GRIFFITH COLLEGE DUBLIN

Assignment Cover Sheet

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Lecturer Name:	**Paddy Fahy**		
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Please note: *Students* ***MUST*** *retain a hard / soft copy of* ***ALL*** *assignments as well as a receipt issued and signed by a member of Faculty as proof of submission.*

Question 1

(a) In relation to random numbers, what precisely is meant by the term random?

Answer:

Random numbers are numbers that occur in a sequence such that two conditions are met: (1) the values are uniformly distributed over a defined interval or set, and (2) it is impossible to predict future values based on past or present ones. Random numbers are important in statistical analysis and probability theory.

(b) Outline a method of selecting three random numbers in the range 1 to 6.
Answer:

```
Random rand = new Random();
int ran = rand.nextInt(6) + 1;
```

Question 2

Library methods such as Java's Math.random(), return a pseudo-random number rather than a truly random number. Explain clearly why this is the case.

Answer:

Methods such as Math.random() returns a pseudo-number rather than a truly random number because computer uses an algorithm utilising a seed, or input. However, there is an algorithm there and as the computer is a deterministic device, if we know the seed and the algorithm we can predict these numbers.

Truly random numbers are can only be created by natural phenomena such as radioactive decay, cosmic microwave background radiation, or atmospheric noise which is impossible for computers to generate. Hence, the library methods such as Javs's Math.random() returns pseudo-random number.

Question 3

Show how to calculate the number of ways that a team of 3 people can be selected from a group of 10?

Answer:

N = 10   r = 3

Since, the order doesn't matter we use combination.

= n! / r!*(n-r)!
= 10! / 3! * (10 – 3)!
=10! / 3! * 7!
=120

Question 4

(a) Is a computer password a combination or a permutation? Explain.

Answer:

A computer password must be entered in a specific order. If order matters then it is a permutation and if order doesn't matters then it's combination. Here, in our case it's a computer password so it is a combination.

(a) If in a certain country, car registrations consist of 3 letters followed by four numbers, how many registrations are possible?

Answer:

There are 26 choices for first letter. For each of these letters there are 26 choices. Therefore, we have 26 * 26 * 26 = 17576. (Note that a repeat letter such as DD is allowed so we do not use 26P3.

There are 10 possibilities for the first number, 10 for the second and so on. That means there are 10 * 10 * 10 * 10 = 10000.

Combining these results we can have,

17576 * 10000

= 175760000

Question 5

(a) Internet Protocol Version 4 (IPV4) addresses consist of 32 bits. The addresses can be thought of in their more human readable form as composed of 4 8-bit numbers. How many unique addresses (including zeros) are possible with IPV4?

Answer:

(b) Internet Protocol Version 6 proposes network addresses consisting of 128 bits. How many unique IP addresses are possible with IPV6?

Question 6

A company introduces a computer password system for a local area network which enforces the use of passwords consisting of 8 alphanumeric. More precisely, passwords must consist of 5 lower case letters and 3 digits in any order without repetition. How many different passwords are possible using this system?

Answer:

Condition 8 Alphanumeric Password where we need 5 L.C followed by 3 digits

For 5 lowercase letters
= 26 * 25 * 24 * 23 * 22 * 21
=165765600
(As repetition is not allowed the alphabet will decrease by one as one of them were used before.)

For 3 numbers
= 10 * 9 * 8
= 720
(As repetition is not allowed the number that we can choose for the second time will be reduced by 1)

Now, the total number of passwords possible from this
= 1.193 * 10 ^ 11

Question 7

Explain, with the help of one example in each case, what types of problems knowledge of the following data distributions is helpful in solving. In particular, explain the precise nature of the data in each case.

(a) Poisson Distribution
A statistical distribution showing the frequency probability of specific events when the average probability of a single occurrence is known. It is a discrete function. The Poisson distribution can be used to calculate the probabilities of various numbers of "successes" based on the mean number of successes.
In order to apply the Poisson distribution, the various events must be independent. Term "success" does not mean success in the traditional positive sense. It just means that the outcome in question occurs.
Suppose we know that the mean number of calls to a fire station on a weekday is 8. What is the probability that on a given weekday there will be 11 calls? This can be solved by using the following formula based on Poisson distribution.

$$p = \frac{e^{-\mu} \mu^x}{x!}$$

where,

e is the base of natural logarithms (2.7183)

μ is the mean number of "successes"

x is the number of "successes" in question

For this example,

$$p = \frac{e^{-8} 8^{11}}{11!} = 0.072.$$

(b) Binomial Distribution

The binomial distribution is a probability distribution that summarizes the likelihood that a value will take one of two independent values under a given set of parameters or assumptions.

A binomial distribution summarizes the number of trails, or observations, when each trial has the same probability of attaining one particular value. The binomial distribution determines the probability of observing a specified number of successful outcomes in a specified number of trials. The expected value, or mean, of a binomial distribution is calculated by multiplying the number of trials by the probability of successes. For example, the expected value of the number of heads in 100 trials is 50. If an event is repeated n times and the probability of success in an event is r then

P(r success from n events)

= nCr * p^r *(1-p) ^ n-r

Question 8

A minibus has 9 passenger seats. The probability of a seat being occupied is estimated to be 0.63. Calculate the probability that on a typical run:

<u>Answer:</u>

It is a binomial data. The formulae used is as follows:-

P(r success from n events)

= nCr * p^r * (1-p) ^ n-r

(a) there are no passengers;

p(0) = 9C0 * 0.63 ^ 0 * (1 – 0.63) ^ 9 – 0

$= 1 * 1 * (0.37) ^ 9$
$= 1.2996 * 10^{-4}$
$= 0.00012996$

(b) there is just 1 passenger;

$p(1) = 9C1 * 0.63 ^ 1 * (1-0.63) ^ 9 - 1$
$= 9 * 0.63 * (0.37) ^ 8$
$= 1.991 * 10^{-3}$
$= 0.001991$

(c) there are exactly 2 passengers;

$p(2) = 9C2 * 0.63 ^ 2 * (1-0.63) ^ 9 – 2$
$=36 * 0.3969 * (0.37) ^ 7$
$= 0.01356$

(d) there are at least 3 passengers.

$p (\geq 3)$ = Total probability – (p(0) + p(1) + (p2))
$= 1 – (0.00012996 + 0.001991 + 0.01356)$
$= 1 – (0.01568096)$
$= 0.984$

Question 9

Calls at a call centre are observed to arrive at a mean rate of two per minute. What is the probability of receiving three calls in a minute?

Answer:

It is a Poisson distribution. If an event happens λ time in a given time Poisson, then the probability of happening r time in a similar time period is given by

$P(r) = \lambda ^ r e - \lambda / r!$
$\lambda = 2 \quad r = 3$

$= 2 ^ 3 e ^ -2 / 3!$
$= 8 e^ -2 / 6$
$= 0.18$

Question 10

Observations at a certain large organisation show that on average, there is a server outage every 6 months. What is the probability of getting through a year without any server outage at all?

Answer:

It is a Binomial distribution because there are two condition i.e. there will or will not be server outage. Binomial distribution states that if an event is repeated n times and the probability of success in an event is r then
P(r success from n events)
= nCr * P^r *(1-P) ^(n-r)
According to the question there is server outage every 6 month then the probability of having server outage in every month is 1/6. Hence we have 12 months in a year the probability of having server outage every year is 1/6 + 1/6 = 1/3 i.e. 0.33. Now using the formula, we have
n = 2
r = 0(We need to go through the year without any outage)
= nCr * P^r *(1-P) ^(n-r)
= 2C0 * 0.33 ^ 0 (1 – 0.33) ^ 2 – 0
= 1 * 1 * (0.67)^ 2
= 1 * 0.45
= 0.45
Hence the probability of going through a year without server outage is 0.45