D&D Resources Ltd
Mathematics Exam Preparation Made Easy

External Achievement Standard - 91585

Practice External Assessments 3

Probability

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NCEA 3 Statistics

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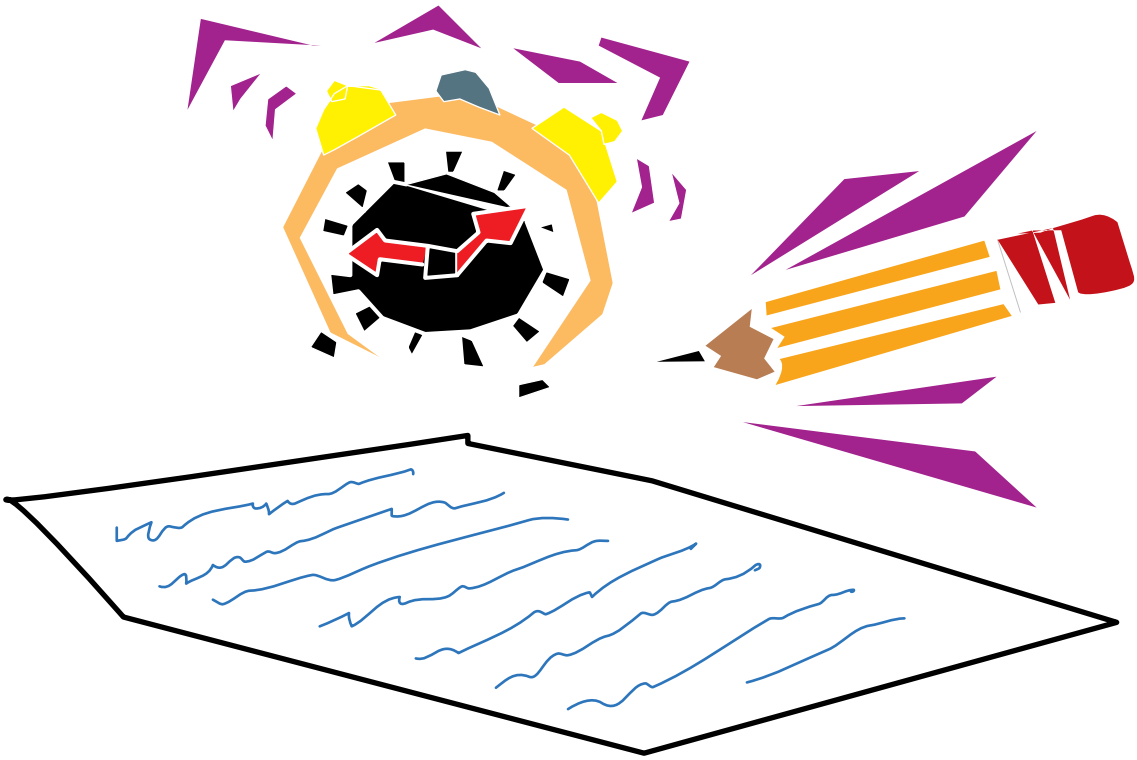


The questions in the practice assessments are NOT in order of difficulty. Attempt all questions or you may not provide enough evidence to achieve the required standard.

Achievement Standard

91585 **Apply Probability Concepts in Solving Problems**

Achievement	Achievement with Merit	Achievement with Excellence
• Apply probability concepts in solving problems.	• Apply probability concepts, using relational thinking, in solving problems.	• Apply probability concepts, using extended abstract thinking, in solving problems.

- This achievement standard is derived from Level 8 of The New Zealand Curriculum and is related to the achievement objectives
  - Investigate situations that involve elements of chance
    - calculating probabilities of independent, combined, and conditional events.
- Apply probability concepts in solving problems involves:
  - selecting and using methods
  - demonstrating knowledge of concepts and terms
  - communicating using appropriate representations.
- Relational thinking 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 statements.
- Extended abstract thinking 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 generalisation;

  and also, where appropriate, using contextual knowledge to reflect on the answer.
- Problems are situations that provide opportunities to apply knowledge or understanding of mathematical concepts and methods. Situations will be set in real-life or statistical contexts.
- Methods include a selection from those related to:
  - true probability versus model estimates versus experimental estimates
  - randomness
  - independence
  - mutually exclusive events
  - conditional probabilities
  - probability distribution tables and graphs
  - two way tables
  - probability trees
  - Venn diagrams.

91585 **PEA 1**

You are advised to spend 60 minutes answering this assessment.

You should show ALL working and answer ALL parts of ALL questions.

QUESTION ONE

(a) A mobile phone manufacturer at a tech convention approaches people and asks them to view and give feedback on their latest mobile phone model.

Of the 450 males approached, 380 gave feedback and of the 175 females approached, 52 gave feedback.

Suppose one of the people approached by the mobile phone company for feedback is selected at random.

(i) What is the probability that they gave feedback?

(ii) How many times more likely is it that a male gave feedback on the new phone model compared to that of a female?

Support your answer with appropriate statistical statements.

(iii) The mobile phone manufacturer claims that, in general males are more likely to give feedback than females.

Give TWO reasons why the mobile phone manufacturer should be careful about using this data to make such a claim.

Reason 1:

Reason 2:

(c) The game straight craps, often played at a casino, involves rolling two dice.

If you roll a total of 7 or 11 on the first roll you win.

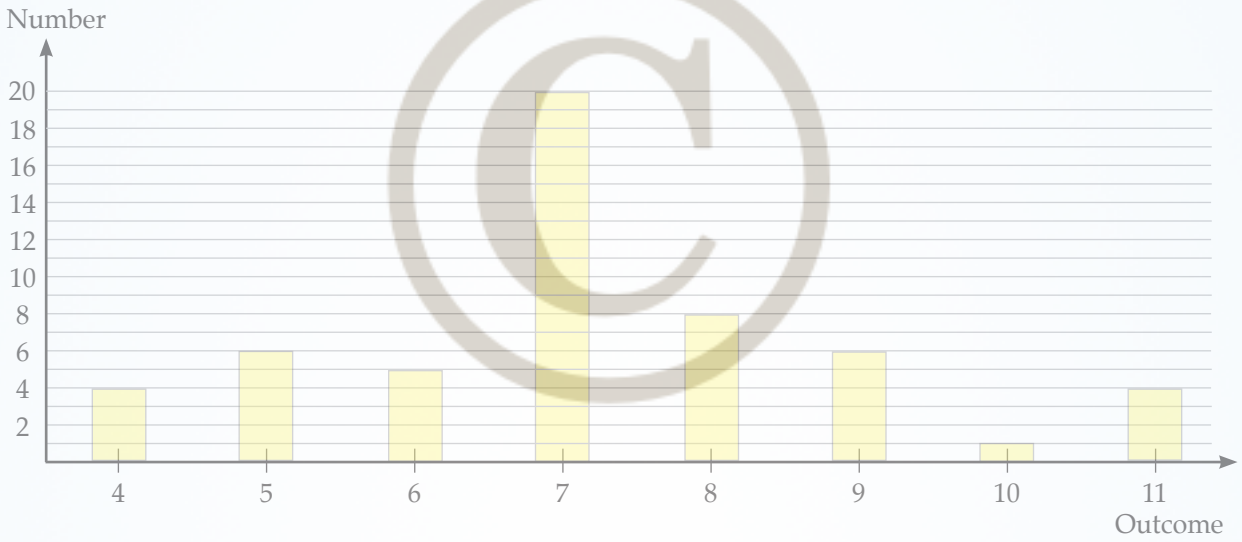
If you roll a total of 2, 3, or 12 on the first roll you lose.

If you roll a total of 4, 5, 6, 8, 9, 10 on your first roll this number becomes your 'point'.

You continue to roll the dice. If you get your 'point' total before a roll of 7 you win. If you roll a 7 before your 'point' total you lose.

In straight craps you win a dollar for each dollar you bet.

Simon recorded the number of times he won playing straight craps on a particular night when rolling a total of 4, 5, 6, 7, 8, 9, 10, 11 on his first throw (see the graph below). He played 100 games during the night.



(i) Use Simon's results on this particular night to estimate the probability of winning at straight craps on one roll of the dice? How does this result compare with the theoretical probability?

(ii) Using theoretical probability what is the probability of an individual in a random game rolling a 5 on the initial roll and then rolling another 5 before they roll a 7. Justify your answer.

QUESTION TWO

(a) USA breast cancer research shows that 30% of women biopsied for breast cancer actually have the disease and if fine needle aspiration cytology is used for testing, it results in a false positive rate of 3% and a false negative rate of 13%.

Study the partially completed table below of 100 000 women who were biopsied.

	Have breast cancer	Do not have breast cancer	TOTAL
Test result was positive			
Test results was negative	3900		
TOTAL	30 000	70 000	100 000

(i) Explain the terms 'false positive' and false negative' in the context of this question.

(ii) Complete the table and calculate the probability that a women with a negative result actually had breast cancer.

(iii) Comment on the reliability of the fine needle aspiration cytology biopsy test based on these results. Justify your answer.

(b) The company's 100 employees get a free heart check each year.
Their blood pressure is tested as well as whether they have an irregularity in their heartbeat.

The results of the screening show that:

- 18% of employees have high blood pressure
- 22% have low blood pressure
- 16% have an irregular heartbeat
- of those employees with an irregular heartbeat, one-quarter have high blood pressure
- of those employees with normal blood pressure, one-tenth have an irregular heartbeat.

(i) What is the probability that a random employee from the company has a regular heartbeat and low blood pressure?

(ii) Are the company employees, who do NOT have normal blood pressure more likely to have an irregularity in their heartbeat?

Support your answer with appropriate statistical statements.

(iii) After a blood test one of the employees indicates the presence of a blood disorder which appears in only 1% of the population. The test for the disease indicates a positive result for the disease 97% of the time when the person has the disease and 2% of the time when the disease is not present.

What is the probability that the employee actually has the blood disorder given the test is positive?

91585 **PEA 6**

You are advised to spend 60 minutes answering this assessment.

You should show ALL working and answer ALL parts of ALL questions.

QUESTION ONE

(a) The table below shows the number of motor vehicle crashes reported to the NZ Police over a three year period and their seriousness in terms of injury. (*Source: Ministry of Transport*)

	Year 1	Year 2	Year 3
Fatal	259	267	239
Serious injury	1717	1730	1653
Minor injury	7828	7607	7456
Non injury	22530	20735	20622
TOTAL	32334	30339	29970

(i) Which of the years, (Year 1, Year 2 or Year 3) had the lowest overall risk of a serious injury in a motor vehicle crash? Use appropriate calculations to justify your answer.

(ii) Give ONE reason why the risks you calculated in part (i) for the Years 1 to 3 are likely to be estimates only.

Answers – 91585 PEA 5

(b) (iii) cont...	P(has disease | positive result) $= \frac{0.01 \times 0.97}{(0.01 \times 0.97) + (0.99 \times 0.02)}$ $= \frac{0.0097}{(0.0097) + (0.0198)}$ $= 0.3288$	• one part of probability correctly calculated.	• two parts of probability correctly calculated.	• all parts correctly calculated and correct probability given.
THREE				
(a)	<table><tr><th></th><th>Bio</th><th>Chem</th><th>Phy</th><th>Total</th></tr><tr><td>Boys</td><td>8</td><td>26</td><td>34</td><td>68</td></tr><tr><td>Girls</td><td>15</td><td>9</td><td>23</td><td>47</td></tr><tr><td>Total</td><td>23</td><td>35</td><td>57</td><td>115</td></tr></table> P(Chemistry best | Boy) $= \frac{26}{68}$ (0.3824)	• tree, table or Venn diagram. Conditional probability found from incorrect tree, table or Venn diagram.	• tree, table or Venn diagram. Conditional probability correctly calculated.	
(b) (i)	P(4 or more children) $= \frac{30+20+8+5+2}{600} = \frac{65}{600}$ $= 0.1083$	• probability is correctly calculated (allow for slight variation in reading values from the graph).		
(b) (ii)	To have a family of five children must have four girls followed by a boy so P(GGGGB) $= \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} = \frac{1}{32}$	• correct probability with applicable explanation.		
(b) (iii)	Scenario (b), P(1 child, B) $= \frac{1}{2}$ P(2 children, GB) $= \frac{1}{4}$ P(3 children, GGB) $= \frac{1}{8}$ etc. So average number of children per family $= 1 \times \frac{1}{2} + 2 \times \frac{1}{4} + 3 \times \frac{1}{8} + 4 \times \frac{1}{16} + \ldots = 2$ Part iii), P(1 child) = 0, P(2 children, BG, GB) $= \frac{1}{2}$ P(3 children, BBG, GGB) $= \frac{1}{4}$ P(4 children), BBBG, GGGB) $= \frac{1}{8}$ etc. Average number of children per family = $1 \times 0 + 2 \times \frac{1}{2} + 3 \times \frac{1}{4} + 4 \times \frac{1}{8} + \ldots = 3$	• explanation of average number of children in (b) with correct value (2).	• some explanation of average number of children in part iii) with incorrect value.	• explanation of average number of children in part iii) with correct value (3).

Marking Schedule for Questions 1, 2 and 3

N1	N2	A3	A4	M5	M6	E7	E8
One partial solution	1 of A	2 of A	3 of A	1 of M	2 of M	1 of E	2 of E