University of Toronto
ECO 227Y1
Quantitative Methods in Economics

Professor Chuan Goh

2010–2011 Academic Year
(REVISED SYLLABUS FOR SPRING 2011)

1 Basic Information

- This is a two-semester course. **Chuan Goh** will be the instructor for both semesters.
- Lectures will be held on Tuesday evenings between 6:10 and 8:00 in SS 1087.
- Lectures will be followed by a one-hour tutorial led by **Christine Tewfik**, who is the teaching assistant for this course. She may be reached by e-mail at `christine.tewfik@utoronto.ca`. The tutorials will be held in SS 1087.

2 Instructor Contact Information

- Professor Goh will hold office hours on **Tuesday afternoons between 2 and 4 o'clock** in Max Gluskin House, 150 St. George St., Room 232.
- His office telephone number is (416) 978-4964.
- He can also be reached by e-mail at `goh@economics.utoronto.ca`.

E-mail is welcome from students enrolled in the course, and will usually be answered on weekdays between 9 AM and 6 PM within a delay of 24 hours. Occasionally questions that cannot be answered quickly will not receive a response; in these cases students are asked to repeat their questions in person. Students should not expect quick responses during the evening hours or on weekends. Students have a responsibility to ensure that their e-mail to the instructor does not end up being categorized as "spam" by the instructor's mail server.

3 Required Textbook

The lectures in this course are based on the material covered in Dennis D. Wackerly, William Mendenhall III and Richard L. Scheaffer, *Mathematical Statistics with Applications*, Seventh Edition (2008), Thomson Brooks/Cole, ISBN 978-0-495-11081-1. The text is bundled with a Students Solutions Manual by William J. Owen (ISBN 978-0-495-38506-6) which contains solutions to the odd-numbered exercises in the textbook. Students are welcome to use the sixth edition instead of the seventh for the purpose of studying the material. Homework problems, however, will be assigned from the seventh edition.

4 This Course on the Web

Students are asked to take note of the URL for the course webpage:

`http://www.chuangoh.org/eco227y.html`.

Assignments and any announcements or class handouts will be made available directly on this site.

5 Course Description and Intended Learning Outcomes

This course is designed to serve as an introduction to statistical methods as they are most commonly applied to problems in economics and business. To this end, students will be expected to develop the ability to define, understand and recognize important statistical concepts as they appear in various situations in the social

sciences and business. Basic methods of data analysis will be taught, and students will have opportunities to apply them to datasets drawn from real-world situations.

This course aims to instil in undergraduates an enthusiasm for the modelling of random phenomena, and should be useful for further work in a wide range of different disciplines. Furthermore, many of the major decisions affecting the lives of *everyone* on this planet have some statistical justification or basis, and the way of thinking to which students are exposed in this course will be relevant to understanding those decisions.

6 Prerequisites

ECO 100Y is required with a minimum grade of 70%. Students are also expected to have had an introductory undergraduate course in calculus. In particular, passing MAT 133Y with a minimum grade of 63%; MAT 123H and MAT 124H each with minimum grades of 63%; MAT 135Y with a minimum grade of 60%; MAT 137Y with a minimum grade of 55% or MAT 157Y with a minimum grade of 55% will satisfy the calculus prerequisite for this course. It is also recommended that students be enrolled in second-year courses in linear algebra (i.e., MAT 223H or MAT 240H) and multivariate calculus (i.e., MAT 235Y; MAT 237Y or ECO 210H) at the same time as their enrolment in ECO 227Y.

7 Homework

Weekly problem sets will be given. Although **these problem sets will not be graded**, their completion will be essential for success in this course.

8 Grading Scheme

The final grade in this course will be computed as the sum of the final grades recorded at the end of each semester of the course. The grade for each semester will be based solely on performance on **two term tests**:

- During the fall semester, the first term test will be written in class on **October 19th** and will count for 40% of the first-semester grade (i.e., 20% of the final grade in the course). The second term test will be written during the

December examination period and will count for 60% of the first-semester grade (i.e., 30% of the final grade in the course).

- During the spring semester, the first term test will be written in class on **March 8th** and will count for 40% for the second-semester grade (i.e., 20% of the final grade in the course). The second term test will be written during the April examination period and will count for 60% of the second-semester grade (i.e., 30% of the final grade int he course).

Students will have a maximum of three hours to complete each of these term tests. The first term test of each semester will be based on the material covered by the lectures given during the first half of the semester. The second term test of each semester will be based on the entire semester's material, but with emphasis placed on the material covered by the lectures given during the second half of the semester.

The distribution of final grades may be adjusted in April to improve the grades for all students.

9 Policies on Missed Term Tests

There will be no "make-ups" for missed term tests in this course. Missed term tests will generally result in a grade of zero, with the following exceptions:

- Students who miss the October term test for acceptable medical or personal reasons will have their grade on the December term test count for 50% of their final grade in the course.

- Students who miss the March term test for acceptable medical or personal reasons will have their grade on the April term test count for 50% of their final grade in the course.

- Students who write the October term test, but miss the December term test for acceptable medical or personal reasons will have the weight for that portion of their final grade shifted to the second semester. Specifically, the March term test will count for 32% of their final grade in the course, and the April term test will count for 48% of their final grade in the course.

- Students who miss both the October and December term tests for whatever reasons are encouraged to take this course again at a later time.

- Students who miss the April term test for whatever reason are required to file a petition to write a deferred examination with their college registrar.

The only generally acceptable excuse for missing a term test is illness. In this connection, students should take note of the new policy instituted by the Faculty of Arts and Science covering student absences. The short version of this policy as it applies to missing any of the first three term tests in ECO 227Y1 is as follows:

1. Students who miss the October, December or March term test must record their absence online using the ROSI Absence Declaration.

2. (a) In the case of medical absences, a University of Toronto Student Medical Certificate[1] must be filled out by the student's physician and given in person to Professor Goh at the earliest possible opportunity. Professor Goh will contact the physician in question to verify that the student's absence was in fact legitimate.

   (b) Students who miss a term test for non-medical reasons will generally not be accommodated.

Students who miss the April term test should petition the Faculty to write a deferred examination. The reason for this is that the Faculty treats all tests written during the April examination period as final exams. College registrars will have the necessary information on how to submit petitions for deferred examinations.

[1]The University of Toronto Student Medical Certificate may be downloaded from `http://www.artsci.utoronto.ca/current/undergraduate/course/timetable/2006-2007-fall-winter-timetable/medcert.pdf/view`

10 Course Timetable for the Fall Semester

The schedule of problem sets and term tests is subject to change.

10.1 Scheduling of Problem Sets

- Problem Set 1: Questions from Chapter 1. Assigned September 14, "due" September 21.
- Problem Set 2: Questions from Chapter 2. Assigned September 21, "due" September 28.
- Problem Set 3: Questions from Chapter 2. Assigned September 28, "due" October 5.
- Problem Set 4: Questions from Chapter 3. Assigned October 5, "due" October 12.
- Problem Set 5: Questions from Chapter 3. Assigned October 12, "due" October 19.
- Problem Set 6: Questions from Chapter 3. Assigned October 26, "due" November 2.
- Problem Set 7: Questions from Chapter 4. Assigned November 2, "due" November 9.
- Problem Set 8: Questions from Chapter 4. Assigned November 9, "due" November 16.
- Problem Set 9: Questions from Chapter 4. Assigned November 16, "due" November 23.
- Problem Set 10: Questions from Chapter 5. Assigned November 23, "due" November 30.
- Problem Set 11: Questions from Chapter 5. Assigned November 30, "due" by the date of Term Test 2.

10.2 Scheduling of Term Tests

- Term Test 1: Based on Chapters 1 and 2 and the first half of Chapter 3. October 19.
- Term Test 2: Based on Chapters 1–4 and the first half of Chapter 5, with an emphasis on the material in the second half of Chapter 3, Chapter 4 and the first half of Chapter 5. December examination period. Date and location to be announced.

11 List of Topics for the Fall Semester

We will cover most of the material in Chapters 1–5. In general, only topics covered in both the lectures *and* the textbook will appear on the term tests. A detailed listing follows:

1. Working with Data (Chapter 1); September 14.

   (a) sample vs. population, rationale for statistical inference, descriptive statistics, measures of central tendency, measures of variability, histogram, Chebyshev's theorem and the "empirical rule"

   Read Chapter 1

2. Probability Basics (Chapter 2); September 21, 28.

   (a) role of probability in statistical inference, set theory, probability spaces, axioms of probability measure, calculating probability over discrete sample spaces, combinatorics, conditional probability, Bayes' Theorem, numerical encoding of random events, random sampling from a large population

   Read Chapter 2

3. Discrete Random Variables (Chapter 3); October 5, 12, 26.

   (a) random variables $\leftrightarrow$ distribution, distribution $\leftrightarrow$ density, expression of assumptions of probability model in the manner/rate in which a distribution function increases, discrete vs. continuous random variables, expectation of a discrete random variable, expectation of a function of a random variable, variance/standard deviation of a random variable

   (b) special discrete distributions I (sequences of Bernoulli trials): Bernoulli, binomial, geometric, negative binomial, hypergeometric distributions

   (c) special discrete distributions II (Poisson process): Poisson distribution

   (d) moments, moment-generating functions, Chebyshev's theorem

   Read all of Chapter 3 apart from Section 3.10

4. Continuous Random Variables (Chapter 4); November 2, 9, 16.

   (a) continuous probability distributions, expectations of continuous random variables

   (b) special continuous distributions: exponential (including link with Poisson process), uniform, normal, gamma, beta distributions

   (c) Chebyshev's theorem

   Read all of Chapter 4 apart from Section 4.11

5. Probability Distributions Over Two or More Dimensions (Chapter 5); November 23, 30

   (a) multivariate probability distributions, marginal and conditional distributions, independent random variables, expectation of a function of several random variables

   Read Sections 5.1–5.5.

12 Course Timetable for the Spring Semester

The schedule of problem sets and term tests is subject to change.

12.1 Scheduling of Problem Sets

- Problem Set 12: Questions from Chapter 6. Assigned January 11, "due" January 18.
- Problem Set 13: Questions from Chapter 7. Assigned January 18, "due" January 25.
- Problem Set 14: Questions from Chapter 8. Assigned January 25, "due" February 1.
- Problem Set 15: Questions from Chapter 8. Assigned February 1, "due" February 8.
- Problem Set 16: Questions from Chapter 9. Assigned February 8, "due" February 15.
- Problem Set 17: Questions from Chapter 10. Assigned February 15, "due" March 1.
- Problem Set 18: Questions from Chapter 10. Assigned March 1, "due" March 15.
- Problem Set 19: Questions from Chapter 10. Assigned March 15, "due" March 22.
- Problem Set 20: Questions from Chapter 11. Assigned March 22, "due" March 29.
- Problem Set 21: Questions from Chapter 11. Assigned March 29, "due" April 5.
- Problem Set 22: Questions from Chapter 11. Assigned April 5, "due" by the date of Term Test 4.

12.2 Scheduling of Term Tests

- Term Test 3: Based on Chapters 6–9. March 8, 6:10–9:10 PM, SS 1087.
- Term Test 4: Based on Chapters 6–11, with an emphasis on the material in Chapters 10–11. April examination period. Date and location to be announced.

13 List of Topics for the Spring Semester

We will cover most of the material in Chapters 6–11. In general, only topics covered in both the lectures *and* the textbook will appear on the term tests. A detailed listing follows:

1. Functions of Several Random Variables (Chapter 6); January 11.
   (a) importance for statistical inference, method of distribution functions, method of transformations, method of moment-generating functions.

   Read Sections 6.1–6.5.

2. Sampling Theory and the Central Limit Theorem (Chapter 7); January 18.
   (a) sampling distributions of statistics, sampling distributions of statistics corresponding to samples drawn from normal populations, the Classical Central Limit Theorem, the De Moivre-Laplace CLT

   Read Chapter 7

3. Point and Interval Estimation (Chapter 8); January 25, February 1.
   (a) point estimators, bias and mean squared error, performance criteria
   (b) exact confidence intervals, large-sample confidence intervals
   (c) selecting the sample size
   (d) exact confidence intervals for population means, exact confidence intervals for the two-sample problem
   (e) confidence intervals for population variances

   Read Chapter 8

4. Statistical Performance Criteria and Methods of Estimation (Chapter 9); February 8.
   (a) relative efficiency, consistency, sufficiency
   (b) minimum-variance unbiased estimation, the Rao-Blackwell Theorem
   (c) the method of moments
   (d) the method of maximum likelihood, large-sample properties of maximum-likelihood estimators

   Read Chapter 9

5. Hypothesis Testing (Chapter 10); February 15, March 1, March 15
   (a) general paradigm
   (b) theory of tests: power, sample size, relationship with confidence intervals, p-values
   (c) exact tests for population means, exact tests for the two-sample problem

(d) tests regarding population variances

(e) The Neyman-Pearson Lemma, likelihood ratio tests

Read Chapter 10

6. Linear Models (Chapter 11); March 22, March 29, April 5

(a) linear statistical models, the method of least squares

(b) simple linear regression

(c) multiple linear regression

Read Chapter 11