A warm welcome to…

Core Maths

Although it includes a lot of GCSE Maths content, Core Maths has a very different emphasis: it's about using maths to help you process and understand lots of different real-life questions and scenarios. Often, several different 'correct' answers and several different approaches are all valid. The aim is to help you use maths to understand the world around you better, from evaluating statistical arguments and diagrams to personal finance (mortgages, tax etc). The better you understand the world around you, the better your decision-making in adult and professional life.

To give you an idea what this is like, you can have a look at this investigation into population signs. The main tasks are in the green boxes, and are designed to get you thinking like a Core Mathematician: how can we use maths to understand the questions better and start to develop some answers? If you do decide to have a go and want to send me your work, or you have any questions about Core Maths not answered on the school website, email s.mcclean@allsaints.sheffield.sch.uk. Enjoy!

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Population signs

Which population figure will be out of date first?
What information would help you to decide?

Have a think first, then see the next slide for some hints

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Which sign will be out of date first? Questions to think about:

- How do you think the figures have been rounded?
- Will there be different factors affecting the population in Bryson compared to Toronto?
- What statistical information affects the population figure? (When you’re ready, look at the next slide for some relevant statistics)

Some data

2019 Data	USA	Canada
Birth rate per 1000 population	11.979	10.300
Death rate per 1000 people	8.880	7.803
***Net migration per 1000 population**	2.857	6.468

*net migration (people coming in – people leaving)

<u>Task</u>*: Can you use these statistics to develop a mathematical approach to answering the question? When you've had a go, look at the next two slides to see one possible approach. Do you agree? How does it compare to yours?

A possible approach…

It is possible to estimate the population change per 1000 people, using birth rate plus net migration minus death rate. See below.

2019 Data	USA	Canada
Birth rate per 1000 population	11.979	10.300
Death rate per 1000 people	8.880	7.803
*Net migration per 1000 population	2.857	6.468
Change per 1000	5.956	8.965

For Bryson USA with a population of 528:

The population next year is estimated by $528 + \frac{528}{1000} \times 5.956 = 531.14$ *so* ***531***

For Toronto Canada with a population between 2,503,500 - 2,504,500:

The population next year is estimated by $2{,}503{,}500 + \frac{2{,}503{,}500}{1000} \times 8.965$ *to* $2{,}504{,}500 + \frac{2{,}504{,}500}{1000} \times 8.965$

2,525,943.88 to 2,526,952.84   so 2,525,944 to 2,526,953

This means both signs would be out of date in a year.

To reach a decision, you could assume the change in population is linear. The reasonableness of this could later be questioned by looking at the seasonality of births/deaths/migration

Assuming a linear change

We estimate that the population of Bryson will increase by 3 in a year, so an increase of 1 person, to make the sign out of date, would take about a third of a year, or 121.66 days (122 days to the nearest day), see below.

$\frac{1}{3}$ x 365 = 121.66 or **122 days** to the nearest day

Assuming the best case for Toronto, a starting population of 2,503,500, the population change for the next year is estimated to be 22443.8775 or 22444 to the nearest person.

The sign will need to change when the population (2,503,500) grows by 1000. This is estimated to be after 16 days, see below.

So $\frac{1000}{22444}$ x 365 = 16.2 days or **16 days**.

Questions to think about:

- How often would a population sign need replacing?
- What is a sensible level of accuracy for a population sign?
- What information would help you to reach a decision?

Task: Using the data below, produce a set of recommendations so that a UK village/town/city can produce a population sign that will remain accurate for 5 years.

When you've had a go, you can look at the next two slides for one possible approach

2019 Data	UK
Birth rate per 1000 population	11.488
Death rate per 1000 people	9.398
*Net migration per 1000 population	3.566

A possible approach…

You can use $birth\ rate + net\ migration - death\ rate$ to calculate an estimate of the overall change per 1000 people per year. You can then use this to estimate the change person per year and the change per person per 5 years:

2019 Data	UK
Birth rate per 1000 population	11.488
Death rate per 1000 people	9.398
*Net migration per 1000 population	3.566
Change per 1000 people	5.656
Change per person	0.005656
Change per person in 5 year period	0.02828

There are different levels of accuracy possible with the population signs: they can be rounded to the nearest 1,10,100 and so on. Dividing 1, 10, 100 …. by the estimated change in 5 years gives the following:

Round to Nearest	Population Limit	Rounded down limit population limit
1	35.4	35
10	353.6	353
100	3,536.1	3,536
1,000	35,360.7	35,360
10,000	353,606.8	353,606
100,000	3,536,067.9	3,536,067
1,000,000	35,360,678.9	35,360,678

From this it is possible to conclude that:

- For populations 35 or lower, the sign could show the actual population.
- Anywhere with a population of 36 to 353 should round their signs to the nearest 10.
- Anywhere with a population of 354 to 3536 should round their signs to the nearest 100.
- Anywhere with a population of 3537 to 35,360 should round their signs to the nearest 1,000.
- Anywhere with a population of 35,361 to 353,606 should round their signs to the nearest 10,000
- Anywhere with a population of 353,607 to 3,536,067 should round their signs to the nearest 100,000
- Anywhere with a population of 3,536,068 to 35,360,678 should round their signs to the nearest 1,000,000