



General Certificate of Education
Advanced Level Examination
June 2010

Human Biology

HBI6T/Q10/task

Unit 6T A2 Investigative Skills Assignment Task Sheet

The effect of using one or two eyes on the perception of distance

Introduction

In this investigation, you will attempt to drop a counter into a small container.

You are going to investigate how using one or two eyes affects your ability to judge distance.

You will measure your ability to judge distance with one eye open and with two eyes open.

It is important that you do **not** practise any of the steps in this investigation before starting work.

You will need to make some decisions for yourself.

Materials

You are provided with

- 10 plastic counters
- a small container with a thin layer of cotton wool at the bottom
- a clear, flat surface to work on
- a ruler or tape measure

You may ask your teacher for any other apparatus you require.

Outline Method

Read these instructions carefully before you start your investigation.

1. Place the container on the clear, flat surface. There should be nothing else on the surface.
2. Sit down facing the surface with both hands on your lap.
3. Take the container in one hand and then close both your eyes. Slide the container to a place over 30 cm from you. Remove your hand from the container and replace it on your lap.
4. Open one eye and use your other hand to pick up a counter.
5. Hold the counter at eye level, and immediately try to drop the counter into the container.
6. Record a 'hit' or a 'miss.'
7. Repeat steps 3 to 6 by moving the container to another position.
8. Repeat steps 3 to 7 as many times as necessary to carry out a suitable statistical test.
9. Repeat steps 3 to 8 but this time drop the counter with both eyes open.

You will need to decide for yourself

- what is a 'hit' and what is a 'miss'
- how many repeats to do
- which statistical test to carry out.

ISA HBI6T/Q10 Candidate Results Sheet: Stage 1

The effect of using one or two eyes on the perception of distance

Centre Number

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Candidate Number

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Candidate Name

Record your data in a table in the space below.

(2 marks)

Hand in this sheet at the end of each practical session.

Turn over ►

ISA HBI6T/Q10 Candidate Results Sheet: Stage 2

The effect of using one or two eyes on the perception of distance

Centre Number

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Candidate Number

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Candidate Name

Use the space below to analyse your data with a suitable statistical test. You may use a calculator and the statistical sheet that has been provided to perform this test.

(6 marks)

You should

- state your null hypothesis

- give your choice of statistical test

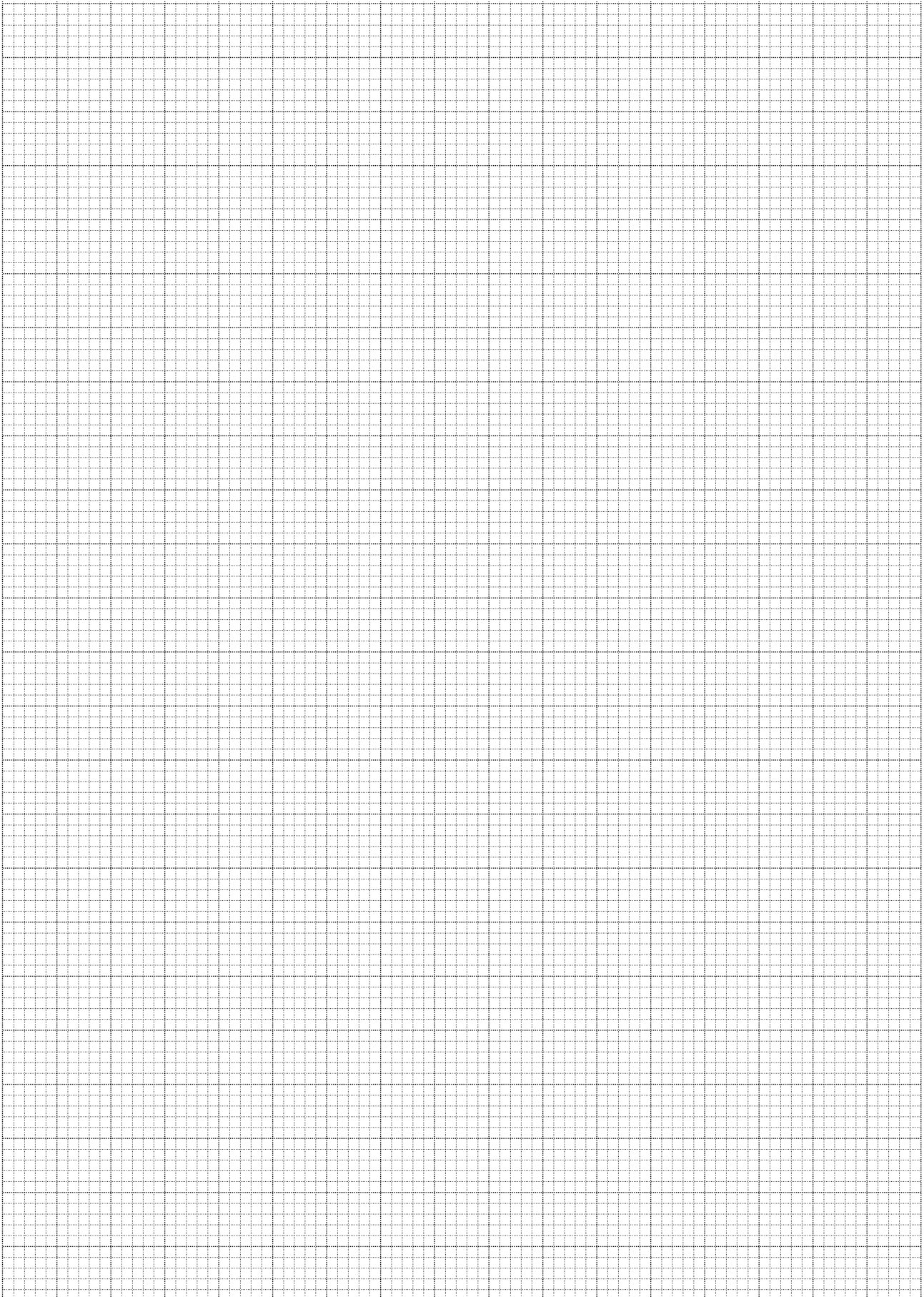
- give reasons for your choice of statistical test

- carry out the test and calculate the test statistic

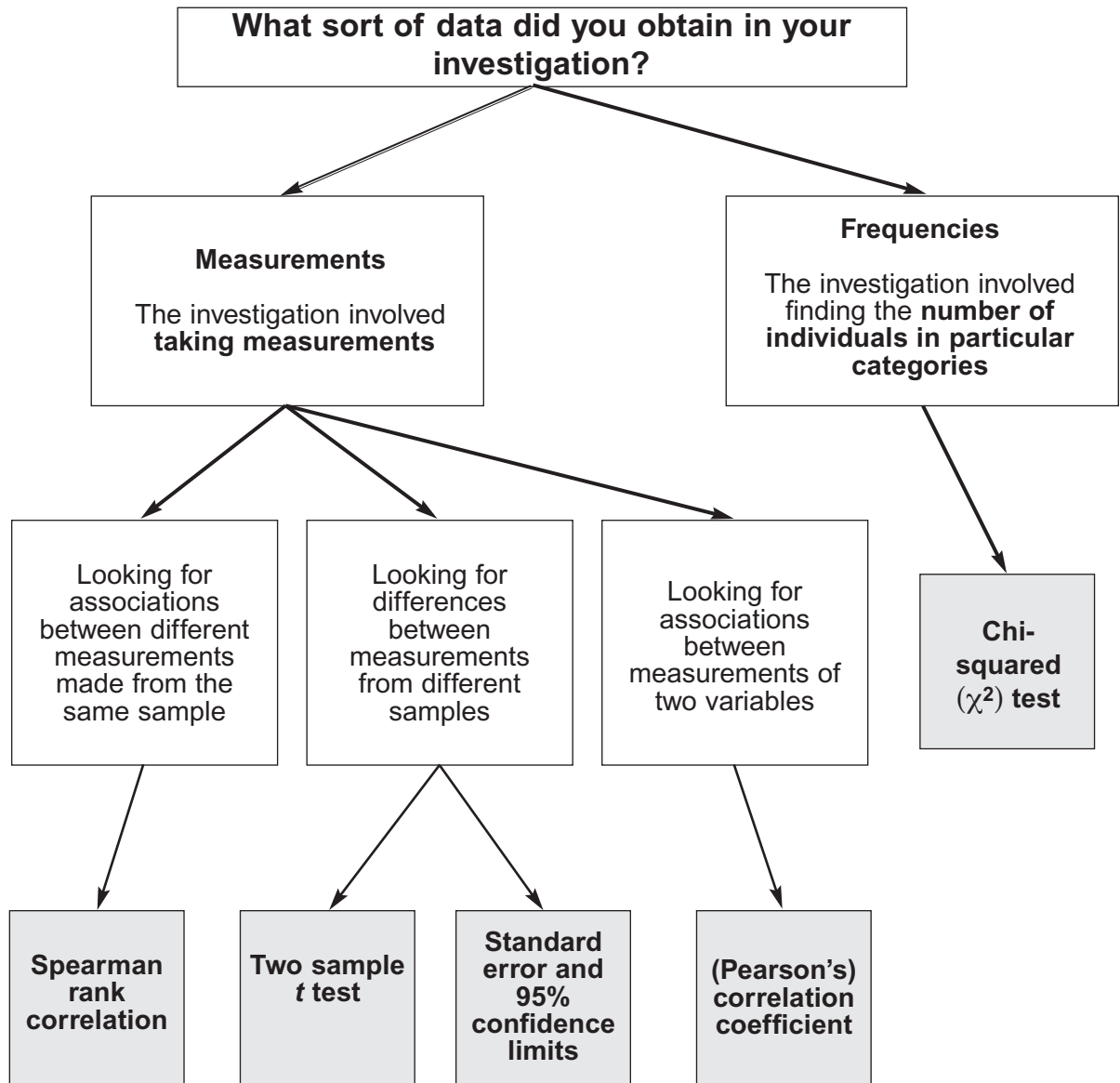
- interpret the test statistic in relation to the null hypothesis being tested.

This graph paper is provided for use if you need it.

Hand in this sheet at the end of the practical session.



Students' Statistics Sheet



For use in the A2 ISA and EMPA assessment

Turn over ►

Statistical tests and tables of critical values

Tables of critical values

A table of critical values is provided with each statistical test. If your calculated test statistic is less than, or equal to, the critical value, then the result of your statistical test is significant. This means that your null hypothesis should be rejected.

Spearman rank correlation test

Use this test when

- you wish to find out if there is a significant association between two sets of measurements from the same sample
- you have between 5 and 30 pairs of measurements.

Record the data as values of X and Y.

Convert these values to rank orders, 1 for largest, 2 for second largest, etc.

Now calculate the value of the Spearman rank correlation, r_s , from the equation

$$r_s = 1 - \left[\frac{6 \times \sum D^2}{N^3 - N} \right]$$

Where N is the number of pairs of items in the sample.

D is the difference between each pair (X-Y) of measurements.

A table showing the critical values of r_s for different numbers of paired values.

Number of pairs of measurements	Critical value
5	1.00
6	0.89
7	0.79
8	0.74
9	0.68
10	0.65
12	0.59
14	0.54
16	0.51
18	0.48

Correlation coefficient (Pearson's correlation coefficient)

Use this test when

- you wish to find out if there is a significant association between two sets of measurements measured on interval or ratio scales
- the data are normally distributed.

Record the data as values of variables X and Y.

Now calculate the value of the (Pearson) correlation coefficient, r , from the equation

$$r = \frac{\Sigma XY - [(\Sigma X)(\Sigma Y)]/n}{\sqrt{\{\Sigma X^2 - [(\Sigma X)^2/n]\} \{\Sigma Y^2 - [(\Sigma Y)^2/n]\}}}$$

Where n is the number of values of X and Y.

A table showing the critical values of r for different degrees of freedom.

Degrees of freedom	Critical value	Degrees of freedom	Critical value
1	1.00	12	0.53
2	0.95	14	0.50
3	0.88	16	0.47
4	0.81	18	0.44
5	0.75	20	0.52
6	0.71	22	0.40
7	0.67	24	0.39
8	0.63	26	0.37
9	0.60	28	0.36
10	0.58	30	0.35

For most cases, the number of degrees of freedom is = $n - 2$

The t test

Use this test when

- you wish to find out if there is a significant difference between two means
- the data are normally distributed
- the sample size is less than 25.

t can be calculated from the formula

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{(s_1^2/n_1) + (s_2^2/n_2)}}$$

Where \bar{x}_1 = mean of first sample

\bar{x}_2 = mean of second sample

s_1 = standard deviation of first sample

s_2 = standard deviation of second sample

n_1 = number of measurements in first sample

n_2 = number of measurements in second sample

A table showing the critical values of t for different degrees of freedom.

Degrees of freedom	Critical value	Degrees of freedom	Critical value
4	2.78		
5	2.57	15	2.13
6	2.48	16	2.12
7	2.37	18	2.10
8	2.31	20	2.09
9	2.26	22	2.07
10	2.23	24	2.06
11	2.20	26	2.06
12	2.18	28	2.05
13	2.16	30	2.04
14	2.15	40	2.02

The number of degrees of freedom = $(n_1 + n_2) - 2$

Standard error and 95% confidence limits

Use this when

- you wish to find out if the difference between two means is significant
- the data are normally distributed
- the sizes of the samples are at least 30. For assessment purposes, five samples are acceptable providing that this is acknowledged either at a convenient place in the statistical analysis or in the conclusions.

Standard error

Calculate the standard error of the mean, SE , for each sample from the following formula:

$$SE = \frac{SD}{\sqrt{n}}$$

Where SD = the standard deviation

n = sample size

95% confidence limits

In a normal distribution, 95% of datapoints fall within ± 2 standard deviations of the mean.

Usually, you are dealing with a sample of a larger population. In this case the 95% confidence limits for the sample mean is calculated using the following formula

$$95\% \text{ confidence limits} = \bar{x} \pm 2 \times \frac{SD}{\sqrt{n}} \quad \text{OR} \quad \bar{x} \pm 2 \times SE$$

Turn over ►

The chi-squared test

Use this test when

- the measurements relate to the number of individuals in particular categories
- the observed number can be compared with an expected number which is calculated from a theory, as in the case of genetics experiments.

The chi-square (χ^2) test is based on calculating the value of χ^2 from the equation

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

Where O represents the observed results

E represents the results we expect.

A table showing the critical values of χ^2 for different degrees of freedom.

Degrees of freedom	Critical value
1	3.84
2	5.99
3	7.82
4	9.49
5	11.07
6	12.59
7	14.07
8	15.51
9	16.92
10	18.31

The number of degrees of freedom = number of categories – 1