Business Analytics Course Development at UNL

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Abstract

The experience of a Big Ten US University in implementing business analytics at the undergraduate and master's levels is reviewed, to include motivation, curriculum design, and course delivery. Each program element is described, to include motivating factors impinging on curricular design. Course content in each of these programs is summarily presented, along with problems encountered and the solutions implemented. Comparison with other Big Ten institutions is briefly reviewed. The impact in terms of current enrollments will be discussed.
Keywords: Business analytics, curricular development, quantitative analysis

1. Introduction

Reports by leading research and technology firms predict that Data Analytics, especially Big Data Analytics is poised to usher in the next generation of innovations in productivity and competition and transform national economies. A recent study (Capgemini Inc., 2012) finds that 9 out of 10 business leaders "*believe data is now the fourth factor of production, as fundamental to business as land, labor and capital*." The explosion in digital data combined with new tools for analyzing the data has sparked massive interest in the field of data analytics. Consulting firm Deloitte (Lee and Stewart, 2012) expects over 90 percent of the Fortune 500 companies to initiate Big Data projects by the end of this year.

This presentation reports efforts at the University of Nebraska-Lincoln to create and implement business analytic programs at the undergraduate core, undergraduate minor, master's certificate, MBA elective, and Master's of Business Analytics levels. There are a number of ways in which business analytics programs can be delivered. An MIS focus was the basis of Chiang et al. (2012) and Gupta et al. (2015), which are perfectly valid approaches. At the other extreme, a data science approach is common from computer science disciplines. More quantitative approaches are taken by faculties based on operations research background (which is the case at UNL).

2. Motivation

Gartner studies indicate that 4.4 million IT jobs will be created world-wide to support big data, generating 1.9 million IT jobs in the United States (Gartner, 2012). According to Peter Sondergaard, senior vice president at Gartner and global head of Research "*There is not enough talent in the industry. Our public and private education systems are failing us. … Data experts will be a scarce, valuable commodity…IT leaders will need immediate focus on how their organization develops and attracts the skills required. These jobs will be needed to grow your business. These jobs are the future of the new information economy*".

COE Forum was contracted by UNL (for CBA) to conduct a study into potential online Master of Science programs. Business Analytics was found to have very high market growth, with the total number of job postings for business analytics professionals at the Master level increasing

182 percent in the past five years, the fastest growth rate of the six programs considered. The Bureau of Labor Statistics projects faster than average growth for seven top business analytics positions. High market demand is evidenced by employers posting over 146,000 open positions between October 2014 and September 2015.

Organizations of all sizes are turning to people who are capable of translating this trove of data into predictive insights that lead to business value. In recent years, the title "data scientist" has been coined to refer to professionals with both IT and statistical training to make discoveries in the world of big data. Data Scientists have been named the sexiest job of the 21st century (Davenport and Patil, 2012). Moreover, according to the January 2012 Monthly Labor Review published by the US BLS, "*Computer and mathematical occupations are projected to add 778,300 new jobs between 2010 and 2020, after having added 229,600 new jobs from 2006 to 2010. This represents 22.0 percent growth from 2010 to 2020, making the computer and mathematical occupational group the sixth-fastest-growing major occupational group.*"

In the past five years, after this survey commissioned by the new Dean, the College of Business at the University of Nebraska-Lincoln has revised a number of programs related to business analytics.

- An undergraduate core course required of all College students was converted from Introduction to MIS to Business Analytics
- A graduate certificate program was offered in a cooperative effort with the Economics Department (covering statistics) and Marketing Department (covering customer relationship management)
- A minor in business analytics was developed and offered at the request of the Accounting Department
- An on-line master's program was developed and is being offered in Business Analytics.

Thus we have developed programs at these four levels in the past five years. The undergraduate core class is described in more depth than the others. That course has been in place four years and has proven successful. The graduate certificate program has also run four years as part of the College MBA program, with similar success. The undergraduate minor is in its second year of delivery, and the master's program is just beginning to be delivered. The experience demonstrates that there is a strong market for business analytics programs, but as always, there are lessons to be learned. There are a variety of formats in which business analytics can be delivered. The UNL circumstances required in-class delivery for undergraduates, and on-line delivery for graduate courses. The differences in format will be discussed, along with resources required. Thus this paper briefly describes these programs and gives initial results.

3. Core Undergraduate Course

Business statistics is usually taught using traditional lecture. Other approaches that might be better could use active learning methods with minimal lecture. The College of Business Administration (CBA) of the University of Nebraska at Lincoln (UNL) has a core course for sophomores involving traditional statistics that has been quite successful. They had a course at the junior level required of all CBA students in the introduction to Management Information Systems (MIS) that was, at a minimum, unpopular. At the instigation of CBA faculty, who called for better spreadsheet skills on the part of students, this introduction to MIS course was redesigned as a follow-up course to business statistics. The SAS JMP product was used as a spreadsheet tool with excellent graphical support. The course was offered initially as a pilot course and has become the core course replacing the former Intro to MIS. It is currently a permanent course in the Department of Supply Chain Management & Analytics at UNL.

Learning Objectives of the Business Statistics Course and Methodology

The core curriculum is intended to teach to undergraduate business majors the following topics (see Table 1):

Table 1. Undergraduate Core Course Topics

Descriptive statistics	Time series analysis	Regression
Exploratory data analysis	Confidence intervals	Multiple regression
Sampling distributions & Sampling error	One-way ANOVA	Forecasting

Students were also intended to gain experience in working in groups, organizing, analyzing, and presenting their analyses. This was accomplished through lectures and case studies that accompanied the JMP statistical software used in the course. Thus, it was a practical approach to teaching statistical topics to students using case studies, data sets, and statistical software.

The class size was limited to 28 students (currently this limit is 40 per section). There are approximately 750 students per year in CBA, so currently about 20 sections are offered annually. Study groups of four to five students were formulated and students studied in these groups for the entirety of the semester. Groups were expected to develop PowerPoint presentations on each case study and then present their work to the class. Thus the students also obtained experience in working in groups, conducting analysis, and presenting conclusions. They were also exposed to standard business decisions and related data. JMP provided a rich suite of cases, from which topics were selected and data expanded from original sources on the Web.

The topics and statistical methods studied, business scenarios of the case studies, and statistical/graphical tools used are listed in Table 2. The case study library illustrates the application of statistical tools to real-world problems. Each case study "provides background information, a task, data, complete JMP Pro 12 software illustrations, a summary of insights and implications, and exercises." (https://www.jmp.com/en_us/academic/case-study-library.html)

Table 2. Topics and Tools

Topics and Statistical Methods	**Business Scenarios of Case Studies**	**Statistical Graphical Tools Used**
Descriptive Statistics, Graphics, and Exploratory Data Analysis	Medical Malpractice Case Study: Explore claim payment amounts for medical malpractice lawsuits and identify factors	Histogram, summary statistics, bar chart and frequency distributions, Pareto Plot, pie chart, and box plots.
Descriptive Statistics and Time Series Plots	Airline Baggage Complaints Case Study: Compare the baggage complaints for three airlines	Time series plots, summary statistics, and calculating rates.
Sampling Distributions and Sampling Error	Defect Sampling Case Study: Explore the effectiveness of different sampling plans in detecting changes in the occurrence of manufacturing defects	Histograms, summary statistics, and time series plots.

Confidence Intervals and t-Tests for Paired Samples	Price Quotes Case Study: Determine whether pricing experts are providing different price quotes to customers	Histograms, summary statistics, confidence interval for the mean, and One Sample t-Test (for a difference).
One-Way ANOVA and Kruskal-Wallis	Cost of Living: Use data from the World Factbook to determine if various geographic regions differ in overall wealth	Geographic mapping, histograms, log transformation, ANOVA, Welch's ANOVA, Kruskal-Wallis.
Regression and Forecasting	Direct Mail Case Study: Determine whether sales are related to a direct mail campaign	Time series plots, simple linear regression, creating lagged variables, predicted values and prediction intervals.
Logistic Regression	Lost Sales Case Study: Determine whether certain conditions make it more likely that a customer order will be won or lost.	Bar charts and frequency distributions, chi-squared tests, logistic regression, predicted values and confusion matrix.
Multiple Regression - Multicollinearity and Model Building	Housing Prices Case Study: After determining which factors relate to the selling prices of homes located in and around a ski resort, develop a model to predict housing prices	Scatterplot matrix, pairwise and partial correlations, multiple regression, model diagnostics.
Simple Linear Regression and Time Series	Contributions Case Study: Predict annual contributions in an employee fund-raising drive	Summary statistics, time series plots, simple linear regression

The assignment of the initial case studies evolved over subsequent semesters and new cases were substituted into learning units based on students' responses to the subject matter and understanding of the graphics options in the JMP software. Students have been very positive about JMP, and have used it heavily in subsequent courses, thus demonstrating the value of the software for communicating analytic content.

The benefits of the new course include:

1. Students have the opportunity to use their statistical skills they were exposed to as sophomores (and they were recommended to retain their statistics text for the SCMA 350 course).
2. Students gain experience in working in groups to analyze problems together, and to create a presentation both written and oral.
3. Students are exposed to decisions and data sets related to real business problems.

While student evaluation results follow normal variation by instructor, students feel in general that they have a more valuable use of this core requirement.

4. Business Analytics Undergraduate Minor

There has been an interest among undergraduates exemplified by student inquiries. A minor was created consisting of:

SCMA 331 (a required CBA core course) and SCMA 350 or MRKT 350 (a required CBA core course) as a prerequisite to taking SCMA or MRKT courses below. The three required courses are:

SCMA 335 Supply Chain Decision Making Models

This course provides learning outcomes of applying optimization models and understanding quantitative techniques

SCMA 451 Introduction to Predictive Analytics – business analytic tools

This course develops skills in analyzing complex data sets, understanding data mining modeling techniques, and formulating complex decision problems

SCMA 452 Database Management Systems – big data plus data mining

This course provides learning outcomes of understanding big data, learning database storage and retrieval systems, and applying basic data mining tools

A fourth course for the minor comes from the following:

ACCT 308 Managerial Accounting – cost accounting

This course provides learning outcomes of understanding budget variance analysis and applying revenue and cost reports for decision making

ACCT 309 Accounting Systems – information systems in accounting

This course provides learning outcomes of modeling business decision making processes as well as evaluating and designing system internal controls

MRKT 355 Marketing Metrics

This course provides learning outcomes of understanding marketing research roles in business decisions

SCMA 437 Supply Chain Risk Management – simulation modeling

This course provides learning outcomes of learning probabilistic business decision modeling as well as risk management in business

Twelve hours of coursework only allow limited exposure beyond the core business analytic course. But students are finding the job market very strong at this point.

5. Graduate Certificate in Business Analytics

The aim of this program is to provide broad understanding and knowledge of important business analytic topics and how they can be used to support decision making in all business areas, government, education, and agriculture. Emphasis is placed on the technical procedures that are used to describe, predict and prescribe data into information for decision making. Students learn how data exploration results in a sequence of descriptive, predictive and prescriptive processes to result in unique and new information on which decisions can be made.

GRBA 851 Business Analytics

The course is 3 credit hours, on-line. It is self-paced except for group reports and exams.
During the semester, student groups submit a paper on an optimization application they find in the INFORMS journal *Interfaces* dated 2015 or more recently, which is available in the UNL library to describe what the problem was, and outline the logic used. Then the model used and its assumptions are analyzed. Each student group also selects a semester project related to the implementation of optimization. Ideally, these projects will involve real projects. But report of a published application can also be used. Cite sources. Papers should be 5-10 pages of prose, explaining the study, giving sources.

Individual assignments are given on the topics of visualization, control charts, time series forecasting, multiple regression, linear programming, and sensitivity analysis. Excel software serves for all assignments (to include SOLVER).

Econometrics
The course is 3 credit hours, on-line, taught by Econometrics faculty. The course rigorously presents statistical modeling in business. It has been taught using SAS, but other computer statistical software has also been used

Marketing Analytics
This course, also 3 credit hours on-line, taught by Marketing faculty. It presents marketing database concepts and applications, to include customer relationship marketing. It coordinates software with the Econometrics class.

Predictive Analytics
Predictive modeling in today's environment involves applying knowledge management to analyze massive quantities of data. Forecasting can be supported by quantitative analysis using computer tools to provide business intelligence needed in today's business environment.
The purpose is to introduce the student to analytic methods and software commonly used in forecasting and classification in business, enabling them to use the basic methods and software packages to solve business problems.

The course is 3 credit hours, on-line. It is self-paced except for group reports and exams. This course focuses on how knowledge management has been successfully applied in business in the form of forecasting. It will also describe in non-technical terms how the statistical and artificial intelligence-based tools commonly used in forecasting and other business decisions involving big data. Predictive analytics extend statistical and/or artificial intelligence to provide forecasting capability. Individual assignments include six data mining models using Rattle open source software.

6. Master's in Business Analytics

The proposed Master of Science in Business Analytics consists of 30 credit hours, capable of being taken in one year. Courses will be offered in five 8-week sessions along with CBA online MBA coursework. A focus of the coursework is developing foundational understanding of analytic decision making tools as well as the role of big data in contemporary business, followed by exposure to tools and applications. Tool courses will include data management (database management and SQL), statistics, predictive modeling, and classification data mining models.

Business analytics involves collaboration across data acquisition and storage, business functional decision making, and quantitative analysis. Our proposed program offers coursework in data acquisition and management, functional business decision making in marketing and general business applications, and statistical analysis as well as data mining modeling.

Contribution to Society and Economic Development
The proposed business analytics masters' program will train students in skills useful in a society faced with a flood of data from a variety of sources. Training will emphasize looking for opportunities to develop new and innovative solutions to emerging problems, thus providing leaders to cope with a rapidly changing society and economy.
Comparative Costs
The proposed cost of the program to students is about $1,800 per hour for 30 hours, or $54,000 total. Cost comparisons were made with other institutions. Note that costs and programs offered are highly dynamic, but there is a clear trend for more business analytics master's programs. Within Nebraska:

Creighton has a 33 hour program costing $820 per hour in class and $1,025 per hour on-line

Bellevue has a 36 hour program costing $525 per hour (they list $18,900)

Costs were also compared with other conference schools (Table 3). (As noted, programs are rapidly evolving, and costs change regularly.)

Table 3. Similar Programs within Midwestern Higher Education Compact States

College	Offerings	In-State	Out-of-State	Delivery Mode
Illinois				
Indiana	MS Business Analytics	$ 34,350.00		Online
	Business Analytics Certificate	$ 13,740.00		Online
Iowa	MS Business Analytics	$ 19,950.00		Campus
	Business Analytics Certificate	$ 9,975.00		Campus
Maryland	MS Marketing Analytics	$ 46,140.00		Online
Michigan	MS Business Analytics	$ 24,271.00	$ 38,255.00	Campus
Michigan State	MS Business Analytics	$ 36,000.00	$ 39,000.00	Campus
Minnesota	MS Business Analytics	$ 30,916.00	$ 47,360.00	Online
Northwestern	MS Business Analytics	$ 97,248.00	$ -	Campus
Ohio State	Coursework	N/A	N/A	N/A
Penn State	Applied Statistics Certificate	$ 9,660.00	$ -	Online
Purdue	MS Business Analytics	$ 29,000.00	$ 46,000.00	Campus
Rutgers	MS Business Analytics	$ 40,764.00	$ 49,536.00	Both
	Post-MBA Certificate	N/A	N/A	N/A
Wisconsin	N/A	N/A	N/A	N/A

The UNL program degree meets the goals outlined in Comprehensive *Statewide Plan for Postsecondary Education* by the Nebraska Coordinating Commission for Postsecondary Education (CCPE). CCPE wants to make certain that postsecondary education develops graduates who can both contribute and succeed in a highly technological world. The Master of Science in Business Analytics program strengthens that goal by:

- Developing skills, knowledge, and critical thinking abilities of graduates;
- Meeting the needs of the State of Nebraska by providing workforce development and ongoing training in the fields of business analytics and data management;
- Contributing to the health and prosperity of the people of Nebraska through research, technology transfer and technical assistance by helping business analytic problems for Nebraska companies;
- Increasing participation and access of students by recruiting students across Nebraska and the Midwest regardless of economic status, age, culture, disability, color, national origin, or gender;
- Meeting accountability and effectiveness as well as partnership goals by developing and sustaining exemplary teaching, learning, research, and public service activities through faculty coordination with peers and with firms involved in business analytics and data management.

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focus of the coursework is developing foundational understanding of analytic decision making tools as well as the role of big data in contemporary business, followed by exposure to tools and applications. Tool courses will include data management (database management and SQL), statistics, predictive modeling, and classification data mining models. Applications will be exposed through coursework in marketing and data management. Advanced modeling tools and/or business applications will be covered through System Dynamics Modeling, and probabilistic analysis will be covered through Supply Chain Risk Management.

Table 4. Required Courses BA Masters (24 hours)

Course Number	Title	Credits	Development
GRBA 851	Business Analytics	3	Existing course
SCMA 8xx	Big data and contemporary business	3	New course
SCMA 852	Data management	3	New course
ECON 817	Introductory Econometrics	3	Existing course
SCMA 851	Predictive modeling	3	New course
SCMA 853	Data Mining Applications	3	Existing course
MRKT 850	Strategic Database Marketing	3	Existing course
MRKT 845	Advanced Marketing Analytics	3	On-line development
SCMA 8xx	System Dynamics Modeling	3	New course
SCMA 837	Supply Chain Risk Management	3	On-line development

7. Conclusions

Business analytics clearly is growing in importance. At UNL, it has been incorporated to date in four ways: Conversion of an undergraduate core class formerly covering MIS; offering of an undergraduate minor; a graduate certificate program offered within the MBA program; and a new master's in business analytics program. This has been accomplished over the past five years, from conception to delivery, hiring faculty as the program has evolved. There have been numerous challenges obtaining faculty, but this also has been successfully accomplished thus far.

The primary lessons are that there are a number of ways in which a business analytics program can be delivered. In our case we chose an operations research focus, which matches our department structure and faculty interests. There certainly are other approaches, to include information systems focus.

In our case, our courses are primarily designed around the model of learning by doing – through assignments given in a business decision context, with the intent of demonstrating typical business decisions supported by analytics, data types, and model types. Students are tasked with writing reports, and in classroom venues, presenting results in teams.

We also utilize papers requiring students to search and learn through reading publications as well as Web material. This is intended to give students some practice in conducting a type of research.

The master's programs are on-line, because that is where the market is for our college. This draws students from across the globe. It is possible to hold classes virtually, and some faculty do, but others operate almost as each student being an independent study. Asynchronous activities are very difficult to coordinate.

The experiences at UNL in delivering business analytics have been quite successful. There is a great deal of competition as almost every US university is seeing the need to deliver content on-line, reflecting the desires of millennial students. Change is constant, and every academic institution needs to take advantage of matching their skill set with opportunities.

References

1. CapGemeni Inc. (2012), The Deciding Factor: Big Data & Decision Making. Retrieved from http://www.capgemeni.com/resources/the-deciding-factor-big-data-decision-making.
2. Chiang, R.H., Goes, P., Stohr, E.A.: Business intelligence and analytics education, and program development: A unique opportunity for the information systems discipline. *ACM* Transactions on Management Information Systems 3 (3), 12:1-12:13 (2012).
3. COE Forum: Market Research Brief: Program Opportunity Analysis for the University of Nebraska-Lincoln: Analysis of Nationwide Market Viability of Potential Specialized Master Degrees in Business Related Fields (Dec 2015).
4. Davenport, T., Patil, D.J.: Data Scientist: The Sexiest Job of the 21st Century. Harvard Business Review 90 (10), 70-76 (2012).
5. Department of Labor: Monthly Labor Review (2012). Retrieved from http://www.bls.gov/opub/mlr/2012/01/art5full.pdf
6. Gartner: Big Data Creates Big Jobs: 4.4 Million IT Jobs Globally to Support Big Data by 2015 (2012). Retrieved from http://222.gartner.com/newsroom/id/2207915.
7. Gupta, B., Goul, M., Dinter, B.: Business intelligence and big data in higher education: Status of a multi-year model curriculum development effort for business school undergraduates, MS graduates, and MBAs. *Communications of the Association for Information Systems* 36 (23), 449-477 (2015).
8. Lee, P., Stewart, D.: Technology, Media and Telecommunications Predictions. Deloitte Touche Tomahatsu Limited (2012). Retrieved from htttp://www.deloitte.com/assets/Dcom-Guam/Local%20Assets/Documents/TMT%20Predictions%202213.pdf.