This is an introductory course in the use of mathematical methods in economics, with an emphasis on model building and analysis. The approach is two dimensional:

- **Mathematics:** we will cover topics in univariate and multivariate calculus, linear algebra, real analysis, optimization, and if time permits, difference and differential equations. (Note that the course is misnamed: there is in fact a second semester *Math for Economists* course, which we call *Econometrics*.)

- **Economics:** we will be working through a large number of applications in micro- and macroeconomics.

This is an Economics course… with a focus on the language of mathematics, and tools and applications (rather than lemmas, theorems and proofs). If you are really just interested in the math, I recommend the math department, which offers excellent courses in each of the topic areas listed above.

Most of you are taking other economics courses, which will be using some of the tools we are covering in this class. Please let me know if there are particular applications that you’d like to see us cover, and I’ll try to work those into the semester.

**Prerequisites:** At least one intermediate economics course (EC 201, 202, 203 or 204) and MT 100 (or its equivalent). No exceptions.


A copy of BBT will be placed on reserve at the O’Neil Library.

**Some additional texts:** There is no need to purchase any of these (most are available at O’Neill). I list them just because sometimes it is useful to see a different presentation of the material.

**Warning:** Most of these are more technical than BBT.

Boston College  
Math for Economists  
EC 311


**Grading:**

- Two Mid-Term exams (40% total) - tentative schedule: Tu, Feb 23rd and Th, April 8th.
- Comprehensive Final exam (40%): Th, May 13th @ 9 AM.
- Quizzes (20%): four – six in-class quizzes (15 minutes each) on material covered in the Problem Sets. These will be announced ahead of time; the lowest score will be dropped in computing your course grade.

Only in extraordinarily compelling situations will I even consider the possibility of a “make up” exam. It is your responsibility to plan your schedule accordingly. (You will have at least two weeks notice of the actual mid-term exam dates.)

**Problem Sets:** The Problem Sets will be very helpful in learning the course material. There will be four – six of them over the course of the semester. These are optional, but will be graded if they have been submitted on time. We will review the Problem Set answers in class, and that material will be the basis for the in-class quizzes. While not factoring explicitly into your course grade, strong Problem Set performance will help “borderline” students move to the higher grade level. I encourage you to work collaboratively on the Problem Sets, but please submit your own write-ups.

**BlackboardVista:** All handouts, problem sets, exams, and answers will eventually be posted on the course’s BlackboardVista site and on my website, [http://www.cmaxxsports.com](http://www.cmaxxsports.com). Let me know if you have trouble accessing that material.

**Calculators/computers:** You are not allowed to use programmable, graphing, or business calculators, computers, phones or similar electronic devices during the exams or quizzes. You may use five function calculators {+, -, *, /, =}… however, they will be probably be unnecessary as the quiz and exam questions will be written so that the arithmetic will be **so simple that even a cave man could do it**. (Note that as a factual matter, I believe that cave men and women predated arithmetic, by a long shot.)

**Academic Integrity:** The Deans have requested that I remind you that you will be held to Boston College’s standards of academic integrity. If you have any questions as to what that means, please go to [http://www.bc.edu/integrity](http://www.bc.edu/integrity).

**Topics:**

We will be following the presentation in BBT (the outline numbers below correspond to the BBT chapters). I may pick and choose amongst the applications if we get behind schedule.

As with all great things,¹ the course divides into three parts (with an exam following each Part):

A. Univariate Calculus and Linear Algebra

B. Multivariate Calculus and Unconstrained Optimization

C. Constrained Optimization

¹ This is, of course, a reference to the opening line in Caesar’s *Gallic Wars:* “Gallia Est Omnis Divisa in Partes Tres.”
Part A: Univariate Calculus and Linear Algebra

1. Introduction: Mathematical models; Optimization; Envelope theorem; Appendix (calculus review)

2. Optimization Intro – Applications
   - Micro: Labor unions; Profit maximization (differing market structures; taxes)
   - Macro: Simple Keynesian model I

3. Matrix Theory – Linear Algebra: Scalars, vectors and matrices and operations; Systems of linear equations; Inverse and identity matrices

4. Linear Models – Applications
   - Micro: Competitive markets; Differentiated products; Duopolies
   - Macro: Simple Keynesian model; ISLM

Mid term Exam #1 will be about here

Part B: Multivariate Calculus and Unconstrained Optimization

5. Multivariate Calculus: Partial and total derivatives; Differentials; Implicit functions; Level curves; Homogeneity

6. Multivariate Calculus – Applications
   - Macro: Balanced budget multipliers; Monetary policy effectiveness (guest lecturer?)
   - Micro: Tax incidence (differing market structures); Utility maximization; Homogeneity of demand (consumers and producers)

7. Unconstrained optimization: Optimization (univariate and multivariate); Concavity and convexity; Comparative statics

8. Unconstrained optimization – Applications
   - Micro: Cost minimization; Efficiency wages; Multiplant firm; Multimarket monopoly; Pollution taxes and emissions
   - Statistical estimation: OLS

Mid-term Exam #2 will be about here

Part C: Constrained Optimization

9. Constrained optimization with binding constraints: Lagrangian methods; Comparative statics; Value functions and Lagrange multipliers I

10. Constrained optimization with binding constraints – Applications
This is the likely end of the semester …

But if there is time, we will continue with selections from:

11. Constrained optimization with inequality constraints: One variable optimization; Non-negativity constraints; Inequality constraints (Kuhn Tucker); Linear programming (and duality)

12. Constrained optimization with inequality constraints – Applications
   - Micro: Utility maximization; Two-good diet problem; Sale maximization; Labor supply
   - Macro: Inter-temporal consumption (with liquidity constraints)

13. Value functions and the Envelope Theorem: Unconstrained optimization; Constrained optimization; Lagrangian multipliers

14. Value functions and the Envelope Theorem – Applications
   - Micro: Roy’s Identity; Shephard's Lemma; Duality; Slutsky symmetry conditions; Cost functions (TC, MC and AC): SR and LR; Two part tariffs; Ramsey taxes

15. Dynamics: Difference and differential equations; Appendix (eigenvalues and eigenvectors; dynamic optimization)

16. Partial adjustment models
   - Micro: Marshallian (quantity) adjustment; Cobweb; nFirms in an oligopoly; Fisheries
   - Macro: ISLM; Philips curve; Solow growth model

In Addition: While I think that BBT text is excellent, we may cover some additional topics (which, as far as I can determine, are not in that text), including, but not limited to:

- Sets (closed, bounded and compact); correspondences; inverse functions
- Cartesian products and Euclidean space; ; rank and linear (in)dependence
- Limits and convergence; present values
- Continuous and monotonic functions
- Taylor series approximations; differentiability; gradients
- Exponents and logarithms
- Integration (briefly)
- Very simple topology: Fixed point theorems

These topics will be woven into the consideration of the BBT material.