Multivariate Statistical Models & Data Processing Methods in Civil Engineering

CIV ENG 745

Fall 2019

Course Instructor
Moataz Mohamed
Assistant Professor of Civil Engineering
JHE 230
mmohame@mcmaster.ca

1- Course information

Course Name	Multivariate Statistical Models & Data Processing Methods in Civil Engineering
Course ID	CIV ENG 745
Term	Fall 2019
Class Times & location	Wednesdays, 18:30-21:30 JHE 144
Tutorial Times & location	NA
Term 1 Dates	Sep. 3rd – Dec. 4th, 2019 (Graduate courses will start in Week 2)
Fall Term Dates	September 3rd – December 4th, 2019
Office Hours	Tuesdays, 4:00-5:00 pm (JHE 230)

2- Course Overview

This course presents an overview of the general topic of multivariate data analysis with an emphasis on their practical applications in civil engineering research. The course will enable students to develop, apply, and interpret multivariate statistical models while considering the inherited limitations and the advantages of each modelling technique. More specifically, the course focuses on four main themes: data manipulation & preparation, data mining techniques, prediction models, and latent (unmeasurable variables) models. Such procedures will be facilitated through the course weekly assignments.

The course is holistically arranged in four general themes; Data manipulation & preparation, data processing techniques, prediction modelling techniques, and latent variables (unmeasurable variables) modelling. Students from all engineering disciplines will be able to implement the techniques and skills offered in this course in their disciplines.

3- Intended Learning Outcomes (ILOs)

Upon successful completion of this course, you will be able to:
- Identify and apply the statistical hypothesis for multivariate data analysis.
- Identify and prepare the required data for multivariate statistical models.
- Perform the necessary calculations for a wide variety of statistical models using IBM SPSS package.
- Interpret statistical model and derive modelling contribution.

4- Course materials

Lecture Notes Lecture notes and assignment will be made available through Avenue to Learn.

Text Book   **Required**

Hair, J., Anderson, R., Black, B., Babin, B., 2016. **_Multivariate Data Analysis_**. 7th edition, Pearson Education.

Supplementary Optional Reading

Spencer, N.H., 2013. **_Essentials of Multivariate Data Analysis_**. CRC Press.

5- Course outline

Data Manipulation & Preparation	
Week 2	Introduction to Multivariate Data Analysis
Week 3	Missing data, sampling, level of confidence, hypothesis formulation, and error types (I & II)

Data Mining Techniques	
Week 4	Exploratory Factor Analysis (EFA)
Week 5	Cluster Analysis (Hierarchal)
Week 6	Cluster Analysis (Non-hierarchal)

Prediction Modelling Techniques	
Week 8	Multiple Linear Regression Models (Enter & Stepwise)
Week 9	Logistic Regression
Week 10	Hierarchical and Ordinal Regression

Latent Modelling Techniques	
Week 11	Confirmatory Factor Analysis (CFA)
Week 12	Structural Equation Models (SEM)

Conclusion & Remarks	
Week 13	Final Exam

6- Distribution of grades

The final mark for this course will be determined as follows:

Technical Presentation 1		10%
Technical Presentation 2		10%
Assignments	5*10=	50%
Final Exam (Open Book)		20%
Total		**100%**

Detailed guidelines for each assignment will be available on Avenue to Learn.

7- Methods of evaluation

The methods of evaluation include:
- Technical presentation of individual assignments (20% of the course grade). A rubric will be made available to all students and will be used by the course instructor (15%) and peer-evaluators (5%).
- Bi-weekly technical assignment reports (50% of the course grade). A rubric will be made available to all students.
- Final exam (20% of the course grade).

==It should be noted that:==
- Failing to attend more than **two classes** without an excuse acceptable by the instructor would result in failing the course.
- Students **MUST** score a passing grade in each of the weekly assignments and the final exam to pass the course and failing in any of these items would result in failing the course.

8- Professional class conduct

Attending lectures and tutorials is mandatory.

Our goal is to provide an environment that is free of discrimination and harassment, as well as that supports you to become competent in transportation engineering. Therefore, we have the following expectations;

- Lectures should be treated as discussion sessions. Please be prepared to work, and participate actively in every meeting,
- Please arrive on time, and minimize disruption if you are late,
- You are encouraged to ask questions related to the content of this course,
- Please avoid eating during class if possible, breaks will be provided,
- Please make sure all your electronic devices (e.g. cell phones and mp4 players) are on silent mode,

- If you urgently need to leave the class, please do it quietly to minimize disruption,
- Additional aspects will be discussed in Week 1.

9-   Deadlines and late penalties

In the event of an absence for medical or other reasons, students should review and follow the Academic Regulation in the Undergraduate Calendar "Requests for Relief for Missed Academic Term Work" (MSAF). **Please note these regulations have changed beginning Fall 2015.** When using the MSAF, report your absence to mmohame@mcmaster.ca **and directly to your supervisor**. Absences lasting more than three days must be reported to the Associate Dean's Office (KTH-129 for Social Science students, BSB-129 for Science students, and JHE-A214 for Engineering Students) and appropriate documentation must be provided.

For medical absences, the University reserves the right to require students to obtain medical documentation from the Campus Health Centre. **Please note that this form is simply a request for relief; the nature of the relief is left to the instructor's /supervisor's discretion**. Once the form is filled out, the student must contact their supervisor and the course instructor (mmohame@mcmaster.ca) as soon as possible in order to make necessary arrangements for making up work.

Generally, the accommodation will be **to grant an extension which matches the length of the absence**, at the discretion of the supervisor and in consultation with the course coordinator.

Please review the University's policy on missed term work that is available at:
http://academiccalendars.romcmaster.ca/content.php?catoid=7&navoid=559

Late submissions that are not subject to the aforementioned criteria will lose 5% of the assignment/exercise grade for every late business day.

10- Communication, discussion, and feedback

All formal communications regarding this course will be through **McMaster e-mail accounts** and/or **Avenue to Learn**. Please be sure to check your McMaster account regularly. Similar information will be posted on Avenue to Learn. E-mail subject line **must start with the course number**, followed by a colon and includes a relevant description of the content in the e-mail (e.g. *745: Assignment 1 question*). Otherwise, your e-mail will be filtered out.

Following this policy, students may expect a response from the instructor in three business days. E-mails that do not follow this policy may not receive a response.

You are encouraged to discuss the feedback that you receive on your assignments with the course TA and the course instructor. If you believe that you have received incorrect grades, you must contact the teaching team immediately with a **written explanation**. This process should be no later than one week of the day that the assignment was returned.

Periodically, you will be asked to **provide feedback on your own** experience during this course, including your opinion on the effectiveness of the lectures, tutorials, and assignments in contributing to your learning. This feedback will be solicited to help improve your experience, so it is in your best interest to make this feedback as informative, constructive, and respectful as possible.

11- Accessibility

Students with diverse learning styles and needs are welcome in this course. Students with disabilities who require academic accommodation must contact Student Accessibility Services (SAS) to make arrangements with a Program Coordinator. Student Accessibility Services can be contacted by phone at 905-525-9140 ext. 28652 or e-mail sas@mcmaster.ca. For further information, consult McMaster University's Academic Accommodation of Students with Disabilities policy.

12- Academic integrity

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:
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 another credit has been obtained,
2. Improper collaboration in group work,
3. Copying or using unauthorized aids in tests and examinations.

In this course, we will be using a web-based service (Turnitin.com) to reveal the authenticity and ownership of student-submitted work. Students are be expected to submit their work electronically either directly to Turnitin.com or via Avenue to Learn (A2L) plagiarism detection (a service supported by Turnitin.com), so it can be checked for academic dishonesty.

Students who do not wish to submit their work through A2L and/or Turnitin.com must still submit an electronic and/or hardcopy to the instructor. No penalty will be assigned to a student who does not submit work to Turnitin.com or A2L. All submitted work is subject to normal verification that standards of academic integrity have been upheld (e.g., online search, other software, etc.). To see the Turnitin.com Policy, please go to www.mcmaster.ca/academicintegrity.

13- Academic accommodation for religious, indigenous or spiritual observances (RISO)
Students requiring academic accommodation based on religious, indigenous or spiritual observances should follow the procedures set out in the RISO policy. Students requiring a RISO accommodation should submit their request to their Faculty Office normally within ten working days of the beginning of the 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.

14- In-class participation
Questions posed during lectures will be both quantitative (requiring simple calculation) and qualitative (requiring an extra bit of thinking). You are expected to have the required tools with you during lecture such that you may answer these questions in a timely manner.

15- Extreme circumstances
The University reserves the right to change the dates and deadlines for any or all courses in extreme circumstances (e.g., severe weather, labour disruptions, etc.). Changes will be communicated through regular McMaster communication channels, such as McMaster Daily News, A2L and/or McMaster e-mail.