Mathematics for Economists
ECO 740
Section 1
TR 5:30 to 6:45 PM
BEH 223
Stephen M. Miller
BEH 508 (office)
(702) 895-3969 (office)
(702) 895-1354 (fax)
stephen.miller@unlv.edu (e-mail)
http://www.unlv.edu/faculty/smiller/ (home page)

Fall 2010


Office Hours: TR 4:00 to 5:30 PM and by appointment

Objective: Students who successfully complete this course will learn the basic tools of differential calculus, matrix algebra, difference equations, and game theory used in our MA program. In addition, all of the tools receive illustration with economic examples from both microeconomic and macroeconomic theory as well as other specific field courses such as industrial organization.

Evaluation: The course evaluation for each student involves two separate components. First, each student must do the 14 homework assignments. I drop the four lowest scores. Homework assignments are due in the Thursday class. Second, each student will take the three in-class exams. The first two exams are given in the Tuesday class. The final exam is not comprehensive, but only covers the material not covered in exams 1 and 2. The final exam is given during the exam week on Tuesday, December 7 from 6:00 to 8:00 PM. While I prefer to maintain some flexibility in the weights assigned to the components in the final course grade, I will weight the component parts as follows: 35% for the graded homework assignments, 15% for the first exam, and 25% each for the last two exams.

WebCampus: This course is a WebCampus course. I will post the course outline, homework assignments, other handouts, and so on at the WebCampus site. You can access this site 24/7, except for scheduled maintenance on the system and unexpected downtimes due to technical glitches.

Copyright and Fair Use: The University requires all members of the University Community to familiarize themselves with and to follow copyright and fair use requirements. You are individually and solely responsible for violations of copyright and fair use laws. The University will neither protect nor defend you nor assume any responsibility for employee or student violations of fair use laws. Violations of copyright laws could subject you to federal and state civil penalties and criminal liability as well as disciplinary action under University policies. To help familiarize yourself with copyright and fair use policies, the University encourages you to visit its copyright web page at: http://www.unlv.edu/committees/copyright.
Academic Integrity: Violations to academic integrity (e.g., cheating and plagiarism) will not be tolerated. At the instructor’s discretion, a student suspected of academic dishonesty may receive an F for the course and be expelled from the class. Additional penalties, up to expulsion from the University or revocation of degree, are possible. Please see page 33 of the UNLV Graduate Catalog, 2005-2007

Disabilities: If you have a documented disability that may require assistance, you will need to contact the Disability Resource Center (DRC) for coordination in your academic accommodations. Disabilities Services is located within Learning Enhancement Services (LES), in the Reynolds Student Services Complex, Suite 137. The phone number is 895-0866 or TDD 895-0652. The e-mail address is drcssccmail.nevada.edu.

### Course Outline

<table>
<thead>
<tr>
<th>Week 1</th>
<th>Topics Covered</th>
<th>Assigned Readings and Homework Problems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Review of derivatives</td>
<td>BBT: Chapters 1, including appendix, and 2.</td>
<td></td>
</tr>
<tr>
<td>Rules for derivatives</td>
<td>D: Chapters 1, 2, 3, 4, 7, and 8.</td>
<td></td>
</tr>
<tr>
<td>Partial derivatives</td>
<td>Practice Problems: A1(a),(b), (f),(h); A2(a),(f); A3(a),(d); A6(a),(c), 2.3, 2.5</td>
<td></td>
</tr>
<tr>
<td>Concavity and convexity</td>
<td>Homework 1: 2.15</td>
<td></td>
</tr>
<tr>
<td>Marginal analysis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elasticities</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Economic models</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Optimization</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Examples of optimization</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Profit maximization</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Competitive firm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Monopoly</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Duopoly</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Simple macroeconomic model:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Keynesian multipliers</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Week 2</th>
<th>Topics Covered</th>
<th>Assigned Readings and Homework Problems</th>
</tr>
</thead>
<tbody>
<tr>
<td>System of equations</td>
<td>BBT: Chapter 3.</td>
<td></td>
</tr>
<tr>
<td>- Matrix form</td>
<td>D: Chapters 10, 11, and 12.</td>
<td></td>
</tr>
<tr>
<td>Definition of scalars, vectors, and matrices</td>
<td>Practice Problems: 3.2, 3.3, 3.10</td>
<td></td>
</tr>
<tr>
<td>- Addition, subtraction, and multiplication</td>
<td>Homework 2: 3.11, 3.12</td>
<td></td>
</tr>
<tr>
<td>Identity matrix</td>
<td>Homework 1 due.</td>
<td></td>
</tr>
<tr>
<td>Inverse matrix</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cramer’s rule</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Week 3</th>
<th>Topics Covered</th>
<th>Assigned Readings and Homework Problems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Applying matrix algebra</td>
<td>BBT: Chapter 4.</td>
<td></td>
</tr>
<tr>
<td>- One competitive market</td>
<td>D: Chapters 10, 11, and 12.</td>
<td></td>
</tr>
<tr>
<td>- Two firms with differentiated products</td>
<td>Practice Problems: 4.1, 4.4</td>
<td></td>
</tr>
<tr>
<td>- Simple and complex duopoly</td>
<td>Homework 3: 4.6</td>
<td></td>
</tr>
<tr>
<td>- Simple Keynesian model</td>
<td>Homework 2 due.</td>
<td></td>
</tr>
<tr>
<td>- IS-LM model</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Week 4</th>
<th>Topics Covered</th>
<th>Assigned Readings and Homework Problems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Partial derivatives</td>
<td>BBT: Chapter 5.</td>
<td></td>
</tr>
<tr>
<td>Differentials</td>
<td>D: Chapters 5, 6, and 9.</td>
<td></td>
</tr>
<tr>
<td>Total differentials</td>
<td>Practice Problems: 5.7(a),(b); 5.8(a),(b)</td>
<td></td>
</tr>
<tr>
<td>Implicit function theorem</td>
<td>Homework 4: 5.5(b), 5.6(b)</td>
<td></td>
</tr>
<tr>
<td>Level curves</td>
<td>Homework 3 due.</td>
<td></td>
</tr>
<tr>
<td>Homogeneity, Euler’s theorem, and corollary</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Exam 1 (weeks 1 to 3)
| Week 5 | Applications of multivariate calculus  
| • Balanced budget multipliers  
| • IS-LM-(AD)-AS model  
| • Fiscal and monetary policy effectiveness  
| • Excise tax on monopolist  
| • Duopoly  
| • Labor supply  
| • Utility maximization  
| • Homogeneity of consumer demands  
| • Homogeneity of input demands | BBT: Chapter 6.  
D: Chapters 5, 6, and 9.  
Practice Problems: 6.5, 6.14, 6.16, 6.28  
Homework 5: 6.7  
Homework 4 due. |
| Week 6 | One-variable optimization: Review  
Two-variable optimization  
Hessian determinants  
Multiple-variable optimization  
Concavity, convexity, and optimization  
Comparative static analysis | BBT: Chapter 7.  
D: Chapters 5, 6, and 9.  
Practice Problems: 7.4(a), 7.9(b)  
Homework 6: 7.1(e), 7.9(b)  
Homework 5 due. |
| Week 7 | Examples of multivariate optimization  
• Competitive firm input choice  
• Efficiency wages  
• Multi-market monopoly profit maximization  
• Deriving least squares estimates | BBT: Chapter 8.  
D: Chapters 5, 6, and 9.  
Practice Problems: 8.2, 8.4, 8.9  
Homework 7: 8.11  
Homework 6 due. |
| Week 8 | Constrained optimization  
Lagrangian method  
Bordered Hessian determinants  
Quasi-concavity, quasi-convexity, and constrained optimization  
Comparative static analysis  
Value functions: Preview | BBT: Chapter 9.  
D: Chapters 5, 6, and 9.  
Practice Problems: 9.1(d), 9.2(d), 9.3(d), 9.4(d), 9.5  
Homework 8: 9.1(d), 9.3(d)  
Homework 7 due. |
| Week 9 | Examples of constrained optimization  
• Cost minimization and input demands  
• Profit maximization and input demands  
• Utility maximization and individual demands  
• Labor supply  
• Intertemporal consumption: Time preference  
• Macro tradeoffs: Phillips curves | BBT: Chapter 10.  
D: Chapters 5 and 6.  
Practice Problems: 10.3(a), (c),(d), 10.17(c)  
Homework 9: 10.16(a)  
Homework 8 due. |
| Week 10 | Professor Viner and the cost curves  
Value function  
Envelope theorem  
Interpretation of Lagrangian multiplier  
Applications of value function and envelope theorem  
• Duality  
• Roy’s identity  
• Shepard’s lemma  
• Slutsky equation  
• Cost curves and Professor Viner: Revisited  
• Reciprocity relations | BBT: Chapters 13 and 14.  
D: Chapter 13.  
Practice Problems: 13.4, 13.6, 14.1  
Homework 10: 13.6  
Homework 9 due. |

Exam 2 (weeks 4 to 9)
| Week 11 | Applications of value function and envelope theorem  
| • Duality  
| • Roy’s identity  
| • Shepard’s lemma  
| • Slutsky equation  
| • Cost curves and Professor Viner: Revisited  
| • Reciprocity relations  
| Difference equations  
| • First order  
| • Phase diagrams  
| • Non-linear  
| • Systems  
| Differential equations  
| • First order  
| • Phase diagrams  
| • Systems  
| BBT: Chapter 14 and 15.  
| D: Chapter 13, 16, and 17.  
| Practice Problems: 14.3, 14.5, 15.1(b), 15.2(d)  
| Homework 11: 14.5  
| Homework 10 due. |

| Week 12 | Difference equations  
| • First order  
| • Phase diagrams  
| • Non-linear  
| • Systems  
| Differential equations  
| • First order  
| • Phase diagrams  
| • Systems  
| Partial-adjustment models  
| Marshallian quantity adjustment  
| Cobweb model  
| Cournot duopoly  
| IS, LM, Fed reaction function  
| Solow growth model  
| BBT: Chapter 15 and 16.  
| D: Chapter 16 and 17.  
| Practice Problems: 15.6(b), 15.6(e)  
| Homework 12: 15.2(c), 15.4(c)  
| Homework 11 due. |

| Week 13 | Static games: Complete information  
| Games in normal form  
| Dominance and iterated elimination  
| Nash equilibrium  
| Mixed strategies  
| Applications of static games  
| • Two-firm investment in natural monopoly setting  
| • Cournot duopoly model revisited  
| • Bertrand duopoly model  
| • Rent-seeking behavior  
| • Public goods  
| BBT: Chapter 17 and 18.  
| Practice Problems: 16.6, 16.23  
| Homework 13: 16.26  
| Homework 12 due. |
| Week 14 | Applications of static games  
| - Two-firm investment in natural monopoly setting  
| - Cournot duopoly model revisited  
| - Bertrand duopoly model  
| - Rent-seeking behavior  
| - Public goods  
| Dynamic games: Complete information  
| Games in extensive form  
| Equilibrium in extensive-form games  
| Sub-game perfect Nash equilibrium  
| Two-stage games  
| Repeated games  
| BBT: Chapter 18 and 19. Practice Problems: 17.1(b), 17.2(c)  
| Homework 14: 17.4  
| Homework 13 due. |

| Week 15 | Applications of dynamic games  
| - Sequential bargaining models  
| - Trade policy and oligopoly  
| - Two-stage duopoly game  
| - Repeated games and oligopoly  
| BBT: Chapter 20. Practice Problems: 19.1(c), 19.2(c), 20.1, 20.2  
| Homework 14 due. |

| Week 16 | Exam 3 (weeks 10 to 15) |