

Topic Test

Summer 2022

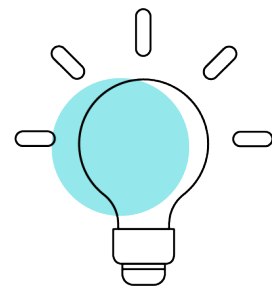
Pearson Edexcel GCE Mathematics (9MA0)

Paper 3 – Statistics

Topic 3: Probability and Venn diagrams

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General guidance to Topic Tests

Context

- Topic Tests have come from past papers both [published](#) (those materials available publicly) and unpublished (those currently under padlock to our centres) presented in a different format to allow teachers to adapt them for use with candidates.

Purpose

- The purpose of this resource is 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 advance information for the subject as well as general marking guidance for the qualification (available in published mark schemes).

Revise Revision Guide content coverage

The questions in this topic test have been taken from past papers, and have been selected as they cover the topic(s) most closely aligned to the [A level](#) advance information for summer 2022:

- Topic 3: Discrete probability distributions; normal approximation

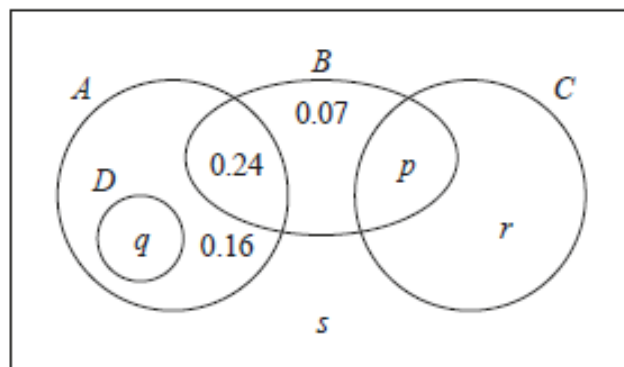
The focus of content in this topic test can be found in the Revise Pearson Edexcel A level Mathematics Revision Guide. Free access to this Revise Guide is available for front of class use, to support your students' revision.

| Contents | Revise Guide page reference | Level |
|------------------|-----------------------------|---------|
| Pure Mathematics | 1-111 | A level |
| Statistics | 112-147 | A level |
| Mechanics | 148-181 | A level |

Content on other pages may also be useful, including for synoptic questions which bring together learning from across the specification.

Question T3_Q2

1. The Venn diagram shows the probabilities associated with four events, A , B , C and D



(a) Write down any pair of mutually exclusive events from A , B , C and D

(1)

Given that $P(B) = 0.4$

(b) find the value of p

(1)

Given also that A and B are independent

(c) find the value of q

(2)

Given further that $P(B^c|C) = 0.64$

(d) find

(i) the value of r

(ii) the value of s

(4)

Question T3_Q3

4. The discrete random variable D has the following probability distribution

| | | | | | |
|------------|----------------|----------------|----------------|----------------|----------------|
| d | 10 | 20 | 30 | 40 | 50 |
| $P(D = d)$ | $\frac{k}{10}$ | $\frac{k}{20}$ | $\frac{k}{30}$ | $\frac{k}{40}$ | $\frac{k}{50}$ |

where k is a constant.

(a) Show that the value of k is $\frac{600}{137}$ **(2)**

The random variables D_1 and D_2 are independent and each have the same distribution as D .

(b) Find $P(D_1 + D_2 = 80)$
Give your answer to 3 significant figures. **(3)**

A single observation of D is made.

The value obtained, d , is the common difference of an arithmetic sequence.

The first 4 terms of this arithmetic sequence are the angles, measured in degrees, of quadrilateral Q

(c) Find the exact probability that the smallest angle of Q is more than 50° **(5)**

Question T3_Q4

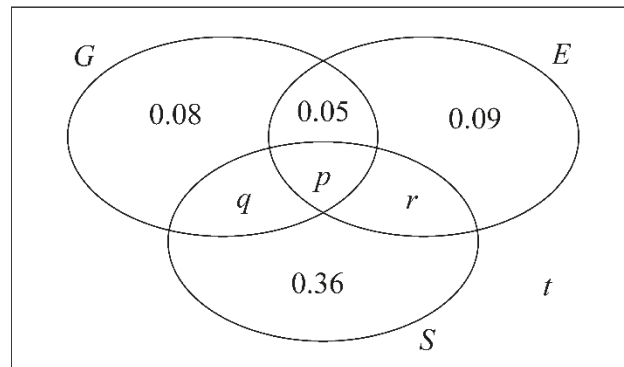
4. A large college produces three magazines. One magazine is about green issues, one is about equality and one is about sports. A student at the college is selected at random and the events G , E and S are defined as follows

G is the event that the student reads the magazine about green issues

E is the event that the student reads the magazine about equality

S is the event that the student reads the magazine about sports

The Venn diagram, where p , q , r and t are probabilities, gives the probability for each subset.



- (a) Find the proportion of students in the college who read exactly one of these magazines.

(1)

No students read all three magazines and $P(G) = 0.25$

- (b) Find

(i) the value of p

(ii) the value of q

(3)

Given that $P(S | E) = \frac{5}{12}$

- (c) find

(i) the value of r

(ii) the value of t

(4)

- (d) Determine whether or not the events $(S \cap E')$ and G are independent. Show your working clearly.

(3)

Mark Scheme

Question T3_Q1

| Question | Scheme | Marks | AOs |
|--|---|-------|------|
| 1(a) | | B1 | 1.1b |
| | | dB1 | 1.1b |
| | | (2) | |
| (b) | $\frac{9}{10} \times \frac{4}{5} \times \frac{2}{3}$ | M1 | 1.1b |
| | $= \frac{12}{25} (= 0.48)$ | A1 | 1.1b |
| | (2) | | |
| (c) | $\frac{9}{10} \times \frac{1}{5} + \frac{9}{10} \times \frac{4}{5} \times \frac{1}{3}$ or $1 - \left(\frac{1}{10} + \frac{9}{10} \times \frac{4}{5} \times \frac{2}{3} \right)$ | M1 | 3.1b |
| | $= \frac{21}{50} (= 0.42)$ | A1 | 1.1b |
| | (2) | | |
| (d) | $[P(\text{Red from } B \text{Red selected})] = \frac{\frac{9}{10} \times \frac{1}{5}}{\frac{1}{10} + \frac{9}{10} \times \frac{1}{5} + \frac{9}{10} \times \frac{4}{5} \times \frac{1}{3}} \left[= \frac{9}{26} \right]$ | M1 | 3.1b |
| | $= \frac{9}{26}$ | A1 | 1.1b |
| | (2) | | |
| (8 marks) | | | |
| Notes | | | |
| Allow decimals or percentages throughout this question. | | | |
| (a) | B1: for correct shape (3 pairs) and at least one label on at least two pairs G(reen) and R(ed) allow G and G' or R and R' as labels, etc. condone 'extra' pairs if they are labelled with a probability of 0 dB1: (dep on previous B1) all correct i.e. for all 6 correct probabilities on the correct branches with at least one label on each pair | | |
| (b) | M1: Multiplication of 3 correct probabilities (allow ft from their tree diagram) A1: $\frac{12}{25}$ oe | | |
| (c) | M1: Either addition of only two correct products (product of two probs + product of three probs) which may ft from their tree diagram or for $1 - (' \frac{1}{10}' + '(b)')$ A1: $\frac{21}{50}$ oe | | |
| (d) | M1: Correct ratio of probabilities or correct ft ratio of probabilities e.g. $\frac{' \frac{9}{10}' \times ' \frac{1}{5}'}{1 - '(b)'}$ or $\frac{' \frac{9}{10}' \times ' \frac{1}{5}'}{' \frac{1}{10}' + '(c)'}$ with num < den A1: $\frac{9}{26}$ (allow awrt 0.346) | | |

Question T3_Q2

| Qu 1 | Scheme | Marks | AO |
|---------------|---|--------------------------|--------------|
| (a) | A, C or D, B or D, C | B1 | 1.2 |
| (b) | $[p = 0.4 - 0.07 - 0.24 =]$ 0.09 | B1 (1) | 1.1b |
| (c) | A and B independent implies $P(A) \times 0.4 = 0.24$ or $(q + 0.16 + 0.24) \times 0.4 = 0.24$ so $P(A) = 0.6$ and $q =$ 0.20 | M1 A1 also (2) | 1.1b |
| (d)(i) | $P(B' C) = 0.64$ gives $\frac{r}{r+p} = 0.64$ or $\frac{r}{r+0.09} = 0.64$ $r = 0.64r + 0.64$ "p" so $0.36r = 0.0576$ so $r =$ 0.16 | M1 A1 | 3.1a 1.1b |
| (ii) | Using sum of probabilities = 1 e.g. "0.6" + 0.07 + "0.25" + $s = 1$ so $s =$ 0.08 | M1 A1 (4) | 1.1b 1.1b |
| | | (8 marks) | |
| Notes | | | |
| (a) | B1 for one correct pair. If more than one pair they must all be correct. Condone in a correct probability statement such as $P(A \cap C) = 0$ or correct use of set notation e.g. $A \cap C = \emptyset$ BUT e.g. "P(A) and P(C) are mutually exclusive" alone is B0 | | |
| (b) | B1 for $p = 0.09$ (Maybe stated in Venn Diagram [VD]) [If values in VD and text conflict, take text or a value <u>used</u> in a later part] | | |
| (c) | M1 for a correct equation in one variable for $P(A)$ or q using independence or for seeing both $P(A \cap B) = P(A) \times P(B)$ and $0.24 = 0.6 \times 0.4$ A1 also for $q = 0.20$ or exact equivalent (dep on correct use of independence) | | |
| Beware | Use of $P(A) = 1 - P(B) = 0.6$ leading to $q = 0.2$ scores M0A0 | | |
| (d)(i) | 1 st M1 for use of $P(B' C) = 0.64$ leading to a correct equation in r and possibly p . Can fit their p provided $0 < p < 1$ | | |
| | 1 st A1 for $r = 0.16$ or exact equivalent | | |
| (ii) | 2 nd M1 for use of total probability = 1 to form a linear equation in s . Allow p, q, r etc Can follow through their values provided each of p, q, r are in $[0, 1)$ | | |
| | 2 nd A1 for $s = 0.08$ or exact equivalent | | |

Question T3_Q3

| Qu 4 | Scheme | Marks | AO | |
|--------------|--|---|------|-----|
| (a) | $\frac{k}{10} + \frac{k}{20} + \frac{k}{30} + \frac{k}{40} + \frac{k}{50} = 1 \text{ or } \frac{1}{600}(60k + 30k + 20k + 15k + 12k) = 1$ $\text{So } k = \frac{600}{137} (*)$ | M1 | 1.1b | |
| | | A1cso | 1.1b | |
| | | (2) | | |
| | | (b) (Cases are:) | M1 | 2.1 |
| | | $P(D_1 + D_2 = 80) = \frac{k}{50} \times \frac{k}{30} \times 2 + \left(\frac{k}{40}\right)^2$ $= 0.0375619... \text{ awrt } \underline{\underline{0.0376}}$ | M1 | 3.4 |
| (c) | <p>Angles are: $a, a+d, a+2d, a+3d$</p> $S_4 = a + (a+d) + (a+2d) + (a+3d) = 360$ $2a + 3d = 180 \text{ (o.e.)}$ <p>Smallest angle is $a > 50$ consider cases: $d = 10$ so $a = 75$ <u>or</u> $d = 20$ so $a = 60$ [$d = 30$ gives $a = 45$ no good]</p> $P(D = 10 \text{ or } 20) = \frac{3k}{20} = \frac{90}{137}$ | M1 | 3.1a | |
| | | M1 | 2.1 | |
| | | A1 | 2.2a | |
| | | M1 | 3.1b | |
| | | A1 | 1.1b | |
| (5) | | (10 marks) | | |
| Notes | | | | |
| Verify | (a) | M1 for clear use of sum of probabilities = 1 (all terms seen) A1 cso (*) M1 scored and no incorrect working seen. | | |
| | (Assume $k = \frac{600}{137}$) to score the final A1 they must have a <u>final</u> comment " $\therefore k = \frac{600}{137}$ " | | | |
| (b) | 1 st M1 | for selecting at least 2 of the relevant cases (may be implied by their correct probs) e.g. allow 30, 50 and 50,30 i.e. D_1 and D_2 labels not required | | |
| | 2 nd M1 | for using the model to obtain a correct expression for two different probabilities. May use letter k or their value for k . | | |
| | | Allow for $\frac{k}{50} \times \frac{k}{30} + \left(\frac{k}{40}\right)^2$ <u>or</u> $2 \times \left(\frac{k}{50} \times \frac{k}{30} + \left(\frac{k}{40}\right)^2\right)$ | | |
| | A1 | for awrt 0.0376 (exact fraction is $\frac{705}{18769}$) | | |
| (c) | 1 st M1 | for recognising the 4 angles and finding expressions in terms of d and their a | | |
| | 2 nd M1 | for using property of quad with these 4 angles (equation can be un-simplified) Allow these two marks for use of a (possible) value of d e.g. $a + a + 10 + a + 20 + a + 30 = 360$ (If at least 3 cases seen allow A1 for e.g. $4a = 300$) <u>or</u> allow M1M1 for a set of 4 angles with sum 360 and possible value of d (3 cases for A1) e.g. (for $d = 20$) 60, 80, 100, 120 | | |
| | 1 st A1 | for $2a + 3d = 180$ condition (o.e.) [Must be in the form $pa + qd = N$] | | |
| | 3 rd M1 | for examining cases and getting $d = 10$ and $d = 20$ only | | |
| | 2 nd A1 | for $\frac{90}{137}$ or exact equivalent | | |
| | | The correct answer and no obviously incorrect working will score 5/5 A final answer of awrt 0.657 (0.65693...) with no obviously incorrect working scores 4/5 | | |

Question T3_Q4

| Qu 4 | Scheme | Marks | AO |
|--------------|--|-------------------------|----------------------|
| (a) | $0.08 + 0.09 + 0.36 = \underline{0.53}$ | B1 (1) | 1.1b |
| (b)(i) | $[P(G \cap E \cap S) = 0 \Rightarrow] \underline{p = 0}$ | B1 | 1.1b |
| (ii) | $[P(G) = 0.25 \Rightarrow] 0.08 + 0.05 + q + "p" = 0.25$ $\underline{q = 0.12}$ | M1 A1 (3) | 1.1b 1.1b |
| (c)(i) | $[P(S E) = \frac{5}{12} \Rightarrow] \frac{r + "p"}{r + "p" + 0.09 + 0.05} = \frac{5}{12}$ $[12r = 5r + 5 \times 0.14 \Rightarrow] \underline{r = 0.10}$ | M1 A1ft A1 | 3.1a 1.1b 1.1b |
| (ii) | $[0.08 + 0.05 + "0.12" + "0" + 0.09 + "0.10" + 0.36 + t = 1 \Rightarrow] \underline{t = 0.20}$ | B1ft (4) | 1.1b |
| (d) | $P(S \cap E') = 0.36 + "q" [= 0.48]$ $P([(S \cap E')] \cap G) = "q" [= 0.12]$ and $P(G) = 0.25$ and $P(S \cap E') \times P(G) = "0.48" \times \frac{1}{4}$ <u>or</u> 0.12 $P(S \cap E') \times P(G) = 0.12 = P([(S \cap E')] \cap G)$ so are independent | B1ft M1 A1 (3) | 1.1b 2.1 2.2a |
| Notes | | | |
| (a) | B1 for 0.53 (or exact equivalent) [Allow 53%] | | |
| (b)(i) | B1 for $p = 0$ (may be placed in Venn diagram) | | |
| (ii) | M1 for a linear equation for q (ft letter " p " or their value if $0, p, 0.12$) \Rightarrow by $p + q = 0.12$ A1 for $q = 0.12$ (may be placed in Venn diagram) | | |
| (c)(i) | M1 for a ratio of probabilities (r on num and den) (on LHS) with num < den and num <u>or</u> den correct ft. Allow ft of letter " p " <u>or</u> their p where $0, p < 0.86$ but "+ 0" is not required. 1 st A1ft for a correct ratio of probabilities (on LHS) allowing ft of their p where $0, p < 0.86$ 2 nd A1 for $r = 0.1(0)$ or exact equivalent (may be in Venn diagram) Ans only 3/3 | | |
| (ii) | B1ft for $t = 0.2(0)$ (o.e.) <u>or</u> correct ft i.e. $0.42 - (p + q + r)$ where p, q, r and t are all probs | | |
| (d) | B1ft for $P(S \cap E') = 0.48$ (with label) (ft letter " q " or their value if $0, q, 0.12$) M1 for attempting all required probs (labelled) and using them in a correct test (allow ft of q) A1 for all probs correct and a correct deduction (no ft deduction here) | | |
| SC | No "P" If correct argument seen apart from P for probability for all 3 marks, award (B0M1A1) If unsure about an attempt using conditional probabilities, please send to review. | | |

