Hong Kong Baptist University
Faculty of Science
Department of Mathematics

Title (Units): ORBS7130 Survey Sampling and Experimental Design (3,3,0)

Course Aims: This course introduces the overall planning of the survey operation and design and selection of samples and the design of questionnaires; the various survey sampling methods and the corresponding data analysis, especially the estimation methods of population mean and proportion. This course introduces various kinds of experimental designs involving factorial and uniform designs as well as design for computer experiments.

Prerequisite: No

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Remark: This course is delivered by staff of HKBU.

Course Intended Learning Outcomes (CILOs):

Upon successful completion of this course, students should be able to:

No.	Course Intended Learning Outcomes (CILOs)
1	Explain the fundamental principles of survey sampling and experimental design
2	Identify suitable experimental designs for each particular study
3	Evaluate various experimental designs

Teaching & Learning Activities (TLAs):

CILO	TLAs will include the following:
1,2,3	Lectures with rigorous mathematical discussions and concrete examples. Lecturer will constantly ask questions in class to make sure that the majority of students are following the teaching materials.
1,2,3	Assignments to monitor both students' learning and mastering of the taught materials. In addition, common mistakes will also be addressed and analyzed.

Assessment:

No.	Assessment Methods	Weighting	CILO Addressed	Remarks
1	Assignments	40%	1, 2, 3	Assignments are designed to measure students' understanding of the theory, techniques, and applications of experimental design. The assignments are conducted to monitor the students' understanding of the theory, techniques and skills taught in the class. This may involve, but not limited to, in-class discussions of rigorous technical problems and their solutions.
2	Final Project	60%	1,2	Final Project is designed to see how far students have achieved their intended learning outcomes especially in the knowledge domain. Students should have a thorough understanding of the knowledge and apply them correctly in dealing with real-case analysis in the project. Students are

				required to design and gather practical authentic data based on the theories and methodologies introduced in the course. Suitable data analysis and a final report must be completed by the end of the course. Students may also be asked to conduct an oral presentation in order to introduce their findings in the project.

Course Intended Learning Outcomes and Weighting:

Content	**CILO No.**	**Teaching (in hours)**
1. Introduction	1	3
2. Experiments with a Single Factor	1,2	6
3. Factorial Designs in Physical Experiments	1,2	12
4. Optimal Designs	3	3
5. Design of Computer and Simulation Experiments	1,2,3	12

References:

1. Y.K. Chan, F.W.H. Ho, K.W. Ng and S.M. Shen, *A Practical Guide to Sample Surveys, Hong Kong Statistical Society*, 1991 (English Edition) and 1992 (Chinese Edition).
2. W.G. Cochran, *Sampling Techniques*, Wiley, 3rd Ed., 1997.
3. J.A. Cornell, *Experiments with Mixtures*, 2nd Ed., Wiley, 1990.
4. M.Hamada and Jeff C.F. Wu, *Experiments: Planning, Analysis, and Parameter Design Optimization*, Wiley, 2000.
5. L. Kish, *Survey Sampling*, Wiley 1965.
6. D.C. Montgomery, *Design and Analysis - Analysis of Experiments*, 5th Ed., Wiley, 2001.
7. R.L. Scheaffer, W. Mendenhall III and L. Ott, *Elementary Survey Sampling*, Duxbury Press, 5th Ed., 1996.
8. H. Toutenbury, *Experimental Design and Model Choice*, Physica-Verlag, 1995.

Course Content in Outline:

Topic	Hours
1. Introduction A. What is experimental design? B. Applications of experimental design C. Basic concepts D. Brief introduction to various designs	3
2. Experiments with a Single Factor A. Two kinds of errors B. Analysis of variance C. Fixed effects and random effects D. Multiple comparison tests	6
3. Factorial Designs in Physical Experiments A. Two-factor factorial designs B. Fractional Factorial Designs: orthogonal and uniform designs C. Orthogonal designs without and with interactions D. Criteria for comparing factorial designs E. Uniform designs	12
4. Optimal Designs A. Models B. Optimality measures C. Kinds of optimal designs	3
5. Design of Computer and Simulation Experiments A. Design in system engineering B. Uniform designs C. Modeling techniques D. Construction of uniform designs E. Applications of uniformity to factorial designs	12

(Approved by the Science Faculty Board Meeting 31 October 2023)
(Approved by the Department Management Committee on 5 September 2023)