

## Game Theory and Economics

### Day 1:

Introductions. (Do introduction worksheet.) Intro to economics: three part economic problem. Economics: Understand objectives, alternatives, & constraints. Marginal vs. fixed costs/benefits. Opportunity cost. Efficiency and equity.

Game Theory: Prisoner's Dilemma, Chicken. Define dominant strategy, Nash equilibrium and the relation between them. Discuss the difference between dynamic and static games. Also discuss common knowledge of payoffs (complete game) versus incomplete games.

Pre-test.

Activities: Studying problem. Sage problem. Introduction worksheet.

HW: Read Frank, Ch. 1 + problems #3, 5, 7, 9, 11, 13.

**Day 2:** Introduction to laws of supply and demand. Relate supply to firm's marginal cost curve. Relate demand to firm's marginal benefit curve. Discuss equilibrium. Excess demand. Excess supply. Consumer surplus. Producer surplus. Maximization of consumer/producer welfare can occur at equilibrium. Discuss externalities.

Game theory: define zero sum game. Define minimax and maximin strategies.

Activities: Matching pennies game, zero-one dollar game. Worksheet of 2x2 zero sum games.

HW: Read Frank, first half of Ch. 2. + problems # 3, 5, 7, 9.

**Day 3:** Intro to expected (average) payoffs. Application of expected payoffs to mixed strategies. Relate to maximin and minimax. Supply and demand curve shifters. Define total revenue, total profit, and total cost. Define pure monopoly as someone who has total control over price.

Activities: Calculating the class average of quiz grades. More practice with 2x2 games. Intro to finding the maximum point on a parabola.

Night session: Quiz, finish reading chapter 2 of Frank

**Day 4:** Mixed strategies continued. Profit maximization exercises continued. Rent control. Go over quiz. Use Newcombe's problem as a prelude to dynamic (sequential) games.

Activities: Hotelling's ice cream vendor on the beach problem. Newcombe's paradox. Revenue calculation worksheet. Profit maximization problems. 2x2 games with mixed strategies. Candle and rope problem. The 2/3 game.

HW: Read Ch. 13 of Frank. Exercises on quantities/prices changing with demand/supply shifts.

### **Day 5:**

Economics: Sales taxes vs. excise taxes: is there a difference? Elasticity. Incidence of tax. Review of concepts for afternoon quiz.

Activities: Dot game tournament, Let's Make a Deal. Umbrella problem. Expected values in lotteries: are they worth playing? Zelmo game: analyze for dominant strategies.

Quiz

Sunday night: 2x2 games with mixed strategies, more practice. Read Ch. 8, Frank.

### **Day 6:**

Monday: Braess' paradox. A parable of hawks and doves. Signals: full disclosure and the costly (or impossible) to fake principle. Sequential (extensive, dynamic) game exercises & expected payoffs.

Activities: Battle of the sexes. Braess' paradox exercises. Taxicabs and probability exercise.

More practice with mixed strategies: worksheets. Rock, Paper, Scissors Tournament.

Night: quiz, Centipede game activity, read section of chapter 6 on signals in Frank.

### **Day 7:**

Activities: Tic-tac toe. NIN.

Go over quiz.

Introduction to backwards induction in sequential games (use Tic-tac-toe, dot game as examples.)

Signals: Full disclosure principle and costly-to-fake principle. Separating equilibrium vs. pooling equilibrium. The choice to go to college or not: college as a signal. Relating signals to dominant strategy.

Night: Read Monopoly, Oligopoly Chapter excerpts. Mixed/pure strategy problems. Arrows' theorem: transitivity and independence of irrelevant alternatives related to strategic voting.

### **Day 8:**

Hilbert hotel and Hilbert bus. Proof of  $0.999 = 1$ . Adding up Infinite series. Application of infinite series to repeated games. Calculating payoffs over infinite time frames when discounting is considered.

Sequential games: Mutually Assured Destruction. More backwards induction.

Night: self-written worksheet on repeated games and infinitely repeated games. Also review mixed strategies

**Day 9:**

Introduction to auctions. First-price, second-price, third-price auctions. Coin-jar auction. Winner's curse. Dominant strategies in sealed-bid auctions.

Iterated elimination of dominated strategies: 3x3, 4x4 matrices and beyond.

Activities: Luring Lottery, King-Ace Game. Class auctions of coins and candy.

Night: Traveler's Dilemma. Coalition game. Bankruptcy game.

**Day 10:**

Review categories of games we have covered: static & complete, dynamic & complete, and static & incomplete. Give examples and also introduce example of new type of game: dynamic & incomplete. (Use Gibbons' Game Theory for Economists book.) Introduce games where strategy is to maximize expected payoff and where player does not know type of other players. Relate to college as a signal and use Gibbons' example.

Activities: Pizza Business Game: students act out scenarios of perfect competition and modified duopoly. Three-Person Duel.

Sunday night: read packet on "Real People Making Decisions". More practice problems with mixed strategies, iterated elimination of dominated strategies and payoffs in infinitely repeated games.

**Day 11:**

Activities: Zeus-Athena music business sequential game. Do for all the different combinations in which either Zeus or Athena each may or may not have perfect information and/or complete information.

0,1 game (revisited)

Police-Anarchists game

Nuclear weapon/anti-missile game

Night: explain games from afternoon. Practice problems on dominant strategies in these games.

**Day 12:**

Review of all topics in preparation for post-test. (Have students work on similar, but not identical, questions to post test questions.)

Activities: Staircase game. Magic Square game. Card games: is there a dominant strategy in poker? How do we compute the odds of getting each poker hand?

**Day 13:**

Pre-test

Math Olympiad

Read Ch.3 in Frank + Go over answers to Math Olympiad

**Day 14:**

Go over post-test.

Movie: Tucker (relate to a market entrant facing an oligopoly. Ask if fixed costs matter for new market entrants. Explore monopsony too.)

Activity: Envelope game

Student Evaluations

Indifference curves and budget lines (if time).

**Day 15:**

Review indifference curves. (if time)

Overview of economics: microeconomics, macroeconomics, industrial organization, labor economics.

Activity: Coalition Game

Activity: Mafia Game