

Statistics 12 – Binomial Distribution (2)

Please **complete** this homework by _____. Start it early. If you can't do a question you will then have time to ask your teacher for help or go to a drop in session.

Section 1 – Review of previous topics. Please complete all questions.

1. A teacher recorded the time, to the nearest minute, spent reading on a particular day by each child in a group. The times were summarised in a grouped frequency distribution and represented by a histogram. The first group was 10-19 and its frequency was 8 children. On the histogram the height of the rectangle representing the class was 2.4 cm and the width was 2 cm. The total area under the histogram was 53.4 cm². Find the number of children in the group.
2. The number of errors, x , on each of 200 pages of typescript were recorded. The results when summarised showed that:

$$\sum x = 920 \quad \sum x^2 = 5032$$

Calculate the mean and standard deviation of the number of errors per page.

3. For the grouped frequency distribution shown which gives the speed of service of the top 50 men's professional tennis players, estimate the following;
 - (a) the median,
 - (b) the lower quartile,
 - (c) the third decile.

Service speed (m.p.h.)	90-94	95-99	100-104	105-109	110-114	115-119	120-124	125-129
Frequency	2	7	9	14	9	4	3	2

Section 2 – Consolidation of this week's topic. Please complete all questions.

Use your calculator to answer the following questions

1. The random variable $X \sim B(10, 0.3)$ find:
 - a) $P(X \leq 3)$ **(1 mark)**
 - b) $P(X > 7)$ **(2 marks)**
 - c) $P(2 \leq X \leq 5)$ **(2 marks)**
 - d) $P(X = 3 \cup X = 8)$ **(2 marks)**
 - e) $P(X > 3 \cap X < 8)$ **(2 marks)**
2. Let p represent the probability of a biased coin landing on tails. The coin is flipped three times.
 - a) Find an expression for the probability of obtaining one tail **(2 marks)**
 - b) Find an expression for the probability of obtaining two tails **(2 marks)**
 - c) Given that the probability of obtaining one tail is twice as likely as getting two tails, find the value of p . **(2 marks)**

3. There are 12 students in a class. The independent probability that each of them has a blue pen during a lesson is 0.6. Find the probability that:
- a) Half of them have a blue pen **(2 marks)**
 - b) Three quarters of them have a blue pen **(1 marks)**
 - c) Between one half and three quarters (inclusive) have a blue pen **(2 marks)**
4. From studying the large data set from 1987 Abdul realises that the probability of the daily mean total cloud cover in Heathrow being at least 7 oktas is 0.2. Charles takes a sample of 15 days in Heathrow in 1987. Find the probability that:
- a) At least three of them are at least 7 oktas **(3 marks)**
 - b) There are at least 7 oktas between 6 and 14 (exclusive) days **(2 marks)**
 - c) Exactly 4 days have at least 7 oktas **(1 mark)**
5. According to the registers after the first 2 weeks of college, 65% of students have not missed a single lesson. Let X represent the number of students with perfect attendance. Assuming the binomial model is appropriate, for a class of ten students, find:
- a) The probability that less than 4 have perfect attendance **(2 marks)**
 - b) The probability that more than 7 have perfect attendance **(2 marks)**
 - c) $P(5 < X \leq 8)$ **(2 marks)**
 - d) The probability that at least 2 have missed at least one lesson **(2 marks)**
 - e) Explain why the binomial model may not be appropriate **(2 marks)**
6. In a survey it was found that 70% of farm animals were infected with a bacteria. In a random sample of 20 animals, calculate the probability that
- (a) More than 15 are infected **(2 marks)**
 - (b) Fewer than 10 are infected **(2 marks)**

(Total 40 Marks)

Section 3 – Extension questions. If you are aiming for a top grade, you should attempt these questions.

A factory is considering two method, A and B, of checking the quality of production of the batches of items it produces.

Method A consists of taking a random sample of 10 items from a large batch and accepting the batch if there are no defectives and rejecting the batch if there are two or more defectives. If there is one defective in the sample, another random sample of 10 items is taken from the batch. The batch is accepted if there are no defectives in this second sample and rejected otherwise.

Method B consists of taking a random sample of 20 items from a batch and accepting the batch if there is at most one defective in the sample. Otherwise the batch is rejected.

The factory knows that 1% of the items it produces are defective and wishes to use that method of checking the quality of production for which the probability of accepting the batch is larger. Decide whether the factory should use Method A or Method B.