Answers

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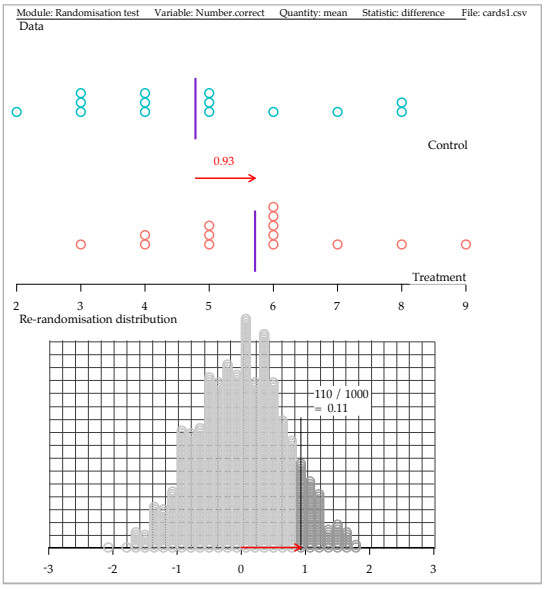
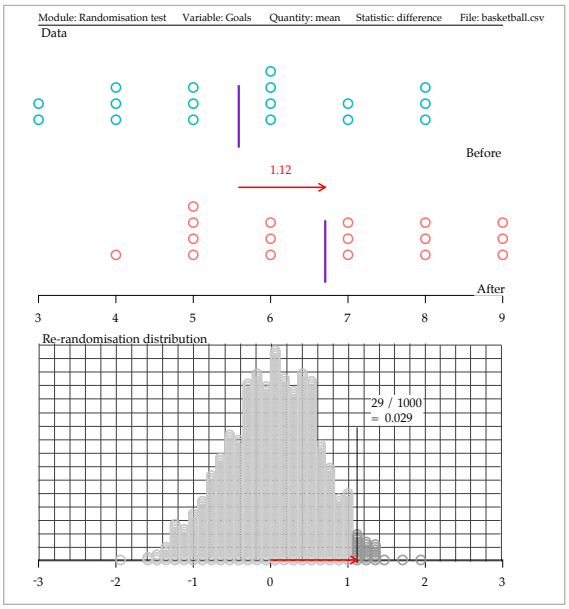
Note: As this is a random process answers will vary slightly. Your answer must be consistent with your random sample. If the proportion is under 10% then it is accepted that the result cannot be attributed to chance alone.

1. a)



b) There is an 11% chance that this difference is the result of chance alone. As this figure is greater than 10% we cannot rule out that the non-replacement group got their results by chance alone.

2. a)



b) There is a 2.9% chance that this difference in free throw results is the result of chance alone. On the basis of this figure it is highly unlikely that chance alone resulted in the increase in free throw goals. Therefore it is reasonable to assume that the treatment has contributed to this increased result.

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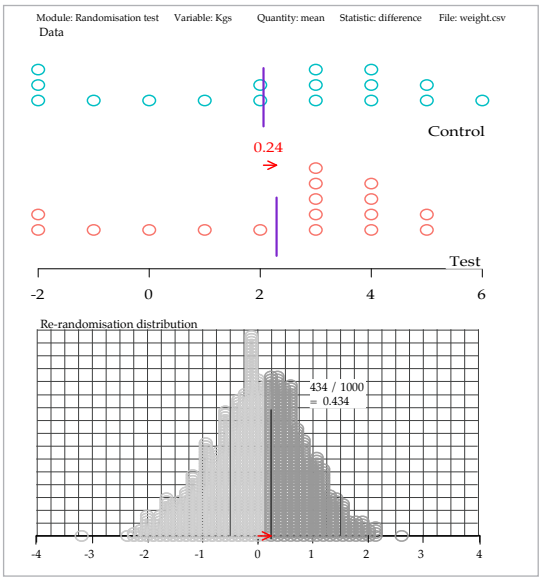
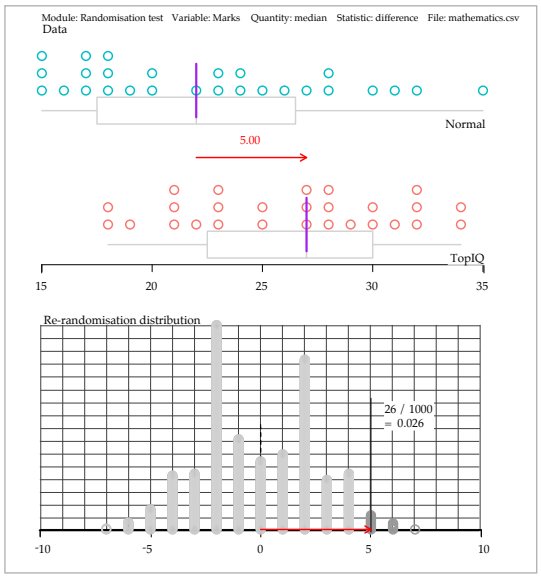
3. a)



b) There is a 43.4% chance that this difference is the result of chance alone. It is highly likely that the difference in weight loss was due to chance alone and not the result of the weight loss drug. Therefore it is reasonable to assume that the weight loss drug has little or no effect on weight loss.

4. a)



b) There is a 2.6% chance that this difference is the result of chance alone. It is highly unlikely that the difference in marks was due to chance alone. Therefore it is reasonable to assume that the teacher's expectations have contributed to the increased marks.

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The following should be treated as examples.

Other investigations are possible.

5. Will the gender of a person in a photograph affect the estimate of the height? The control group photos will be the same gender as the participant while the treatment group photos will be similar photographs but the opposite gender. Each Year 13 participant will get three random photographs from each set. All photos will be taken from three metres, directly in front, at standing subjects.

I would expect the heights of the same gender as the participant to be more accurate and those from the opposite gender to be less accurate.

In this case my treatment is the gender in the photograph.

My response variable is the absolute value of the error in predicting the height.

My population is Year 13 students.

6. Will background music effect a participant's accuracy at predicting a time interval between 30 and 45 seconds? Year 12 mathematics students will be randomly divided into control and treatment groups. The control group will be asked to estimate the length of two intervals with no distractions. The treatment group will also be asked to estimate two intervals while light popular music is playing in the background.

I would expect that the no distraction (control) group would be more accurate at estimating the time interval.

In this case my treatment is the music in the background.

My response variable is the absolute value of the error in predicting the time interval.

My population is Year 12 students.

7. Will giving students something to chew during a lesson increase their ability to recall facts? Year 12 mathematics students will be randomly divided into control and treatment groups. The control group will be taught with no chewing. The treatment group will be asked to chew (whether they wanted to or not) during the lesson.

I would expect the chewing group (treatment) would remember more facts.

In this case my treatment is the action of chewing.

My response variable is the number of facts remembered in a test.

My population is Year 12 students.

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8. Will students without shoes run faster over 100 metres? Year 11 PE students will be randomly divided into control and treatment groups. The control group will be asked to run 100 metres and their time recorded.
The treatment group will be asked to remove their shoes and run 100 metres.

I would expect the without shoe (treatment) group to run faster.

In this case my treatment is absence of shoes.

My response variable is the time to run 100 metres.

My population is Year 11 students.

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9. The confounding variables may be:

- gender (one sex is more sensitive to pain)
- number of hairs on the arm (the more hairs the more the plaster will stick)
- the reaction of others in earshot. If someone has called out previously it could sensitise the following participants.

Design. Use the same individuals as the control and treatment group. Put two plasters on each participant. One on the same part of each arm The control group will be the slow pull off group and the treatment group the fast pull off group.

Randomly allocate the order of the treatments and each participant in isolation gets one then the other plaster removed. After each plaster is removed they are asked to rate the pain from 1 (no pain) to 10 (very painful).

10. The confounding variables may be:

- gender (one sex may be faster then the other)
- whether the person is left or right-hand dominant

Design. Using a test retest approach means the proportion of each group will be the same, we just need to minimise the possible learning effect of the test. Identify whether the participants are left-handed, right-hand or ambidextrous (neither left or right).

Randomly allocate the order of the test so each participant uses one hand then the other three times. The results for each hand are averaged.

The ambidextrous group are kept separate as neither hand is dominant.

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11. Purple may be a favourite or least favourite colour. Give a small questionnaire to find the least and most favourite colour. The confounding variables may be:

- Likes purple
- Dislikes purple

Design. Divide the participants up into blocks, likes purple, dislikes purple or no opinion of purple.

Randomly allocate the participants in each block to the control and treatment groups so there is an even number of participants from each block in each of the two groups. Tell both groups that they are to taste a new cordial developed at school and need to rate it from 1 horrible to 10 great. This way they do not know that the experiment is about colour and not taste (single blind).

12. Some students may dislike the taste of sports drink or fruit juice. The possible confounding variables may be:

- Dislikes sports drinks
- Dislikes fruit juice.

Design. Ask beforehand how often they have either sports drink or juice and divide the participants into blocks. Lower frequency sports drink in one block, lower frequency fruit juice in the second and the rest in the third block.

Randomly allocate the participants in each block to the control and treatment groups so there is an even number of participants from each block in each of the two groups.

A potentially better way is to use the same drink for both groups and add some caffeine to the treatment drink. It is unlikely that a school will allow students to add caffeine to a drink but they may allow them to drink a sports drink containing caffeine.

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13. Both groups will be told to record the time taken and who got how many sticks but the time taken is the response variable. The confounding variables may be:

- Gender. Maybe one sex is more competitive than the other.
- Degree of socialisation. Will social isolates be more or less competitive?

Design. Ask them beforehand how many of the forty participants they know.

Then divide them into blocks by gender and then further divide each blocks by whether they know more or less than five participants.

Page 22 Q13 cont...

Randomly allocate the participants in each block to the control and treatment groups so there is an even number of participants from each block in each of the two groups. Tell the control group to pair up with someone in their group. The control group will be told to work together to collect the sticks while sticking to the rules. The treatment group will also be told the total time is important and which of them has the most sticks is important. This way they do not know that the experiment is just about time (single blind).

14. The possible confounding variables may be:

- Gender
- Part time job.

Design. Ask beforehand whether they have a part time job and then divide the group into two blocks based on gender and further divide the two blocks based on the part time work.

Randomly allocate the participants in each block to the control and treatment groups so there is an even number of participants from each block in each of the two groups. Tell both groups this is an exercise in how people spend large amounts of money. This way they do not know that the two groups are getting different instructions (single blind).

Page 27

15. a) Five individuals should each be tested three times with dominant hand and non-dominant hand. The hand tested would be decided randomly for each drop.

The hand would rest on a flat surface (so it could not drop with the ruler) and the thumb and forefinger would be 20 mm apart. The time for release would be varied without any pattern from 5 to 30 seconds.

b) As this is an experiment the results will vary.

c) The results will vary but a dot plot and histogram of differences should be given along with the proportion of differences greater than the experiment results.

d) If the proportion is greater than 0.1 (10%) then we can state that we have no evidence against chance acting alone in this experiment. If the proportion is less than 0.1 (10%) then we can conclude that we have evidence that chance is not acting alone and the dominance of the hand affects the reaction time.

Pages 28 to 29

16. a) Place the coin always 'tail' up on your thumb and rest the hand on the desk so it cannot not move and effect the result. Then flip the coin with a minimum of force so it rises just clear of the hand each time and does not just fall off. Hopefully the coin does the same number of rotations each time.

b) I had fifteen participants randomly allocated to each of two groups. The control group were asked to flip the coin twenty times each and record the results. I asked each member of the test group to follow the procedure described in a).

Where the coin did not settle on the desk and rolled off or rolled onto a book etc. then we repeated that particular throw.

c) As this is an experiment the results will vary.

d) Observations should include how well the test group followed the instructions and what they did when the coin fell on the floor.

e) The results will vary but a dot plot and histogram of differences should be given along with the proportion of differences greater than the experiment results.

f) If the proportion is greater than 0.1 (10%) then we can state that we have no evidence against chance acting alone in this experiment. If the proportion is less than 0.1 (10%) then we can conclude that we have evidence that chance is not acting alone and the procedure affects the probability of getting a 'head'.

Pages 30 to 32

17. a) Generally worked but sometimes the participants omitted a feature such as the chin in which case it scored 0.

b) As this is an experiment the results will vary.

c) Observations should include comments about whether the test group tended to rotate the shield so the text was at the bottom and whether similar rotation was seen from the control group.

d) The results will vary but a dot plot and histogram of differences should be given along with the proportion of differences greater than the experiment results.

e) If the proportion is greater than 0.1 (10%) then we can state that we have no evidence against chance acting alone in this experiment. If the proportion is less than 0.1 (10%) then we can conclude

Pages 30 to 32 Q17 e) cont...

17. e) that we have evidence that chance is not acting alone and the text description affected whether the shield was more or less face like.

Pages 33 to 34

18. a) Results will vary with the year level of the students but there should be a significant difference for some students in the test group (students with visual memory).

b) Observations should include how well the test group with pen and paper followed instructions and the sort of things they recorded.

c) The results will vary but a dot plot and histogram of differences should be given along with the proportion of differences greater than the experiment results.

d) If the proportion is greater than 0.1 (10%) then we can state that we have no evidence against chance acting alone in this experiment. If the proportion is less than 0.1 (10%) then we can conclude that we have evidence that chance is not acting alone and that making notes while you are being given information increases the amount you can remember even if the notes are not referred to again.

Pages 35 to 38

19. a) Need one selection of 1, 2, 3 or 4.

b) Description needs to be precise and consistent with treatment.

c) Results will vary with the year level of the students but there should be a significant difference between the control and test groups for some treatments.

d) Observations should include how well they followed instructions and difficulty in keeping to the procedure (e.g. acting out some words).

e) The results will vary but a dot plot and histogram of differences should be given along with the proportion of differences greater than the experiment results.

f) If the proportion is greater than 0.1 (10%) then we can state that we have no evidence against chance acting alone in this experiment. If the proportion is less than 0.1 (10%) then we can conclude that we have evidence that chance is not acting alone and the treatment increases the amount you can remember.

Pages 39 to 42

20. a) Results vary but most suggest little or no effect. Test a particular colour.

b) Get one class and randomly allocate half to a control group and the rest form the test group. They can sit the test at the same time with the same instructions. The only difference is the test group will have green test papers.

c) As this is an experiment the result will vary.

d) Observation should include how students reacted to the different colours. along with the proportion of differences greater than the experiment results.

Pages 39 to 42 Q 20 cont...

e) The results will vary but a dot plot and histogram of differences should be given

f) If the proportion is greater than 0.1 (10%) then we can state that we have no evidence against chance acting alone in this experiment. If the proportion is less than 0.1 (10%) then we can conclude that we have evidence that chance is not acting alone and the colour of paper affects the performance of students.

Pages 45 to 49 and Pages 50 to 56

Practice Internal Assessments – Chewing Gum and Stoop Effect (same marking scheme).

Final grades will be decided using professional judgement based on a holistic examination of the evidence provided against the criteria in the Achievement Standard.

	Evidence/Judgements for Achievement	Evidence/Judgements for Achievement with Merit	Evidence/Judgements for Achievement with Excellence
	The student conducts an experiment to investigate a situation using experimental design principles.	The student conducts an experiment to investigate a situation using experimental design principles, with justification.	The student conducts an experiment to investigate a situation using experimental design principles, with statistical insight.
	The student has produced a report that shows they have undertaken each component of the investigation process.	The report shows that they have linked components of the process of investigating a situation by experiment to the context, explaining relevant considerations made in the investigation process and supporting findings with statements which refer to evidence gained from the experiment.	The report shows they have integrated statistical and contextual knowledge throughout the investigation process. This may be demonstrated through such evidence as: reflecting about the process; discussing how possible sources of variation were dealt with during the design phase; and considering other confounding relevant variables.
	The student has:	The student has:	The student has:
Posing an investigative question about a given experimental situation.	• clearly stated what they are going to investigate (the experimental situation). • posed a causal relationship question that can be investigated by conducting an experiment.	• clearly stated what they are going to investigate (the experimental situation). • posed a causal relationship question that can be investigated by conducting an experiment. • made a prediction for their experiment, with justification using research findings.	• used contextual and statistical knowledge informed by research to develop an investigative question. • posed a causal relationship question that can be investigated by conducting an experiment. • made a prediction for their experiment with justification using research findings.

	Achievement	Achievement with Merit	Achievement with Excellence
Planning an experiment using experimental design principles.	• identified the type of experiment to be conducted. • identified the experimental units for the experiment. • identified the treatment variable and how it will be manipulated along with the response variable and how it will be measured. • described how the treatments will be allocated to the experimental units. • identified other sources of variation that could affect the results of the experiment.	• identified the type of experiment to be conducted and the experimental units. • identified the treatment variable and how it will be manipulated along with the response variable and how it is measured. • justified the allocation of the treatment to the experimental units. • identified other sources of variation and how they might affect the experiment.	• identified the type of experiment to be conducted and the experimental units. • justified how the treatment variable (including levels and groups) and response variable were defined for the experiment. • used contextual knowledge to identify relevant variables that could affect the response variable and used statistical knowledge to describe how these sources of variation could be controlled or balanced.
Conducting the experiment.	The student has collected and recorded the data from the experiment, and recorded any issues that arose during the experiment.	The student has collected and recorded the data from the experiment, identifying any issues that arose during the experiment and how they might affect their findings.	The student has reflected on how the experiment was conducted, identifying key issues in the design and explaining how any design issues might be addressed.
Selecting and using appropriate displays and summary statistics.	• produced displays and statistics appropriate to the design of the experiment. • described key features of the displays and statistics relevant to the experiment. • used an appropriate statistical method to obtain evidence to answer the investigative question.	• produced displays and statistics appropriate to the design of the experiment. • described key features of the displays and statistics relevant to the experiment. • used an appropriate statistical method to obtain evidence to answer the investigative question. • justified their statistical method in relation to the causal relationship.	• produced displays and statistics appropriate to the design of the experiment. • used features of the data to explore further factors and effects. • used an appropriate statistical method to obtain evidence to answer the investigative question. • used statistical insight to justify their method in relation to the causal relationship.
Making an appropriate formal statistical inference.	The student has used the statistical method selected to make a correct inference about the causal relationship investigated.	The student has assessed and interpreted the strength of evidence for the inference about the causal relationship investigated.	The student has assessed and interpreted the strength of the evidence for the inference about the causal relationship investigated.
Communicates findings in a conclusion.	The student has clearly communicated each component of the investigative process.	• clearly communicated each component of the investigative process. • linked the design of the experiment to their results and research findings.	• discussed how their findings relate to other research findings. • used informed contextual knowledge to generalise to the wider experimental situation in their discussion of their findings.