What Should We Be ‘Teaching’ in the Beginning Statistics Course (and When)?

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Should Add: Where and How

Computer Studio Lab

Meeting Schedule

• 240 Students in class
• One large group meeting (LGM) each week (50 minutes—all 240 students)
• Four lab sections per class (60 students each)
• Each lab section meets two times per week in computer labs

Conduct of Meetings

• Instructor conducts LGM (large group meeting) with 2 TA’s and 2 undergraduate interns assisting.
• TA with 1 undergraduate intern meets first computer lab after LGM
• Instructor meets second computer lab after LGM with 1 TA and 1 undergraduate intern

Goals: Students should be able to

• Understand the reasoning by which findings from sample data can be extended to larger, more general populations.
• Critically evaluate the results of scientific studies
• Design, conduct, and analyze a scientific research study.

Goals (continued)

• Read statistical summaries
• Analyze data using statistical software
• Study and understand examples and applications from a variety of fields
• Learn how to read and apply statistical new techniques

Are we dreaming? Who’s kidding who?
Learning Assumptions

- Learning is enhanced by collaborative group activities
- Students can learn independently
- There are different kinds of learners (holist, serialist, field dependent and independent, etc.)

Technology Assumptions

- Computer labs dedicated to instructional use are available
- Statistical software is available on-line (for example, Minitab, SPSS, SAS,...)
- Instructors and students can communicate synchronously and asynchronously

Is he Anti-Computer?

Guiding Principles

- Give responsibility for learning basic concepts to students (and let instructor's role be that of a facilitator)
- Provide as much hands-on work as feasible
- Use technology appropriately
- Reduce time between ‘concepts’ and ‘applications’ to a minimum—more on this later.

Professor Lecturing

Readiness Assessment Testing (RATs)

- Students are asked to do pre-assigned readings before coming to class and prior to any instruction on the material.
- Goal: Students are to learn some of the basic concepts of the course on their own.
- Reading assignments cover a unit or major topic of instruction (a ‘module’)
Readiness Assessment Tests (Otherwise Known as RATs)
- Individual
- Group
- Appeal

RATs Procedure
- Students
- take individual test with multiple choice and true/false items on assigned readings
- take a 'Group Rat Test' on same quiz.
- can appeal (as a group) incorrect answers
- are given immediate feedback by instructor

Goals of RATs
- Individual: ensure individual accountability and understanding of general concepts and principles rather than small, detailed facts.
- Group: help individual members of the group comprehend ideas that they may not have gotten on their own.
- Appeals: help members understand why their answers were incorrect

Instructor Use of RATs
- to determine where students still have misconceptions or misunderstandings.
- to provide feedback to students on concepts that students are having troubles with.
- enables instructor to focus instruction and activities on application of the course content rather than spending time covering topics easily understand on their own.

Consequences of Using RATs
- Time devoted to learning basic concepts is more efficiently used: less time on easier concepts and more on harder concepts
- Students are well prepared for applications in the computer labs.
- Students become accustomed to learning concepts on their own, enabling greater flexibility in sequencing of topics

Student Reactions to RATs
- They prefer studying on their own to sitting through lectures (are you surprised at this?)
- Their performance on RATs is much better than you would ever guess!
- They like having to keep up with course on a regular basis.
Recommended Reading
(Handouts)
1. Readiness Assessment Process
2. Step-by-Step Outline of the RAT Process
3. Effective Assessment: Using Small Groups to Improve the Quality of Learning in Higher Education
4. Article by Larry K. Michaelson: Myths and Methods in Successful Small Group Work

Course Materials
- printed text (we are using a draft of a book authored by Jessica Utsi and Bob Heckard that will be published in the Spring 2001)
- web course—Cyberstats—available on-line in the Spring 2000 and undergoing revision for Fall 2000
- special readings prepared by instructors

Cyberstats Courseware

Individual/Group Work in Computer Labs
- In first lab after the RAT, lead by a TA, students work alone or in pairs (a 'Dyad') and quiz is given at end of lab on the activities done.
- In second lab, led by instructor, activities are done by groups of four, and are more challenging. A group quiz is given at end of lab on the activities done.

Lab Activities
- Focus on application of concepts covered by RAT
- Activities in the first lab after RAT, led by TA, are moderately structured, to reinforce learning of the concepts at a basic level
- Activities in the second lab after RAT, led by instructor, are more unstructured and require a higher level of analysis.

Prior Views on Sequencing
Why have most texts generally adopted the same sequencing of topics?
Moore and McCabe View: Puzzle with three pieces:
i. Describing data
ii. Producing data (designs, probability)
iii. Inference
Sequencing of Topics: Overview

- Introduce inference early (within the first two weeks)
- Whenever appropriate, include inference with new topics as you go—for example, in covering descriptive statistics, using a case study, specify null and alternative hypotheses, obtain p-value and make decision

Sequencing of topics: Overview (Continued)

- Build on topics previously covered by adding new bells and whistles, while reinforcing them over and over again.
- Keep applications closely tied to new concepts—don't say "you'll understand why we are doing this six weeks from now!"
- Be careful not to use concepts not needed for course unless there is a good reason.

Sequencing of Topics by Week

- Week 1: Course Overview; Data, Types of Variables, Descriptive Statistics for Categorical Variables
- Week 2: Basic Concepts of Inference: Margin of Error and Confidence Intervals Hypotheses; Making Decisions; Types of Errors, Probabilities of Errors; P-value

Sequencing of Topics (continued)

- Week 3: Describing Numerical Data, Interwoven with Inference
- Week 4: RV's, Probability Distributions, Expected Values, Binomial and Normal Distributions; Inference for the Median
- Week 5: Sampling Distributions, in General and for Means and Proportions; T-Distribution

Sequencing of Topics (continued)

- Week 6: Inference for One Mean and One Proportion
- Week 7: Surveys, Experiments, Types of Studies
- Week 8: Project Work; Review for Midterm
- Week 9: Project Work on Surveys, Types of Studies, and Experiments.

Project 1

- Design a Good Poll
- Design a Bad Poll
- Design an Experiment
See Handout on Project 1

- Students will need to find examples of good polls and bad polls, on the web, based on their readings of the course materials.
- Clues are given on where to look for good and bad examples.
- Students will be asked to design a randomized experiment (with 2 treatments or more)

Sequencing of Topics (continued)

- Week 10: Inference for Two Means, Two Proportions, and Paired Comparisons
- Week 11: Correlation and Regression
- Week 12: Project Work
- Week 13: Chi-Square Tests; 1 Factor AOV
- Week 14: Selection of Statistical Procedures
- Week 15: Review for Final Exam, Wrap-Up

Project 2

- Major Study Involving:
  - Creating a Survey (on Music)
  - Students Filling Out Survey
  - Analyzing Survey Responses. Using at Least 4 or 5 Statistical Techniques
  - Synthesizing Semester Topics
  - Writing a summary Report

See Handout on Project 2

- Students will need to determine whether to use mean or median as measure of location
- They will need to read about nonparametric tests and to use appropriate one if the median is used.
- Nonparametric inference, except for the sign test, is not covered in course. But through RATS they should be prepared!

Some Closing Comments:

- It is easy to list the set of topics one will select to choose from to include in the course. It is not so easy to make careful final decisions on coverage.
- Free yourself of preconceived notions on the order in which you think topics ought to be covered. Then assemble a sequence that you think meets your course goals.

Session 6.1 not available