Society of Actuaries in Ireland

Probability Tutorial Questions 2021/2022

Question 1

[2016 Paper 2, Q5 (a)]

In an archery competition, the team consisting of John, David and Mike will win 1st prize if at least two of them hit the bullseye with their last arrows. From past experience, they know that the probability that John, David and Mike will hit the bullseye on their last arrow is 1/5, 1/6 and ¼ respectively.

i. Complete the table below to show all the ways in which they could win 1st prize.

	Way 1	Way 2	Way 3	Way 4
John	√			
David	√			
Mike	×			

Where

√=Hit

×=Miss

ii. Hence or otherwise find the probability that they will win the competition.

Question 2

[2020 Paper 2, Q5 a (i) (ii)]

(a) Two A and B are such that P (A) =3/4 and P(A ∩ B) = ½

(i) Find P(B|A). Give your answer as a fraction in its simplest form.

(ii) P(A U B) = 11/12. Investigate if the events A and B are independent.

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Question 3

[2020 Paper 2, 6(ii)]

The overall pass rate for all drivers at another centre is ½ (Whether it is their first attempt or a subsequent attempt).

On a particular day, n people take the test in this centre.

The probability that two people or less than two people pass the test can be written in the form.

$$(an^2 + bn + c) / 2^{n+1}$$

Where a, b, c, $\in$N.

Find the value of a, the value of b and the value of c.

Question 4

[2018, Paper 2, Q1] (25 marks)

In a competition Mary has a probability of 1/20 of winning, a probability of 1/10 of finishing in second place, and a probability of $1/4$ of finishing in third place. If she wins the competition she gets €9000. If she comes second she gets €7000 and if she comes third she gets €3000. In all other cases she gets nothing. Each participant in the competition must pay €2000 to enter.

(a) Find the expected value of Mary's loss if she enters the competition.

(b) Each of the 3 prizes in the competition above is increased by the same amount (€x) but the entry fee is unchanged. For example, if Mary wins the competition now, she would get €(9000 + x). Mary now expects to break even. Find the value of x.

Question 5

[2018, Paper 2, Q3] (25 marks)

(a) A security code consists of six digits chosen at random from the digits 0 to 9. The code may begin with zero and digits may be repeated. For example 0 7 1 7 3 7 is a valid code.

(i) Find how many of the possible codes will end with a zero.

(ii) Find how many of the possible codes will contain the digits 2 0 1 8 together and in this order.

(b) Find a, b, c and d if $\frac{(n+3)!(n+2)!}{(n+1)!(n+1)!} = an^3 + bn^2 + cn + d$, where a, b, c and d $\in \mathbb{N}$.

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Question 6

[2017, Paper 2, Q8 (b)]

In Galway, rain falls in the morning on 1/3 of the school days in the year.

When it is raining the probability of heavy traffic is ½.

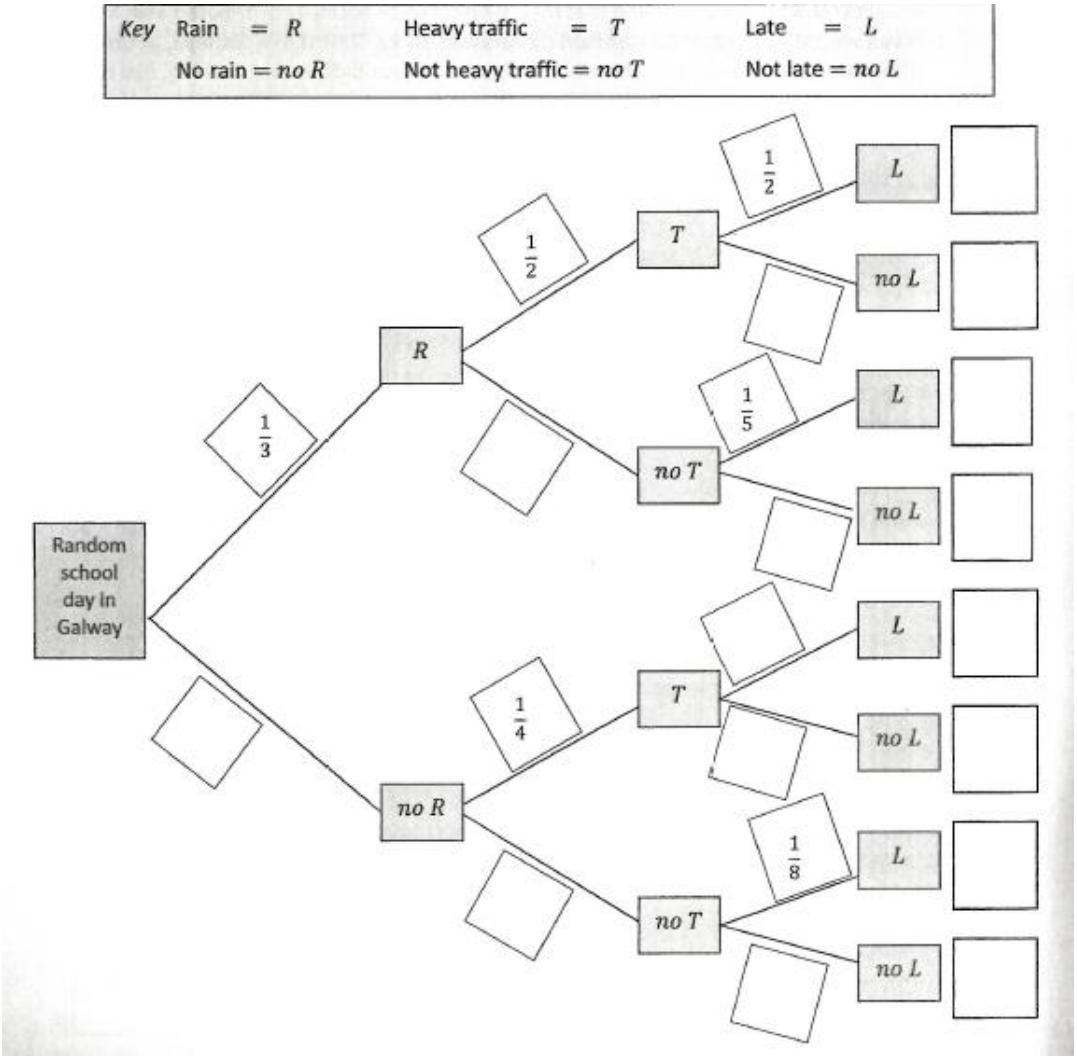
When it is not raining, the probability of heavy traffic is ¼.

When it is raining and there is heavy traffic, the probability of being late for school is ½.

When it is not raining and there is no heavy traffic, the probability of being late for school is 1/8.

In any other situation the probability of being late for school is 1/5.

Some of this information is shown in the tree diagram below.



i) Write the probability associated with each branch of the tree diagram **and** the probability of each outcome into the blank boxes provided.
Give each answer in the form of a/b, where a, b are natural numbers.

ii) On a random school day in Galway, find the probability of being late for school.

iii) On a random school day in Galway, find the probability that it rained in the morning, given you were late for school.

Question 7 2021 Paper 2 Q8

(a) In a school all First Years sat a common maths exam.
The results, in integer values, were normally distributed with a mean of 176 marks and a standard deviation of 36 marks.
The top 10% of students will go forward to a county maths competition.

(i) Find the minimum mark needed on the exam to progress to the county stage.

(ii) The school awarded a Certificate of Merit to any student who achieved between 165 marks and 210 marks.
Find the percentage of First Years who received the Certificate of Merit

(b) A news report claimed that 6th year students in Ireland studied an average of 21 hours per week, outside of class time. A Leaving Cert class surveyed 60 students in 6th year, chosen at random, from different schools. It found that the average study time was 19·8 hours and the standard deviation was 5·2 hours.

(i) Find the test statistic (the z-score) of this sample mean.

(ii) Find the p-value of this test statistic. Comment on what can be concluded from its value, in a two-tailed hypothesis test at the 5% level of significance, in relation to the news report claim.

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Question 8

2021 Paper 2 Q10 a (i) (ii) (iii)

People with O-negative blood type are called "universal donors" because their blood can be given to anyone else. In Ireland approximately 8% of the population have O-negative blood type (source: Blood Transfusion Service).

(a)

(i) At a blood donation clinic, ten donors give blood, one after the other. Find the probability that the tenth person is the third O-negative donor. Give your answer correct to four decimal places.

(ii) At a blood donation clinic, five donors give blood. What is the probability that at least one of the five donates O-negative blood? Give your answer correct to four decimal places.

(iii) Find the minimum number of blood donors required, so that the probability that at least one of them is type O-negative is greater than 0·97.

Question 9

2019 Paper 2 Q8 a (i) (ii) (iii)

(a) A motoring magazine collected data on cars on a particular stretch of road. Certain details on 800 cars were recorded.

(i) The ages of the 800 cars were recorded. 174 of them were new (less than 1 year old). Find the 95% confidence interval for the proportion of new cars on this road. Give your answer correct to 4 significant figures.

(ii) The data on the speeds of these 800 vehicles is normally distributed with an average speed of 87·3 km per hour and a standard deviation of 12 km per hour. What proportion of cars on this stretch of road would you expect to find travelling at over 95 km per hour?

(iii) The driver of a car was told that 70% of all the speeds recorded were higher than his speed. Find the speed at which this driver was recorded. Give your answer correct to the nearest whole number.

