

Additional Assessment Materials

Summer 2021

Pearson Edexcel GCE in Mathematics

9FM0\_3B (Public release version)

Resource Set 1: Topic 2

Poisson and Binomial

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Additional Assessment Materials, Summer 2021

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**General guidance to Additional Assessment Materials for use in 2021**

**Context**

* Additional Assessment Materials are being produced for GCSE, AS and A levels (with the exception of Art and Design).
* The Additional Assessment Materials presented in this booklet are an optional part of the range of evidence teachers may use when deciding on a candidate’s grade.
* 2021 Additional Assessment Materials have been drawn from previous examination materials, namely past papers.
* Additional Assessment Materials have come from past papers both published (those materials available publicly) and unpublished (those currently under padlock to our centres) presented in a different format to allow teachers to adapt them for use with candidate.

**Purpose**

* The purpose of this resource to provide qualification-specific sets/groups of questions covering the knowledge, skills and understanding relevant to this Pearson qualification.
* This document should be used in conjunction with the mapping guidance which will map content and/or skills covered within each set of questions.
* These materials are only intended to support the summer 2021 series.

1. The random variable *X* has probability distribution *X* ~ B (120, 0.1).

Show that use of the Poisson approximation to estimate P (*X* < 10) gives an error of 0.0138 to 3 significant figures.

**(Total for Question 1 is 4 marks)**

1. Indre works on reception in an office and deals with all the telephone calls that arrive.

Calls arrive randomly and, in a 4-hour morning shift, there are on average 80 calls.

1. Using a suitable model, find the probability of more than 4 calls arriving in a particular 20-minute period one morning.

**(3)**

Indre is allowed 20 minutes of break time during each 4-hour morning shift, which she

can take in 5-minute periods. When she takes a break, a machine records details of any

call in the office that Indre has missed.

One morning Indre took her break time in 4 periods of 5 minutes each.

(*b*)Find the probability that in exactly 3 of these periods there were no calls.

**(2)**

On another occasion Indre took 1 break of 5 minutes and 1 break of 15 minutes.

(*c*)Find the probability that Indre missed exactly 1 call in each of these 2 breaks.

**(3)**

**(Total for Question 2 is 8 marks)**

1. Jack and Gill have an argument about which one of them is best at bringing back buckets of water from the well at the top of the hill. Jack claims that he can successfully bring back more buckets of water from the well in one hour than Gill can.

Jack consistently makes 3 journeys to the well and back each hour and the journeys are independent of each other. On each journey the probability that he is unsuccessful in bringing back a bucket of water is 0.4, because he falls over and loses the water.

The number of successful journeys that Gill can make in one hour, *Y*, is modelled by a Poisson distribution with mean 2.1.

The number of successful journeys that Jack makes is independent of the number of successful journeys that Gill makes.

Showing your working, calculate the probability that in one hour,

(*a*) Jack and Gill each successfully bring back 3 buckets of water from the well,

**(3)**

(*b*) Jack successfully brings back more buckets of water from the well than Gill.

**(4)**

(*c*) Explain why the Poisson distribution may not be a reasonable model for the number of successful journeys that Gill can make in one hour.

**(1)**

**(Total for Question 3 is 8 marks)**

1. The discrete random variables *W*, *X* and *Y* are distributed as follows

*W* ~ B(10, 0.4) *X* ~ Po(4) *Y* ~ Po(3)

*(a*) Explain whether or not Po(4) would be a good approximation to B(10, 0.4)

**(1)**

(*b*) State the assumption required for *X* + *Y* to be distributed as Po(7)

**(1)**

Given the assumption in part (b) holds,

(*c*) find P(*X* + *Y* < Var(*W*))

**(2)**

**(Total for Question 4 is 4 marks)**

1. At a seaside town, one tourist attraction is a whale watching boat trip. The owner claims that on afternoon trips, which each have a duration of four hours, there have been an average of 2.4 whale sightings per trip.

A rival business doubts this claim and sends some employees to monitor whale sightings on 60 afternoon trips. The results are shown in the table below.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Number of sightings** | 0 | 1 | 2 | 3 | 4 | 5 | 6 or more |
| **Number of trips** | 4 | 18 | 20 | 8 | 6 | 3 | 1 |

The number of whale sightings per trip is modelled by a Poisson distribution.

(*a*) Test the owner’s claim at the 10% significance level. Show your working, including the expected frequencies, the test statistic and the critical value, and state your hypotheses clearly.

**(9)**

During one of the trips the only sighting was a single group of 8 whales.

(*b*) With reference to the model, state giving a reason, how this sighting should have been recorded.

**(2)**

**(Total for Question 5 is 11 marks)**

1. Tim and Sue are each typing a manuscript and they make errors at random.

On average, Tim makes 0.45 errors per page and Sue makes 0.2 errors per page.

A random sample of *n* pages of Tim’s typing is taken. The probability that these *n* pages

contain no errors is less than 0.05

(a) Find the smallest possible value of *n*.

**(3)**

The random variable *X* represents the total number of errors in a random sample of

5 pages of Tim’s typing and 5 pages of Sue’s typing.

(b) Find P(*X* = 2), stating a necessary assumption.

**(3)**

Random samples, each consisting of 5 pages of Tim’s typing and 5 pages of Sue’s typing,

are selected.

(c) Find the probability that in 10 of these samples there are at least 2 with no errors.

**(4)**

**(Total for Question 6 is 10 marks)**