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Excerpt
More Information

Introduction: Why Simulation and Excel?

> At this stage of the argument the general public, though welcome at the debate, are only eavesdroppers at an attempt by an economist to bring to an issue the deep divergences of opinion between fellow economists which have for the time being almost destroyed the practical influence of economic theory, and will, until they are resolved, continue to do so.
> – John Maynard Keynes

This book is meant to be read and used by professors and economists. It assumes familiarity with economic theory and data analysis, so it will not make sense to a student or beginner. It is a manual for utilizing teaching materials that are available on the Web at http://www.depauw.edu/learn/macroexcel. It is assumed that the professor has a favorite textbook or readings that neither this book nor the online files will replace. Instead, delivery of content via Microsoft Excel will supplement and improve the teaching and learning process.

After explaining what is available and how to use it, this introduction presents a pedagogical argument in favor of simulation and Excel. Much of our teaching in economics is based on how we were taught and what we feel works, but advances in neuroscience make clear that many of our strategies and methods are flawed.

Excel Files and Screencasts

Professors who use these materials will have their students work with two types of resources: Excel files and screencasts (video recordings of the computer screen with audio narration). The Excel files include macro-enhanced workbooks that contain everything students need, including a *ToDo* sheet with links to screencasts and tasks (i.e., questions) to enable assessment. In addition, Excel add-ins, special files that extend the functionality of Excel, are provided.

Each chapter in this book lists the workbooks and screencasts available with a brief description providing a quick overview of the content and enabling professors to zero in on appropriate material. Each chapter begins with a section on common student problems and recommendations for ways to minimize confusion. The rest of the chapter is then devoted to more detailed description of the content in the workbooks and screencasts, answers to tasks, and suggestions for teaching.

The pedagogical principle behind the Excel workbooks and screencasts is that of strongly guided instruction via worked examples. The screencasts are meant to be viewed with Excel open so that each step can be replicated. Videos can be paused or repeatedly replayed as often as needed. Some tasks are easy, requiring simple replication, while others do more than simply repeat the screencasts by asking the student to extend a result or consider a related, but different, scenario.

How to Provide Students with Files

The easiest way to deliver a workbook or screencast to students is to send an e-mail with the link. For example, suppose someone is having trouble creating a chart in Excel. Visit the *Teaching Macro with Excel* website at http://www.depauw.edu/learn/macroexcel and go to the *Screencasts* page. Right-click the first screencast and copy the link address (http://vimeo.com/econexcel/how-to-chart-in-excel). Paste the link into an e-mail and send it. When the student receives the e-mail and clicks on the link, he or she will go directly to the screencast.

This same procedure can be used to send an Excel workbook: right-click any file on the *Excel Workbooks* page of the *Teaching Macro with Excel* website, copy the address, and paste it into an e-mail. When the recipient clicks on the link, the workbook will download and open in Excel.

Links to workbooks and screencasts from a course management system (e.g., Moodle or Blackboard) or class web pages are another way to deliver files to students. In addition, Excel workbooks may be downloaded and saved on network drives, in course folders, or to other locations to which students have access. Finally, the link to the website itself, http://www.depauw.edu/learn/macroexcel, can be shared with students and colleagues.

How to Teach with These Resources

As a professor, you can use these materials in several ways. You can view the videos in a workbook, practice and perfect the tasks on your own, then project the file in class and incorporate it into your lecture. In a lab setting, the entire class could watch a video, after which you could provide personalized support as students work on specific tasks on their own. You can also simply distribute a workbook to your students (via a link in an e-mail or by providing the workbook itself on a network drive) and have them view the screencasts and complete assigned tasks as homework. A truly radical idea would invert the classroom – assign a workbook so that students view and replicate the screencasts as homework, then have them come to class to do the tasks with your help and support. I did this in spring 2014, and I offer handouts, teaching notes, and exams online at http://www.depauw.edu/learn/macroexcel.

The files can be projected in class as part of a lecture, used in lab settings, or assigned as homework, but they do not replace a textbook or professor. The Excel files are meant as complements, not substitutes, to a traditional book, and the professor is responsible for picking and choosing which workbooks to use as supplements as well as when and how to use them. This printed book offers guidance and information to help you make these pedagogical decisions. It has suggestions on how to teach the material and use the files. It also points out where and how students might struggle with concepts or in using Excel.

ToDo **Sheet Task Answers**

Each workbook has a list of questions in a *ToDo* sheet that require students to replicate aspects of a screencast and apply a concept or test a claim. These tasks vary in difficulty and are described in this book.

There is no master answer key to the tasks, but some answers are provided in concealed sheets in the workbooks, which can be revealed by running the *ToggleHideUnhide* macro using any of these three methods: (1) from the **Developer** tab, click **Macros**; (2) press ALT-F8 and select the *ToggleHideUnhide* macro and click **Run**; or (3) use the keyboard shortcut CTRL-SHIFT-U. These answer sheets cannot be seen simply by viewing the hidden sheets in the workbook because they are given the special property of being *VeryHidden* and can only be revealed by running the macro. The code, however, is not password protected, so a student expert in Visual Basic could access these sheets. This seems highly unlikely, but if this concerns you, reveal and delete the answer sheets before distributing the workbook. Answers to some tasks, along with tips for easy grading, are described in this book. Sometimes the question is so obvious that no answer is provided.

Why Simulation?

All of the workbooks rely on using Excel to create concrete illustrations and strong visual displays of theoretical concepts. Models and theories are implemented in Excel, and simulation is used to explore and explain properties and behaviors. This is the fundamental advantage of teaching with a spreadsheet. Instead of a dead graph that has been prepared by someone else, Excel enables students to change a parameter and instantly observe its effect on endogenous variables. The ability to control which exogenous variable is manipulated and to see the results on-screen as a shift of or movement along a curve is key to the learning process. The student creates relationships between variables and can literally see theoretical connections that used to require difficult abstract thinking. The student can also perform an endless series of experiments with random parameters, discovering and exploring comparative statics properties.

There is perhaps no better example of the power of simulation and visual presentation than the Solow Model. Its iterative, dynamic operation puts growth theory beyond the grasp of almost all undergraduate students. While a book can certainly show the model's solution in a Solow diagram, once technological progress is added so that the steady state is displayed in terms of efficiency units, it is unreasonable to expect the typical undergraduate to be able to map the solution to a graph of actual output or consumption over time. Excel can do this transformation quickly, with striking graphs that make clear how technological progress is the key to modern economic growth. Changing parameters and answering comparative statics questions enable students to truly understand the model. The easy access to data (population and GDP per capita) to calibrate the model and test theoretical predictions with real-world outcomes is icing on the cake.

In fact, I would argue that simulation should become part of every economist's teaching toolkit. Schmidt (2003) points out that there is a substantial literature on simulations, games, and experiments in the classroom and focuses on computerized simulations. After listing several benefits, Schmidt turns to costs:

> The instructor has to be able to install and run the simulation, and someone has to code the simulation.
>
> Once written, however, the code can be easily shared with many different instructors. It would be desirable to have a central database of publically available simulation programs to facilitate sharing them. Schmidt (2003, 154)

Fortunately, because the simulation of the Solow Model is embedded in the Excel workbooks, the installation costs are negligible – simply download and open the workbook (enabling macros) and it is ready to go. As for the central database of simulation programs suggestion, visit "Teaching with Simulations," available at http://serc.carleton.edu/sp/library/simulations, for an overview of simulation pedagogy and example applications.

Grossman (1999, 93) points out tangible advantages of teaching with simulation: "We find that performing queuing simulations in spreadsheets offers six benefits: explicitness, immediacy, insight, flexibility, active modeling, and accessibility. These benefits apply not only to students, but also to instructors with expertise in queuing theory." Each of these benefits has a common root – it reduces abstraction. This is the core, pedagogical trump card of simulation and explains why teaching with spreadsheet implementations of models is so effective.

Why Excel?

Even if one accepts that simulation is a powerful teaching tool, there is still the issue of the appropriate software to use. The choice set is large, from open-source spreadsheets to R to Java applets or other browser-based implementations to high-end mathematical packages such as Matlab and Mathematica. Barreto (2015) makes the case that Excel is "just right," not too easy so that anyone can master it and not too hard so that it does not require large start-up investment.

A moment's reflection should convince you of the latter claim. Students have experience with Excel and are quite comfortable with it. They can add and subtract cells and use formulas to compute sums and averages. You can tell any student to type "= RAND()" in a cell and hit F9, thereby instantly producing a random number generator. There is no programming needed. Of course, in a macro-enhanced workbook, students can click buttons and scroll bars to change variables and immediately see the updated display.

But there is a world of Excel knowledge beyond the rudimentary skills of the typical student. It is in acquiring advanced skills and mastery that Excel proves to be the optimal software choice. Charting provides a good example. Although most students can select data and create a chart, they must be taught how to properly label it, and there are many additional charting features that they can apply (as described in the next chapter). Learning how to use advanced Excel functions, install and manage add-ins, and analyze data demonstrates a level of proficiency that is not easily attained and that employers keenly desire. By learning economics via Excel, the student is also acquiring valuable skills in Excel. The student is aware of this value and is willing to work hard, certainly much harder than in a standard chalk-and-talk course. For the professor interested in maximizing student learning, this may be the best reason of all to use Excel.

Conclusion

You would think that professors know how students learn, but just like everyone else, we hold on to incorrect beliefs, and our intuition can lead us astray. For example, Brown et al. (2014) point out that most people believe cramming is an effective method because it feels like hard work. In fact, interleaved practice and spacing the material is vastly superior to repeating the same thing. Experiments have consistently shown that shooting a basketball from different areas or throwing different pitches is far better than shooting from the exact same place or throwing the exact same pitch for an entire practice.

Similarly, you might think that Excel is a big distraction that necessarily subtracts from economics content. After all, if the brain is a reservoir of fixed size, then Excel crowds out economics. This zero-sum model is completely wrong. When it comes to learning, bombarding the mind with many sensory inputs is much better than a single channel. This is why listening to a lecture passively is inferior to listening and taking notes, which in turn is inferior to working with a computer (with its additional stimuli). The natural sciences take this to another level when students do lab work – now they are actively moving their hands and using all of their senses so that their brains are making all kinds of connections.

The physical processes involved in learning, encoding information so it can be retrieved and used later, is complicated. Medina (2008, 104) says, "The little we know suggests that it is like a blender left running with the lid off. The information is literally sliced into discrete pieces as it enters the brain and splattered all over the insides of our mind." When you look at a graph, your brain performs a series of remarkable steps. Lines are separated from curves and stored in different areas of the brain. Colors, numbers, sound, motion, and other information of what we see, hear, feel, smell, and taste are distributed all throughout the brain. What neuroscientists call the binding problem, that is, how the brain manages and reconstructs all of these bits of data, is the focus of intense research.

With this model of the brain, it makes sense that multiple inputs entrench information more deeply and give more hooks for retrieval. A lecture on the Solow Model with a homework assignment one day that is followed by a screencast and in-class problem session and then a computer-lab meeting is better than three lectures on the same material. We exclusively lecture because it is low cost, not because it maximizes learning.

Augmenting your classroom with Excel (and other ways of delivering content) is sure to improve your teaching and how much your students learn. This book gives you the opportunity to incorporate Excel into your curriculum with little effort. The material is modular, so you can pick and choose what to use. You can also vary how you utilize the files, from displaying them in a lecture to assigning them as homework or working together in a computer lab to flipping the classroom. Experimentation and change are the keys to successful teaching. This book offers a low-cost way to try out new ways to teach economics.

Sources and Further Reading

The epigraph is from the preface to J. M. Keynes, *The General Theory of Employment, Interest and Money* (1936), http://www.marxists.org/reference/subject/economics/keynes/general-theory.

On simulation as a teaching tool:

Grossman, T. 1999. "Teachers' Forum: Spreadsheet Modeling and Simulation Improves Understanding of Queues." *Interfaces* 29, no. 3: 88–103.

Schmidt, S. 2003. "Active and Cooperative Learning Using Web-Based Simulations." *Journal of Economic Education* 34, no. 2: 151–67.

For a review of spreadsheets in the teaching of economics and a detailed argument in favor of Excel:

Barreto, H. 2015. "Why Excel?" *Journal of Economic Education* 46, no. 3: 300–309. http://www.tandfonline.com/doi/abs/10.1080/00220485.2015.1029177.

The lessons of modern neuroscience with respect to learning make for interesting and helpful reading for professors and advisers:

Brown, Peter C., Henry L. Roediger, and Mark A. McDaniel. 2014. *Make It Stick: The Science of Successful Learning*. Belknap Press of Harvard University Press.

Medina, John M. 2008. *Brain Rules: 12 Principles for Surviving and Thriving at Work, Home and School*. Pear Press.

1

Charting in Excel

1.1

Introduction

[With a chart,] as much information may be *obtained in five minutes as would require whole days to imprint on the memory in a lasting manner by a table of figures*.
– William Playfair

The contents of this book are meant to be modular – chapters can be used in any order, and individual Excel workbooks can be smoothly paired with any textbook. It could be argued, however, that this chapter on creating charts is a prerequisite to the study of economic models and data and, therefore, merits its leadoff status. A chart, also known as a graph, plot, or diagram, is so fundamental to the way economists visualize models and display data that it is often overlooked. Books present charts as if they were words, with no prior explanation, implicitly assuming that everyone knows how to read a chart. Using Excel to teach economics, with an emphasis on actively doing something rather than passively observing, forces explicit consideration of best practice methods for making a chart. Beginning with charting is an excellent way to introduce students to Excel and offers an opportunity to cover an ignored area of the undergraduate curriculum. The skills learned are sure to be used extensively in future courses and outside the classroom.

Students think that charting is trivial, but it is actually a complicated, serious matter, and there is, of course, a substantial literature on visualization and presentation of data. However, this is not a book about displaying data, so the optimal stopping point is reached quickly. A reasonable teaching goal is for a student to be able to produce a clear, basic graph in Excel. Be sure to emphasize that a guiding principle is to *minimize chartjunk*: irrelevant text, colors, or other visual elements that distract from and obscure the information being displayed. There is no doubt about it – a minimalist, simple approach is best.

Unfortunately, Excel is not helpful when it comes to creating a chart. It presents a bewildering array of chart types and options. Most students know that, in Excel, charts are created by selecting data, then clicking on a chart type button (or using the **Chart Wizard** button in older versions of Excel). Students need instruction, however, on exactly which chart type to use and how to best convey information. Creating a chart is a mix of art and science. Some things are just plain wrong, while others are simply ugly.

The work in this brief chapter proceeds in increasing order of difficulty. The first section walks through the process of making a chart in Excel and is easy enough to be suitable even for first-year students. To avoid tedious lessons on how to create a chart in Excel, simply send a student this link:

http://www.depauw.edu/learn/macroexcel/excelworkbooks/Charting/HowToChart.xls

The second section is more ambitious. It uses the *Econ Chart Enhancer* add-in to insert shaded bars in a scatterplot. This approach is often used to highlight recessions in a time series chart, and the add-in contains recession dates for the United States from the National Bureau of Economic Research. A second example is based on indicating high income inequality with shaded bars.

The *Econ Chart* add-in has a number of options that are not discussed in the screencasts for students. They are self-explanatory and briefly reviewed at the end of the chapter.

Sources and Further Reading

The epigraph is from William Playfair, *Playfair's Commercial and Political Atlas and Statistical Breviary*, edited and with an introduction by Harold Wainer and Ian Spence (1786; repr., Cambridge University Press, 2005), xii. Playfair invented graphical analysis, and his introductory comments reveal a deep appreciation of the power of visual representation:

> As the eye is the best judge of proportion, being able to estimate it with more quickness and accuracy than any other of our organs, it follows, that wherever *relative quantities* are in question, a gradual increase or decrease of any revenue, receipt, or expenditure of money, or other value, is to be stated, this mode of representing it is peculiarly applicable; it gives a simple, accurate, and permanent idea, by giving form and shape to a number of separate ideas, which are otherwise abstract and unconnected. In a numerical table there are as many distinct ideas given, and to be remembered, as there are sums, the order and progression, therefore of those sums are also to be recollected by another effort of memory, while this mode unites proportion, progression, and quantity, all under one simple impression of vision, and consequently one act of memory.