

4.6 Normal Distributions

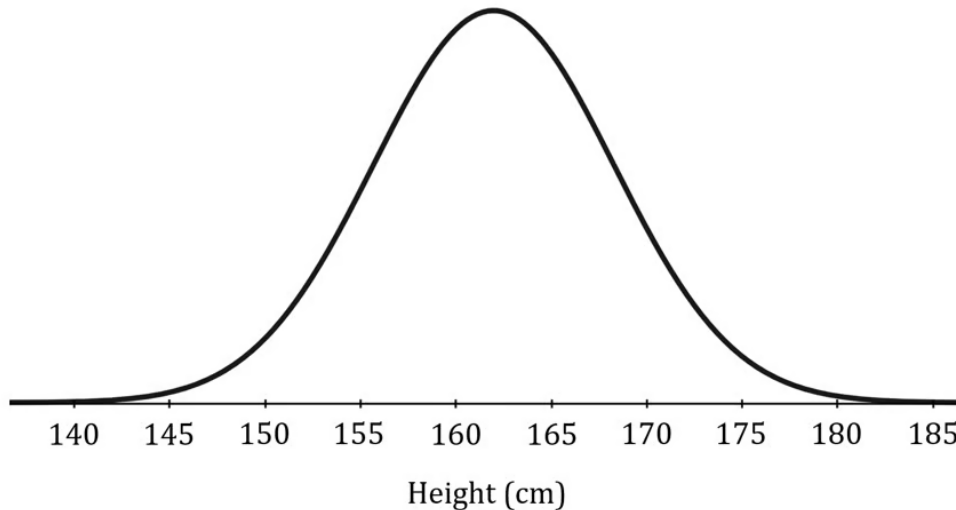
Question Paper

Course	DPIB Maths
Section	4. Statistics & Probability
Topic	4.6 Normal Distributions
Difficulty	Medium

Time allowed: 50
Score: /38
Percentage: /100

Question 1a

The random variable, X , is seen on the following diagram which shows the distribution of heights, in cm, of adult women in the UK:



The distribution of heights follows a normal distribution, with a mean of 162 cm and a standard deviation of 6.3 cm.

(a) On the diagram above, shade in the region representing $P(X > 155)$.

[2 marks]

Question 1b

- (b) (i) Find the probability that a randomly selected woman has a height of more than 155cm.
- (ii) Use your answer from part (b)(i) to find the probability that a randomly selected woman has a height of more than 169cm.

[4 marks]

Question 1c

(c) Suggest a range of heights within which the height of approximately

(i) 68%

(ii) 95%

(iii) 99.7%

of adult women in the UK will fall.

[3 marks]

Question 2a

(a) For the random variable $X \sim N(23, 4^2)$ find the following probabilities:

(i) $P(X < 20)$

(ii) $P(X \geq 29)$

(iii) $P(20 \leq X < 29)$

[3 marks]

Question 2b

(b) For the random variable $Y \sim N(100, 225)$ find the following probabilities:

(i) $P(Y \leq 90)$

(ii) $P(Y > 140)$

(iii) $P(85 \leq Y \leq 115)$

[3 marks]

Question 3a

The weight, W g, of a chocolate bar produced by a certain manufacturer is modelled as $W \sim N(200, 1.75^2)$.

(a) Find:

(i) $P(W < 195)$

(ii) $P(W > 203)$

[2 marks]

Question 3b

Heledd buys a pack containing 12 of the chocolate bars. It may be assumed that the 12 bars in the pack represent a random sample.

(b) Find the probability that all of the bars in the pack have a weight of at least 195 g.

[2 marks]

Question 4a

The random variable $X \sim N(330, 10^2)$.

(a) Find the value of a , to 2 decimal places, such that:

(i) $P(X < a) = 0.25$

(ii) $P(X > a) = 0.25$

(iii) $P(315 \leq X \leq a) = 0.5$

[4 marks]

Question 4b

The random variable $Y \sim N(10, 10)$.

(b) Find the value of b and the value of c , each to 2 decimal places, such that:

(i) $P(Y < b) = 0.4$

(ii) $P(Y > c) = 0.25$

[2 marks]

Question 4c

(c) Use a sketch of the distribution of Y to explain why $P(b \leq Y \leq c) = 0.35$.

[2 marks]

Question 5a

The test scores, X , of a group of RAF recruits in an aptitude test are modelled as a normal distribution with $X \sim N(210, 27.8^2)$.

- (a) (i) Find the values of a and b such that $P(X < a) = 0.25$ and $P(X > b) = 0.25$.
- (ii) Hence find the interquartile range of the scores.

[3 marks]

Question 5b

Those who score in the top 30% on the test move on to the next stage of training.

- (b) One of the recruits, Amelia, achieves a score of 231. Determine whether Amelia will move on to the next stage of training.

[2 marks]

Question 6a

A machine is used to fill cans of a particular brand of soft drink. The volume, V ml, of soft drink in the cans is normally distributed with mean 330 ml and standard deviation σ ml.

It is known that approximately 16% of the cans contain more than 333.28 ml of soft drink.

- (a) Using the properties of the normal distribution, explain why 3.28 ml would provide a good approximation for the value of σ .

[2 marks]

Question 6b

- (b) Using $\sigma = 3.28$ ml, find $P(320 \leq V \leq 340)$.

[1 mark]

Question 6c

Six cans of the soft drink are chosen at random.

- (c) Again using $\sigma = 3.28$ ml, find the probability that all of the cans contain less than 329 ml of soft drink.

[3 marks]



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