Teacher sheet - Population signs

Getting started

This slide is intended to prompt thinking.

Bryson is a small settlement in the USA, whilst Toronto is a large city in Canada.

Which population figure will be out of date first?

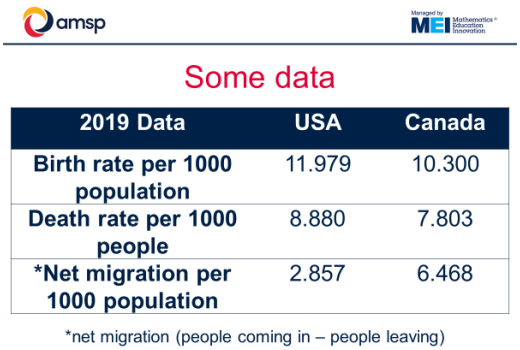
Answering this question requires the students to consider whether the population of Toronto will change by 500, before the population of Bryson changes by 1.

Is it fair to assume that the population of Toronto will change in a different way to the population of Bryson? Why?

What information would help you to decide?

Students need to think about the factors which cause a population to change in size, for example the number of births/deaths and the level of migration, in and out, of the place in question. Such information is often not readily available at the level of individual towns and cities, but national figures can usually be found.

At an appropriate point, show the information on the slide below, then ask the students to use this to help answer the question from slide 1 - Which population figure will be out of date first?



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)

Note: This data above was obtained by using a google search.

See *https://population.un.org/wpp/DataQuery/* for the latest data

One approach to arriving at an answer is given below.

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 + $\frac{528}{1000}$ x 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 + $\frac{2,503,500}{1000}$ x 8.965 to 2,504,500 + $\frac{2,504,500}{1000}$ x 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This means both signs would be out of date in a year.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**.

Now, the students can be encouraged to complete the task on the next slide, see below.

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Task

- Produce a set of recommendations so that a UK village/town/city can produce a population sign that will remain accurate for 5 years

One possible approach

Inputting the figures into a spreadsheet, then calculating an estimate of the change per person per year and the change per person per 5 years. See below.

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

Thinking about the different levels of accuracy possible with the population signs. The signs 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