

IBEHS 4C03
Statistical Methods in Biomedical Engineering
Winter 2022
Course Outline

CALENDAR/COURSE DESCRIPTION

Probability theory, random variables, random processes, statistical inference, regression, correlation, error analysis, and experimental design.

PRE-REQUISITES AND ANTI-REQUISITES

Prerequisite(s): Registration in Level III or above of the Integrated Biomedical Engineering and Health Sciences (IBEHS) program

Antirequisite(s): STATS 3J04, STATS 3Y03, MATLS 3J03

COURSE SCHEDULE

Lectures: Lectures at 9:30am to 10:20am KTH B135 Tuesdays, Wednesdays, and Fridays – [Virtual Classroom on MS Teams]

Tutorials: Tutorial at 8:30am to 9:20am HH 302 on Wednesdays– [Virtual Classroom on MS Teams]

INSTRUCTOR OFFICE HOURS AND CONTACT INFORMATION

Carol W. Bassim

bassimc@mcmaster.ca

Office Hours:

Wed from 4 to 5p, (on MS Teams or IBEHS office)

Or by appointment

TEACHING ASSISTANT OFFICE HOURS AND CONTACT INFORMATION

Aidee Verónica Arizpe

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Office Hours:

To be arranged

Or by appointment

COURSE WEBSITE/ALTERNATE METHODS OF COMMUNICATION

Course information, announcements, weekly modules and assignments located at Avenue to Learn:

<http://avenue.mcmaster.ca/>

Couse Teams (McMaster University Office 365) Site: Synchronous online classes, tutorials, and office hours.

COURSE OBJECTIVES

By the end of this course, students should be able to:

1. Characterize and visualize univariate and bivariate data using descriptive statistics.
2. Demonstrate an understanding of the basic concepts of random variables, probability distributions, and the sampling distribution of a statistic.
3. Compute and Interpret confidence intervals and significant differences using hypothesis testing.
4. Understand how and when to use nonparametric hypothesis testing.
5. Fit and interpret a least squares model, and describe the model limitations.
6. Use and interpret process monitoring charts.
7. Design your own experiment and then interpret experimental data.
8. Use statistical software for statistical computing and analysis of student's t-tests, linear regression, and design of experiments.

MATERIALS AND FEES

Required Texts:

There is no official course textbook. We will be using material from a previous instructor of engineering statistics: Kevin Dunn's book, Process Improvement using Data. This book is available as a PDF from the <http://learnche.org> website.

Other optional books that will be used to supplement the course material:

1. Rosner, Fundamentals of Biostatistics. This is a basic introduction to statistics with human subjects, overviewing statistical practices most often used in the medical literature.
2. Box, Hunter and Hunter: Statistics for Experimenters. This book is recommended for its practical engineering perspectives on data analysis.
G.E.P. Box, J.S. Hunter, and W.G. Hunter, Statistics for Experimenters – Design, Innovation and Discovery, 2nd edition, Wiley. ISBN: 978-0471718130.

Other Materials:

Use of a computer is required in the course. Python will be used as the statistical computing software. Lecture slides and accompanying materials are posted on Avenue to Learn.

COURSE OVERVIEW

Please note that this is the intended course plan. Deviations might occur due to delays or changes in topic coverage.

| Week | Topic |
|------|---|
| 1 | Describe and Visualize data |
| 2 | Probability and Probability Distributions |
| 3 | Inferential Statistics |
| 4 | Confidence Intervals |
| 5 | Hypothesis Testing |
| 6 | ROC curves and Tables |
| 7 | Midterm recess |

| | |
|----|---|
| 8 | Least squares regression |
| 9 | Multiple linear regression |
| 10 | Logistic regression and survival analysis |
| 11 | ANOVA and Design of Experiments |
| 12 | DOE Full Factorial and Fractional Designs |
| 13 | Response Surface Modeling |

ASSESSMENT

| Component | Weight |
|--------------------|--------|
| Assignments (6*5%) | 30% |
| Midterm 1 | 25% |
| Midterm 2 | 25% |
| DOE Project | 20% |
| Total | 100% |

ACCREDITATION LEARNING OUTCOMES

The Learning Outcomes defined in this section are measured for Accreditation purposes only, and will not be directly taken into consideration in determining a student's actual grade in the course.

| Outcomes | Indicators |
|---|------------|
| Fit and interpret a least squares model, and describe the model limitations. | 1.1 |
| Compute and Interpret confidence intervals and significant differences using hypothesis testing. | 1.3 |
| Design your own experiment and then interpret experimental data. | 1.4 |
| Use software for statistical computing and analysis of student's t-tests, linear regression, and design of experiments. | 5.2 |

For more information on Accreditation, please visit: <https://www.engineerscanada.ca>

CONDUCT EXPECTATIONS

As a McMaster student, you have the right to experience, and the responsibility to demonstrate, respectful and dignified interactions within all of our living, learning and working communities. These expectations are described in the [Code of Student Rights & Responsibilities](#) (the "Code"). All students share the responsibility of maintaining a positive environment for the academic and personal growth of all McMaster community members, **whether in person or online.**

It is essential that students be mindful of their interactions online, as the Code remains in effect in virtual learning environments. The Code applies to any interactions that adversely affect, disrupt, or interfere with reasonable participation in University activities. Student disruptions or behaviours that interfere with university functions on online

platforms (e.g. use of Avenue 2 Learn, WebEx or Zoom for delivery), will be taken very seriously and will be investigated. Outcomes may include restriction or removal of the involved students' access to these platforms.

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. **It is your responsibility to understand what constitutes academic dishonesty.**

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. For information on the various types of academic dishonesty please refer to the [Academic Integrity Policy](#), located at <https://secretariat.mcmaster.ca/university-policies-procedures-guidelines/>

The following illustrates only three forms of academic dishonesty:

- plagiarism, e.g. the submission of work that is not one's own or for which other credit has been obtained.
- improper collaboration in group work.
- copying or using unauthorized aids in tests and examinations.

AUTHENTICITY / PLAGIARISM DETECTION

Some courses may use a web-based service (Turnitin.com) to reveal authenticity and ownership of student submitted work. For courses using such software, students will be expected to submit their work electronically either directly to Turnitin.com or via an online learning platform (e.g. A2L, etc.) using plagiarism detection (a service supported by Turnitin.com) so it can be checked for academic dishonesty.

Students who do not wish their work to be submitted through the plagiarism detection software must inform the Instructor before the assignment is due. No penalty will be assigned to a student who does not submit work to the plagiarism detection software. **All submitted work is subject to normal verification that standards of academic integrity have been upheld** (e.g., on-line search, other software, etc.). For more details about McMaster's use of Turnitin.com please go to www.mcmaster.ca/academicintegrity.

ACADEMIC ACCOMMODATION OF STUDENTS WITH DISABILITIES

Students with disabilities who require academic accommodation must contact [Student Accessibility Services](#) (SAS) at 905-525-9140 ext. 28652 or sas@mcmaster.ca to make arrangements with a Program Coordinator. For further information, consult McMaster University's [Academic Accommodation of Students with Disabilities](#) policy.

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 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.

ACADEMIC ACCOMMODATIONS FOR RELIEF FOR MISSED ACADEMIC TERM WORK

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.

INCLUSIVE ENVIRONMENT STATEMENT

We consider this classroom to be a place where you will be treated with respect, and we welcome individuals of all ages, backgrounds, beliefs, ethnicities, genders, gender identities, gender expressions, national origins, religious affiliations, sexual orientations, ability – and other visible and non-visible differences. All members of this class are expected to contribute to a respectful, welcoming and inclusive environment for every other member of the class. We will gladly honour your request to address you by an alternate name or gender pronoun. Please advise us of this preference early in the term.

COURSES WITH AN ON-LINE ELEMENT

Some courses may use additional on-line elements (e.g. e-mail, Avenue to Learn (A2L), LearnLink, web pages, capa, Moodle, ThinkingCap, etc.). Students should be aware that, when they access the electronic components of a course using these elements, private information such as first and last names, user names for the McMaster e-mail accounts, and program affiliation may become apparent to all other students in the same course. The available information is dependent on the technology used. Continuation in a course that uses on-line elements will be deemed consent to this disclosure. If you have any questions or concerns about such disclosure please discuss this with the course instructor.

ONLINE PROCTORING

Some courses may use online proctoring software for tests and exams. This software may require students to turn on their video camera, present identification, monitor and record their computer activities, and/or lock/restrict their browser or other applications/software during tests or exams. This software may be required to be installed before the test/exam begins.

REQUESTS FOR RELIEF FOR MISSED ACADEMIC TERM WORK

McMaster Student Absence Form (MSAF): 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".

COPYRIGHT AND RECORDING

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.

REFERENCE TO RESEARCH ETHICS

The two principles underlying integrity in research in a university setting are these: a researcher must be honest in proposing, seeking support for, conducting, and reporting research; a researcher must respect the rights of others in these activities. Any departure from these principles will diminish the integrity of the research enterprise. This policy applies to all those conducting research at or under the aegis of McMaster University. It is incumbent upon all members of the university community to practice and to promote ethical behaviour. To see the Policy on Research Ethics at McMaster University, please go to <https://reo.mcmaster.ca/>.

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 email.

NOTICE REGARDING POSSIBLE COURSE MODIFICATION

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.