

Eco 685 Graphs, Tables, and Definitions

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Fall, 2017

Introduction

Introduction

Managerial Economics Definition

Definition 1

Managerial Economics is the application of economic theory to decisions made by managers and firms.

Definition 2

Economics is the study of the allocation of scarce resources.

Value of the Firm

Definition 3

The **value** of a firm is the present value of the firm's expected future profits.

Economic Profits

Definition 4

Economic Profits Revenues less opportunity costs.

Definition 5

Accounting Profits Revenues less accounting costs

Definition 6

Opportunity Cost Accounting costs plus the value of inputs in their next best use.

Production Theory

Part I: Production Theory

Definition

Definition 7

The **Production Function** is a graph, table, or equation showing the maximum output rate that can be achieved by any specified set of inputs.

Table Form

$$Q = 30L + 20L^2 - L^3 \quad (0.1)$$

Full time laborers (L)	Parts Produced (Q)
0	0
1	
2	
3	
6	
9	
12	
14	
15	

Table 1 : Production data for Thompson Machine Co.

Table Form

$$Q = 30L + 20L^2 - L^3 \quad (0.2)$$

Full time laborers (L)	Parts Produced (Q)
0	0
1	49
2	132
3	243
6	684
9	1161
12	1512
14	1596
15	1575

Table 1 : Production data for Thompson Machine Co.

Graph Form

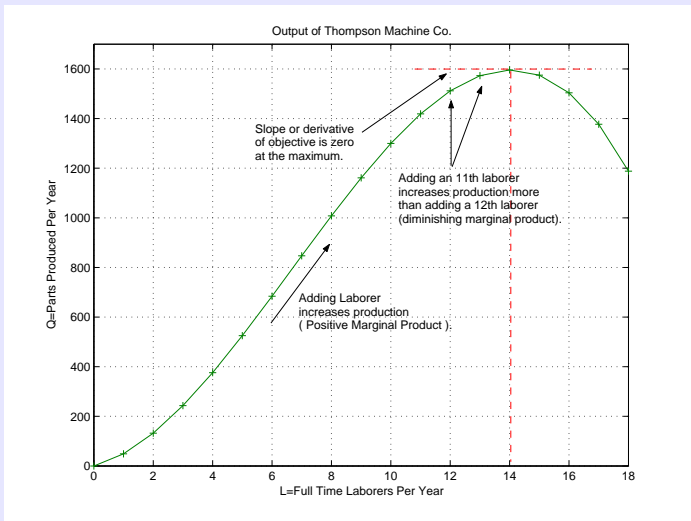


Figure 1 : Typical production function using one input.

Marginal Product

Definition 8

The **Marginal Product** is the additional output from an additional unit of an input.

Marginal Product Table

Full time laborers (L)	Parts Produced (Q)	Marginal Product (MP)
0	0	-
1	49	
2	132	
3	243	
6	684	
9	1161	
12	1512	
14	1596	
15	1575	

Table 2 : Production function and marginal product.

Marginal Product Table

Full time laborers (L)	Parts Produced (Q)	Marginal Product (MP)
0	0	-
1	49	49
2	132	83
3	243	111
6	684	147
9	1161	159
12	1512	117
14	1596	42
15	1575	-21

Table 2 : Production function and marginal product.

Marginal Revenue Product and Marginal Expenditure

Definition 9

Marginal Revenue Product is the amount of additional revenue from an additional unit of an input.

Definition 10

The **Marginal Expenditure** is the amount of additional costs from an additional unit of input.

Marginal Revenue Product and Marginal Expenditure Table

Full time laborers (L)	Parts Produced (Q)	Marginal Product (MP)	Marginal revenue product ($MRP = MR \cdot MP$)
0	0	-	-
1	49		
2	132		
3	243		
6	684		
9	1161		
12	1512		
14	1596		
15	1575		

Table 3 : Production function and marginal revenue product.

Marginal Revenue Product and Marginal Expenditure Table

Full time laborers (L)	Parts Produced (Q)	Marginal Product (MP)	Marginal revenue product ($MRP = MR \cdot MP$)
0	0	-	-
1	49	49	\$24,500
2	132	83	\$41,500
3	243	111	\$55,500
6	684	147	\$73,500
9	1161	159	\$79,500
12	1512	117	\$58,500
14	1596	42	\$21,000
15	1575	-21	\$-10,500

Table 3 : Production function and marginal revenue product.

Isoquant Definition

Definition 11

An **Isoquant** is a curve which shows all possible input levels capable of producing a given output level.

Isoquant Graph

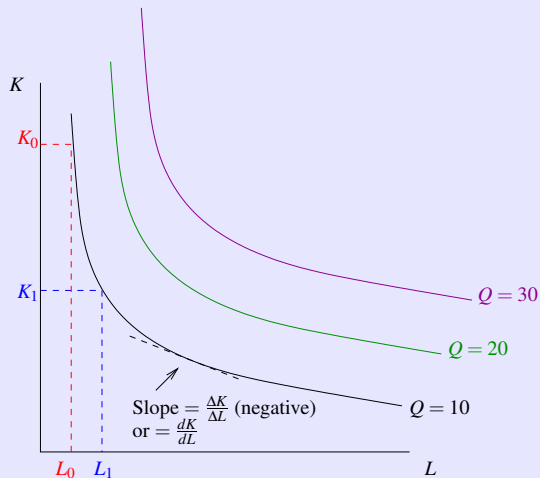


Figure 2 : Isoquants for a typical production function corresponding to $Q = 10, 20, 30$.

MRTS and Isocost

Definition 12

The **Marginal Rate of Technical Substitution** (MRTS) is the rate at which one input is substituted for another while keeping production constant. It is the negative of the slope of the isoquant.

Definition 13

The **Isocost** curve shows all input combinations that have the same total budget.

Isocost Graph

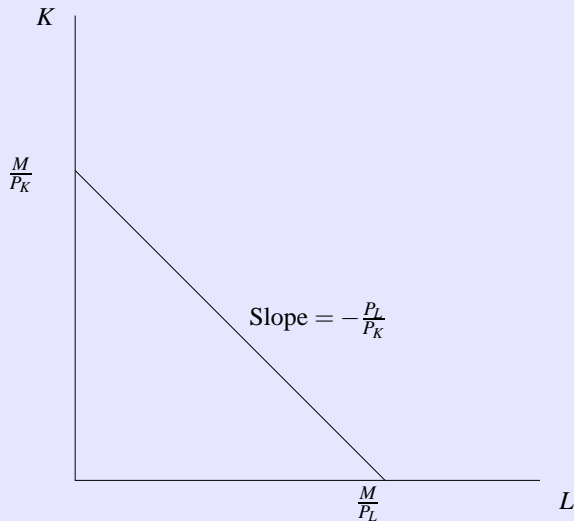


Figure 3 : Isocost for a budget of M .

Optimal Inputs

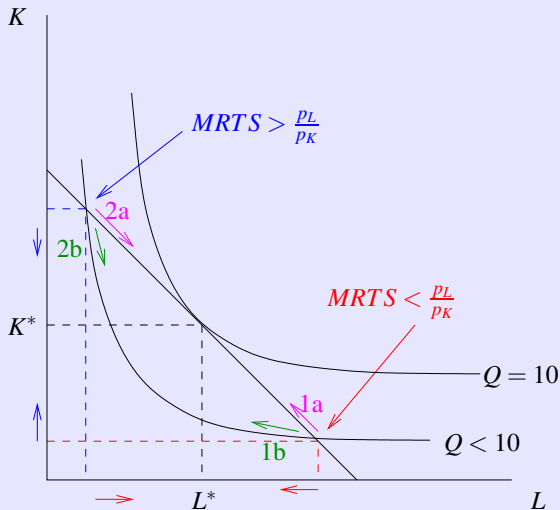


Figure 4 : Efficient and inefficient input combinations.

Returns to Scale

Definition 14

The production function exhibits **Increasing (decreasing, constant) returns to scale** if increasing all inputs by a proportion increases output by more than (less than, exactly) the same proportion

Output Elasticity

Definition 15

The **output elasticity** is the percentage increase in output from a one percent increase in inputs.

Production Theory

Part II: Cost Theory

Accounting and Opportunity Costs

Definition 16

Accounting Costs: Costs that would appear as costs in an accounting statement.

Definition 17

Opportunity Costs: The value of all inputs to a firm's production in their most valuable alternative use.

Fixed, Variable, and Sunk Costs

Definition 18

Total Variable Cost The total cost of all inputs that change with the amount produced (all variable inputs).

Definition 19

Total fixed costs The total cost of all inputs that do not vary with the amount produced (all fixed inputs).

Definition 20

Sunk costs Are costs that have been incurred and cannot be reversed.

Average and Marginal Costs

Definition 21

Average Costs: Costs divided by output.

Definition 22

Marginal Costs: The cost of one additional unit of an input.

Cost Formulas

Type of Cost	Total Cost equals	Variable Costs	Plus Fixed Costs
Total	$TC =$	TVC	$+TFC$
Average	$ATC = \frac{TC}{Q} =$	$AVC = \frac{TVC}{Q}$	$+AFC = \frac{TFC}{Q}$
Marginal	$MC = \frac{dTC}{dQ} = \frac{\Delta TC}{\Delta Q}$		

Short Run Total Costs

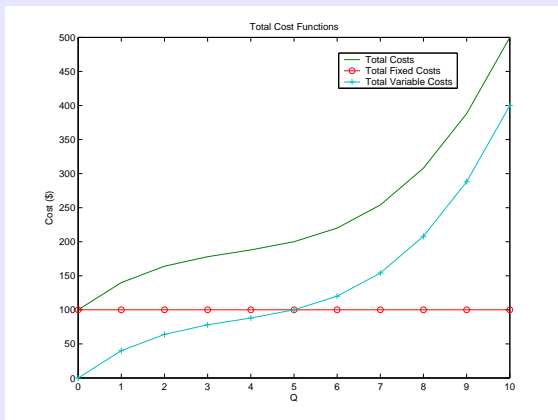


Figure 5 : Typical short total cost curves.

Short Run Average and Marginal Costs

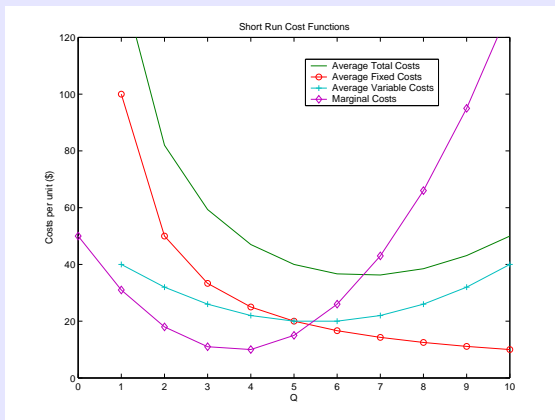


Figure 6 : Typical short run average and marginal cost curves.

Average vs Marginal Costs

Cruises (Q)	Total variable costs (TVC)	Marginal costs (MC)
0	0	–
20	$= (20^2)/20 = 20$	$= (20 - 0)/(20 - 0) = 1$
25	$= (25^2)/20 = 31.25$	$= (31.25 - 20)/(25 - 20)$ $= 2.25$
30	45	2.75
35	61.25	3.25
40	80	3.75

Table 4 : Variable costs on a cruise ship

Average vs Marginal Costs

Typical Data			Calculate this!	
Gas Production (Q)	Total costs (TC)	Average Total costs (ATC)	Marginal Costs (MC)	Profits (π)
20	1271		-	
22	1359			
24	1456			
26	1562			
28	1675			
30	1797			
32	1928			
34	2067			
36	2214			
38	2370			
40	2534			
42	2707			
44	2888			
46	3077			
48	3275			

Average vs Marginal

Typical Data			Calculate this!	
Gas Production (Q)	Total costs (TC)	Average Total costs (ATC)	Marginal Costs (MC)	Profits (π)
20	1271	63.6	-	89
22	1359	61.8	44.0	137
24	1456	60.7	48.5	176
26	1562	60.1	53.0	206
28	1675	59.8	56.5	229
30	1797	59.9	61.0	243
32	1928	60.3	65.5	248
34	2067	60.8	69.5	245
36	2214	61.5	73.5	234
38	2370	62.4	78.0	214
40	2534	63.4	82.0	186
42	2707	64.5	86.5	149
44	2888	65.6	90.5	104
46	3077	66.9	94.5	51
48	3275	68.2	99.0	-11

Long Run Average Costs

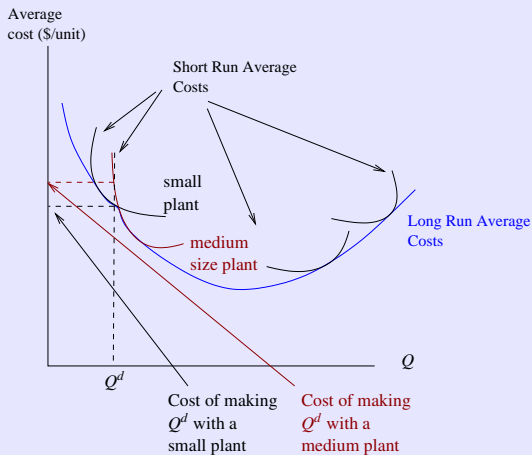


Figure 7 : Long run average cost curve.

Plant Size Example

Cost Type	Plant Size		
	Small	Medium	Large
<i>AVC</i>			
Labor	\$3.70	\$2.50	\$1.10
Materials	\$1.80	\$1.40	\$0.90
Other	\$2.00	\$2.60	\$3.00
<i>TFC</i>	\$25,000	\$75,000	\$300,000
Capacity	50,000	100,000	200,000

Table 7 : Plant size and *LRAC*.

Plant Size Example 2

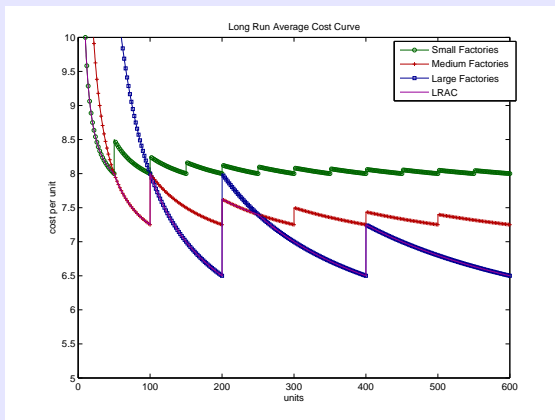


Figure 8 : Long run average cost curve.

Market Demand Table

Price of beer	Quantity Demanded
\$3	1000
\$5	500
\$7	300
\$10	90

Table 8 : Market demand for beer.

Elasticity Meaning

elasticity	economics term	pricing power	level of competition	price sensitivity
$e_p = -\infty$	perfectly elastic	none	perfect competition	very sensitive
$e_p < -1$	elastic	little	competitive	sensitive
$e_p = -1$	unitary elastic	moderate	moderate competition	moderate
$-1 < e_p < 0$	inelastic	strong	imperfect competition	not very sensitive
$e_p = 0$	perfectly inelastic	infinite	no competition	insensitive

Table 9 : Terminology for price elasticity.

Calculate Price Elasticity Using the Table

Price of beer	Quantity Demanded	e_p
\$3	1000	NA
\$5	500	
\$7	300	
\$10	90	

Table 10 : Price elasticity for beer.

Calculate Price Elasticity Using the Table

Price of beer	Quantity Demanded	e_p
\$3	1000	NA
\$5	500	-2.5
\$7	300	-2.33
\$10	90	-7.78

Table 11 : Price elasticity for beer.

Elasticity: Examples

Industry	Price Elasticity	Interpretation
Beer	-2.83	elastic/price sensitive
Wine	-0.198	inelastic/insensitive
Domestic Cars	-0.78	inelastic/insensitive
Foreign Cars	-1.09	elastic/sensitive
Cigarettes (everyone)	-0.42	inelastic/insensitive
Cigarettes (young adults)	-0.8	inelastic/insensitive
Prescription Drugs	-0.17	inelastic/insensitive
Emergency Room Visits	-0.37	inelastic/insensitive
Legal Services	-0.4	inelastic/insensitive
Higher Education	-1.1	elastic/sensitive
Fresh Tomatoes	-4.6	elastic/sensitive
Economy airline tickets	-1.30	elastic/sensitive
First class tickets	-0.45	inelastic/insensitive

Table 12 : Price elasticities across industries.

Table of Optimal Price

Typical Data					Calculate this!			
Q	P	TR	TC	ATC	MC	MR	$P - ATC$	π
20	70	1400	1271	63.6	-	-	6.5	129
22	69.75	1534.5	1359	61.8	44.0		8.0	175.5
24	69.25	1662	1456	60.7	48.5		8.6	206
26	68.75	1787.5	1562	60.1	53.0		8.7	225.5
28	68	1904	1675	59.8	56.5		8.2	229
30	67.25	2017.5	1797	59.9	61.0		7.4	220.5
32	66.5	2128	1928	60.3	65.5		6.3	200
34	65.75	2235.5	2067	60.8	69.5		5.0	168.5
36	65	2340	2214	61.5	73.5		3.5	126
38	64	2432	2370	62.4	78.0		1.6	62
40	63	2520	2534	63.4	82.0		-0.4	-14
42	62	2604	2707	64.5	86.5		-2.5	-103
44	60.5	2662	2888	65.6	90.5		-5.1	-226
46	59	2714	3077	66.9	94.5		-7.9	-363
48	57	2736	3275	68.2	99.0		-11.2	-539

Table 13 : Average and marginal costs in the gas industry.

Table of Optimal Price

Typical Data					Calculate this!			
Q	P	TR	TC	ATC	MC	MR	$P - ATC$	π
20	70	1400	1271	63.6	-	-	6.5	129
22	69.75	1534.5	1359	61.8	44.0	67.3	8.0	175.5
24	69.25	1662	1456	60.7	48.5	63.8	8.6	206
26	68.75	1787.5	1562	60.1	53.0	62.8	8.7	225.5
28	68	1904	1675	59.8	56.5	58.3	8.2	229
30	67.25	2017.5	1797	59.9	61.0	56.8	7.4	220.5
32	66.5	2128	1928	60.3	65.5	55.3	6.3	200
34	65.75	2235.5	2067	60.8	69.5	53.8	5.0	168.5
36	65	2340	2214	61.5	73.5	52.3	3.5	126
38	64	2432	2370	62.4	78.0	46.0	1.6	62
40	63	2520	2534	63.4	82.0	44.0	-0.4	-14
42	62	2604	2707	64.5	86.5	42.0	-2.5	-103
44	60.5	2662	2888	65.6	90.5	29.0	-5.1	-226
46	59	2714	3077	66.9	94.5	26.0	-7.9	-363
48	57	2736	3275	68.2	99.0	11.0	-11.2	-539

Table 14 : Average and marginal costs in the gas industry.

Income Elasticity

Income Elasticity	Economics Term	Sensitivity
$e_I > 1$	Luxury Good, Normal Good	Sensitive to income
$0 < e_I < 1$	Necessity, Normal Good	Not sensitive
$-1 < e_I < 0$	Inferior Good	Not sensitive
$e_I < -1$	Inferior Good	Sensitive

Table 15 : Meaning of income elasticity.

Payoff Matrix

Definition 23

The **payoff matrix** lists all rewards that each player gets as a function of decisions made by all players.

Price War Game

		Firm B	
		Hold prices	Cut prices
Firm A	Hold prices	3,3	1,4
	Cut prices	6,-1	0,0

Table 16 : Payoff matrix for the price war game.

Dominant Strategy

Definition 24

A **Dominant Strategy** is an action that is at least as good as all other actions regardless what the opposing player chooses.

Nash Equilibrium

Definition 25

A **Nash Equilibrium** is a set of strategies such that each player accurately believes that he/she is acting optimally given the strategy of the other players.

Definition 26

A **(non) credible** threat is a threat that it is (not) optimal to carry out.

Nash Equilibrium

Definition 25

A **Nash Equilibrium** is a set of strategies such that each player accurately believes that he/she is acting optimally given the strategy of the other players.

Definition 26

A **(non) credible** threat is a threat that it is (not) optimal to carry out.

Price War Game II

		Firm B	
		Hold prices	Cut prices
Firm A	Hold prices	3,3	1,4
	Cut prices	5,1	0,0

Table 17 : Price war game, version 2.

Price War Game II

		Firm B	
		Hold prices	Cut prices
Firm A	Hold prices	3,3	1,(4)
	Cut prices	5,(1)	0,0

Table 18 : Price war game, version 2.

Price War Game II

		Firm B	
		Hold prices	Cut prices
Firm A	Hold prices	3,3	(1), (4)
	Cut prices	(5), (1)	0,0

Table 19 : Price war game, version 2.

Coordination Game

		Car B	
		B's Left Side	B's Right Side
Car A	A's Left Side	10,10	-5,-5
	A's Right Side	-5,-5	10,10

Table 20 : Typical coordination game.

Coordination Game

		Car B	
		B's Left Side	B's Right Side
Car A	A's Left Side	$(10, 10)$	$-5, -5$
	A's Right Side	$-5, -5$	$(10, 10)$

Table 21 : Typical coordination game.

Anti-Coordination: Reduce Competition

		Buell	
		Sport Bikes	Cruisers
Harley	Sport Bikes	0,0	5,2
	Cruisers	2,5	0,0

Table 22 : Anti-coordination game.

Anti-Coordination Game

		Buell	
		Sport Bikes	Cruisers
Harley	Sport Bikes	0,0	(5), (2)
	Cruisers	(2), (5)	0,0

Table 23 : Anti-coordination game.

Store Location Game

Macy's

	Target			
	Uptown	Center City	East Side	West Side
Uptown	30,40	50,95	55,95	55,120
Center City	115,40	100,100	130,85	120,95
East Side	125,45	95,65	60,40	115,120
West Side	105,50	75,75	95,95	35,55

Table 24 : Location game. Coordinate or not?

Store Location Game

Macy's

Target

	Uptown	Center City	East Side	West Side
Uptown	30,40	50,95	55,95	55,120
Center City	115,40	100,100	130,85	120,95
East Side	125,45	95,65	60,40	115,120
West Side	105,50	75,75	95,95	35,55

Table 25 : Location game. Coordinate or not?

Price War

		Firm B	
		Hold prices	Cut prices
Firm A	Hold prices	3,3	0,5
	Cut prices	5,0	1,1

Table 26 : Prisoner's dilemma game.

Price War

		Firm B	
		Hold prices	Cut prices
Firm A	Hold prices	$SB = 6$	$SB = 5$
	Cut prices	$SB = 5$	$SB = 2$

Table 27 : Social benefit of the prisoner's dilemma game.

Price Matching

		Firm B	
		Hold and match prices	Cut prices
Firm A	Hold and match prices	3,3	1,1
	Cut prices	1,1	1,1

Table 28 : Price matching game.

3 Player Game

Alec Sells

April

		Sells	Holds out
Jack	Sells	45,45,45	50,40,50
Holds Out	40,50,50	48,48,65	

Alec Holds Out

April

		Sells	Holds Out
Jack	Sells	50,50,40	65,48,48
Holds Out	48,65,48	48,48,48	

Table 29 : Takeover game.

3 Player Game

Alec Sells

April

		Sells	Holds Out
Jack	Sells	45, 45, 45	50, 40, 50
	Holds Out	40, 50, 50	48, 48, 65

Alec Holds Out

April

		Sells	Holds Out
Jack	Sells	50, 50, 40	65, 48, 48
	Holds Out	48, 65, 48	48, 48, 48

Table 30 : Takeover game solution.

Blue Light Special

		Customer	
		Shop today	Shop tomorrow
Firm	Sale today	4,12	8,6
	Sale Tomorrow	12,8	6,10

Table 31 : Blue light special game.

Anti-Coordination

		Customer B	
		Shop TJ Maxx	Shop Macy's
Customer A	Shop TJ Maxx	4,4	10,7
	Shop Macy's	7,10	5,5

Table 32 : Anti-coordination game.

Sequential Anti-Coordination

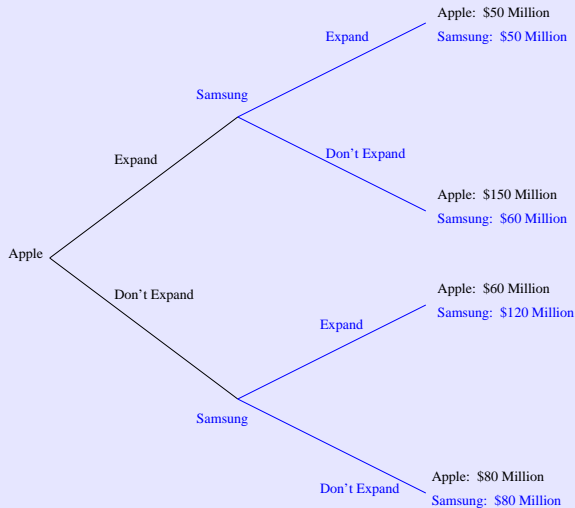


Figure 9 : Anti-coordination game in sequential form.

Sequential Anti-Coordination

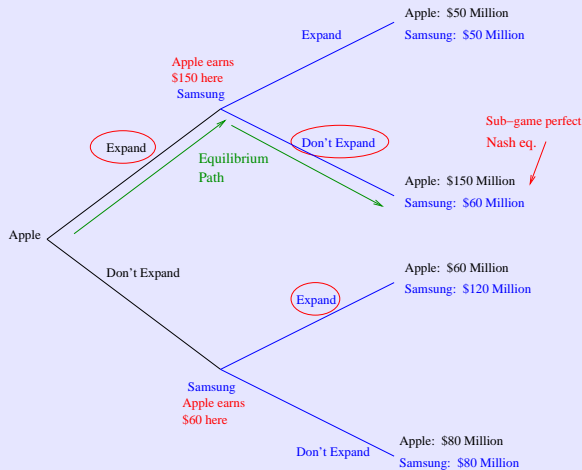


Figure 10 : Anti-coordination game in sequential form.

Simultaneous First Mover

		Samsung	
		Expand	Don't Expand
Apple	Expand	50,50	150,60
	Don't Expand	60,120	80,80

Table 33 : Simultaneous first mover game.

First Mover Advantage

Definition 27

First Mover Advantage: Advantage to the first mover in sequential games when the simultaneous game has multiple Nash Equilibria.

Entry Game

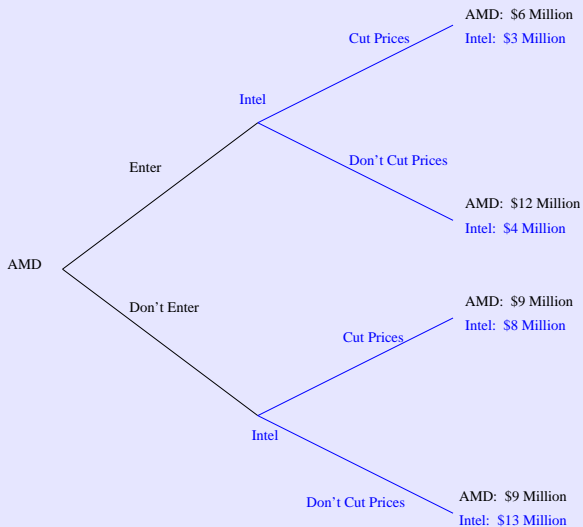


Figure 11 : Entry game.

Entry Game

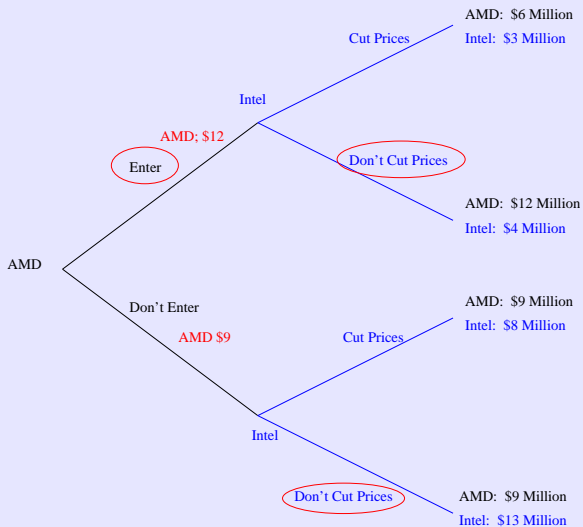
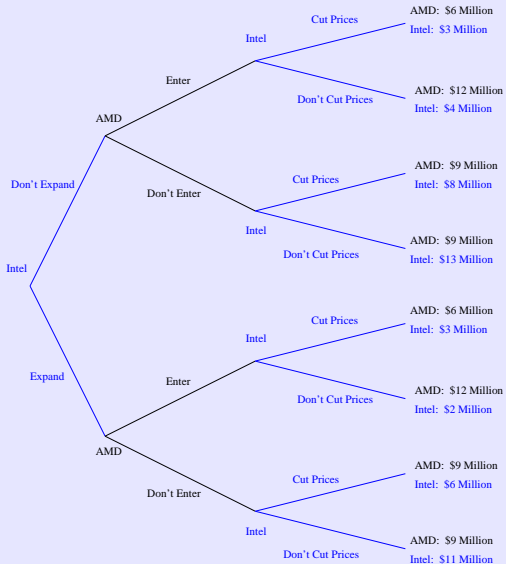
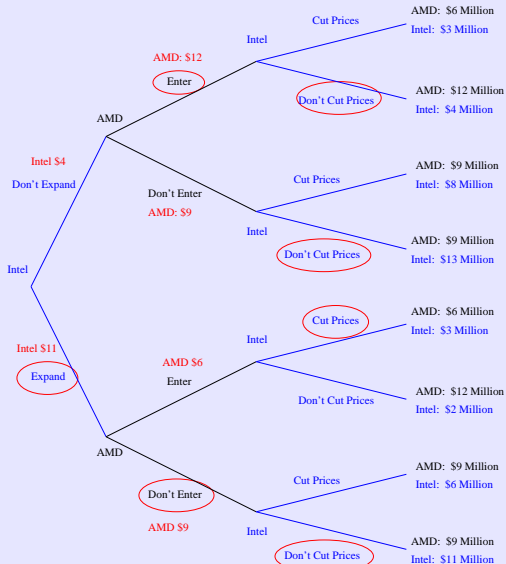


Figure 12 : Entry game.

Entry Game II



Entry Game II



Preemption

Definition 28

Preemption is an action taken to deter later actions by other players.

Summary and Takeaways

- 1 **Be on the lookout for better opportunities.** Avoid committing time and resources to low-profit endeavors.
- 2 **Think marginally.** Think: is this hire going to bring in more revenue than his/her salary? Think: is this client going to bring in more revenue than the cost of servicing the client? Avoid thinking in terms of averages. These tell you only what has happened in the past.
- 3 **Ignore sunk costs.** It is sometimes painful, but one has to sometimes ignore the sunk costs and move on. Hanging on too long because of past investments can cause more pain later.

Summary and Takeaways cont.

- 4 **Think carefully about expansion.** The graveyard is littered with firms that over-expanded. Conversely many firms get stuck at a size which is too small. Find a way (merge/expand/spin-off/fire clients) to get to an ideal size.
- 5 **Use tiered pricing tricks.** Profits are not easy to come by. Getting some extra profits by charging different prices to different groups is one of the few easy ways to increase profits.
- 6 **Predict: how will competitors react to my plan?** Try to anticipate the reaction of other firms and coworkers to your plans.

Summary and Takeaways cont.

- ⑦ **Remember: other firms and consumers will eventually react to your decisions.** Avoid decisions which are easy to react to, such as having a sale at the end of every month. Consumers will catch on quickly.
- ⑧ **Segment markets. Avoid head-to-head competition.** In general, it is better to segment a market by producing a version of a product which is of interest only to a subset of the consumers, than to compete head on with an established firm.
- ⑨ **Preempt, do not react.** Acting preemptively is always cheaper and more decisive than reacting to moves by other firms.

Repeated Prisoner's Dilemmas

		Firm B	
		Hold prices	Cut prices
Firm A	Hold prices	3,3	0,5
	Cut prices	5,0	1,1

Table 34 : Prisoner's dilemma game.