General Information

Instructor:	Robert Weiss	
Office:	PH 51-269	
Mail box:	51-254	
Office Hours:	MW noon. Come on by! No appointment needed	
	Finals week: June 9, 10, 10am.	
	Other times by appointment	
E-mail:	robweiss@ucla.edu	
Web page:	`http://rem.ph.ucla.edu/rob/mv/index.html`	
Class:	MW 10:00-11:50	CHS 41-268
Not meeting	F 11:00-11:50	CHS 71-257
Mid-quarter:	W 10:00-10:50	May 12 Monday Room 41-268
Presentations	MW Week 8, 2 per day	
Final Exam:	M 3:00pm-6:00pm	June 10 Tuesday Room 41-268

Prerequisites

B or preferably much better in Biostatistics 250A and 250B. Or permission of the instructor.

Texts and References

Seber, G.A.F. (1984). *Multivariate Observations*. Wiley, New York. Paperback. Required.

Weiss, R. E. (2005). Modeling Longitudinal Data. Springer. Required, particularly if you haven't previously studied longitudinal data modeling.

Weiss, R. E. (2006). Multivariate Lecture Notes. Required. Accessible from our web page. `http://http://faculty.biostat.ucla.edu/robweiss/biostat251`

Everitt, Brian (2005). An R and S-PLUS companion to Multivariate Analysis. Springer. Handy discussions with code on how to run various multivariate analyses in R.

Gelman, Andrew; Carlin, John B.; Stern, Hal S.; Dunson, David B.; Vehtari, Aki; Rubin, Donald B. (2013). Bayesian Data Analysis, 3rd Ed. CRC Press. Highly recommended.

Krzanowski, W.J. and Marriott, F. H. C. (1994). *Multivariate Analysis*, Part 1, Distributions, Ordination and Inference. Edward Arnold, London. Optional, but useful if you would like to see a different presentation of the traditional multivariate material.

Krzanowski, W.J. and Marriott, F. H. C. (1994). *Multivariate Analysis*, Part 2, Classification, Covariance Structure and Repeated Measurements. Edward Arnold, London. Optional, but useful if you would like to see a different presentation of the traditional multivariate material.

Gelman, A. and Hill, J. (2006). Data Analysis Using Regression and Multilevel/ Hierarchical Models. Cambridge University Press. I run into a lot of people using/referring to/reading this.

Grading

The grade will be based upon homework, mid-quarter, presentation and final. The mid-quarter will be 2 hours 10-11:50 on Wednesday TBA. It will cover everything through the Monday of that week, including material that may be on homework not graded or turned in at that time. Exams are closed book, closed notes, no calculator. If your percentile on the final is greater than on the mid-quarter, then the mid-quarter percentile will be set equal to the final percentile.

Homework	10%
Mid-quarter	35%
Presentation	10%
Final	45%

Homework due dates may be adjusted. Homework is accepted in class up to one week late, after which it is automatically 50% off. Homework is not accepted two weeks after the date originally due, nor after the tenth week of the quarter.

Homework Due Dates

Dates to be updated shortly
HW1 **April 16**
HW2 **April 23**
HW3 **April 30**
HW4 **May 7**
HW5 **May 14**
HW6 **May 28**
HW7 **May 28**
Week 8 Monday 2 presentations
Week 8 Wednesday 2 presentations
HW8 **June 4**

Stat Packages & Computing

You will need to find a statistics or computational package for doing applied homework problems. R is recommended and free and of high quality. SAS Proc Mixed is required for fitting structured covariance matrices. Example Proc Mixed programs are available at `http://rem.ph.ucla.edu/rob/rm/new/index.html`. In particular, check out the labs.

Office Hours

Please come and see me during office hours. No appointment necessary, just show up! Appointments needed at other times. Or send an email. See `http://faculty.biostat.ucla.edu/robweiss/office-hours` for times.

Collaboration

You may discuss homework among yourselves, but you may not share files or text. All writing and programming must be your own.

Learning Objectives

- How to write a statistical model.
  - Regression model
  - Hierarchical model
  - Longitudinal model

- Reading and presenting a multivariate statistics paper.
  - Experience reading a stat paper.
  - Experience presenting a stat paper.
- Multivariate statistics.
  - Multivariate normal distribution
  - Wishart
  - Hotelling's T^2
  - Multivariate normal inferences
- Likelihood how to write it out.
- Models
  - Longitudinal modeling
    - Plotting data.
    - Covariance model specification
    - Mean model specification
  - Hierarchical models
    - Nesting
    - Random effects
- Bayes modeling
  - Priors
  - Likelihood
  - Posteriors
  - Inferences
  - Shrinkage
- Classical multivariate
  - Principal components
  - Biplot
  - Cluster analysis
  - Discriminant analysis
  - Multivariate regression

Presentation

Presentations are on multivariate and longitudinal papers. Each person presents a separate paper. Presentations should be 25 to 30 minutes long. Your goal is to communicate clearly to the class

1. the model,
2. reasons why the model is useful,
3. the example,
4. the results, discussion and
5. your own critique both positive and negative.

I suggest a 'chalk' talk for the notation and model, slides for text material discussing the model, and scanned in figures and tables for the example results. I'm not so interested in fitting algorithms, though key features of the algorithms certainly can be mentioned.

Presentations will be in the 8th week, 2 on Monday, 2 on Wednesday at the start of class. Papers are assigned on a first come first served basis, and the same for scheduling. Email communication for choice of paper and scheduled time is preferred. Verbal communication with me is okay, but please follow up by and immediate email.

You are strongly encouraged to meet with me twice about the papers, once to clarify that you understand the contents of the paper and a second time to review your talk. Grading will be on (1) clarity, (1) accuracy and (3rd) thoroughness of presentation.

Required Reading

The reading in Seber and in Weiss is required and Gelman is strongly recommended.

Topics	**Chapters in Seber**
Algebra	Appendices A, B
Distribution Theory	1,2,3,8
Principal Components	5, esp. 5.1, 5.2, 5.3 & Notes
Factor Analysis	5.4
Canonical Correlation	5.7
Discriminant Analysis	6
Cluster Analysis	7 Spatial Data notes, if time

Topics	**Modeling Longitudinal Data Chapter**
Intro	1
Plots	2

MV Normal	5
Tools	6
Covariates	7
Covariance Models	8
Random Effects Models	9
Discrete Data	11
Multivariate Longitudinal	13

Topics	**Bayesian Data Analysis**
Overview	Chapter 1
One Parameter Models	Chapter 2
Multivariate Models Intro	Chapter 3
Computation	Chapters 10,11

Topics	**Chapters in Krzanowski & Marriott**
Algebra	Appendices A, B in Seber
Distribution Theory	1, 2.1-2.14, 2.27, Appendix, 6, 7
Principal Components	4.1-4.8 & RM Notes
Biplot	4.9
Factor Analysis	12, esp 12.17-12.32, 12.43-12.44
Canonical Correlation	4.10-4.11
Multidimensional Scaling	3.25-3.27, 5, especially 5.1-5.12, also 5.28-5.30
Discriminant Analysis	9
Cluster Analysis	10