AS-Level

Topic : Binomial & Geometric Distribution

May : 2013- May :2025

Question

Question 1

In a certain country, on average one student in five has blue eyes.

(i) For a random selection of n students, the probability that none of the students has blue eyes is less than 0.001. Find the least possible value of n. [3]

(ii) For a random selection of 120 students, find the probability that fewer than 33 have blue eyes. [4]

Question 2

Robert uses his calculator to generate 5 random integers between 1 and 9 inclusive.

(i) Find the probability that at least 2 of the 5 integers are less than or equal to 4. [3]

Robert now generates n random integers between 1 and 9 inclusive. The random variable X is the number of these n integers which are less than or equal to a certain integer k between 1 and 9 inclusive. It is given that the mean of X is 96 and the variance of X is 32.

(ii) Find the values of n and k. [4]

Question 3

Fiona uses her calculator to produce 12 random integers between 7 and 21 inclusive. The random variable X is the number of these 12 integers which are multiples of 5.

(i) State the distribution of X and give its parameters. [3]

(ii) Calculate the probability that X is between 3 and 5 inclusive. [3]

Fiona now produces n random integers between 7 and 21 inclusive.

(iii) Find the least possible value of n if the probability that none of these integers is a multiple of 5 is less than 0.01. [3]

Question 4

In a large consignment of mangoes, 15% of mangoes are classified as small, 70% as medium and 15% as large.

(i) Yue-chen picks 14 mangoes at random. Find the probability that fewer than 12 of them are medium or large. [3]

(ii) Yue-chen picks n mangoes at random. The probability that none of these n mangoes is small is at least 0.1. Find the largest possible value of n. [3]

Question 5

In a certain country 12% of houses have solar heating. 19 houses are chosen at random. Find the probability that fewer than 4 houses have solar heating. [4]

Question 6

(i) State three conditions which must be satisfied for a situation to be modelled by a binomial distribution. [2]

George wants to invest some of his monthly salary. He invests a certain amount of this every month for 18 months. For each month there is a probability of 0.25 that he will buy shares in a large company, there is a probability of 0.15 that he will buy shares in a small company and there is a probability of 0.6 that he will invest in a savings account.

(ii) Find the probability that George will buy shares in a small company in at least 3 of these 18 months. [3]

Question 7

The number of books read by members of a book club each year has the binomial distribution B(12, 0.7).

(i) State the greatest number of books that could be read by a member of the book club in a particular year and find the probability that a member reads this number of books. [2]

(ii) Find the probability that a member reads fewer than 10 books in a particular year. [3]

Question 8

(i) Four fair six-sided dice, each with faces marked 1, 2, 3, 4, 5, 6, are thrown. Find the probability that the numbers shown on the four dice add up to 5. [3]

(ii) Four fair six-sided dice, each with faces marked 1, 2, 3, 4, 5, 6, are thrown on 7 occasions. Find the probability that the numbers shown on the four dice add up to 5 on exactly 1 or 2 of the 7 occasions. [4]

Question 9

Screws are sold in packets of 15. Faulty screws occur randomly. A large number of packets are tested for faulty screws and the mean number of faulty screws per packet is found to be 1.2.

(i) Show that the variance of the number of faulty screws in a packet is 1.104. [2]

(ii) Find the probability that a packet contains at most 2 faulty screws. [3]

Damien buys 8 packets of screws at random.

(iii) Find the probability that there are exactly 7 packets in which there is at least 1 faulty screw. [4]

Question 10

A fair die is thrown 10 times. Find the probability that the number of sixes obtained is between 3 and 5 inclusive. [3]

Question 11

In a certain town, 76% of cars are fitted with satellite navigation equipment. A random sample of 11 cars from this town is chosen. Find the probability that fewer than 10 of these cars are fitted with this equipment. [4]

Question 12

When people visit a certain large shop, on average 34% of them do not buy anything, 53% spend less than $50 and 13% spend at least $50.

(i) 15 people visiting the shop are chosen at random. Calculate the probability that at least 14 of them buy something. [3]

(ii) n people visiting the shop are chosen at random. The probability that none of them spends at least $50 is less than 0.04. Find the smallest possible value of n. [3]

Question 13

The faces of a biased die are numbered 1, 2, 3, 4, 5 and 6. The random variable X is the score when the die is thrown. The following is the probability distribution table for X.

x	1	2	3	4	5	6
P($X = x$)	p	p	p	p	0.2	0.2

The die is thrown 3 times. Find the probability that the score is 4 on not more than 1 of the 3 throws. [5]

Question 14

A fair triangular spinner has three sides numbered 1, 2, 3. When the spinner is spun, the score is the number of the side on which it lands. The spinner is spun four times.

(i) Find the probability that at least two of the scores are 3. [3]

(ii) Find the probability that the sum of the four scores is 5. [3]

Question 15

Visitors to a Wildlife Park in Africa have independent probabilities of 0.9 of seeing giraffes, 0.95 of seeing elephants, 0.85 of seeing zebras and 0.1 of seeing lions.

(i) Find the probability that a visitor to the Wildlife Park sees all these animals. [1]

(ii) Find the probability that, out of 12 randomly chosen visitors, fewer than 3 see lions. [3]

(iii) 50 people independently visit the Wildlife Park. Find the mean and variance of the number of these people who see zebras. [2]

Question 16

Hebe attempts a crossword puzzle every day. The number of puzzles she completes in a week (7 days) is denoted by X.

(i) State two conditions that are required for X to have a binomial distribution. [2]

On average, Hebe completes 7 out of 10 of these puzzles.

(ii) Use a binomial distribution to find the probability that Hebe completes at least 5 puzzles in a week. [3]

(iii) Use a binomial distribution to find the probability that, over the next 10 weeks, Hebe completes 4 or fewer puzzles in exactly 3 of the 10 weeks. [3]

Question 17

Eggs are sold in boxes of 20. Cracked eggs occur independently and the mean number of cracked eggs in a box is 1.4.

   (i) Calculate the probability that a randomly chosen box contains exactly 2 cracked eggs.   [3]

 (ii) Calculate the probability that a randomly chosen box contains at least 1 cracked egg.   [2]

(iii) A shop sells n of these boxes of eggs. Find the smallest value of n such that the probability of there being at least 1 cracked egg in each box sold is less than 0.01.   [2]

Question 18

A statistics student asks people to complete a survey. The probability that a randomly chosen person agrees to complete the survey is 0.2. Find the probability that at least one of the first three people asked agrees to complete the survey.   [2]

Question 19

An experiment consists of throwing a biased die 30 times and noting the number of 4s obtained. This experiment was repeated many times and the average number of 4s obtained in 30 throws was found to be 6.21.

   (i) Estimate the probability of throwing a 4.   [1]

 (ii) find the variance of the number of 4s obtained in 30 throws,   [1]

(iii) find the probability that in 15 throws the number of 4s obtained is 2 or more.   [3]

Question 20

The results of a survey at a certain large college show that the proportion of students who own a car is $\frac{1}{4}$.

   (i) Five students at the college are chosen at random. Find the probability that at least four of these students own a car.   [3]

 (ii) For a random sample of n students at the college, the probability that at least one of the students owns a car is greater than 0.995. Find the least possible value of n.   [3]

(iii) For a random sample of 160 students at the college, use a suitable approximate distribution to find the probability that fewer than 50 own a car.   [4]

Question 21

The random variable X has the distribution $N(-3, \sigma^2)$. The probability that a randomly chosen value of X is positive is 0.25.

   (i) Find the value of σ.   [3]

 (ii) Find the probability that, of 8 random values of X, fewer than 2 will be positive.   [3]

Question 22

In a certain country, 60% of mobile phones sold are made by Company A, 35% are made by Company B and 5% are made by other companies.

  (i) Find the probability that, out of a random sample of 13 people who buy a mobile phone, fewer than 11 choose a mobile phone made by Company A.   [3]

 (ii) Use a suitable approximation to find the probability that, out of a random sample of 130 people who buy a mobile phone, at least 50 choose a mobile phone made by Company B.   [5]

Question 23

In Pelmerdon 22% of families own a dishwasher.

  (i) Find the probability that, of 15 families chosen at random from Pelmerdon, between 4 and 6 inclusive own a dishwasher.   [3]

 (ii) A random sample of 145 families from Pelmerdon is chosen. Use a suitable approximation to find the probability that more than 26 families own a dishwasher.   [5]

Question 24

The weights of apples sold by a store can be modelled by a normal distribution with mean 120 grams and standard deviation 24 grams. Apples weighing less than 90 grams are graded as 'small'; apples weighing more than 140 grams are graded as 'large'; the remainder are graded as 'medium'.

  (i) Show that the probability that an apple chosen at random is graded as medium is 0.692, correct to 3 significant figures.   [4]

 (ii) Four apples are chosen at random. Find the probability that at least two are graded as medium.   [4]

Question 25

Jake attempts the crossword puzzle in his daily newspaper every day. The probability that he will complete the puzzle on any given day is 0.75, independently of all other days.

  (i) Find the probability that he will complete the puzzle at least three times over a period of five days.   [3]

Kenny also attempts the puzzle every day. The probability that he will complete the puzzle on a Monday is 0.8. The probability that he will complete it on a Tuesday is 0.9 if he completed it on the previous day and 0.6 if he did not complete it on the previous day.

 (ii) Find the probability that Kenny will complete the puzzle on at least one of the two days Monday and Tuesday in a randomly chosen week.   [3]

Question 26

At the Nonland Business College, all students sit an accountancy examination at the end of their first year of study. On average, 80% of the students pass this examination.

 (i) A random sample of 9 students who will take this examination is chosen. Find the probability that at most 6 of these students will pass the examination. [3]

 (ii) A random sample of 200 students who will take this examination is chosen. Use a suitable approximate distribution to find the probability that more than 166 of them will pass the examination. [5]

 (iii) Justify the use of your approximate distribution in part (ii). [1]

Question 27

The results of a survey by a large supermarket show that 35% of its customers shop online.

 (i) Six customers are chosen at random. Find the probability that more than three of them shop online. [3]

 (ii) For a random sample of n customers, the probability that at least one of them shops online is greater than 0.95. Find the least possible value of n. [3]

 (iii) For a random sample of 100 customers, use a suitable approximating distribution to find the probability that more than 39 shop online. [5]

Question 28

On average, 34% of the people who go to a particular theatre are men.

 (i) A random sample of 14 people who go to the theatre is chosen. Find the probability that at most 2 people are men. [3]

 (ii) Use an approximation to find the probability that, in a random sample of 600 people who go to the theatre, fewer than 190 are men. [5]

Question 29

The probability that Janice will buy an item online in any week is 0.35. Janice does not buy more than one item online in any week.

 (i) Find the probability that, in a 10-week period, Janice buys at most 7 items online. [3]

 (ii) The probability that Janice buys at least one item online in a period of n weeks is greater than 0.99. Find the smallest possible value of n. [3]

Question 30

In a certain country the probability that a child owns a bicycle is 0.65.

 (i) A random sample of 15 children from this country is chosen. Find the probability that more than 12 own a bicycle. [3]

 (ii) A random sample of 250 children from this country is chosen. Use a suitable approximation to find the probability that fewer than 179 own a bicycle. [4]

Question 31

A competition is taking place between two choirs, the Notes and the Classics. There is a large audience for the competition.

- 30% of the audience are Notes supporters.
- 45% of the audience are Classics supporters.
- The rest of the audience are not supporters of either of these choirs.
- No one in the audience supports both of these choirs.

(i) A random sample of 6 people is chosen from the audience.

(a) Find the probability that no more than 2 of the 6 people are Notes supporters. [3]

(b) Find the probability that none of the 6 people support either of these choirs. [2]

Question 32

In Quarendon, 66% of households are satisfied with the speed of their wifi connection.

(i) Find the probability that, out of 10 households chosen at random in Quarendon, at least 8 are satisfied with the speed of their wifi connection. [3]

(ii) A random sample of 150 households in Quarendon is chosen. Use a suitable approximation to find the probability that more than 84 are satisfied with the speed of their wifi connection. [5]

Question 33

Annan has designed a new logo for a sportswear company. A survey of a large number of customers found that 42% of customers rated the logo as good.

(i) A random sample of 10 customers is chosen. Find the probability that fewer than 8 of them rate the logo as good. [3]

(ii) On another occasion, a random sample of n customers of the company is chosen. Find the smallest value of n for which the probability that at least one person rates the logo as good is greater than 0.995. [3]

Question 34

In Greenton, 70% of the adults own a car. A random sample of 8 adults from Greenton is chosen.

(a) Find the probability that the number of adults in this sample who own a car is less than 6. [3]

A random sample of 120 adults from Greenton is now chosen.

(b) Use an approximation to find the probability that more than 75 of them own a car. [5]

Question 35

In a certain large college, 22% of students own a car.

(a) 3 students from the college are chosen at random. Find the probability that all 3 students own a car. [1]

(b) 16 students from the college are chosen at random. Find the probability that the number of these students who own a car is at least 2 and at most 4. [3]

Question 36

On any given day, the probability that Moena messages her friend Pasha is 0.72.

(a) Find the probability that for a random sample of 12 days Moena messages Pasha on no more than 9 days. [3]

(b) Moena messages Pasha on 1 January. Find the probability that the next day on which she messages Pasha is 5 January. [1]

Question 37

The company also produces large boxes of sweets. For any large box, the probability that it contains more jellies than chocolates is 0.64. 10 large boxes are chosen at random.

Find the probability that no more than 7 of these boxes contain more jellies than chocolates. [3]

Question 37

The 13 00 train from Jahor to Keman runs every day. The probability that the train arrives late in Keman is 0.35.

(a) For a random sample of 7 days, find the probability that the train arrives late on fewer than 3 days. [3]

A random sample of 142 days is taken.

(b) Use an approximation to find the probability that the train arrives late on more than 40 days. [5]

Question 38

An ordinary fair die is thrown until a 6 is obtained.

(a) Find the probability that obtaining a 6 takes more than 8 throws. [2]

Two ordinary fair dice are thrown together until a pair of 6s is obtained. The number of throws taken is denoted by the random variable X.

(b) Find the expected value of X. [1]

(c) Find the probability that obtaining a pair of 6s takes either 10 or 11 throws. [2]

Question 39

A fair six-sided die, with faces marked 1, 2, 3, 4, 5, 6, is thrown repeatedly until a 4 is obtained.

(a) Find the probability that obtaining a 4 requires fewer than 6 throws. [2]

On another occasion, the die is thrown 10 times.

(b) Find the probability that a 4 is obtained at least 3 times. [3]

Question 40

Kayla is competing in a throwing event. A throw is counted as a success if the distance achieved is greater than 30 metres. The probability that Kayla will achieve a success on any throw is 0.25.

(a) Find the probability that Kayla takes more than 6 throws to achieve a success. [2]

(b) Find the probability that, for a random sample of 10 throws, Kayla achieves at least 3 successes. [3]

Question 41

A fair spinner with 5 sides numbered 1, 2, 3, 4, 5 is spun repeatedly. The score on each spin is the number on the side on which the spinner lands.

(a) Find the probability that a score of 3 is obtained for the first time on the 8th spin. [1]

(b) Find the probability that fewer than 6 spins are required to obtain a score of 3 for the first time. [2]

Question 42

Three fair six-sided dice, each with faces marked 1, 2, 3, 4, 5, 6, are thrown at the same time, repeatedly. For a single throw of the three dice, the score is the sum of the numbers on the top faces.

(a) Find the probability that the score is 4 on a single throw of the three dice. [3]

(b) Find the probability that a score of 18 is obtained for the first time on the 5th throw of the three dice. [3]

Question 43

Every day Richard takes a flight between Astan and Bejin. On any day, the probability that the flight arrives early is 0.15, the probability that it arrives on time is 0.55 and the probability that it arrives late is 0.3.

(a) Find the probability that on each of 3 randomly chosen days, Richard's flight does not arrive late. [1]

(b) Find the probability that for 9 randomly chosen days, Richard's flight arrives early at least 3 times. [3]

(c) 60 days are chosen at random.

Use an approximation to find the probability that Richard's flight arrives early at least 12 times. [5]

Question 44

An ordinary fair die is thrown repeatedly until a 5 is obtained. The number of throws taken is denoted by the random variable X.

(a) Write down the mean of X. [1]

(b) Find the probability that a 5 is first obtained after the 3rd throw but before the 8th throw. [2]

(c) Find the probability that a 5 is first obtained in fewer than 10 throws. [2]

Question 45

In Questa, 60% of the adults travel to work by car.

(a) A random sample of 12 adults from Questa is taken.

Find the probability that the number who travel to work by car is less than 10. [3]

(b) A random sample of 150 adults from Questa is taken.

Use an approximation to find the probability that the number who travel to work by car is less than 81. [5]

(c) Justify the use of your approximation in part **(b)**. [1]

Question 46

In a certain region, the probability that any given day in October is wet is 0.16, independently of other days.

(a) Find the probability that, in a 10-day period in October, fewer than 3 days will be wet. [3]

(b) Find the probability that the first wet day in October is 8 October. [2]

(c) For 4 randomly chosen years, find the probability that in exactly 1 of these years the first wet day in October is 8 October. [2]

Question 47

Two fair coins are thrown at the same time. The random variable X is the number of throws of the two coins required to obtain two tails at the same time.

(a) Find the probability that two tails are obtained for the first time on the 7th throw. [2]

(b) Find the probability that it takes more than 9 throws to obtain two tails for the first time. [2]

Question 48

Ramesh throws an ordinary fair 6-sided die.

(a) Find the probability that he obtains a 4 for the first time on his 8th throw. [1]

(b) Find the probability that it takes no more than 5 throws for Ramesh to obtain a 4. [2]

Ramesh now repeatedly throws two ordinary fair 6-sided dice at the same time. Each time he adds the two numbers that he obtains.

(c) For 10 randomly chosen throws of the two dice, find the probability that Ramesh obtains a total of less than 4 on at least three throws. [4]

Question 49

In a large college, 28% of the students do not play any musical instrument, 52% play exactly one musical instrument and the remainder play two or more musical instruments.

A random sample of 12 students from the college is chosen.

(a) Find the probability that more than 9 of these students play at least one musical instrument. [3]

A random sample of 90 students from the college is now chosen.

(b) Use an approximation to find the probability that fewer than 40 of these students play exactly one musical instrument. [5]

Question 50

Jacob has four coins. One of the coins is biased such that when it is thrown the probability of obtaining a head is $\frac{7}{10}$. The other three coins are fair. Jacob throws all four coins once. The number of heads that he obtains is denoted by the random variable X. The probability distribution table for X is as follows.

x	0	1	2	3	4
$P(X = x)$	$\frac{3}{80}$	a	b	c	$\frac{7}{80}$

(a) Show that $a = \frac{1}{5}$ and find the values of b and c. [4]

(b) Find $E(X)$. [1]

Jacob throws all four coins together 10 times.

(c) Find the probability that he obtains exactly one head on fewer than 3 occasions. [3]

(d) Find the probability that Jacob obtains exactly one head for the first time on the 7th or 8th time that he throws the 4 coins. [2]

Question 51

Company A produces bags of sugar. An inspector finds that on average 10% of the bags are underweight.

10 of the bags are chosen at random.

Find the probability that fewer than 3 of these bags are underweight. [3]

Question 52

At a company's call centre, 90% of callers are connected immediately to a representative.

A random sample of 12 callers is chosen.

Find the probability that fewer than 10 of these callers are connected immediately. [3]

Question 53

The residents of Persham were surveyed about the reliability of their internet service. 12% rated the service as 'poor', 36% rated it as 'satisfactory' and 52% rated it as 'good'.

A random sample of 8 residents of Persham is chosen.

Find the probability that more than 2 and fewer than 8 of them rate their internet service as poor or satisfactory. [3]

Question 54

80% of the residents of Kinwawa are in favour of a leisure centre being built in the town.

20 residents of Kinwawa are chosen at random and asked, in turn, whether they are in favour of the leisure centre.

(a) Find the probability that more than 17 of these residents are in favour of the leisure centre.   [3]

(b) Find the probability that the 5th person asked is the first person who is **not** in favour of the leisure centre.   [1]

(c) Find the probability that the 7th person asked is the second person who is **not** in favour of the leisure centre.   [2]

Question 55

A children's wildlife magazine is published every Monday. For the next 12 weeks it will include a model animal as a free gift. There are five different models: tiger, leopard, rhinoceros, elephant and buffalo, each with the same probability of being included in the magazine.

Sahim buys one copy of the magazine every Monday.

(a) Find the probability that the first time that the free gift is an elephant is before the 6th Monday.   [2]

(b) Find the probability that Sahim will get more than two leopards in the 12 magazines.   [3]

(c) Find the probability that after 5 weeks Sahim has exactly one of each animal.   [3]

Question 56

The probability that a driver passes an advanced driving test is 0.3 on any given attempt.

(a) Dipak keeps taking the test until he passes. The random variable X denotes the number of attempts required for Dipak to pass the test.

    (i) Find P$(2 \leqslant X \leqslant 6)$.   [2]

    (ii) Find E(X).   [1]

Five friends will each take their advanced driving test tomorrow.

(b) Find the probability that at least three of them will pass tomorrow.   [3]

75 people will take their advanced driving test next week.

(c) Use an approximation to find the probability that more than 20 of them will pass next week.   [5]

Question 57

George has a fair 5-sided spinner with sides labelled 1, 2, 3, 4, 5. He spins the spinner and notes the number on the side on which the spinner lands.

(a) Find the probability that it takes fewer than 7 spins for George to obtain a 5.   [2]

George spins the spinner 10 times.

(b) Find the probability that he obtains a 5 more than 4 times but fewer than 8 times.   [3]

Question 58

Hazeem repeatedly throws two ordinary fair 6-sided dice at the same time. On each occasion, the score is the sum of the two numbers that she obtains.

(a) Find the probability that it takes exactly 5 throws of the two dice for Hazeem to obtain a score of 8 or more. [2]

(b) Find the probability that it takes no more than 4 throws of the two dice for Hazeem to obtain a score of 8 or more. [2]

(c) For 8 randomly chosen throws of the two dice, find the probability that Hazeem obtains a score of 8 or more on fewer than 3 occasions. [3]

Question 59

Sam is a member of a soccer club. She is practising scoring goals. The probability that Sam will score a goal on any attempt is 0.7, independently of all other attempts.

(a) Sam makes 10 attempts at scoring goals.

Find the probability that Sam will score goals on fewer than 8 of these attempts. [3]

(b) Find the probability that Sam's first successful attempt will be before her 5th attempt. [2]

(c) Wei is a member of the same soccer club. He is also practising scoring goals. The probability that Wei will score a goal on any attempt is 0.6, independently of all other attempts.

Wei is going to keep making attempts until he scores 3 goals.

Find the probability that he scores his third goal on his 7th attempt. [3]

Question 60

Salah decides to attempt the crossword puzzle in his newspaper each day. The probability that he will complete the puzzle on any given day is 0.65, independent of other days.

(a) Find the probability that Salah completes the puzzle for the first time on the 5th day. [1]

(b) Find the probability that Salah completes the puzzle for the second time on the 5th day. [2]

(c) Find the probability that Salah completes the puzzle fewer than 5 times in a week (7 days). [3]

(d) Use a suitable approximation to find the probability that Salah completes the puzzle more than 50 times in a period of 84 days. [5]

Question 61

The residents of Mahjing were asked to classify their local bus service:

- 25% of residents classified their service as good.
- 60% of residents classified their service as satisfactory.
- 15% of residents classified their service as poor.

(a) A random sample of 110 residents of Mahjing is chosen.

Use a suitable approximation to find the probability that fewer than 22 residents classified their bus service as good. [5]

(b) For a random sample of 10 residents of Mahjing, find the probability that fewer than 8 classified their bus service as good or satisfactory. [3]

(c) Three residents of Mahjing are selected at random.

Find the probability that one resident classified the bus service as good, one as satisfactory and one as poor. [2]

Question 62

Rajesh applies once every year for a ticket to a music festival. The probability that he is successful in any particular year is 0.3, independently of other years.

(a) Find the probability that Rajesh is successful for the first time on his 7th attempt. [1]

(b) Find the probability that Rajesh is successful for the first time before his 6th attempt. [2]

(c) Find the probability that Rajesh is successful for the second time on his 10th attempt. [2]

Question 63

In a certain area in the Arctic the probability that it snows on any given day is 0.7, independent of all other days.

(a) Find the probability that in a week (7 days) it snows on at least five days. [3]

A week in which it snows on at least five days out of seven is called a 'white' week.

(b) Find the probability that in three randomly chosen weeks at least one is a white week. [2]

In a different area in the Arctic, the probability that a week is a white week is 0.8 .

(c) Use a suitable approximation to find the probability that in 60 randomly chosen weeks fewer than 47 are white weeks. [5]

Question 64

A factory produces chocolates. 30% of the chocolates are wrapped in gold foil, 25% are wrapped in red foil and the remainder are unwrapped.

Indigo chooses 8 chocolates at random from the production line.

(a) Find the probability that she obtains no more than 2 chocolates that are wrapped in red foil. [3]

Jake chooses chocolates one at a time at random from the production line.

(b) Find the probability that the first time he obtains a chocolate that is wrapped in red foil is before the 7th choice. [2]

Keifa chooses chocolates one at a time at random from the production line.

(c) Find the probability that the second chocolate chosen is the first one wrapped in gold foil given that the fifth chocolate chosen is the first unwrapped chocolate. [5]

Question 65

In a game, players attempt to score a goal by kicking a ball into a net. The probability that Leno scores a goal is 0.4 on any attempt, independently of all other attempts. The random variable X denotes the number of attempts that it takes Leno to score a goal.

(a) Find $P(X = 5)$. [1]

(b) Find $P(3 \leqslant X \leqslant 7)$. [2]

(c) Find the probability that Leno scores his second goal on or before his 5th attempt. [3]

Leno has 75 attempts to score a goal.

(d) Use a suitable approximation to find the probability that Leno scores more than 28 goals but fewer than 35 goals. [5]

Question 66

Nicola throws an ordinary fair six-sided dice. The random variable X is the number of throws that she takes to obtain a 6.

(a) Find $P(X < 8)$. [2]

(b) Find the probability that Nicola obtains a 6 for the second time on her 8th throw. [2]

Question 67

A fair six-sided dice with faces labelled 1, 2, 3, 4, 5, 6 is thrown repeatedly until a 3 is obtained. The number of throws taken is denoted by the random variable X.

(a) Find $P(X = 8)$. [1]

(b) Find $P(X < 9)$. [2]

(c) Find the probability that a 3 is obtained for the second time before the 6th throw. [3]

Question 68

At a large college, all students who study Science also study exactly one of Art or Drama or Music. 20% of these students study Art, 45% study Drama and 35% study Music.

(a) 3 students are selected at random from the students who study Science.

Find the probability that at least 1 of these students studies Drama. [2]

(b) 10 students are selected at random from the students who study Science.

Find the probability that more than 7 study Art or Music. [3]

Question 69

Vehicles approaching a certain road junction from Bromley must go either left, right or straight on. Over time, it is known that 30% turn left, 25% turn right and 45% go straight on. The driver of each vehicle chooses a direction independently of all other drivers.

(a) Find the probability that the next three vehicles approaching this junction from Bromley all go in different directions. [2]

(b) Find the probability that, from the vehicles approaching this junction from Bromley today, the 1st vehicle to go left is before the 9th vehicle. [2]

(c) Find the probability that, from the vehicles approaching this junction from Bromley today, the 2nd vehicle to go left is the 7th vehicle. [2]

Question 70

In Millford, 70% of the residents own a bicycle. A random sample of 160 residents is selected.

Use a suitable approximation to find the probability that more than 120 of these residents own a bicycle. [5]

Question 71

Every Saturday, a particular community holds a 'Puzzle' event to raise money for a new Leisure Centre. Competitors attempt to solve a puzzle as quickly as possible.

Last Saturday, 600 competitors took part. The times taken to complete the puzzle were normally distributed with mean 32.4 minutes and standard deviation 2.5 minutes.

(a) How many competitors would you expect to have times within 1.2 minutes of the mean time? [4]

In this Saturday's event, 60% of the competitors had times less than 36.0 minutes.

(b) 9 competitors who took part in this Saturday's event are selected at random.

Find the probability that at least 2 and fewer than 8 of these competitors had times less than 36.0 minutes. [3]

(c) 80 competitors who took part in this Saturday's event are selected at random.

Use a suitable approximation to find the probability that more than 50 of these competitors had times less than 36.0 minutes. [5]