Statistical analysis of S217 student survey data

Prepared by:

Dr Nicky Wright
BioSigma Ltd

Record of Changes

Version	Date	Details of change
1.0	25 November 2016	First issue

Note: Users of this document should confirm that it is the latest version before relying on information contained within the document

Table of Contents

1   INTRODUCTION

Previous data have indicated that women do less well in second level physics than men, based upon analysis of S207 (Jordan et al, 2015). A survey has subsequently been conducted among S217 students in order to understand the reasons for the differences in performance (OU report, 2016).

The current report describes the analysis of gender differences in S217, based on the results of the survey, and provides recommendations that will inform a series of interviews (the next phase in this project).

2   ANALYSIS

For each of the survey questions with quantitative answers (Q1, Q2, Q2a, Q4 and Q6), the responses are plotted as bar charts showing the percentage of males and females giving a particular response. The percentages were the number of counts divided by the total number of individuals of each gender (26 females and 64 males). Each chart is accompanied by a table showing the number of individuals giving a particular response (count) and the percentage of gender.

Charts and tables were also produced for the associated demographic variables of age, occupational status, occupational type and ethnicity.

For each of the questions and demographic variables, a likelihood ratio (LR) test was carried out to assess whether the distribution of responses across categories differed statistically between males and females. The test will show whether particular responses were statistically more frequent for males or females. The resultant LR test values and associated significance levels (p-values) are shown below each table. For a LR test result to be statistically significant the p-value must be less than 0.05.

Visual inspection of the charts suggested some interesting findings which did not achieve statistical significance. In these cases, some response categories were combined and re-tested.

3   RESULTS AND DISCUSSION

None of the results were statistically significant according to the statistical analysis. However, the charts showed some numerical patterns in the various questions. These are described for each question, as follows.

Q1 Please indicate which of the following qualifications you have obtained in Maths and Physics before your Open University studies (Please select all that apply). (see Figure 1 and Table 1).

The percentages for the 'GCSE/similar' category were very similar for males and females, with both maths and physics, being around 60±1%.

However, for the categories representing higher qualifications (A level, ONC, HND and degree) the males had more of these higher qualifications than females, having roughly three times the number of maths and physics qualifications than the women (maths: 42 for males vs 11 for females, giving 65.6% vs 42.1% respectively; physics: 32 for males vs 9 for females, giving 50.0% vs 34.6% respectively).

The 'postgraduate' category for maths and physics showed similar percentages for males and females at around 3±1%, and only involved three students for each subject.

For both maths and physics, females had a substantially higher proportion of the 'none of these' category, i.e. no maths or physics qualifications, than males, with an increase of around 10±1%. Although the student numbers for this category are low, the 5 students in this category of the physics question represents nearly 20% of the female sample.

Q2 Before studying S217, which of the following modules did you study? (Please select all that apply) (see Figure 1 and Table 1).

Males had studied more science and maths modules than females (2.4 vs 2.0 courses per student overall), although more females than males studied MU123, MST121 and MS221. Six females (23.1% of the sample of females) had studied none of the modules listed, in comparison with four males (6.3% of the sample of males). More results relating to modules studied by males and females are shown in Figure 13 and Table 13.

Q2a In the final part of the S104 Exam which optional question did you answer? (Please select one only) (see Figure 3 and Table 3).

Substantially more males (57.8%) selected the Physics (Book 7) option compared with only 26.9% of females.

Q4 In terms of your OU studies: (Please select one only in each row)
1 - How comfortable do you feel about writing about science in English?
2 - How comfortable are you when reading scientific information in English i.e. reading your module materials? (see Figure 4 and Table 4).

Half the students were 'very comfortable' with writing about science in English. Slightly more than half (61% vs 54% for males and females respectively) were 'very comfortable' with reading about science in English.

Only two male students were 'uncomfortable' with 'Reading'; three students (2 females, one male) were 'uncomfortable' and one female 'very uncomfortable' with 'Writing'. There would appear to be virtually no gender-related effects in these aspects of communication.

Q6 Would you be prepared to take part in an interview about your experiences of studying physics at the OU?

More males were willing to be interviewed than females, with 70.3% of males responding 'Yes' compared with 65.4% of females.

Age distribution by gender (see Figure 6 and Table 6).

The peak of the age distribution for females was 30-39 years, and for males peaks occurred at 25-29 and 50-59 years. However, the differences between the distributions for males and females are likely to be random fluctuations within the age ranges 22-24 and 65 and above.

Occupational status by gender (see Figure 7 and Table 7).

The majority of students were in full-time employment (54.7% and 57.7% for males and females respectively). 14.1% of men were retired from work, whereas 11.1% of females looked after the home/family.

Occupational type by gender (see Figure 8 and Table 8).

More males were in professional or technical roles ('Modern Professional Occupations', 'Senior Managers or Administrators', Technical and Craft Occupations' and 'Traditional Professional Occupations'), whereas females were more likely to be in clerical and routine roles ('Clerical and Intermediate Occupations', 'Routine Manual and Service Occupations' and 'Semi-routine Manual and Service occupations').

Ethnicity by gender (see Figure 9 and Table 9).

The majority of male and female students (81% for males and females) were in the 'White' category, with under 10% having other ethnicities. There was no discernible pattern across gender.

Grouped education by gender (see Figure 10 and Table 10).

A greater percentage of females had 'A levels or equivalent' and 'HE Qualifications' than males, whereas 20.3% of males had 'Less than A levels' compared with no females in this category. These qualifications refer to all subjects rather than being just maths and physics as shown in Figure 1.

Scatter plot of age and education (see Figure 11)

The students with qualifications in the 'Less than A levels' category, who were all males (see Figure 10 and Table 10), spanned the age range from 22-65 years. Students with 'A levels or equivalent' and 'HE qualification' spanned similar age ranges across gender, other than an extreme value (male) in each category. Female students with a PG qualification tended to be younger than the males in this category.

Number of prior qualifications – from Question 1 (see Figure 12 and Table 12)

Over 60% of the students of both gender had one prior qualification in maths and in physics. Males were more likely than women to have two qualifications in both maths and physics (23.4% for males and 11.5% for females in maths; 20.3% for males and 11.5% for females in physics).

Number of prior modules (see Figure 13 and Table 13)

More males than females had studied three science and maths modules (56.3% vs 34.5%) before starting S217. The combinations of the three modules that males and females had studied is shown in Table 14. Within these combinations, 31.3% of males had studied the combination S104, MST124 and MST125, compared with only 3.9% of females. The latter two maths modules comprise more advanced concepts whereas the other maths modules contain more introductory material.

4   CONCLUSIONS AND RECOMMENDATIONS

The following conclusions and considerations are relevant to interpreting the S217 data with respect to comparisons between males and females:

- *Males completed more study of maths and physics before starting S217 than females.*
  This is shown both in terms of the number of OU physics and maths modules completed and in their level of prior qualifications such as A levels and degree level subjects.

- *Males appear to have a greater level of motivation towards studying physics than females.*
  More males selected physics (book 7) as the optional question in S104, and slightly more males than females were willing to be interviewed about S217. This could be interpreted as being more interested in, and enthusiastic towards, physics. The females may be less interested in physics and/or have less confidence in their ability to understand physics, reflecting a view that physics is a 'male subject'. Reduced confidence and interest may in turn lead to less time spent studying physics, and failure to engage with the physics component of S104 i.e. book 7. The females may avoid studying physics as much as possible.

- *Females may find physics more difficult to understand than males.*
  This could also be associated with (both leading to/resulting from) a lower level of confidence, and may be due to lower aptitude for physics or to the reduced amount of relevant prior study that they complete in comparison with males. The latter interpretation is supported by the data, where for example only one female completed S104, MST124 and MST125, in contrast with 20 males. Comparing this female's overall mark in the exam and assignments with those of males who completed these three courses may throw

light on her aptitude. This could also be done with females who had completed two or more maths courses.

The following recommendations are intended to assist in the development of interview questions (the next phase of the study):

- Since females had studied fewer maths modules, the reasons guiding their choice of prior modules should be examined. These could include:

  - whether they avoid maths courses because of dislike/lack of interest/ lack of confidence in doing maths;
  - whether they enjoyed maths;
  - previous performance (good/poor) at maths.

- The motivation of males and females for studying S217 should be established. This would include:

  - level of interest in and enthusiasm for physics e.g. had they previously avoided physics where possible;
  - whether they had previously had bad experiences studying physics at school e.g. unhelpful comments from male teachers;
  - whether they only did S217 to complete the number of science modules required to gain a science degree.

- The barriers to doing well in S217 from the student's point of view should be identified. These may include:

  - lack of interest and enthusiasm towards studying physics;
  - finding physics difficult;
  - whether student's main interest in doing a science degree was something other than physics e.g. biology;
  - insufficient learning of the basics of physics;
  - insufficient mathematical knowledge;
  - whether they liked maths, or had avoided maths as much as possible.

More information would be gained from the data in this survey if exam and assessment scores were included in the analysis, because a subset of the females are likely to have performed well in S217, thus blurring the correlation between gender, S217 performance, and the various questions addressed by the survey. For example, the subset of females who failed or gained a relatively low level pass could be identified and the various survey questions re-examined.

5   REFERENCES

Sally Jordan, Pam Budd, Niusa Marigheto, Victoria Pearson, Richard Jordan, Jimena Gorfinkiel (2015). 'Why do women do less well on some of our physics modules?', VICE/PHEC 20th August 2015.

OU report, 2016. Report on the findings from: Studying S217 - your OU Physical Science module.

6   CHARTS AND TABLES

6.1 Q1: Prior qualifications

Please indicate which of the following qualifications you have obtained in Maths and Physics before your Open University studies (Please select all that apply)
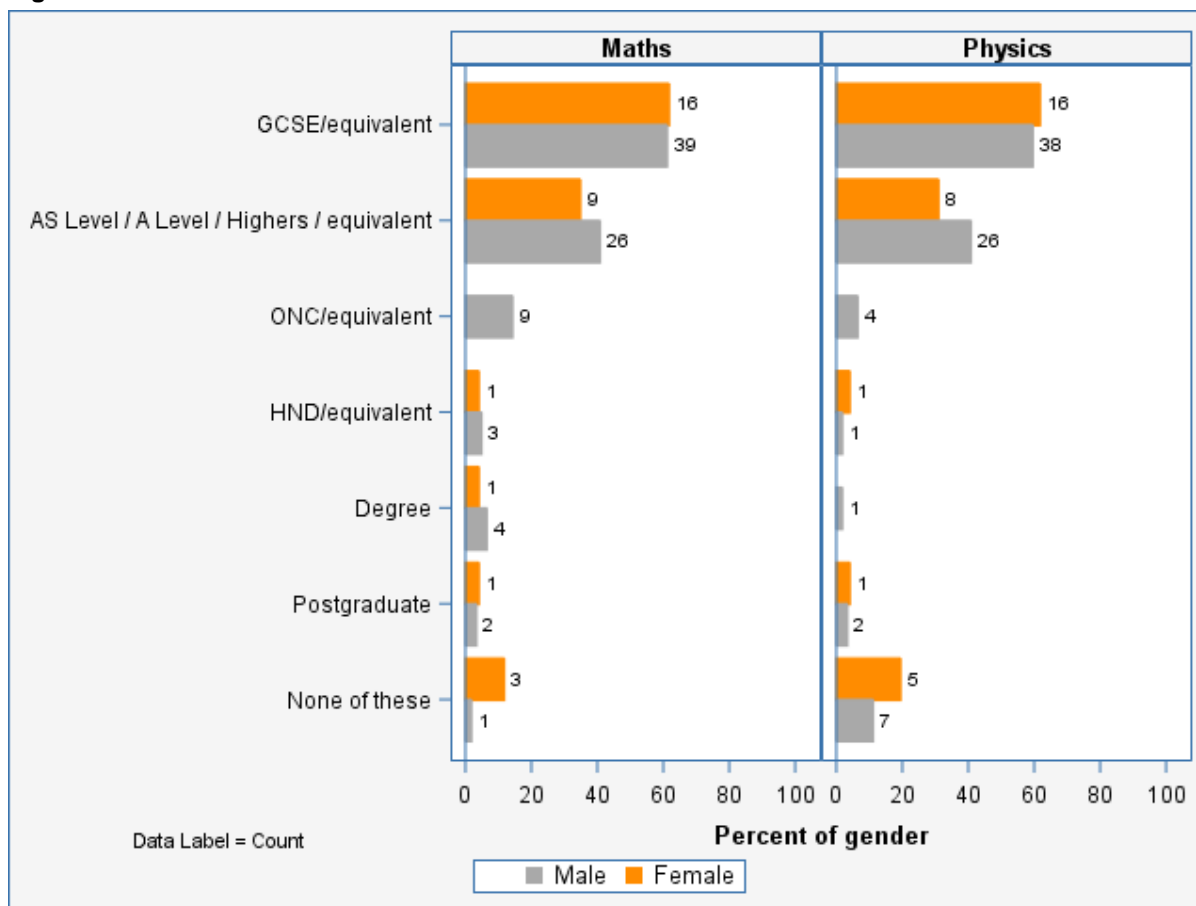
Figure 1

Table 1

Subject	Gender		GCSE/ equivalent	AS Level/ A Level/ Highers/ equivalent	ONC/ equivalent	HND/ equivalent	Degree	Post graduate	None of these	Total Count
Maths	Female	Count	16	9	0	1	1	1	3	31
		Percent of gender	61.5%	34.6%	0.0%	3.8%	3.8%	3.8%	11.5%	
	Male	Count	39	26	9	3	4	2	1	84
		Percent of gender	60.9%	40.6%	14.1%	4.7%	6.3%	3.1%	1.6%	
Physics	Female	Count	16	8	0	1	0	1	5	31
		Percent of gender	61.5%	30.8%	0.0%	3.8%	0.0%	3.8%	19.2%	
	Male	Count	38	26	4	1	1	2	7	79
		Percent of gender	59.4%	40.6%	6.3%	1.6%	1.6%	3.1%	10.9%	

	Likelihood ratio test value	p-value
Maths	10.00	0.125
Physics	5.20	0.518

6.2 Q2: Prior modules

Before studying S217, which of the following modules did you study? (Please select all that apply)
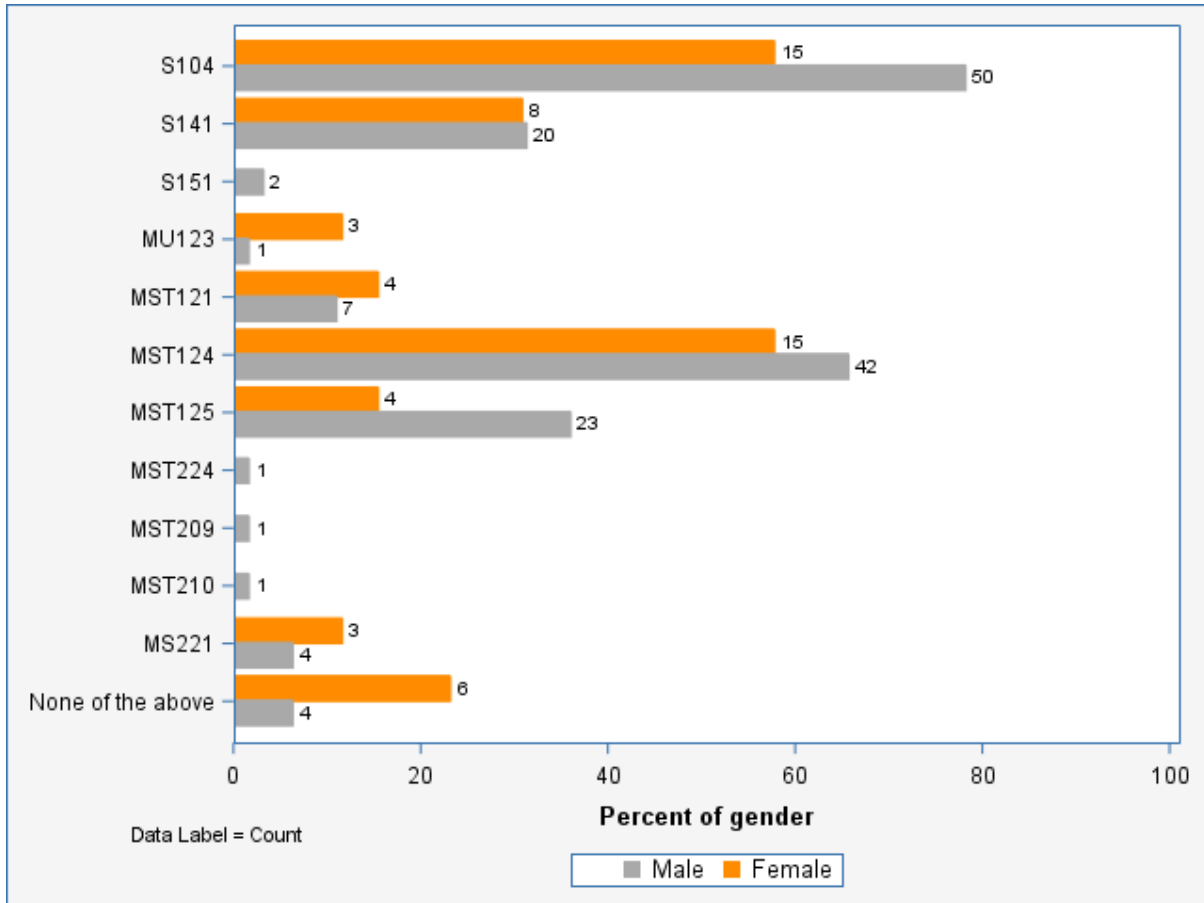
Figure 2

Table 2

Module	Gender	Count	Percent of gender
S104	Female	15	57.7%
	Male	50	78.1%
S141	Female	8	30.8%
	Male	20	31.3%
S151	Female	0	0.0%
	Male	2	3.1%
MU123	Female	3	11.5%
	Male	1	1.6%
MST121	Female	4	15.4%
	Male	7	10.9%
MST124	Female	15	57.7%
	Male	42	65.6%

Module	Gender	Count	Percent of gender
MST125	Female	4	15.4%
	Male	23	35.9%
MST224	Female	0	0.0%
	Male	1	1.6%
MST209	Female	0	0.0%
	Male	1	1.6%
MST210	Female	0	0.0%
	Male	1	1.6%
MS221	Female	3	11.5%
	Male	4	6.3%
None of the above	Female	6	23.1%
	Male	4	6.3%
Total	Female	58	
	Male	156	

Likelihood ratio test value	p-value
16.05	0.139

6.3 Q2a: S104 exam optional question

In the final part of the S104 Exam which optional question did you answer? (Please select one only)

Figure 3

Data Label = Count
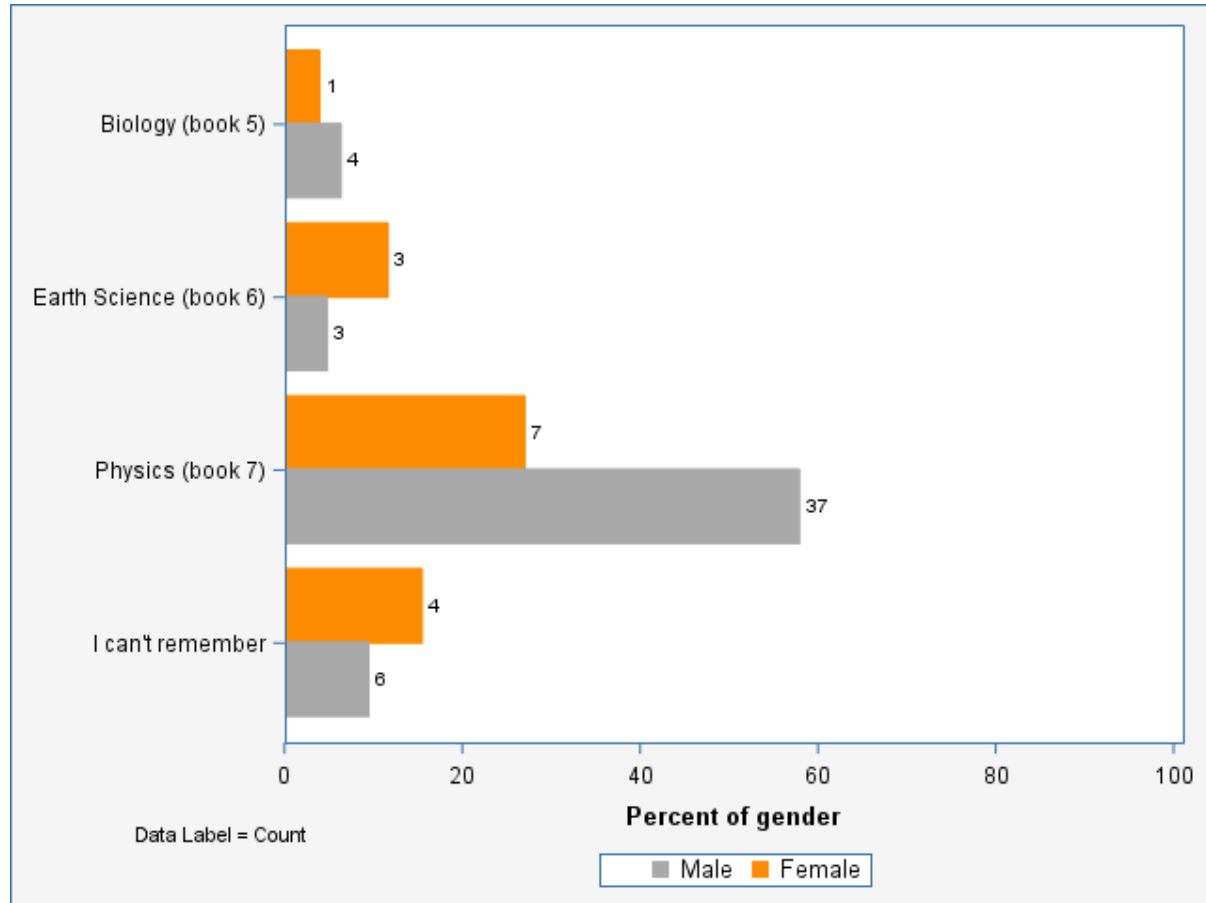
Table 3

Optional Question	Gender	Count	Percent of gender
Biology (book 5)	Female	1	3.8%
	Male	4	6.3%
Earth Science (book 6)	Female	3	11.5%
	Male	3	4.7%
Physics (book 7)	Female	7	26.9%
	Male	37	57.8%
I can't remember	Female	4	15.4%
	Male	6	9.4%
Total	Female	15	
	Male	50	

Likelihood ratio test value	p-value
4.89	0.180

6.4 Q4: Comfort levels for writing and reading in English

In terms of your OU studies: (Please select one only in each row)

1 - How comfortable do you feel about writing about science in English?
2 - How comfortable are you when reading scientific information in English i.e. reading your module materials?

Figure 4

Table 4

Question	Gender		Very comfortable	Comfortable	Neither comfortable nor uncomfortable	Uncomfortable	Very uncomfortable	Total Count
Writing	Female	Count	13	5	5	2	1	26
		Percent of gender	50.0%	19.2%	19.2%	7.7%	3.8%	
	Male	Count	32	19	8	1	0	60
		Percent of gender	50.0%	29.7%	12.5%	1.6%	0.0%	
Reading	Female	Count	14	6	6	0	0	26
		Percent of gender	53.8%	23.1%	23.1%	0.0%	0.0%	
	Male	Count	39	16	3	2	0	60
		Percent of gender	60.9%	25.0%	4.7%	3.1%	0.0%	

	Likelihood ratio test value	p-value
Writing	5.60	0.231
Reading	6.97	0.073

6.5   Q6: Willingness to be interviewed

Would you be prepared to take part in an interview about your experiences of studying physics at the OU?

Figure 5
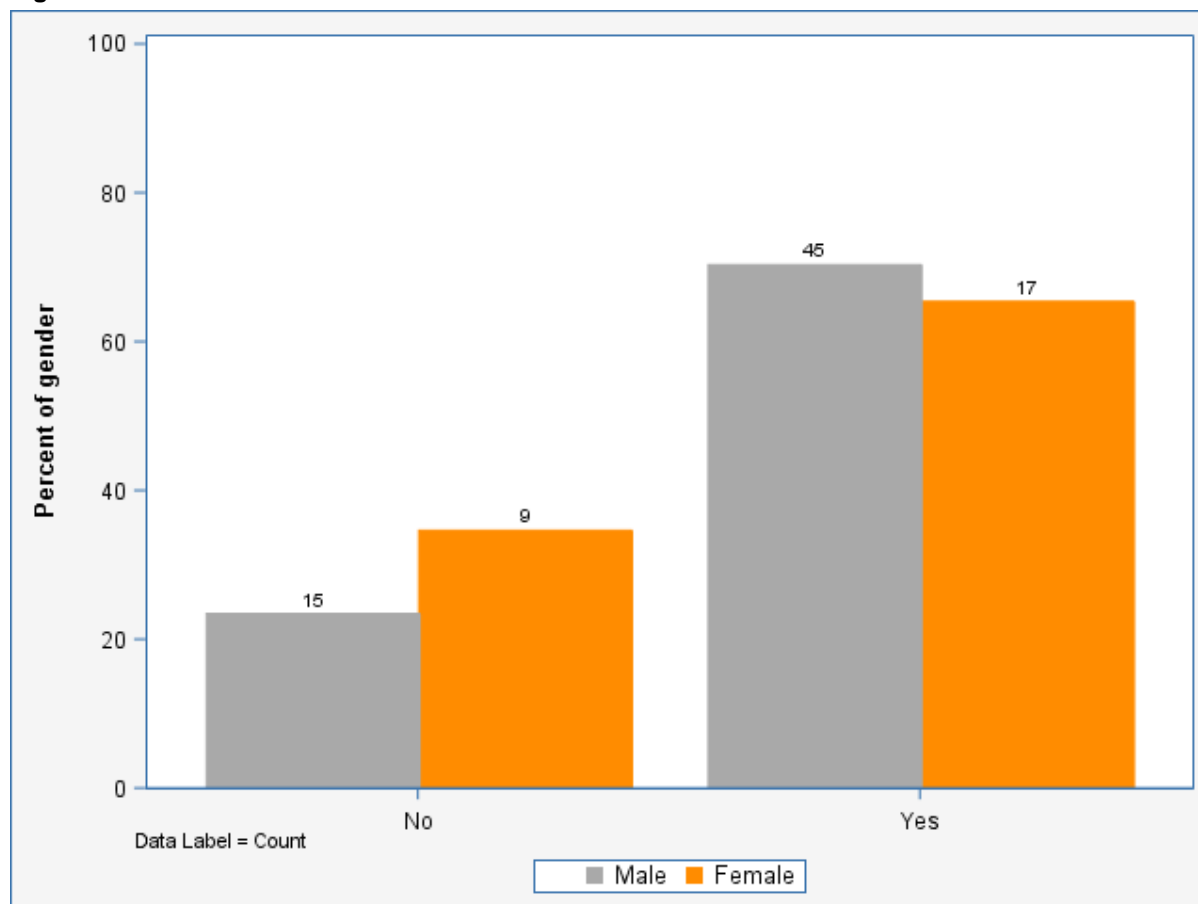
Table 5

Answer	Gender	Count	Percent of gender
Yes	Female	17	65.4%
	Male	45	70.3%
No	Female	9	34.6%
	Male	15	23.4%

Likelihood ratio test value	p-value
0.82	0.367

6.6   Age

Figure 6

Data Label = Count
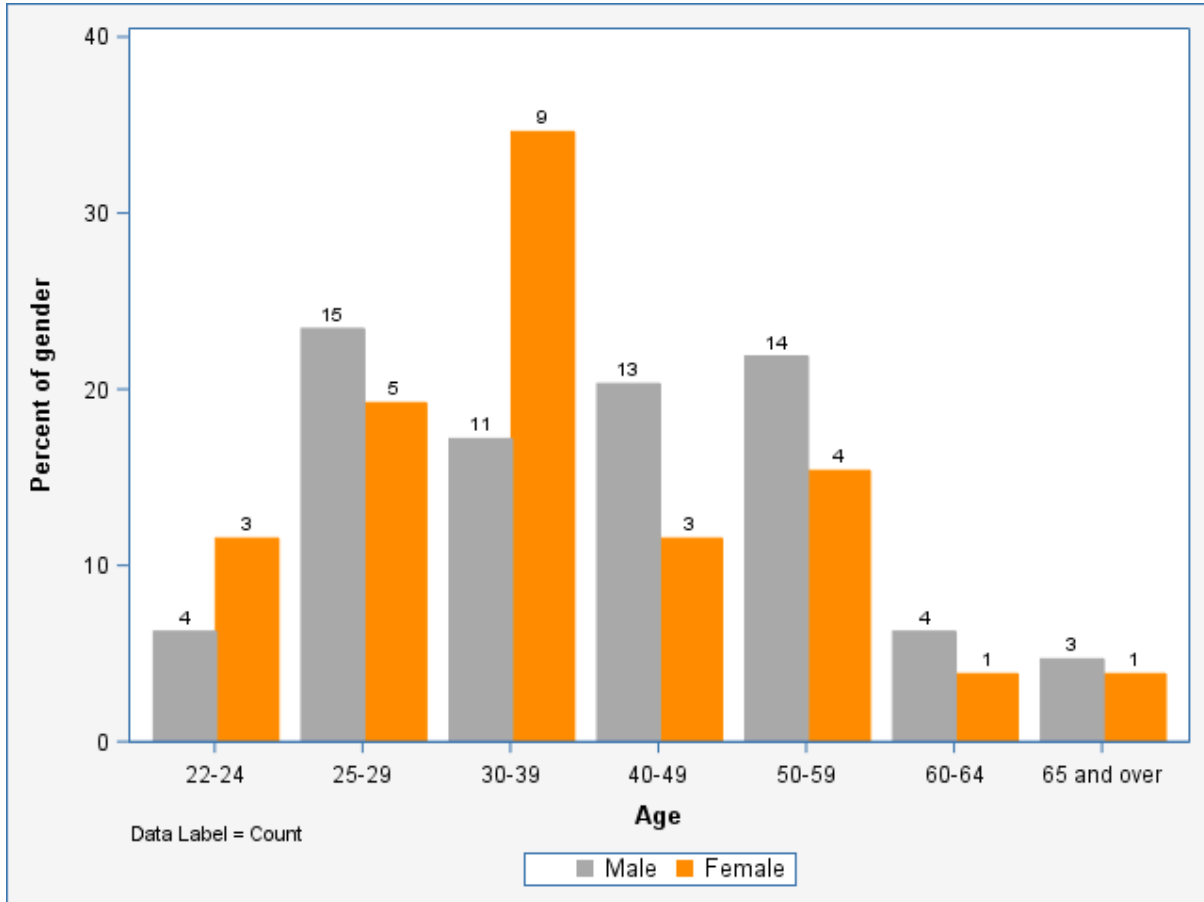
Table 6

Age Range	Gender	Count	Percent of gender
22-24	Female	3	11.5%
	Male	4	6.3%
25-29	Female	5	19.2%
	Male	15	23.4%
30-39	Female	9	34.6%
	Male	11	17.2%
40-49	Female	3	11.5%
	Male	13	20.3%

Age Range	Gender	Count	Percent of gender
50-59	Female	4	15.4%
	Male	14	21.9%
60-64	Female	1	3.8%
	Male	4	6.3%
65 and over	Female	1	3.8%
	Male	3	4.7%
Total	Female	26	
	Male	64	

Likelihood ratio test value	p-value
4.61	0.594

6.7   Occupational status

Figure 7
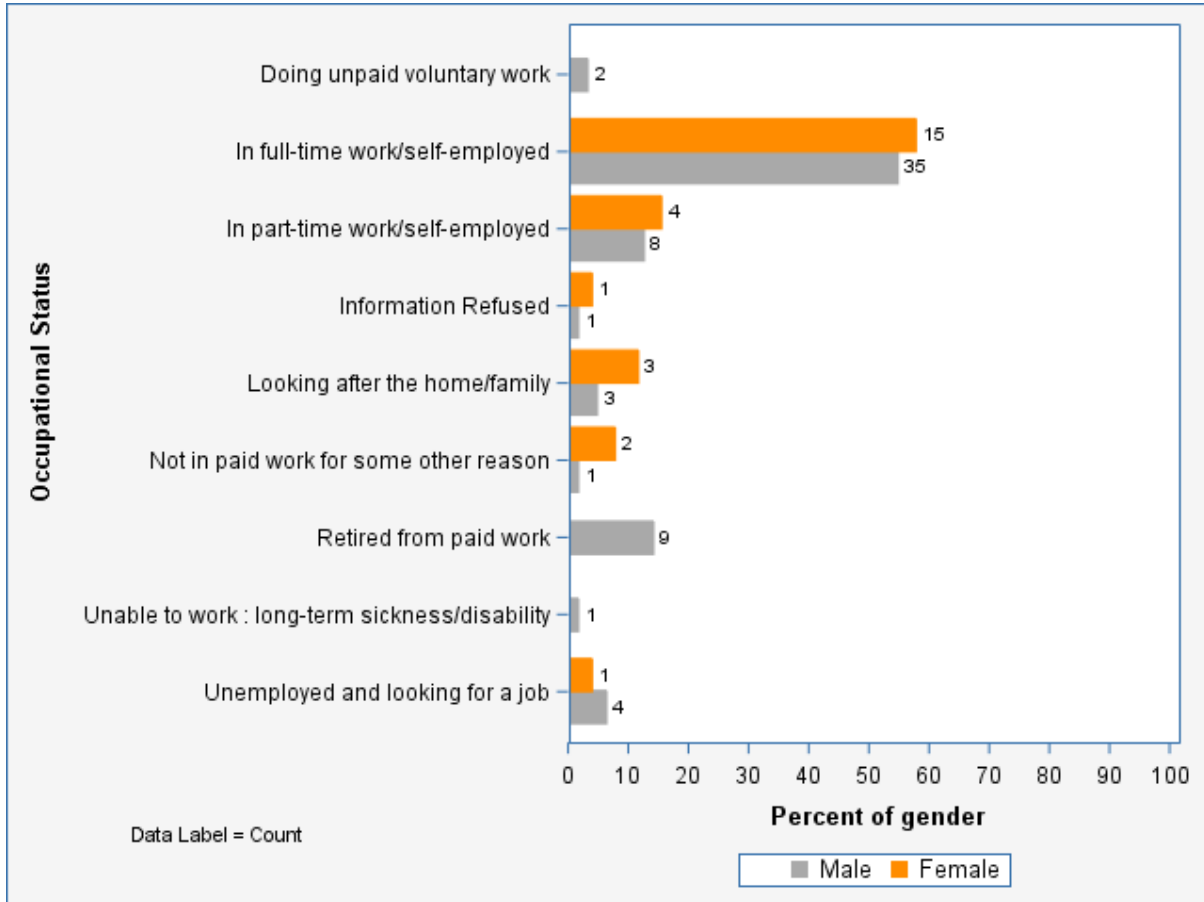
Table 7

Occupational Status	Gender	Count	Percent of gender
Doing unpaid voluntary work	Female	0	0.0%
	Male	2	3.1%
In full-time work/self-employed	Female	15	57.7%
	Male	35	54.7%
In part-time work/self-employed	Female	4	15.4%
	Male	8	12.5%
Information Refused	Female	1	3.8%
	Male	1	1.6%
Looking after the home/family	Female	3	11.5%
	Male	3	4.7%

Occupational Status	Gender	Count	Percent of gender
Not in paid work for some other reason	Female	2	7.7%
	Male	1	1.6%
Retired from paid work	Female	0	0.0%
	Male	9	14.1%
Unable to work : long-term sickness/disability	Female	0	0.0%
	Male	1	1.6%
Unemployed and looking for a job	Female	1	3.8%
	Male	4	6.3%
Total	Female	26	
	Male	64	

Likelihood ratio test value	p-value
-	-

(insufficient data in each category)

6.8   Occupational type

Figure 8
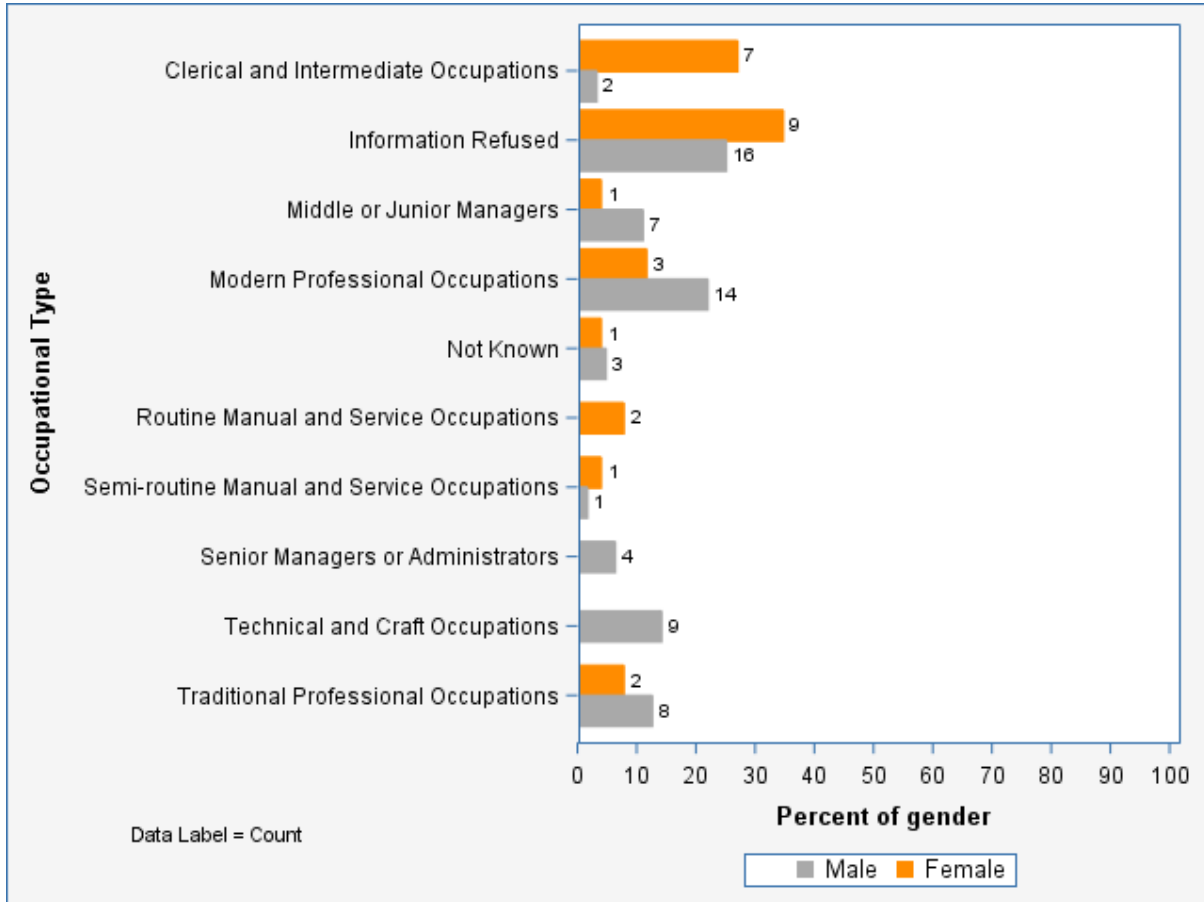
Table 8

Occupational Type	Gender	Count	Percent of gender
Clerical and Intermediate Occupations	Female	7	26.9%
	Male	2	3.1%
Information Refused	Female	9	34.6%
	Male	16	25.0%
Middle or Junior Managers	Female	1	3.8%
	Male	7	10.9%
Modern Professional Occupations	Female	3	11.5%
	Male	14	21.9%
Not Known	Female	1	3.8%
	Male	3	4.7%

Occupational Type	Gender	Count	Percent of gender
Routine Manual and Service Occupations	Female	2	7.7%
	Male	0	0.0%
Semi-routine Manual and Service Occupations	Female	1	3.8%
	Male	1	1.6%
Senior Managers or Administrators	Female	0	0.0%
	Male	4	6.3%
Technical and Craft Occupations	Female	0	0.0%
	Male	9	14.1%
Traditional Professional Occupations	Female	2	7.7%
	Male	8	12.5%
Total	Female	26	
	Male	64	

Likelihood ratio test value	p-value
-	-

(insufficient data in each category)

6.9   Ethnicity

Figure 9
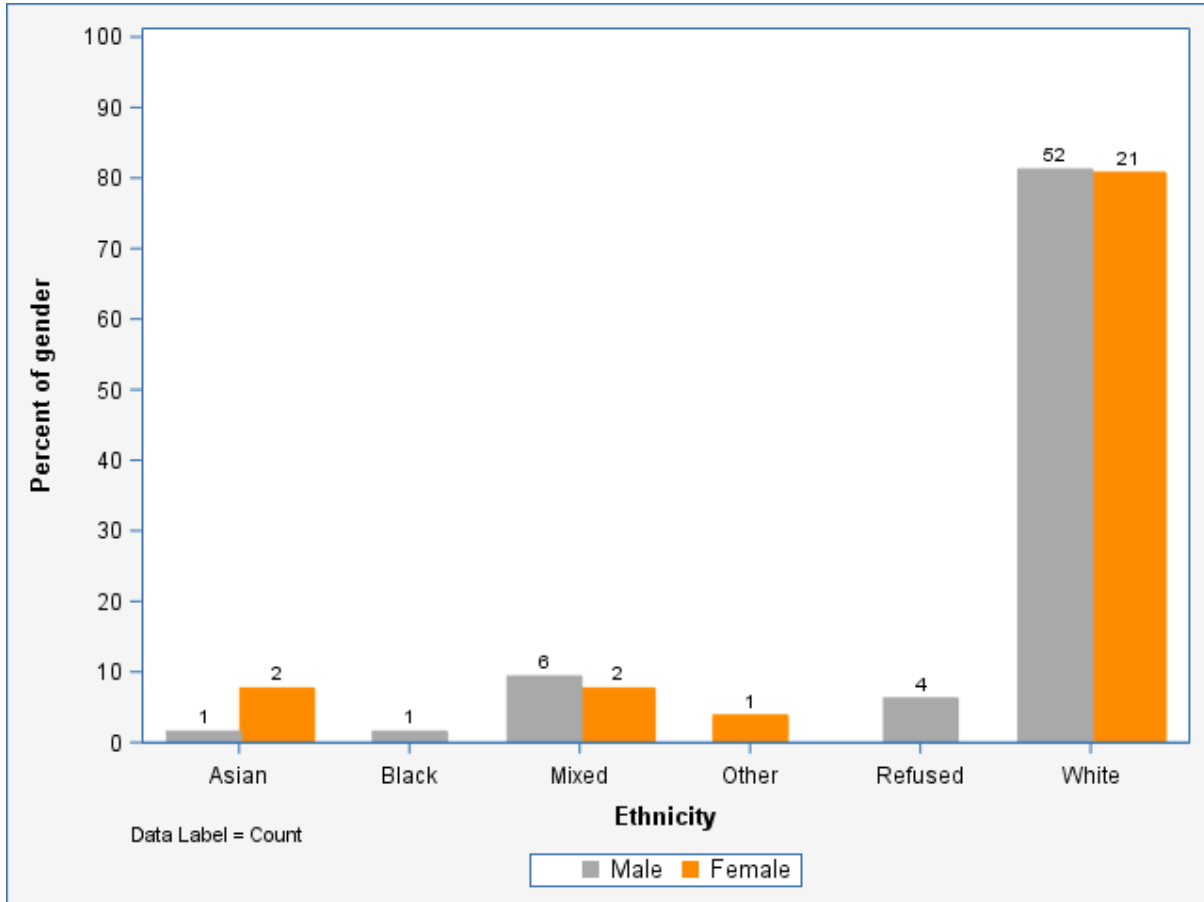
Table 9

Ethnicity	Gender	Count	Percent of gender
Asian	Female	2	7.7%
	Male	1	1.6%
Black	Female	0	0.0%
	Male	1	1.6%
Mixed	Female	2	7.7%
	Male	6	9.4%
Other	Female	1	3.8%
	Male	0	0.0%

Ethnicity	Gender	Count	Percent of gender
Refused	Female	0	0.0%
	Male	4	6.3%
White	Female	21	80.8%
	Male	52	81.3%
Total	Female	26	
	Male	64	

Likelihood ratio test value	p-value
7.78	0.169

6.10   Grouped education

Figure 10
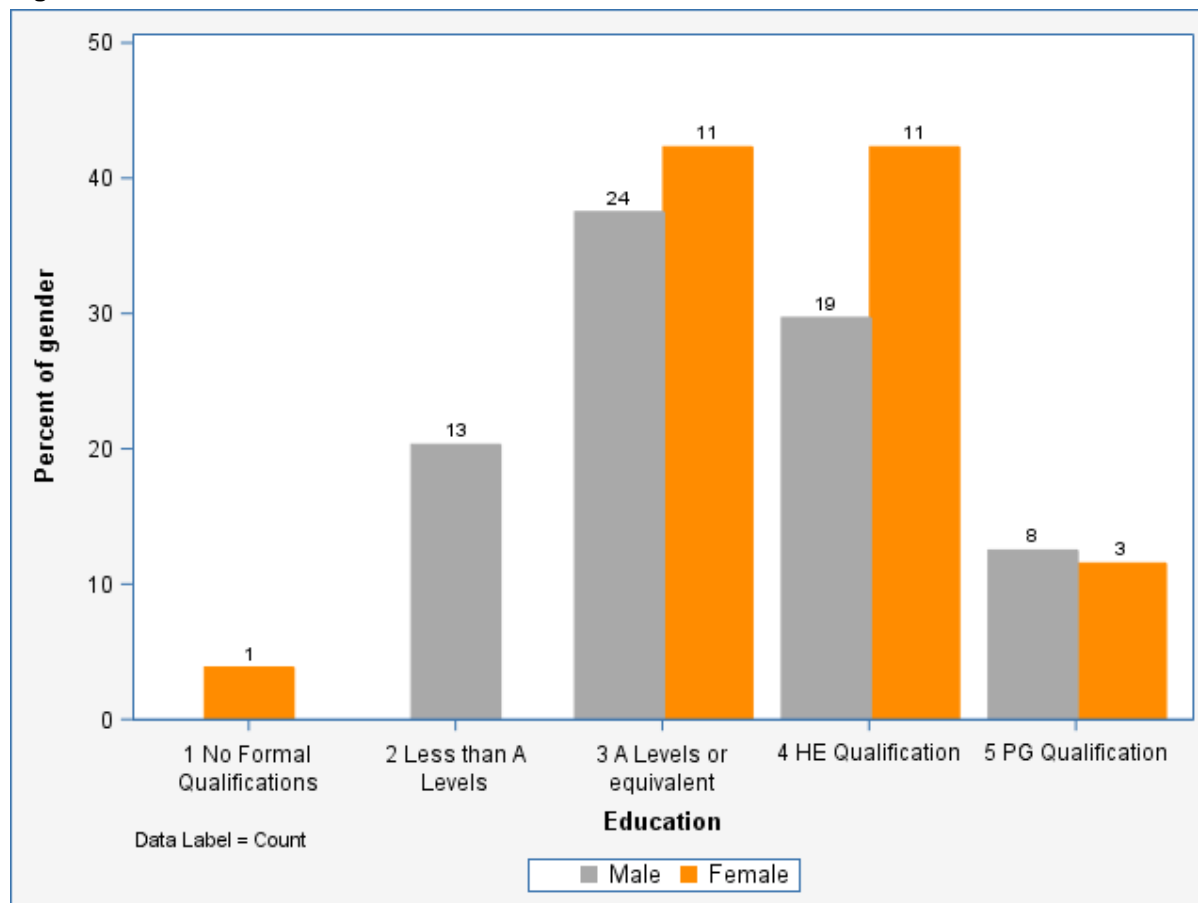
Table 10

Grouped Education	Gender	Count	Percent of gender
No Formal Qualifications	Female	1	3.8%
	Male	0	0.0%
Less than A Levels	Female	0	0.0%
	Male	13	20.3%
A Levels or equivalent	Female	11	42.3%
	Male	24	37.5%

Grouped Education	Gender	Count	Percent of gender
HE Qualification	Female	11	42.3%
	Male	19	29.7%
PG Qualification	Female	3	11.5%
	Male	8	12.5%
Total	Female	26	
	Male	64	

Likelihood ratio test value	p-value
5.11	0.164

6.11 Scatter plot of age and education

Figure 11
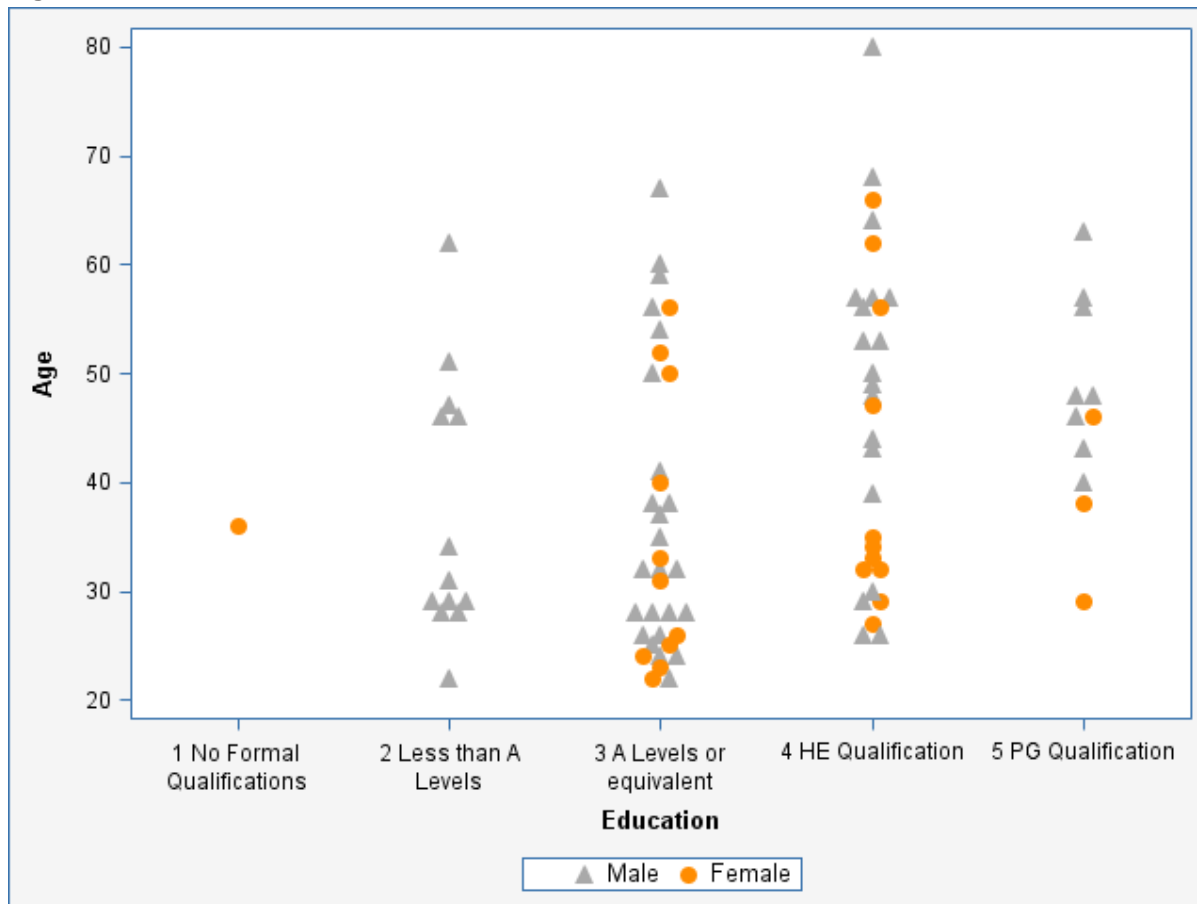
6.12   Number of prior qualifications

Figure 12
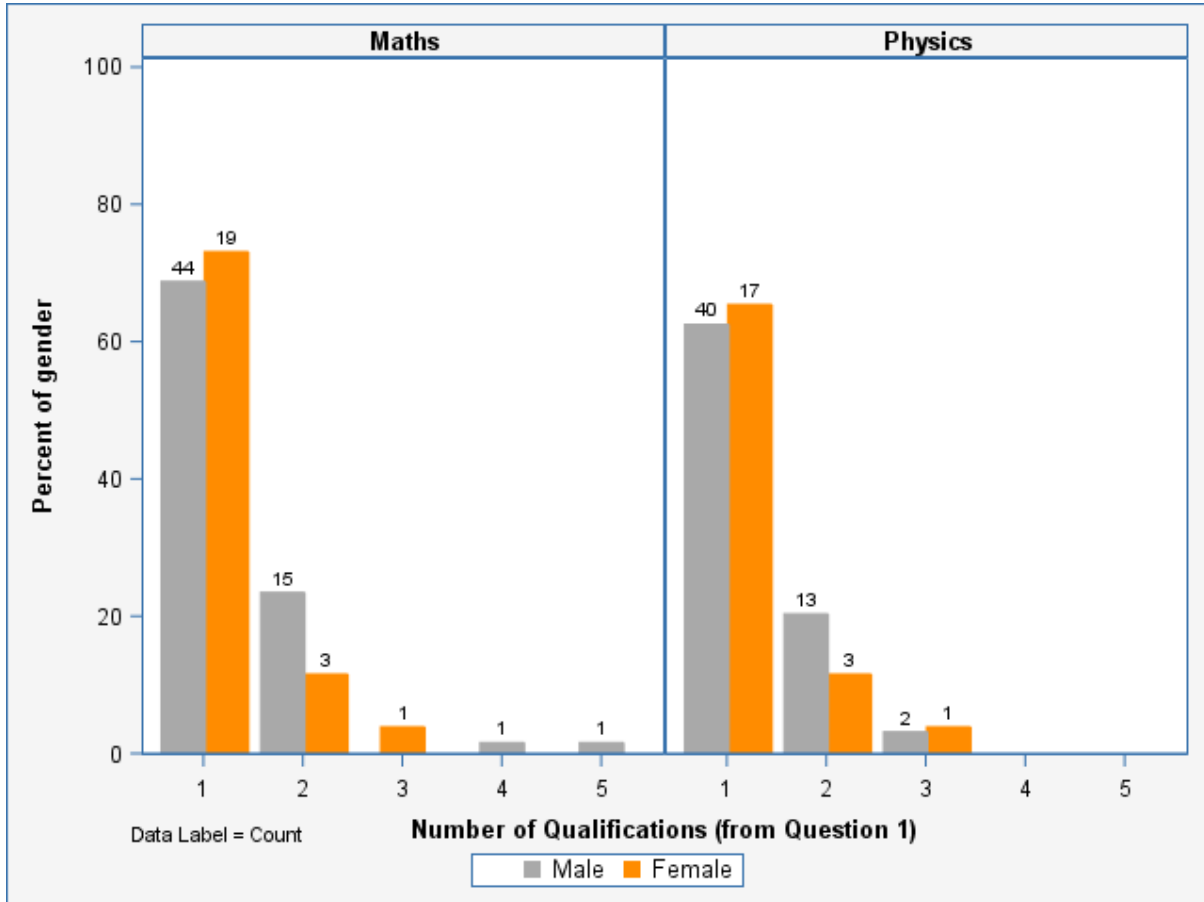
Table 12

Subject	Gender		Number of qualifications					Total
			1	2	3	4	5	
Maths	Female	Count	19	3	1	0	0	23
		Percent of gender	73.1%	11.5%	3.8%	0.0%	0.0%	
	Male	Count	44	15	0	1	1	61
		Percent of gender	68.8%	23.4%	0.0%	1.6%	1.6%	
Physics	Female	Count	17	3	1	0	0	21
		Percent of gender	65.4%	11.5%	3.8%	0.0%	0.0%	
	Male	Count	40	13	2	0	0	55
		Percent of gender	62.5%	20.3%	3.1%	0.0%	0.0%	

	Likelihood ratio test value	p-value
Maths	5.26	0.261
Physics	0.87	0.649

6.13   Number of prior modules

Figure 13
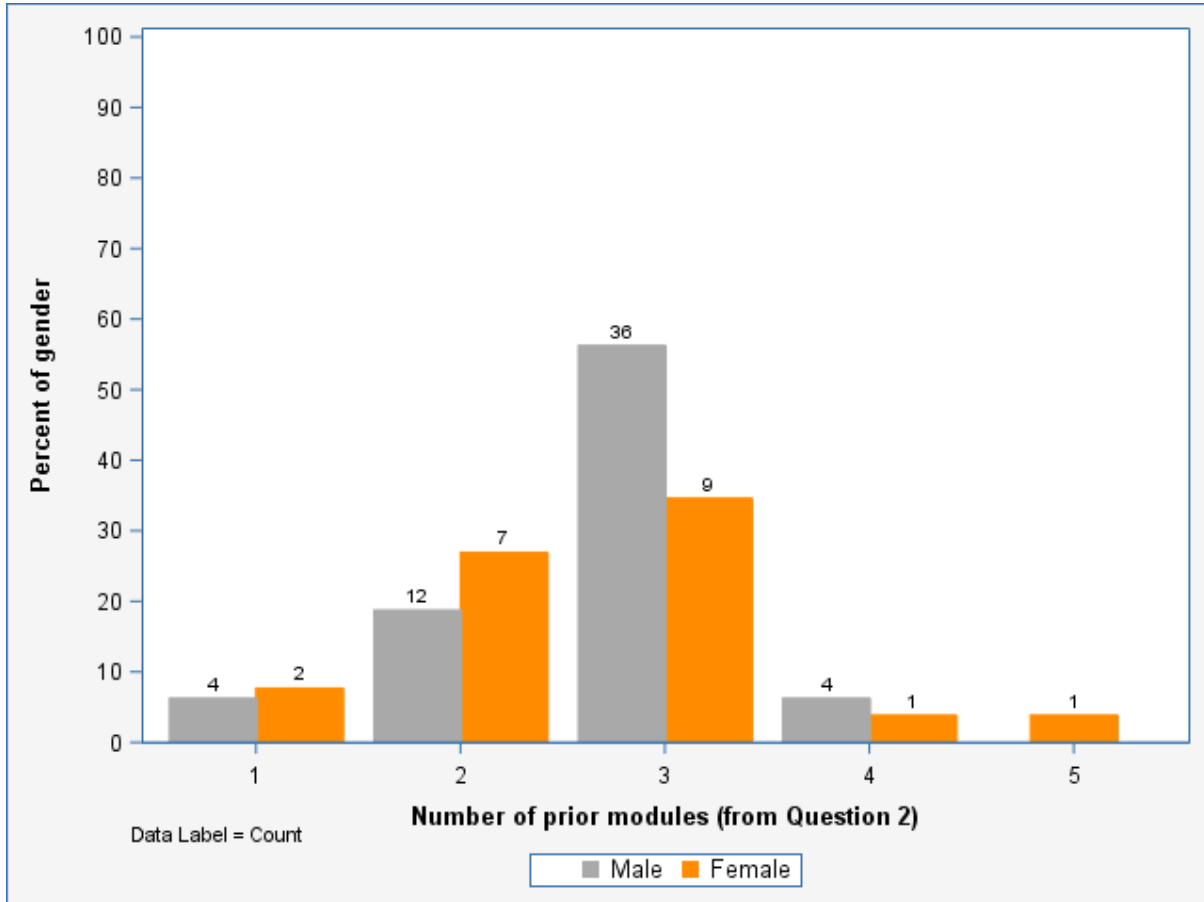
Table 13

Number of modules	Gender	Count	Percent of gender		Number of modules	Gender	Count	Percent of gender
1	Female	2	7.7%		4	Female	1	3.8%
1	Male	4	6.3%		4	Male	4	6.3%
2	Female	7	26.9%		5	Female	1	3.8%
2	Male	12	18.8%		5	Male	0	0.0%
3	Female	9	34.6%		Total	Female	20	
3	Male	36	56.3%		Total	Male	56	

Likelihood ratio test value	p-value
4.92	0.296

6.14   Further analysis of students with 3 prior modules

Table 14

Prior Modules										Female		Male	
S104	S141	S151	MU123	MST121	MST124	MST125	MST224	MST210	MS221	Count	Percent of gender	Count	Percent of gender
X	X				X					6	23.08%	11	17.19%
X	X					X				1	3.85%		
X					X	X				1	3.85%	20	31.25%
				X	X				X	1	3.85%		
X	X			X								2	3.13%
X					X			X				1	1.56%
		X	X		X							1	1.56%
				X	X				X			1	1.56%