

Exercise 7A

1 Number of boxes of gold assortment = x

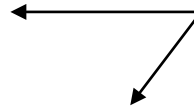
Number of boxes of silver assortment = y

Objective: maximise $P = 80x + 60y$

Constraints

- Time to make chocolate, $30x + 20y \leq 300 \times 60$
which simplifies to $3x + 2y \leq 1800$
- Time to wrap and pack, $12x + 15y \leq 200 \times 60$
which simplifies to $4x + 5y \leq 4000$
- 'At least twice as many silver as gold' $2x \leq y$
- Non-negativity $x, y \geq 0$

All units now in minutes



In summary: maximise $P = 80x + 60y$

Subject to:

$$3x + 2y \leq 1800$$

$$4x + 5y \leq 4000$$

$$2x \leq y$$

$$x, y \geq 0$$

2 Number of type A = x

Number of type B = y

Objective: minimise $C = 6x + 10y$

Constraints

- Display must be at least 30 m long $x + 1.5y \geq 30$
which simplifies to $2x + 3y \geq 60$
- 'At least twice as many x as y ' $2y \leq x$
- At least six type B $y \geq 6$
- Non-negativity $x, y \geq 0$

In summary: minimise $C = 6x + 10y$

Subject to:

$$2x + 3y \geq 60$$

$$2y \leq x$$

$$y \geq 6$$

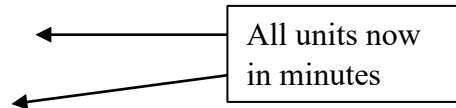
$$x, y \geq 0$$

- 3 Number of games of Cludopoly = x
 Number of games of Trivscrab = y

Objective: maximise $P = 1.5x + 2.5y$

Constraints

- First machine: $5x + 8y \leq 10 \times 60$
 which simplifies to $5x + 8y \leq 600$
- Second machine: $8x + 4y \leq 10 \times 60$
 which simplifies to $2x + y \leq 150$
- At most 3 times as many x as y , $3y \geq x$
- Non-negativity $x, y \geq 0$



In summary: maximise $P = 1.5x + 2.5y$
 Subject to:

$$5x + 8y \leq 600$$

$$2x + y \leq 150$$

$$3y \geq x$$

$$x, y \geq 0$$

- 4 Number of type 1 bookcases = x
 Number of type 2 bookcases = y

Objective: maximise $S = 40x + 60y$

Constraints

- Budget: $150x + 250y \leq 3000$
 which simplifies to $3x + 5y \leq 60$
- Floor space: $15x + 12y \leq 240$
 which simplifies to $5x + 4y \leq 80$
- 'At most $\frac{1}{3}$ of all bookcases to be type 2': $y \leq \frac{1}{3}(x + y)$
 which simplifies to $2y \leq x$
- At least 8 type 1: $x \geq 8$
- Non-negativity $x, y \geq 0$

In summary: maximise $S = 40x + 60y$
 Subject to:

$$3x + 5y \leq 60$$

$$5x + 4y \leq 80$$

$$2y \leq x$$

$$x \geq 8$$

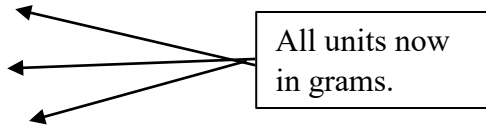
$$x, y \geq 0$$

5 Let x = number of kg of indoor feed and y = number of kg of outdoor feed.

Objective: maximise $P = 7x + 6y$

Constraints

- Amount of A: $10x + 20y \leq 5 \times 1000$
which simplifies to $x + 2y \leq 500$
- Amount of B: $20x + 10y \leq 5 \times 1000$
which simplifies to $2x + y \leq 500$
- Amount of C: $20x + 20y \leq 6 \times 1000$
which simplifies to $x + y \leq 300$
- At most 3 times as much y as x , $y \leq 3x$
- At least 50kg of x , $x \geq 50$
- Non-negativity $y \geq 0$ ($x \geq 0$ is unnecessary because of a previous constraint).



In summary: maximise $P = 7x + 6y$

Subject to:

$$x + 2y \leq 500$$

$$2x + y \leq 500$$

$$x + y \leq 300$$

$$y \leq 3x$$

$$x \geq 50$$

$$y \geq 0$$

6 Number of A smoothies = x , number of B smoothies = y and number of C smoothies = z .

Objective: maximise $P = 60x + 65y + 55z$

Constraints

- oranges $x + \frac{1}{2}y + 2z \leq 50$
which simplifies to $2x + y + 4z \leq 100$
- raspberries $10x + 40y + 15z \leq 1000$
which simplifies to $2x + 8y + 3z \leq 200$
- kiwi fruit $2x + 3y + z \leq 100$
- apples $2x + \frac{1}{2}y + 2z \leq 60$
which simplifies to $4x + y + 4z \leq 120$
- non-negativity $x, y, z \geq 0$

In summary: maximise $P = 60x + 65y + 55z$

Subject to:

$$2x + y + 4z \leq 100$$

$$2x + 8y + 3z \leq 200$$

$$2x + 3y + z \leq 100$$

$$4x + y + 4z \leq 120$$

$$x, y, z \geq 0$$

- 7 Let number of hours of work for factory $R = x$
Let number of hours of work for factory $S = y$

Objective: minimise $C = 300x + 400y$

Constraints

- milk $1000x + 800y \geq 20\,000$
which simplifies to $5x + 4y \geq 100$
- yoghurt $200x + 300y \geq 6000$
which simplifies to $2x + 3y \geq 60$
- At least $\frac{1}{3}$ of total time for R $x \geq \frac{1}{3}(x + y)$
which simplifies to $2x \geq y$
- At least $\frac{1}{3}$ of total time for S $y \geq \frac{1}{3}(x + y)$
which simplifies to $2y \geq x$
- Non-negativity $x, y \geq 0$

In summary: minimise $C = 300x + 400y$

Subject to:

$$5x + 4y \geq 100$$

$$2x + 3y \geq 60$$

$$2x \geq y$$

$$2y \geq x$$

$$x, y \geq 0$$