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93201Q



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Scholarship 2015 Statistics

9.30 a.m. Thursday 12 November 2015
Time allowed: Three hours
Total marks: 40

QUESTION BOOKLET

There are FIVE questions in this booklet. Answer ALL questions.

Pull out Formulae and Tables Booklet S–STATF from the centre of this booklet.

Write your answers in Answer Booklet 93201A.

Show ALL working. Start your answer to each question on a new page. Carefully number each question.

Check that this booklet has pages 2–13 in the correct order and that none of these pages is blank.

YOU MAY KEEP THIS BOOKLET AT THE END OF THE EXAMINATION.

The overall theme of this paper involves the occupation and selling of real estate.

QUESTION ONE (8 marks)

The following two line graphs, Figure 1 and Figure 2, illustrate **monthly** median house prices and sales volumes in Auckland over the five years from March 2010 to March 2015.

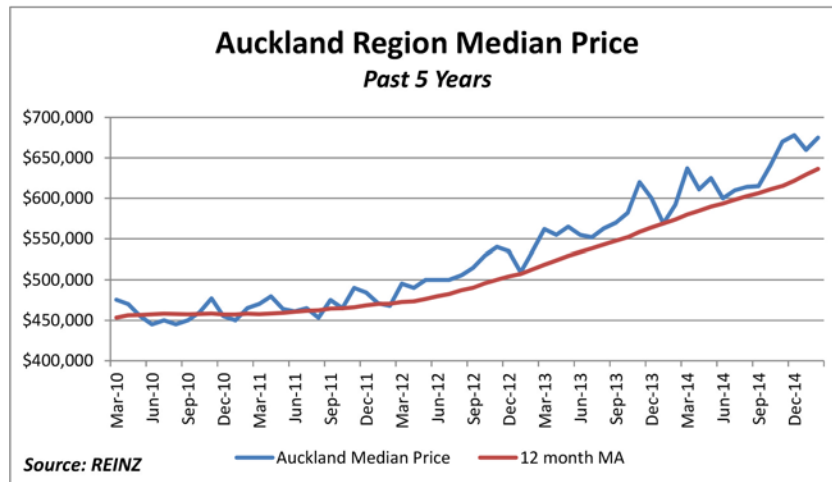


Figure 1: Auckland Region Median Price

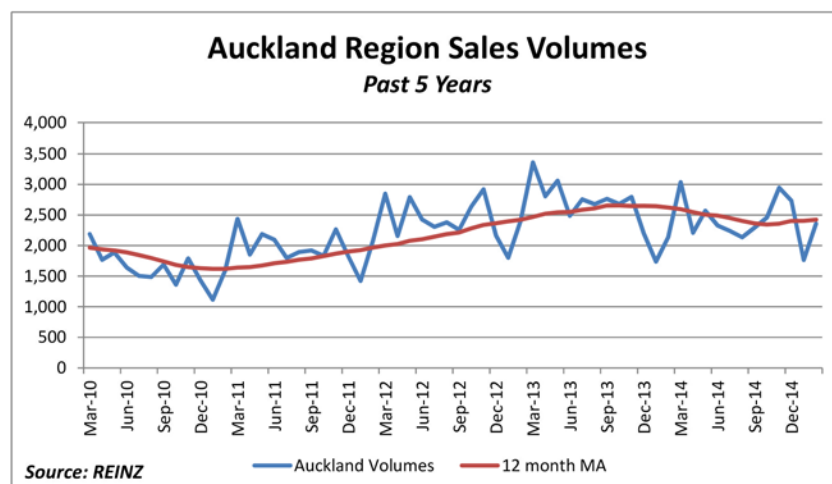


Figure 2: Auckland Region Sales Volumes

- (a) Using Figures 1 and 2, write a one-page summary describing and comparing median house prices and sales volumes in Auckland over these five years.

(b) Table 1 below gives median house prices and sales volumes in the Auckland Region.

Auckland Region Trends			Price ↗	Volumes ↘	Days to Sell ↘	Overall →
	Median Price			Volume Sold		
	Feb-15	Jan-15	Feb-14	Feb-15	Jan-15	Feb-14
North Shore City	\$875,000	\$838,000	\$744,000	392	313	378
Waitakere City	\$620,000	\$589,000	\$530,000	342	257	293
Auckland City	\$753,000	\$749,250	\$675,000	704	470	648
Manukau City	\$630,000	\$620,000	\$575,000	467	376	440
Metro Auckland	\$705,000	\$685,000	\$625,000	1,996	1,481	1,834
Rodney District	\$670,000	\$657,500	\$562,500	189	126	144
Outer Auckland	\$556,000	\$547,500	\$480,000	363	283	309
Auckland Region	\$675,000	\$660,000	\$592,000	2,359	1,764	2,143
	Vs...	Jan-15	Feb-14	Vs...	Jan-15	Feb-14
North Shore City		4.4%	17.6%		25.2%	3.7%
Waitakere City		5.3%	17.0%		33.1%	16.7%
Auckland City		0.5%	11.6%		49.8%	8.6%
Manukau City		1.6%	9.6%		24.2%	6.1%
Metro Auckland		2.9%	12.8%		34.8%	8.8%
Rodney District		1.9%	19.1%		50.0%	31.3%
Outer Auckland		1.6%	15.8%		28.3%	17.5%
Auckland Region		2.3%	14.0%		33.7%	10.1%

Table 1: Median house prices and sales volumes in the Auckland Region

For the cities North Shore, Waitakere, and Manukau, compare the change in the median house price, sales volume, and estimated total sales value from February 2014 to February 2015.

- (c) In using Figure 2 to find a forecast for the total sales volume for the Auckland Region in 2016:
- (i) What components of the time series data should be taken into account?
 - (ii) Describe how to get a forecast for the total sales volume.

QUESTION TWO (8 marks)

Read the following abridged extract from the REINZ News Release.

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Question Two continues on the following page.

Answer the following questions:

- (a) Give two points of evidence provided in the extract to support the claim that “regional markets are showing strength.”
- (b) Suggest a reason why median prices are quoted in the extract, rather than mean prices.
- (c) What is the advantage of using seasonally adjusted values over raw data?
- (d) In April 2015, 76% of houses sold by auction nationally were in Auckland, and 45% of the houses sold nationally were in Auckland.

Suggest a reason why the figure of 76% is so much greater than the figure of 45%.

- (e) Suggest a reason why a stratified housing price index is used, as opposed to a non-stratified index.
- (f) Suggest a reason why margins of error are not quoted on any of the percentage changes given in the extract.
- (g) Suggest a reason why both median prices and sales volumes are compared in the extract.
- (h) Suppose the base of the NZ House Price Index (HPI) was taken as 100 in January 2011. The median prices in Auckland over January 2011 and April 2014 were \$450 000 and \$612 000, respectively.

Use this information and the information in the extract to compute a HPI for **Auckland** in April 2015.

**This page has been deliberately left blank.
The examination continues on the following page.**

QUESTION THREE (8 marks)

- (a) A survey about living conditions in Auckland and Christchurch was conducted in September 2014. The graphs and statistics in Figure 3 and Table 2 below show the survey data for the number of people occupying a house in Auckland and in Christchurch.

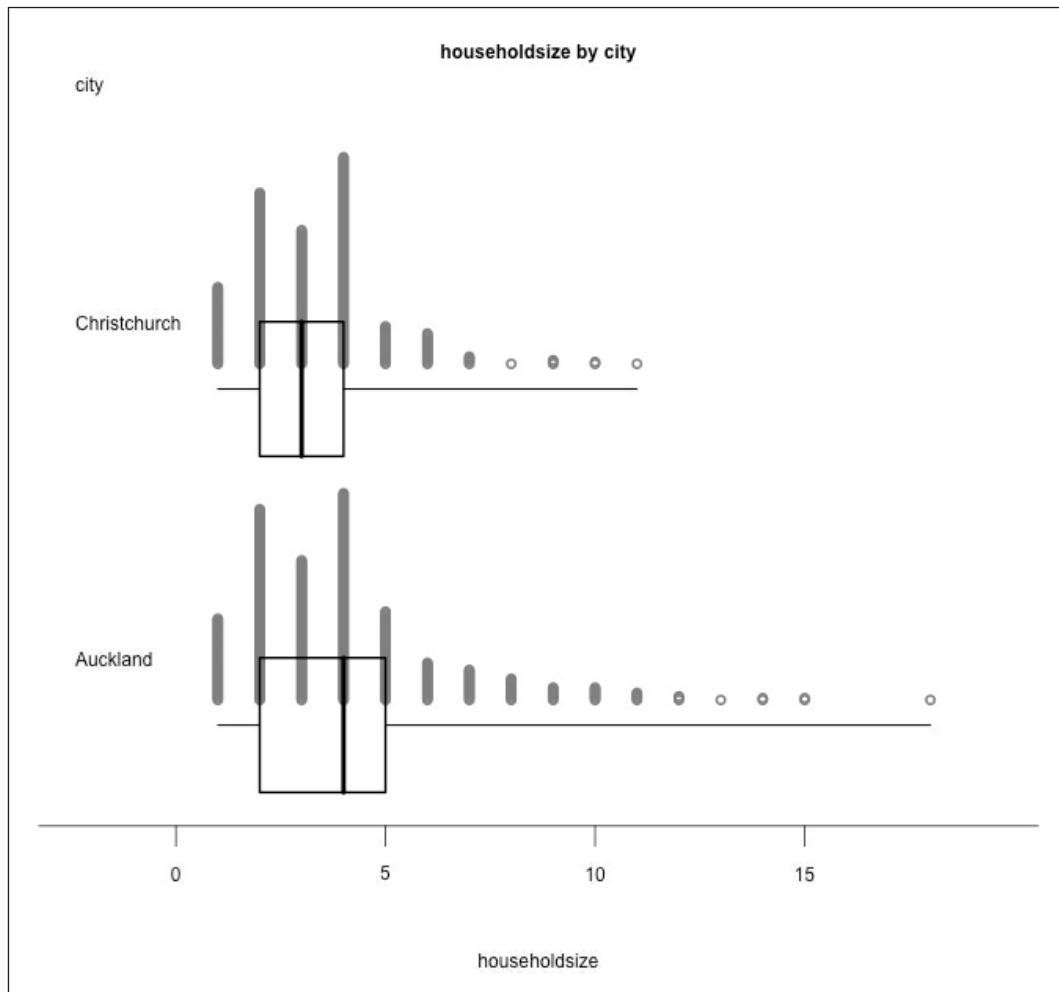


Figure 3: Number of people occupying a house in Auckland and in Christchurch

	Min	1st Qu	Median	Mean	3rd Qu	Max	Std dev	Sample size
Christchurch	1	2	3	3.246	4	11	1.605	386
Auckland	1	2	4	3.947	5	18	2.519	488

Table 2: Number of people occupying a house in Auckland and in Christchurch

The survey data was used to estimate the difference between the mean number of people per occupied house in Auckland and the mean number of people per occupied house in Christchurch. Bootstrapping was used to produce an estimate.

Figure 4 below shows a bootstrap distribution and an associated bootstrap confidence interval.

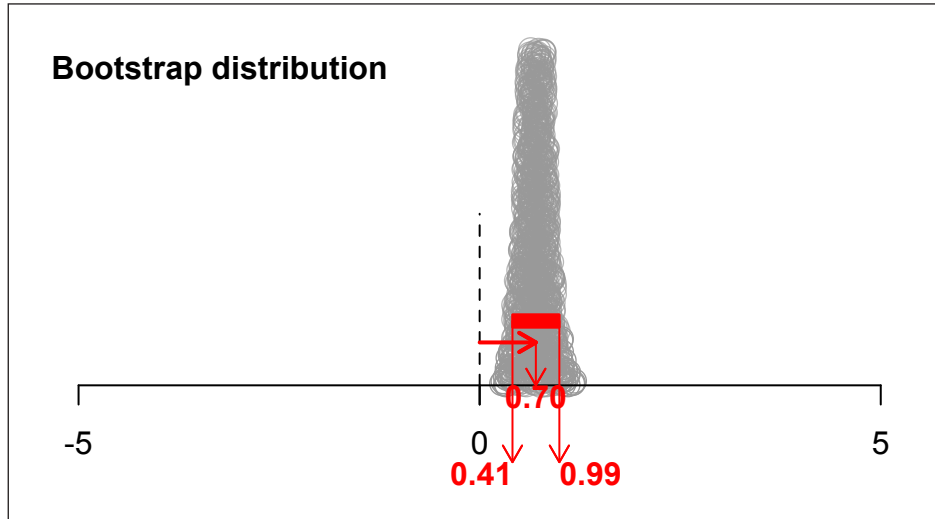


Figure 4: Bootstrap distribution for difference of means (Auckland – Christchurch)

- (i) Write a short paragraph describing and comparing the number of people per occupied house in Auckland and in Christchurch.
- (ii) Census 2013 data was used to produce the graph and statistics, in Figure 5 and Table 3 below, of the mean number of people per house for each of the 413 suburbs in Auckland.

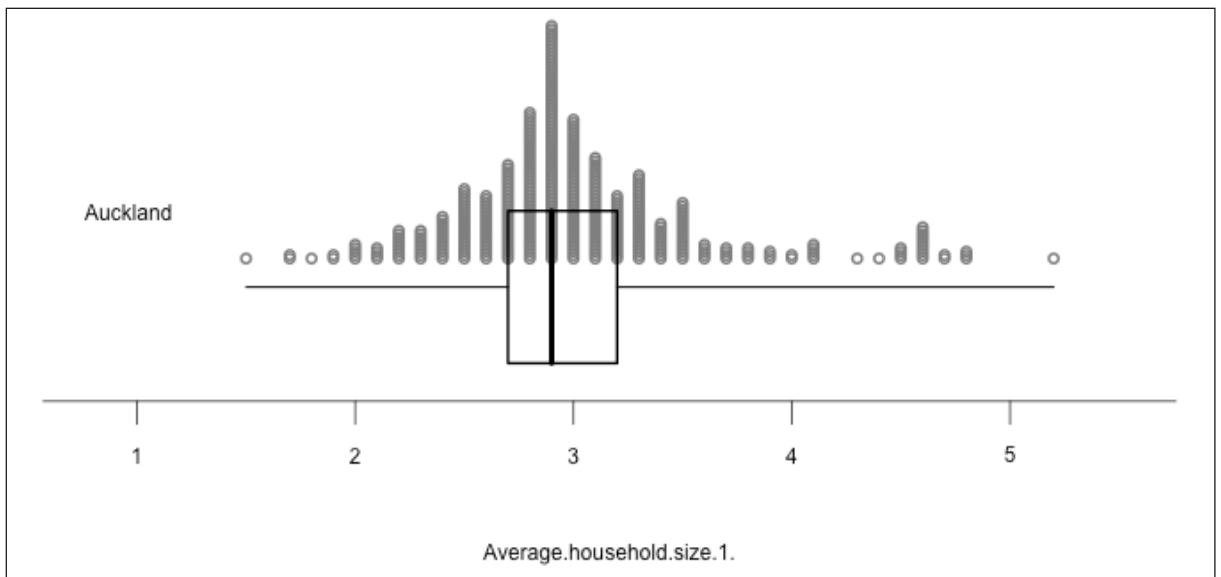


Figure 5: Mean number of people per occupied house for each Auckland suburb

	Min	1st qu	Median	Mean	3rd qu	Max	Std dev	Sample size
Auckland	1.5	2.7	2.9	3.0	3.2	5.2	0.563	413

Table 3: Mean number of people per occupied house for each Auckland suburb

Discuss the differences between the distribution of the data in Figure 5 and Table 3, and the distribution of the Auckland data in Figure 3 and Table 2 on page 8.

- (iii) Explain which mean (3.0 from Table 3 or 3.947 from Table 2) would more likely reflect the mean number of people per occupied house in Auckland.

(b) Data were obtained on properties advertised for sale on Trade Me (April 2015) from the main cities in New Zealand. A property includes a house and the land on which it is built. Five of the variables are:

- **Asking Price** the price that the vendor is asking a buyer to pay for the house in thousands of dollars (\$000).
- **Bedroom** the number of bedrooms in the house.
- **Floor Area** the floor area of the house in square metres (m^2).
- **Capital Value** the probable price (\$000) that would have been paid for the property at the date of the valuation (1 July 2014).
- **Land Area** the area of the plot of land that the house is built upon, in square metres (m^2).

Figures 6, 7, 8, and 9 show graphs of the asking price plotted against the number of bedrooms, floor area, capital value, and land area respectively.

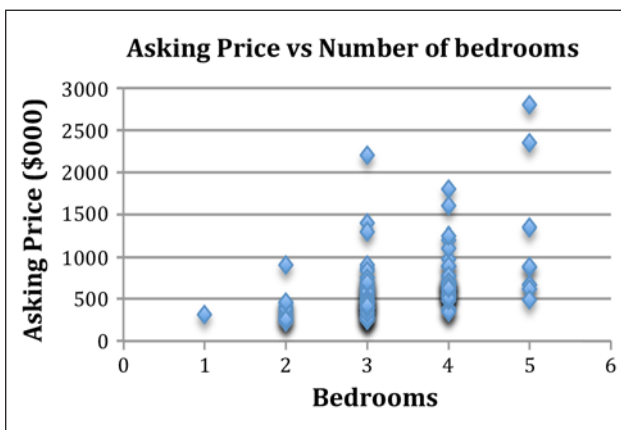


Figure 6

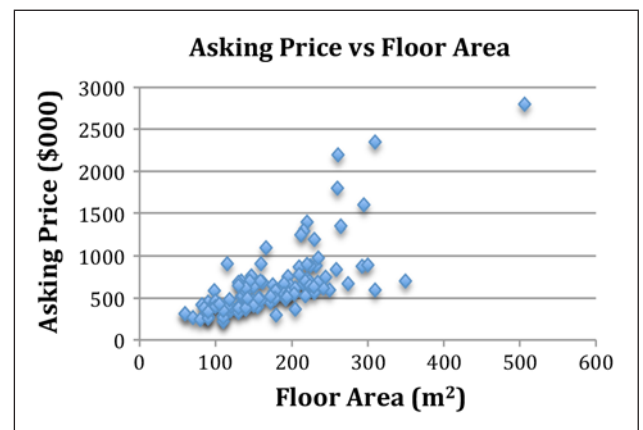


Figure 7

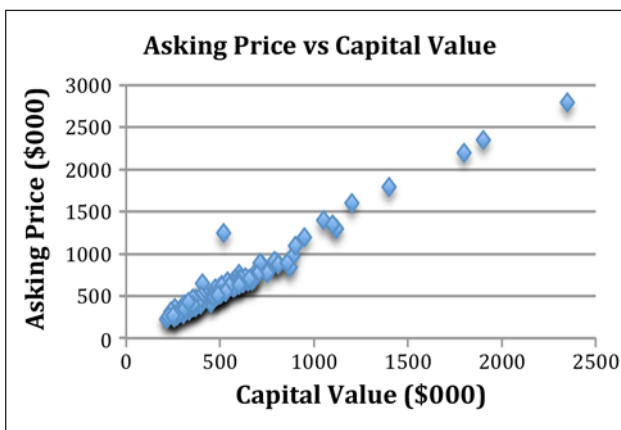


Figure 8

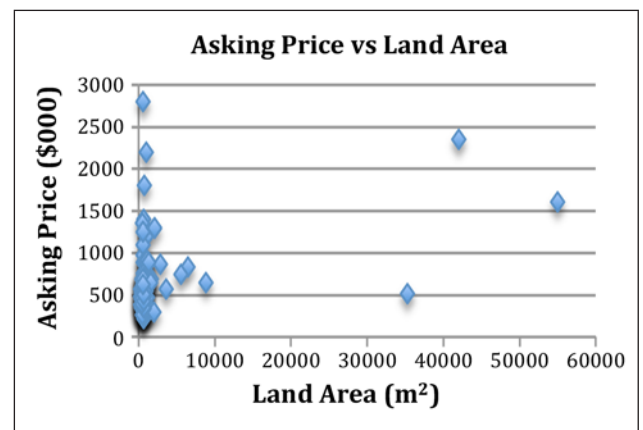


Figure 9

- Write a paragraph describing how the asking price of a property relates to the other four variables.
- From the information given, explain how you would predict the asking price of a three bedroom house with a floor area of 245 m^2 and a capital value of \$1 000 000.
- Name two other variables, one categorical and one numerical, that would be expected to affect the selling price of a house.

Explain how each of your chosen variables might affect the selling price.

QUESTION FOUR (8 marks)

- (a) A real estate office has found that 28% of the houses (apartments and free-standing houses) that they have sold were apartments. Of the apartments, 74% had one or two bedrooms and 6% had four or more bedrooms. 86% of the free-standing houses had three bedrooms. 28% of the houses had one or two bedrooms.
- (i) What is the probability that a free-standing house chosen at random had one or two bedrooms?
- (ii) How many times as likely is it that a one or two bedroom house was an apartment rather than a free-standing house?
- (b) Table 4 and Figure 10 show the selling prices of the 325 houses the real estate office sold in the past year.

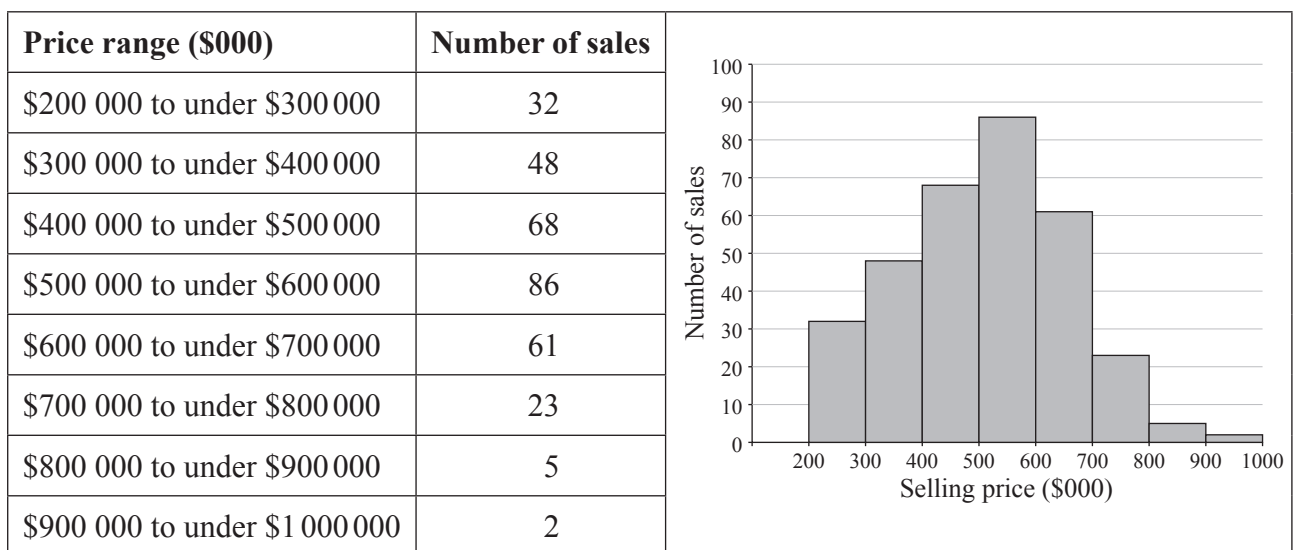


Table 4 and Figure 10: Selling prices of houses sold by the real estate office in the past year

- (i) Use the information in Table 4 and/or Figure 10 to estimate the proportion of houses that sold for between \$450 000 and \$750 000.
- (ii) Suggest two different probability distribution models to fit this data.
State the parameters for each of your suggested models.
Use each model to estimate the probability that a randomly selected house sold for between \$450 000 and \$750 000.
Discuss how well each model fits the data.

QUESTION FIVE (8 marks)

An experiment was carried out to compare two training courses, X and Y, that teach selling techniques for real estate agents.

Forty agents from the same firm were randomly assigned into two groups of 20. One group received Course X and the other received Course Y. Vendors answered a questionnaire about the agent who sold their house. The questionnaire had 10 statements with a five-point Likert scale for each question; 1 = least effective, 5 = most effective). The total score out of 50 was calculated for each sale. A score was obtained for each agent by calculating the mean total score for sales made before the training (Before). A similar process was undertaken for sales made after the training (After).

The scores are shown in Table 5 below:

Course X		Course Y	
Before	After	Before	After
17	24	17	27
20	24	30	34
21	32	27	37
25	30	27	27
20	30	26	21
23	36	21	30
22	24	21	19
20	23	19	25
19	34	31	26
30	36	27	35
26	31	25	19
23	28	26	29
23	31	23	28
26	32	23	30
16	16	22	21
21	26	32	39
24	31	28	34
33	38	26	28
18	22	27	33
17	26	21	24

Table 5: Scores for each agent by course

For each agent, the difference in scores (After – Before) was calculated. Summary statistics and plots of the differences, by course, are shown in Table 6 and Figure 11, page 13.

- (a) Write a short paragraph describing and comparing the distributions of the differences for courses X and Y.
- (b) A randomisation test using means was carried out on the differences in scores. The output is shown in Figure 12, page 13.
 - (i) Explain why random assignment was used to form the two groups.
 - (ii) Suggest a reason why both before and after scores were considered in the analysis.
 - (iii) What can be concluded from the randomisation test output?
Justify your answer.

- (iv) It was claimed that there would be a strong positive correlation between the Before and After scores **obtained by the 20 agents** who received Course X, and similarly for the 20 agents who received Course Y.

Comment on this claim.

	Min	1st Qu	Median	Mean	3rd Qu	Max	Std dev	Sample Size
X	0	4.75	5.5	6.5	8.25	15	3.66	20
Y	-6	-0.25	4.5	3.35	7	10	5.03	20

Table 6: Differences in scores (After – Before) by course

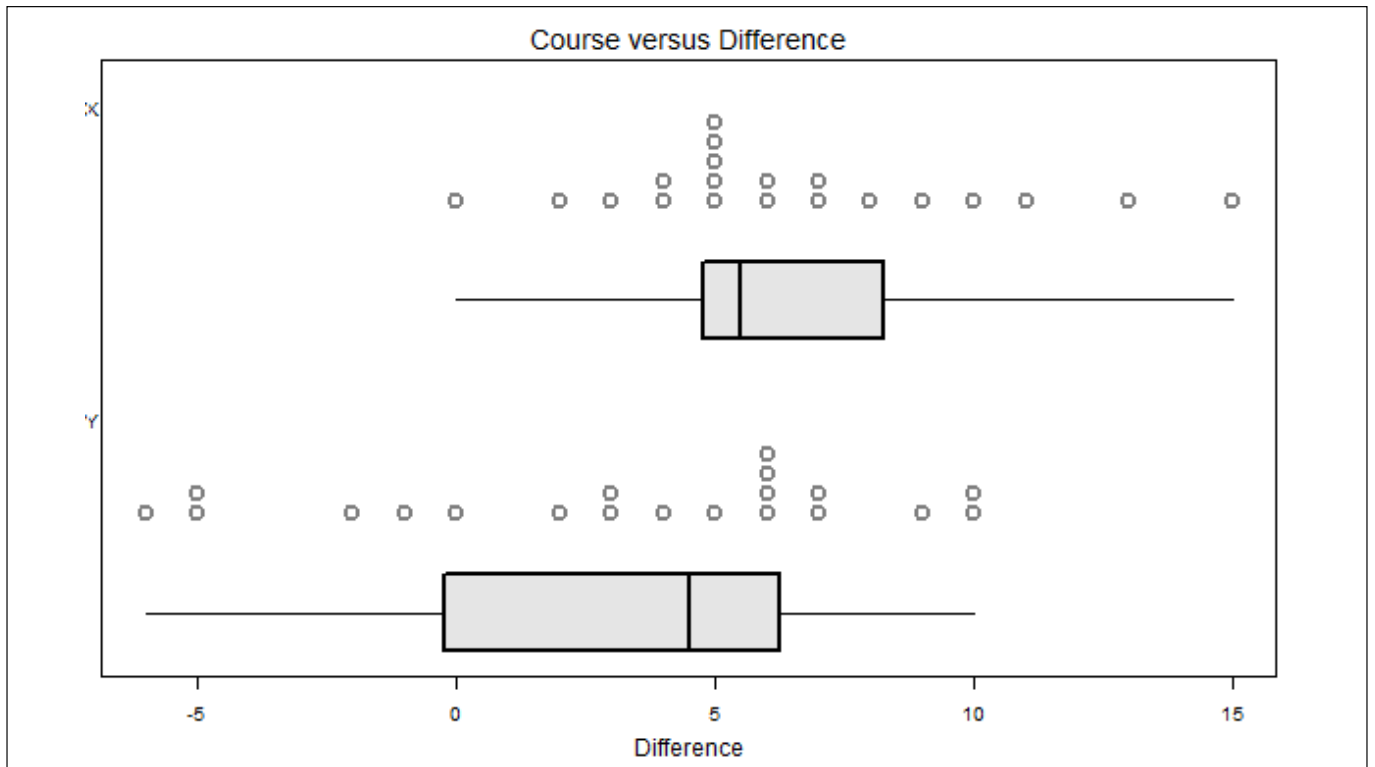


Figure 11: Differences in scores (After – Before) by course

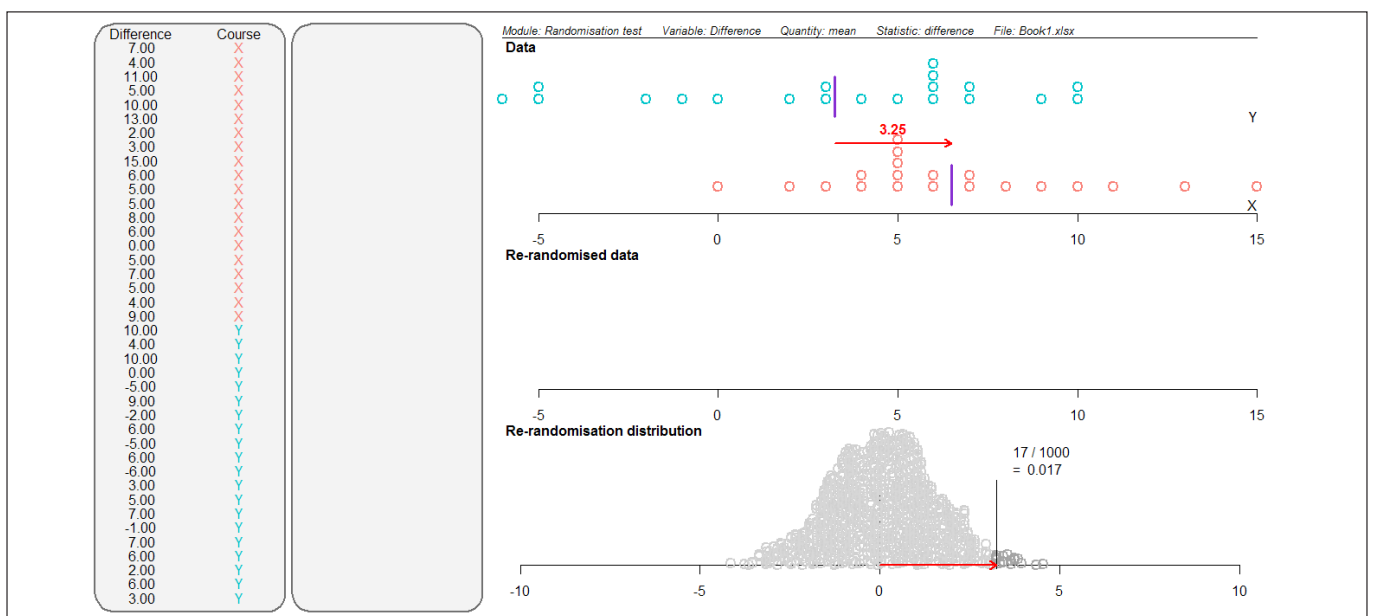


Figure 12

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