Commuter Altruism Study

Questions 19 to 25 refer to the following information.

In a study from the University of Queensland[1], researchers were interested in altruism (unselfishness) in society. They conducted a study into who is unselfish and who is selfish at selected traffic intersections, analysing data on 959 commuters at intersections where drivers could choose to let another commuter from a side road enter the main road (they were unselfish) or drivers could choose to keep going and save themselves a few seconds (they were selfish).

Two of the variables recorded are defined as follows:

Status Based on an estimate of the worth of the car:

- Low ($25,000 or less)
- Medium ($25,001 to $60,000)
- High (Over $60,000)

Altruistic choice A measure of altruism according to whether or not the driver chooses to let another commuter in:

- Unselfish (Driver lets another commuter in)
- Selfish (Driver does not let another commuter in)

The 959 drivers were cross-classified according to **Altruistic choice** and **Status**.

The results are shown in Table 6 and Figure 1.

	Status			
Altruistic choice	Low	Average	High	**Total**
Unselfish	116	192	71	379
Selfish	247	217	116	580
Total	363	409	187	959

Table 6: Altruistic choice of commuters

[1] Institute for the Study of Labour (IZA), April 2011, http://ftp.iza.org/dp5648

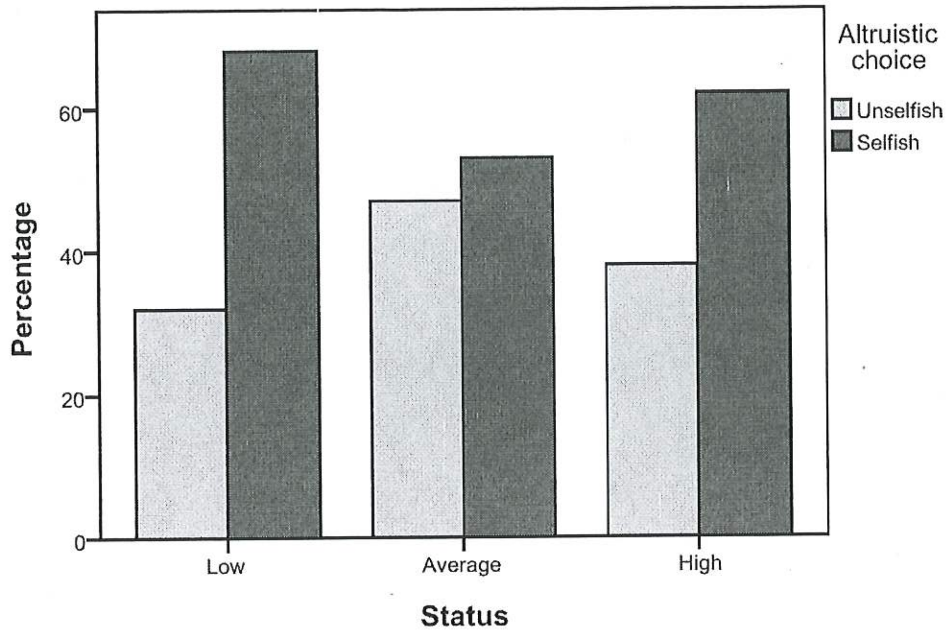


Figure 1: Bar graph of choice on letting another commuter in

A Chi-square test was conducted to see if the distribution of altruistic choice depends on social status (as measured by the worth of their car). The results of the Chi-square test are shown in Table 7.

			Status			
			Low	Average	High	Total
Altruistic choice	Unselfish	Count	116	192	71	379
		Expected Count	143.5	161.6	73.9	379.0
		Cell contribution	5.256	5.703	0.114	
	Selfish	Count	247	217	116	580
		Expected Count	219.5	247.4	113.1	580.0
		Cell contribution	3.434	3.727	++	
Total .		Count	363	409	187	959
		Expected Count	363.0	409.0	187.0	959.0

biggest contr. obs (192) more than exp (161.6)

Q22

$\frac{(116-113.1)^2}{113.1} = .074$

Chi-Square Tests

	Value	df	Sig.
Pearson Chi-Square	18.308	++	.000
Likelihood Ratio	18.382	++	.000
Linear-by-Linear Association	4.868	++	.027
N of Valid Cases	959		

Note: Some values have been replaced by ++.

$df = (2-1)(3-1) = 1 \times 2 = 2$

Q23

Table 7: Chi-square test output

Questions 19 to **25** refer to the **Commuter Altruism Study** information, given above (on pages 19 and 20).

19. The variable **Status** is **best** described as:

(1) an ordinal categorical variable.

(2) a categorical numeric variable.

(3) a continuous numeric variable.

(4) a dependent variable.

(5) a discrete numeric variable.

Note: Questions 20 to **25** assume that the 959 drivers form a simple random sample of Australian drivers.

Questions 20 to **25** refer to the Chi-square test described on page 20.

20. Which **one** of following give **correct** hypotheses for this Chi-square test?

(1) H_0: The underlying distribution of altruistic choice is the same for all three status groups.
H_1: The underlying distribution of altruistic choice is different for each status group.

(2) H_0: The underlying distribution of altruistic choice is the same for all three status groups.
H_1: The underlying distribution of altruistic choice is not the same for all three status groups.

(3) H_0: The underlying distribution of altruistic choice is not the same for all three status groups.
H_1: The underlying distribution of altruistic choice is the same for all three status groups.

(4) H_0: The underlying distribution of altruistic choice is different for each status group.
H_1: The underlying distribution of altruistic choice is the same for all three status groups.

(5) H_0: The underlying distribution of altruistic choice depends on the status group.
H_1: The underlying distribution of altruistic choice does not depend on the status group.

21. Which **one** of the following gives the **best** justification concerning the validity of this Chi-square test?

(1) Because none of the cells have an expected count less than 5, there are no concerns about the validity of this Chi-square test.

(2) Because none of the cells have an expected count less than 1, there are no concerns about the validity of this Chi-square test.

(3) Because fewer than 80% of the cells have cell contributions greater than 5 there are concerns about the validity of this Chi-square test.

(4) Because none of the cells have an observed count less than 5, there are no concerns about the validity of this Chi-square test.

(5) Because at least one of the cells has a cell contribution less than 1 there are concerns about the validity of this Chi-square test.

Questions 22 to **25** assume that the use of the Chi-square test is appropriate.

(Note: This assumption may not be correct.)

22. Consider the cell in Table 7, page 20, for those who are categorised as **selfish** and **high** status.

This cell's contribution to the Chi-square test statistic, to 3 decimal places, is:

(1) 2.900

(2) −2.900

(3) 0.074

(4) 0.073

(5) 3.100

23. The number of degrees of freedom, *df*, for this Chi-square test is:

(1) 6

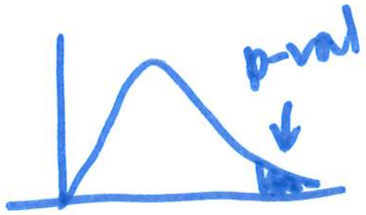
(2) 958

(3) 5

(4) 2

(5) 959

24. The *P-value* for this Chi-square test is calculated by:



(1) pr($X^2 \geq 959.0$) where $X^2 \sim$ Chi-square(*df*)

(2) pr($X^2 \leq 959.0$) where $X^2 \sim$ Chi-square(*df*)

(3) pr($X^2 \leq 18.308$) where $X^2 \sim$ Chi-square(*df*)

(4) pr($0 \leq X^2 \leq 959.0$) where $X^2 \sim$ Chi-square(*df*)

(5) pr($X^2 \geq 18.308$) where $X^2 \sim$ Chi-square(*df*)

25. Which **one** of the following gives the **best** reason for the *P-value* of 0.000?

(1) For all categories there are roughly the number of drivers you would expect if **Altruistic choice** and **Status** were unrelated.

(2) For those drivers whose choice was unselfish, there are far fewer in the low status category and far more in the average status category than would be expected if **Altruistic choice** and **Status** were related.

(3) For those drivers whose choice was unselfish, there are far more in the low status category and far fewer in the average status category than would be expected if **Altruistic choice** and **Status** were unrelated.

(4) For those drivers in the high status category there are roughly the number of drivers that you would expect to get for both the unselfish and the selfish choice, if **Altruistic choice** and **Status** were related.

(5) For those drivers whose choice was unselfish, there are far fewer in the low status category and far more in the average status category than would be expected if **Altruistic choice** and **Status** were unrelated.

Questions 26 to **32** refer to the following information.

The University of Otago Injury Prevention Research Unit published a report titled *Road traffic practices among a cohort of young adults in New Zealand*. The aim of the study was to describe the road safety practices of young adults in New Zealand. Face-to-face interviews were conducted with 21-year-olds who were born in Dunedin. The report concluded that unsafe road practices, especially among males, were unacceptably high.

One area of the study investigated the wearing of seat belts. Some results are given in Table 8 below, a two-way table of counts for seat belt usage by rear seat passengers:

	Usage				
Gender	Always	Nearly Always	Sometimes	Never	**Total**
Female	138	79	139	107	463
Male	103	66	152	161	482
Total	241	145	291	268	945

Table 8: Self-reported seat belt usage by rear seat passengers

A Chi-square test was conducted to investigate whether there was a difference in **Usage** distribution between females and males. SPSS output is given in Table 9 below.

			Usage				Total
			Always	Nearly Always	Sometimes	Never	
Gender	Female	Count	138	79	139	107	463
		Expected Count	118.1	++	142.6	++	++
		Cell contribution	++	++	0.091	4.497	
	Male	Count	103	66	152	161	482
		Expected Count	122.9	++	148.4	++	++
		Cell contribution	3.222	0.865	0.087	4.320	
Total		Count	241	145	291	268	945
		Expected Count	241.0	145.0	291.0	268.0	945.0

Chi-Square Tests

	Value	df	Sig.
Pearson Chi-Square	17.335[a]	++	.001
Likelihood Ratio	17.422	++	.001
Linear-by-Linear Association	16.754	++	.001
N of Valid Cases	945		

a 0 cells (.0%) have expected count less than 5. The minimum expected count is 71.0.

Note: Some values have been replaced by ++.

Table 9: Self-reported seat belt usage by rear seat passengers

26. For this investigation, the null hypothesis is:

(1) H_0: The distribution of Usage is different for females and males.

(2) H_0: The factors Gender and Usage are associated.

(3) H_0: $p_1 = p_2 = p_3 = p_4$ where p_i is the proportion of 21-year-olds in each Usage group.

(4) H_0: The distribution of Usage is the same for females and males.

(5) H_0: The factors Female and Male are dependent.

27. The expected cell count, under the null hypothesis, for those 21-year-old **males** who **never** wear a rear seat belt is:

(1) 137.1

(2) 130.3

(3) 136.8

(4) 131.3

(5) 136.7

28. The **degrees of freedom** for this Chi-square test is:

(1) 6

(2) 4

(3) 8

(4) 3

(5) 2

29. Consider the cell for **Female** and **Always**. This cell's **contribution** to the Chi-square test statistic value of 17.335 is:

(1) 2.9

(2) 0.1

(3) 1.6

(4) 0.2

(5) 3.4

30. The *P-value* for this Chi-square test is calculated by:

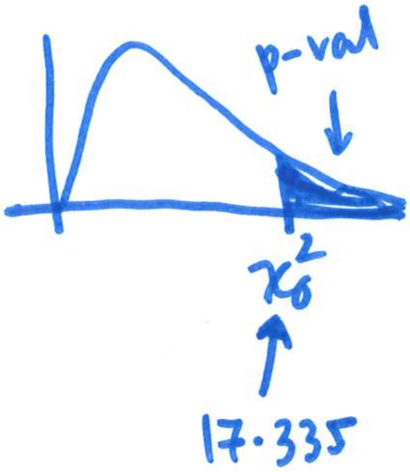
(1) 2 × pr($\chi^2 \geq 17.335$) where $\chi^2 \sim$ Chi-square(*df*)

(2) 2 × pr($\chi^2 \leq 17.335$) where $\chi^2 \sim$ Chi-square(*df*)

(3) pr($\chi^2 \leq 17.335$) where $\chi^2 \sim$ Chi-square(*df*)

(4) pr($0 \leq \chi^2 \leq 17.335$) where $\chi^2 \sim$ Chi-square(*df*)

(5) pr($\chi^2 \geq 17.335$) where $\chi^2 \sim$ Chi-square(*df*)



31. Which **one** of the following statements regarding the *P-value* of 0.001 is **true**?

(1) Such a small *P-value* indicates that there must be a big difference between the **Female** and **Male Usage** distributions.

(2) Such a small *P-value* indicates that the alternative hypothesis must be true.

(3) The probability that the null hypothesis is false is 0.001.

(4) If the null hypothesis for this test is true, then the probability of getting a test statistic at least as large as 17.335 is 0.001.

(5) The probability that the null hypothesis is true is 0.001.

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

(1) One of the main reasons for such a small *P-value* in this test is because of the relatively small number of **Males** who said that they were **Always** users of rear seat belts.

(2) If the Chi-square test statistic had been 27.000 instead of 17.335, then the resulting *P-value* would have been smaller than 0.001.

(3) One of the main reasons for such a small *P-value* in this test is because of the relatively large number of **Males** who said that they were **Sometimes** users of rear seat belts.

(4) If one of the cells had an expected count of less than 1, then it would have been unwise to interpret the output from this test.

(5) The sum of the expected counts for **Males** is 482 and the sum of the expected count for **Females** is 463.