2.7 Statistics: Probability Depth: 2-hour Pack

EDEXCEL 9MA0 · Calculator allowed · about 120 minutes

Total Marks

Name: _____ Date: ____ / ____ / _____

Answer ALL questions. Show all your working.

A-Level Statistics: Probability Depth Practice

Original material written for Revision Library, styled on Edexcel AS/A-level Mathematics (9MA0) Statistics content.

This pack extends core probability skills to full A-level depth: Venn diagrams and set notation for two and three events, tree diagrams for dependent and independent trials, conditional probability, testing and proving independence algebraically, and probability models involving an unknown to be found from a given equation, including quadratics arising from probability statements. All contexts and figures are original.

1 124 club members were asked which of three sports they prefer, and whether they are left-handed or right-handed. The results are:
Sport: Swimming, Tennis, Golf
Left-handed: 12, 30, 38
Right-handed: 25, 6, 13

(a) A member is chosen at random. Find the probability that the member prefers tennis. **(2)**

(b) Given that the member prefers tennis, find the probability that the member is left-handed. **(2)**

(c) Given that the member is left-handed, find the probability that the member prefers swimming. **(2)**

(Total for Question 1 is 6 marks)

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2 A bag contains 4 red counters and 6 blue counters. Two counters are taken at random from the bag, one after the other, without replacement.

(a) Draw a tree diagram, labelling each branch with its probability, and state the probability that both counters are red. **(4)**

(b) Find the probability that the two counters are the same colour. **(2)**

(c) Given that the two counters are different colours, find the probability that the first counter was red. **(2)**

(Total for Question 2 is 8 marks)

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3 The events A and B are independent, with P(A) = 1/3 and P(B) = 2/3.

(a) Find P(A and B) and P(A or B). **(4)**

(b) The independent events C and D satisfy P(D) = 2/3 and P(C or D) = 7/9. Find P(C). **(3)**

(c) Find P(A | B') and state what this shows about A and B. **(3)**

(Total for Question 3 is 10 marks)

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4 184 club members were asked which of three sports they prefer, and whether they are left-handed or right-handed. The results are:
Sport: Swimming, Tennis, Golf
Left-handed: 39, 33, 23
Right-handed: 40, 22, 27

(a) A member is chosen at random. Find the probability that the member prefers tennis. **(2)**

(b) Given that the member prefers tennis, find the probability that the member is left-handed. **(2)**

(c) Given that the member is left-handed, find the probability that the member prefers swimming. **(2)**

(Total for Question 4 is 6 marks)

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5 In a survey of 20 students, 9 study French (F) and 9 study Spanish (S). 3 students study both languages.

(a) Complete the Venn diagram by finding the number of students in each region (F only, S only, both, neither). **(3)**

(b) A student is chosen at random. Find the probability that the student studies at least one of the languages. **(2)**

(c) Given that a randomly chosen student studies Spanish, find the probability that the student also studies French. **(2)**

(d) Determine whether studying French and studying Spanish are statistically independent events. **(2)**

(Total for Question 5 is 9 marks)

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6 168 club members were asked which of three sports they prefer, and whether they are left-handed or right-handed. The results are:
Sport: Swimming, Tennis, Golf
Left-handed: 29, 20, 26
Right-handed: 36, 33, 24

(a) A member is chosen at random. Find the probability that the member prefers tennis. **(2)**

(b) Given that the member prefers tennis, find the probability that the member is left-handed. **(2)**

(c) Given that the member is left-handed, find the probability that the member prefers swimming. **(2)**

(Total for Question 6 is 6 marks)

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7 In a survey of 20 students, 8 study French (F) and 7 study Spanish (S). 3 students study both languages.

(a) Complete the Venn diagram by finding the number of students in each region (F only, S only, both, neither). **(3)**

(b) A student is chosen at random. Find the probability that the student studies at least one of the languages. **(2)**

(c) Given that a randomly chosen student studies Spanish, find the probability that the student also studies French. **(2)**

(d) Determine whether studying French and studying Spanish are statistically independent events. **(2)**

(Total for Question 7 is 9 marks)

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8 170 club members were asked which of three sports they prefer, and whether they are left-handed or right-handed. The results are:
Sport: Swimming, Tennis, Golf
Left-handed: 12, 37, 40
Right-handed: 38, 20, 23

(a) A member is chosen at random. Find the probability that the member prefers tennis. **(2)**

(b) Given that the member prefers tennis, find the probability that the member is left-handed. **(2)**

(c) Given that the member is left-handed, find the probability that the member prefers swimming. **(2)**

(Total for Question 8 is 6 marks)

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9 In a survey of 100 students, 8 study French (F) and 9 study Spanish (S). 3 students study both languages.

(a) Complete the Venn diagram by finding the number of students in each region (F only, S only, both, neither). **(3)**

(b) A student is chosen at random. Find the probability that the student studies at least one of the languages. **(2)**

(c) Given that a randomly chosen student studies Spanish, find the probability that the student also studies French. **(2)**

(d) Determine whether studying French and studying Spanish are statistically independent events. **(2)**

(Total for Question 9 is 9 marks)

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10 The events A and B are independent, with P(A) = 1/5 and P(B) = 2/3.

(a) Find P(A and B) and P(A or B). **(4)**

(b) The independent events C and D satisfy P(D) = 2/3 and P(C or D) = 11/15. Find P(C). **(3)**

(c) Find P(A | B') and state what this shows about A and B. **(3)**

(Total for Question 10 is 10 marks)

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11 The events A and B are independent, with P(A) = 2/5 and P(B) = 3/8.

(a) Find P(A and B) and P(A or B). **(4)**

(b) The independent events C and D satisfy P(D) = 3/8 and P(C or D) = 5/8. Find P(C). **(3)**

(c) Find P(A | B') and state what this shows about A and B. **(3)**

(Total for Question 11 is 10 marks)

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12 In a survey of 100 students, 47 study French (F) and 48 study Spanish (S). 19 students study both languages.

(a) Complete the Venn diagram by finding the number of students in each region (F only, S only, both, neither). **(3)**

(b) A student is chosen at random. Find the probability that the student studies at least one of the languages. **(2)**

(c) Given that a randomly chosen student studies Spanish, find the probability that the student also studies French. **(2)**

(d) Determine whether studying French and studying Spanish are statistically independent events. **(2)**

(Total for Question 12 is 9 marks)

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Mark scheme · 2.7 Statistics: Probability Depth: 2-hour Pack

Question 1

(a) tennis total = 30 + 6 **M1**

(a) 36/124 = 9/31 **A1**

(a) Answer: 9/31

(b) conditional probability: left-handed tennis players / all tennis players **M1**

(b) 30/36 = 5/6 **A1**

(b) Answer: 5/6

(c) left-handed swimmers / all left-handed members **M1**

(c) 12/80 = 3/20 **A1**

(c) Answer: 3/20

Question 2

(a) first branches 2/5 (red) and 3/5 (blue) **B1**

(a) second branches 1/3, 2/3 after red; 4/9, 5/9 after blue **B1**

(a) P(RR) = 2/5 x 1/3 **M1**

(a) 2/15 **A1**

(a) Answer: 2/15

(b) P(RR) + P(BB) **M1**

(b) 7/15 **A1**

(b) Answer: 7/15

(c) conditional probability: P(RB)/P(different) **M1**

(c) 1/2 **A1**

(c) Answer: 1/2

Question 3

(a) independent so P(A and B) = P(A) x P(B) **M1**

(a) 2/9 **A1**

(a) P(A or B) = P(A) + P(B) - P(A and B) **M1**

(a) 7/9 **A1**

(a) Answer: P(A and B) = 2/9, P(A or B) = 7/9

(b) forms p + 2/3 - 2/3p = 7/9 **M1**

(b) rearranges: p(1 - 2/3) = 1/9 **M1**

(b) P(C) = 1/3 **A1**

(b) Answer: P(C) = 1/3

(c) P(A | B') = P(A and B')/P(B') = P(A)P(B')/P(B') **M1**

(c) 1/3 **A1**

(c) it equals P(A), confirming that A and B are independent **B1**

(c) Answer: 1/3

Question 4

(a) tennis total = 33 + 22 **M1**

(a) 55/184 = 55/184 **A1**

(a) Answer: 55/184

(b) conditional probability: left-handed tennis players / all tennis players **M1**

(b) 33/55 = 3/5 **A1**

(b) Answer: 3/5

(c) left-handed swimmers / all left-handed members **M1**

(c) 39/95 = 39/95 **A1**

(c) Answer: 39/95

Question 5

(a) F only = 9 - 3 **M1**

(a) F only 6, S only 6, both 3 **A1**

(a) neither = 20 - 6 - 6 - 3 = 5 **A1**

(a) Answer: F only 6, S only 6, both 3, neither 5

(b) P(F union S) = P(F) + P(S) - P(F and S) **M1**

(b) 3/4 **A1**

(b) Answer: 3/4

(c) P(F | S) = P(F and S)/P(S) **M1**

(c) 1/3 **A1**

(c) Answer: 1/3

(d) compares P(F) x P(S) = 81/400 with P(F and S) = 3/20 **M1**

(d) not independent **A1**

(d) Answer: not independent

Question 6

(a) tennis total = 20 + 33 **M1**

(a) 53/168 = 53/168 **A1**

(a) Answer: 53/168

(b) conditional probability: left-handed tennis players / all tennis players **M1**

(b) 20/53 = 20/53 **A1**

(b) Answer: 20/53

(c) left-handed swimmers / all left-handed members **M1**

(c) 29/75 = 29/75 **A1**

(c) Answer: 29/75

Question 7

(a) F only = 8 - 3 **M1**

(a) F only 5, S only 4, both 3 **A1**

(a) neither = 20 - 5 - 4 - 3 = 8 **A1**

(a) Answer: F only 5, S only 4, both 3, neither 8

(b) P(F union S) = P(F) + P(S) - P(F and S) **M1**

(b) 3/5 **A1**

(b) Answer: 3/5

(c) P(F | S) = P(F and S)/P(S) **M1**

(c) 3/7 **A1**

(c) Answer: 3/7

(d) compares P(F) x P(S) = 7/50 with P(F and S) = 3/20 **M1**

(d) not independent **A1**

(d) Answer: not independent

Question 8

(a) tennis total = 37 + 20 **M1**

(a) 57/170 = 57/170 **A1**

(a) Answer: 57/170

(b) conditional probability: left-handed tennis players / all tennis players **M1**

(b) 37/57 = 37/57 **A1**

(b) Answer: 37/57

(c) left-handed swimmers / all left-handed members **M1**

(c) 12/89 = 12/89 **A1**

(c) Answer: 12/89

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Question 9

(a) F only = 8 - 3 **M1**

(a) F only 5, S only 6, both 3 **A1**

(a) neither = 100 - 5 - 6 - 3 = 86 **A1**

(a) Answer: F only 5, S only 6, both 3, neither 86

(b) P(F union S) = P(F) + P(S) - P(F and S) **M1**

(b) 7/50 **A1**

(b) Answer: 7/50

(c) P(F | S) = P(F and S)/P(S) **M1**

(c) 1/3 **A1**

(c) Answer: 1/3

(d) compares P(F) x P(S) = 9/1250 with P(F and S) = 3/100 **M1**

(d) not independent **A1**

(d) Answer: not independent

Question 10

(a) independent so P(A and B) = P(A) x P(B) **M1**

(a) 2/15 **A1**

(a) P(A or B) = P(A) + P(B) - P(A and B) **M1**

(a) 11/15 **A1**

(a) Answer: P(A and B) = 2/15, P(A or B) = 11/15

(b) forms p + 2/3 - 2/3p = 11/15 **M1**

(b) rearranges: p(1 - 2/3) = 1/15 **M1**

(b) P(C) = 1/5 **A1**

(b) Answer: P(C) = 1/5

(c) P(A | B') = P(A and B')/P(B') = P(A)P(B')/P(B') **M1**

(c) 1/5 **A1**

(c) it equals P(A), confirming that A and B are independent **B1**

(c) Answer: 1/5

Question 11

(a) independent so P(A and B) = P(A) x P(B) **M1**

(a) 3/20 **A1**

(a) P(A or B) = P(A) + P(B) - P(A and B) **M1**

(a) 5/8 **A1**

(a) Answer: P(A and B) = 3/20, P(A or B) = 5/8

(b) forms p + 3/8 - 3/8p = 5/8 **M1**

(b) rearranges: p(1 - 3/8) = 1/4 **M1**

(b) P(C) = 2/5 **A1**

(b) Answer: P(C) = 2/5

(c) P(A | B') = P(A and B')/P(B') = P(A)P(B')/P(B') **M1**

(c) 2/5 **A1**

(c) it equals P(A), confirming that A and B are independent **B1**

(c) Answer: 2/5

Question 12

(a) F only = 47 - 19 **M1**

(a) F only 28, S only 29, both 19 **A1**

(a) neither = 100 - 28 - 29 - 19 = 24 **A1**

(a) Answer: F only 28, S only 29, both 19, neither 24

(b) P(F union S) = P(F) + P(S) - P(F and S) **M1**

(b) 19/25 **A1**

(b) Answer: 19/25

(c) P(F | S) = P(F and S)/P(S) **M1**

(c) 19/48 **A1**

(c) Answer: 19/48

(d) compares P(F) x P(S) = 141/625 with P(F and S) = 19/100 **M1**

(d) not independent **A1**

(d) Answer: not independent

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