Reflections on the Creation of a Business Analytics Minor

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Abstract

This article presents the details of a business analytics minor that we created at our institution in the fall of 2019. In the two years since, our program has successfully met our enrollment goals. Out of over 50 minors offered at our institution, our business analytics minor is currently ranked fourth in enrollment. In this article we will present the process that we followed to create our minor, cover our curriculum (including course descriptions), the staffing of the courses, program enrollment, enrollment by course/semester, and enrollment by major/semester. Finally, we will conclude with some reflections on our experience. The hope is that this paper can help others who are contemplating, or in the process of, introducing a business analytics minor.

Keywords: Business Analytics Minor, Business Analytics Minor Curriculum, Education in Data Analytics

1. INTRODUCTION

This article is a follow-up to an article written by the authors in 2019 (Burns, T. J., Sherman, C. (2019). In that previous article our research was focused on determining the optimum curriculum for a minor in business analytics. In order to determine that curriculum, we gathered data from sixty business analytics minor programs. Later in this paper we include a synopsis of the results of that original paper. In the years since that paper was published, we have successfully created a business analytics minor at our institution with a curriculum based on the results.

The purpose of this article is to present the details of the minor that we created. We introduced our business analytics minor in the fall of 2019. In the two years since, our program has successfully met our enrollment goal. Out of over 50 minors offered at our institution, our business analytics minor is currently ranked fourth in enrollment. In this article we will present the process we followed to create our minor, our curriculum (including course descriptions), the staffing of the courses, program enrollment, enrollment by course/semester, and enrollment by major/semester. Finally, we will conclude with some reflections on our experience. The hope is that this paper can help others who are contemplating, or in the process of, introducing a business analytics minor.

In recent years, there has been an explosion in the demand for personnel in the field of analytics. An understanding of analytics has the potential to add value to almost any career path as analytics spans across all disciplines and industry sectors. Students with these skills are in high demand in a variety of industries and sectors. Ranked second in a *Computerworld* survey on the most difficult skills to find, analytics expertise is scarce (Computerworld, 2018). McKinsey Global Institute reports that the United States could face a shortage of between 140,000 and 190,000 individuals who possess business analytics skills

and an additional 1.5 million managers with the skills to implement the results (McKinsey Global Institute, 2018).

Given that the demand for this skill set cuts across so many disciplines, it is a useful addition to any major and an ideal candidate for an academic minor. In fact, 16% of job offers for those with bachelor's degrees in information technology are in data analytics and the average salary is approximately $63,000. For graduates with master's degrees, data analytics job offers constitute 42% and the average salary is approximately $20,000 more (AIS and Temple University, 2019).

Furthermore, as the underlying analytics tools and techniques emerge from disciplines such as management science, operations research, statistics, business intelligence, information systems, and traditional business fields, the school of business makes an ideal place to house an analytics minor.

A proposed undergraduate information systems curriculum, under development by the IS Task Force of the AACSB MaCuDe project, may offer more guidance as to the components of the minor (Lyytinen, K, Topi, H. & Tang, J., 2020).

2. LITERATURE REVIEW

The starting point for creating a business analytics minor was to research existing curricula models and programs. However, this proved somewhat problematic. The literature related to data analytics education is not abundant and it remains scattered and difficult to retrieve by a keyword search. This is in part due to an imprecision in nomenclature which is a natural outgrowth of an evolving discipline. For example, terms such as "business analytics," "data analytics," or "decision science" are often used as substitute terms (Zheng, 2018). To add to the confusion, a business analytics program can be offered through a computer science department or be interdisciplinary, making it difficult to identify programs which could be used as models (Phelps & Szabat, 2015).

Also, according to a survey by Phelps and Szabat (2015), most schools were not yet even offering an undergraduate major in business analytics or decision sciences and 59% did not offer a minor. However, 30% of the respondents were considering creating such a major and 26% were considering a minor, a strong demonstration of interest and of future direction for the field.

Wymbs (2016) echoed the findings of Phelps and Szabat (2015) noting that as of 2016, there were 517 data science/data analytics programs of which 374 were Master's programs, 88 Certificate programs, 36 Bachelor's programs, and 10 PhD programs. A query of the AACSB database of 1,500 institutions indicated only 11 undergraduate programs in data analytics and data science but 56 programs in business analytics.

Utilizing an outcomes-based approach to curriculum development, Wymbs (2016) discussed insights provided by the 2015 Business Higher Education Forum Conference which was attended by organizations in a number of business and public sectors including investment banks, accounting firms, tech companies, and the Federal Reserve. Attendees identified "R" and Python as programming languages of choice and also made specific reference to the needs of the accounting profession. They indicated new accounting graduates would need to demonstrate data analytics proficiency in order to be hired. In fact, this recent focus on business analytics in the accountancy field is reflected in upcoming changes to the CPA exam (Dorata, 2021). And, given that accounting is a robust major at most business schools, a new emphasis on data analytics within accountancy should affect every aspect of a business analytics minor, including enrollment, staffing, double-counting of courses, resource sharing, and the like.

As with many new undertakings, it can prove difficult to find the correct focus for a program. Wilder and Ozgur (2015) provided a model for addressing this conundrum by identifying the "output of business analytics programs," i.e. industry needs for personnel in the field. They identified the data scientist, the data specialist, and the data-savvy manager as potential graduates of business analytics programs. While a data scientist requires a foundation in mathematics and computer science, a data specialist functions more as a traditional information technology (IT) worker and a data-savvy manager must know how to identify suitable questions to be answered through data analysis and how to frame these questions.

To connect their observations to curricula development, Wilder and Ozgur (2015) identified 49 pertinent graduate programs and suggested using their curricula as a starting point. Based on this research, they proposed six required courses: Data Management (tools such as SQL), Descriptive Analysis (statistics), Data Visualization (key indicators, scorecards,

dashboards), Predictive Analytics (advanced statistics), Prescriptive Analytics (Spreadsheet Models), and Data Mining (CRISP-DM).

The market demand for students with an analytics skill set was also a driving force behind the Business Intelligence Congress sponsored by the AIS Special Interest Group on Decision Support, Knowledge and Data Management Systems (SIGDSS) and the Teradata University Network (TUN) (Wixom (2014). Utilizing surveys and insights from industry representatives, they investigated academia's response to this demand and noted the dramatic increase in Business Analytics and Business Intelligence programs and the increased access to teaching resources. They also noted the continuing need for students to have foundations skills and practical experience and that demand for analytics graduates was continuing to outpace supply. While communications skills remained a top demand of employers, SQL and basic analytics, such as descriptive statistics, regression and ANOVA were in second and third place.

They also noted that major questions about curricula remained unanswered and that there was very little in the way of guidelines or model curricula. Decisions about the number and type of courses, prerequisites, and integration with other majors were yet to be answered in a systematic manner. However, one survey revealed that 296 out of 313 professors were participating in business analytics academic alliance programs to offer software to students. Interestingly, another survey revealed that students were now taking analytics courses because they wanted to do so, rather than because it was a requirement for a degree.

Conceptually, there is therefore some agreement as to what a business analytics minor might include but on a more granular basis there continues to be disagreement. Meyer (2015) stated that there was no defined curriculum for data analytics. He described the subject as multi-disciplinary and developed a cross-college program with the potential to earn a degree in either the College of Arts and Sciences or the College of Business.

Meyer concluded that the elements of data analytics are: data/database, statistics, operations research, computer science, and managerial strategy. Because these courses already exist, it is only necessary to add courses such as Data Visualization, Programming in R, or Customer Sentiment Analysis to initiate a program in data analytics.

In fact, the Association for Computing Machinery (ACM) and the Association for Information Systems (AIS) have recognized the afore-mentioned diversity of curricula in the IT field. Rather than specifying courses, they articulated the competencies that graduates should attain upon completing a graduate program in information systems (Topi, 2016). They describe a telescoping model which consists of competency areas that contain competency categories with individual foundational competencies.

In keeping with the discovery that more research was needed before developing a business analytics minor, the authors (Burns & Sherman, 2019) reviewed the curricula of sixty colleges and universities, in the United States, offering a business analytics minor. Most commonly, the subject universities required courses in statistics and IT. Accordingly, Management Statistics and Principles of Information Technology became the prerequisites for our minor. Principles of Information Technology covers, at least cursorily, traditional IT subjects such as database, spreadsheets, programming, and networking. The required courses of our minor, Business Analytics I and II cover the basic statistical, analytical, and visualization tools comprising business analytics as well as the role of business analytics in an organization. Two electives, selected from a list of eight, encourage specialization in functional business areas or deeper study of specific mathematical and software tools. Our minor is open to students of any major, which reflects the interdisciplinary nature of the college.

3. THE PROCESS TO CREATE THE MINOR

In this section we will explain the process that we went through to introduce the new business analytics minor at our institution. Listed below are the general steps that we followed. As each institution is unique, this process is not intended to be a "cookie cutter" approach, but rather a general guide that can be used by other institutions that are interested in developing a business analytics minor program.

We included the following steps in developing our business analytics minor:

1. Reviewed business analytics minors offered at other institutions.
2. Defined the curriculum for the minor.
3. Developed the program description, mission, learning goals/outcomes, and assessment process.

4. Developed new courses needed including course description, materials, and syllabus.
5. Followed the institution's administrative process to introduce a new minor.
6. Scheduled new courses.
7. Hired needed faculty.
8. Marketed the new program

Review of business analytics minors offered at other institutions.

For this first step, sixty colleges/universities that offer a business analytics minor were randomly selected (see Burns & Sherman 2019 for an in-depth discussion of this process). The curriculum for each of the programs was then reviewed, analyzed, and tabulated. For each program, it was determined the number and nature of the prerequisite courses, required courses, and elective courses. A list of the courses was then recorded. Once the courses were identified, the researchers then reviewed the catalog descriptions of the courses. Based on the catalog descriptions a list of the topics covered was compiled. The end result was three lists; 1) a list of the most common prerequisite topics, 2) a list of the most common required topics, and 3) a list of the most common elective topics offered. The analysis of the sixty programs showed that, on average, business analytics minor programs have two prerequisite courses, three required courses, and two electives.

Definition of the Curriculum.

Table 1 lists the curriculum of the minor that was developed based on the results of the review of other programs. The course descriptions from our college catalog are shown in Appendix A.

Our curriculum has two required prerequisites, (Management Statistics and Principles of IT). The role of the prerequisite courses is to prepare the student for the material covered in the minor (particularly students from non-technical majors) The Management Statistics course covers statistical theories and techniques commonly used in the analysis of business data. Emphasis is on descriptive measures, probability theory, estimation techniques and forecasting methods, hypothesis testing, and time series analysis. The Principles of IT course topics include the following: computer hardware and software architecture, organizing data, telecommunications and networks, types of systems and their development, and the role of information technology in business and society.

The prerequisite courses listed in table one are those offered in our school of business (which is the home school for our minor). We designed our minor so that it could be added to any major in the college. Minors are open to students regardless of school affiliation. Therefore, non-business students enrolled in the minor are able to fulfill the prerequisite courses with similar courses offered in their home school (or with courses taken at other institutions).

Prerequisites:
Management Statistics
Principles Of Information Technology
Required:
Business Analytics I
Business Analytics Ii
Electives: Select Two
Econometrics
Introduction To Programming
Introduction To SAS
Database Management Systems
Data Visualization
Decision Support Systems
Management Science
Marketing Research

Table 1 Business Analytics Minor Curriculum (See Appendix A for course descriptions)

Our curriculum has two required courses: Business Analytics I and Business Analytics II. The Business Analytics I course provides students with the fundamental concepts and tools needed to understand the emerging role of business analytics in organizations. The course covers managerial statistical tools in descriptive analytics and predictive analytics, including probability distributions, sampling and estimation, statistical inference, and regression analysis. Students develop an understanding of basic visualization techniques and how to apply them which enables them to effectively communicate with analytics professionals and make better business decisions.

The second required course, Business Analytics II, provides students with advanced concepts and tools needed to understand the role of data analytics in organizations. Topics include forecasting, risk analysis, simulation, data mining, and decision analysis. Emphasis is on

applications, concepts and interpretation of results, as well as conducting statistical analyses.

The elective courses in the curriculum help the students develop skills that increase their knowledge of a specialized area within their field. Our curriculum requires two electives. The electives offered are shaped by the goals of the program and, at least to start, the available course offerings at our institution.

Developed the program description, mission, learning goals/outcomes, and assessment process.

Once we had defined the curriculum for the program we moved on to the overall definition of the program. This included developing a program description, mission, learning goals/outcomes, and an assessment process.

Our program description is:

"Business Analytics studies data in order to identify patterns or trends that can then be used to predict future patterns or trends, allowing businesses to make better decisions. We live in a time when large amounts of data are being collected, in almost every aspect of society—and there is a tremendous demand for people with analytics skills. The U.S. Bureau of Labor Statistics predicts a strong demand for people with business analytics skills well into the next decade. The Business Analytics minor is available to students in any major to add to their marketable skills and knowledge."

Our mission statement is:

"The Business Analytics Minor prepares students to have the knowledge, skills, tools, and competencies required for the methodical exploration and investigation of data. Using descriptive, predictive, and prescriptive statistical tools, students will support decision-making and gain insight into business performance."

Our program has two learning goals and outcomes:

Goal 1: Foundation - Our students will have a broad-based knowledge in the functional areas of business analytics.

Outcome 1: Students will comprehend principles and practices in key business analytics disciplines.

Goal 2: Communication - Our students will demonstrate effective visualization of data skills.

Outcome 2: Students will effectively present the results of business analytics cases visually using graphics.

Learning Goal and Related Outcomes:	Direct Measure(s)	Indirect Measure(s)
Goal 1: Foundation: Students will have a broad-based knowledge in the functional areas of business analytics. Outcome 1: Students will comprehend principles and practices in key business analytics disciplines.	Rubric-based evaluation of students' analysis of business cases. The rubric will evaluate how well students comprehend principles and practices in key business analytics disciplines.	Syllabi Review and Student Perception of Learning Survey
Goal 2: Communication: Students will demonstrate effective visualization of data skills. Outcome 2: Students will effectively present the results of business analytics visually using graphics.	Rubric-based evaluation of the presentation of business analysis results. The rubric will evaluate the visualization skills of the students. Evaluation will take place in Business Analytics II	Syllabi Review and Student Perception of Learning Survey

Table 2 Direct/Indirect Measures of Assessment

Our initial assessment measures and process:

"The assessment process will take place over a five-year cycle with the Business Analytics faculty assessing the program bi-annually, evaluating each outcome twice in five years. The outcomes will be assessed in courses taken in the final semester of the program utilizing both direct and indirect measures. The BA faculty in conjunction with the School Assessment Committee will develop rubrics. The ITM faculty will discuss results and closing the loop suggestions will be

implemented as needed to close identified gaps in achievement of learning outcomes."

Table 2 lists the direct and indirect measures of assessment that were developed.

Developed new courses needed including course description, materials, schedule, and syllabus.
The prerequisite courses and most of the electives already existed in our college catalog. So, for the new program, we were required to create four new courses. Those courses included the two required courses (Business Analytics I and Business Analytics II) and two new electives (Data Visualization and Introduction to SAS).

The two required courses were developed based on a graduate introductory analytics course that was already being offered in the MBA program. We were able to identify a textbook (*Business Analytics* by James Evans) that covered the topics we had identified through our prior research and based on the coverage of the MBA course. Given the broad spectrum of topics covered by the textbook we were able to use the same book for both courses. Also, using the textbook we were able to develop a schedule of topics covered.

For the elective, Data Visualization, we relied on the expertise of a current faculty member. He had previously developed a similar course and had extensive experience in the subject matter. He was able to draw upon his expertise to develop the course. The elective "Introduction to SAS" was developed by a new faculty member who had certification and expertise in the topic. Both faculty selected the textbook and materials for their respective courses.

Followed the institution's administrative process to introduce a new minor.
The process to introduce a new program at our institution took about a year. After preliminary approval by the convening group (department) and Dean of the school, a new program proposal was prepared for the Provost. This proposal included a feasibility study that summarized the program, the program's impact on the college and other programs within the college, the need for the program, a comparison to other programs in our state, and the program's anticipated enrollment from launch to optimal level. In addition, the proposal included a curriculum section that listed the program's mission and learning goals, the program assessment measures, the program's relationship to the college mission and strategic plan, degree requirements, and details of the curriculum.

Once the Provost approved the program proposal, a series of documents were prepared for the college's Academic Review Committee (ARC). These documents included a form that described the new program and a form for each new course in the minor. Each of these forms had to be approved by the convener (department chair), the chair of the school curriculum committee, and the Dean before they were sent to ARC. ARC then reviewed the documents, provided feedback, and then eventually approved the program.

The ARC documents were then sent to the Provost for approval. Once the Provost approved the program it was presented to the entire college faculty for approval. The program then went to the college's board of trustees and ultimately to the state for final approval.

Scheduled new courses.
We decided to offer the Business Analytics I course in the fall and winter semesters and Business Analytics II in the spring semester. The prerequisites are offered every semester (they were already required courses for the business students) and the electives are offered in different combinations every semester. By offering Business Analytics I in the winter semester it allowed students who wanted to start the program in the spring to complete Business Analytics I before the spring semester (as Business Analytics I is a prerequisite to Business Analytics II).

Hired needed faculty.
As most of the courses were already part of the business curriculum and currently staffed by existing faculty, our need for new faculty was limited. An existing faculty member was able to develop and teach the new course, Data Visualization. We ended up needing one new faculty member to teach three courses (Business Analytics I, Business Analytics II, and Introduction to SAS). We convened a search committee (consisting of IT management faculty and faculty with analytics experience) and conducted a search in academic year 2018/2019. We had over 100 applicants for the position. Eventually we were able to narrow the list to three candidates, and after visits to campus, we were able to make an offer to our top candidate (who accepted the position). The ideal candidate had the experience and education to teach the new analytics courses as well as other courses in the IT Management curriculum.

Marketed the new program.
Once all the pieces were in place, we were ready to launch our program in the fall semester of

2019. We were able to market the program to the college community through several vehicles. First, we added a blurb about the new program to the college's "Daily Digest" email that is delivered daily to the entire college community. We ran the blurb for a week or two. We then sent a specific targeted email to all students in the school of business. This email introduced and explained the new minor to the students. We also added a slide about the new minor that became part of the display on hall monitors that are posted throughout the school of business building. Finally, we asked all business faculty to announce the new minor in their classes.

4. ENROLLMENT

This section will discuss the enrollment numbers in our program. Table 3 shows the total enrollment in our minor by semester. Our original projected goal was to have 20 students in the program. As Table 3 shows we were able to surpass that goal in the spring 2021 semester and attain a total of 34 students by the fall 2021 semester. Table 3 also shows how the program has grown over the last two years. It should be noted that the total undergraduate enrollment at our institution is 4,981 students.

Fall 2021	34
Spring 2021	27
Fall 2020	15
Spring 2020	19
Fall 2019	2

Table 3 Business Analytics Minor Enrollment by Semester

The largest major is biology with 435 students. The Information Technology major has 86 students enrolled.

Psychology	79
Crime and Justice	51
Marketing	39
Business Analytics	34
Spanish	27

Table 4 Enrollment by Minor Fall 2021

Table 4 is included to show where the business analytics minor ranks in enrollment in comparison to other minors at our institution. There are approximately 50 minors offered at our institution and business analytics ranks fourth with a total of 34 students. This is especially notable, *and highly significant*, given that the business analytics minor is only two years old and psychology (the most popular minor) and the other popular minors have been established for many years.

Table 5 shows, by semester, which major programs our students are pairing with the business analytics minor. These numbers vary by semester, but it appears that most students minoring in business analytics, major in marketing, finance, or international business.

Enrollment By Major	F19	S20	F20	S21	F21
Accounting		1	1	2	3
Business Admin	1	5	4	4	
Communication Arts			1	1	
Economics		1			2
Finance		3	2	3	7
ITM	1	5	1	4	3
International Business				1	4
Management		2	2	2	3
Mathematics				1	1
Marketing		1	3	8	10
Theater		1	1	1	1
Total	2	19	15	27	34

Table 5 Business Analytics Minor Enrollment by Major/Semester

Tables 6, 7, 8, and 9 are included to show the enrollment in the new courses that were created for the new business analytics minor. It should be noted that the new courses offered also were added to the pool of elective courses available to students majoring in IT management and that's why the numbers don't coincide exactly with the minor enrollment numbers.

Fall 2021	20
Winter 2021	6
Fall 2020	22
Winter 2020	10
Fall 2019	15

Table 6 Enrollment in Business Analytics I Course by Semester

Spring 2021	22
Spring 2020	11

Table 7 Enrollment in Business Analytics II Course by Semester

Spring 2021	24
Spring 2020	14

Table 8 Enrollment in Data Visualization Course by Semester

Fall 2021	6
Fall 2020	4

Table 9 Enrollment in Introduction to SAS Course by Semester

5. Other Measures of Success

	1	2	3	4	5	Mean
BA1						
F19		4	2	5	2	3.38
W20				3	4	4.57
F20			4	3	12	4.42
W21			1	0	5	4.67
F21	1	0	6	0	7	4.15
W22		1	1		6	4.38
BA2						
S21		1	5	1	13	4.30
DV						
S21			3	1	15	4.63
SAS						
F21					6	5.00
Total	**2**	**8**	**25**	**17**	**75**	**4.29**

Table 10 Student Rating of Learning

Even though the enrollment numbers are excellent, enrollment alone may not be sufficient to show the success or failure of the curriculum design. Tables 10 and 11 show data from student opinion surveys collected from several of the courses. The left column lists the course and the semester. Table 10 shows student responses when asked to rank how well they learned the subject on a scale from 1 to 5. Table 11 shows student responses when asked to rank how excellent the course was on a scale from 1 to 5. Both tables show an overall mean greater than 4.2 which indicates that students rate both measures very high.

	1	2	3	4	5	Mean
BA1						
F19	1	4	4	2	2	3.25
W20			2	1	4	4.29
F20			4	2	13	4.47
W21				2	4	4.67
F21	1	0	4	3	7	4.29
W22			2	1	5	4.38
BA2						
S21	2		4	4	10	4.44
DV						
S21		2	4	1	12	4.21
SAS						
F21					6	5.00
Total	**5**	**8**	**27**	**20**	**68**	**4.24**

Table 11 Student Rating of Excellence

We also chose our institution's program learning assessment process that is used for accreditation and internal measurement as a metric for the business analytics minor. Our institution implements a bi-annual assessment process with each program (majors, minors, and certificates) being assessed every two years. The results of the assessment of student learning for the business analytics minor will be reported in future research as the first scheduled assessment and subsequent report will be completed at the end of the spring 2022 semester. The assessment process consists of preparing an assessment plan that is approved by committees both within the school of business and college wide, and then implementing the plan and analyzing the assessment results. Appendix B is a copy of the assessment plan that was prepared for the business analytics minor (and will be implemented later year).

The plan details the learning goals and desired outcomes for the program (also shown in table 2). The two goals include foundational business analytics knowledge demonstrated by the comprehension of the principles and practices in key business analytics disciplines and

communication demonstrated by effectively presenting the results of business analytics cases visually using graphics. The goal will be assessed using a business case involving business analytics completed by the students in a required second level course. The students' responses will be evaluated using a Business Analytics Rubric (shown in appendix C). The outcome will be assessed by business analytics faculty using a blind review after an inter-rater reliability session. The achievement target is that 75% or more of students will be rated "Very Good to Excellent".

6. REFLECTIONS/CONCLUSION

The overall reflection/conclusion of the effort that we undertook to create a business analytics minor is that it was a worthwhile and successful initiative. For us, the most labor-intensive parts of the project were the administrative process to have the minor approved at our institution and the hiring of new faculty. The administrative process involved a lot of "red tape," bureaucratic tasks that slowed the process. Hiring a new faculty member was labor-intensive because at the time there was a lot of competition for candidates with analytics and IS education/experience.

It should be noted that one thing, fortunately, that we had in our favor was that our school, dean, and institution supported the minor. Our institution had recently decided to undertake a major data science effort in conjunction with the computer science and math departments. We were able to introduce the business analytics minor as a program that fit the business niche of the data science program.

The primary limitation of this research is that the program is only two years old and we have not yet had enough time to collect enough data to properly assess the program. Future research on this topic will report on assessment data and results. However the strong initial enrollment in the program serves as a promising indicator of future success.

Our hope is that we can use the same process again to introduce a graduate degree in business analytics. If you are contemplating, or in the process of, introducing a business analytics minor, we hope that the information contained in this article has been helpful.

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Appendix A – Course Descriptions

MANAGEMENT STATISTICS: A study of statistical theories and techniques commonly used in the analysis of business data. Special emphasis will be placed on descriptive measures, probability theory, estimation techniques and forecasting methods, hypothesis testing, and time series analysis.

PRINCIPLES OF INFORMATION TECHNOLOGY: The course focuses on why and how information technology should be used to meet organizational goals. Topics include the following: computer hardware and software architecture; organizing data; telecommunications and networks; types of systems and their development; and the role of information technology in business and society. Students will solve selected business problems using the Microsoft Office Professional for Windows suite of software and acquire the background to serve as internal systems consultants to all the functional areas of an organization. Prerequisite: Knowledge of MS Office and facility with the Internet.

BUSINESS ANALYTICS I: The course provides students with the fundamental concepts and tools needed to understand the emerging role of business analytics in organizations. Through lectures, hands on analyses, and various assignments, students learn how to apply basic business analytics tools in a spreadsheet environment. Students will become familiar with advanced Microsoft Excel functions and the use of Excel in solving analytical problems. Students also learn how to communicate with analytics professionals to effectively use and interpret analytic models and results for making better business decisions. The course covers managerial statistical tools in descriptive analytics and predictive analytics, including regression. Emphasis is on applications, concepts and interpretation of results as well as conducting statistical analyses. Students form groups to collect and analyze data, and to write and present a final report.

BUSINESS ANALYTICS II: The course provides students with advanced concepts and tools needed to understand the emerging role of business analytics in organizations. Through lectures, hands on analyses, and various assignments, students learn how to apply business analytics tools in a spreadsheet environment. Students also learn how to communicate with analytics professionals to effectively use and interpret analytic models and results for making better business decisions. The course covers managerial statistical tools in predictive and prescriptive analytics. Topics include forecasting, risk analysis, simulation, data mining, and decision analysis. Emphasis is on applications, concepts and interpretation of results as well as conducting statistical analyses. Students form groups to collect and analyze data, and to write and present a final report.

ECONOMETRICS: Econometrics is the application of mathematical and statistical methods and techniques in order to: 1) help understand, analyze, and interpret economic and financial data, 2) test economic and financial hypotheses/theories, and 3) generate predictions about particular economic and financial variables. Econometrics is fundamentally a regression-based correlation methodology used to measure the overall strength, direction, and statistical significance between a "dependent" variable - the variable whose movement or change is to be explained - and one or more "independent" variables that will explain the movement or change in the dependent variable. Students are expected to have a solid grounding in algebra and Management Statistics.

INTRODUCTION TO PROGRAMMING: Introduces students to the basics of computer programming using a modern computer programming language. Emphasis will be on designing structured, event-driven programs to solve business problems. Topics include programming constructs, object-oriented programming, algorithms and problem-solving and event-driven programming.

INTRODUCTION TO SAS: This course introduces students to the latest SAS platform and basic knowledge in data management and exploratory data analysis using SAS software. Students are provided the opportunity to learn a comprehensive set of SAS data-related techniques through lessons, demonstrations, and ab/homework assignments. Students will learn how to import data, structure data, prepare data for analysis, explore data, and create reports. Students will work in teams and learn how to communicate with analytics professionals by creating and presenting effective data-driven reports. The material covered in this course is designed to prepare students for starting their SAS certification journey.

DATABASE MANAGEMENT SYSTEMS: A study of theoretical and practical aspects of database management systems, with emphasis on relational systems, the SQL language, and database

design. Applications will be designed using Microsoft Access and/or other relational database software.

DATA VISUALIZATION: Business processes in the current times are data driven which makes it important for managers to consume the data correctly. Data mining, processing and analysis prepares the data to provide business analytics. However a visual of the analytics is what makes the data consumption process seamless and more impactful. This course is focuses on understanding the underpinnings of data visualization process. The course will leverage the power of visualization tools to facilitate the visualization process.

DECISION SUPPORT SYSTEMS: A study of ways in which computers can clarify complex data needed for making strategic business decisions. Students will acquire introductory knowledge of decision theory and methods of making best decision in complex situations. Topics will include optimization and linear programming, network modeling, regression analysis, time-series analysis, simulation, and decision analysis. Problems will be analyzed using advanced spreadsheet tools, especially those in the Microsoft Excel software.

MANAGEMENT SCIENCE: Planning and control are among the essential functions performed by a manager. This involves strategic conceptualization, decision-making and analysis of processes within the business and its environment. This course introduces quantitative and computing techniques that contemporary managers use to create models representing the business problems they need to solve. The emphasis of this course will be on the integration and development of modeling skills including problem recognition, data collection, model formulation, analysis, and communicating the results. Building logical thinking and quantitative skills are among the objectives of this course.

MARKETING RESEARCH: An examination of the concepts and practical methodology used in market research. Emphasis will be given to research methods and techniques, including market analysis, questionnaire formulation, sampling, interviewing, and panels.

Appendix B – Assessment Plan

Program Name: Business Analytics Minor

Discipline Goal:

1. Foundation: Our students will have a broad-based knowledge in the functional areas of business analytics.

Outcome 1: Students will comprehend principles and practices in key business analytics disciplines.

2. Communication - Our students will demonstrate effective visualization of data skills.

Outcome 2: Students will effectively present the results of business analytics cases visually using graphics.

Measure:

Who will assess the outcome (e.g., faculty who are not teaching the course? Note: if necessary, faculty can assess their own courses provided there are at least two readers and an interrater reliability session)?

The students' work will be reviewed by the BA faculty.

What is the instrument or method (e.g., rubric, survey, multiple-choice questions…)? Note that rubrics and other instruments can be attached to the template. The students' responses will be evaluated using a Business Analytics Rubric.

The Business Analytics Rubric provides five categories or "traits" which are appraised on a scale of 1 to 6 with: 1-2 being "poor / below average," 3-4 being "average / good," and 5-6 being "very good / excellent".

What is the student product (e.g., paper, final exam question)?

The goal will be assessed using a business case involving business analytics. The entire class will be assessed.

What is the assessment process (e.g., blind review after an inter-rater reliability session and number of readers)?

Blind review after an inter-rater reliability session

When will it be measured (e.g., fall 2018)?

Spring 2022

What courses or which student populations will be measured (e.g., CA 456)?

The assessment will be performed using student work in the course INFO 311 Business Analytics II. INFO 311 is a required course for all Business Analytics students.

How many student products will the program assess (e.g., 25% of the total)?

100%

Achievement Target

75% or more of students will be rated "Very Good to Excellent".

Appendix C – Assessment Rubric

TRAIT	Unacceptable (0-1)	Acceptable (2-3)	Excellent (4-5)	Score
Problem Definition	Does not identify and summarize the problem, is confused or identifies a different or inappropriate problem.	Identifies the main problem and subsidiary, embedded, or implicit aspects of the problem.	Identifies not only the basics of the issue, but recognizes constraints and nuances of the issue.	
Data Collection	Did not collect meaningful data.	Collected most of the needed data, but data cleaning and prepration was not done.	Collected the appropriate data and the data was properly cleaned and prepared.	
Methods	Statistical methods were completely misapplied, were applied but with significant errors or omissions, or were absent.	One or two statistical methods were correctly applied, but the it was not justified why it is a proper method to answer the problem.	At least two statistical methods were fully and correctly applied. Use of the methods were justified.	
Presentation of Results	Results presented in an unclear manner. Little use of charts or tables.	Approriate tables and charts used to clearly convey the results.	Advanced charts and tables used to present the results in an aesthetically pleasing manner.	
Discussion	Entirely missed the point of the experiment.	Analyzed only the most basic points.	Results and discussion well focused and included all important points.	