled opportunities for conducting research swiftly and comprehensively. The availability of these materials does not, however, release the student from citing sources where appropriate; or applying standard rules associated with avoiding plagiarism. Specifically, the instructor will be expecting to review papers written by students drawing ideas and information from various sources (cited appropriately), presented generally in the student's words after careful analysis, synthesis, and evaluation. An assembly of huge blocks of other individuals' existing material, even when cited, does not constitute an appropriate representation of this expectation. Uncited, plagiarized material shall be treated as academically dishonest. If the student is confused as to what constitutes plagiarism, s/he should review the CU Honor Code on this topic, and refer to the following excellent resources: [http://www.northwestern.edu/ucc/plagiar.html](http://www.northwestern.edu/ucc/plagiar.html) and [http://owl.english.purdue.edu/owl/printable/589/](http://owl.english.purdue.edu/owl/printable/589/)

Students agree that by taking this course all required papers may, at the discretion of the instructor, be subject to submission for a Textual Similarity Review to Turnitin.com for the detection of plagiarism. All submitted papers will be added as source documents in the Turnitin.com reference database solely for the purpose of detecting plagiarism of such papers in the future.
Finally, the Engineering Management Program faculty have established a policy whereby all students enrolled in an EMP course must, at the beginning of each semester, take and pass a basic quiz about the CU Honor Code. Each student must take the quiz only once each semester, regardless of how many courses they are taking in the department. The instructions for taking the quiz on-line and reporting the results are available on the eCollege website associated with each EMP course.

f. Sexual Harassment

The University of Colorado Boulder (CU-Boulder) is committed to maintaining a positive learning, working, and living environment. The University of Colorado does not discriminate on the basis of race, color, national origin, sex, age, disability, creed, religion, sexual orientation, or veteran status in admission and access to, and treatment and employment in, its educational programs and activities. (Regent Law, Article 10, amended 11/8/2001). CU-Boulder will not tolerate acts of discrimination or harassment based upon Protected Classes or related retaliation against or by any employee or student. For purposes of this CU-Boulder policy, "Protected Classes" refers to race, color, national origin, sex, pregnancy, age, disability, creed, religion, sexual orientation, gender identity, gender expression, or veteran status. Individuals who believe they have been discriminated against should contact the Office of Discrimination and Harassment (ODH) at 303-492-2127 or the Office of Student Conduct (OSC) at 303-492-5550. Information about the ODH, the above referenced policies, and the campus resources available to assist individuals regarding discrimination or harassment can be obtained at http://www.colorado.edu/odh.

g. Proper Use of Copyrighted Materials

The Engineering Management Program (EMP) has a large distance learning population and, as such, many copyrighted materials are offered electronically to students. EMP has the responsibility to comply with the copyright law regulating distance education for a non-profit, state institution, i.e., the Technology, Education and Copyright Harmonization (TEACH) Act of 2002. It’s the student’s responsibility to comply with U.S. copyright law with respect to the use and sharing of the electronic materials (this includes the videos of class lectures) provided within the program.

h. Appropriate Classroom Use of Laptops

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.

i. E-mail Account

You are expected to use your CU student e-mail account. All of your e-mail from professors and the university will be sent to your CU e-mail account. You can choose to redirect your CU email to an alternate (work/personal) email account if you so desire. For assistance in activating your email account and forwarding email, contact the Help Desk at 303-735-HELP or
Help@colorado.edu.

j. Disabilities and Disability Accommodations

If you qualify for accommodations because of a disability, please submit to your professor a letter from Disability Services in a timely manner (for exam accommodations provide your letter at least one week prior to the exam) so that your needs can be addressed. Disability Services determines accommodations based on documented disabilities. Contact Disability Services at 303-492-8671 or by e-mail at dsinfo@colorado.edu. If you have a temporary medical condition or injury, see Temporary Injuries under Quick Links at Disability Services website and discuss your needs with your professor.

k. Religious Observances

Campus policy regarding religious observances requires that faculty make every effort to deal reasonably and fairly with all students who, because of religious obligations, have conflicts with scheduled exams, assignments or class attendance. Students for whom religious observances conflict with class schedules should contact the instructor no later than two weeks before the potential conflict to request special accommodations. See full details at http://www.colorado.edu/policies/fac_relig.html.