Developing Case-Based Business Statistics Courses
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We provide guidelines for developing case-based business statistics courses. Specifically, we describe both the benefits and pitfalls of case-based courses, and list resources available for course development. We describe the characteristics of the instructor (and the classroom!) which augur well for case-based teaching.

KEY WORDS: Cases; Class discussion; Communication skills; Interactive education; Management; Problem-solving; Statistical education.

1. INTRODUCTION

Although case studies are used in many business courses, notably in management, marketing, and capstone classes, the case method has not been widely adopted in business statistics courses. Reluctance to incorporate cases into statistics classes might be attributed to a variety of uncertainties in the minds of instructors. How might cases be used to convey topics that are quantitative in nature? What will cases accomplish that traditional methods do not? How much effort is involved in conversion to a case-based course and what resources are available? By drawing on the authors’ experiences with developing their own case-oriented business statistics courses, this article addresses these concerns.

We admit a bias. We are sold on the pedagogical effectiveness of the case study method. For us, cases work! Cases have enhanced our students’ experiences in a number of important ways. First, cases influence the classroom environment and educational process:

- Cases require nontraditional problem-solving and self-discovery by the students, translating into longer retention of theoretical concepts and their applications.
- Because our students like cases, classes are lively, interactive, and stimulating. Students are more willing to take charge of assignments and studying; the occasional surliness and hostility are gone.

- Business students may have encountered the case method in other classes. If so, this is a method they have grown to enjoy and are accustomed to.

Second, cases can provide integration with other courses in the curriculum and serve employment needs of the business community:

- Businesses are calling for graduates who can work effectively in groups. The often ambiguous nature of cases provides an environment for practicing team-based skills such as negotiation and group decision-making.
- Businesses are calling for graduates who can communicate well. The final product of a case study can be a business memo or oral presentation.
- By the nature of case analysis, cases force students to integrate statistical results with business decision-making. An answer giving the “best regression model,” rather than a recommended business decision or action, is seen as unhelpful to the manager.

Finally, cases impart reality. Students report increased confidence in their ability to apply statistical methods in the workplace:

- When cases are multi-phased, they send the message that the analysis of data often involves a process rather than a static numerical exercise. They, together with management simulations, are one of the best methods the authors have found for giving the students a good treatment of the actual processes of decision-making and process improvement.
- When cases describe realistic business problems using real data, they more effectively communicate the need for statistical methods in the business world.

The literature is filled with woes about traditional statistics courses. As Hogg (1991) tells us: “Some of us have taken the ‘joy and fun’ out of studying statistics, because we fail to communicate our enthusiasm and excitement about statistics. This often happens when introductory courses are given low priority. To be blunt, many of us are lousy teachers, and our efforts to improve are feeble.” Or from Dallal (1990): “The field of statistics is littered with students who are frustrated by their courses, finish with no useful skills, and are turned off to the subject for life.”

Even so, progress is being made. Recent authors now suggest that it is appropriate: to treat statistics courses (particularly introductory ones) as something other than a special course in mathematics (Moore 1988; Moore and Roberts 1989; Hogg 1991; Watts 1991; Radke-Sharpe 1991; and Snee 1993); to admit to our students that there are of-
ten no right or wrong answers in applied data analysis (Watts 1991; Wild 1994); to engage in classroom activities other than the traditional lecture format (Tanner 1985; Snee 1993; and Bradstreet 1996); and to require our students to communicate their statistical results in non-technical language (Roberts 1987; Gaudard and Hahn 1991; Radke-Sharpe 1991; Wild 1994; and Ledolter 1995). Cases can be an effective vehicle to pursue each of these non-traditional pedagogues.

Cases demonstrate aspects of data analysis that go far beyond formulas. For instance, cases can: provide little or no direction on what method should be applied to solve the case; contain messy (missing, outlying, and even miscoded) data; describe a situation in need of data and allow students to devise their own survey instrument; address managerial/humanistic issues arising from the analysis of data (e.g., mistrust of statistical outcomes or reluctance to participate in data collection); and demonstrate ethical dilemmas that sometimes arise in the analysis and reporting of data. These and other features of well-written cases provide a more realistic simulation of data-driven projects than is commonly found in the traditional courses.

Instructors inexperienced with the case method argue that there is simply no time to pursue these goals. We believe it is imperative to do so. To do otherwise does a great dis-service to our students and ultimately to the reputation of statistics as a useful profession. If we do not have time now to help students learn how to actually use the methods we teach, when will we find time? Are they better off learning on the job with supervision from others, often with lesser statistical knowledge?

Medical students work first on cadavers, then perform surgery under the watchful eye of a skilled surgeon. Navy pilots train in simulators and fly many hours under the tutelage of experienced pilots. Yet, if the model of the traditional business statistics course was to be followed, we would have our teenagers watch a video on helpful driving hints, then hand them the keys to the car. Cases allow students to experience real, difficult, ambiguous, and meaningful situations requiring the analysis of data before sending them on their ways.

Only when instructors try the case method for themselves do they begin to appreciate the value of the method. This was the experience for both of the authors of this article. We approached case-based teaching with fears, uncertainties, and lack of confidence, and have emerged, quite a few years later, with great confidence in case-based methods. We advocate it to our colleagues.

This article is organized as follows. Cases can be used in a wide range of business statistics courses, from undergraduate to graduate level, from introductory to special topics courses; Section 2 details an introductory business statistics course and a graduate statistical process control course. Cases will challenge your students in ways other than just mathematics. Section 3 describes what new skills your students may need in a case-based course, and how you can help them to develop these skills. Cases also require a new set of skills from the you, the instructor; Section 4 tells you what to anticipate and how to prepare for the unexpected. Section 5 lists course materials, seminars, and other resources for course development. Final thoughts are given in the concluding section.

2. HOW WE USE CASES: TWO SCENARIOS

What exactly is a case? Which business statistics courses are most amenable to the case method? How is a case used in the classroom? These and other issues are addressed in this section via detailed descriptions of two ongoing case-based statistics courses at the University of Tennessee and the University of Colorado at Denver.

Cases come in all shapes and sizes. Cases are sometimes used for illustrative purposes in textbooks; the case describes the problem and solution to the reader. We address here assignments in which the student is given a scenario and a data set, and asked to ponder the problem, devise a solution, and report on the findings. Thus, our use of the term “case” refers to the hands-on, practiced study of the analysis of data, and forming conclusions and recommendations based on that analysis.

2.1 Introductory Business Statistics Courses

The business school at the University of Colorado at Denver has used the case method in its graduate and undergraduate introductory statistics courses for years. Our experiences with the undergraduates and graduates are quite similar. Although the MBA/MS class is described here, the methods apply equally well to the introductory undergraduate course. When a different approach works better in the undergraduate classroom, it is noted.

Our students are older and often work during the daytime. Graduate classes contain about equal numbers of MBA and MS business students, with class size averaging about 45. Our graduate students may or may not have had earlier course work in statistics. Undergraduate classes average about 40 in size, and these students have no statistics background.

At the graduate level, traditional first-semester topics are given little weight. Inference from one- and two-populations is not covered; probability is not highlighted as a stand-alone topic, but introduced tangentially when needed to illustrate the foundation of an inferential method. (These topics are still covered in the undergraduate course.) Instead, the graduate course relies heavily on regression analysis as the unifying methodological theme. With regression as the core, student assignments involve the construction and interpretation of statistical models. Time-series methods (including control charts), questionnaire design and analysis, and other topics are also studied. An illustrative syllabus is available at http://carbon.cudenver.edu/public/business/faculty/masmith.html.

Students are asked to purchase MINITAB, a collection of cases, and a textbook or manuscripts produced in-house. Students prepare anywhere from five to ten cases per 16-week semester, depending on instructor preference. Course grades are determined by performance on these cases, classroom discussion of the cases, final student projects, and
classroom presentations. Some instructors also give in-class exams.

(We’ve mostly shied away from traditional textbooks at the graduate level. In our experience, when traditional textbooks are assigned, they become the primary source of students’ learning. Because we want the analysis and write-up of the cases to be the focus of the class, we downplay the role of traditional textbooks.)

In our use of the word, a case involves a four-part process: description of the problem and data set, analysis, and communication of the results in both written and oral formats.

1. Students are provided with a background description and a data set in machine readable form. At the graduate level, where students are more mature and fairly comfortable with ambiguity, we choose cases that provide little or no guidance about what technique to apply. The problem stated in the case might be something like, “Prepare a report addressing the issues discussed at the last staff meeting,” and not, for instance, “Calculate the means and standard deviations of the profits and sales figures.” Introductory statistics students must grapple with choice of methodologies. If we tell them what to do in class, they won’t feel confident about how to proceed on their own. Undergraduates benefit from a bit more guidance; even so, it is crucial that undergraduates wrestle with methodological issues as well.

(To reinforce the message that students are responsible for methodological issues, we sometimes assign cases that are unrelated to the most recent lecture. As a result, students may dutifully report the results of the runs test of cross-sectional data because last week’s lecture covered time-series methods. Students quickly learn that they are responsible for selecting an appropriate methodology. To be most effective, this message must be sent early on and consistently throughout the course.)

2. Students analyze the data. Because of the highly ambiguous nature of the cases assigned, students are encouraged to work in groups.

3. Students prepare a written summary of their analysis. Strict guidelines are imposed.

• A business memo format is required. A prototype is provided early in the semester.
• The memo must contain a recommendation and clear statement of limitations. It is not enough to do the analysis; students must clearly relate the statistical information back to the problem.
• Statistical or other jargon is prohibited. Students are asked to prepare the report for a boss who has no statistical background.
• The memo must follow standard rules of style and grammar. A report is downgraded for spelling and grammatical errors.
• A strict page limit is enforced, typically one or two typed, double-spaced pages.

A report prepared according to these guidelines serves several purposes. Students learn standard written communication styles appropriate to the workplace. By asking students to translate technical jargon into nontechnical words, they are forced to think hard about what statistical terms really mean. Finally, the page limit forces students to consider carefully the substance of their findings; they must sift through the myriad computer printouts and grab the crucial message discovered in the data. (As one of our referees wisely pointed out, students should be taught that computer printouts generated by many statistical software packages often do not present statistical results in a user-friendly format. Students should manage their appended outputs as carefully as their written analysis. This might necessitate using another graphics package or undertaking extensive word processing of the statistical output.)

4. Students engage in a classroom discussion of their findings. The discussion takes the form of a business meeting in which students are asked to provide a recommendation, describe their analysis, and defend their actions to others. Again, several goals are accomplished. Students practice oral presentation skills. Students see different approaches to the same problem. Students must defend their approach when controversy arises, and they are sometimes forced to admit that another group’s approach or interpretation is superior to theirs. Classroom discussions last anywhere from 15 minutes to an hour, depending on the difficulty of the case.

After a semester of preparing cases, students undertake their own projects. Final course projects require students to define the research problem, collect and analyze the data, and report the findings in an expanded business report. Course projects usually involve a multivariate modeling exercise. Students report great satisfaction with these final projects. With earlier cases acting as a springboard, students are confident in their ability to undertake independent research. These projects are presented to the class at the end of the semester.

Anyone who has taught a traditional introductory statistics course will recognize the uniqueness of the case studies approach described here. This course requires students to solve real problems, to deal with ambiguity, to practice their written and oral communication skills, and to interact with others in groups or in classroom discussions and presentations. During the process of solving a case, students must decide for themselves what technique to apply, understand and communicate the implications of their study, and provide appropriate caveats. In essence, the case studies method has effectively transformed the neglected stepchild of our business curriculum into an integrated component of a business student’s education.

2.2 An MS Course in Statistical Process Control
(Statistics 566)

At the University of Tennessee, Knoxville, we teach a graduate course in statistical process control. The course is taken by all students in the MS program in statistics, and is taken as a second-year elective by MBA students who have a strong interest in operations management, logistics, or quality management.
As a result of the mixing of the students, age follows a bimodal distribution, with the MS in statistics students being 21–25, and the MBA students being 30–35. Class size varies from 20 to 40. Students in the MS in statistics program typically have had several prior courses in statistics, and are taking Statistics 566 in their first semester of graduate study. The MBA students have usually had an undergraduate course in applied statistics, often five to ten years earlier, and have had the equivalent of about a four-hour course in statistics as part of the integrated first year of the MBA program, covering basic statistics, regression (simple and multiple), and statistical process control (the basic chart types, subgrouping and use of SPC in process improvement).


Methodological issues covered in the class include: review of the basic chart types (p, c, u, Xbar and R, Xbar and S, MR and X); study of components of variance from a process point of view; subgrouping strategy; analytical and enumerative distinction and its implications; tolerancing; capability analysis; study of measurement processes; control charting and correlated data; CUSUM charts; EWMA; multivariate control charts; Shainin methods (multivari and precontrol); and comparison of control chart methods.

With only a very few exceptions, all methods are introduced using actual cases either written by the instructor for the special purpose of Statistics 566 or used at the Institutes for Productivity through Quality at the University of Tennessee. Students do most of their analysis by hand. When hand calculations are infeasible or tiresome, instruction is provided in using JMP (a product of the SAS Institute) which has an excellent capability for control chart analysis.

Students engage in several variants of using cases during the course:

1. Written case analysis. About once a week, the students are given a case. Such a case consists of a background process description and data. They are required to prepare two things in writing. The first is a one-page memo written without statistical jargon to their manager, summarizing their recommendations for action and providing possibilities for further data collection. The second is a more detailed writeup of their analysis with all the computations and details. A special variant of the written case analysis model is provided by multiphase cases which can extend to five or more phases. These illustrate problem-solving and process improvement over a broader window than that provided by a one-phase case. Sometimes each student turns in a case analysis. Other times students must work in teams of four or five to do the case analysis and writeup. (A brief piece of advice if you do team-based case analysis: It has major benefits in reducing the time for evaluation by a factor of four or five, but allow ample time for the students to do their first team case analysis. They will doubtless need at least a week, and several team meetings, to get the work done.)

2. Case discussion. About once a week, students are given a case which they prepare for discussion during the next class meeting. They do not turn in any written materials for these discussions. Class discussion of the case tends to revolve around such questions as: (i) what analyses are most appropriate; (ii) what are their conclusions; and (iii) what are their recommendations for decision, action, or further process study. Case discussion is not explicitly included in determination of course grade. Our experience, validated over multiple offerings of the course over seven years, has been that those students who prepare well and participate vigorously are also those who do well in the course, as measured by grades.

3. Guided cases. In guided cases, students are asked to read through the case before class, but not required to do any detailed writeup or preparation. Then, in class the instructor takes them on a guided tour. In guided cases, extensive intermediate computations are provided to simplify the analysis which is done real time in class. Guided cases are also used to explain new methods. There is very little formal lecture in Statistics 566.

These multiple uses of cases make the course quite distinct from a traditional lecture-based course, no matter how amenable that lecture-based course might be to class discussion. Students take more ownership for determining “good answers” as the instructor steps back from that traditional role. Students raise more issues of alternative analyses and alternative recommendations than they would in a lecture-based course.

Students react in a very positive fashion. Feedback (captured on the WWW homepage for this course at http://funnelweb.utcc.utk.edu/~wparr/Stat566.html) shows that they find the course very enjoyable. The mix of MBA and MS statistics majors is good for the course; the MBAs are already familiar with the case method, while the statistics majors come in with a much stronger statistics background, and learn much about the case method and class discussion from the MBAs.

It seems clear to the authors that the case method is not infinitely extensible. The thought of teaching, for instance, a first year graduate theory sequence in statistics by the case method is currently beyond our imagination. The method seems to work well in courses with a strong applied flavor, where material can be presented as managerial problems to be addressed by data.

3. HINTS FOR HELPING STUDENTS

Your students may or may not have had an earlier case studies experience by the time they get to your statistics course. Even so, by the nature of expectations surrounding a statistics class, they will likely be quite unprepared for the sorts of tasks you’ll be asking them to do. This is particularly true of those students who have had a more traditional statistics course. You can help them to make the adjustment by providing them with resources and encouragement.
You will probably find that students need guidelines on what it means to analyze a case. Many such writeups exist. Call someone in the management or marketing department at your university, and ask them what they give their students to guide them in case analysis. Ask if you can borrow a copy, and perhaps even if you can specialize it to meet your needs. Graduate students are more likely to have experienced the case method before your class and will be comfortable with the approach. To undergraduates, the case method may be a whole new experience; they will likely need more guided instruction at least initially. Be prepared to spend some time explaining how to write a case and how to engage in classroom discussions of the case.

You may find your students’ writing skills to be substandard. Several actions on your part can help. First, provide students with study guides. Give them a handout that defines what you expect in the way of their writeup, perhaps with a written example from another case. As part of the course materials, require or make optional reference manuals on business writing and assign readings from these materials in your syllabus. If your university has on-campus facilities such as writing labs, indicate so in your course outline. Second, and most important, provide immediate and clear feedback on the strengths and weaknesses of their writing. If you do this for the first case on which they are required to turn in a written report, you will be able to shape expectations quickly. Make it clear, in written feedback and in the grade for the case, that communication and interpretation of the results are as important as the analysis of the data. We’ve noticed that when the grade on the first case is lowered because of grammatical and style errors, student performance improves dramatically.

Many business programs now include a managerial communications course. If such a course exists in your curriculum, make and enforce the course as a prerequisite for the statistics course.

Your students may have difficulty dealing with the ambiguity that is often inherent to case studies. Ambiguity can come in many forms. Some cases end with the message that the analysis of data invokes more questions than answers; students who have experienced a traditional statistics course will believe their task is to provide the “right” answer. Some data sets yield several equally good insights; students will want to find the one “best” right answer. Because cases ask students to use the statistical results to illuminate a managerial problem, those students who easily grasp the mathematics, but do not wrestle with interpretation and implication of the statistical results, do poorly on cases.

(Caution: this ambiguity can also be quite vexing for graduate students doing grading! Be sure to talk extensively with your teaching assistant, if you are lucky enough to have one, about the sorts of difficulties that might arise. Otherwise, you can end up with a massive set of complaints that turn out to be justified.)

You can help students overcome their anxieties by talking about them in class. Insist that real life statistical insights involve a process, not a one-time mathematical exercise. Avoid the urge to provide students with the “right” answer when there is some ambiguity; instead, lead the discussion in the direction of advantages and disadvantages of competing approaches. Make it acceptable, both in your classroom discussion of the case and in your written feedback, to have some ambiguity arise when appropriate.

Finally, students are often happy to sit at their seats and take notes. Case study classes tend to be more interactive than traditional lecture format courses. Send the message on the very first day of class that you expect participation from your students.

4. HELPFUL HINTS FOR NEW INSTRUCTORS

Moving to a case-based course will require some changes in your role as the instructor. This section offers helpful hints to new instructors along two lines: things you might need to do differently in the classroom, and things you might consider doing behind the scenes.

4.1 Tips for Inside the Classroom

Class size is an important indicator of the success of the case method. Some instructors report successful use of the case method with large classes. The authors have yet to attempt it with more than 95. Larger classes usually include both lecture and recitation sections. If you have, for instance, three meetings per week, with one meeting per week being with a teaching assistant, you might find it convenient to do cases during the recitation session. This would enable you to experiment with the case method without relying on it exclusively. Small classes provide an excellent environment for case discussions, but not always! Fewer than about 15 or 20 students can be troublesome if there are not several very alert, eager, and well-considered students in the class.

Many of us came to the field of statistics because we liked mathematics, which seemed to promise objective answers. By the very ambiguity inherent to real, complex data analyses, the case method may force you to accept several correct answers from your students. It can require a conscious effort to not rank students’ responses during a class discussion. You may find it helpful to practice phrases like, “I don’t think I fully understand your reasoning on that,” or “Can you tell us a little more about why you have selected Position A over Position B?” Similarly, at the end of a case discussion, expect your students to look to you for the “right” answer. Avoid the temptation to do so. Of course, you want to correct any statements made in class that are technically incorrect.

If you decide to pursue class discussions of the cases, you will have to learn to tolerate long stretches of silence. This can be frightening. The most dangerous response, on your part, is to fill the silence. The authors have, at times, tried things such as: cold calling (calling on students who have not volunteered, and asking them pointed questions), walking to the back of the room and sitting down, asking a question and leaving the room for a few minutes, or, in desperation, staking out an extreme or even absurd position and then letting the class attack it.
The case method will force you to give up some control. This is difficult. But it’s necessary to accept the idea that your voice, now perhaps active 75% of the time, may capture only 20% or less of the class period. (It might be useful to audiotape a class and then listen to the tape, timing the fraction of the time someone besides the instructor is talking!) The class may decide, by their discussion, what gets stressed in a given discussion. Your control is exercised through other methods: skillfully deciding on whom to call, selection of good cases, and so forth.

4.2 Beyond the Classroom

If you are considering written case analyses, be aware that these are much more time-consuming to evaluate than ordinary homework consisting of worked problems. Student case writeups will vary widely in quality, and your assessment of content and style will be required. Teaching assistant support can be extremely helpful. The student helping with the grading will typically find it a very useful experience.

You may not have access to a grader. The issue of grading time required of the case method is nontrivial, particularly for those facing the tenure clock. There are several ways to alleviate a heavy grading load. First, require your students to work in groups for some or all of the case assignments. Although there are well-known problems with groups, teamwork has become an important component of a business education. There is probably someone in your management department who can give you tips on how to make teamwork go more smoothly. Second, set a strict page limit on the length of the reports. Not only does a page limit force students to pick through the rubble, it also requires less grading time on your part. One of the authors states openly in class, “I will not read after the first page.” You will find it helpful to specify font size, margins and spacing; if you don’t offer the information, you will be asked (or find students making assumptions useful to them but injurious to your eyesight).

An alternative to grading written cases is to evaluate students on their oral participation in class, either in the form of a class discussion or student presentations. We have tried both of these methods and have found them effective. Some combination of written and oral presentations will make the grading demon manageable.

Class discussions of cases will take up class time, meaning that something will have to go or will have to be done differently. The issue of appropriate topical coverage, particularly in the introductory business statistics course, is important yet beyond the scope of this article. Even so, begin taking some preliminary steps by being proactive within your organization. What topics currently taught in your statistics course are needed in downstream courses? What depth of detail is needed? You might find it enlightening to pose these questions to your colleagues. Finding no room to cut content, you might think about teaching the same topics more efficiently. This could involve relying on software to undertake the more involved mathematical calculations, as one example.

Another possibility is to relegate some of the more tedious topics to the background. This does not necessarily mean teaching less of the mathematics of statistics. Rather, we suggest placing the mathematics of statistics in a secondary position, with the analysis of data being the primary focus of the classroom. Here’s an example. Having introduced the uniform probability distribution, have students read about and work problems on the normal distribution on their own with no lecture from you. A quiz may be needed to entice student participation. By doing so, you’ve substituted a 10-minute, in-class quiz for a 90-minute lecture.

A method to aid you in moving technical topics to the background is to supply students with ample sets of short material, in the form of “A Short Note on the c Chart,” or “A Note on Analytical and Enumerative Methods,” which they can read and study on their own. A few technical problems to be solved may aid them in confirming their understanding of the material.

This business of having students learn technical material on their own time may sound a bit frightening. As instructors, we may have come to believe that students will not or cannot learn statistics without first hearing us lecture. To some extent, this is true; we are not advocating a lectureless classroom. Rather, we believe that placing mundane topics outside of the classroom, and using class time for interactive discussions of the analysis of data greatly enhances the learning experience of our students’.

5. RESOURCES

In this section, we list various resources available to assist developing a case-based course. The list is by no means comprehensive; it includes some of the resources we have found useful in our own endeavors.

5.1 Case Collections

The following is a list of stand-alone casebooks that may be used as a primary or secondary source of case assignments for students.

- Bryant and Smith (1995). Fifty cases come in two volumes, the first geared to an undergraduate business statistics course, the second toward more advanced students (advanced undergraduates or first semester master’s students). A third volume of 25 new cases will be available this fall. An introduction to the student provides tips on writing business memos; an extensive instructor’s guide includes ways to conduct classroom discussions of the cases. Most, but not all, data sets are real and the majority of the cases are drawn from a business environment. A data disk is included with the instructor’s guide. Custom publishing of ten or more cases is available.

- Carlson (1997). These 28 cases are business-oriented, using real data sets and real business scenarios. Methodological coverage runs from descriptive statistics through multiple regression. These cases would be appropriate for the undergraduate business statistics course, but a few of the more advanced cases would appeal to MBA students. The cases provide guided instructions about what statistical techniques to apply. Theoretical background and statistical
formulas sometimes appear within the case. A data diskette comes with the instructor’s manual. Custom publishing is available.

- Chatterjee, Handcock, and Simonoff (1995). Over 60 cases in this single volume run the gamut of needs for a first-year course. An instructor’s edition contains comments about the cases. In the student edition, some of the cases are fully worked out, which permits students to study the case methodology on their own before attempting some of the other partially or fully solved cases in the collection. An occasional attempt is made at teaching methodology and defining technical terms in the cases. All data sets appear to be real; only a few of the data sets are geared specifically toward business problems. The data diskette is included in the student edition.

- Klimberg, Arnold, and Berger (1994). Each of the 22 cases has a managerial flavor to them: people with names and titles interact with each other to solve a problem. The cases give varying degrees of direction to the student. For instance, one case tells the student to construct a histogram; another simply directs the student to analyze the data, addressing the concerns expressed in the case, and prepare a report. An instructor’s guide includes answers to the cases, teaching notes, MINITAB printouts, and the data diskette.

- Peters and Gray (1994). Eighteen cases are geared exclusively toward business applications. The casebook provides more guided instruction (specific questions and assigned tasks to solve the case) than most. Like the Klimberg et al. (1994) cases, these involve managerial settings. The data diskette comes with the student casebook.

There are several case studies books geared toward both operations management and statistics topics: Bodily, Carraway, Frey, and Pfeifer (1996), and Lapin and Whisler (1996). Those of you who teach an integrated quantitative methods course will find cases involving traditional OM topics such as simulation, queuing, inventory, and transportation problems as well as statistical topics like regression and forecasting.

In addition to these case books, the authors and others (e.g., Roberts 1991) have found student projects to be a rich source of case studies. The Bryant and Smith (1995) casebook contains many former student projects, and the statistical process control course at the University of Tennessee now requires students to write up cases in a form appropriate for future classes.

A number of traditional textbooks contain cases from real business situations as illustration. Examples appropriate for introductory statistics courses include Levine, Ramsey, and Berenson (1995) and Siegel (1997) among many others. Leitnaker, Sanders, and Hild (1996) contains quite a few cases, all focused on various uses of the control chart for business process analysis and improvement. Also in preparation are the University of Tennessee cases from the Institutes for Productivity through Quality. These cases are not currently available for use outside the University of Tennessee.

### 5.2 Workshops on Teaching and Writing Cases

The annual meeting entitled Making Statistics More Effective in Schools of Business typically includes several sessions on teaching by the case method, with applications specifically targeted toward business statistics courses. The conference is hosted at various institutions around the country, usually convening in June. It is announced in publications such as *Amstat News*, the periodical of the American Statistical Association (1429 Duke Street, Alexandria, VA 22314).

The Decision Sciences Institute offers case writing and teaching workshops at its annual conventions in November. The half-day seminars are geared toward both beginning and experienced case writers and teachers. The workshops are announced in *Decision Line* (a publication of the Decision Sciences Institute, College of Business Administration, Georgia State University, Atlanta, GA 30303).

Perhaps the best source of information on teaching cases is to watch an experienced case teacher. Most business schools have a handful of instructors who teach exclusively from this method. Often, a capstone or senior level course in marketing or management will involve extensive use of the case method. Talk to these faculty about their experiences and ask to sit in on their classes. Most faculty who teach using cases are very excited about it, and are happy to share their experiences with others.

### 5.3 Other Resources

Numerous published materials discuss the case method. A good place to start is the Christensen (1987) and Barnes, Christensen, and Hansen (1994) books. Bibliographies contain citations to topics including leading classroom discussions, invoking student participation in the classroom, and other case-related issues. Christensen, Garvin, and Sweet (1991) is another excellent source for beginning case teachers. It includes tales of experiences with case-based teaching, and, of special interest, includes one really good article on handling technical material via the case method.


### 6. FINAL THOUGHTS

What are the benefits of teaching a case-based business statistics course? In addition to a more pleasant classroom experience for both the instructor and students, this method accomplishes a number of important goals. Students obtain virtual, “flight simulator” type experience in statistical methods. They can hone both written and oral communication skills. From the experience of making statistically based decisions and defending those decisions to others,
students gain confidence in their abilities and knowledge. Students learn about skills useful in teamwork, such as active listening.

Even so, we initially had many reservations about moving toward a case-based course. Here are some commonly perceived drawbacks to case teaching, and some comments from us about each of them.

- **Students lack written and oral communication skills to successfully participate in cases.** Maybe so, but when will they develop them in the future, if not during the course?
- **Students may be too shy to participate fully in case discussions during class.** This can be a particular problem for students from other cultures in which it is regarded as impolite to openly disagree with someone else. Cold calling can be quite effective. We would advise warning students in the first class that they can expect cold calling to occur throughout the course. Another option is to make class participation part of their course grade.
- **The instructor worries about what the students will learn from the case discussion.** Will the students come away with good ideas or just the ideas of those who are most forceful in the discussion? Clever use of the whiteboard or blackboard to capture major points made by students can be a good way to send the message that the instructor is overseeing the process while also remaining somewhat removed from the discussion. Whatever the instructor in a case-based class writes down on the board is almost certain to be faithfully captured by the students; the very fact that the instructor speaks less often in a case-based class gives punctuation to those times when the instructor does step forward for more than a brief sentence or two.
- **Grading students on cases and class discussions is extremely subjective.** This is the fear generated by the mathematicians in us, accustomed to grading numerical homework problems. Admittedly, it’s difficult, especially for those relatively new to case-based teaching, to capture impressions on who is well-prepared, who contributes well to the class, and how to assign grades to business memos. This is one fear that will dissipate with experience. As with all assessments of your students, be clear in your expectations and consistent across students in your evaluation.

Course development can be a time-consuming and nerve-wracking experience, particularly when it involves challenging our traditional teaching methods. If you decide to move toward a case method statistics course, start slowly. Try one case in one class. Get student feedback about the case; evaluate your own reaction to the case’s effectiveness. Move toward a case-based course, start slowly. If you decide to wracking experience, particularly when it involves challenging our traditional teaching methods. If you decide to move toward a case-based course, start slowly. If you decide to move toward a case-based course, start slowly. If you decide to move toward a case-based course, start slowly.

This article is meant as an introduction to the case method. The authors are preparing further articles about leading case discussions and writing cases (Parr 1997).

[Received May 1997. Revised February 1998.]

REFERENCES


