# 4.1 concept\_reliablity\_and\_Sampling techniques\_P\_2

**1a.** *[1 mark]*

The marks achieved by eight students in a class test are given in the following list.



Find the mean.

**1b.** *[1 mark]*

Find the standard deviation.

**1c.** *[1 mark]*

The teacher increases all the marks by 2. Write down the new value for

the mean.

**1d.** *[1 mark]*

the standard deviation.

**1e.** *[3 marks]*

A ninth student also takes the test.

Explain why the median is unchanged.

**2a.** *[2 marks]*

Willow finds that she receives approximately 70 emails per working day.

She decides to model the number of emails received per working day using the random variable , where  follows a Poisson distribution with mean 70.

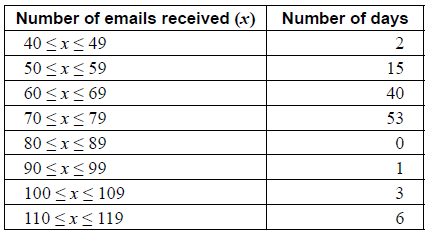
Using this distribution model, find .

**2b.** *[2 marks]*

Using this distribution model, find the standard deviation of .

**2c.** *[3 marks]*

In order to test her model, Willow records the number of emails she receives per working day over a period of 6 months. The results are shown in the following table.



From the table, calculate

an estimate for the mean number of emails received per working day.

**2d.** *[2 marks]*

an estimate for the standard deviation of the number of emails received per working day.

**2e.** *[1 mark]*

Give one piece of evidence that suggests Willow’s Poisson distribution model is not a good fit.

**2f.** *[3 marks]*

Archie works for a different company and knows that he receives emails according to a Poisson distribution, with a mean of  emails per day.

Suppose that the probability of Archie receiving more than 10 emails in total on any one day is 0.99. Find the value of *λ*.

**2g.** *[5 marks]*

Now suppose that Archie received exactly 20 emails in total in a consecutive two day period. Show that the probability that he received exactly 10 of them on the first day is independent of *λ*.

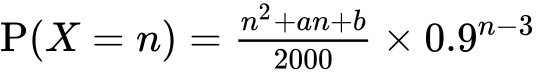
**3a.** *[3 marks]*

A Chocolate Shop advertises free gifts to customers that collect three vouchers. The vouchers are placed at random into 10% of all chocolate bars sold at this shop. Kati buys some of these bars and she opens them one at a time to see if they contain a voucher. Let  be the probability that Kati obtains her third voucher on the  bar opened.

(It is assumed that the probability that a chocolate bar contains a voucher stays at 10% throughout the question.)

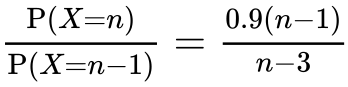
Show that  and .

**3b.** *[5 marks]*

It is given that  for .

Find the values of the constants  and .

**3c.** *[4 marks]*

Deduce that  for .

**3d.** *[5 marks]*

(i)     Hence show that  has two modes  and .

(ii)     State the values of  and .

**3e.** *[3 marks]*

Kati’s mother goes to the shop and buys  chocolate bars. She takes the bars home for Kati to open.

Determine the minimum value of  such that the probability Kati receives at least one free gift is greater than 0.5.

**4a.** *[2 marks]*

Six balls numbered 1, 2, 2, 3, 3, 3 are placed in a bag. Balls are taken one at a time from the bag at random and the number noted. Throughout the question a ball is always replaced before the next ball is taken.

A single ball is taken from the bag. Let  denote the value shown on the ball.

Find .

**4b.** *[3 marks]*

Three balls are taken from the bag. Find the probability that

the total of the three numbers is 5;

**4c.** *[3 marks]*

the median of the three numbers is 1.

**4d.** *[3 marks]*

Ten balls are taken from the bag. Find the probability that less than four of the balls are numbered 2.

**4e.** *[3 marks]*

Find the least number of balls that must be taken from the bag for the probability of taking out at least one ball numbered 2 to be greater than 0.95.

**4f.** *[8 marks]*

Another bag also contains balls numbered 1 , 2 or 3.

Eight balls are to be taken from this bag at random. It is calculated that the expected number of balls numbered 1 is 4.8 , and the variance of the number of balls numbered 2 is 1.5.

Find the least possible number of balls numbered 3 in this bag.

**5a.** *[3 marks]*

The data of the goals scored by players in a football club during a season are given in the following table.



Given that the mean number of goals scored per player is  , find the value of .

**5b.** *[3 marks]*

It is discovered that there is a mistake in the data and that the top scorer, who scored 22 goals, has not been included in the table.

(i)     Find the correct mean number of goals scored per player.

(ii)     Find the correct standard deviation of the number of goals scored per player.

**6.** *[6 marks]*

Consider the data set  and .

The mean of the data set is  and its variance is .

Find the value of  and the value of .

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