Practice for L3 Linear Programming #4

An importer starts to sell a range which includes a radio controlled helicopter and a radio controlled plane.

A plane costs him $150 and a helicopter costs $300.

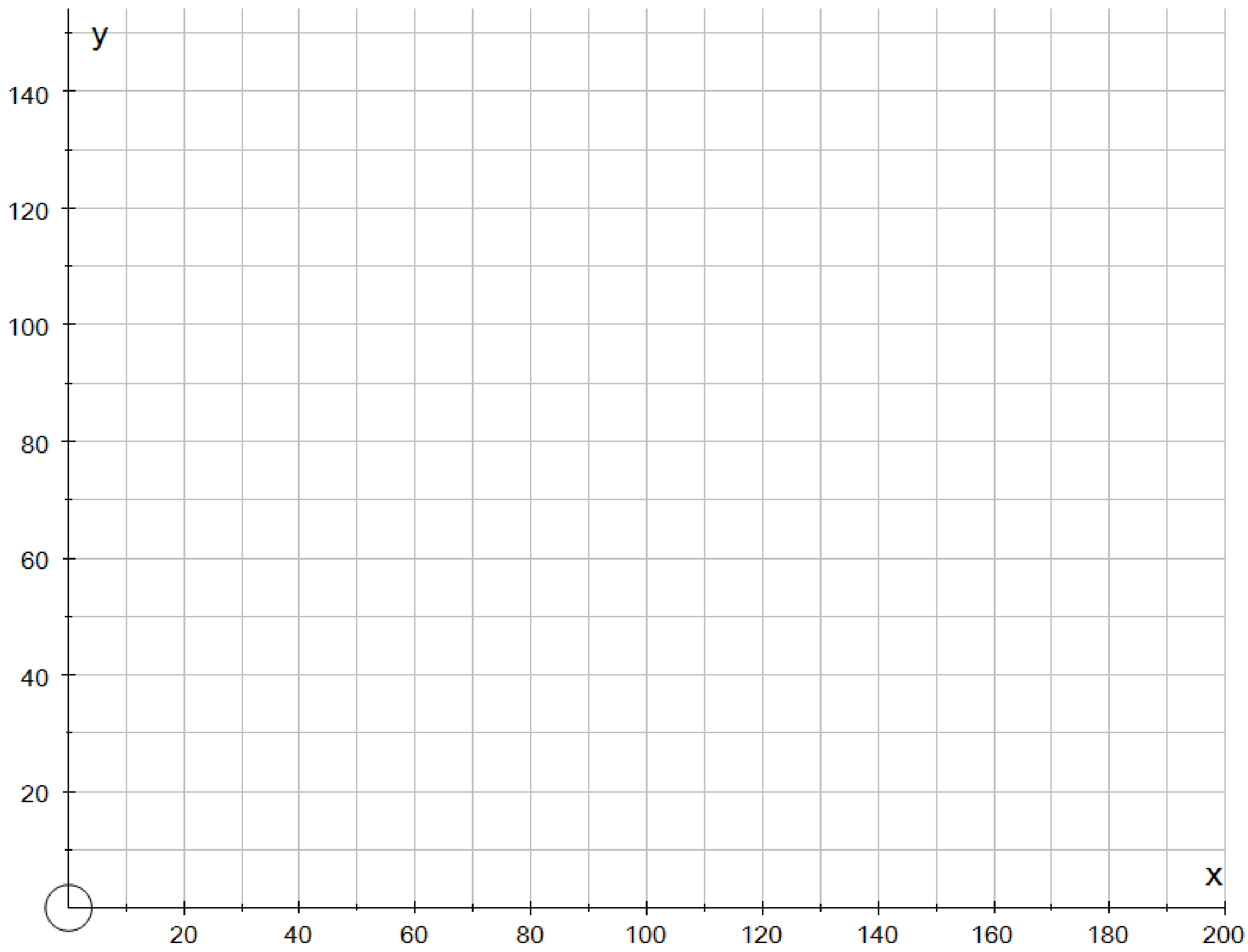
He has $24,000 in his budget to buy radio controlled planes and helicopters.

As he can only keep at most 120 of them in his storage area at a time. As he doesn't know which will be more popular, he wants to order at least 20 of each type.

If x = number of plane and y = number of helicopters, the following constraints represent the amount imported by the shop owner:

$x + y \le 120$ $150x + 300y \le 24000$ $x \ge 20$ $y \ge 20$

Draw these constraints on the axes below, and show the feasible region.



The importer reckons he can sell each plane for $295 (so a profit of $145) and each helicopter for $545 (so a profit of $245) i.e. the overall profit, in dollars, is P = $145x + 245y$.

How many of each should he import? Justify your answer.

Question 2

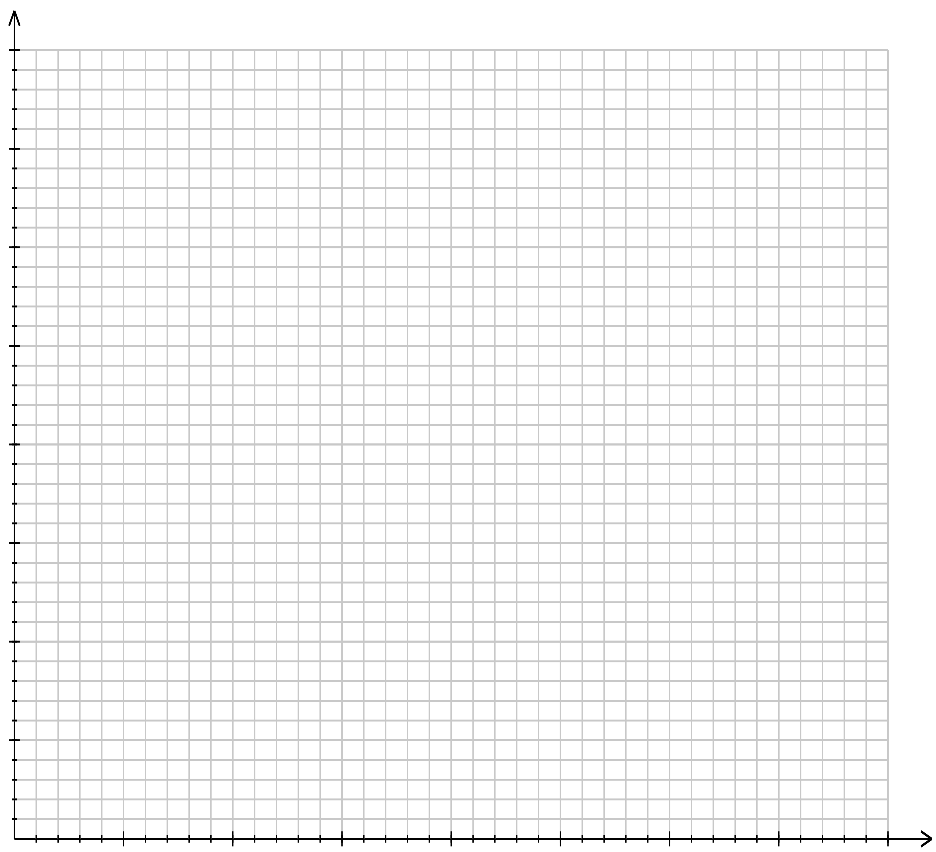
A chocolate manufacturer buys equipment to make 120 kg of soft centres and 160 kg of hard centres each week.

The intention is to sell them in two mixtures.

The first mixture will contain the same amounts of each variety and be sold for $16 per kilogram.

The second mixture will contain one third soft and two-thirds hard and be sold for $12 per kilogram.

How many kilograms of each mixture should it sell to maximize its profit?



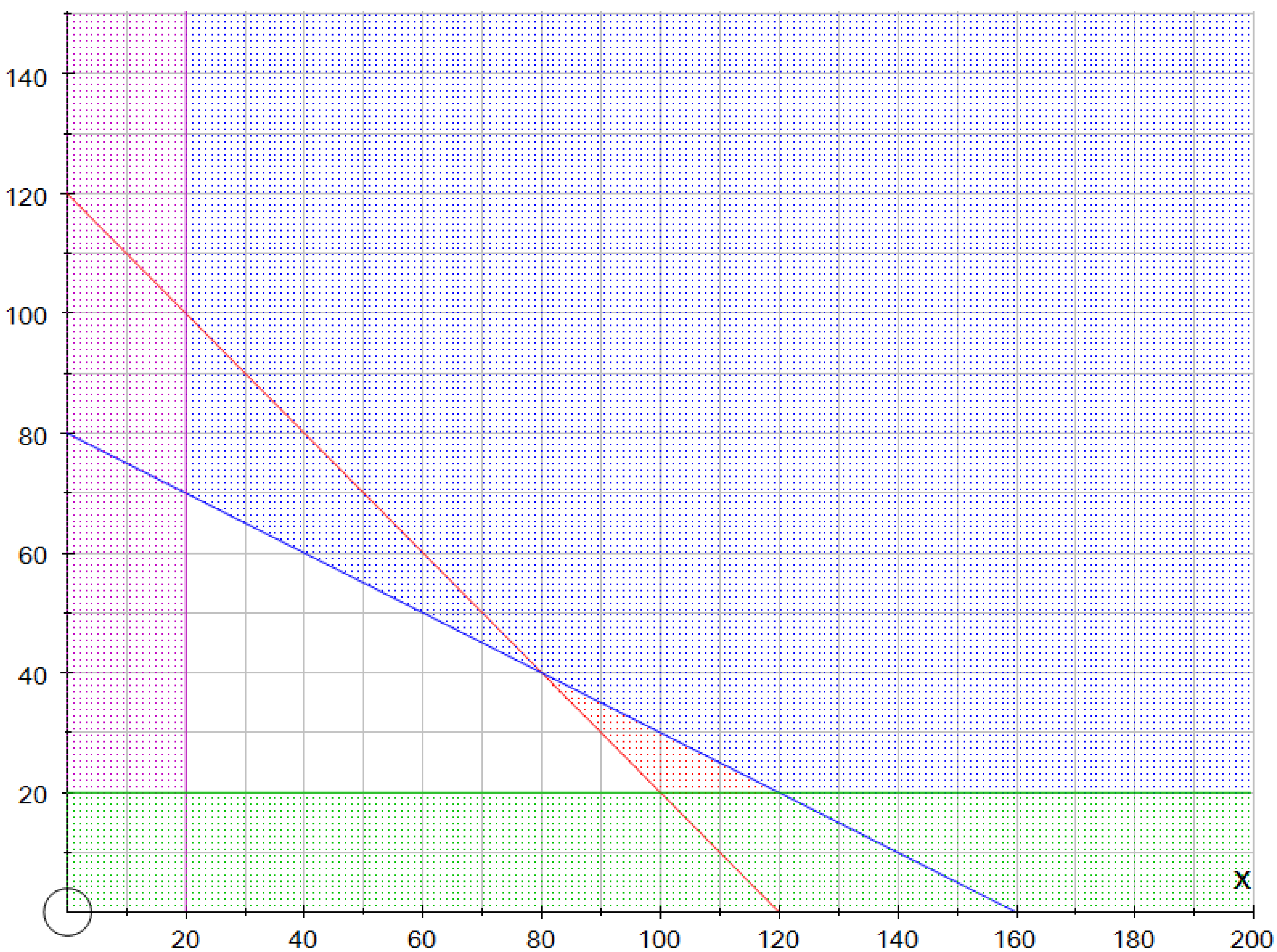
What would be the effect of changing the price that the first mixture was sold at be on the best ratio for sales.

What assumptions have you made in your answer above?

Answers: Practice for L3 Linear Programming #4

Vertex	P = 145x + 245y
(20, 70)	20050
(80, 40)	21400
(100, 20)	19400

80 planes and 40 helicopters give maximum of $21,400

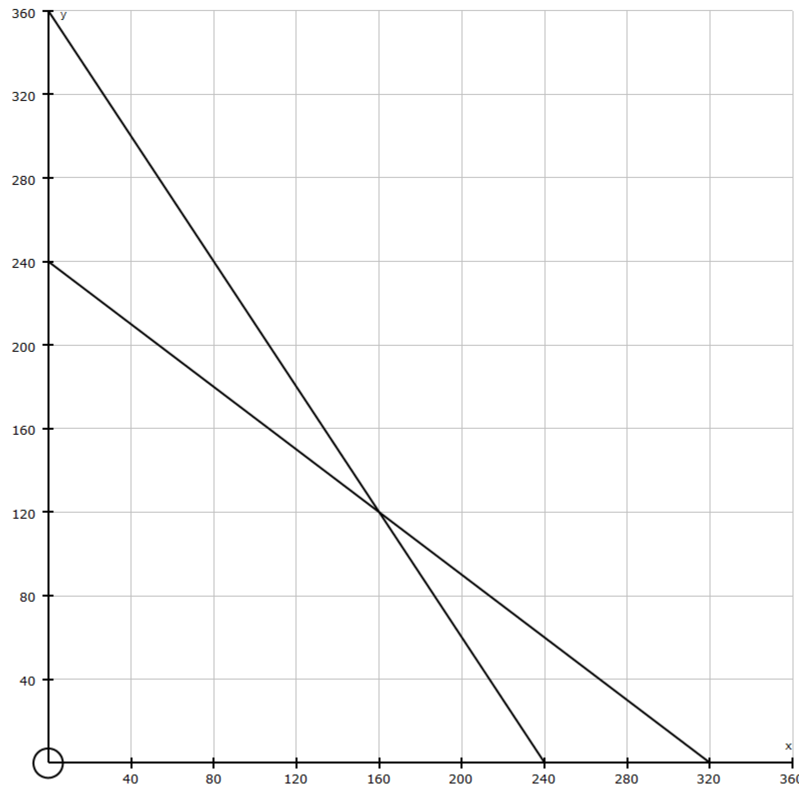


Let x be the amount of mix1, and y be the amount of mix2. (Note, **not** s being the amount of soft and h being the amount of hard, since the constraints work on the amount of each **mix** produced.)

The constraints are:

$$\frac{x}{2} + \frac{y}{3} \le 120 \qquad \frac{x}{2} + \frac{2y}{3} \le 160 \qquad x \ge 0 \qquad y \ge 0$$

(or equivalents, obviously)



Objective Function	*Profit* = 16x + 12y
(240, 0)	\$38400
(160, 120)	\$4000
(0, 240)	\$2880

Maximum profit is \$4000, for 160 kg first mixture and 120 kg second mixture.

Mix one becomes preferable when the (240, 0) point exceeds the (160, 120) point.

So, $240\,k + 0 \times 12 > 160\,k + 120 \times 12 \Rightarrow k > 18$

Mix two remains preferable when the (0, 240) point exceeds the (160, 120) point

So, $0\,k + 240 \times 12 > 160\,k + 120 \times 12 \Rightarrow k > 9$

So, for any sale price between \$9 a kilo and \$18 a kilo for Mix1, the 160/120 combination is best. Above that price only Mixture One should be sold. Below that range only Mixture Two should be sold.

(Note this can also be done by the slope method, with the slope being m = –360/240 = –1.5 to for Mix1 to be advantaged, and m = –240/320 = 0.75. Multiplying 12 by these gives 18 and 9.)

The calculations above assume that any spare chocolates, whether hard for Mix1 above \$18 or soft for Mix1 below \$9, have zero value for sale. That is unlikely to be true though.