

STATISTICS 416
STATISTICAL DESIGN AND ANALYSIS OF MICROARRAY EXPERIMENTS
SPRING 2009

Location: 1106 Pearson
Time: 2:10-3:30 p.m. Tuesday and Thursday
Instructor: Dan Nettleton dnett@iastate.edu <http://www.public.iastate.edu/~dnett/>
Office: 239C Kildee (phone: 515-294-7754)
Hours: 10:00-10:50 a.m. Monday and Friday or other times by appointment

Purpose of the Course:

Statistics 416 is a course for graduate students outside of statistics who are interested in learning how to use statistical methods to design and analyze microarray experiments. Students completing 416 should gain a sound understanding of the statistical principles important for good microarray experimental design and analysis, be able to design and analyze their own microarray experiments, become comfortable using the R statistical computing environment, and be able to offer an informed critique of the statistical aspects of microarray experimentation and analysis described in scientific research papers.

Prerequisites:

STAT 401 is the formal prerequisite for STAT 416.

Grading:

Homework	25%
Midterm Exam	25% Tuesday, March 3, 2:10-3:30 p.m.
Project	15% Friday, April 24, 5:00 p.m.
Final Exam	35% Monday, May 4, 12:00-2:00 p.m.

On exam days, be sure to arrive early with a calculator and pen or pencil. No make-up exams will be given unless circumstances are exceptional. Your final course percentage will be determined by the following formula:

$$\text{Course Score} = 0.25 H + 0.25 M + 0.15 P + 0.35 F$$

where H, M, P, and F represent the score out of 100 possible on homework, the midterm exam, the project, and the final exam, respectively. Letter grades will be assigned according to the course scores. Students with similar course scores (as judged by the instructor) will receive similar letter grades. The order of the course scores will match the order of the letter grades.

All students have the opportunity to earn good grades in Statistics 416 by learning the course material well. Please let your instructor know of any difficulties as soon as possible. If a student has a disability that qualifies under the Americans with Disabilities Act and Section 504 of the Rehabilitation Act and requires accommodations, he/she should contact the Disability Resources (DR) office for information on appropriate policies and procedures. DR is located on the main floor of the Student Services Building, Room 1076. Their phone number is 515-294-6624.

Homework Guidelines:

- The purpose of all homework assignments in Statistics 416 is to help you learn the course material.
- All homework assignments are posted at <http://www.public.iastate.edu/~dnett/microarray/hw.shtml>.
- Due dates are posted on the web site and written on the homework documents.
- No late homework is accepted, but your lowest homework score will not be used to compute your grade.
- Answers to homework assignments should be neatly written or typed and well organized with no extraneous information.
- You are welcome to work with other students on homework problems. You must, however, write your own answers to the questions. Copying another's work is prohibited.

Intended Course Coverage:

1. Introduction to statistical design and analysis of microarray experiments
2. The basics of cDNA microarray technology
3. The basics of oligonucleotide microarray technology
4. Microarray image processing
5. Normalization of two-color microarray data
6. Normalization and construction of expression measures using Affymetrix microarray data
7. Introduction to microarray experimental design
8. Split-plot experimental designs in microarray experimentation
9. Incomplete block experimental designs
10. Latin square experimental designs
11. Introduction to mixed linear models
12. Choosing between competing experimental designs
13. Multiple testing methods for the analysis of microarray data
14. Mixture modeling of the p -value distribution
15. Power and sample size calculations for microarray experiments
16. Introduction to randomization tests
17. Significance Analysis of Microarrays (SAM)
18. Estimation of gene-specific variances
19. Parametric empirical Bayes methods for microarrays
20. Cluster analysis of microarray data
21. Identifying differentially expressed gene categories

Additional topics may include quantitative real-time reverse transcriptase polymerase chain reaction for verification of differential expression, mapping expression quantitative trait loci, next generation sequencing technologies, or other current research topics on the statistical design and analysis of microarray experiments.

We will use the free statistical software R throughout the course to help with statistical computing. SAS may be used occasionally.