

## STT 667 Midterm Review – Chapters 15-18

### Chapter 15: Intro to Design of Studies

Experimental vs observational studies, establishing causation

Experimental studies: factors, treatments, experimental units, randomization, completely randomized design, response variable

### Chapter 16: Single-Factor ANOVA for Fixed Effects Model

Factor effects model, cell means model, matrix models, constraints, (linear) estimable functions

ANOVA (hypotheses, decision rules,  $\alpha$ , P-values, conclusion, interpretation, . . .), general linear test, least squares estimates, power, planning sample sizes for power

Randomization tests

### Chapter 17: Analysis of Factor Level Effects

Motivation for analysis/comparison of factor level effects

Treatment contrasts, pairwise comparisons, least squares estimates, standard errors

Individual confidence intervals and tests based on the  $t$ -distribution

Motivation for multiple comparison procedures, (and the basis for the Bonferroni method)

Methods of multiple comparisons and formulae:

- Bonferroni:  $\hat{L} \pm B s(\hat{L})$ , where  $B = t(1 - \alpha/2g; \nu)$ , for  $g$  preplanned treatment contrasts
- Tukey:  $\hat{D} \pm T s(\hat{D})$ , where  $T = q(1 - \alpha; r, \nu)/\sqrt{2}$ , for all pairwise comparisons
- Scheffé:  $\hat{L} \pm S s(\hat{L})$ , where  $S^2 = (r - 1)F(1 - \alpha; r - 1, \nu)$ , for all treatment contrasts

Minimum significant difference, choosing the best applicable method

Tukey's method: Studentized range distribution, graphical summary, Tukey-Kramer method

Scheffé's method: relation to  $F$ -test

Planning sample sizes for confidence intervals

### Chapter 18: Diagnostics and Remedial Measures

Model assumptions ("LINE"), order of checking model assumptions ("LIEN", why?). Linear model/lack-of-fit, independent errors, equal variances/homoscedasticity, normality.

Residual analysis: residuals  $e_{ij} = y_{ij} - \hat{y}_{ij}$  as surrogates for error terms,  $\sum_j e_{ij} = 0$  for each treatment.

Residual plots, tests for equal variances (Hartley's test, Brown-Forsyth Test), testing normality

Robustness

Remedial measures: if lack of fit, Box-Cox transformations, Satterthwaite's approximation (and the Bonferroni method)

Nonparametric methods: Non-parametric rank  $F$ -test (assumptions, procedure, . . .), multiple comparison tests, awareness of confidence intervals for  $\Delta$ .

### Use of SAS throughout