

Using Excel to Integrate Data Analytics into the Management Accounting Curriculum

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EXECUTIVE SUMMARY

To equip accounting students with advanced analytical and problem-solving skills, traditional cost and management accounting coursework could be enhanced with quantitative analysis and management science modeling using Excel-based applications.

Cloud computing, Big Data, blockchain, machine learning, and AI are driving a significant change in the desired skill sets for accounting and assurance professionals. The rapid transformation of the business environment has been addressed by the American Association to Advance Collegiate Schools of Business (AACSB), the American Institute of Certified Public Accountants (AICPA), IMA® (Institute of Management Accountants), the American Accounting Association (AAA), and other organizations affecting accounting education. In response, accounting educators are developing strategies to answer the challenges of the technological shift and assure the relevance of their accounting programs.

This article focuses on the strengthening of quantitative analysis in the cost and management accounting curriculum. It provides guidance on analytical tools that could easily enhance students' skills and prepare them for further data analytics training and for successful professional careers. Because the current business environment opens great opportunities for professionals with advanced analytical skills, the management accounting curriculum should incorporate quantitative analysis and management science modeling to a greater degree than it has been customarily done in the past.

THE NEED FOR CHANGE IN THE CURRICULUM

A number of accounting bodies and organizations have responded to the growing importance of accounting professionals needing greater technology skills. Accounting programs will need to adjust to face the new challenge presented.

The AACSB specifies its requirements for integrating current and emerging information technology in accredited accounting programs in Standard A5. Data analytics, including statistical techniques, data management, modeling, analysis, predictive analytics, and visualization, are among the three primary components of this integration. The other components are (1) information systems and data processes and (2) developing information technology agility among students and faculty.¹ Yet the AACSB does not prescribe how the standard is implemented, leaving it to the accounting departments within colleges and universities.

ICMA® (Institute of Certified Management Accountants) implemented changes to the CMA® (Certified Management Accountant) exam in 2020 based on the results of a job analysis survey indicating that the exam should cover data analytics in more depth. A new section, Technology and Analytics, was added to Part 1 of the exam.² The IMA Management Accounting Competency Framework also identifies data analytics and visualization knowledge and skills required from accounting professionals in the Digital Age.³ Most recently, IMA's Management Accounting Competency Task Force released *Essential Management Accounting Competencies for All Entry-Level Accountants*, listing the management accounting competencies needed by entry-level accountants to remain relevant and influential in the Digital Age. The report addresses technology, analytics, and data management among other key management accounting competencies.⁴

The new Uniform CPA Examination Blueprints, effective July 1, 2021, require candidates to demonstrate quantitative analysis skills as applicable to budgeting, financial modeling, forecasting, and projection.⁵ More significant changes to the exam are expected in 2024. The exam will follow the Core-Plus-Discipline model, with increased emphasis on high-level critical thinking and problem-solving skills,

as well as data management and data analysis.

Currently, the professional exams do not require applications of any new software packages such as Tableau or programming languages such as R or Python. The CPA (Certified Public Accountant) exam includes some Excel applications, while the CMA exam does not cover software applications.

Meanwhile, the industry is demanding that accounting education programs develop curricula that will adequately address the technological change and instill in students a higher level of data analysis capabilities. Grant Thornton LLP, for example, considers auditors' proficiency with Excel and Access a minimum and expects experience with at least some of the following:

- For automation: Alteryx, Automation Anywhere, Power Apps, Power Automate;
- For analysis: R, Python, Power Query, other analytic packages; and
- For visualization: Tableau, Power BI, and other visualization engines.⁶

Business analytics involves using information technology, data, statistical analysis, quantitative methods, and computer algorithms to gain insight and business intelligence crucial to support decision making. Therefore, it is crucial for management accountants to possess the knowledge and skills necessary to work with data scientists to build the most relevant models analyzing and visualizing the data to enhance decision making throughout the company's value chain.

MANAGEMENT ACCOUNTING: STILL THE EXCEL OPPORTUNITY

Institutions of higher education try to use a variety of approaches to adapt to a rapidly changing environment. The majority of AACSB accredited schools offer business analytics courses. It is less common for accounting programs to offer stand-alone accounting analytics course(s). Instead, technology is being integrated into the existing curriculum, especially in accounting information systems courses, while data analytics content is successively added to all or selected coursework.

AAA organizes and sponsors conferences and workshops on incorporating technology and data ana-

lytics into the curriculum. AAA members have been developing and sharing guidance and instructional resources. Business community professionals provide support as well.

Still, many accounting departments face significant implementation challenges, such as insufficient funding and faculty shortage. Quite often, the accounting departments facing these challenges seek cooperation with other departments. The core curricula are being revised to strengthen the quantitative content, and relevant courses are being offered by information systems, management, or finance departments.⁷

There is an ongoing discussion about Excel being a “legacy” technology no longer adequate to handle Big Data. Research indicates, however, that accounting professionals resist adopting new analytics technology and moving beyond Excel.⁸ By all accounts, Excel is still by far the most used application for data analysis, and a mastery of Excel is a must-have skill expected by those who employ accounting and finance professionals.

Most accounting programs include extensive Excel training to respond to the calls for technological proficiency to be demonstrated by the graduates applying for entry-level positions. In most cases, however, the training focuses on spreadsheet proficiency while the advanced analytical capabilities of Excel are not fully explored.

Since advanced analytical skills will be expected from accounting professionals in the near future, why not start utilizing the spectrum of Excel functions as well as supplemental capabilities provided by the selected add-ins? There are a number of Excel add-ins useful in solving managerial accounting problems. The Analysis ToolPak and Solver are already built into Excel and only require activation. There also are some external add-ins, such as Real Statistics Resource Pack, BYTreePlan, and @RISK, that need only be downloaded and installed. These spreadsheet enhancements facilitate teaching the statistical concepts and models that are so valuable to management accountants and the decision makers they support.

Students should gain sufficient quantitative analysis skills in their core courses. The accounting educators can then proceed to relevant applications supported by the tools at hand. For example, when students

learn regression analysis, the key is that they understand how to set up a model, are able to interpret the output, and can make decisions based on it. It is secondary whether they learned it using Excel’s Analysis ToolPak add-in or using SPSS, SAS, or R. Students may master large data sets extraction, manipulation, and optimization in another course, but once they have their data ready for analysis, they will know what to do with it and how to interpret the results of their analysis.

Tables 1A-1E (see pp. 23-27) present a list of management science modeling techniques that could be easily incorporated into the managerial accounting curriculum using Excel. These tables are organized by analytic tools and link the modeling techniques with professional examination/designation requirements. They specify Excel and analytical skills required, offer application examples, and highlight the critical thinking involved in each type of analysis. The content of the tables is based on the assumptions that (1) students successfully completed their core classes in mathematics and statistics and (2) the academic units serving the students coordinated their curricula and requirements.

SOFTWARE OPTIONS

Some of the add-ins presented, like the Analysis ToolPak and Solver, are widely applied and well known. Others may require some explanation.

The Real Statistics Resource Pack is an Excel add-in that provides advanced worksheet functions and data analysis tools extending Excel’s standard statistics capabilities. This software supports all versions of Excel for Windows from 2007 (including Excel 365) and all versions of Excel for Mac from 2011. A free copy of the package can be downloaded from the Real Statistics website (bit.ly/3zv06ZT).

The BYTreePlan add-in helps to build a decision tree diagram in an Excel worksheet using dialog boxes. Like the Real Statistics Resource Pack, it can be downloaded free of charge (bit.ly/3HEzOUJ).

Palisade’s @RISK is an Excel add-in allowing risk analysis using Monte Carlo simulation. It explicitly introduces uncertainty into a spreadsheet model by allowing several inputs (those with significant effects on a key output variable) to be considered random with

a known probability distribution. Then it simulates random values from these distributions and summarizes the impact of numerous iterations on the key output variable in a histogram. @RISK has a feature to determine which of the inputs is most correlated with the key output variable. This sensitivity analysis is very important for real applications. It will enable the decision maker to focus on the most significant input variables affecting the outcome.

While @RISK is not the only software on the market providing Monte Carlo simulation capabilities, the products are all relatively expensive.⁹ Textbook authors or institutions of higher education may be able to negotiate to receive these add-ins at no or low cost. If that is not a workable option, accounting literature has demonstrated how Excel's RAND function for generating random numbers can be used to complete the same introductory-level simulation tasks as @RISK and other specialized software.¹⁰

AN OPPORTUNITY FOR MANAGEMENT ACCOUNTANTS

As public accounting firms have focused increasingly on technology skills, they have also been hiring more nonaccounting graduates. In 2019, 31% of all new graduates hired in public accounting were not accounting majors.¹¹ Automation and the availability of data are changing the value chain functions within companies as well.

This shift creates opportunities for management accountants to become expert interpreters of management science models and outputs. Management accountants may serve as intermediaries between data scientists, equipped with programming and statistical modeling skills, and management.

To prepare accounting students for this role, not only should greater emphasis be placed on critical thinking, problem-solving, logic, and quantitative analysis, but it should begin earlier in the accounting curriculum. Research shows that the grades students receive in the core knowledge courses that are typically taken in the earlier semesters of business programs are strong predictors of overall academic success.¹² Based on coordinated core curriculum outcomes, a significant data analytics component can

be easily built into the cost/management accounting courses with little or no extra resources needed. ■

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ENDNOTES

- 1 AACSB International, *2018 Eligibility Procedures and Accreditation Standards for Accounting Accreditation*, April 23, 2018, bit.ly/31sE6iD.
- 2 ICMA, *Learning Outcomes Statements: CMA® (Certified Management Accountant)*, 2020, bit.ly/3F1dNOp.
- 3 IMA, *IMA Management Accounting Competency Framework*, April 2019, bit.ly/309rjw8.
- 4 IMA, *Essential Management Accounting Competencies for All Entry-Level Accountants*, December 2021, bit.ly/3pQFmPg.
- 5 AICPA, *Uniform CPA Examination Blueprints*, October 23, 2020, bit.ly/3n1OmGn.
- 6 Brian Wolohan and Vern Richardson, "Data Analytics in Accounting," Calcbench Webinar, March 3, 2021, bit.ly/3zwTOG8.
- 7 Lindsay M. Andiola, Erin Masters, and Carolyn Norman, "Integrating Technology and Data Analytic Skills into the Accounting Curriculum: Accounting Department Leaders' Experiences and Insights," *Journal of Accounting Education*, March 2020, pp. 1-18.
- 8 Pamela J. Schmidt, Jennifer Riley, and Kimberly Swanson Church, "Investigating Accountants' Resistance to Move beyond Excel and Adopt New Data Analytics Technology," *Accounting Horizons*, December 2020, pp. 165-180.
- 9 @RISK's cost ranges from \$2,495 for a one-year subscription to \$1,622 for a three-year subscription. A competing product like, for example, Oracle's Crystal Ball (standard edition) can be purchased for \$945.25, while an Analytic Solver Simulation first-year license costs \$1,995.
- 10 See, for example, Sylvia Gornik-Tomaszewski, "Capital Budgeting Simulation Using Excel: Enhancing the Discussion of Risk in Managerial Accounting Classes," *Management Accounting Quarterly*, Summer 2014, pp. 12-17, bit.ly/3sZUDGI.
- 11 AICPA, *2019 Trends in the Supply of Accounting Graduates and the Demand for Public Accounting Recruits*, 2019, bit.ly/3G6F6rS.
- 12 Mehdi Kaighobadi and Marcus T. Allen, "Investigating Academic Success Factors for Undergraduate Business Students," *Decision Sciences Journal of Innovative Education*, July 2008, pp. 427-436.

Table 1A: Descriptive Analytics Using Descriptive Statistics

Learning Objectives	Professional Competency Requirements	Excel and Analytical Skills Required	Example of Application	Critical Thinking
Modeling Technique: Univariate Analysis				
<p>Learn how to summarize a data set by calculating:</p> <ul style="list-style-type: none"> • Mean • Standard error • Median • Mode • Standard deviation • Sample variance • Kurtosis • Skewness • Range • Minimum • Maximum • Sum • Count <p>Select a chart for data visualization.</p>	<p>CMA Exam: Part 1, Section F4, Data Analytics</p>	<p>Enable the Analysis ToolPak add-in and select the Descriptive Statistics analysis tool. Select summary statistics with 95% confidence levels.</p>	<p>In preparation for the following correlation and regression analysis, apply descriptive statistics to cost data and the competing cost drivers data. Descriptive statistics require variables to be interval or ratio, measured on a continuous scale, or measured on a discrete scale with many values.</p>	<ul style="list-style-type: none"> • Each descriptive statistic helps to reduce data into a simpler summary. • Descriptive statistics provide insight into data distribution, variability, patterns, etc. • Critical analysis of the data is important for the effective application of predictive models and machine learning.

Table 1B: Predictive Analytics Using Forecasting Techniques

Learning Objectives	Professional Competency Requirements	Excel and Analytical Skills Required	Example of Application	Critical Thinking
Modeling Techniques: Scattergraph; Correlation Simple Linear Regression and Multiple Regression				
<p>Scattergraph: Plot the data and the regression line.</p>	<p>CMA Exam: Part 1, Sections B3, Forecasting Techniques, and F4, Data Analytics. CPA Exam: BEC Part, Area VD, Operation Management/Planning Techniques</p>	<p>Scattergraph: Prepare scatter chart(s) to visualize the relationship between the dependent variable and the independent variable(s). Analyze the scatter chart(s). Identify outliers.</p>	<p>Set up the linear cost function with cost as a dependent variable and cost driver(s) as the independent variable(s). Estimate the cost function for several competing cost drivers to select the best cost driver based on three criteria:</p>	<ul style="list-style-type: none"> • Critical analysis of cost behavior. • Understanding the role of the cost function in business decision making. • Effective use of cost function in budgeting.
<p>Correlation simple linear regression; multiple regression: Estimate the linear cost function based on the past data to predict future costs.</p>		<p>Correlation simple linear regression; multiple regression: Enable the Analysis ToolPak add-in in order to:</p> <ul style="list-style-type: none"> • Perform correlation analysis • Perform regression analysis. <p>Read the correlation and regression outputs.</p> <p>Demonstrate an understanding of the correlation coefficient and the coefficient of determination (R-squared).</p> <p>Interpret results including standard error of the estimate, goodness of fit, confidence interval, <i>F</i> and <i>t</i> statistics.</p>	<p>1. Economic plausibility; 2. Goodness of fit; and 3. Significant effect of the cost driver on costs.</p> <p>Set up multiple regression with two or more cost drivers to explore whether the model's predictive ability improves.</p>	

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Table 1B: Predictive Analytics Using Forecasting Techniques

Learning Objectives	Professional Competency Requirements	Excel and Analytical Skills Required	Example of Application	Critical Thinking
Modeling Technique: Logistic Regression				
Estimate non-linear function with a categorical (most often binary) dependent variable.	CMA Exam: Part 1, Sections B3, Forecasting Techniques, and F4, Data Analytics.* CPA Exam: BEC Part, Area VD, Operation Management/ Planning Techniques	Download and enable the Real Statistics Resource Pack add-in.** Perform the logistic regression. Read and interpret the output with an emphasis on the significance of the independent variable(s) and the model's goodness of fit.	Set up binary dependent variable as "buy" = 1 and "not buy" = 0 for existing customers of a company to determine their probability of buying a new product the company has to offer. Use continuous variable(s) as the independent (predictor) variable(s), for example, cost of the product, customer income, etc.	<ul style="list-style-type: none"> • Critical thinking in setting up a model that fits the data. • Selection of the most significant predictors.
Modeling Technique: Time Series Analysis				
Perform time series analysis	CMA Exam: Part 1, Section F4, Data Analytics	Three alternative approaches: 1. Insert chart Insert line chart, add the trendline. Use the trendline options to find the best fit for the historical data. Confirm the best fit with R-squared unless selecting the moving-average option. Read the forecast from the best-fitting trendline. 2. Forecast Sheet Use historical data to create a visual forecast worksheet. Forecast into the selected number of future periods. 3. From Analysis ToolPak, use: <ul style="list-style-type: none"> • Moving average • Exponential smoothing with graphs 	Based on monthly sales data for the past few years, develop a sales forecast for the first three months (first quarter) of the next year. Use the forecast as a cornerstone of the first quarter operating budget.	<ul style="list-style-type: none"> • Data analysis. • Visualization in order to find patterns. • Fitting the best trendline.

*Although the current exam specifications do not mention logistic regression by name, Srikant M. Datar and Madhav V. Rajan introduced it as one of the most commonly used tools for building models in a world of Big Data in *Hornngren's Cost Accounting: A Managerial Emphasis*, 17th edition, Pearson, 2021.

**Make sure that the Solver is enabled first.

Table 1C: Predictive Analytics Using Decision Analysis Tools

Learning Objectives	Professional Competency Requirements	Excel and Analytical Skills Required	Example of Application	Critical Thinking
Modeling Technique: Expected Monetary Value (EMV) Decision Tree				
<p>Explain the elements of a decision tree model.</p> <p>Write the rules for the decision tree.</p> <p>Build a decision tree model.</p> <p>Evaluate and interpret the outcome.</p>	<p>CMA Exam: Part 1, Section B3, Forecasting Techniques</p>	<p>Download and enable the BYTreePlan add-in.</p> <p>Enter in Excel spreadsheet data for decision making under uncertainty. The problem should include:</p> <ul style="list-style-type: none"> • Possible decision alternatives, • The set of outcomes and their probabilities, and • Monetary values for the various combinations of decisions and outcomes. <p>Use the decision tree analysis to identify the alternative with the largest EMV and follow up with sensitivity analysis.</p>	<p>A store is considering two suppliers of a certain product it sells. The probability distributions of the percentage of defective units of the product from the two suppliers are given. Considering the product selling price set by the store and the product and defective unit replacement cost, choose the supplier that maximizes the store's EMV.</p>	<ul style="list-style-type: none"> • A critical look at the expected value concept. • Fitting data into models that do not assume a particular functional relationship between feature variables and the target variable.

Table 1D: Prescriptive Analytics Using Optimization Techniques

Learning Objectives	Professional Competency Requirements	Excel and Analytical Skills Required	Example of Application	Critical Thinking
Modeling Technique: Linear Programming (LP)				
Determine the objective function. Specify the constraints. Find the optimal solution.	CMA Exam: Part 1, Section D4, Supply Chain Management	Enable the Solver add-in. Develop the spreadsheet optimization model containing the following elements: • Data inputs • Changing cells • Target (objective) cell • Constraints • Nonnegativity Use Solver to find the optimal solution. Experiment with new inputs (“what-if” analysis).	Find an optimal product mix maximizing the company’s profit.*	<ul style="list-style-type: none"> • Formulate a production mix problem as an LP problem. • Interpret the output as a support for decision making.

*Hornsgren’s Cost Accounting: A Managerial Emphasis provides a profit maximization LP example in the current and several previous editions.

Table 1E: Prescriptive Analytics Using Decision-Making Tools Dealing with Risk and Uncertainty

Learning Objectives	Professional Competency Requirements	Excel and Analytical Skills Required	Example of Application	Critical Thinking
Modeling Technique: Monte Carlo Simulation				
Develop the simulation model. Specify simulation settings. Run the simulation with a significant number of iterations. Examine the results.	CMA Exam: Part 1, Section F4, Data Analytics, and Part 2, Section E, Investment Decisions	Excel’s RAND function (its built-in random number generator)	Build a capital budgeting model based on net present value technique. Determine few variables to be random. Estimate probability distribution for each of these variables using RAND. Replicate the simulation and summarize the outcomes in a histogram.	<ul style="list-style-type: none"> • Understanding risk inherent to capital budgeting decisions. • Dealing with the random nature of capital budgeting inputs. • Application of concepts to other decision models with built-in uncertainty.