Hong Kong WSC 2013 - Short Course programme
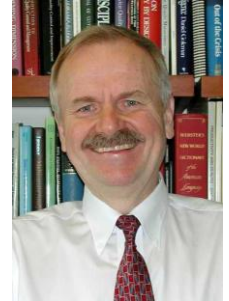
COURSE TITLE

Design of Experiments with Applications in Marketing and Service Operations

DURATION

1 day

INSTRUCTOR

Johannes Ledolter, Professor, Department of Management Sciences, Tippie College of Business University of Iowa, Iowa City, Iowa USA

BIOGRAPHICAL SKETCH

Johannes Ledolter is the C. Maxwell Stanley Professor of Management Sciences at the University of Iowa and a Professor of Statistics at the Vienna University of Economics and Business. He is an elected fellow of ISI, ASA, and ASQ. He is the author of several books, including *Statistical Methods for Forecasting* (with B. Abraham, Wiley 1983), *Statistical Quality Control: Strategies and Tools for Continual Improvement* (with C. Burrill, Wiley 1999), *Introduction to Regression Modeling* (with B. Abraham, Duxbury Press 2006) and *Testing 1–2–3: Experimental Design with Applications in Marketing and Service Operations* (with A. Swersey, Stanford University Press 2007).

COURSE DESCRIPTION

Present basic concepts of experimental design. Discuss applications of factorial and fractional factorial experiments to problems in marketing and service operations. Participants will gain expertise with these methods and will be able to design, analyze, and interpret multi-factor experiments.

SYLLABUS

Reference: Ledolter, Johannes and Swersey, Arthur J.: *Testing 1 – 2 – 3: Experimental Design with Applications in Marketing and Service Operations.* Stanford University Press, 2007.

Morning Session 1: Introduction to design of experiments and analysis of resulting data

Summary of courses objectives
Principles of good experimental design: Replication, randomization, blocking,
          sequential experimentation

Comparing 2 groups
Completely randomized experiment: 2-sample t-test
Blocked (paired) experiment: Paired t-test
Example: AdTel (Section 2.6). Paired comparison and paired t-test.

Comparing more than 2 groups
Completely randomized experiment: ANOVA one-way layout
Randomized (complete) block experiment: ANOVA two-way layout

Designs with several factors
Difficulties with experiments that change one factor at-a-time
Advantages of simultaneously testing multiple factors

Introduction to 2-level factorial and fractional factorial designs
Motivating examples (cracked pots; Mother Jones)

Relevant reading in Ledolter/Swersey: Chapter 1, Section 2.5 of Chapter 2, Chapter 3

Morning Session 2: Two-level factorial experiments

Calculation and interpretation of main effects and interaction effects

Assessing the significance of effects using replications: Continuous response
Example 1: 2^3 Cracked Pots Example (page 65 in Ledolter and Swersey)

Assessing the significance of effects using replications: Binary response
Example 2: 2^4 Direct Mail Credit Card Offer (page 82 in Ledolter and Swersey)

Assessing the significance of effects when no replications are available: Normal
probability plots
Example 3: 2^4 Hot Dog Taste Test

Relevant reading in Ledolter/Swersey: Chapters 4.

Afternoon Session 1: Two-level fractional factorial experiments

Motivation

2^{5-1} design: Half-fraction of 2^5 factorial design
Coffee example: Generator, defining relationship, confounding of effects. Interpretation of estimated effects

2^{4-1} design: Cracked Pots Revisited

Resolution of fractional design and higher-order fractions
Collection of useful fractional factorials and their confounding patterns
8-run fractional factorial designs
16-run fractional factorial designs

Mother Jones: 2^{7-3} design. Confounding patterns and interpretation of computer output

Improving e-mail advertising (page 135 in Ledolter and Swersey): 2^{8-4} design. Confounding patterns and interpretation of estimation results

Resolving ambiguities using follow-up experiments

Relevant reading in Ledolter/Swersey: Chapter 5

Afternoon Session 2: Plackett-Burman designs and introduction to more advanced design issues

Plackett-Burman designs
Example 1: Direct mail credit card campaign (page 155 in Ledolter and Swersey).

General factorial experiment with factors at 3 or more levels: Experimental designs and analysis of the resulting data.
Example 2: Baking a cake

Fractional factorial designs with factors at 3 or more levels
Confounding of fractional 3-level and mixed-level designs

Second-order designs (response surface designs): Box-Behnken and central composite designs

Concluding remarks. Computer software (Minitab and JMP)

Relevant reading in Ledolter/Swersey: Chapters 6 and parts of Chapters 7 and 8.

TARGET AUDIENCE

This course is directed to both academic and practitioner audiences. Quality professionals, management consultants, and practitioners who wish to design experiments in a business setting. Academics who want to introduce concepts and applications of design of experiments into undergraduate and graduate (MBA) business programs.