**GREENWOOD COLLEGE**

**Mathematics Methods Unit 3**

**Test 4 Discrete Random Variables**

**Non Calculator Section**

Name Mark /18

**All electronic devices must be switched off and in bags.  
Access to Formulae Sheet allowed. No notes.  
No calculators allowed in this section. Time limit 20 minutes.**

1. **[3 Marks: 1,1,1]**

Determine if each of are probability distribution functions. Justify your answer either way

a)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | -3 | -5 | -7 | 4 |
|  | 0.4 | 0.2 | 0.1 | 0.2 |

b)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | 0 | 1 | 2 | 3 |
|  | 0.5 | 0.3 | 0.2 | 0.1 |

c)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | 0 | 1 | 2 | 3 |
|  | 0.2 | -0.1 | 0.7 | 0.2 |

1. [4 Marks]

Suppose has a probability distribution:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | 1 | 2 | 3 | 4 |
|  |  |  |  |  |

Given , find

1. [Marks 6: 1, 3, 1, 1]

Let if greater than 4 is rolled on a fair die and otherwise. Let sum of X for 3 trials of X.

1. State the type of probability distribution function for X. Justify.

b) State the probability distribution for .

b) Find

c) Find

1. [5 Marks: 1, 3, 1]

Two dice have the numbers 1,2,3,1,1,3 on the sides of the dice. Let be the sum of the numbers rolled on the dice.

Find:

1. the most likely value for
2. the mean value for

**GREENWOOD COLLEGE**

**Mathematics Methods Unit 3**

**Test 4 Discrete Random Variables**

**Calculator Section**

Name Mark /35

**All electronic devices must be switched off and in bags.  
Access to Formulae Sheet and one sheet of A4 notes allowed.   
Use of approved calculators is assumed in this section. Time limit 35 minutes.**

1. [Marks 10: 3, 1, 3, 3]

It is known that the probability of finding a defective calculator in a large batch of calculators is 0.03. The calculators are sold in boxes of 10.

1. Find the expected number of defective calculators in any given box and its associated standard deviation
2. Find the probability of exactly 1 defective calculator
3. Given a box had at no more than two defective calculators, find the probability of at least one defective calculator
4. 50 schools are each sent a box of calculators, find the probability of no more than 5 schools receiving a defective calculator.
5. [Marks 3: 2,1]

The discrete random variable X has the following probability distribution.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | 1 | 2 | 3 | 4 | 5 |
|  | 0.1 | 0.15 | 0.4 | 0.15 | 0.2 |

1. Determine the Expected value of and the standard deviation of (2dp)
2. Determine
3. [4 Marks, 2,2]

The Mathematics Methods exam in 2016 had a mean of 60 and a standard deviation of 8. The Mathematics exam in 2017 had a mean of 65 and a standard deviation of 12. Byrnie completed the 2016 and scored 63 on then repeated year 12 in 2017 test and scored 67.

1. Find the standard scores for Byrnie for both years
2. Using the standard scores justify whether repeating significantly improved Byrnie’s result.
3. [2 Marks: 1,1]

Given that find the largest value of n which

1. b)
2. [7 Marks: 3,1,1,2]

It is known that 65% of people are likely to get sick from the flu. A sample of 20 people are selected from the Greenwood population.

Let : Number of people in Greenwood that get the flu in 2019

i) Show that must be a binomial variable. State the parameters of this variable.

ii) Find the probability that at least 14 people in Greenwood became sick from the flu.

iii) Find the probability that no more than 18 people became sick if it was known that at least 14 became sick from the flu.

iv) Find the most likely number of people that became sick.

1. **[2 Marks]**

Show working. Is this discrete probability distribution a Binomial Distribution?

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| x | 0 | 1 | 2 | 3 |
| P(X=x) | 0.216 | 0.4310 | 0.2890 | 0.064 |

1. **[2 Marks]**

Daniel has been offered a sales position at a car yard. His weekly pay will comprise two components, a retainer of $300 and a commission of $500 for each new car sold. The following table shows the probability of his selling specific numbers of cars each week.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| X | 0 | 1 | 2 | 3 | 4 |
| P(X=x) | 0.3 | 0.4 | 0.25 | 0.04 | 0.01 |

Calculate Daniel’s expected weekly pay.

1. **[5 Marks: 3,2]**
2. A discrete random variable X where X = 2,3,4,5,6 has a uniform distribution.
   1. Sketch the distribution
   2. Find the probability distribution, expected value and variance for X.
3. A discrete random variable Y where Y=1,2,3,4,5 has a uniform distribution. Sketch the distribution and compare X&Y using the graphs, probability distribution, expected value and variance of each.

**General discrete random variables**

3.3.1 ***develop the concepts of a discrete random variable and its associated probability function, and their use in modelling data***

3.3.2 use relative frequencies obtained from data to obtain point estimates of probabilities associated with a discrete random variable

3.3.3 ***identify uniform discrete random variables and use them to model random phenomena with equally likely outcomes***

3.3.4 examine simple examples of non-uniform discrete random variables

3.3.5 identify the mean or expected value of a discrete random variable as a measurement of centre, and evaluate it in simple cases

3.3.6 identify the variance and standard deviation of a discrete random variable as measures of spread, and evaluate them using technology

3.3.7 ***examine the effects of linear changes of scale and origin on the mean and the standard deviation***

3.3.8 ***use discrete random variables and associated probabilities to solve practical problems***

**Bernoulli distributions**

3.3.9 ***use a Bernoulli random variable as a model for two-outcome situations***

3.3.10 ***identify contexts suitable for modelling by Bernoulli random variables***

3.3.11 ***determine the mean and variance of the Bernoulli distribution with parameter***

3.3.12 ***use Bernoulli random variables and associated probabilities to model data and solve practical problems***

**Binomial distributions**

3.3.13 ***examine the concept of Bernoulli trials and the concept of a binomial random variable as the number of ‘successes’ in independent Bernoulli trials, with the same probability of success in each trial***

3.3.14 ***identify contexts suitable for modelling by binomial random variables***

3.3.15 ***determine and use the probabilities associated with the binomial distribution with parameters and ; note the mean and variance of a binomial distribution***

3.3.16 ***use binomial distributions and associated probabilities to solve practical problems***