

# Teaching Introductory Statistics to Graduate Students in the Behavioural and Social Sciences : Unique Problems and Instructional Methods

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## 1. Introduction

One of the largest groups of students taking introductory statistics in the United States is that of graduate students in the behavioural and social sciences, hereafter referred to simply as the social sciences. The primary reason for this is the inordinately large number of institutions of higher learning providing masters and doctoral level programmes in the social sciences which require at least one course in statistics. At this introductory level the course is usually taught for graduate credit in a department of Psychology, Sociology, Statistics and/or a College of Education. At Florida State University (FSU) the course in educational statistics, EDF 5400, is one such introductory course and is offered in the College of Education. This course and the unique characteristics and problems associated with its enrollees is the focus of this paper which has a two-fold purpose:

- (i) to describe the relatively unique nature of the course and its students;
- (ii) to describe a set of instructional methods, techniques and evaluations utilised in the teaching of the course.

These instructional methods are not to be construed as a guide to how introductory graduate statistics *should* be taught, but rather as an example of how one instructor *tries* to teach adult learners in an elementary statistics environment.

## 2. The nature of the course

The content of EDF 5400 is similar to that of hundreds of other such introduct-

ory courses in the social sciences taught in graduate schools throughout the country. It covers descriptive and inferential statistics to include hypothesis testing and confidence intervals through the two sample cases and simple correlation and regression. The course is offered for four semesters' hours graduate credit and has no formal prerequisites - mathematical or statistical.

It is apparent that EDF 5400 is a graduate course in name only since it is the most elementary statistics course possible, the content of which could be and is easily taught in high school or college. With no mathematical or statistical prerequisites it is distinguishable from any other introductory statistics course only by the nature of students who take it. Although the course is taught in the College of Education, approximately half of its enrollees are from other colleges including sociology, psychology, social welfare, home and family life, urban planning, business, economics, political science, communication, criminology, library science, nursing and interior design. Enrolment for the author's section of EDF 5400 is 40-60 depending on the term in which it is being taught. This diversity of major interest areas as well as the relatively large graduate enrolment directly affects the instructional methods as well as the student evaluation system utilised.

### 3. The nature of the students

Although the material in the EDF 5400 course is truly elementary from a statistical viewpoint, the students are not "beginners" as students; they have all completed at least one baccalaureate degree (with the exception of a small number of special permission senior undergraduates) and 54% have masters degrees (based on Spring 1990 data). These introductory statistics graduate students are, on the average, about 10 years older than typical undergraduates. Almost all (92%) registered students are working toward advanced degrees (MS, specialist or doctorate) and are motivated to do well in the course because of its required nature in their degree tracks. Approximately 90% report that the course is required in their area with over half of them reporting it as the only statistics course required.

The vast majority of students in EDF 5400 have undergraduate degrees in areas other than the "hard" sciences and as a result have taken only the minimal required mathematics. This is usually, and at most, a college algebra course taken approximately nine years previously.

Graduate students in the social sciences bring with them a plethora of anxieties relative to the course and the instructor, a large portion of which are the result of rumour and hearsay concerning the course and the demands of the instructor. Although anxieties are common in all graduate courses (and might even have some beneficial effects), they appear to be amplified for this statistics course; perhaps because the course is outside the students' field and in an area they perceive to be mathematical in nature. This, coupled with their weak mathematical background, fairly well explains their anxiety. Even those who are comfortable with the mathematical aspects express concern over things like maintaining a minimal grade point average and not "appearing stupid" to the instructor and their peers who have previously done well in the course. Those for whom passing this course is tantamount to admission to a programme are bearing a double burden of anxiety. This writer considers these anxieties, justified or not, to be the

greatest inhibitors of good performance in this introductory course.

Being present for classroom lectures and presentation is not a problem with these graduate students. It is as if they are fearful of missing something and go to great lengths to justify and make-up any absences. Even attendances at professional meetings, when these conflict with class attendance, often cause concern on the part of the students relative to "staying caught up". This speaks well for their motivation, but may increase their anxiety level.

More so than most students taking an introductory statistics course, these graduate students are grade conscious. The need to maintain a "B" average to stay in graduate school explains this partially, but there appears to be an excessive amount of concern about doing well in an "outside" area like statistics. Very possibly this is due to the rumour that statistics will "ruin your average". (When this writer has followed up on this rumour it usually means that statistics may ruin a straight "A" average.)

Probably as a result of a perceived weak mathematical background and the anxiety associated with an outside area, graduate students in this course do not express their views or ask questions as frequently as in other non-statistics or less elementary courses. This may be a function of the instructor's personality and style, but more likely is related to the need of the instructor to cover a relatively large body of content devoid of much subsequent discussion. The adult, graduate student ego may be rearing its ugly head here also in that students report that they do not wish to ask "stupid questions" in what is purported to be an elementary course.

A concern expressed more often among graduate students than undergraduates is that of the relevance of statistics to their field and immediate future. This may be due to a more solid view of what they will be doing in their careers or simply maturity, but it is nevertheless a pervading theme. Examples, illustrations, analogies and real-life experiences having some "cash validity" are commonly requested by these adult students.

As a result of asking open-book, discussion type questions the author finds that most graduate students in the course articulate very poorly in writing. This may reflect their exposure to multiple-choice evaluation instruments in previous courses so that they have not developed or exercised the ability to respond to a discussion question. International students working on advanced degrees have a particularly hard time writing intelligible responses to such questions.

#### 4. One instructor's methods

As mentioned, the following description should not be construed as a guide, but as an illustration of what one instructor is trying to do to minimise the negative impact of the student characteristics and concerns discussed above.

*Teaching and assessment philosophy:* On the first day of class the students are given, in writing, the course outline, standards for grades in the course, told how assessment information will be collected, and informed of the availability of videotapes of the entire set of lectures. During this and subsequent class sessions the instructor's teaching and assessment philosophy is discussed in great detail with copies of old examinations being made available to give the "flavour" of assessment techniques. In language as plain as the instructor can muster, to avoid any misunderstanding, the following points are made in class and on videotapes.

- (i) The student's purpose is to gain an understanding of and appreciation for the concepts of statistics whereas the instructor's purpose is to create an atmosphere in which this is enhanced.
- (ii) The instructor has no interest in or use for "number crunching". The concept of the mean, for example, can be grasped and explained with three single-digit numbers as effectively as with a thousand four-digit numbers. The concept only is important since calculators and computers can do the manual labour. If, however, a student needs to work many problems to gain confidence, the student is encouraged to do so.
- (iii) The life the students will lead in the social sciences and the research related thereto will be "open-book" in nature. Thus, all assessment samples will be open-book and open-notes with most questions being of a conceptual, discussion type. Recall and regurgitation of formulas, equations, names, terms, etc., will not be a part of the assessment sampling either on examinations or homework. If the students want to memorise great masses of information and feel this is beneficial they may do so, but recall, the lowest level of learning, will not be assessed per se. They are told, for testing purposes, "if you can memorise it, then forget it".
- (iv) Examinations are scheduled outside of class in a specified testing room. No new material is covered in class on the day of the examination, but review questions are entertained on that day. The students may bring any materials they wish to the examination room and may consult anything except a live consultant during the examination. The examinations are designed to be taken in approximately one hour, but the students are allowed up to 14 hours (8.00 am to 10.00 pm) to take the examination, as long as it is in a single sitting. The object is to allow the students sufficient time to reflect, write and rewrite as often as possible to produce "the best professional piece of writing of which they are capable at the time". In order to minimise the students "hanging themselves with too much rope", answers to questions are often restricted to 25 words or less or to a space provided on the examination paper. Virtually no calculations are required on examinations except for some simple ones on statistical testing, correlation and regression. Florida State University is on an honour system so no proctor is utilised during examinations and the need to do one's own work is stressed in class and on the videotapes. Copies of many old examinations are available any time the students need to refer to them, even during examination periods. (Example examination items are available on request from the author.)
- (v) If four or more examinations are given during a term, the lowest examination score is deleted and the final average score calculated on the remaining examination scores. The idea here is to allow each student to have at most one "bad" day of testing. All examinations are scored by the instructor, returned to the students and discussed item by item in class. The students keep all their examinations with homework problems often being assigned using examination scores as the sample data.
- (vi) Homework is oriented to the student's field of interest with assignments consisting, generally, of finding examples and illustrations of statistical concepts in their published literature. Calculations, using limited data sets from real situations in the textbook, are reserved for homework assignments which are taken up sporadically to keep the students caught up with the instructor. These assignments are checked and sometimes scored on a numerical scale to let the students know how they are doing. The homework must all be done and handed in on request, but it only counts to help borderline students obtain a higher grade. If the instructor judges the homework to be of

high quality and on time then this may add a few (one to two) points to their average. If not of high quality and often late it does nothing for the student's grade. (Example homework assignments are available on request from the author.)

*Videotapes of the course:* For the past 10 years videotapes of all the lectures by this instructor have been available for anyone to view. Students are told to view these tapes as often as they wish, and as a result many copies have been made from the master tapes due to excessive usage. For example, during the Fall 1989 term, 275 tapes were viewed for 219 hours.

*Peer-conducted help sessions:* Although not a formal part of the course requirements or student evaluations, "help sessions" are scheduled for 1-4 hours per week outside of class for any students who need extra help. These sessions are conducted by graduate students who have recently and successfully completed the course with this instructor and who have volunteered to provide help for other students presently in the course. These "peer tutors" are responsible for arranging meeting times and rooms and may conduct their sessions as they wish as long as they cover only material previously discussed by this instructor during regular lecture sessions. These tutors have one purpose which is stressed by this instructor - to help the students in understanding concepts. Some of these assistants prepare extensive handouts while others try to allay the students' inherent fear of statistics by much "hand holding". Old examinations are often reviewed during these help sessions to guide the students' thinking about concepts. This instructor does not attend these help sessions except by request and to make spot observations of how well the tutor is explaining the material. In fact, the instructor's presence may be an inhibitor since the tutor is "one of them" and is helping them, without pay, to understand what the instructor is trying to teach. The tutors provide the instructor with feed-back on students with particular problems, information on the effectiveness of the instruction and the evaluation, and the students' attitudes towards it.

## 5. Evidence of effectiveness of the methods

Instructors never know for sure if the methods used by them are maximally effective for any group of students. Instructor evaluation instruments, faculty teaching reviews, unsolicited letters from former students, and teaching awards are a few of the tangible bits of evidence that methods used are having the desired effect, e.g., that students are learning and have a positive attitude toward statistics.

At FSU each instructor is required to administer, once a year, the Student Instructional Rating System (SIRS) Form for each course taught, upon which promotion, tenure and merit pay increases are partially based. The ratings are compared with other similar courses throughout the university as well as within the department. These and unsolicited letters from former students are reviewed by a departmental Faculty Evaluation Committee and each faculty member is ranked on teaching effectiveness. Since 1978 this writer has been ranked in the top three (among approximately 30 faculty) each year and has been ranked number one more often than any other faculty member. For 1987-1988 he was given an Outstanding Teacher Award by Florida State University, "for recognition of excellence in teaching". On the SIRS form is an item, "in general, the instructor was an effective teacher". For the time span Fall 1988 to Fall 1989, 136 students responded to this item with 93% reporting that they agreed with the

statement. Although the above may not indicate that the methods utilised are effective, they do indicate that this instructor's approach may have some merit in the teaching of introductory social statistics to graduate students.

## 6. Comments and conclusions

The instruction of graduate students probably nets less attention than that of any other group of people involved in learning. This may be due to the belief that they are adults who possess the basics, and are so well motivated that they are immune to poor or non-existent instruction. Nowhere is this inattention more evident than in the teaching of introductory statistics to students from the social sciences. It is not unusual for new, inexperienced faculty (who are, themselves, recent graduate students) to be assigned the teaching of the introductory statistics course. The oft-given reply when questioning this practice is, "anyone can teach basic statistics". Another, possibly more plausible, reason is that senior faculty want to teach small numbers of graduate students in advanced seminars, leaving the junior faculty with the responsibility for relatively large sections of beginning students. Although teaching introductory statistics may be viewed as a "rite of passage" for a new instructor, the practice should be reversed with the most effective and experienced faculty teaching the more elementary courses. The adult nature, diversity and weak mathematical background of the students calls for an instructor with the willingness, experience and imagination to provide an array of examples, illustrations and analogies for maximum grasp of concepts. The fact that this course is foundational to all other statistics courses which follow it is justification enough to provide the most effective instruction possible.

This instructor's use of open-book testing, videotaped lectures, and peer-conducted help sessions was intended to minimise some of the trauma associated with evaluations and difficult concepts. They, however, have their drawbacks. For example, grading of the tests must be done by the instructor due to their discussion nature and involves a good deal of time compared to testing under a closed-book, multiple-choice format. This is the price which must be paid if an instructor wants to find out if students can generate a reasonable answer as opposed to picking a correct one.

The high rate of videotape usage is both a blessing and a curse. The blessing is that students praise their availability and claim they help, whereas the curse is that tapes wear out with such extensive use and must be recopied from mastertapes or retaped in the case of worn out mastertapes.

The help sessions which garner almost universal praise for getting the students "through the course" must be shielded from forms of misuse to retain their effectiveness. Students every now and then, particularly international students, come to view the help sessions as a requirement (rather than an option) and build around them unrealistic expectations associated with success in the course. One extreme example was a student who held the peer helper responsible for a poor performance on an examination. This form of expectation is minimised by pointing out that these helpers are unpaid volunteers who bear no responsibility for the students' success or failure in the course, but merely try to elucidate concepts covered by the instructor.

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