Course Syllabus

General Information

    Course Number: InIn 6046
    Course Title: **Advanced Industrial Experimentation**
    Credit-Hours: Three

Course Description

Applications, analogies and differences among confidence intervals, prediction intervals, and tolerance intervals. Fundamental concepts and applications of response surface methodology and evolutionary operations to manufacturing processes. Case study of manufacturing experiments with dichotomous or polytomous response variables. Use of logistic regression for modeling the relationship between a categorical variable and a set of covariates. Effective modeling strategies and the interpretation of results are emphasized. Fundamental concepts in the design and analysis of experiments with mixtures. Statistical data analysis.

Prerequisites

    ININ 6005 – Experimental Statistics
    Authorization of the Department Director.

Suggested Textbook and References

- Hahn, G.J. and Meeker, W.Q., Statistical Intervals: a Guide for Practitioners, John Wiley and Sons, New York. (ISBN: 0471887692)
- Agresti, A., 2002, Categorical Data Analysis, John Wiley and Sons, New York. (ISBN: 0471360937)
- Artiles-León, N., 1993, Reducing Label Nonconformances by DOE and Logistic Regression, 47th. ASQC Quality Congress Transactions, Boston.
- Artiles-León, N. 1996, AA Pragmatic Approach to Multiple-Response Problems Using Loss Functions@, Quality Engineering. Vol 9 No 2.
- Bingham, D.R. and Sitter, R.R, Design Issues in Fractional Factorial Split Plots. Journal of Quality Technology, 33(1), pp. 2-15
- Myers, R. H., and Montgomery, D. C., 2002, Response Surface Methodology: Process and Product Optimization Using Designed Experiments, 2nd Edition, John Wiley and Sons.
- Box, G.E.P. and Draper, N.R., 1998, Evolutionary Operations, John Wiley and Sons, New York. (ISBN: 0471255513)
- Cornell, J.A., 2002, Experiments With Mixture, 3rd Edition, John Wiley and Sons, New York, (ISBN: 0471393673)
- Cornell, J.A., 1990, How to Run Mixture Experiments For Product Quality, ASQC Press. (ISBN: 0873890213)
- Cornell, J.A., 1990, How to Apply Response Surface Methodology, ASQC Press. (ISBN: 0873890663)
- Draper, N., and Smith, H., 1998, Applied Regression Analysis, 3rd Edition, John Wiley and Sons, New York. (ISBN: 0471170828)
- Huang, P., Cheng, D., and Voelkel, J.O, Minimum Aberration TwoLevel Split Plot Design. Tecnometrics, 40(4), pp. 314-326
- Khuri, A.I. and Cornell, J.A., 1996, Response Surface, Design and Analysis, 2nd Edition, CRC. (ISBN: 0824797418)
- Mason, R.L., Gunst, R.F., and Hess, J.L., 2003, Statistical Design and Analysis of Experiments, John Wiley and Sons, New York. (ISBN: 0471372161)
- Montgomery, D.C., 2004, Design and Analysis of Experiments, 6th Edition, John Wiley and Sons, New York. (ISBN: 047148735X)
- Myers, R.H., 2000, Classical and Modern Regression with Applications, 2nd Edition, Duxbury Press. (ISBN: 0534380166)
- Nelson, L.S. Transformation for Attribute Data, Journal of Quality Technology, 15, pp. 55-56.
- Pignatiello, J. J. Jr., May 1993, Strategies For Robust Multiresponse Quality Engineering, IIE Transactions,, 25(3), pp. 5-15.

Purpose

This course is primarily designed for majors in Industrial Engineering (IE) at the graduate level; however, it is appropriate for science and engineering graduate students interested in experimental design. The purpose of the course is to prepare students for: i) mastering the theoretical and applied framework to design, conduct, and analyze specialized experimental designs such as: response surfaces, mixture experiments, categorical and multiple response variables experiments and ii) conducting meritorious research in the experimental design area. Emphasis is placed on effective modeling strategies and interpretation of results and in the use of statistical software packages as well. This course is an elective in the M.E. in IE.

Course Goals

At the completion of this course students will be able to:
Clearly distinguish the differences between confidence, prediction, and tolerance intervals.

- Design and perform experiments with mixtures.
- Design experiments with mixtures with constraints in the components proportions.
- Use Stat Graphics, SAS, MINITAB, or other statistical package to analyze experiments with mixtures.
- Design and perform experiments with a discrete response variable.
- Use S Plus, StatGraphics, SAS, MINITAB, or other statistical package to analyze experiments with a discrete response variable.

Requirements

All students are expected to come to class 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.

Grading System

☒Quantifiable (letters) ☐ Not Quantifiable

89.500	→	100	A
79.500	→	89.499	B
65.500	→	79.499	C
59.500	→	65.499	D
0	→	59.499	F

Evaluation Strategies

	Quantity	Percent
Exams	2	50%
Final Exam	1	30%
Short Quizzes		
Oral Reports		
Monographies		
Portfolio		
Projects		10%
Journals		
Other, specify: Homework		10%
TOTAL:		100%

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:After been identified with the professor and the institution, the students with disabilities will receive reasonable accommodations in their courses and evaluations. For more information, please contact *Student Services with Disabilities* at the Student Dean's Office at (Q-019), 787-265-3862 ó 787-832-040 x-3250 ó 3258.

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.

Course Outline and Schedule

Week	Topic	Readings
1	Experimental designs for fitting response surfaces. Central composite designs. Box-Behnken designs. Geometric designs	[H&M] Ch. 1. [Mont] Secs. 14.1 to 14.4
2	Fractional factorial split plots. Minimum aberrations designs	[Bings] and [Huan]
3	Strategies for multiresponse quality engineering. Case of study	[Pign] and [Art2]
4	Evolutionary operations. Organization and implementation of EVOP programs. Two variable and three-variable EVOP	[Mont] Sec. 14.6
5	Statistical Intervals: Introduction and assumptions. Overview of different types of statistical intervals. Use of tables for constructing statistical intervals for a normal population	[H&M] Chapters 2 and 3
6	Computing statistical intervals for a normal population	[H&M] Chapter 4
7	Distribution-free statistical intervals. Sample size requirements	[H&M] Chaps. 5, 8 and 9
8	The general mixture experiments	[Crn2] Ch. 1
9	The simplex-lattice designs and associated polynomial models	[Crn2] Ch. 2
10	Multiple constraints on proportions; the XVERT algorithm	[Crn2] Ch. 3
11	The analysis of mixture data	[Crn2] Ch. 4
12	Experiments with a binary response. Transformations for attribute data Weighted regression. Logistic regression	[Nels] [Myer] Secs. 7.1 & 7.4
14	Maximum likelihood estimation for grouped and ungrouped data. Estimation and standard error of the coefficients. Case study	[Myer] Sec. 7.4 [Art1]

Coordinator: Dr. Noel Artiles

mcv/mayo 2004