THE USE OF SPREADSHEET MODELLING IN THE TEACHING OF CORPORATE FINANCE

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Abstract

The use of spreadsheets and computer simulations using programs such as Excel has become pervasive in practice. Although the use of spreadsheets and computer simulation are relevant in the teaching of corporate finance, research on the use of spreadsheets has tended to focus on the teaching of financial accounting and management accounting. Yet, the use of spreadsheets and financial modelling in the teaching of finance has grown due to the perceived educational benefits as well as the demand by business that students should develop skills to enable them to undertake corporate finance applications rather than simply understand corporate finance theory. The introduction of spreadsheet models will enhance the students' ability to apply corporate finance theory to real world applications.

Introduction

The objectives of this paper are to document and set out why spreadsheet modelling is valuable to the learning process and to explore the tools in Excel that can be used in "what-if" analysis. We address some key issues relating to spreadsheet design, documentation and minimising spreadsheet errors, which are often overlooked when spreadsheet models are used in an educational setting. We consider that Excel can be used to support student understanding of the key concepts in finance. Spreadsheets may also enable students to see beyond the formulae and understand some of the more complex and quantitative aspects of corporate finance. We submit that spreadsheet modelling can be employed in a corporate finance course to enable students not only to apply financial theory but more importantly to bring financial concepts to life. The focus should be on spreadsheets and technology enabling the learning process, particularly in relation to the use of case studies and business simulations in the teaching of corporate finance.

The Role of Spreadsheet Modelling in the Learning Process

Coldwell and Rose (2006) state that one of the main challenges facing educators seeking to enhance learning, as well as practitioner and student satisfaction, is to create opportunities for students to apply financial concepts and theory to real world cases. Bennis and O'Toole (2005) argue that business education has been preoccupied with imparting theory and concepts rather than practical skills which would enable students to be successful business professionals. According to Albrecht and Sack (2000) educational models focus excessively on content at the expense of skill development. Marriott (2004) argues that if students wish to learn spreadsheets because proficiency in financial modelling will enhance their skills and job opportunities, then educators should facilitate the use of spreadsheets in the classroom.

Brooks and Oliver (2004) introduced a new course designed to combine management accounting concepts and technology. The technology component emphasized spreadsheet design and communication. The use of cases studies ensured that the curriculum was relevant and simulated "real life" situations. This enhanced the relevance of the course. It also enabled the educators to change their role to facilitators rather than instructors as the students took on a greater responsibility for their own learning (Brooks & Oliver, 2004).

In the pedagogical literature, this is often termed as 'constructivism' as students take responsibility for the learning process and become autonomous and independent. The lecturer is no longer the sole authority but acts rather as a facilitator, a guide, supporting learners in the process of constructing knowledge (Neo, Neo, & Tai, 2007). Students develop important thinking and problem solving skills and acquire the skills required to work in a team. Experiential learning leads to the enhancement of their knowledge base and the ability to learn how to learn. David Kolb is often regarded as the founder of experiential learning and with Roger Fry, set out a learning cycle which included four elements: concrete experience, observation and reflection, the formation of abstract concepts and testing in new situations (Kolb & Fry, 1975). Learning involves the use of concrete experience to test ideas. Technology is a critical component of the learning process (Neo, Neo, & Tai, 2007). Information and communications technologies can be used to support experiential learning environments (Di Challis & Rice, 2005).

Brooks and Oliver (2004) reported a continual improvement in skills and confidence over the course of the unit and an improved ability by students to deal with problem solving situations.

In the Masters of Financial Management programme at the University of Cape Town (UCT), we use Bruner (2007) which contains real world cases involving mostly well known companies facing corporate finance decisions. The focus is on decision making. These case studies are lengthy and extensive, involving advanced data analysis. Technology enables "learning by doing" and it is not possible to undertake a relevant case study mode of education in corporate finance without students acquiring financial modelling skills. Spreadsheets enable the teaching of corporate finance using the case study approach.

At UCT, financial modelling is integrated within the programme and each case study requires students to apply financial modelling in Excel such as preparing pro forma financial statements and cash flows and applying Excel tools such as Goalseek, Data Tables, Scenario Manager, Monte Carlo Simulation, Financial functions and specific add-ins and add-ons. These follow a building block approach which is integrated with specific cases. For example, in analysing the prospects of a new drug in the pharmaceutical/biotech sector, students will be required to undertake a Monte Carlo Simulation in Excel as well as using CrystalBall™. At UCT, the combination of using Excel financial modelling skills and the case study approach results in a significant improvement in the ability of students to deal with complex business situations and apply advanced spreadsheet modelling skills.

The effectiveness of the learning model is reflected in extremely positive student evaluations at the end of the first year of the programme.[1] It is also true that students experience difficulties in the first 3 months of the programme as they come to terms with the new learning model.[2] The focus is on applied corporate finance and financial decision making. However, there is a need to ensure that students do not become model centric. The course is focused on financial decision making and that the focus is on industry and strategic analysis, financial analysis and valuations. Spreadsheet and financial modelling is only a part of the process of getting to a decision. Solutions are sometimes hard to pin down as there are alternative courses of action. There may not be one solution but there is one decision.

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[1] Students in course evaluations often state that the case study method is the most positive aspect of the course.

[2] Difficulties to overcome include the integrated nature of cases which deal with strategic and industry issues, and often include a number of corporate finance topics in a single case, the length of cases, the financial modelling requirements and the focus on reaching a decision rather than a solution.

The setting of spreadsheet modelling as only part of the process of solving a case study in corporate finance is consistent with the experience of Marriott (2004) who employed spreadsheet modelling as a key component in a course requiring students to deal with business simulations. Marriott (2004) states that students were required to use the information set out in the introduction to the business simulation to prepare a spreadsheet model to produce financial forecasts for a business plan. The spreadsheet model was required to be placed in a practical setting but is secondary to the main purpose of the assessment which is to prepare a business plan. In relation to the use of computerised business simulations, Marriott states that "it presents an opportunity for students to develop algorithmic thinking, to use spreadsheet-modelling skills in a realistic setting, to enhance cognition in understanding the 'whole' of a business problem, and to reduce instrumentality through the intrinsic enjoyment of problem-based learning" (Marriott, 2004, p.55).

The use of business simulations achieves learning objectives from acquiring computer modelling skills to students acquiring a wider and deeper understanding of the financial management of companies. Marriott (2004) sees computer modelling skills as part of experiential learning which requires active involvement by students. Although computer simulation and a case study forms the focus of student learning, it is also true that spreadsheet modelling enables and facilitates the use of case studies and business simulations. It may be argued that without spreadsheet modelling, that the use of case studies in corporate finance would be difficult to implement. Holden and Womack (2000) contrast spreadsheet modelling to the use of spreadsheet templates and state that templates can become "black boxes" if students do not build the equations or graphs. Templates represent passive learning whilst spreadsheet modelling represents active learning.

Spreadsheets and Mathematical Equations

Holden and Womack (2000) state that spreadsheet modelling enables students to overcome "equation phobia" as spreadsheets enable the use of equations in non-equation form. Time lines and graphs can be effective alternatives to mathematical equations. However, financial modelling, in contrast to using Excel templates, may require students to build formulae or relationships between variables.

Spreadsheets can break down barriers that students have when trying to learn formulae with summation signs, integrals and other notations. Time value of money problems are more easily understood by students once the cash flows are set out in a spreadsheet format. The use of formulae may represent "short-cuts" to solving business problems but may result in complex equations to relatively

simple problems. For example, let's evaluate the case of a growing annuity which requires us to apply the following formula:

$$\text{PV of a Growing Annuity} = \text{PMT}\,(1+g)\left\{\left[\frac{1-\frac{(1+g)^n}{(1+r)^n}}{r-g}\right]\right\} \quad \text{(Formula 1.1)}$$

Students often find Formula 1.1 rather challenging, and yet Formula 1.1 refers to a conceptually simple time value of money problem if we set out the example in a spreadsheet form. Assume that the required return is 9% and the annuity growth rate is 6% per year for 10 years. The first payment is $45 000 (1+0.06). The cash flows of this growing annuity are depicted in Figure 1 over a timeline of 10 years.

Figure 1: The Present Value of a Growing Annuity

	0	1	2	3	4	5	6	7	8	9	10
Annuity	45 000	47 700	50 562	53 596	56 811	60 220	63 833	67 663	71 723	76 027	80 588
Present Value	387 207										

Students are required to increase each year's annuity by 6% to determine the cash flow for the following year and use the NPV function in Excel to determine the Present Value of the future growing annuity. Conceptually, this is much easier to understand and "see through" than the formula for a growing annuity.

Before the widespread use of spreadsheets, the use of a formula represented a practical short-cut to manually setting out the cash flows over the next 10 years. As we indicate to students, doing it the long way in Excel only takes seconds to achieve. Essentially, doing it the long way is not what it used to be. The use of a formula may not be a short cut to a solution after all and may create an impediment to the understanding of financial concepts. Although the use of spreadsheet models can play a pivotal role in the teaching of corporate finance, we find that there is little attention by educators to spreadsheet design, documentation and minimising the potential for spreadsheet errors.

The Design and Layout of Financial Models

The flexibility of Excel enables financial analysts, accountants and practitioners to create and design applications to solve advanced business problems. Yet, this flexibility and simplicity will often lead users to ignore important design

considerations in setting up their models. This may lead to poor documentation standards and more importantly may lead to significant errors. Setting documentation standards enables users of the model to understand the how the model works. We consider three, often interrelated, issues of *design and layout*, *documentation*, and *avoidance of errors* to be crucial in setting up a financial model.

In a corporate finance course that uses spreadsheet models, students should be made aware of the importance of design and layout principles, inserting appropriate documentation within the model and always being conscious of the potential for errors. The design and layout of the financial model will assist in minimising errors but is not a sufficient condition for avoiding most errors. Examples of poor design, poor documentation and errors in spreadsheets are often very effective in conveying to students the need for adhering to good practice in relation to designing and building financial models. The integrity of a financial model, the ability to maintain a model as circumstances change and the ability to undertake "what-if" analysis is critical to in setting up any model.

There has been a significant increase in the number of corporate finance textbooks that include Excel spreadsheets. Unfortunately, textbooks often do not adhere to layouts that will enhance the ability for students to undertake sensitivity or "what-if" analysis. Instructors that use Bruner's otherwise excellent case book (Bruner, 2007), might be expected to attest to the poor design of many of the Excel models found in the solutions.

It is important that even at the undergraduate level, students adhere to good design and layout methods in setting up a financial model. For example, in setting a simple capital budgeting example, students should be exposed to the proper methods of design and layout even if this increases the time required to complete a simple model.

The layout of a spreadsheet model should follow certain principles depending on the application.

- Inputs. There should be a separate section for inputs. All formulae should refer to this section for data values. Data values should not be included in formulae and input data values should be colour coded.

- Outputs/Results. The results of the financial model should be placed in a separate section that is close to the Input section, therefore enabling changes to inputs to be analysed immediately in terms of the effect on the results.

- Calculations section. In a capital budgeting or valuation application, this section depicts the cash flows per section. In Capital budgeting applications, tax calculations should form a separate section and in a valuation case, inputs may be related to each period. This section should only consist of formulae linked to values in the input section. Data values should not be embedded in any cells of this part of the section — it should consist only of references to the input section.

- Sensitivity or "What if" analysis section. The use of data tables in Excel or tornado graphs as well as Scenario Manager Tool can be useful to depict potential changes in results to changes in inputs.

- Workings section. Workings are an important part of the spreadsheet design. Workings should be referenced and will enable preparers to reduce the complexity of formulae used in the main section of the spreadsheet.

Individual applications will require adjustments to this layout of a financial model, particularly for valuation models which will include projected financial statements as well as free cash flows, financing flows and projected financial ratios. The separation of inputs, calculations and results is useful and is often applied in valuations and capital budgeting applications. It also optimises the functionality of Excel. However the insertion and particularly the deletion of columns can create risks for maintaining the integrity of the model and this should be balanced against the ease of moving from one section to another section of the spreadsheet.

A cascade approach to spreadsheet design will enable the deletion and insertion of columns without this impacting on other parts of the financial model, but will make it more difficult to move around the spreadsheet model. However, the allocation of range names to sections of the model, which can be set out in a separate reference section, will enable users to move around quickly in within a spreadsheet model. Although, the cascade approach may have advantages, its use is limited in practice as practitioners use separate worksheets within a workbook to manage the different sections of a financial model.

Formulae within a spreadsheet should not include both numbers and cell references within the same formula. A cell formula should only include references to the values in the input section. This will facilitate undertaking "what if" analysis as well as making changes to variables that will apply across the model. For example, the corporate tax rate will be located in the input section and formulae in the spreadsheet requiring the inclusion of the tax rate will refer to a single cell in the input section. If the corporate tax rate changes, this will enable the model to

implement the effect of a change to the tax rate throughout the model and will minimise possible errors where there are multiple inputs.

Avoiding Spreadsheet Errors

Although spreadsheets are extensively used in practice, it has been found that most financial models have errors. Janvrin (2008) offers the example of a mutual fund that was required to change the distribution from $4.32 to $0.00 per share due to an analyst omitting to insert the minus sign in reporting a $1.2 billion capital loss when completing the distribution spreadsheet.

Janvrin (2008) refers to studies that indicate that 20 percent to 80 percent of all operational spreadsheets contain errors. A financial model review by KPMG (1997) confirmed the frequency and seriousness of spreadsheet errors. Their report states that in 95% of the financial models reviewed, at least five errors were found.

Beaman, Waldman and Krueger (2005) undertook a survey of accounting students who were required to undertake a spreadsheet exercise. The study found that quantitative and spreadsheet design errors were widespread but were reduced significantly after a semester of teaching spreadsheet design principles. Beaman et al. conclude that educators should include a course in spreadsheet design principles and problem-solving techniques as part of an undergraduate accounting program.

It is important that students should be exposed to good design principles for setting up spreadsheet models which will minimise the potential for quantitative and qualitative errors. Understanding the nature of spreadsheet errors may lead to a significant reduction in spreadsheet errors. Spreadsheet errors have been divided into two different types — quantitative and qualitative errors (Panko & Halverson, 1996; Teo & Tan, 1999).

Qualitative errors arise mainly from poor spreadsheet design (Beaman et al., 2005). Although qualitative errors may not result in immediate “errors” in results, they increase the potential for errors once a user applies “what-if analysis” or changes variables when circumstances change. Qualitative errors are indicated by the following attributes:

- Lack of separation of inputs, calculations and results.
- Data embedded in formulae in different parts of the spreadsheet, particularly data that may be subject to change. It is not practical to change data in formulae when a user wishes to undertake “what-if”

analysis. It is much easier to simply change data values in the input section of a spreadsheet.

- Data that is placed irregularly and haphazardly across a model which makes it difficult to keep track of input values.

- Complex formulae within cells. Whilst it may not be possible to avoid complexity in relation to the use of functions, formulae should be simplified as much as possible, by for example, creating separate intermediate calculations in separate parts of the worksheet. A complex formula increases the potential for error if changes need to be made to a formula at a later stage.

- No documentation or poor explanatory notes. Use a separate worksheet to explain the parameters and objectives of the model. Use the cell comments facility in Excel to explain a cell's data or formula. Use version numbers, author information and use names for cells.

- Unprotected worksheet. It is recommended that formulae should be protected to avoid accidental overwriting.

- Data validation. It is possible to set limits to data inputs. For example, a discount rate may be limited to a feasible range of between 4% and 40%. An error alert will mean that you cannot proceed unless a user complies with the validation terms. Combo boxes can also be used to limit the possible changes made to a model's input values.

The following is a formula in a single cell from a spreadsheet to one of Bruner (1999)[3] case study Excel spreadsheets.

```
=(('Exh. 11'!F10*'Exh. 11'!G10)+('Exh. 11'!F11*'Exh. 11'!G11)+('Exh. 11'!F12*'Exh. 11'!G12)+('Exh. 11'!F14*'Exh. 11'!G14)+('Exh. 11'!F15*'Exh. 11'!G15)+('Exh. 11'!F16*'Exh. 11'!G16)+('Exh. 11'!F17*'Exh. 11'!G17)+('Exh. 11'!F18*'Exh. 11'!G18)+('Exh. 11'!F19*'Exh. 11'!G19)+('Exh. 11'!F20*'Exh. 11'!G20)+('Exh. 11'!F21*'Exh. 11'!G21)+('Exh. 11'!F22*'Exh. 11'!G22)+('Exh. 11'!F23*'Exh. 11'!G23)+('Exh. 11'!F24*'Exh. 11'!G24)+('Exh. 11'!F25*'Exh. 11'!G25)+('Exh. 11'!F26*'Exh. 11'!G26)+('Exh. 11'!F31*'Exh. 11'!G31)+('Exh. 11'!F32*'Exh. 11'!G32)+('Exh. 11'!F33*'Exh. 11'!G33)+('Exh. 11'!F35*'Exh. 11'!G35))/1000
```

[3] Calaveras Vineyards Case Study — see Exhibit 7 of the Student Spreadsheet supplement.

This demonstrates clearly how formulae should *not* be set out in a spreadsheet model. Quantitative errors result in incorrect bottom line values (Panko & Halverson, 1996). Calculations are incorrect and input values may be incorrect. Quantitative errors have been further categorised by Panko and Halverson (1996) into three major types:

- Mechanical or accidental errors such as mistyping a number or pointing to the wrong cell when setting up a reference or formula. Errors may occur when a user or developer accidentally alters a formula or value or uses an existing model as the base for a new model but forgets to update all formulae and carries over information from a prior model.

- Logic errors which reflect errors in formulae due to poor reasoning skills.

- Omission errors which reflect errors arising from data or inputs that are missing but should have been included in the analysis. These type of errors may be difficult to detect in a complex model.

The use of Excel may itself prove a barrier to an accurate solution. Further the particular rules of Excel need to be understood to ensure accuracy and reduce the potential for errors. For example, applying the NPV function[4] will result in the discounting of any range of cells even if period zero has been included within the range. Another example relates to the insertion of the last row prior to the summation row whose value may not be included in the total. However, this has now been fixed in Excel2007. Statistical functions may not be accurate although Excel2007 has improved things in this areas well.

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[4] The NPV function in Excel can be used to determine the present value of a future series of cash flows. Although termed as Net Present Value (NPV), the function assumes that the first cash flow occurs in one period's time. We need to make adjustments to determine the NPV if the first cash flow occurs at time zero.

The Use of Spreadsheet Models in Teaching Corporate Finance

It is paramount to recognise that finance graduates as financial analysts, brokers, accountants, and CFOs will be employing spreadsheet modelling as a core component of the requirements of the job and spreadsheet models will often be used as decision supports. It is critical that if students are required to use spreadsheet models in corporate finance, then students should be exposed to the principles of good design and be taught how to avoid the potential for errors. Students should be required to go through the following steps in the construction of spreadsheet models in corporate finance:

Students should be required to write up the objectives, reports and explain the design criteria. It is recommended that, as far as possible, financial modelling should be integrated into the corporate finance course. This will be facilitated at the post-graduate level, yet at the undergraduate level, students should be required to undertake a project in Excel which requires students to follow good practice in setting up financial models. Separate sections should be used for inputs, calculations and results. These may be set up in separate spreadsheets but we encourage the use of a single worksheet to facilitate the audit of the model using the audit toolbar which cannot easily move from one worksheet to the other. Students should be exposed to the type of errors found in Excel spreadsheets and the tools to minimise errors such as data validation and balancing totals.

Further, students should be exposed to the extent of errors found in practice and possible impacts on financial decision making. The importance of testing is paramount, particularly stress testing where we employ extreme values for input variables to ensure that the model works and results in credible results.

The use of tools such as the auditing toolbar and named ranges are useful. Students should construct models with view that maintainability and “what-if” analysis is critical. This will promote avoiding the use of hard coded cells and formulae with embedded data values. Students should be exposed to the importance of documentation in setting up a model and students should be required to protect cell formulae as well as use data validation. Spreadsheets are effective at displaying timelines and lecturers should use the spreadsheet format to explain most concepts in finance.

Setting documentation standards, good design practice at an early stage of the course will facilitate the ability of lecturers to grade financial models at a later stage. The reality is that spreadsheet models are easy to prepare and hard to verify.

The Application of "What-if" Analysis in Excel

A key objective of a spreadsheet model is to undertake "what-if" analysis. Students should be exposed to the following Excel functions that will enhance the ability of a financial model to perform what-if analysis:

- **Form Controls** — the use of combo boxes, scroll bars and spin buttons can assist in quickly analysing the impact of changes in key variables on the result. The use of the **Offset** function can also be useful to minimise errors when doing what-if analysis on key variables and this may be combined with the dynamic graphical abilities of Excel.

- **Data Tables** are very useful to depict possible results, like the NPVs of a project, for a range of varying values of a key input variable. Using a Data Table, we can for example display the NPVs for a range of discount rates or we can display the values of a company for a range of WACCs and terminal growth rates.

- The **Scenario Manager** facility in Excel enables setting out a number of possible scenarios — combinations of input variables that may include worst case and best case scenarios. This may require some hard coding of input variables (due to the limitations of Excel) and often is undertaken as a separate exercise within a model.

- The use of a **Tornado Graph** is very effective at displaying the relative impact of a change of in an input variable on the final result. This may be modelled within Excel or it is possible to employ an add-in to Excel.

- **Goalseek** is a very effective tool in Excel which works backward from a result to change an input variable. For example, assume you have estimated a future share price and determined based on this price and future dividend flows that the IRR is 10%. Using Goalseek, we can ask the model to work out the future share price so that a target IRR of 25% is achieved.

- **Solver** which is an Excel add-in is an optimisation tool which enables input variables to be changed subject to specified constraints so that the target NPV is achieved.

- **Monte Carlo Simulation** may be set up in Excel by setting up a capital budgeting with simulations by for example employing the =RAND() function. It is however preferable to use an add-on program such at Crystal Ball or @RISK to perform detailed Monte Carlo Simulations.

We submit that finance graduates will be using many of these functions in practice as supports to financial decision making once they commence employment and it is possible to integrate the use of these functions within the corporate finance course. In Annexure 1, we have set out examples of using Scenario Manager in Excel, a Tornado Graph for indicating relative sensitivities for the same example and a Monte Carlo simulation histogram and cumulative probability graph. Although, corporate finance textbooks are starting to use Excel spreadsheets, the use of these "what-if" tools is limited. However, Correia et al. (2005) and Correia et al. (2007) do make use of Scenario Manager, Data Tables, and Monte Carlo Simulation. Then there are the specialised textbooks such as Benninga (2008) on financial modelling.

Topics in Corporate Finance

In relation to the content of a corporate finance course, topics such as Time Value of Money, Risk and Return, Capital Budgeting and Valuations are particularly well suited for the use of spreadsheet modelling. In practice, the use of spreadsheet modelling is pervasive in the areas of capital budgeting, leasing, valuations, financial analysis and option pricing. The teaching of corporate finance should include spreadsheet modelling particularly in these areas of a corporate finance course. Further, it is submitted that spreadsheet models are highly effective in explaining finance concepts. Understanding portfolio theory and efficient frontiers is facilitated by the use of an Excel model. The use of Regression and scatter graphs may explain the use of betas and CAPM. Explaining how IRR and YTM work and the effect of the implied reinvestment assumption when using IRR for decision is facilitated through the use of a simplified model. Our experience in teaching finance, particularly to accounting students, is that they understand the numbers and we use this background to translate numbers into graphs and to improve the understanding of corporate finance concepts. This applies when we depict option pay-off structures. We stress test Excel option pricing models in front of the class in order to explain how option pricing works. When we explain that owning a deep-in-the-money option is like owning a share, understanding this is facilitated by doing the numbers in Excel. We ask students to apply a discrete process but stretch this in order to facilitate the understanding of continuous

discounting. Students are required to build a simplified binomial option pricing model (although this leads to inaccurate results) so that they understand the process of option pricing models. We then expand this by using a more complex binomial model in Excel. Students are also required to use the ASX binomial option pricing model. In Annexure 2, we have set in greater detail how we use Excel in the teaching of a corporate finance course.

Conclusion

Spreadsheet modelling represents "learning by doing" and may empower students to take charge of the learning process. This is particularly relevant when spreadsheet modelling is integrated within the corporate finance course and is used in case studies or business simulations. Spreadsheet modelling often enables the use of case studies in the learning of corporate finance. Further, financial modelling skills are important for the employment of finance graduates and finance and accounting job advertisements often specify that applicants should have strong Excel skills. Although the flexibility of spreadsheet models is powerful, and its use is pervasive, spreadsheet errors are widespread. If students are to use spreadsheet models in learning corporate finance, then good design practices and how to minimise the potential for errors should be part of the learning process.

Spreadsheet modelling should be integrated within the corporate finance course and the powerful "what-if" tools in Excel should form a key component in the teaching of capital budgeting, risk analysis and valuations. The application of spreadsheet models particularly to such areas as portfolio theory, time value of money, capital budgeting and option pricing can facilitate the understanding of some complex financial concepts. However, spreadsheet modelling should be an enabler and students should not become model centric. The objective is financial decision making and the use of spreadsheet modelling is only an, albeit important, decision support.

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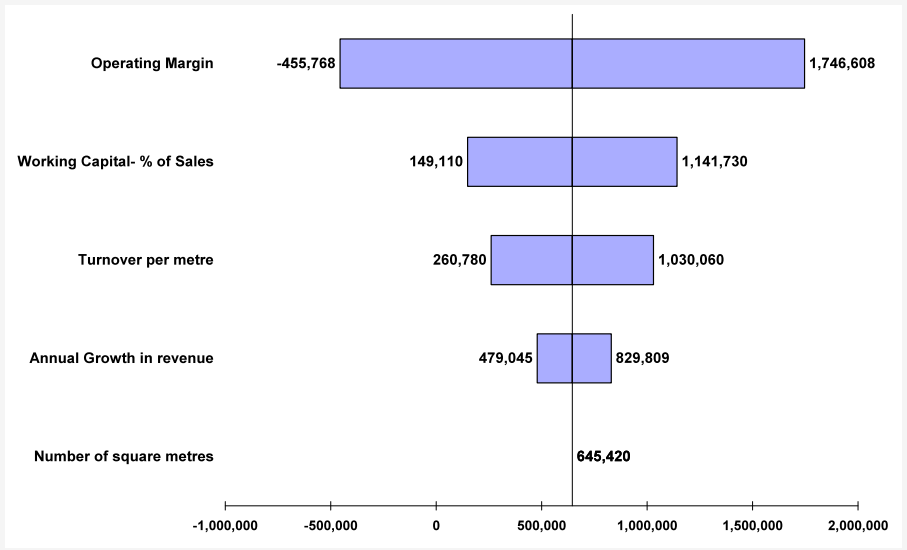
Annexure 1 Examples of Scenario Manager, Tornado Graph and Monte Carlo Simulation

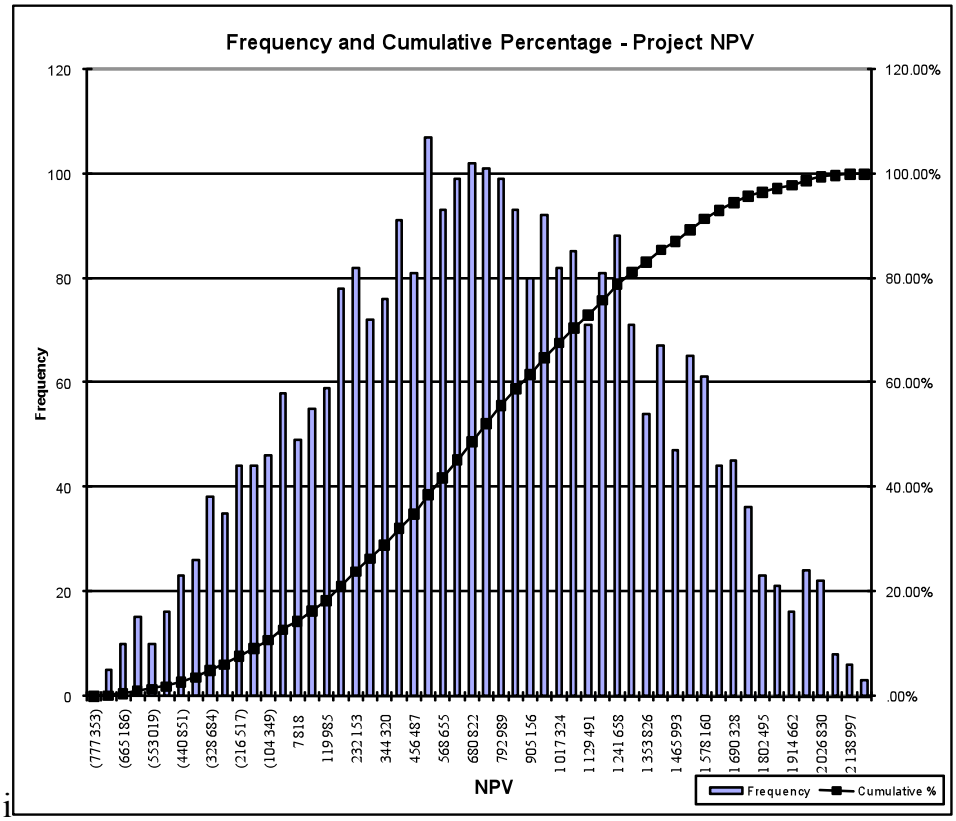
Scenario Summary		Current Values:	Expected	Best	Worst
Changing Cells:					
Operating margin	**C4**	4.0%	4.0%	5.0%	3.0%
Turnover p/metre	**C5**	25000	25000	30000	20000
No. of metres	**C6**	900	900	900	900
Working capital %	**C7**	10%	10%	8%	12%
Growth in revenue	**C8**	8%	8%	10%	6%
Result Cells:					
NPV	**B23**	**645,420**	**645,420**	**3,352,118**	**-1,039,760**
IRR	**B24**	**18.4%**	**18.4%**	**27.7%**	**11.9%**

Notes: Current Values column represents values of changing cells at time Scenario Summary Report was created. Changing cells for each scenario are highlighted in gray.

Sensitivity Analysis: Tornado Graph



Monte Carlo Simulation



Annexure 2 Spreadsheet modelling for selected topics in corporate finance

Financial statement analysis	Set up financial statements in Excel. Download financial statements in Excel (if available) from company websites. Comparative analysis and determining trends in Excel. Use Graphs. Undertake Index Analysis in Excel by linking revenue, costs and income figures such as EBIT and NI to sales Common size analysis in Excel where income statement and balance sheet items are stated as a % of sales Calculate financial ratios in Excel and insert industry ratio benchmarks. Refer to rating agency ratio benchmarks and use pivot tables to allot a simulated rating to the company. Du Pont analysis (structured ratio analysis) in Excel with "What-if" analysis Application of Altman's Financial distress model Calculate a company's Economic Value Added (Link to WACC spreadsheet)
Time value of money	Use time value of money functions in Excel such as PV, NPER, FV, RATE and PMT. Effective rates for different compounding periods including continuous compounding Use time lines to depict cash flows and use PV, NPV, and IRR functions Growing perpetuities and growing annuities - compare formulae to cash flows on a timeline. For growing perpetuities - use time periods such as 100 periods to indicate how eternity reaches a limit. Loan amortisation table with separate input section and use graph to depict the payment of interest and principal amount over time.
Risk and return	Degree of operating leverage (DOL). Set up contribution statements in Excel with production volumes, variable cost and selling price set within an input section. Apply and test the DOL formulae. Apply the DOL formulae and test DOL in the contribution statement. Expand DOL by including the Degree of financial leverage (DFL)calculation and test with changes in production. Setup table of possible returns with related probabilities and calculate the variance and standard deviation the "long way" in Excel by calculating deviations from the mean, squared deviations and the product of the probabilities and the squared deviation. Use Excel functions of STDEV and STDEVP to determine the standard deviation of a series of returns. Use the COVAR function to determine the covariance between two series or returns and also use the CORREL function to detemine the correlation between the two series of returns. Download a series of share prices for two listed companies and use such Excel functions as AVERAGE, STDEV and COVAR and CORREL to detemine average returns, standard deviations and correlations.
Portfolio Theory	Determine average returns and standard deviations for two companies for a number of periods. Use the GRAPH capabilities of Excel to depict returns for individual companies as well as the return for the portfolio of the two companies. Show graphically how a portfolio will reduce the variability of returns by comparing individual returns to the portfolio return for each period. Calculate the standard deviations for each company and the standard deviation of the portfolio. Use examples that indicate a high degree of correlation as well as an example indicating a low degree of correlation. Set up a table in Excel showing different weightings of each share in a portfolio and show the resulting portfolio returns and portfolio standard deviations. Plot this as a scatter diagram in Excel to show the feasible set of portfolio of two assets. Do an efficient frontier in Excel. For Beta analysis, plot as a scatter graph in Excel the excess returns of investing in a company in relation to the excess returns of investing in the market index. Use the Regression tool in Excel (under Data analysis) or add a trendline (linear) and specify Excel to include the y= a +bx function on the chart with R^2.
Valuations	
Fixed income securities	Set out spreadsheet with coupon payments and the redemption of principal. Use an input section. Undertake sensitivity analysis by setting varying terms to maturity and varying coupon rates for different bonds and plot the resulting bond values so that students can see the impact of interest rate risk on values. Also, use data tables. Use Excel tables to determine the duration of a bond. Plot the term structure of interest rates at different times to indicate upward and downward sloping yield curves. Use examples, where the bond value is given, and use the IRR function in Excel to determine the YTM of a bond. Determine Yield to Call if applicable. Use Excel graphs to explain convexity and plot interest rate spreads.
Equity/Company valuations	Set up a dividend discount model for a listed company. Determine compound growth rates for dividends and earnings (to indicate sustainability) and divide the model into a two or three stage model. Use an input section. Set up a detailed Free Cash Flow Model to value a listed company including proforma financial statements, free cash flows, financing flows and financial ratios. Use Data tables, Scenario manager, Goal Seek functions in Excel. Undertake an EVA valuation in Excel. Design separate sections for inputs, results, historical data and ratios, prospective data will include checks such as free cash flows should equal the financing flows. Calculate future financial ratios which can also be used to check the integrity of the assumptions as well as the calculations. Show use of plugs, impacts of possible circular references and how to deal with iterations.
Weighted Average Cost of Capital	Structure of WACC spreadsheet with references and link to Free Cash Flow valuations if applicable. Focus on CAPM parameters and links to market data and beta services. However, also undertake regression analysis to determine a company beta. Use scatter diagrams and trend lines. Include unlevering and relevering formula if applicable and set up capital structures based on book values, market values and target capital structures.
Capital Budgeting	Set out separate sections for inputs, results, calculations with intermediate workings. Do a separate taxation section and link to main calculations section. Employ Data Tables, Scenario Manager and Tornado graph for sensitivity purposes. Set up Monte Carlo simulation for a simple capital budgeting case and plot histogram and cumulative probability. Set up a NPV profile in Excel. For internal rate of return, use a financial model to explain the impact of the reinvestment rate assumption and apply the MIRR function in Excel to overcome the problems with the IRR function. Use equivalent annual costs to detemine an optimal replacement cycle. Use Excel's Solver function in capital rationing by setting out capital constraints.
Working Capital Mngt	Set up a working capital cycle showing how financing requirements change with changes in inputs Set up an EOQ inventory model in Excel using varying EOQ input values and use Graphs. Cash budgeting can be effectively set up as an Excel worksheet to indicate financing requirements