

The independent investigation is worth 20% of the overall marks in A level Geography

This guide will help you through the processes of planning, collecting and presenting data, analysis and evaluation

Independent investigations

Introduction and planning

This guide takes the enquiry approach to help you structure your independent investigation.

Enquiry approach



Geographical enquiry involves:

- asking a geographical question
- gathering relevant evidence (quantitative and/or qualitative) to answer the question
- presenting and analysing the evidence, which may include statistical analysis of numerical data although this is not essential
- drawing conclusions: creating a geographical argument to interpret the evidence
- evaluating your methods and conclusions

Other approaches to fieldwork

There are other valid approaches to fieldwork. It is also possible to incorporate elements of these other approaches into a geographical enquiry.

Hypothesis testing Use geographical theory to generate hypotheses. Test each hypothesis by collecting appropriate field data, then analyse data using statistical tests.

Discovery fieldwork Explore a place for yourself by making observations, taking photographs or collecting objects. Consider urban drifting, where you take a structured but unplanned journey through a city.

Discovery fieldwork includes ethnographic techniques such as participant observation.

Places can also be explored using creative writing, images and film. Here the evidence can be interpreted by iconological content analysis, image analysis and coding.

Sensory fieldwork Explore a place by sense of smell, touch, sight, hearing or taste. You can deprive other senses, perhaps with a blindfold, to heighten awareness of the target sense.

Possible strategies include sound mapping, back-to-back field sketching, aroma mapping and emotional mapping.

Enquiries are driven by curiosity. What would you like to know about that would involve you doing some research of your own? Think about which geographical concepts affect you. Your independent investigation can be based on any part of your awarding body's A level Geography specification.

Aims and hypotheses

Aim A statement of what you are trying to find out. In Geography there are broadly two kinds of aims:

- Are things different from each other?
e.g. 'Why does the rate of coastal erosion vary between different parts of Holderness?'
- Are things associated with each other?
e.g. 'Is there a link between deprivation and clone towns in north Suffolk?'

Hypothesis An idea or explanation that can be tested through study and experimentation. A well written hypothesis is clear, directional and measurable.

e.g. 'There is an inverse relationship between the index of multiple deprivation and the clone town index in north Suffolk.'

Data and evidence

Data A set of values, recorded and interpreted to produce information.

Evidence Facts and information used as the grounds for belief or disbelief.

Primary data Data you have collected yourself, such as pebble measurements, questionnaire responses, photos and audio/video recordings.

Secondary data Data collected by someone other than yourself. It includes published data (such as census results and records of rainfall), historical data (such as old photos) and data collected by other students.

Quantitative data Data that records quantities (e.g. numbers, sizes or frequencies).

Qualitative data Data that records subjective qualities (e.g. opinions, attitudes and beliefs).



Methods and data collection

Collecting quantitative data

The things that you are interested in measuring are called **variables**. There are two types:

- **Independent variable** is not affected by other things. It is *independent* of other variables.
- **Dependent variable** is affected by other things. It is *dependent* on other variables.

An independent variable causes a change in a dependent variable. A dependent variable cannot cause a change in an independent variable.

There are four measurement scales for variables:

- **Nominal** Variables that are not numerical, e.g. *categories* like gender and ethnicity.
- **Ordinal** Variables where order has meaning, but the difference between values is not important, e.g. *ranks* like 1st, 2nd and 3rd.
- **Interval** Variables where the difference between values is important, e.g. *actual numbers* like the temperature in °C.
- **Ratio** Interval data with a natural (absolute) zero point. Time in seconds has a ratio scale, but temperature in °C does not (since 0°C does not mean no heat).

Collecting qualitative data

Observation

Observational data is commonly recorded as notes, sketches or audio/video recordings. There are three types of observation method:

- **Naturalistic** Observing people in their natural environment.
- **Participant** Observing behaviour as a participant in a group.
- **Controlled** Observing behaviour(s) under certain conditions and/or time parameters.

Consider validity (does your presence influence behaviour?) and ethics (do you have consent?).



Questioning (quantitative or qualitative)

- **Closed questions** Answers are limited to single words, numbers or listed options. The collated data is quantitative.
Example: 'Do you feel safe in High Street at 11pm?' *Answers:* Yes / No / Don't know
- **Statements** Answers are limited to positions on a scale. The collated data is quantitative.
Example statement: 'High Street is safe at 11pm.' *Answers:* Strongly agree / Agree / Don't know / Disagree / Strongly disagree
- **Open questions** Answers are detailed text. The data is qualitative. If the results are categorised, the number of responses per category (i.e. frequencies) can be treated as quantitative data. *Example:* 'Is High Street safe?'

Questionnaires can cover a large sample population. They are useful for gathering data on people's perceptions and experiences of place.

Interviews often involve a smaller sample than questionnaires. They can gather more in-depth data. *Focus groups* are a type of interview involving multiple interviewees in a focused discussion.

Sampling

Sampling is the process of collecting data from some sites or people in order to obtain a perspective on the population. It is applicable to both qualitative and quantitative methods.

Sample A limited number of things, such as a group of 100 people or 50 pebbles on a beach.

Population The total number of things, such as all residents of a city or all pebbles on a beach.

Representative How closely the relevant characteristics of the sample match the characteristics of the population.

Bias An inclination or prejudice towards or against a specific finding or outcome.

You should explain how representative a sample is. It affects how the findings can be applied.



Probability sampling

The aim of probability sampling is to select a sample which is representative of the population. There are three techniques:

Random sampling This is where each member of the population is equally likely to be included.

Stratified sampling This is where a proportionate number of observations is taken from each part of the population.

Systematic sampling This is where observations are taken at regular intervals, such as every 10 metres or every 5th person.

Non-probability sampling

For some qualitative methods like interviews, it may be impractical to select a representative sample. In non-probability sampling, the sample is selected through the subjective judgment of the researcher. There are three techniques:

Convenience sampling Select people who are easy to reach, e.g. giving out a questionnaire to the first 100 people you see in the High Street on a particular morning.

Snowball sampling Select at least two people. Ask each person to help you find more interviewees. Continue finding new people until you have achieved your desired sample size.

Quota sampling Deliberately select a proportionate number of people from each part of the population.

Enquiry considerations

Methods and data collection

Be objective: Think about frequency and timing of observations. Have you taken enough samples to be representative? How did you avoid bias? For non-probability sampling, what are the limitations? Did interviewees understand the questions? How did you deal with non-responders?

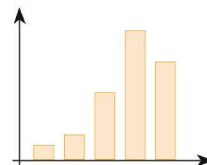
Be critical: Have you chosen the best method? Were you accurate and precise?

Be ethical: How did you avoid damaging the environment or causing offence? Did you have consent to carry out observations?

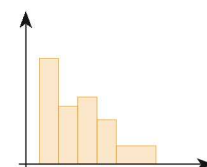


You must be able to justify the choice of each data presentation technique.

Bar chart Nominal data. Categories on x-axis. Bar height represents frequency. Leave gaps between bars as data are discontinuous.



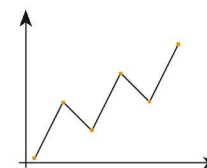
Histogram Interval or ratio data. Bar area shows frequency. Bars are not necessarily of equal width. No gaps between bars as data are continuous.



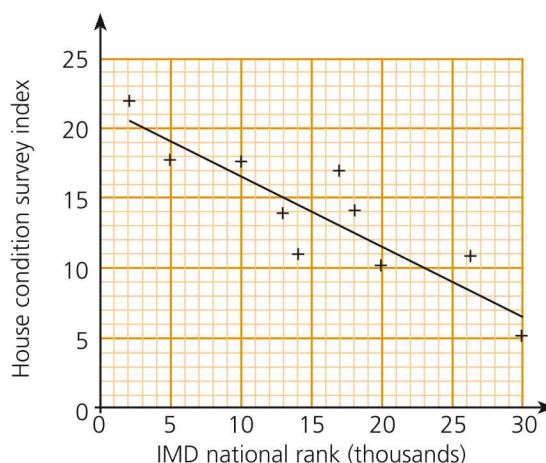
Pie chart Nominal or ordinal data. Area of circle segment represents proportion. Multiple pie charts can be used with the radius of the circle having meaning.



Line graph Ordinal, interval or ratio data. Both axes are numerical. If time is one of the variables, always plot it on the x-axis. Only join up the points if the data are continuous.



Scattergraph Needs one independent variable (on x-axis) and one dependent variable (on y-axis). Both axes need interval or ratio data, and both must be continuous data. Do not join up each point, but use a line of best fit instead.



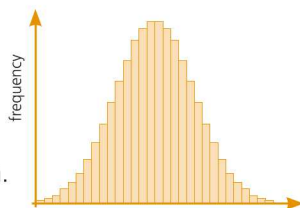
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Measures of central tendency

Normal distribution

The symmetrical bell-shaped distribution from a large series of measurements plotted on a frequency histogram.

The mean is in the middle, with an equal number of smaller and larger values either side of it.



Mean Add all the measurements together then divide by the number of measurements taken. The mean can only be used if the data approximate to a normal distribution, and have an interval or ratio measurement scale.

Median Arrange the data in order, and take the middle value as the median. It can be used for data which are not normally distributed. Suitable for variables with an ordinal scale.

Mode The value which occurs most often. Suitable for variables with a nominal scale.

Measures of dispersion

Dispersion The spread of data around the average, usually expressed as the mean \pm interquartile range or mean \pm standard deviation.

Range is the distance between the highest and lowest value.

Interquartile range is the part of the range that covers the middle 50% of the data.

If the variable has an interval or ratio scale and if the data are normally distributed, use the interquartile range or the standard deviation. Otherwise use the median and range to show dispersion.

Enquiry considerations

Data presentation

Be objective: Are all your graphs accurate? Is your choice of measures of central tendency and dispersion appropriate for the type of data?

Be critical: Are your charts, graphs and other data presentation techniques valid?

Be ethical: Have you acknowledged all the sources of secondary data you have used?



Analysing quantitative data

Spearman's Rank Correlation Test

$$r_s = 1 - \frac{6\sum D^2}{n(n^2-1)}$$

D = difference between ranks
 n = number of pairs of measurement

- tests the strength of the association (relationship) between two variables
- needs variables with an ordinal scale
- needs at least 12 pairs of measurements

Reject the null hypothesis if calculated r_s is **above** the critical value

Chi-squared Test

$$\chi^2 = \sum \frac{(O - E)^2}{E}$$

O = observed values
 E = expected values

- tests data you have collected against a set of expected values
- needs variables with a nominal scale
- frequencies must be independent of each other, and no frequency can be under 5

Reject the null hypothesis if calculated χ^2 is **above** the critical value

Mann-Whitney U Test

$$U_1 = n_1 \times n_2 + 0.5 n_2(n_2 + 1) - \sum R_2$$

$$U_2 = n_1 \times n_2 + 0.5 n_1(n_1 + 1) - \sum R_1$$

R = ranks (so $\sum R_1$ is sum of ranks of first data set)
 n = number of replicates (so n_1 is of first data set)

- tests whether there is a significant difference between two sets of data
- needs variables with an ordinal scale
- needs at least 6 replicates per data set, but the number of replicates per data set do not have to be the same
- data do not need to be normally distributed

Reject the null hypothesis if calculated U is **below** the critical value

Data analysis

Spearman's Rank Correlation Test

Table of critical values		
Number of pairs	p = 0.01	p = 0.05
12	0.727	0.587
13	0.703	0.560
14	0.679	0.538
15	0.654	0.521
16	0.635	0.503
17	0.618	0.488
18	0.600	0.472
19	0.584	0.460
20	0.570	0.447

Significance

Significance testing finds the probability that any patterns in the data observed have arisen by chance. Test the *null hypothesis*, i.e. there is no relationship between the variables.

Check if your findings are statistically significant by comparing calculated value with critical values. A critical significance level of $p=0.05$ means that there is less than a 5% probability that the relationships or patterns observed in the data have arisen by chance.

Analysing qualitative data

Qualitative information (such as interview transcripts, photographs, creative writing and film) can be analysed objectively.

Frequency analysis

Frequency analysis identifies how often a particular theme occurs. For example, in a series of open-ended interviews about a city centre, 45% of the interviewees mentioned crime.

Thematic analysis

Thematic analysis helps you to look for recurring themes within your data. **Coding** is a useful technique of thematic analysis.

Descriptive coding Read the response several times. Try to summarise each line with a *label* consisting of a single word or short phrase.

Analytic coding Read your labels again. Try to group labels together into a few *concepts*.

Chi-squared Test

Table of critical values		
Degrees of freedom	p = 0.01	p = 0.05
1	6.64	3.84
2	9.21	5.99
3	11.35	7.81
4	13.28	9.49
5	15.09	11.07
6	16.81	12.59
7	18.48	14.07
8	20.09	15.51
9	21.67	16.92
10	23.21	18.31

Mann-Whitney U Test

Table of critical values (p = 0.05)													
		n ₁ (must be larger sample)											
		5	6	7	8	9	10	11	12	13	14	15	
n ₂	5	2	3	5	6	7	8	9	11	12	13	14	
	6		5	6	8	10	11	13	14	16	17	19	
	7			8	10	12	14	16	18	20	22	24	
	8				13	15	17	19	22	24	26	29	
	9					17	20	23	26	28	31	34	
	10						23	26	29	33	36	39	
	11							30	33	37	40	44	
	12								37	41	45	49	
	13									45	50	54	
	14										55	59	
	15											64	

Enquiry considerations

Data analysis

Be objective: Can you provide a mathematical justification for your choice of statistical test? For qualitative data, have you eliminated your own subjectivity as much as you can?

Be critical: Are your results statistically significant? Have you checked your figures to make sure your calculations are correct?

Be ethical: Have you ensured confidentiality and anonymity in analysing the results?



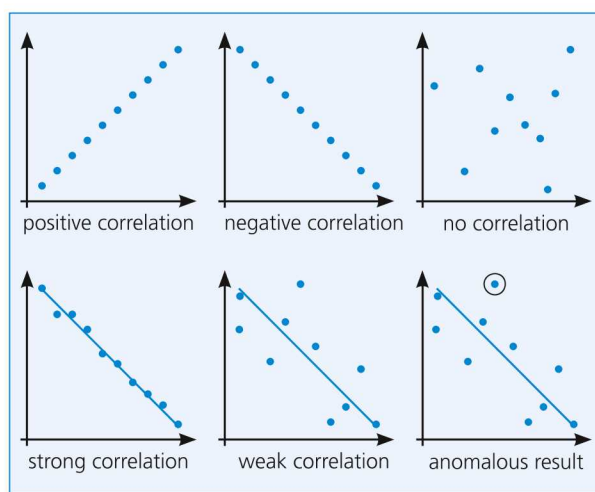
Describing your results

Write a commentary describing the trends, patterns or relationships in your results. Make comparisons between different locations or groups of people. Use numbers to support each statement. Here are some useful words.

Trends Increase, decrease, no change.

Patterns Equally distributed, unequally distributed, dispersed, concentrated, sparse.

Relationships Direction of correlation (positive, negative, none), strength of correlation (strong, weak), statements of proportion (e.g. 'A is 40% higher than B').



Explaining your results

Try to explain each finding you have described, with reference to geographical theory. Finally state whether your key findings show if your hypothesis is correct, partly correct or incorrect.

Enquiry considerations

Conclusions

Be objective: Have you described every single trend, pattern and relationship from your data presentation and data analysis? Are your conclusions statistically significant?

Be critical: Are all your conclusions supported by the evidence?

Be ethical: Is there a statement which details the ethical considerations of your research?

Evaluating your methods

True value The value that would be obtained in an ideal measurement.

Accuracy How close a measurement is to the true value.

The closer a measured value is to the true value, the more accurate it is. The further a measured value is from the true value, the greater the error.

Precision Precise measurements have very little spread about the mean value. A precise measurement is not necessarily accurate.

Errors An error is the difference between the result that you found and the true value.

There are three possible *sources of error*:

- **Measurement error:** mistakes made when collecting the data, such as a student mis-reading a thermometer.
- **Operator error:** differences in the results collected by different people, such as different people giving different scores.
- **Sampling error:** local differences meaning that one sample gives slightly different results to another.

These can produce two possible *types of error*:

- **Random error:** these cause results to be spread about the true value. For example, imagine a student takes 20 temperature readings and mis-reads the thermometer for 2 of the readings. The effect of random errors can be reduced by taking more measurements.
- **Systematic error:** these cause results to differ from the true value by a consistent amount each time the measurement is made. For example, imagine a student uses weighing scales which have not been zeroed, so all the results are 10g too high. The effect of systematic errors cannot be reduced by taking more measurements.

Anomalies These are values in a set of results which are judged not to be part of the variation caused by random uncertainty.



Evaluation

Evaluating your conclusions

A *valid conclusion* is supported by reliable data obtained using a valid method and based on sound reasoning.

Validity The suitability of the method to answer the question that it was intended to answer.

Reliability This is the extent to which measurements are consistent.

Enquiry considerations

Evaluation

Be objective: Have you considered all three sources of error?

Be critical: How have you judged that your conclusions are valid?

Be ethical: How successfully have you minimised the harm that your enquiry may have upon the environment and the people in it?

Interested in geography and want to do more?

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This guide was developed by Trevor Collins, Victoria Cooper and Lucinda Kerawalla (Open University Children's Research Centre) and Simon Norman and Sam Rudd (Field Studies Council). The authors wish to thank Rebecca Kitchen and Alan Kinder (Geographical Association) for their advice on an earlier draft.

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