Department of Economics
Course Outline

		Term:	Fall 2005
Course:	Economics 305 [Computational Optimization and Economic Applications I]	**Section:**	01
Time:	MWF 12:00 - 12:50	**Place:**	ST 126 (subject to change)
Instructor:	Dr. J. G. Rowse		
Office:	SS 452	**Telephone:**	220-6109 (Office) 220-5857 (Department)
Office Hours:	MW 09:30 - 10:30 F 10:30 ? 11:30	**E-Mail:**	rowse@ucalgary.ca

***Required*: Textbook(s):** **Winston, Wayne and Munirpallam Venkataramanan, *Introduction to Mathematical Programming: Applications & Algorithms,* 4th edition, Thomson, 2003. (This text is bundled with Windows software for LINDO)**

Book(s) on Reserve:

- Anderson, D., Sweeney, D., & T. Williams, *An Introduction to Management Science: Quantitative Approaches to Decision Making*, West Publishing Co., 7th edition. 1994.
- Baumol, W., *Economic Theory and Operations Analysis*, Prentice-Hall, 1977, 4th edition.
- Boulding, K., *Linear Programming and the Theory of the Firm*, MacMillan, 1960.
- Bronson, R., *Schaum?s Outline: Theory and Problems of Operations Research*, McGraw-Hill, 1982.
- Dorfman, R., Samuelson, P., & R. Solow, *Linear Programming and Economic Analysis*, McGraw-Hill, 1958.
- Hillier, F. & G. Lieberman, *Introduction to Mathematical Programming*, McGraw-Hill, 1995, 2nd edition.
- Mills, Gordon, *Optimization in Economic Analysis*, Allen & Unwin, 1985.
- Murty, K., *Operations Research: Deterministic Optimization Models*, Prentice-Hall, 1995.
- Nash, Stephen & Ariela Sofer, *Linear and Nonlinear Programming*, McGraw-Hill, 1996.
- Pannell, D., *Introduction to Practical Linear Programming*, Wiley-Interscience, 1997.
- Paris, Q., *An Economic Interpretation of Linear Programming*, Iowa State Univ. Press, 1991.

- van de Panne, C., *Linear Programming and Related Techniques*, North Holland, 1976, 2nd edition.
- Vandermeulen, Daniel, *Linear Economic Theory*, Prentice-Hall, 1971.
- Wagner, Harvey, *Principles of Management Science*, Prentice-Hall, 1975, 2nd edition.
- Winston, Wayne and Munirpallam Venkataramanan, *Introduction to Mathematical Programming: Applications & Algorithms*, 4th edition, Thomson, 2003

Discussion and Course Outline:

Much economic analysis deals with "doing the best with what you?ve got" or, in economic parlance, optimizing under resource constraints. Analysis may involve a consumer, a firm or a sector of an economy. Because of the pervasiveness of resource constraints and the desire to maximize profits or minimize costs or maximize efficiency in resource use, many disciplines beyond economics are interested in solving resource-constrained problems as well; examples are business management, geography, environmental design, medicine, astronomy, applied mathematics, physics, chemistry, biology, engineering, etc. Most real-world problems are complex and involve many decision variables (products, co-products, intermediate products, factor inputs) and many resource constraints (cash, resource availabilities, skilled labour), and perhaps many constraints arising from such things as limits on pollution emissions or contract provisions requiring satisfaction. Many time periods may also be involved. In addition, real-world constraints typically are inequalities, not equalities. Furthermore, in the optimal solution, some or many variables may take on zero values; that is, a product is not produced or a factor is not hired, because some alternative course of action dominates. These features of real-world problems take them outside the standard economic paradigm for studying resource allocation problems in which resource constraints typically are equalities, decision variables are few and corner solutions (values of zero for some decision variables) are the exception, not the rule. Moreover, decision rules which emerge from optimizing standard economic models, such as equating one marginal something to another marginal something, do not apply directly for determining optimal allocations in a complex decision environment.

Complex real-world resource allocation problems won?t go away, no matter how much analysts might like them to! How have such problems been addressed? Through computational optimization. This course involves computational optimization and, in particular, linear optimization, in which the objective function and all constraints are linear. Surprisingly perhaps, a very large number of interesting decision problems can be formulated as linear optimization problems, just as the general linear model in econometrics is widely applicable. Linear optimization techniques allow for many decision variables (hundreds or thousands or more), many constraints (hundreds or thousands or more), three types of constraints (=, <= and >=) and non-negativity restrictions which allow all decision variables to take on optimal values of zero.

Two attractive features of linear optimization are that its most useful concepts/ideas can be learned using small models and the mathematics needed for its study is simple; only facility with arithmetic, basic algebra and graphing straight lines is needed. High school mathematics is ample, and calculus is not necessary. Small models and simple mathematics are the principal expository tools used, and hence the only course prerequisite is satisfactory performance in Economics 201. Another attractive feature is that lessons learned using the standard economic paradigm carry over (in slightly modified form) to results from linear optimization models.

The major topic areas covered are:

1. What is Computational Optimization? Why is it useful to economists?
2. Introduction to Linear Programming (LP).
3. Formulating LP Models and Economic Modelling.
4. Algebra and Geometry of LP Models.
5. The Simplex Algorithm for solving linear programs.

6. Sensitivity Analysis, Duality and Economic Decision Making.

Linear algebra will not be used (because it is not necessary for the important lessons to be learned) and thus Chapter 2 of the textbook will NOT be discussed. Furthermore, the LINDO software, which comes with the textbook, will be discussed at appropriate times during the course.

Grade Determination and Final Examination Details:

Examination I	Wednesday, October 26, 2005	20%
Examination II	Wednesday, November 23, 2005	20%
Assignments		10%
Final Examination		50%

All examinations will be *closed book*. Calculators *will not be allowed* on any examination.

The final examination will be scheduled by the Registrar in the classroom and will last two hours. It will be a comprehensive examination of all material covered in the course.

A numerical grade will be determined for each item of work submitted and a final numerical grade will be determined using the above percentage weighting scheme. A course letter grade will be assigned based upon the following conversion chart. A passing grade on any particular exam is not essential to pass the course as a whole.

A+	90 -100	B	73 - 76	C-	60 ? 62
A	83 ? 89	B-	70 ? 72	D+	57 - 59
A-	80 - 82	C+	67 ? 69	D	50 - 56
B+	77 - 79	C	63 ? 66	F	0 - 49

If, for some reason, the distribution of grades determined using the aforementioned conversion chart appears to be abnormal, the instructor reserves the right to change the grade conversion chart if the instructor, *at the instructor?s discretion*, feels it is necessary to more fairly represent student achievement.

Tests and exams will not involve multiple choice questions.

Finally, special attention should be directed toward the sections concerning attendance, tape recording of lectures, and student misconduct, on page 43 and pages 52-56 of the 2005-2006 Calendar.

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Notes:

- Students seeking reappraisal of a piece of graded term work (term paper, essay, etc.) should discuss their work with the Instructor *within* fifteen days of the work being returned to the class.
- Make-up or deferred examinations will not be given. Any student who finds it necessary to miss an examination or assignment must notify the instructor in advance and produce a valid medical certificate or other required documentation in order to have the weighting transferred to the final exam. **Late assignments will receive a grade of zero**. Also, examinations will not be given *before* the indicated dates.
- E-mail policy: The Instructor strongly prefers to interact with students in person. If necessary, use e-mail only to arrange a time to see the Instructor.
- **CAUTION**
  : Lectures and readings from the text are complements, not substitutes, and students are responsible for material presented in both lectures and readings. Students are also responsible for dates for assignments and tutorials that are discussed in class. Regular class attendance is ***VERY STRONGLY ADVISED***.

Safewalk / Campus Security: 220-5333

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2005-07-28