IMPROVING THE TEACHING OF STATISTICS IN BUSINESS EDUCATION: LESSONS AND REFLECTIONS

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Undergraduate business students in the United States and U.S. - modeled educational institutions, often take a course in research methodology or a research seminar during their final year which requires basic statistics courses as prerequisites. This paper speaks about improving the teaching of statistics in business schools to serve the final year research methodology course. It identifies the need for a change in the methodology of teaching statistics so as to enable the students to better identify the appropriate statistical procedures and synthesize statistical results in their real world research project. Revisions in the syllabi and philosophy of teaching of statistics are suggested.

BACKGROUND AND INTRODUCTION

The author is at present a professor at the University of Puerto Rico and has been teaching, statistics and research methodology at business schools both at the graduate and undergraduate levels at Puerto Rican universities for the last twenty-five years. Puerto Rico is a Caribbean island territory of the United States; the students are primarily Spanish-speaking but bilingual. Although the setting of this course is distinctive, its curriculum is similar to those of research methods courses and basic business statistics courses taught in BBA (Bachelor of Business Administration) programs throughout the United States.

This paper describes the statistics courses which are prerequisites to many business courses and their context in the business curriculum. It identifies student difficulties in using statistics, and analyzes her understanding of student statistical preparation. It proposes changes in the way statistics should be taught as a service course in business faculties.

The research methods course is a seminar course where students solve a real life business problem. It is intended to be an integrating course, in which students are expected to bring to bear the knowledge learned in their business field of specialty as well as the methodological techniques they have acquired, particularly in statistics, the use of spreadsheets and statistical software. The textbook followed is Zikmund's *Business Research Methods*, which along with many others, is one of the standard texts in the field. Topics in the course include: the business research process, the research proposal, secondary and primary data, survey design, measurement, scales, questionnaire writing and communication of research results. About one third of a standard text deals with sampling, univariate and multivariate statistics. However, these sections are not reviewed in the research methods course not only for want of time but because two semesters of business statistics are a prerequisite to the course.

The first semester of the statistics course includes descriptive statistics, probability concepts, distributions, sampling and sampling distributions, and the Central Limit Theorem. The second semester begins with estimation, hypothesis testing, analysis of variance, nonparametric statistics, regression and correlation analysis. The portions of the first course applicable to the business research methods course include interpretation of survey data using descriptive statistics and graphics. Application of the second course relevant to the analysis of survey data include hypotheses testing, model building and correlation analysis.

In the research methods course, the following techniques are particularly important: For the design component of the course, they must draw upon their knowledge of statistics for identifying target population, sample frame, sample size determination for the sampling design. As they analyze their survey, they must be able to identify the variable and type of variable in each question, the scale of measurement, so as to calculate the appropriate descriptive statistics. For example, the mean has no meaning for categorical data measured on a nominal scale. They should be able to state propositions and formulate the hypotheses that they will later test. They should also identify the applicable procedures for testing. They should be arriving at valid to write conclusions in the context of the business problem.

STUDENT PERFORMANCE

In general students seem to have difficulties with statistical reasoning and written communication. The author's general findings, having taught the course for several years are as follows:

1. Students in general have problems with writing statistical results in words.
2. In the section of the expected outcomes they have difficulty formulating testable hypotheses.
3. They do not give valid justification of the relevant sample size chosen.
4. Students *are* able to input the data into spreadsheets and *MINITAB*. They are able to get graphics and the descriptive statistics but are not always able to interpret properly.
5. They have problems with the identification of the type of variables and the scales of measurement in each question.
6. They do not differentiate well between sample statistics and parameters and just conclude that the sample statistics obtained from a survey as completely true for the population.
7. Identification of the proper statistical procedures to test their propositions is very difficult for them.
8. They have troubles with categorical data which are not emphasized in the statistics courses but used in the surveys.
9. Very few students use correlation and regression analyses.
10. More than anything else, it is a great challenge for the students to write an overall statistical summary of the survey. They repeat percentages and numerical descriptive statistics from the computer output for each question and do *not synthesize.*

STUDENT PERCEPTION OF APPLICATIONS OF STATISTICS TO RESEARCH

Feedback and suggestions were sought from the students for serving them better in the research methodology course and what they wished they learnt in statistics better. Their perception of the courses is as follows:

1. They do not remember in the final year most of their statistics taken in the sophomore year.
2. They need a review and feel that the research methods course should be divided into two courses. Applications of statistics, statistical software and questionnaire data analysis should be taught in the first course and research course must follow it.
3. They were unaware of the importance of statistics as a research tool when they took the introductory statistics and did not foresee that they would need this knowledge again.
4. Interpretation and applications should be stressed more in statistics courses so as to be helpful in the research course.
5. They wished to be better trained to do research and applications of statistics in the concentration courses where possible**.**

CHANGES REQUIRED

It is recognized by many statisticians that changes in statistical education are needed. For more than a quarter century the importance of writing in statistics has been pointed out. Robert Hayden (1989) discussed the need for writing assignments to improve student learning. The Guidelines for Assessment and Instruction in Statistics Education (GAISE) (2005) report emphasizes statistical literacy and development of statistical thinking. The report gives suggestions about how to make these changes, and includes numerous examples. Garfield (1992 and 1994) points out the importance of assessment methods in improved learning.

The importance of statistics as a research tool is also well acknowledged now. Since the eighties, active learning through real life project data is being promoted vigorously by educators as it will improve statistical thinking and writing skills. Smith (1998) speaks about how a sequence of projects with written and oral reports of the results helped in development of statistical reasoning and improved test scores. Griffiths and Evans (1976) argue that projects build perceptive, analytical, and presentation skills that can be as useful to the analysis of a problem as the statistical techniques used.

The author's solutions and suggestions, among many possible, are stated below.

1. Statistical thinking and communication of results must be emphasized in the statistics courses.

a) Emphasis must be on interpreting and writing in statistics courses and not on technology and algebra.

b) Textbooks must include more worked out examples both on techniques and interpretation.

c) More exercises that deal with concepts and interpretation, with the data output already given must be included in the problems sections.

d) Applications to questionnaire data must be part of business statistics courses as a very great percentage of business research has to deal with surveys to customers, consumers and employees.

e) A statistics lab must be part of the statistics courses.

f) Statistics is an unfamiliar subject and repeated exposures are needed as students tend to forget. An additional course may be needed for review and applications of statistics in the final year before the research course is taken.

2. Modification in the evaluation of student performance is needed.

a) A statistical project which requires manual calculations, equivalent computer calculations, interpretation of each result, formulating propositions and hypotheses testing and model building should be part of the assignments. A written report, oral presentation and a poster presentation that will improve communication skills must be part of the major part of assessment of student performance.

b) While it is useful for students to know how to do computations by hand to understand the process, the examinations should be more on an explanation of the results and not on algebraic computations. In a given case or business situation, data analyses may be presented as computer output and questions can be only about understanding and interpretation.

3. Modification of assessment in other courses that use statistics is necessary.

a) Writing skills must be embedded in all courses, particularly in concentration courses for which statistics is a prerequisite.

b) Multiple choice examinations must be to the minimum and a research paper and projects should be included where possible to train the student in writing.

c) Evaluation must include application of the statistical knowledge during the concentration courses where statistics is a prerequisite.

4. Cooperation of administration in policy is necessary.

Academic committees in the colleges of Business must promote writing and research skills in the curriculum revisions in the various concentration areas as this is one of the important standards for accreditation by American Association of Collegiate Schools of Business (AACSB).

CHALLENGES FOR THE PROPOSED CHANGES

There are budget and time constraints for the student, teacher and administration in bringing out the required changes but it is worthwhile...

1. In a semester, the professor usually meets the student forty-five academic hours. Examinations, quizzes, minute papers, feedback, enrichment material and project instructions take about 10 hours**.** The professor is hard pressed for time**.** Correction of any writing assignments and research projects and feed back take an extra-ordinary amount of time for the teacher as compared with the usual multiple choice exams in many business courses.
2. Student has also an increased load of work when writing and research are required.
3. Graduate student assistance to the professor for laboratory work and correction is required which puts strain on the university resources.

GLOBAL CHANGES IN EDUCATION

Vast changes are taking place in the pedagogy, technology in the fields of statistics and business over Demands on the students themselves have increased Employers are also very choosy about student knowledge. The world has become smaller due to internet and business has become intensely competitive and international .Survival of the fittest is the rule. Communication skills are at a premium and language skills are a must for the business manager. A great amount of information is available on the Web, at present. Learning the skills of summarizing that data

and information is an unavoidable task for the present student to prosper as a professional and responsible citizen.

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