"So What…is it"

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Background

Joined the Department of Applied Economics and Management of Cornell University in 1988.

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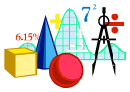

Introductory Statistics

An introduction to statistical methods. Topics to be covered include the descriptive analysis of data, probability concepts and distributions, estimation and hypothesis testing, regression and correlation analysis. Applications from business, economics, and the biological sciences are used to illustrate the methods covered in the course.

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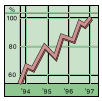

Business Statistics

This course focuses on methods used to analyze data from marketing research, business, and economics. Topics studied include: experimental design, time series and forecasting, and contingency table analysis. Introductions to non-parametric methods and multivariate techniques are also presented. The course will involve a research project designed to give experience in collecting and interpreting data.

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Decision Models

The course is focused on economic and statistical models of decision analysis and their application in large and small business settings. It will be shown how use of models can improve the decision process by helping the decision-maker: understand the structure of the decision, incorporate subjective probabilities as a way to portray risk, measure outcomes in a way that is consistent with attitudes toward risk, and understand the value of information.

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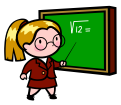
From Calculators to Communicators



The Early Years: Calculating and graphing took significant lecture and homework time.

Presently: While there is value in computing and graphing (manual mathematics), the focus has shifted to interpretation and the statistical investigative process

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From Calculators to Communicators

As Deborah Rumsey in her article "Statistical Literacy as a Goal for Introductory Statistics Courses" (2002) states:

"We can give students many opportunities to explain and discuss statistical ideas with each other, and watch closely while they do this. I am convinced that students who are most likely to be good statistical citizens and research scientists are those that are successful at incorporating statistical concepts, terms, and ideas into their own language."

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From Calculators to Communicators

In the ASA (2004) Guidelines for Assessment and Instruction in Statistics Education", it reinforces that: Students should understand the parts of the process through which statistics works to answer questions, namely:

How to obtain or generate data.

How to graph the data as a first step in analyzing data, and how to know when that's enough to answer the question of interest.

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From Calculators to Communicators

How to interpret numerical summaries and graphical displays of data - both to answer questions and to check conditions (in order to use statistical procedures correctly).

How to make appropriate use of statistical inference.

How to communicate the results of a statistical analysis.

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Communication Venues

- Student to Classroom
- Student to Teacher
- Teacher to Classroom

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Student To Classroom Communication

"Say it" - if you can't say it, you probably don't really understand it.

Examples: We have just computed a slope estimate of 3 inches/year. "Say it".

We have just computed a 95% confidence interval for the population mean of ($1000, $2000). "Say it".

The 95th percentile is 94 points. "Say it".

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Student To Classroom Communication

"Say it" - if you can't say it, you probably don't really understand it.

Study Tip: Point to a number on a homework or lab section assignment. Try to explain (out loud) what that number means.

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Student To Classroom Communication

"So What?"

Examples:

You have just constructed a bar graph, "so what do you see"?

You have just found the estimated regression line, "so what will you do with it?"

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Student To Classroom Communication

"So What?"

Examples:

You have just rejected the null hypothesis, "so what do you do next"?

We just completed the "Read Beads Experiment", "so what lessons did we learn from this"?

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Student To Classroom Communication

Think/Pair/Share : a structure first developed by Professor Frank Lyman at the University of Maryland in 1981.

- Teacher poses a problem or question.
- Teacher gives the students "think time" and directs them to think about the question.
- Following the "think time" students turn to face their Learning Partner and work together, sharing ideas, discussing, clarifying and challenging.

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Student To Classroom Communication

Think/Pair/Share :

- The pair then share their ideas with another pair, or with the whole class. It is important that students need to be able to share their partner's ideas as well as their own.

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Student To Classroom Communication

"Literacy Moment"

Students are encouraged to bring examples of uses and misuses of statistics in the popular press (newspapers, journal articles, magazines, on-line Information) to the classroom and present them to the group.

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Student To Classroom Communication

Oral Reports

In "Learning Statistics by Doing Statistics", (1998) Gary Smith notes that:

"Oral reports can not only help students develop the ability to speak coherently and persuasively, but can also help them learn statistics."

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Student To Classroom Communication

Please check off the appropriate rankings for each section, and give constructive comments.

	5 Excellent	4 Very Good	3 Good	2 Satisfactory	1 Unsatisfactory
Content					
Description of the decision					
Explanation of the tree					
Justification of probabilities and objective function					

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Student To Classroom Communication

	5 Excellent	4 Very Good	3 Good	2 Satisfactory	1 Unsatisfactory
Content					
Explanation of final conclusion					
Explanation of sensitivity analysis results					

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Student To Classroom Communication

	5 Excellent	4 Very Good	3 Good	2 Satisfactory	1 Unsatisfactory
Content					
Discussion of additional considerations (qualitative aspects, utility, etc.)					

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Student To Classroom Communication

	5 Excellent	4 Very Good	3 Good	2 Satisfactory	1 Unsatisfactory
Form					
Preparation and organization					
Use of visual aids					
Timing of presentation					
Coordination of speakers					

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Student To Classroom Communication

Stat Jeopardy

Used in Lab sections - students organized into teams.

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Old Material	New Material	Same Name
This is the absolute value of the difference between an unbiased point estimator and the population parameter.	Probability of committing a Type II error	Largest Star & Lad
This theorem uses a prior probability and new information to calculate a posterior probability.	The probability of rejecting the null hypothesis when it is false is known as this.	Fly Above & Tender
This is the statistical tool used to measure how wide the box is in a Box Plot.	These represent the weights in the pooled variance	Big Red & Naked
This type of distribution shape results from the mean being less than the median.	The assumption you make whenever you use a tcalc	Wed & Happy

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210 Jeopardy Final Round

x = # of hours a student studies for AEM 210 Final

y = A student's score on the AEM 210 Final

Least Squares Regression Line → $r^2 = .8$

What is r^2?
Translate/Interpret r^2 in terms of the problem (i.e. in words).

(Need to get both parts correct in order to receive credit.)

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Communication Venues

- Student to Classroom - Other suggestions?
- Student to Teacher
- Teacher to Classroom

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Student To Teacher Communication

Written Term Project

The group project will give you the opportunity to analyze data in an area of personal interest. The educational goals that I have set for this exercise are:

- Illustrate the relevance of statistics
- The opportunity to apply technological tools
- Experience in writing statistical reports
- Experience in collaborative learning with your peers

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Assessment

Overall then, your work will be judged not only on the quality of your statistical results, but on the clarity, readability, and organization of your paper. Note: grammar and punctuation are important considerations. Don't forget to "Spell Check."

The final product will be graded in the following way:

Proposal	_____	**(5)**
Part I	_____	**(30)**
Peer Evaluation	_____	**(5)**
Final Report:		
Organization and Presentation	_____	**(10)**
Executive Summary	_____	**(5)**
Results	_____	**(20)**
Data Limitations	_____	**(10)**
Conclusion	_____	**(5)**
Appendix	_____	**(10)**

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PEER EVALUATION FORM

Please use this form to evaluate your project team members. Each member of the team must evaluate all of the members of his/her team. This form must be handed in by Monday, December 8th at the latest. If the form is not completed, you will receive no credit for your team contribution.

Your name: _____

Team Number: _____

Please assume you have $10,000 to be divided among you and your fellow team members for your work. Indicate below how much you believe should be given to each team member.

Please consider things such as attendance, preparation, and willingness to contribute and share ideas, attitude, and overall performance.

Please be candid and fair. Your evaluation will be kept in the strictest of confidence. Thank you.

NAME OF STUDENT TEAM MEMBER:	AMOUNT OF MONEY THE PERSON SHOULD RECEIVE
1.) YOU	
2.)	
3.)	
4.)	

Additional comments (if needed):

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Student To Teacher Communication

Homework Assignments include Open Questions - the written version of "say it" and "so what".

Examples: 6th step in Hypothesis Testing is: State your decision in terms of the original research question. Rumsey (2002) calls this the "research conclusion".

State what making a Type I error would mean "in terms of this problem".

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Student To Teacher Communication

Rumsey (2002) also points out three common misconceptions:

1.Calculations demonstrate understanding of statistical ideas.

2.Formulas help students understand the statistical idea.

3.Students who explain things in statistical language demonstrate their understanding of a statistical idea.

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Student To Teacher Communication

Ruth Hubbard (1997) offers some useful techniques for creating new questions:

a.) Ask the students to make up a question.

b.) Suggest that some aspect of a standard situation changed and ask students to explain how the change affects the solution.

c.) Link graphical and symbolic representations of a concept.

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Student To Teacher Communication

Ruth Hubbard (1997) example:

A few weeks ago you studied simple regression. Describe a problem that could occur in one of the other subjects you are studying or in the context of one of your hobbies that could be solved using simple regression. Pretend you have collected some data to solve your problem. Write the data down indicating the independent and dependent variables, but do not do any calculations.

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Student To Teacher Communication

"Stat Chats"

Have individual or small groups of students come to my office so we can just "chat" about statistical concepts.

"Say to me what a confidence interval is."

"Explain the Central Limit Theorem to me."

"What are the assumptions for a one-sample t-test?"

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Communication Venues

- Student to Classroom
- Student to Teacher - Other suggestions?
- Teacher to Classroom

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Teacher to Student Communication

Broad "perspective" discussions:

Eric Sowey in "Teaching Statistics: Making it Memorable" (1995) points out that "A perspective view woven into the exposition from time to time brings students at least three benefits:

a.) it helps them chart their progress through the syllabus.

b.) it promotes understanding of the coherence of the subject.

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Teacher to Student Communication

Broad "perspective" discussions

c.) it makes clear what parts of the area under study are not currently being treated in detail.

Teacher to Student Communication

Broad "perspective"

- Chapter Overviews

Teacher to Student Communication

CHAPTER 2

I. Methods of Describing Numerical Data
   A. Stem and Leaf Display
   B. Tabular Methods - Frequency, Relative Frequency, Cumulative and Cumulative Relative Distributions
   C. Graphical Methods - Histogram, Ogive
II. Graphically Describing Two Numerical Variables
   A. Scatter Diagram
III. Methods of Describing Categorical Data
   A. Tabular Methods - Frequency and Relative Frequency Distributions
   B. Graphical Methods - Bar Graph, Pie Chart
IV. Describing Two Categorical Variables
   A. Contingency Table
   B. Side-by-Side Bar Chart

Teacher to Student Communication

Broad "perspective"

- Chapter Overviews
- "True Colors"

Thanks to William Harkness, Penn State University

Show Your True Colors!

(Pick a Card Color)

- ☐ Use RED to say "2-Sample t-test"
- ☐ Use GREEN to say "Paired t-test"
- ☐ Use YELLOW to say "Regression"
- ☐ Use WHITE to say "Don't Know!" (Or none of the above)

A certain professor at Cornell told me that she heard that the length of a person's forearm and the length of their feet were the same. I think that what is meant by her statement is that the average length of the forearm of all people is the same as the average length of their feet. To test this claim, the length of the right forearm and the right foot of 28 students in ARME 210 were measured. For example, the measurements on one student were 25.5 cm and 26 cm respectively. In testing the professor's claim, which technique should be used?

- ☐ RED (2-Sample t-test)
- ☐ GREEN (Paired t-test)
- ☐ YELLOW (Regression)
- ☐ WHITE (Don't Know! Or none of the above)

Teacher to Student Communication

Broad "perspective"

- Chapter Overviews
- "True Colors"
- Overview discussion on appropriate analyses for different types of variables: For example, you are comparing two quantitative variables, what graph(s) would you construct, what type of analyses would you do?

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Teacher to Student Communication

Broad "perspective"

- Chapter Overviews
- "True Colors"
- Overview discussion on appropriate analyses for different types of variables.
- Be conscious of the "statistical process" when techniques are introduced.

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Teacher to Student Communication

Broad "perspective"

Beth Chance (2002) points out that:
"Recently there have more and more calls for instructing novices, including non-majors, in the mental habits and problem solving skills needed to think statistically. These mental habits include:

- consideration of how to best obtain meaningful and relevant data to answer the question at hand.

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Teacher to Student Communication

Broad "perspective"

- constant reflection on the variables involved and curiosity for other ways of examining and thinking about the data and problem at hand.
- seeing the complete process with constant revision of each component.
- omnipresent skepticism about the data obtained.

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Teacher to Student Communication

Broad "perspective"

- constant relation of the data to the context of the problem and interpretation of the conclusion in non-statistical terms.
- thinking beyond the textbook."

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Teacher to Student Communication

Broad Perspective Written Material

- Review sheets

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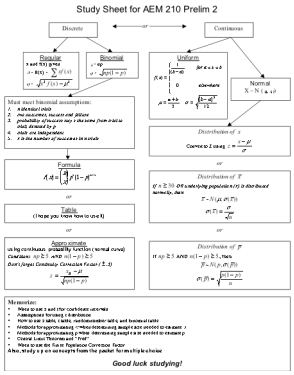

Teacher to Student Communication

Broad Perspective Written Material

Study Tip: Xerox pages with textbook problems at the end of each section covered on the exam. Cut them into individual questions. Mix them up and put them in a big envelope. At least a week before the test start pulling questions out of the envelope and see if you can answer them. Focus on how you identified the research question.

Teacher to Student Communication

Broad Perspective Written Material

This approach is one way to give the opportunity to do what Beth Chance (2002) calls "Think beyond the textbook". She points out that:

"These examples also highlight the dependency students develop on knowing which section of the book a question comes from. Students learn to apply procedures when directed, but then after the course are at a loss of where to begin when presented with a novel question."

Communication Venues

- Student to Classroom
- Student to Teacher
- Teacher to Classroom - Other suggestions?

From Calculators to Communicators

Presently: While there is value in computing and graphing (manual mathematics), the focus has shifted to interpretation and the statistical investigative process

From Calculators to Communicators

In discussing the main goals of an introductory statistics course, Garfield (1994) states that:

"We would like our students to be able to intelligently collect, analyze, and interpret data; to use statistical thinking and reasoning; and to communicate effectively using the language of statistics."

From Calculators to Communicators

And her question to us then is:

"Are they learning to use statistical thinking and reasoning, to collect and analyze data, to write up and communicate the results of solving real statistical problems?"

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References

Rumsey, D.J. (2002), "Statistical Literacy as a Goal for Introductory Statistics Courses", *Journal of Statistics Education*, v.10, n.3.

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