

Vanguard University
School for Professional Studies
Degree Program

“BUSINESS MATH”
MATH #106

Student Guide

10/07
DS 01/10

COURSE DESCRIPTION

This course applies the principles and practices of mathematics to every day business problems and situations. The course prepares students to understand the mathematical and business concepts in number sets, problem solving, ratios and proportions, percentages, business measurements, insurance, simple and compound interest, installment loans, consumer credit, depreciation, graphing linear functions, and linear programming. The course includes a brief overview of number sense and algebra concepts in its overall design to introduce students to common mathematical skills necessary for courses in business. (meets Natural Science/Math requirement)

LEARNING OUTCOMES

At the conclusion of this class, students will learn to:

1. become more enlightened consumers and investors in working with several financial formulas that are used for borrowing and investing money,
2. understand mathematical principals involving business measurements, insurance, and depreciation,
3. use inductive and deductive reasoning to draw logical conclusions,
4. categorize and manipulate large quantities of data, providing the essential tools to organize, interpret and analyze such data,
5. experience how different variables can be brought together to make optimal solutions,
6. participate in a variety of mathematical topics and problem solving skills that relate to aspects of everyday life,
7. acquire a solid understanding of number sense and critical algebra concepts, and
8. develop and use critical thinking skills through finding solutions to real-world situations.
9. comprehend and manipulate problems in proportion, percentage and linear graphing exercises,

TEXTS AND MATERIALS

Required text and calculator:

*Tuttle, M.D. (2001). *Practical Business Math: An Applications Approach* (8th Edition). Upper Saddle River, New Jersey: Prentice Hall. ISBN: 0130256609.

There are two versions of this text – THE CLASS DOES NOT USE THE BRIEF EDITION – please do not purchase the Brief edition.

***Calculator** with basic mathematical functions (addition, subtraction, multiplication, division)

COURSE POLICIES

Disability Services:

For students with documented medical or psychological disabilities, please contact the Coordinator of Disability Services to request reasonable accommodations. The Coordinator of

Disability Services is located in the Counseling Center on the second floor of the Scott Academic Center and can be reached at extension 4489 or by email at disabilityservices@vanguard.edu

For students with a documented learning disability who would like to request appropriate accommodations, please contact the Director of Learning Skills, located upstairs in Scott Academic Center at extension 2540 or by email at disabilityservices@vanguard.edu

STUDENT EVALUATION

Students in this course will be evaluated by the University's 4.0 grading system. You should refer to the University's Student Handbook for further details on the grading system.

The following criteria will be used in determining the student's grade:

Assignment/Grading	Points	Date Due
Assignments/Homework	250 (25%)	Weeks 1-7
Attendance/Participation	100 (10%)	Weeks 1-7
Weekly Quizzes	150 (15%)	Weeks 2, 3, 5, 6
Mid-term Exam	250 (25%)	Week 4
Final Exam	250 (25%)	Week 7

TOTAL POINTS: 1000 points (100%)

Percentages	Points	Grade	Significance	GPA
93-100%	930-1000	A	Exceptional	4.00
90-92.9%	900-929	A-		3.67
87-89.9%	870-899	B+	Above Average	3.33
83-86.9%	830-869	B		3.00
80-82.9%	800-829	B-		2.67
77-79.9%	770-799	C+	Average	2.33
73-76.9%	730-769	C		2.00
70-72.9%	700-729	C-		1.67
67-69.9%	670-699	D+		1.33
63-66.9%	630-669	D	Below Average	1.00
60-62.9%	600-629	D-		0.67
00-59.9%	000-599	F	Failure	0.00

OVERVIEW

Assignments are listed in the weekly outline. Students are expected to read the listed definitions, terms, laws, formulas, theorems and/or properties in each of the required sections **before** coming to class. The text contains several "Challenge" questions and problems. When appropriate, students should attempt to understand and answer these on their own. If students have questions of any of these items, time will be given in class for discussion. Class time will provide opportunities to discuss in detail any questions that may arise from the reading or assignments. Completed assignments are due on the week that they are assigned. Each assignment will be graded and returned to the student.

DESCRIPTION OF ASSIGNMENTS AND POLICIES

ASSIGNMENTS/HOMEWORK: Students must read through each specified assignment and complete the assigned problems prior to the start of each class. Students will be graded both on accuracy and completion of each assignment. All homework assignments must be done in *“pencil”* only. Some homework assignments require students to do **“2 skip 2”** problems, which means that they must do the first two problems, then skip the next two problems, do the next two, skip the next two, etc. This pattern allows students to check the solutions of each odd-numbered problem in the back of the text, followed by an even-numbered problem. For a reference, a list of **“2 skip 2”** problems (from 1 to 98) includes the following numbers: #1-2, 5-6, 9-10, 13-14, 17-18, 21-22, 25-26, 29-30, 33-34, 37-38, 41-42, 45-46, 49-50, 53-54, 57-58, 61-62, 65-66, 69-70, 73-74, 77-78, 81-82, 85-86, 89-90, 93-94, and 97-98. Homework assignments will constitute *twenty-five* percent of the overall course grade.

WEEKLY QUIZZES: Regular review of mathematical, logical, and business concepts is critical in the development and understanding of the subject matter. Chapter or sectional quizzes will be given throughout the course. Weekly quizzes will constitute *fifteen* percent of the student’s overall course grade.

MID-TERM EXAM: A mid-term exam will be given during the fourth class session. The midterm exam will constitute *twenty-five* percent of the student’s overall course grade.

FINAL EXAM: Students will take a *comprehensive* final exam during their last class session. The final exam will constitute *twenty-five* percent of the student’s overall course grade.

ATTENDANCE AND TARDY POLICY

You must attend class on time and remain present until dismissed. Class attendance is necessary in order to complete the course. The School for Professional Studies relies on the dynamics of class interaction and group processing in order to integrate and apply the learning of academic content. This model also emphasizes the development and practice of interpersonal communication skills and teamwork (e.g., group problem solving and negotiation). The format therefore necessitates class attendance. In practical terms, one course session is equivalent to three weeks of traditional semester course work.

Students who miss two class meetings (or more than five class hours) in any given course will automatically receive a failing grade and need to retake the course to obtain a passing grade. If an instructor deems that a student’s second absence was under extremely unavoidable and unusual circumstances (i.e., an auto accident), the professor may file an academic petition on behalf of the student to the Director of SPS. If the academic petition is approved, the instructor may give the student a “W” (withdrawal) grade in place of a failing grade. The student will still be required to retake the course.

Students who arrive late disturb the class. At the professor’s discretion, students who arrive late may not receive participation points for the unit covered. Students who are habitually late may be asked to drop the course.

CLASS PARTICIPATION

You must be prepared and participate in all discussions. Criterion: Is the student engaged in classroom discussions? Does the student demonstrate an ability to handle assigned material with a degree of proficiency? (E.g., demonstrate the type of questions and issues consistent, and reflecting a familiarity with the assigned material). Participation evaluated according to quality, not quantity, of participation. Attendance will be scored, and no participation points will be awarded if the student is absent.

SUBMISSION OF PAPERS/FINAL EXAMS

The School for Professional Studies office does not assume responsibility for any final papers. No homework or final papers will be accepted for professors in the SPS office, nor will final papers be returned to students through the SPS office.

The method for the submission of homework and the final exam or final paper will be determined by the professor. The professor will discuss the method which will be employed during the first night of class. All exchanges of papers will be between the student and the professor.

LATE PAPER POLICY

You are responsible for submitting assignments on time (by 6:00 pm). Unless authorized by the Professor in advance, no credit will be given for assignments not turned in when due. It is the student's responsibility to insure all assignments are received by the professor; sending an email is not confirmation of an email received.

ACADEMIC DISHONESTY

Work submitted for assessment purposes must be the independent work of the student concerned. Plagiarism, or copying and use of another's work without proper acknowledgment, is not permitted. Nor is it permissible for any former or present student to allow another student to refer to, use as a sample, or in any way copy or review their work. Any student who commits plagiarism or is a knowing party to plagiarism in this class will receive a failing grade for the course. If a student needs guidance, he or she must seek the Professor's assistance.

LOGISTICS CHART

Week	Hour 1	Hour 2	Hour 3	Hour 4
1	Introductions Course expectations <i>Review:</i> Preliminary Skills Assessment Exam	<u><i>Chapter 7</i></u> OBJECTIVE 7.1 through OBJECTIVE 7.3	<i>BREAK</i> OBJECTIVE 7.4 through OBJECTIVE 7.5	OBJECTIVE 7.6 OBJECTIVE 7.7
2	Correct and review Chapter 7 QUIZ #1 Chapter Seven	<u><i>Chapter 9 & 10</i></u> OBJECTIVE 9.1 through OBJECTIVE 9.2	<i>BREAK</i> OBJECTIVE 9.3 OBJECTIVE 9.4	OBJECTIVE 10.1 through OBJECTIVE 10.2 OBJECTIVE 10.3
3	Correct and review Chapter 9 & 10 QUIZ #2 Chapter 9 & 10	<u><i>Chapter 13</i></u> OBJECTIVE 13.1 through OBJECTIVE 13.2	<i>BREAK</i> OBJECTIVE 13.3 OBJECTIVE 13.4	OBJECTIVE 13.5
4	Correct and review Chapter 13 MID-TERM EXAM	<u><i>Chapter 14</i></u> OBJECTIVE 14.1	<i>BREAK</i> OBJECTIVE 14.2	OBJECTIVE 14.3 OBJECTIVE 14.4
5	Correct and review Chapter 14 QUIZ #3 Chapter Fourteen	<u><i>Chapter 15</i></u> OBJECTIVE 15.1 through OBJECTIVE 15.3	<i>BREAK</i> OBJECTIVE 15.5 through OBJECTIVE 15.6	OBJECTIVE 15.7 *Break-Even Point Analysis
6	Correct and review Chapter 15 QUIZ #4 Chapter Fifteen	<u><i>Chapter 16</i></u> OBJECTIVE 16.1	<i>BREAK</i> OBJECTIVE 16.2a OBJECTIVE 16.2b	OBJECTIVE 16.3 *Contribution per Unit Analysis
7	Correct and review Chapter 16 hmwk. Review: CHAPTER 7	Review: CHAPTER 9 & 10 Review: CHAPTER 13-14	<i>BREAK</i> Review: CHAPTER 15-16 FINAL EXAM	FINAL EXAM

WEEK ONE: -----STUDENT ASSIGNMENTS-----

ASSIGNMENT: DUE CLASS SESSION #1. Complete each of the problems (#1-33 all) on the following *Preliminary Skills Assessment assignment* **prior** to coming to the first class session (Week 1). Complete the problems on a separate sheet of paper. Since this review is an assessment exercise, please attempt each problem on your own without help from any outside source or person. These problems will be reviewed and discussed during the first class session.

DO NOT work any of the problems from the following individual sections identified below – **work only the *Preliminary Skills Assessment* problems (#1-33)** assigned for the first class session (the Assessment assignment is located on the following pages of this guide).

Week One In-Class:

Review Preliminary Skills Assessment

Discuss Chapter 7

Objectives 7.1-7.3 What Percent Means, pages 128-129

Percent to a fraction; Percent to a decimal; Decimal to a fraction; Decimal to a percent; Fractional percent

In-Class Work: page 129: Exercise A (#1-5), Exercise B (#1-5), and Exercise C (#1-5)

Objectives 7.4-7.5 Percent Problems, pages 130-131

Base, Rate, and Amount; The formulas; The model

Objective 7.6 a Solving for the Unknown, pages 131-133

Four steps in problem solving; Finding what is missing; Finding what is unnecessary; Solving a problem by making lists; Solving a problem by using diagrams; Solving problems with more than one solution

In-Class Work: page 132: Exercise D (#1-10)

Objective 7.6 b Four-Step Process, pages 133-134

Identify the factors; Select the formulas; Substitute the values for the factors; Complete the fundamental process called for in the problem

In-Class Work: page 133: Exercise E (#1-6) and page 134: Exercise F (#1-6)

Objective 7.7 Increases and Decreases, pages 134-136

Finding the increase; Finding the decrease

In-Class Work: page 136: Exercise G (#1-10)

MATH 106 Preliminary Skills Assessment Basic Mathematics Review Assignment

Directions: Complete the following problems on a separate sheet of paper **prior** to the first class session. Since this review is an assessment exercise, please attempt each problem on your own without help from any outside source or person. DO NOT USE A CALCULATOR!

A. Symbols and Order of Operation

1.) $2 + 5 \times 7 = ?$

2.) $(2 + 5) \times 7 = ?$

3.) $3 \times 4 + 2 \times 5 = ?$

4.) $3 \times (4 + 2) \times 5 = ?$

5.) $4 + 2^2 - 1 = ?$

6.) $(4 + 2)^2 - 1 = ?$

7.) $12 \div 3 + 1 = ?$

8.) $12 \div (3 + 1) = ?$

Proportions, Fractions, Decimals, and Percentages

9.) Express $\frac{14}{80}$ as a decimal.

10.) Convert $\frac{14}{40}$ to a percentage.

11.) Convert 18% to a fraction.

12.) $\frac{4}{5} \times \frac{2}{3} = ?$

13.) $\frac{7}{12} \times \frac{5}{6} = ?$

14.) $\frac{1}{8} + \frac{4}{6} = ?$

15.) $7.833 + 0.67 = ?$

16.) A company reports that three-eighths of its employees are women. If there are 56 employees, how many are women?

Negative and Positive Numbers

17.) $5 \times (-4) = ?$

18.) $4 + (-2) - 5 - (-3) = ?$

19.) $-5 - (-4) = ?$

20.) $(-7) \times (-6) = ?$

21.) $-75 \div (-5) = ?$

22.) $-7 (5) (-1) = ?$

Basic Algebra and Equations

Solve for X.

$$23.) X + 7 = 13$$

$$24.) 11 = X + 3$$

$$25.) \frac{X}{4} = 36$$

$$26.) 3X - 6 = -18$$

$$27.) \frac{X + 3}{2} = 14$$

Exponents and Square Roots

$$28.) 4^3 = ?$$

$$29.) (-2)^4$$

$$30.) \text{If } a = 4 \text{ and } b = -2, \text{ then } a^2 b^3 = ?$$

$$31.) \frac{49}{\sqrt{49}} = ?$$

$$32.) \text{If } a = 9 \text{ and } b = 25, \text{ then } \sqrt{a + b} = ?$$

$$33.) (4 + 5)^2 - \sqrt{81} = ?$$

HINTS FOR MATH SUCCESS

1. *Mathematics is different from other subjects.*

One topic builds on another, and you need to make sure that you understand each topic before progressing to the next one.

2. *You must make a commitment to attend each class.*

Obviously, unforeseen circumstances can come up, but you must plan to attend class regularly. Pay attention to what your teacher says and does, and take notes. If you must miss class, write an outline of the text corresponding to the missed material, including working out each text example on your notebook paper.

3. *You must make a commitment to daily work.*

Do not expect to save up and do your mathematics work once or twice a week. It will take a daily commitment on your part, and you will find mathematics difficult if you try to "get it done" in spurts. You could not expect to become proficient in tennis, soccer, or playing the piano by practicing once a week, and the same is true of mathematics. Try to schedule a regular time to study mathematics each day.

4. *You must read the text carefully.*

Many students expect to get through a mathematics course by beginning with the homework problems, then reading some examples, and reading the text only as a desperate attempt to find an answer. This procedure is backward; do your homework only *after* reading the text.

5. *You must ask questions.*

Learning mathematics may involve frustration. Do not put off asking questions when you don't understand something, or if you feel an anxiety attack coming. Stop and put this book aside for a while. Talk to your instructor or a fellow student.

Derived From *Mathematics: Its Power and Utility* by K.J. Smith, pp. 5-6

WEEK TWO: -----STUDENT ASSIGNMENTS-----

The following assignments indicated below are **DUE** for this class session (Week 2).

WEEK 2 HOMEWORK ASSIGNMENT: Pages 137-140

Chapter 7

1. Skill Problems: #1-55 (*ALL*)
2. Business Application Problems: #3-30 (*multiples of 3*) [3,6,9,12, etc.]

Quiz

3. Prepare for in-class quiz on homework sections due this week.

WEEK TWO IN-CLASS:

Quiz Week 2: Chapter 7

This quiz will cover sections of the homework due this week.

Discuss Chapter Nine: Simple Interest *and* Chapter Ten: Promissory Notes

Objectives 9.1-9.2 What Interest Means/The Calendar, pages 161-166

Interest; Principal; Rate; Time; Calendar; Time calculation model; Computing time factor; Computing with leap year; Time tables

In-Class Work: pages 165-166: Exercise A (#1-5) and Exercise B (#1-5)

Objective 9.3 The Interest Formula, pages 166-168

Ordinary interest; Exact interest; Rate; Principal

In-Class Work: pages 167-168: Exercise C (#1-6) and Exercise D (#1-6)

Objective 9.4 Other Interest Problems, pages 168-169

Computing principal; Computing Rate; Computing Time

In-Class Work: page 169: Exercise E (#1-20)

Objectives 10.1-10.2 Legal Environment/Promissory Notes, pages 179-181

Legal Environment; Promissory note; Maker; Payee; Face value; Term of note; Maturity value; Noninterest-bearing note; Interest-bearing note

In-Class Work: page 181: Exercise A (#1-10)

Objective 10.3 Discounting, pages 181-185

Discount rate; Term of discount; Computing discount; Computing proceeds

In-Class Work: pages 183-185: Exercise B (#1-8) and Exercise C (#1-10)

WEEK THREE: -----STUDENT ASSIGNMENTS-----

The following assignments indicated below are **DUE** for this class session (Week 3).

WEEK 3 HOMEWORK ASSIGNMENT: Pages 171-191

Chapter 9 (pages 171-176)

1. Skill Problems: #1-58 (**2 skip 2**) [*i.e.*, 1-2, 5-6, 9-10, 13-14, *etc.*]
2. Business Application Problems: #3-24 (*multiples of 3*)

Chapter 10 (pages 187-191)

3. Skill Problems: #1-25 (**ALL**) and 42-50 (*even*)
4. Business Application Problems: #3-21 (*multiples of 3*)

Quiz

5. Prepare for in-class quiz on homework sections due this week.

WEEK THREE IN-CLASS:

Quiz Week 3: Chapters 9 and 10

This quiz will cover sections of the homework due this week.

Discuss Chapter Thirteen: Compound Interest and Present Value

Objective 13.1-13.2 Compound Interest, pages 235-240

Compound interest; Compound amount; Savings accounts; Interest charts

In-Class Work: page 240: Exercise A (#1-10)

Objective 13.3 Present Value, page 240-244

Present value; Compound interest and present value model; Present value charts

In-Class Work: page 244: Exercise B (#1-10)

Objective 13.4 Annuities, pages 244-250

Annuity; Ordinary annuity; Annuity due; Growth of an annuity; Ordinary annuity table rate per-interest-period chart

In-Class Work: page 250: Exercise C (#1-10)

Objective 13.5 Sinking Funds, pages 250-251

Sinking funds; future amount desired; interest rate; frequency that the investment is to be compounded; length of time before the desired amount is required

In-Class Work: page 251: Exercise D (#1-10)

WEEK FOUR: ----STUDENT ASSIGNMENTS-----

The following assignments indicated below are **DUE** for this class session (Week 4).

WEEK 4 HOMEWORK ASSIGNMENT: Pages 255-259

Chapter 13

1. Skill Problems: #1-45 (ALL) and 49-82 (2 skip 2)* [i.e., 49-50, 53-54, etc.]
2. Business Application Problems: #3-21 (multiples of 3)

Midterm Exam

3. Prepare for in-class midterm exam on chapters 7, 9, 10, and 13.

Suggested Mid-Term Review Exercises (Optional): Ch. 7 Mastery Test, page 141 (#1-15); Ch. 9 Mastery Test, page 177 (#1-12); Ch. 10 Mastery Test, page 193 (#1-11); Ch. 13 Mastery Test, page 261 (#1-10)

WEEK FOUR IN-CLASS:

Mid-Term Exam on chapters 7, 9, 10, and 13

Discuss Chapter Fourteen: Discounts

Quiz #3: Chapter 14

This quiz will cover sections of the homework due this week (see assignments below).

Objective 14.1 Trade Discounts and Direct Method, pages 263-265

Trade discounts; List price; Selling price; Finding the selling price; Series of trade discounts; Direct method

In-Class Work: page 265: Exercise A (#1-10)

Objective 14.2 Equivalent Trade Discount, page 266

In-Class Work: page 266: Exercise B (#1-10)

Objective 14.3(a) Cash Discount, pages 266-269

Cash discounts; Terms of trade; Finding the net price

In-Class Work: page 268-269: Exercise C (#1-10)

Objective 14.3(b) End of the Month & Receipt of Goods, pages 269-270

End of the Month (E.O.M.) stipulation; Receipt of Goods (R.O.G.) stipulation

In-Class Work: page 269: Exercise D (#1-10) **and** page 270: Exercise E (#1-10)

Objective 14.3(c) Combination of Cash and Trade Discounts, pages 270-271

In-Class Work: page 271: Exercise F (#1-5)

Objective 14.4 Transportation Charges, pages 271-275

Free on board (F.O.B.); F.O.B. destination; F.O.B. shipping point; F.O.B. cost comparison; Cash on delivery (C.O.D)

In-Class Work: page 274: Exercise G (#1-5) and Exercise H (#1-5)

WEEK FIVE: -----STUDENT ASSIGNMENTS-----

The following assignments indicated below are **DUE** for this class session (Week 5).

WEEK 5 HOMEWORK ASSIGNMENT: Pages 277-282

Chapter 14

1. Skill Problems: #1-62 (*2 skip 2*)* [i.e., 1-2, 5-6, 9-10, 13-14, 17-18, etc.]
2. Business Application Problems: #3-24 (*multiples of 3*)

Quiz

3. Prepare for in-class quiz on homework sections due this week.

* **Note:** “2 skip 2” means to do problems #1-2, 5-6, 9-10, 13-14, 17-18, 21-22, 25-26, 29-30, 33-34, 37-38, 41-42, 45-46, 49-50, 53-54, 57-58, 61-62.

WEEK FIVE IN-CLASS:

Quiz Week 5: Chapter 14

This quiz will cover sections of the homework due this week.

Discuss Chapter Fifteen: Markup (Optional: Break-Even Point Analysis)

Objective 15.1 Markup on Cost, pages 285-288

Markup; Cost price; Selling price; Markup on sales

In-Class Work: page 287: Exercise A (#1-5), Exercise B (#1-5), and Exercise C (#1-10)

Objectives 15.2-15.3 Finding Cost, Sales, Markup, or Markdown, pp. 288-290

Finding the cost price and markup when the markup is on cost; Finding the cost price and markup when the markup is on sales

In-Class Work: page 290: Exercise D (#1-15)

Objective 15.4 Markdown or Loss, pages 290-291

In-Class Work: page 291: Exercise E (#1-8)

Objectives 15.5-15.6 Conversion of Markup Rate, pages 291-292

In-Class Work: page 292: Exercise F (#1-10)

Objective 15.7 Catalog Pricing, pages 292-294

List price; Cost price; markup; selling price; Additional trade price

In-Class Work: page 293-294: Exercise G (#1-10) and Exercise H (#1-5)

OPTIONAL:

Break-Even Analysis

In-Class Work: Review and discuss various examples, explanations, and exercises regarding *Break-Even Point Analysis*.

Break-Even Point Analysis

Owners and managers need to be familiar with tools and techniques that aid them in making short-term and long-term decisions. One good tool that helps in making decisions is known as **Cost-Volume-Profit Relationships**.

Cost-Volume-Profit Analysis deals with how costs and profits change with a change in volume. It analyzes the effects on profits of changes in such factors as variable costs, fixed costs, selling prices, volume, and the mix of products sold.

Break-Even Analysis, one of the tools of Cost-Volume-Profit Analysis, determines the break-even sales which is the units and/or sales dollars where total sales equals total costs (expenses).

Some examples of decisions where Cost-Volume-Profit analysis can provide help are:

- What price(s) should we charge for our products or services?
- How many units of a product should we produce?
- Should we spend more on advertising?
- Should we add or delete a product line?
- Should we accept or decline a special order?
- What sales mix (different products) should we strive for?
- What is the effect of a change to a different raw material supplier?
- Should we increase or decrease our work force?
- How should we make our products?

Break-even Analysis lets you know when you are making money and that suggests ways to make more. Break-even analysis is another accounting tool developed by business owners to help plan and control the business operations.

The Break-Even Point

The break-even point is the point at which the income from sales will cover all costs with no profits. The business owner or manager usually considers several factors when studying break-even analysis:

- The capital structure of the company.
- Fixed expenses such as rent, insurance, heat, and light.
- Setup of the organization.
- Variable expenses.
- The inventory, personnel, and space required to operate properly.

The study of these factors will inform the business owner of the possibilities of lowering the break-even point and increasing the gross profit margins. When attempting to determine the prospect of success for a new operation, the analysis of the break-even point may indicate the advantages or disadvantages in modifying the proposed level of operation.

Break-Even Analysis

The break-even point informs the business owner of the level of sales at which the business will realize neither a profit nor a loss. It can be expressed in numbers or by the use of graphs. To arrive at the break-even point using either method, we need to calculate the projected and fixed manufacturing, selling, and administrative expenses, and the expected ratios of sales for each category of expenses.

Types of Costs

To fully understand break-even formulas, it is important to know that different types of costs exist.

The *total fixed cost* is the sum of all costs that do not change regardless of the level of sales. Rent and executive salaries are two examples. The *total variable cost*, on the other hand, is the sum of all the expenses that fluctuate directly with the level of activity or sales. Cost of materials to produce a product or purchases of items for resale are two variable costs.

The *average fixed cost* is the figure obtained by dividing the total fixed cost by the number of units (covers, meals, etc.) produced. The *average variable cost* is obtained by dividing the total variable cost by the quantity produced. The *average cost* is calculated by dividing the total cost by the number of units produced.

Break-Even Point Formulas

To determine the break-even point, we should use the following formula: Sales (S) *equals* Fixed Expenses (FE) *plus* Variable Expenses (VE).

It is a usual business policy to evaluate expenses as a percentage of sales. We will use this method when determining the break-even point. For example, if the fixed costs are \$100,000 and variable expenses equals 50 percent of the sales of a specific store, the break-even point is computed as follows:

$$\begin{aligned} S &= \$100,000 + 0.5S \\ -0.5S + S &= \$100,000 \\ 0.5S &= \$100,000 \\ S &= \$200,000 \end{aligned}$$

To prove the result, we can substitute the figures for the letters in the equation.

At this point, it is easy to see how the break-even analysis can be used to determine the level of sales required to realize a certain amount of net income. The formula used will be Sales (S) *equals* Fixed Expenses (FE) *plus* Variable Expenses *plus* Net Income (I). Using the formula above, we can easily determine the level of sales that will produce a net income of \$40,000.

$$\begin{aligned} S &= \$100,000 + .05S + \$40,000 \\ -0.5S + S &= \$100,000 + \$40,000 \\ 0.5S &= \$140,000 \\ S &= \$280,000 \end{aligned}$$

Restaurants and fast-food chains will often want to express their break-even point by the number of portions sold. This is fairly easy to compute. Here, the break-even point is determined by applying the following formula: break-even point (in units) *equals* Total Fixed Cost divided by (selling price per unit *minus* variable cost per unit).

If the selling price of a steak is \$1.20, the total fixed cost is \$30,000, and the variable cost per unit is 80 cents, how many units must be sold to break-even?

If we apply the formula, the break-even point is

$$\frac{30,000}{\$1.20 - 0.80} = \frac{30,000}{0.40} = 75,000 \text{ units}$$

Using this formula, we can compare different sale prices. The break-even point for each price will be calculated and an analysis of the results will determine how reasonable they are and which is to be used when forecasting and budgeting.

Another possibility that the break-even point offers is for a study of the relation between the revenue and cost. A chart can be drawn showing the total revenue and cost at different levels of production when selling a hamburger or a drink at a specified price.

Graphing the Break-Even Point

Break-even point can also be indicated by graphing. Figure 1 below is a sample graph for a business. To draw the graph, we should follow these steps:

Number of units produced is marked along the horizontal axis and the total revenue expressed in dollars is set on the vertical axis.

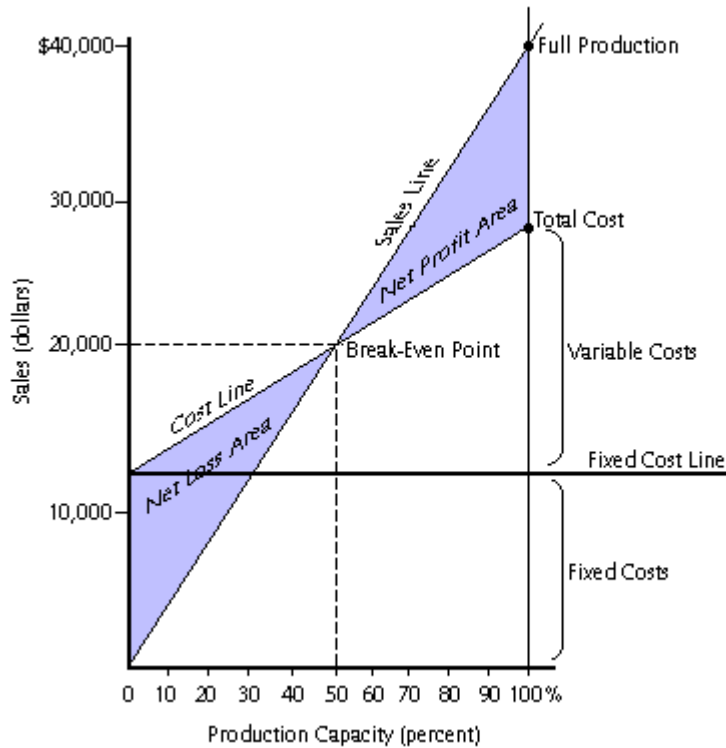
The sales line is drawn to indicate the sales at each level of production.

A horizontal line is drawn at the \$12,000 level of sales to represent the fixed costs for our sample business.

A total cost line is drawn from the point of intersection of the fixed cost line and the vertical axis to the point of total costs as full capacity --\$28,000.

The intersection of the total cost line with the sales line represents the break-even point, in this case \$20,000. The dotted lines represent the level of production and the total costs at this level of operation.

Areas of net loss and of net profit are marked.



**Figure 1
A Break-Even
Graph**

The break-even point graph helps the business owner determine the levels of production that will create profits for every level of sales. The business owner then

works to increase profits without investing extra funds. To do this, he/she should study the following important points:

1. A possible increase in utilization of existing capacity through reduction of idle time.
2. Better repair and maintenance of equipment to reduce down time --time elapsed from the moment the machine breaks down to the time it gets back in service.
3. Improved working schedules and inventory levels.
4. Longer business hours.
5. Improved production control.
6. Markup policy.

Markup Policy

Another item to study when considering ways to improve profit without increasing investment is the company's markup policy. Markup is the amount above cost that the business charges for an item. Too many business owners believe that the only way to larger profits is through

higher markups. As a result, they tend to use either a fixed percentage of cost markup or some vague and arbitrary "rule of thumb" which multiples costs by some mystical figure in the manager's head to arrive at the selling price.

Actually, markup should be flexible. Break-even analysis allows studies to be made of volumes of sales at various price levels. It is often discovered that a lower markup will produce a higher volume of sales and increased profits.

If a customer feels costs are too high he/she will take their business elsewhere. Reduced turnover means slow sales. It also means that the business owner may have to raise prices to cover its inventory investment. This will drive more customers away.

An appreciation of the meanings of break-even analysis can prevent such a vicious cycle from even starting.

Figure 2 illustrates the point. Assume that a restaurant is presently operating at 6,000 meals per week; present profit is expressed by line P_1P_1 and is about \$2,000. We feel we can increase business to 7,500 meals per week by reducing price 10 percent. A new sales line S_2S_2 would have to be drawn. Profit would be increased considerably; new profit is represented by line P_2P_2 . We were able to increase our profit because costs rose at a lesser rate than sales rose.

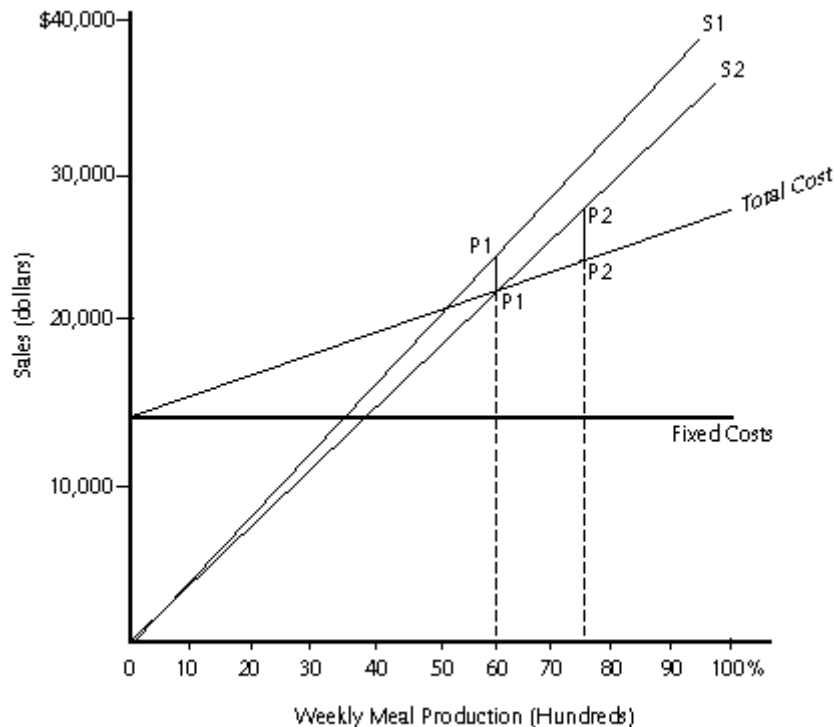


Figure 2. A Practical Application of Break-Even Analysis.

From Beancounter.com and Bizbound.com

WEEK SIX: -----STUDENT ASSIGNMENTS-----

The following assignments indicated below are **DUE** for this class session (Week 6).

WEEK 6 HOMEWORK ASSIGNMENT: Pages 295-300

Chapter 15

1. Skill Problems: #1-94 (2 skip 2)* [i.e., 1-2, 5-6, 9-10, 13-14, 17-18, etc.]
2. Business Application Problems: #3-24 (multiples of 3)

Quiz

3. Prepare for in-class quiz on homework sections due this week.

WEEK SIX IN-CLASS:

Quiz Week 6: Chapter 15

This quiz will cover sections of the homework due this week.

Discuss Chapter Sixteen: Inventory and Turnover (Optional: Contribution / Unit)

Lesson 16.1 Inventory Methods and Valuation, pages 303-310

Beginning inventory; Purchases; Goods available for sale; Ending inventory; Cost of goods sold; Inventory valuation; Last in-first out (L.I.F.O.); First in-first out (F.I.F.O.); First in-still there (F.I.ST.)

In-Class Work: page 310: Exercise A (#1-4)

Lesson 16.2(a) Average Cost, pages 310-312

In-Class Work: page 311-312: Exercise B (#1-4)

Lesson 16.2(b) Retail Inventory Estimating Method, pages 312-313

In-Class Work: page 313: Exercise C (#1-4)

Lesson 16.3 Turnover, pages 313-314

Specific Identification Method; Turnover; Sales at cost; Average inventory

In-Class Work: page 314: Exercise D (#1-5)

Contribution Per Unit Analysis

In-Class Work: On the previous *three* pages, review and discuss the various examples, explanations, and exercises regarding *Contribution Per Unit Analysis*.

OPTIONAL

Contribution

Contribution per unit is determined by:

- the variable costs
- the selling price

Contribution is revenue (selling price) less variable costs.

For each unit that we sell, if we subtract from the selling price unit the variable cost of that unit, what remains is the contribution that we make to the fixed cost.

If we sell a chair for \$300 and there is \$200 of material and labor that went into making it, then the contribution will be the difference of the selling price and that variable cost. That is what's left over to cover the fixed costs and ultimately to make a profit.

When we talk of contribution, we mean selling price *per unit*, less variable cost *per unit*.

On a per unit basis contribution is selling price (SP) less variable cost per unit (VC).

Contribution (C) = SP/unit - VC/unit

Increasing the **contribution per unit** will increase the chances of making profits overall.

Total contribution is found by multiplying contribution per unit by quantity. Contribution provides a quick way of calculating profit.

Example:

Use the following information to determine the unit contribution margin:

- Sells cartoon watches that have a cost of \$10.00 (variable cost-expense)
- All unsold watches may be returned to the supplier
- Booth rental costs \$ 100.00 for the day (fixed costexpense)
- Selling price of the watches is \$20.00

Contribution Margin Method

The **Unit** Contribution Margin is the difference between your product's unit selling price and its unit variable cost.

Unit Contribution Margin = Unit Sales Price - Unit Variable Cost

Unit Contribution Margin (watches) = \$20.00 - \$10.00

Unit Contribution Margin = \$10.00

Breakeven Point = (Fixed Expenses + Desired Profit) / Unit Contribution Margin

Let X = Number of units (watches) that need to be sold to break even

X = (\$100.00 + 0) / \$10.00

Look at the highlighted line in the Basic Breakeven Equation. It's the same as the line above. The contribution margin method is merely a shortcut version of the Basic Breakeven Equation Method.

$$X = 10 \text{ units (watches)}$$

You can use either method to calculate breakeven units and/or sales dollars. The choice is a matter of personal preference.

What if you want to see how many units you need to sell to not just breakeven but make a certain amount of profit? If you want to make a profit of \$200.00 from your sale of watches, all you need to do is include your desired amount of profit in your breakeven calculation.

$$\text{Breakeven Point} = (\text{Fixed Expenses} + \text{Desired Profit}) / \text{Unit Contribution Margin}$$

$$X = (\$100.00 + \$200.00) / \$10.00$$

$$X = \$300 / \$10.00$$

$$X = 30 \text{ units (watches)}$$

Let's do one more thing to check our calculation. We'll construct a simple profit and loss statement.

Sales of Watches	30 watches @ \$20.00	\$600.00
Cost of Watches	30 watches @ \$10.00	300.00
Booth Rental (Fixed Cost)		100.00
Profit		\$200.00

Sure enough, if we sell 30 watches, we'll make a profit of \$200.00.

The term contribution margin may be expressed as a total dollar amount, as an amount per unit (as the prior example), or as a percentage. In our last example

- Unit Contribution Margin is Unit Selling Price less Unit Variable Cost or \$20.00 – \$10.00 = \$10.00
- Total Contribution Margin is Units Sold multiplied by the Unit Contribution Margin 30 watches X \$10.00 = \$300.00
- Percentage Contribution Margin is the Unit Contribution Margin / Unit Selling Price or \$10.00 / \$20.00 = 50% or .50

Using our example where we wanted a profit of \$200.00 on our sale of watches, we can calculate the **Sales Dollars** needed with another variation of the Breakeven Equation.

Sales Dollars Needed = (Fixed Expenses + Desired Profit) / Contribution Margin Ratio

$$\text{Sales Dollars Needed} = (\$100.00 + \$200.00) / .50$$

$$\text{Sales Dollars Needed} = \$600.00$$

Break-even Volume in terms of Contribution per unit

The break-even volume of production (BE) is calculated by dividing the Fixed Costs (FC) by the Contribution per unit (C).

To calculate the break-even volume, we need to know the fixed cost, variable cost per unit and what price we are going to sell the unit at.

How are we going to find the number of units that we have to sell to breakeven, in other words to make enough just to cover our fixed costs and our variable cost?

The break-even volume is calculated by dividing the Fixed Cost (FC) by the Contribution per unit(C).

We have learned that contribution is selling price per unit less variable cost per unit. So if we take \$300 as the selling price(SP/unit), less \$200(VC/unit) as the variable cost, we then have \$100 Contribution (C) to pay for the fixed costs.

If we have \$100,000 of fixed costs (FC) and we are making \$100 dollars of contribution per chair, then we have to sell 1000 chairs in order to cover those costs. If we sell a thousand chairs, then we have just exactly broken even. If we sell 1001 chairs, then we are going to end up making \$100 of profit and every chair we sell after that is going to add \$100 to profit. The break-even volume in this case was 1000 units.

$$\mathbf{BE = FC/C \text{ or } BE = FC/(SP-VC)}$$

From *Smallbiz.uk.com*

WEEK SEVEN: -----STUDENT ASSIGNMENTS-----

The following assignments indicated below are **DUE** for this class session (Week 7).

WEEK 7 HOMEWORK ASSIGNMENT: Pages 315-320

Chapter 16

1. Skill Problems: #1-10, 13-18, 23-28, 35-40, 49-54, and 67-78 (ALL)
2. Business Application Problems: #3-18 (multiples of 3)

Quiz

3. Prepare for final exam.

Suggested Final Exam Review Exercises (Optional): Ch. 7 Mastery Test, page 141 (#1-15) ; Ch. 9 Mastery Test, page 177 (#1-12); Ch. 10 Mastery Test, page 193 (#1-11); Ch. 13 Mastery Test, page 261 (#1-10); Ch. 14 Mastery Test, pages 283-284 (#1-23); Ch. 15 Mastery Test, page 301 (#1-15); Ch. 16 Mastery Test, pages 321-322 (#1-14)

WEEK SEVEN IN-CLASS:

Review assignment due week 7 and review for final exam.

Final Exam (Chapters 7, 9, 10, 13, 14, 15, and 16)

The final exam will cover material from chapters 7, 9, 10, and 13-16. The final exam will constitute *twenty-five* percent of the student's overall course grade.