Normal Distribution

▶ **from the Formula Booklet – SL & HL** ◀

standardized normal variable $z = \dfrac{x - \mu}{\sigma}$

Exercises – calculator allowed on all questions   [answers included]

1. A machine fills plastic bottles with mineral water. The volume of mineral water that the machine pours into each bottle follows a normal distribution with a mean of 498 ml and a standard deviation of 3.4 ml. Each can has a maximum capacity of 506 ml. On the label of each bottle is printed the statement: **Contents 500 ml**

    Find the probability that a bottle chosen by random

    (a) has a volume less than 500 ml;

    (b) has a volume between 500 ml and 506 ml;

    (c) is completely full, i.e. has a volume of 506 ml

2. The length of a certain skateboard model is advertised to be 81 cm. The actual length, *X* metres, follows a normal distribution with a mean of 81.04 cm and a standard deviation of 1.2 cm.

    (a) Find: (i) $P(X < 80)$

                         (ii) $P(80 < X < 82)$

     (b) Given that the value of the standard deviation does not change, find the mean length necessary to guarantee that only 1% of skateboards have lengths less than 80 cm. Give your answer accurate to four significant figures.

3. The weights of a certain animal are normally distributed with a mean of 36.4 kg and a standard deviation of 4.7 kg. Find the probability that when one of these animals is chosen at random it will have a weight that is:
    (a) 40.0 kg or less;
    (b)   more than 45.0 kg;
    (c) between 32.0 kg and 41.0 kg.

4. The random variable *X* represents the annual consumption, in cubic metres, of water by households in the town of Hippsburg. *X* is normally distributed with mean μ and standard deviation σ. Given that 30% of households use more than 200 cubic metres annually and 20% of households use less than 120 cubic metres annually, find the value of μ and the value of σ.

5. Adult male customers for t-shirts have chest measurements which may be modelled by a normal distribution with mean 101 cm and standard deviation 5 cm. T-shirts to fit customers with chest measurements less than 98 cm are classified as 'small'. Find the median chest measurement of customers requiring 'small' t-shirts.

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Answers

1. (a) 0.722   (b) 0.269   (c) 0.0198

2. (a) (i) 0.193   (ii) 0.595   (b) 82.79 cm

3. (a) 0.779   (b) 0.0336   (c) 0.0198

4. $\mu \approx 58.6 \text{ m}^3$, $\sigma \approx 169 \text{ m}^3$

5. median $= 95.6$ cm