Department of Statistics

First Year Statistics

Mid-Semester Test: Second Semester, 2014

VERSION 1

ANSWERS ON PAGE 18

Instructions:

- All questions have a single correct answer.
- All questions carry the same mark value.
- If you do not know the answer, then take a guess.
- Multiple answers to a question will ALL be marked wrong.
- Incorrect answers are not penalised.

There are 20 questions.

Answer ALL questions on the ANSWER SHEET provided (attached to the front of the test paper).

- Hand in your answer sheet **only**.
- Keep a personal record of your answers on the test paper — answers will be announced on Cecil tomorrow.

References

Bourdot, G. W., Hurrell, G. A., Skipp, R. A., Monk, J., and Saville, D. J. (2011). Mowing during rainfall enhances the control of Cirsium arvense. *Biocontrol Science and Technology*, **21**(10), 1213–1223.

Douglas, C. (2014). Kiwisaver Survey March Quarter 2014. http://www.morningstar.co.nz/kiwisaver/article/march-quarter-kiwisaver-survey-2014/6474.

ResearchNZ (2014). Should dog owners have to be registered? http://www.researchnz.com/pdf/Media

UNDP (2012). Human Development Index and its components. https://data.undp.org/dataset/Table-1-Human-Development-Index-and-its-components/wxub-qc5k.

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Questions 1 and **2** refer to the following information.

Market researchers were interested in the amount of TV watched per day by children between the ages of 5 and 12 from New Zealand and Singapore. A survey was carried out by randomly selecting 20 Singaporean children and 20 New Zealand children within this age group to see how much time, in minutes, Singaporean and New Zealand (NZ) children spent watching TV each day.

A bootstrap confidence interval for the difference between the population means was constructed and the three plots from the iNZightVIT bootstrap confidence interval construction output are shown in Figure 1.

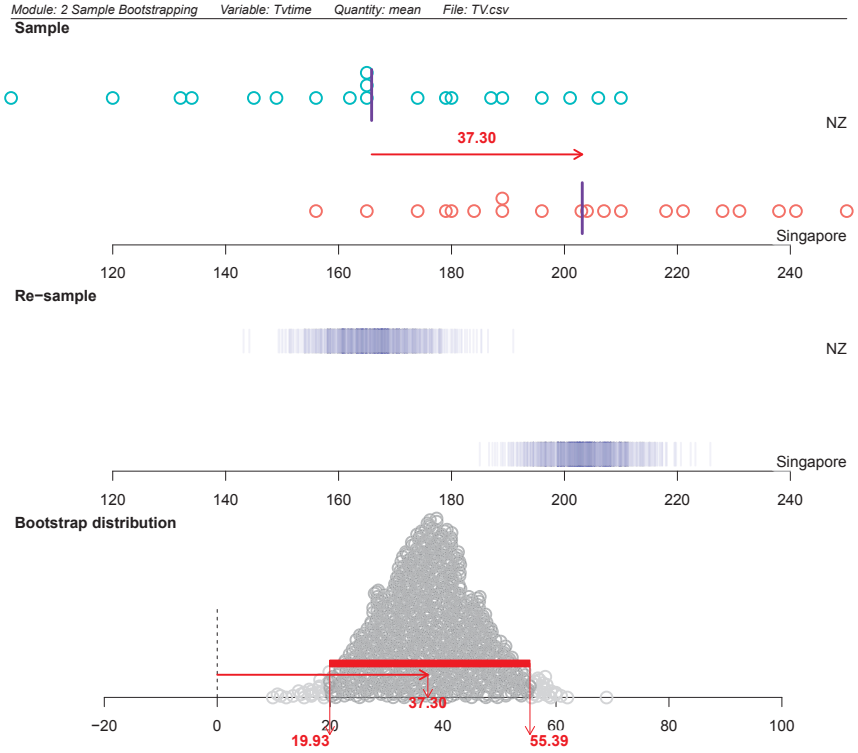

Figure 1: Bootstrap confidence interval construction output

1. Which **one** of the following statements is the **best** interpretation of this bootstrap confidence interval?

   (1) The time spent watching TV each day by Singaporean children is 37 minutes more than that by NZ children.

   (2) The time spent watching TV each day by Singaporean children is somewhere between 20 and 55 minutes more than that by NZ children.

   (3) It's a fairly safe bet that the time spent watching TV each day by Singaporean children is somewhere between 20 and 55 minutes more than that by NZ children.

   (4) It's a fairly safe bet that the mean time spent watching TV each day by Singaporean children is 37 minutes more than that by NZ children.

   (5) It's a fairly safe bet that the mean time spent watching TV each day by Singaporean children is somewhere between 20 and 55 minutes more than that by NZ children.

2. Suppose that it is claimed that the mean time spent watching TV each day by Singaporean children is 60 minutes more than that by NZ children.

   Which **one** of the following statements is **true**?

   (1) This claim is believable because some of the 1000 re-samples taken with replacement from the original samples produced differences between means of 60 minutes or more.

   (2) This claim is not believable because the time spent watching TV each day by Singaporean children is approximately 205 minutes and that by NZ children is approximately 165 minutes.

   (3) This claim is not believable because the difference between the mean time spent watching TV each day by Singaporean children and that by NZ children is approximately 37 minutes.

   (4) This claim is believable because all of the 1000 re-samples taken with replacement from the original samples produced positive differences between means.

   (5) This claim is not believable because 60 minutes is not in the interval constructed from the differences in re-sample means formed by the 1000 re-samples taken with replacement from the original samples.

Questions 3 to **6** refer to the following information.

The Human Development Index (HDI) for a country is a summary measure of human development. It measures the average achievements in a country in three basic dimensions of human development: a long and healthy life, access to knowledge and a decent standard of living. Standard of living is measured using Gross National Income per capita (GNI) in purchasing power parity dollars.

Table 1 is an extract from the 2012 HDI data tables (UNDP, 2012).

HDI rank	Country	HDI	GNI
175	Afghanistan	0.374	$1,000
⋮	⋮	⋮	⋮
157	Nepal	0.463	$1,137
4	Netherlands	0.921	$37,282
6	New Zealand	0.919	$24,358
129	Nicaragua	0.599	$2,551
186	Niger	0.304	$701
1	Norway	0.955	$48,688
⋮	⋮	⋮	⋮
172	Zimbabwe	0.397	$424

Table 1: HDI and GNI for selected countries

3. Suppose information from this table is to be used to identify the countries with a very low Gross National Income per capita.

Which **one** of the following changes to the table would **best improve** the presentation for this purpose?

(1) Order the countries by **GNI** from lowest to highest and add a column showing the GNI rank.

(2) Order the countries by **HDI** from lowest to highest.

(3) Round the values of **GNI** to the nearest thousand dollars.

(4) Add a row at the bottom to show the average **HDI** and average **GNI**.

(5) Add a column grouping the countries by region and order the countries by **GNI** from lowest to highest within each region.

Questions 4 and **5** refer to the following additional information.

The HDI of individual countries can be categorised as low, medium, high or very high. Table 2 shows the breakdown of HDI categories by region for the 187 countries for which the 2012 HDI was calculated.

	HDI Category				
Region	Low	Medium	High	Very High	**Total**
Africa	37	10	3	0	50
Americas	1	10	19	5	35
Asia	6	21	11	9	47
Europe	0	1	14	31	46
Oceania	2	5	0	2	9
Total	46	47	47	47	187

Table 2: HDI category by region, 2012

4. The percentage of these countries with a low HDI is approximately:

(1) 19.8%

(2) 24.6%

(3) 26.7%

(4) 75.4%

(5) 4.8%

5. Of the countries in Asia, the proportion that have a high or very high HDI is approximately:

(1) 0.426

(2) 0.503

(3) 0.213

(4) 0.234

(5) 0.107

6. 55% of the Arab states are in Asia and the remaining ones are in Africa. 50% of the Arab states have a high or very high HDI and 63.6% of the Asian Arab states have a high or very high HDI. The proportion of African Arab states with a high or very high HDI is approximately:

(1) 0.450

(2) 0.300

(3) 0.334

(4) 0.150

(5) 0.666

Questions 8 to **11** refer to the following information.

Morningstar (Douglas, 2014) publishes a quarterly KiwiSaver Performance Survey designed to help New Zealand investors assess the performance of their KiwiSaver superannuation options. Data were collected from different KiwiSaver fund providers.

Some of the variables included in their March 2014 report were:

Fund Type The type of fund (categories ordered from lowest to highest potential return)
- Conservative
- Moderate
- Balanced
- Growth
- Aggressive

Member fees The current annual fees charged to investors by KiwiSaver fund providers (dollars per year).

1-year returns The return for investors in this fund as a percentage (%) of the total invested for the year ending 31 March 2014.

3-year returns The return for investors in this fund as a percentage per year (% p.a.) of the total invested for the 3 years ending 31 March 2014.

5-year returns The return for investors in this fund as a percentage per year (% p.a.) of the total invested for the 5 years ending 31 March 2014.

7. **No longer examined**

8. Figure 2 shows the distribution of the 5-year returns for the five different fund types.

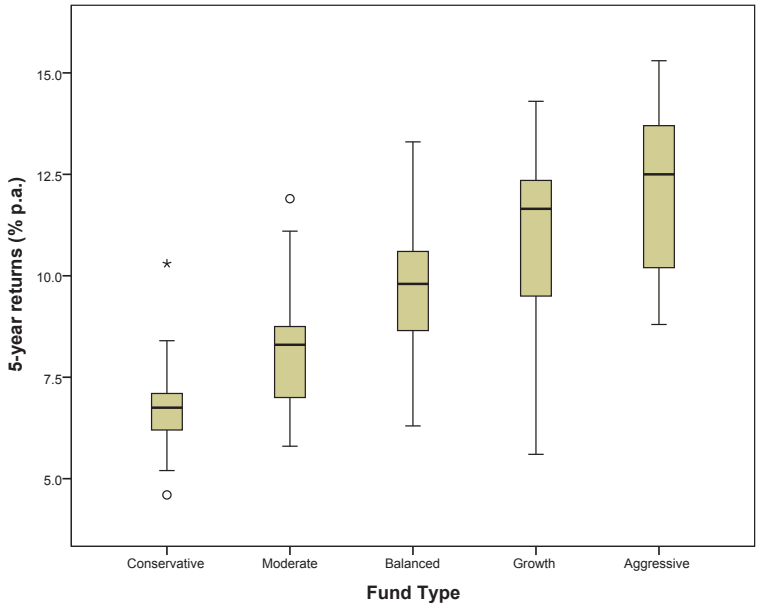

Figure 2: 5-year returns by Fund Type

Based on Figure 2, which **one** of the following statements is **false**?

(1) The 5-year returns for Growth funds appear to be the most variable.

(2) All the 5-year returns from Aggressive funds were greater than those from Conservative funds.

(3) The distributions of the 5-year returns for Growth and Aggressive funds were negatively (left) skewed.

(4) About 75% of the 5-year returns from Aggressive funds were greater than 10.0%.

(5) As the potential return for the types of fund increase the medians of the 5-year returns increased.

9. Figure 3 shows a scatter plot of 5-year returns against 3-year returns for the Balanced funds.

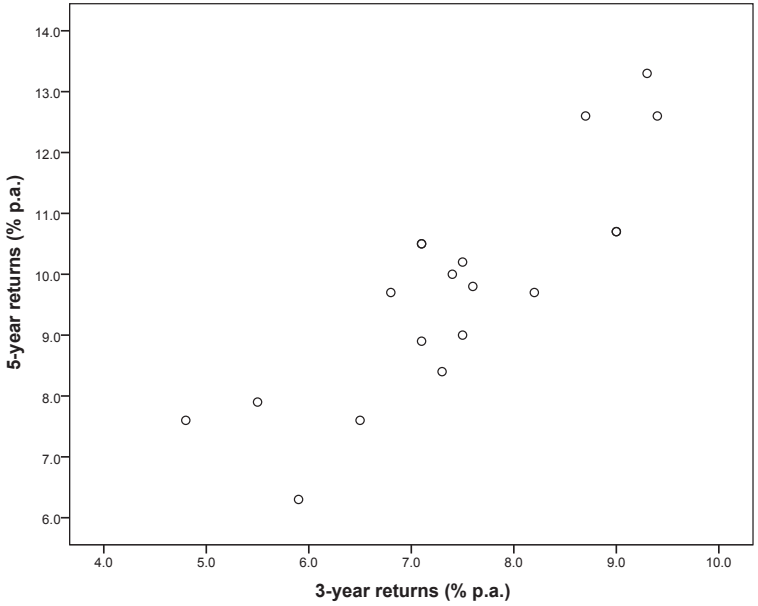

Figure 3: Returns from Balanced funds

Based on Figure 3, which **one** of the following statements is **false**?

(1) For these data the fund with the lowest 3-year return does not have the lowest 5-year return.

(2) For these data the variability of the 5-year returns is reasonably constant for all values of the 3-year returns.

(3) For these data the 5-year returns are all greater than their corresponding 3-year returns.

(4) For these data there is a moderate positive linear association between the 3-year returns and the 5-year returns.

(5) These data show separation into three distinct groups.

Question 11 refers to the following additional information.

Assume that the data on 1-year returns for Aggressive and Growth funds represents a random sample of returns from all such funds.

Let:

μ_A be the mean 1-year return from all Aggressive funds

and

μ_G be the mean 1-year return from all Growth funds.

Some summary statistics of the data are shown in Table 3.

Group Statistics

	Fund type	N	Mean	Std. Deviation	Std. Error Mean
1-year returns (%)	Aggressive	11	11.391	3.3177	1.0003
	Growth	25	9.960	2.9329	.5866

Table 3: Summary statistics for 1-year returns

10. No longer examined

11. A 95% confidence interval for $\mu_A - \mu_G$ is $(-1.15, 4.02)$.

Which **one** of the following statements is **true**?

With 95% confidence, it is estimated that:

(1) the mean 1-year return for all Aggressive funds is greater than that for all Growth funds by 4.02 percentage points.

(2) the mean 1-year return for all Aggressive funds is 1.43 percentage points greater than that for all Growth funds with a margin of error of 5.17 percentage points.

(3) the mean 1-year return for all Growth funds is 1.15 percentage points and that for all Aggressive funds is estimated to be 4.02 percentage points.

(4) the mean 1-year return for all Aggressive funds is somewhere between 1.15 percentage points and 4.02 percentage points less than that for all Growth funds.

(5) the mean 1-year return for all Aggressive funds is somewhere between 1.15 percentage points less than and 4.02 percentage points greater than that for all Growth funds.

Questions 12 to **15** refer to the following information.

Californian thistle (thistle) is a problematic weed found in grazed pastures throughout New Zealand. Researchers (Bourdot *et al.*, 2011) working for AgResearch Ltd carried out a study to investigate whether mowing pasture during heavy rainfall would reduce the prevalence of thistle in grazed pastures. Nine farms distributed across New Zealand were used in the study. In each farm, a paddock with a large quantity and even distribution of thistle was selected. Within each paddock, three plots were partitioned off. For each plot the percentage of ground area covered by thistle was measured and recorded. Numbers (1, 2 and 3) were randomly allocated to the plots and treated as follows:

- Plot 1: In the growing season (early autumn), the pasture was mowed to ground level during heavy rainfall.
- Plot 2: The pasture was mowed to ground level during dry conditions one to fourteen days after Plot 1 was mowed.
- Plot 3: The pasture was not mowed.

The plots were then grazed normally. In late spring the percentage of ground area covered by thistle was again measured. For each of the three plots the percentage point change between the autumn and spring measurements was recorded (Autumn − Spring). Dot plots of the data, the overall median (vertical dotted line) and the group medians (vertical solid lines) are shown in Figure 4.

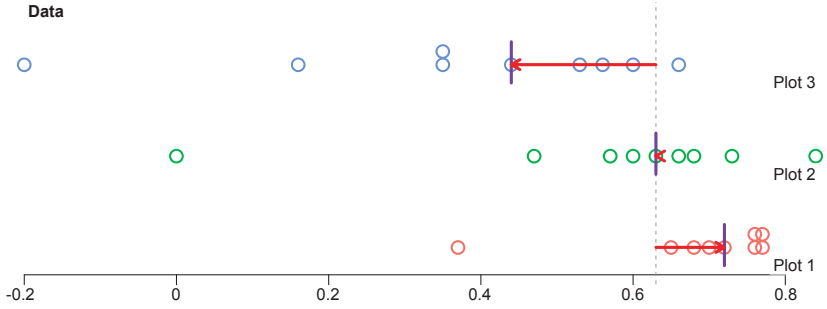

Figure 4: Thistle data (percentage point change, Autumn − Spring)

12. Which **one** of the following statements is **false**?

(1) There was blocking in the study because the plots were blocked on whether the pasture was mowed to ground level or not mowed.

(2) This study is an experiment because the plots were randomly allocated to receive different treatments.

(3) The participating farms were distributed across New Zealand in an attempt to reduce any regional effects on the study results.

(4) The purpose of the random allocation of numbers to plots was to reduce potential subconscious bias in the way the treatments were allocated.

(5) The plots that were not mowed can be considered as a control group.

13. If the mowing of pasture had made no difference to the percentage of ground area covered by thistle then we can say that the observed average (absolute) deviation from the overall median had happened by chance alone.

Which **one** of the following statements is **false** under this chance alone scenario?

(1) The observed average (absolute) deviation from the overall median had nothing to do with whether the pasture had been mowed to ground level (either in heavy rainfall or in dry conditions) or not mowed.

(2) The observed average (absolute) deviation from the overall median is due solely to the random allocation of plots in each paddock.

(3) If the plot with the −0.2 percentage point change had been mowed it would have had a positive percentage point change.

(4) The plot whose percentage point change was highest would have still had the highest percentage point change regardless of whether the pasture had been mowed to ground level (either in heavy rainfall or in dry conditions) or not mowed.

(5) The average (absolute) deviation from the overall median can be simulated by randomly re-allocating the observed percentage point changes to the three groups.

Questions 14 and **15** refer to the following additional information.

A randomisation test was performed on the data. Assume this test is appropriate. The test output in Figure 5 shows a re-randomisation distribution of 1000 average (absolute) deviations under chance alone and the observed average (absolute) deviation from the overall median.

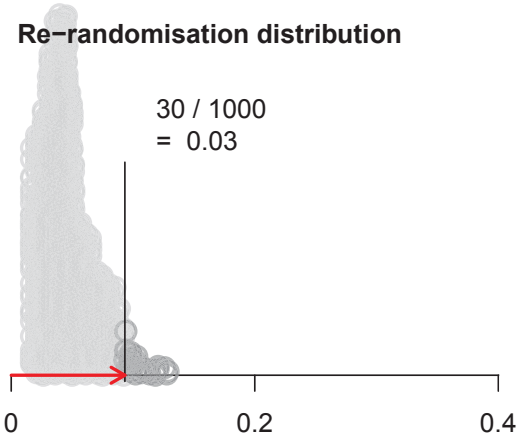

Figure 5: Re-randomisation distribution for the thistle data

14. Which **one** of the following statements about this test output is **true**?

(1) 30 of 1000 re-randomisations under chance alone produced an average (absolute) deviation from the overall median equal to that observed.

(2) 30 of 1000 re-randomisations under chance alone produced an average (absolute) deviation from the overall median at least as big as that observed.

(3) If the study was repeated 1000 times, then about 30 of those 1000 studies would produce an observed average (absolute) deviation from the overall median at least as big as that observed in this study.

(4) At least 30% of 1000 re-randomisations under chance alone produced an average (absolute) deviation from the overall median as big as that observed.

(5) If 1000 different researchers repeated this study 1000 times, then about 30 of those 1000 studies would produce an observed average (absolute) deviation from the overall median at least as big as that observed in this study.

15. Which **one** of the following statements is a **not** a valid interpretation from the randomisation test result?

(1) Chance is acting alone is not a plausible explanation for the observed average (absolute) deviation.

(2) We may claim that the observed average (absolute) deviation was due to the groups being treated differently together with a chance effect.

(3) In this study, the chances of obtaining an average (absolute) deviation at least as big as that observed is small.

(4) We may claim a 'mowing' effect but we are unable to determine whether both mowing treatments had an effect on the percentage of ground area covered by thistle.

(5) We may claim that the observed average (absolute) deviation is so large that it is unlikely to have happened by chance alone.

16. In Semester 1 2014, 1287 stage 1 statistics students took part in an online web survey. Suppose that a simple random sample of 10 of these students is to be selected for participation in a focus group. Each student is allocated an identification number from 1 to 1287. Using the random numbers below identify the first three students that will be chosen. Start at the beginning of the row and use consecutive digits.

```
51450 74987 01992 33573 07491 11216 12201 60889
```

The first three students sampled would have had identification numbers:

(1) 514, 749 and 19

(2) 1450, 1121 and 160

(3) 749, 749 and 1112

(4) 749, 1112 and 889

(5) 1450, 1992 and 1121

Questions 17 to **20** refer to the following information.

Research New Zealand conducts monthly surveys in which they survey, by telephone, a random sample of New Zealanders aged 18 years or over (adult New Zealanders). In the April 2014 survey a question was included in order to measure the opinions of adult New Zealanders on dog owner registration (ResearchNZ, 2014).

The question asked was:

> *It is currently a legal requirement in New Zealand to register a dog. In light of recent dog attacks on children and adults, some people have said that it should be a legal requirement for dog owners to also be registered.*
>
> *On a scale of 0-10, where 0 is strongly disagree and 10 is strongly agree, how much do you agree or disagree that dog owners should be registered?*

17. The results of this survey may not represent the opinions of all adult New Zealanders **mainly** because of possible:

(1) transferring findings and question effects.

(2) nonresponse bias and self-selection bias.

(3) selection bias and question effects.

(4) selection bias and self-selection bias.

(5) self-selection bias and question effects.

Questions 18 to **20** refer to the following additional information.

The responses to the question (**Answer**), which were classified by **Gender**, are shown in Table 4.

	Gender		
Answer	Female	Male	**Total**
Disagree (0 − 2)	30	38	68
Neutral (3 − 7)	58	75	133
Agree (8 − 10)	158	136	294
Don't know/Refused	4	2	6
Total	250	251	501

Table 4: **Answer** by **Gender**

Let:

p_{F} be the proportion of all female adult New Zealanders who agree

and

p_{M} be the proportion of all male adult New Zealanders who agree.

18. The sampling situation for calculating the standard error of the estimate, $\text{se}(\widehat{p}_{\text{F}} - \widehat{p}_{\text{M}})$, is:

(1) two independent samples of size 250 and 251.

(2) one sample of size 501, several response categories.

(3) one sample of size 501, many yes/no items.

(4) one sample of size 294, several response categories.

(5) two independent samples of size 158 and 136.

19. A 95% confidence interval for $p_F - p_M$ is (0.004, 0.176).

Which **one** of the following statements **may not be true**?

(1) A claim that the proportion of all female adult New Zealanders who agree is the same as the proportion of all male adult New Zealanders who agree is not believable.

(2) The difference between the proportion of all female adult New Zealanders who agree and the proportion of all male adult New Zealanders who agree is inside the 95% confidence interval.

(3) With 95% confidence we estimate that the proportion of all female adult New Zealanders who agree is 0.090 greater than the proportion of all male adult New Zealanders who agree, with a margin of error of 0.086.

(4) It is plausible that the proportion of all female adult New Zealanders who agree is not the same as the proportion of all male adult New Zealanders who agree.

(5) With 95% confidence we estimate that the proportion of all female adult New Zealanders who agree is up to 0.18 greater than the proportion of all male adult New Zealanders who agree.

20. Suppose that 1000 females and 1000 males took part in the survey and that the proportions were similar to those obtained from Table 4, page 16. Also suppose that a new 95% confidence interval for $p_F - p_M$ will be constructed using these larger group sizes.

When comparing the new 95% confidence interval with the original 95% confidence interval in **Question 19**, which **one** of the following statements is **true**?

The new interval will be about:

(1) the same width of the original interval.

(2) twice the width of the original interval.

(3) quarter the width of the original interval.

(4) four times the width of the original interval.

(5) half the width of the original interval.

ANSWERS

1. (5)	2. (5)	3. (1)	4. (2)	5. (1)
6. (3)	8. (2)	9. (5)	11. (5)	12. (1)
13. (3)	14. (2)	15. (3)	16. (4)	17. (3)
18. (1)	19. (2)	20. (5)		