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AS and A Level Psychology

MATHEMATICAL GUIDANCE

Mathematical Skill Requirements for GCE Psychology 2015

ALWAYS LEARNING

PEARSON

Psychology 2015

Mathematical Skill Requirements

Contents

New Mathematical Skills requirements

The 2015 Psychology specification has a number of changes from the 2008 specification. One of the new requirements is that the 2015 specification must include a minimum of 10% of at least Level 2 mathematical skills as part of the overall marks. This is in line with the DfE document published for science A-levels (see www.gov.uk/government/uploads/system/uploads/attachment_data/file/371209/2014-04-09-gce-subject-level-conditions-and-requirements-for-psychology.pdf). Please see Appendix 3 in the 2015 Psychology specification for the Mathematical Skills required.

The 2008 specification largely required candidates to be able to interpret data given during their assessment. However, you need to be aware that your candidates will now have to be able to also perform calculations during the assessment. This document has been written to help you identify the differences in the mathematical skills required and also gives advice and suggestions regarding the delivery of the mathematical skills within the 2015 specification.

The table below gives a direct comparison of the mathematical skills required in the GCSE Mathematics, 2008 AS/A2 Psychology specification and 2015 AS and A-level Psychology specification. **Bold text** indicates mathematical skills which will only be assessed as part of the Advanced GCE qualification. *Italic text* indicates option topic (one of Child, Health or Criminological Psychology must be covered).

Where a skill is measured specifically in GCE 2008 it is referenced, otherwise the requirement is in the Appendix for GCE 2008 and acknowledged as such.

Mathematical skill		Pearson GCSE Mathematics (Linear 2012)	2008 Psychology Specification	2015 Psychology Specification
D.0.1	Recognise and use expressions in decimal and standard form	Foundation and Higher	Required and in Appendix 8 (90.1) Psychodynamic 6c	• Can be done for practicals with quantitative data (Section 5) • Psychological skills (9.1.11
D.0.2	Use ratios, fractions and percentages	Foundation and Higher	Required and in Appendix 8 (90.2)	• Can be done for practicals with quantitative data (Section 5) • Cognitive (2.2.11) • Psychological skills (9.1.10)
D.0.3	Estimate results	Foundation and Higher	Required and in Appendix 8 (90.3)	• Can be done for practicals with quantitative data (Section 5) • Psychological skills (9.1.10)
D.1.1	Use an appropriate number of significant figures	Foundation and Higher	Required an in Appendix 8 (91.1) Psychodynamic 6c	• Can be done for practicals with quantitative data (Section 5) • Cognitive (2.2.12) • Biological (3.2.2) • *Options Sections 2 and 5 as appropriate* Psychological skills (9.1.11)
D.1.2	Find arithmetic means	Foundation and Higher	Required an in Appendix 8 (91.2) Cognitive (6c; 6dvi)	• Can be done for practicals with quantitative data (Section 5) • Social (1.2.5) • Cognitive (2.2.11) • *Options Sections 2 and 5 as appropriate* Psychological skills (9.1.10)
D.1.3	Construct and interpret	Foundation and	Required an in Appendix	• Can be done for practicals

	frequency tables and diagrams, bar charts and histograms	Higher. Interpret histograms on Higher only.	8 (91.3) Cognitive (6c; 6dviii)	with quantitative data (Section 5) • Social (1.2.5) • Cognitive (2.2.11) • *Options Sections 2 and 5 as appropriate* Psychological skills (9.1.10)
D.1.4	Understand simple probability	Foundation and Higher	Required an in Appendix 8 (91.4) Biological (2ciii, 6dviii)	• Can be done for practicals with quantitative data (Section 5) except social psychology practical • Cognitive (2.2.12) • Biological (3.2.2) • *Options Sections 2 and 5 as appropriate* Psychological skills (9.1.11)
D.1.5	Understand the principles of sampling as applied to scientific data	Foundation and Higher – understand sample and sample size	Required an in Appendix 8 (91.5) Social (2f, 6div) Psychodynamic (2h)	• Can be done for practicals with quantitative data (Section 5) • Social (1.2.4) • Cognitive (2.5.1) • *Options Sections 2 and 5 as appropriate* Psychological skills (9.1.2)
D.1.6	Understand the terms mean, median and mode	Foundation and Higher	Required an in Appendix 8 (91.6) Cognitive (6c, 6dvi)	• Can be done for practicals with quantitative data (Section 5) • Social (1.2.5) • *Options Sections 2 and 5 as appropriate* Psychological skills (9.1.10)
D.1.7	Use a scatter diagram to identify a correlation between two variables	Foundation and Higher	Required an in Appendix 8 (91.7) Psychodynamic (2g)	• Biological (3.2.1, 3.2.2, 3.5.1) • *Criminological (6.2.4)* • Psychological skills (9.1.10)
D.1.8	Use a statistical test	Not required	Required an in Appendix 8 (91.8) Psychodynamic (6c) Biological (6b) Learning (6c)	• Can be done for practicals with quantitative data except the social psychology practical (Section 5) • Cognitive (2.2.12) • Biological (3.2.2 and 3.5.1) • Learning (4.2.3 and 4.5.1) • *Options Sections 2 and 5 as appropriate* • Psychological skills (9.1.11)
D.1.9	Make order of magnitude calculations	Foundation and Higher	Required an in Appendix 8 (91.9) ~~Not required~~	• Can be done for practicals with quantitative data (Section 5) • Psychological skills (9.1.10)
D.1.10	**Distinguish between levels of measurement**	Not required	Biological (2cvii, 6dxiii) Learning (2ci)	• Can be done with practicals using quantitative data (Section 5) • Biological (3.2.2) • Learning (4.2.3) • *Options Sections 2 and 5 as appropriate* Psychological skills (9.1.11)
D.1.11	Know the characteristics of normal and skewed distributions	Not required	Not required	• Can be done with practicals using quantitative data (Section 5) as appropriate • Cognitive (2.2.12) • Psychological skills (9.1.10)
D.1.12	**Select an appropriate statistical test**	Not required	Required in Appendix 8 (91.8) Learning (2cii)	• Can be done with practicals using quantitative data (Section 5) except for social psychology practical • Cognitive (2.2.12) • Biological (3.2.2) • Learning (4.2.3) • *Options Sections 2 and 5 as appropriate* Psychological skills (9.1.11)

D.1.13	**Use statistical tables to determine significance**	Not required	Learning (2ciii)	• Cognitive (2.2.12) • Biological (3.2.2) • Learning (4.2.3) • *Options Sections 2 and 5 as appropriate* Psychological skills (9.1.11)
D.1.14	Understand measures of dispersion, including standard deviation and range	Foundation and Higher for range. Standard deviation not required.	Cognitive (6c, 6dvii) – standard deviation not required	• Social (1.2.5 and 1.5.1) • Cognitive (2.2.11 and 2.5.1) • *Options Sections 2 and 5 as appropriate* Psychological skills (9.1.10)
D.1.15	Understand the differences between qualitative and quantitative data	Not required	Social (2c; 6diii, vii) Learning (6avii, iii)	• Social (1.2.5; 1.2.6) • Cognitive (2.2.13) • Learning (4.2.1 and 4.2.3) • Clinical (5.2.5) • *Options Sections 2 and 5 as appropriate* Psychological skills (9.1.1)
D.1.16	Understand the difference between primary and secondary data	Collect data from primary and secondary sources	Clinical (1bvi, 2ab)	• Clinical (5.2.2) • Psychological skills (9.1.1)
D.2.1	Understand and use the symbols: =, <, <<, >>, >, ∝, ~.	Not required	Required in Appendix 8 (92.1) Not ∝ or ~ but others used in unit 2 (e.g. Psychodynamic 2ciii)	• Can be done with practicals using quantitative data (Section 5) except for social psychology practical • e.g. Cognitive (2.2.12) • Psychological skills (9.1.11)
D.2.2	**Substitute numerical values into algebraic equations using appropriate units for physical quantities**	Foundation and Higher	Required in Appendix 8 (92.3)	• Standard deviation is often asked for in different Topic Areas • e.g. Learning (4.2.3 and 4.5.1) • Psychological skills (9.1.11)
D.2.3	**Solve simple algebraic equations**	Foundation and Higher	Required an in Appendix 8 (92.4)	• The statistical tests used algebraic equations and are found in many Topic Areas • e.g. Learning (4.2.3 and 4.5.1) • Psychological skills (9.1.10)
D.3.1	Translate information between graphical, numerical and algebraic forms	Foundation and Higher	Required an in Appendix 8 (93.1) Cognitive (6c, dviii)	• Social (1.2.5 and 1.5.1) • Cognitive (2.2.11 and 2.5.1) • Learning (4.5.1) • *Options Sections 2 and 5 as appropriate* Psychological skills (9.1.10)
D.3.2	Plot two variables from experimental or other data	Foundation and Higher	Required an in Appendix 8 (93.2) Cognitive 6c; 6vii) Psychodynamic (6b)	• Biological (3.2.2 and 3.5.1) • *Options Sections 2 and 5 as appropriate* Psychological skills (9.1.10)

Delivery of Mathematical Skills requirements using topic approach

With the 2015 specification being linear there is greater flexibility in how you are able to deliver the qualification, including the new mathematical skill requirements.

One possible delivery approach would be to use a topic-based method consistent with the 2008 modular qualification. This would involve delivering the mathematical skills whilst covering the different topics. Below is an indication of how this may be delivered to cover all relevant aspects by the AS level and A level examinations (as appropriate). For each of the practical investigations it is anticipated that you will also include other psychological skills necessary (for example, IV, DV, operationalisation etc.) but these are not included here as they are not Mathematical Skills.

Topic 1: Social Psychology

As part of the practical investigation (1.5.1) you could ensure the students:

- Explain how they sampled their participants from a target population (D.1.5)
- Estimate the range based on all raw scores obtained (D.0.3)
- Calculate and comment on the range (D.1.14)
- Estimate the mean score for each condition based on all raw scores obtained (D.1.9)
- Calculate and comment on the mean, median and mode for the data (D.1.2, D.1.6) including which is most and least appropriate for the data and why
- Draw a bar chart for the results (D.1.3, D.3.1)
- Analyse data from both open-ended and closed-ended questions (D.1.15).

Topic 2: Cognitive Psychology

As part of the practical investigation (2.5.1) you could ensure the students:

- Complete a frequency table for the results (D.1.3)
- Calculate and comment on the standard deviation of the scores obtained (D.1.14)
- Draw a histogram for the results (D.1.3)
- Explain whether the scores are normally distributed or skewed (D.1.11)
- Carry out a Mann Whitney U test (D.1.8) to include appropriate level of significance ($p \leq .10$. $p \leq .05$, $p \leq .01$) (D.1.4) and a Wilcoxon test, and choose the appropriate test (D.1.12)
- Use a table of critical values to judge whether there was a significant difference between the experimental and control groups (D.1.13) using symbols as appropriate (D.2.1)

Topic 3: Biological Psychology

As part of the practical investigation (3.5.1) you could ensure the students:

- Draw a scatter graph for the results (D.3.2)
- Interpret whether the type of relationship found (positive, negative) and strength of relationship (D.1.7)

- Insert the *n* value (for number of scores) into the Spearman's rho formula (D.2.2)
- Carry out a Spearman's rho test (D.1.8) to include appropriate level of significance (p≤.10. p≤.05, p≤.01) (D.1.4) and see how to choose the appropriate test (D.1.12)
- Express the correlation coefficient to three significant figures (D.1.1)
- Use a table of critical values to judge whether there was a significant correlation between the two conditions (D.1.13) using symbols as appropriate (D.2.1).

Topic 4: Learning Theories

As part of the practical investigation (4.5.1) you could ensure the students:

- Calculate and comment on the percentage of scores in each condition (D.0.2)
- Convert the scores in each condition into decimal form to construct a pie chart for the results (D.0.1)
- Calculate the degrees of freedom for the chi-squared test (D.2.3)
- Carry out a Chi Squared test (D.1.8) to include appropriate level of significance (p≤.10. p≤.05, p≤.01) (D.1.4) and see how to choose the appropriate test (D.1.12)
- Use a table of critical values to judge whether there was a significant difference between the two conditions (D.1.13) using symbols as appropriate (D.2.1)
- Analyse the qualitative data using thematic analysis (D.1.15).

Topic 5: Clinical Psychology

As part of the practical investigation (5.5.1) you could ensure the students:

- Explain whether they used primary or secondary data and reasons for using this data (D.1.16).

Topics 6–8: Criminological or Child or Health Psychology

As part of the practical investigation (6.5.1 or 7.5.1 or 8.5.1) you could ensure the students:

- Explain why they chose the statistical test (D.1.12) using the level of measurement as part of the justification (D.1.10)
- Carry out an appropriate test (D.1.8) to include appropriate level of significance (p≤.10. p≤.05, p≤.01) (D.1.4) and see how to choose the appropriate test (D.1.12)
- Use a table of critical values to judge whether there was a significant correlation between the two conditions (D.1.13) using symbols as appropriate (D.2.1).

Delivery of Mathematical Skills requirements using skills-based approach

One possible delivery approach would be to use a skills-based method. This would involve delivering the Mathematical Skills during a single period of time during the two-year course. The table below indicates how this may be delivered.

Conducting a research study

- Differences in primary or secondary data and reasons for using this data (D.1.16)
- Differences between qualitative and quantitative data (D.1.15)
- Sampling techniques used to recruit participants from a target population (D.1.5)

❖ As part of this topic it is recommended that other aspects of Psychological Skills are covered (for example, ethical guidelines, variables, hypotheses etc.).

Manipulating raw data

- Estimate the mean score for each condition based on all raw scores obtained (D.1.9)
- Calculate and comment on the mean, median and mode for the data (D.1.2, D.1.6) including which is most and least appropriate for the data and why
- Estimate the range based on all raw scores obtained (D.0.3)
- Calculate and comment on the range (D.1.14)
- Calculate and comment on the standard deviation of the scores obtained (D.1.14)
- Calculate and comment on the percentage of scores in each condition of a study (D.0.2)
- Convert the scores in each condition of a study into decimal form (D.0.1)
- Analyse the qualitative data using thematic analysis (D.1.15).

Presenting data

- Complete a frequency table for a set of results (D.1.3)
- Draw a bar chart for a set of results (D.1.3, D.3.1)
- Draw a histogram for a set of results (D.1.3)
- Explain whether the scores are normally distributed or skewed (D.1.11)
- Draw a scatter graph for a set of results (D.3.2) and interpret whether the type of relationship found (positive, negative) and strength of relationship (D.1.7).

Probability

- Explain the reasons behind choice of a statistical test (D.1.12) using the level of measurement as part of the justification (D.1.10)
- Carry out a Mann–Whitney U test (D.1.8) to include appropriate level of significance (at least $p=0.05$) (D.1.4)

- Calculate the degrees of freedom for the chi-squared test (D.2.3)
- Carry out a chi-squared test (D.1.8) to include appropriate level of significance (D.1.4).
- Insert the *n* value (for number of scores) into the Spearman's rho formula (D.2.2)
- Carry out a Wilcoxon Signed Ranks test (D.1.8) to include appropriate level of significance (D.1.4)
- Carry out a Spearman's rho test (D.1.8) to include appropriate level of significance (D.1.4)
- Express the correlation coefficient to three significant figures (D.1.1)
- Use a table of critical values to judge whether there was a significant difference or significant correlation between the conditions (D.1.13) using symbols as appropriate (D.2.1).

Formulae and statistical tables

You may have already noticed the new 'Formulae and Statistical Tables' at the beginning of the Sample Assessment Material papers. These will be included in all AS and A level assessment papers within the 2015 specification. There is a copy of these within the 2015 specification documents (Appendix 4 in both AS and A level specification).

There is no requirement for your candidates to remember the Formulae and Statistical Tables. However, candidates may be asked to use the Formulae and Statistical Tables to perform any of the following:

- Calculate standard deviation for a set of data
- Calculate a statistical test (Spearman's, chi-squared, Mann–Whitney, Wilcoxon) to derive an observed/calculated value
- Use a table of critical values to find a relevant critical value and compare it to an observed/calculated value (A level only)
- State whether an observed/calculated value shows a significant difference or correlation (using the footer on each table of critical values).

Please see the worked example in Appendix 1 to help you prepare your students for the types of question they may come across during assessment.

Appendix 1: Worked example of Spearman's rho (Q9 on the new A level SAMs paper)

Val was conducting research into aggression. She asked seven participants to rate their own aggression on a scale of 1–9 and then asked the best friend of each participant to give a peer rating of their aggression.

Table 3 shows the data from the investigation.

(a) Complete Table 3 and calculate Spearman's rank correlation coefficient between self-rated aggression and peer-rated aggression.

Table X data from the investigation

Self-rated aggression	Rank 1	Peer-rated aggression	Rank 2	*d*	d^2
2	6.5	3	6		
2	6.5	6	4		
4	5	2	7		
5	4	5	5		
8	3	7	3		
9	1.5	8	2		
9	1.5	9	1		
				Total:	

Step 1: Work out the differences (*d*) between rank 1 and rank 2:

Self-rated aggression	Rank 1	Peer-rated aggression	Rank 2	***d***	d^2
2	6.5	3	6	***–0.5***	
2	6.5	6	4	***–2.5***	
4	5	2	7	***-2***	
5	4	5	5	***-1***	
8	3	7	3	***0***	
9	1.5	8	2	***-0.5***	
9	1.5	9	1	***-0.5***	
				Total (Σd^2):	

Step 2: Square the differences (d^2; multiply the number by itself if they are not using a scientific calculator):

Self-rated aggression	Rank 1	Peer-rated aggression	Rank 2	*d*	d^2
2	6.5	3	6	0.5	***0.25***
2	6.5	6	4	2.5	***6.25***
4	5	2	7	-2	***4***
5	4	5	5	-1	***1***
8	3	7	3	0	***0***
9	1.5	8	2	-0.5	***0.25***
9	1.5	9	1	-0.5	***0.25***
				Total (Σd^2):	

Step 3: Calculate the sum of the differences squared column (Σd^2):

Self-rated aggression	Rank 1	Peer-rated aggression	Rank 2	*d*	d^2
2	6.5	3	6	–0.5	0.25
2	6.5	6	4	–2.5	6.25
4	5	2	7	2	4
5	4	5	5	1	1
8	3	7	3	0	0
9	1.5	8	2	0.5	0.25
9	1.5	9	1	0.5	0.25
				Total (Σd^2):	***12***

Steps 4-8: Use the Spearman's rank correlation formulae to calculate the correlation coefficient. Σd^2 is the sum of the d^2 column ($\Sigma d^2 = 12$) and n is the number of participants ($n = 7$). Remember to remind your students to calculate anything in brackets first and encourage them to calculate each step and write it down – not just the final answer! See below for an example.

$$r_s = 1 - \frac{6\Sigma d^2}{n(n^2-1)}$$

Σd^2 = **12** and n = **7**

$$r_s = 1 - \frac{6 \times 12}{7(7^2-1)}$$

6 x **12** = 72

7(7² – 1) = 7(49 – 1) = 336

$$r_s = 1 - \frac{72}{336}$$

72/336 = 0.214285714

r_s = 1 – 0.214285714

r_s = 0.785714286

the correlation coefficient is **0.786** to 3 significant figures

(b) Using the critical value table for Spearman's rank in Appendix 4 of the specification, state the relationship between self-rated and peer-rated measures of aggression.

The critical value for p = 0.05 (minimum accepted level of significance in Psychology) is 0.679 for 7 participants (n = 7). (The calculated value needs to be equal to or exceed the critical value for a significant correlation).

The calculated value of 0.786 is greater than the critical value of 0.679, so there is a significant correlation between self-rated aggression and peer-rated aggression.