**GCE A level Further Mathematics (9FM0) – Shadow Paper (Set 1)**

**9FM0-3B AL Further Statistics 1**

**October 2021 Shadow Paper mark scheme**

**Please note that this mark scheme is not the one used by examiners for making scripts. It is intended more as a guide, indicating where marks are given for correct answers. As such, it may not show follow-through marks (marks that are awarded despite errors being made) or special cases.**

**It should also be noted that for many questions, there may be alternative methods of finding correct solutions that are not shown here – they will be covered in the formal mark scheme from the original paper.**

**This document is intended for guidance only and may differ significantly from the examiners’ final mark scheme for the original paper which was published in December 2021.**

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| **Guidance on the use of codes within this document** |
| M1 – method mark. This mark is generally given for an appropriate method in the context of the question. This mark is given for showing your working and may be awarded even if working is incorrect.  A1 – accuracy mark. This mark is generally given for a correct answer following correct working.  B1 – working mark. This mark is usually given when working and the answer cannot easily be separated.  Some questions require all working to be shown; in such questions, no marks will be given for an answer with no working (even if it is a correct answer). |

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| **Question** | **Scheme** | **Marks** | **AOs** |
| **1(a)** | = 55 | B1 | 3.4 |
|  |  | (1) |  |
| **(b)** | since the only constraint is that the totals agree | B1 | 2.4 |
|  | (1) |  |
| **(c)** | H0: The die is unbiased | B1 | 2.1 |
| H1: The die is biased |
| Test Statistic = | M1 | 1.1b |
| = 6.4651…. | A1 | 1.1b |
|  | B1 | 1.1b |
| Not in the critical region since 7.815 > “6.465…” therefore insufficient evidence to reject H0  Inconclusive test - consistent with the **die** being unbiased. | A1 | 3.5a |
|  | (5) |  |
| **(7 marks)** | | | |

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| **Question** | **Scheme** | **Marks** | **AOs** |
| **2(a)** | *F* ~ Poisson (4.8) | M1 | 3.3 |
| *awrt 0.857* | A1cso | 1.1b |
|  | (2) |  |
| **(b)** | *A* ~ B(7, “0.857”) | M1 | 3.3 |
| … | A1 | 1.1b |
|  | (2) |  |
| **(c)** |  | B1 | 1.1b |
| *E* ~ B(120, “0.0147..”)  mean = 120[= 1.764] | M1 | 3.3 |
| *E* ~ Po(“1.764…”)  P = | M1 | 3.4 |
| = 0.103 | A1cso | 2.1 |
|  | (4) |  |
| **(d)** | The number of periods is large and the probability of getting 10 faults is small | B1  (1) | 2.4 |
| **(e)** | H0: H1: | B1 | 2.5 |
|  | (1) |  |
| **(f)** |  | B1 | 3.3 |
|  | M1 | 1.1b |
| = 0.08687… | A1 | 1.1b |
| 0.087… > 0.025 or no evidence to reject H0  There is insufficient evidence at the 5% level of significance that the number of **faults produced** is different on a Saturday | A1  (4) | 2.2b |
| **(14 marks)** | | | |

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| **Question** | **Scheme** | **Marks** | **AOs** |
| **3** | oe | M1 | 3.1a |
|  | A1 | 1.1b |
|  | dM1 | 3.4 |
|  | A1 | 1.1b |
|  | (4) |  |
| **(4 marks)** | | | |

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| **Question** | **Scheme** | **Marks** | **AOs** |
| **4(a)** | 2E(*N*) + 5 =9.6 or E(*N*) = 2.3 | M1 | 3.1a |
| *a+* | M1 | 1.1b |
| so | M1 | 3.1a |
| and |  |  |
|  | M1 | 1.1b |
|  | dM1 | 1.1b |
| = 2.71 | A1\* | 2.1 |
|  | (6) |  |
| **(b)** | |  |  |  |  |  |  |  | | --- | --- | --- | --- | --- | --- | --- | | Winnings | 0.10 | 0.10 | 0.10 | 0.20 | 0.20 | 0.20 | | P(*N* = *n*) | *a* | 0.2 | 0.05 | 0.25 | *b* | *c* | | M1 | 3.3 |
|  | M1 | 1.1b |
| = £0.135 | A1 | 1.1b |
|  | (3) |  |
| **(c)** | Poisson distribution will assign substantial probability to *N* > 5 | B1 | 3.5b |
|  |  | (1) |  |
| **(10 marks)** | | | |

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| **Question** | **Scheme** | **Marks** | **AOs** |
| **5(a)** | P( at least 3 green) = | M1 | 1.1b |
| = 0.88473.. awrt 0.885 | A1 | 1.1b |
|  | (2) |  |
| **(b)** | P( 2nd yellow on 10th draw) = | M1 | 3.3 |
| = 0.00104 | A1 | 1.1b |
|  | (2) |  |
| **(c)** | and | M1  A1 | 3.1b1.1b |
| oe | M1 | 1.1b |
|  | A1 | 1.1b |
|  | (4) |  |
| **(d)** | H0: *p* = 0.04 H1: *p* < 0.04 | B1 | 2.5 |
| *J* ~ Geo(0.04) | M1 | 3.3 |
|  | M1 | 3.4 |
|  | M1 | 1.1b |
|  | A1 | 1.1b |
|  | (5) |  |
| **(e)** | 24 is not in the Critical region | M1 | 1.1b |
| There is no evidence to suggest that bag C contains a smaller proportion of yellow counters than bag A | A1 | 2.2b |
|  | (2) |  |
| **(f)** | Power of test = | M1 | 2.1 |
|  | = oe | M1 | 1.1b |
|  | = 0.3797…. | A1\* | 1.1b |
|  |  | (3) |  |
| **(18 marks)** | | | |

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| **Question** | **Scheme** | **Marks** | **AOs** |
| **6(a)** | G*X*(1) = 1 | M1 | 2.1 |
|  | A1\*cso(2) | 1.1b |
| **(b)** | P is coefficient of *t*2 so G*X* (*t*) = | M1 | 1.1b |
|  | A1  (2) | 1.1b |
| **(c)** |  | M1  A1 | 3.1a |
|
| **(d)** |  | M1 | 3.1a |
|  | A1  (2) | 1.1b |
| **(e)** |  | M1 | 2.1 |
|  | A1ft | 1.1b |
|  | M1 | 2.1 |
|  | A1 | 1.1b |
|  | M1 | 2.1 |
|  | A1  (6) | 1.1b |

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| **Question** | **Scheme** | **Marks** | **AOs** |
| **7(a)** | Size of the test = 0.01 | B1 | 1.2 |
|  | (1) |  |
| **(b)(i)** | Let CR be |  |  |
|  | M1 | 3.4 |
| *k* = | A1 | 1.1b |
|  | M1d  A1ft | 3.4  1.1b |
|  | oe | M1d | 1.1b |
| *n* = 9 | A1cso | 2.1 |
|  | (6) |  |
| **(ii)** | The probability of a Type II error would decrease. | B1 | 2.2a |
|  | (1) |  |
| **(8 marks)** | | | |