Course Syllabus

General Information

Course Number: InIn 6078
Course Title: **Quality Control Systems**
Credit-Hours: Three

Course Description

Advanced topics in statistical process control. Design of control charts. EWMA charts. The SPRT and its applications in quality engineering: CUSUM and continuous sampling plans. Multivariate control charts. Principles of quality engineering and Taguchi methods. The loss function and its applications to multiresponse experiments.

Prerequisites

Authorization of the Director of the Department.

Textbook and References

Texts:
Books:

☐ Montgomery, D. 2013, Introduction to Statistical Quality Control. 7th Edition. John Wiley and Sons.
☐ Montgomery, D. and Runger, G. 2011, Applied Statistics and Probability for Engineers. 5th Edition John Wiley and Sons.
☐ Mitra, A. 2016, Fundamentals of Quality Control and Improvement. 4th Macmillan Publishing Co. New York.
☐ Phadke, M.S.1989, Quality Engineering Using Robust Design. Prentice Hall.
☐ Anderson, T. W. 2003, An Introduction to Multivariate Statistical Analysis. 3rd Edition. John Wiley and Sons.
☐ Kolarick, W 1999, Creating Quality Process Design for results. MacGraw-Hill.
☐ Duncan, A.1986, Quality Control and Industrial Statistics. 5th Edition. Irwin, Homewood IL.
☐ Hogg R. and Ledoter, J. 1987, Engineering Statistics. Macmillan Publishing Co. New York.

Journal Articles

☐ Artiles-León, N. 1996, A Pragmatic Approach to Multiple-Response Problems Using Loss Functions. Quality Engineering. 9(2), 213-220.
☐ Artiles-León, N. 1995, Simple Formulas for Statistically Designing Control Charts with Supplementary Stopping Rules. Quality Engineering, 7(4) 719-731.
☐ Artiles-León, N., David, H. T., and Meeks, H. D. 1996, Statistical Optimal Design of Control Charts with Supplementary Stopping Rules. IIE Transactions, 28, 225-236.
☐ Artiles-León, N. and Pérez-Matos, R. 1993, Optimization of Average-Run-Length Properties of Control Charts using Recurrent Events. Computers and Industrial Engineering. Vol. 25, 449-452.
☐ Crowder, S. V. 1987, Average Run Length of Exponentially Weighted Moving Average Control Charts. Journal of Quality Technology, 19 (3), 161-164.

Journal Articles (Cont.)

☐ Crowder, S. V. 1987, A Simple Method for Studying Run-Length Distributions of Exponentially Weighted Moving Average Charts. Technometrics 29(4), 401-407.
☐ Crowder, S. V. and Hamilton, M. D. 1992, An EWMA for Monitoring a Process Standard Deviation. Journal of Quality Technology. 24(1), 12-21.

☐ Hunter, J.S. 1986, The Exponentially Weighted Moving Average. Journal of Quality Technology, 18 (4), 203-209.

☐ Lorensen, T.J. and Vance, L.C. 1986, The Economic Design of Control Charts: A Unified Approach. Technometrics, 28(1), 3-10.

☐ Mason, R. L., Tracy, N. D., and Young, J, C. 1997, A Practical Approach for Interpreting Multivariate Control Chart Signals. Journal of Quality Technology. 29(4), 396-406.

☐ Pignatiello, J. J. 1988, An Overview of the Strategy and Tactics of Taguchi. IIE Transactions, 20(3).

☐ Sauers, D. G. 1997, Hostelling=s T5 Statistic for Multivariate Statistical Process Control: A Nonrigorous Approach. Quality Engineering, 9(4) 627-637.

Purpose

This is a course primarily designed for graduate students whose major concentration is quality control. It is appropriate for engineering graduate students with interests in advanced quality control and Taguchi techniques applied to manufacturing and service industries. The purpose of the course is to prepare each student for (i) the statistical analysis of common quality control charts and procedures; (ii) mastering the basic principles of quality engineering and robust design and (iii) conducting meritorious research in quality engineering. This course is a requirement in the quality control options of the M.S. in Industrial Engineering and the M.E. in Industrial Engineering.

Course Goals

After completing this course, students should
- ☐ Understand the mathematical and statistical basis for the most common quality control procedures and their desirable properties.
- ☐ Be familiarized with current quality-control literature and develop skills to do research in the area of quality control.
- ☐ Understand the modern concepts and apply the modern tools of statistical-aided manufacturing and the new vision and realities of the quality-engineering profession.

Requirements

All students are expected to come to class all the time, on time, and prepared; do all assigned readings and related homework; actively participate in class discussions; and satisfy all assessment criteria to receive credit for the course.

Department and Campus Policies

Class attendance: Class attendance is compulsory. The University of Puerto Rico, Mayagüez Campus, reserves the right to deal at any time with individual cases of non-attendance. Professors are expected to record the absences of their students. Frequent absences affect the final grade, and may even result in total loss of credits. Arranging to make up work missed because of legitimate class absence is the responsibility of the student. (Bulletin of Information Undergraduate Studies)

Absence from examinations: Students are required to attend all examinations. If a student is absent from an examination for a justifiable reason acceptable to the professor, he or she will be given a special examination. Otherwise, he or she will receive a grade of zero of "F" in the examination missed. (Bulletin of Information Undergraduate Studies)

Final examinations: Final written examinations must be given in all courses unless, in the judgment of the Dean, the nature of the subject makes it impracticable. Final examinations scheduled by arrangements must be given during the examination period prescribed in the Academic Calendar, including Saturdays. (see Bulletin of Information Undergraduate Studies).

Partial withdrawals: A student may withdraw from individual courses at any time during the term, but before the deadline established in the University Academic Calendar. (see Bulletin of Information

Undergraduate Studies).

Complete withdrawals: A student may completely withdraw from the University of Puerto Rico, Mayagüez Campus, at any time up to the last day of classes. (see Bulletin of Information Undergraduate Studies).

Disabilities: All the reasonable accommodations according to the Americans with Disability Act (ADA) Law will be coordinated with the Dean of Students and in accordance with the particular needs of the student.

Ethics: Any academic fraud is subject to the disciplinary sanctions described in article 14 and 16 of the revised General Student Bylaws of the University of Puerto Rico contained in Certification 018-1997-98 of the Board of Trustees. The professor will follow the norms established in articles 1-5 of the Bylaws.

General Topics

Lecture	Topic
I. Advanced Aspects of Process Control	
1-3	Introduction. Review of control charts. Properties of control charts: The OC and the ARL curves.
4	Control charts with supplementary stopping rules. Introduction to Markov chains.
5-7	Calculation of the ARL of control charts with supplementary stopping rules using Markov chains.
8	Statistical design of control charts
9	Economic design of control charts
10-12	The EWMA control chart. ARL properties.
13-16	The SPRT and its applications to quality control (CUSUM and sequential sampling)
17	The multivariate normal distribution.
18-20	Multivariate control charts for measurement data
21-24	Acceptance sampling by variables.
II. Quality Engineering and Robust Design	
25	Introduction to quality engineering
26-28	Principles of quality engineering
29-31	Matrix experiments using orthogonal arrays
32	Robust design
33-36	Signal-to-noise ratios. Achieving activity
37-40	Optimization of multi-response problems using loss functions