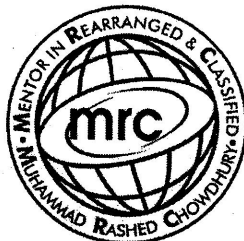


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Probability & Statistics 1

TOPIC- Discrete random variables

Discrete random variables

- 1 For n values of the variable x , it is given that $\Sigma(x - 100) = 216$ and $\Sigma x = 2416$. Find the value of n . [3]



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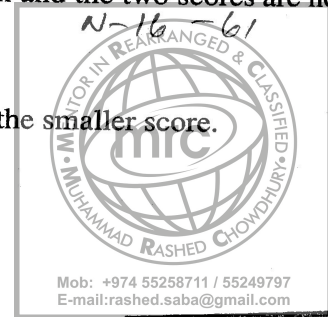


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Discrete random variables

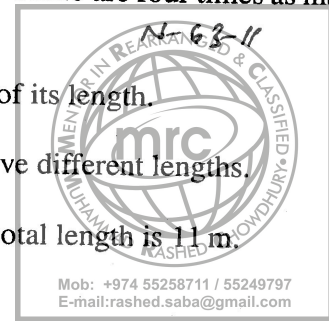
- 2 Two fair six-sided dice with faces numbered 1, 2, 3, 4, 5, 6 are thrown and the two scores are noted. The difference between the two scores is defined as follows.
- If the scores are equal the difference is zero.
 - If the scores are not equal the difference is the larger score minus the smaller score.

Find the expectation of the difference between the two scores.



Discrete random variables

- 3 A factory makes a large number of ropes with lengths either 3 m or 5 m. There are four times as many ropes of length 3 m as there are ropes of length 5 m.
- (i) One rope is chosen at random. Find the expectation and variance of its length. [4]
- (ii) Two ropes are chosen at random. Find the probability that they have different lengths. [2]
- (iii) Three ropes are chosen at random. Find the probability that their total length is 11 m. [3]



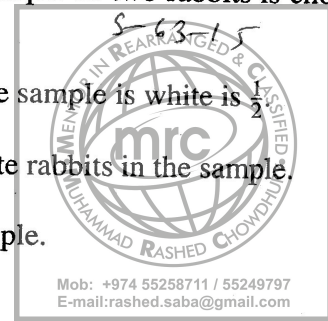
P
B
E



Discrete random variables

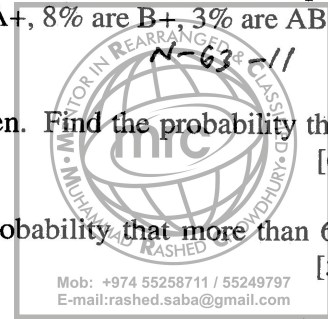
4 A pet shop has 9 rabbits for sale, 6 of which are white. A random sample of two rabbits is chosen without replacement.

- (i) Show that the probability that exactly one of the two rabbits in the sample is white is $\frac{1}{2}$ [2] P
- (ii) Construct the probability distribution table for the number of white rabbits in the sample. [3] E
- (iii) Find the expected value of the number of white rabbits in the sample. [1]



Discrete random variables

- 6 Human blood groups are identified by two parts. The first part is A, B, AB or O and the second part (the Rhesus part) is + or -. In the UK, 35% of the population are group A+, 8% are B+, 3% are AB+, 37% are O+, 7% are A-, 2% are B-, 1% are AB- and 7% are O-.
- (i) A random sample of 9 people in the UK who are Rhesus + is taken. Find the probability that fewer than 3 are group O+. [6]
- (ii) A random sample of 150 people in the UK is taken. Find the probability that more than 60 people are group A+. [5]



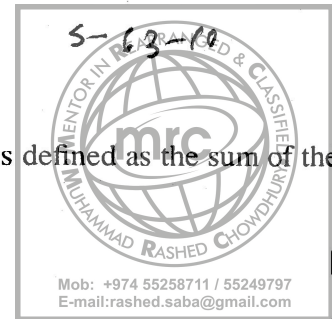
Discrete random variables

5 Set A consists of the ten digits 0, 0, 0, 0, 0, 0, 2, 2, 2, 4.

Set B consists of the seven digits 0, 0, 0, 0, 2, 2, 2.

One digit is chosen at random from each set. The random variable X is defined as the sum of these two digits.

- (i) Show that $P(X = 2) = \frac{3}{7}$. [2]
- (ii) Tabulate the probability distribution of X . [2]
- (iii) Find $E(X)$ and $\text{Var}(X)$. [3]
- (iv) Given that $X = 2$, find the probability that the digit chosen from set A was 2. [2]



Discrete random variables

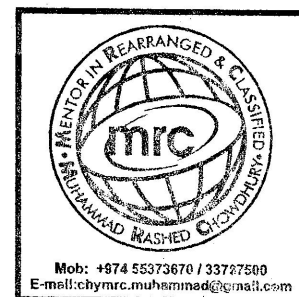
- 7 Judy and Steve play a game using five cards numbered 3, 4, 5, 8, 9. Judy chooses a card at random, looks at the number on it and replaces the card. Then Steve chooses a card at random, looks at the number on it and replaces the card. If their two numbers are equal the score is 0. Otherwise, the smaller number is subtracted from the larger number to give the score.

- (i) Show that the probability that the score is 6 is 0.08.
(ii) Draw up a probability distribution table for the score.
(iii) Calculate the mean score.



If the score is 0 they play again. If the score is 4 or more Judy wins. Otherwise Steve wins. They continue playing until one of the players wins.

- (iv) Find the probability that Judy wins with the second choice of cards. [3]
(v) Find an expression for the probability that Judy wins with the n th choice of cards. [2]



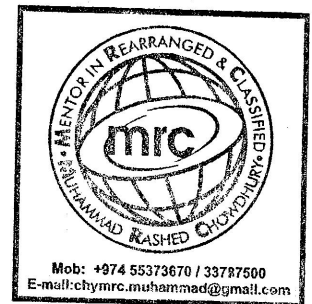
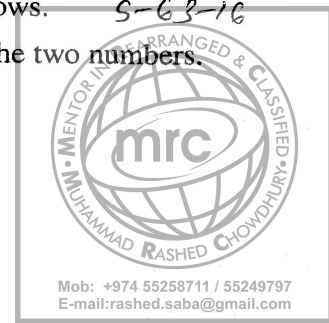
Discrete random variables

3 Two ordinary fair dice are thrown. The resulting score is found as follows.

- If the two dice show different numbers, the score is the smaller of the two numbers.
- If the two dice show equal numbers, the score is 0.

(i) Draw up the probability distribution table for the score.

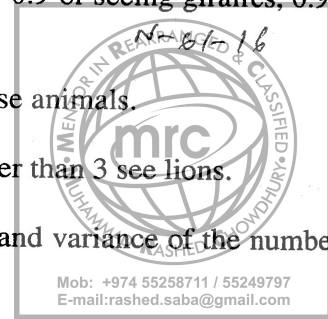
(ii) Calculate the expected score.



Discrete random variables

3 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]



Discrete random variables

- 1 The ages, x years, of 150 cars are summarised by $\Sigma x = 645$ and $\Sigma x^2 = 8287.5$. Find $\Sigma(x - \bar{x})^2$, where \bar{x} denotes the mean of x . [4]



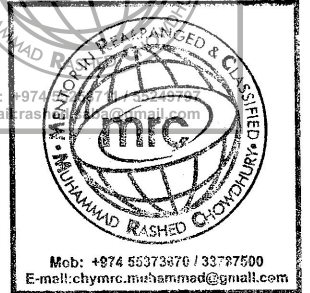
Discrete random variables

- 1 The time taken, t hours, to deliver letters on a particular route each day is measured on 250 working days. The mean time taken is 2.8 hours. Given that $\Sigma(t - 2.5)^2 = 96.1$, find the standard deviation of the times taken. [3]

sd



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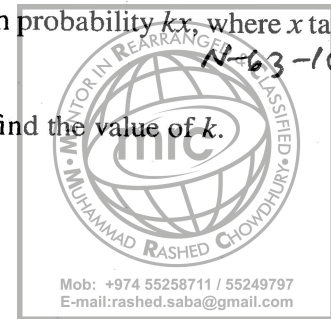


Discrete random variables

2 In a probability distribution the random variable X takes the value x with probability kx , where x takes values 1, 2, 3, 4, 5 only.

(i) Draw up a probability distribution table for X , in terms of k , and find the value of k . [3]

(ii) Find $E(X)$. [2]



Discrete random variables

- 3 The random variable X is the length of time in minutes that Jannon takes to mend a bicycle puncture. X has a normal distribution with mean μ and variance σ^2 . It is given that $P(X > 30.0) = 0.1480$ and $P(X > 20.9) = 0.6228$. Find μ and σ .

[5] M



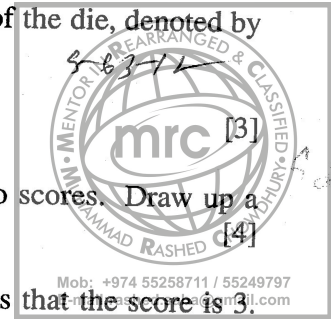
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Discrete random variables

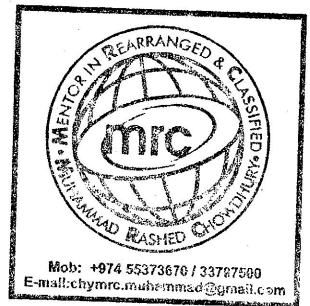
4 The six faces of a fair die are numbered 1, 1, 1, 2, 3, 3. The score for a throw of the die, denoted by the random variable W , is the number on the top face after the die has landed.

- (i) Find the mean and standard deviation of W . [3]
- (ii) The die is thrown twice and the random variable X is the sum of the two scores. Draw up a probability distribution table for X . [4]
- (iii) The die is thrown n times. The random variable Y is the number of times that the score is 3. Given that $E(Y) = 8$, find $\text{Var}(Y)$. [3]



Discrete random variables

- 6 A small farm has 5 ducks and 2 geese. Four of these birds are to be chosen at random. The random variable X represents the number of geese chosen.
- (i) Draw up the probability distribution of X . [3]
- (ii) Show that $E(X) = \frac{8}{7}$ and calculate $\text{Var}(X)$. [3]
- (iii) When the farmer's dog is let loose, it chases either the ducks with probability $\frac{3}{5}$ or the geese with probability $\frac{2}{5}$. If the dog chases the ducks there is a probability of $\frac{1}{10}$ that they will attack the dog. If the dog chases the geese there is a probability of $\frac{3}{4}$ that they will attack the dog. Given that the dog is not attacked, find the probability that it was chasing the geese. [4]



Discrete random variables

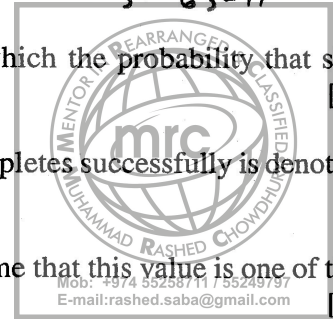
6 The probability that Sue completes a Sudoku puzzle correctly is 0.75.

- (i) Sue attempts n Sudoku puzzles. Find the least value of n for which the probability that she completes all n puzzles correctly is less than 0.06. [3]

Sue attempts 14 Sudoku puzzles every month. The number that she completes successfully is denoted by X .

- (ii) Find the value of X that has the highest probability. You may assume that this value is one of the two values closest to the mean of X . [3]
- (iii) Find the probability that in exactly 3 of the next 5 months Sue completes more than 11 Sudoku puzzles correctly. [5]

S-63-11



P

E

B



Discrete random variables

- 6 The lengths, in cm, of trout in a fish farm are normally distributed. 96% of the lengths are less than 34.1 cm and 70% of the lengths are more than 26.7 cm.

(i) Find the mean and the standard deviation of the lengths of the trout.

[5]

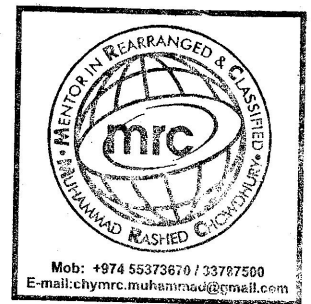
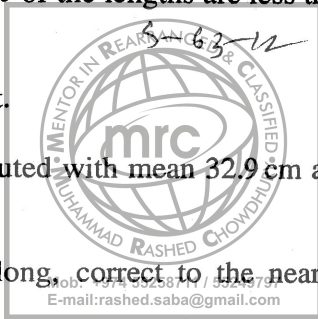
In another fish farm, the lengths of salmon, X cm, are normally distributed with mean 32.9 cm and standard deviation 2.4 cm.

(ii) Find the probability that a randomly chosen salmon is 34 cm long, correct to the nearest centimetre.

[3]

(iii) Find the value of t such that $P(31.8 < X < t) = 0.5$.

[4]



Probability

6 Deeti has 3 red pens and 1 blue pen in her left pocket and 3 red pens and 1 blue pen in her right pocket. 'Operation T ' consists of Deeti taking one pen at random from her left pocket and placing it in her right pocket, then taking one pen at random from her right pocket and placing it in her left pocket. P

(i) Find the probability that, when Deeti carries out operation T , she takes a blue pen from her left pocket and then a blue pen from her right pocket. [2]

The random variable X is the number of blue pens in Deeti's left pocket after carrying out operation T .

(ii) Find $P(X = 1)$. [3]

(iii) Given that the pen taken from Deeti's right pocket is blue, find the probability that the pen taken from Deeti's left pocket is blue. [4]

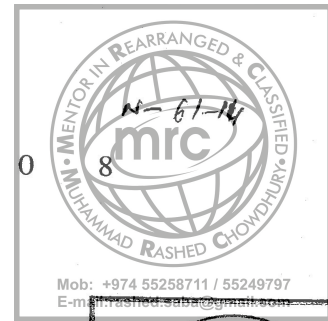


Discrete random variables

2

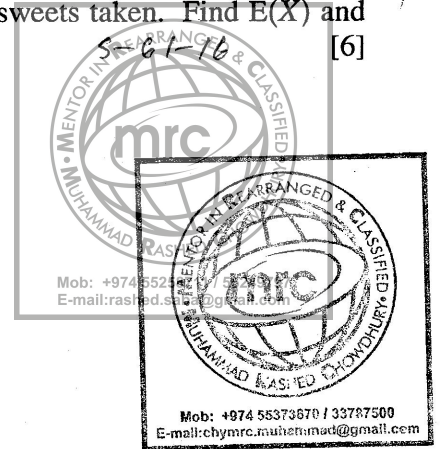
1 Find the mean and variance of the following data.

5 -2 12 7 -3 2 -6 4



Probability

- 4 A box contains 2 green sweets and 5 blue sweets. Two sweets are taken at random from the box, without replacement. The random variable X is the number of green sweets taken. Find $E(X)$ and $\text{Var}(X)$. [6]

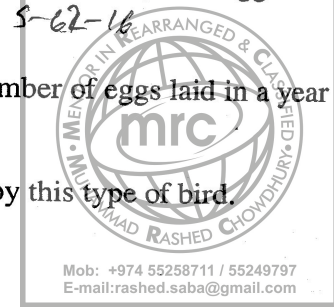


Discrete random variables

3 A particular type of bird lays 1, 2, 3 or 4 eggs in a nest each year. The probability of x eggs is equal to kx , where k is a constant.

(i) Draw up a probability distribution table, in terms of k , for the number of eggs laid in a year and find the value of k . [3]

(ii) Find the mean and variance of the number of eggs laid in a year by this type of bird. [3]

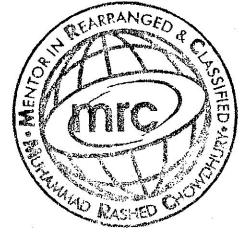


Discrete random variables

- 3 The possible values of the random variable X are the 8 integers in the set $\{-2, -1, 0, 1, 2, 3, 4, 5\}$. The probability of X being 0 is $\frac{1}{10}$. The probabilities for all the other values of X are equal. Calculate
- (i) $P(X < 2)$,
 - (ii) the variance of X ,
 - (iii) the value of a for which $P(-a \leq X \leq 2a) = \frac{17}{35}$.



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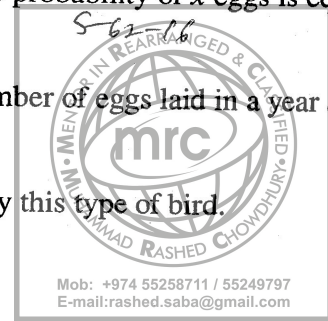


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Discrete random variables

3 A particular type of bird lays 1, 2, 3 or 4 eggs in a nest each year. The probability of x eggs is equal to kx , where k is a constant.

- (i) Draw up a probability distribution table, in terms of k , for the number of eggs laid in a year and find the value of k . [3]
- (ii) Find the mean and variance of the number of eggs laid in a year by this type of bird. [3]



Discrete random variables

- 4 A box contains 2 green sweets and 5 blue sweets. Two sweets are taken at random from the box, without replacement. The random variable X is the number of green sweets taken. Find $E(X)$ and $\text{Var}(X)$. [6]



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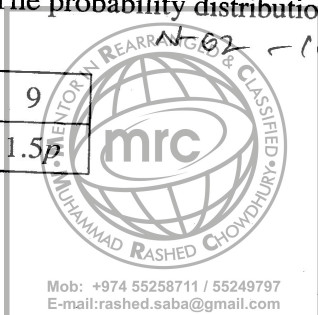
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Discrete random variables

- 1 The discrete random variable X takes the values 1, 4, 5, 7 and 9 only. The probability distribution of X is shown in the table.

x	1	4	5	7	9
$P(X = x)$	$4p$	$5p^2$	$1.5p$	$2.5p$	$1.5p$

Find p .



[3]



Discrete random variables

- 1 The probability distribution of the discrete random variable X is shown in the table below.

x	-3	-1	0	4
$P(X = x)$	a	b	0.15	0.4

Given that $E(X) = 0.75$, find the values of a and b .



[4]

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Discrete random variables

- 7 Sanket plays a game using a biased die which is twice as likely to land on an even number as on an odd number. The probabilities for the three even numbers are all equal and the probabilities for the three odd numbers are all equal.

(i) Find the probability of throwing an odd number with this die. [2]

Sanket throws the die once and calculates his score by the following method.

- If the number thrown is 3 or less he multiplies the number thrown by 3 and adds 1.
- If the number thrown is more than 3 he multiplies the number thrown by 2 and subtracts 4.

The random variable X is Sanket's score.

(ii) Show that $P(X = 8) = \frac{2}{9}$. [2]

The table shows the probability distribution of X .

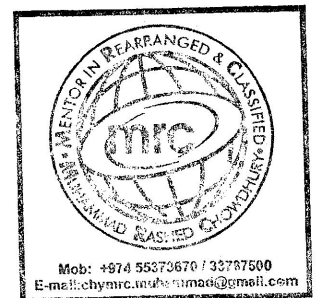
x	4	6	7	8	10
$P(X = x)$	$\frac{3}{9}$	$\frac{1}{9}$	$\frac{2}{9}$	$\frac{2}{9}$	$\frac{1}{9}$

(iii) Given that $E(X) = \frac{58}{9}$, find $\text{Var}(X)$. [2]

Sanket throws the die twice.

(iv) Find the probability that the total of the scores on the two throws is 16. [2]

(v) Given that the total of the scores on the two throws is 16, find the probability that the score on the first throw was 6. [3]



Discrete random variables

6 A fair spinner A has edges numbered 1, 2, 3, 3. A fair spinner B has edges numbered $-3, -2, -1, 1$. Each spinner is spun. The number on the edge that the spinner comes to rest on is noted. Let X be the sum of the numbers for the two spinners.

(i) Copy and complete the table showing the possible values of X .

		Spinner A			
		1	2	3	3
Spinner B	-3	-2			
	-2			1	
	-1				
	1				



[1]

(ii) Draw up a table showing the probability distribution of X .

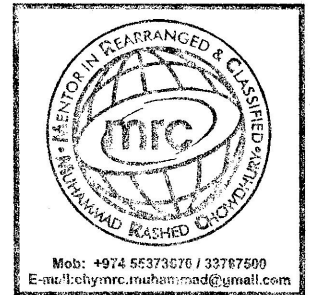
[3]

(iii) Find $\text{Var}(X)$.

[3]

(iv) Find the probability that X is even, given that X is positive.

[2]

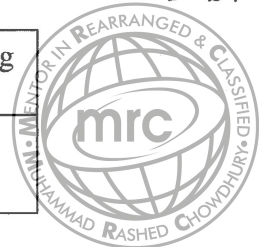


Discrete random variables

- 4 The numbers of rides taken by two students, Fei and Graeme, at a fairground are shown in the following table.

	Roller coaster	Water slide	Revolving drum
Fei	4	2	0
Graeme	1	3	6

- (i) The mean cost of Fei's rides is \$2.50 and the standard deviation of the costs of Fei's rides is \$0. Explain how you can tell that the roller coaster and the water slide each cost \$2.50 per ride. [2]
- (ii) The mean cost of Graeme's rides is \$3.76. Find the standard deviation of the costs of Graeme's rides. [5]



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Probability

- 2 The discrete random variable X has the following probability distribution.

x	-3	0	2	4
$P(X = x)$	p	q	r	0.4

Given that $E(X) = 2.3$ and $\text{Var}(X) = 3.01$, find the values of p , q and r .



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[6]



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