LOYOLA UNIVERSITY CHICAGO | QUINLAN SCHOOL of BUSINESS

Economics 303-102: Intermediate Microeconomics
Spring Semester 2018

Instructor: Paul E. Gabriel (pgabrie@luc.edu)
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Office Hours: Tuesday & Thursday, 2:30 – 4:00 p.m., and by appointment
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Course Schedule : Tuesday & Thursday, 1:00 pm – 2:15 pm, Schreiber 525
Course Prerequisites: Sophomore standing, minimum grade of ***C-*** in ECON 201 and 202; Math 131 (or equivalent) is recommended.
Text: **Microeconomics**, 9th Edition, by R.S. Pindyck and D.L. Rubinfeld, available at the WTC bookstore. (Earlier editions may be used)

Course Description:
This course applies the tenets of Neoclassical economic theory to the study of consumer and firm behavior. The interactions of these economic agents are explored within a variety of market structures.
Course Objectives and Learning Outcomes:
This course utilizes the tools of microeconomic theory to examine how firms and other economic agents achieve their objectives. An important goal of this course is to provide a logical and rational perspective for analyzing business problems. The students will develop analytical skills to understand and predict consumer and firm behavior, and evaluate dynamic market strategies.
Grading System:
There will be two examinations during the semester and a final examination. Each exam is worth 30% of your final grade. Thus, examinations count for 90% of the course grade. If your final exam score is higher than either of the in-class exams, the lowest exam score is dropped and the final is worth 60% of your course grade. Note: smartphones are not permitted for exam use. The remaining 10% of your course grade is based on homework assignments distributed during the semester. *Please note: late assignments are **NOT** accepted.*

Grading Scale:

93% - 100%	**A**	79% - 82%	**B-**	67% - 68%	**D+**
90% - 92%	**A-**	77% - 78%	**C+**	60% - 66%	**D**
87% - 89%	**B+**	72% - 76%	**C**	0% - 59%	**F**
83% - 86%	**B**	69% - 71%	**C-**		

Important Dates:

February 8 (Thursday)	Homework 1		*April 24 (Tuesday)*	Homework 3
February 15 (Thursday)	Exam 1		*May 4* (Friday) (1:00 – 3:00 p.m.)	Final Exam
March 22 (Thursday)	Homework 2			
March 29 (Thursday)	Exam 2			

Economics 303
Course Outline and Reading Assignments*

*I. Consumer Theory and Market Demand***

Consumer Behavior: Chapter 3 (sections 3.1 – 3.3, 3.5)
Individual and Market Demand: Chapter 4
Additional course material on elasticity, market demand, and linear demand functions.

Exam 1: February 15th

II. The Theory of the Firm: Production and Cost

Production Analysis: Chapter 6
Cost Analysis: Chapter 7 (sections 7.1 – 7.4, plus appendix)
Additional course material on production and cost functions, economic profit, and break-even analysis.

III. The Analysis of Market Structures

Perfect Competition -- Short-run Outcomes: Chapter 8 (sections 8.1 – 8.4)
Perfect Competition -- Long-run Outcomes: Chapter 8 (sections 8.5 – 8.7)

Exam 2: March 29th

Monopoly: Chapter 10 (sections 10.1 – 10.4)
Chapter 11 (sections 11.1 – 11.3)
Oligopoly: Chapter 12 (sections 12.2 – 12.6)
Monopolistic Competition: Chapter 12 (section 12.1)
Additional course material on competitive and non-competitive pricing models.
Additional topics as time permits.

Final Exam: May 4th (1:00 – 3:00 pm)

* Further reading assignments, and adjustments to the course outline, may be made in class.

** If you feel the need for a quick refresher on the basic supply and demand model, please review Chapter 2 of the text.

Quinlan School of Business Policies:

Attendance
Class attendance and participation are fundamental components of learning, so punctual attendance at all classes, for the full class meeting period, is expected of Quinlan students. The student is responsible for any assignments or requirements missed during an absence.

Make-Up Examinations
Loyola University academic policy provides that tests or examinations may be given during the semester or summer sessions as often as deemed advisable by the instructor. Because Quinlan faculty believe examinations represent a critical component of student learning, required examinations should be taken during the regularly scheduled class period. If you miss an exam during the semester, the weight of that exam is shifted to the final. Exceptions may be granted only by the faculty member or department chair, and only for unavoidable circumstances (illness verified by a signed physician’s note, participation in intercollegiate athletic events, subpoenas, jury duty, military service, bereavement, or religious observance). Make-up exams will not be scheduled if the graded exam has been returned to the class. A make-up final examination may be scheduled only with the permission of the appropriate Quinlan Assistant or Associate Dean.

Academic Integrity
All members of the Quinlan School shall refrain from academic dishonesty and misconduct in all forms, including plagiarism, cheating, misrepresentation, fabrication, and falsehood. Plagiarism or cheating on the part of the student in individual or group academic work or in examination behavior will result minimally in the instructor assigning the grade of “F” for the assignment or examination. In addition, all instances of academic dishonesty must be reported to the chairperson of the department involved.

For further information about expectations for academic integrity and sanctions for violations, consult the complete Quinlan School of Business Honor Code and Statement of Academic Integrity on the Quinlan website:

Intermediate Microeconomics

Course Supplements & Handouts

Spring Semester, 2018

Paul E. Gabriel

Summary Sheet 1: Consumer Behavior Analysis

ECONOMIC MAN
At the heart of economic theory is *homo economicus (economic man)*, the economist's model of human behavior. In traditional Classical Economics, and in Neo-classical Economics, it was assumed that people acted in their own self-interest. Adam Smith argued that society was made better off by everybody pursuing their selfish interests through the workings of free and competitive markets. However, in recent years, mainstream economists have tried to include a broader range of human motivations in their models. For example, **Behavioral Economics** has drawn on psychological insights into human behavior to explain economic phenomena.

UTILITY
Utility refers to the ability of goods and services to satisfy consumer wants or needs; it is a measure of consumer satisfaction and welfare (i.e. benefits). Underlying most economic theory is the assumption that people do things, such as consuming goods and services, because doing so gives them utility. People want as much utility as they can get, subject to their **budget constraints**.

MARGINAL UTILITY
The rate of change in consumer utility (satisfaction) caused by adjusting the consumption level of a good is referred to as marginal utility MU. MU measures the incremental impact on a consumer's utility caused by changing the level of consumption of a good.

LAW of DIMINISHING MARGINAL UTILITY (LDMU)
LDMU refers to the notion that the more consumers have of a product, the less *incremental* benefit (i.e. marginal utility) they receive by consuming an additional unit of it. Thus, the increment to consumer utility declines as the level of consumption increases. This suggests that consumer utility begins to increase, *at a decreasing rate,* with consumption.

Utility-maximization rule (also referred to as consumer equilibrium): To maximize total utility, a consumer will purchase goods to the point where the ratio of marginal utility, per dollar spent on each good, is equal across all goods. Thus, if the consumer chooses from *n* goods (1, 2, …,n), she will purchase the goods in amounts $q_1^*,\ q_2^*, \ldots, q_n^*$ at the point where:

$$\frac{MU_1}{P_1} = \frac{MU_2}{P_2} = \cdots = \frac{MU_n}{P_n}$$

For 2 goods, X and Y, X^*, Y^* occur where:

$$\frac{MU_x}{P_x} = \frac{MU_y}{P_y}$$

INDIFFERENCE CURVE:
The various combinations of two products that provide a consumer with the same overall level of benefits (utility). Standard indifference curves have the following properties:

- Negative slopes
- Indifference curves pass through all possible consumption combinations
- Indifference curves further away from the origin denote higher levels of utility
- Indifference curves do not intersect
- Convex to the origin (i.e., the MRS changes as more of good is consumed, relative to the other)

MARGINAL RATE OF SUBSTITUTION
The rate at which a consumer is willing to exchange one product for another, and remain equally satisfied, is known as the marginal rate of substitution (**MRS**). For 2 goods, X and Y,

$$MRX_{YX} = \left.\frac{\Delta y}{\Delta x}\right|_{\bar{U}} = \frac{MU_x}{MU_y}$$

BUDGET CONSTRAINT
A consumer's ability to acquire goods and services during a given period is determined primarily by the budget constraint. The budget constraint helps to specify the affordable combinations of goods. The important determinants of the budget constraint are: market prices, the consumer's disposable income, and, to a lesser extent, the consumer's ability to borrow. For 2 goods, X and Y, the budget constraint is expressed as:

$$(P_x \times X) + \left(P_y \times Y\right) = M,$$

where P_x, P_y = market prices of X, Y ($ per unit); X, Y = number of units of goods X and Y purchased; M = consumer income per period.

Graphically, the budget constraint is shown by the ***budget line equation***:

$$Y = \frac{M}{P_y} - \left(\frac{P_x}{P_y}\right) X$$

Consumer equilibrium with the Ordinal Utility Model:
The consumer reaches the highest level of utility at X^*, Y^* -- the level of consumption where the budget line is tangent to the highest possible Indifference Curve. Given the product prices, P_X and P_Y, and the consumer's income M, $X^*, Y^* \Rightarrow$

$$|slope\ of\ I\ Curve| = |slope\ of\ budget\ line| \Rightarrow$$

$$MRS_{YX} = \frac{P_x}{P_y} \Rightarrow \frac{MU_x}{MU_y} = \frac{P_x}{P_y}$$

$$\therefore \frac{MU_x}{P_x} = \frac{MU_y}{P_y}$$

Consumer utility-maximizing outcome given a Cobb-Douglas utility function:

$$\max_{X,Y} U = AX^{\alpha}Y^{\beta} \quad subject\ to: P_xX + P_yY = M$$

$$MRS_{yx} = \frac{P_x}{P_y} \quad \Longrightarrow \quad \frac{MU_x}{MU_y} = \frac{P_x}{P_y} \Longrightarrow \quad \frac{MU_x}{P_x} = \frac{MU_y}{P_y}$$

With a Cobb-Douglas utility function,

$MU_x = \frac{\partial U}{\partial x} = A\alpha\, X^{(\alpha-1)}Y^{\beta};\ MU_y = \frac{\partial U}{\partial y} = A\beta X^{\alpha}Y^{(\beta-1)}$ thus,

$$(1) \qquad \frac{MU_x}{MU_y} = \frac{P_x}{P_y} \Longrightarrow \frac{A\alpha\, X^{(\alpha-1)}Y^{\beta}}{A\beta X^{\alpha}Y^{(\beta-1)}} = \frac{P_x}{P_y}$$

Simplifying,

$$(2) \qquad \frac{\cancel{A}\alpha\, X^{(\alpha-1-\alpha)}Y^{(\beta-\beta+1)}}{\cancel{A}\beta X^{\cancel{\alpha}}\ \cancel{Y^{(\beta-1)}}} = \frac{P_x}{P_y} \quad \Longrightarrow \boldsymbol{\frac{\alpha Y}{\beta X} = \frac{P_x}{P_y}}$$

Using the budget line equation, $\boldsymbol{Y = \frac{M}{P_y} - \frac{P_x}{P_y} X}$, we can substitute for Y and solve for X*:

$$(3) \qquad \frac{\alpha\left[\frac{M}{P_y} - \frac{P_x}{P_y}X\right]}{\beta X} = \frac{P_x}{P_y} \Longrightarrow$$

$$(4) \qquad \Rightarrow \alpha\left[\frac{M}{P_y} - \frac{P_x}{P_y}X\right] = \frac{P_x}{P_y}\beta X$$

$$(5) \qquad \alpha M - \alpha P_xX = P_x\beta X$$

$$(6) \qquad \alpha M = P_x\beta X + \alpha P_xX, \quad \Longrightarrow \quad \alpha M = P_xX\,(\beta + \alpha)$$

$$(7) \qquad \frac{\alpha M}{(\beta + \alpha)} = P_xX \quad \therefore \mathbf{X}^{*} = \frac{\boldsymbol{\alpha}\mathbf{M}}{\mathbf{P_x}\,(\boldsymbol{\beta} + \boldsymbol{\alpha})}$$

A similar process yields the utility-maximizing outcome for good Y:

$$(8) \qquad \mathbf{Y}^{*} = \frac{\boldsymbol{\beta}\mathbf{M}}{\mathbf{P_y}\,(\boldsymbol{\beta} + \boldsymbol{\alpha})}$$

Market Demand:

Demand measures the relationship between the amount of a good or service that consumers are both willing and able to buy, and the price, holding other influences constant. **Quantity demanded** is the actual amount of a good or service that consumers are willing and able to purchases (usually abbreviated as Q^D), at a given price. The **law of demand states** that there is an inverse relationship between quantity demand and price, ***ceteris paribus(Latin: "other things remaining equal")***. In other word, as the price of a good rises, fewer people are willing and able to purchase it (and vice versa).

In addition to price, the demand for a good depends on several other influences, known as **non-price demand determinants.** A partial list of these determinants might include:

> **Consumer Income:** (a measure of purchasing power), denoted by the variable **M.** A **normal good** is a product that has a direct relationship between the amount demanded and the level of consumer income. An **inferior good** has a negative (inverse) relationship between income and amount demanded.
>
> **Consumer Tastes and Preferences:** The ability of the good or service to meet consumer wants and needs. (**T**)
>
> **Price(s) of a Related Good(s) P_Y:** There are two types of related products that may affect the demand for a given good: **substitutes** (competing or similar products) and **complements** (products and services that tend to consumed jointly with a good). For example, if the price of a substitute increases, consumers will increase their willingness to purchase a particular good. On the other hand, if the price of a complement increases, consumers will likely reduce the amount demanded for a good.
>
> **Number of Potential Consumers (N):** There is a direct relationship between the amount demanded and the number of consumers in the market.
>
> **Consumer Expectations (E):** Psychological factors that influence consumer opinion about current and future market information.

Thus, the **Market Demand for Good X** can be expressed in the following general terms:

$$D_X: \quad Q_X^D = f(P_X, M, T, P_Y, N, E)$$

The demand relationship, $D_X: \quad Q_X^D = f(P_X, M, T, P_Y, N, E)$, also can be specified as a **linear demand model** (equation):

$$Q_X^D = a + bP_x + cM + dP_y + \cdots \quad where,$$

$$b = \frac{dQ_X^D}{dP_X}; \quad c = \frac{dQ_X^D}{dM}; \quad d = \frac{dQ_X^D}{dP_Y} \cdots$$

Summary Sheet 2: Elasticity of Demand

{Own} price elasticity of demand:
The percentage change in quantity demanded resulting from a percentage change in price, *ceteris paribus*.

GENERAL FORMULA: $$(1)\quad e_P = \frac{\%\Delta Q^D}{\%\Delta P}$$

NOTE: The price elasticity of demand coefficient may be expressed numerically without regard to sign, and can range from zero to infinity.

$\lvert e_P \rvert$	Classification of e_P
$\lvert e_P \rvert = \infty$	perfectly elastic
$\lvert e_P \rvert > 1.0$	relatively elastic
$\lvert e_P \rvert = 1.0$	unit elastic
$\lvert e_P \rvert < 1.0$	relatively inelastic
$\lvert e_P \rvert = 0$	perfectly inelastic

CALCULATING e_P:

Point Formula: $$(2)\quad e_P = \left| \left(\frac{dQ^D}{dP}\right) \bullet \left(\frac{P}{Q^D}\right) \right|$$

where the first term on the right-hand-side of (2) is the coefficient on price from a linear demand equation.

OTHER ELASTICITY MEASURES:

INCOME ELASTICITY OF DEMAND: The percentage change in quantity demanded resulting from a percentage change in income.

$$(3)\quad e_M = \left(\frac{dQ^D}{dM}\right) \bullet \left(\frac{M}{Q^D}\right)$$

where M is consumer income. A positive value for e_M indicates a normal good; a negative value indicates an "inferior" good. If $e_M > 1$, the good is classified as a 'luxury' good; if $0 < e_M < 1$, the good is classified as a 'necessity' good.

CROSS PRICE ELASTICITY OF DEMAND:

The percentage change in quantity demanded of good X resulting from a percentage change in the price of good Y.

$$(4)\ e_{XY} = \left(\frac{d\,Q_X}{d\,P_Y}\right) \bullet \left(\frac{P_Y}{Q_X}\right)$$

where Q_X is the quantity demanded of good X and P_Y is the price of good Y. If e_{XY} is negative, then X and Y are **complements**; if e_{XY} is positive, then X and Y are **substitutes**.

Summary Sheet 3: Production Theory

FIRMS
A firm is the basic, private organizational entity in a market economy that employs economic resources to produce goods and services. An ***industry*** is a collection of firms producing similar or identical goods and services.

PRODUCTION FUNCTION
A mathematical way to describe the relationship between the quantity of inputs used by a firm and the level of output (**q**) produced.

Production function, general form -- q = f(A, B, C, etc.)
where A, B, C,..., represent various types of inputs (economic resources).

SHORT RUN
The short run is the period of time in which the firm employs both fixed and variable factors of production. Thus, given the presences of at least one fixed input, the firm is able to adjust its output only by increasing or decreasing its use of the variable input(s). The ***long run***, or planning horizon, allows the firm to simulate production and cost outcomes, assuming that all inputs can be varied in employment.

Short-run production function (assuming 2 inputs: capital and labor)--

q = f(K, L) ; where q = units of output per time period,
K = number of units of homogeneous capital, (assumed to be fixed in the short run)
L = number of units of homogeneous labor services.

PRODUCTIVITY
The notion of productivity is used to describe the amounts of inputs that are required to produce a desired level of output. Productivity is generally applied to individual factors of production. Labor productivity is the most widely used measure and is usually calculated by dividing total output by the number of workers or the number of hours worked.

Productivity measures (short run):

Total Product (TP) = physical volume of output per period (q);

Average Product (AP) = output per unit of the variable factor;

Marginal Product (MP) = the change in total product attributable to changing the usage of the variable input, ceteris paribus.

If labor (L) is the variable factor, then

$$AP_L = \frac{q}{L}; \qquad MP_L = \frac{dq}{dl}\ (continuous)$$

$$= \frac{\Delta q}{\Delta l}\ (discrete)$$

LAW OF DIMINISHING RETURNS (MARGINAL PRODUCT)
As a firm increases its employment of a variable input in the short run, eventually a point is reached where the additional output (i.e., marginal product) of the input begins to decline. Thus, the firm's output increases at a decreasing rate as more of the input is used. In other words, if each extra unit of output requires a growing amount of inputs to produce it, the firm faces diminishing marginal product.

3 STAGES OF PRODUCTION (SHORT-RUN PRODUCTION FUNCTION)

Stage I: TP_L begins to increase at a decreasing rate; MP_L starts to decrease (point of diminishing returns); AP_L is rising; and MP_L is greater than AP_L.

Stage II: TP_L increases at a decreasing rate; MP_L and AP_L are falling; and $AP_L > MP_L$.

Stage III: TP_L is falling; AP_L is falling; $MP_L < 0$.

The *Cobb-Douglas* production function can be specified in general as:

$$q = A\,K^{\alpha}\,L^{\beta}$$

where q is output per period, L is units of labor services employed, K is units of capital. A, α, and ß are assumed to be positive parameters.

Given the production function above, the per-unit labor productivity measures (AP_l and MP_l) can be expressed as:

$$AP_L = \frac{q}{l} = A\,K^{\alpha}\,L^{(\beta-1)} \qquad MP_L = \frac{dq}{dl} = A\beta\,K^{\alpha}\,L^{(\beta-1)}$$

Cobb-Douglas Example:

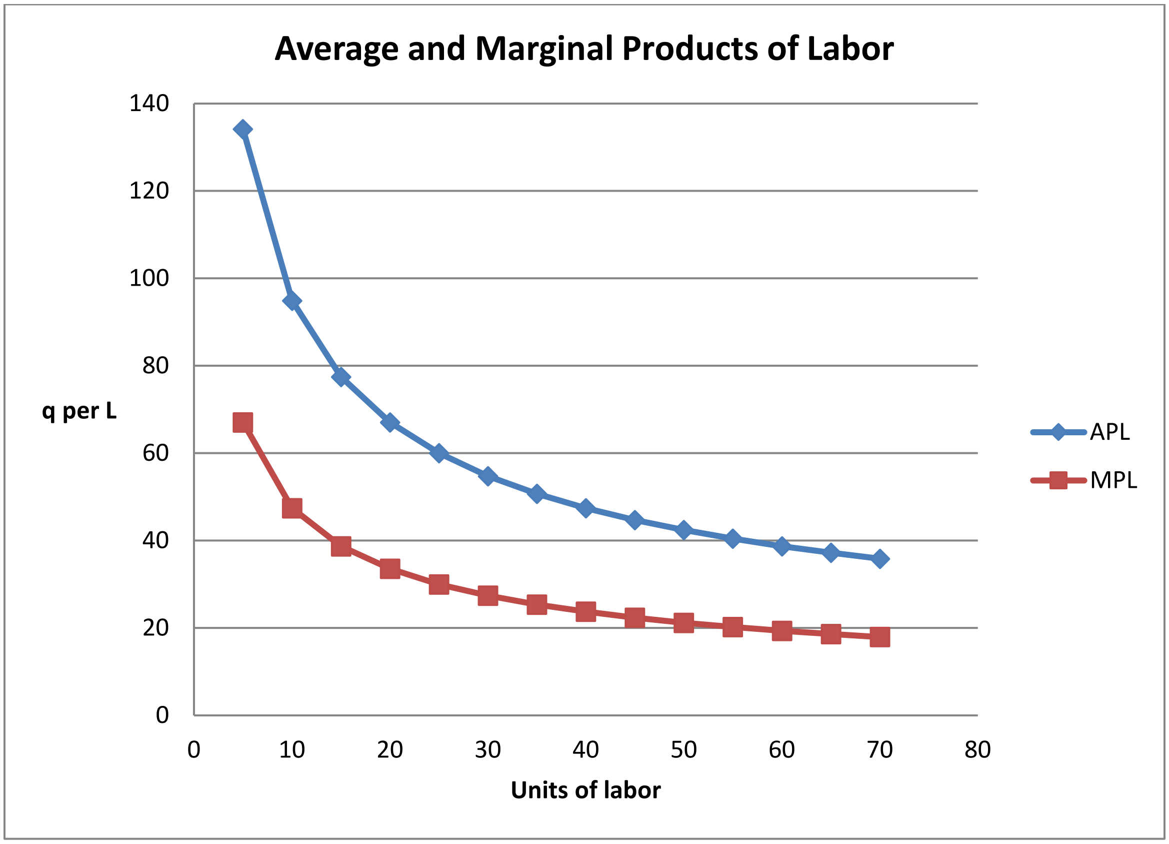
Given, $q = 100K^{0.5}L^{0.5}$, then AP_L and MP_L can be written as:

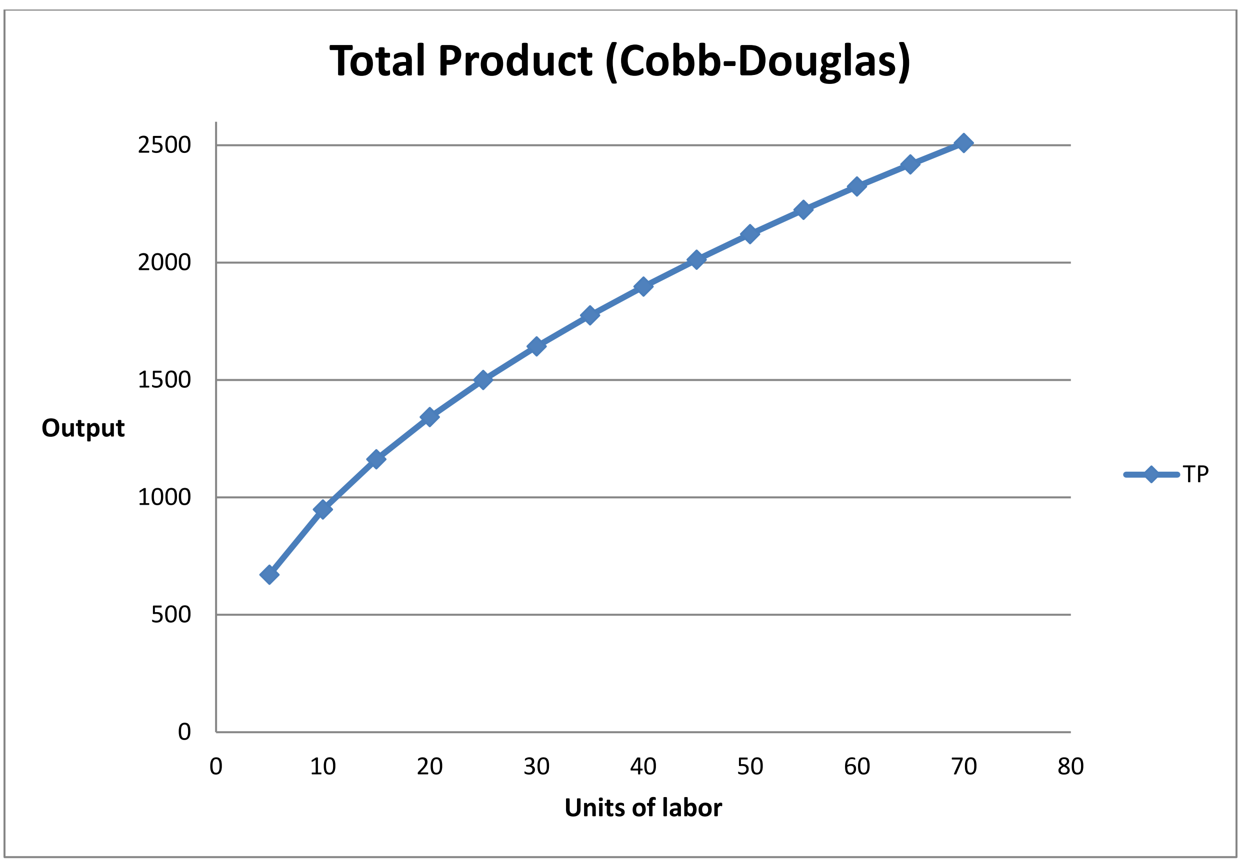
$$MP_L = 50\frac{K^{0.5}}{L^{0.5}} \quad AP_L = 100\frac{K^{0.5}}{L^{0.5}}$$

$$MP_L = 50\sqrt{\frac{K}{L}} \quad AP_L = 100\sqrt{\frac{K}{L}}$$

If we assume that capital is fixed at K = 9, the per-unit productivity measures become,

$AP_L = \frac{300}{\sqrt{L}}; MP_L = \frac{150}{\sqrt{L}}$, and appear as follows:


Average and Marginal Products of Labor
140
120
100
80
60
40
20
0
q per L
0
10
20
30
40
50
60
70
80
Units of labor
APL
MPL


Total Product (Cobb-Douglas)
2500
2000
1500
1000
500
0
Output
0
10
20
30
40
50
60
70
80
Units of labor
TP

Summary Sheet 4: Short-run Production Costs

FIXED COSTS
Fixed costs are those production costs that do not change when the quantity of output produced changes. For instance, the cost of renting an office or factory space, depreciation expenses, and property taxes may be considered fixed costs.

VARIABLE COSTS
A firm's variable costs are the production costs that change according to how much output it produces. Examples include raw materials, payments for production labor energy costs. In the long run, most costs can be varied.

Standard Short-run Cost Expressions:

TC: Total Cost ($ per period); TFC: Total Fixed Cost; TVC: Total Variable Cost
ATC: Average Total Cost ($ per unit of output, per period);
AFC: Average Fixed Cost; AVC: Average Variable Cost; MC: Marginal Cost

$$TC = TFC + TVC$$

$$ATC = \frac{TC}{q} = \left(\frac{TFC}{q} + \frac{TVC}{q}\right) = AFC + AVC$$

$$AFC = \frac{TFC}{q}; \quad AVC = \frac{TVC}{q}$$

$$MC = \frac{dTC}{dq} = \frac{\Delta TC}{\Delta q} = \frac{dTVC}{dq}$$

If labor is the only variable input,

$$TC = Fixed\ Costs + labor\ costs\ (w \times L)\ \therefore TVC = (w \times L)\ , and,$$
$$AVC = \frac{w}{AP_L}; \quad MC = \frac{w}{MP_L}$$

Types of Total Cost Functions:

1) Linear Cost Function

General Form: (1) TC = α + βq (where α, $\beta > 0$)

Given (1), TFC = α; TVC = βq

With a linear total cost function, the per-unit cost functions are defined as:

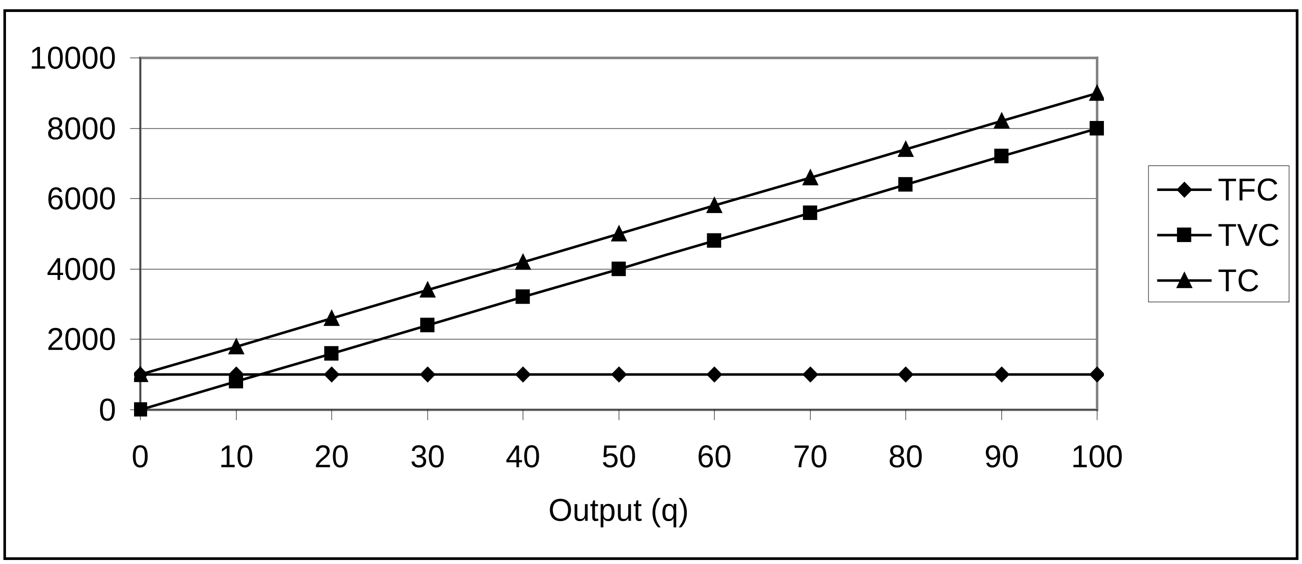
$$ATC = \frac{\alpha}{q} + \beta; \quad AFC = \frac{\alpha}{q}; \quad AVC = \beta; \quad MC = \frac{dTC}{dq} = \beta$$

Linear Cost Example: TC = 1000 + 80q

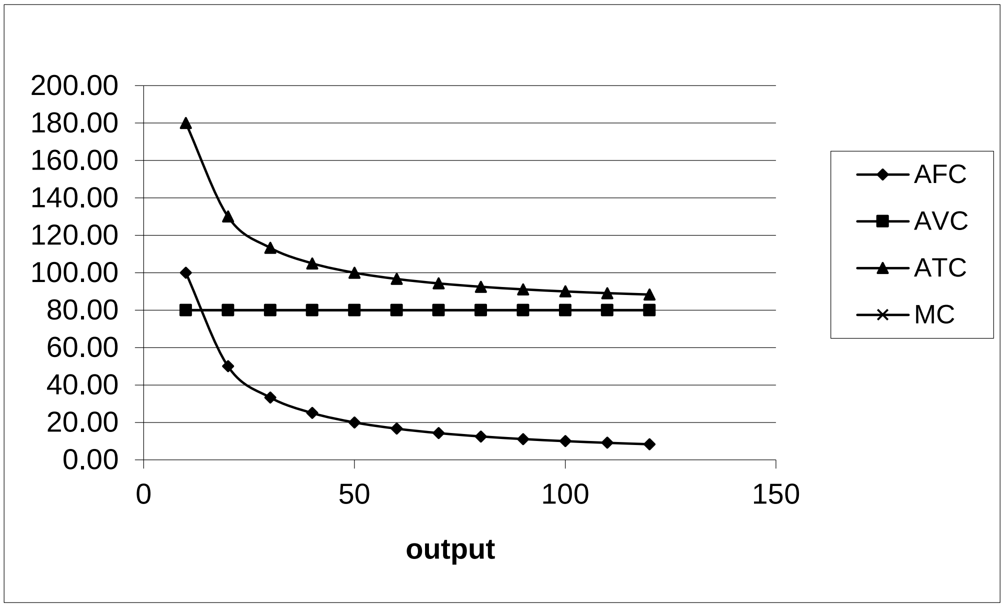
$$TFC = 1000;\ TVC = 80q;\ AFC = \frac{1000}{q};\ AVC = \frac{80q}{q} = 80;\ ATC = \frac{1000}{q} + 80;\ MC = \frac{d\,TC}{d\,q} = 80$$

output (q)	TFC	TVC	TC
0	1000	0	1000
10	1000	800	1800
20	1000	1600	2600
30	1000	2400	3400
40	1000	3200	4200
50	1000	4000	5000
60	1000	4800	5800
70	1000	5600	6600
80	1000	6400	7400
90	1000	7200	8200
100	1000	8000	9000

output (q)	AFC	AVC	ATC	MC
10	100.00	80	180.00	80
20	50.00	80	130.00	80
30	33.33	80	113.33	80
40	25.00	80	105.00	80
50	20.00	80	100.00	80
60	16.67	80	96.67	80
70	14.29	80	94.29	80
80	12.50	80	92.50	80
90	11.11	80	91.11	80
100	10.00	80	90.00	80
110	9.09	80	89.09	80
120	8.33	80	88.33	80



per-unit costs:



2) Quadratic Cost Function

General Form: $\mathbf{TC = \alpha + \beta q + \delta q^2}$ (where $\alpha, \beta, \delta > 0$)

$\mathbf{TFC = \alpha; \quad TVC = \beta q + \delta q^2}$

With a quadratic total cost function, the per-unit cost functions are defined as:

$$ATC = \frac{\alpha}{q} + \beta + \delta q$$

$$AFC = \frac{\alpha}{q}$$

$$AVC = \beta + \delta q$$

$$MC = \frac{dTC}{dq} = \beta + 2\delta q$$

Quadratic Cost Function Example: Given $\mathbf{TC = 1000 + 10q + 0.5q^2}$

$$TFC = 1000$$

$$TVC = 10q + 0.5q^2$$

$$ATC = \frac{1000}{q} + 10 + 0.5q$$

$$AFC = \frac{1000}{q}$$

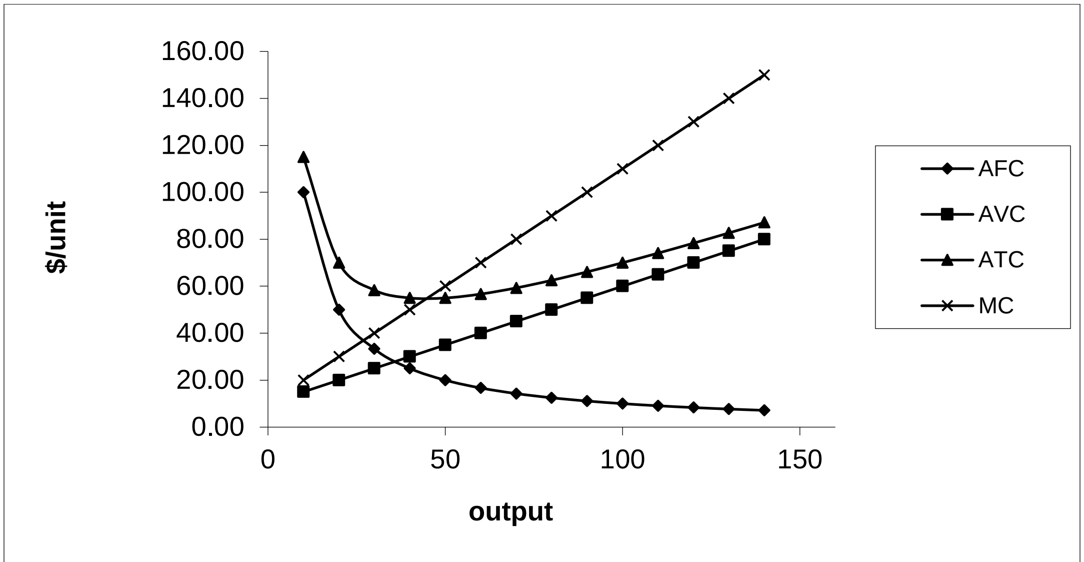
$$AVC = 10 + 0.5q$$

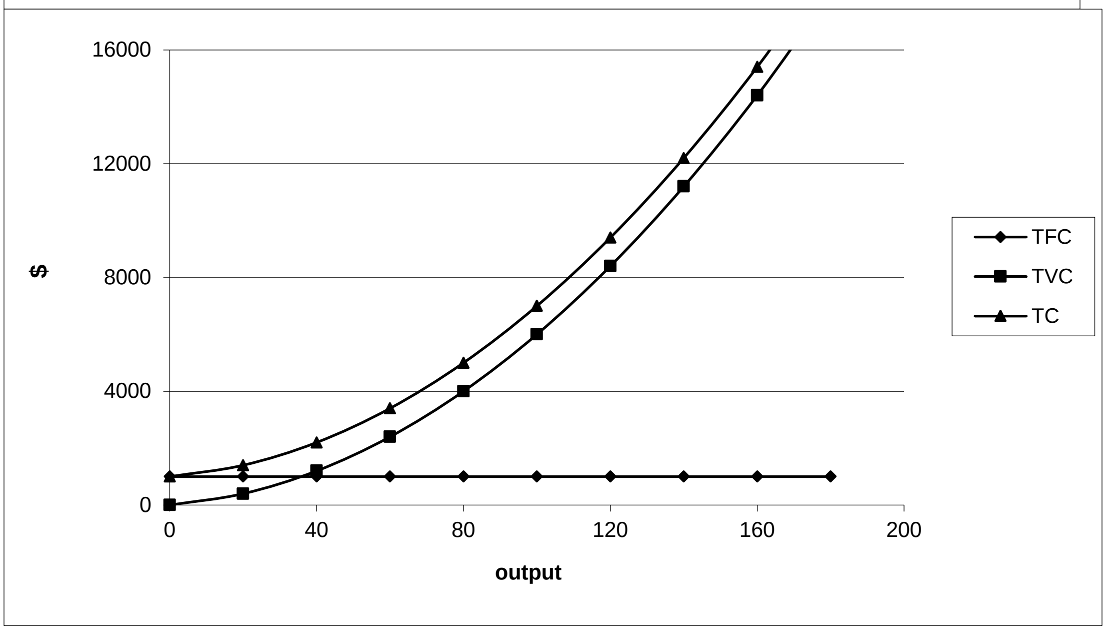
$$MC = 10 + q$$

These cost functions can be illustrated as:

output	TFC	TVC	TC
0	1000	0.00	1000.00
20	1000	400.00	1400.00
40	1000	1200.00	2200.00
60	1000	2400.00	3400.00
80	1000	4000.00	5000.00
100	1000	6000.00	7000.00
120	1000	8400.00	9400.00
140	1000	11200.00	12200.00
160	1000	14400.00	15400.00
180	1000	18000.00	19000.00
200	1000	22000.00	23000.00

output	AFC	AVC	ATC	MC
10	100.00	15.00	115.00	20
20	50.00	20.00	70.00	30
30	33.33	25.00	58.33	40
40	25.00	30.00	55.00	50
50	20.00	35.00	55.00	60
60	16.67	40.00	56.67	70
70	14.29	45.00	59.29	80
80	12.50	50.00	62.50	90
90	11.11	55.00	66.11	100
100	10.00	60.00	70.00	110
110	9.09	65.00	74.09	120
120	8.33	70.00	78.33	130
130	7.69	75.00	82.69	140
140	7.14	80.00	87.14	150
150	6.67	85.00	91.67	160





Summary Sheet – 5: Long-run Production and Cost Outcomes

Isoquant: The various combinations of 2 factors which yield the same level of total output.

Marginal Rate of Technical Substitution (MRTS): measures the amount of one input that must be substituted for another to maintain a constant level of output (q_o).
For 2 inputs, K and L,

$$MRTS = \left|\frac{\Delta K}{\Delta L}\right|_{q=q_0} = \frac{MP_L}{MP_K}$$

Isocost: The various combinations of 2 factors which result in the same level of total costs ($) for the firm -- holding factor prices constant.

For 2 factors, K and L, total cost (TC) can be expressed as

TC = wL + rK

where w = cost of each unit of labor services;
r = cost of each unit of capital services.

For a given level of total cost (TC_0), the equation of the isocost is:

$$K = \frac{TC_0}{r} - \left(\frac{w}{r}\right)L$$

Least-cost rule of factor employment: employ resources to the point where the marginal product per dollar spent on each factor is the same. For 2 factors (e.g., capital (K) and labor (L)), this is the point where the isoquant is tangent to the lowest possible isocost line--given factor prices w and r.
With 2 factors, K and L, cost-minimization implies

$$MRTS = \frac{MP_L}{MP_K} = \frac{w}{r}$$

$$\Downarrow$$

$$\frac{MP_L}{w} = \frac{MP_K}{r}$$

Thus, for n-factors,

$$\frac{MP_A}{P_A} = \frac{MP_B}{P_B} = \dots = \frac{MP_n}{P_n}$$

where A, B, ..., n are the factors; and P_A, P_B, ..., P_n are the relevant factor prices.

Summary Sheet 6: Cost-minimization with a Cobb-Douglas production function

For a firm using capital (K) and labor (L), the optimum employment outcome can be expressed as:

$$given \quad q_0 = AK^{\alpha}L^{\beta}, and \ \ TC = wL + rK \quad \Rightarrow$$

$$\min TC \ subject \ \ to \ q = q_0 \quad \Rightarrow$$

$$L^* = \left(\frac{r}{w}\cdot\frac{\beta}{\alpha}\right)^{\frac{\alpha}{(\alpha+\beta)}} \times \left(\frac{q_0}{A}\right)^{\frac{1}{\alpha+\beta}} \ and \ \ K^* = \left(\frac{w}{r}\cdot\frac{\alpha}{\beta}\right)^{\frac{\beta}{(\alpha+\beta)}} \times \left(\frac{q_0}{A}\right)^{\frac{1}{(\alpha+\beta)}}$$

Example: let $q = 10\ K^{0.5}L^{0.5}$, w = \$100, r = \$400, and q_0 = 500 (target output level). Given this information, the optimum employment outcome for capital (K^*) and labor (L^*) can be expressed as:

$$L^* = \left(\frac{400}{100}\cdot\frac{0.5}{0.5}\right)^{\frac{0.5}{(1)}} \times \left(\frac{500}{10}\right)^{\frac{1}{(0.5+0.5)}} \quad = 100\ units$$

$$and \ \ K^* = \left(\frac{100}{400}\cdot\frac{0.5}{0.5}\right)^{\frac{0.5}{(1)}} \times \left(\frac{500}{10}\right)^{\frac{1}{(1)}} = 25\ units$$

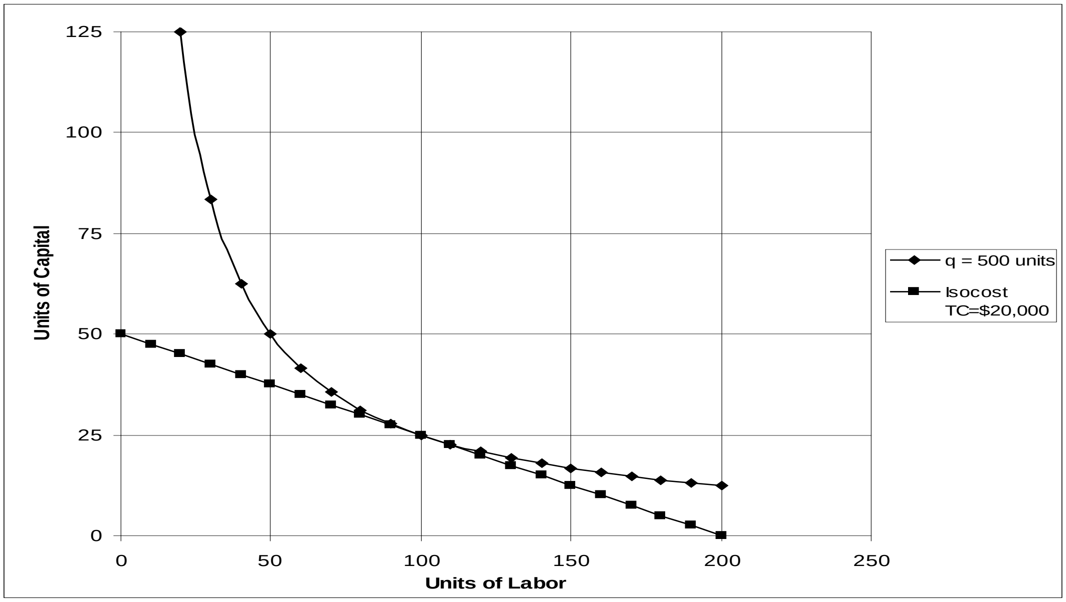
Total cost for the firm:

TC = wL + rK = \$100x100 + \$400x25 = \$20,000

Labor's share: (\$10,000/\$20,000) = 50%; Capital's share: (\$10,000/\$20,000) = 50%

Thus, the isocost equation can be expressed as: $K = \left(\frac{20000}{400}\right) - \left(\frac{100}{400}\right)L \rightarrow K = 50 - 0.25\,L$

Given the information above, the optimum employment outcome for capital (K^*) and labor (L^*) can be shown as:



125
100
75
50
25
0
Units of Capital
0
50
100
150
200
250
Units of Labor
q = 500 units
Isocost
TC=$20,000

Summary Sheet 7: Long-run Production and Cost Relationships

Returns to Scale: Measures the effect on output (production) of equal proportionate changes in the employment of all inputs.

3 general cases:

If all inputs are increased (decreased) by a given proportion, and the firm's output increases (decreases) by a larger proportion, then there are increasing returns to scale.

If all inputs are increased (decreased) by a given proportion, and the firm's output increases (decreases) by the same proportion, then there are constant returns to scale.

If all inputs are increased (decreased) by a given proportion, and the firm's output increases (decreases) by a smaller proportion, then there are decreasing returns to scale.

Long-run Total Cost (LTC): Total firm costs for producing a given level of output -- assuming all factors are variable in employment and factor prices are given (i.e., the level of total cost corresponding to the tangency between an isoquant and isocost).

Long-run Average Cost (LAC): Per-unit costs for all levels of output = LTC/Q

The shape of a firm's long-run average cost (LAC) is determined by economies or diseconomies of scale as follows:

Economies of scale: reductions in per-unit costs (i.e., LAC) as output expands -- due to increasing returns to scale or other market factors. This implies that the rate of change in output is proportionately greater than the rate of change in long-run total cost (LTC).

Diseconomies of scale: increases in per-unit costs (LAC) as output expands -- resulting from decreasing returns to scale or other market factors. This implies that the rate of change in output is proportionately less that the rate of change in LTC.

***Note: If a firm is experiencing Constant Returns to Scale, there is no change in per-unit costs as output changes (i.e., LAC is constant as output increases). In this case, the proportionate changes in output and LTC are the same.**

Summary Sheet 8: Profit Analysis

PROFIT MAXIMIZATION

Profit maximization is the presumed goal of firms in a market economy. Firms attempt to maximize profits by choosing the correct (optimum) output level. If a firm is unable to earn a positive economic profit, it will attempt to **minimize losses** in the short run. With the exception of the shut-down case, the operating rules for short-run loss minimization are identical those for profit maximization. In practice, businesses often consider the trade-offs between making as much profit as possible against other goals, such as building market share, being popular with staff and enjoying life.

Firm's basic objective: Determine the level of output which maximizes total profit (or, if positive profits are not possible, minimizes total losses); that is,

$$\textit{(1)} \qquad \begin{aligned} &\textit{maximize } \Pi = TR - TC \\ &= Pxq - (TFC + TVC) \end{aligned}$$

$$\textit{(1a)} \qquad \textit{minimize } -\Pi = -(TR - TC)$$

The profit-maximizing (or equilibrium) level of output, q*, occurs when the profit function is maximized (or the loss function is minimized) with respect to q:

$$\max \Pi(q) = TR(q) - TC(q) \ \Rightarrow \frac{d\Pi}{dq} = 0 \ \therefore \left(\frac{dTR}{dq}\right) - \left(\frac{dTC}{dq}\right) = 0$$

$$\Rightarrow MR - MC = 0 \ \therefore \ MR = MC$$

i.e., where marginal cost = marginal revenue

If $\Pi < 0$, then q^* represents the **loss-minimizing** level of output.

Economists also distinguish between **normal profit** and **excess profit**.

- **(Π = 0) Normal profit** covers the opportunity cost of the entrepreneur, the amount of profit just sufficient to keep the firm in business. If profit is any lower than that, then enterprise would be better off engaged in some alternative economic activity.
- **(Π > 0) Excess profit**, also known as **economic rent**, is profit above normal profit and is usually evidence that the firm enjoys some market that allows it to be more profitable than it would be in a market with perfect competition.

The above relationships are applicable as long as the firm is NOT subject to the (short-run) **shut-down rule**: The firm sets q = 0 in the short run if,

$$TR < TVC \ for\ all\ levels\ of\ output \ (P < AVC)$$

$$if\ q = 0, \Pi = 0 - TFC = -TFC$$
$$(since\ TR = \$0\ and\ TVC = \$0)$$

Other profit definitions:

Average Profit (per-unit profit) is defined as $A\Pi = (P - ATC)$

therefore, profit can also be defined as, $\boldsymbol{\Pi = A\Pi \times q = (P - ATC) \times q}$

Alternative to Profit-max: Break-even Analysis

Standard assumptions:

a. firm faces a given (constant) price
b. total cost function is linear

The break-even level of output is defined as,

$$q_{b/e} = \frac{TFC}{(P - AVC)}, where\ (P - AVC) is\ the\ contribution\ margin$$

With a target level of profit ($T), the break-even level can be defined as,

$$q_{b/e} = \frac{(TFC + T)}{(P - AVC)}$$

SUMMARY SHEET 9: MARKET STRUCTURE

MARKET STRUCTURE
Economists have identified several factors that describe how buyers and sellers interact within markets, three of which are **competition, market power, and concentration**.

MARKET COMPETITION
The more competitive a market structure, the less influence individual economic agents (firms, consumers) have over market outcomes such as price. In general, as the number of economic agents increases (e.g., number of firms), there is greater potential for competition in that market.

MARKET POWER
When one buyer or seller in a market has the ability to exert influence over the quantity of goods and services traded or the market price at which they are sold. Market power does not exist in perfect competition, but it does when there is a monopoly or oligopoly.

MARKET CONCENTRATION
As a percentage of total market output, the greater the proportion that is controlled by a smaller number of firms, the greater the degree of market concentration that is present.

Summary Sheet 10: Perfect Competition

INDUSTRY (MARKET) CHARACTERISTICS:

1. large number of sellers
2. homogeneous product
3. firms are "price takers"
4. perfect mobility of resources (free entry and exit)
5. no nonprice competition
6. perfect knowledge

Short Run Operation

1. if P > AVC, each firm will produce at output level where MR = MC
2. if P < AVC, the firm will shut down (i.e., set q=0)
3. the individual firm's supply curve is the MC curve above AVC
4. industry supply is the horizontal sum of individual firms' supply curves

Long Run Outcomes

1. For each firm, P = MC = ATC in industry due to free entry and exit:
   .
   -- if P > ATC, new firms enter the industry
   -- if P < ATC, firms leave the industry

2. The shape of the long run industry supply curve is independent of that of firms -- due to the effects of entry and exit. Three possibilities:
   a. increasing costs -- upward sloping
   b. constant costs -- horizontal
   c. decreasing costs -- downward sloping (rare)

GENERAL CONCLUSIONS:

1. marginal cost pricing in short and long run
2. price converges with average cost in the long run; hence, zero economic profit
3. firms may make profits or losses in the short run
4. each firm produces most efficient output level (where LAC is min) in the long run

Summary Sheet 11: Monopoly

CHARACTERISTICS:

1. a single firm produces the entire industry output
2. price searching behavior, thus changing output requires a change in price
3. barriers to entry
   a. technological (economies of scale)
   b. institutional (license, patents, etc.)
4. no close substitutes for the product or service
5. goodwill advertising

RESULTS:

1. Firm's demand is industry demand
2. Price is above MR (MR < P) at all positive levels of output
3. Firm sets price where P > MC in both short run and long run
4. There is no supply curve
5. There are usually long-run economic profits -- since other firms are barred from competing
6. Firm may be technologically inefficient -- since inefficiency will not necessarily drive the firm out of business

Revenue Functions and Elasticity for Price-searching firms:

$$given, q = a - bP \;\; \Rightarrow AR: P = \left(\frac{a}{b}\right) - \left(\frac{1}{b}\right)q$$

$$TR = P \times q; \;\therefore TR = \left(\left(\frac{a}{b}\right) - \left(\frac{1}{b}\right)q\right) \times q = \left(\left(\frac{a}{b}\right)q - \left(\frac{1}{b}\right)q^{2}\right);$$

$$MR = \frac{dTR}{dq} = \left(\frac{a}{b}\right) - \left(\frac{2}{b}\right)q$$

For a linear demand function,

$$|e_P| = \left|\frac{dQ}{dP} \times \left(\frac{P}{Q}\right)\right| = \left|-b \times \left(\frac{P}{Q}\right)\right|; \;\; e_P = -b \times \left(\frac{P}{Q}\right)$$

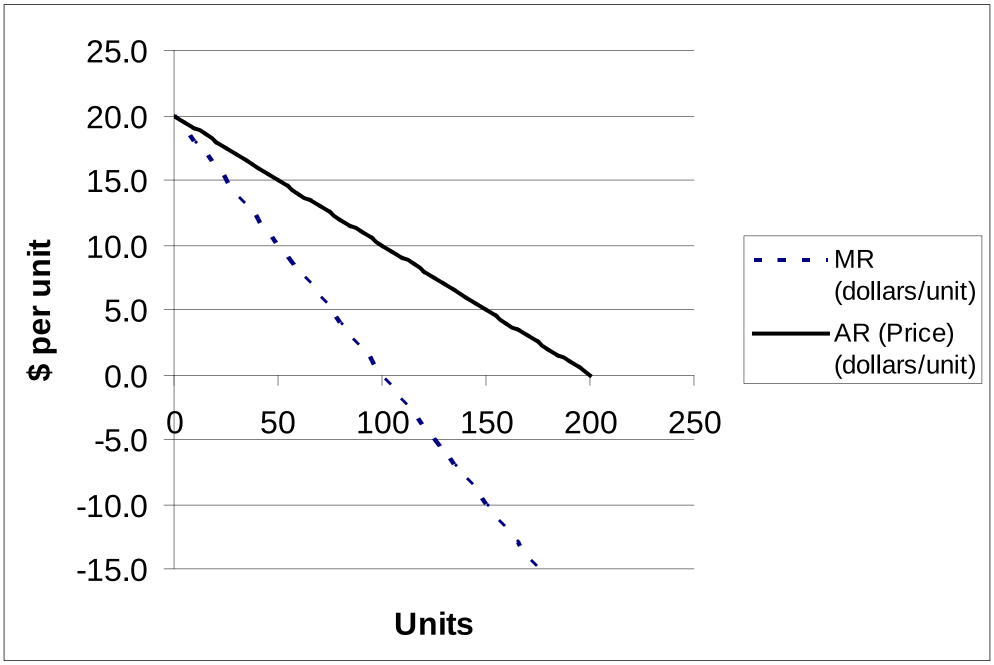
MR can also be expressed in terms of price elasticity as:

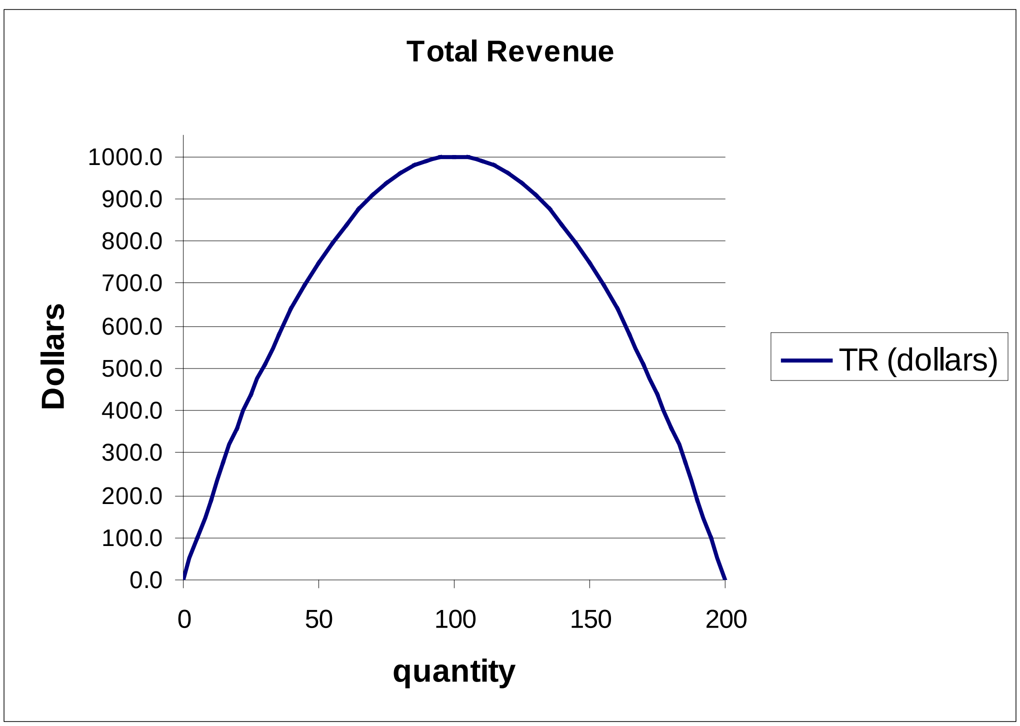
$$\boldsymbol{MR = P\left(1 - \frac{1}{|e_P|}\right) = P\left(1 + \frac{1}{e_p}\right)}$$

$$Example:\ given,\ Q = 200 - 10P \quad \Rightarrow \quad AR: P = 20 - 0.1Q$$

$$TR = 20Q - 0.1Q^2 \qquad MR = \frac{dTR}{dQ} = 20 - 0.2Q$$

Graphs:





Summary Sheet 12: Alternate Pricing Policies in Non-competitive Markets

Assume a linear total cost curve (TC = α + ßq). Therefore, AVC = MC = ß.

Gross margin (GM):

$$GM = \frac{selling\ \ price - \ purchase\ \cos t}{selling\ \ price}$$
$$= \frac{P - AVC}{P} \quad = \quad \frac{P - MC}{P}$$

Profit markup over cost (MU):

$$MU = \frac{selling\ \ price - \ purchase\ \cos t}{purchase\ \cos t}$$
$$= \frac{P - AVC}{AVC} \quad = \quad \frac{P - MC}{MC}$$

If the firm attempts to maximize profits (i.e., MC = MR), then GM and MU can also be expressed as:

$$Given\ \ MR = P\left(1 + \frac{1}{e_P}\right) = P + \frac{P}{e_P}, \quad profit - \max \quad (q^*) \Rightarrow MC = MR \ \Rightarrow MC = P + \frac{P}{e_P}$$

$$\therefore \quad GM = \quad \frac{P - MC}{P} \quad = \frac{P - \left[P + \frac{P}{e_P}\right]}{P} = -\left(\frac{1}{e_P}\right) \ and,$$

$$MU = \frac{P - MC}{MC} \ = \frac{P - \left[P + \frac{P}{e_P}\right]}{\left[P + \frac{P}{e_P}\right]} = \frac{-\left(\frac{1}{e_P}\right)}{1 + \frac{1}{e_P}} = \ -\left(\frac{1}{e_P + 1}\right)$$

$$note\colon e_p < 0$$

Summary Sheet 13: Price Discrimination

Price Discrimination: establishing price differences for similar or identical goods that are not reflected by incremental production cost differences between them.

Pre-conditions:

1. firm is a price searcher
2. firm can easily identify different market segments (i = 1, 2,...,n)
3. different segments have differing price elasticities of demand
4. market must be "sealed"

Note: TC and MC are functions of total output Q (across all segments); MR is a function of the output in <u>each</u> segment i.

If there are n market segments (i = 1, 2,...,n), the equilibrium (π-max) result implies:

$$MR_1 = MR_2 = ... = MR_n = MC$$

For example, with 2 market segments,

$$MR_1 = P_1(1+\frac{1}{e_p^1}); \; MR_2 = P_2(1+\frac{1}{e_p^2})$$

$$\Pi\text{ - max} \Rightarrow \quad MC = MR \Rightarrow MC = P_1(1+\frac{1}{e_p^1}) = P_2(1+\frac{1}{e_p^2})$$

$$\therefore \; MC = P_i(1+\frac{1}{e_p^i})$$

Summary Sheet 14: Oligopoly

A. Market characteristics

1. few large firms - each firm is aware of its rivals
2. barriers to entry and exit
3. product type
    a. identical - pure oligopoly
    b. differentiated - differentiated oligopoly
4. mutual interdependence in pricing policies
5. price searchers

MARKET CONCENTRATION
The portion of industry output that is controlled by the largest firms in the market. Market concentration can be measured by:

a. the *n-firm* **concentration ratio (CR_N) =** $\sum_1^n S_i$

$$\textit{where } S_i = \textit{market share } (\%) \textit{ of the ith firm} = \frac{q_i}{Q^{MKT}}$$

b. the **Herfindahl–Hirschman Index, (HHI) =** $10,000 \times \sum_1^n S_i^2$

$$\textit{where } n = \textit{number of firms}$$

Summary Sheet 15: Models of Oligopoly Outcomes

1. Dominant-firm Price Leadership Oligopoly Outcome:

Assume: 1 dominant firm -- i.e., the "leader" (L); and numerous other firms -- i.e., the "competitive fringe" (cf).

Let, $D_I = Q_D^I$ = industry demand function;
S_F = supply function for competitive fringe;
D_L = leader's demand function.

$$D_L(P) = D_I(P) - S_f(P)$$
$$\Pi\text{-max } \textit{for leader} \Rightarrow MR_L = MC_L;\ P = P_L;\ q = q_L$$
$$cf\ output:\ q_f = Q - q_L$$
$$where\ Q = industry\ quantity\ demanded\ at\ P_L$$

2. Cournot-Nash equilibrium for an oligopoly:

Given a market demand curve represented by $Q_d = a - bP$, the Cournot-Nash duopoly (2-firm) outcome can be expressed as follows:

If there are n firms in a Cournot oligopoly industry, and all costs are "sunk" (i.e., MC = 0), the equilibrium output for each firm (firm i; i = 1,...,n) is equal to:

$$q_1 = q_2 = \ldots = q_n = \frac{1}{n+1} \times a$$
$$where\ a = industry\ output\ under\ perfect\ competition.$$

$$Q_{ind} = \left(\frac{n}{n+1}\right) \times a$$

$$Alternatively,\quad if\ MC > 0,$$
$$TC_1 = \alpha_1 + \beta_1 q_1 \quad TC_2 = \alpha_2 + \beta_2 q_2 \quad \Rightarrow MC_1 = \beta_1 \quad MC_2 = \beta_2$$
$$and,$$
$$Q = a - bP; \quad P = \left(\frac{a}{b}\right) - \left(\frac{1}{b}\right)Q; \quad (Q = q_1 + q_2)$$

$$q_1^* = \frac{\left(\frac{a}{b}\right) - 2\beta_1 + \beta_2}{3\left(\frac{1}{b}\right)}; \qquad q_2^* = \frac{\left(\frac{a}{b}\right) - 2\beta_2 + \beta_1}{3\left(\frac{1}{b}\right)}$$

$$Note:\ if\ \beta_1 = \beta_2 = \beta, then\ q_1^* = q_2^* = \frac{\left(\left(\frac{a}{b}\right) - \beta\right)}{\left({}^{3}/_{b}\right)}$$

Summary Sheet 16: *Monopolistic Competition*

A. characteristics

1. Many small firms
2. Relatively free entry and exit
3. differentiated product
4. extensive non-price competition
5. limited price control (price searchers)

B. market behavior

1. small difference between P and MR (i.e., very elastic demand for firm's product)
2. in the short-run, firms can earn economic profits or losses
3. normal economic profits in LR for **typical** firm
4. excess capacity in LR for **typical** firm