Day 86 **A Tier 10-a-day: Model Solutions**

1 Median and interquartile range

Here are the ages, in years, of 11 people.
30 51 62 37 31 73 9 55 74 79 78
(a) Work out the median.
(b) Work out the interquartile range.

Put in order: 9, 30, 31, 37, 51, 55, 62, 73, 74, 78, 79
(a) The middle value is number 6, so the median is 55
(b) Lower half: 9, 30, 31, 37, 51, so LQ = 31
Upper half: 62, 73, 74, 78, 79, so UQ = 74
IQR = 74 − 31 = 43
Answer: (a) 55 (b) 43

2 Loci and constructions

A radio mast is at point A. Its signal reaches up to 6 km.
A radio mast at B reaches up to 8 km.
Describe the region where both signals can be received.

Each signal covers the inside of a circle
Both signals are received where the two circles overlap
Answer: Inside both circles: the overlap of a circle of radius 6 km centred on A and a circle of radius 8 km centred on B

3 Exchange rates

The exchange rate is £1 = €1.15. (Calculator)
A hotel room costs €138 a night.
Work out the cost in pounds.

Divide by the exchange rate: 138 ÷ 1.15
= £120
Answer: £120

4 Simultaneous equations in context

4 adult tickets and 1 child ticket cost £37.
3 adult tickets and 2 child tickets cost £39.
Work out the cost of one adult ticket.

Let a = cost of one adult ticket in £ and c = cost of one child ticket in £
4a + c = 37 (1)
3a + 2c = 39 (2)
Multiply (1) by 2 to make the c coefficients match
8a + 2c = 74 (1)
3a + 2c = 39 (2)
The c terms have the same sign, so subtract equation (2) from equation (1)
5a = 35, so a = 7
Substitute a = 7 into equation (1) to find c = 9
Answer: £7

5 Time

(a) A train leaves London at 1550. The journey takes 4 hours 13 minutes. Work out the time it ends.
(b) Change 2.75 hours into hours and minutes.

(a) 1550 + 4 hours = 1950, then + 13 minutes = 2003
(b) 0.75 hours = 0.75 × 60 = 45 minutes, so 2.75 hours = 2 hours 45 minutes
Answer: (a) 2003 (b) 2 hours 45 minutes

Day 86 **A Tier 10-a-day: Model Solutions**

6 Capture-recapture

A scientist wants to estimate the number of frogs in a pond.
She catches 60 frogs, marks each one and returns them.
Later she catches a second sample of 40 frogs. 8 of these are marked.
Work out an estimate for the total number of frogs in a pond.

Proportion marked in the second sample = $\frac{8}{40}$

This is the same as the proportion in the whole population: $\frac{60}{N}$

$\frac{60}{N} = \frac{8}{40}$, so N = 60 × 40 ÷ 8 = 300

Answer: 300

7 Area of shaded regions with circles

A circle of radius 6 cm fits exactly inside a square.
The circle touches all four sides of the square. (Calculator)
Work out the area of the shaded region.
Give your answer to 3 significant figures.

Side of square = 2 × 6 = 12 cm
Square: 12 × 12 = 144
Circle: $\pi \times 6^2 = 36\pi$
Shaded area = $144 - 36\pi = 30.9$
Answer: 30.9 cm^2

8 Equations with fractions

Solve $\frac{x+2}{2} + \frac{x+5}{4} = 0$

Multiply every term by 4 (the lowest common multiple of 2 and 4)
2(x + 2) + (x + 5) = 4 × 0
3x + 9 = 0
3x = −9
x = −3
Answer: x = −3

9 Combined means

The mean age of 12 workers is 60 years.
One of them, aged 16, leaves.
Work out the mean age of the remaining workers.

Total age = 12 × 60 = 720
Total after one leaves = 720 − 16 = 704
Mean = 704 ÷ 11 = 64
Answer: 64 years

10 Equations with algebraic fractions

Solve $\frac{6}{(x+2)} + \frac{6}{(x-3)} = 1$

Multiply every term by (x + 2)(x − 3)
6(x − 3) + 6(x + 2) = (x + 2)(x − 3)
$12x - 6 = x^2 - x - 6$
$x^2 - 13x = 0$
x(x − 13) = 0
x = 0 or x = 13
Answer: x = 0 or x = 13