

How to Excel in Engineering Economics



Dr. Ronald Pelot

Industrial Engineering



Navin Chari

Industrial Engineering

The Engineering Economics course IENG2005 at Dalhousie University is mandatory for all Engineering students, and can be taken at any point between the second and fourth years of enrolment. As the composition of students is quite varied in terms of engineering discipline, age, and work term experience, we aim to tailor the course to accommodate these differences. Performing cost analysis using spreadsheets is an important aspect of the course, but the incoming students' facility with Excel ranges from nil to very good. Over the years the computer tutorials had to be geared to the lowest common denominator, and proceeded at a snail's pace. This is counterproductive, as it is not only boring for the more advanced students, but it precludes us from achieving a moderate level of expertise by the end of classes.

We conducted a focus group two years ago with graduates of this course to explore options for revamping the material. With the Canadian Engineering Accreditation Board planning to change their assessment procedure in 2014 to become outcomes-based, this was a good opportunity to revise the objectives, and amend the course content and delivery accordingly. Aside from noting the disparity in Excel skills, the focus group students also suggested more challenging, realistic, problems to work on, and described some difficulty in translating "word problems" into corresponding mathematical representations.

One key mechanism for addressing these deficiencies was to create a series of interactive online tutorials. We created four spreadsheet tutorials based on numerical problem descriptions (Using Basic Excel Knowledge to Build an Income Statement; Solving a Cash Flow Series Problem Using Excel; Creating a Loan and Data Table; and Bonds and Conditional Functions), and two problem-solving tutorials (Coffee Shop Profitability; and Understanding Sunk Costs). These exercises allow the student to learn spreadsheet functions, starting with the most basic and progressing to the more advanced

tools needed in the course. At the same time, the tutorials use material being taught concurrently in the class, thus allowing additional practice other than the homework assignments. Some of the more challenging Excel functions were also presented during the in-class tutorials to complement the online learning. Since the tutorials are self-paced and can be repeated at will, benefits of the online tutorials included accommodating several learning styles, diverse Excel capabilities, and English interpretation difficulties. Furthermore, we ensured uniformity across the online course materials by creating standardized PowerPoint slides for the foundation, as well as embedding videos, providing a jpeg image of what the final spreadsheet from each exercise should look like, and linking with a glossary of Excel and Engineering Economics terms.

To bolster the course outcomes, we also decided to further blend the instructional and experiential learning by creating case studies and in-class assignment/tests in order to reinforce course outcomes and other goals. These include enhancing the comprehension of written material; performing and applying some external data searches; enhancing analysis and problem solving; and obliging students to make a leap from basic course concepts to more difficult applied concepts. The online tutorials are important stepping stones in allowing the students to tackle these more complex spreadsheet-based case analyses.

One complication was to devise a case study for a class of 165 students that would allow for some flexibility in problem formulation and solutions across 35 groups, while ensuring a modicum of consistency for fairness and ease of marking. Therefore, the case studies were carefully designed by providing all groups with the same scenario describing the problem context and some limitations, while allowing some latitude on assumptions such as expense patterns, expected inflation rates, etc. Thus the form and difficulty of each group's solution were comparable, but the exact answers differed. The benefits of the case study are that it parallels and expands on the current curriculum; is broken-down into multiple submissions over the tenure of the course; requires the use of the Excel functions that the students are learning in class and through the online tutorials; and requires students to plan for gathering information, perform research, and work in groups.

After the course was completed, we conducted an online survey using *Opinio*. We assessed: which online tutorials the students completed (Table 1); which was the most/least useful (Figures 1 and 2); which helped in the understanding of Engineering Economics concepts (Table 2); and which helped in the completion of assignments and case studies (Table 2).

Table 1: Online Tutorial Completion

	Percentage Completed
T1: Basic Excel Techniques	77%
T2: Cash Flow Series	73%
T3: Creating a Loan Table	69%
T4: Bonds & Conditional Functions	55%
Coffee Shop Profitability	3%
Understanding Sunk Costs	7%

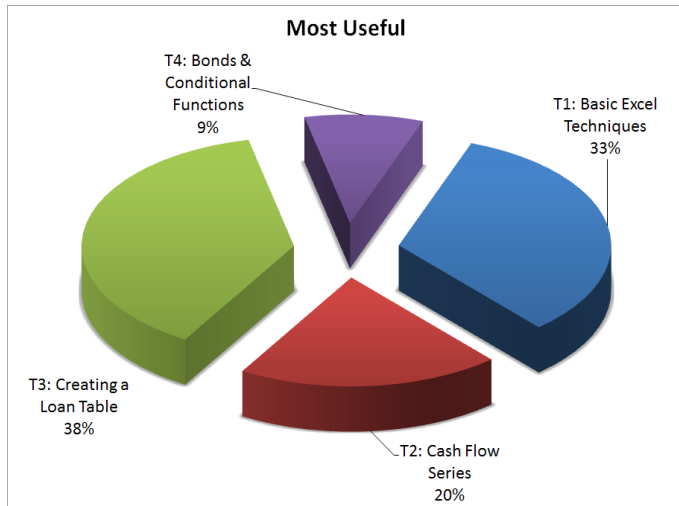


Figure 1: Most Useful Tutorial

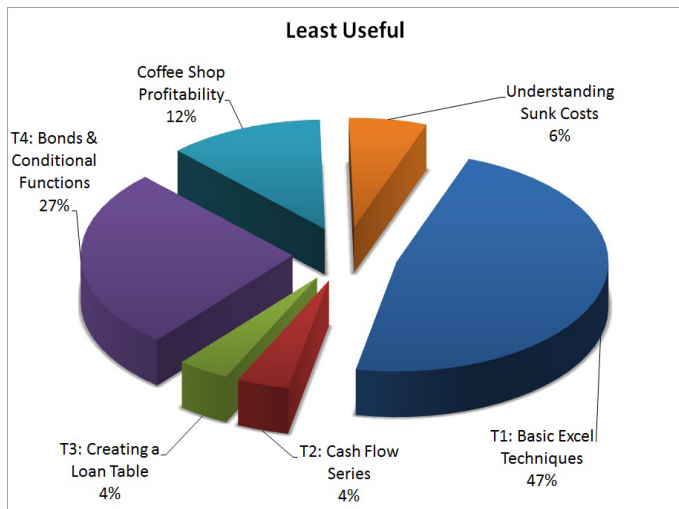


Figure 2: Least Useful Tutorial

The most interesting detail gleaned from Figures 1 and 2 is that the first tutorial was the most useful for a third of the class, and also the least useful to half the class, thus reinforcing our prior belief that some students need to learn all the introductory Excel features, while others skimmed through it as it was superfluous to their prior learning. In contrast, Tutorial 3 was found to be the most useful to the greatest number of students, while few found it to be relatively useless. The two problem-solving tutorials were only prepared later in the course, so most students did not take advantage of them. Table 2 shows that all the online spreadsheet tutorials help in many respects, although the introductory one, T1, had less value added overall.

Table 2: Value of Online Tutorials

	T1	T2	T3	T4
Helped Understand Concepts	70%	96%	91%	84%
Confidence in Using Excel	94%	98%	98%	81%
Helped With Assignments	64%	82%	87%	81%
Helped With Case Studies	74%	86%	85%	76%

A sample of comments from the online survey includes the following:

“It used functions that I had never seen before, and I ended up having to use these functions several times throughout the course.”

“I feel more confident about Excel since taking this course and I have been able to apply [it] to my other classes.”

“The tutorial was clear [on] how to calculate a coupon value and various techniques to use on Excel not explained in class.”

In terms of an overall assessment of this pilot project, we have found that the students would like tutorials on more topics, particularly in the areas of income taxes and return-on-investment. For our second iteration of the course revision, we will also review the balance between self-study and instructor guidance for working through the tutorials, the amount of emphasis on the case study, group work versus individual assignments, and the proportion of theory versus practical content.

We would like to acknowledge Industrial Engineering students Megan Barteaux and Joseph Langer for their help in preparing these tutorials, as well as the Dean of Engineering for funding this course development activity.