Chapter One: Management Science

PROBLEM SUMMARY

1. Total cost, revenue, profit, and break-even
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4. Break-even volume
5. Graphical analysis (1–2)
6. Graphical analysis (1–4)
7. Break-even sales volume
8. Break-even volume as a percentage of capacity (1–2)
9. Break-even volume as a percentage of capacity (1–3)
10. Break-even volume as a percentage of capacity (1–4)
11. Effect of price change (1–2)
12. Effect of price change (1–4)
13. Effect of variable cost change (1–12)
14. Effect of fixed cost change (1–13)
15. Break-even analysis
16. Effect of fixed cost change (1–7)
17. Effect of variable cost change (1–7)
18. Break-even analysis
19. Break-even analysis
20. Break-even analysis
21. Linear programming
22. Linear programming
23. Linear programming
24. Forecasting/statistics

PROBLEM SOLUTIONS

1a. $v = 300$, $c_f = \$8{,}000$, $c_v = \$65$ per table, $p = \$180$; $TC = c_f + vc_v = \$8{,}000 + (300)(65) = \$27{,}500$; $TR = vp = (300)(180) = \$54{,}000$; $Z = \$54{,}000 - 27{,}500 = \$26{,}500$ per month

b. $v = \dfrac{c_f}{p - c_v} = \dfrac{8{,}000}{180 - 65} = 69.56$ tables per month

2a. $v = 12{,}000$, $c_f = \$60{,}000$, $c_v = \$9$, $p = \$25$; $TC = c_f + vc_v = 60{,}000 + (12{,}000)(9) = \$168{,}000$; $TR = vp = (12{,}000)(\$25) = \$300{,}000$; $Z = \$300{,}000 - 168{,}000 = \$132{,}000$ per year

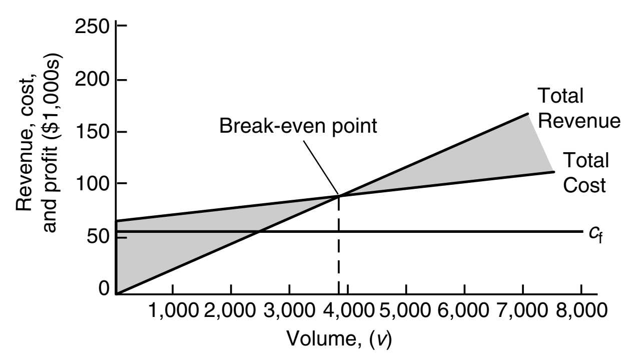
b. $v = \dfrac{c_f}{p - c_v} = \dfrac{60{,}000}{25 - 9} = 3{,}750$ tires per year

3a. $v = 18{,}000$, $c_f = \$21{,}000$, $c_v = \$.45$, $p = \$1.30$; $TC = c_f + vc_v = \$21{,}000 + (18{,}000)(.45) = \$29{,}100$; $TR = vp = (18{,}000)(1.30) = \$23{,}400$; $Z = \$23{,}400 - 29{,}100 = -\$5{,}700$ (loss)

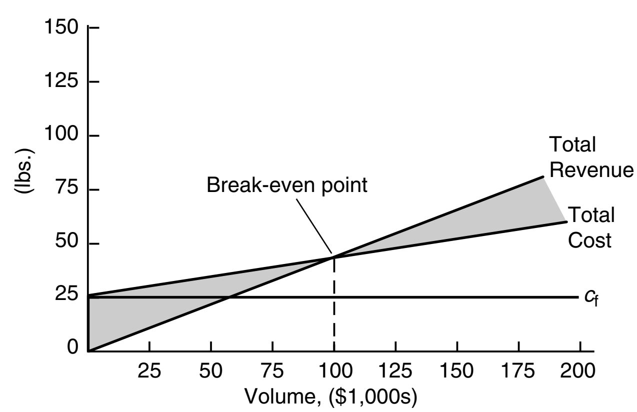
b. $v = \dfrac{c_f}{p - c_v} = \dfrac{21{,}000}{1.30 - .45} = 24{,}705.88$ yd per month

4. $c_f = \$25{,}000$, $p = \$.40$, $c_v = \$.15$, $v = \dfrac{c_f}{p - c_v} = \dfrac{25{,}000}{.40 - .15} = 100{,}000$ lb per month

5.



6.



7. $v = \dfrac{c_f}{p - c_v} = \dfrac{\$25{,}000}{30 - 10} = 1{,}250$ dolls

8. Break-even volume as percentage of capacity $= \dfrac{v}{k} =$

$\dfrac{3{,}750}{8{,}000} = .469 = 46.9\%$

9. Break-even volume as percentage of capacity $= \dfrac{v}{k} =$

$\dfrac{24{,}705.88}{25{,}000} = .988 = 98.8\%$

10. Break-even volume as percentage of capacity $= \dfrac{v}{k} =$

$\dfrac{100{,}000}{120{,}000} = .833 = 83.3\%$

11. $v = \dfrac{c_f}{p - c_v} = \dfrac{60{,}000}{31 - 9} = 2{,}727.3$ tires per year; it reduces the break-even volume from 3,750 tires to 2,727.3 tires per year.

12. $v = \dfrac{c_f}{p - c_v} = \dfrac{25{,}000}{.60 - .15} = 55{,}555.55$ lb per month; it reduces the break-even volume from 100,000 lb per month to 55,555.55 lb.

13. $v = \dfrac{c_f}{p - c_v} = \dfrac{25{,}000}{.60 - .22} = 65{,}789.47$ lb per month; it increases the break-even volume from 55,555.55 lb per month to 65,789.47 lb per month.

14. $v = \dfrac{c_f}{p - c_v} = \dfrac{39{,}000}{.60 - .22} = 102{,}631.57$ lb per month; it increases the break-even volume from 65,789.47 lb per month to 102,631.57 lb per month.

15. Initial profit: $Z = vp - c_f - vc_v = (9{,}000)(.75) - 4{,}000 - (9{,}000)(.21) = 6{,}750 - 4{,}000 - 1{,}890 =$ \$860 per month; increase in price: $Z = vp - c_f - vc_v = (5{,}700)(.95) - 4{,}000 - (5{,}700)(.21) = 5{,}415 - 4{,}000 - 1{,}197 =$ \$218 per month; the dairy should not raise its price.

16. $v = \dfrac{c_f}{p - c_v} = \dfrac{35{,}000}{30 - 10} = 1{,}750$

The increase in fixed cost from \$25,000 to \$35,000 will increase the break-even point from 1,250 to 1,750 or 500 dolls, thus, he should not spend the extra \$10,000 for advertising.

17. Original break-even point (from problem) 7 = 1,250
New break-even point:

$v = \dfrac{c_f}{p - c_v} = \dfrac{17{,}000}{30 - 14} = 1062.5$

18. a) $v = \dfrac{c_f}{p - c_v} = \dfrac{\$27{,}000}{8.95 - 3.75} = 5{,}192.30$ pizzas

b) $\dfrac{5{,}192.3}{20} = 259.6$ days

c) Revenue for the first 30 days $= 30(pv - vc_v)$
$= 30[(8.95)(20) - (20)(3.75)]$
$= \$3{,}120$
\$27,000 – 3,120 = \$23,880, portion of fixed cost not recouped after 30 days.

New $v = \dfrac{c_f}{p - c_v} = \dfrac{\$23{,}880}{7.95 - 3.75} = 5{,}685.7$ pizzas

Total break-even volume = 600 + 5,685.7 = 6,285.7 pizzas

Total time to break-even $= 30 + \dfrac{5{,}685.7}{20}$
$= 314.3$ days

19. a) Cost of Regular plan = \$55 + (.33)(50 minutes)
= \$71.50
Cost of Executive plan = \$75 + (.25)(20 minutes)
= \$80
Select regular plan.

b) $55 + (x - 70)(.33) = 75 + (x - 100)(.25)$
$31.9 + .33x = 50 + .25x$
$x = 226.25$ minutes per month

20. a) $14{,}000 = \dfrac{7{,}500}{p - .35}$

$p = \$0.89$ to break even

b) If the team did not perform as well as expected the crowds could be smaller; bad weather could reduce crowds and/or affect what fans eat at the game; the price she charges could affect demand.

c) This will be an objective answer, but \$1.25 seems to be a reasonable price.

$Z = vp - c_f - vc_v$
$Z = (14{,}000)(1.25) - 7{,}500 - (14{,}000)(0.35)$
$= 17{,}500 - 12{,}400$
$= \$5{,}100$

21. There are two possible answers, or solution points:

$x = 25, y = 0$ or $x = 0, y = 50$

Substituting these values in the objective function:

$Z = 15(25) + 10(0) = 375$
$Z = 15(0) + 10(50) = 500$