VNIVERSITAT DE VALÈNCIA

Facultat d'Economia

DEGREE IN BUSINESS ADMINSTRATION

35836 Operations Management: Decisions and Resources

(OR/English Group)

Solved Practical Exercises Lesson 8 Capacity and Break-even Point Analysis

Course: 202223

Professor: Emilio Camarena Gil

BREAK-EVEN POINT

As a tool to help us to take sound decisions, we are going to practise the concept of break-even point.

Study the class handouts and the attached document:

HEIZER RENDER MUNSON 2017 BREAK-EVEN ANALYSIS

Once the theory has been studied, the following exercises will be practised in the classroom:

Exercise BP.1

Markland Manufacturing intends to increase capacity by adding new equipment to overcome a bottleneck. Two vendors have presented proposals. The fixed costs for proposal A are $50,000, and for proposal B, $70,000. The variable cost for A is $12, and for B, $10. The revenue generated by each unit is $20.

a) What is the break-even point in units for proposal A?
b) What is the break-even point in units for proposal B?

SOLUTION:

A : FC = $50,000 **B: FC = $70,000**

VC= $12 **VC= $10**

Sales price = $20 **Sales price = $20**

Break-even= $\frac{FC}{CM} = \frac{50{,}000}{\$8} = 6250\ units$ **Break-even=** $\frac{FC}{CM} = \frac{70{,}000}{\$10} = 7000\ units$

Exercise BP 2

Luca Pacioli, the owner of Pizzeria Moderna, is considering a new oven to bake the firm's signature dish, a vegetarian pizza. Oven type A can handle 20 pizzas an hour. The fixed costs associated with oven A are $20,000 and the variable costs are $2 per pizza. Oven B is larger and can handle 40 pizzas an hour. The fixed costs associated with oven B are $30,000 and the variable costs are $1.25 per pizza. The pizzas sell for $14 each.

a) What is the break-even point for each oven?
b) If the owner expects to sell 9,000 pizzas, which oven should he purchase?
c) If the owner expects to sell 12,000 pizzas, which oven should he purchase?
d) At what volume should Luca switch ovens?

SOLUTION:

a)A : FC = $20,000 B: FC = $30,000

VC= $2 VC= $1.25

Sales price = $14 Sales price = $14

Break Even= $\frac{FC}{CM} = \frac{20{,}000}{(14-2)\,\$} = 1666\ units$ Break-even= $\frac{FC}{CM} = \frac{30{,}000}{14-1{,}25\,\$} = 2352\ units$

b+c)

9000 units: Profit A = 9000·12-20000 = $88,000 Profit B= 9000·12,75 -30000 = $84,750

12,000 units: Profit A = 12000·12-20000 = $124,000 Profit B= 12000·12,75 -30000 = $123,000

d)

Profit oven A = x · 12 – 20,000 = x· 12,75-30,000 = Profit oven B → X = 13,333 units

At this point, both profit lines give the same profit, and for higher volumes, oven B is a better solution.

Exercise BP 3

John and Mary have joined forces to start J&M Lettuce Products, a processor of packaged shredded lettuce for catering. John has years of food processing experience, and Mary has extensive commercial food preparation experience. The process will consist of opening crates of lettuce and then sorting, washing, slicing, preserving, and finally packaging the prepared lettuce. Together, with help from vendors, they believe they can adequately estimate demand, fixed costs, revenues, and variable costs per 5-pound bag of lettuce. They believe a largely manual process will have monthly fixed costs of $37,500 and variable costs of $1.75 per bag. A more mechanised process would have fixed costs of $75,000 per month with variable costs of $1.25 per 5-pound bag. They expect to sell the shredded lettuce for $2.50 per 5-pound bag.

a) What is the break-even quantity for the manual process?

b) What is the revenue at the break-even quantity for the manual process?

c) What is the break-even quantity for the mechanised process?

d) What is the revenue at the break-even quantity for the mechanised process?

e) What is the monthly profit or loss of the manual process if they expect to sell 60,000 bags of lettuce per month?

f) What is the monthly profit or loss of the mechanised process if they expect to sell 60,000 bags of lettuce per month?

g) At what quantity would John and Mary be indifferent to the process selected?

h) Over what range of demand would the manual process be preferred over the mechanised process? Over what range of demand would the mechanised process be preferred over the manual process?

SOLUTION:

a) MANUAL PROCESS

b)

PROFIT = $2.50 \cdot x - (37500 + 1.75 \cdot x) = 0.75 \cdot x - 37500$

BREAKEVEN: $\frac{37500}{0.75} = 50.000$ UNITS → REVENUE $50.000 \cdot 2.50 = 125.000\ \$$

c/d) MECHANIZED PROCESS

PROFIT = $2.50 \cdot x - (75000 + 1.25 \cdot x) = 1.25 \cdot x - 75000$

BREAKEVEN = $\frac{75000}{1.25} = 60.000$ UNITS → REVENUE $60.000 \cdot 2.50 = 150.000\ \$$

e) MANUAL PROCESS

PROFIT = $0.75 \cdot x - 37500 = 0.75 \cdot 60.000 - 37500 = 7500\ \$$

f) MECHANIZED PROCESS

PROFIT (60.000 BAGS) = 0 → IT'S BREAKEVEN POINT

g) h)

PROFIT (MANUAL) = $0.75 \cdot x - 37500$ = PROFIT (MECH) = $1.25 \cdot x - 75000$

$75000 - 37500 = (1.25 - 0.75) \cdot x$

$75000 = x$ UNITS

OUTPUT < 75000 UNITS: MANUAL PROCESS

75000 UNITS → MECHANIZED PROCESS

Exercise BP 4

As a prospective owner of the Blue Dahlia club, you want to know the volume of sales necessary in the year ahead to reach break-even. You decide to break down the sales for the club into four categories, the first category being beer. Your estimate of beer sales is that 30,000 drinks will be served. The selling price for each unit will average $1.50; and the cost is 75 cents.

The second major category is meals. You expect 10,000 units with an average price of $10 and a cost of $5. The third major category is desserts and wine of which you also expect to sell 10,000 units, but with an average price of $2.50 per unit sold and a cost of $1 per unit.

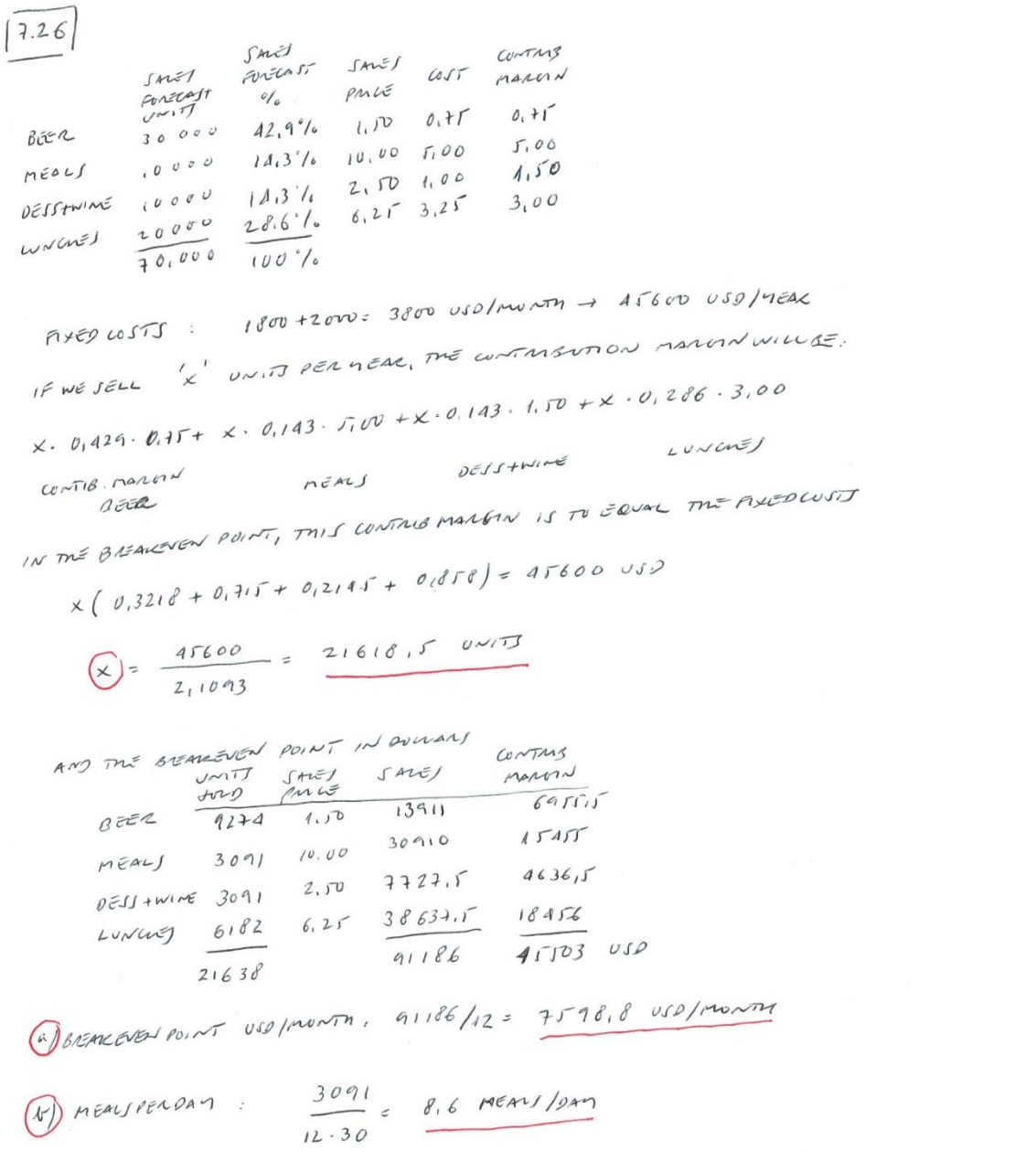
The final category is lunches and inexpensive sandwiches, and you expect to sell 20,000 units at an average price of $6.25 with a food cost of $3.25. Your fixed cost (such as rent and utilities) is $1800 per month plus $2000 per month for entertainment.

a) What is your break-even point in dollars per month?

b) What is the expected number of meals each day for break-even if you are open 30 days a month?

SOLUTION:

		estimation sales units	% in units	selling price	cost	estimation sales	% in dollars	sales dollars at breakeven	sales units at breakeven	contribution at break even	contribution margin unit	forecast contri margin
	beer	30000	43%	1,50	0,75	45000	15%	13911,86	9274,58	6955,93	0,75	22500
	meals	10000	14%	10,00	5,00	100000	34%	30915,25	3091,53	15457,63	5,00	50000
	dess+wine	10000	14%	2,50	1,00	25000	8%	7728,81	3091,53	4637,29	1,50	15000
	lunches	20000	29%	6,25	3,25	125000	42%	38644,07	6183,05	18549,15	3,00	60000
		70000	100%			295000	100%	91200,00		45600,00		147500
	fixed costs			3800	45600						profit	101900
				month	year			7600	8,587570621			
						0,30915254						



Exercise BP 5

The Mediterranean Sunset Hotel has 25 VIP rooms, 80 double rooms, and 43 single rooms. During the 2021, the selling price of the rooms were, respectively: €120, €85, and €50 per night, and their variable unit costs were: €65, €50, and €35 per night, respectively. Opening

365 days a year, the break-even point of the hotel would be reached with an average occupancy rate during the year of 72.2%.

For the 2022 season, works have been carried out on the hotel and the number of rooms has been increased to 30 VIP rooms, 90 double rooms, and 50 single rooms. It is estimated that the fixed costs will increase by 10%, and that the selling price can only be increased by 5%, with the variable unit cost of each room remaining constant. The hotel will be open only 360 days during 2022. What average occupancy must be attained during the year to reach the break-even point? Give the value to one decimal percentage point.

SOLUTION:

					Days/year	365	
2021	nº rooms	Sales price	Var unit cost	CM	Occup rate	Total CM	Fixed costs
VIP room	25	120	65	55	0.722	362,353.75	
Double room	80	85	50	35	0.722	737,884.00	
Single room	43	50	35	15	0.722	169,976.85	
Total	148					1,270,214.60	1,270,214.60 Fixed costs in 2021

Data in 2021 have been used to calculate the fixed cost for the same period.

2022

Room number in all three types has increased, also sales prices (+5%), but not unit variable costs.

	Number	Selling price	Unit varCost	Contrib margin	
VIP room	30	126.00	65	61.00	Occ rate x
Double room	90	89.25	50	39.25	Occ rate x
Single room	50	52.50	35	17.50	Occ rate x
Total	170				

Days opened in 2022·X Occup rate·(Weighted CM per day) = Fixed costs in 2022= Fixed costs in 2021·X (1+10%)→

360 · x · (30·61 + 90·39.25 + 50·17.50) = 1270214,60·1.1 → Occ Rate = x= 0.622= 62.2%

Exercise BP 6

Vocesa manufactures loudspeakers for audio equipment with fixed costs of €16,000, an average unit sales price of €80, and an average variable unit cost of €40. Increasingly reduced spaces have made Vocesa consider developing smaller speakers. This requires acquiring new technology by changing the manufacturing process. Fixed costs will be increased by €6000, and the average variable unit costs will fall by 10%. From these data, please answer the following questions:

a. For a production volume of 800 units, analyse whether to undertake this new investment;

b. If Vocesa makes the investment and wants to increase its old profit by 25%. What should be the average unit selling price?

SOLUTION

a) NEW INVESTMENT

$FC = 16000 + 6000 = 22000$ €

$SP = 80$ €

VAR. UNIT COST $= 0.9 \cdot 40 = 36$ €

$$B.E.P. = \frac{FC}{CONTRIB} = \frac{FC}{SP - VUC} = \frac{22000}{80-36} = 500 \text{ UNITS}$$

THIS B.E.P IS 500 UNITS, BELOW THE NEW PRODUCTION VOLUME.

BUT IF WE MAINTAIN THE OLD TECHNOLOGY, PROFIT IS:

OLD TECH : PROFIT $= 800 \cdot 80 - \left[FC + 800 \cdot VUC^{OLD}\right] = 64000 - \left[16000 + 800\,40\right] = 16000$ €

NEW TECH: PROFIT $= 800 \cdot 80 - \left[FC^{NEW} + 800 \cdot NEWVUC\right] = 64000 - \left[22000 + 800\,36\right] = 13200$ €

OBVIOUSLY, THE NEW INVESTMENT IS NOT ATTRACTIVE

b) OLD PROFIT: $16000 \cdot 1{,}25 = 20000$ €

NEW PROFIT $= SP \cdot 800 - \left[22000 + 800 \cdot 36\right] = 20000$ €

$$\Rightarrow SP = \frac{70800}{800} = 88.50 \text{ €}$$

Exercise BP 7

Tucasa designs, manufactures, and distributes fabrics characterised by a colour and texture that are highly appreciated on the market. It has the following operating account:

- Sales volume: €300,000
- Variable expenses:
  - Materials used in process: €90,000
  - Supplies: €22,500
  - Transport: €45,000
  - Direct personnel expenses: €22,500
- Fixed costs:
  - Depreciation: €5000
  - Financial expenses: €1500

Advertising: €10,000

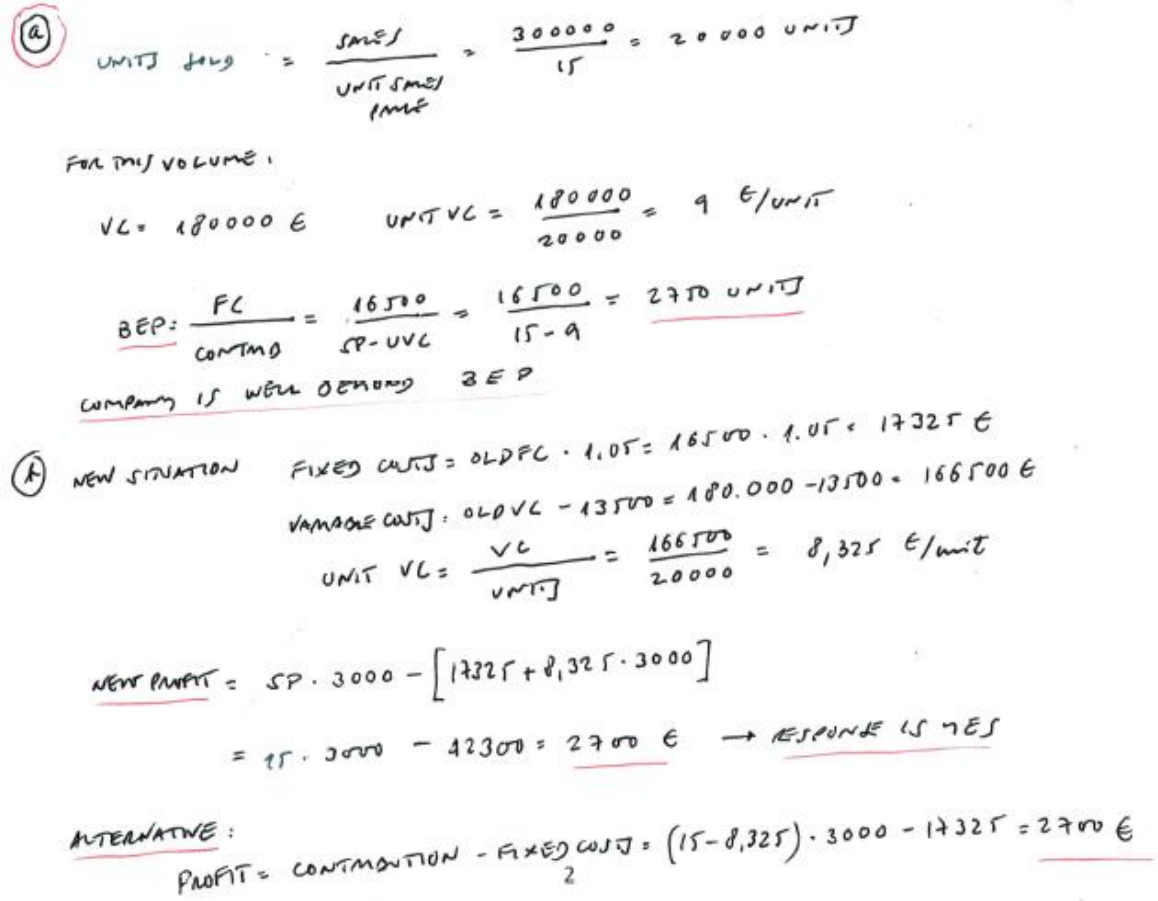
Decide:

a. If the unit sales price is €15; determine the break-even point in physical units.

b. Tucasa considers the reutilization of water as an operations competitive strategy. This could be done by increasing fixed costs by 5%, and thus reducing the water consumption by €13,500 for the mentioned production volume.

Is this change in the production process and cost structure sufficient to make a profit of €2,000 with expected sales of 3,000 meters of fabric? (The selling price does not vary).

SOLUTION



Exercise BP 8

Businessman Manuel Bustos is making calculations for a new concession he has obtained – the cafeteria at the Economics Faculty. Its capacity is 150 users, it will be open 220 days a year, and an average utilisation rate of 87 % is expected.

The price of the menu is set at €12 and Manuel estimates that the fixed yearly costs of the cafeteria will be €115,210. The cafeteria at the Law Faculty, which he also operates, has variable costs of €132,514 and sales of €265,783.

Manuel wants to make an annual profit of €80,000 from the cafeteria at the Economics Faculty. What variable unit cost must his menu have to obtain this figure?

SOLUTION

CUSTOMERS: $150 \cdot 220 \cdot 0{,}87 = 28710$ pax/year

SELLING PRICE 12 €

FC 115.210 €

PROFIT = REV − COSTS

$$80000 = 28710 \cdot 12 - [115210 + 28710 \cdot x]$$

$$x = \frac{28710 \cdot 12 - 115210 - 80000}{28710} = 1{,}20\ €$$