Quantitative Genetics -ANSCI 317 Spring 1999

CLASS TIME: Monday and Wednesday 2 PM
Friday 2 PM to 4 PM
CLASS ROOM: 107 ASL
OFFICE HOURS: Monday and Wednesday 3 PM to 4 PM (ROOM: 306 ASL)
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Course Objectives
Present the basic concepts of quantitative genetics, provide the students with sufficient knowledge to conduct research in the area and understand its application in the industry and their research. Students will be introduced to genetic, statistical and computational concepts that provide the knowledge used for the improvement of plant and livestock production. This theory has developed from an abstract notation of the effects of genes into complex statistical methods dominated by mixed model theory. The flexibility of this theory has permitted the easy incorporation the newer molecular aspects of genetics.

Objectives to accomplish:
1) Develop an understanding of the theory and practice of quantitative genetic principles.
2) Present an integrated approach to the prediction of random effects (notably breeding values) and the underlying theory involved.
3) Illustrate the techniques in genetic applications.
4) Provide an introduction to the software available for breeding value prediction and variance component estimation.

An understanding of the procedures will be stressed with applications and analysis of real data. Emphasis will be given to critical evaluation of alternative models and methodology.

Course Grading
Performance on the course will be assessed with 4 assignments, 2 Midterms and 1 Final exam.

Contribution to final grade:

		¾ unit course	1 unit course[1]
Evaluation type	Value	Value	
Homeworks[2]		35%	25%
Midterm I [3]March 10		15%	10%
Midterm II April 14		20%	15%
Final exam[4]		30%	25%
Extra Project		0%	25%

[1] Students taking an additional ¼ credit are required to prepare a comprehensive project due by April 30. Requirements for the extra project will be defined on April 1, 1999.

[2]Assignments will be collected at the beginning of the lecture corresponding to the due day and returned the following week. The importance of homework assignments is evident in the percentage of the total grading. It is expected that much of your learning will take place while working the homework problems. Homework assignments should be well organized and reasonably neat. Credit will be given to answers that are accompanied with corresponding work and derivations. Late homework will only be accepted in extenuating circumstances and conditional on prior arrangement with the instructor.

[3] Midterms will take place on March 10 and April 14. Exams will cover lecture and homework materials. Midterms will take place during the regularly scheduled class time and will be closed-book and closed-notes.

[4] Final exam: 1:30-4:40pm Friday, May 7, 1999. Final will be closed-book and closed-notes.

Background

Required courses (or equivalent) are ANSCI 316, CPSCI 340, ANSCI 345. Concurrent registration in CPSCI 440 is recommended. Equivalent courses or knowledge in population genetics and statistics are acceptable. Students are expected to have a basic knowledge of matrix algebra and distributional theory and have a basic understanding of linear model theory. Concepts of population genetics from ANSCI 316 (or equivalent) will be drawn on and extended to incorporate these topics into modern quantitative genetic theory. Some assignments will include statistical analysis of data. Hence, the students are expected to have some expertise on at least one statistical software package, equivalent to SAS®.

Textbook

Lynch and Walsh's Fundamentals of quantitative genetics.
(http://nitro.biosci.arizona.edu/zbook/book.html)
Volume 1: Genetic and analysis of quantitative traits (1997)
Lynch, M. and B. Walsh. Sinauer Associates, Inc. Publishers
(Web site for errors and updated information
http://nitro.biosci.arizona.edu/zbook/volume_1/vol1.html)
Advanced notes for Volume 2: Evolution and selection of quantitative traits
http://nitro.biosci.arizona.edu/zbook/volume_2/vol2.html

Suggested Reference

Falconer, D. S. and T.F.C. Mackay (1996) Introduction to quantitative genetics. 4th edition. Longman Sci. and Tech., Harlow, UK. Second and third editions are adequate.

Additional sources of information:

Bulmer, M.G. 1980. The mathematical theory of quantitative genetics. Oxford Univ. Press, NY.
Henderson, C. R. 1984. Applications of linear models in animal breeding. Univ. Guelph, Guelph, Ontario, CA
Li, C. C. 1975. Path analysis - a primer. Boxwood, Pacific Grove, CA.
Mrode, R. A. 1996. Linear models for the prediction of animal breeding values. CAB International, Wallingford, UK.
Searle, S.R. 1971. Linear models. John Wiley and Sons, NY.
Searle, S. R. 1982. Matrix algebra useful for statistics. John Wiley and Sons, NY.
Searle, S. R., G. Casella, and C. E. McCulloch. 1992. Variance components. John Wiley and Sons, NY.
Van Vleck, L. D. 1993 Selection index and introduction to mixed model methods. CRC Press, Inc. FL.

Topics to be covered by week

1) Matrix algebra, probability, distributions, expectations and quadratic forms.
   Lynch and Walsh's Chapters: 1, 2, 3, 8; Appendix A1.
2) General linear model theory incorporating regression, ANOVA.
   Lynch and Walsh's Chapters: 3, 8; Appendix A3.
3) Estimable functions, expectations of sum of squares, types of sum of squares and hypothesis testing.
   Lynch and Walsh's Chapters: 3, 8; Appendix A1.
4) Single locus, two loci and multiple loci models and the infinitesimal model.
   Lynch and Walsh's Chapters: 4, 5.
5) Genetic models, resemblance between relatives, inbreeding, path diagrams and Mendelian sampling.
   Lynch and Walsh's Chapter: 7; Appendix A2.
6) Estimation of population parameters using resemblance between relatives.
   Lynch and Walsh's Chapters: 7, 17, 18.
7) Animal Model, the **A** matrix and it's inverse.
   Lynch and Walsh's Chapter: 26.
8) Henderson's Mixed Model equations and their properties.
   Lynch and Walsh's Chapter: 26.
9) Extension of the animal model and multiple trait models.
   Lynch and Walsh's Chapter: 26.
10) Introduction to estimation of variance components including ML and REML.
    Lynch and Walsh's Chapter: 27; Appendix A4.
11) Effects of selection.
    Falconer and Mackay Chapters 2 and 11. Lynch and Walsh Volume 2 notes.
12) Response to selection and selection experiments.
    Falconer and Mackay Chapters 11 and 12. Lynch and Walsh Volume 2 notes.
13) Detection of genes.
    Lynch and Walsh's Chapters:13, 14, 15, 16.
14) Marker assisted selection.
    Assorted papers to be announced.