3 Notes on the unstructured problems

Planning and organising **Organising a table tennis tournament**

Links to Case Studies

This problem is concerned with planning and organising. It involves allocating limited resources under realistic constraints in order to find an optimal solution. This is similar to other optimisation problems within the Case Studies, for example:

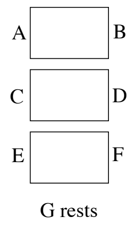
- **Outbreak** where pupils are asked to find ways of mixing ingredients to create an antidote for a virus and devise a vaccination programme.
- **Mystery tours**, where pupils plan a nationwide tour to satisfy time/money/customers
- **Highway link design**, where pupils propose the optimum location of a bypass using data used by the Highways agency.

A sample solution

Pupils should quickly notice that it is impossible to use all four tables simultaneously as there are only seven players. On each occasion, therefore someone has to rest. One possible way of organising the matches is shown below.

Start time	Table 1	Table 2	Table 3	
1.00	AvB	CvD	EvF	G rests
1.30	CvA	EvB	GvD	F rests
2.00	EvC	GvA	FvB	D rests
2.30	GvE	FvC	DvA	B rests
3.00	FvG	DvE	BvC	A rests
3.30	DvF	BvG	AvE	C rests
4.00	BvD	AvF	CvG	E rests

This solution was obtained by writing all the players' names on scraps of paper and placing them next to the three tables as shown. Every half an hour the players move one place clockwise. In this way each player plays against all the others once. It is also 'fair' in other ways; each player plays on each side of each table exactly once. Notice also that if there were 8 players, the matches would not take any longer. The additional player could play the resting player.



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3 Notes on the unstructured problems (continued)

Designing and testing **Designing a box for 18 sweets**

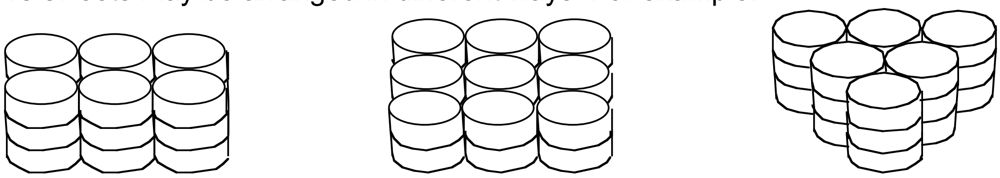
Links to Case Studies

This problem involves designing and making a product subject to given constraints (18 sweets, A4 card). The product is then tested for suitability. This is similar to several problems within the Case Studies, most notably:

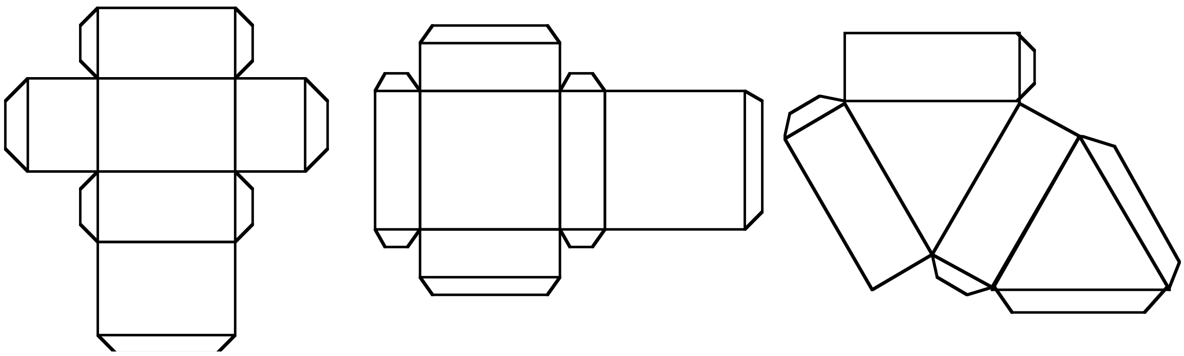
- **Product wars**, where pupils are asked to package a drink and test it through market research.
- **Digi design,** where pupils create a graphical design for a character and test it through market research.

A sample solution

18 sweets may be arranged in different ways. For example:



Each arrangement will lead to a different box design. Their dimensions may be calculated theoretically, or a more concrete approach may be adopted by drawing round sweets with appropriate dimensions[1]. Furthermore any given design may be constructed from card in several different ways. Some possible box designs are illustrated below:



[1] Fruit pastels and wine gums are commonly sold with these dimensions.

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3 Notes on the unstructured problems (continued)

Exploring and discovering **Calculating Body Mass Index**

Links to Case Studies

This problem is concerned with the systematic controlling of variables in order to find underlying relationships in a real situation and to use these relationships to make predictions and check the model. This is similar to several problems within the Case Studies, most notably:

- **Crash test,** where pupils systematically explore the effect of different variables when crash testing cars.
- **Speed cameras**, where pupils systematically investigate the effects of different sites for speed cameras.

A sample solution

It is easy to find the boundaries at which someone becomes underweight/overweight/obese if one variable is held constant while the other is varied systematically. The boundaries occur at:

	BMI
Underweight	Below 18.5
Ideal weight	18.5 - 24.9
Overweight	25.0 - 29.9
Obesity	30.0 and Above

In order to find out how the calculator works, it is better to forget realistic values for height and weight and simply hold one variable constant while changing the other systematically. For example, if pupils hold the height constant at 2 metres (not worrying if this is realistic!), then they will obtain the following table and/or graph:

Weight (kg)	60	70	80	90	100	110	120	130
BMI	15	17.5	20	22.5	25	27.5	30	32.5
	Underweight		Ideal weight		Overweight		Obese	

From this it can be seen that there is a proportional relationship between weight and BMI. (If you double weight, you double BMI; Here BMI = Weight/4)

If they now hold the weight constant and double the height, they will see that the BMI decreases by a factor of 4. This is an inverse square law, which may be outside the experience of many pupils. They may be able to explore the relationship by graphing, however.

So, if the BMI is proportional to weight and inversly proportional to the square of the height, it makes sense to try the relationship BMI = k x (weight)/(height)^2. The result is that k = 1.

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