Cinema problem

Mixed methods

Prerequisite knowledge

- Mental methods of addition, subtraction, multiplication and division
- Understanding of place value

Why do this problem?

'Cinema problem' demonstrates the power of working logically through different possibilities. This ordered approach narrow reveals patterns which down the options.

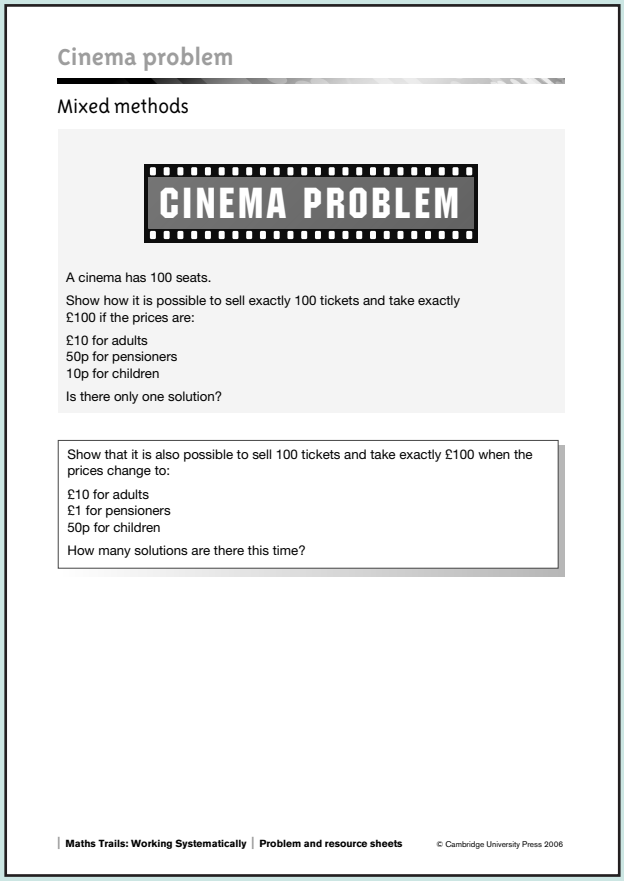
Time

One or two lessons

Resources

CD-ROM: problem sheet

NRICH website (optional): www.nrich.maths.org, October 2003, 'Cinema problem'


Cinema problem

Mixed methods

CINEMA PROBLEM

A cinema has 100 seats.

Show how it is possible to sell exactly 100 tickets and take exactly £100 if the prices are:

£10 for adults
50p for pensioners
10p for children

Is there only one solution?

Show that it is also possible to sell 100 tickets and take exactly £100 when the prices change to:

£10 for adults
£1 for pensioners
50p for children

How many solutions are there this time?

Maths Trails: Working Systematically | Problem and resource sheets

Introducing the problem

Set the scene of the first part of the problem, as shown on the problem sheet, using an OHT or by writing up necessary information on the board as a reminder. In order to assist the pupils' understanding of the problem, ask a few preliminary questions such as:

- How much would 10 adult tickets cost?
- How many children would be in the cinema if you had taken £100 and there were no adults/pensioners?

These initial questions should help the class to get a feel for the mathematics.

Main part of the lesson

Now probe a little more deeply into the problem and its underlying mathematics by asking the class if they have some ideas about how to tackle it.

- We have seen that 10 adults are too many. What could we try next? (9 adults)
- How many more people do we need to fill the cinema then?
- Who could they be?

Set the pupils off in small groups to investigate for themselves, starting with 9 adults. After a short period, encourage them to share their findings with the rest of the class. Perhaps pupils will have got as far as trying 8 adults. Tabulate some of their findings (it would be helpful to have columns showing the numbers of adults, pensioners and children along with the income) so that it is easier to see any patterns that might be emerging. As you create the table for 9 adults, here are some questions to extend pupils' thinking:

- What happens to the total cost if you replace a pensioner by a child?
- Similarly, what happens to the total cost if you replace a child by a pensioner?

The difference in income created by replacing a pensioner by a child or vice versa can help you decide whether the total of £100 is possible from a particular starting point. The difference with each 'change' is 40p, so if you have a total of £99.50, you will not be able to get £100.

Following this discussion, pupils should be able to work towards a solution.

Plenary

The plenary would be a good opportunity to ask how the pupils know the solution they have found is the only one.

- Have you tried all possible options?
- Might there be other ways to solve the problem (algebraically for example)?

If desired, a second lesson could address the second part of the problem, in the box on the problem sheet. It might be appropriate to tackle it using a different, and more efficient, method.

Solution notes

10 adults would use all the £100 but there would only be 10 in the audience.

It is also not possible to have 9 adults.

With 8 adults the rest of the 100 tickets can then be shared between the pensioners and the children. Every time you replace a pensioner by a child the amount drops by 40p, similarly replacing a child by a pensioner means the addition of 40p, so you have to be adrift by a multiple of 40p for this to work.

Takings from 8 adults = £80
Takings from 27 pensioners = £13.50
Takings from 65 children = £6.50

There are six solutions to the second part of the problem. They are:

no adults, 100 pensioners and no children;

1 adult, 81 pensioners and 18 children;

2 adults, 62 pensioners and 36 children;

3 adults, 43 pensioners and 54 children;

4 adults, 24 pensioners and 72 children;

5 adults, 5 pensioners and 90 children.