2020 Quiz 2

Due No due date **Points** 23 **Questions** 20 **Time Limit** None

Instructions

This quiz is open from 1pm AEST to 3pm AEST.

You may refer to your lecture notes in answering the quiz.

Answers must be your own work.

Plagiarism declaration

By submitting work for this quiz I hereby declare that I understand the University's policy on academic integrity (https://academicintegrity.unimelb.edu.au/) and that the work submitted is original and solely my work, and that I have not been assisted by any other person (collusion) apart from where the submitted work is for a designated collaborative task, in which case the individual contributions are indicated. I also declare that I have not used any sources without proper acknowledgment (plagiarism). Where the submitted work is a computer program or code, I further declare that any copied code is declared in comments identifying the source at the start of the program or in a header file, that comments inline identify the start and end of the copied code, and that any modifications to code sources elsewhere are commented upon as to the nature of the modification.

Attempt History

	Attempt	Time	Score
LATEST	Attempt 1	109 minutes	21 out of 23

⓵ Correct answers are no longer available.

Score for this quiz: **21** out of 23
Submitted Jul 15 at 14:49
This attempt took 109 minutes.

Question 1 — 1.5 / 1.5 pts

An experiment investigated the effect of age on postural sway. Seventeen adults were classified as either "young" or "old", dividing them into two groups. Each subject stood barefoot on a "force platform" and was asked to maintain a stable upright position and to react as quickly as possible to an unpredictable noise by pressing a hand held button. The noise came randomly and the subject concentrated on reacting as quickly as possible. The platform automatically measured how much each subject swayed in millimetres in both the forward/backward and the side-to-side directions. Assume that the participants are a random sample from the population of adults.

The outcomes studied were the "forward/backward sway" (FBSway) and the "side-to-side sway" (SideSway).

Which of the follow describe population parameters that could be estimated from this study? (Tick as many as apply.)

- [ ] The observed difference of means in side-to-side sway (old versus young).
- [ ] The observed difference in the proportion of adults with a side-to-side sway of more than 15 mm (old versus young).
- [x] The true difference in the proportion of adults with a side-to-side sway of more than 15 mm (old versus young).
- [x] The true mean side-to-side sway in young adults.
- [x] The true difference of means in side-to-side sway (old versus young).
- [ ] The observed mean side-to-side sway in the young adults in the experiment.

A parameter refers to the true value in the population. The observed value is used to estimate the value of the parameter.

Question 2

1 / 1 pts

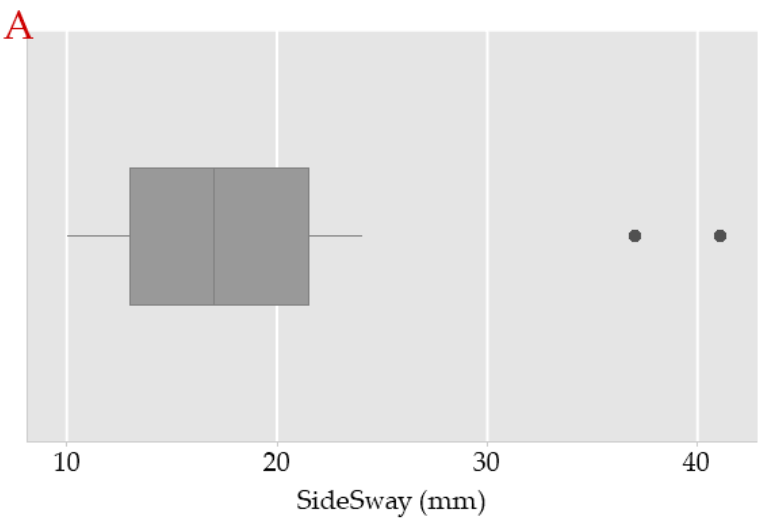
The data in sway.mwx describe the results of the experiment investigating the forward/backward sway and side-to-side sway in the experiment referred to in Question 1.

You do not need to use the data to answer the question but you may refer to it if you wish to.

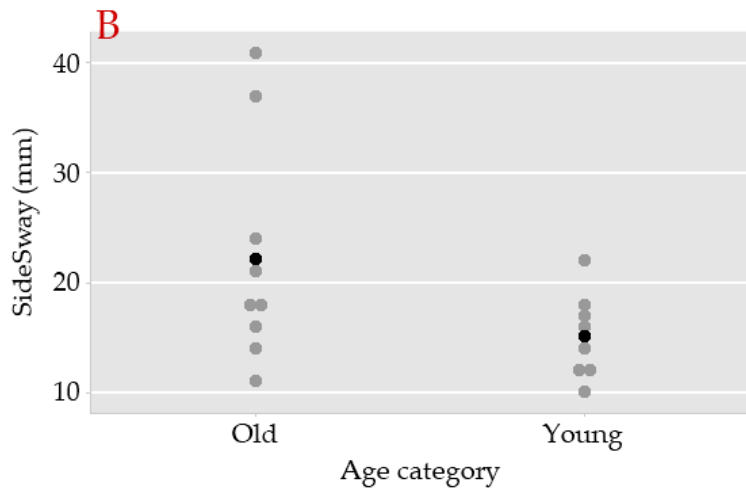
Consider the side-to-side sway (SideSway).

Which visual display best addresses the question of the difference in SideSway between the old and young adults in the experiment?

A

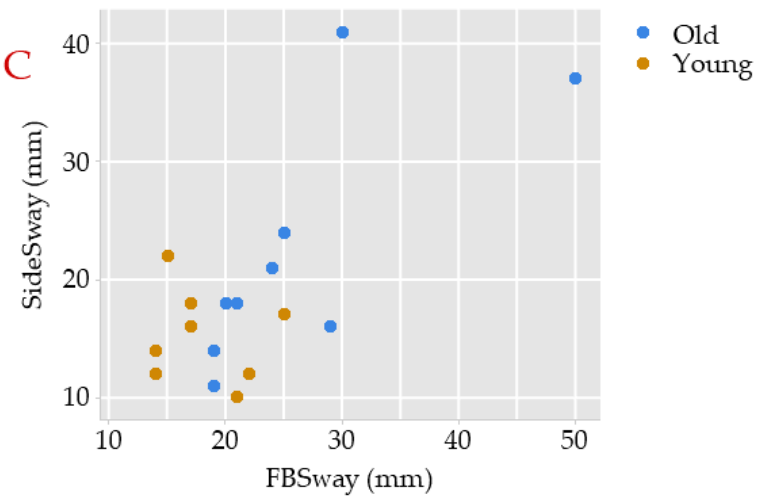


B

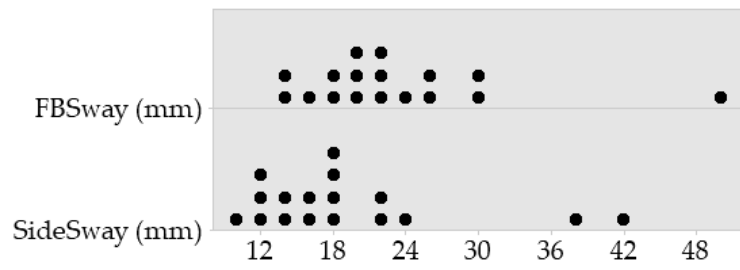


Black dots show the means

C



D



C

B

A

D

The top right hand graph shows the data for the young and old group. The bottom left shows the association between side-to-side sway and front-to-back sway; it shows old and young but does not allow comparison of the differences on side-to-side sway as clearly as the top right graph.

Question 3

1 / 1 pts

Questions 3, 4 and 5 refer to an analysis carried out on an experiment.

The experiment investigated the effect of vitamin B12 on the weight gain of pigs. The outcome measured was the amount of weight gained (in kilograms) over a four week period. Pigs were randomly assigned to one of two groups - one received a vitamin B12 supplement added to their food, the other group did not. Assume, also, that the pigs for the experiment were randomly sampled from a large population of eligible pigs.

The analysis is shown in the following Minitab output, which you should refer to for these questions.

Method

μ_1: population mean of Weight gain over four weeks kg when Vitamin B12 = Yes
μ_2: population mean of Weight gain over four weeks kg when Vitamin B12 = No
Difference: $\mu_1 - \mu_2$

Equal variances are assumed for this analysis.

Descriptive Statistics: Weight gain over four weeks kg

Vitamin B12	N	Mean	StDev	SE Mean
Yes	6	1.382	0.179	0.073
No	6	1.112	0.112	0.046

Estimation for Difference

Difference	Pooled StDev	95% CI for Difference
0.2700	0.1493	(0.0779, 0.4621)

Test

Null hypothesis $H_0: \mu_1 - \mu_2 = 0$
Alternative hypothesis $H_1: \mu_1 - \mu_2 \neq 0$

T-Value	DF	P-Value
3.13	10	0.011

What is the estimate of the true difference in means (vitamin B12 minus No vitamin B12), based on this analysis (to 2 decimal places)?

- (•) 0.27
- ( ) 0.46
- ( ) 0.08
- ( ) 1.38
- ( ) 3.13

The estimate for the difference of means, as shown in the output, is 0.27.

Partial

Question 4

1 / 1.5 pts

Consider the results above again.

Which of the following assumptions have been made in carrying out the analysis? (Tick as many as apply.)

- [ ] The distribution of weight gain over four weeks is Normal in the population of pigs taking B12 and in the population of pigs not taking B12.
- [x] The effect of the treatment (vitamin B12 or not) on any one pig is unrelated to the effect on another pig.
- [ ] Vitamin B12 will have an effect on the growth of pigs.
- [x] The population variances are the same for pigs taking vitamin B12 and pigs not taking vitamin B12.
- [ ] The population variance for pigs taking vitamin B12 may be different from the population variance for pigs not taking vitamin B12.

Question 5

1.5 / 1.5 pts

Consider the analysis shown in the output.

According to these results and conventions of interpretation, which of the following are plausible values for the true difference of means? (Tick as many as apply.)

- [x] 0.27 kg

- [ ] 0.50 kg
- [x] 0.10 kg
- [ ] 0.01 kg
- [x] 0.40 kg
- [ ] 0.00 kg

Plausible values for the true mean difference are those inside the confidence interval.

Question 6

0.5 / 0.5 pts

A health promotion campaign in schools aimed to teach children to choose healthy foods when selecting snacks.

A random sample of 120 children who had heard the campaign were selected and asked what kind of snacks they had eaten on the previous day.

A separate random sample of 110 children from schools where the campaign has not been run were asked the same question.

Of the 120 children who had heard the campaign, 75 had chosen healthy snacks.

Of the 110 who did not hear the campaign, 47 chose healthy snacks.

Find an estimate for the true difference in the proportion of children choosing healthy snacks in the two groups (Campaign - No campaign).

Report the estimate to three decimal places. Make sure your answer is a difference of proportions, **not** a difference of percentages.

0.198

Question 7

0.75 / 0.75 pts

For the study above, use Minitab to find a 95% confidence interval for the true difference in the proportion of children choosing healthy snacks in the two groups (Campaign - No campaign).

Report the **lower** limit of the confidence interval to three decimal places. Make sure your answer is a difference of proportions, **not** a difference of percentages.

0.071

From the results shown for question 6, the confidence interval is 0.071, 0.324.

The lower bound is 0.071.

Question 8

0.75 / 0.75 pts

For the study above, use Minitab to find a 95% confidence interval for the true difference in the proportion of children choosing healthy snacks in the two groups (Campaign - No campaign).

Report the **upper** limit of the confidence interval to three decimal places. Make sure your answer is a difference of proportions, not a difference of percentages.

0.324

From the results shown for question 6, the confidence interval is 0.071, 0.324.

The upper bound is 0.324.

Incorrect

Question 9

0 / 1 pts

Consider the study of the healthy snacks campaign. Based on the information above and the analysis, which of the following statement can be made about the campaign's success?

- The success of the campaign is established by the higher proportion of children choosing healthy snacks in the schools running the campaign.
- The success of the campaign is established as the 95% confidence interval includes only positive differences: the children who heard the campaign clearly do better.
- We could be confident about the success of the campaign if the schools were randomly assigned to receive the campaign or not.
- The success of the campaign cannot be evaluated as no hypothesis testing has been carried out.
- We can be confident about the success of the campaign as the choice of healthy snacks is likely to depend only on exposure to the campaign.

The study design needs to be considered here, in particular, in drawing causal conclusions about the campaign. Attribution of causality in this kind of study relies on randomisation of groups to the different treatments. If this is not used, there may be differences other than participation in the campaign that might explain differences in children's behaviour, for example, the socio-economic status of children at schools which did, or did not, choose to receive the campaign.

Question 10

1 / 1 pts

A chocolate manufacturer is adding a new production line to produce a very popular type of chocolate bar - the Venus bar.

The average weight of the Venus bar is specified on the wrapper as 140 grams. The manufacturer plans to run a trial of the new production line to check on the weight of the bars produced. A random sample of 120 bars is taken from the trial run of the production line, and each bar is weighed.

Which of the following describes the parameter of interest in words?

- The probability of finding Venus bars with the weight specified on the packet.
- The average weight of Venus bars specified on the packet.
- The observed mean weight of Venus bars produced by the new production line.
-

The true mean weight of the Venus bars produced by the new production line.

Parameters refer to characteristics of populations.

The observed mean weight is a characteristic of a sample.

The value on the packet is a claim about the mean weight.

Question 11

1 / 1 pts

For the trial the manufacturer is conducting in Question 10, which of the following is an appropriate null hypothesis for the parameter of interest?

- The observed mean weight of Venus bars produced by the new production line is 140 grams.
- [x] The true mean weight of the Venus bars is 140 grams.
- The true mean weight of the Venus bars is more than 140 grams.
- The probability of finding Venus bars with the weight specified on the packet is less than 0.05.

A null hypothesis is a precise statement about the value of a population parameter; it gives a value to the parameter.

Question 12

1.5 / 1.5 pts

The data are collected for the trial described in Question 10, and the average weight from the sample of 120 bars is 143.1 grams.

The manufacturer's statistician carries out a 2-sided test of the null hypothesis, and finds that the *P*-value is $P = 0.12$.

Assume that the test was correctly carried out.

Which of the following are correct? (Tick as many as apply.)

- [x] As the P-value is large the data are consistent with the null hypothesis.
- [ ] The probability that the null hypothesis is true is equal to 0.12.
- [ ] As the P-value is large, the null hypothesis is true.
- [x] The probability of observing a mean weight at least 3.1 grams away from 140 is 0.12, if the true mean weight is 140 grams.

The P-value is the probability of the result observed, or more extreme, assuming the null hypothesis is true.

Question 13

1.5 / 1.5 pts

The statistician now finds a standard 95% confidence interval for the true mean weight of the Venus bars from the new production line. Which of the following are true? (Tick as many as apply.)

(The average weight based on the sample of 120 bars is 143.1 grams. For the 2-sided test of the null hypothesis, $P = 0.12$.)

- [ ] There is not enough information to tell if the 95% confidence interval includes 140 or not.
- [x] The lower limit of the 95% confidence interval will be less than 140.
- [x] The upper limit of the confidence interval will be more than 146.2.
- [ ] The 95% confidence interval will not include the value of 143.1.
- [ ] The 95% confidence interval will not include the value of 140.

We are carrying out an inference for the true mean weight of bars produced by the new production line. There is a connection between P-values and confidence intervals, which means that in this case, where P = 0.12, the 95% confidence interval will include the null value, 140; otherwise, the P-value would be smaller than 0.05. The 95% confidence interval will be symmetric around the observed mean, 143.1. Given that its lower limit must be less than 140, this means that its upper limit must be greater than 143.1 + 3.1 = 146.2.

Question 14

1.5 / 1.5 pts

The 120 Venus bars were a sample from the single trial run of the production line. What assumptions, if any, are involved about making an inference from these data? (Tick as many as apply.)

- [ ] The null hypothesis is true.
- [ ]

The sample of Venus bars on the first day need not be random as a production line produces almost identical bars.

- [x] There are no particular influences arising from running the production line for the first time.

- [x] The results of this single run represent the characteristics of the production line in general.

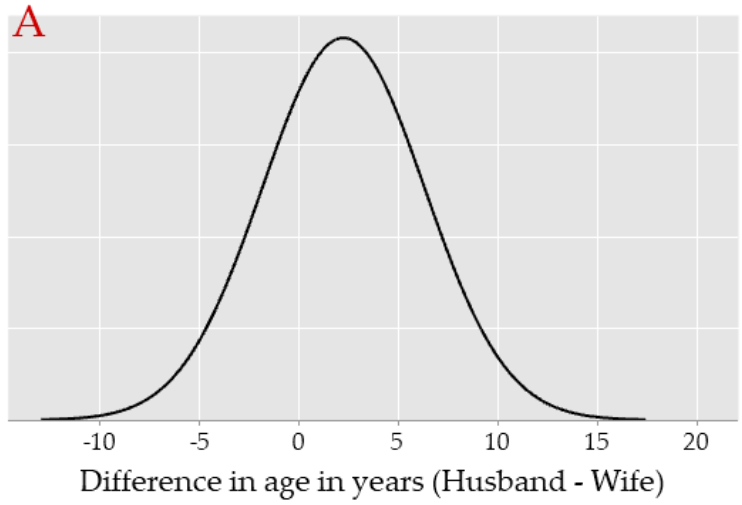
If we have only used a single run of the production line but wish to generalise, we need to assume that the results of this single run represent the characteristics of the production line in general, and that there are no particular influences arising from running the production line for the first time.

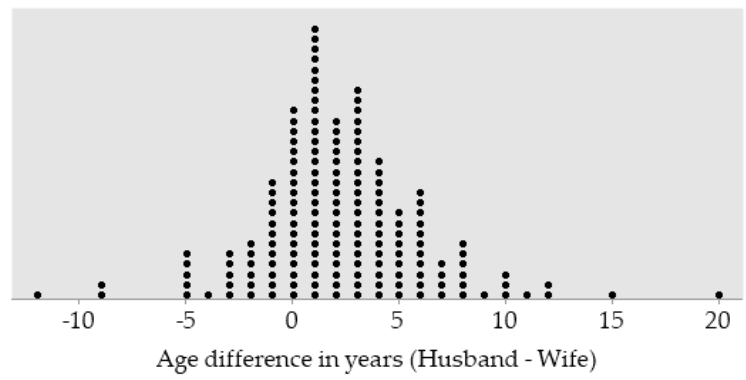
We don't assume the null hypothesis is true in making an inference; the inference is about the null hypothesis.

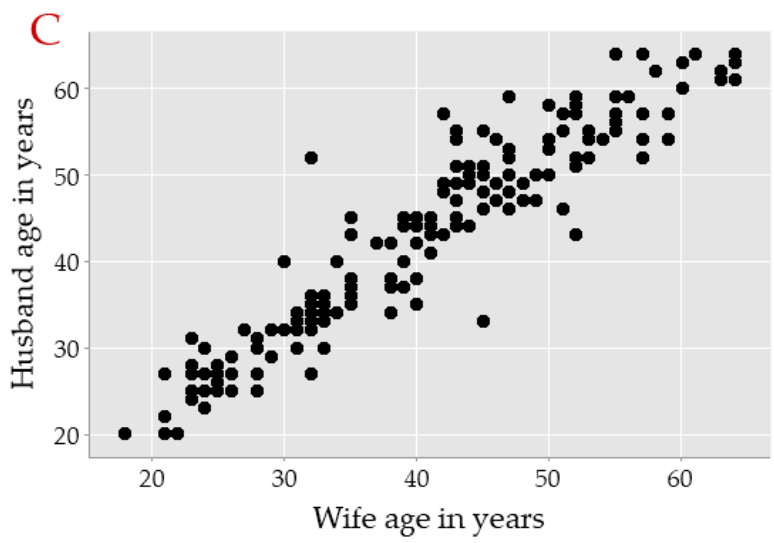
Question 15

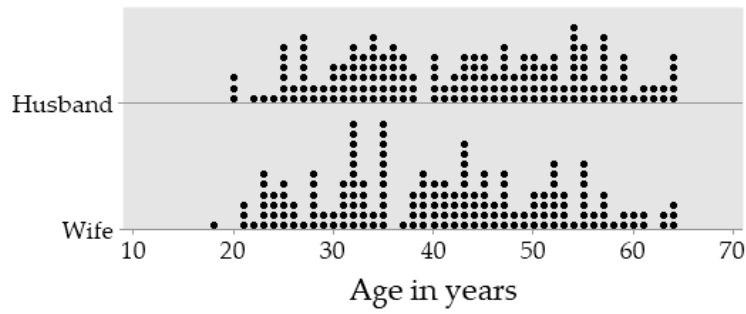
1 / 1 pts

Use the file couplesGB.mwx
It contains data from a random sample of married couples collected in Great Britain by a government body in 1980.
Each row shows the ages of a married couple.
The husband's age is in the first column, and the wife's age is in the second column. There are 170 couples.
There is a popular belief suggesting husbands will be older than their wives, on average.
Which graph which is most suitable for examining the data in relation to this question?









A

C

B

D

The dotplot of the differences is best. The design is paired, and we are interested in the distribution of differences.
The picture on the top left shows a Normal distribution; this is a model for a population, not data.
The separate dotplots do not reflect the pairing in the data.
The picture on the bottom left shows the association between ages, but not the differences directly.

Question 16

1 / 1 pts

Consider the popular belief described in the question above.

What is the alternative hypothesis?

- The alternative hypothesis is that husbands will be the same age as their wives, on average. That is, the population mean difference in age equals zero.
- The alternative hypothesis is that husbands' ages will be different from their wives' ages, on average. That is, the population mean difference in age is not equal to zero.
- The alternative hypothesis is that in the sample, the husbands' ages will be different from their wives' ages, on average. That is, the sample mean difference in age is not equal to zero.
- The alternative hypothesis is that in the sample, the husbands will be the same age as their wives, on average. That is, the sample mean difference in age equals zero.

Hypotheses are about population parameters, in this case the population mean difference.

Hypotheses are not about sample means.

The relevant null hypothesis here is that the husbands will be the same age as their wives, on average. This is a null hypothesis of no difference and it specifies a precise value of the population parameter of interest.

The alternative hypothesis is hence that husbands' ages will be different from their wives' ages, on average, in the population.

Question 17

1.5 / 1.5 pts

Which of the following methods of statistical inference are appropriate for the couples data set? (Tick as many as apply.)

- [x] Wilcoxon matched pairs test
- [ ] Confidence interval for the difference of means in independent samples
- [x] Sign test
- [x] Confidence interval for the mean difference for paired samples

As the design is paired, any of the procedures except the confidence interval for independent samples are appropriate.

Question 18

1 / 1 pts

The results for the four different methods of statistical inference, from Minitab, are provided below.

Consider **only** the analyses you consider to be appropriate. Based on these, which of the following are correct? (Tick as many as apply.)

Paired T-Test and CI: Husband age, Wife age

Descriptive Statistics

Sample	N	Mean	StDev	SE Mean
Husband age	170	42.918	11.757	0.902
Wife age	170	40.682	11.414	0.875

Estimation for Paired Difference

Mean	StDev	SE Mean	95% CI for μ_difference
2.235	4.075	0.313	(1.618, 2.852)

μ_difference: mean of (Husband age - Wife age)

Test

Null hypothesis	H_0: μ_difference = 0
Alternative hypothesis	H_1: μ_difference ≠ 0

T-Value	P-Value
7.15	0.000

Two-Sample T-Test and CI: Husband age, Wife age

Method

μ_1: mean of Husband age

μ_2: mean of Wife age

Difference: $\mu_1 - \mu_2$

Equal variances are not assumed for this analysis.

Descriptive Statistics

Sample	N	Mean	StDev	SE Mean
Husband age	170	42.9	11.8	0.90
Wife age	170	40.7	11.4	0.88

Estimation for Difference

Difference	95% CI for Difference
2.24	(-0.24, 4.71)

Test

Null hypothesis	H_0: $\mu_1 - \mu_2 = 0$
Alternative hypothesis	H_1: $\mu_1 - \mu_2 \neq 0$

T-Value	DF	P-Value
1.78	337	0.076

Sign Test for Median: Age difference (Husband - Wife)

Method

η: median of Age difference (Husband - Wife)

Descriptive Statistics

Sample	N	Median
Age difference (Husband - Wife)	170	2

Test

Null hypothesis	H_0: $\eta = 0$
Alternative hypothesis	H_1: $\eta \neq 0$

Sample	Number < 0	Number = 0	Number > 0	P-Value
Age difference (Husband - Wife)	32	19	119	0.000

Wilcoxon Signed Rank Test: Age difference (Husband - Wife)

Method

η: median of Age difference (Husband - Wife)

Descriptive Statistics

Sample	N	Median
Age difference (Husband - Wife)	170	2

Test

Null hypothesis	H_0: η = 0
Alternative hypothesis	H_1: η ≠ 0

Sample	N for Test	Wilcoxon Statistic	P-Value
Age difference (Husband - Wife)	151	9460.00	0.000

The 95% confidence interval for the true mean difference excludes zero, so the P-value for a corresponding hypothesis test will be greater than 0.05.

There are couples in the data for whom the wife is older than the husband. This disproves the null hypothesis.

The 95% confidence interval for the true difference of means includes zero, so the data are not consistent with a true mean difference of zero, between the ages of husbands and wives.

As the P-value is small (P < 0.001), the data are not consistent with a true mean difference of zero, between the ages of husbands and wives.

For any of the paired sample analyses, the P-value is small. The only correct statement is that for a small P-value, the data are not consistent with the null hypothesis that the true mean difference is zero.

Question 19

1.5 / 1.5 pts

You are now informed that the couplesGB.mwx file is a cleaned up version of the data. In the actual data set, there are 29 other couples; in each case the husband's age is known but the wife's age is missing. There are no couples with the wife's age known and the husband's age missing. What difference does this make, if any, to the inferences drawn? (Tick as many as apply.)

- [ ] Whenever the wife's age is missing, the difference between the husband's age and the wife's age is not known. These observations are therefore automatically excluded from the analysis, and the inference drawn without them is therefore reliable.
- [x] It is possible that wives who were older than their husbands tended to withhold their age in the survey. If that did occur, it makes the conclusions above unreliable.
- [ ] Missing data in a survey are to be expected and can be safely ignored in this case.
- [x] It would be helpful to know why 29 wives' ages are missing.

In making inferences from this sample to the population of couples, we assume we have a random sample of couples.

If data are missing, this assumption may not be reasonable. If wives who are older than their husbands typically withhold their age, the estimate of the mean difference in age we have will be biased (in the direction of being too small). The inference will be affected. Hence it would be useful to know why the 29 wives' ages were missing.

Partial

Question 20

0.5 / 1 pts

Standard practice in the removal of wisdom teeth in the chair involves a primary anaesthetic and a supplementary anaesthetic.

A dentist carried out a large study comparing patients randomly assigned to have either the primary anaesthetic only (A) or both anaesthetics (B).

The outcome was the use of strong pain relief in the four hours after surgery (yes or no).

The difference between the percentages (A minus B) using strong pain relief was 3%, with a 95% confidence interval of (-4% to 11%).

The *P*-value for a test of no true difference in the percentages was 0.5.

Which of the following would be reasonable in an appropriate summary of the study? (Tick as many as apply.)

- [ ] The 95% confidence interval suggests at most about 11% more people need strong pain relief if the supplementary anaesthetic is not used.
- [ ] Since P = 0.5 it is 10 times more likely that the null hypothesis is true, than if P = 0.05 had been found.

- [x] The result is consistent with no true difference in the percentages, as P = 0.5.

- [ ] As the P-value is large, there is no need for the supplementary anaesthetic.

Quiz Score: **21** out of 23