

## **A Case Method Approach to Teaching Cost-Volume-Profit Analysis**

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*This paper presents a Multi-Disciplinary Case-Method approach to teaching Cost-Volume-Profit (CVP) Analysis allowing students to use their own assumptions to simulate a real-life business startup analysis. The proposed business venture is one of starting a milkshake shack in the island of Hawaii. Students will learn to distinguish between fixed and variable costs, apply some of their own assumptions, and determine whether it would be profitable to open up a new business.*

### **INTRODUCTION**

I present an alternative, more comprehensive teaching approach, for Cost-Volume-Profit (CVP) analysis from the commonly used approach which simply teaches students how to use a series of equations to solve various questions related to CVP analysis, in which unit selling price, total fixed costs, and unit variable costs are assumed to remain constant (Garrison et al. 2010; Choo and Tan, 2010). I use a multi-disciplinary approach in the context of a realistic case-analysis. I believe this approach offers useful insights and provides a useful learning tool for students pursuing an advanced Master's Degree. The case at hand requires students to: (a) make assumptions about costs in a dynamic and interactive way, and (b) research a variety of marketing issues for the proposed business that simulates a real life business situation. This paper's approach also helps students see the interrelationships between several concepts learned in basic graduate courses taken in their Master Degree program, and how CVP analysis can be an extremely useful tool for determining the potential success of a business they might consider opening one day. Particular attention is given to important concepts such as break-even analysis and the effect of changing working assumptions on final results.

Students are assumed to come into this course with a basic understanding of concepts learned in core courses such as Finance, Financial Accounting, Marketing and Management. In addition to being familiar with concepts of fixed versus variable costs, students are assumed to be familiar with how changes in these costs interact with changes in sales revenue to determine net income; concepts which should have already been covered in their Managerial Accounting course. An additional benefit of this case is that students can treat it as a simulation exercise in which they vary assumptions about different variables such as: sales price, direct materials' quality, total fixed costs, depreciation lives, and sales mix, etc. to see how all variables, individually and collectively, affect their break-even points. This point is often overlooked in textbooks that focus more on an equation approach in a static rather than a dynamic analytical approach.

## DEVELOPMENT OF THE CASE

The case assumes students will open a milkshake shack on the beach of a resort on the “big Island” of Hawaii. I have studied existing restaurants, read industry reports, and have done some research on expected minimum costs to be incurred in operating the business. A unique feature of my milkshakes is that I will serve them with flavored straws that match the flavor of the chosen milkshakes by customers. My research embeds the following assumptions:

Sales prices of milkshakes (\$7.00 for small, and \$10.00 for large)

Cost of materials needed to make milkshakes:

DIRECT MATERIAL INGREDIENTS	Small (8 oz. size)	Large (12 oz. size)
Whole Milk (\$15 for a 5 gallon=740 oz.)	(need 2 oz. of milk)	(need 3 oz. of milk)
Cream (\$20 for 1 gallon=128 oz.)	(need 2 oz. of cream)	(need 3 oz. of cream)
Sugar (\$10 for a 15 lb. bag=30 cups)	(need ½ cup of sugar)	(need ¾ cup of sugar)
Premium Vanilla Ice Cream (\$24 for 600 oz.)	(need 6 oz.)	(need 9 oz. of cream)
Flavorings	.25 per shake	.40 per shake
Flavored specialty straws	.75 per straw	.75 per straw
Cups (500 8 oz. cups @ a cost of \$200)		-----
Cups (500 12 oz. cups @ a cost of \$250)	-----	

### Fixed costs:

- Shack rental: \$500 a month
- Cleaning and other miscellaneous supplies: \$100 a month
- Equipment: Industrial Milk Shake Maker: \$72 per machine x 10 machines=\$720
- Equipment: Industrial Refrigerator/freezer: \$480
- Countertops: \$1,200
- Tables and benches for customers to sit outside: \$108 per bench-set x 10=\$1,080
- Annual insurance: \$600 a year
- Sign: use your marketing knowledge to think of a good name= \$100

Total Fixed Costs = \$4,780 for which students are assumed to take out a non-owner loan. A self-amortizing loan is assumed to be obtained from a bank, and carries an annual interest rate of 6% payable over 2 years with monthly payments (each monthly payment consists of both principal and interest).

### Employees:

Two part-time employees: with each receiving a monthly salary of \$800 per month (including taxes and benefits).

### Other costs:

10% of gross sales must be given to resort where shack will be located on its premises.

Owner’s capital will be used to cover direct materials’ costs.

## REQUIREMENTS OF THE CASE

In order to answer the questions below, you will need to make assumptions, and add/change fixed and variable costs (please clearly indicate all assumptions made).

- 1) Using the above information, determine the number of milkshakes you will need to sell to break even. In order to do this, you will need to set a sales price as well as classify the above costs into fixed or variable. (Hint: keep all costs on either a weekly, monthly or yearly basis throughout your analysis).

- 2) Now build-in a salary for yourself, and determine the amount of milkshakes you will need to sell to break even.
- 3) Should you leave your job to open the milkshake shack?

### ANSWERS TO THE CASE

Presented below are two possible answers to this case. The first answer uses only information provided in the case with the following assumptions: 1) the milkshakes' sales-mix will be 60% large and 40% small, 2) the suggested sales prices are used to be competitive with other vendors, and 3) the milkshake makers, tables and benches are assumed to last for 3 years, but the refrigerator/freezer and counter tops are assumed to last for 10 years. Since this is a simulation exercise, the case allows students to see how the break-even sales volume changes depending upon different assumptions about product sales-mix, sale prices, depreciable lives of long-term assets as well as variable costs, and allows them to add other necessary fixed costs to the cost structure of the business conditional on their own unique business strategy. Accordingly, I present a second solution after changing some of the assumptions to show the effect that different assumptions have on break-even sales volume.

#### Monthly fixed costs:

• Salary of 2 part-time workers	1,600.00	
• Rental	500.00	
• Supplies	100.00	
• Milk Shake Maker depreciation	20.00	(720/ 36months)
• Refrigerator/freezer depreciation	4.00	(480/120 months)
• Counter tops depreciation	10.00	(1,200/120months)
• Tables and benches depreciation	30.00	(1,080/36 months)
• Annual insurance	50.00	(600/12months)
• Interest on loan	211.85	
• Sign	<u>100.00</u>	
<b>Total monthly Fixed Costs</b>	<b>\$2,625.85</b>	

#### Variable Costs per unit:

<u>Ingredient</u>	<u>Cost</u>		<u>Small</u>	<u>Large</u>
Whole milk	\$15 for 740 oz.	0.02027 per oz.	0.04	0.06
Cream	\$20 for 120 oz.	0.16667 per oz.	0.33	0.50
Sugar	\$10 for 30 cups	0.33333 per cup	0.17	0.25
Premium Vanilla Ice Cream	\$24 for 600 oz.	0.04000 per oz.	0.24	0.36
Flavorings			0.25	0.40
Flavored Specialty Straws			0.75	0.75
Cups-8 ounces	\$200 for 500 cups	0.40000 per cup	0.40	
Cups-12 ounces	\$250 for 500 cups	0.50000 per cup		<u>0.50</u>
<b>TOTAL DIRECT MATERIAL COST PER UNIT</b>			<b>\$2.18</b>	<b>\$2.82</b>

**Variable Cost Income Statement:** using a 40% (small) and 60% (large) sales-mix in determining the break-even sales volume:

	Small (40%)	Large (60%)	Weighted total
Sales price per unit after taking out the 10% owed to resort	$\$7 \times 90\% = 6.3 \times 40\% = 2.520$	$\$10 \times 90\% = \$9 \times 60\% = 5.400$	7.920 per unit
Variable cost per unit	$2.18 \times 40\% = .872$	$2.82 \times 60\% = 1.692$	2.564 per unit
Contribution margin per unit	1.648	3.708	5.356 per unit
Total Fixed costs			2,625.85

1) You will need to sell 490 milkshakes/month to break even =  $(\$2,625.85/5.356)$ . Of the 490 milkshakes, 196  $(490 \times 40\%)$  will be small, and 294  $(490 \times 60\%)$  will be large.

2) If you build into the analysis a salary of \$5,000 a month, you will need to sell 1,424 milkshakes/month to break even  $(\$2,625.85 + \$5,000)/5.356$ . Of the 1,424 milkshakes, 570  $(1,424 \times 40\%)$  will be small and 854  $(1,424 \times 60\%)$  will be large.

**Variable Cost Income Statement:** using 40% (small) and 60% (large) sales-mix in determining the break-even sales volume (no salary allowance for owner):

	Small (40%)	Large (60%)	Weighted total
Sales price per unit after taking out 10% owed to resort	$\$6.30 \times 196 \text{ milkshakes}$ \$1,234.80	$\$9 \times 294 \text{ milkshakes}$ \$2,646.00	\$3,880.80
- Variable cost per unit	$\$2.18 \times 196 \text{ milkshakes}$ \$427.28	$\$2.82 \times 294 \text{ milkshakes}$ \$837.90	\$1,265.18
Contribution margin per unit	\$807.52	\$1,808.10	\$2,615.62
Total Fixed costs			\$2,625.85
Net Income			0 or (10.23) rounding error

*Note: The break even sales volume is 490.26 milkshakes. The Variable Cost Income Statement uses the breakeven quantity of 490 milkshakes. A small loss is shown due to rounding error since you cannot sell fractional milkshakes.*

**Variable Cost Income Statement:** using 40% (small) and 60% (large) sales-mix in determining the break-even sales volume (with a salary allowance of \$5,000 salary per month for owner):

	Small (40%)	Large (60%)	Weighted total
Sales price per unit after taking out 10% owed to resort	$\$6.30 \times 570 \text{ milkshakes}$ \$3,591.00	$\$9 \times 854 \text{ milkshakes}$ \$7,686.00	\$11,277.00
- Variable cost per unit	$\$2.18 \times 570 \text{ milkshakes}$ \$1,242.60	$\$2.82 \times 854 \text{ milkshakes}$ \$2,408.28	\$3,650.88
Contribution margin per unit	\$2,348.40	\$5,277.72	\$7,626.12
Total Fixed costs			\$7,625.85
Net Income			0 or 0.27 rounding error

*Note: The break even amount is now 1,423.79 milkshakes. The Variable Cost Income Statement uses the breakeven quantity of 1,424 milkshakes. A small profit is shown due to rounding error since you cannot sell fractional milkshakes.*

In the second set of answers, sensitivity of break-even sales volume to changes in inputs to CVP Analysis is demonstrated. Here, the sales mix is changed to 20% small and 80% large milkshakes (instead of 40/60), and the sales price is changed to \$6 for a small milkshake and \$9 for a large milkshake

in an attempt to be more price-competitive. Additionally, advertising costs of \$100 a month (instead of no advertising costs), and a higher salary for the owner of \$6,000 (instead of \$5000) per month is assumed.

**Variable Cost Income Statement:** using a 20% (small) and 80% (large) sales-mix in determining the break-even sales volume:

	Small (20%)	Large (80%)	Weighted total
Sales price per unit after taking out the 10% owed to resort	$\$6 \times 90\% = 5.4 \times 20\% = 1.080$	$\$9 \times 90\% = \$8.1 \times 80\% = 6.480$	7.560 per unit
Variable cost per unit	$2.18 \times 20\% = .436$	$2.82 \times 80\% = 2.256$	2.692 per unit
Contribution margin per unit	0.644	4.224	4.868 per unit
Total Fixed costs			$2,625.85 + 100 = 2,725.85$

1) You will need to sell 560 milkshakes/month to break even ( $\$2,725.85 / 4.868$ ). Of the 560 milkshakes, 112 ( $560 \times 20\%$ ) will be small and 448 ( $560 \times 80\%$ ) will be large.

2) If an owner's salary of \$6000 per month is built into the fixed costs structure, you will need to sell 1,793 milkshakes/month to break even ( $\$2,725.85 + \$6,000 / 4.868$ ). Of the 1,793 milkshakes, 359 ( $1,793 \times 20\%$ ) will be small, and 1434 ( $1,793 \times 80\%$ ) will be large.

**Variable Cost Income Statement:** using 20% (small) and 80% (large) sales-mix in determining the break-even sales volume (no salary allowance for owner):

	Small (20%)	Large (80%)	Weighted total
Sales price per unit after taking out 10% owed to resort	$\$5.40 \times 112 \text{ milkshakes}$ \$604.80	$\$8.10 \times 448 \text{ milkshakes}$ \$3,628.80	\$4,233.60
- Variable cost per unit	$\$2.18 \times 112 \text{ milkshakes}$ \$244.16	$\$2.82 \times 448 \text{ milkshakes}$ \$1,263.36	\$1,507.52
Contribution margin per unit	\$360.64	\$2,365.44	\$2,726.08
Total Fixed costs			\$2,725.85
Net Income			0 or (.23) rounding error

*Note: The break even sales volume is 559.95 milkshakes. The Variable Cost Income Statement uses the breakeven quantity of 560 milkshakes. The income Statement shows a small profit (due to rounding error) since you cannot sell fractional milkshakes.*

**Variable Cost Income Statement:** using 20% (small) and 80% (large) sales-mix in determining break-even sales volume (with a salary allowance of \$6,000 per month for owner):

	Small (20%)	Large (80%)	Weighted total
Sales price per unit after taking out 10% owed to resort	$\$5.40 \times 359 \text{ milkshakes}$ \$1,938.60	$\$8.10 \times 1434 \text{ milkshakes}$ \$11,615.40	\$13,554.00
- Variable cost per unit	$\$2.18 \times 359 \text{ milkshakes}$ \$782.62	$\$2.82 \times 1434 \text{ milkshakes}$ \$4,043.88	\$ 4,826.50
Contribution margin per unit	\$1,155.98	\$7,571.52	\$8,727.50
Total Fixed costs			\$8,725.85
Net Income			0 or 1.65 rounding error

*Note: The break even amount is 1,792.49 milkshakes. The Variable Cost Income Statement uses 1,793 milkshakes as the breakeven quantity. The Income Statement will show a small profit since you cannot sell fractional milkshakes.*

## **CONCLUSION**

I believe that this case adds to students' understanding of CVP Analysis beyond traditional approaches to teaching that concept. The multi-disciplinary approach used adds breadth to the analysis since it is important for students to realize how basic courses taken in their Master's Degree Program are interrelated, and how knowledge gained from these courses can be used to: (a) set sales prices and build-in advertising costs into the analysis (concepts learned in a marketing class), (b) choose quality of direct materials and labor, both of which affect variable costs (concepts learned in a management class), (c) make assumptions about depreciation lives (concepts learned in a financial accounting class), and (d) last but not least, prepare amortization schedules for monthly payments, and breaking down each payment into its two components interest and principle (concepts learned in a finance class). The case also gives students flexibility to make different assumptions about necessary business start-up costs, and immediately see the impact of varying assumptions on break-even points. It is important for students to understand how CVP analysis can be an extremely useful tool for determining potential success of a business venture they may start one day. Moreover, the case provides them with experience in conducting dynamic simulations, and understanding how changing assumptions affect estimated break-even points. This latter point is often overlooked in textbooks which usually focus on an equation-based approach to solving for breakeven points in a static analytical framework which may not mimic real-life situations that embed changing business conditions.

In closing, I would like to present a couple of selected comments from students who have, in the past, analyzed a similar case in an online class I teach at the University of Massachusetts, Amherst's Professional MBA (PMBA) Program: "...Last week I had a unique business opportunity fall into my lap, and have actually started a small business. In just 4 days, I've already sold products on-line from NY, to CA. I've been able to use several items learned in your course to help me with this rapid and kind of overwhelming process. In particular, I'm finding the Break Even Analysis, to be VERY helpful--for setting prices and goals." Also: "...I just wanted to say thank you. I am a program manager for a manufacturing company and I have been able to put this all to use immediately, especially CVP analysis".

## **REFERENCES**

Choo, F. & Tan K.B. (2011). An Income Statement Approach for Cost-Volume-Profit (CVP) Analysis by Using a Company's CVP Model. *Journal of Accounting and Finance*, 11(4), 23-36.

Garrison, R.H, Noreen E., & Brewer P.C. (2010). *Managerial Accounting*, 12<sup>th</sup> edition. New York: Irwin/McGraw-Hill.