McGill University - Department of Animal Science
Statistical Methods II AEMA-610

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Evaluation : 20% weekly assignments
30% mid-term examination, Tuesday October 24th, 18:00-21:00 PM,
Centennial Centre Ballroom
50% final examination (regular December exam period, up to Dec 22nd)

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In the event of extraordinary circumstances beyond the University's control, the content and/or evaluation scheme in this course is subject to change

Course description

Principles of linear models, multiple regression equations and classification models. Introduction to Analysis of Variance and common statistical designs used in agricultural and environmental sciences. Interpretation of results and which effects are estimable and when and/or why not. Interpretation of published results in the scientific literature. Emphasis on balanced and unbalanced designs and data structures; their analysis and tests of statistical significance.

Course Notes, etc

The course notes and additional useful information are available for downloading and printing from McGill MyCourses. The course notes are available in PDF format (for reading and printing via Adobe Acrobat reader).

Documentation and manuals (on-line and PDF to print) from SAS:

URL (address, SAS) http://support.sas.com/documentation/index.html

Prerequisites

You should know and thoroughly understand the material covered in Statistical Methods I (AEMA-310), or an equivalent. This covers basic statistical concepts such as distributions, sampling of normally distributed data (Normal distributions), Binomial distributions, t-tests, comparisons of means, calculation of variances, coefficients of variation, mean and standard error of a mean. It is assumed that you have covered simple linear regression and simple correlations between variables, basic One-Way Completely Randomized Design and two-way RCBD Randomized Complete Block Design models. You should have an introductory knowledge about matrices.

Selected references

1. Steel, R.G.D., Torrie, J.H. and Dickey, D.A. 1997. Principles and Procedures of Statistics. A Biometrical Approach. 3^{rd} edition. McGraw-Hill.

2. Steel, R.G.D., and Torrie, J.H. 1980. Principles and Procedures of Statistics. A Biometrical Approach. 2^{nd} edition. McGraw-Hill.

3. Searle, S.R. 1971. Linear Models. Wiley.

4. Searle. S.R. 1966. Matrix Algebra for the Biological Sciences. Wiley.

5. Cochran, W.G. and Cox, G.M. 1957. Experimental Designs. Wiley.

6. Mead, R., Curnow, R.N. and Hasted, A.M. 1993. Statistical Methods in Agriculture and Experimental Biology. Chapman and Hall.

7. Littel, R.C., Freund, R.J. and Spector, P.C. 1991. SAS System for Linear Models, 4th edition.

8. Littel, R.C., Milliken, G.A., Stroup, W.W. and Wolfinger, R.D. 1996. SAS System for Mixed Models, 2nd edition.

9. Westfall, P. H., Tobias, R. D., Rom, D., Wolfinger, R.D., and Hochberg, Y. 1999. Multiple Comparisons and Multiple Tests using the SAS System.

10. Milliken, G. A., and Johnson, D. E. Analysis of Messy Data: Vols 1, 2 and 3.

Course Outline

1. Multiple Regression
   - assumptions
   - linear model
   - parameters
   - least squares
   - solutions and parameter estimates
   - Analysis of Variance

2. t test

3. Confidence Interval

4. Linear and Quadratic regressions

5. Predicted Values

6. Curve fitting

7. Correlations
   - partial correlations
   - sampling distribution
   - statistical significance
   - confidence interval

8. One-Way classification
   - linear model and parameters
   - hypotheses
   - matrix equations

- solutions and estimates
- ANOVA using SAS
- differences between treatments
- testable hypotheses
- fixed or random effects
- expected mean squares

9. Multiple comparisons

10. Partitioning Sums of Squares
    - SAS code for contrasts

11. Homogeneity of Variance
    - basic formulae
    - use of residuals

12. Multiway classification
    - linear model and parameters
    - Normal equations
    - hypotheses to be tested
    - partitioning the Sums of Squares
    - ANOVA using SAS/GLM
    - Type I and Type III Sums of Squares

13. Least Squares Means

14. Subsamples, nested models
    - parameters and the linear model
    - computing the Sums of Squares
    - ANOVA, tests of significance

15. Factorial experiments
    - linear model, parameters and hypotheses
    - derivation of testable hypotheses
    - SAS code for factorial
    - interactions and main effects

16. Latin Square
    - linear model and parameters

17. Analysis of Covariance

18. Split Plot designs

19. Introduction to Mixed Models

20. Cross-Over designs

21. Repeated measures

Outcomes/competencies

At the end of this course students should be able to:

- specify a statistical model for a multiple regression model, including the correct definitiion for each model term.

- for common statistical designs (CRD, RCBD, two-way fixed effects models, nested designs, Factorial esigns and ANCOVA), be able to specify an appropriate statistical model, including the correct definition for each model term.

- use SAS (proc GLM and proc MIXED) to run an appropriate statistical analysis and suitably interpret the results, including constructing an ANOVA table.

- be able to formally specify the conclusions about what can, or cannot be considered to be statistically significant, and why.

- identify which terms in a model are to be considered as fixed effects and which terms should be considered as random effects, and explain the choice.