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| **NAME:** | **TEACHER:** |

**Level 2 Mathematics and Statistics**

**2012**

|  |
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| **91267 Apply probability methods in solving problems** |

# Credits: Four

**You should answer ALL parts of ALL the questions in this booklet.**

You should show ALL your working for ALL questions.

The questions in this booklet are NOT in order of difficulty.

If you need more space for any answer, use the page(s) provided at the back of this booklet and clearly number the question.

**YOU MUST HAND THIS BOOKLET TO YOUR TEACHER AT THE**

**END OF THE EXAMINATION.**

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| **For Assessor’s use only Achievement Criteria** | | |
| **Achievement** | Achievement **with Merit** | **Achievement**  **with Excellence** |
| Apply probability methods in solving problems. | Apply probability methods, using relational thinking, in solving problems. | Apply probability methods, using extended abstract thinking, in solving problems. |
| Overall Level of Performance | | |

You are advised to spend 60 minutes answering the questions in this booklet.

Assessor’s

use only

**QUESTION ONE**

FOOD4ALL are packing packets of frozen peas.

The weights of the packets of frozen peas are normally distributed with mean weight of 1.1 kg

and standard deviation of 0.1 kg. The questions below in (a) and (b) all relate to this model.

(a) (i) What is the probability a packet of frozen peas weighs between 1.1 and 1.25 kg?

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(ii) What percentage of bags of frozen peas weigh more than 1.32 kg?

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(iii) In one batch of 8000 packets of frozen peas how many of them weigh less than 1 kg?

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(iv) What weight are 5% of the packets of frozen peas less than? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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(v) What is the interquartile range of weights of packets of frozen peas?

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(b) FOOD4ALL are concerned about the number of customers purchasing packets of frozen

peas that are under the stated weight on the packet of 1 kg.

Assessor’s

use only

(i) The company can reset the mean of their packaging machine for the frozen peas.

They wish to do this so that only 1% of the packets of frozen peas are under the stated

weight of 1 kg. How does the mean setting on the machine have to be changed to

achieve this. Note: Assume that the standard deviation setting remains at 0.1 kg.

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(ii) The company could alternatively change the standard deviation on their packaging

machine for the frozen peas. If the mean is fixed at 1.1 kg what would be the value

of the new standard deviation so that 1% of packets of frozen peas are under the

stated weight of 1 kg?

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(iii) Assuming either of the resets could be done by FOOD4ALL and there was no

Assessor’s

use only

significant difference in cost between them which of the two options in (i) and (ii)

above would you recommend that the company adopt to have 1% of the packets

of frozen pea packets under the stated weight of 1 kg.

You should back up your comments with statistical reasons.

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**QUESTION TWO**

(a) People with dandruff are treated with shampoo GONE or a hair wash OFF.

Assessor’s

use only

Their hair condition was observed after a week as to whether their dandruff condition had

improved or had not improved.

The table below show the results of the different treatments.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Dandruff  improved | Dandruff  didn’t improve | **TOTALS** |
| Used GONE | 254 | 126 | **380** |
| Used OFF | 183 | 105 | **288** |
| **TOTALS** |  |  | **668** |

(a) (i) What proportion of people treated either with GONE or OFF had their dandruff

condition improved?

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(ii) What proportion of people treated with GONE had no improvement in their

dandruff condition?

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(iii) What percentage of people who did not have their dandruff condition improve had

been treated with GONE?

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(iv) In a study with 2000 school students using GONE how many would you expect to

have their dandruff condition improve?

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(v) If you had dandruff which of the products GONE or OFF would you use on the

Assessor’s

use only

basis of the study above?

Give full statistical reasons in your answer, together with any relevant calculations.

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(b) In the study with 668 people above there were 94 males taking part and 64 had their

dandruff situation improved. Twenty five males were treated with OFF and the same number

with OFF as with GONE had not improved after treatment.

|  |  |  |  |
| --- | --- | --- | --- |
|  | Males whose dandruff improved | Males whose dandruff didn’t improve | **TOTALS** |
| Used GONE |  |  |  |
| Used OFF |  |  |  |
| **TOTALS** |  |  | **94** |

(i) Find the probability that a male whose dandruff had improved had been using GONE?

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(ii) A company spokesman for GONE stated that, for a male using GONE compared to

a male using OFF, the relative risk of being cured is 2.

Give statistical reasons, supported by statistics, for the claim.

Assessor’s

use only

You should comment further on the accuracy of the claim.

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(c) One study involving GONE and OFF was done using 2000 secondary school students .

A researcher stated that this was from a normally distributed population.

State, with reasons, why/why not the ages of the students at secondary school would come

from a normal distribution.

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**QUESTION THREE**

Assessor’s

use only

The score in a table tennis game between Zoe and Barry is 21 - 20 to Zoe.

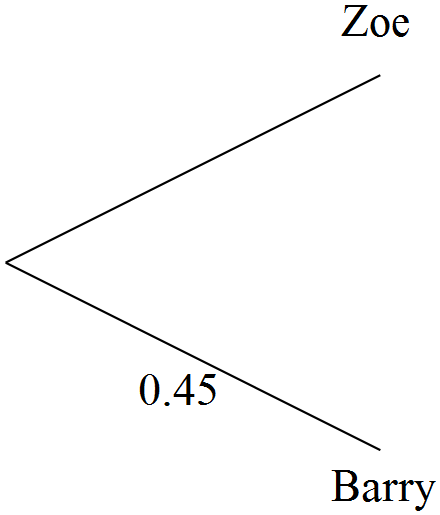
To win a game a player must get to 21 points AND must win by at least two points.

In this game they must keep playing until one of them is two points ahead.

The probability of Barry winning a point is 0.45 each time a point is played.

Whenever a point is played either Zoe of Barry wins the point.

Some of this information is shown on the diagram below.



(a) What is the probability that the game was won on the next point played?

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(b) What is the probability that Barry won the game in the next two points played?

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(c) What is the probability that Barry won the game in the next three points played?

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(d) If the game was won in any of the next three points played what was the probability that

Assessor’s

use only

it was won by Barry?

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(e) Given that Zoe won the game in any of the next three points played, what was the probability

that she won on the first point played?

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(f) What is the probability that the game was not won in any of the next three points played?

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(g) Write down an expression to calculate the probability of Zoe winning the next game 21 – 0.

Assessor’s

use only

Do not evaluate your answer.

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| **Extra paper for continuing your answers, if required.**  Assessor’s  use only  **Clearly number the question(s).** |

**Question**

**Number**

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**ASSESSMENT SCHEDULE**

#### **91267 Apply probability methods in solving problems**

|  |  |  |
| --- | --- | --- |
| **Achievement** | **Achievement with Merit** | **Achievement with Excellence** |
| *Apply probability methods in solving problems* involves*:*  • selecting and using methods  • demonstrating knowledge of  probability concepts and terms  • communicating using appropriate  representations.  . | *Apply probability methods, using relational thinking, in solving problems* involves one or more of:  • selecting and carrying out a logical  sequence of steps  • connecting different concepts or  representations  • demonstrating understanding of  concepts;  and also relating findings to a context, or  communicating thinking using appropriate mathematical statements. | *Apply probability methods, using extended abstract thinking, in solving problems* involves one or more of:  • devising a strategy to investigate or solve  a problem  • identifying relevant concepts in context  • developing a chain of logical reasoning  • making a statistical generalisation;  and also, where appropriate, using contextual knowledge to reflect on the answer. |

Sufficiency for each question:

N0: no relevant evidence

N1: Attempt at one question

N2: 1 **u**

A3: 2 **u** OR A3: 1 **r +** 1 **u**

A4: 3 **u** OR A4: 1 **r +** 2 **u**

M5: 2 **r**

M6: 3 **r**

E7: 1 **t**

E8: 2 **t**

**Judgement Statement**

NOTE: This is an estimate as no examinations have yet been held.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Not Achieved** | **Achievement** | **Achievement with Merit** | **Achievement with Excellence** |
| **Score range** | 0 - 8 | 9 - 13 | 14 - 18 | 19 -24 |

| Question One | Evidence | Achievement (u) | Merit (r) | Excellence (t) |
| --- | --- | --- | --- | --- |
|  |  | **Apply probability methods in solving problems.** | *Apply probability methods, using relational thinking, in solving problems.* | *Apply probability methods, using extended abstract thinking, in solving problems.* |
| 1a(i) | 0 < *z* < 1.5  Probability = 0.43319 | Correct probability calculated. |  |  |
| 1a(ii) | *z* > 2.2  Probability = 0.013903  1.39 percent | Correct probability calculated and answer written as percentage. |  |  |
| 1a(iii) | *z* < - 1  Probability = 0.15865  Expected number 1269 (or 1270) | Correct probability calculated. | Expected number calculated. |  |
| 1a(iv) | *z* = - 1.645  0.93551 kg | Correct weight calculated. |  |  |
| 1a(v) | 25% either side of mean  ie *z* =  Between 1.0325 kg and 1.1 674 kg  ie IQR = 0.1349 kg | Inverse normal value of z found. | Limits of weights found. | Correct IQR specified. |
| 1b(ii) | For 1% when mean is 1.1 *x* = 0.86736  So have to increase mean to **1.23264 kg**  (the difference between 1 and 0.86736)  OR  *z* = - 2.326 and use | Found the *x* value for 1% less than. | New mean with insufficient explanation /  justification. | Complete statement (new mean OR increase old mean by 0.1326 kg) completely and correctly justified. |
| 1b(iii) | New Std dev = 0.042925 | Progress shown in finding new SD. | SD calculated. |  |
| 1b(iii) | Second choice of changing the SD.  First choice has mean packet weight of 1.23264 kg and the second choice has a mean packet weight of 1.1 kg.  Thus the first choice would result in an increase in mean of 0.13264 kg per packet or 12 % more peas being used – not a good option for the company. | Statement with incomplete justification. | Complete statement completely and correctly justified. |  |

**NOTE:**

There will be differences between probability answers quoted if students use normal distribution tables rather than GC. Either should be accepted.

Values used here are all GC values

| Question TWO | Evidence | Achievement (u) | Merit (r) | Excellence (t) |
| --- | --- | --- | --- | --- |
|  |  | **Apply probability methods in solving problems.** | *Apply probability methods, using relational thinking, in solving problems.* | *Apply probability methods, using extended abstract thinking, in solving problems.* |
| 2a(i) | [  0.654] | Correct probability calculated. |  |  |
| 2a(ii) | [  0.332] | Correct probability calculated. |  |  |
| 2a(iii) | [  0.545] = 54.5% | Correct percentage calculated. |  |  |
| 2a(iv) | = 1336 (or 1337) | Correct probability calculated. | Expected number calculated. |  |
| 2a(v) | Using GONE:  0.668 have improved dandruff.  Using OFF :  0.635 have improved dandruff.  I would use GONE as the chance of improved dandruff is slightly greater.  OR  There is very little difference in the two results and it may depend on the price or aroma as to my choice. |  | Comparison made between GONE and OFF. | Correct conclusion AND supported by calculations. |
| 2b(i) | |  |  |  |  | | --- | --- | --- | --- | |  | **dandruff imp** | **dandruff**  **not imp** | **Tot** | | **GONE** | 54 | 15 | 69 | | **OFF** | 10 | 15 | 25 | | **Total** | 64 | 30 | 94 |   Prob required =  0.843 | Correct table or numbers calculated. | Correct probability calculated. |  |
| 2b(ii) | Prob (dandruff of a male’s dandruff improving using GONE) =  0.783  Prob (dandruff of a male’s dandruff improving using OFF) = 0.4    So relative risk of dandruff improving using GONE is 1.96 so company claim is close to being correct.  However sample using OFF was very small and may have been misleading and possibly changed a lot with a bigger sample. Perhaps further study with a larger trial should be undertaken before results used. | A correct probability calculated. | Both correct probabilities calculated. | Probabilities correctly compared and a justified statement made. |
| 2c | The distribution of secondary school students is NOT close to normal. It is closer to be a uniform distribution with very much the same numbers at year 9, 10 and 11 with a small decrease in year 12 and year 13.  No modal central value.  An approximate sketch graph would be useful. | Statement correct with some justification. | Statement correct with full justification. |  |

| Question Three | Evidence | Achievement (u) | Merit (r) | Excellence (t) |
| --- | --- | --- | --- | --- |
|  |  | **Apply probability methods in solving problems.** | *Apply probability methods, using relational thinking, in solving problems.* | *Apply probability methods, using extended abstract thinking, in solving problems.* |
| 3a | 0.55 | Correct probability calculated. |  |  |
| 3b | 0 | Correct probability calculated. |  |  |
| 3c |  | Correct probability calculated. |  |  |
| 3d | P (Zoe won in next 3 points)  =  = 0.686125  Reqd Prob =  = 0.117 | A correct probability calculated. | Correct probability for Zoe winning in next 3 points calculated. | Correct probability calculated. |
| 3e | P (Zoe won on first point) = .55    P (Zoe won on third point)  =  = 0.136125  Reqd prob =  = 0.802 | A correct probability calculated. | Total probability calculated for a faulty part. | Correct probability calculated. |
| 3f | P( BZB+ BBZ)  = +  = 0.22275 | A correct probability calculated. | Correct total probability calculated. |  |
| 3g |  |  | Correct probability written. |  |