Stat2labS

Integrating Interdisciplinary Research into a Statistics Course

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Stat2labs

Multi-day labs that address advanced statistical techniques encouraging students to

1) collect data,
2) determine appropriate techniques for analysis,
3) integrate technology,
4) perform analysis,
5) make inferences and
6) interpret the results.

Outline

- Project Goals
- Discipline Specific Lab Components
- Lab Supplements
- Example Materials

Project Goals

1) Broaden student understanding of the intellectual content and applicability of statistics as a discipline
2) Provide opportunities for mathematics majors to interact with other scientific disciplines
   - Interdisciplinary lab modules
   - Encourage multidisciplinary group work
3) Strengthen student-faculty research
   - Read and evaluate primary literature
   - Emphasize the process of science and data analysis
   - Oral and written reports with peer review

Project Goals

4) Incorporate the GAISE guidelines:

- Emphasize statistical literacy and develop statistical thinking;
- Use real data;
- Stress conceptual understanding rather than mere knowledge of procedures;
- Foster active learning in the classroom;
- Use technology for developing conceptual understanding and analyzing data;
- Use assessments to improve and evaluate student learning;

Discipline Specific Lab Components

- Journal article or reading assignment that incorporates a statistical concept into another discipline
- An experiment or activity students can conduct and analyze
- Guided questions for peer review or evaluation of primary literature

Lab Supplements

- Introduction to the statistical topic
- List of any prerequisite knowledge that is needed
- Statistical software instructions (Minitab & R)
- Directions for writing a research paper or poster
- Suggestions for instructors
- On-line lab assessment tool

Materials

1) Investigating Statistical Concepts, Applications and Methods (ISCAM)
   - A. Rossman and B. Chance
   - NSF DUE-9950476: A Data-Oriented, Active Learning, Post-Calculus Introduction to Statistical Concepts Methods, and Theory
2) Stat2labs
   - NSF DUE#0510392: Kuiper, Moore, and Collins
   - For the end of a 1st course or in any 2nd course
   - http://web.grinnell.edu/individuals/kuipers/stat2labs/

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Lab Modules For a 1st or 2nd Statistics Course

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Lab Modules

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Topics in Statistics

How to Write a Scientific Poster or Paper

Guidelines for Statistics Education

Assessment

IRB Approval

Labs	Topic	Discipline	Prerequisites	Supplements	Lab Components	Software Instructions
Simon	Design of Experiments	Psychology	2-sample t-test paired t-test	ANOVA Tutorial: Full Factorial Designs ANOVA Tutorial: Advanced Designs	Experiment with an on-line game Paper or Poster	Minitab R
Perfection	Design of Experiments	Psychology	2-sample t-test paired t-test	ANOVA Tutorial: Full Factorial Designs ANOVA Tutorial: Advanced Designs	Experiment with an on-line game Paper or Poster	Minitab R
Seed Germination	Design of Experiments	Ecology	ANOVA	ANOVA Tutorial: Full Factorial Designs	Experiment in biology lab Paper or Poster	Minitab R
Build a Better Cup	Response Surface Methodology/Optimization	Engineering			Predict optimum value of unknow equation based on sample data	
How Much is Your Car Worth?	Multiple Regression Introduction	Econometrics	Simple Linear Regression	Car Lab 1 data Collected using tables from the 05 Central Edition of the Kelley Blue Book. Copyright Kelley Blue Book Co., Inc. All Rights Reserved	Workshop style lab, with Minitab intructions.	R
Cash for Condoms	Multiple Regression Advanced Lab	Econometrics	Introduction to Multiple Regression	2002 Worldbank Data	Research on population control and economic growth in third world countries Paper or Poster	R
Stock Market Values	Principal Component Analysis Introduction	Finance		2006 Financial Data	Workshop style lab with Minitab instructions	R
Global Warming Hockey Stick Graph	Principal Component Analysis Advanced Lab	Environmental Studies	Introduction to Principal Component Analysis	betas sigmas.txt	Simulation study with R instructions on techniques used to reconstruct global surface temperatures Paper or Poster	Minitab

Tutorial Topics

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On-line Tutorials

Topic	Prerequisites	Status	Labs	Software Instructions
Graphs, Charts, and ANOVA Assumptions		In progress		Introduction to Minitab Lab
Introduction: Making Connections Between Models 2-sample t-test, ANOVA, and regression	2-sample t-test	In progress		
ANOVA: Full Factorial Designs-Powerpoint	2-sample t-test Summation notation	Complete	Simon-psychology Perfection-psychology Seed Germination-ecology	Minitab R
ANOVA: Advanced Designs-Powerpoint	Full Factorial Designs	Complete	Simon-psychology Perfection-psychology Seed Germination-ecology	Minitab R
Response Surface Methodology-Optimization	Full Factorial Designs	In progress	Build a Better Cup-engineering	Minitab R
Data Mining				
Reliability				
Introduction to Multivariate Regression		Complete	How Much is Your Car Worth?	Car Lab Data
Principle Component Analysis		Complete	2006 Stock Market Values	2006 Financial Data
Discriminant Analysis				
ANCOVA				
Time Series		In progress		
General Linear Models		In progress		
Logistic Regression				
Bayesian Methods				
Markov Chain Monte Carlo				
Variable Selection in Multiple Regression				
Spatial Sstatistics				
Nonparametric tests		In progress		

Writing a Scienticfic Poster or Paper

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The following was copied with permission from the Grinnell College Investigations Manual, the complete manual is found here.

For a printable copy of **The Scientific Poster** go to: http://www.grinnell.edu/academic/biology/links/includes/ScientificPoster_from_BC_manual.pdf

For a printable copy of **The Scientific Paper** go to: http://www.grinnell.edu/academic/biology/links/includes/ScientificPaper_from_BC_manual.pdf

The last two pages consist of a checklist for paper evaluation. A paper/poster checklist is also available here.

From Investigations 2005, p. 32-34

The Scientific Poster

What is a poster and why do you do it?

Professional scientists regularly present the results of their work at local, national, and international meetings. At most scientific meetings, posters are the primary means by which scientists exchange information about their work. The poster, although a smaller unit than the published journal article, is thus a fully professional entity, and almost always the first form in which your story is made public. It is also the most egalitarian form of presentation in that tenured researchers and students alike use it. Its principal advantage is that it promotes extensive two-way communication between the presenter and the audience. Not only are results and conclusions presented to the audience, but also the presenting scientist usually receives ideas and suggestions that help in planning future experiments.

What is a poster? A poster is a visual way of presenting scientific results. A good poster is virtually self-explanatory; it will contain the elements of a paper (Title, Abstract, Introduction, Materials and Methods, Results, Discussion, Conclusions, and References), but it is a distinct form in which different elements are emphasized. There are several examples of research posters distributed around the science building. Look them over. If you still have questions or are unclear about the elements and structure of posters, talk to your instructor.

The poster audience may be divided into three main groups. At professional meetings, Group 1 comprises those colleagues, collaborators, and students who follow work in your area of biology very closely. In this course, that means

the other students who have chosen to focus on topics very similar to yours. This group is familiar enough with the methods and background of your work not to find detail intimidating. At professional meetings, Group 2 includes those scientists who work in the same general area as you, but not on your particular specialty. This group is much larger than Group 1; in this course, it includes the other members of your course. At professional meetings, Group 3 would include those researchers whose work is largely unrelated to yours. In this course, it includes other students within the Science Division who may come to view your poster, as well as the very general audience likely to be present at Parents' Weekend. Keep in mind that your poster must address the needs and abilities of all three groups in order to be successful!

Contents of a Scientific Poster.

Title and Author Panel.

The title should be descriptive but short, in **boldface** letters 1.5 inches high. The authors' names may be somewhat smaller.

Abstract

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The following pretest - posttest assessment is heavily adapted from the Research on Learning and Education (ROLE) survey, NSF #0087611 and the Classroom Undergraduate Research Experience (CURE) survey. This assessment focuses on questions related to an overall evaluation of the lab, demographics, science/statistics attitudes, contributions to career choice, and determining if undergraduate research experiences can successfully be integrated into a course.

For both the Pretest and Posttest it is essential to fill out the first three questions carefully. If the following three questions are not identical to your professor instructions, you will not receive credit for filling out the assessment.

Institution in which you conducted this lab:

Course Name and Number:

Instructor's Name:

Pretest

Posttest

Grinnell College

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Dr. Shonda Kuiper