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Reality 101: Profit Planning with Spreadsheets

By Mike Thomas, Ph.D.

Using Microsoft Excel's Scenario Manager and Goal Seek, students learn how to solve real-world management accounting problems.

EXECUTIVE SUMMARY In a project developed for introductory management accounting classes and used in seven courses at two universities, students create a spreadsheet program to conduct "what-if" and goal-seeking analyses using the built-in financial functions of Microsoft® Excel. When asked about the program, 310 students responded with a strong belief that: (1) the instructions are sufficient for students to create the program without any prerequisite spreadsheet knowledge, (2) knowing how to create this program is an important "real-world" management accounting skill needed by all business majors, and (3) building the program should be a required component in both undergraduate and MBA introductory management accounting courses. Supplementary evidence shows students also believe creating this program aided them in their course exams.

In keeping with the theme from the 2003 IMA Annual Conference, "Creating Business Knowledge for Strategic Leadership," a project was developed for introductory management accounting classes that requires students to create a spreadsheet program similar to the real-world programs they will be expected to use in strategic profit planning decisions. The program contains a simple contribution margin income statement and uses Excel's Scenario Manager and Goal Seek functions to assess the change in projected profits from various what-if and profit-goal scenarios. This project provides at least five benefits:

- A better understanding of the role for, and importance of, cost-volume-profit (CVP) analysis in strategic planning,
- A strong, direct linkage illustrating how the profit equation and the contribution margin income statement are the same tool,
- A practical spreadsheet skill of building template programs that are documented with formulas using cell names,
- Students are exposed to two important spreadsheet profit modeling tools not usually covered in introductory computer-related courses or found in the usual business degree curriculum, and
- Most important, students gain an appreciation for

how CVP analysis (the profit equation) is an important real-world tool they will be expected to know upon graduation and is not just another formula to be memorized for an exam.

Most introductory management accounting texts and courses require students to manually solve the profit equation for target profit given the sales price, variable costs, volume, and fixed costs. Too often, students view this as another exercise in linear algebra, solving the equation: Profit = (CMU x Volume) – Fixed costs. Whether solving the equation given a target profit (for example, setting profit equal to zero and solving for break-even volume, which is goal seeking) or solving for a new profit when given values for the other equation variables (what-if analysis), students fail to realize how important CVP analysis is as a strategic planning tool and how they will be expected to use it for strategic planning decisions.

For example, consider the normal strategic planning process. Upper management begins by creating or revising its vision statement and mission. The mission statement sets the objectives for the annual strategic plan, which includes a preliminary pro forma income statement. The pro forma statement is then subjected to a series of "profit planning games," in which the profit effects of various scenarios are considered. After the decision is made as to which scenarios will be incorporated into the strategic plan, a final pro forma income statement is agreed upon, and a cash budget is prepared. When analyzing the profit effects from various scenarios, upper management does not expect the business graduate to repeatedly solve the profit equation manually while they wait. Instead, as each scenario is considered, the graduate projects a spreadsheet program from his or her laptop to a viewing screen for all to see.

So even though students learn how to solve the equation manually, they will not be expected to do so in the professional world. Spreadsheet programs exist for this purpose, but only one introductory management accounting text (that I am aware of) demonstrates the spreadsheet applications available for CVP.

By requiring students to build a spreadsheet program for these profit-planning games and linking goal-seeking and what-if analyses to the strategic planning process, they gain a better insight into the reality of this management information process.

The Contribution Margin Income Statement Program

The program students are required to create is shown in Table 1. In addition to the income statement, it includes calculations for break-even point (volume) and revenues, margin-of-safety, and a column for calculating changes in these key outcomes.

The program incorporates data from Problem 3-10 found in *Management Accounting: A Road of Discovery*, which uses Excel's Scenario Manager to conduct what-if analyses. The program then is used with Problem 3-9 from the same text to conduct goal-seeking analyses. These two problems are reprinted in Appendix A. The solutions are presented in Appendix B.

Three goals exist for this program:

- Build a reusable (template) program by using formulas instead of entering specific amounts into the income statement cells;
- Provide an auditable program by using cell names—instead of cell addresses—in the formulas; and
- Use Excel's Scenario Manager for "what-if" analyses and Goal Seek to solve for a target profit.

Building a Template Program

The raw data need their own cells separate from the income statement's cells, so the first step for students in building a template program is to create a "data section." The numeric values for sales price, variable costs, fixed costs, and volume are entered into these cells.

Next, students create the "solution section," which contains the income statement, break-even volume and revenues, and margin-of-safety. A column is added on the right side to calculate changes in key outcome variables from each of the scenarios in Problem 3-10. Cells in the solution section cannot contain numeric input. Instead, each cell must be a formula that recalls a numeric value from the data section. In this manner, students can easily enter a number into a cell in the data section and automatically see how it affects the net income. For example, the formula "+sales price" is in the sales price cell ("Per unit revenues" cell of the income statement). "Sales price" is the cell name for the data section cell containing this value. If $16,000 is

Table 1: THE INCOME STATEMENT PROGRAM

Mike Thomas, ACC 202, Spring 2002
Spreadsheet Assignment 1: CVP analysis
Problem 3-10a: What-if analysis

Data section:

Sales price	$15,000	per mile
Volume	1,200	miles per year
Variable costs	$12,500	per mile
Fixed costs	$1,800,000	per year

Solution section:

	INCOME STATEMENT			What-if changes from Part a
	Per unit	%age	Totals @ 1,200	
Revenues	$15,000	100%	$18,000,000	
Less: Variable costs	(12,500)	(83%)	(15,000,000)	
Contribution Margin	**$2,500**	**17%**	**$3,000,000**	
Less: Fixed costs			(1,800,000)	
Profit			**$1,200,000**	**$0**
Break-even volume:	**720**	**miles**		**0**
Break-even revenues:	**$10,800,000**	**per year**		**$0**
Margin of Safety:	**40%**			**0%**

Cell name table:

BEP_change	=Sheet1!$F$25
BErevs	=Sheet1!$B$27
BErevs_change	=Sheet1!$F$27
BEvolume	=Sheet1!$B$25
CMratio	=Sheet1!$C$20
CMU	=Sheet1!$B$20
Fixed_costs	=Sheet1!$B$11
MOS	=Sheet1!$B$29
MOS_change	=Sheet1!$F$29
Profit	=Sheet1!$D$23
Profit_change	=Sheet1!$F$23
Sales_price	=Sheet1!$B$8
Variable_costs	=Sheet1!$B$10
Volume	=Sheet1!$B$9

Cell names used: 14

Table 2: Cell Formula Printout of the Income Statement Program

	A	B	C	D	E	F
1						
2						
3						
4	=NOW()					
5						
6						
7	***Data section:***					
8	Sales price	15000	per mile			
9	Volume	1200	miles per year			
10	Variable costs	12500	per mile			
11	Fixed costs	1800000	per year			
12						
13	***Solution section:***					
14						
15				**INCOME STATEMENT**		**What-if**
16				**Totals @**		**changes**
17		**Per unit**	**%age**	**=Volume**		**from Part a**
18	Revenues	=Sales_price	1	=Sales_price*Volume		
19	Less: Variable costs	=-Variable_costs	=-Variable_costs/Sales_price	=-Variable_costs*Volume		
20	**Contribution Margin**	**=SUM(B18:B19)**	**=CMU/Sales_price**	**=IF(SUM(D18:D19)=CMU*Volume,CMU*Volume,"error")**		
21						
22	Less: Fixed costs			=-Fixed_costs		
23	**Profit**			**=SUM(D20:D22)**		**=Profit-1200000**
24						
25	***Break-even volume:***	**=Fixed_costs/CMU**	**miles**			**=BEvolume-720**
26						
27	***Break-even revenues:***	**=Fixed_costs/CMratio**	**per year**			**=BErevs-10800000**
28						
29	***Margin of Safety:***	**=(Volume-BEvolume)/Volume_**				**=MOS-0.4**
30						
31	***Cell name table:***					
32	BEP_change	=Sheet1!$F$25				
33	BErevs	=Sheet1!$B$27				
34	BErevs_change	=Sheet1!$F$27				
35	BEvolume	=Sheet1!$B$25				
36	CMratio	=Sheet1!$C$20				
37	CMU	=Sheet1!$B$20				
38	Fixed_costs	=Sheet1!$B$11				
39	MOS	=Sheet1!$B$29				
40	MOS_change	=Sheet1!$F$29				
41	Profit	=Sheet1!$D$23				
42	Profit_change	=Sheet1!$F$23				
43	Sales_price	=Sheet1!$B$8				
44	Variable_costs	=Sheet1!$B$10				
45	Volume	=Sheet1!$B$9				
46						
47	*Cell names used:*	=COUNTA(B32:B46)				
48						

entered in the data-section sales price cell instead of $15,000, the profit changes to $2.4 million, an increase of $1.2 million. Students also see that the break-even volume decreases to 514 miles, and margin-of-safety increases to 57%.

Detailed instructions are provided for students so that they understand how to build it properly (See Appendix C). In two of the courses surveyed, the class sizes were small enough that the instructor could demonstrate how to build the program in a computer lab. The two courses were four-credit courses containing a two-hour-per-week computer lab. Two lab classes were needed to build the program and use it to solve Problems 3-10 and 3-9. The other courses surveyed were too large for the computer labs. In those instances, the instructor built the program in class while students watched. They were encouraged to bring laptops and build the program as the professor did, but most just followed along with the instructions, taking notes as needed. Building the program in class took one 75-minute class period.

Creating an Auditable Program

Rather than just typing numbers into the income statement cells as each scenario is considered, formulas are used to provide a convenient, less error-prone method to calculate income statement changes. These cells can use either cell addresses or cell names. Cell addresses are difficult to understand because the contents of each cell must be looked up in order to verify that the formula is correct. By assigning names for the cells used in formulas, analyzing the formulas becomes more efficient and effective. For example, the margin-of-safety formula using cell addresses is "+(B9-B25)/B9" but becomes "+(Volume-Break-even volume)/Volume" when using cell names, making it possible to check the formula's correctness without having to look up every cell to which it refers.

To ensure cell names refer to the proper cells, the third component of this program is a cell-name table. The table contains an alphabetical listing of all cell names, along with their addresses. In this program, 14

Table 3: Scenario Summary for Problem 3-10

Scenario Summary	a Original	b Vol=+10%	c SP=+10%	d VC=+10%	e FC=+10%	f SP=($500) Vol=+10%	g SP=+10% Vol=(10%)
Changing Cells:							
Sales_price	$15,000	$15,000	$16,500	$15,000	$15,000	$14,500	$16,500
Volume	1,200	1,320	1,200	1,200	1,200	1,320	1,080
Variable_costs	$12,500	$12,500	$12,500	$13,750	$12,500	$12,500	$12,500
Fixed_costs	$1,800,000	$1,800,000	$1,800,000	$1,800,000	$1,980,000	$1,800,000	$1,800,000
Result Cells:							
Profit	$1,200,000	$1,500,000	$3,000,000	($300,000)	$1,020,000	$840,000	$2,520,000
Profit_change	$0	$300,000	$1,800,000	($1,500,000)	($180,000)	($360,000)	$1,320,000
BEvolume	720	720	450	1,440	792	900	450
BEP_change	0	0	(270)	720	72	180	(270)
MOS	40%	45%	63%	(20%)	34%	32%	58%
MOS_change	0%	5%	23%	(60%)	(6%)	(8%)	18%

cell names are the required minimum. To audit the program, students print the formulas as seen in Table 2.

Using Scenario Manager for "What-if" Analyses

In demonstrating how to solve each part of Problem 3-10, the instructor simply inputs the new value into the data-section cell. For example, in Part B, volume increases 10%. The new volume (1,320 miles) can be entered, or the program can calculate the 10% increase by editing the data cell's contents. Students immediately see how the template program provides the new solution for this scenario. Each scenario can then be solved by simply entering the new values into the data-section cells.

A template program works fine for conducting ad hoc analyses. If many scenarios need to be evaluated, however, remembering the outcomes is virtually impossible. For a systemic comparison, saving the outcomes of each scenario is necessary. This is where Scenario Manager is most useful.

A section on how to use Scenario Manager is included in the instructions in Appendix C and is demonstrated by the instructor in class. To use it, simply click on the Tools menu and select "Scenarios." In the dialogue box that appears, students enter the new data value (rather than inputting it into the program's data-section cell). Excel then displays and automatically saves the new solution. Each subsequent scenario is created and saved in this way until all parts of Problem 3-10 are completed. With another click of the mouse, a new sheet with the scenario summary is added to the workbook. The summary compares key outputs from each scenario. Table 3 shows the scenario summary for Problem 3-10.

Students compare their manually prepared answers to the scenario summary. By checking their solutions to the program, students can see the relationship between the profit equation and the contribution margin income statement. In other words, the income statement is simply the profit equation rotated 90°. For this project, students hand in three pages: the program (Table 1), the cell formulas printout (Table 2), and the scenario summary (Table 3).

Using Goal Seek

A "what-if" analysis asks, "What's the change in profit if a profit equation variable is changed?" In other words, we change a data-section value and work down through the income statement for a new solution. Goal seeking, however, works the opposite way. A profit goal is specified, and the program works backwards through the income statement to find the new data-section value resulting in that profit goal. An example of goal seeking is the break-even calculation required in Problem 3-9: Target profit is set to zero, and the program solves for the required volume.

Excel's Goal Seek is easier to use than Scenario Manager. Students click on the Tools menu and select Goal Seek. A dialogue box appears, and students input the target cell (profit), its goal (zero), and the cell to be changed in order to create this goal (volume). Another dialogue box appears displaying the new solution. Goal Seek, however, does not save the solutions as Scenario Manager does. To save each solution for Problem 3-9, students must paste the Excel screen image into a Word document. An example of this output is included in their instructions.

An interesting phenomenon occurs when students get to Part D of Problem 3-9. This part asks for the volume necessary to return a 10% profit. Students have solved this manually (80,000 miles), but when they use Goal Seek, the solution is usually incorrect! While Goal Seek yields different results among students, very

Table 4: Summary of Questionnaire Responses

CVP Spreadsheet Assignment												
Sample	Sample size	Usable responses	Q1-Yes	Q1-No	Q1-?	Q4-Yes	Q4-No	Q4-?	Q5-Yes	Q5-No	Q5-?
F2000	30	26	85%	8%	8%	77%	15%	8%	81%	15%	4%
Sp2001	37	33	61%	12%	27%	79%	9%	12%	79%	15%	6%
Sp2002	70	64	95%	2%	3%	100%	0%	0%	64%	33%	3%
F2002	165	162	82%	9%	9%	96%	3%	1%	87%	10%	2%
MBA	32	25	92%	0%	8%	100%	0%	0%	96%	4%	0%
Totals	334	310	84%	7%	10%	94%	4%	3%	82%	15%	3%

Questions:

1 Were the instructions useful?
4 Do you think knowing how to create spreadsheet programs like this will be important in the "real world"?
5 Should this assignment be required in an introductory management accounting course?

rarely does it provide the correct answer. For example, if the data-section cell for volume contains the value 0, Goal Seek returns an error message and cannot provide a solution. If the original volume is 1, the new volume from the Goal Seek solution is 79,604. Using the previous part's volume (40,000), Goal Seek's solution becomes 79,349. It should be noted, however, that some students obtain different answers than these using the same original volumes!

Solver, Excel's linear programming module, also can be used for goal seeking. It, too, however, often yields an incorrect answer for Part D, though it is very close.

Students learn a valuable lesson: They cannot always blindly trust software to work properly. As business professionals, they will need to understand the underlying formulas and will be the ones responsible for numbers. Computer programs—and technology in general—should not be accepted as a black box that simply accepts the data and spits out the correct solution. Our graduates are responsible for verifying the output, particularly with important strategic decisions such as these.

Student Feedback

At the conclusion of this assignment, students were asked to complete a short questionnaire containing the following questions:

1. Were the instructions useful?
2. If you answered "no," please explain why the instructions were not useful.
3. Do you have any suggestions about how I can improve the instructions?
4. Do you think this assignment is important? In other words, is knowing how to create spreadsheet programs like this a skill you will need in the "real world"?
5. Do you believe this assignment should be a required assignment for this course?
6. Do you have any other comments about this assignment?

Table 4 presents the results from surveying seven courses at two universities. Six courses were introductory management accounting courses required of all undergraduate business majors (generally taken in the sophomore year). The seventh was an MBA introductory management accounting course.

The survey had a response rate of 93% (310 of 334 students), of which 84% felt the instructions were useful. Of the 7% responding negatively, many of their suggestions were incorporated into revised instructions used in subsequent courses. This probably explains the lower percentages of negative responses to question 1 in the Spring 2002, Fall 2002, and MBA courses.

Responses to question 4 show that students strongly believe this assignment represents a real-world application of CVP analysis—94% of the total and 100% of the MBAs answered in the affirmative. The higher negative responses in the Fall 2000 and Spring 2001 classes were due to an abnormally high percentage of students who were not business majors. For the Spring and Fall 2002 classes, virtually all students were business majors.

Regarding question 5, 82% of the students believed the assignment should be required. Interestingly, 92% of the MBAs thought it should be required at the graduate level. This attests to the belief that the use of spreadsheet programs is not taught sufficiently at the undergraduate level, at least at that particular university. The Spring 2002 classes had the highest negative response. Of the 33% who thought it shouldn't be required, 14% commented in question 6 that the assignment should be extra credit. It was an extra credit assignment in the two Spring 2002 classes, but not in others. Also, 6% felt that

spreadsheet programs should be restricted to computer information systems (CIS) courses.

Many students have said that building spreadsheet programs such as this contributes to their understanding of the theory and use of CVP, the profit equation, the contribution margin income statement, and their exam performance. To gain further insight about this issue, a post-questionnaire was administered to the Fall 2002 classes after the students completed a midterm exam covering CVP.

Seventy percent of the students completing this assignment responded. Of those, 70% believed building the program helped them when solving contribution margin income statement problems on the exam. Seventy-four percent believed they did better on the exam in performing CVP (profit equation) calculations, and 53% believed building the program in class was more beneficial to their exam performance than using that particular class day to do additional homework problems.

Adding New Perspectives

The students surveyed over the past two years strongly believe learning how to build auditable, template spreadsheet programs and learning how to use Scenario Manager and Goal Seek are important skills they will need in business. But they represent only one of the stakeholders. Before arguing that programs such as this should be a required component of introductory courses, academics and practitioners also need to be surveyed. Both of these groups can bring an experiential perspective students (especially undergraduates) may not possess.

Creating spreadsheet programs adds a practical dimension to the classroom experience. Students often comment on this new, "fun" component. Spreadsheet programs also can be created for activity-based management (ABM) measures (using spreadsheet graphics), cash budgets, balanced scorecards, and capital budgeting. By bringing the real world into the classroom, students learn how to create business knowledge for strategic leadership. ■

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Appendix A: Problems to Use With This Program

Reprinted from *Management Accounting: A Road of Discovery* by Mike Thomas, Ph.D.

ACC 202, Fall 2002

Spreadsheet Assignment 1: CVP analysis

For each part of these 2 problems, first solve it using the profit equation. After solving these problems manually, we will create a spreadsheet program to provide the solutions. The spreadsheet program will verify your manual solutions by using a contribution margin income statement. Note, check figures appear in parentheses following each part.

1. CVP analysis for what-if situations. The Power Connection Company builds power lines. The company's revenues come from the miles of power lines constructed and sold to regional utility companies. Its proforma income statement projects 1,200 miles of line constructed and sold next year, based on the following data:

Average sales price	$15,000	per mile
Average variable costs	$12,500	per mile
Fixed costs	$1,800,000	per year

As part of its strategic planning process, management is evaluating how various decisions affect projected net income.

a. Prepare a contribution margin-based income statement. (Net income = $1,200,000)
b. What is the change in profit if the company increases miles of line constructed by 10%? (+$300,000)
c. What is the change in profit if sales price per mile is increased 10%? (+$1,800,000)
d. What is the change in profit if variable expenses increase by 10%? (-$1,500,000)
e. What is the change in profit if fixed expenses increase by 10%? (-$180,000)
f. What is the change in profit if selling price decreases $500 per mile and miles constructed increase 10%? (-$360,000)
g. What is the change in profit if selling price increases 10% and total miles constructed decreases 10%? (+$1,320,000)
h. What is the change in profit if fixed costs increase by

10% for advertising that increases total miles constructed by 10%? (+$120,000)

i. Based on the analysis, what observations and recommendations would you share with the company?

2. CVP analysis for profit planning. Magnum Manufacturing makes a home security product selling for $10 with variable costs of $8 per unit. Fixed costs are $80,000.

a. Compute break-even revenues. ($400,000)

b. Compute break-even volume. (40,000 products)

c. Magnum has a target profit of $20,000 and expects to sell 40,000 units. Compute the selling price it must charge to earn the target profit. ($10.50)

d. Magnum wants to keep its selling price at $10 per unit and earn a 10% profit. Calculate the number of products it must sell. (80,000 products)

Appendix B: Solutions to Problems 3-10 and 3-9

Reprinted from *Management Accounting: A Road of Discovery* by Mike Thomas, Ph.D.

P10. KO4: CVP analysis for what-if situations.

The Power Connection Company builds power lines. The company's revenues come from the miles of power lines constructed and sold to regional utility companies. Its proforma income statement projects 1,200 miles of line constructed and sold next year, based on the following data:

Average price	$15,000	per mile
Average variable costs	$12,500	per mile
Fixed costs	$1,800,000	per year

a. Prepare a contribution margin-based income statement.

	Per unit	%	Totals @ 1,200
Revenues	$15,000	100%	$18,000,000
Less: Variable costs	(12,500)	(83%)	(15,000,000)
Contribution margin	**$2,500**	**17%**	**$3,000,000**
Less: Fixed costs			(1,800,000)
Net income			**$1,200,000**

b. What is the change in profit if the company increases miles of line constructed by 10%?

(Key point: Selling one more product increases profit by the CMU)

ΔVolume = +10% = +120 miles:

ΔContribution margin = 120 miles x $2,500 CMU = +$300,000

c. What is the change in profit if sales price per mile is increased 10%?

(Key point: Changing the sales price (or variable cost) changes CMU)

ΔSales price = +10% = +$1,500 = DCMU:

ΔContribution margin = $1,500 DCMU x 1,200 miles = +$1,800,000

d. What is the change in profit if variable expenses increase by 10%?

(Key point: Changing the sales price (or variable cost) changes CMU)

ΔVariable costs = +10% = +$1,250: DCMU = ($1,250)

ΔContribution margin = ($1,250) DCMU x 1,200 miles = ($1,500,000)

e. What is the change in profit if fixed expenses increase by 10%?

(Key point: If fixed costs go up $1, profit goes down $1)

ΔFixed costs = +10% = +$180,000: ΔProfit = ($180,000)

f. What is the change in profit if selling price decreases $500 and miles constructed increase 10%?

(Key point: When making two simultaneous changes, calculate the new contribution margin and compare it to the old contribution margin)

ΔSales price = ($500)

ΔCMU = ($500): *New* CMU = $2,000

ΔVolume = 10% = +120 miles: x *New* Volume = x1,320

New CM = $2,640,000

ΔCM = *New* CM - *Old* CM = $2,640,000 - $3,000,000 = ($360,000)

g. What is the change in profit if selling price increases 10% and miles constructed decreases 10%?

(Key point: When making two simultaneous changes, calculate the new contribution margin and compare it to the old contribution margin)

ΔSales price = +10% = +$1,500

ΔCMU = +$1,500: *New* CMU = $4,000

ΔVolume = (10%) = (120 miles): x *New* Volume = x1,080

New CM = $4,320,000

ΔCM = *New* CM - *Old* CM = $4,320,000 – $3,000,000 = +$1,320,000

h. What is the change in profit if fixed costs increase by 10% for advertising that increases total miles constructed by 10%?

(Key point: Net the change in contribution margin and the fixed cost change)

ΔVolume = +10% = +120 miles

ΔCM = 120 miles X $2,500 CMU = +$300,000

ΔFixed costs = +10% = +$180,000: ΔProfit = ($180,000)

Net ΔProfit = +$120,000

P9. KO3: CVP analysis for profit planning. Magnum Manufacturing makes a home security product selling for $10 with variable costs per unit of $8. Fixed costs are $80,000. Using the following information, determine the following:

a. Break-even revenues

Revenues = Fixed cost + Profit / CM ratio

= $80,000 + $0 / 20% of sales ← Profit = zero at break-even point; CM ratio = CMU ÷ Sales price

CMU = $10 – $8

= $400,000

b. Break-even volume

Volume = Fixed cost + Profit

CMU = $80,000 + $0 / $2 per product

= $40,000 product

c. Magnum has a target profit of $20,000 and expects to sell 40,000 units. Compute the selling price it must charge to earn the target profit.

Profit = [(Sales price – Variable cost) x Volume] – Fixed costs

$20,000 = [(Sales price – $8 per unit) x 40,000] – $80,000

Sales price = $10.50

d. Magnum wants to keep its selling price at $10 per unit and earn a 10% profit. Calculate the number of products it must sell.

Profit = (CMU x Volume) – Fixed Costs

10% x Revenues = ($2.00 x Volume) – $80,000

.1 x ($10 x Volume) = ($2.00 x Volume) – $80,000

Volume = 80,000 products

Appendix C: Instructions for Building the Program

(from a separate handout provided to students)

Spreadsheet Assignment 1:
Strategic Planning and CVP analysis
What-if and Goal Seeking Using Excel

Problem 3-10: What-if analysis

1. **Create a template program for the proforma income statement using the part a data.** See [Table] 1 for format. Globally format all cells (click corner box to the left of column headings and above row headings to highlight entire spreadsheet) to display as currency, no dollar sign or decimal places, negative numbers in parentheses (Format/Cells/Number, Currency option), and set to Arial font, size 10 (Format/Cells/Font).
2. **Heading section:**
   a. Enter this information in cells A1-A4. Use a dynamic date command to display the current date in cell A4 (click the Paste function icon on the toolbar, Function category = date & time, choose "now" or "today"). Format the cell to display the date in usable form (Format/Cells/Number, Category = date, and choose a specific format).
   b. Center all four rows over columns A – F (to center all four rows at once, highlight the cells, and use the menu: Format/Cells/Alignment/Horizontal/Center across selection).
   c. Border the heading (toolbar icon = outside borders), and add a shadow (Drawing toolbar icon, shadows icon).
3. **Data section:**
   a. Type in the row headings in column A, the data given in the problem in column B, and the units of measure in column C.
   b. "Data section" heading: bold (toolbar icon), change font color to white (toolbar icon = font color), and background to black (toolbar icon = fill color).
   c. Set-up cell names on the column B cells using the column A row headings (highlight A8 through B11, Insert/Name/Create, "left column" should

be checked).

4. **Solution section:**
   a. Column headings (e.g., "Per unit") should be right-aligned over the numbers.
   b. Cell D17 is a formula containing the sales volume cell name from the data section. (Formula = +Volume. Enter plus sign and click on cell B9. Or, enter plus sign, hit the F3 function key on your keyboard to list names, double click on the name, and hit enter.)
   c. B18 and B19 are formulas using their data section cell names (start the B19 formula with a minus sign). CMU is a sum command (use Autosum toolbar icon). Create a cell name for CMU (click on cell, Insert/Name/Define, and type in the name. Don't name this cell "contribution margin" as CM is cell D20!). An alphabetical list of cell names is in the "Cell name table" section of the spreadsheet.
   d. In C18, set revenues equal to 100% (type in the number one). Format C18 through C20 for percentages. Note, negative percentages appear with a minus sign. If you want to change this format so negative percentages are in parentheses, Excel's internal coding commands must be changed ("Format/style"). However, we will not change Excel's default styles in this assignment.
   e. Variable cost ratio and CM ratio are formulas using cell names (do not use a sum command for CM ratio). Create a cell name for CM ratio by clicking on the name box (left of Formula bar below toolbars), typing the name, and hitting enter (shortcut for Insert/Name/Define).
   f. Total revenues (D18) and total variable costs (D19) are formulas using cell names. CM is an If-Then statement (if summing down = CMU x Volume, input either value, otherwise "error"), and profit is a sum command. Name D23. To create an If-then formula, use the toolbar Paste Function icon, Function category = all or logical, Function name = IF, Logical test: D18+D19=CMU x Volume, True value: D18+D19, False value: "error."
   g. The equations in B25, B27, and B29 use cell names. Name each of these cells.
   h. The "What-if changes" in Column F use formulas in which the cell names for the current part of the problem are subtracted from the part A numeric answers (e.g., F23 formula is +profit-1200000). Name each of these cells.
   i. Reformat the cells that should have dollar signs (hold down the Control key and click on each cell to be reformatted, Format/Cells/Number, Currency, dollar sign option, no decimal places, negative numbers in parentheses).

5. **Cell name table:**
   Click on the upper left cell where the table will be (A32). Insert/Name/Paste/Paste list. Use a "Counta" command for the number of cell names in B47.

6. **Printing:**
   a. Click on Print preview toolbar icon, choose Setup/Margins and adjust margins to 1" with 1/2" header and footer. Center horizontally and vertically.
   b. While still in Print Preview/Setup, click on the Page tab and enlarge to fill the page ("Scaling, Adjust to" and increase the sizing percentage), or shrink to fit on one page ("Scaling, Fit to" and set to 1 page wide by 1 page tall).
   c. While still in Print Preview, click on the Header/Footer tab and set up the file name as a footer. No header is needed.
   d. While still in Print Preview, click on the Sheet tab and make sure that "Print/Gridlines" and "Print/Row and column headings" are not checked (don't include column or row headings or gridlines on a formal report!).
   e. Print the part a solution.

7. **Scenarios:**
   a. Save part a as scenario "a" using Tools/Scenarios (click on the Add button, Scenario name = a, Cells B8 through B11 are the "changing cells").
   b. Parts b – h:
      i. Before creating each new part's scenario, be sure to have part a's solution displayed (in Scenarios, click on scenario a, and then on Show).
      ii. Create a new scenario for part b (Tools/Scenarios/Add). Input the new data values for part b (in Scenario values, change volume to

Scenario Summary	a	b	c	d	e	f	g	h
	Original	Vol=+10%	SP=+10%	VC=+10%	FC=+10%	SP=($500) Vol=+10%	SP=+10% Vol=(10%)	FC=+10% Vol=+10%
Changing Cells:								
Sales_price	$15,000	$15,000	$16,500	$15,000	$15,000	$14,500	$16,500	$15,000
Volume	1,200	1,320	1,200	1,200	1,200	1,320	1,080	1,320
Variable_costs	$12,500	$12,500	$12,500	$13,750	$12,500	$12,500	$12,500	$12,500
Fixed_costs	$1,800,000	$1,800,000	$1,800,000	$1,800,000	$1,980,000	$1,800,000	$1,800,000	$1,980,000
Result Cells:								
Profit	$1,200,000	$1,500,000	$3,000,000	($300,000)	$1,020,000	$840,000	$2,520,000	$1,320,000
Profit_change	$0	$300,000	$1,800,000	($1,500,000)	($180,000)	($360,000)	$1,320,000	$120,000
BEvolume	720	720	450	1,440	792	900	450	792
BEP_change	0	0	(270)	720	72	180	(270)	72
MOS	40%	45%	63%	(20%)	34%	32%	58%	40%
MOS_change	0%	5%	23%	(60%)	(6%)	(8%)	18%	0%

1200*1.1, the other data values are the same as in scenario a). Save the solution as scenario b. Display the part a solution again, and create a new scenario for each remaining part.

iii. After finishing scenario h, create a Scenario Summary (Tools/Scenarios/Summary). Report type should be "Scenario summary." The "Result cells" are D23, F23, B25, F25, B29, and F29. Because each of these cells is named, the cell names appear on the Scenario Summary (rather than the cell addresses). A new worksheet containing the summary is created preceding sheet 1. Edit it to look like the summary [above]. Include the file name in its footer ("Print Preview/Setup/Header-Footer"). Print the scenario summary sheet in landscape (Print preview/Setup/Page tab, Orientation = landscape).

8. **Print the cell formulas in landscape on one page with column and row headings and gridlines.**
   a. While holding down the control key, hit the tilde key (keyboard key in upper left corner just left of number 1/exclamation point key) to switch to cell formulas layout.
   b. Click on "Insert/Name/Apply," highlight all cell names, and click "OK." Cell addresses should be replaced with their names. This doesn't always work, though, so you may have to repeat the process. When using this command, be sure you click in only one cell. If multiple cells are highlighted when this command is used, only those cells will have names applied.
   c. Adjust column widths so all formulas can be read. Make sure no formulas are truncated! Narrow the column A width to show only the row names (so font size can be as big as possible when printing). Because column A's width was narrowed, you may not see the heading rows at the top of the spreadsheet. This is okay.
   d. Align the rows 16 & 17 column headings over the formulas (Align Left toolbar icon).
   e. Print in landscape and scale-to-fit on one page (Print Preview/Setup/Page). In the Sheet tab, print gridlines and row and column headings. In the Margins tab, center horizontally and vertically on the page.
   f. Print the cell formulas and check it to make sure all cell names appear.
9. **When handing in the assignment, the part a solution should be first, followed by the Scenario Summary page, and then the cell formulas page. Landscape pages should face to the right when stapling pages.**

Problem 3-9: Goal seeking

1. **Use the Problem 3-10 program.** Delete columns E and F. Delete the cell names that were in column F (Insert/Name/Define, choose the name, hit "delete"). Change the problem name in A3 to "Problem 3-9a,b". Save as Problem 3-9 (File/Save as). Go into Print Preview and change the footer to the new file name. Format the sales price, variable costs, and CMU cells (B8, B10, B18-20) to display two decimal places ("control-click" on each cell, and use the toolbar icon for adding decimal places).
2. **Parts a and b:**
   a. Input Problem 3-9's values for sales price, variable costs, and fixed costs into the data section. Set volume = 0.

b. Solve for BEP and BE Revenues with Tools/Goal Seek. Our goal is zero profit by changing the sales volume. So, "Set cell" is the goal cell (D23), and its value ("To value") is zero, "by changing cell" B9. When you click "OK," the correct solution is displayed.

c. So I know you used the Goal Seek function, change B9 back to zero. Repeat the previous step but do not click "OK." Move the Goal Seek dialogue box to a blank part of the screen so it does not block any of the numbers, and hit the Print Screen keyboard button. Open a blank Word file and click on the Paste toolbar button. You should see a screen image of the spreadsheet pasted into the Word file, showing the Goal Seek dialogue box and the original solution with volume = 0. Change the view to Print Layout View (lower left button next to horizontal scroll bar), use the Zoom toolbar icon to display the entire page, and insert a blank line below the Excel image.

d. Go back to Excel and click "OK." You should now see the Goal Seek Status dialogue box noting a solution was found. Move it out of the way of any numbers. Hit Print Screen again, return to Word and paste this image into the Word file. Size both images so that they fit on one page (click on the image, move mouse to lower right corner handle, hold down the left mouse button and drag inward), and center them (Center toolbar icon). Insert a hard page break (Control key + Enter).

e. While in page 1, insert a header and footer. Using File/Page Setup/Layout/Headers and footers, make sure "Different first page" is not checked. Using View/Header and Footer, type a header containing the information [your name, course number, semester, assignment name, date, and page number and number of pages]. Use the icons for date, page number, and number of pages. Also set-up the file name as a footer.

3. **Part c:**

a. Change the heading to part c (cell A3). Run Goal Seek again, setting D23 to $20,000 by changing B8. Before clicking "OK", print screen and paste on page 2 of your Word document.

b. Return to Excel and finish the Goal Seek command. When the correct solution appears with the Goal Seek Status dialogue box, Print Screen again and paste into your Word document. Size the two images in your Word file so they fit on page two. Insert a hard page break.

4. **Part d:**

a. Return to Excel and change the heading to part d. Change B8 back to $10.00. In Goal Seek, set D23 to 10% of D18 (D18*.1). You will get an error message. Goal Seek only works when values are numbers. So, create a formula in F23 for the profit ratio (format cell as a percentage). Repeat goal seek by setting this cell to 10%. Goal Seek will find a solution, however it is wrong! Using Print Screen, paste these two screen images onto page 3. Insert a hard page break.

b. So, let's try the linear programming function (Tools/Solver). "Set target cell" F23 "Equal to value of" 0.1, by changing cell B9. Note, the linear programming function also provides a wrong solution! Print screen and paste these two screen images onto page 4 of your Word file. Print the Word file and staple it behind the Excel printouts for Problem 3-10.