INTRODUCTION TO QUANTITATIVE GENETICS
SPRING, 2009

Course Venue:

Course Number:	PCB 6555
Instructor:	Dudley Huber 363 Newins-Ziegler Hall; email:dahuber@ufl.edu Phone: 846-0898; Fax: 846-1277
Lecture:	4th Period Tuesday and Thursday Room 222 Newins-Ziegler Hall
Lab & Recitation:	TBA
Exams:	TBA

Course Objectives:

The overall goal is to introduce students to important concepts, methods and applications in quantitative genetics and analysis of genetic data. A sample of the main course topics includes: Polygenic traits, resemblance among relatives, inbreeding, estimation of variance components, heritability, genetic correlation, genotype x environment interaction, genetic gain from selection, selection index, use of molecular markers and analysis of microarray experiments.

Intended Audience:

The course is designed for both MS and PhD graduate students in the following disciplines: Plant or animal genetics; plant or animal breeding; molecular genetics or biotechnology; conservation biology in botany, zoology or fisheries. The prerequisite is one course in statistical methods such as Statistics 6166.

Course Format:

The course is structured as two one-hour lectures and one three-hour laboratory period each week. The lectures cover concepts and their application. The laboratory section is used for several purposes to reinforce and enhance the lecture material and to expose students to a range of analyses of genetic data.

INTRODUCTION TO QUANTITATIVE GENETICS
PCB 6555: COURSE SYLLABUS

I. Catalog Description: Prereq. Stat 6161. Intended for graduate students of all scientific disciplines who are interested in an introduction to the genetic principles and biometric evaluation of characters that exhibit continuous variation in natural populations or breeding programs. Lectures stress concepts and applications; laboratories describe and apply useful analytical methods. Offered spring semesters of odd-numbered years.

II. Course Format and Instructor: The course consists of one two-hour lecture and one three-hour laboratory/recitation period each week. The course stresses concepts and principles supported by quantitative genetic theory.

III. Outline of Lecture Portion of Course

A. Review of Population Genetics
1. Allele and genotype frequencies (Hardy-Weinberg equilibrium)
2. Inbreeding and assortative mating

B. Genetic Values
1. Population mean
2. Average effect of an allele and breeding value of an individual
3. Dominance deviation and epistatic deviation

C. Genetic Variances
1. Genetic components of variance
2. Genetic covariance and/or interaction with environment
3. Environmental components of variance

D. Resemblance Between Relatives and Heritability
1. Genetic covariance (parent-offspring, among siblings)
2. Environmental covariance
3. Estimation of heritability (parent-offspring, sib analysis)
4. Precision of estimates

E. Correlated Characters
1. Genetic correlations and environmental correlations
2. Genotype x environment interaction expressed as a correlation

F. Mass Selection: Prediction and Experimental Results
1. Prediction of response (Selection differential and intensity, gains from selection)
2. Impact of selection on allele frequencies and variances
3. Empirical results from selection experiments (short-term experiments & long-term)

G. Selection Using Information from Relatives and Other Traits
1. Derivation of a general prediction equation
2. Simple methods (family and sib selection, progeny testing, within-family selection)
3. Combined selection
4. Indirect selection and correlated responses

H. Inbreeding and Crossbreeding
1. Changes in mean values (inbreeding depression and heterosis)
2. Changes in variances with inbreeding, mutation, and outcrossing
3. Applications of inbreeding & outcrossing in breeding programs of plants and animals

I. Scale Effects and Threshold Characters

1. Scale: Distributions, interactions and transformations
2. Binary traits and threshold models
3. Selection for threshold traits

J. **Microarray Experiments**

1. Concepts of gene expression experiments
2. Design of microarray experiment
3. Univariate and multivariate analysis of microarray experiments

K. Uses of Molecular Marker

1. Characteristics of molecular markers and QTL concepts
2. Linkage *versus* linkage disequilibrium
3. QTL analysis through recombination and linkage analysis
4. QTL analysis through association studies (SNPs)

IV. Outline of Laboratory/Recitation Portion of Course (each item represents one 3-hour lab)

A. Algebra of expected values, variances and covariance
B. Linear statistical models: Fixed & random effects, averages & variances
C. Estimation of fixed effects
D. Estimation of variance components
E. Analysis of genotype x environment interaction as fixed and/or random effects
F. Introduction to Best Linear Unbiased Prediction (BLUP)
G. Applications of BLUP
H. Multivariate BLUP
I. **MIDTERM EXAM**
J. Path Coefficients
K. Design and analysis of microarray experiments I
L. Design and analysis of microarray experiments II
M. QTL analysis I
N. QTL analysis II

V. Textbooks (Falconer required; others available for reading in N-Z 358)

1. Falconer, D.S. and T.F.C. MacKay. 1996. Introduction to quantitative genetics. Longman Group, London. 464 p.

VI. Grading

1. Mid-term exam	25%
2. Final exam	25%
3. Problem sets (4)	20%
4. Laboratory exercises and write-ups (11)	30%

There will be 12 laboratory exercises assigned, and you will receive grades for the best 10 laboratory write-ups. Students may work together in groups on laboratory exercises, but the final report must be hand-written by each student (no word processors). The four problem sets should be done individually by each student, not in groups.