

MASTERING MANAGERIAL ACCOUNTING

Key Concepts through Problem Sets

By Christine Denison

MASTERING MANAGERIAL ACCOUNTING

Key Concepts through Problem Sets

First Edition

By Christine Denison
Iowa State University



Bassim Hamadeh, CEO and Publisher
Michael Simpson, Vice President of Acquisitions
Jamie Giganti, Managing Editor
Jess Busch, Senior Graphic Designer
Mark Combes, Acquisitions Editor
Luiz Ferreira, Licensing Specialist
Mandy Licata, Interior Designer

Copyright © 2015 by Cognella, Inc. All rights reserved. No part of this publication may be reprinted, reproduced, transmitted, or utilized in any form or by any electronic, mechanical, or other means, now known or hereafter invented, including photocopying, microfilming, and recording, or in any information retrieval system without the written permission of Cognella, Inc.

First published in the United States of America in 2015 by Cognella, Inc.

Trademark Notice: Product or corporate names may be trademarks or registered trademarks, and are used only for identification and explanation without intent to infringe.

Cover image: Copyright © 2011 Depositphotos Inc./Sandalise.

Printed in the United States of America

ISBN: 978-1-62661-118-4 (pbk) / 978-1-62661-119-1 (br)

Contents

INTRODUCTION	v
CHAPTER ONE	
<i>Review</i>	1
CHAPTER TWO	
<i>The Operating Budget</i>	45
CHAPTER THREE	
<i>Additional Budgeting Topics</i>	73
CHAPTER FOUR	
<i>Variance Analysis</i>	105
CHAPTER FIVE	
<i>Capital Budgeting under Uncertainty</i>	131
CHAPTER SIX	
<i>Joint Cost Allocation</i>	155
CHAPTER SEVEN	
<i>Service Department Allocation</i>	179

CHAPTER EIGHT	
<i>Process Costing</i>	213
CHAPTER NINE	
<i>Job Costing</i>	241
CHAPTER TEN	
<i>Normal Costing</i>	261
CHAPTER ELEVEN	
<i>Pricing</i>	287
CHAPTER TWELVE	
<i>Production under Constraints</i>	315
APPENDIX	
<i>Review Problems</i>	335

Introduction

Welcome to *Mastering Managerial Accounting*! This book is designed to help you learn more complex managerial accounting methods than those taught in introductory managerial accounting courses in a methodical, step-by-step manner. Each chapter is organized as follows:

Recommended Reading: On the title page of each chapter is a list of recommended readings from three different textbooks. To get a full picture of the topics taught in this book, placed in a complete business context, you should do the readings from one of these other textbooks.

The Theory: In each chapter, there are one to two pages of text on the theory behind the methods you will learn. This is a bare-bones summary of the theory and, along with the method section, is the very minimum you should read.

The Method: This section outlines the methods taught in each chapter in one to two pages.

Illustrative Example: This section walks through the methods outlined in the method section using a complete example.

Stop—Check! Problem: You should practice the methods for the first time using this problem, which allows you to check your work periodically as the problem progresses.

Lecture Exercises/Notes: This section includes exercises that may be used by your instructor during the lecture, and a space where you can take notes during the lecture.

Step-by-Step Exercises: These short exercises focus on each step in the method, one step at a time, so that you can build your skills gradually.

Complete Problems: These problems are complete problems, requiring you to use the methods in their entirety.

- Assignment Problem:** This problem may be assigned by your instructor as homework to be turned in or as an in-class exercise.
- Challenge Problem:** This problem is intended to be very complex. Students who want a challenge can try it—if you dare!
- Check Figures:** Numerical answers to step-by-step exercises, complete problems, and challenge problems.

Textbooks Referenced in Recommended Readings

Eldenburg, Leslie G., and Susan K. Wolcott. 2011. *Cost Management*. 2nd ed. Hoboken, NJ: John Wiley & Sons.

Hilton, Ronald W., Michael W. Maher, and Frank H. Selto. 2008. *Cost Management*. 4th ed. Boston, MA: McGraw-Hill Irwin.

Horngren, Charles T., Srikant M. Datar, and Madhav Rajan. 2012. *Cost Accounting: A Managerial Emphasis*. 14th ed. Boston, MA: Prentice Hall.

Thanks to Sue Ravenscroft, Mike Bootsma, Diane Janvrin, Winston Chappell, Ting Li Zhou, and Laura Enderson for feedback and testing of these materials.

Chapter 1

Review

Learning Objectives

1. Understand the role of managerial accounting in an organization
2. Review basic vocabulary from introductory managerial accounting
3. Estimate a cost function using the high-low method
4. Analyze a short-term decision
5. Use cost-volume-profit analysis
6. Calculate net present value

Recommended Readings

1. Eldenburg and Wolcott (2011): Chapter 1, pp. 2–23; Chapter 2, pp. 38–54; Chapter 3, pp. 88–94; Chapter 4, pp. 128–142; Chapter 12, pp. 464–474
2. Hilton, Maher, and Selto (2008): Chapter 1, pp. 4–21; Chapter 2, pp. 40–61; Chapter 11, pp. 418–423, 429–430; Chapter 12, pp. 468–474; Chapter 13, pp. 521–533; Chapter 14, pp. 569–576
3. Horngren, Datar, and Rajan (2012): Chapter 1, pp. 5–18; Chapter 2, pp. 26–48; Chapter 3, pp. 62–76; Chapter 10, pp. 340–351; Chapter 11, pp. 390–401; Chapter 21, pp. 738–743

MANAGERIAL ACCOUNTING

Managerial accounting is the branch of accounting that provides financial information to managers for their use in making decisions. When this information is used internally only and is not included in external financial reports, it is not required to follow generally accepted accounting principles (GAAP). However, some information that is provided by managerial accountants *is* used in external financial reports, such as the value of inventories and cost of goods sold.

Managerial accounting is used in planning, implementing, and controlling operations. It includes such functions as preparing budgets, calculating costs, providing information for both short- and long-term decisions, and evaluating the performance of the firm and its employees.

This course focuses on planning, costing, and operations. Students in this course should have previously completed an introductory managerial accounting course. This course will review topics from the introductory level that need little expansion, elaborate on other topics from the introductory

level, and introduce new topics as well. The course is not intended to be a comprehensive study of every function performed by managerial accountants, but rather is intended to teach some basic concepts and tools used by managerial accountants, so that the student can learn how managerial accountants think and operate.

VOCABULARY

Define each of the following terms:

Actual cost
Average cost
Budgeted cost
Conversion costs
Cost
Cost allocation
Cost driver
Cost object
Cost of goods manufactured
Direct cost
Direct labor
Direct materials
Finished goods inventory
Fixed cost
Indirect cost
Manufacturing overhead
Net income
Operating income
Period cost
Product cost
Raw materials inventory
Revenues
Unit cost
Variable cost
Work-in-process inventory

THE COST FUNCTION: THEORY

The cost function of a firm splits its typical costs into variable and fixed portions, and expresses those costs algebraically:

$$\text{Total Cost} = \text{Variable cost per unit} \times \text{Units} + \text{Fixed cost}$$

Variable costs per unit stay relatively constant over time, as do fixed costs in total, so once a firm has estimated a cost function it can plug in the expected volume of units and solve for projected total cost.

Cost functions can be estimated using past costs. The firm gathers data on unit volume at several points in time, and the corresponding total costs at those times. These volume-cost pairs can be plotted on a scatterplot, and a line fitted to them using linear regression or the high-low method. The firm's cost function is the equation for that line. We will focus on the high-low method of cost estimation.

THE COST FUNCTION: METHOD

The high-low method builds a cost function from only two data points.

First, find the volume-cost pairs with the highest volume and the lowest volume. These are the high and low points, respectively.

Next, find the variable cost per unit by using the slope formula:

$$\text{Variable cost per unit} = \frac{\text{High cost} - \text{Low cost}}{\text{High volume} - \text{Low volume}}$$

Next, find the total fixed cost by plugging the variable cost per unit and either the high or low point into the cost function formula, and solving for fixed cost:

$$\begin{aligned} \text{Total cost} &= \text{Variable cost per unit} \times \text{Units} + \text{Fixed Cost} \\ \text{So, Fixed cost} &= \text{Total cost} - \text{Variable cost per unit} \times \text{Units} \end{aligned}$$

Next, build the firm's cost function by replacing the variables for variable cost per unit and fixed cost with the calculated numbers. Total cost and units remain variables in the equation.

Finally, use the firm's cost function to predict future costs for different levels of volume.

ILLUSTRATIVE EXAMPLE

Jaworski Company gathered information on sales volume and total costs for the first 3 years of the company's operation:

	Units	Cost
Year 1	300,000	\$2,250,000
Year 2	240,000	\$1,950,000
Year 3	280,000	\$2,400,000

Determine the firm's cost function, and predict costs for a year in which 275,000 units are sold.

First, find the high and low points:

- The high volume is 300,000 units, so (300,000, \$2,250,000) is the high point.
- The low volume is 240,000 units, so (240,000, \$1,950,000) is the low point.

Next, find the variable cost per unit:

- Variable cost per unit = $(\$2,250,000 - \$1,950,000) / (300,000 - 240,000) = \5.00

Next, find the total fixed cost:

- Fixed cost = $\$2,250,000 - 300,000 \times \$5 = \$750,000$
- Or, Fixed cost = $\$1,950,000 - 240,000 \times \$5 = \$750,000$

Next, build the firm's cost function:

- Total cost = $\$5 \times \text{Units} + \$750,000$

Finally, use the firm's cost function to predict future costs:

- Total cost = $\$5 \times 275,000 + \$750,000 = \$2,125,000$

STOP-CHECK PROBLEM

Doxman Enterprises compiled the following information about the last 6 months:

	Unit sales	Total cost
March	20,000	\$ 702,000
April	48,000	\$1,076,000
May	32,000	\$ 940,000
June	40,000	\$1,012,000
July	18,000	\$ 716,000
August	29,000	\$ 921,000

Determine the firm's cost function, and predict costs for a month in which 25,000 units are sold.

- a. First, find the high and low points. **Stop—Check!**
- b. Next, find the variable cost per unit. **Stop—Check!**
- c. Next, find the total fixed cost. **Stop—Check!**
- d. Next, build the firm's cost function. **Stop—Check!**
- e. Finally, use the firm's cost function to predict future costs. **Stop—Check!**

Stop—Check! Figures: (a) High (48,000, \$1,076,000), Low (18,000, \$716,000); (b) \$12;
 (c) \$500,000; (d) Total cost = \$12 x Units + \$500,000; (e) \$800,000

SHORT-TERM DECISION MAKING: THEORY

Often, firms need to make short-term, nonrecurring decisions, such as whether to make or buy a product component, whether to accept a special order for their product, or whether to keep or drop a segment of the business. In these situations, firms must consider which costs and benefits are relevant to the decision at hand. Relevant costs and benefits (1) occur in the future, and (2) differ across alternatives.

The relevant costs and benefits of each decision alternative should be compared, and a net benefit of the decision calculated. The *net benefit* of the decision is the effect it will have on the company's profit.

SHORT-TERM DECISION MAKING: METHOD

A number of different formats exist for organizing relevant costs and benefits for decision making. The following is one such method.

First, identify the decision alternatives, and make a column for each.

Next, identify the relevant costs and benefits of each alternative, and place them in the appropriate column.

Finally, total each column and find the difference between the columns. This difference is the net benefit of the decision. Determine which decision alternative results in the higher profit for the firm.

ILLUSTRATIVE EXAMPLE

Pellinore Company has received a special order from Maxwell, Inc. Pellinore incurs \$150 in variable costs to manufacture each unit, and assigns \$30 in fixed costs to each unit as well. Maxwell requires product modifications that will require an extra \$15 in variable costs per unit. Pellinore ordinarily charges \$220 per unit. Maxwell has offered \$200,000 for the entire order of 1,000 units. Pellinore has enough production capacity to fill the order in addition to its regular production needs.

Determine whether it would be financially beneficial for Pellinore to accept the order, and calculate the net benefit.

First, make a column for each decision alternative.

- Pellinore can accept the special order or reject it (see columns to the right).

Next, place the relevant costs and benefits of each alternative in the columns.

- The regular variable cost of \$150 per unit will be incurred for the 1,000 units if the order is accepted, but not if it is rejected, so this is relevant.
- Fixed costs will not change if the order is accepted, so this is not relevant.
- The additional cost of \$15 per unit will be incurred for the 1,000 units if the order is accepted, but not if it is rejected, so this is relevant.
- The regular price of \$220 applies only to regular sales, which will be incurred whether the order is accepted or not, so this is not relevant.
- The \$200,000 offer will be received if the order is accepted, but not if it is rejected, so this is relevant.

	<u>Accept</u>	<u>Reject</u>
VC	\$(150,000)	\$0
Add'l	(15,000)	0
Offer	<u>200,000</u>	<u>0</u>
Total	\$ 35,000	\$0
	└─ \$35,000 ─┘	

Finally, find the net benefit of the decision and determine which alternative results in higher profit.

- The net benefit of the decision is \$35,000, and favors accepting the special order.

STOP-CHECK PROBLEM

Sapulpa Company currently manufactures all components of its product. The manager is trying to decide whether the company should continue to manufacture one of the parts or purchase it from an outside supplier, who would charge \$15 per part. Fixed costs associated with manufacturing the part are unavoidable. Expected unit sales are 50,000. Sapulpa incurs the following cost per unit to manufacture the part:

Direct materials (DM)	\$ 4.00
Direct labor (DL)	6.00
Variable overhead (VOh)	3.00
Fixed overhead	<u>4.50</u>
Per-unit cost	\$17.50

Determine whether it is financially beneficial for Sapulpa Company to purchase the part from the outside supplier, and calculate the net benefit.

- a. First, make a column for each decision alternative. **Stop—Check!**
- b. Next, place the relevant costs and benefits of each alternative in the columns. **Stop—Check!**
- c. Finally, find the net benefit of the decision and determine which alternative results in higher profit. **Stop—Check!**

Stop—Check! Figures: (a) Make the part or purchase it; (b) Make: DM \$200,000, DL \$300,000, VOh \$150,000; Purchase \$750,000; (c) \$100,000, favors making the part

COST-VOLUME-PROFIT ANALYSIS: THEORY

Cost-volume-profit (CVP) analysis uses the cost structure of a firm to calculate the volume (in units or dollars) required to break even or hit a target profit, and to analyze the effect of changes in cost structure on profit. To use CVP analysis, you must understand the concepts of fixed costs (FC) and variable costs (VC), and the meaning of contribution margin (CM). CVP analysis is based on the equation for before-tax profit:

$$\text{Profit} = \text{Revenue} - \text{Variable costs} - \text{Fixed costs}$$

Or, because Contribution margin = Revenue – Variable costs:

$$\text{Profit} = \text{Contribution margin} - \text{Fixed costs}$$

Contribution margin can be expressed on a per-unit basis (unit contribution margin, or UCM) or as a percentage of revenues (contribution margin ratio, or CMR), so the equation for before-tax profit can be rewritten as follows:

$$\text{Profit} = \text{UCM} \times \text{Units} - \text{FC} \quad \text{or} \quad \text{Profit} = \text{CMR} \times \text{Revenue} - \text{FC}$$

COST-VOLUME-PROFIT ANALYSIS: METHOD

To calculate before-tax profit:

$$\text{Profit} = \text{UCM} \times \text{Units} - \text{FC} \qquad \text{Profit} = \text{CMR} \times \text{Revenue} - \text{FC}$$

To calculate volume required to break even (profit = 0):

$$\begin{array}{ll} 0 = \text{UCM} \times \text{Units} - \text{FC} & 0 = \text{CMR} \times \text{Revenue} - \text{FC} \\ \text{So, Units} = \text{FC} / \text{UCM} & \text{Revenue} = \text{FC} / \text{CMR} \end{array}$$

To calculate volume required to hit a target before-tax profit:

$$\begin{array}{ll} \text{Target profit} = \text{UCM} \times \text{Units} - \text{FC} & \text{Target profit} = \text{CMR} \times \text{Revenue} - \text{FC} \\ \text{So, Units} = (\text{Target profit} + \text{FC}) / \text{UCM} & \text{Revenue} = (\text{Target profit} + \text{FC}) / \text{CMR} \end{array}$$

Two cost structures can be compared by setting their before-tax profit equations equal to one another, at which point the business would be indifferent between the two cost structures.

ILLUSTRATIVE EXAMPLE

Jonesmith, Inc., incurs \$30 per unit in variable costs, and \$500,000 in total fixed costs. Each unit sells for \$80. Jonesmith is considering making an investment that would increase fixed costs by \$50,000, but decrease variable costs by \$2 per unit.

Calculate the following:

- Before-tax profit if Jonesmith sells 20,000 units
- Before-tax profit if Jonesmith earns revenue of \$2,000,000
- The units Jonesmith needs to sell to break even
- The revenues Jonesmith needs to earn to break even
- The units Jonesmith needs to sell to achieve \$200,000 in before-tax profit.
- The revenues Jonesmith needs to earn to achieve \$400,000 in before-tax profit.
- The unit sales at which Jonesmith would be indifferent between making and not making the new investment.

Calculate the before-tax profit if Jonesmith sells 20,000 units:

- $UCM = \$80 - \$30 = \$50$
- $Profit = \$50 \times 20,000 - \$500,000 = \$500,000$

Calculate the before-tax profit if Jonesmith earns revenue of \$2,000,000:

- $CMR = \$50 / \$80 = 62.5\%$
- $Profit = 62.5\% \times \$2,000,000 - \$500,000 = \$750,000$

Calculate the units Jonesmith needs to sell to break even:

- $\$500,000 / \$50 = 10,000$

Calculate the revenues Jonesmith needs to earn to break even:

- $\$500,000 / 62.5\% = \$800,000$

Calculate the units Jonesmith needs to sell to achieve \$200,000 in before-tax profit:

- $(\$200,000 + \$500,000) / \$50 = 14,000$

Calculate the revenues Jonesmith needs to sell to achieve \$400,000 in before-tax profit:

- $(\$400,000 + \$500,000) / 62.5\% = \$1,440,000$

Calculate the unit sales at which Jonesmith would be indifferent between making and not making the new investment:

- $New\ UCM = \$80 - 28 = \52 ; $New\ FC = \$500,000 + \$50,000 = \$550,000$
- $\$50 \times Units - \$500,000 = \$52 \times Units - \$550,000$; $Units = 25,000$

STOP-CHECK PROBLEM

Orchid, Inc., had the following income last year, when 50,000 units were sold:

Revenues	\$1,000,000
Variable cost	<u>600,000</u>
Contribution margin	\$ 400,000
Fixed cost	<u>150,000</u>
Before-tax profit	\$ 250,000

Orchid currently pays its sales manager solely on commission (20% of revenues). Orchid is considering paying her a fixed salary of \$80,000 instead.

Calculate the following:

- a. The before-tax profit if Orchid sells 40,000 units. **Stop—Check!**
- b. The before-tax profit if Orchid earns revenue of \$600,000. **Stop—Check!**
- c. The units Orchid needs to sell to break even. **Stop—Check!**
- d. The revenue Orchid needs to earn to break even. **Stop—Check!**
- e. The units Orchid needs to earn to achieve a before-tax profit of \$100,000. **Stop—Check!**
- f. The revenue Orchid needs to earn to achieve a before-tax profit of \$320,000. **Stop—Check!**
- g. The unit sales at which Orchid would be indifferent between paying the sales manager a commission or a fixed salary. **Stop—Check!**

Stop—Check! Figures: (a) \$170,000; (b) \$90,000; (c) 18,750; (d) \$375,000; (e) 31,250; (f) \$1,175,000; (g) 20,000

NET PRESENT VALUE ANALYSIS: THEORY

Net present value analysis is a widely used technique for analyzing potential long-term investments. The future cash flows of the project are discounted to their present value using the firm's required rate of return as a discount factor, and the initial investment in the project (which is already at present value) is subtracted. A positive net present value indicates that the project would earn more than the required rate of return, and would therefore be financially beneficial to accept, while a negative net present value indicates that the project would earn less than the required rate of return, and would therefore be financially beneficial to reject.

When performing net present value analysis, only cash flows are considered, including cash flows from taxes. Thus, all annual cash flows should be included on an after-tax basis, and the tax effects from depreciation, gains, and losses should be included as well.

NET PRESENT VALUE ANALYSIS: METHOD

First, calculate the net initial investment, the annual cash flows, and the terminal cash flows of the project:

Cost of new assets – Sales value of old assets +/- Tax effects from gain or loss <u>on sale of old assets</u> Net initial investment	Yearly cash inflows – Yearly cash outflows – Tax on yearly cash flows + <u>Tax effects from depreciation</u> Annual cash flows
--	--

Terminal cash flows are any expected cash flows at the end of the project, resulting from sales or disposal of assets or recovery of working capital. It can be helpful to place cash flows on a timeline to better understand when they occur.

Next, discount the annual cash flows and terminal cash flows to present value:

- If annual cash flows are the same each year, the annual amount can be multiplied by the discount factor from the annuity table
- If annual cash flows are different each year, the amount each year can be multiplied by the discount factor from the single value table
- Terminal cash flows should be multiplied by the discount factor from the single value table

Finally, add the present values of the annual cash flows and terminal cash flows, and subtract the net initial investment.

PRESENT VALUE TABLES

Present Value of a Single Amount

	6%	7%	8%	9%	10%	11%	12%	13%	14%	15%
1	0.9434	0.9346	0.9259	0.9174	0.9091	0.9009	0.8929	0.8850	0.8772	0.8696
2	0.8900	0.8734	0.8573	0.8417	0.8264	0.8116	0.7972	0.7831	0.7695	0.7561
3	0.8396	0.8163	0.7938	0.7722	0.7513	0.7312	0.7118	0.6931	0.6750	0.6575
4	0.7921	0.7629	0.7350	0.7084	0.6830	0.6587	0.6355	0.6133	0.5921	0.5718
5	0.7473	0.7130	0.6806	0.6499	0.6209	0.5935	0.5674	0.5428	0.5194	0.4972
6	0.7050	0.6663	0.6302	0.5963	0.5645	0.5346	0.5066	0.4803	0.4556	0.4323
7	0.6651	0.6227	0.5835	0.5470	0.5132	0.4817	0.4523	0.4251	0.3996	0.3759
8	0.6274	0.5820	0.5403	0.5019	0.4665	0.4339	0.4039	0.3762	0.3506	0.3269
9	0.5919	0.5439	0.5002	0.4604	0.4241	0.3909	0.3606	0.3329	0.3075	0.2843
10	0.5584	0.5083	0.4632	0.4224	0.3855	0.3522	0.3220	0.2946	0.2697	0.2472
11	0.5268	0.4751	0.4289	0.3875	0.3505	0.3173	0.2875	0.2607	0.2366	0.2149
12	0.4970	0.4440	0.3971	0.3555	0.3186	0.2858	0.2567	0.2307	0.2076	0.1869
13	0.4688	0.4150	0.3677	0.3262	0.2897	0.2575	0.2292	0.2042	0.1821	0.1625
14	0.4423	0.3878	0.3405	0.2992	0.2633	0.2320	0.2046	0.1807	0.1597	0.1413
15	0.4173	0.3624	0.3152	0.2745	0.2394	0.2090	0.1827	0.1599	0.1401	0.1229

Present Value of an Annuity

	6%	7%	8%	9%	10%	11%	12%	13%	14%	15%
1	0.9434	0.9346	0.9259	0.9174	0.9091	0.9009	0.8929	0.8850	0.8772	0.8696
2	1.8334	1.8080	1.7833	1.7591	1.7355	1.7125	1.6901	1.6681	1.6467	1.6257
3	2.6730	2.6243	2.5771	2.5313	2.4869	2.4437	2.4018	2.3612	2.3216	2.2832
4	3.4651	3.3872	3.3121	3.2397	3.1699	3.1024	3.0373	2.9745	2.9137	2.8550
5	4.2124	4.1002	3.9927	3.8897	3.7908	3.6959	3.6048	3.5172	3.4331	3.3522
6	4.9173	4.7665	4.6229	4.4859	4.3553	4.2305	4.1114	3.9975	3.8887	3.7845
7	5.5824	5.3893	5.2064	5.0330	4.8684	4.7122	4.5638	4.4226	4.2883	4.1604
8	6.2098	5.9713	5.7466	5.5348	5.3349	5.1461	4.9676	4.7988	4.6389	4.4873
9	6.8017	6.5152	6.2469	5.9952	5.7590	5.5370	5.3282	5.1317	4.9464	4.7716
10	7.3601	7.0236	6.7101	6.4177	6.1446	5.8892	5.6502	5.4262	5.2161	5.0188
11	7.8869	7.4987	7.1390	6.8052	6.4951	6.2065	5.9377	5.6869	5.4527	5.2337
12	8.3838	7.9427	7.5361	7.1607	6.8137	6.4924	6.1944	5.9176	5.6603	5.4206
13	8.8527	8.3577	7.9038	7.4869	7.1034	6.7499	6.4235	6.1218	5.8424	5.5831
14	9.2950	8.7455	8.2442	7.7862	7.3667	6.9819	6.6282	6.3025	6.0021	5.7245
15	9.7122	9.1079	8.5595	8.0607	7.6061	7.1909	6.8109	6.4624	6.1422	5.8474

ILLUSTRATIVE EXAMPLE

Zarbine Company is considering replacing a piece of machinery with a book value of \$100,000. The new machine will cost \$800,000, and will have a useful life of 5 years, after which its salvage value will be \$250,000. The machine would save the company \$200,000 a year in operating costs. The current machinery could be sold now for \$20,000, but it is believed it will be obsolete in 5 years. Zarbine has a tax rate of 30%, and a required rate of return of 12%.

Find the net present value of the machine replacement.

First, calculate the net initial investment, the annual cash flows, and the terminal cash flows of the project:

- Net initial investment:
 - Cost of new machine: \$800,000
 - Sales value of old machine: \$20,000
 - Tax savings from loss on sale of old machine: $(\$100,000 - \$20,000) \times 30\% = \$24,000$
 - Total: $\$800,000 - \$20,000 - \$24,000 = \$756,000$
- Annual cash flows:
 - Annual cash flows: \$200,000
 - Tax on cash flows: $\$200,000 \times 30\% = \$60,000$
 - Tax savings from depreciation
 - Straight-line depreciation: $(\$800,000 - \$250,000) / 5 = \$110,000$
 - Tax savings: $\$110,000 \times 30\% = \$33,000$
 - Total: $\$200,000 - \$60,000 + \$33,000 = \$173,000$
- Terminal cash flows: \$250,000

Next, discount the annual cash flows and terminal cash flows to present value:

- Present value factors for 5 years, 12%: Single amount 0.5674, Annuity 3.6048
- Annual cash flows: $\$173,000 \times 3.6048 = \$623,630.40$
- Terminal cash flows: $\$250,000 \times 0.5674 = \$141,850$

Finally, add the present values of the annual cash flows and terminal cash flows, and subtract the net initial investment:

- Net present value = $\$623,630.40 + \$141,850 - \$756,000 = \$9,480.40$

STOP-CHECK PROBLEM

Turquette Corporation is considering whether to launch a new product line. The product life is expected to be 10 years. The launch would require an initial investment in assets of \$12,000,000. The salvage value of the assets is \$2,000,000. Turquette estimates that annual revenues from the product would total \$4,000,000, and annual costs would total \$1,500,000. Turquette has a tax rate of 25%, and a required rate of return of 10%.

Find the net present value of the new product line.

- a. First, calculate the net initial investment, the annual cash flows, and the terminal cash flows of the project. **Stop—Check!**
- b. Next, discount the annual cash flows and terminal cash flows to present value. **Stop—Check!**
- c. Finally, add the present values of the annual cash flows and terminal cash flows, and subtract the net initial investment. **Stop—Check!**

Stop—Check! Figures: (a) NII \$12,000,000, ACF \$2,125,000, TCF \$2,000,000; (b) ACF \$13,057,275, TCF \$771,000; (c) \$1,828,275

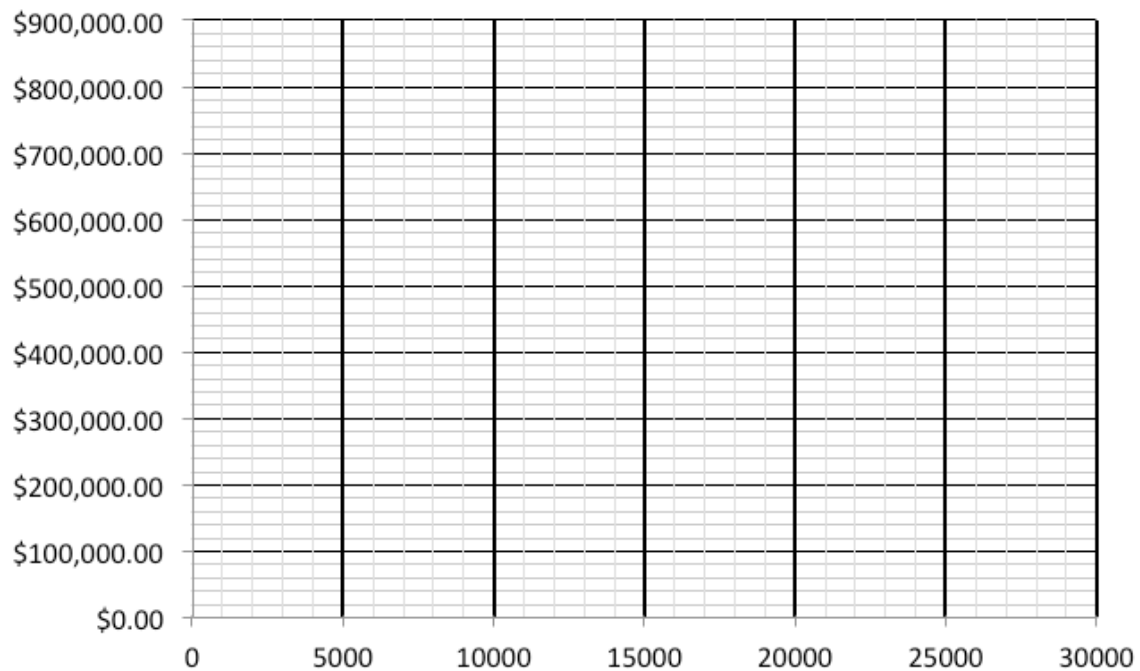
LECTURE EXAMPLES

Your firm has collected the following information on unit sales and total costs for the past 6 months:

	<u>Unit sales</u>	<u>Total costs</u>
July	23,000	\$810,000
August	18,000	\$600,000
September	15,000	\$625,000
October	20,000	\$720,000
November	19,000	\$670,000
December	26,000	\$790,000

Highlight or circle the high and low points.

Make a scatterplot of the points:



Calculate variable cost per unit:

Calculate fixed cost:

The firm's cost function:

If the firm sells 25,000 units this month, what will total costs be?

Bonus: How would you draw the firm's cost function on the scatterplot? Draw the cost function.

Toastem manufactures small appliances. The costs of manufacturing these appliances are listed below. Toastem has received a special order for 2,400 toasters from an appliance retailer whose usual supplier cannot supply the toasters because of a labor strike. Toastem would not incur any variable marketing costs on the special order. The retailer has offered Toastem \$10 per toaster. Toastem normally charges \$13 per toaster. The following costs are based on a production level of 30,000 toasters per year.

	<u>Per unit</u>	<u>Total</u>
Manufacturing costs:		
Direct labor	\$ 3.00	\$ 90,000
Direct materials	3.50	105,000
Variable overhead	2.50	75,000
Fixed overhead	<u>1.50</u>	<u>45,000</u>
Total	<u>\$10.50</u>	<u>\$315,000</u>
Marketing costs:		
Variable marketing	\$ 1.00	\$ 30,000
Fixed marketing	<u>0.75</u>	<u>22,500</u>
Total	<u>\$ 1.75</u>	<u>\$ 52,500</u>
Total product costs	<u>\$12.25</u>	<u>\$367,500</u>

If Toastem has the capacity to produce 35,000 toasters per year, should they accept the special order?

If Toastem has the capacity to produce 30,000 toasters per year, should they accept the special order?

Information about your firm:

Selling price per unit: \$400

Variable cost per unit: \$250

Annual fixed costs: \$6,000,000

Units the business will sell next year: 50,000

Unit contribution margin:

Contribution margin ratio:

Before-tax profit at expected unit sales level:

Unit sales if the business wants to earn \$1,800,000 in before-tax profit:

Revenue if the business wants to earn \$1,800,000 in before-tax profit:

Breakeven point in units:

Breakeven point in revenues:

Your firm can purchase a new machine that will increase annual fixed costs by 18.75% but will decrease variable cost per unit by 10%. At what level of production would your firm be indifferent between purchasing and not purchasing the new machine?

Your firm is considering purchasing a new piece of equipment that would cost \$400,000. It will last 10 years, after which it can be sold for \$50,000. The new equipment will generate cost savings of \$60,000 per year over the firm's existing equipment, which has a book value of \$20,000 and could be sold now for \$40,000. Your firm has a tax rate of 25% and a required rate of return of 12%.

Calculate the net initial investment.

Calculate the annual cash flows.

Discount the annual cash flows and the terminal cash flows to present value.

Find the net present value of purchasing the new equipment.

LECTURE NOTES

STEP-BY-STEP EXERCISES

The Cost Function

First, find the high and low points.

1. Marbury Corporation compiled the following data from last year:

	Units	Cost
January	25,000	\$325,000
February	27,000	\$315,000
March	35,000	\$378,000
April	50,000	\$450,000
May	33,000	\$407,000

Find the high and low points.

2. Johnson Company compiled the following data from last year:

	Units	Cost
April	2,700	\$52,000
May	3,950	\$67,400
June	1,500	\$35,980
July	1,470	\$37,640
August	3,900	\$70,530

Find the high and low points.

Next, find the variable cost per unit.

3. The high point is (20,000, \$400,000), and the low point is (15,000, \$350,000).

Find the variable cost per unit.

4. When sales were at their highest at 500,000 units, total costs were \$750,000. When sales were at their lowest at 200,000 units, total costs were \$420,000.

Find the variable cost per unit.

Next, find the total fixed cost.

5. The variable cost per unit is \$500. The high point is (1,200, \$700,000), and the low point is (700, \$450,000).

Find the total fixed cost.

6. The variable cost per unit is \$6. When sales were at their highest at 750,000 units, total costs were \$6,500,000. When sales were at their lowest at 500,000 units, total costs were \$5,000,000.

Find the total fixed cost.

Next, build the firm's cost function.

7. Variable cost per unit is \$7, and total fixed costs are \$100,000.

Build the firm's cost function.

8. Variable cost per unit is \$37, and total fixed costs are \$320,000.

Build the firm's cost function.

Finally, use the firm's cost function to predict future costs.

9. Sutherland Enterprises is trying to estimate total costs for next month, when it expects to sell 300,000 units. Its cost function is as follows:

$$\text{Total cost} = \$15 \times \text{Units} + \$5,000,000$$

Use the firm's cost function to predict next month's costs.

10. McCullough Corporation wants to estimate total costs for next year, when it expects to sell 2,500 units. Its cost function is as follows:

$$\text{Total cost} = \$3,000 \times \text{Units} + \$10,000,000$$

Use the firm's cost function to predict next year's costs.

Short-Term Decision Making

First, make a column for each decision alternative.

11. Vreeland Corporation is trying to decide whether to eliminate a segment of its business that has shown a loss for the last seven quarters.

Make a column for each decision alternative.

12. Kimber Company is trying to decide whether to accept an order from Kline Corporation for a special batch of its products with Kline Corporation's logo printed on each.

Make a column for each decision alternative.

Next, place the relevant costs and benefits of each alternative in the columns.

13. Grenda Company has received a special order for 300 units from Jordan Company, which requires that its logo be placed on each unit at an extra cost of \$20 per unit. Apart from that modification, the units would be identical to Grenda's regular units, which it manufactures at a cost of \$75 (\$40 in materials, \$20 in labor, \$5 in other variable costs, and \$10 in fixed costs) and sells to customers for \$100. Grenda currently operates at full capacity, so if it were to fill the special order, it would have to give up regular sales to do so. Jordan has offered \$115 per unit for the order. The decision alternatives are to accept or reject the order.

Place the relevant costs and benefits of each alternative in the columns.

14. Robotechnology Corporation currently manufactures all parts of its product. The firm is trying to decide whether to purchase circuitry from an outside manufacturer instead of making the circuitry. Current monthly costs to manufacture the circuitry are as follows:

Direct materials	\$15,000
Direct labor	26,000
Variable overhead	19,000
Fixed overhead	<u>23,000</u>
Total	\$83,000

The outside supplier would charge \$75,000 for the circuitry. If Robotechnology did not manufacture the circuitry, it could use the current manufacturing space for storage that currently costs the company \$10,000 offsite. Decision alternatives are to make or buy the circuitry.

Place the relevant costs and benefits of each alternative in the columns.

Finally, find the net benefit of the decision and determine which alternative results in higher profit.

15. Noble Company identified the following relevant costs and benefits of a decision whether to keep or drop an unprofitable customer:

	<u>Keep</u>	<u>Drop</u>
Revenue	\$240,000	\$180,000
Variable cost	(230,000)	(100,000)
Avoidable fixed cost	(15,000)	0

Find the net benefit of the decision and determine which alternative results in higher profit.

16. Norman Corporation identified the following relevant costs and benefits of a decision whether to accept or reject a special order:

	<u>Accept</u>	<u>Reject</u>
Revenue	\$17,000	\$15,000
Additional cost	(3,000)	0

Find the net benefit of the decision and determine which alternative results in higher profit.

Cost-Volume-Profit Analysis

Calculate before-tax profit.

17. Passi Company sells its products for \$15 per unit. Variable costs are \$7 per unit, and fixed costs are \$300,000. Passi sold 40,000 units this period.

Calculate before-tax profit.

18. Tessera Corporation had revenues of \$500,000, variable costs of \$300,000, and fixed costs of \$400,000. Next year, revenues are projected to increase to \$1,200,000.

Calculate next year's before-tax profit.

Calculate volume required to break even.

19. Eagle, Inc., sells its product for \$100 per unit. Variable costs are \$35 per unit. Fixed costs are \$975,000.

Calculate the volume in units required to break even.

20. Farr Company has \$200,000 in fixed costs. Variable costs are 60% of revenues.

Calculate the volume in revenues required to break even.

Calculate volume required to hit a target before-tax profit.

21. Willco sells its products for \$50 per unit. Variable costs are \$20 per unit, and fixed costs are \$450,000 per month. Willco's target before-tax profit next month is \$180,000.

Calculate the volume in units required to hit the target before-tax profit.

22. Rogers Enterprises had \$600,000 in revenues last year, as well as \$240,000 in variable costs and \$300,000 in fixed costs. Rogers hopes to increase before-tax profit by 10% next year.

Calculate the volume in revenues required to hit the target before-tax profit.

Calculate the point of indifference between two cost structures.

23. Kattico currently has revenues of \$4,500,000, variable costs of \$1,125,000, and fixed costs of \$3,000,000. Kattico is thinking of making improvements to the production process that would increase fixed costs by \$500,000, but would decrease variable costs by 40%.

At what level of revenues would Kattico be indifferent between making and not making the improvements?

24. Deussin Company sells its product for \$160 per unit. Variable costs are \$90 per unit, and fixed costs are \$77,000 per month. Deussin currently pays each of its 5 salespeople a fixed salary of \$4,000 per month. Deussin is considering lowering that amount to \$2,000 per month, and adding a 5% sales commission for each salesperson.

At what level of unit sales would Deussin Company be indifferent between paying the current fixed salary and paying a lower fixed salary plus commissions?

Net Present Value Analysis

First, calculate the net initial investment, the annual cash flows, and the terminal cash flows of the project.

25. Dama, Inc., is considering purchasing a new machine costing \$1,200,000 to replace its current machine, which has a book value of \$350,000 and could be sold for \$75,000. The new machine would last 10 years, and would have a salvage value of \$200,000. Each year, the new machine would save \$300,000 in operating expenses. Dama has a tax rate of 30%, and a required rate of return of 9%.

Calculate the net initial investment, the annual cash flows, and the terminal cash flows of the project.

26. Palles Company is considering a new investment that would cost \$700,000 for new assets that would have a salvage value of \$100,000. The project would last for 6 years, and would bring in \$200,000 in additional income each year. To free up capacity for the new project, Palles would have to sell off assets with a book value of \$100,000 and sales value of \$250,000. Palles has a tax rate of 20%, and a required rate of return of 11%.

Calculate the net initial investment, the annual cash flows, and the terminal cash flows of the project.

Next, discount the annual cash flows and terminal cash flows to present value.

27. A project requires a \$100,000 net initial investment, has a terminal cash flows of \$12,000, and increases cash flows by \$25,000 each year over its 5-year life. The required rate of return is 8%.

Discount the annual cash flows and terminal cash flows to present value.

28. A project requiring a net initial investment of \$800,000 yields annual cash flows of \$120,000 and has a terminal cash flows of \$50,000 at the end of its 10-year life. The required rate of return is 10%.

Discount the annual cash flows and terminal cash flows to present value.

Finally, calculate the net present value.

29. A proposed project requires a net initial investment of \$1,000,000. The present value of annual cash flows is \$1,137,236.03, and the present value of the terminal cash flows is \$31,046.07.

Calculate the net present value.

30. A proposed project requires a net initial investment of \$600,000. The present value of annual cash flows is \$565,022.30, and the present value of the terminal cash flows is \$13,392.86.

Calculate the net present value.