

Design of Experiments Fall, 2020

Special Version: Experimental Design used in COVID-19 Research

Level	Course Number	CRN
Undergraduate	ISYE 4330	28308
Graduate	ISYE 6020	27556

Instructor:

Dr. Stanley Dunn, Office of Graduate Education, 1516 Peoples Avenue. email:
(smd@rpi.edu)

Office hours by appointment; please contact Ms. Jenni Mullet, (mullej6@rpi.edu)

Days and Time:

Monday/Thursday, 10:00 AM to 11:20 AM;

WebEx: <https://rensselaer.webex.com/meet/dunns6>

Short Description:

****Note:**** A background in the life sciences is not required to take this course.

This course covers the statistical design of experiments for systematically testing hypotheses about properties of a system. Topics covered will include: introduction to experiments, the scientific method and randomized controlled trials; tools for reproducible research; completely randomized, blocking, full factorial and fractional designs; optimal experimental designs including response surface methods, and Taguchi designs.

We have a unique opportunity this year to study the experimental design of research being conducted to find a vaccine for COVID-19. Many of the preprint of journal papers on the subject are store at the med archive [medRxiv](https://medrxiv.org) located at <https://medrxiv.org>

We will dissect papers from this archive and focus solely on the experimental design, it's relationship to the hypothesis, the statistical analysis, and the conclusion. In the process, we will bring in the necessary theory to understand the designs and statistical analysis used (or not used, as the case may be).

Prerequisites:

A basic course in descriptive and inferential statistics is necessary. Programming experience and especially programming in R may be helpful. A background in the life sciences is not required.

Textbook(s):

The Design and Analysis of Experiments by Douglas Montgomery, 9th edition.

A First Course in the Design and Analysis of Experiments by Gary Oehlert

Introduction to Statistical Thought by Michael Levine

Additional Resources:

- The R Project for Statistical Computing, <http://www.r-project.org>
- RStudio, <https://www.rstudio.com/>
- The NIST/SEMATECH e-Handbook of Statistical Methods, <<http://www.itl.nist.gov/div898/handbook/>>
- Papers from the literature

Topics To Be Covered (probably not in this order):

- (1.) Introduction to the design of experiments and medRxiv
- (2.) Analysis of Variance
- (3.) Factorial Designs
- (4.) Null Hypothesis Statistical Testing, Power, Sample Size and Regression
- (5.) 2^k designs
- (6.) Fractional Factorial Designs
- (7.) Cross Over Designs
- (8.) Response Surface Methods
- (9.) Taguchi Designs

The Course Projects

By using the COVID-19 literature, you will learn incrementally how to read the scientific literature, identify the experimental design, assess its efficacy and consider alternatives.

Course Grading:

Assessment	Grade Percentage
Project 1: Identify Design	10%
Project 2: Relate Design to Statistical Analysis	20%
Project 3: Relate Design and Analysis to Hypothesis and Conclusion	30%
Project 4: Give new design in a case where there was a faulty design	40%

You will be given specific questions to be answered in each of the four projects to test your mastery of the material.

The grading for 4330 will be based on the mastery of the course topics; the grading for 6020 will be based on this and additional theoretical material; i.e., the 6020 project questions will require a deeper theoretical knowledge that is not expected of 4330 registrants.