STAT 2000

Basic Statistical Analysis II

Fall 2009

Calendar Description

(Formerly 005.200) The study of estimation and hypothesis testing procedures for means and proportions in one, two, and multiple sample situations, introduction to the analysis of variance; regression and correlation analysis; optional topics may include nonparametric procedures, design of experiments, probability models. Not to be held with *STAT 2001*. Prerequisite: *STAT 1000* (C) or *STAT 1001* (C) (or *005.100* (C)).

Teaching Philosophy and Goals

It is the desire of the Department of Statistics to present this course in a manner that emphasizes and illustrates the "real-world" aspects of statistical analysis. Whenever possible, we will attempt to bring real-life examples and data into the classroom. This will be done using, as appropriate, videotape clips showing statisticians at work, newspaper articles, in-class demonstrations and experiments, and the like. It should be noted that this is a 2000 level course. As such, a certain level of maturity is expected.

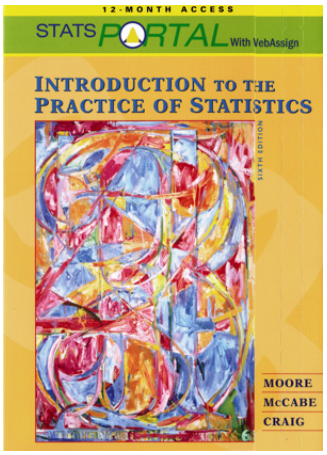
The course is designed to include those topics deemed crucial for an understanding of the foundations of statistical thinking and reasoning. The concepts of statistical analysis will be stressed rather than mathematical or probabilistic derivations or extensive numerical calculations. The course will place an emphasis on the development of critical thinking skills.

To aid in the analysis of data, extensive use will be made of the computer — with virtually every assignment involving the computer in some fashion. The computer package that has been selected for this course, JMP, is easy to use and is available for use with Macintosh or Windows systems. The package also has many advanced statistical features that you will find useful in subsequent courses.

We are interested in feedback from you. If you can think of ways in which this course could be improved, please let us know.

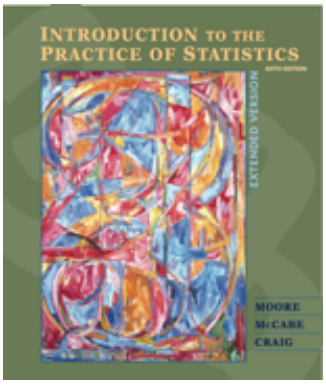
Text & Supplementary Material (Required)

Introduction to the Practice of Statistics (IPS), David S. Moore, George P. McCabe and Bruce A. Craig, 6^{th} edition, W.H. Freeman, New York, 2009. There are two options for purchasing the required material:



Option 1: (ISBN 1-4292-2532-4) This option includes all required and supplementary materials for this course in electronic form, including the textbook. This may be a good option if you happen to have a copy of the book, or do not wish to have a hard copy, but would like access to the electronic supplements and the JMP software. This option must be asked for at the check-out counters in the bookstore.

This includes the following components: (i) the WebAssign access card (which gives you access to the WebAssign online homework system for one class within a 1-year period), (ii) the StatsPortal access card (which gives you 1-year access to the electronic version of the book, with associated tools such as StatTutor, the *Study Guide*, the JMP *Manual*, and access to the JMP software).



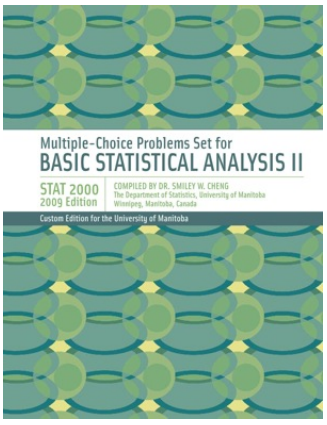
Option 2: (ISBN 1-4292-5231-6) This option includes all materials from Option 1 above, plus a hard copy of the textbook and a CD to accompany the book (containing statistical applets, tables, data sets, supplementary material and companion chapters).

Note that JMP software (included in both options above) is required for this course. There are many computers on campus that can be used for running JMP. In particular, the Department of Statistics has a number of Macintosh computers in the Statistics Lab (Room 311 Machray Hall) that you may use and the software is also available on the computers in the "open area" ACN computer labs. More details will be given in class.

i▸clickers

Throughout the course, extensive use of the i▸clicker classroom response system will be made in order to enhance your understanding of the material and promote classroom participation. Note that i▸clicker participation constitutes a portion of your grade in this course and as such you are required to bring your i▸clicker to each class.

Problems Set (Optional)



Multiple-Choice Problems Set for Basic Statistical Analysis II, STAT 2000, Compiled by Dr. Smiley W. Cheng. (2009 Edition) The Department of Statistics, University of Manitoba; Winnipeg, Manitoba, Canada ISBN: 0558303625. You should find this problems set to be useful when studying for the test and final exam. It contains term tests and final exams for this course for recent years. In addition, it contains a collection of multiple-choice questions that have been taken from previous introductory courses in statistics, and some supplementary material related to Modules IV and VII below.

Demonstrator Hours

In the Statistics Lab in Room 311 Machray Hall (which contains a number of computers), graduate students and senior undergraduate students in statistics are available to help you at the following times (from September 14 until December 11):

Mondays, Wednesdays & Thursdays	9:30 a.m.–4:00 p.m.
Tuesdays	9:30 a.m.–7:00 p.m.
Fridays	9:30 a.m.–12:00 noon

Mark Breakdown

Assignments	15%
i►clicker Questions / Participation	5%
Term Test	30%
Final Examination	50%

There are no firm cut-offs for grades. However, *subject to the caveat in the paragraph below*, the following are "guarantees" to you: A+ (≥ 90), A (≥ 80), B+ (≥ 75), B (≥ 70), C+ (≥ 65), C (≥ 60), D (≥ 50). This means, for example, that if you obtain 80% or more, you will receive no worse than an A.

However, there is an **additional requirement** for obtaining a C or a D in the course: **to obtain a grade of C or better, you must obtain at least 45% on the final examination; to obtain a D you must obtain at least 35% on the final examination.**

Assignments

The assignments in this course will be done in `WebAssign`, an on-line assignment system. There will be 12 weekly assignments. Assignments will be **due at 11:59 p.m.** on the due dates.

It is very important that you complete all 12 assignments. However, only the best 10 of the 12 assignments will be used to determine your Assignment Mark. **Consequently, assignment extensions will not be given.**

It is important that you do lots of problems on a regular basis. For extra practice you should do questions from the text; the answers to most of the odd-numbered questions are given in the back of the book and many detailed solutions are given in the *Study Guide*.

Test and Examination

The term test will be 1.5 hours in duration and will be held on Saturday, October 31, 2009 as noted in the `Aurora Student Online Class Schedule`. The material to be covered will be announced in class. The final examination will be 2 hours in duration and will be scheduled by the Registrar's Office. It will cover the entire course with emphasis on material covered since the mid-term test. Members of the University's (Provincial or National) athletic teams should normally give 3 weeks notice for special arrangements to be made for writing the term test or final examination off campus.

The term test will be all multiple-choice. The final examination will contain both multiple-choice questions and a written component, in an approximate 70:30 ratio. For the test and examination: (i) non-programmable hand-held calculators are permitted (graphing calculators are not permitted), (ii) electronic devices, such as cell phones and head phones, are prohibited, (iii) statistical tables will be provided, if required, (iv) selected formulae will be provided.

Videotape Series

There are two series of videotapes (*Statistics: Decisions Through Data* and *Against all Odds: Inside Statistics*) that are quite closely related to the text. Your instructor may show some of these during the classes. However, two copies of the complete set of the second title are also available for viewing in the Science Library; tapes and headphones may be obtained at the Reserve Desk. Each tape is approximately 26 minutes in length.

Voluntary Withdrawal

Note that the voluntary withdrawal date is November 18, 2009 (by which time you will have received your marks for the test and several assignments).

Academic Dishonesty

It is important that you understand what constitutes academic dishonesty and that you are familiar with the very serious consequences. Links to resources that that describe academic dishonesty (including plagiarism, cheating, inappropriate collaboration and examination impersonation) can be found at:
`http://www.umanitoba.ca/faculties/science/student/webdisciplinedocuments.html`.

Typical penalties imposed within the Faculty of Science for academic dishonesty are also described. See also:
`http://webapps.cc.umanitoba.ca/calendar10/regulations/plagiarism.asp`.

Course Content

The following is a non-exhaustive list of topics. Most of these are covered in the text.

Module I: Inference for the Mean of a Single Population when σ is Known or the Sample Size is Large; Inference for the Mean of a Single Population when σ is Not Known (1.5 weeks) Chapter 6 (§6.1–§6.4) and §7.1

- Review of principles of statistical inference: testing and estimation, confidence intervals
- Statistical decisions: Type I and Type II errors and their probabilities, power of a test
- Review of t-distribution (comparison with normal distribution), tests and confidence intervals. Robustness of t-procedures

Module II: Inference for the Means of Two Populations (2 weeks) Chapter 7 (§7.1–§7.2)

- Review of procedures for matched pairs procedures
- Inference for the equality of means in two populations: assumptions of normality, independence and equality of variances
- Robustness of t-procedures

Module III: Inference for the Means of Two or More Populations (2 weeks) Chapter 12 (§12.1)

- Inference for the equality of means in two or more populations: introduction to ANOVA, basic ideas of multiple comparisons
- The F-distribution
- Graphical comparison of distributions

Module IV: Probability and Discrete Distributions (1 week) Chapter 4 (§4.4), §5.1 (also *Multiple-Choice Problems Set for Basic Statistical Analysis II*)

- Random variables, probability distributions, mean and variance of a random variable
- Review binomial distribution
- Poisson distribution

The material to be covered in the Term Test will be announced in class. **The test is on Saturday, October 31, 2009 from 1:30 p.m. to 3:00 p.m.**

Module V: Study of Attribute Data (2 weeks) §8.2, Chapter 9 (§9.1–§9.4)

- Inference for proportion(s)
- Comparing proportions in two samples: introduction to contingency tables (2x2)

- Equivalence of Z-test and chi-square test
- Inference for $(r \times c)$ two-way tables: tests of independence and homogeneity of proportions, chi-square test, expected values, degrees of freedom
- Graphical comparisons of proportions
- Goodness of fit tests—binomial and Poisson

Module VI: Regression and Correlation (3 weeks) Chapter 10 (§10.1–§10.2), Chapter 11 (§11.1–§11.2)

- Inference in simple linear regression (slope, y-intercept, confidence intervals, prediction intervals)
- Correlation: inference, correlation vs. regression
- Analysis of residuals and use of diagnostic tools
- Introduction to other types of regression models: multiple regression, polynomial regression

Module VII: Topics Related to Future Courses in Statistics (1.5 weeks)

§7.1, Chapter 15, Chapter 17, (*Multiple-Choice Problems Set for Basic Statistical Analysis II*)

- Introduction to nonparametric tests (sign tests, tests based on ranks)
- Design of experiments
- Statistics for quality control
- Further courses in statistics, programs and careers in statistics

[Note that the material to be covered in Module VII may differ from section to section.]

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After STAT 2000

After you have completed STAT 2000, you may want to take further courses in statistics, or possibly become a statistician! So, what courses should you take? Here are some options for your next course:

If you are interested in entering an honours or major program in statistics, then you should take **STAT 2400 (Introduction to Probability)**, if you have not already done so. This course introduces the basic concepts of probability from a rigorous mathematical perspective and provides a solid foundation for further courses in mathematical statistics. The prerequisites for STAT 2400 are a grade of C or better in STAT 1000 and in one of MATH 1700 or MATH 1690. STAT 2400 is a required course in any honours or major program in statistics.

Without taking STAT 2400, you can also take a number of applied statistics courses. These are listed in the *University Calendar*. The only requirement to take these courses is a grade of C or better in STAT 2000.

2009–2010 REGISTRATION ADVISORY

Important Note from the Dean of Science:

It is your responsibility to ensure that you are entitled to be registered in this course. This means that you have:

- the appropriate prerequisites, as noted in the calendar description, or have permission from the instructor to waive these prerequisites;
- not previously taken, or are concurrently registered in, this course and another that has been identified as "not to be held with" in the course description. For example, STAT 1000 cannot be held for credit with STAT 2220.

The registration system may have allowed you to register in this course, but it is your responsibility to check. If you are not entitled to be in this course, you will be withdrawn, or the course may not be used in your degree program. There will be no fee adjustment. This is not appealable. Please be sure to read the course description for this and every course in which you are registered.

Selected Formulae for STAT 2000

1. $SE\left(\overline{x}_1 - \overline{x}_2\right) = \sqrt{\dfrac{s_1^2}{n_1} + \dfrac{s_2^2}{n_2}}$ with $df = \dfrac{\left(\dfrac{s_1^2}{n_1} + \dfrac{s_2^2}{n_2}\right)^2}{\dfrac{1}{n_1 - 1}\left(\dfrac{s_1^2}{n_1}\right)^2 + \dfrac{1}{n_2 - 1}\left(\dfrac{s_2^2}{n_2}\right)^2}$

2. $SE\left(\overline{x}_1 - \overline{x}_2\right) = s_p\sqrt{\dfrac{1}{n_1} + \dfrac{1}{n_2}}$ with $df = n_1 + n_2 - 2$ if $\sigma_1^2 = \sigma_2^2$

   where $s_p^2 = \dfrac{(n_1 - 1)s_1^2 + (n_2 - 1)s_2^2}{n_1 + n_2 - 2}$

3. $SSG = \displaystyle\sum_{i=1}^{I} n_i \left(\overline{X}_i - \overline{\overline{X}}\right)^2$

4. Poisson Distribution $P(X = k) = \dfrac{e^{-\lambda}\lambda^k}{k!}, \quad k = 0, 1, 2, \ldots$

5. $t = \dfrac{r\sqrt{n-2}}{\sqrt{1 - r^2}}$

6. $SE_{b_1} = \dfrac{s_e}{\sqrt{\sum\left(x_i - \overline{x}\right)^2}}, \quad s_e = \sqrt{MSE}$

7. $SE_{b_0} = s_e\sqrt{\dfrac{1}{n} + \dfrac{\overline{x}^2}{\sum\left(x_i - \overline{x}\right)^2}}$

8. $SE_{\hat{\mu}} = s_e\sqrt{\dfrac{1}{n} + \dfrac{\left(x^* - \overline{x}\right)^2}{\sum\left(x_i - \overline{x}\right)^2}}$

9. $SE_{\hat{y}} = s_e\sqrt{1 + \dfrac{1}{n} + \dfrac{\left(x^* - \overline{x}\right)^2}{\sum\left(x_i - \overline{x}\right)^2}}$

10. $SE\left(\hat{p}_1 - \hat{p}_2\right) = \sqrt{\hat{p}(1 - \hat{p})\left(\dfrac{1}{n_1} + \dfrac{1}{n_2}\right)}$ if $p_1 = p_2$ where $\hat{p} = \dfrac{x_1 + x_2}{n_1 + n_2}$

    $SE\left(\hat{p}_1 - \hat{p}_2\right) = \sqrt{\dfrac{\hat{p}_1(1 - \hat{p}_1)}{n_1} + \dfrac{\hat{p}_2(1 - \hat{p}_2)}{n_2}}$ if $p_1 \neq p_2$