

S1 Normal Distribution Challenge

Challenge 1

In order not to be late for a job interview, Anita needs to leave her house in a taxi no later than 3.00 pm. Past experience has shown that, when she telephones for a taxi from company *A*, the time it takes to arrive at her house may be modelled by a normal distribution with a mean of 12 minutes and a standard deviation of 3 minutes.

- (a) Given that she telephones for a taxi at 2.45 pm, find the probability that she will not be late for the interview. *(3 marks)*
- (b) Find, to the nearest minute, the latest time that she should telephone for a taxi in order to have a probability of 0.99 of not being late for the interview. *(3 marks)*

As well as wishing not to be late, Anita would prefer not to arrive too early, as waiting outside an interview room makes her nervous. The time taken to arrive at her house by a taxi from company *B* may be modelled by a normal distribution with a mean of 12 minutes and a standard deviation of 2 minutes.

- (c) State, giving a reason, which taxi firm you would advise Anita to use. *(2 marks)*



Challenge 2

A study showed that the time, T minutes, spent by a customer between entering and leaving Fely's department store has a mean of 20 with a standard deviation of 6.

Assume that T may be modelled by a normal distribution.

- (a) Find the value of T exceeded by 20% of customers. *(4 marks)*
- (b) (i) Write down the standard deviation of the mean time spent in Fely's store by a random sample of 90 customers. *(1 mark)*
- (ii) Find the probability that this mean time will exceed 21 minutes. *(4 marks)*



Challenge 3

A gas supplier maintains a team of engineers who are available to deal with leaks reported by customers. Most reported leaks can be dealt with quickly but some require a long time. The time (excluding travelling time) taken to deal with reported leaks is found to have a mean of 65 minutes and a standard deviation of 60 minutes.

- (a) Assuming that the times may be modelled by a normal distribution, estimate the probability that:
- (i) it will take more than 185 minutes to deal with a reported leak; *(3 marks)*
 - (ii) it will take between 50 minutes and 125 minutes to deal with a reported leak; *(4 marks)*
 - (iii) the mean time to deal with a random sample of 90 reported leaks is less than 70 minutes. *(4 marks)*
- (b) A statistician, consulted by the gas supplier, stated that, as the times had a mean of 65 minutes and a standard deviation of 60 minutes, the normal distribution would not provide an adequate model.
- (i) Explain the reason for the statistician's statement. *(2 marks)*
 - (ii) Give a reason why, despite the statistician's statement, your answer to part (a)(iii) is still valid. *(2 marks)*



Final Challenge

The weights, in grams, of the contents of tins of mackerel fillets are normally distributed with mean μ and standard deviation 2.5. The value of μ may be adjusted as required.

- (a) Find the proportion of tins with contents weighing between 125.0 grams and 130.0 grams when $\mu = 129.0$. *(5 marks)*
- (b) (i) State, without proof, the value of μ which would maximise the proportion of tins with contents weighing between 125.0 grams and 130.0 grams. *(1 mark)*
- (ii) Find the proportion of tins with contents weighing between 125.0 grams and 130.0 grams when μ is equal to the value you have specified in part (b)(i). *(3 marks)*
- (c) Find, to one decimal place, the value of μ such that 99% of the tins have contents weighing more than 125.0 grams. *(4 marks)*
- (d) The normal distribution provides a good model for many continuous distributions which arise in production processes or in nature. Explain why the Central Limit Theorem provides another reason for the importance of the normal distribution. *(2 marks)*

