

## MBA O711 – Predictive Modeling & Analytics Winter 2023 Course Outline

### Operations Management Area DeGroote School of Business - McMaster University

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#### ***COURSE OBJECTIVE***

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This course will introduce students to the foundational concepts of predictive analytics using R, Microsoft Excel, and Analytic Solver. The course will focus on applied aspects of predictive modeling and discuss practical approaches to solving business cases using predictive analytics. The course will use Microsoft Excel to build intuition, R to build well-structured and programmable predictive workflows and Analytic Solver to build predictive models from the perspective of a business analyst. This course will use a hands-on approach to solve mini-cases from diverse industries and functional areas and help learn predictive analytics by understanding modern business practices in leveraging predictive models for mining data and making evidence-informed decisions. This course will provide an overview of all stages of a predictive analytics workflow including data ingestion, data cleaning, transformation, visualization, model building, model assessment, statistical inference, model communication and decision making using predictive models.

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#### ***INSTRUCTOR, TA, AND COURSE COMMUNICATIONS***

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*Instructor*

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**TBA**

*TA*

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Office Hours: TBA

**Course website:** [BUSADMIN O711:Predictive Modelling and Analytics](#)

**Teams site:** [O711- Winter 2023 Microsoft Teams](#)

Credit Value: 3	Leadership: No	IT skills: Yes	Global view: Yes
Avenue: Yes	Ethics: Yes	Numeracy: Yes	Written skills: Yes
Participation: Yes	Innovation: Yes	Group work: Yes	Oral skills: Yes
Evidence-based: Yes	Experiential: Yes	Final Exam: Yes	Guest speaker(s): No

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### ***COURSE DESCRIPTION***

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The first part of this course will focus on data ingestion in R using excel or csv files and learning to use data cleaning, data transformation and visualization using commonly used R packages for data wrangling and data exploration. The second part of the course will focus on implementing supervised learning approaches like Linear Regression, Logistic Regression, KNN, Naïve Bayes, Decision Trees, and Ensemble methods. The third part of the course will focus on implementing unsupervised learning algorithms such as Clustering, PCA and Market Basket Analysis. The fourth part of the course will focus on model evaluation and model performance optimization based on key business metrics. The fifth part of the course would focus on Time Series forecasting using AR, MA, ARMA and ARIMA models. Apart from the first part which is based on R exclusively, all other parts will use a mix of tools like Microsoft Excel, R and Analytic Solver. The course will highlight when a specific model is used, the pros and cons of the model and how to make business decisions using them.

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### ***LEARNING OUTCOMES***

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Upon completion of this course, students will be able to complete the following key tasks:

- Define essential requirements for building a predictive model based on data.
- Become familiar with key predictive analytics tools and techniques.
- Demonstrate the ability to apply statistics and analytical techniques to the given data set.
- Work in R software environment to build predictive models.
- Work in Analytic Solver, an excel add-in, to build predictive models.
- Understand why and how models work by using excel based intuitions and formulae.
- Demonstrate the knowledge and ability to apply different predictive analytics techniques to analyze the given managerial problem.
- Demonstrate competence in summarizing to “tell the story” of the data at hand and provide well-rounded recommendations and conclusion.
- Understand how to assess model performance and tune model parameters to maximize the accuracy and relevance of the predictive models

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## ***REQUIRED COURSE MATERIALS AND READINGS***

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- Avenue registration for lecture notes, course content, readings, and datasets - <http://avenue.mcmaster.ca>
- ISE BUSINESS ANALYTICS, 2<sup>nd</sup> Edition, by Sanjiv Jaggia, Alison Kelly, Kevin Lertwachara, Leida Chen. McGraw-Hill.
  - ✓ Print - ISBN: 9781265087685
  - ✓ ETEXT BUSINESS ANALYTICS W/ CONNECT 12 MONTH ACCESS - ISBN: ISBN13: 9781266025471
  - ✓ [Link to McMaster Bookstore - BUSNADMIN 0711](#)

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## ***EVALUATION***

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Learning in this course results primarily from in-class discussion and participation of business cases as well as out-of-class analysis. The balance of the learning results from the lectures on strategic concepts, from related readings, and from researching your presentations, cases, assignments, simulation decisions. All work will be evaluated on an individual basis except in certain cases where group work is expected. In these cases, group members will share the same grade adjusted by peer evaluation. In this course, there is no evaluation component at the group level. Your final grade will be calculated as follows:

### **Quizzes (45%)**

There will be three quizzes based on mini cases that can be completed using Excel, R or Analytic Solver. Final responses will be marked using a multiple-choice question format. These quizzes are all conducted in-class. All quizzes must be completed by each participant independently.

Please note that each student has to write the midterm test. If you are unable to write the exam on the scheduled date, and have advanced knowledge and permission, the instructor will provide you with an opportunity to write an alternate version of the test at an alternate time. Note that this is not automatic and that a written request for alternate exam has to be made, along with the supporting documents, well ahead of the scheduled date.

The quizzes are planned as per the following schedule:

- Quiz #1: Weight: 15%. Date: January 30, 2023
- Quiz #2: Weight: 15%. Date: February 27, 2023
- Quiz #3: Weight: 15%. Date: April 03, 2023

### **Mid-Term (25%)**

There will be one mid-term assessment and it would be released on March 13, 2023 and can be completed anytime by 10 pm on March 20, 2023. It would likely take a candidate about 2-hour 30 minutes to complete the assessment using Excel, R or Analytic Solver. Final answers must be marked using a multiple-choice question format. Working files must be submitted for auditing purposes.

Please note that each student has to write the midterm test. If you are unable to write the exam on the scheduled date, and have advanced knowledge and permission, the instructor will provide you with an opportunity to write an alternate version of the test at an alternate time. Note that this is not automatic and that a written request for alternate exam has to be made, along with the supporting documents, well ahead of the scheduled date.

### **Final Exam (30%)**

Final Exam will be held during the exam week, and more details will be provided in the class. It will be a 3-hour exam. You will complete this exam using Excel, R or Analytic Solver. Final answers must be marked using a multiple-choice question format. Working files must be submitted for auditing purposes.

Please note that each student has to complete the final exam. If you are unable to write the exam on the scheduled date, and have advanced knowledge and permission, the instructor will provide you with an opportunity to write an alternate version of the test at an alternate time. Note that this is not automatic and that a written request for alternate exam has to be made, along with the supporting documents, well ahead of the scheduled date.

### **Components and Weights**

Quizzes	(individual)	45%
Mid-Term	(individual)	25%
Final Exam	(individual)	30%
<b>Total</b>		<b>100%</b>

#### NOTES:

- Any requests for a re-read of the assignments or examinations should be made within two weeks of the date of distribution of the marks.
- The use of a McMaster standard calculator is allowed during examinations in this course. See McMaster calculator policy at the following URL:

<http://www.mcmaster.ca/policy/Students-AcademicStudies/GradExamsPolicy.pdf>

### Grade Conversion

At the end of the course your overall percentage grade will be converted to your letter grade in accordance with the following conversion scheme:

LETTER GRADE	PERCENT	POINTS
A+	90-100	12
A	85-89	11
A-	80-84	10
B+	75-79	9
B	70-74	8
B-	60-69	7
F	00-59	0

### Communication and Feedback

Students that are uncomfortable in directly approaching an instructor regarding a course concern may send a confidential and anonymous email to the respective Area Chair or Associate Dean:

<http://mbastudent.degroote.mcmaster.ca/contact/anonymous/>

Students who wish to correspond with instructors or TAs directly via email must send messages that originate from their official McMaster University email account. This protects the confidentiality and sensitivity of information as well as confirms the identity of the student. Emails regarding course issues should NOT be sent to the Administrative Assistant.

Instructors are encouraged to conduct an informal course review with students by Week #4 to allow time for modifications in curriculum delivery. Instructors should provide evaluation feedback for at least 10% of the final grade to students prior to Week #8 in the term.

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### ***ACADEMIC DISHONESTY***

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You are expected to exhibit honesty and use ethical behaviour in all aspects of the learning process. Academic credentials you earn are rooted in principles of honesty and academic integrity.

Academic dishonesty is to knowingly act or fail to act in a way that results or could result in unearned academic credit or advantage. This behaviour can result in serious consequences, e.g. the grade of zero on an assignment, loss of credit with a notation on the transcript (notation reads: "Grade of F assigned for academic dishonesty"), and/or suspension or expulsion from the university.

It is your responsibility to understand what constitutes academic dishonesty. For information on the various types of academic dishonesty please refer to the Academic Integrity Policy, located at:

[www.mcmaster.ca/academicintegrity](http://www.mcmaster.ca/academicintegrity)

The following illustrates only three forms of academic dishonesty:

1. Plagiarism, e.g. the submission of work that is not one's own or for which other credit has been obtained.
2. Improper collaboration in group work.
3. Copying or using unauthorized aids in tests and examinations

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### ***MISSED ACADEMIC WORK***

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#### ***Missed Mid-Term Examinations / Presentations / Tests / Class Participation***

Where students miss a regularly scheduled mid-term or class participation for legitimate reasons as determined by the Student Experience – Academic (MBA) office, the weight for that test/participation will be distributed across other evaluative components of the course at the discretion of the instructor. Documentation explaining such an absence must be provided to the Student Experience – Academic (MBA) office within five (5) working days upon returning to school.

To document absences for health related reasons, please provide to Student Experience – Academic (MBA) office the Petition for Relief for MBA Missed Term Work and the McMaster University Student Health Certificate which can be found on the DeGroote website at <http://mbastudent.degroote.mcmaster.ca/forms-and-applications/> Please do not use the online McMaster Student Absence Form as this is for Undergraduate students only. University policy states that a student may submit a maximum of three (3) medical certificates per year after which the student must meet with the Director of the program.

To document absences for reasons other than health related, please provide Student Experience – Academic (MBA) office the Petition for Relief for MBA Missed Term Work and documentation supporting the reason for the absence.

Students unable to write a mid-term at the posted exam time due to the following reasons: religious; work-related (for part-time students only); representing university at an academic or varsity athletic event; conflicts between two overlapping scheduled mid-term exams; or other extenuating circumstances, have the option of applying for special exam arrangements. Such requests must be made to the Student Experience – Academic (MBA) office at least ten (10) working days before the scheduled exam along with acceptable documentation. Instructors cannot themselves allow students to unofficially write make-up exams/tests. Adjudication of the request must be handled by Student Experience – Academic (MBA).

If a mid-term exam is missed without a valid reason, students will receive a grade of zero (0) for that component.



## ***Missed Final Examinations***

A student who misses a final examination without good reason will receive a mark of 0 on the examination. All applications for deferred and special examination arrangements must be made to the Student Experience – Academic (MBA) office. Failure to meet the stated deadlines may result in the denial of these arrangements. Deferred examination privileges, if granted, must be satisfied during the examination period at the end of the following term. There will be one common sitting for all deferred exams.

Failure to write an approved deferred examination at the pre-scheduled time will result in a failure for that examination, except in the case of exceptional circumstances where documentation has been provided and approved. Upon approval, no credit will be given for the course, and the notation N.C. (no credit) will be placed on the student's transcript. Students receiving no credit for a required course must repeat the course. Optional or elective courses for which no credit is given may be repeated or replaced with another course of equal credit value.

Requests for a second deferral or rescheduling of a deferred examination will not be considered.

Any student who is unable to write a final examination because of illness is required to submit the Application for Deferred MBA Final Examination and a statement from a doctor certifying illness on the date of the examination. The Application for Deferred MBA Final Examination and the McMaster

University Student Health Certificate can be found on the DeGroot website at <http://mbastudent.degroot.mcmaster.ca/forms-and-applications/> Please do not use the online McMaster Student Absence Form as this is for Undergraduate students only. Students who write examinations while ill will not be given special consideration after the fact.

In such cases, the request for a deferred examination privilege must be made in writing to the Student Experience – Academic (MBA) office within five business days of the missed examination.

Special examination arrangements may be made for students unable to write at the posted exam time due to compelling reasons (for example religious, or for part-time students only, work-related reasons):

- Students who have religious obligations which make it impossible to write examinations at the times posted are required to produce a letter from their religious leader stating that they are unable to be present owing to a religious obligation.
- Part-time students who have business commitments which make it impossible to write examinations at the times posted are required to produce a letter on company letterhead from the student's immediate supervisor stating that they are unable to be present owing to a specific job commitment.

In such cases, applications must be made in writing to the Student Experience – Academic (MBA) office at least ten business days before the scheduled examination date and acceptable documentation must be supplied.

If a student is representing the University at an academic or athletic event and is available at an overlapping scheduled time of the test/examination, the student may write the test/examination at an

approved location with an approved invigilator, as determined by the Student Experience – Academic (MBA) office.

In such cases, the request for a deferred examination privilege must be made in writing to the Student Experience – Academic (MBA) office within ten business days of the end of the examination period.

Note: A fee of \$50 will be charged for a deferred exam written on campus and a fee of \$100 for deferred exams written elsewhere. In cases where the student's standing is in doubt, the Graduate Admissions and Study Committee may require that the student with one or more deferred examination privileges refrain from re-registering until the examination(s) have been cleared.

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### ***STUDENT ACCESSIBILITY SERVICES***

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Student Accessibility Services (SAS) offers various support services for students with disabilities. Students are required to inform SAS of accommodation needs for course work at the outset of term. Students must forward a copy of such SAS accommodation to the instructor normally, within the first three (3) weeks of classes by setting up an appointment with the instructor. If a student with a disability

chooses NOT to take advantage of an SAS accommodation and chooses to sit for a regular exam, a petition for relief may not be filed after the examination is complete. The SAS website is:

<http://sas.mcmaster.ca>

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### ***RELIGIOUS, INDIGENOUS OR SPIRITUAL OBSERVATIONS (RISO)***

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Students requiring academic accommodation based on religious, indigenous or spiritual observances should follow the procedures set out in the [RISO](#) policy. Students should submit their request to their Faculty Office normally within 10 working days of the beginning of term in which they anticipate a need for accommodation or to the Registrar's Office prior to their examinations. Students should also contact their instructors as soon as possible to make alternative arrangements for classes, assignments, and tests.

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### ***COPYRIGHT AND RECORDING***

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Students are advised that lectures, demonstrations, performances, and any other course material provided by an instructor include copyright protected works. The Copyright Act and copyright law protect every original literary, dramatic, musical and artistic work, including lectures by University instructors.



The recording of lectures, tutorials, or other methods of instruction may occur during a course. Recording may be done by either the instructor for the purpose of authorized distribution, or by a student for the purpose of personal study. Students should be aware that their voice and/or image may be recorded by others during the class. Please speak with the instructor if this is a concern for you.

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### ***POTENTIAL MODIFICATION TO THE COURSE***

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The instructor and university reserve the right to modify elements of the course during the term. The university may change the dates and deadlines for any or all courses in extreme circumstances. If either type of modification becomes necessary, reasonable notice and communication with the students will be given with explanation and the opportunity to comment on changes. It is the responsibility of the student to check their McMaster email and course websites weekly during the term and to note any changes.

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### ***ACKNOWLEDGEMENT OF COURSE POLICIES***

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Your registration and continuous participation (e.g. on A2L, in the classroom, etc.) to the various learning activities of MBA O711 will be considered to be an implicit acknowledgement of the course policies outlined above, or of any other that may be announced during lecture and/or on A2L. **It is your responsibility to read this course outline, to familiarize yourself with the course policies and to act accordingly.**

Lack of awareness of the course policies **cannot be invoked** at any point during this course for failure to meet them. It is your responsibility to ask for clarification on any policies that you do not understand.

**COURSE SCHEDULE – MONDAYS 11:30 AM TO 2:20 PM**

SESSION	DATE	TOPICS
1	Mon. Jan. 09	Getting Started with Data Analysis using R <ul style="list-style-type: none"> <li>✓ Installation of R and RStudio</li> <li>✓ Introduction to the tidyverse package</li> </ul>
2	Mon. Jan. 16	Data Wrangling using R <ul style="list-style-type: none"> <li>✓ Data cleaning</li> <li>✓ Data transformation</li> <li>✓ Data exploration</li> </ul>
3	Mon. Jan. 23	Data Visualization using R <ul style="list-style-type: none"> <li>✓ Introduction to ggplot2</li> <li>✓ Building visuals</li> <li>✓ Communicating data stories</li> </ul>
4	Mon. Jan. 30	Linear Regression using Excel, R and/or Analytic Solver <ul style="list-style-type: none"> <li>✓ Multiple Regression</li> <li>✓ Regression Diagnostics</li> </ul> <b>Quiz 1</b>
5	Mon. Feb. 06	KNN using Excel, R and/or Analytic Solver <ul style="list-style-type: none"> <li>✓ Intuition</li> <li>✓ Implementation</li> <li>✓ Pros and Cons</li> </ul>
6	Mon. Feb. 13	Naïve Bayes using Excel, R and/or Analytic Solver <ul style="list-style-type: none"> <li>✓ Intuition</li> <li>✓ Implementation</li> <li>✓ Pros and Cons</li> </ul>
7	Mon. Feb. 27	Decision Trees using R and/or Analytic Solver <ul style="list-style-type: none"> <li>✓ Intuition</li> <li>✓ Implementation</li> <li>✓ Pros and Cons</li> </ul> <b>Quiz 2</b>

8	Mon. Mar. 06	Ensemble Tree Models using R and/or Analytic Solver <ul style="list-style-type: none"> <li>✓ Intuition</li> <li>✓ Implementation</li> <li>✓ Pros and Cons</li> </ul>
9	Mon. Mar. 13	Model Performance Assessment using R and/or Analytic Solver <ul style="list-style-type: none"> <li>✓ Concepts</li> <li>✓ Formulae</li> <li>✓ Implementation</li> </ul> Mid Term - released on Mar.13 and due by Mar. 20
10	Mon. Mar. 20	Clustering using R and/or Analytic Solver <ul style="list-style-type: none"> <li>✓ Concepts</li> <li>✓ Approaches</li> <li>✓ Implementation</li> </ul>
11	Mon. Mar. 27	Principal Components Analysis (PCA) using R <ul style="list-style-type: none"> <li>✓ Concepts</li> <li>✓ Approaches</li> <li>✓ Implementation</li> </ul>
12	Mon. Apr. 03	Basic Time Series Analysis using Excel or R or Analytic Solver <ul style="list-style-type: none"> <li>✓ Moving Average</li> <li>✓ Exponential Smoothing</li> <li>✓ Holt-Winters</li> </ul> <b>Quiz 3</b>
13	Mon. Apr. 10	ARIMA Models using R and/or Analytic Solver <ul style="list-style-type: none"> <li>✓ AR and MA</li> <li>✓ ARMA</li> <li>✓ ARIMA</li> </ul>
TBD		FINAL EXAM