

Core Maths Weekly Skills Test

This is a series of weekly skills tests designed to build your skills in key areas for Core Maths

Tick each answer you get right. Track your progress using this table

Question	Skill	Week 1	Week 2	Week 3	Week 4	Week 5
1	Comparing 2 data sets					
2	Payslip deductions – Tax NI & student loans					
3	Interest rates – AER, APR & Compound interest					
4	Fermi estimates					
5	Critical Analysis of statements (percentages)					
6	Normal Probabilities & Inverse normal					
7	Confidence intervals					
8	PMCC & regression lines					
	My total out of 8					

Formulas & tax bands

Financial calculation - AER

The annual effective interest rate (AER), r , is given by

$$r = \left(1 + \frac{i}{n}\right)^n - 1$$

Tax: Personal Allowance £12 500

Taxable income	Tax rate
Up to 37 500	20%
37 500 – 137 500	40%
Over 137 500	45%

Income	NI rate
Up to £8 632	0%
£8 632 - £50 000	12%
Over £50 000	2%
Income	Student loan repayment
Up to £21 000	0%
Over £21 000	9%

Core Maths Weekly Skills Test: Week 1

1) Who is better at darts?

Sam scores: 27, 54, 16, 1, 39, 5, 60, 25, 8, 40, 20

Ella scores: 26, 12, 51, 20, 50, 19, 48, 57, 30, 24, 21, 15

2) Calculate the Tax, NI & net monthly pay for someone on a salary of £25 000.

They do not have a student loan.

3) You put £250 in a savings account 10 years ago. You now have £294.45 in the account.

What is the AER to 2dp?

4) As part of a healthy eating initiative a primary school plans to give every child an apple at break time every day for a year. Estimate the cost.

5) My council tax was £902.50 a month and now it is £950. The council say this is a 0.05% increase. What is wrong with their calculation?

$$£950 - £902.50 = £47.50$$

$$47.50 \div 950 = 0.05$$

6) Blackbird wing lengths are distributed normally with a mean of 130mm and a standard deviation of 4mm.

a) Calculate the probability that a blackbird will have a wing longer than 137mm

b) Calculate the max wing length for the bottom 10% of blackbirds

7) It is thought that blackbird wingspans may be increasing due to climate change.

A sample of 100 blackbirds is captured, measured and released. The sample mean wingspan is 137mm. Use the standard deviation from Q6 to calculate a 90% confidence interval for the blackbird wing lengths based on this sample.

8) Calculate the PMCC and regression line for this dataset

Wing length (mm)	124	133	134	136	136	138	133	128	133	133
Weight (g)	94	113	119	105	113	118	118	94	119	104

Core Maths Weekly Skills Test: Week 1

1) Who is better at darts?

Sam scores: 27, 54, 16, 1, 39, 5, 60, 25, 8, 40, 20, 32 mean = 27.25 sx = 18.7

Ella scores: 26, 12, 51, 20, 50, 19, 48, 57, 30, 24, 21, 15 mean = 31.1 sx = 15.9

Ella is better because her mean is higher and her performance is less variable

2) Calculate the Tax, NI & net monthly pay for someone on a salary of £25 000.

They do not have a student loan.

$$(25\,000 - 12\,500) \times 0.2 = 2500 \text{ tax} \quad (25\,000 - 8632) \times 0.12 = 1964.16 \text{ NI}$$

$$(25\,000 - 2\,500 - 1\,964.16) / 12 = \text{£}1\,711.32 \text{ net pay per month}$$

3) You put £250 in a savings account 10 years ago. You now have £294.45 in the account.

What is the AER to 2dp?

$$294.45 / 250 = 1.1778 \quad \sqrt[10]{1.1778} = 1.016499 \quad (1.016499 - 1) \times 100 = 1.65\% \text{ AER}$$

4) As part of a healthy eating initiative a primary school plans to give every child an apple at break time every day for a year. Estimate the cost.

Assume number of children in a class \approx 30 Assume classes in year \approx 4 Assume school days per year \approx 190

Assume cost per apple \approx £0.20 Primary school so Reception – Year 6 = 7 year groups

$$30 \times 4 \times 190 \times 0.20 \times 7 = \text{£}31\,920$$

5) My council tax was £902.50 a month and now it is £950. The council say this is a 0.05% increase. What is wrong with their calculation?

$$\text{£}950 - \text{£}902.50 = \text{£}47.50$$

$$47.50 \div 950 = 0.05$$

Should divide by original amount, should multiply by 100 to get %

$$47.50 / 900 \times 100 = 5.28\% \text{ increase}$$

6) Blackbird wing lengths are distributed normally with a mean of 130mm and a standard deviation of 4mm.

c) Calculate the probability that a blackbird will have a wing longer than 137mm $P = 0.04006$

d) Calculate the max wing length for the bottom 10% of blackbirds Area = 0.1 so 124.9 mm

7) It is thought that blackbird wingspans may be increasing due to climate change.

A sample of 100 blackbirds is captured, measured and released. The sample mean wingspan is 137mm. Use the standard deviation from Q6 to calculate a 90% confidence interval for the blackbird wing lengths based on this sample.

We can say with 90% confidence $136.3 < \mu < 137.7$ this sample supports hypothesis

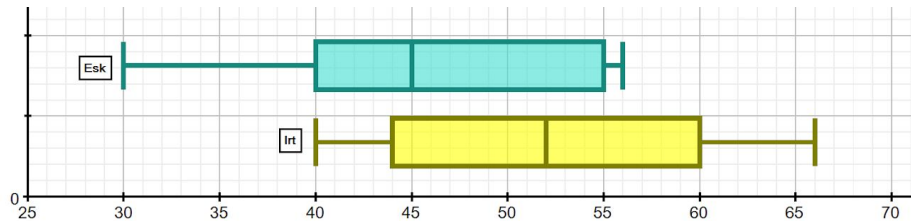
8) Calculate the PMCC and regression line for this dataset

Wing length (mm)	124	133	134	136	136	138	133	128	133	133
Weight (g)	94	113	119	105	113	118	118	94	119	104

$r = 0.734$ $y = -126.8 + 1.78x$

Core Maths Weekly Skills Test: Week 2

1) Which long distance running club is better?



2) Calculate the Tax, NI & net monthly pay for someone on a salary of £17 000. They do not have a student loan.

3) Comparing saving accounts you find two:

A: 5% for the first year and then 1% for the next 2 years

B: 2.5% fixed for 3 years

Which account has a better average AER?

4) Estimate how much money you could save by bringing a packed lunch to college instead of paying for lunch in the canteen for 1 year

5) A company has seen its profits rise and as a result it decides to increase the hourly wages of its employees. There are two suggestions:

A: To give every worker a £0.50 per hour pay rise.

B: To give every worker a 1% pay rise.

How much would you need to be earning for option B to be better?

6) Blackbird weights are distributed normally with a mean of 107g and a standard deviation of 12.6g.

a) Calculate the probability that a blackbird will weigh less than 95g

b) Calculate the max weight for the bottom 25% of blackbirds

7) It is thought that blackbird weights may be decreasing due to climate change.

A sample of 100 blackbirds is captured, measured and released. The sample weight is 98g. Use the standard deviation from Q6 to calculate a 90% confidence interval for the blackbird weights based on this sample.

8) Calculate the PMCC and regression line for this dataset

Wing length (mm)	136	130	130	132	131	130	128	135	133	132
Weight (g)	113	100	94	102	107	106	101	97	88	101

Core Maths Weekly Skills Test: Week 2

1) Median for Esk is 45min, for Irt is 52min, so the runners from Esk are faster on average

IQR for Esk is $55-40=15$, IQR for Irt is $60-44=16$, so Esk runners are also slightly more consistent

2) $(17\,000 - 12\,500) \times 0.2 = 900$ tax $(17\,000 - 8632) \times 0.12 = 1004.16$ NI

$(17\,000 - 900 - 1\,004.16)/12 = \pounds 1\,257.99$ net pay per month

3) Consider what would happen if you put $\pounds 100$ in each account for 3 years

A: $\pounds 100 \times 1.05 \times 1.01^2 = \pounds 107.11$ $\sqrt[3]{107.1105} \div 100 = 1.0232$ so 2.32% AER

B: $\pounds 100 \times 1.025^3 = \pounds 107.67$ AER is 2.5% (given) Account B is better

4) Assume lunch costs $\pounds 2.50$ in the canteen Assume 190 days in school year

Assume packed lunch costs $\pounds 0.50$ to make Daily saving = $\pounds 2.50 - \pounds 0.50 = \pounds 2$

$190 \times 2 = \pounds 380$ saved

5) $\pounds 0.50 \div 0.01 = \pounds 50$ per hour. Most workers would be better off with option A

6) Blackbird weights are distributed normally with a mean of 107g and a standard deviation of 12.6g.

a) Calculate the probability that a blackbird will weigh less than 95g $P = 0.17045$

b) Calculate the max weight for the bottom 25% of blackbirds $\text{Area} = 0.25$ so 98.5g

7) It is thought that blackbird weights may be decreasing due to climate change.

A sample of 100 blackbirds is captured, measured and released. The sample weight is 98g. Use the standard deviation from Q6 to calculate a 90% confidence interval for the blackbird weights based on this sample.

We can say with 90% confidence $95.9 < \mu < 100.1$ so this sample supports hypothesis

8) Calculate the PMCC and regression line for this dataset

Wing length (mm)	136	130	130	132	131	130	128	135	133	132
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Weight (g)	113	100	94	102	107	106	101	97	88	101
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$r = 0.147$

$y = 45.6 + 0.420x$ (poor predictive value because low r)

Core Maths Weekly Skills Test: Week 3

1) Compare boys & girls heights

2) Calculate the Tax, NI, student loan contribution & net monthly pay for someone on a salary of £29 000

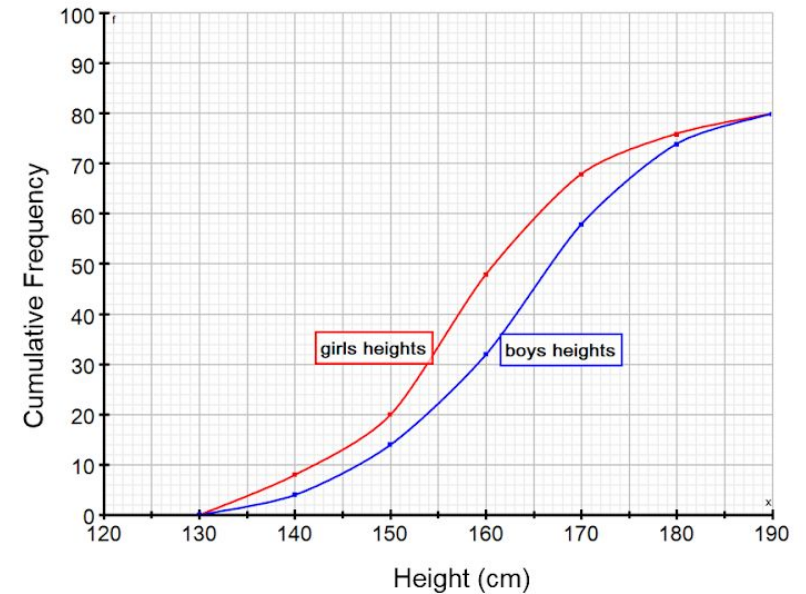
3) You buy a sofa on a payment plan. The APR is 17% and you make 3 monthly payments of £250 each. What is the value of the sofa?

4) Estimate how many disposable cups the people in your class use in a month

5) A shop owner raises the price of a pair of £100 shoes by 50%. After a few weeks because of falling sales the owner reduces the price of the shoes by 50%. Are the shoes back to the original price?

6) Levels of Nitrogen dioxide in the air are measured. The mean of the data is 31.8 parts per million and the median is 27 parts per million. Would a Normal distribution be a good model for this data?

7) It is thought that the levels of nitrogen dioxide may be higher at rush hour. The levels are measured on 15 consecutive days and the sample mean is 46.5 parts per million. The population standard deviation is 21.9 parts per million.



Construct a 95% confidence interval for the population mean at rush hour

8) Calculate the PMCC and regression line for this dataset

Year	1980	1984	1988	1992	1996	2000	2004	2008
Maximum area of ozone hole (million km ²)	3.3	14.7	13.8	24.9	26.9	29.9	22.7	26.5

Core Maths Weekly Skills Test: Week 3

1) Median height for girls is 161cm, for boys is 167cm, so on average the boys are taller
IQR for girls is $(178-152)=26$ cm, for boys is $(181-156)=25$ cm so they are equally variable

2) $(29\,000 - 12\,500) \times 0.2 = 3300$ tax $(29\,000 - 8632) \times 0.12 = 2444.16$ NI
 $(29\,000 - 21\,000) \times 0.09 = 720$ loan repayment

$(29\,000 - 3\,300 - 2\,444.16 - 720)/12 = \pounds 1877.99$ net pay per month

$$3) c = \frac{250}{(1+0.17)^{12}} + \frac{250}{(1+0.17)^{12}} + \frac{250}{(1+0.17)^{12}} = \pounds 730.67$$

4) Assume 12 students Assume 1 cup each per day $12 \times 30 = 360$ cups per month

5) $\pounds 100 \times 1.5 \times 0.5 = \pounds 75$ They are not back to the original price

- 6) The normal distribution would not be a good model because the mean and the median are different. In a Normal distribution mean = median = mode.
- 7) We can do a confidence interval because even when the underlying population is not normally distributed the sample means distribution is Normal

We can say with 95% confidence $35.4 < \mu < 57.6$ so this sample supports hypothesis

- 8) Calculate the PMCC and regression line for this dataset

Year	1980	1984	1988	1992	1996	2000	2004	2008
Maximum area of ozone hole (million km ²)	3.3	14.7	13.8	24.9	26.9	29.9	22.7	26.5

$r = 0.821$

$y = -1479.3 + 0.752x$

Core Maths Weekly Skills Test: Week 4

1) The Stem & Leaf diagram shows the number of birds on a cliff every day in May.

Has the number of birds increased in Year 2?

Year 1		Year 2
3	18	
7 3	19	2
6 5 4 0	20	3 5 6
7 6 2 2	21	4 5
9 8 6 5	22	5 7 9
7 6 4 2 1	23	5 6 6 7 8 9 9
8 7 5 3 0	24	3 4 5 6 8 8
3 3 2	25	0 1 3 5
1 0	26	2 4 5 7

2) Calculate the Tax, NI, student loan contribution & net monthly pay for someone on a salary of £39 000

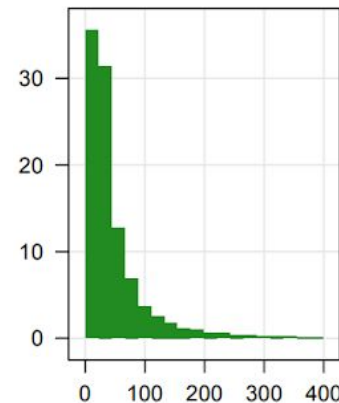
3) You buy car insurance on a payment plan. The APR is 24% and you make 12 monthly payments of £67.50 each. How much would you save if you could pay up front?

4) Estimate how many pairs of shoes you will own in your lifetime

5) The annual number of burglaries in a town fell by 40% in 2012 and then Does this mean the number of burglaries has fallen by 70% over the two year

6) Levels of NOX in the air are measured. The data is shown in this graph. million and the y axis is the percentage of measurements that are at Would a Normal distribution be a good model for this data?

7) NOX levels are measured hourly for 24 hours and the sample mean is deviation is 78.9 parts per million



by 30% in 2013. period?

The x axis is the amount of NOX in parts per this level.

97.4 parts per million. The population standard

Construct a 95% confidence interval for the population mean

8) Calculate the PMCC and regression line for this dataset

Year	2000	2001	2002	2003	2004	2005	2006	2007
Maximum area of ozone hole (million km ²)	29.9	26.5	21.9	28.4	22.7	26.9	29.3	24.8

Core Maths Weekly Skills Test: Week 4

1) Median height for year 1 is 231, for year 2 is 239, so there are more birds on average in Year 2
IQR for year 1 is $(245 - 212)=33$, IQR for year 2 is $(250 - 227)=23$ so there are consistently more in Year 2

2) $(39\,000 - 12\,500) \times 0.2 = 5300$ tax $(39\,000 - 8632) \times 0.12 = 3644.16$ NI
 $(39\,000 - 21\,000) \times 0.09 = 1\,620$ loan repayment

$(39000 - 5300 - 3644.16 - 1620)/12 = \text{£}2369.65$ net pay per month

$$3) \quad c = \sum_{x=1}^{12} \frac{67.50}{1.24^x} = \text{£}722.29$$

You pay $12 \times 67.50 = \text{£}810$ so you would save $810 - 722.29 = \text{£}87.71$ paying up front

4) Assume you buy 3 pairs of shoes a year and you live to be 75
 $3 \times 75 = 225$ pairs of shoes

5) $0.60 \times 0.70 = 0.42$ This is a 58% reduction, not 70%

6) The normal distribution would not be a good model because the data is not symmetrical

7) We can do a confidence interval because even when the underlying population is not normally distributed the sample means distribution is Normal

We can say with 95% confidence $65.8 < \mu < 129.0$

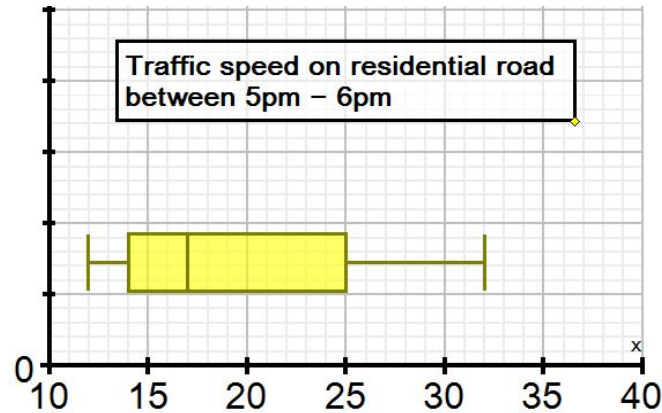
8) Calculate the PMCC and regression line for this dataset

Year	2000	2001	2002	2003	2004	2005	2006	2007
Maximum area of ozone hole (million km ²)	29.9	26.5	21.9	28.4	22.7	26.9	29.3	24.8

$r = -0.122$

$y = 322.1 - 0.148x$ (poor predictive power because low r)

Core Maths Weekly Skills Test: Week 5



- 1) Compare the speed of traffic in the evening with the speed in the morning
- 2) Calculate the Tax, NI, student loan contribution & net monthly pay for someone on a salary of

£32 000.

- 3) You pay for an emergency boiler repair on a credit card with an APR of 24%. The repair costs £750 and you plan to pay it off over 6 months. How much do you have to pay each month?
- 4) Estimate how much time you will spend asleep in your lifetime. Give your answer in years.
- 5) Who is the better employee?

	satisfied customers: day 1	satisfied customers: day 2
Angela	$45/50 = 90\%$	$100/150 = 67\%$
Bertha	$120/150 = 80\%$	$30/50 = 60\%$

- 6) Levels of ozone in the air are measured. The mean is 44.0 parts per million and the median is 43.7 parts per million. Would a Normal distribution be a good model for this data?
- 7) It is thought that ozone levels are lower on weekends. The Ozone level is measured hourly for 24 hours one Sunday and the sample mean is 31.2.

Use a population standard deviation of 22.2 to construct a 95% confidence interval for the population mean on Sundays

- 8) Calculate the PMCC and regression line for this dataset (Note there is no measurement in 1995)

Year	1990	1991	1992	1993	1994	1996	1997	1998	1999
Maximum area of ozone hole (million km ²)	21.1	22.5	24.9	25.8	25.2	26.9	25.1	27.9	25.8

Core Maths Weekly Skills Test: Week 5

1) Median height for morning is 19mph, evening is 17mph, so traffic is faster in the morning
IQR for morning is $(24 - 16)=8$, IQR for evening is $(25 - 14)=11$ so speeds are more varied in the evening

2) $(32\ 000 - 12\ 500) \times 0.2 = 3900$ tax $(32\ 000 - 8632) \times 0.12 = 2804.16$ NI
 $(32\ 000 - 21\ 000) \times 0.09 = 990$ loan repayment

$(32000 - 3900 - 2804.16)/12 = \text{£}2\ 025.50$ net pay per month

3) $750 = A \left(\sum_{x=1}^6 \frac{1}{1.24^{12x}} \right)$ so $750 = 5.6378 A$ so $A = \text{£}133.03$ monthly

4) Assume you sleep 7 hours a night out of 24 hours and you live to be 75

$$7/24 \times 75 = 21.9 \text{ years}$$

5) Angela served 200 customers & had 145 satisfied
Bertha served 200 customers and had 150 satisfied, which is better

6) Yes, the mean and the median are pretty similar so the Normal distribution would be a good model

7) We can say with 95% confidence $22.3 < \mu < 40.1$ This falls below the population mean in Q6 which supports the hypothesis that levels are lower on Sundays

8) Calculate the PMCC and regression line for this dataset

Year	1990	1991	1992	1993	1994	1996	1997	1998	1999
Maximum area of ozone hole (million km ²)	21.1	22.5	24.9	25.8	25.2	26.9	25.1	27.9	25.8

$$r = 0.787$$

$$y = -996.5 + 0.512x$$