

## Review for Exam I - STAT 642 - Wednesday, March 4, 2015

**Exam will cover Handouts 1-4 and the lectures discussing these handouts**

- Bring to the Exam:
  - \* Calculator - Your device cannot facilitate a connection to the web or emailing or texting
  - \* Summary Sheets: 3-Pages (8.5'' × 11''), Self Generated Summary Sheets (both sides)
- I will attach to the exam the Tables contained in  
**STAT642 Exam Tables** in the *Review for Exams* folder on eCampus.
- **The 2014 First Exam with Partial answers are posted on eCampus in the**  
*Review for Exams* **folder**

### Topics Covered on EXAM:

#### I. Experimental Design Principles:

1. Design experiments/studies to estimate and control variation
2. How to control variation
3. Six major principles of scientific experimentation
4. Properly Conducted Statistical Designed Experiments are
  - a. Economical
  - b. Allow the estimation of the impact of factors on response
  - c. Allow the estimation of variability
  - d. Allow the development of tests of hypotheses and confidence intervals
5. Experimental Design Terminology

Experimental Unit, Measurement Unit, Homogeneous EU's, Blocks, Factor, Levels of Factors, Treatment, Replication, Subsampling, Repeated Measures, Response, Effect of Treatments, Interaction, Confounding, Covariates
6. Common Problems in Experimental Designs
  - a. Masking of Factor Effects
  - b. Uncontrolled Factors
  - c. Erroneous Principles of Efficiency
7. Randomization
  - a. Assignment of Treatments to EU's
  - b. Randomly selecting EU's from Existing Populations
  - c. Order in which measurements are taken or the position of EU's in Laboratories must be randomized
  - d. Valid inferences only occur with proper randomization
  - e. Permutation Tests

## II. Components of a Designed Experiment:

1.  $C_1$  : Randomization - Completely Randomized, Blocked, Latin Squares, Random Factor Levels, Subsampling, Incomplete Blocks, Split-Plot, Split-Split-Plot, Strip-Plot, Crossover, Repeated Measures
2.  $C_2$  : Treatment Structure - Single Factor, Crossed, Nested, Crossed/Nested, Fractional Factorials  
Factor Levels - Fixed, Random
3.  $C_3$  Measurement Structure - Single measurement, Subsampling, Repeated Measures
4. Given the description of an experiment:
  - a. Identify the Treatment Structure and Whether the Levels of the Factors are Fixed or Random. Also, identify any blocking factors and/or covariates
  - b. Describe the method of randomization and the EU's
  - c. Identify the measurement structure and the MU's

## III. Completely Random Design (CRD):

1. Model: Interpretation of parameters and LSE
  - a. Cell Means:  $y_{ij} = \mu_i + e_{ij}$ ;  $i = 1, \dots, t$ ;  $j = 1, \dots, n_i$
  - b. Effects models with restrictions:  $y_{ij} = \mu + \tau_i + e_{ij}$ ;  $i = 1, \dots, t$ ;  $j = 1, \dots, n_i$  with  $\sum_{i=1}^t n_i \tau_i = 0$  or  $\tau_t = 0$
  - c. Matrix formulation of the models
2. AOV & F-Test
  - a. F-test of  $H_o : \mu_1 = \mu_2 = \dots = \mu_t$  vs  $H_1$  : At least one pair of means differ
  - b. Power of F-test: noncentrality parameter, Use textbook's graphs to compute power
3. Determination of Number of Reps  
Specify number of treatments,  $\hat{\sigma}_e$ ,  $\alpha$ , bound on power, bound of effect size
4. Estimation of Treatment Means  
LSE, standard errors, C.I., Treatment Effects
5. Treatment Comparisons
  - a. Type I Error Rates - Per Comparison (PC) vs Familywise (FWER) vs False Discovery Rate (FDR)
  - b. Bonferroni Procedures
  - c. Scheffé Procedures
  - d. Contrasts:
    - i. Comparisons of linear combinations of treatment means: F-test, t-test
    - ii. Orthogonal Polynomials
    - iii. Tests for Trends
    - iv. Scheffe, Bonferroni F-test
    - v. Simultaneous tests of m contrasts using Hypothesis Matrix
  - e. Control vs Treatment Means: Dunnett Procedure
  - f. Determine Group of Best Treatments: Hsu Procedure
  - g. All Pairwise Comparisons of Treatment Means: Tukey, Protected LSD, SNK