Core Areas of Competency for Graduates of M.S in Business Analytics Program

The following are the six key areas of competency for that we should target for graduates of the Business Analytics Program

1. Data Mining/ Machine Learning
2. Programming and Software Tools
3. Applied Probability and Statistics
4. Databases and Data Processing
5. Quantitative Algorithms
6. Business Acumen

The rest of this document attempt to describe topics related to each dimension and the current mapping of our core courses in the MSBA program to these topics. This has been compiled by consulting with syllabi documents and detailed course materials (where available) from our MSBA courses and are subject to review, changes and update.

**Important Note:** Three levels of priority can be defined for various topics to be covered in the MS program. Using a *MoSCoW* methodology, these priority levels are color coded in this document as follows:

* **Must Have:** These are the topics that the program must cover and are critical. These topics are represented in red throughout this document.
* **Should Have:** These are the topics that are important but are not as critical as the Must Have Items. These topics are represented with an orange color.
* **Could Have:** These are the topics that are nice to have them covered in the program and are normally refer to advanced or very new concepts. These items are represented in Green throughout this document.

1. **Data Mining/ Machine Learning**
2. **Principles of Machine Learning and Data Modelling** 
   * Data Structures and Types of Variables (MIS 64036)
   * Supervised vs. Unsupervised Machine Learning Modelling (MIS 64036)
   * Data Preparation Techniques (MIS 64036)
   * Feature Engineering (MIS 64037)
   * Evaluation of Machine Learning Models (MIS 64036, MIS 64037)
   * Optimizing Machine Learning Models (MIS 64037)
   * Ensemble Learning (MIS 64037)
   * Common Mistakes in Modelling (MIS 64036, MIS 64037)
3. **Regression Modelling** 
   * Concepts and Definitions (MIS 64036)
   * Performance Metrics (MIS 64036)
   * Linear Regression (MIS 64036)
   * Generalized Linear Models (GLM) (MIS 64037)
4. **Classification Modelling** 
   * + Concepts and Definitions (MIS 64036, MIS XXX)
     + Performance Metrics (MIS 64036, MIS XXX)
     + Logistic Regression (MIS 64036)
     + k-Nearest Neighbor (k-NN) (MIS XXX)
     + Naïve Bayes (MIS XXX)
     + Decision Trees (applied to Regression as well) (MIS 64036)
     + Random Forrest (applied to Regression as well) (MIS 64037)
     + Gradient Boosted Machines (applied to Regression as well) (MIS 64037)
     + Support Vector Machines (applied to Regression as well) (MIS 64037)
     + Neural Networks (applied to Regression as well) (MIS 64037)
5. **Segmentation and Clustering**
   * Concepts and Definitions (MIS XXX)
   * Performance Metrics (MIS XXX)
   * k-means Clustering (MIS XXX)
   * Hierarchical Clustering (MIS XXX)
6. **Recommendation Systems** 
   * Concepts and Definitions (MIS XXX)
   * Performance Metrics (MIS XXX)
   * Apriori algorithm for Association Mining (MIS XXX)
7. **Time Series Analysis** 
   * Concepts and Definitions (MIS YYY)
   * Performance Metrics (MIS YYY)
   * Stationarity, causality and invertibility (MIS YYY)
   * Autoregressive Integrated Moving Average (ARIMA) (MIS YYY)
8. **Deep Learning** 
   * Concepts and Definitions (MIS YYY)
   * Recurrent Neural Networks (MIS YYY)
   * Long Short Term Memory (MIS YYY)
   * Convolutional Neural Networks (MIS YYY)
   * Implementation on GPU Systems and Cloud (MIS YYY)
9. **Graph Analytics** 
   * Concepts and Definitions
   * Centrality and Connectivity Measures
   * Application to Social Network Analysis
10. **Text Analytics** 
    * Concepts and Definitions (MIS 64037)
    * Feature Extraction (MIS 64037)
    * Topic Modelling (MIS 64037)
    * Sentiments Analysis (MIS 64037)
11. **Programming and Software Tools**
12. **Data Mining, Machine Learning and Quantitative Programming: R**

Implementation of the following Data Mining/ Machine Learning methods:

* + - Linear Regression (MIS 64036)
    - Generalized Linear Models (MIS 64037)
    - Logistic Regression (MIS 64036)
    - Decision Trees (MIS 64036)
    - Random Forrest (MIS 64037)
    - Gradient Boosted Machines (MIS 64037)
    - Support Vector Machines (MIS 64037)
    - Neural Networks (MIS 64037)

Implementation of the following Quantitative methods:

* + - Linear Programming (MIS 64018)
    - Integer Programming (MIS 64018)
    - Goal Programming (MIS 64018)
    - Simulated Annealing (MIS 64018)
    - Network Models (MIS 64018)
    - Genetic Algorithms/ Programing (MIS 64018)

1. **Data Preparation General Purpose Programing: R**
   * + Calculating Various Statistics and Math Calculations (MIS 64036)
     + Calculating Probability Values (MIS 64036)
     + Data Input/ Export (MIS 64036, MIS 64037, MIS 64018)
     + Data Cleansing (MIS 64036, MIS 64037, MIS 64018)
     + Data Wrangling and Data Subsetting (MIS 64036, MIS 64037, MIS 64018)
     + Feature Engineering (MIS 64037)
     + Applying summarization and Aggregate functions (MIS 64036)
2. **Database: SQL**
   * + Principals of Database Design (MIS 64082)
     + Using SQL to Create, Update and Delete Tables (MIS 64082)
     + Using SQL to Select a subset of Data (MIS 64082)
     + Using SQL to Join Tables (MIS 64082)
     + Using SQL to perform various Aggregate Functions (MIS 64082)
3. **Visualization: R/ Tableau**

* Using R ‘ggplot’ for explanatory analysis and communicating the insights (MIS 64018)
* Using R ‘Shiny’ for interactive visualization and dash boarding (MIS 64018)
* Add elements, text, animation, and colors to plots (MIS 64018)

1. **Software Repository and Development Platforms: Github/Git**

* Creating a new repository (MIS 64018)
* Fork and Push changes to a repository (MIS 64018)
* Clone a public project (MIS 64018)
* Send a pull request/ Merge changes from a pull request (MIS 64018)

1. **Big Data and High performance Computing: Spark, Hadoop, AWS, Azure, MLlib, R**

* Spark and Big Data Ecosystem (MIS YYY)
* Using Spark's MLlib for Machine Learning
* Scale up Spark jobs using Amazon Web Services (MIS YYY)
* Using R in Azure Machine Learning Studio (MIS YYY)
* Parallel computing using R (MIS YYY)

1. **Applied Probability and Statistics**

* Statistics: Measures of Central Tendencies (MIS 64036)
* Statistics: Measures of Dispersion (MIS 64036)
* Statistics: Measures of Skewness (MIS 64036)
* Statistics: Measures of Dependence (MIS 64036)
* Statistics: Statistical Significance (MIS 64036)
* Probability: Probability Distributing Functions (MIS 64036)
* Probability: Normal Distribution (MIS 64036)
* Probability: Uncertainty and Confidence Intervals (MIS 64036)
* Probability: Conditional Probabilities (MIS XXX)
* Probability: Bayesian Probability (MIS XXX)
* Probability: Information Entropy (MIS 64037)

1. **Databases and Data Processing**
2. **Relational Databases**

* Concepts and Definitions (MIS 64082)
* Entity-Relationship Diagrams (MIS 64082)
* Structured Query Language (SQL) (MIS 64082)
* Normalization, Transaction Management and Concurrency Control (MIS 64082)
* SQL as an Analytical Tool (MIS 64082)
* Intro to NoSQL Databases and Applications (MIS 64082)

1. **Big Data Platforms**

* Big Data Paradigms (e.g. MapReduce) (MIS YYY)
* Big Data Platforms (e.g. Hadoop) (MIS YYY)
* Big Data Extraction/Integration (MIS YYY)
* Big Graph Processing
* Big Data Stream Techniques and Algorithms

1. **Quantitative Algorithms**

* Linear Programming (MIS 64018)
* Duality in Linear Programming (MIS 64018)
* Integer Programming(MIS 64018)
* Goal Programming (MIS 64018)
* Simulated Annealing (MIS 64018)
* Network Models (MIS 64018)
* Genetic Algorithms/ Programing (MIS 64018)

1. **Business Acumen**

* Practical Case Studies Based on Real-World Data from Different Industries (All Courses with more emphasis in MIS 64038)
* Formulation of Business Problems to Solve Using Analytics (All Courses)
* Policy and Managerial Implications of Deploying Analytics Solutions (MIS 64038)
* Ethical Considerations in Deploying Analytics Solutions (MIS 64038)
* Specific applications of Analytics in Marketing (MIS 64038)
* Specific applications of Analytics in Finance and Accounting (MIS 64038)
* Specific applications of Analytics in Management & Strategy (MIS 64038)
* Organizational challenges of Deploying Analytics Solutions. (MIS 64038)
* Future trends in Business Analytics (MIS 64038)
* Data Collection and Communication of Findings (All Courses)
* Operationalizing Analytical Models in Practice (All Courses with more emphasis in MIS 64038)
* Common Mistakes in Analytical Modeling (All Courses)

**Appendix I: List of Core Courses for the MS in MSBA Courses**

**Fall Offerings**

* + MIS 64036:   Business Analytics
  + MIS 64082: Database Management and Database Analytics
  + MIS XXX: To replace CS 63015 Data Mining Techniques
  + MIS 64018: Quantitative Management Modeling

**Spring Offerings**

* + MIS 64037: Advanced Data Mining and Predictive Analytics
  + MIS YYY: To replace CS 63016 Big Data Analytics
  + MIS 64038: Analytics in Practice

**Summer Offerings**

* + MIS 64098:   Capstone Project in Business Analytics