

Estimate the number of grains of sand on all the beaches of the earth.

The number of grains of sand will be the volume of sand divided by the the volume per grain.

$$N = \frac{\text{Volume_of_sand}}{\text{Volume_of_grain}}$$

The volume of sand is available from the product of the length of all beaches in the world, their average width and average depth.

$$\text{Volume_of_sand} = (\text{length_of_beaches}) (\text{width}) (\text{depth})$$

We will need to estimate the parameters on the right.
To get going we use the idea that the length of beaches is some percentage of the length of shores.

$$\text{length_of_beaches} = \frac{\% \text{shores}}{100} \text{length_of_shores}$$

The length of shores is related to the size of the earth. We choose to include the size in terms of the circumference.

$$\text{length_of_shores} = (\text{multiple_of_circumference}) (\text{earth_circumference})$$

$$N = \frac{\left(\frac{\% \text{shores}}{100} \left((\text{multiple_of_circumference}) \text{earth_circumference} \right) \right) (\text{width}) (\text{depth})}{\text{Volume_of_grain}}$$

We use rough but reasonable values for the parameters.

$$\% \text{shores} = 25$$

$$\text{multiple_of_circumference} = 5$$

$$\text{earth_circumference} = 40000 \text{ km} \quad \text{km} = 1000 \text{ m} \quad \text{m} = 1000 \text{ mm}$$

$$\text{width} = 30 \text{ m}$$

$$\text{depth} = 5 \text{ m}$$

$$\text{Volume_of_grain} = 1 \text{ mm}^3$$

$$N = \frac{\left(\frac{25}{100} \left((5) (40000 (1000 (1000 \text{ mm}))) \right) \right) (30 (1000 \text{ mm})) (5 (1000 \text{ mm}))}{1 \text{ mm}^3}$$

$$N = 7.5 \times 10^{18}$$

The numbers used can readily be varied to introduce more refined estimates of the parameters.