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A-Level Psychology

Maths and Statistics · Calculations

Edexcel Psychology (9PS0) | Calculations | 30 entries

Every maths and statistics skill Edexcel Psychology tests - what each is, when to use it, and how to work it out.

Descriptive statistics

Mean	**What it is:** the arithmetic average of a set of scores. **When to use:** with interval or ratio data that has no extreme outliers, because it uses every value. **How to work it out:** add all the scores together, then divide by how many scores there are. For 4, 6, 8 and 10, the total is 28 and there are 4 scores, so the mean is 28 ÷ 4 equals 7.
Median	**What it is:** the middle score once the data are placed in order. **When to use:** with ordinal data, or with interval data that contains outliers, since extreme values do not distort it. **How to work it out:** rank the scores from lowest to highest and take the central one. For 3, 5, 7, 9 and 11 the median is 7. With an even number of scores, take the mean of the middle two.
Mode	**What it is:** the most frequently occurring score. **When to use:** with nominal data, or when you need the most typical or common category. **How to work it out:** count how often each value appears and select the one that occurs most often. In 2, 3, 3, 3, 7 and 8 the mode is 3. A set can have two modes or none.
Range	**What it is:** the simplest measure of dispersion, showing the spread from lowest to highest. **When to use:** for a quick indication of how spread out scores are. **How to work it out:** subtract the lowest score from the highest, and by convention add 1. For scores from 4 to 19, the range is 19 − 4 equals 15, plus 1 gives 16.
Standard deviation	**What it is:** a measure of dispersion showing the average distance of scores from the mean. **When to use:** with interval or ratio data; a fuller measure of spread than the range because it uses every score. **How to work it out:** find each score's deviation from the mean, square the deviations, average them and take the square root. A small value means scores cluster tightly around the mean and the group is consistent; a large value means scores are widely spread.

Inferential statistics - choosing a test

Why use an inferential test	**What it is:** a statistical test that decides whether a result is likely to be real or simply down to chance. **When to use:** whenever you must judge whether to accept the alternative hypothesis or retain the null. **How to work it out:** calculate the observed value, compare it with the critical value at $p \leq 0.05$, and decide whether the pattern in the data is statistically significant.
Choosing the right test	**What it is:** selecting a test using three questions about the study. **When to use:** at the analysis stage of any experiment or correlation. **How to work it out:** decide whether you are looking for a difference or a relationship; if a difference, whether the design is unrelated (independent groups) or related (repeated measures or matched pairs); then check the level of measurement to pick the correct test.
Mann-Whitney U	**What it is:** a test of difference for two separate groups of people. **When to use:** with an unrelated (independent groups) design and at least ordinal data. **How to work it out:** rank all scores across both groups, sum the ranks for each group and apply the U formula. The result is significant when the observed U is less than or equal to the critical value.

Wilcoxon signed-ranks	**What it is:** a test of difference for the same or matched participants. **When to use:** with a related design (repeated measures or matched pairs) and at least ordinal data. **How to work it out:** find the difference for each pair, rank the differences ignoring sign, then total the ranks of the less frequent sign to give T. It is significant when observed T is less than or equal to the critical value.
Spearman's rho	**What it is:** a test of correlation between two co-variables. **When to use:** when looking for a relationship rather than a difference, with at least ordinal data. **How to work it out:** rank each variable, find the difference in ranks for each pair, square and total those differences, then apply the rho formula. Significance is reached when observed rho ≥ the critical value.
Chi-squared (χ^2)	**What it is:** a test of difference or association using frequencies in categories. **When to use:** with an unrelated design and nominal (count) data arranged in a contingency table. **How to work it out:** work out the expected frequency for each cell, then sum (observed − expected) squared, divided by expected. The result is significant when observed $\chi^2 \geq$ the critical value.
Related or unrelated design	**What it is:** the distinction between testing the same people twice and testing two separate groups. **When to use:** when deciding between related and unrelated tests of difference. **How to work it out:** a related design uses repeated measures or matched pairs, so scores come in linked pairs; an unrelated design uses independent groups, so the two sets of scores are from different people and cannot be paired.
Difference or relationship	**What it is:** the first decision in choosing a test, between comparing conditions and linking variables. **When to use:** at the very start of test selection. **How to work it out:** if the study manipulates an independent variable to compare conditions you are testing for a difference; if it measures two naturally occurring variables to see how they vary together you are testing for a relationship, which points to a correlation.

Significance and errors

Levels of significance	**What it is:** the probability cut-off used to judge whether a result is due to chance. **When to use:** set before testing to decide how confident you must be. **How to work it out:** psychology normally uses $p \leq 0.05$, meaning a 5 percent or smaller probability that the result is down to chance. A stricter level such as $p \leq 0.01$ is chosen where a false claim would be costly.
Probability and the 0.05 level	**What it is:** the meaning of the conventional 5 percent threshold. **When to use:** whenever interpreting a significance decision. **How to work it out:** $p \leq 0.05$ means there is a 5 in 100 or smaller probability that the result occurred by chance; if the test reaches this level you are confident enough to reject the null hypothesis and accept the alternative.
Critical values	**What it is:** the boundary figure from a statistical table that the observed value is judged against. **When to use:** at the final step of every inferential test. **How to work it out:** read the table using the number of participants (N) or degrees of freedom, whether the hypothesis is one-tailed or two-tailed, and the chosen significance level, then compare your observed value with it.
Observed versus critical value	**What it is:** the comparison that produces the significance decision. **When to use:** once you have both your calculated value and the table value. **How to work it out:** check the direction of the test - for Mann-Whitney and Wilcoxon the observed value must be ≤ the critical value, while for Spearman and chi-squared it must be ≥ it, for the result to be significant.
One-tailed and two-tailed tests	**What it is:** whether the hypothesis predicts a direction or not. **When to use:** to read the correct column of critical values. **How to work it out:** a directional (one-tailed) hypothesis predicts which way results will go, so use the one-tailed value; a non-directional (two-tailed) hypothesis only predicts a difference or relationship, so use the two-tailed value.

Type 1 error	**What it is:** a false positive - rejecting a true null hypothesis and claiming an effect that is not really there. **When to use:** when evaluating the risk of a lenient significance level. **How to work it out:** the chance of a Type 1 error equals the significance level, so at $p \leq 0.05$ there is a 5 percent risk. Setting a more lenient level such as 0.10 raises this risk.
Type 2 error	**What it is:** a false negative - retaining a false null hypothesis and missing a real effect. **When to use:** when evaluating the risk of an overly strict significance level. **How to work it out:** choosing a very strict level such as $p \leq 0.01$ lowers the Type 1 risk but raises the chance of a Type 2 error, so the level chosen always balances the two kinds of mistake.

Maths skills

Levels of measurement	**What it is:** the four ways data can be measured - nominal, ordinal, interval and ratio. **When to use:** to choose a measure of central tendency and the correct inferential test. **How to work it out:** nominal data are named categories, ordinal data are ranked positions, interval data sit on an equal-unit scale, and ratio data have equal units and a true zero. The higher the level, the more information it carries.
Percentages	**What it is:** a proportion expressed out of 100. **When to use:** to compare results from samples of different sizes on the same scale. **How to work it out:** divide the part by the whole and multiply by 100. If 18 of 24 participants obeyed, that is $18 \div 24 \times 100$ equals 75 percent. To find a percentage of a quantity, multiply the quantity by the percentage written as a decimal.
Fractions	**What it is:** a part of a whole written as one number over another. **When to use:** to express proportions and to feed into percentage or probability calculations. **How to work it out:** the top number is the part and the bottom number is the whole; simplify by dividing both by their highest common factor. 15 out of 60 is 15/60, which simplifies to 1/4, the same as 25 percent.
Ratios	**What it is:** a way of comparing two or more quantities of the same kind. **When to use:** to describe how a sample splits, such as males to females or experimental to control. **How to work it out:** write the quantities separated by a colon and simplify by dividing by a common factor. A group of 20 men and 30 women is 20:30, which simplifies to 2:3.
Significant figures	**What it is:** the number of meaningful digits used to report a value. **When to use:** to round results sensibly and to a consistent precision. **How to work it out:** count digits from the first non-zero digit, then round the last kept digit up if the next digit is 5 or more. The value 0.04827 to 2 significant figures is 0.048; 153.8 to 3 significant figures is 154.
Standard form	**What it is:** a compact way of writing very large or very small numbers. **When to use:** to express figures such as probabilities or population sizes clearly. **How to work it out:** write the number as a value between 1 and 10 multiplied by a power of 10. 47000 becomes 4.7×10^{4}, and 0.0029 becomes 2.9×10^{-3}; a positive power means large, a negative power means small.
Choosing a graph	**What it is:** matching the type of display to the type of data. **When to use:** when summarising results visually. **How to work it out:** use a bar chart for the totals or means of separate categories with gaps between bars; a histogram for continuous data with touching bars; a scattergram for the relationship between two co-variables in a correlation.
Interpreting a scattergram	**What it is:** reading the pattern of points to judge a correlation. **When to use:** when a study measures two variables for a relationship. **How to work it out:** points rising from bottom-left to top-right show a positive correlation; points falling from top-left to bottom-right show a negative correlation; a shapeless cloud shows no correlation. The tighter the points cluster to a line, the stronger the relationship.

Interpreting a bar chart or histogram	**What it is:** drawing conclusions from the height and shape of bars. **When to use:** when comparing categories or examining a distribution. **How to work it out:** read each bar against the labelled axes, compare heights to see which condition scored more, and look at the overall shape - a histogram can reveal whether a distribution is symmetrical, skewed or has outliers.
Normal and skewed distributions	**What it is:** the shape formed when scores are plotted as a frequency curve. **When to use:** when describing how a set of scores is spread. **How to work it out:** a normal distribution is a symmetrical bell shape in which the mean, median and mode coincide; a positive skew has a tail of high scores pulling the mean to the right, and a negative skew has a tail of low scores pulling the mean to the left.