

Course Name:	DESIGN & ANALYSIS OF EXPERIMENTS
Course Code:	STAT3003
Number of Credits:	3
Semester:	II
Level:	3
Pre-requisites:	STAT2001: Inferential Statistics

RATIONALE: Experiments are the main way of discovering knowledge in most areas of science. For example, medical scientists test new drugs and treatments, agricultural scientists investigate new crop varieties and new ways of growing crops; educationalists examine ways of teaching; industrialists investigate ways of improving product quality. The course is designed to introduce students to relevant concepts and methods, so that they know how to design an experiment for a scientific investigation, and how to analyse the resulting data using appropriate methods with the aid of statistical software.

COURSE DESCRIPTION: Statisticians contribute to experiments by helping to make them more efficient. In a designed experiment, the scientist is free to fix the levels of the explanatory variables, or let them be random or mixed the levels of the exploratory variables. Design is about choosing the combinations of these levels at which to observe the response variable. The course describes the various ways of structuring data to eliminate the effects of confusing factors so that the main factors of interest can be investigated more reliably. The course will be practical-based, involving the use of the packages e.g. MINITAB and R. Theory underlying the models will be studied but the emphasis will be on the practical interpretation of the data and appropriate models.

LEARNING OUTCOMES: On successful completion of the course, the students should be able to:

- State the principle in designing an experiment
- Analyse and interpret the results of statistical output
- Assess and validate statistical models to ensure they are appropriate
- Design a suitable experiment given a set of criteria and/or information
- Construct and interpret appropriate hypotheses and confidence intervals
- Apply the correct statistical methods to analyse a set of data
- Produce a written report for a non-technical individual

COURSE CONTENT

- 1. Introduction:** Collecting data by experiment, Principles of experimental design, Simple design ideas, quick look at ANOVA
- 2. Background Theory:** Models, matrix formulation, GLM's, parameter estimation, contrasts inference, subdivision of TSS, Cochran's theorem, parameterisations
- 3. Completely Randomised Designs:** Fixed and Random effects model, residual analysis, contrasts, quantitative factors by polynomial regression and Tukey's test
- 4. Randomised Block Designs:** Fixed, Random and Mixed models, randomised block designs, Efficiency, additivity, interaction, missing values, Balanced incomplete block, Latin Squares, Graeco-Latin squares, Youden square, Transformation, analysis of covariance
- 5. Multifactor Experiment:** Factorial treatment structure, nested models, 2^k and 3^k experiments, confounding, partial confounding, fractional replication in 2^k experiments

TEACHING METHODOLOGY: The course will be delivered by a combination of interactive lectures, tutorials and computer laboratory. The **39** contact hours is consists of: **25 hours of lectures, 8 hours of problem based learning** and **12 hours of supervised laboratory time**. Course materials such as problem papers, assignments, solutions, etc., will be posted on the webpage <http://ourvle.mona.uwi.edu/>

ASSESSMENT:

The course assessment is as follows:

- Mid-term test (1 hour) worth **15%** of the student's final grade
- Problems papers (about 4), worth **10%**
- A written Project report worth **15%**
- Final written examination paper worth **60%** will be two hours in length.

REFERENCE MATERIALS:

Books:

Prescribed

- Montgomery D., 2012, *Design and Analysis of Experiments*, 8th edition, Wiley, ISBN-13:978-1118146927

Highly Recommended

2. Morris M., D, 2010, *Design of Experiments: An Introduction Based on Linear Models*, 1st edition, Chapman and Hall/CRC, ISBN-13: 978-1584889236

Recommended

3. Cox D, R, 1992, *Planning of Experiments*, 1st edition, Wiley-Interscience, ISBN-13: 978-0471574293

ONLINE RESOURCES

<http://www.causeweb.org/>

<http://www.getstats.org.uk/>

<http://www.ats.ucla.edu/stat/seminars/statteach/sites.htm>

<http://onlinestatbook.com/rvls.html>