IB MATHEMATICAL STUDIES INTERNAL ASSESSMENT

The Role of Gender Performance on Academic Achievement

Student Name

Candidate number 000205-XXX

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Contents

Gender Performance Role on Academic Achievement

000205-001

While I was reading an article about gender performance and academic achievement I was surprised to read that girls perform better than boys on academic achievement. This led me to wonder whether gender plays a role in academic achievement at my school.

Statement of the Task

Student grade point averages are confidential records. However as a general measure of academic achievement, I will be using the school's honor roll that is published each semester. In this investigation I will include high school students only. I will tabulate honor roll students and non- honor roll students by gender for grades 9 through 12 for both last year February 2011-June 2011 and this year's semester of February 2012 – June 2012.

Based on the tabulated data, I will create pie charts to compare the honor roll of males in each grade and females in each grade to see the differences in grade years. This will give me a general idea of any difference in academic achievement between gender and grade levels. Then I will perform chi-squared tests on each grade and each semester to determine whether academic performance is independent of gender.

Throughout the project, I will be considering problems with the use of the chi-square tests of collecting the data. I will consider some percentage rounding errors.

Data Collection Procedure

To collect the data, I went to the assistant to the school counselors. He provided me with the total male and female students in each grade for high school last year (2010-2011) semester and this year's semester (2011-2012). As grade point averages are confidential records Mr. Frerot gave me the school's honor roll that was published for last year (2010-2011) semester and this year's semester (2011-2012) which were separated by grade. From there, I identified and counted the males and females for each grade level. The tables with the raw data are in Appendix A. Then I calculated all honor roll students from each grade and by gender. That helped me determine whether academic performance is independent of gender.

Student Name
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Data Presentation and Analysis

Last Year 2010-2011 Semester

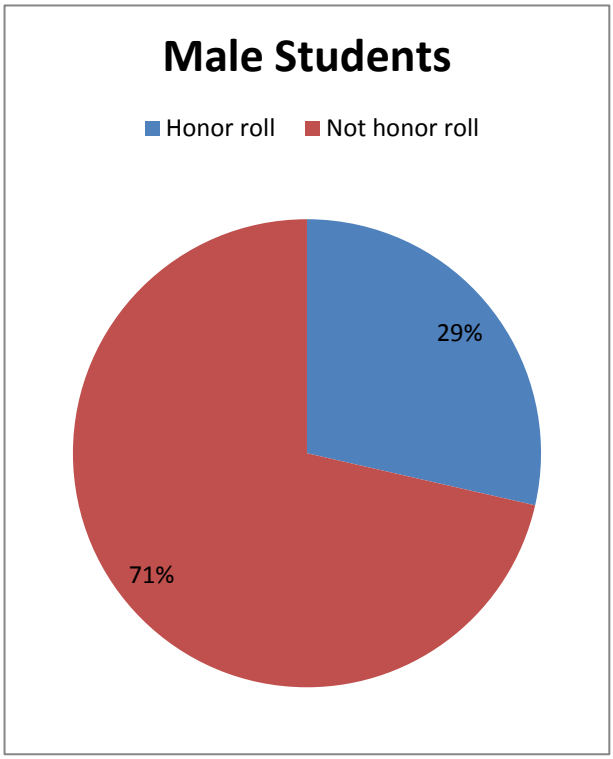
Pie Charts:

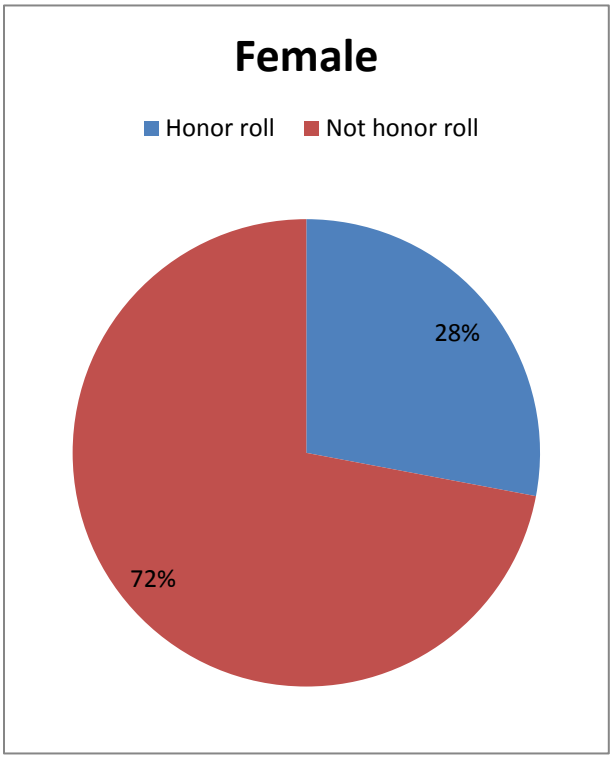
The pie charts shown help me visualize my data and results, as seen on the first pie chart I get a visualization and percentage of students of male and female students who are on the honor roll and students who are not in the honor roll. This helped me get a general idea of the relationship between gender and academic performance, I also did pie charts that show the percentage of student who are on the honor roll/non-honor roll by each separate high school grade.

Percentage of students of who are in the honor roll and are not, by gender:

Male honor roll: $\frac{42}{147} \times 100 = 28.6\%$ Male not honor roll: $\frac{105}{147} \times 100 = 71.4\%$

Female honor roll: $\frac{33}{118} \times 100 = 28\%$ Female not honor roll: $\frac{85}{118} \times 100 = 72\%$





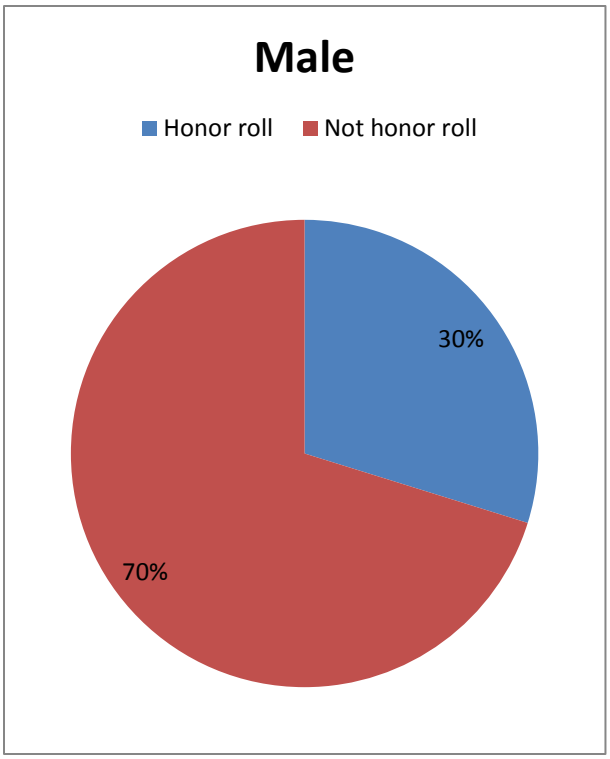
Comparing the pie charts between gender seems that they are quite similar although there is 1% more of male in the honor roll, but by a very small amount. As seen from the pie graph and calculations there seems to be no significant impact of gender on academic performance, the numbers were very close.

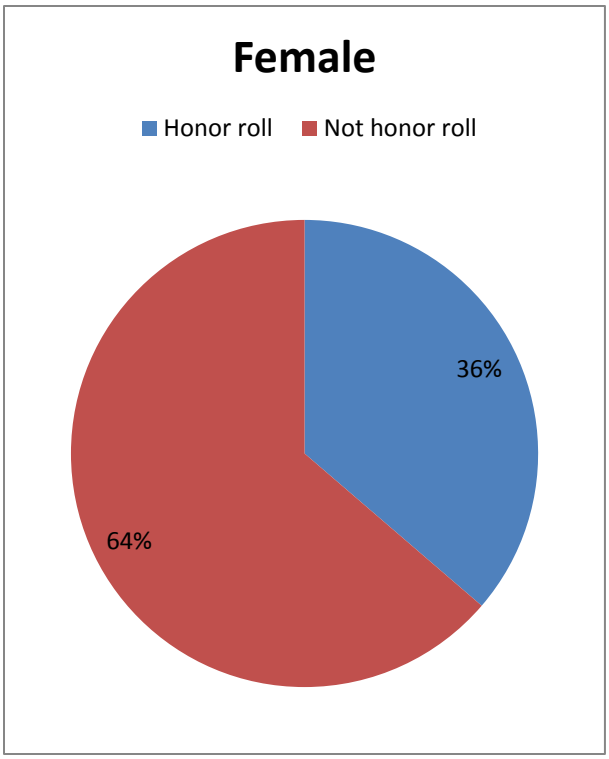
This Year 2011-2012 Semester

Percentage of students of who are in the honor roll and are not by gender:

Male: $\frac{45}{151} \times 100 = 29.8\%$ Not honor roll $100 - 29.8 = 70.2\%$

Female: $\frac{49}{135} \times 100 = 36.3\%$ Not honor roll $100 - 36.3 = 63.7\%$





Comparing the pie charts between genders for this year seems that they are quite similar although there more females are in the honor roll about 36% of females conversely 30% of male students are on the honor-roll unlike last year there is a greater difference, but by a very small amount. However, this also shows no impact of gender on academic performance.

Now I wanted to find out if gender was really independent of academic performance by using the chi-square test

Last Year 2010-2011

Semester

χ^2 *Test*

Testing my hypothesis:

To test my hypothesis I will use the chi-square test that will help me test for independence.

So thus, my hypotheses for Gender Performance Role on Academic Achievement are…

- **Null hypothesis (H_0):** Gender performance is independent of academic achievement
- **Alternate hypothesis (H_1):** Gender performance is dependent of academic achievement

So if the χ^2calculated which is the independece test that is calculated by hand or calculator and indicates whether the data is independent or not based on its χ^2critical which suggests if categrorcal variables are different from one another. Thus if the χ^2calculated bigger than the χ^2critical, we reject the null hypothesis and accept the alternate hypothsis suggesting the idenpendece of data, however if the χ^2calculated s smaller than the χ^2critical we accept the null hypothsis and reject the alternate hypothesis and this will suggest that the data is not independet of each other.

Student Name
Candidate number: 000205-XXX

Observed Values:

Gender	Total Honor roll Students	Not Honor roll	Total
Male	42	105	147
Female	33	85	118
Total	75	190	265

Expected Values:

Gender	Total Honor roll Students	Not Honor roll	Total
Male	$\frac{147 \times 75}{265} = 41.6$	$\frac{147 \times 190}{265} = 105$	147
Female	$\frac{118 \times 75}{265} = 33.4$	$\frac{118 \times 190}{265} = 84.6$	118
Total	75	190	265

Calculate the χ^2 statistic:

Since I am using 2x2 chi –square test I have to use the Yates Correction for Continuity

$$\chi^2_{yates} = \sum \frac{(|f_o - f_e| - 0.5)^2}{f_e}$$

Observed (f_o)	Expected (f_e)	$f_o - f_e$	$(\|f_o - f_e\| - 0.5)^2$	$\frac{(\|f_o - f_e\| - 0.5)^2}{f_e}$
42	41.6	0.4	0.01	0.00024
33	33.4	-0.4	0.81	0.02425
105	105	0	0.25	0.00238
85	84.6	0.4	0.01	0.00012
			Total	χ^2 =0.02699

Degrees of freedom

To find the degrees of freedom (df), the equation $v = (r-1)(c-1)$, where r equals the number of rows and c equals the number of columns minus one. $v = (2-1)(2-1) = 1$ Thus the degree of freedom is equal to one.

χ^2 Critical Value with 5% significant level

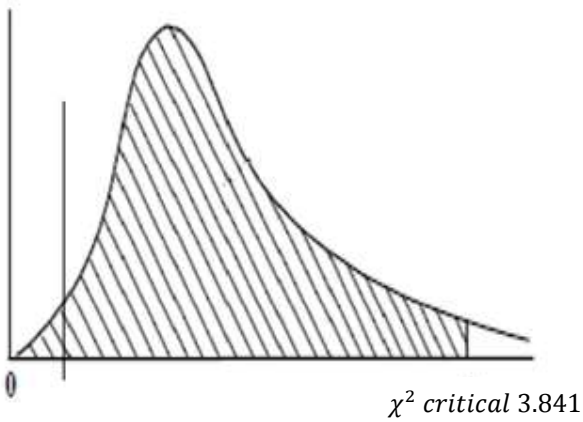
To test this with 5% significance level the χ^2 critical value is 3.841 and the χ^2 calculated is not bigger that the χ^2 critcal value as seen on the chi − square graph below 0.02699 is smaller then 3.841 which is the χ^2 Critcal Value.

The chi-square measures independence between two or more categories which means that if χ^2 calculated is biggerthen χ^2 critcal then we reject the alternate hypothesis and accept the null hypothesis that gender performance and academic achievement are independent of each other. This seems to be a reasonable conclusion because the results from the pie charts showed that there wasn't a huge difference between the female and male students in the honor-roll.

χ^2 Critical Value with 5% significant level

3.841

Graph



This Year 2011-2012

Semester

χ^2 *Test*

Testing my hypothesis:

To test my hypothesis I will use the chi-square test that will help me test for independence.

So thus, my hypotheses for Gender Performance Role on Academic Achievement are…

- **Null hypothesis (H_0):** Gender performance is independent of academic achievement
- **Alternate hypothesis (H_1):** Gender performance is dependent of academic achievement

So if the χ^2calculated which is the independece test that is calculated by hand or calculator and indicates whether the data is independent or not based on its χ^2critical which suggests if categrorcal variables are different from one another. Thus if the χ^2calculated bigger than the χ^2critical, we reject the null hypothesis and accept the alternate hypothsis suggesting the idenpendece of data, however if the χ^2calculated s smaller than the χ^2critical we accept the null hypothsis and reject the alternate hypothesis and this will suggest that the data is not independet of each other.

Observed Values:

Gender	Total Honor roll Students	Not Honor roll	Total
Male	45	106	151
Female	49	86	135
Total	94	192	286

Expected Values:

Gender	Total Honor roll Students	Not Honor roll	Total
Male	$\frac{151 \times 94}{286} = 49.6$	$\frac{151 \times 192}{286} = 101$	151
Female	$\frac{135 \times 94}{286} = 44.4$	$\frac{135 \times 192}{286} = 90.6$	135
Total	94	192	286

Calculate the χ^2 statistic:

$$\chi^2_{yates} = \sum \frac{(|f_o - f_e| - 0.5)^2}{f_e}$$

Observed (f_o)	Expected (f_e)	$f_o - f_e$	$(\|f_o - f_e\| - 0.5)^2$	$\frac{(\|f_o - f_e\| - 0.5)^2}{f_e}$
45	49.6	−4.6	26.01	0.52440
49	44.4	4.6	16.81	0.37860
106	101	5	20.25	0.20050
86	90.6	−4.6	26.01	0.28709
Total				χ^2 =1.39059

Degrees of Freedom

To find the degrees of freedom (df), the equation $v = (r - 1)(c - 1)$, where r equals the number of rows and c equals the number of columns minus one. $v = (2 - 1)(2 - 1) = 1$ Thus the degree of freedom is equal to one.

χ^2 Critical Value with 5% significant level

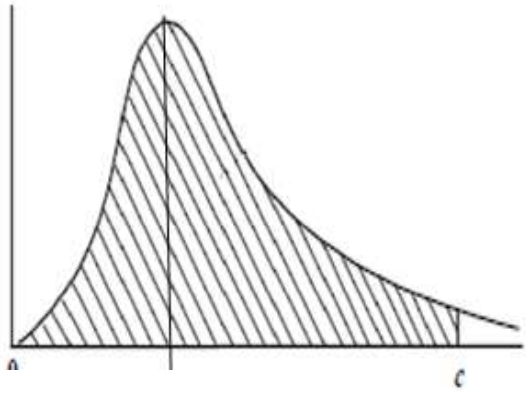
To test this with 5% significance level the χ^2 critcal value is 3.841 and the χ^2 calculated is not bigger that the χ^2 critcal value as seen on the chi − square graph below 1.39059 is smaller then 3.841 which is the χ^2 Critcal Value.

This means that we reject the alternate hypothesis and accept the null hypothesis that gender performance and academic achievement are independent of each other. I accept this because as seen with the pie charts above there results were very close to each other and there wasn't a huge difference between the female and male student in the honor-roll however the chi-square did have a larger value then last year's result meaning that the data last year was much more independent then this year's.

χ^2 Critical Value with 5% significant level

3.841

Graph



$\chi^2 calculated\ Yates$ 1.39059 $\chi^2\ critical$ 3.841

Percentage Error

Last year: Percentage Error between $\chi^2_{calc\ Yates}$ by hand and by calculator

$Percentage\ error = \frac{V_a - V_e}{V_e} \times 100$ Where V_a is the approximate value and V_e is the exact value.

$$\frac{0.012 - 0.02699}{0.02699} \times 100 = -55.5\%$$

As well I calculated the percentage error between the χ^2_{calc} used by the Yates correction and with the calculator. To calculate the χ^2_{calc} in the calculator I went to second matrix and listed the amount of rows and columns and then I went to stat, test and $\boldsymbol{\chi^2}$test and the χ^2_{calc} was displayed and I got 0.012 with calculator as seen above with percentage formula there -55.5% percentage error, so this suggests that the calculator did not use the Yates Correction for Continuity due to the large amount of percentage difference.

This year percentage error

$$\frac{1.36 - 1.39059}{1.39059} \times 100 = -2.20\%$$

As well I calculated the percentage error between the χ^2_{calc} by hand and with the calculator. To calculate the χ^2_{calc} in the calculator I went to second matrix and listed the amount of rows and columns and then I went to stat, test and $\boldsymbol{\chi^2}$ test and the χ^2_{calc} was displayed and I got 1.36 with calculator as seen above with percentage formula there was -2.20% percentage error, so very small error.

Conclusion

In conclusion, the results above suggest that gender is independent of academic performance. When I used the pie charts there was very small difference in the number of females and males on the honor roll this suggest that there is no significant impact. When I went on to test the chi-square test the chi-square calculated fro both this year and last year had a smaller value then chi-square critical stating independence. Here I come with a conclusion that gender is independent of academic performance.

To make my project valid, I had to use the chi-square test to determine the independence of two variables, and all of my expected values were greater then 5 so that is valid. Since I had 2x2 matrix I had to use the Yates continuity correction so the results are valid.

There were some limitations to my project, the data I collected was only valid fro high school male and females, and not middle school nor elementary school, and this reduced the range of available data. Another limitation would be that I used just one school instead of two or three which could have mad my project more accurate. To improve my project next time I would perhaps collect data for middle and elementary school as well I could have compared two or three schools to have a greater range of data and thus this will increase accuracy.

Appendix

Appendix A: Raw Data

Maryam Abdulla

Total of Honor roll students

Last Year 2010-2011

Semester

Gender	Grade 9	10	11	12
Male	6	16	11	10
Female	8	10	7	7
Total	14	26	18	17

This Year 2011-2012

Semester

Gender	Grade 9	10	11	12
Male	8	14	23	14
Female	11	8	12	5
Total	19	22	35	19