

End of Topic Test – Chapter 5: The Normal Distribution

Answer all questions in the spaces provided.

1. Understanding the normal distribution

The heights of adult women in a certain region are modelled as being normally distributed with mean 165 cm and standard deviation 7 cm.

- (a) (2 points) Sketch a labelled normal distribution curve showing the mean and one standard deviation on each side.

- (b) (2 points) State what proportion of women are expected to have heights between 158 cm and 172 cm.

- (c) (2 points) Explain why the normal distribution is a suitable model for adult heights.

2. Calculating probabilities

A test score X is normally distributed with mean 50 and standard deviation 12.

(a) (3 points) Calculate $P(X > 70)$.

(b) (3 points) Calculate $P(40 < X < 65)$.

(c) (2 points) Interpret your answer to part (b) in context.

3. Running times

The time (in minutes) taken by runners to complete a 5k race is normally distributed with mean 27.4 and standard deviation 4.1.

- (a) (3 points) Find the probability that a randomly selected runner completes the race in under 25 minutes.

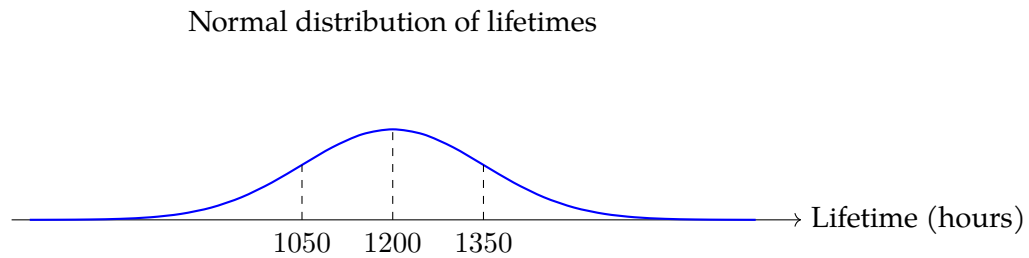
- (b) (3 points) The fastest 10% of runners receive a medal. Find the time threshold for receiving a medal.

- (c) (2 points) Explain why the normal distribution may not perfectly model the slowest runners.

4. Interpreting a normal distribution diagram

A company measures the lifetimes of its lightbulbs. The lifetimes are approximately normally distributed with mean 1200 hours and standard deviation 150 hours.

The diagram below shows a simplified normal curve.



- (a) (2 points) What proportion of bulbs last between 1050 and 1350 hours?
- (b) (3 points) Estimate the proportion lasting more than 1500 hours.
- (c) (2 points) Give one reason why the company might still use the normal model even if the real data is slightly skewed.

5. Interpreting a study using the normal distribution

A recent educational psychology study examined the distribution of IQ scores among a large sample of students. The researchers reported that IQ scores in the population are “approximately normally distributed with a mean of 100 and a standard deviation of 15.” The study also noted:

“Although the normal model provides a useful approximation, real data often show slight deviations due to sampling variation, measurement error, and differences in testing conditions.”

The authors explained that these small departures from the idealised model do not undermine the usefulness of the normal distribution, but they emphasised that analysts should interpret extreme values with caution. They argued that factors such as test anxiety, inconsistent administration, and limited sample diversity can all influence the accuracy of very high or very low scores. As a result, the study recommended using confidence intervals or repeated testing when making decisions based on unusually high IQ values.

- (a) (2 points) State the meaning of “normally distributed” in this context.

- (b) (3 points) Using the model with mean 100 and standard deviation 15, calculate the proportion of students expected to have an IQ above 130.

- (c) (3 points) Explain how the quotation challenges the assumption that the normal model perfectly represents real IQ data.

- (d) (2 points) Suggest one reason why extreme IQ scores may be less reliable than scores near the mean.