

SIX SIGMA FOR CONTINUOUS IMPROVEMENT AND DESIGN ONLINE SYLLABUS

Course ID: MATH 737/837

FALL 2019

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Course Overview

Six Sigma is a popular, data-focused methodology used worldwide by organizations to achieve continuous improvement of their existing processes, products and services or to design new ones. This one-semester course provides a thorough education in the Six Sigma principles, methods, and applications for continuous improvement (DMAIC process) and some background in Design for Six Sigma (DFSS) will be provided. The coverage will include both manufacturing and non-manufacturing (transactional Six Sigma) applications. Emphasis will be placed on the use of case studies to motivate the use of the Six Sigma methodology and to teach proper application of Six Sigma. We will also cover the basic principles of lean manufacturing, which is used to eliminate waste from manufacturing and service processes. Lean and Six Sigma are often used in combination.

Course Format

This course is taught online in an asynchronous format, which means that there are no regularly scheduled class sessions. For those off campus a trip to Durham is not required to successfully complete the course. The course materials are delivered through a series of Learning Modules; each module focused on a different set of topics related to Six Sigma and continuous improvement. All course lecture materials are delivered through Videos, many of which are made by the instructor and some are Youtube videos. Links to the videos are provided with each associated learning module. In addition instructor created notes are provided with each learning module.

Prerequisite

I am not enforcing prerequisites for this course other than you must have at least Junior academic standing to enroll; however a basic, introductory course in statistics is helpful, but not required to successfully complete the class. Undergraduates enroll in Math 737 and Graduate students in Math 837.

Textbook

One book will be used during the semester. The book is “Visual Six Sigma: Making Data Analysis Lean” by Cox, et. al., first edition. There is a similar second edition, but I will use the first. A free e-book link is available through the library for the second edition only; use the following link (you will probably have to login with your UNH ID to access the book) <https://ebookcentral.proquest.com/lib/unh/detail.action?docID=4537251&query=visual+six+sigma> (you will most likely be prompted to login). The first edition is still available through some retailers and the second edition is readily available and as I mentioned similar to the first edition – **either edition will work**. The book is not very expensive if you wish to purchase a copy (e.g., https://www.amazon.com/Visual-Six-Sigma-Making-Analysis/dp/0470506911/ref=sr_1_2?s=books&ie=UTF8&qid=1503773196&sr=1-2&keywords=visual+six+sigma+making+data+analysis+lean).

Software

The JMP Pro 14 statistical software is fully integrated into the course and students will need the software to complete many assignments. The software is available as a free download for UNH students and faculty. Please go to the following link and follow the directions to download and install JMP; <https://td.unh.edu/TDClient/KB/ArticleDet?ID=770>.

Statistical Thinking for Industrial Problem Solving (STIPS)

STIPS is a new free, online course in statistics with a focus on industry that has been created by the SAS Institute (JMP is a division of SAS). Your instructor was very much involved in the design and the content of the course. You can learn about the course and watch an introductory video at the link https://www.jmp.com/en_us/statistical-thinking.html. Some of the modules in the STIPS course will be assigned as a part of this course. More details on STIPS will be provided when modules are assigned. Remember the course is free and is quite comprehensive; we will not cover the entire the course content, but will cover quite a few of modules. For each assigned module one has to successfully pass an online module quiz for which the

SIX SIGMA FOR CONTINUOUS IMPROVEMENT AND DESIGN ONLINE SYLLABUS

Course ID: MATH 737/837

FALL 2019

student is awarded a e-**Badge**; you will be required to upload the **Badge** to the Canvas course to receive credit for the module – instructions will be provided during the semester. For those who might be interested, if you complete all of the STIPS modules it is possible to become certified. The course also has a JMP Learning Lab where you can gain more experience in how to use JMP for analyses. You may use your own copy of JMP (preferred) doing the course or a server version is available through the course site.

Learning Objectives

Six Sigma and Lean skills are highly valued by employers across a wide range of disciplines including: manufacturing, microelectronics, chemicals, pharmaceuticals, healthcare, and biotechnology; and many more. Students successfully completing the class will be able to:

- Understand and apply the fundamental concepts of continuous improvement and lean using the Six Sigma DMAIC paradigm.
- Understand what constitutes a good project and how to create a project charter, problem statements, objectives, and identify proper key performance indicators.
- Know how to visualize a process or system with process maps, value stream maps, and SIPOC models.
- Know how to explore data to learn about processes and find potential causal relationships.
- Know how to use Statistical Process Control to assess process performance over time and baseline current state performance.

- Examine data for quality issues and learn how to evaluate the capability of measurement systems.
- Use powerful statistical tools to find root causes of quality problems and evaluate possible solutions.
- Evaluate potential solutions and perform a risk assessment before implementation.
- Develop implementation plans to improve quality.
- Develop control strategies to maintain and assess process improvements after implementation.

Course Structure

The class will be delivered through the use recordings of lectures made by the instructor and some from YouTube sources.

<i>Course Navigation</i>	<i>Description</i>
Home Page	Regular class announcements regarding assignments, overall class progress or messages and information and reminders about upcoming events or assignments.
Course Information	The syllabus, course schedule and other key class documents are located here.
Learning Modules	This area contains the weekly Modules. The majority of course content, activities, assignments and participation is located in this area. See below for structure
STIPS and Short Quizzes	Occasionally short, online quizzes will be posted on myCourses through the Learning Modules and students will typically have a 48-hour window in which to complete the quiz. These are given to encourage students to stay engaged in the course. The quizzes are to be done individually and students are not to collaborate in completing them. In addition, assigned STIPS modules must be successfully completed and involve taking an online quiz at the end of each assigned module.
Homework	Homework will be assigned regularly to assess class learning and motivate class participation. These assignments will be posted on myCourses through the associated Learning Module and students given sufficient time to complete them.

SIX SIGMA FOR CONTINUOUS IMPROVEMENT AND DESIGN ONLINE SYLLABUS

Course ID: MATH 737/837

FALL 2019

<i>Module Structure</i>	
Lecture	The lectures will primarily be made using recordings made by the instructor and occasionally relevant Youtube videos.
Resources (or Review)	PDFs of course notes will be distributed to the class via myCourses and readings from the notes will be assigned for each module.
Participation	Students are expected to participate by watching recordings in a timely fashion, read notes available for each module, and take part in discussion forums as they are assigned. Also, completion of the assigned STIPS modules in a timely manner as evidenced by earning the Badge for each module.
Assignments	Graded homework assignments will be given and a final team project based on a comprehensive designed experiment will be required. All assignments are to be completed in a timely fashion and submitted electronically in PDF format through the original Assignment location on myCourses. Hand written assignments are no longer accepted.

Grades

The final grade is based upon the final exam (take home), participation in discussion forums, completion of the homework, quizzes, and completion of STIPS modules.

Item	% or points	Requirements
STIPS & Quizzes	30%	Number of quizzes will be determined during the semester
Class Participation	10%	Participation in Discussion forums when assigned.
Homework	30%	Your solutions for the homework are to be submitted electronically via myCourses; simply upload your completed assignment through the original assignment posted on myCourses. Electronic submittals for regular homework must be in PDF format. Uploading the assignments via myCourses is important for grading purposes.
Final Exam	30%	Take home exam that will also be submitted electronically through myCourses.

Policy on Late Submissions and Quizzes

- An assignment can be submitted late up to one week after the due date if sufficient reason is given for the lateness.
- Quizzes deployed through myCourses will be locked after the due date and will not be reopened, so students must complete the online quiz within the allotted time and typically will be given two opportunities to complete each quiz.

Student to Instructor Communication Expectations

Questions related to assignments should be directed to me via email or virtual office hours. Email communication should be concise and focused as I tend to receive a great deal of email and do not have the bandwidth to read long rambling communications. As an example, if you have a homework question clearly state the exact item (in words) in the homework (do not just say question 2) you have a question about and be very clear as to what you want to know. Of course, I will not give explicit answers to homework problems so questions should be for clarification or direction in working to a solution. Also, please do not send attachments via email asking to me to examine partial or complete solutions to homework for correctness. I will not provide feedback on such attachments if they are sent to me.

Course Schedule by Module (This is a preliminary schedule for planning purposes only, actual coverage and assignments will vary during the semester)

<i>Week</i>	<i>Date</i>	<i>Topics Covered</i>	<i>Assignments and Due Dates</i>
One & Two	Aug 26 – Sep 09	Module 1: Learn JMP Module 2: Define Phase Part 1, Overview of Six Sigma, Lean Principles, Project Charters,	<ul style="list-style-type: none">• Watch assigned Module 1 videos on JMP• Do assigned readings for Module 2• Watch assigned videos for Module 2• Complete Homework Assignment #1
Three & Four	Sep 09 – Sep 23	Module 3: Define Phase Part 2, Basic Statistics for Six Sigma	<ul style="list-style-type: none">• Complete Module 3 assigned readings• Watch assigned Module 3 videos• Complete quiz for Module 3
Five	Sep 23 – Sep 30	Module 4: Define Phase Part 3, Exploring Data	<ul style="list-style-type: none">• Complete Module 4 assigned readings• Watch assigned Module 4 videos• Complete Homework Assignment #2

SIX SIGMA FOR CONTINUOUS IMPROVEMENT AND DESIGN ONLINE SYLLABUS

Course ID: MATH 737/837

FALL 2019

Six	Sep 30 – Oct 07	Module 5: Measure Phase Part 1: Measurement Systems Analysis	<ul style="list-style-type: none"> • Complete Module 5 assigned readings • Watch assigned Module 5 videos • Complete Homework Assignment #3
Seven	Oct 07 – Oct 14	Module 6: Measure Phase Part 2: Process Capability	<ul style="list-style-type: none"> • Complete Module 6 assigned readings • Watch assigned Module 6 videos • Complete Homework Assignment #4
Eight	Oct 14 – Oct 21	Module 7: Analyze Phase Part 1, Statistical Intervals and Hypothesis testing for Six Sigma	<ul style="list-style-type: none"> • Complete Module 7 assigned readings • Watch assigned Module 7 videos • Complete quiz for module 7
Nine and Ten	Oct 21 – Nov 04	Module 8: Analyze Phase Part 2, Comparing Populations in Six Sigma	<ul style="list-style-type: none"> • Complete Module 8 assigned readings • Watch assigned Module 8 videos • Complete Homework Assignment #5
Eleven	Nov 04 – Nov 11	Module 9: Analyze Phase Part 3, Inference for nominal data, Partition Analysis, Simple Regression	<ul style="list-style-type: none"> • Complete Module 9 assigned readings • Watch assigned Module 9 videos • Complete Homework Assignment #6
Twelve	Nov 11 – Nov 18	Module 10: Improve Phase Part 1, Design of Experiments	<ul style="list-style-type: none"> • Complete Module 11 assigned readings • Watch assigned Module 11 videos • Complete Discussion Forum assignment
Thirteen, (Thanksgiving week), Fourteen	Nov 18 – Nov 25	Module 11: Improve Phase Part 2, Solution Selection and Implementation.	<ul style="list-style-type: none"> • Complete Module 12 assigned readings • Watch assigned Module 12 videos • Complete Discussion Forum assignment
Fourteen	Dec 02 – Dec 09	Module 12: Control Phase Activities Distribute, Final Exam and finish up any loose ends from the semester	<p style="text-align: center;">Cover any loose ends from semester</p> <ul style="list-style-type: none"> • Complete Module 13 assigned readings • Watch assigned Module 13 videos • The final exam is due by the end of day Dec 11th. Further details will be provided during the semester.

Tentative Outline of Course Topics Arranged by DMAIC phase or stage (please be aware that many topics will occur in more than one stage)

Define

- Six Sigma and Lean Overview, Project Selection and Definition.
- The DMAIC process for continuous improvement and DMADV process for design.
- Six Sigma roles and responsibilities.
- Voice of the Customer and introduction to Quality Function Deployment and identification of Critical to Quality characteristics (CTQs).
- Project Charter creation and Key Performance Indicator (KPI) identification.
- Basic team building and tools.
- Process visualization with SIPOC Models, Process Mapping, Value Stream Mapping, Cause and Effect (Ishikawa) Diagrams, Affinity Diagrams (the list is not exhaustive).

Measure

- Understanding types of process variation: common cause, special cause, and systematic. Dangers of process tampering.
- Basics of probability distributions with emphasis on the Normal.
- Statistical Process Control (SPC) to assess process stability, baseline current process behavior.
- Accessing or collecting data and pre-processing data prior to formal analysis, identifying data quality issues.
- Exploring, Visualizing, and describing data.
- Basic one-sample statistical inference (statistical intervals and tests).
- Measurement Systems Analysis (MSA).
- Process Capability Analysis (current baseline performance) , including process capability indices, PPM defect rates, and sigma quality level metrics.

Analyze

- Two and multiple sample inference (e.g., ANOVA)
- Statistical Modeling including Simple and Multiple Linear

SIX SIGMA FOR CONTINUOUS IMPROVEMENT AND DESIGN ONLINE SYLLABUS

Course ID: MATH 737/837

FALL 2019

Regression, Logistic Regression and CART to identify causal relationships.

- Introduction to Design of Experiments and Optimization for validation of causal relationships and verification of potential solutions.
- Basic non-statistical root cause analysis and concepts.

Improve

- Improve phase activities
- Use of tools such as brainstorming, multivoting, and nominal group techniques for identifying solutions and improvements (note many of these topics were also covered in the Define phase).
- Solution selection matrices (Pugh matrices) and selection criteria.
- ROI analysis for identified solutions.
- Optimization of a solution using statistical tools and models.
- Implementation and Communication plans.
- Mistake Proofing and FMEA

Control

- Control phase activities
- Process Control plans.
- Out of control action plans (OCAP).
- Implementation of SPC for KPIs, CTQ's, and other key process input and output variables.
- SPC to monitor process stability and maintenance.
- Assess process capability after implementation of improvements (previously discussed in the Measure phase).
- Final process and project documentation.
- Transfer plans: from project team to a

Green Belt Certification

Students who successfully pass Math 737/837 and subsequently pass a 100 question Certification Exam, will be certified as Six Sigma Green Belt practitioners. The exam is typically offered following the end of the semester in which Math 737/837 is offered. The exam is online and open book. Details will be provided during the semester.

University Disability Accommodations

The University is committed to providing students with documented disabilities equal access to all university programs and facilities. If you think you have a disability requiring accommodations, you must register with Disability Services for Students (DSS). Contact DSS at (603) 862-2607 or disability.office@unh.edu. If you have received Accommodation Letters for this course from DSS, please provide me with that information privately in my office so that we can review those accommodations. Of course, you should always feel free to discuss any disability issues with me and all such conversations are kept in strict confidence.

Emotional or Mental Health Distress: Your academic success in this course is very important to me. If, during the semester, you find emotional or mental health issues are affecting that success, please contact the University's [Counseling Center](#) (3rd fl, Smith Hall; 603 862-2090/TTY: 7-1-1), which provides [counseling appointments](#) and other [mental health services](#) .

Academic Honesty and Plagiarism

Students are required to abide by the UNH Academic Honesty as described in the student handbook . Students are expected to submit their own original work and further guidelines will be issued with specific assignments during the semester; plagiarism will not be tolerated, especially copying homework from one another and cheating on quizzes. The rules will be enforced. An important links on academic honesty is given below

<https://www.unh.edu/student-life/09-academic-honesty>