TEACHING NOTES

When you prepare to teach a case, you make notes, draft an outline, do your analysis, anticipate questions, plan how your boards will unfold, and a variety of other things. For a new case, this can take as much as 8 to 10 hours. Then, as you teach each case, you will find that some of your plans “worked” (in a learning sense), while others did not: some questions stimulated discussion; others became obstacles to learning rather than facilitators; one sequencing of class segments flowed well and another didn’t. So, after each class, you modify your teaching notes and outline. You make notes to yourself for next year and put them in the file. Over the course of time, as you re-prepare and re-think each class, you develop a set of notes and hints for your repertoire of cases that will improve your classes and greatly shorten your preparation time each iteration. This collection of teaching ideas and heuristic methods, a set for each case, comprises a set of teaching notes.

If you are using cases others have written, you will be interested in whether or not there is a teaching note for those cases. If so, they can be a real help. If you are interested in other people using cases you have written or taught, you may assemble your teaching ideas into a typed teaching note that you can distribute to others. All Darden cases, for instance, and many Harvard cases have such teaching notes. Usually, they are a big help. Teaching notes don’t give you the only way to teach a case or even the best way, but they do give you ideas about how other people have taught the case and what worked for them. They often have tips, supplemental anecdotes or data, a fairly rigorous analysis, and, often, an epilogue.

This chapter will outline some things to remember as you draft teaching notes for your cases or as you develop teaching notes for cases written by others that you are teaching.

Bill Rotch, a professor at the Darden School, has written a working paper¹ that compares case writing to art and points out the value of good teaching notes:

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"Case writing is a complex art form in which the teaching notes play an essential role. When an instructor looks at a case without a teaching note, it is like looking at a landscape painter’s carefully prepared palette without having the actual picture. Most artists could paint a landscape of some sort with the palette, but knowing what picture the artist would paint completes the creative process for us."

Teaching notes have several uses. We typically think of a teaching note as an aid to the teacher of that case. The teaching note may addressed, however, to a broader audience which includes those searching for materials appropriate to their courses. Here the teaching note provides a quick way of ascertaining whether or not the case and the issues it raises fits the course intended. Teaching notes can also be an aid to the non-teaching research assistants who often write cases. Having an outline of the teaching note and the analysis intended for that class, the case writer can be guided in the kind of data to collect for the case and the way in which the case should be structured. The teaching note also helps teachers of different sections of the same course to coordinate their coverage of the important points for which the case was chosen. In this way, the teaching note serves as a "quality control" mechanism.

There are, obviously, good and not-so-good teaching notes. A good teaching note will cover the following nine areas:

1) Synopsis of the case (which helps those searching for particular kinds of cases),
2) Scope and intended teaching objectives of the case,
3) How the case fits in the overall topical sequence of a course or module on broad topics,
4) Proposed teaching questions,
5) Full analysis of the case (including all or several sides of the issues),
6) Probable (if the case is a new one) or actual student responses,
7) Suggested sequence of class discussion,
8) Supplemental materials and their use. Possible role-playing, video/audio equipment and supplemental readings available to support the case, and
9) Epilogue.

EXPLANATION OF THE CONTENT AND EXAMPLES OF A GOOD TEACHING NOTE

1) Synopsis

The synopsis should be a good one paragraph summary of the case that mentions the relevant issues the case raises. This can save the potential case user a lot of time by superseding the need to read the case to see whether or not it is close to what is being sought.
Here is an example of a synopsis from the Teaching Note for Cyberlab (A) and (B) (UVA-QA-382/383TN) written by Larry Weatherford and Samuel Bodily.

**Synopsis**

The president of a large and established manufacturer of laboratory equipment has to decide whether to invest one million dollars for 30% equity in a start-up company in the field of lab robotics. The agreement would also allow his company the right to market the product. He already has a Lotus spreadsheet that projects the best guess of the future scenario and calculates several measures of performance (ROS, ROE, ROI, NPV, and IRR). He must decide which of the criteria are most useful. There is a relevant cost issue that is introduced and that must be resolved because it makes a big difference in the combined NPV his company faces (i.e. it swings the value from -$495.6K with the costs included in the deterministic income statement to +$237K with these costs removed).

**2) Scope and intended teaching objectives of the case**

A statement of the usual objectives which the case can meet is very helpful for the instructor searching for good materials. These objectives give the prospective teacher a sense of the scope of the case and the variety of purposes for which it can be used. Most cases can be slanted in many directions, each emphasizing a different aspect of the topic or even different topics. You might also mention here the appropriate level of the case whether it is suited for undergraduates or graduates.

**3) How the case fits in the overall topical sequence**

This section should include a statement about how the case could be most effectively sequenced in a course or module. One case might be best used as an introduction to a particular subject, another as a heavy duty analysis case in the middle of a module, and another might be perfectly suited as a summary case that pulls several key concepts in the module together.

Student learning is enhanced when each class is seen to fit into an overall plan that progresses naturally. Introductions to a case that explicitly make these connections and describe how it ties in with previous cases are a great way to provide this on-going overview. These bridges between classes or so called "segues" provide glue that can help the whole course hang together for the students and faculty.
Here is an example from the Teaching Note for Sprigg Lane (A) (UVA-QA-372TN, Rev 12/88) written by Larry Weatherford and Samuel Bodily.

Case Use and Objectives

The case is intended as a first opportunity for students to carry out a risk analysis Monte Carlo simulation. It would follow 1 or more days of introduction to Monte Carlo simulation and assumes that the student can use the electronic spreadsheet for proforma analysis. The case offers an opportunity to meet joint finance/quantitative analysis objectives in the classroom. It may be co-taught by faculty from both areas, or its companion (B) case may be taught by finance and the (A) case taught by quantitative analysis.

The student is expected to do the following:

- choose the probability distribution for the uncertainties in the case
- use add-in software to place the uncertainty into the spreadsheet
- run the Monte Carlo simulation
- interpret the resulting probability distribution of NPV and cash flow time pattern
- answer the question relating to the probability of a positive NPV
- decide go/no go on the project

The analysis described here has used the @RISK software; other software products can be used for the same purposes.

4) Proposed assignment/teaching questions

Preassigned study questions give both the students and the professor a common ground from which to develop the class. Generally, these questions are given to the students with the case at least the day before class. Teaching note questions certainly are not the only questions that can be asked to teach the case, but they should be the result of teaching that has worked for the author. They then represent one optional set of working questions.

Again, an example from the Teaching Note for Sprigg Lane (A) (UVA-QA-372TN, Rev 12/88). Students are given the case along with an introductory guide to @RISK software. The students are told that they may assume Sprigg Lane Natural Resources will retain 100% ownership to simplify the analysis, then given the following questions:

Suggested Assignment

1. Based on the base case scenario and the two alternatives down side
possibilities, is this investment economically attractive?

2. What benefit can Monte Carlo simulation add to Tom’s understanding of the economic benefits of the Bailey prospect?
3. Incorporate uncertainties into the spreadsheet using @RISK. What do the Monte Carlo results reveal? What is the probability that the NPV will be greater than zero? Should Tom invest?

5) Full analysis of the case (including all or several sides of the issues)

To make the teaching note consistent, this analysis should match up with the assignment questions just stated. If you give four assignment questions, the analysis should cover those questions. If the analysis draws from case facts, it is helpful to the reader if you specify exactly where the facts are in the case.

The long term learning benefit of the case method lies in the generalizability of the case specific discussion. The students should learn frameworks and tools and principles that they can apply to other situations. Consequently, there are seldom no clear "right" answers, but rather a multitude of possible actions. The teaching note should reflect sensitivity to this fact and give ample perspective on several courses of action and their consequences. Students and faculty should see from the teaching note that the analysis of a case is much more complex than just deriving the solutions to a problem set.

Here is the analysis section of the Teaching Note for Sprigg Lane (A). It is a bit lengthy, but you can see how a teaching note analysis might proceed.

Analysis

Initially, the students will look at Exhibit 1 of the case and think that this is a great deal based on an internal rate of return greater than 40% and a net present value of $110,26K at 15% interest. The stream of cash flows shows that over 80% of the net present value is returned by year 10, making the actual duration of the project much less than the 25 years that it appears to be on the surface.

After looking at Exhibits 5 and 6 of the case, the student should become a little concerned at the potential down side. The real issue then becomes how likely the down side outcomes are? This is where Monte Carlo simulation comes into play. Monte Carlo is a powerful tool to analyze multiple levels of uncertainty that would otherwise be too cumbersome to evaluate (even with bracket medians or Pearson-Tukey approximations).
The results of 10,000 Monte Carlo simulation trials show that the expected NPV equals $138,718 using a discount rate of 9.3% (a reasonable risk-free rate from Exhibit 3) with a standard deviation of $108,082. There's an 89.85% chance that the actual NPV would be positive. See Exhibit I for the graph of the risk profile of the NPV and its associated statistics. Exhibit II shows the NPV up through any year of the project. It is very interesting to note that the Monte Carlo expected NPV is higher than the NPV from Tom's original scenario. This is due to moving from a risk-adjusted discount rate of 15% to the risk-free rate of 9.3%. In fact, a Monte Carlo run with a discount rate of 15% yields an expected NPV of $83,244 (Exhibit III), $27,016 less than Tom's base case result.

Exhibit IV is a graph of the simulated levels of the six uncertain quantities extracted from the case. Students may have used slightly different assumptions in their analysis.

Unless Tom is risk averse, this appears to be a super investment opportunity. The proper discount rate to use is a very subtle point because in the initial deterministic spreadsheet Tom used a value of 15% to incorporate the high level of risk that the project entailed. Now that the spreadsheet is probabilistic, the discount rate must be a risk-free rate, but of what duration? To be exact, the duration could be calculated as the weighted average of the time value maturities of the cash flows and then this value would be used to find the risk-free rate of the corresponding duration. Because of its subtlety and the small difference in the rates for durations between 7 and 30 years, a rate of 9.3% was used.

6) Probable student responses

In addition to a thorough analysis, give some typical student responses in your teaching notes. This will help the reader anticipate the kinds of questions and discussion that will arise and help the teacher to avoid known "traps" or unproductive discussions.

Here's a sample of student responses from the Teaching Note for Shumway, Horch, and Sager (A) and (B) (UVA-QA-396/397TN) written by Larry Weatherford and Samuel Bodily.

Student Responses

"It seems prudent, on an expected value basis, to raise the rate base one
month early. Because of the relative closeness of the EMV's, we investigated using 10-bracket medians to compare the choices. This gave a result of $4,857K for the "raise early" vs. $4,780 for the "wait" decision."

NOTE: Some students may be tempted to use the critical fractile formula based on $C_u=1$ and $C_o=2$ and decide to set the rate base at the .33 $(1/(1+2))$ fractile of demand. This value turns out to be 4,939,979 (.44 std dev's below mean) assuming demand is normally distributed. This would be wrong because the costs are not linear in demand due to the "cap" on revenue.

7) Suggested sequence of class discussion

It is difficult to predict how a given class will turn out. In fact, the same case (taught at two different times or to two different sets of students), often results in very different discussions. A case teaching map can be a helpful tool in dealing with this phenomenon. To set up such a map, ask yourself, "What are the major topics one might discuss in the case? What are the transitions that will get you from one topic to another? About how much time is appropriate for each major topic?" As is mentioned in Jim Clawson and Sherwood Frey's paper "Mapping Case Pedagogy" (which appears elsewhere in this volume) it is very helpful to write these major topics out on 3" by 5" index cards with the points to be covered under each major topic. You can then lay these cards out in different arrangements on your desk and prepare questions or lecturette bridges that take you from one topic to another. This technique also helps you to visualize the various possible paths the discussion might take; this visualization may help you manage when things are happening quickly in the class.

Preparing a board plan for the most likely scenario is also a good preparation exercise and something to include in a teaching note. A board plan is basically a snapshot of what the boards would look like if you took a picture of them at the end of the class. If you only have one board, it would represent a picture of each board right before you erase it to start the next board.

A tentative class plan from the Teaching Note for Sprigg Lane (A) follows. This case is taught jointly by the Quantitative Analysis and Finance faculties at the Darden School. The time refers to elapsed time in the class.

Class Discussion

0 minutes QA can start by announcing that a Finance colleague has come along to help us in the discussion and that the Finance colleague will start off the discussion. The QA faculty member may then be seated for the time being, perhaps by the computer in case it becomes appropriate to run any spreadsheet what-ifs with video projection.
2 minutes: What analysis has Tom done so far? The Finance faculty member can then talk about the income statement in Exhibit 1 of the base case. What assumptions are made, what financial measures are important?

Based on this analysis, what do you think of the project? It satisfies all of Tom's three criteria; go for it.

At this point the QA faculty may interject: "Wait a minute; you run one case and you think you're done. What about the assumptions you've tidily kicked under the rug?" Finance reluctantly responds: "OK, we'll look at a down side scenario." They then look at one or more scenarios on the pessimistic side. The students may turn to the two in Exhibits 5 and 6, or they may suggest their own what-if case to be run in real time on the computer. The discussion should uncover at least one bad situation where the project loses a lot of money.

20-25 mins Now what are we going to do? The down side cases don't look good. Mr. Thomas wants to know how likely the down side is?

The students will suggest simulation. The Finance professor will feign ignorance and defer to QA.

Why do simulation? The students will suggest this as a reasonable approach to finding the probability that NPV>0. The more astute may also recognize that E(NPV) from Monte Carlo is not equal to the NPV calculated from the means of the uncertain quantities.

What uncertainties are we going to simulate? What do you know about these uncertainties? How do you model them?

A. Will gas be produced? It is given in the case twice that this is a discrete probability distribution with a 90% chance of success (1) and 10% chance of failure (0).

B. How much gas is there? Again the students are told that this is a lognormal distribution with a mean of 33,000 mcf and standard deviation of 4,930 mcf. All they have to do is convert from 33 million cubic feet to 33,000 mcf and continue.

C. What is the total well cost? The case says the "average" cost (mean) is $160K and that there's a 95% chance that actual cost will be within $5,400 of the average. This implies a normal distribution with mean=160K and 2
standard deviations = 5,400. Therefore, 1 standard deviation = 2,700.

D. What is the BTU content? The case gives the lowest possible value (1,055), the most likely (1,160) and the highest value (1,250). The student then models these three values with a triangular distribution.

E. How will production decline? The students are given the most likely decline factors and it is suggested that all of these be multiplied by the same uncertain quantity each trial. In some other cell of the worksheet, a triangular probability distribution with low value of .5, most likely value of 1.0 and high value of 1.75 is entered. This value is then multiplied by each of the production decline factors given.

F. What is the proper inflation value to use? Tom is currently using his best guess of 3.5% If you calculate the arithmetic average of the 3 forecasts given in Exhibit 4 of the case, you get 3.73%. This compares with a historical 4.91% average inflation rate over 25 year periods since 1953. No one forecasts inflation for the next 25 years, so you're left with a choice between historic performance or a 3 year forecast as a proxy for a 25 year forecast.

The issue here is whether to use historic values or not. Do you believe inflation is going to be as high as it has been recently? If you look at the 1953-87 period by comparing the last 35 years average inflation (4.5%) to the last 25 years average (5.39%) to the last 16 years average, (6.31%), there is a trend towards increasing inflation which argues for using a forecast for the next 25 years. The odd thing is that the forecast (3.73%) is lower than the last 25 years, defying the increasing trend. We used the lower inflation value because it is more conservative (gives a lower NPV).

The analysis reported uses a normal distribution with a mean of 3.73% (fcst) and a standard deviation of 0.46% (historic). The difference in the expected NPV's is only $11,137 if you use a 4.9% rate (Exhibit V). It would be more realistic, though probably not worth the effort, to model inflation on a year-by-year basis and incorporate the roughly 2.5% percent standard deviation of year-to-year variations.

How does the simulation work? The students will describe what happens in the worksheet for each trial, which they should know from a previous class. The process makes objective selection of scenarios based on the probability inputs above and progresses through many trials.

What are our results? The expected value of NPV and the prob(NPV> 0) is
identified. The students may have only run 100 or so trials. Thus, there may be
discussion of sampling error and whether enough trials have been run. They will
be aware that the sampling error of the mean is the standard deviation reported
by the simulation divided by the square root of n.

Some students may have looked at how the distribution of the average NPV per
well varies when you invest in a package of 10 wells as opposed to a single
well. The case mentions that this is what SLNR actually does, but the
assignment allows them to simplify the analysis by looking at a single well. Of
course, the package concept allows you to diversify away much of the dry hole
risk with the result being a much tighter standard deviation of $34,736 and
99.99% chance of the average NPV being greater than 0 (See Exhibit VI).

65-70 mins  Now Finance can come back in and both faculty then deal with questions about
the treatment of risk.

If risk is treated by adjusting the expected NPV for the spread in the NPV
distribution, then should you use a discount rate that is already risk-adjusted?

The project looks too good to be true. Note that all of the input numbers came
from Tom, who is also selling this to investors. He has a major stake in this
business working out well and may be optimistic. (In actuality, SLNR takes a
25% reversionary royalty out of net revenues once the well reaches payout, that
is, when cumulative after-tax cash flow = initial investment) What is your model if
you were putting your own money into this? This should result in what might be
called a skeptical risk analysis.

If you widen and shift the uncertainties in the following way: Well cost: mean
165,000, std. dev. 5000, enough to produce: probability .85 production decline
multiplier: triangular (1,1.2,2), GNP deflator: normal (2%,1.5%) and add these
uncertainties:

Federal tax rate: triangular (34%,38%,48%), annual lease expense: triangular
(1000,4000,10000) and make the well expense inflation factor equal to the GNP
deflator, rather than one-half of it, you obtain the results in Exhibit VII. The
project has a 77.8% chance of a positive NPV and an expected value of $42K
at 9.3 percent discount rate; it still looks good enough for a "go." The value of
this project comes largely from the federal tax credit which expires in the year
2000. A Monte Carlo simulation was run with no tax credit and the expected
NPV decreased $72,000 to a value of -$30K.

80-85 mins  What is your decision? The students will probably conclude this is a "go."
8) Possible role-playing, video/audio equipment and supplemental readings available to support the case

This final section of the teaching note outlines audio-visual possibilities (films to show, new clips to report, overhead transparencies that work well, etc.) and any other supplemental materials that may add to the learning in the class. You might have a video tape of an interview with an officer of the company in the case or you might have samples of the company’s product. These supplements to the class should reinforce student learning and not be used if they detract from the their attention on the subject.

You might also include here a list of supplemental readings that are available (to professor and student alike) to increase one’s knowledge of the basic tools and concepts being used or taught in the case. These readings or technical notes may be handed out with the case or just be referenced for those who wish to read further.

9) Sequel or outcome to the case

Students often want to know what happened in the real situation. This can be dangerous if the students rely too heavily on what the company did as opposed to their own analysis. Reporting the epilogue is not useful if it creates a "dependent learning style" in the students. They should learn to trust their own judgment and skill and not to rely necessarily on what was done. Sometimes it can be enlightening to look at what actually happened to compare and contrast that result with the class' approach. Both the pros and the cons of the actual approach should be discussed here so that the students do not interpret it to be the "only right" approach.

CONCLUSION

Neither cases nor teaching notes are static. They are preferably living documents. After a case has been taught once or twice, you may find things that need editing or rewriting. You may get additional information on the case or see a new way of teaching it. 60-90 sets of eyes reading and analyzing a case in detail can produce wonderful and varied perspectives on the situation. Armed with these perspectives, you can revise the case and/or the teaching note to keep them current and more effective in teaching. This iterative process will keep the case alive for you and the students. The modifications in the teaching notes allow you to build on the things you've learned in the past and get better in the future.