



EMORY

ROLLINS  
SCHOOL OF  
PUBLIC  
HEALTH

**DEPARTMENT:** Environmental Health

**COURSE NUMBER:** EHS 760    **SECTION NUMBER:** 1

**CREDIT HOURS:** 2                      **SEMESTER:** Spring 2020

**COURSE TITLE:** Advanced Risk Assessment

**CLASS HOURS AND LOCATION:** 3:00 - 4:50 PM Wednesday

**INSTRUCTOR NAME:** P. Barry Ryan and Qiang Zhang

### **INSTRUCTOR CONTACT INFORMATION**

P. Barry Ryan  
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**OFFICE HOURS:** By appointment

**Teaching Assistant(s):** None

### **COURSE DESCRIPTION**

This course provides students with experience in quantitative methods used in environmental health risk assessment. The course will focus on areas such as: types of models used in estimation of health risks, quantification of variabilities and uncertainties in model-based estimates, Benchmark Dose (BMD) modeling for estimating reference doses, physiologically-based toxicokinetic (PBTK) modeling for internal exposure estimation and in vitro assay-based approach for chemical safety assessment. The course is taught at a PhD level and assumes familiarity with basic concepts of risk assessment as taught in EH 524.

**Course role:** Elective

**Year/semester offered:** Spring

**Prerequisite:** Risk Assessment I (EH 524) or equivalent at a different University

**MPH/MSPH FOUNDATIONAL COMPETENCIES:**

- Evidence-based Approaches to Public Health
  - Select quantitative and qualitative data collection methods appropriate for a given public health context
  - Analyze quantitative and qualitative data using biostatistics, informatics, computer-based programming and software as appropriate
  - Interpret results of data analysis for public health research, policy or practice

**EHS PHD CONCENTRATION COMPETENCIES:**

- Apply advanced methods for assessing human exposures to environmental agents
- Apply epidemiologic and risk assessment methods to describe the risks associated with exposure to environmental agents

**EH MASTER CONCENTRATION COMPETENCIES:**

- Apply the principles of exposure science to characterize and quantify environmental exposures
- Apply the principles of toxicology to assess health effects of environmental exposures
- Evaluate the risks posed by environmental hazards using risk assessment methods

**COURSE LEARNING OBJECTIVES:**

- To develop detailed understanding and competence in performing risk assessment calculations that take into account population variability and parameter uncertainty.
- To developed detailed understanding of toxicokinetic (TK) and physiologically-based (PBTK) modeling using realistic models of human and ecological systems with interacting components
- To enumerate similarities and differences between realistic risk calculations and TK models

## EVALUATION

Students will be evaluated based upon attendance, homework and projects.

Attendance	10%
Homework #1	15%
Homework #2	15%
Homework #3	15%
Homework #4	15%
Project #1	15%
Project #2	15%

A:  $\geq 95$ , A-:  $\geq 90$ , B+:  $\geq 85$ , B:  $\geq 80$ , B-:  $\geq 75$ , C:  $\geq 60$ , F < 60

## COURSE STRUCTURE

The course comprises lectures and hands-on computer simulation exercises. Each student will be required to bring a laptop computer to simulation sessions.

Literature papers will be assigned for reading after some sessions to further solidify the concepts taught in class.

MPH/MSPH Foundational Competencies assessed	Representative Assignment
Select quantitative and qualitative data collection methods appropriate for a given public health context	Homework 1-4
Analyze quantitative and qualitative data using biostatistics, informatics, computer-based programming and software as appropriate	Homework 1-4, paper reading assignments
Interpret results of data analysis for public health research, policy or practice	Homework 1-4, paper reading assignments
EHS Concentration Competencies assessed	Representative Assignment
Apply advanced methods for assessing human exposures to environmental agents	Homework 1-2, Project 1
Apply epidemiologic and risk assessment methods to describe the risks associated with exposure to environmental agents	Homework 3-4, Project 2

EH Concentration Competencies assessed	Representative Assignment
Apply the principles of exposure science to characterize and quantify environmental exposures	Homework 1-2, Project 1
Apply the principles of toxicology to assess health effects of environmental exposures	Homework 3-4, Project 2
Evaluate the risks posed by environmental hazards using risk assessment methods	Projects 1 and 2

## COURSE POLICIES

Attendance is required and counts toward 10% of the final score. Each student is expected to complete the homework assignments independently and Projects in groups. Reading assignment will also be prescribed through the semester. There is no required textbook, but the following can be used as optional reference textbooks:

- (1) Cullen and Frey, *Probabilistic Techniques in Exposure Assessment. A Handbook for Dealing with Variability and Uncertainty in Models and Inputs*.
- (2) Reddy MB, Yang RSH, Clewell III HJ, Andersen ME. *Physiologically Based Pharmacokinetics: Science and Applications*. New York, NY: John Wiley and Sons, Inc. (2004). ISBN-13: 9780471478140.

As the instructors of this course we endeavor to provide an inclusive learning environment. However, if you experience barriers to learning in this course, do not hesitate to discuss them with me and the Office for Equity and Inclusion, 404-727-9877.

## RSPH POLICIES

### Accessibility and Accommodations

Accessibility Services works with students who have disabilities to provide reasonable accommodations. In order to receive consideration for reasonable accommodations, you must contact the Office of Accessibility Services (OAS). It is the responsibility of the student to register with OAS. Please note that accommodations are not retroactive and that disability accommodations are not provided until an accommodation letter has been processed.

Students who registered with OAS and have a letter outlining their academic accommodations are strongly encouraged to coordinate a meeting time with me to discuss a protocol to implement the accommodations as needed throughout the semester. This meeting should occur as early in the semester as possible.

Contact Accessibility Services for more information at (404) 727-9877 or [accessibility@emory.edu](mailto:accessibility@emory.edu). Additional information is available at the OAS website at <http://equityandinclusion.emory.edu/access/students/index.html>

## Honor Code

**You are bound by Emory University's Student Honor and Conduct Code.** RSPH requires that all material submitted by a student fulfilling his or her academic course of study must be the original work of the student. Violations of academic honor include any action by a student indicating dishonesty or a lack of integrity in academic ethics. *Academic dishonesty refers to cheating, plagiarizing, assisting other students without authorization, lying, tampering, or stealing in performing any academic work, and will not be tolerated under any circumstances.*

The RSPH Honor Code states: "Plagiarism is the act of presenting as one's own work the expression, words, or ideas of another person whether published or unpublished (including the work of another student). A writer's work should be regarded as his/her own property."

([http://www.sph.emory.edu/cms/current\\_students/enrollment\\_services/honor\\_code.html](http://www.sph.emory.edu/cms/current_students/enrollment_services/honor_code.html))

## COURSE CALENDAR

### Week 1

#### Introduction

- Administrative- Logistics, grading, discussion of syllabus
- Review of Risk I Concepts
- Use of R language in Risk Modeling

### Week 2

#### Compartmental models and Deterministic Approaches to Risk and TK Modeling

*Homework #1 Distributed*

### Week 3

#### Variability and uncertainty

- Population Parameter Variability with Examples
- Parameter Uncertainty in Risk Modeling with Examples
- Discussion of Ineffectiveness of Deterministic Approaches and Complexity of Including Population Variability and Parameter Uncertainty

#### Distribution types and selection of parameters

- Uniform
- Triangular

- Normal
- Special Distributions
  - Lognormal
  - Gamma
  - Beta
  - Weibull

#### **Week 4**

##### **One-Dimensional Monte Carlo Unit**

- One-Dimensional Model
- Deterministic Risk Model
- Introduction of Population Variability into Models
- Discussion of Parameter Uncertainty in Risk Models
- Distinguish between Reducible Uncertainty and Irreducible Variability

*Project 1 Distributed*

#### **Week 5**

##### **Two-Dimensional Monte Carlo Unit**

- Expansion of One-Dimensional Monte Carlo (1DMC) to account for parameter uncertainty and model uncertainty using Two-Dimensional Monte Carlo (2DMC) Approaches

*Homework #1 Due*

*Homework #2 Distributed*

#### **Week 6**

##### **Analysis of Two-dimension Monte Carlo approaches sensitivity analyses**

- Working session using specific modeling approaches in 2D MC
- Sensitivity Analysis

#### **Week 7**

##### **Presentation of Project 1**

*Homework #2 Due*

#### **Week 8**

##### **Introduction to PBTK/PBPK modeling Construction of PBTK/PBPK models**

#### **Week 9**

##### **Describing individual tissue compartments and Introduction to Berkeley Madonna simulation software**

#### **Week 10**

##### **Building a full PBPK model (Styrene)**

*Homework #3 Distributed*

**Week 11**

**Modeling population variability and uncertainty**

**Week 12**

**BMD modeling (EPA approach)**

*Project 2 Distributed*

**Week 13**

**BMD modeling (Bayesian approach)**

*Homework #3 Due*

*Homework #4 Distributed*

**Week 14**

**Next-generation risk assessment and in vitro to in vivo extrapolation (IVIVE)**

**Week 15**

**Presentation of Project 2**

*Homework #4 Due*

## **COURSE OUTLINE**

Please see Course Calendar above