

# **Spreadsheet-based Modeling for Teaching Finance and Accounting Courses**

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### **Abstract**

The teaching of the quantitative aspects in accounting and finance poses inherent challenges and even if students have such quantitative skills, they often find it hard to really grasp the meaning of such theories or concepts. This paper advocates embedding the teaching of these concepts into spreadsheet and computer modeling exercises. The approach is motivated by the author's experience of teaching dedicated spreadsheet-based modeling courses in finance whose structure and content is documented with this article. These courses put modeling into the centre while students acquire truly applicable concepts in finance and accounting almost automatically along the way. This practical "hands-on" method does not only provide a means of enhancing understanding and retention but it is also bound to improve employability of students as they become more adept in their use of analysis tools widely used in today's work environment.

**Keywords:** Teaching, Finance Education, Spreadsheets, Computer Modeling, Excel

## Spreadsheet-based Modeling for Teaching Finance and Accounting Courses

### INTRODUCTION

Finance is perceived as one of the glamorous, but also more difficult subjects taught in business schools as it is an inherently more quantitative subject. Similarly, related areas in accounting such as financial, management and tax accounting require a good numerical literacy to cope with the concepts. However, even if students possess such quantitative skills, they often find it hard to really grasp the meaning of concepts in finance and accounting. This paper presents spreadsheet modeling as a means of maximizing understanding and retention of finance and accounting concepts by students. It is motivated by the author's experience of teaching dedicated hands-on financial modeling courses for a number of years which includes much positive feedback from former students who have now entered their professional working careers.

Despite such apparent benefits, it is surprising that coverage of this subject in the educational literature is quite patchy, particularly with regard to the use of spreadsheets in finance courses. It is usually limited to the presentation of sample spreadsheet models to enhance learning experience. The only exception in this respect is perhaps a brief note by Holden & Womack (2000) who do touch on the benefits of spreadsheet-based teaching in finance but at same time do not document actual curriculum implementation and also fail to connect this to the more general issue of conveying quantitative concepts. After all, this problem is not unique to finance or accounting but it is also encountered in areas such as mathematics, science and engineering at all educational levels from primary right through to tertiary teaching institutions. Accordingly, in a first section the

article reviews the current understanding of how technology in the class rooms might change the way teaching and learning will occur in the future. The subsequent section then develops the specific motivation for spreadsheet-based teaching in accounting and finance. Doing this, the paper will primarily focus on spreadsheet modeling in finance as it is fair to assume that related issues in accounting subjects will be quite similar. The article concludes with a presentation of structure and content of an undergraduate, respectively graduate level financial modeling course taught at this author's university. As supplementary information, appendix 1 contains a review and evaluation of selected spreadsheet-based teaching resources currently available.

#### MODELING AND TECHNOLOGY SUPPORTED LEARNING IN THE LITERATURE

There is a wide array of pedagogical literature that studies the impact of new technology on the teaching and learning process. This section focuses on what this literature has found with regard to the application of computer and in particular spreadsheet modeling in the process of acquiring knowledge. The first part looks at two general theories, the "constructivist" learning approach as presented in Boethel & Dimock (1999) as well as a motivational view as the basis for understanding the pedagogical benefits of using spreadsheets in the classroom. This is followed by a review of specific literature related to spreadsheet use in teaching accounting and finance courses.

In the field of education, the term constructivism has almost become a kind of a buzz word. According to Null (2004), the theory is hard to pin down as it represents a philosophy rather than a concrete prescription. What is common however among the numerous views of what it represents is a definition which includes a notion of knowledge being "constructed" by the learner. When reviewing the ample literature on constructivism in detail, Boethel & Dimock (1999) note that technology, particularly computer-based technology can become an essential piece of a new type

constructivist learning environment as students become more empowered and spend more time in active construction of knowledge when using technology. Ordinary software such as spreadsheets are found to be particularly useful learning tools as they give the user control of almost everything that happens [Maddux, Johnson, & Willis (1997) as cited in Boethel & Dimock (1999) p. 17]. Like Holden & Womack (2000), Maddux et al. (1997) advocate the use of spreadsheet models which are built from scratch by the students as opposed to pure templates which simply allow them to alter the input values.

The factor of student motivation is an equally important aspect in teaching. When reviewing the benefits of using spreadsheet modeling in teaching, some researchers have thus focused on the motivational aspects of using spreadsheets. One example is Ghani & D'Mello (1993) who studied the learning experience for a sample group of graduate finance students who were assigned a spreadsheet-based finance problem. Ghani & D'Mello's starting point was the so-called "flow", defined as a state of being where an individual is completely absorbed in an activity and derives enjoyment from it. Individuals who enjoy an activity will probably want to repeat it, presumably improving their skill level. It must thus be the goal of an educator to generate a flow experience for students and Ghani & D'Mello (1993) in their survey identified a sense of control together with an adequate level of challenge as key components enhancing the level of flow, i.e. increasing the feeling of self-actualization and self-competence. Addictive properties of computer modeling are indeed in line with this author's teaching experience when there is anecdotal evidence that some students dedicate themselves almost exclusively to completing, or rather over perfecting their modeling assignments while at the same time neglecting coursework of other classes. Conversely, there is a minority of students who become disillusioned with computer work as they either lack perseverance or simply fail to cope with the complexity of the task. Such increased skepticism and frustration among learners have also been documented by Mariott (1992) in a study on the

effectiveness of using spreadsheets to teach financial accounting. It is thus of utmost importance that educators find the right, possibly a staggered level of challenge to cater for a variety of skill levels and prevent frustration among more marginal students.

Beside these more fundamental theories which provide an understanding of why spreadsheet modeling would be useful for educational purposes, there are obviously various educational articles in finance and accounting journals that illustrate examples of spreadsheet applications for teaching purposes. More recent examples include Kruck & Maher (1999), who show an adaptable spreadsheet-based mortgage analysis project, as well as Hwang (2002), who provides educators with a classroom spreadsheet example to introduce accounting for derivative instruments according to FAS 133. Arnold, Crack, & Schwartz (2004) present an instructional model to introduce implied binomial trees for option valuation. Riley (2002) finally gives a simple method for estimating volatility applied to actual stock prices using a spreadsheet. Not in the category of true creative, self-built models falls the application of spreadsheets in Lehman & Herring (2003) who show a method for designing spreadsheets that enable students to obtain immediate feedback on the accuracy of their answers to rule-based accounting problems. While spreadsheets may certainly be used to program such testing software, this is definitely not a core capability of such analysis packages. All in all however, the bulk of example models for instructional purposes are not found in the academic literature but rather in dedicated teaching resources — some of which are reviewed in Appendix 1 to of this article — and on educational websites (see for example links in *IT Learning Materials: An Educational Resource*, 2004).

## SPECIFIC BENEFITS OF SPREADSHEET MODELLING

This section deals in some greater detail with the benefits and motivations for using computer modeling in teaching finance as they have been identified in this author's teaching practice. Two benefits stand out. Firstly, spreadsheets fill mathematically demanding theories with life and, secondly, the spreadsheet skills acquired prove extremely relevant for entry level analytical jobs.

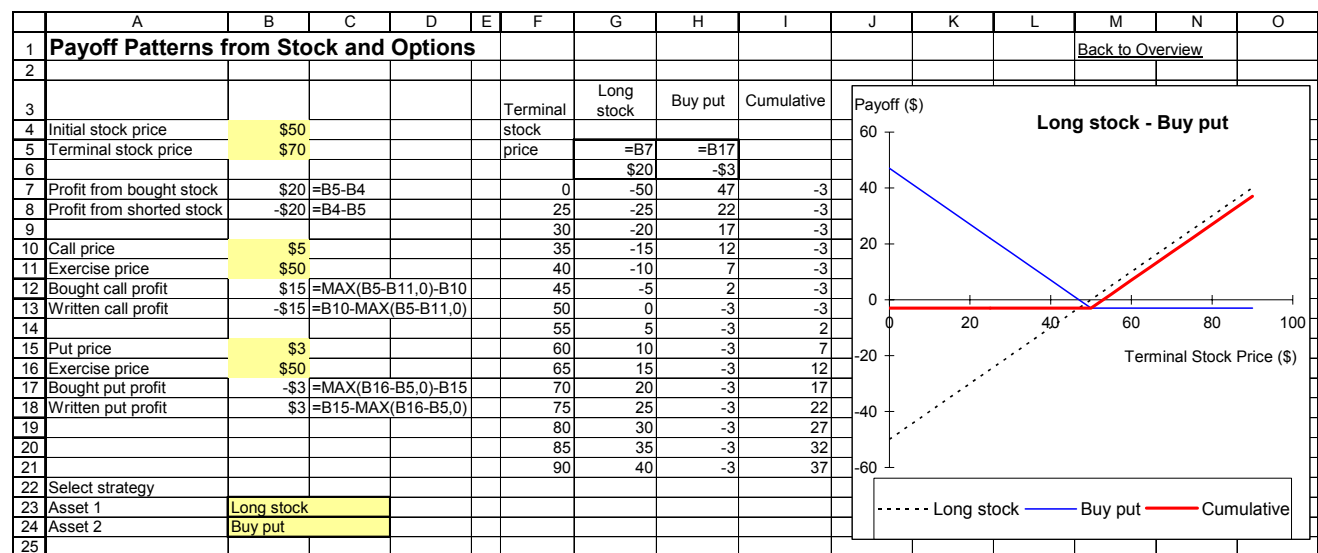
### Bringing Mathematical Formulae to Life

All major theories in finance, beginning with the time value of money concept right through to the most complex models of stochastic processes in financial markets, are inherently quantitative and require at least a basic understanding of math. Many students in business schools, including those majoring in accounting, finance or economics, often do not feel fully comfortable with algebra, even if it just involves understanding a basic annuity formula. In their article, Holden & Womack (2000) term this an "equation-phobia" that has to be overcome. Using spreadsheets, and for more advanced courses computer languages like VBA, brings life into unworldly looking formulas containing summation signs, derivatives, integrals etc. For instance, while the intuition behind the time value of money concept will be easy to grasp for most students, only its implementation on a spreadsheet by summing a series of discounted cash flows will actually provide a real understanding for many learners.

Such benefits are not purely limited to simpler concepts in finance. If one takes option theory as an example, the meaning of a Geometric Brownian Motion underlying most standard

option pricing models really only becomes clear once implemented as a discrete process on a spreadsheet. Similarly, numerical and simulation methods to price options beyond the simple European type are better understood if implemented programmatically by the student of an advanced finance course. As a simpler example, Figure 1 provides a screenshot of an instructional payoff model to become familiar with option strategies.

**Figure 1: Final solution of instructional model to practice option payoff diagram**



### Equipping Students for a Finance Job

What would be a typical job of a finance student upon graduation? They will not enter organizations as CFOs, but many will commence their career doing analytical type work. It is even safe to say that there will be no entry-level finance function nowadays that will not require the use of spreadsheets like Excel on a regular basis. While some finance professors might think teaching students spreadsheet skills to be someone else's job, in reality they will fail to equip students with the skills to do an actual finance job. In the words of Holden & Womack (2000), such a narrow

focus on pure finance is tantamount to saying "I teach financial theory. They have to figure out how to do it. Whether they really learn what they need to know to do finance is not my job". Such work skills are all the more critical as recent surveys and studies indicate that business education appears to drift away from the practitioners' view of what should be taught<sup>1</sup>.

There is another aspect that might elude instructors who have spent their careers teaching finance in academic institutions. For most financial analysis type work, the actual "finance content" in a strict academic sense is in fact fairly minimal. The very few real "finance quants" are typically recruited from science and math PhDs and the work of an "ordinary" financial analyst is in fact much less mathematical. They will spend much of their energy retrieving, rearranging, and analyzing information. In the process, they will detect missing, conflicting and erroneous data items that need cleaning and filtering. For example, identifying prospective EVAs (Economic Value Added) for a range of strategies probably requires little effort compared to retrieving and condensing the raw data from an antiquated accounting system before this analysis can even be started. Knowing how to effectively use spreadsheets, including the data handling and analysis tools that come with them is thus a key to success in this profession. This is not to say that we should convert finance and accounting classes to IT courses but if we can pass on such essential computer skills in the process of teaching, we kill two birds with one stone.

To sum this up, the successful completion of financial modeling papers has often been cited as a "door-opener" by former students. This in the sense that it provided a place on the short list for employment opportunities offered by firms keen to hire "can do" financial analysts for their team.

## EXAMPLE CONTENT OF FINANCIAL MODELING COURSES

The example financial modeling curriculum presented in this section describes the structure of two modeling papers as they are currently taught at this author's university. This not to say that one should omit modeling and spreadsheet exercises as part of traditional text-book based courses. At this university, modeling begins right with the introductory finance paper FINA201 which includes numerous and some very involved spreadsheet assignments that count towards the final grade. In a major project, students have to retrieve a personal set of securities data from a financial data base which they then use to determine returns and an index, to conduct an event study and, finally, to do a risk return analysis.

The following subsections first cover the undergraduate, respectively graduate teaching level course which is then followed by some remarks on the teaching experience in general.

### Undergraduate Financial Modeling Course

This is a dedicated fourth year financial modeling paper at an undergraduate level. Classes are held as computer lab sessions even though capacity constraints might potentially force a change of format. It is recommended that students acquire the Benninga (2000) financial modeling textbook (reviewed in Appendix 1) as a resource but the course does not follow it but rather uses proprietary models and provides students with specific handouts where required.

Table 1 below splits the topics of this course into two groups. Firstly, it shows the actual finance topics, most of which the student should have heard about in previous finance papers. Accordingly, there is usually no dedicated lecture on these topics but self-study material and optional "refresher tutorials" are offered. In this, quite a few students have commented that even though they had successfully coped with theories in earlier courses in the sense that they had been

able to answer the standard textbook questions, they only really gained an understanding after building the models themselves.

The second part of Table 1 then lists the specific spreadsheet skills — one can also call them financial analyst skills — that are to be developed. They are not taught on their own but are embedded in the solution of finance problems mentioned above.

**Table 1: FINA415 Computer Modeling in Finance: Finance & Spreadsheet Topics**

<b>Finance Topics</b>	
Company financial modeling	Practical development of proforma financial statements. Starting point are the published historical financials of a listed company Use this company model to conduct a valuation (DCF, DDM) and other types of financial analysis (e.g. EVA, credit analysis)
Time value of money problems	Modeling solutions of standard time value of money problems (e.g. project finance, lease vs. buy)
Fixed income analytics	This is a specialty topic treated in some more depth. Bond yield, duration, convexity, spreads Topics in term structure of interest modeling
Models in portfolio theory and statistics	Meaning of basic statistical parameters. Regressions applied to CAPM, APT problems. Two, respectively multi-asset portfolio optimization problems: efficient frontier, minimum variance and optimal portfolio
<b>Financial Analyst Skills</b>	
(Selection of some of the EXCEL/VBA features covered)	
Spreadsheet structuring and handling	General layout and structuring of workbooks. Freezing, splitting panes. Effective cell formatting. Print set-up. Working with several sheets. Hyperlinks for efficient navigation. Auditing/debugging spreadsheets. Automating repetitive tasks.
Analysis of financial data	Data tables. Pivot table data analysis. Data group and ungroup. Excel data analysis functions and data analysis features. Financial and statistical functions. Simple user-defined functions.
Visualization of financial data	Graphing and charting features. Effective use of drawing objects. Application of controls on forms/control toolbox toolbars.

As can be seen from Table 1, this course goes beyond simple spreadsheet modeling.

Applying the programming language VBA for repetitive tasks and some more advanced financial

functions adds another tool to the box of a proficient financial analyst. Often one spontaneous feedback from students working on larger term or thesis papers is that these newly gained skills come extremely handy for the data mining work typical in empirical research projects.

The grade assessment is based on three individual class tests and five project assignments. The tests are fully electronic. Students are given an Excel file which they have to complete in a two-hour computer lab session. At the conclusion, they use a web-based file submission facility rather than traditional floppy disks to hand in their solutions. This submission facility enables the instructor to check and track submitted work and can also be used to return marks and comments to the students.

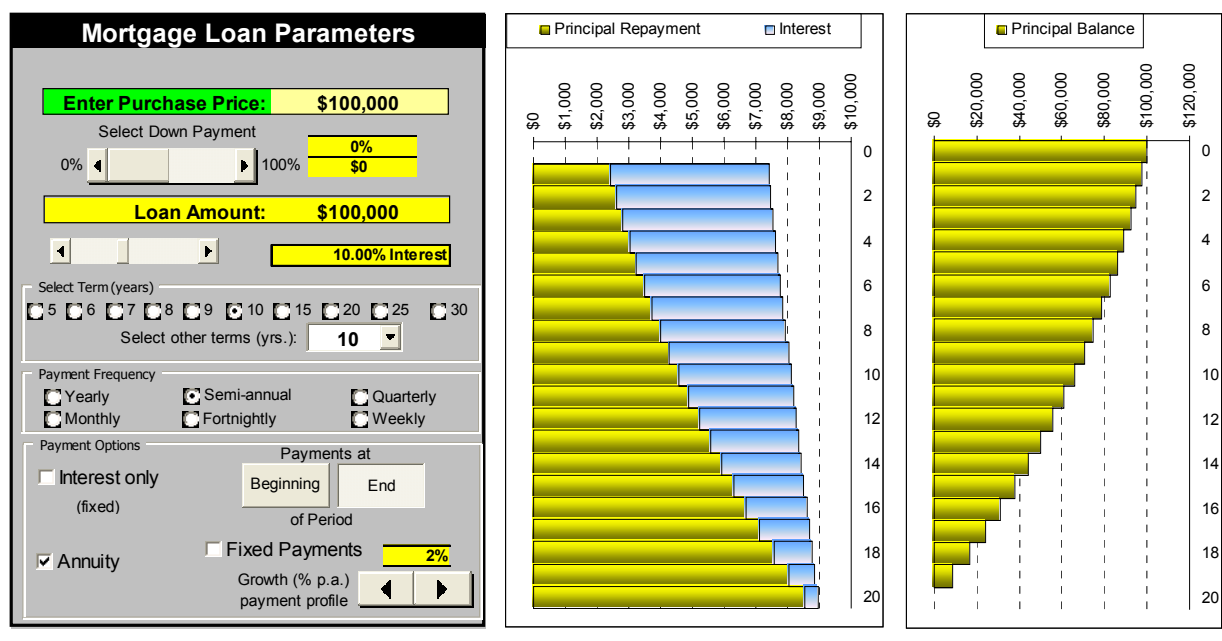
Significant components of the course are the project assignments. Their importance is highlighted by the fact that their cumulative weight for the overall course mark exceeds the weight allocated to the tests. While the tests are well defined, projects are more open-ended. This means there will generally be a minimum requirement which, if completed satisfactorily, is rewarded with a medium level mark. Beyond this, there are optional elements to the projects for which students are faced with increased complexity. Because there is a wide range of spreadsheet and also quantitative skill levels, the base requirements will typically not involve VBA programming but pure spreadsheet solutions.

Table 2 describes the topics and contents of these project assignments.

**Table 2: FINA415 Computer Modeling in Finance: Project Assignments**

Project	Description
Company valuation project	Student teams build a company valuation model (DCF method) for a listed company. They have to present their results to a key shareholder in an investment bankers “beauty contest” in order to gain an advisory mandate for the disposal of this strategic stake.
Spreadsheet automation	Short VBA program to rearrange a set of financial data to be used for further empirical analysis
Mortgage calculator	Students design an interactive mortgage calculator to advise bank clients on optimal financing solutions. The calculator in its basic version can be implemented as a spreadsheet solution but some optional features require VBA programming. Figure 2 provides a screenshot of a potential solution to this assignment.
Cash flow valuation	Project involves bootstrapping zero rates from quoted swap rates (real time data source) and the valuation of a series of cash flows. No VBA is required but some additional marks are given for VBA based functions.
Simulation of feasible portfolios	Random simulation (Monte Carlo) of a large number of feasible portfolios composed of 6 stocks to identify optimal portfolio. Visualization of results. Optional check of solution with alternative methods. Basic solution does not require VBA programming.

**Figure 2: Screenshot of potential solution for a mortgage calculator modeling project**



### Graduate Financial Modeling Course

The finance department also runs an advanced modeling paper for graduate students. It is based on skills acquired in FINA415 Computer Modeling in Finance but students with advanced spreadsheeting and/or programming skills are admitted without completing this course.

Table 3 provides an overview of topics usually covered in the course but, as can be expected from a graduate paper, students have more freedom of choosing the type of modeling problems they wish to tackle. There are a set number of smaller assignments of which the student may pick the two he feels most comfortable with. Main assessment component, however, is a larger modeling project defined by the learner himself. Unlike in the undergraduate course, there is also a choice of software tools which is not limited to Excel with VBA to complete the course work. This is in line with a stronger focus on “application for research” as opposed to “application for a finance job” in the undergraduate FINA415 course. Students can thus also use this course to familiarize themselves either with advanced econometric software or lower level computer languages like C+ which are often employed for numerical and simulation problems in finance.

**Table 3: FINA518 Advanced Financial Modeling: Selected topics covered**

Topic	Description
Forex arbitrage	Develop cross-currency foreign exchange arbitrage tool fed by real time bid/ask exchange rate data.
Options	Analysis of ASX warrants: pricing, the “Greeks”, volatility smiles etc.
Advanced programming	For reasons of performance, advanced finance models are often not programmed in Excel/VBA. Some other tools are shown that are often used (C+, Gauss, Mathematica etc.). Programming exercise with Java Script as an example of lower level language.
Simulation	Simulation of stock price paths (Brownian motion, jump diffusion). Monte Carlo simulation for option valuation. Programming exercise: replication of Longstaff & Schwartz (2001) plain vanilla American option valuation.
Numerical methods	Finite differences methods in finance and lattice models to value options, convertibles etc.
Risk Management	Value at risk models, portfolio insurance, credit risk (JP Morgan CreditMetrics)
Topics in corporate finance	Company valuation with stochastic parameters (Schwartz & Moon, 2000)

Many of the models covered in this course are inspired by the more advanced financial modeling and derivatives books, some of which are reviewed in Appendix 1. They include Wilmott (2000a; 2000b), Jackson & Staunton (2001), Haug (1997) as well as Hull (2000).

### Teaching Experience

What has been the experience teaching such modeling courses? The undergraduate FINA415 paper was first taught in 1999 and the graduate FINA518 in 2001. The comments below relate primarily to the first of these two dedicated modeling papers.

With regard to spreadsheet skills of students entering the course, these were initially overestimated which meant more time had to be spent on getting the class more familiar with MS Excel. With the introduction of spreadsheet exercises in prerequisite finance courses, these abilities have been steadily improving, however. As the course progresses, one can observe a kind of polarization among students. There is a larger group that will do fine with basic spreadsheet

handling but will touch VBA programming only as much as required. On the other hand, there are the programming aficionados that seem to spend incredible amounts of time on their projects. It does however not mean that these keen programmers in fact achieve higher marks as they often lose control of their software development. With their overly sophisticated, error prone solutions, they sometimes find it hard to satisfy even the basic requirements of an assignment.

Too much time spent with spreadsheets also means that the students at times lose sight of the purpose of financial models. An example would be the company modeling and valuation exercise for a listed company. A small report and a presentation are important components of this project and consequently less than 50% of the marks are in fact assigned to the valuation model itself. It must nevertheless be suspected that students spend close to 90% of their time on the model itself. They forget that any model only has value if its results are also communicated well to an interested user, respectively client. This means successful financial modelers must also be sound communicators who are able to explain results found in an intuitive way. In particular, they must know how to employ a language understood by the decision-makers and not just by fellow finance wizards.

With so much energy and time going into spreadsheet modeling, it is sometimes a challenge to actually preserve the course as a finance paper. This is best achieved by applying the modeling to examples of the real finance world. Students must be able to relate to the usefulness of an application. The design of a mortgage calculator shown in Figure 2, for instance, provokes an incredible diversity of most creative and innovative solutions.

As a final note, one can observe that some students find it particularly hard to meet due dates in a modeling course. In other courses they might be able to finish that important report in the night before the due date. Not so in this modeling course. If stuck with a software problem at 2am in the morning on the day the model is due, the student will find little help.

On the whole, the teaching of such modeling papers has been a very gratifying experience and demand has been exceeding the lab space available. Students are highly motivated as they realize the meaning and application of what is taught. This is reflected in regularly very positive course evaluations. One open question in the evaluation form asks how students would characterize this course to a friend and the term “useful” is a consistent top response.

## CONCLUSION

In the areas of finance and accounting, an important technological advancement has been the development of spreadsheet software programs such as Excel. Freshly minted business school graduates are expected to possess a fundamental knowledge of spreadsheets because these programs enable users to conduct financial analysis in an efficient and sophisticated manner. In teaching finance and accounting such spreadsheet software provides an excellent tool for understanding the computational intricacies involved in financial modeling. By integrating spreadsheet modeling into the teaching of finance and accounting, one will actually achieve two goals at once: students find it easier to understand finance concepts and become more employable as they pick up valuable real-world skills.

In light of such benefits, it is no surprise that numerous books on financial modeling have been published, some of which are presented in Appendix 1 of this paper. Moreover, many finance and accounting texts are now accompanied by some kind of spreadsheet exercise and the financial calculator, once the standard tool of the financial analyst, is increasingly replaced by spreadsheet-based analysis packages. Based on practical experience, this article recommends the inclusion of spreadsheet exercises as well as dedicated financial and accounting modeling classes into the

curriculum. This should start at the introductory finance course and students can then acquire advanced modeling skills in dedicated courses at an undergraduate and graduate level. Based on this author's experience, there is great demand for these courses as the business world looks for graduates who "can do the job". This will further strengthen the role of modeling in teaching business students.

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## TEACHING RESOURCES FOR MODELING IN FINANCE AND ACCOUNTING

This appendix lists and briefly reviews some of the resources for teaching spreadsheet modeling in finance and accounting. It is by no means complete as there are innumerable books available that deal with this issue in one way or another. For more details on the publications discussed below, refer to the references section of this article. The resources are classed into the following categories:

- Finance textbooks with spreadsheet examples
- Simple spreadsheet modeling books to accompany finance and accounting texts
- Dedicated financial modeling books using spreadsheets and VBA macros
- Spreadsheet (Excel/VBA) resources with limited or no specific finance or accounting content

### Finance textbooks with spreadsheet examples

The overview starts with two examples of standard finance textbooks, most of which now include spreadsheet modeling exercises. There are many more as Holden & Womack (2000) find in their survey<sup>2</sup> on spreadsheet modeling exercises that are either part of a primary textbook or provided as a supplement on an accompanying CD or on a dedicated website.

Aswath Damodaran specializes in corporate finance textbooks. An example would be his "Corporate Finance Theory and Practice" (Damodaran, 2001) where the author provides the student with a great number of spreadsheet templates such as models to determine the optimal financing mix or for valuing firms. These spreadsheets can be freely downloaded from the author's

website (Damodaran, 2004). While his sample models are generally very useful, they often contain so many parameters that it takes some time to ascertain which ones actually affect the model output. Admittedly, the process of exploring the dynamics of such an open-code template can be a valuable learning experience by itself but on the other hand, it does not provide guidance how such models should be developed.

Bodie, Kane & Markus (2002) are authors of "Investments", one of the leading textbooks in the field. With the fifth edition they provide students with a small number of Excel spreadsheet applications that help them explore the topics covered. Again, they are downloadable from a website (Bodie, Kane, & Marcus, 2004) and usually involve little assignments to be completed by the learner.

#### Simple spreadsheet modeling books to accompany finance and accounting texts

The aim of such books can typically be summarized as follows: "Pick up the spreadsheet skills to implement some of the models and concepts introduced in a major finance or accounting textbooks" As such they are not stand-alone textbooks and one will need to obtain the theory from another source. They are all based on Excel, the most popular software package, but refrain from venturing into VBA programming. Particularly Holden (2002a; 2002b) nonetheless illustrates how one can push the envelope of pure spreadsheet-based models. The best resource in this category would indeed be the Holden (2002a; 2002b) spreadsheet modeling books for corporate finance and investments. Versions are adapted to accompany leading undergraduate texts in these fields. He does not simply present models but provides starting sheets which are then used by the students to work out solutions.

Hovey's *Spreadsheet Modelling in Corporate Finance* (Hovey, 2002) covers concepts in finance in a very general way. In our assessment however, both the finance content is quite basic

and spreadsheet topics do not go beyond showing some standard features, mainly finance functions which might just as well be picked up from help screens. Accordingly, there are innumerable screenshots of the Excel function wizard and dialogues which add limited value. Similarly, one skill not developed in this book is, for instance, the translation of a given algebraic formula into a spreadsheet formula. This “translation” skill is essential for implementing most financial models.

Smith, Smith, & Smith (2003a; 2003b) are authors of two spreadsheet textbooks for the area of management and cost accounting. The Excel examples are very basic and it does not cover many advanced spreadsheet features useful for the accounting specialist. Accordingly, it clearly caters to introductory level courses.

#### Dedicated financial modeling books using spreadsheets and VBA macros

There are a number of specialized financial modeling books available. With the exception of the Benninga (2000) book discussed below, financial modeling there is usually understood as “financial modeling for quantitative finance and economics”. As such, these books often cater to graduate students in view of their academic research or to the comparably small number of quantitative analysts employed by financial institution. These books generally require a solid quantitative foundation to be fully appreciated. Of these the Jackson & Staunton (2001) and Willmott (2000a; 2000b) books are reviewed here. One must also realize that using Excel and VBA for such advanced models is stretching the limits of Excel meaning advanced models often require mathematical or statistical tools not available in Excel/VBA. but need either special add-ins or are better constructed using specialized mathematical software like Gauss, Matematica or Matlab. Having said this, performance is typically no longer a limiting factor, particularly not in a learning and research environment. This is why Excel/VBA have strong edge compared to compiled lower

level compiled programming languages like C+ or Fortran which require expert programming skills but obviously run much faster in productive applications.

The most useful of these would certainly be Benninga's widely used textbook "Financial Modeling" (Benninga & Czaczkas, 2000). We consider this as one of the most comprehensive resource on spreadsheet modeling for both advanced undergraduate and graduate level finance. Benninga presents a large number of financial models and shows how they can be solved, respectively simulated using Excel and VBA. Benninga is currently preparing a tuned-down version of a modeling book, omitting the use of VBA. This book "Principles of Finance with Excel" (Benninga, 2004) will be published soon with preview copies can be found on the author's web site.

Jackson & Staunton (2001) are authors of "Advanced modelling in finance using Excel and VBA". The book has been compiled from material developed for modeling courses at various leading European business schools which becomes apparent in a certain lack of structure. Having said this, the book shows how to implement a great number of advanced finance models and is thus be most suitable for a graduate level course. It also includes a primer on VBA but the reader will certainly need another resource to become familiar with this programming language.

One could describe Paul Wilmott almost as a cult author. Titles of his two more recent books on quantitative finance include his personal name like the two volume advanced version "Paul Wilmott on Quantitative Finance" (Wilmott, 2000b) or the smaller teaching version "Paul Wilmott Introduces Quantitative Finance" (Wilmott, 2000a). His company operates an extensive website that includes forums where finance quants discuss most advanced modeling and programming problems. His books are not on financial modeling per se but they use Excel and sometimes VBA code fragments to illustrate complex concepts and numerical methods, mostly from the world of financial derivatives.

Spreadsheet (Excel/VBA) resources with limited or no specific finance or accounting content

There are many pure Excel books in the market. This is no surprise as this spreadsheet package would probably be the most widely used application software not considering MS Word. We just list a few resources.

John Walkenbach's "Power Programming with Excel 2002" must be considered as the currently leading pure Excel/VBA resource in the market (Walkenbach, 2001). It is however too comprehensive and more a computer manual than a teaching Excel/VBA book.

Albright's "VBA for Modelers - Developing Decision Support Systems with MS Excel" (Albright, 2001) is not an Excel resource per se but he shows applications of VBA and MS Excel for applications in operations research.

Fulford's "The Accountants Guide to Advanced Excel" (Fulford, 1999) is listed in this category because it does not really have an accounting content as one would infer from the title. The book provides rather basic examples and claims to cover VBA but this involves mainly controls (spinners etc.) from the control toolbox as well as some recorded macros.

Read & Batson's "Spreadsheet Modelling Best Practice" (Read & Batson, 1999) is a useful book or better brochure published by auditing firm PriceWaterhouseCoopers. It gives valuable hints on how to design and build spreadsheet models, particularly in a corporate finance and accounting environment.

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ENDNOTES

<sup>1</sup> See for example Tan, Fowler, & Hawkes (2004) for the field of management accounting or Fitzgerald (2003) for the MIS areas. Moreover, Starkey & Madan (2001) discuss the relevance gap of management research in more general terms.

<sup>2</sup> See website address given in Holden (2004) for more details.