



Min and Max sample models



Min and Max Sample Models.xls is an Excel Workbook made up of a number of individual worksheets, called GST table, Sports scores, Hire purchase, Timesheet, Sausages and several more. These models illustrate concepts related to modelling. Even if you are not familiar with Excel, you should try the following exercise. You should only change values in cells shaded green or blue, not pink.

	A	B	C	D
1	Goods and Services tax			
2	Tax rate:	12.5%		input
3				formula
4	Price	GST	Price including GST	
5	\$1.00	\$0.13	\$1.13	
6	\$2.00	\$0.25	\$2.25	
7	\$3.00	\$0.38	\$3.38	
8	\$4.00	\$0.50	\$4.50	
9	\$5.00	\$0.63	\$5.63	
10	\$6.00	\$0.75	\$6.75	
11	\$7.00	\$0.88	\$7.88	
12	\$8.00	\$1.00	\$9.00	
13	\$9.00	\$1.13	\$10.13	
14	\$10.00	\$1.25	\$11.25	
15	\$11.00	\$1.38	\$12.38	
16	\$12.00	\$1.50	\$13.50	

1. GST table

Look at the GST table worksheet. (You may need to click on the tab at the bottom that says GST table.) It is used to calculate the Goods and Services tax on some given amounts. Look at the formula in cell B5. You do this by clicking on the cell, then looking at the formula bar above.

(The formula bar is the white space to the right of the **fx** symbol. If you move the mouse onto it and pause briefly, the words "formula bar" should appear.)

How would you use this spreadsheet if the rate of GST changed to 10%?

2. Sports scores

Look at the Sports scores worksheet. (You may need to click on the tab at the bottom that says Sports scores.) Work out what it is about. How are the scores calculated? What happens if a different scoring system is used? Change the values in B3, C3 and D3 to 2, 1 and 0 respectively. Does this change the ranking of the teams at all? What aspects of a sports tournament does this model represent? What are some aspects that are not included in the model?

	A	B	C	D	E
1	Sports scores				
2		Won	Drawn	Lost	
3	Points	5	3	1	
4	Team				Score
5	Applets	4	0	1	21
6	Beavers	3	0	2	17
7	Chromosomes	2	1	2	15
8	Frames	2	0	3	13
9	Jammers	1	1	3	11
10	Lambs	1	0	4	9

	A	B
1	Hire purchase payments	
2		
3	Inputs	
4	Purchase price	\$ 3,300.00
5	Deposit	\$ 300.00
6	Payment periods per year	12
7	Interest rate	6.5%
8	Number of years	2
9	Outputs	
10	Payment amount	\$133.64
11	Total amount paid	\$ 3,507.33

3. Hire purchase

Now move to the hire purchase worksheet. Use it to find out how much you would pay per month for a \$2000 stereo, on which you paid \$500 deposit, with interest charged at 8% per annum, paying over 3 years. (The answer is \$47.) Say you can only afford \$30 per month. Change the value in B8 to find out how long will it take to pay it off. (You will need to use trial and error.) Have a look at the formulas in the pink cells. One of them (B10) uses an Excel function. This saves typing out a complex formula. The actual formula is:

$$P = V \left[\frac{i}{1 - (1 + i)^{-n}} \right]$$

where V is the purchase price less the deposit,

i is the interest rate,

n is the number of periods

and P is the payment amount.

4. Breakfast model

	A	B	C	D	E	F	G	H	
1	Breakfast choice								
2		Daily requirements:			10000	55	120	30	
3					Values given per			100 g	
4	Food item	servings chosen	serving	serving size in g	kJ	protein (g)	fat	fibre	
5	poached egg	1	1 egg	62	715	11.7	13.8	0	
6	cornflakes		30g	30	1510	6.4	1.5	3.7	
7	regular milk		200ml	200	259	3.34	3.4	0	
8	trim milk		200ml	200	177	4.32	0.41	0	
9	wholegrain bread		slice	31	940	7.28	0.88	5.7	
10	white bread		slice	37	877	6.2	0.58	4.9	
11	margarine		5g	5	2,887	0.51	77.8	0	
12	orange juice		200ml	200	176	0.6	0.2	0.2	
13	toasted muesli		30g	30	1685	11.9	14	7.1	
14	sugar		1 tsp	5	1700	0	0	0	
15									
16			Consumed this meal:			1056.00	8.60	7.25	1.11
17			Percentage of daily requirements met:			10.6%	15.6%	6.0%	3.7%
18									
19	Note that the values given are indicative only.						input		
20	The daily requirements are a rough guide.						formula		
21						decision			

Click on the tab for the breakfast model. Can you work out the purpose of this spreadsheet? Try out some different possible breakfasts. See if you can find a combination that gives you about 20% of the daily allowance for each of the four measurements. (Don't spend too long on this – the solution is pretty strange.) What elements of reality are not covered in this model? How could the model be improved?

5. Sausage stand

Background story

Laura and Cassie are thinking about running a sausage stand to earn a little money. They see radio stations giving sausages away, and charitable groups charging \$1 for sausages. They think they should be able to make a little money for themselves. Laura likes to make sure everything is going to work before she gets started, but Cassie is keen to borrow her father's gas barbecue and trailer and get going. Laura develops a spreadsheet to calculate the profit margins. They want to see what sort of hourly rate they will make.

Look now at the sausage stand example that goes with this scenario. Have a look at each of the green values and see if you agree with them. What happens as you change them? For instance, what happens if they sell 100 sausages, rather than 200? Look at the formulas in the pink cells. Make sure you understand what each of them means. What aspects of the situation has this model left out? How does the design of the spreadsheet help you to understand its function. How could it be improved?

	A	B	C	D	E	F
1	Sausage Stand profitability					
3	Inputs					
4	Hours of operation	3 hours				input
5	Number of workers	2 people				formula
6	Selling price	\$ 1.00	per sausage			
7	Expected sales	200 sausages				
9	Outputs					
10	Expected revenue	\$ 200.00				
11	Total ingredient cost	\$ 124.89				
12	Total other cost	\$ 65.75				
13	Profit	\$ 9.36	profit			
15	Calculations					
16	Ingredients	Purchase unit	Cost per purchase unit	Sales unit	Number of sales units in purchase unit	Cost per sales unit
17	Sausages	kilogram	\$ 4.00	sausage	11	\$ 0.36
18	Onions	kilogram	\$ 2.00	slice	30	\$ 0.07
19	Tomato sauce	litre	\$ 5.00	blob	45	\$ 0.11
20	Bread	loaf	\$ 0.99	slice	23	\$ 0.04
21	Margarine	500g	\$ 3.00	spread	100	\$ 0.03
22	paper towel	roll	\$ 2.00	towel	200	\$ 0.01
24					Ingredient cost per unit:	\$ 0.62
26	Other costs	Purchase unit	Cost			Cost per day
27	gas	9kg tank	\$ 13.95	10 hours per fill up		\$ 4.19
28	labour	wage per hour:	\$ 10.00			\$ 60.00
29	rubber gloves	24	\$ 4.70	4 gloves per worker		\$ 1.57

Laura and Cassie think they really need to make \$15 per hour each. Change this value on the spreadsheet. (Cell C28).

1. How many sausages will they need to sell now, to break even? (Break even means to make a profit of \$0)
2. Assuming they can only sell 200 sausages, how much should they put the price up in order to break even? Can you see any problems with this strategy?

They think that if they worked another hour (4 hours instead of 3), they could sell an extra 50 sausages. Using the original pay rate of \$10 per hour, make these changes on the spreadsheet.

3. Is it worth working the extra hour?
4. Would it be worth it for just one of them to work the extra hour?

Try adding another ingredient, such as mustard or sweet chilli sauce or grated cheese. You will need to insert a new row in the ingredients section.

Some questions to think about

1. How else would you like to modify the model?
2. Why are some modifications easier than others?
3. What are some limitations of the model?
4. What aspects of the real situation does the model represent well?
5. What aspects of the real situation does the model not represent well, but could do if you made the model more complex?
6. What aspects of the real situation could never be represented using a model such as this?
7. How does the model deal with uncertainty? (for example we don't really know how many sausages we will sell.)
8. What are some advantages of using a mathematical model?