University of Colorado at Boulder - Engineering Management Program

EMEN 5042 - Methods for Quality Improvement - Fall, 2008

Instructor: Steven Ouellette

1. Course Description

This course is intended to follow EMEN 5040, where students will have been expected to master the content associated with:

- the history and theory of the quality sciences in the United States;
- the role of Quality in creating value, strategic differentiation, and maintaining a viable value proposition;
- modern theories associated with the meaning of Quality, loss, and profitability; and
- Dr. W. Edwards Deming's theories of management and Profound Knowledge.

Students will also be expected to have knowledge of the material associated with EMEN 5005 – Introduction to Applied Statistics; or to have successfully completed this course.

In this course, we will investigate in depth the basic concepts, tools, and techniques used in the management and measurement of Quality, productivity, and competitiveness in an international environment. Topics will include basic statistics and probability (review); process variation; statistical process control charting for process, product, and management systems; the analysis of process, product, and system capability; and an introduction to the topic of Experimental Design / Design of Experiments (EXD/DOE) in business and industry. Time permitting, additional tools associated with the quality sciences (e.g. QFD, FMEAs, FMECAs) will be reviewed.

These topics will be explored through the examination of specific examples and case studies from companies such as Anheuser-Busch, Earthgrains, ALCOA, Molex, IBM, Applied Magnetics, Sheldahl, Inland Steel, Ford Motor Company, Motorola, Whirlpool, General Electric, Sun Microsystems, and Boeing. All of the data sets employed in this course, whether presented as part of a PowerPoint lecture, or provided to the students for self-reviews or homework assignments, are actual data sets collected from applications in Fortune 500 businesses.

2. Course Objectives

On a broad level, each student mastering the content in this course will be capable of describing, employing, and consuming data associated with the major tools of the Quality Sciences. Specifically, as a result of successfully completing this course, students will be capable of:

a) Describing a Process;
b) Describing how basic laws of probability and descriptive statistics apply to Common and Special Causes of Variation affecting processes;
c) Selecting, constructing, and interpreting Statistical Process Control (SPC) charts for Variables data;
d) Selecting, constructing, and interpreting Statistical Process Control (SPC) charts for Attributes data;
e) Conducting process capability studies, including the proper selection and calculation of standard performance and capability indices;
f) Explaining the difference between a Research and Experimental design;
g) Explaining the difference between Enumerative and Analytic studies;
h) Defining the nature, purpose, and conditions required to execute an Experimental Design in industry, and identify the major types of Experimental Designs available;
i) Explain the inter-relationship between Descriptive and Inferential Statistics, Experimental Designs, and Sampling Procedures;
j) Describe the differences in experimental design approaches / requirements associated with the identification of Special versus Common causes of variation;
k) Describe the applications of Experimental Design and Statistical Process Control in the Problem-Solving and Quality Improvement Strategies;
l) Describe some of the other major tools and methods utilized in the quality sciences for quality improvement, problem-solving, reliability improvement, cost reduction, supply chain management, and customer satisfaction improvement.

3. Instructor

Steven Ouellette, MSc
Engineering Center - ECOT 533
Office Hours : Wednesday 1:00 – 4:00 pm
Other days and times by appointment/arrangement
E-mail : Steven.Ouellette@colorado.edu
Office Phone : 303-492-4914

4. Textbook / Software / References

The textbook for this course is:

Gitlow, H., Oppenheim, A., Oppenheim, R., Levine, D. *Quality Management*. 3rd Edition, McGraw-Hill/Irwin, 2005. ISBN 0-07-366263-1

During the course, students will be required to generate and interpret statistical process control charts, perform capability studies, and generate various descriptive statistics for self-reviews, homework, and exams. The software we will use for this purpose is **MVPStats**.

To obtain this software, it is important to download the software from the following URL:

http://www.mvpprograms.com/html/student.html

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 periodically, also resident on many of the computers in the Engineering building, will be SPSSPc for Windows. SPSSPc 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 Graduate Version/Pack can be purchased from a number of sites. The lowest price I have identified for the Graduate Version/Pack is for $190-$210, with a perpetual license at JourneyEd: http://www.journeyed.com/ . The SPSSPc Graduate Version can also be leased for a 6 or 12 month period from: http://www.e-academy.com/. The last time I checked, a 6 month lease was $80.

If you intend to take EMEN 5610 and 5620 in the future, you should probably invest in this (SPSSPc) program in addition to MVPStats. If you have access to equivalent programs (e.g. SAS, Minitab, Excel Add-Ins such as PhStat) and wish to use them instead of obtaining SPSSPc, that is up to you. All of the homework assignments, self-review problems, and exams can be completed using MVPStats alone, so if you are going to purchase only one program, purchase MVPStats.

The text for this course displays the use of Minitab, which is also an acceptable package. However, use and applications associated with Minitab will not be presented / taught in this course.

Regardless of which package is selected, if an alternative package to MVPStats is selected, it is the sole responsibility of the **student** to confirm that the package

performs all of the necessary functions as MVPStats; and that identical answers are generated.

Optional readings will also be identified from time-to-time by the instructor to enhance your understanding of the content presented. It will be the student's responsibility to decide which, if any, of these materials are reviewed.

5. **Course Website**

All students must register on the web at XXXXXXXXXXXXXXXX for access to eCompanion (look for the *register* link). ALL of the lectures and materials used in this course are contained on this website; all of the communication during the semester including announcements, due dates, etc. will take place via the ECollege website utilities.

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 you CU e-mail address for this purpose (e.g. typically, 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 during the conduct of the course. 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 to you, 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.

6. Course Requirements

There will be two (2) equally-weighted examinations covering the following material:

1. Fundamentals & Foundations of Quality
    - Understanding Variation
    - Process Documentation & the SIPOC Model
    - Basic Statistical Methods & Probability Distributions
    - Displaying Sample Data
    - Generating Point and Confidence Interval Estimates
    - Principles of Process Variation
    - Problem-Solving versus Quality Improvement

2. Statistical Process Control & Capability Analyses
    - Nature & Use of Process Control Charts
    - Control Chart Selection & Interpreting Out-of-Control Conditions
    - Variables Control Charts – Construction & Interpretation
    - Attributes Control Charts – Construction & Interpretation
    - Performing Capability Studies for Variables Data Applications
    - Performing Capability Studies for Attributes Data Applications
    - Performance & Capability Indices – Use, Interpretation, Cautions

The exams will be open-book, open-notes, open computer. In other words, you may use any references you wish, as long as you work alone.

To assist you in performing well on the exams, there will be five (5) homework exercises assigned during the semester. These exercises will be 'assigned' at the end of each major content section. These exercises will not be submitted for grading, and are intended to allow you to confirm you have mastered the material taught in preparation for the exams. Correct answers to the exercises, as well as the assignments themselves, will be posted on the course website.

Final grades will be assigned on the following basis:

- ✓ Mid-Term Examination: 50%
- ✓ Final Examination: 50%

Specifically, for purposes of illustration, the final grade will be calculated by assigning the weighted averages of the scores received.

Let's use the grades earned by a student in the past as an example:

Mid-Term Examination: B- = 2.7
Final Examination: A+ = 4.3

Final Grade GPA Calculation : (0.50*2.7) + (0.50*4.3) = 3.50

Final Letter Grade Calculation: A-

which is found by applying the calculated GPA value to the scale which follows:

3.85 - 4.3000	A	
3.50 - 3.8499	**A-**	(the category within which the sample GPA value falls)
3.15 - 3.4999	B+	
2.85 - 3.1499	B	
2.50 - 2.8499	B-	
2.15 - 2.4999	C+	
1.85 - 2.1499	C	
1.50 - 1.8499	C-	
1.15 - 1.4999	D+	
0.85 - 1.1499	D	
0.70 - 0.8499	D-	
< 0.70	F	

Although this is the way the grade is calculated, your GradeBook in ECollege will display your grade calculations in a slightly different way; although the result will be exactly the same when the final grade is generated. Using the same sample grades as previously displayed, ECollege will display the following results:

Examinations
B- = 2.7/4 = 67.5%
A+ = 4.3/4.0 = 107.5%

Final Course Grade = ((5*.675)+(5*1.075)) / 10 = .875

To convert this value into a GPA equivalent, simply multiply 4.00 (the maximum final GPA equivalent grade – A – that can be earned per CUB guidelines) by the weighted proportion above:

0.875 * 4.00 = 3.50 which was exactly the calculation previously shown. Applying this calculated value to the GPA table above, the final grade earned is A-; again, the same grade previously displayed.

7. A Note on Academic Honesty & Plagiarism

I am certain that the following statement is unnecessary in a course of this nature. However, please be advised that exams submitted by any student, completed in part or in whole by someone other than that student, including unauthorized assistance, shall be considered to constitute fraud under the University Honor Code, and will result in the assignment of an 'F' for the entire course, and an appropriate report of the incident to the University Honor Code Council will be processed. Students are expected to affirm the following for all work submitted in completion of the requirements for this course: "*On my honor, as a University of Colorado at Boulder student, I have neither given nor received unauthorized assistance on this work.*"

8. Tentative Content Outline, Lectures, & Assigned Reading

Lecture Topic	Textbook Assignment (Required)	Want To Learn More? (Optional Support Reading)
Introduction to the Course & Course Requirements * Syllabus * Content Outline * Homework Assignments * Examinations * Suggested Support References Introduction to the Instructor * Background & Experience * Case Study & Data File Sources	N.A.	N.A.
Foundations of SPC & DOE * Tools, Methods, and Strategies * Types of Data and Measurement * Introduction/Overview: Descriptive Statistics & Probability * Introduction/Overview of Estimation	Chapters 3, 4 & 5	*Process Quality Management & Improvement Guidelines*, AT&T, Issue 1.1 *Statistical Methods for Quality Improvement*, H. Kume, AOTS
Understanding Variation : Principles, and General Methods * Types of Variation * Methods of Measurement * Variation in Administrative Applications * Variation in Production Systems * Variation in Service Systems * Product versus Process Control * Out-of-Control Conditions & Patterns	Chapters 6 & 9	*Understanding Variation : The Key to Managing Chaos*, D. Wheeler, SPC Press

Lecture Topic	Textbook Assignment (Required)	Want To Learn More? (Optional Support Reading)
Introduction to Variables Control Charts * Selecting the Correct Control Chart * Rational Subgrouping * X-Bar & R Charts * X-Bar & s Charts	Chapter 8	*Quality With Confidence in Manufacturing*, J. Luftig, SPSS, Inc. *Quality Control Handbook*, J. Juran, McGraw-Hill *Elementary Statistical Quality Control*, I. Burr, ASQC Quality Press *Statistical Process Control Methods*, G. Griffith, ASQC Quality Press
Advanced Topics – Variables Control Charts * X & Moving R Charts * Control Limit Calculations / Examples for Non-Normal Distributions * Trend Charts		
Introduction to Process Capability * Control Limits vs. Process (Natural Tolerance) Limits vs. Specification Limits * Process Capability Analysis for Variables Data – Normal Distributions * Performance and Capability Indices; - P_p; P_pU; P_pL; $P_{pk;}$ P_{pm} - $C_{p;}$ C_pU; C_pL; $C_{pk;}$ C_{pm} And why the C_{pm} is the only *true* Capability Index	Chapter 11	*How to Test Normality and Other Distributional Assumptions*, Samuel S. Shapiro, ASQC Statistics Division *User's Manual*, SPSSPc Quality Analyst

Lecture Topic	Textbook Assignment (Required)	Want To Learn More? (Optional Support Reading)
Introduction to Attribute Control Charts; Attribute Charts for Non-Conforming Units (Defectives) * Selecting the Correct Control Chart * the p chart (equal and unequal n) * the np chart	Chapter 7	*Quality With Confidence in Manufacturing*, J. Luftig, SPSS, Inc. *Quality Control Handbook*, J. Juran, McGraw-Hill *Elementary Statistical Quality Control*, I. Burr, ASQC Quality Press *Statistical Process Control Methods*, G. Griffith, ASQC Quality Press
Attribute Charts for Nonconformities (Defects / Counts) * the c chart * the u chart * special purpose attribute charts		
Introduction to Design of Experiments (DOE/DOX/EXD) * The Inter-Relationship Between Experimental Design and Inferential Statistics * The Nature and Purpose of a Research Design * Types of Research Designs * Types of Experimental Designs – Flawed and Robust * Lessons from the Front: Case Studies in the Application of Experimental Designs for Quality Improvement and Problem-Solving	Chapter 12	*Design of Experiments in Quality Engineering*, J. Luftig & V. Jordan, McGraw-Hill / Irwin Publishing Company *Statistics for Experimenters*, Box, Hunter, and Hunter, John Wiley Publishing Company

9. Additional Course Clarifications Recommended for Inclusion by the University of Colorado – Boulder and the Engineering Management Program

UNIVERSITY PROVISIONS AND REQUIREMENTS

1. If you qualify for accommodations because of a disability, please submit a letter to the instructor from Disability Services in a timely manner so that your needs may be addressed. Disability Services determines accommodations based on documented disabilities. For further information, see www.Colorado.EDU/disabilityservices, contact 303-492-8671, or visit Willard 322.

2. 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.

3. Students and faculty each have responsibility for maintaining an appropriate learning environment. Students who fail to adhere to such behavioral standards may be subject to discipline. Faculty have the professional responsibility to treat all students with understanding, dignity and respect, to guide classroom discussion and to set reasonable limits on the manner in which they and their students express opinions. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with differences of race, culture, religion, politics, sexual orientation, gender variance, and nationalities. See polices at http://www.colorado.edu/policies/classbehavior.html and at http://www.colorado.edu/studentaffairs/judicialaffairs/code.html#student_code

4. Academic Honesty & Plagiarism: 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, he/she should review the CU Honor Code on this topic, and / or refer to either or both of the following excellent sources:

   http://www.georgetown.edu/honor/plagiarism.html

   http://www.northwestern.edu/uacc/plagiar.html

Information on the CU Honor Code can be found at
http://www.colorado.edu/policies/honor.html and at
http://www.colorado.edu/academics/honorcode /

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.

5. 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/

6. 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 provided within the program.

7. 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.