ENGG*4510 Assessment and Management of Risk
Winter 2014

UNIVERSITY of GUELPH
School of Engineering

1 INSTRUCTIONAL SUPPORT

1.1 Instructor

Instructor: Richard Harvey, Ph.D. Candidate, M. Eng.
Office: THRN 2116
Email: rharvey@uoguelph.ca
Office hours: TBA on Courselink or by appointment

1.2 Teaching Assistants

GTA	Email	Office Hours
Haley Piagno	piagnoh@uoguelph.ca	TBA on Courselink

2 LEARNING RESOURCES

2.1 Course Website

Course material, news, announcements, and grades will be regularly posted to the ENGG*4510/6010 Courselink site. You are responsible for checking the site regularly.

2.2 Required Resources

The following library material is essential, as it will be the textbook:

1. E. McBean and F. Rovers. 1998. *Statistical Procedures for Analysis of Environmental Monitoring Data and Risk Assessment.* Prentice-Hall Publishing Co. Inc., Englewood Cliffs, New Jersey.

The text will be supplemented with focused materials from the technical literature for purposes of enhancing background information available to the students. Example of supplementary material include:

2. K. Asante-Duah. 1998. *Risk Assessment in Environmental Management.* John Wiley and Sons, New York.
3. J. Hubert. 2004. *Environmental Risk Assessment*. Department of Mathematics and Statistics, University of Guelph.
4. B. Neely. 1994. *Introduction to Chemical Exposure and Risk Assessment.* Lewis Publishers, Ann Arbor, Michigan.
5. J. Louvar and B. Louvar. 1997. *Health and Environmental Risk Analysis – Fundamentals with Applications*. Prentice Hall PTR.

2.3 Recommended Resources

1. Access to spreadsheet programs such as Excel.

2.4 Additional Resources

Lecture Information: Selected lecture notes will be made available to students on Courselink/D2L but these are not intended to be stand-alone course notes. During lectures, the instructor will expand and explain the content of notes and provide example problems that supplement posted notes.

Non-mandatory Assignments: Non-mandatory assignments will be posted on the web page. Although these assignments will not be marked (and do not count towards your final grade) it is strongly advised that you work through them. They will allow you to practice solving the types of questions that might appear on a midterm or final exam. Solutions to the assignments will be covered during tutorial sessions with the teaching assistant and posted on Courselink following the tutorial.

2.5 Communication & Email Policy

Please use the lectures and tutorial sessions as your main opportunity to ask questions about the course. Major announcements will be posted to the course website.

It is your responsibility to check the course website regularly.

As per university regulations, all students are required to check their <uoguelph.ca> e-mail account regularly: e-mail is the official route of communication between the University and its students.

3 ASSESSMENT

3.1 Dates and Distribution

Quizzes: 10% (best 3 of 4)

Quiz #1 (15 minutes) – Monday, January 20, in class
Quiz #2 (15 minutes – Monday, February 3, in class
Quiz #3 (15 minutes) – Monday, March 10, in class
Quiz #4 (15 minutes) – Monday, March 24, in class

Project: 25%

A term project will be required from students, to provide experience in developing a risk assessment application.

- Assigned: January 20
- Students will work in groups.
- One paragraph description of proposed topic: January 27
- Five minute video pitch due date TBA.
- Final Report: April 4, 2014 (last day of class)
  Note: Both paper and electronic copies of the final report are to be submitted.

Midterm Test: 25%

Monday, February 10 (19:00-20:30), in class.

Final Exam: 40%

Tuesday, April 15, 08:30-10:30, Room TBA on Webadvisor

3.2 Course Grading Policies

Missed Assessments: If you are unable to meet an in-course requirement due to medical, psychological, or compassionate reasons, please email the course instructor. Please see below for specific details and consult the undergraduate calendar for information on regulations and procedures for Academic Consideration:
http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-ac.shtml

Accommodation of Religious Obligations: If you are unable to meet an in-course requirement due to religious obligations, please email the course instructor within two weeks of the start of the semester to make alternate arrangements. See the undergraduate calendar for information on regulations and procedures for Academic Accommodation of Religious Obligations:
http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-accomrelig.shtml

Passing grade: In order to pass the course, you must achieve a 50% grade.

Missed midterm tests: If you miss a test due to grounds for granting academic consideration or religious accommodation, the weight of the missed test will be added to the final exam. There will be no makeup midterm tests.

4 AIMS, OBJECTIVES & GRADUATE ATTRIBUTES

4.1 Calendar Description

This course will develop the bases by which risk to human health and the environment can be assessed. Issues of hazardous waste cleanups, permitting of water and air discharges, food safety, flood protection, as examples, are addressed. The course also examines how decisions are made to manage the risks to acceptable levels.

Prerequisite(s): STAT*2040 or STAT*2120

4.2 Course Aims

The world seems a very hazardous place. Every day, the newspapers announce that some chemical has been found to be carcinogenic, or some catastrophic accident has occurred. Humans have always sought to eliminate unwanted risks to health and safety. However, there is acknowledgement by scientists, engineers, and others who have thought carefully about risk, that the real problem is not the unachievable task of making technologies and lifestyles risk-free, but the more subtle problem of determining how to make the many causative features of risk appropriately safe.

Politicians, engineers and scientists frequently become disturbed when they discover that the question "how safe is safe enough?" has no simple answer. In response, this course develops the bases by which we can assess and manage risk in engineering. The fundamentals of the course deal with fate of problems that create risk (to humans and the environment), as relevant to engineering and how these aspects are employed in the making of decisions on how to manage risk. In this respect, engineering risk assessment has become an increasingly important tool as risk assessments are being performed in application to the spectrum of issues including many concerns examples of which include:

- hazardous waste cleanups,
- fate and transport of chemicals and pathogens in the environment,
- flood protection in water resources, and,
- establishing environmental quality standards and guidelines.

From the assessment of the magnitude of engineering risks, the course examines how decisions are made to manage the risks to acceptable levels for health, safety and the environment, based on fate principles. One of the differentiating keys to engineering assessment and management of risk is to understand the context of finite amounts of data that are typically available, and how the engineering principles apply, in understanding what the data mean (e.g. how reliable are the data). Risk assessment and management considerations in engineering are evolving rapidly, despite the associated uncertainties in assessment methodologies and data limitations. Elements of applications in both developed and developing countries will be presented.

4.3 Learning Objectives

Upon the successful completion of this course, the student will have demonstrated the ability to:

1. Use the knowledge of everyday risks in society, to establish the context of risk assessment and management of engineering risk, as it pertains to human health and the environment.
2. Understand basic statistical concepts used in risk assessment.
3. Assemble, interpret, and analyze environmental data as a basis from which risk assessments can be developed, including fate and transport concerns associated with engineering risk concerns.
4. Identify strategies which can be used to determine if the collection of additional data are warranted. Questions as to how many additional data points have value, are considered.
5. Develop concepts, and then build the concepts/techniques into engineering risk assessments, for application to simple and complex fate issues.
6. Understand how to access various data sources from epidemiology and toxicology as inputs to engineering risk assessments.
7. Develop plans for appropriate engineering risk assessment and management, reflecting legal, economic, and socioeconomic considerations.

4.4 Graduate Attributes

Successfully completing this course will contribute to the following CEAB Graduate Attributes:

Graduate Attribute	Learning Objectives	Assessment
1. Knowledge Base for Engineering	1,2,3,4	Quizzes, Exams
2. Problem Analysis	3,5, 7	Quizzes, Exams
3. Investigation	3,4	Project
4. Design	-	-
5. Use of Engineering Tools	3,6	Project
6. Individual and Teamwork	3,5,7	Project
7. Communication	5,7	Project
8. Professionalism	1,7	Quizzes, Exams, Project
9. Impact of Engineering on Society and the Environment	1,7	Quizzes, Exams, Project
10. Ethics and Equity	-	-
11. Economics & Project Management	-	-
12. Life-Long Learning	-	-

4.5 Instructor's Role and Responsibility to Students

The instructor's role is to develop and deliver course material in ways that facilitate learning for a variety of students. Selected lecture notes will be made available to students on Courselink/D2L but these are not intended to be stand-alone course notes. During lectures, the instructor will expand and explain the content of notes and provide example problems that supplement posted notes. Scheduled classes will be the principal venue to provide information and feedback for tests and project.

4.6 Students' Learning Responsibilities

Students are expected to take advantage of the learning opportunities provided during lectures and tutorials. In-class discussions will stimulate students to consider alternative magnitudes of risk which are faced on a regular basis, and how to extend that knowledgebase to communication with the public (and to get public liaison committees to build consensus on decision making).

Students, especially those having difficulty with the course content, should also make use of other resources recommended by the instructor. Students who do (or may) fall behind due to illness, work, or extra-curricular activities are advised to keep the instructor informed. This will allow the instructor to recommend extra resources in a timely manner and/or provide consideration if appropriate.

4.7 Relationships with other Courses & Labs

Previous Courses:

STAT*2040: Statistics 1 – where the following material was covered: descriptive statistics; univariate models such as binomial, Poisson, uniform and normal; central limit theorem; expected value; the t, F and chi-square models; point and interval estimation; hypothesis testing methods up to two-sample data; simple regression and correlation; ANOVA for CRD and RCBD.

Or

STAT*2120: Probability and Statistics for Engineers – where the following material was covered: Sample spaces; probability, conditional probability and independence; Bayes' theorem; probability distributions; probability densities; algebra of expected values; descriptive statistics; inferences concerning means, variances, and proportions; curve fitting, the method of least squares and correlation. An introduction to quality control and reliability is provided.

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5 TEACHING AND LEARNING ACTIVITIES

5.1 Timetable

Lectures:

Monday	19:00 – 21:50	RICH 2529

Tutorial:

Wednesday	14:30 – 15:30	ANNU 156

5.2 Lecture Schedule

The course will progress through the following material:

- introduce the concepts of risk as understood by the general public through their perceptions, and understand how risk assessments conducted in a scientific way, can give the correct picture to the general public, to establish the context for engineering risk assessment and management;
- cover basic statistical concepts which are essential for understanding environmental data, determining which data might still be needed for decision-making, examine distributional assumptions of data and how these are used to characterize inputs to risk assessment methodologies;
- describe exposure assessments in human health and the environment, considering bio-accumulation, bio-magnification, ecological modeling, and dose-response methodologies as inputs to engineering risk assessments and management;
- quantitatively characterize risk associated with engineering issues as inputs to human health and the environment;
- the students will be exposed to a variety of examples that demonstrate concepts which have gone into building risk assessment methodologies for engineering assessment; and,
- develop an understanding of risk communication and management strategies including acceptable risk, legislation on risk assessment, and deficiencies in engineering risk assessment processes.

The course material will be presented in three hours of lecture per week. The topics to be covered are shown in the following table (although the order of the subjects may be adjusted):

Lectures	Lecture Topics	References	Learning Objectives
Week 1	Background to engineering exposure risks to human health, safety and the environment.	Lecture Notes, Textbook chapters 1 and 12	1
Week 2	Engineering exposure assessments and dose response information.	Lecture notes	3,5
Week 3	Databases and information sources	Lecture notes	6
Week 4	Fundamentals of statistics and probability.	Lecture Notes, Textbook chapters 2, 3, 4 and 5	2
Week 5	Fundamentals of statistics and probability (con.)	Lecture notes, Textbook chapters 6 and 7.	2
Week 6	Working with censored data and the detection of outliers within datasets.	Lecture notes, textbook chapters 6 and 10.	2,4
Week 7	Evaluating differences between monitoring records (hypothesis testing)	Lecture notes, Textbook Chapter 8	2,3
Week 8	Engineering risk assessment methodologies for the environment.	Lecture notes	5,7
Week 9	Engineering risk assessment methodologies for human health.	Lecture notes	5,7
Week 10	Risk communication and management.	Lecture notes	1,7
Week 11	Case studies.	Lecture notes	5,7

Week 12	Larger views of risk including considerations relevant to the developing world. Future scenarios will be examined including significant effort to utilize engineering risk assessment and management as strategies through the globe, to address trade-offs. Significant differences that exist between approaches adopted in developed and developing countries will be investigated.	Lecture notes	1,7

5.3 Other Important Dates

Monday, January 6 2014: First day of class
Monday, February 17 – Friday, February 21 2014: Winter Break
Friday, March 7: drop date – 40th class
Friday, April 4 2014: last day of class

6 LAB SAFETY

Safety is critically important to the School and is the responsibility of all members of the School: faculty, staff and students. As a student in a lab course you are responsible for taking all reasonable safety precautions and following the lab safety rules specific to the lab you are working in. In addition, you are responsible for reporting all safety issues to the laboratory supervisor, GTA or faculty responsible.

If the laboratory rules are not followed, consequences will include removing student's access to the lab. If this results in lab work not being completed, the student will receive a grade of 0.

7 ACADEMIC MISCONDUCT

The University of Guelph is committed to upholding the highest standards of academic integrity and it is the responsibility of all members of the University community faculty, staff, and students to be aware of what constitutes academic misconduct and to do as much as possible to prevent academic offences from occurring. University of Guelph students have the responsibility of abiding by the University's policy on academic misconduct regardless of their location of study; faculty, staff and students have the responsibility of supporting an environment that discourages misconduct. Students need to remain aware that instructors have access to and the right to use electronic and other means of detection.

Please note: Whether or not a student intended to commit academic misconduct is not relevant for a finding of guilt. Hurried or careless submission of assignments does not excuse students from responsibility for verifying the academic integrity of their work before submitting it. Students who are in

any doubt as to whether an action on their part could be construed as an academic offence should consult with a faculty member.

7.1 Resources

The Academic Misconduct Policy is detailed in the Undergraduate Calendar:
http://www.uoguelph.ca/registrar/calendars/undergraduate/current/c08/c08-amisconduct.shtml

A tutorial on Academic Misconduct produced by the Learning Commons can be found at:
http://www.academicintegrity.uoguelph.ca/

Please also review the section on Academic Misconduct in your Engineering Program Guide.

The School of Engineering has adopted a Code of Ethics that can be found at:
http://www.uoguelph.ca/engineering/undergrad-counselling-ethics

8 ACCESSIBILITY

The University of Guelph is committed to creating a barrier-free environment. Providing services for students is a shared responsibility among students, faculty and administrators. This relationship is based on respect of individual rights, the dignity of the individual and the University community's shared commitment to an open and supportive learning environment. Students requiring service or accommodation, whether due to an identified, ongoing disability for a short-term disability should contact the Centre for Students with Disabilities as soon as possible

For more information, contact CSD at 519-824-4120 ext. 56208 or email csd@uoguelph.ca or see the website: http://www.uoguelph.ca/csd/

9 RECORDING OF MATERIALS

Presentations which are made in relation to course work—including lectures—cannot be recorded or copied without the permission of the presenter, whether the instructor, classmate or guest lecturer. Material recorded with permission is restricted to use for that course unless further permission is granted.

10 RESOURCES

The Academic Calendars are the source of information about the University of Guelph's procedures, policies and regulations which apply to undergraduate, graduate and diploma programs:
http://www.uoguelph.ca/registrar/calendars/index.cfm?index