

BIOM601 Biostatistics I



Lecturer: Frank Siewerdt
College Park, Fall 2008

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Course Objectives

- Basic terminology in statistical methods
- Assumptions and limitations of statistical techniques in data analysis
- Identification of proper analysis technique
- Hypothesis formulation and testing
- Use of SAS® for data analysis

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Expectations: FS and Teaching Assistants

- Properly present contents
- Answer questions in class
- Assist with laboratory work (TA)
- Be available extra-class
 - Office hours
 - Assistance through e-mail

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Expectations: Attendants

- Attend lectures and laboratory sessions
- Attendance policy
- Study assigned materials *before* lecture
- Participation in class (questions and discussions)
- Contribute research experience to lectures and laboratory sessions

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Evaluation System

- Midterm Exams: October 7, November 6 (25% each)
- **Final Exam:** December 11, 12:30 a.m. – 1:45 p.m., ANSC 0408 (30%)
- Lab Assignments (best six of seven; 20%)
- No quizzes!
- Missed make-up exams or assignments: weight is added to final exam

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Exceptions and Special Arrangements

- Handicaps
- Religious observances (September 30)
- Pregnancy, childbirth, and lactation
- Civic duties (voting, court appearance)
- [Family] emergencies

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Code of Academic Integrity

- Student initiative
- Consequences of cheating, fabrication, facilitation, and plagiarism
- "I pledge on my honor that I have not given or received any unauthorized assistance on this examination (assignment)."
- <http://www.shc.umd.edu>




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Learning Support

- Office Hours: Th 10:15 a.m. – 11:30 a.m.
– Other times by appointment
- Teaching Assistant
 - Mr. Apratim Mitra (amitra83@umd.edu)
 - Laboratory activities, SAS manuals
- Website for BIOM601
(<http://ansc.umd.edu/siewerdt/biom601master.html>)
- UMEG e-mail reflector


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Authoritative Texts




Principles and Procedures of Statistics:
A Biometrical Approach
R.G. D. Steel, J.H. Torrie, D.A. Dickey
McGraw-Hill, 1996 (3rd ed.)

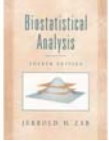


Experimental Designs
W.G. Cochran & G. Cox
John Wiley & Sons Inc (2nd ed., 1992
reprint)


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Textbook Options




Biostatistical Analysis
Jerrold H. Zar
Prentice-Hall, 1999 4th ed.)
(Used in Fall 2007 and Summer 2008)



Experimental Design and Data Analysis for Biologists
Gerry P. Quinn & Michael J. Keough
Cambridge, 2002
(Used in Fall 2006; possibly adopted in
BIOM602)

• Selection of topics: arbitrary


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Lectures (First Part)

- Concepts, limitations, uses of basic statistical methods
- Statistical distributions
- Exploring data sets and detecting outliers
- Estimation and hypothesis testing: frequentist and Bayesian approaches (♥)
- Sampling and power

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Lectures (Second Part)

- Analysis of variance: principles
- Analysis of variance: one and two factors
- Comparison of treatment means (♥)
- Analysis of discrete data

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Lectures (Third Part)

- Covariance and correlation
- Simple linear regression: frequentist and Bayesian approaches (♥)
- Multiple linear regression
- Model selection in regression analysis

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Laboratory Activities

- Software used: SAS®
- Self-pacing option
- Explore SAS tutorial
- Assignments and work ethics
- Share your research interests, data sets
- Alternative statistical software:
 - SPSS, Minitab, Excel
- Laboratory activity schedule, instructors

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Scientific Method

1. Identifying the problem
2. Establishing a hypothesis
3. Design of experiment
4. Data collection
5. Data analysis (hypothesis testing)
6. Interpretation and reporting (verifiability)


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Scientific Method (Short Version)

CHALLENGE AUTHORITY !

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Scientific Method (1. Identifying the Problem)

Descriptive problems (simplest)

↓

Finding mechanisms (most complex)

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Scientific Method (2. Establishing a Hypothesis)


The Equivalence Principle

Biological
Meaning

Statistical
Capability

Testable Hypothesis


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Scientific Method (3. Design of Experiment)

- Is experimental testing feasible?
- Resource allocation (sample size)
- Separating signal from noise
- Final definition of the statistical model
 - Statistical analysis is defined once experimental design is established

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Scientific Method (4. Data Collection)

- Maintain impartiality (blind collection, if possible)
- Timing of data capture
- Precision of collected data
- Respect experimental design

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Scientific Method (5. Hypothesis Testing)

- Significance level
- Power level
- Accepting or rejecting a hypothesis
- Inferences based on standing hypothesis

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Scientific Method (6. Interpretation and Reporting)

- Translate statistical language into biological phenomena
- Publication shares your findings and your interpretation of results
- Description of essential procedures
- Must be independently verifiable

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Statistical Inference

- Expands results from sample to population
- Limitations to statistical inference
 - Target population
- Alternatives
 - Deduction (formal mathematics or logic)
 - Induction (generalization)
- Experimental verification: mostly inductive
- Pitfalls of induction

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False Induction

- **Problem:** Can we formulate a rule to rapidly calculate the square root of a four-digit number?

3025	$30 + 25 = 55$
2025	$20 + 25 = 45$
9801	$98 + 01 = 99$
0001	$00 + 01 = 1$

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We have a new “rule”!

“To obtain the square root of a four-digit number, simply separate the first two digits from the last two digits and add the ensuing two-digit numbers.”

However...

These are the only four-digit numbers for which this “rule” works.

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For the cost of a 12-pack!



Introduction to Scientific Research

E. Bright Wilson, Jr.

Dover 1990, (3rd ed.)

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