

IBEHS 4C03
Statistical Methods in Biomedical Engineering
Winter 2021
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: Mon, Thurs (9:30-10:20 AM) and Tues (10:30-11:20 AM) – [Virtual Classroom on MS Teams, lectures will be recorded and links posted on Avenue]

Tutorials: Thurs (11:30-12:20 PM) – [Virtual Classroom on MS Teams]

INSTRUCTOR OFFICE HOURS AND CONTACT INFORMATION

Carol W. Bassim

bassimc@mcmaster.ca

Office Hours:

Tuesdays – 1:00-2:00 PM (on MS Teams)

Or by appointment

TEACHING ASSISTANT OFFICE HOURS AND CONTACT INFORMATION

Jonathan L'Heureux-Hache

lheureuj@mcmaster.ca

Andrew Lofts

loftsa@mcmaster.ca

Elyse Rier

riere@mcmaster.ca

Melissa Temkov

temkovm@mcmaster.ca

Office Hours:

Tuesday – 9:30 – 10:30 (on MS Teams)

Or by appointment

COURSE WEBSITE/ALTERNATE METHODS OF COMMUNICATION

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

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

Couse Teams (McMaster University Office 365) Site: Synchronous 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. The R-language (<http://www.r-project.org/>) will be used, and is a freely available software package that runs on Linux, Apple and Windows computers. R software tutorials are available at: http://learnche.mcmaster.ca/4C3/Software_tutorial.

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	Hypothesis Testing
5	Least squares regression
6	Midterm recess

7	Logistic regression and survival analysis
8	ANOVA and Design of Experiments
9	Full Factorial Designs
10	Fractional Designs
11	Response Surface Modeling
12	Process Monitoring
13	Introduction to Principal Component Analysis

ASSESSMENT

Component	Weight
Assignments (6*6%)	36%
Quizzes (best 10 of 12; 10*2%)	20%
Regression Project Proposal	5%
Regression Project	15%
DOE Project Proposal	4%
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.

Integrated Biomedical Engineering & Health Sciences (IBEHS) Labs/Design Studio Safety

Information for Laboratory Safety and Important Contacts

This document is for users of IBEHS instructional laboratories at the following locations:

- ETB - 533/534 (Medical Imaging & Medical Instrumentation Labs)
- ABB - C104 (Design Studio)
- HSC - 4N72 (Genetic Engineering Lab)

This document provides important information for the healthy and safe operation of IBEHS instructional laboratories. This document is required reading for all laboratory supervisors, instructors, researchers, staff, and students working in or managing instructional laboratories in IBEHS. It is expected that revisions and updates to this document will be done continually. A McMaster University [lab manual](#) is also available to read in every laboratory.

General Health and Safety Principles

Good laboratory practice requires that every laboratory worker and supervisor observe the following:

1. Food and beverages are not permitted in the instructional laboratories.
2. A Laboratory Information Sheet on each lab door identifying potential hazards and emergency contact names should be known.
3. Laboratory equipment should only be used for its designed purpose.
4. Proper and safe use of lab equipment should be known before using it.
5. The course TA leading the lab should be informed of any unsafe condition.
6. The location and correct use of all available safety equipment should be known.
7. Potential hazards and appropriate safety precautions should be determined, and sufficiency of existing safety equipment should be confirmed before beginning new operations.
8. Proper waste disposal procedures should be followed.
9. [Personal ergonomics](#) should be practiced when conducting lab work.
10. [Current University health and safety](#) issues, and protocols should be known.

Location of Safety Equipment

Fire Extinguisher

On walls in halls outside of labs or
ABB C103/A

ETB 534/A, ABB C103/A, HSC 4N72 or dial
"88" after 4:30 p.m.

Telephone

On the wall of every lab near the door

First Aid Kit

Fire Alarm Pulls

Near all building exit doors on all floors

Who to Contact

Emergency Medical / Security:

On McMaster University campus, call Security at extension **88** or **905-522-4135** from a cell phone.

Hospital Emergency Medical / Security:

For McMaster HSC, call Security at extension **5555** or **905-521-2100** from a cell phone.

Non-Emergency Accident or Incident: Immediately inform the TA on duty or Course Instructor.

University Security (Enquiries / Non-Emergency):

Dial 24281 on a McMaster phone or dial 905-525-9140 ext. 24281 from a cell phone.

See TA or Instructor: For problems with heat, ventilation, fire extinguishers, or immediate repairs.

Environmental & Occupational Health Support Services (EOHSS): For health and safety questions dial 24352 on a McMaster phone or dial 905-525-9140 ext. 24352 from a cell phone.

IBEHS Specific Instructional Laboratory Concerns: For non-emergency questions specific to the IBEHS laboratories, please contact appropriate personnel below from a McMaster phone...

- Leela Pilli – 26888
- Parmveer Bola – 23521
- Alexa Huang – 24548

In Case of a Fire (Dial 88)

When calling to report a fire, give name, exact location, and building.

1. Immediately vacate the building via the nearest Exit Route. Do not use elevators!
2. Everyone is responsible for knowing the location of the nearest fire extinguisher, the fire alarm, and the nearest fire escape.
3. The safety of all people in the vicinity of a fire is of foremost importance. But do not endanger yourself!
4. In the event of a fire in your work area shout "*Fire!*" and pull the nearest fire alarm.
5. Do not attempt to extinguish a fire unless you are confident it can be done in a prompt and safe manner utilizing a hand-held fire extinguisher. Use the appropriate fire extinguisher for the specific type of fire. Most labs are equipped with Class A, B, and C extinguishers. Do not attempt to extinguish Class D fires which involve combustible metals such as magnesium, titanium, sodium, potassium, zirconium, lithium, and any other finely divided metals which are oxidizable. Use a fire sand bucket for Class D fires.
6. Do not attempt to fight a major fire on your own.
7. If possible, make sure the room is evacuated; close but do not lock the door and safely exit the building.

Clothing on Fire

Do not use a fire extinguisher on people.

1. Douse with water from safety shower immediately or
2. Roll on floor and scream for help or
3. Wrap with fire blanket to smother flame (a coat or other nonflammable fiber may be used if blanket is unavailable). Do not wrap a standing person; rather, lay the victim down to extinguish the fire. The blanket should be removed once the fire is out to disperse the heat.

Equipment Failure or Hazard

Failure of equipment may be indicative of a safety hazard - You must report all incidents.

Should you observe excessive heat, excessive noise, damage, and/or abnormal behaviour of the lab equipment:

1. Immediately discontinue use of the equipment.
2. In Power Lab, press wall-mounted emergency shut-off button.
3. Inform your TA of the problem.
4. Wait for further instructions from your TA.
5. TA must file an incident report.

Protocol for Safe Laboratory Practice

Leave equipment in a safe state for the next person - if you're not sure, ask!

Defined Roles

TA	The first point of contact for lab supervision	
IBEHS Lab Technician	Leela Pilli	pillil@mcmaster.ca
IBEHS Instructional Assistant	Parmveer Bola	bolap1@mcmaster.ca
IBEHS Co-Directors	Dr. Greg Wohl	wohlg@mcmaster.ca
	Dr. Michelle MacDonald	macdonml@mcmaster.ca
IBEHS Administrator	Alexa Behar-Bannelier	huanqa2@mcmaster.ca
IBEHS Course Instructor	Please contact your specific course instructor directly	