

1.

Let  $x_v$  be liters of vanilla flavour  
 ||  $x_m$  || || maple flavour  
 ||  $x_c$  || || cherry flavour  
 ||  $x_R$  || || raw syrup  
 ||  $y_v$  || || vanilla syrup  
 ||  $y_m$  || || maple syrup  
 ||  $y_c$  || || cherry syrup  
 ||  $D_v$  || demand || vanilla syrup  
 ||  $D_m$  || demand || maple syrup  
 ||  $D_c$  || demand || cherry syrup

$$1800 \geq x_v + x_m + x_c$$

$$300 \leq y_v$$

$$300 \leq y_m$$

$$300 \leq y_c$$

$$D_v \geq y_v$$

$$D_m \geq y_m$$

$$D_c \geq y_c$$

$$y_v \leq x_v$$

$$y_m \leq x_m$$

$$y_c \leq x_c$$

Max  
 $y, x$

$$6y_v + 7y_m + 8y_c - 0.5x_R - 2x_v - 2x_m - 2.5x_c$$

Stays the same

$$E[D_v] = 900(.4) + 500(.6) = 660$$

$$E[D_m] = 600(.5) + 300(.5) = 450$$

$$E[D_c] = 1100(.7) + 700(.3) = 980$$

8 different combinations of demands

$$\begin{aligned} \max_{y, x} \quad & 6(.4y_v^1 + .6y_v^2) + 7(.5y_m^1 + .5y_m^2) + 8(.7y_c^1 + .3y_c^2) \\ & - 2x_v - 2x_m - 2.5x_c - .5x_R \end{aligned}$$

$$y_v^1 \leq x_v, \quad y_v^2 \leq x_v$$

$$y_m^1 \leq x_m, \quad y_m^2 \leq x_m$$

$$y_c^1 \leq x_c, \quad y_c^2 \leq x_c$$

$$900 \geq y_v^1 \quad 1100 \geq y_c^1$$

$$600 \geq y_m^1$$

$$500 \geq y_v^2 \quad 700 \geq y_c^2$$

$$300 \geq y_m^2$$

$$1800 \geq y_v^1 + y_m^1 + y_c^1$$

$$300 \leq y$$

$$1800 \geq y_v^1 + y_m^1 + y_c^2$$

$$1800 \geq y_v^1 + y_m^1 + y_c^1$$

$$1800 \geq y_v^1 + y_m^1 + y_c^2$$

$$1800 \geq y_v^2 + y_m^1 + y_c^1$$


$$1800 \geq y_v^2 + y_m^1 + y_c^2$$

$$1800 \geq y_v^2 + y_m^2 + y_c^1$$

$$1800 \geq y_v^2 + y_m^2 + y_c^2$$

2.  $\tilde{b} = Ax$      $A = 5 \times 8$  matrix

$b = 5 \times 1$  column vector

$5 \times 8 \quad 8 \times 1$   
  
 size of  $x$

$\min_x$

$$\begin{aligned} & (1.0x_1 + .5x_2 + .3x_3 + .2x_4 + .1x_5 + .7x_6 + .2x_7 + .1x_8 - .3)^2 + \\ & (0.5x_1 + 1.0x_2 + .4x_3 + .3x_4 + .2x_5 + .1x_6 + .3x_7 + .9x_8 - 1)^2 + \\ & (0.4x_1 + .4x_2 + 1.0x_3 + .8x_4 + .6x_5 + .4x_6 + .2x_7 + .1x_8 - .8)^2 + \\ & (0.3x_1 + .6x_2 + .8x_3 + 1x_4 + .8x_5 + .6x_6 + .4x_7 + .2x_8 - .7)^2 + \\ & (0.2x_1 + .2x_2 + .5x_3 + .8x_4 + 1x_5 + .8x_6 + .6x_7 + .4x_8 - .5)^2 \end{aligned}$$

$x \geq 0$