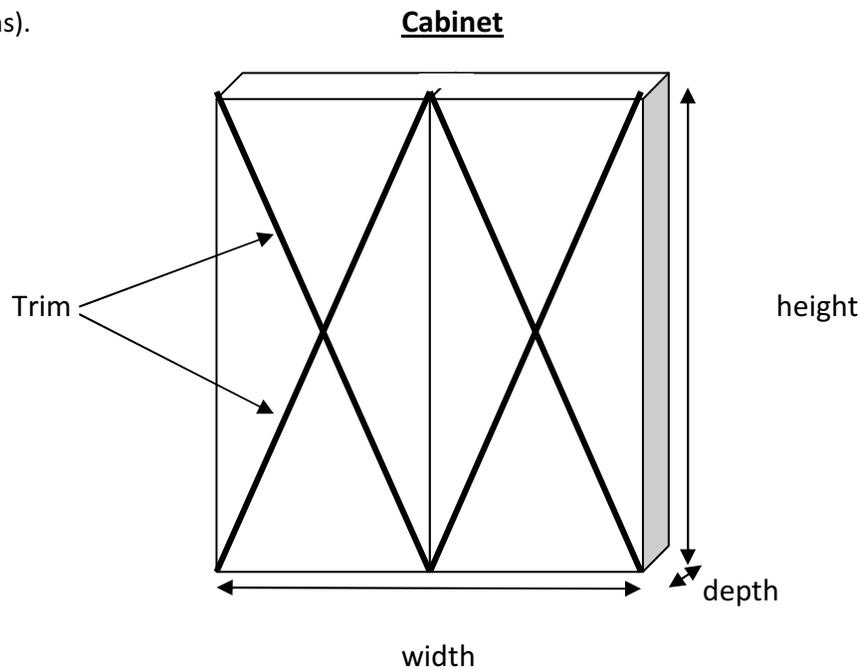# The Cabinet Maker

You have been hired by a cabinet maker to calculate the exact cost of producing a new series of cabinets he intends to build. You have been assigned a budget of $4 500 (all costs given include the different taxes), to complete the following tasks based on cost:

- Figure out the formula to quickly calculate the quantity of wood needed to build an cabinet.
- Choose the type and calculate the cost of wood used for the cabinets.
- Calculate the cost of the trim used to decorate the cabinets.
- Choose how many coats of varnish can be used.
- Calculate the exact cost of purchasing all the materials to complete the project.

You must then submit a detailed report which will be reviewed by the cabinet maker. The report must include the materials you've selected and the total cost of production of the cabinets.

The cabinet maker wants to build 12 cabinets. The cabinets are shaped like rectangular-based prisms. To estimate the costs, you have to take into consideration that wood is needed on all 6 sides of the cabinets (prisms).

Cabinet

(Figure not to scale)

The trim corresponds to the two X-shapes on the diagram above.

The dimensions used by the cabinet maker to build the cabinets are always the same: the width is 3 times greater than the depth plus 4, and the height is 7 times greater than the depth minus 20, when the dimensions are in centimetres.

The formula

The cabinet maker wants you to figure out the formula that would give the total area of a cabinet. This way, he could use an Excel-type spreadsheet to quickly calculate how much wood is needed to build one cabinet.

(Reminder: Area of a rectangle = length x width)

Wood costs

To help you figure out how much wood is needed, the cabinet maker informs you that for this cabinet, the sum of the 3 dimensions comes up to exactly 314 centimetres.

The cabinet maker also tells you that he does not want to spend less than 50% of his budget, or more than 75%, on wood.

Here are the wood types you can choose from:

Wood types

Type	Price ($/m^2)
Teak	18.00
Rosewood	25.00
Brazilian Tulipwood	50.00
Ebony	70.00

(Reminder: 1 m = 100 cm and 1 m^2 = 10 000 cm^2, Area of a rectangle = length x width)

The trim and the hardware

The trim is sold in strips of 4 metres at a cost of $28.00 per strip. For each cabinet, the cabinet maker will need 24 screws at $0.15 each, 2 handles at $6.50 each, and 4 hinges at $2.75 each. You need to figure out the total cost for the trim and the hardware.

The varnish

The varnish costs $12.00 per litre and each litre of varnish covers 8 m^2. You need to figure out how many coats of varnish can be used to stay within budget.

Solution to The Cabinet Maker

The formula

Width = 3x + 4
Depth = x
Height = 7x – 20

Total area for 1 cabinet:

Front and Back: $\quad$ 2 x width x height = 2(3x + 4)(7x – 20) = $42x^2$ - 64x -160

Left and Right: 2 x depth x height = 2(x)(7x – 20) = $14x^2$ – 40x

Top and Bottom: $\quad$ 2 x width x depth = 2(3x + 4)(x) = $6x^2$ + 8x

Total area = ($42x^2$ - 64x -160) + ($14x^2$ – 40x) + ($6x^2$ + 8x) = $62x^2$ – 96x -160

So the formula is: $\underline{62x^2 – 96x -160}$

Wood costs

Width = 3x + 4
Depth = x
Height = 7x – 20
3x + 4 + x + 7x – 20 = 314
11x – 16 = 314
11x = 330
X = 30 cm

Width = 3(30)+4 = 94 cm or 0.94 m
Depth = 30 cm or 0.30 m
Height = 190 cm or 1.90 m
Total area for 1 cabinet:
Front and Back: 0.94 x 1.90 x 2 = 3.572 m^2
Left and Right: 0.30 x 1.90 x 2 = 1.14 m^2
Top and Bottom: 0.94 x 0.30 x 2 = 0.564 m^2
Total = 5.276 m^2
12 cabinets: 12 x 5.276 = 63.312 m^2

Costs:
Teak: 63.312 x 18.00 = $1139.62

Rosewood: 63.312 x 25.00 = $1582.80

Brazilian Tulipwood: 63.312 x 50.00 = $3165.60

Ebony: 63.312 x 70.00 = $4431.84

50% of budget = 0.50 x 4500 = $2250

75% of budget = 0.75 x 4500 = $3375

Only the Brazilian Tulipwood falls in that range.
Wood cost: $\underline{\$3165.60}$

The trim and the hardware

Hardware for 1 cabinet:
24 x 0.15 = $3.60
2 x 6.50 = $13.00
4 x 2.75 = $11.00
Total = $27.60

For 12 cabinets = 12 x 27.60 = $331.20

Trim:

1.90   **trim length is the hypotenuse**

0.94/2 = 0. 47
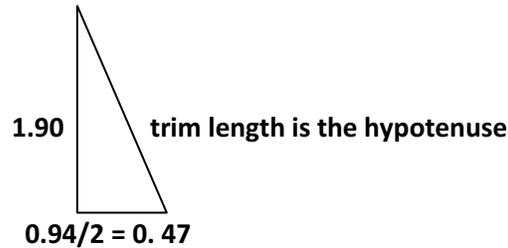
$$c^2 = a^2 + b^2$$
$$c^2 = 1.90^2 + 0.47^2$$
$$c^2 = 3.8309$$
$$c \approx 1.957 \text{ m}$$

4 lengths needed x 12 cabinets:
4 x 12 x 1.957 $\approx$ 93.95 m

Number of strips needed: 93.95 / 4 $\approx$ 23.49 so 24

Cost of the strips: 24 x 28.00 = $672.00

Costs so far:	Wood	+	Trim	+	Hardware	
	$3165.60	+	$672.00	+	$331.20	= $4168.80

The varnish

Money left = $4500 – 4168.80 = $331.20

Total area for 12 cabinets = 63.312 m^2

Number of litres needed = 63.312 / 8 = 7.914 so we round up to 8 litres.

Cost of varnish for 1 coat (12 cabinets) = 8 litres * 12.00 $/L = $96.00

Let x represent the number of coats that can be applied,

$$96x \leq 331.20$$

$$\frac{96x}{96} \leq \frac{331.20}{96}$$

$$x \leq 3.45$$

So only 3 coats of varnish can be applied.