

# Statistical Genomics

Steve Kachman

## 1 Objective

The objective of this course is to develop a better understanding of the statistical methodologies available for the identification of genes. In the first part of the course we will focus on the development of linkage maps. In the second part of the course we will focus on the identification of quantitative trait loci. Basic genetic and statistical concepts will be covered.

## 2 Course Information

- Course:** Biometry 896, Statistical Genomics
- Instructor:** Steve Kachman
- Office:** 104 D Miller Hall
- Phone:** 472-2903
- Office Hours:** MWF 10:00-11:30 and by appointment
- Text Book:** *Statistical Genomics*, Ben Hui Liu
- Prerequisites:** Biometry 801
  - Estimation including confidence intervals
  - Hypothesis testing
  - Analysis of variance
  - Regression
  - SAS
- Homework:** Approximately once a week
  - 20% will be deducted for each day late.
- Exams:** Two exams, will be announced at least one week in advance
- Final Exam:** Wednesday, December 13 10:00–Noon
  - Revise travel plans accordingly.
- Conflicts:** Expected to take exams at the scheduled time
  - If an exam conflicts with an activity vital to your program, please have your major advisor contact me well in advance.
  - I should be notified as soon as possible of any potential conflicts.
- Grading:** Exams 200 pts
  - Final 200 pts
  - Homework & Quizzes 100 pts
  - Grading will be on a straight 90, 80, 70, 60 percent basis.
- Web Page:** <http://www.ianr.unl.edu/ianr/biometry/faculty/steve/896/2000/>

### 3 Topics

- Introduction
  - Basic Genetics
  - Basic Molecular Genetics
  - Chromosome structure
  - Gene Expression
  - Genomics
- Single Locus Models
  - Two Alleles
  - Testing
    - \* Weighted Least Squares
    - \* Example
    - \* Three crosses
    - \*  $F_2$
    - \* Power
    - \* WLS/Catmod
    - \* LRT
    - \* Derivation
    - \* 2 alleles
    - \* Backcross 1
    - \* Backcross 2
    - \* Combined
  - Natural populations
    - \* Allelic detection
    - \* Hardy-Weinberg Equilibrium
    - \* Heterozygosity
- Two Locus: Controlled Crosses
  - Recombination Fraction
  - Controlled Crosses
    - \* Lod
    - \*  $F_2$
  - Dominance
    - \* MLE
    - \* Proc NLIN (ML)
  - Fitness

- Locus Order
  - Linkage Groups
  - Three Locus Order
    - \* Seriation
    - \* Multiple Locus Ordering Statistic
    - \* Number of orders
    - \* Simulated Annealing
    - \* Branch and Bound
  - Framework
  - Uncertainty
- Map Functions
  - Genetic and Physical Maps
    - \* What a map function is and is not
  - Haldane
  - Kosambi
  - Karlin
- Quantitative Trait Loci
  - Comparing Marker groups
    - \* Some problem with marker groups
  - Interval mapping
    - \* Regression
    - \* Distribution
    - \* Mean and Variance