Lecture 2

Produced by Dr. Worldwide

Welcome to the 305

Excel: Break-Even

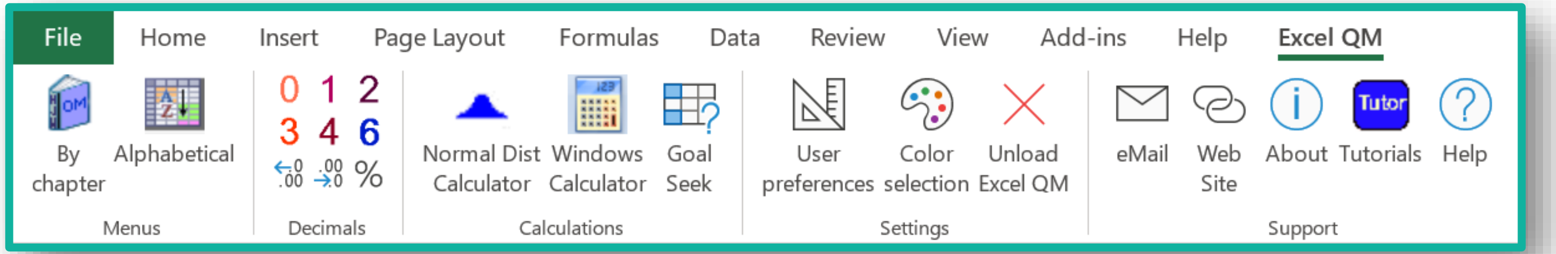
- Download BreakEven.xlsx from website link called Sheet 1
- Enter fixed cost (c_f), variable cost (c_v), and price (p)
- Excel formula used to find break-even point ($x^* = \frac{c_f}{p - c_v}$)

	A	B
1	**Break-even problem**	
2		
3	Fixed cost (cf)	10000
4		
5	Variable cost (cv)	8
6		
7	Price (p)	23
8		
9	*Break-even point:*	666.666667

fx =B3/(B7-B5)

Excel: Break-Even

- Use of Excel QM software for break-even analysis
- Begin by opening Excel QM software from computer shortcut
- Select Excel QM tab and select Alphabetical



- In drop down menu, select Break-even Analysis and then Breakeven (Cost vs Revenue)
- Enter name of report, sheet title, and insert checkmark for graph

Excel: Break-Even

Hello

Breakeven Analysis | **Cost vs. Revenue**

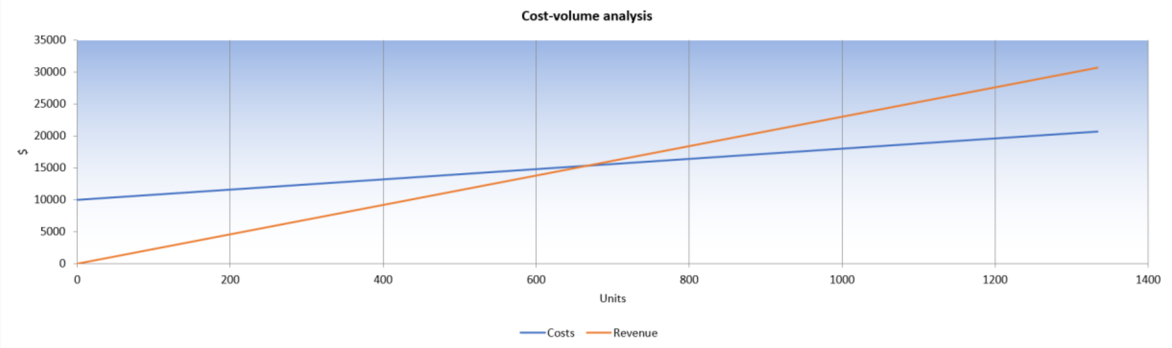
Enter the fixed and variable costs and the selling price in the data area. You may enter a volume at which to perform a volume analysis.

Data

	Option 1
Fixed cost	10000
Variable cost	8
Revenue	23

Results

Breakeven points		
Units	666.6666667	
Dollars	$ 15,333.33	



Linear Programming

- Linear programming is the process of optimizing a linear objective function subject to linear constraints.

- Seven steps of linear programming
  - Define the decision variables
  - Define the linear objective function
  - Use linear inequalities to define constraints
  - Graph resulting system of inequalities (use lines and shading)
  - Find the corners of the region
  - Substitute the coordinates of each corner into the objective function
  - Select the appropriate result based on when the objective function is optimized (either maximized or mininized) and interpret

Ex: Production of Pottery

- Beaver Creek Pottery produces the hottest clay bowls and mugs
  - Bowls require 1 hr. of labor and 4 lbs. of clay
  - Mugs require 2 hrs. of labor and 3 lbs. of clay

- Daily Limitations of resources
  - 40 hrs. of labor
  - 120 lbs. of clay

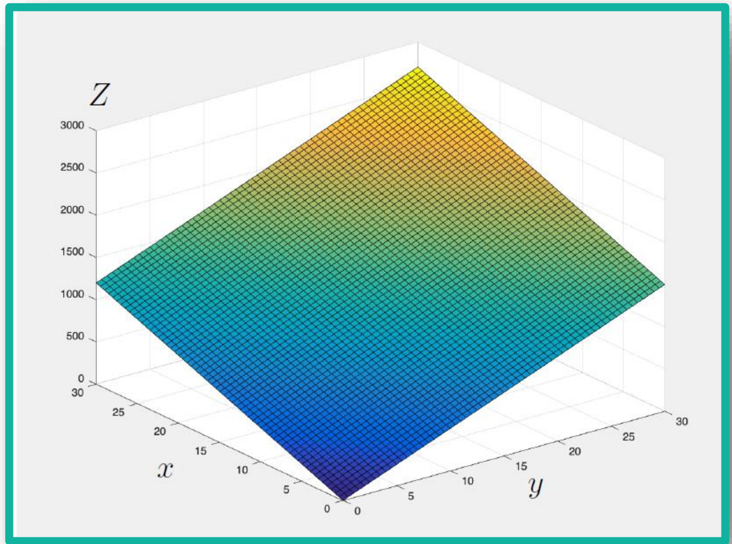
- Profit
  - Bowls return profit of $40
  - Mugs return profit of $50

- Q: What number of clay bowls and mugs should the company make each day to maximize daily profit?

Ex: Production of Pottery

- Decision variables
  - $x = Number\ of\ Bowls\ to\ Produce\ in\ 1\ Day$
  - $y = Number\ of\ Mugs\ to\ Produce\ in\ 1\ Day$

- Objective function
  - We seek to maximize profit
  - $f(x, y) = Z = 40x + 50y$



Ex: Production of Pottery

- Constraints
  - $x + 2y \leq 40$ (labor hours)
  - $4x + 3y \leq 120$ (pounds of clay)
  - $x \geq 0$ (nonnegativity)
  - $y \geq 0$ (nonnegativity

<u>Linear Program</u>

Maximize $\quad Z = 40x + 50y$

Subject to $\quad x + 2y \leq 40$

$4x + 3y \leq 120$

$x \geq 0$

$y \geq 0$

- Feasible region
  - Constraints lie on a two-dimensional plane
  - The feasible region is the set of all (x, y) points where none of the constraints are violated
  - The set $\{(x, y): x + 2y \leq 40 \cap 4x + 3y \leq 120 \cap x \geq 0 \cap y \geq 0\}$
  - Helpful to get constraints in form comfortable for plotting

<u>Constraints in Slope-Intercept Form</u>

$$x + 2y \leq 40 \;\rightarrow\; y \leq 20 - \frac{1}{2}x \quad \& \quad 4x + 3y \leq 120 \;\rightarrow\; y \leq 40 - \frac{4}{3}x$$

Ex: Production of Pottery

- Plotting the feasible region
  - Based on nonnegativity constraints, the feasible region exists somewhere in the positive quadrant
  - Plot inequalities as if they were equalities
  - Shade according to the inequality symbol (check if the origin satisfies the inequality or not
  - The feasible region is the intersection of the shaded areas

<u>Constraints in Slope-Intercept Form</u>

$$y \leq 20 - \frac{1}{2}x$$

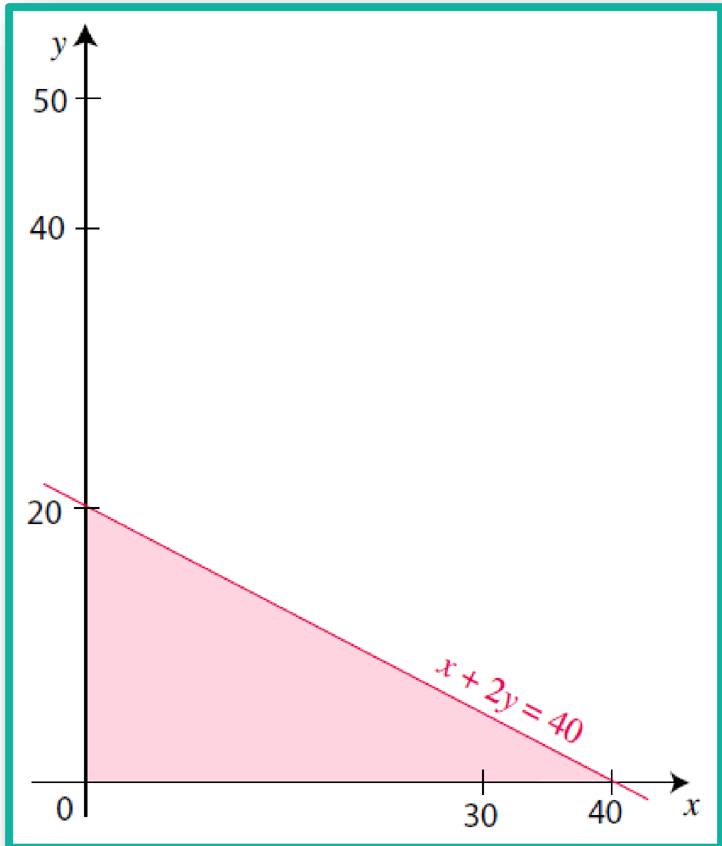
$$y \leq 40 - \frac{4}{3}x$$

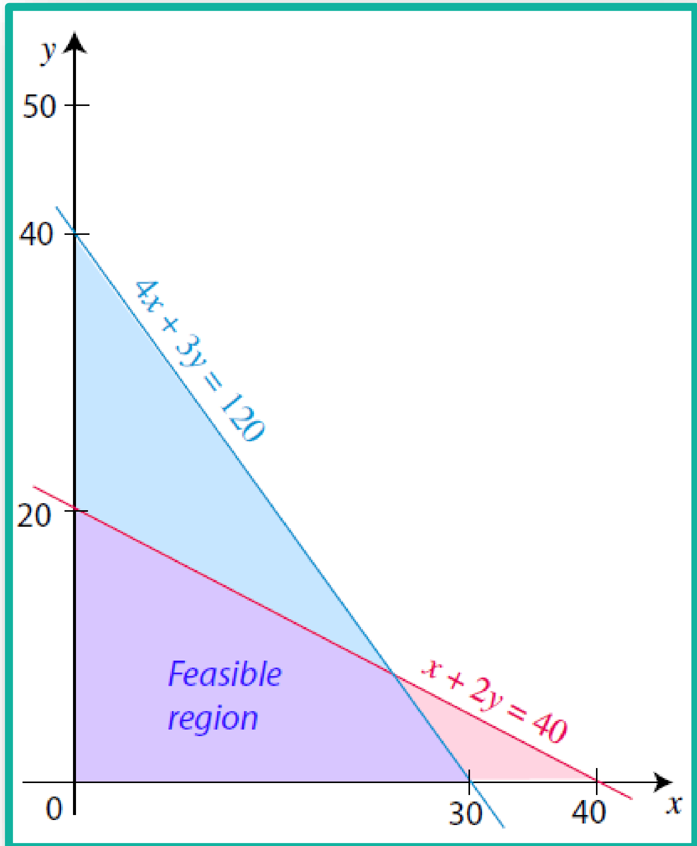
$x \geq 0$ (vertical line)

$y \geq 0$ (horizontal line)

Ex: Production of Pottery

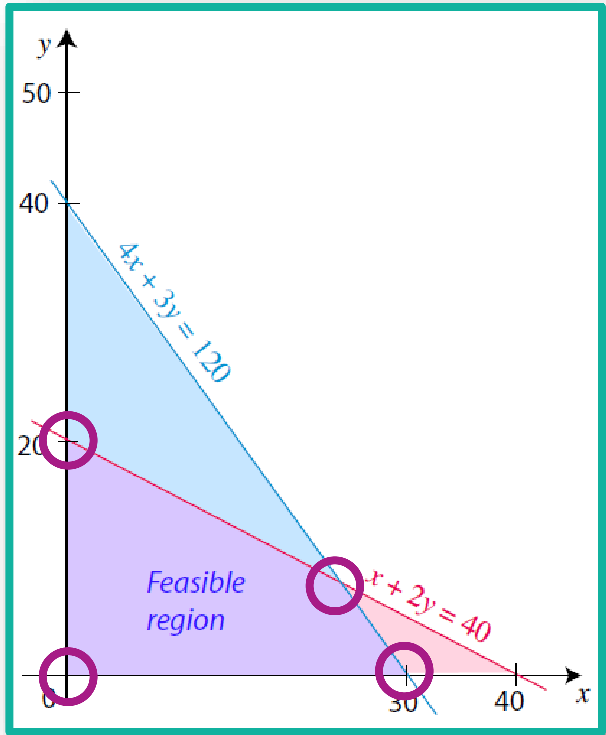
- Plotting the feasible region (Continued)





Ex: Production of Pottery

- Find the corners of the feasible region
  - Origin: (0,0)
  - Intercepts: (0,20) & (30,0)
  - Intersection Point: (24,8)



$$y = 20 - \frac{1}{2}x = 40 - \frac{4}{3}x = y$$

$$-\frac{1}{2}x + \frac{4}{3}x = 20$$

$$\frac{5}{6}x = 20$$

$$x = 24$$

When x=24,

$$y = 20 - \frac{1}{2} * 24 = 8$$

Ex: Production of Pottery

- Find the corners of the feasible region (Continued)
  - Optimal choice of decision variables is one of the corner points around feasible region
  - Plug into objective function

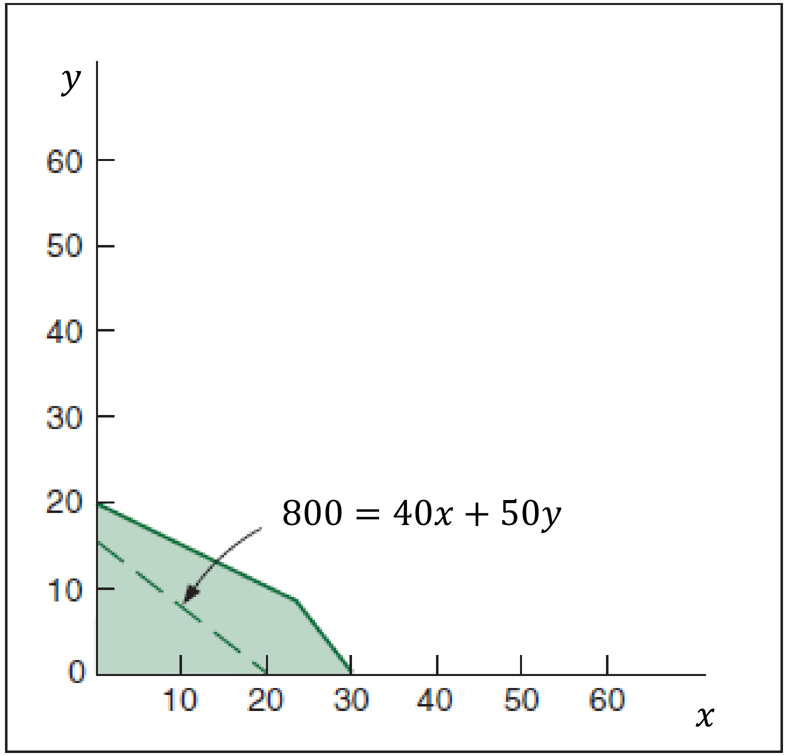
Corner Points and Profit

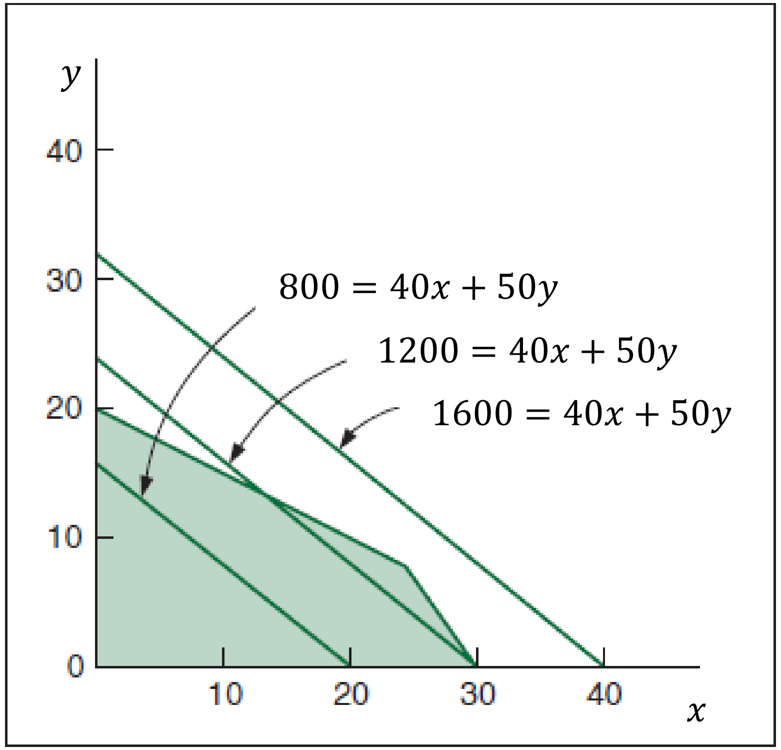
$$(0,0) \rightarrow 40(0) + 50(0) = \$0$$
$$(0,20) \rightarrow 40(0) + 50(20) = \$1000$$
$$(30,0) \rightarrow 40(30) + 50(0) = \$1200$$
$$(24,8) \rightarrow 40(24) + 50(8) = \$1360$$

- Find optimal solution and interpret
  - Ideally, we want to produce 24 bowls and 8 mugs
  - This decision will lead to a maximum profit of $1360

Ex: Production of Pottery

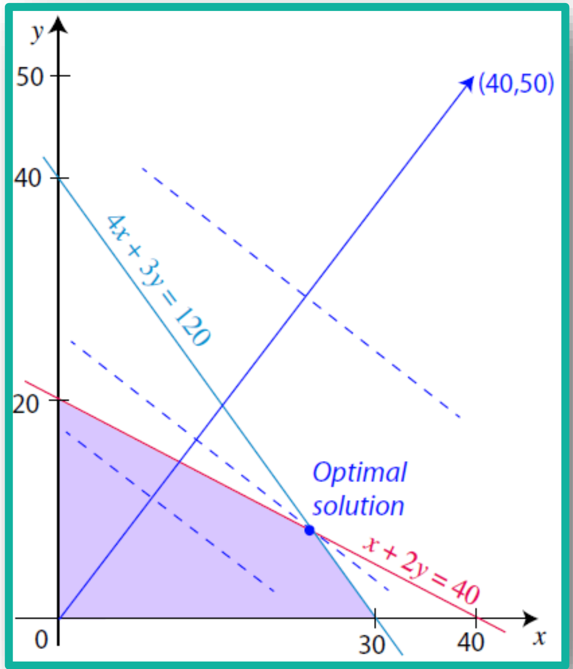
- Another creative look at finding the optimal solution
  - Recall the objective function: $Z = 40x + 50y$





Ex: Production of Pottery

- Another creative look at finding the optimal solution (Continued)
  - Objective function grows in the direction of the vector (40,50)
  - Lines that are perpendicular to this vector are level curves
  - In a maximization problem, the optimal solution will be the point in the feasible region farthest in the direction of growth



The End

Dale