A Data Analytics Elective Course for a Master of Science in Accountancy Program

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Abstract

The American Accounting Association and the International Association to Advance Collegiate Schools of Business, responding to calls from business and the accounting profession, have encouraged the teaching of data analytics in accounting courses. To help accounting educators integrate this new topic into their curricula, we report on how we developed a data analytics elective course for our Master of Science in Accountancy program. This course introduces data analytics from an accounting perspective. It includes four parts: Data and its Significance as an Organizational Asset, Data Analytics Concepts, and Introduction to R, Individual Labs, and Group Case Work. We contribute to accounting information systems education by providing a starting point for faculty members developing an accounting-related data analytics course or integrating the material into existing curricula.

Data analytics has become an important topic in business disciplines, especially in accounting, but many accounting educators are unsure how to integrate data analytics into their curricula. The Association to Advance Collegiate Schools of Business (AACSB) Accounting Standard A5 (2022) requires that analytics topics be integrated into each accounting class. However, limitations in the amount of time available in existing accounting classes and faculty resistance to adding a technology component to their classes are significant barriers to adding analytics to accounting curricula. One solution is to create a stand-alone data analytics course for accounting students. Another is to create a data analytics track within existing programs. This paper explains how our program created a stand-alone data analytics course to address this need. Our Data Analytics in Accounting course is an accounting elective in our one-year Master of Science in Accountancy (MSA) program. We have taught the course multiple times in a hybrid format, meeting every other week for four hours and 15 minutes; the course could also work in a purely online or traditional set of weekly meetings.

Importance of Data Analytics in Accounting Curricula

The growth in computer processing power and the exponential growth in data available to accountants and auditors have made data analytics an essential part of the daily work undertaken by accountants and auditors (PricewaterhouseCoopers [PwC], 2015). For example, auditors can use data analytics to identify outliers and exceptions, allowing them to identify and focus on the riskiest areas of the audit (Kogan et al., 2017). Investors, analysts, and other stakeholders can use data analytics to evaluate a company's financial performance in financial accounting. Accountants can gain more insight into identifying risk factors and predicting future earnings or stock prices by using sentiment analysis or textual analysis to extract meaning from the text in the financial statement footnotes, minutes of meetings, and Twitter feeds (Ren et al., 2013, Hajek et al., 2014). Management accountants can use analytics on large data sets to generate key performance indicators for their firms (Richardson et al., 2021). Tax accountants and investment advisors can use data analytics to identify investment opportunities using behavior patterns noted in textual data (Richardson, et al., 2021).

Both the AACSB (2022) and the American Accounting Association (Foksinska & Brannock, 2022) have stated the importance of integrating information systems and technology into the accounting curriculum. The AACSB's accounting accreditation standard A5 requires programs to include skills and knowledge related to integrating information technology in accounting and business as learning outcomes (AACSB, 2022). This standard also recommends that learning objectives encompass students' acquisition of skills and knowledge in data mining and analytics. The AACSB also requires that analytics topics be incorporated across the curriculum for schools that want to obtain or maintain separate accounting accreditation (AACSB, 2022). The American Accounting Association (AAA) has hosted annual conferences and workshops that provide data analytics training and teaching materials since 2015.

In their review of accounting information systems (AIS) instructional resources, Apostolou et al. (2014) recommend that educators strive to describe and study a common body of AIS knowledge for accounting majors and that AIS topics be integrated throughout the curriculum in a way that coordinates topics and reinforces their learning. Schneider et al. (2015) show how data analytics is used in and impacts accounting environments, highlighting the topic's importance for accounting students. However, our accounting faculty expressed strong concerns about how little time they have to teach new topics in their existing courses and resisted adding technology components to their classes. Thus, we designed an elective course that includes cases drawn from the domains of financial accounting, managerial accounting, tax compliance, tax planning, and auditing.

Educators and accounting professional associations have acknowledged the importance of an integrated, competency-based curriculum for accounting students that includes knowledge of and ability to use information systems and technologies (AAA, 1986; Accounting Education Change Commission [AECC], 1990; American Institute of Certified Public Accountants [AICPA], 1996; Behn et al. 2012; Lawson et al., 2014; Lawson et al., 2015; Lawson et al., 2017). Lawson et al. (2014) proposed the competency-based framework of learning outcomes necessary for accounting graduates' success that we present, as adapted, in Table 1 (on the next page).

Our course covers the six foundational competencies Lawson et al. (2014) propose: information systems, communication, analytical thinking, problem solving, ethics, and technological competency. Our course meets the technological foundational competency by including spreadsheet modeling and information design, practice in accessing large financial datasets, and using advanced technologies such as interactive data visualization to communicate results. We require faculty members teaching our course to be comfortable with database structures, queries, and other systems-related topics.

Table 1
Competency-based Framework of Learning Outcomes (Adapted from Figure 1, Lawson et al., 2014, p. 300)

Accounting competencies	Foundational competencies	Broad management competencies
External reporting and analysis	Communication	Leadership
Planning, analysis, and control	Quantitative	Ethics
Tax compliance and planning	Analytical thinking and problem solving	Process management and improvement
Information systems	Interpersonal	Governance, risk, and compliance
Assurance and internal control	Technological	Additional core business competencies
Professional values, ethics, and attitudes		

Program and Course Learning Objectives

Our Accelerated MSA degree program was designed to meet four program learning objectives (PLOs):

PLO 1: Communication Skills: Students can communicate effectively, both orally and in writing.

PLO 2: Analytical and Problem-Solving Skills: Students can use critical thinking and frameworks to solve business problems and make accounting-related decisions.

PLO 3: Functional Knowledge: Students will demonstrate knowledge of fundamental principles in accounting and the ability to identify current issues in diverse accounting theory and practice areas.

PLO 4: Ethical Awareness: Students are aware of ethical issues and responsibilities in business environments.

We use these PLOs to guide the development of specific courses in the program. The elective course described in this paper contributes to the accomplishment of PLO 2 by meeting the course learning objectives (LOs), which we list in Table 2 with the course elements we use to measure the assurance of learning.

Table 2
Course Learning Objectives (LOs) and Course Elements We Use to Measure Assurance of Learning

LOs	Assignments	Labs	Quizzes	Midterm exam	Final exam	Class participation
1: Students can solve accounting and business-related problems using appropriate data modeling tools.	X	X	X	X	X	X
2: Students will understand how accountants can benefit from using data analytics.	X	X	X	X	X	X
3: Students will understand how to use data warehouses and other data stores to acquire data.	X	X				X
4: Students can identify and evaluate the veracity of sources of unstructured and structured data for analysis.	X	X				X
5: Students can create data visualizations that provide clear insights into associations, relationships, outliers, and other data intimations related to accounting anomalies.	X	X		X	X	X

By accomplishing these LOs, we believe our students will develop data analytics skills through hands-on work with software tools that accounting professionals use. We accomplish the Lawson et al. (2014) foundational competency of communication in PLOs 1, 3, 4, and LO 5. We accomplish the ethics foundational competency in PLO 4, the analytical thinking and problem-solving foundational competency in PLO 2 and LO 2, and the information systems foundational competency in PLO 3 and LOs 1 and 3. In the next section, we describe our data analytics elective course in more detail.

Course Details

This course is an elective in our Accelerated MSA program (Appendix A includes a detailed description of the program). The program has no specific prerequisites, but students must have some Excel knowledge and a level of statistics knowledge that they would learn in a typical undergraduate course in that subject. Our admission process screens students to ensure they have this knowledge.

The course includes four major parts: Data and its Significance as an Organizational Asset, Data Analytics Concepts and an Introduction to R, Individual Labs, and Group Case Work. A significant part of the course involves hands-on work during regular class sessions with the instructor's guidance in a computer-equipped classroom. Students continue to work on these assignments outside of class. Appendix B includes a schedule of class sessions for the course.

We use the Richardson et al. (2021) textbook as a reference and a source for some of the data and labs used in the course. Two other books that could be used with a course such as ours are Albright & Winston (2014) and O'Connell et al. (2018). Appendix C includes a list of software students need to complete the assignments and labs successfully.

Part One: Data and its Significance as an Organizational Asset

In the first part of the course, we introduce students to basic concepts of data analytics in accounting and business using the IMPACT cycle (Richardson et al., 2021). The IMPACT cycle includes (1) Identifying the question, (2) Mastering the data, (3) Performing a test plan, (4) Addressing and refining results, (5) Communicating insights, and (6) Tracking outcomes.

Students also learn about the strategic role of data and its significance as an organizational asset. We explain the effects of data analytics on financial reporting, auditing, managerial accounting, and tax accounting. Thus, we emphasize the integration of analytics across accounting topics while integrating it throughout the curriculum as required by AACSB Standard 5. We also discuss integrity and ethical issues. In addition, we introduce students to some Excel functions and add-ins for data analysis. This course element addresses PLO 4, LO 2, and LO 4.

Part Two: Data Analytics Concepts and Introduction to R

In the second part of the course, students gain hands-on experience with some of the analytics techniques. The lectures include:

- Data analytics concepts: Topics include the three major classes of analytics (descriptive, predictive, prescriptive), data analytics tools (such as SAS Enterprise Guide, SAP HANA, Excel, and R), and data analytics techniques (including regression analysis, cluster analysis, and sentiment analysis).
- Relational databases: This lecture discusses big data and relational database concepts. Students use Microsoft Access to learn the basics of database design and queries. They also learn about data preparation and cleaning.
- Data analytics model: This lecture discusses the Davenport and Kim (2013) six-step model, which includes problem recognition, review of previous findings, modeling, data collection, data analysis, and results presentation and action. Following the conceptual introduction of the model, students see how it is applied using research completed by Farag et al. (2014).

Following the video lectures, students complete five R application exercises in which they download R, navigate the R interface, and practice basic commands and functions such as performing calculations and creating a histogram plot.

Students complete an online exam in our learning management system, which we use to assess their mastery of the material in the first two parts of the course. The exam includes questions (true/false, multiple-choice, and fill-in-the-blank) on the data analytics concepts lecture and fill-in-the-blank questions about the R exercises.

Part Three: Individual Labs

In the third part of the course, students learn data visualization using Tableau and Microsoft Excel. Working individually, students complete a series of queries in Microsoft SQL Server to extract data from a data set that includes more than 128 million records, then use Tableau to analyze and visualize the extracted data. This course element addresses PLO 1 and LOs 4 and 5. These labs include the following:

- Data Reduction Using Fuzzy Matching: Students use the Fuzzy Lookup Excel add-in to identify potentially fictitious vendors or employees who created fake companies.
- Regression in Excel: Students perform a regression on U.S. Department of Education College Scorecard data to examine the relationship between SAT averages and college completion rates.
- Classification: Students use Weka Machine Learning software to use various classification models on data sets provided by LendingClub, a peer-to-peer marketplace for lenders and borrowers.

- Exploratory analysis, geographic data visualizations, and dashboard creation: Students use Tableau to analyze fictitious brewery sales data they have extracted, transformed, and loaded using Microsoft Access. Students create a dashboard with charts and maps showing sales by product, state, and year.

Part Four: Group Casework

In the last part of the course, students work in groups of two or three to complete comprehensive analytics cases in four accounting areas; auditing, managerial accounting, financial accounting, and tax accounting. We include activities from multiple areas of accounting to help students understand that information systems and analytics skills are essential in all areas of accounting. This course element addresses PLOs 2 and 3 and LOs 1, 2, and 5. Students complete the following five cases:

- Auditing: Students use Microsoft SQL Server Management Studio, Microsoft Excel, the PowerPivot add-in for Excel, and Tableau to test a hypothesis and develop a dashboard. Students extract data using SQL Server and then load it using Excel's Get & Transform function. Using PowerPivot, students create two pivot tables, run a t-test to identify differences, and use Tableau to create data visualizations to include in a dashboard.
- Managerial Accounting: Students use Microsoft SQL Server Management Studio, Microsoft Excel, PowerPivot add-in for Excel, and Tableau to build key performance indicators (KPIs), create a baseline measure in Excel, and set a target value. They also analyze sales to develop a KPI, which they add to a dashboard.
- Financial Accounting: Students use Google Sheets and an iXBRL Analyst script to identify questions about an income statement and compute financial ratios for a set of companies, create a dynamic spreadsheet that pulls in multiple companies' XBRL data for comparisons, and use iXBRL Analyst to create dynamic, common-size financial statements.
- Financial Accounting: In a second case for this area, students conduct a sentiment analysis of tweets to forecast stock price changes for a company. Students use Semantria for Excel and Twlets for Excel to complete this case.
- Tax Accounting: Students download and analyze census data from the United States Census Bureau and individual income tax statistics from the Internal Revenue Service to identify how the Tax Cuts and Jobs Act of 2017 (TCJA) has impacted taxpayers depending on their ZIP codes. Students use Excel and Tableau to map percentages and visualize the magnitude of this law's effects.

Efficacy

We give two exams in the course. Students have performed well on the exams and other assignments. They have expressed satisfaction with the course and stated that they learned a great deal. Peer faculty observations made during peer reviews of teaching practices appear in Table 3 and were also very positive.

Table 3
Peer Faculty Observations Made During Peer Reviews)

Observations
"This course is well organized, and the syllabus is comprehensive."
"The subject on analytics in accounting is well aligned with his research expertise and his command on the subject is impressive."
"…asked for students' feedback on the exam and on how to improve their learning experience. The students' feedback was very positive and most of them considered the test effective and fair."
"Lead through a practice example by analyzing the dataset and presenting visualized results."
"Makes connection with the real world by showing students good and bad examples of visualizing data from different sources."
"I have a very positive impression about his teaching method."

Conclusions

We believe the importance of data analytics in accounting will continue to grow. Thus, accounting students must learn multiple data analytics tools and techniques in their coursework. We have seen curricula at other programs integrate data analytics into each accounting course, create a data analytics track, and develop a comprehensive data analytics course for accounting students. This paper presents another alternative: developing a stand-alone analytics elective course.

This course presents basic concepts of data analytics, analytics techniques, and applications in the context of multiple accounting topic areas at the graduate level. This approach overcomes inconsistencies in our students' undergraduate accounting experiences and ensures that data analytics skills and applications in multiple accounting areas are covered in our MSA program. We believe this course comports with AACSB Standard 5, which requires developing student skills and knowledge related to the integration of information technology in accounting and business. Incorporating data analytics into the accounting curriculum should improve students' marketability and job prospects.

We made many significant content changes and refined our delivery methods as we developed the current version of this course using feedback from reviewers and what we learned while attending several data analytics boot camps. Peer faculty observations of the course and careful study of AACSB Standard 5 have also led to deep discussions among our faculty members about how best to integrate these topics into our undergraduate curriculum. These discussions culminated in our developing an undergraduate version of this course, which is now a capstone course.

As with any new course development, limitations remain in our course. Given the vast number of analytics techniques available, the course could only offer a subset of the available techniques. The course also does not dig deeply into some of the topics included because the time available in a single course is limited.

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Appendix A

Detailed Description of the Accelerated MSA Program

The Accelerated Master of Science in Accountancy (MSA) program is for working professionals who wish to advance their careers, either as a Certified Public Accountant (CPA) or in some other areas of accounting. The objectives of the program are to provide working professionals an opportunity to acquire and upgrade their professional accounting skills, advance accounting knowledge and its role in organization and society, and satisfy the State of California educational requirements for CPA licensure. Courses are offered in the evening and weekends, with a combination of face-to-face and hybrid courses. The accelerated program allows students to finish within one year, or at the student's own pace.

Admission

The program accepts students from varied academic backgrounds, including non-accounting majors. For students with no previous study in accounting, one semester of general standing course work is required. Students holding a bachelor's degree with an accounting major are encouraged to apply for advanced standing within the MSA graduate program. To be considered for admission, students must hold a bachelor's degree in any field (recommended overall GPA of at least 3.0), have a Graduate Management Admissions Test score of 500 or higher, have a TOEFL (for international students) of at least 550 (paper-based), 213 (computer-based), 80 (Internet-based), or IELTS with a score of 6.5 or better. Students with an accounting degree from an AACSB-accredited school, earned within the last seven years with a minimum accounting GPA of 3.25 may waive the GMAT; applicants with Accounting and/or Finance certification(s) and extensive work experience may qualify for GMAT waiver. They are still subject to the other admissions requirements.

Curriculum

General Standing: 15 units. Students admitted in Advanced Standing are not required to complete these 15 units. Students must earn a C or better in each of the following (or their equivalent), with a minimum overall GPA for the courses of 3.0. General standing courses are waivable by the MSA Coordinator.

    GBA 6080 Accounting and Managerial Decisions (3)
        (Or take ACC 3210 – Cost Accounting (3))
    ACC 5122 - Financial Accounting and Analysis (3)
        (Or take both ACC 3110 – Intermediate Accounting I (3) and ACC 3120 – Intermediate Accounting II (3))
    ACC 5310 - Introduction to Taxation (3)
    ACC 5510 - Accounting Information Systems (3)
    ACC 5810 - Auditing (3)

Major Required: 18 units

    ACC 6000 - Business Valuation Using Financial Statements (3)
    ACC 6100 - Internal Control and Corporate Governance (3)
    ACC 6200 - Assurance and Regulation in Accounting (3)
    ACC 6400 - Management Accounting Seminar (3)
    ACC 6600 - Contemporary Accounting Issues (3)
    ACC 6900 - Strategic Tax Planning (3)

Major Electives: 12 units. Students may select elective courses from the following:

    ACC 4811 - Accounting Ethics (3)
    ACC 5000 – Special Study for Graduate Students (1-3)
    ACC 5410 – Internship In Accounting (1-3)
    ACC 5990 – Special Topics for Graduate Students (1-3)
    ACC 6300 - International Accounting Issues (3)
    ACC 6500 – Advanced Analytics in Accounting (3)
    ACC 6700 - Management Control in Not-for-Profit Entities (3)
    ACC 6800 - Fraud and Forensic Accounting (3)

Culminating Experience: 1-3 units

    ACC 6950 – Master's Project (3) (with advisor approval) or GBA 6970 - Comprehensive Examination (1)

Notes: Students who take ACC 6950 as the culminating experience require a minimum of 33 units of course work. Additional 4000-level courses from the Accounting Department (no more than 9 units of 4000-level courses can be counted toward the degree; courses used to fulfill bachelor's degree requirements cannot be double-counted) or GBA courses with advisor approval.

Appendix B

Schedule of Classes

Week/ Modality	Themes/Topics	Chapters	Labs
1 In class	Introduction to Data Analytics in Accounting and Business Data and its Significance as an Organizational Asset Strategic Role; Integrity and Ethical Issues Excel Functions and Add-ins for Data Analysis	1	Lab 2-7 Lab 2-8

	Data Warehousing and Data Mining
	    Database Design and Queries (Access)
	    Data Preparation and Cleaning
	    Data Mining Techniques
	Introduction to R
		2	

2 Remote	Watch posted videos about R; complete the five application exercises		

3 In class	Data and Decision Making
	    Critical Thinking and its Place in Data Analytics
	    Modeling and Evaluation: Going from Defining Business Problems
	    and Data Understanding to Analyzing Data and Answering
	    Questions
	Excel Functions and Add-ins for Data Analysis
		3	Lab 3-1
			Lab 3-4

3 Remote	Complete Problems 3-1, 3-2, 3-4 Discussion Board Contribution Take Quiz 1		
5 In class	Data Visualization (Excel/Tableau) Recognizing and Analyzing Patterns Understanding Relationships Between Data	4	Lab 4-3
8 Remote	Complete Problems 4-1, 4-2, 4-4 Discussion Board Contribution Take Quiz 2		
7 In class	Midterm Exam Applied Data Analytics and Decision Making in Auditing	6	Lab 6-1, 6-2
8 Remote	Complete Problems 6-3, 6-4, 6-5, 6-6 Auditing Case Lab (Group) Discussion Board Contribution		
9 In class	Applied Data Analytics and Decision Making in Managerial Accounting	7	Lab 7-2, 7-7
	Applied Data Analytics and Decision Making in Financial Accounting Financial Reporting and Analytics: Slicing and Dicing, Queries, Reports	8	Lab 8-1, 8-4
10 Remote	Complete Problems 8-3, 8-4, 8-5 Managerial Case Lab and Financial Accounting Case Lab (Group) Discussion Board Contribution Take Quiz 3		
11 In class	Applied Data Analytics and Decision Making in Tax	9	Lab 9-1, 9-2, 9-3
12 Remote	Tax Analytics Case Lab (Group) Discussion Board Contribution		
13 In class	Data Analytics Concepts from a Managerial, Audit, and Financial Accounting Perspective	10	
14 Remote	Analyze Dillard's Data to Predict Sales Returns Lab	11	
15 In class	Final Exam		

Appendix C

Software Used in the Course

Software	Source
Microsoft Excel	Microsoft University License
Microsoft Access	Microsoft University License
R Statistical Software	https://www.r-project.org/
Fuzzy Lookup for Excel	https://www.microsoft.com/en-us/download/details.aspx?id=15011
Weka Machine Learning Software	https://www.cms.waikato.ac.nz/ml/weka/index.html
Microsoft SQL Server	Microsoft University License
PowerPivot add-in for Excel	Enabled from within Microsoft Excel
Google Sheets	https://docs.google.com/spreadsheets
iXBRL Analyst	https://findynamics.com/xbrlanalyst/
Semantria for Excel	https://www.lexalytics.com/semantria/
Tableau	https://www.tableau.com/academic

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