UCDAVIS
MECHANICAL AND AEROSPACE ENGINEERING

MAE 298 – Design of Experiments and Statistical Methods for Engineers

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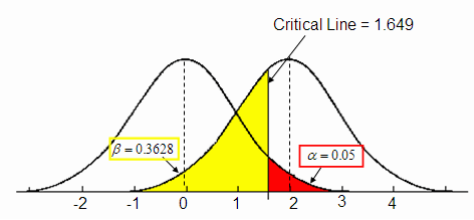

Type I vs. Type II Error

The aim of this course is to provide a solid foundation on designing experiments and the use of statistical tools to support scientific conclusions in engineering research. For various designs of experiments, students will be proficient in generating relevant hypotheses to answer research questions, selecting the appropriate statistical model, computing descriptive and inferential statistics, and efficiently communicating the results through appropriate visualizations and (oral and written) language.

The course will cover a wide variety of statistical tests and models, emphasizing the necessary assumptions that the available data are required to satisfy (a preliminary step that is often "forgotten"). Focus will be given to practical statistical analysis using the R programming language. Challenges and techniques associated with human subject experiments will receive special attention.

"Excellent health statistics - smokers are less likely to die of age related illness"

Learning Objectives

This course is designed to be field independent and relevant for any graduate level engineers – **all graduate students design and conduct experiments, then interpret and communicate results.** Engineering education often does not teach trainees how to do this properly. By the end of the course students will be able to:

- Define, recognize, and describe common parametric and non-parametric tests for analyzing data, and understand the necessary assumptions behind the applications of statistical tests.
- Formulate and apply hypothesis testing and conduct both parametric and non-parametric statistical analyses, including *t*-test, correlation and (simple and multiple) regression, ANOVA (fixed effects, random effects, and mixed), ANOVA-derived methods (e.g., ANCOVA, nested design), post-hoc comparisons, and diagnostics and remedial measures.
- Design experiments with statistical analysis in mind, including considerations of treatments and controls, effect sizes, and statistical power.
- Develop statistical models using a mixed-effects framework, defining fixed and random factors, and conduct post-hoc tests to determine significance.
- Construct models, apply statistical tests, and produce quantitative and visual output using the R programming language.
- Communicate interpretation of statistical results, both written and orally. Report statistics in in publications following best practices.