EXPERT TUITION

Maths Questions By Topic:

Statistical Distributions

A-Level Edexcel

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1. A manufacturer of sweets knows that 8% of the bags of sugar delivered from supplier A will be damp.
A random sample of 35 bags of sugar is taken from supplier A.

Using a suitable model, find the probability that the number of bags of sugar that are damp is

(i) exactly 2

(ii) more than 3

(3)

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Question 1 continued

(Total for Question 1 is 3 marks)

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2. A nursery has a sack containing a large number of coloured beads of which 14% are coloured red.

Aliya takes a random sample of 18 beads from the sack to make a bracelet.

(a) State a suitable binomial distribution to model the number of red beads in Aliya's bracelet.

(1)

(b) Use this binomial distribution to find the probability that

(i) Aliya has just 1 red bead in her bracelet,

(ii) there are at least 4 red beads in Aliya's bracelet.

(3)

(c) Comment on the suitability of a binomial distribution to model this situation.

(1)

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Question 2 continued

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Question 2 continued

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Question 2 continued

(Total for Question 2 is 5 marks)

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3. Afrika works in a call centre.

She assumes that calls are independent and knows, from past experience, that on each sales call that she makes there is a probability of $\frac{1}{6}$ that it is successful.

Afrika makes 9 sales calls.

(a) Calculate the probability that at least 3 of these sales calls will be successful.

(2)

The probability of Afrika making a successful sales call is the same each day.

Afrika makes 9 sales calls on each of 5 different days.

(b) Calculate the probability that at least 3 of the sales calls will be successful on exactly 1 of these days.

(2)

EXPERT TUITION

Question 3 continued

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Question 3 continued

(Total for Question 3 is 4 marks)

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4. A fair 5-sided spinner has sides numbered 1, 2, 3, 4 and 5

The spinner is spun once and the score of the side it lands on is recorded.

(a) Write down the name of the distribution that can be used to model the score of the side it lands on.

(1)

The spinner is spun 28 times.

The random variable X represents the number of times the spinner lands on 2

(b) (i) Find the probability that the spinner lands on 2 at least 7 times.

(ii) Find $P(4 \leqslant X < 8)$

(5)

EXPERT TUITION

Question 4 continued

(Total for Question 4 is 6 marks)

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5. Naasir is playing a game with two friends. The game is designed to be a game of chance so that the probability of Naasir winning each game is $\frac{1}{3}$

Naasir and his friends play the game 15 times.

Find the probability that Naasir wins

(i) exactly 2 games,

(ii) more than 5 games. **(3)**

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Question 5 continued

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Question 5 continued

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Question 5 continued

(Total for Question 5 is 3 marks)

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6. A biased spinner can only land on one of the numbers 1, 2, 3 or 4. The random variable X represents the number that the spinner lands on after a single spin and $P(X = r) = P(X = r + 2)$ for $r = 1, 2$

Given that $P(X = 2) = 0.35$

(a) find the complete probability distribution of X.

(2)

Ambroh spins the spinner 60 times.

(b) Find the probability that more than half of the spins land on the number 4
Give your answer to 3 significant figures.

(3)

The random variable $Y = \dfrac{12}{X}$

(c) Find $P(Y - X \leqslant 4)$

(3)

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Question 6 continued

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Question 6 continued

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Question 6 continued

(Total for Question 6 is 8 marks)

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7. The discrete random variable $X \sim B(30, 0.28)$

Find $P(5 \leq X < 12)$.

(2)

(Total for Question 7 is 2 marks)

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8. The discrete random variable $X \sim B(40, 0.27)$

Find $P(X \geqslant 16)$

(2)

(Total for Question 8 is 2 marks)

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9. George throws a ball at a target 15 times.
Each time George throws the ball, the probability of the ball hitting the target is 0.48

The random variable X represents the number of times George hits the target in 15 throws.

(a) Find

(i) $P(X = 3)$

(ii) $P(X \geqslant 5)$

(3)

George now throws the ball at the target 250 times.

(b) Use a normal approximation to calculate the probability that he will hit the target more than 110 times.

(3)

EXPERT TUITION

Question 9 continued

(Total for Question 9 is 6 marks)

EXPERT TUITION

10. A manufacturer uses a machine to make metal rods.

The length of a metal rod, L cm, is normally distributed with

- a mean of 8 cm
- a standard deviation of x cm

Given that the proportion of metal rods less than 7.902 cm in length is 2.5%

(a) show that $x = 0.05$ to 2 decimal places.

(2)

(b) Calculate the proportion of metal rods that are between 7.94 cm and 8.09 cm in length.

(1)

The **cost** of producing a single metal rod is 20p

A metal rod

- where $L < 7.94$ is **sold** for scrap for 5p
- where $7.94 \leqslant L \leqslant 8.09$ is **sold** for 50p
- where $L > 8.09$ is shortened for an extra **cost** of 10p and then **sold** for 50p

(c) Calculate the expected profit per 500 of the metal rods.
Give your answer to the nearest pound.

(5)

The same manufacturer makes metal hinges in large batches.

The hinges each have a probability of 0.015 of having a fault.

A random sample of 200 hinges is taken from each batch and the batch is accepted if fewer than 6 hinges are faulty.

The manufacturer's aim is for 95% of batches to be accepted.

(d) Explain whether the manufacturer is likely to achieve its aim.

(4)

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Question 10 continued

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Question 10 continued

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Question 10 continued

(Total for Question 10 is 12 marks)

EXPERT TUITION

11. Dian uses the large data set to investigate the Daily Total Rainfall, r mm, for Camborne.

Explain why the distribution B(14, 0.27) might **not** be a reasonable model for the number of days without rain for a 14-day summer event.

(1)

(Total for Question 11 is 1 mark)

EXPERT TUITION

12. In a university 8% of students are members of the university dance club.

A random sample of 36 students is taken from the university.

The random variable X represents the number of these students who are members of the dance club.

(a) Using a suitable model for X, find

(i) $P(X = 4)$

(ii) $P(X \geqslant 7)$

(3)

Only 40% of the university dance club members can dance the tango.

(b) Find the probability that a student is a member of the university dance club and can dance the tango.

(1)

A random sample of 50 students is taken from the university.

(c) Find the probability that fewer than 3 of these students are members of the university dance club and can dance the tango.

(2)

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Question 12 continued

(Total for Question 12 is 6 marks)

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13. The heights of females from a country are normally distributed with

- a mean of 166.5 cm
- a standard deviation of 6.1 cm

Given that 1% of females from this country are shorter than k cm,

(a) find the value of k

(2)

(b) Find the proportion of females from this country with heights between 150 cm and 175 cm

(1)

A female, from this country, is chosen at random from those with heights between 150 cm and 175 cm

(c) Find the probability that her height is more than 160 cm

(4)

EXPERT TUITION

Question 13 continued

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Question 13 continued

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Question 13 continued

(Total for Question 13 is 7 marks)

EXPERT TUITION

14. A health centre claims that the time a doctor spends with a patient can be modelled by a normal distribution with a mean of 10 minutes and a standard deviation of 4 minutes.

(a) Using this model, find the probability that the time spent with a randomly selected patient is more than 15 minutes.

(1)

The health centre also claims that the time a dentist spends with a patient during a routine appointment, T minutes, can be modelled by the normal distribution where $T \sim \mathrm{N}(5, 3.5^2)$

Using this model,

(b) (i) find the probability that a routine appointment with the dentist takes less than 2 minutes

(1)

(ii) find $\mathrm{P}(T < 2 \mid T > 0)$

(3)

(iii) hence explain why this normal distribution may not be a good model for T.

(1)

The dentist believes that she cannot complete a routine appointment in less than 2 minutes.

She suggests that the health centre should use a refined model only including values of $T > 2$

(c) Find the median time for a routine appointment using this new model, giving your answer correct to one decimal place.

(5)

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Question 14 continued

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Question 14 continued

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Question 14 continued

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Question 14 continued

(Total for Question 14 is 11 marks)

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15. Using the data from the large data set, Simon produced the following summary statistics for the daily mean air temperature, x °C, for Beijing in 2015

Simon decides to model the air temperatures with the random variable

$$T \sim \mathrm{N}(22.6, 5.19^2)$$

(a) Using Simon's model, calculate the 10th to 90th interpercentile range.

(3)

Simon wants to model another variable from the large data set for Beijing using a normal distribution.

(b) State two variables from the large data set for Beijing that are **not** suitable to be modelled by a normal distribution. Give a reason for each answer.

(2)

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Question 15 continued

(Total for Question 15 is 5 marks)

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16. Magali is studying the mean total cloud cover, in oktas, for Leuchars in 1987 using data from the large data set. The daily mean total cloud cover for all 184 days from the large data set is summarised in the table below.

Daily mean total cloud cover (oktas)	0	1	2	3	4	5	6	7	8
Frequency (number of days)	0	1	4	7	10	30	52	52	28

Magali is investigating whether the daily mean total cloud cover can be modelled using a binomial distribution.

She uses the random variable X to denote the daily mean total cloud cover and believes that $X \sim \mathrm{B}(8, 0.76)$

Using Magali's model,

(a) (i) find $\mathrm{P}(X \geqslant 6)$

(2)

(ii) find, to 1 decimal place, the expected number of days in a sample of 184 days with a daily mean total cloud cover of 7

(2)

(b) Explain whether or not your answers to part (b) support the use of Magali's model.

(1)

There were 28 days that had a daily mean total cloud cover of 8
For these 28 days the daily mean total cloud cover for the **following** day is shown in the table below.

Daily mean total cloud cover (oktas)	0	1	2	3	4	5	6	7	8
Frequency (number of days)	0	0	1	1	2	1	5	9	9

(c) Find the proportion of these days when the daily mean total cloud cover was 6 or greater.

(1)

(d) Comment on Magali's model in light of your answer to part (d).

(2)

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Question 16 continued

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Question 16 continued

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Question 16 continued

(Total for Question 16 is 8 marks)

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17. A machine puts liquid into bottles of perfume. The amount of liquid put into each bottle, D ml, follows a normal distribution with mean 25 ml

Given that 15% of bottles contain less than 24.63 ml

(a) find, to 2 decimal places, the value of k such that $P(24.63 < D < k) = 0.45$

(5)

A random sample of 200 bottles is taken.

(b) Using a normal approximation, find the probability that fewer than half of these bottles contain between 24.63 ml and k ml

(3)

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Question 17 continued

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Question 17 continued

(Total for Question 17 is 8 marks)

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18. In an experiment a group of children each repeatedly throw a dart at a target.
For each child, the random variable H represents the number of times the dart hits the target in the first 10 throws.

Peta models H as B(10, 0.1)

(a) State two assumptions Peta needs to make to use her model.

(2)

(b) Using Peta's model, find $P(H \geqslant 4)$

(1)

For each child the random variable F represents the number of the throw on which the dart first hits the target.

Using Peta's assumptions about this experiment,

(c) find $P(F = 5)$

(2)

Thomas assumes that in this experiment no child will need more than 10 throws for the dart to hit the target for the first time. He models $P(F = n)$ as

$$P(F = n) = 0.01 + (n - 1) \times \alpha$$

where α is a constant.

(d) Find the value of α

(4)

(e) Using Thomas' model, find $P(F = 5)$

(1)

(f) Explain how Peta's and Thomas' models differ in describing the probability that a dart hits the target in this experiment.

(1)

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Question 18 continued

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Question 18 continued

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Question 18 continued

(Total for Question 18 is 11 marks)

EXPERT TUITION

19. The lifetime, L hours, of a battery has a normal distribution with mean 18 hours and standard deviation 4 hours.

Alice's calculator requires 4 batteries and will stop working when any one battery reaches the end of its lifetime.

(a) Find the probability that a randomly selected battery will last for longer than 16 hours.

(1)

At the start of her exams Alice put 4 new batteries in her calculator.
She has used her calculator for 16 hours, but has another 4 hours of exams to sit.

(b) Find the probability that her calculator will not stop working for Alice's remaining exams.

(5)

Alice only has 2 new batteries so, after the first 16 hours of her exams, although her calculator is still working, she randomly selects 2 of the batteries from her calculator and replaces these with the 2 new batteries.

(c) Show that the probability that her calculator will not stop working for the remainder of her exams is 0.199 to 3 significant figures.

(3)

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Question 19 continued

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Question 19 continued

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Question 19 continued

(Total for Question 19 is 9 marks)

EXPERT TUITION

20. For a particular type of bulb, 36% grow into plants with blue flowers and the remainder grow into plants with white flowers. Bulbs are sold in mixed bags of 40

Russell selects a random sample of 5 bags of bulbs.

(a) Find the probability that fewer than 2 of these bags will contain more bulbs that grow into plants with blue flowers than grow into plants with white flowers.

(4)

Maggie takes a random sample of n bulbs.

Using a normal approximation, the probability that more than 244 of these n bulbs will grow into blue flowers is 0.0521 to 4 decimal places.

(b) Find the value of n.

(6)

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Question 20 continued

(Total for Question 20 is 10 marks)

EXPERT TUITION

21. The lifetimes of batteries sold by company X are normally distributed, with mean 150 hours and standard deviation 25 hours.

A box contains 12 batteries from company X.

(a) Find the expected number of these batteries that have a lifetime of more than 160 hours.

(3)

The lifetimes of batteries sold by company Y are normally distributed, with mean 160 hours and 80% of these batteries have a lifetime of less than 180 hours.

(b) Find the standard deviation of the lifetimes of batteries from company Y.

(3)

Both companies sell their batteries for the same price.

(c) State which company you would recommend. Give reasons for your answer.

(2)

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Question 21 continued

(Total for Question 21 is 8 marks)

EXPERT TUITION

22. The number of hours of sunshine each day, y, for the month of July at Heathrow are summarised in the table below.

Hours	$0 \leqslant y < 5$	$5 \leqslant y < 8$	$8 \leqslant y < 11$	$11 \leqslant y < 12$	$12 \leqslant y < 14$
Frequency	12	6	8	3	2

Helen models the number of hours of sunshine each day, for the month of July at Heathrow by $N(6.6, 3.7^2)$.

(a) Use Helen's model to predict the number of days in July at Heathrow when the number of hours of sunshine is more than 1 standard deviation above the mean.

(2)

(b) Use your answers to part (d) and part (e) to comment on the suitability of Helen's model.

(1)

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Question 22 continued

(Total for Question 22 is 3 marks)

EXPERT TUITION

23. A machine cuts strips of metal to length L cm, where L is normally distributed with standard deviation 0.5 cm.

Strips with length either less than 49 cm or greater than 50.75 cm **cannot** be used.

Given that 2.5% of the cut lengths exceed 50.98 cm,

(a) find the probability that a randomly chosen strip of metal **can** be used.

(5)

Ten strips of metal are selected at random.

(b) Find the probability fewer than 4 of these strips **cannot** be used.

(2)

EXPERT TUITION

Question 23 continued

(Total for Question 23 is 7 marks)

EXPERT TUITION

24. A company sells seeds and claims that 55% of its pea seeds germinate.

(a) Write down a reason why the company should not justify their claim by testing all the pea seeds they produce.

(1)

A random selection of the pea seeds is planted in 10 trays with 24 seeds in each tray.

(b) Assuming that the company's claim is correct, calculate the probability that in at least half of the trays 15 or more of the seeds germinate.

(3)

(c) Write down two conditions under which the normal distribution may be used as an approximation to the binomial distribution.

(1)

A random sample of 240 pea seeds was planted and 150 of these seeds germinated.

(d) Assuming that the company's claim is correct, use a normal approximation to find the probability that at least 150 pea seeds germinate.

(3)

(e) Using your answer to part (d), comment on whether or not the proportion of the company's pea seeds that germinate is different from the company's claim of 55%

(1)

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Question 24 continued

(Total for Question 24 is 9 marks)

EXPERT TUITION

Leave blank

25. The random variable Y has a normal distribution with mean μ and standard deviation σ
The $P(Y > 17) = 0.4$

Find

(a) $P(\mu < Y < 17)$

(1)

(b) $P(\mu - \sigma < Y < 17)$

(4)

Leave blank

Question 25 continued

Leave blank

Question 25 continued

(Total 5 marks)

EXPERT TUITION

Leave blank

26. Farmer Adam grows potatoes. The weights of potatoes, in grams, grown by Adam are normally distributed with a mean of 140 g and a standard deviation of 40 g.

Adam cannot sell potatoes with a weight of less than 92 g.

(a) Find the percentage of potatoes that Adam grows but cannot sell.

(3)

The upper quartile of the weight of potatoes **sold** by Adam is q_3

(b) Find the probability that the weight of a randomly selected potato **grown** by Adam is more than q_3

(2)

(c) Find the lower quartile, q_1, of the weight of potatoes **sold** by Adam.

(5)

Betty selects a random sample of 3 potatoes **sold** by Adam.

(d) Find the probability that one weighs less than q_1, one weighs more than q_3 and one has a weight between q_1 and q_3

(3)

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Leave blank

Question 26 continued

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Question 26 continued

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Question 26 continued

EXPERT TUITION

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Question 26 continued

(Total 13 marks)

EXPERT TUITION

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27. An estate agent is studying the cost of office space in London. He takes a random sample of 90 offices and calculates the cost, £x per square foot. His results are given in the table below.

Cost (£x)	**Frequency (f)**	**Midpoint (£y)**
$20 \leqslant x < 40$	12	30
$40 \leqslant x < 45$	13	42.5
$45 \leqslant x < 50$	25	47.5
$50 \leqslant x < 60$	32	55
$60 \leqslant x < 80$	8	70

(You may use $\sum f y^2 = 226\,687.5$)

Rika suggests that the cost of office space in London can be modelled by a normal distribution with mean £50 and standard deviation £10

(a) With reference to your answer to part (e), comment on Rika's suggestion.

(1)

(b) Use Rika's model to estimate the 80th percentile of the cost of office space in London.

(3)

EXPERT TUITION

Leave blank

Question 27 continued

EXPERT TUITION

Leave blank

Question 27 continued

EXPERT TUITION

Leave blank

Question 27 continued

(Total 4 marks)

EXPERT TUITION

Leave blank

28. Yuto works in the quality control department of a large company. The time, T minutes, it takes Yuto to analyse a sample is normally distributed with mean 18 minutes and standard deviation 5 minutes.

(a) Find the probability that Yuto takes longer than 20 minutes to analyse the next sample.
(3)

The company has a large store of samples analysed by Yuto with the time taken for each analysis recorded. Serena is investigating the samples that took Yuto longer than 15 minutes to analyse.

She selects, at random, one of the samples that took Yuto longer than 15 minutes to analyse.

(b) Find the probability that this sample took Yuto more than 20 minutes to analyse.
(4)

Serena can identify, in advance, the samples that Yuto can analyse in under 15 minutes and in future she will assign these to someone else.

(c) Estimate the median time taken by Yuto to analyse samples in future.
(5)

EXPERT TUITION

Leave blank

Question 28 continued

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Question 28 continued

EXPERT TUITION

Leave blank

Question 28 continued

(Total 12 marks)

EXPERT TUITION

Leave blank

29. A midwife records the weights, in kg, of a sample of 50 babies born at a hospital. Her results are given in the table below.

Weight (w kg)	**Frequency (f)**	**Weight midpoint (x)**
$0 \leqslant w < 2$	1	1
$2 \leqslant w < 3$	8	2.5
$3 \leqslant w < 3.5$	17	3.25
$3.5 \leqslant w < 4$	17	3.75
$4 \leqslant w < 5$	7	4.5

[You may use $\sum fx^2 = 611.375$]

Shyam decides to model the weights of babies born at the hospital, by the random variable W, where $W \sim N(3.43, 0.65^2)$

(a) Find $P(W < 3)$

(3)

(b) With reference to your answers to (b), (c)(i) and (d) comment on Shyam's decision.

(3)

A newborn baby weighing 3.43 kg is born at the hospital.

(c) Without carrying out any further calculations, state, giving a reason, what effect the addition of this newborn baby to the sample would have on your estimate of the

(i) mean,

(ii) standard deviation.

(3)

EXPERT TUITION

Leave blank

Question 29 continued

(Total 9 marks)

EXPERT TUITION

Leave blank

30. The time, in minutes, taken by men to run a marathon is modelled by a normal distribution with mean 240 minutes and standard deviation 40 minutes.

(a) Find the proportion of men that take longer than 300 minutes to run a marathon.

(3)

Nathaniel is preparing to run a marathon. He aims to finish in the first 20% of male runners.

(b) Using the above model estimate the longest time that Nathaniel can take to run the marathon and achieve his aim.

(3)

The time, W minutes, taken by women to run a marathon is modelled by a normal distribution with mean μ minutes.

Given that $P(W < \mu + 30) = 0.82$

(c) find $P(W < \mu - 30 \mid W < \mu)$

(3)

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Question 30 continued

(Total 9 marks)

EXPERT TUITION

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31. The random variable $Z \sim N(0, 1)$

A is the event $Z > 1.1$
B is the event $Z > -1.9$
C is the event $-1.5 < Z < 1.5$

(a) Find

(i) $P(A)$

(ii) $P(B)$

(iii) $P(C)$

(iv) $P(A \cup C)$

(6)

The random variable X has a normal distribution with mean 21 and standard deviation 5

(b) Find the value of w such that $P(X > w \mid X > 28) = 0.625$

(6)

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Question 31 continued

(Total 12 marks)

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Leave blank

32. The heights of adult females are normally distributed with mean 160 cm and standard deviation 8 cm.

(a) Find the probability that a randomly selected adult female has a height greater than 170 cm.

(3)

Any adult female whose height is greater than 170 cm is defined as tall.

An adult female is chosen at random. Given that she is tall,

(b) find the probability that she has a height greater than 180 cm.

(4)

Half of tall adult females have a height greater than h cm.

(c) Find the value of h.

(5)

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Leave blank

Question 32 continued

(Total 12 marks)

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Leave blank

33. The continuous random variable Y has the normal distribution $N(10, 2^2)$

Write down the value of

(i) $P(Y = 10)$

(ii) $P(Y < 10)$

(2)

(Total 2 marks)

EXPERT TUITION

Leave blank

34. The time taken, in minutes, by children to complete a mathematical puzzle is assumed to be normally distributed with mean μ and standard deviation σ. The puzzle can be completed in less than 24 minutes by 80% of the children. For 5% of the children it takes more than 28 minutes to complete the puzzle.

(a) Show this information on the Normal curve below.

(2)

(b) Write down the percentage of children who take between 24 minutes and 28 minutes to complete the puzzle.

(1)

(c) (i) Find two equations in μ and σ.

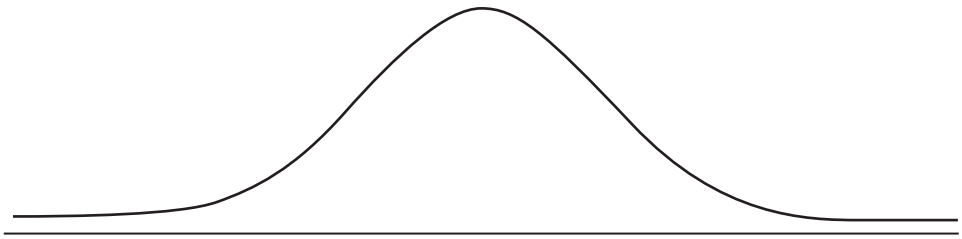
(ii) Hence find, to 3 significant figures, the value of μ and the value of σ.

(7)

A child is selected at random.

(d) Find the probability that the child takes less than 12 minutes to complete the puzzle.

(3)



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Question 34 continued

(Total 13 marks)

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35. The weight, in grams, of beans in a tin is normally distributed with mean μ and standard deviation 7.8

Given that 10% of tins contain less than 200 g, find

(a) the value of μ

(3)

(b) the percentage of tins that contain more than 225 g of beans.

(3)

The machine settings are adjusted so that the weight, in grams, of beans in a tin is normally distributed with mean 205 and standard deviation σ.

(c) Given that 98% of tins contain between 200 g and 210 g find the value of σ.

(4)

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Leave blank

Question 35 continued

(Total 10 marks)

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36. The time, in minutes, taken to fly from London to Malaga has a normal distribution with mean 150 minutes and standard deviation 10 minutes.

(a) Find the probability that the next flight from London to Malaga takes less than 145 minutes.

(3)

The time taken to fly from London to Berlin has a normal distribution with mean 100 minutes and standard deviation d minutes.

Given that 15% of the flights from London to Berlin take longer than 115 minutes,

(b) find the value of the standard deviation d.

(4)

The time, X minutes, taken to fly from London to another city has a normal distribution with mean μ minutes.

Given that $P(X < \mu - 15) = 0.35$

(c) find $P(X > \mu + 15 \mid X > \mu - 15)$.

(3)

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Leave blank

Question 36 continued

(Total 10 marks)

EXPERT TUITION

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37. The length of time, L hours, that a phone will work before it needs charging is normally distributed with a mean of 100 hours and a standard deviation of 15 hours.

(a) Find $P(L > 127)$.

(3)

(b) Find the value of d such that $P(L < d) = 0.10$

(3)

Alice is about to go on a 6 hour journey.
Given that it is 127 hours since Alice last charged her phone,

(c) find the probability that her phone will not need charging before her journey is completed.

(4)

EXPERT TUITION

Leave blank

Question 37 continued

(Total 10 marks)

EXPERT TUITION

Leave blank

38. A survey of 100 households gave the following results for weekly income £y.

Income y (£)	Mid-point	Frequency f
$0 \leqslant y < 200$	100	12
$200 \leqslant y < 240$	220	28
$240 \leqslant y < 320$	280	22
$320 \leqslant y < 400$	360	18
$400 \leqslant y < 600$	500	12
$600 \leqslant y < 800$	700	8

(You may use $\sum fy^2 = 12\ 452\ 800$)

Katie suggests using the random variable X which has a normal distribution with mean 320 and standard deviation 150 to model the weekly income for these data.

(a) Find $P(240 < X < 400)$.

(2)

(b) With reference to your calculations in parts (d) and (e) and the data in the table, comment on Katie's suggestion.

(2)

EXPERT TUITION

Leave blank

Question 38 continued

(Total 4 marks)

EXPERT TUITION

Leave blank

39. The heights of an adult female population are normally distributed with mean 162 cm and standard deviation 7.5 cm.

(a) Find the probability that a randomly chosen adult female is taller than 150 cm.

(3)

Sarah is a young girl. She visits her doctor and is told that she is at the 60th percentile for height.

(b) Assuming that Sarah remains at the 60th percentile, estimate her height as an adult.

(3)

The heights of an adult male population are normally distributed with standard deviation 9.0 cm.

Given that 90% of adult males are taller than the mean height of adult females,

(c) find the mean height of an adult male.

(4)

EXPERT TUITION

Leave blank

Question 39 continued

(Total 10 marks)

EXPERT TUITION

Leave blank

40. A manufacturer fills jars with coffee. The weight of coffee, W grams, in a jar can be modelled by a normal distribution with mean 232 grams and standard deviation 5 grams.

(a) Find $P(W < 224)$.

(3)

(b) Find the value of w such that $P(232 < W < w) = 0.20$

(4)

Two jars of coffee are selected at random.

(c) Find the probability that only one of the jars contains between 232 grams and w grams of coffee.

(3)

EXPERT TUITION

Leave blank

Question 40 continued

(Total 10 marks)

EXPERT TUITION

Leave blank

41. The random variable $X \sim \mathrm{N}(\mu, 5^2)$ and $\mathrm{P}(X < 23) = 0.9192$

(a) Find the value of μ.

(4)

(b) Write down the value of $\mathrm{P}(\mu < X < 23)$.

(1)

(Total 5 marks)

EXPERT TUITION

Leave blank

42. Past records show that the times, in seconds, taken to run 100 m by children at a school can be modelled by a normal distribution with a mean of 16.12 and a standard deviation of 1.60

A child from the school is selected at random.

(a) Find the probability that this child runs 100 m in less than 15 s.

(3)

On sports day the school awards certificates to the fastest 30% of the children in the 100 m race.

(b) Estimate, to 2 decimal places, the slowest time taken to run 100 m for which a child will be awarded a certificate.

(4)

(Total 7 marks)

EXPERT TUITION

Leave blank

43. The weight, X grams, of soup put in a tin by machine A is normally distributed with a mean of 160 g and a standard deviation of 5 g.
A tin is selected at random.

(a) Find the probability that this tin contains more than 168 g.

(3)

The weight stated on the tin is w grams.

(b) Find w such that $P(X < w) = 0.01$

(3)

The weight, Y grams, of soup put into a carton by machine B is normally distributed with mean μ grams and standard deviation σ grams.

(c) Given that $P(Y < 160) = 0.99$ and $P(Y > 152) = 0.90$ find the value of μ and the value of σ.

(6)

EXPERT TUITION

Leave blank

Question 43 continued

(Total 12 marks)

EXPERT TUITION

Leave blank

44. The distances travelled to work, D km, by the employees at a large company are normally distributed with $D \sim \mathrm{N}(30, 8^2)$.

(a) Find the probability that a randomly selected employee has a journey to work of more than 20 km.

(3)

(b) Find the upper quartile, Q_3, of D.

(3)

(c) Write down the lower quartile, Q_1, of D.

(1)

An outlier is defined as any value of D such that $D < h$ or $D > k$ where

$$h = Q_1 - 1.5 \times (Q_3 - Q_1) \quad \text{and} \quad k = Q_3 + 1.5 \times (Q_3 - Q_1)$$

(d) Find the value of h and the value of k.

(2)

An employee is selected at random.

(e) Find the probability that the distance travelled to work by this employee is an outlier.

(3)

EXPERT TUITION

Leave blank

Question 44 continued

(Total 12 marks)

EXPERT TUITION

Leave blank

45. The heights of a population of women are normally distributed with mean μ cm and standard deviation σ cm. It is known that 30% of the women are taller than 172 cm and 5% are shorter than 154 cm.

(a) Sketch a diagram to show the distribution of heights represented by this information.
(3)

(b) Show that $\mu = 154 + 1.6449\sigma$.
(3)

(c) Obtain a second equation and hence find the value of μ and the value of σ.
(4)

A woman is chosen at random from the population.

(d) Find the probability that she is taller than 160 cm.
(3)

EXPERT TUITION

Leave blank

Question 45 continued

(Total 13 marks)

EXPERT TUITION

Leave blank

46. The lifetimes of bulbs used in a lamp are normally distributed.
A company X sells bulbs with a mean lifetime of 850 hours and a standard deviation of 50 hours.

(a) Find the probability of a bulb, from company X, having a lifetime of less than 830 hours.

(3)

(b) In a box of 500 bulbs, from company X, find the expected number having a lifetime of less than 830 hours.

(2)

A rival company Y sells bulbs with a mean lifetime of 860 hours and 20% of these bulbs have a lifetime of less than 818 hours.

(c) Find the standard deviation of the lifetimes of bulbs from company Y.

(4)

Both companies sell the bulbs for the same price.

(d) State which company you would recommend. Give reasons for your answer.

(2)

EXPERT TUITION

Leave blank

Question 46 continued

(Total 11 marks)

EXPERT TUITION

Leave blank

47. The random variable X has a normal distribution with mean 30 and standard deviation 5.

(a) Find $P(X < 39)$.

(2)

(b) Find the value of d such that $P(X < d) = 0.1151$

(4)

(c) Find the value of e such that $P(X > e) = 0.1151$

(2)

(d) Find $P(d < X < e)$.

(2)

EXPERT TUITION

Leave blank

Question 47 continued

(Total 10 marks)

EXPERT TUITION

Leave blank

48. A packing plant fills bags with cement. The weight X kg of a bag of cement can be modelled by a normal distribution with mean 50 kg and standard deviation 2 kg.

(a) Find $P(X > 53)$.

(3)

(b) Find the weight that is exceeded by 99% of the bags.

(5)

Three bags are selected at random.

(c) Find the probability that two weigh more than 53 kg and one weighs less than 53 kg.

(4)

EXPERT TUITION

Leave blank

Question 48 continued

(Total 12 marks)

EXPERT TUITION

Leave blank

49. The weights of bags of popcorn are normally distributed with mean of 200 g and 60% of all bags weighing between 190 g and 210 g.

(a) Write down the median weight of the bags of popcorn.

(1)

(b) Find the standard deviation of the weights of the bags of popcorn.

(5)

A shopkeeper finds that customers will complain if their bag of popcorn weighs less than 180 g.

(c) Find the probability that a customer will complain.

(3)

EXPERT TUITION

Leave blank

Question 49 continued

(Total 9 marks)

EXPERT TUITION

Leave blank

50. A fair coin is spun 6 times and the random variable T represents the number of tails obtained.

(a) Give two reasons why a binomial model would be a suitable distribution for modelling T.

(2)

(b) Find $P(T = 5)$

(2)

(c) Find the probability of obtaining more tails than heads.

(2)

A second coin is biased such that the probability of obtaining a head is $\frac{1}{4}$

This second coin is spun 6 times.

(d) Find the probability that, for the second coin, the number of heads obtained is greater than or equal to the number of tails obtained.

(3)

EXPERT TUITION

Leave blank

Question 50 continued

EXPERT TUITION

Leave blank

Question 50 continued

EXPERT TUITION

Leave blank

Question 50 continued

(Total 9 marks)

EXPERT TUITION

Leave blank

51. The time taken for a randomly selected person to complete a test is M minutes, where $M \sim \mathrm{N}(14, \sigma^2)$

Given that 10% of people take less than 12 minutes to complete the test,

(a) find the value of σ

(3)

Graham selects 15 people at random.

(b) Find the probability that fewer than 2 of these people will take less than 12 minutes to complete the test.

(3)

Jovanna takes a random sample of n people.

Using a normal approximation, the probability that fewer than 9 of these n people will take less than 12 minutes to complete the test is 0.3085 to 4 decimal places.

(c) Find the value of n.

(8)

EXPERT TUITION

Leave blank

Question 51 continued

EXPERT TUITION

Leave blank

Question 51 continued

EXPERT TUITION

Leave blank

Question 51 continued

(Total 14 marks)

EXPERT TUITION

Leave blank

52. In a region of the UK, 5% of people have red hair. In a random sample of size n, taken from this region, the expected number of people with red hair is 3

(a) Calculate the value of n.

(2)

A random sample of 20 people is taken from this region.
Find the probability that

(b) (i) exactly 4 of these people have red hair,

(ii) at least 4 of these people have red hair.

(5)

EXPERT TUITION

Leave blank

Question 52 continued

EXPERT TUITION

Leave blank

Question 52 continued

EXPERT TUITION

Leave blank

Question 52 continued

(Total 7 marks)

EXPERT TUITION

Leave blank

53. In a large school, 20% of students own a touch screen laptop. A random sample of n students is chosen from the school. Using a normal approximation, the probability that more than 55 of these n students own a touch screen laptop is 0.0401 correct to 3 significant figures.

Find the value of n.

(8)

EXPERT TUITION

Leave blank

Question 53 continued

EXPERT TUITION

Leave blank

Question 53 continued

EXPERT TUITION

Leave blank

Question 53 continued

(Total 8 marks)

EXPERT TUITION

Leave blank

54. The proportion of houses in Radville which are unable to receive digital radio is 25%. In a survey of a random sample of 30 houses taken from Radville, the number, X, of houses which are unable to receive digital radio is recorded.

Find $P(5 \leqslant X < 11)$

(3)

(Total 3 marks)

EXPERT TUITION

Leave blank

55. A cadet fires shots at a target at distances ranging from 25 m to 90 m. The probability of hitting the target with a single shot is p. When firing from a distance d m, $p = \frac{3}{200}(90 - d)$.

Each shot is fired independently.

The cadet fires 10 shots from a distance of 40 m.

(a) (i) Find the probability that exactly 6 shots hit the target.

(ii) Find the probability that at least 8 shots hit the target.

(5)

The cadet fires 20 shots from a distance of x m.

(b) Find, to the nearest integer, the value of x if the cadet has an 80% chance of hitting the target at least once.

(4)

EXPERT TUITION

Leave blank

Question 55 continued

EXPERT TUITION

Leave blank

Question 55 continued

EXPERT TUITION

Leave blank

Question 55 continued

(Total 9 marks)

EXPERT TUITION

Leave blank

56. A bag contains a large number of counters. Each counter has a single digit number on it and the mean of all thenumbers in the bag is the unknown parameter μ. The number 2 is on 40% of the counters and the number 5 is on 25% of the counters. All the remaining counters have numbers greater than 5 on them.

The random variable T represents the number of counters in a random sample of 10 with the number 2 on them.

(a) Specify the sampling distribution of T.

(2)

The counters are selected one by one.

(b) Find the probability that the third counter selected is the first counter with the number 2 on it.

(2)

EXPERT TUITION

Leave blank

Question 56 continued

(Total 4 marks)

EXPERT TUITION

Leave blank

57. A telesales operator is selling a magazine. Each day he chooses a number of people to telephone. The probability that each person he telephones buys the magazine is 0.1

(a) Suggest a suitable distribution to model the number of people who buy the magazine from the telesales operator each day.

(1)

(b) On Monday, the telesales operator telephones 10 people. Find the probability that he sells at least 4 magazines.

(3)

(c) Calculate the least number of people he needs to telephone on Tuesday, so that the probability of selling at least 1 magazine, on that day, is greater than 0.95

(3)

EXPERT TUITION

Leave blank

Question 57 continued

EXPERT TUITION

Leave blank

Question 57 continued

(Total 7 marks)

EXPERT TUITION

Leave blank

58. A random variable X has the distribution $B(12, p)$.

(a) Given that $p = 0.25$ find

(i) $P(X < 5)$

(ii) $P(X \geqslant 7)$

(3)

(b) Given that $P(X = 0) = 0.05$, find the value of p to 3 decimal places.

(3)

EXPERT TUITION

Leave blank

Question 58 continued

(Total 6 marks)

EXPERT TUITION

Leave blank

59. In a large restaurant an average of 3 out of every 5 customers ask for water with their meal.

A random sample of 10 customers is selected.

(a) Find the probability that

(i) exactly 6 ask for water with their meal,

(ii) less than 9 ask for water with their meal.

(5)

A second random sample of 50 customers is selected.

(b) Find the smallest value of n such that

$$P(X < n) \geqslant 0.9$$

where the random variable X represents the number of these customers who ask for water.

(3)

EXPERT TUITION

Leave blank

Question 59 continued

EXPERT TUITION

Leave blank

Question 59 continued

(Total 8 marks)

EXPERT TUITION

Leave blank

60. The probability of a telesales representative making a sale on a customer call is 0.15

Find the probability that

(a) no sales are made in 10 calls,

(2)

(b) more than 3 sales are made in 20 calls.

(2)

Representatives are required to achieve a mean of at least 5 sales each day.

(c) Find the least number of calls each day a representative should make to achieve this requirement.

(2)

(d) Calculate the least number of calls that need to be made by a representative for the probability of at least 1 sale to exceed 0.95

(3)

EXPERT TUITION

Leave blank

Question 60 continued

(Total 9 marks)

EXPERT TUITION

Leave blank

61. A disease occurs in 3% of a population.

(a) State any assumptions that are required to model the number of people with the disease in a random sample of size n as a binomial distribution.

(2)

(b) Using this model, find the probability of exactly 2 people having the disease in a random sample of 10 people.

(3)

(Total 5 marks)

EXPERT TUITION

Leave blank

62. Bhim and Joe play each other at badminton and for each game, independently of all others, the probability that Bhim loses is 0.2

Find the probability that, in 9 games, Bhim loses

(a) exactly 3 of the games,

(3)

(b) fewer than half of the games.

(2)

EXPERT TUITION

Leave blank

Question 62 continued

(Total 5 marks)

EXPERT TUITION

Leave blank

63. A manufacturer supplies DVD players to retailers in batches of 20. It has 5% of the players returned because they are faulty.

(a) Write down a suitable model for the distribution of the number of faulty DVD players in a batch.

(2)

Find the probability that a batch contains

(b) no faulty DVD players,

(2)

(c) more than 4 faulty DVD players.

(2)

(Total 6 marks)

EXPERT TUITION

Leave blank

64. A bag contains a large number of counters of which 15% are coloured red. A random sample of 30 counters is selected and the number of red counters is recorded.

Find the probability of no more than 6 red counters in this sample.

(2)

EXPERT TUITION

Leave blank

Question 64 continued

(Total 2 marks)

EXPERT TUITION

Leave blank

65. In a large college 58% of students are female and 42% are male. A random sample of 100 students is chosen from the college. Using a suitable approximation find the probability that more than half the sample are female.

(7)

EXPERT TUITION

Leave blank

Question 65 continued

(Total 7 marks)

EXPERT TUITION

Leave blank

66. Each cell of a certain animal contains 11000 genes. It is known that each gene has a probability 0.0005 of being damaged.

A cell is chosen at random.

Suggest a suitable model for the distribution of the number of damaged genes in the cell.

(2)

(Total 2 marks)

EXPERT TUITION

Leave blank

67. Sue throws a fair coin 15 times and records the number of times it shows a head.

(a) State the distribution to model the number of times the coin shows a head.

(2)

Find the probability that Sue records

(b) exactly 8 heads,

(2)

(c) at least 4 heads.

(2)

EXPERT TUITION

Leave blank

Question 67 continued

EXPERT TUITION

Leave blank

Question 67 continued

EXPERT TUITION

Leave blank

Question 67 continued

(Total 6 marks)

EXPERT TUITION

Leave blank

68. The probability of a bolt being faulty is 0.3. Find the probability that in a random sample of 20 bolts there are

(a) exactly 2 faulty bolts,

(2)

(b) more than 3 faulty bolts.

(2)

These bolts are sold in bags of 20. John buys 10 bags.

(c) Find the probability that exactly 6 of these bags contain more than 3 faulty bolts.

(3)

(Total 7 marks)

EXPERT TUITION