From canned labs to counseling concerned clients: the evolution of a statistics capstone experience

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Abstract #**301441**, **From Canned Labs to Counseling Concerned Clients: The Evolution of a Statistics Capstone Experience**)
Session # **85** on **Sunday, 7/31/2011** beginning at **4:00 PM**

Abstract

Capstone experiences allow for the synthesis of undergraduate coursework and experience. A data practicum in statistics can serve a number of different undergraduate majors. In this talk, the experience of moving from an early manifestation of this practicum course as a well-defined set of lab exercises to an open-ended consulting experience with clients is discussed. The relationship of this redesigned capstone with writing outcomes and with service learning are discussed. Examples of student work, challenges of assessment and reactions to this class will be discussed.

Outline

1. Context of data practicum course
2. Historical implementation
3. Expanding objectives
4. Current context

1. Context of data practicum course

Graduate data practicum class (STA 660)

- *Supervised practice in consulting and statistical data analysis including use of computer programs. Maximum of six hours may be applied toward a degree in mathematics or statistics. Offered credit/no-credit basis only.*
- Developed in 1973 in response to recognition that consulting was often part of job description of working statisticians and exposure to "real world" problems would be good experience
- Prerequisites (implicit): year of graduate study (theory sequence, reg., exp. design, linear models, statistical programming^{RECENT})
- Initially, students worked on labs that were based on consulting center problems that were cleaned prior to use in class.

Undergraduate data practicum class (STA 475)

- Developed as a senior capstone (part of general liberal education requirements for a major)
- Part of major (option list), minors (2 – including required for "Stat Methods" minor) => approx. ½ students from stat or math and ½ from other majors (PSY, ZOO, …) + no guarantees of significant statistical programming experience
- Modeled after graduate cousin
- Prerequisite: regression class (e.g. may only have 2 stat classes)

STA 475 (ugrad data practicum) Course Catalog description

1. Use of statistical data analysis to solve a variety of projects.
2. Emphasis on integrating a broad spectrum of statistical methodology
3. Presentation of results both oral and written
4. Use of statistical computing packages to analyze and display data
5. Introduction to the statistical literature
6. Team project involving teams of students will combine elements of all of the above.

2. Historical implementation

Initially, common features of early versions of data practicum classes included:

- Problems described and motivated by the instructor using artificially clean preprocessed data
- Labs were previously analyzed and a particular solution is likely
- Students alternated presenting by all students submitted reports of each analysis (often initial + final report)
- Stat instructor provided all feedback to oral/written reports

EXAMPLE: Project 1

A company was thought to be polluting a local lake by discharging its manufacturing waste into the lake without pre-treatment. To investigate whether the lake was polluted, the EPA took five samples from the lake receiving the discharge (Lake #2) and five samples from a nearby unpolluted lake (Lake #1). Strontium measurements were recorded for each of the samples.

Data:
Lake #1: 27.2 29.1 33.2 31.4 32.8
Lake #2: 37.4 35.0 41.2 40.6 36.2

Goal:
Determine whether the strontium concentrations are different for the two lakes.

Requirements:
Provide both graphical and numerical summaries as part of your analysis. All reports must be typed. Line printer plots are NOT acceptable.

Reference:
From Dr. Schaefer's STA 660 lab collection

Strengths of historical structure:

1. Labs could be designed to span a breadth of statistical methods
2. Class was usually small (3-8) and students had lots of chances to present.
3. Opportunity to present ideas not formally covered in other classes.
4. Relatively homogeneous student population (teams made up of students with similar majors)

Weaknesses of historical structure:

1. Problems were already well formulated by a statistician – no need to translate problem from a client
2. Data were preprocessed and relatively easy to mold into an analysis data set
3. Relatively homogeneous student population

3. Expanding objectives

Desire:

- Direct engagement in wrestling with client-defined tasks
- writing outcomes
- group work
- service learning

4. Current context

4.1 Getting Clients?

4.2 Projects

4.3 Reflection

4.1 Getting Clients?

* Need to actively recruit clients and screen projects

* Targeted email …

SUBJ: An invitation to propose projects for data analysis capstone / practicum class

Greetings,
Have you or your office collected data that you haven't had the chance to analyze? Are you planning for future studies and would like some assistance determining how many observations you might need? Do you like working with motivated students? If you can answer "yes" to any/all of these questions, then I invite you to put my students to work.

I am teaching the Data Analysis Practicum/undergraduate capstone Class (STA 475) this Spring. I have 20 seniors enrolled in this class. These students have had a basic stat inference class + a regression/ experimental design course sequence + about 1/3 of them have taken the statistical programming class. Last year, students in this class worked on problems brought to them by faculty members, graduate students, university staff and City of Oxford employees. The students produced both oral and written presentations for clients and based on their analyses. Projects included sizing a study for future data collection, modeling energy use over the course of different exercise regimes, and a study of occupancy of parking in the downtown Oxford.

I am casting my net far and wide for projects. In particular, would you, your students, your office have a project where some statistical assistance might be beneficial? This could include but isn't restricted to study design (e.g. determining sample sizes for a study, providing input on a survey or experimental design, etc.), data analysis (descriptive summaries and formal modeling) and report write-up. Given that the class is scheduled for the Spring semester, it is best to have a mix of projects with some having short-term deliverables (e.g. an analysis that could be completed in a week or two) and other projects with longer-time frame deliverables (although I like to minimize projects with a 4 month time frame for obvious reasons, and I don't want these students spending time with routine data entry tasks although some data management such as converting spreadsheet entries into usable data sets is fine). I ask that you or your student(s) come and meet with the

class to present the problem, and then the STA 475 students will work on a solution that would be presented to you. A formal presentation and a written report will be prepared for each client. I supervise and mentor the STA 475 student work on these projects. BTW, I anticipate that this class could complete 8 +/- 4 projects over the course of the semester.

If you have a project(s) where statistical assistance might be valued, then let me know. Please send me a short description of the project including:

(on the email subject, please use the convention - SUBJECT: STA 475 project: your name - project title)

1. Short descriptive project title

2. Goal of the analysis (e.g. design phase - project planning; data analysis, etc.)

3. Data to be analyzed (e.g. Excel data sheets; still to be collected; ...)

4. Type of statistical analysis anticipated (e.g. logistic regression, anova models, etc.)

5. Timeline for analysis (when are results needed).

Thanks for reading this far. Depending on the level of interest, I may not be able to fit all projects into the Practicum class. In this case, I will coordinate other projects with the Statistical Consulting Center.

Please circulate to colleagues who might be interested (with my apologies for missing them on this initial mailing).

Thanks,
John

4.2 Projects

* I am the first client (probably the worst they will have)
* Project: compare dissolved oxygen-depth relationship between two lakes
* Very general guidance on first draft report
* Extensive commenting on first draft to be addressed with revision

* Ideas to convey early …

1. Revision and critical reading of reports key skill and learning outcome
2. Better graphical displays lead to easier writing and communicating with clients
3. Reporting effect estimates often richer than exclusively reporting the results of hypothesis testing
4. Writing a structured report is a skill

Comments on Report content and structure:

Introduction

- cite background (provide reference)
- provide sentence or two about what you did in the report

Methods

- data description
- stat methods description - reference to method? model described? May be only the final you considered. Not a description of all you examined.
- stat software - SAS/R and identify procedure/function

Results

- Descriptive summaries - figures / tables of summary stats
- Inference results - model fits / coefficients
- Figures/Tables - reference in text + meaningful legends - should be to stand alone. You may generate more figures than you report.

Conclusions (+ Discussion)

References

- data source
- background
- stat methods
- computer software

Later projects – teams; charter-traditional schools; CELTUA; OMA; development)

Project life course

1. Client meeting and discussion with class
2. Team work
3. Interim reporting of analyses
4. Draft report produced (class wiki for other teams to comment)
5. Client presentation of final analysis
6. Final report and presentation sent to client)

4.3 Reflection - STA 475 Data Practicum Portfolio and Self evaluation

"Each **Capstone** emphasizes **sharing of ideas**, **synthesis**, and **critical, informed reflection** as significant precursors to action, and each **includes student initiative in defining and investigating problems or projects**" (http://www.units.muohio.edu/led/Capstone). Your final exam is a paper reflecting on the following questions derived from the reflections associated with service learning courses.

What?

What **projects** did you work on this semester?
What was your **role** on project teams? Note that this may change on different projects.
What did you **observe**?
What did you **like/dislike** about working on these projects?
What **missing knowledge or skills** would have made you a more effective contributor to the work on these teams?

So What?

What stuck out about the experience in this capstone?
What was the **best/worst** thing that happened?
What have you **learned about yourself**?
How does this **experience compare** to others you've had?

Now What?

What have you **learned** about **working** as a statistical **collaborator**/consultant?
How did this experience **challenge** you?
Do you believe that this course **prepared you for future collaborative work**? If so, how? If not, why?

Summary

What **grade** would you assign to your efforts this semester? Why?
Describe the work or contribution of particular **individuals** to project teams that you thought was **noteworthy**.

“a unique class in my college education”
“disliked the less prescriptive nature of the assignments”

“communication is the key in group work”
“even in statistics I’ll have to write papers”

“… important things I learned from these projects were how to clearly write (and rewrite), how to translate statistical ideas to clients and how to work on large projects as a team”

“course felt more like a part time consulting job than it did a class … we worked for the clients, report to a boss (you) and we learned on the job at the same time”

Texts and resources

Text(s) [Required / Required / Recommended]:

G. van Belle (2008) *Statistical Rules of Thumb*. 2nd edition John Wiley: New York. ISBN: 978-0-470-14448-0 [Required]

N. B. Robbins (2004) *Creating More Effective Graphs*. John Wiley: New Yortk. ISBN: 978-0-471-27402-5 [Recommended]

Other resources:

ASA:		www.amstat.org (you can join for $15 as students!)
ASA Section on Statistical Consulting:		http://www.amstat.org/sections/cnsl/
Miller	Wiley	*Beyond ANOVA, Basics of Applied Statistics*
Madansky	Springer-Verlag	*Prescriptions for Working Statistician*
Chatfield, C.	Chapman & Hall/CRC	*Problem Solving: A Statistician's Guide*
P.I. Good and J.W. Hardin	Wiley	*Common Errors in Statistics (and How to Avoid Them)*
Derr	Duxbury	*Statistical Consulting: A Guide to Effective Communication*