# MS Business Analytics – Healthcare Analytics Track (MSHA)

## 2019-2020 Academic Year

October 2018 (subject to change)

### List of Courses by Semester

#### Preprogram Foundation Requirements

Preparatory work begins in July/August, is in addition to required credits and does not affect GPA.

**Required:**

- MKT 500V Basics of R Programming (0.5)
- ACCT 560 - Introduction to Financial Accounting (2.0)

Choose at least one of:

- MKT 500R Basics of Statistics Using SPSS (0.5)
- MGT 574 Basics of Stata programming (0.5)
- MGT 573 Basics of SAS programming (0.5)

### Fall Semester (12 core + 3 Track Required = 15 credits)

#### Fall A

- Required: MKT 560G: Database Design and SQL (1.5)

#### Fall B

- Required: MKT 560M: Big Data & Cloud Computing (1.5)  
  OMM 500N: Prescriptive Analytics (1.5)

#### Fall B

- Required: MKT 500S: Predictive Analytics for Business Decision-Making (3)  
  OMM 561: Intro to Python and Data Science (3)  
  MGT 560F: Professional Business Communication (1.5)

#### Track Required:

- MGT 563: Olin Grand Rounds: The Business and Practice of Medicine (3)

### Spring Semester (6 core + 3 track + 3 electives (see page 2) = 12 credits)

#### Spring A

- Required: MGT 560N Introduction to Cybersecurity (1.5)  
  MGT 561 Text Mining (1.5)

#### Spring B

- Required: MKT 500W Causal Inference (3)

#### Track Required:

- MGT 566: Research in Healthcare Management (3)  
  MGT 565: Healthcare Management (3)

### Final Fall Semester (7.5 track + 4.5 electives (see page 2) = 12 credits)

#### Fall A

- Track Required: MGT 564: Health Economics and Policy (3)  
  Healthcare related Practicum (3)

#### Fall B

- Total 39 credits: 18 common core, 13.5 track required, 7.5 electives

Core Analytics Courses
A total of 18 credits are common to all tracks and build your analytics knowledge base.

The first fall semester introduces key concepts and tools including **Database Design and SQL** and **Big Data and Cloud Computing**, as well as:

- **Intro to Python and Data Science** introduces programming language to acquire, clean, analyze, and visualize data (descriptive analytics) for reporting and complex optimization.
- **Predictive Analytics** covers advanced analytic techniques such as neural networks and stochastic gradient boosting to convert raw and messy business data into robust predictions of future customer behavior or critical organizational elements.
- **Prescriptive Analytics** builds upon the descriptive and predictive analytics course work through the use of optimization models and software tools to suggest decision options for a wide variety of business decisions (course is called Optimization for Business in the MSAA track).

In addition, Managerial Communication introduces students to fundamental best practices in business writing and business speaking.

Core requirements conclude in the spring semester with an **Introduction to Cybersecurity** and two advanced analytic topics:

- **Causal Inference** teaches statistical and experimental methods to identify casual relations among data sets and reject prescriptive options based on biased samples or reverse causality.
- **Text Mining** provides techniques, algorithms, and tools for collecting, organizing, summarizing, and analyzing textual data for topic and sentiment analysis and predictive modeling.

**Electives for MS Business Analytics in Healthcare:**

**MGT XXX: The Business of Biology (3)**  
M21 MSB 550: Intro to Bioinformatics (3) [Division of Biostatistics]  
M19 PHS 501: Introductory Clinical Epidemiology (1.5) [Division of Biostatistics]  
M19 PHS 502: Intermediate Epidemiology (1.5) [Division of Biostatistics]  
S55 MPH 4003: Global Burden of Diseases: Methods and Applications (3) [Brown School]

*All letter graded courses, count towards degree and GPA calculation. Math and some CSE courses can be taken Pass/Fail and count towards degree.*

**Note:** Only 12 hours of approved CSE courses may count toward degree requirements.

**Note to International students:** Additional English courses may be required or waived upon arrival. If taken, these courses are over and above required credits, are graded on a pass/fail basis, and do not count towards a student's GPA calculation.

Students may take up to 19.5 credits of business coursework in the fall and spring semesters under the flat tuition rate.

The degree requirements and policies in this document apply to MSHA students entering Washington University during the 2019-20 academic year. Every effort is made to ensure that the information is accurate and correct as of the date of publication (11/26/18). Washington University reserves the right to make changes at any time without prior notice. Therefore, this curriculum document may change from time to time without notice. The governing document at any given time is the then-current version, as published online.
MSA - Healthcare Analytics Course Descriptions

Summer Foundations Courses – Required:

**MKT 500V Basics of R Programming**

R has become the tool of choice for many data science and customer analytics professionals in every industry and field. It is not surprising to see a requirement for being familiar with R in job descriptions. R is very flexible in carry out data analysis. Part of the benefit of being open source is that many programmers/researchers are constantly introducing new statistical analysis tools into R through R packages. Given all the benefits, R does have a relatively steeper learning curve. To better prepare MSCA students, we introduce this 2 day introduction to R programming course. This class will help you master the basics of R. We will start from the very beginning - installation of the program. No prior knowledge in programming is required. Through in class demonstration and lots of hands-on practice, by the end of the second day, you will have the chance to undertake your own data analysis and solve relevant business problems using R. 0.5 Credits. Graded Pass/Fail.

Summer Foundations Courses – Choose at least one of the following:

**MKT 500R Basics of Statistics Using SPSS**

This foundational course, which is a required course for students in the MSA program, will cover material that serves as useful preparation for courses offered in the Olin curriculum that rely extensively on applied statistical concepts (e.g., marketing research, advanced marketing research, database marketing, data analysis for brand management etc.). The course will provide students with both an overview of basic statistical concepts and a practical grasp of statistical analysis. Students will be trained to use SPSS, a popular statistical software package, in order to perform the statistical analysis. The course will also cover interpretation of results. 0.5 Credits. Graded Pass/Fail.

**MGT 573 Basics of SAS Programming**

Statistics using SAS serves as a technical basis for research and data analysis. This course will provide students with an overview of statistical knowledge and with a good practice of analysis techniques. Students will be trained to use SAS, one of the most commonly used tools in commercial analytics markets, to analyze data and interpret results. The course aims to prepare students for more advanced courses in data analytics. Graded pass/fail.

**MGT 574 Basics of Stata Programming**

As one of the most popular statistics software packages, Stata has served as an essential tool of data science in every industry and academia. The goals of the course are to better prepare students for success in future courses and careers. Students will be trained to obtain necessary technical skills of using Stata by the end of this two-day course. The introduction of Stata will be from the very beginning, and therefore there is no prerequisites required. Basic statistics foundations will be reviewed to facilitate the goals of the course. Graded pass/fail.
Required Core Courses

MGT 560G  Database Design and SQL

Databases are at the foundation of every organization's information strategy. Understanding the structure of databases and mastering the tools to analyze data are essential skills in any role. The tools developed in this course assist students in implementing a company's data management strategy and developing well-grounded analytical recommendations. In this course we focus on understanding how data is structured in relational databases. With vast amounts of data available, from disparate sources, effective organization of the data is essential to its utilization. To complement this, we utilize SQL (Structured Query Language) as the primary tool to extract data for managerial reports and for advanced analytical models. Practical experience with current relational database software is developed throughout the course. This course is required for MS/CA students and priority will be given to SMP students. 1.5 Credits.

OMM 500N  Prescriptive Analytics

This course covers optimization models and tools as they apply to the design and analysis of supply chains. Production planning, distribution, network design, and revenue management problems are covered using the methods of linear, non-linear, and integer programming. Upon successful completion of this course, students will demonstrate competency in formulating and solving supply chain optimization models of real-life complexity using state-of-the-art software. They will become proficient with industrial strength software tools like AMPL and Gurobi alongside Excel's Solver. The course emphasizes proficiency in model-building and using software tools rather than theory. 1.5 Credits

MGT 560F  Professional Business Communication

Communication is the process of sending and receiving messages, however, communication is effective only when the message is understood and when it stimulates action or encourages the receiver to think in a new way. This course will introduce students to fundamental best practices in business writing and business speaking that will ensure effective communication. Students will participate in activities that will develop professional business communication skills in both writing and speaking. These will include: preparing, writing and delivering presentations, composing clear concise business messages in a variety of formats, understanding emotional intelligence to reach the audience and utilizing critical thinking as a basis for communication strategies. 1.5 Credits.

MKT 500S  Predictive Analytics for Business Decision-Making

Predictive Analytics deals with the employment of formal learning from business experience, using business data, to predict the future behavior of customers or other critical organizational elements in order to drive better business decisions. This course emphasizes data situations that students are likely to face in marketing, finance, manufacturing and consulting jobs. Students will analyze real-world business datasets using various advanced analytic techniques such as logistic regression, decision trees, neural networks, stochastic gradient boosting, MARSplines, Ensembles, Clustering, Associations etc. The focus of the course lies in the conversion of raw and messy business data in to robust actionable predictions for decision-making. 3 credits.
**OMM 561 Introduction to Python and Data Science**

This is a 3-credit course offered to MSBA students. It provides students the necessary skill set to extract reliable insights from large datasets prevalent in various business applications, such as supply chain management, marketplace operations, healthcare analytics and financial engineering, using Python. In this course, students will develop basic tools to understand Python programs and implement data processing pipelines using Python. In particular, students will learn how to acquire, clean, analyze and visualize data in Python, which they will then use to improve decision-making processes. Throughout the course, students will use the Python programming language, which is very effective for data manipulation, reporting, and complex optimization. Topics covered include introduction to Python programming, data acquisition and cleaning, data manipulation, current multi-source data collection technology used in practice, basic data visualization using Matplotlib, ggplot2 and Bokeh. 3 Credits.

**MGT 560M Big Data and Cloud Computing**

The growth in available data is a challenge to many companies. This presents an opportunity for companies to conquer the vast and various data available to them. The growth in data includes traditional structured data, as well as unstructured data created by both people and machines. It is essential for analysts to be comfortable in the new technologies and tools that are being developed to store, retrieve, analyze, and report, using the vast data resources available. This course introduces students to the technologies currently deployed to overcome the challenges of Big Data. Prerequisite: MGT 560G.

**MGT 561 Text Mining**

Consumers and companies constantly generate large amounts of unstructured or lightly structured texts on the web and offline: exchanges of consumer opinions on products and services on social media, transcripts of phone conversations with customer representatives, open-ended surveys, etc. By employing text analytics, businesses can derive at scale valuable insights into consumer attitudes to brands, competitive landscape, and customer relationships, among other applications. This course introduces students to the methods of mining, organizing, summarizing, and analyzing textual data with the objective of driving business decision-making.

In particular, the course will cover the following substantive topics:
- Sources of business-relevant text data and web crawling;
- Topic analysis;
- Sentiment analysis;
- Use of text in predictive modeling (churn analysis, predicting CTR with search terms);

The focus of the course is on understanding and hands-on implementation of relevant algorithms and techniques, but the course will provide the opportunity to use a number of (open-source) software tools.

**MGT 560N Introduction to Cybersecurity**

This course covers a broad range of cyber security terms, definitions, perspectives, concepts, and current trends with a focus on managing risk and the use of information and cyber security as business enablers. Students will complete a cybersecurity analytics-related project as part of the coursework.
MGT 500W  Causal Inference

This course introduces students to causal inference. The advance in information technology has given an enormous amount of valuable data to businesses. Data analysts and data scientists have become the cool kids due to high demand in data talents. In the meantime, however, artificial intelligence is getting better at finding correlational patterns in data. This means that AI may even replace some tasks performed by data scientists in the coming years.

The good news is that good data-driven decision making often goes beyond discovering correlations in the data. In particular, making the right prescriptive decisions often requires managers to tease out the causal relationship(s) between the prescriptions and outcomes of interest. Artificial intelligence has yet to show such abilities. Therefore, mastering causal inference is likely to become more rewarding over time as AI continues to complement human judgement with quick data analyses at a low cost.

Throughout the course, we will go over many examples of why understanding causal relationships is important. Spoiler alert: in one example, Lewis, Rao, and Reiley (2012) find that a naïve estimation could show that advertisement leads to an 870%--1,200% increase in consumers’ likelihood of search for the advertised brand, while the true causal effect is 0. Imagine how disastrous it would be if companies make advertising decisions based on false causal inferences!

Our goals in the course are
• Use proper statistical tools to tease out the deterministic process that have generated the data in the presence of randomness.
• Become skeptical about claims of causality. You should be able to give alternative data generating processes that could have generated the same data.
• Understand that observational data come from agents’ decisions, and that these decisions could lead to biased samples.
• Understand omitted variable bias and reverse causality
• Design and implement various statistical and experimental methods of addressing the basic causal-inference problem using statistical software.
• Dig deeper into the mechanisms (decision trees) that yield the causal relations.
• Articulate analyses in presentations.

3 Credits

Required Track Courses

MGT 563 Olin Grand Rounds

Grand rounds in medical schools are a forum for presenting new and challenging clinical problems and cases. The goal of Olin Grand Rounds is to focus on the challenges and solutions facing the business of medicine. The course will therefore provide an introduction to the current issues facing the health care sector that integrates management tools and clinical knowledge. The objective is to provide students new insights into how modern management tools can be combined with scientific
and clinical knowledge to manage health care organizations more efficiently and practice medicine more effectively. 3 credits.

**MGT 566 Research in Healthcare Management**

This is the capstone course for the Health Management major where students learn to apply rigorous statistical and analytical approaches to research questions in health services, but not limited to questions relating to management, finance and economics, operations, and policy. Faculty will identify several available research project options, and present these options in class. The goal is to capitalize on the strength of the university medical school and affiliated medical centers, in addition to capitalizing on existing relationships between Olin and healthcare firms to identify the student research projects. Students will also be encouraged to formulate their own research question and to identify potential data sources they could use to address these questions, if they so desire. Students will work in teams of 3-4, using the approach developed for the Practicum and Hatchery courses.

**MGT 565 Healthcare Management**

The goal of the course is to develop facility in applying basic tenets of general management to actual situations and dilemmas that might be faced by health care managers, consultants, financiers, investors, innovators, or providers in the course of their work. Issues addressed will include but not be limited to financial issues, management challenges, and conduct of operations. The first phase will cover the basic background on the structure and financing of the healthcare industry to include very brief reviews of critical topics like insurance and government-provided healthcare. A few basic frameworks will then be developed for students to apply to course topics moving forward, such as cost/benefit analysis and evaluation of risk. The remainder of the course will involve critical analyses of healthcare cases involving varied subjects and management challenges.

**MGT 564 Health Economics and Policy**

The basic tenets of health economics will be covered. This course will place a unique emphasis on incorporating materials from three broad source categories: textbook elements, "lay" press and media, and academic journal publications with the aim to foster application of rigorous, critical thought to media presentations of health care economics and policy issues.

**MGT XXX Healthcare Related Practicum**

**Electives**

**MGT XXX The Business of Biology**

**M21-550 Introduction to Bioinformatics**

This course is designed to provide broad exposure to the basic concepts, methodology and application of bioinformatics to solve biological problems. Specifically, students will learn the basics of
online genomic databases and database mining tools, and acquire understanding of mathematical algorithms in genome sequence analysis (alignment analysis, gene finding/predicting), gene expression microarray (genechip) analysis, and of the impact of recent developments such as protein microarrays or whole-genome DNA chips for genome-wide association studies. Students will also take computer labs and learn basics of bioinformatics tools and databases (BLAST/WUBLAST, Prospector, etc.), practice basics of R/Bioconductor programming, and apply specialized R packages to solve bioinformatics problems pertinent to real medical research of human diseases. Auditors will not have access to the computer lab sessions. 3 Credits.

**PHS 501 Introductory Clinical Epidemiology**

This course introduces the basic principles and methods of epidemiology, with an emphasis on critical thinking, analytic skills, and application to clinical practice. Topics include outcome measures, methods of adjustment, surveillance, quantitative study designs, and sources of data. Designed for those with a clinical background, the course will provide tools for critically evaluating the literature and skills to practice evidence-based medicine. Course activities: lectures, Midterm and final exams, class participation, problem sets, and papers.

**PHS 502 Intermediate Epidemiology**

The second course in the Epidemiology series, this course builds upon the basic principles and methods of epidemiology and introduces additional tools and concepts that are critical to a comprehensive study design. Topics include risk and association, sampling strategies, interaction, confounding, adjustment, lifetables, applied causal inference, validity and reliability, social epidemiology, and approaches to data analysis. Upon exiting this course, students will be prepared to approach the study design portion of a protocol, as required by the final course in the Epidemiology series. Course activities: lectures, Midterm and final exams, class participation, problem sets, and papers. SAS software is required for this course.

**MPH 4003 Global Burden of Diseases: Methods and Applications**

This 3 credit transdisciplinary course provides an overview of the quantitative and qualitative methods and their applications for studying the global burden of diseases. The topics cover infectious diseases, non-communicable chronic medical illness and behavioral disorders. At the end of this course, students will have learned basic methods used for global health research and major trends in global burden of diseases; they will be able to apply the knowledge of measurements to forecast the future of the global burden of specific diseases of interest to develop needed policy recommendations. Students will be able to address prevention and intervention strategies targeted to specific nations or regions using a transdisciplinary approach. Students will have learned major dimensions of sociocultural and economic factors that affect global and regional distributions of major disease categories and how they are linked to global trade and economy in some instances. The transdisciplinary knowledge and hands-on skills learned from this course will assist students with an interest in international research to select a disease or underlying condition with a significant burden on the population of diverse nations or regions. Students will acquire practical skills that can be used in the health professions, including cultural competency training as it applies to medicine and public health.