Economics 393 Prof. Stokey
Preliminary: Dec. 21, 2001 Winter 2002

Dynamic Optimization

This course will focus on the optimal regulation of systems governed by a Brownian motion. Specific topics will include menu cost models of price adjustment, inventory control, consumer durables, and investment.

The course will be based primarily on my lecture notes, which are available on my homepage. These notes cover both mathematical background and economic applications, and most of the material is drawn from other sources on the reading list. These notes are still under revision, and comments are welcome.

Three books, all of them optional, have been ordered at the University Bookstore. Harrison's book is a useful reference. Many of the papers on menu costs are contained in the Sheshinski and Weiss volume. Dixit and Pindyck contains some useful discussion and examples.

Books (optional) :

Harrison, J. Michael. 1990. *Brownian Motion and Stochastic Flow Systems*. Malabar, FL: Robert E. Krieger Publishing Co.

Sheshinski, Eytan, and Yoram Weiss, Eds. 1993. *Optimal Pricing, Inflation, and the Cost of Price Adjustment*. Cambridge, MA: MIT Press.

Dixit, Avinash K., and Robert S. Pindyck. 1994. *Investment under Uncertainty*. Princeton, NJ: Princeton University Press.

Items marked with a "*" are highly recommended. Many of the journal articles are available on the Web. The other required readings are available for photocopying (see Debbie Smith in SS 423) and are on reserve in Regenstein.

Course Requirements: There will be several problems sets and a final exam.

Office hours: Monday 1-3 (by appointment--see Debbie Smith), SS 424.

Course Outline

1. Brownian motion, stochastic calculus (3 weeks)

* Stokey, Ch. 1 - 5.

Dixit and Pindyck, Ch. 3.

Harrison, App. A, B, and Ch. 1, 3, 4.

Dixit, Avinash. 1991. A simplified treatment of the theory of optimal regulation of Brownian motion, *Journal of Economic Dynamics and Control*, 15: 657-673. Reprinted in Sheshinski and Weiss.

* Dumas, Bernard. 1991. Super contact and related optimality conditions, *Journal of Economic Dynamics and Control*, 15: 675-685.

2. Menu cost models (2 weeks)

* Stokey, Ch. 6 - 7.

Caplin, Andrew S., and Daniel F. Spulber. 1987. Menu costs and the neutrality of money. *Quarterly Journal of Economics*, 102: 703-725. Reprinted in Sheshinski and Weiss. (JSTOR)

Caplin, Andrew S., and John V. Leahy. 1991. State-dependent pricing and the dynamics of money and output. *Quarterly Journal of Economics,*106: 683-708. Reprinted in Sheshinski and Weiss. (JSTOR)

Caplin, Andrew S., and John V. Leahy. 1997. Aggregation and optimization with state-dependent pricing. *Econometrica*, 65: 601-625.

* Mankiw, N. Gregory. 1985. Small menu costs and large business cycles: a macroeconomic model of monopoly. *Quarterly Journal of Economics*, 100: 529-539. (JSTOR)

* Caballero, Ricardo J., and Eduardo M. R. A. Engel. 1993. Heterogeneity and output fluctuations in a dynamic menu-cost model. *Review of Economic Studies*, 60: 95-119. (JSTOR)

* Dixit, Avinash. 1991. Analytical approximations in models of hysteresis. *Review of Economic Studies*, 58: 141-151. (JSTOR)

3. Inventory problems (1 week)

* Stokey, Ch. 8.

Constantinides, George M., and Scott F. Richard. 1978. Existence of optimal simple policies for discounted-cost inventory and cash management in continuous time, *Operations Research*, 26: 620-636.

Harrison, J. Michael, Thomas M. Selke, and Allison J. Taylor. 1983. Impulse control of Brownian motion, *Mathematics of Operations Research*, 8: 454-466.

Scarf, Herbert. 1960. The optimality of (*S,s)* policies in the dynamic inventory problem. In Kenneth J. Arrow, Samuel Karlin, and Patrick Suppes, eds., *Mathematical Methods in the Social Sciences*, Stanford: Stanford University Press. Reprinted in Sheshinski and Weiss.

4. Consumer Durables (1 week)

* Stokey, Ch. 9.

Grossman, Sanford J., and Guy Laroque. 1990. Asset pricing and optimal portfolio choice in the presence of illiquid durable consumption goods. *Econometrica*, 58: 25-51. (JSTOR)

Caballero, Ricardo J. 1990. Expenditures on durable goods: a case for slow adjustment. *Quarterly Journal of Economics*, 105: 727-743. (JSTOR)

Caballero, Ricardo J. 1993. Durable goods: an explanation for their slow adjustment. *Journal of Political Economy*, 101: 351-384. (JSTOR)

Hindy, Ayman, and Chi-fu Huang. 1993. Optimal consumption and portfolio rules with durability and local substitution. *Econometrica*, 61: 85-121. (JSTOR)

5. Regulated Brownian motion (1 week)

* Stokey, Ch. 10.

Harrison, Ch. 2, 5.

Harrison, J. Michael and Michael I. Taskar. 1983. Instantaneous control of Brownian motion, *Mathematics of Operations Research*, 8: 439-453.

5. Investment models (2 weeks)

* Stokey, Ch. 11.

* Pindyck, Robert S. 1988. Irreversible investment, capacity choice, and the value of the firm, *American Economic Review,* 78: 969-985. (JSTOR)

* Dixit, Avinash. 1995. Irreversible investment with uncertainty and scale economies. *Journal of Economic Dynamics and Control,* 19: 327-350.

Dixit and Pindyck. Ch. 4, 5.

Abel, Andrew B., and Janice C. Eberly. 1994. A unified model of investment under uncertainty. *American Economic Review,* 84: 1369-84. (JSTOR)

Abel, Andrew B., and Janice C. Eberly. 1997. An exact solution for the investment and value of a firm facing uncertainty, adjustment costs, and irreversibility. *Journal of Economic Dynamics and Control,* 21: 831-52.

6. Aggregate investment (1 week)

* Stokey, Ch. 12.

* Bertola, Giuseppe, and Ricardo J. Caballero. 1990. Kinked adjustment costs and aggregate dynamics. *NBER Macroeconomics Annual,* vol. 5, edited by Olivier J. Blanchard and Stanley Fischer. Cambridge, MA: MIT Press.

* Caballero, Ricardo J., and Eduardo M. R. A. Engel. 1991. Dynamic (S,s) economies. *Econometrica,* 59: 1659-1686. Reprinted in Sheshinski and Weiss. (JSTOR)

* Caplin, Andrew S., and John V. Leahy. 1993. Sectoral shocks, learning, and aggregate fluctuations. *Review of Economic Studies,* 60: 777-794. (JSTOR)

* Bertola, Giuseppe, and Ricardo J. Caballero. 1994. Irreversibility and aggregate investment. *Review of Economic Studies,* 61: 223-246. (JSTOR)

* Kogan, Leonid. 2001. An Equilibrium Model of Irreversible Investment. *Journal of Financial Economics,* 6: 201-45