

The normal distribution

A-level Statistics (Year 2) | Edexcel 9MA0 | 12 questions, 77 marks

A-level Maths topic practice



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Name: _____ **Date:** _____ **Score:** _____ / 77

1 The mass, X grams, of a chocolate bar made by a machine is modelled by $X \sim N(50, 4^2)$

- a. Find $P(X > 56)$
- b. Find $P(46 < X < 53)$
- c. Find the value of a such that $P(X < a) = 0.85$

(4 marks)

Answer _____

2 The random variable $Z \sim N(0, 1^2)$

- a. Find $P(Z < 1.2)$
- b. Find $P(-0.5 < Z < 1.5)$
- c. Find the value of z such that $P(Z > z) = 0.05$
- d. Find the value of a such that $P(-a < Z < a) = 0.8$

(4 marks)

Answer _____

3 The heights, H cm, of the sunflowers in a field are normally distributed. The curve of the probability density function of H has points of inflection at $H = 150$ and $H = 190$

- Write down the mean and the standard deviation of H
- Write down, to the nearest whole number, the percentage of sunflowers with heights between 130 cm and 210 cm.
- Find $P(H > 200)$
- Find the interquartile range of the heights.

(6 marks)

Answer _____

4 A machine cuts wooden dowels. The length, L cm, of a dowel is normally distributed with mean 12 cm and standard deviation σ cm.

Given that 3% of the dowels are shorter than 11.82 cm,

- show that $\sigma = 0.096$ to 3 decimal places.
- Find the proportion of dowels with lengths between 11.9 cm and 12.15 cm.

(5 marks)

Answer _____

5

The times, T minutes, taken by runners to complete a 5 km park run are modelled by a normal distribution with mean μ and standard deviation σ . 20% of the runners take less than 25 minutes and 10% of the runners take more than 38 minutes.

- Find the value of μ and the value of σ . Show your working clearly.
- Find the probability that a randomly chosen runner takes between 28 and 32 minutes.

(7 marks)

Answer _____

6

The masses, M grams, of apples from an orchard are normally distributed with mean 150 g and standard deviation 12 g. Apples with masses between 140 g and 165 g are sold to a supermarket.

- Find the proportion of apples that are sold to the supermarket.
- An apple is chosen at random from those sold to the supermarket. Find the probability that its mass is more than 155 g.

(5 marks)

Answer _____

7

The mass, F grams, of flour in a bag filled by a machine is modelled by $F \sim N(1010, 8^2)$

- A bag with less than 1000 g cannot be sold and is emptied and refilled, at a loss of 30p.
- A bag with between 1000 g and 1025 g is sold at a profit of 40p.
- A bag with more than 1025 g is sold at a profit of 25p.

- Find the proportion of bags that cannot be sold.
- Find the expected profit for every 1000 bags filled. Give your answer to the nearest pound.

(6 marks)

Answer _____

8

Kemi's journey time to work, J minutes, is modelled by $J \sim N(42, 6^2)$. Her journeys on different days are independent.

- Find the probability that a journey takes more than 50 minutes.
- Find the probability that, in 20 working days, more than 2 of her journeys take more than 50 minutes.
- Kemi wants to arrive on time on 95% of days. Find how many minutes before her start time she should leave, giving your answer to the nearest minute.

(7 marks)

Answer _____

9

At a café, the temperature of a cup of tea when served, C °C, is modelled by $C \sim N(72, 4^2)$.

The waiting time, W minutes, for a cup of tea is modelled by $W \sim N(4.5, 1.2^2)$.

A customer is happy if the tea is served at between 65 °C and 80 °C and the waiting time is less than 6 minutes.

- Find the probability that a cup of tea is served at between 65 °C and 80 °C.
- State a necessary assumption about C and W for the manager to calculate the probability that a customer is happy.
- Find the probability that a randomly chosen customer is happy.
- Two customers order tea separately. Find the probability that at least one of them is happy.

(7 marks)

Answer

10

A teacher models the time, T minutes, that students take to finish a short online quiz by $T \sim N(6, 3^2)$

- Find $P(T < 0)$
- Find $P(T < 1 \mid T > 0)$
- Using your answer to part (a), explain why this normal distribution may not be a good model for T

The teacher refines the model by only including values of $T > 0$

- Find the median time to finish the quiz using the refined model.

(8 marks)

Answer

11

A machine fills cups of soup. The volume, V ml, in a cup is normally distributed with mean μ ml and standard deviation 5 ml. Given that 2.5% of cups contain more than 340 ml,

a. find the value of μ

A cup is rejected if it contains less than 320 ml or more than 338 ml.

b. Find the probability that a randomly chosen cup is rejected.

c. A random sample of 12 cups is taken. Find the probability that fewer than 2 of them are rejected.

d. The machine is adjusted so that only 1% of cups contain more than 340 ml. The standard deviation is unchanged. Find the new value of the mean.

(9 marks)

Answer

12

A display board uses 4 bulbs. The lifetime, L hours, of a bulb is modelled by $L \sim N(800, 60^2)$. The display stops working as soon as any one of its bulbs fails. The lifetimes of the bulbs are independent.

A display is fitted with 4 new bulbs.

- Find the probability that a bulb lasts more than 750 hours.
- Find the probability that the display is still working after 750 hours.
- Given that the display is still working after 750 hours, find the probability that it is still working after 800 hours.
- Find the time, to the nearest hour, by which there is a 10% chance that the display has stopped working.

(9 marks)

Answer _____

End of questions | Total 77 marks