Assignment # 1 Solutions

due Friday, August 30th, 2019

1 Set $c_f = \$18,000$, $c_v = \$0.9$/piece, $p = \$3.2$/piece

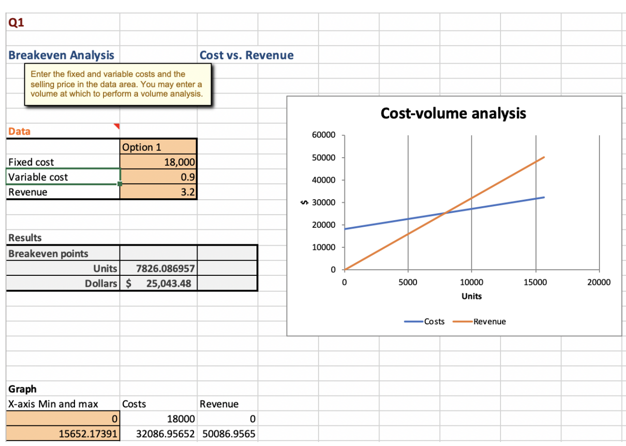
(a) Given $x = 12,000$

$$\begin{aligned} TC &= c_f + c_v x \\ &= 18,000 + (0.9)(12,000) = \$28,800 \\ TR &= px \\ &= (3.2)(12,000) = \$38,400 \\ Profit &= TR - TC \\ &= 38,400 - 28,800 = \$9,600 \end{aligned}$$

(b) To break even, solve $px - (c_f + c_v x) = 0$ for x.

$$x = \frac{c_f}{p - c_v} = \frac{18,000}{3.2 - 0.9} \approx 7,827 \text{ cupcakes.}$$

To break even, the company should sell about 7,827 cupcakes annually.



(c) The break-even volume as a percentage of capacity is $\frac{7827}{12000} \approx 0.6522 = 65.23\%$

2 Set $c_f = \$4,000$, $c_v = \$0.21$/pound.

Case 1: $p_1 = \$0.75$/pound, $x_1 = 9,000$.

$$\begin{aligned} TC_1 &= c_f + c_v x_1 \\ &= 4,000 + (0.21)(9000) = \$5,890 \\ TR_1 &= p_1 x_1 \\ &= (0.75)(9000) = \$6,750 \\ Profit_1 &= TR_1 - TC_1 \\ &= 6,750 - 5,890 = \$860 \end{aligned}$$

Case 2: $p_2 = \$0.95/\text{pound}$, $x_2 = 5,700$.

$$\begin{aligned} TC_2 &= c_f + c_v x_2 \\ &= 4,000 + (0.21)(5700) = \$5,197 \\ TR_2 &= p_1 x_1 \\ &= (0.95)(5700) = \$5,415 \\ Profit_2 &= TR_2 - TC_2 \\ &= 5,415 - 5,197 = \$218 \end{aligned}$$

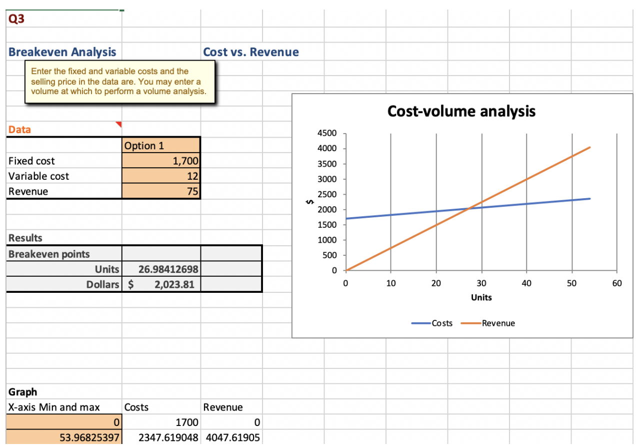
Since $Profit_2 < Profit_1$, the dairy should not raise the price.

3 Set $c_f = \$1,700$, $c_v = 7 + 5 = \$12/\text{student}$, $p = \$75/\text{student}$

(a) To break even, solve $px - (c_f + c_v x) = 0$ for x.

$$x = \frac{c_f}{p - c_v} = \frac{1,700}{75 - 12} \approx 27 \text{ students.}$$

To break even, 27 students need to enroll in Hannah and Kathleen's class.



(b) Given $c_f = \$1,700$, $c_v = 7 + 5 = \$12/\text{student}$, $p = \$75/\text{student}$, solve $5,000 = px - (c_f + c_v x)$ for x.

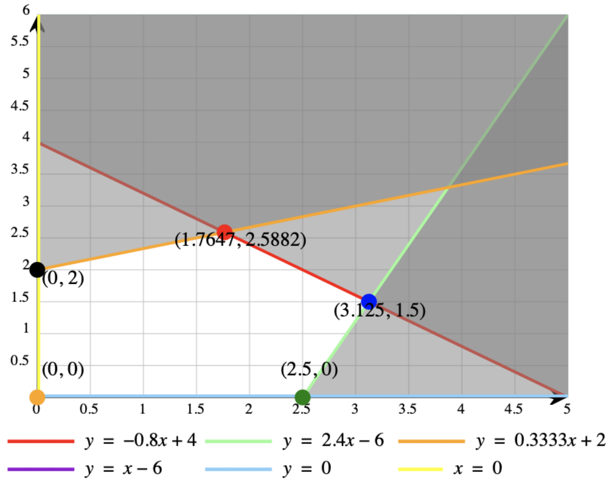
$$x = \frac{5000 + c_f}{p - c_v} = \frac{6,700}{75 - 12} \approx 107 \text{ students.}$$

(c) If $x = 60, c_f = \$1,700$, $c_v = 7 + 5 = \$12/\text{student}$, solve $5,000 = px - (c_f + c_v x)$ for p.

$$p = \frac{5000 + c_f + c_v x}{x} = \frac{7,420}{60} \approx \$123.67$$

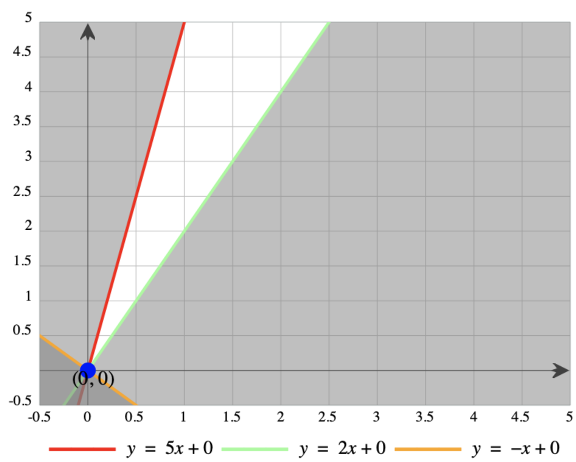
They need to charge \$123.67/student.

4 The feasible region is the white (unshaded) part of the graph. There are 5 extreme points in the feasible region.

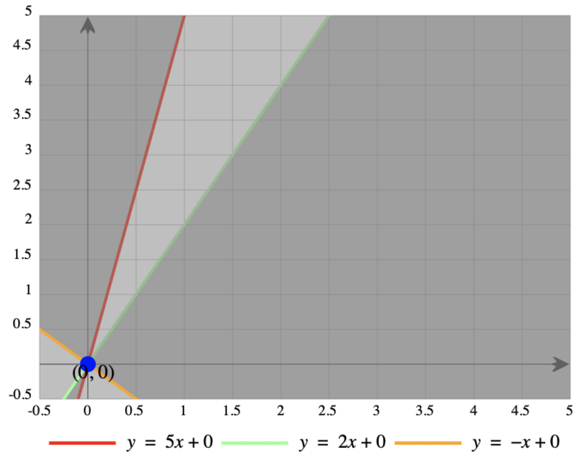


5 The feasible region is the white (unshaded) part of the graph. The feasible region for

$$
\begin{aligned}
5x - y &\geq 0 \\
4x - 2y &\leq 0 \\
x + y &\geq 0
\end{aligned}
$$



If we change the third constraint to $x + y \geq 0$, the feasible region become



Only point $(0, 0)$ is in the feasible region.