Mathematics Stage 5 (Year 10) – assessment task sample solutions

Bivariate data

Contents

[Part 1 – setting up your investigation 2](#_Toc188612595)

[Part 2 – data collection and visualisation 2](#_Toc188612596)

[Part 3 – data visualisation 3](#_Toc188612597)

[Part 4 – data analysis 8](#_Toc188612598)

[Part 5 – limitations of the model 9](#_Toc188612599)

# Part 1 – setting up your investigation

Refer to the Microsoft Excel spreadsheet Average years in school for women 25 and older.

The 2 variables I am investigating are average years in school for women 25 years and older, and the percentage of people in poverty (under $6.85/day). The independent variable is the number of years females were in school, and the percentage of people in poverty is the dependent variable, as I want to see how women being involved in education can affect the poverty they might face, rather than how being in poverty might affect their capacity to attend school, which is something else people might consider investigating.

**Hypothesis:** as the average number of years of school for women increases, the percentage of people living in poverty decreases.

**Well developed:** the student clearly explains their choice for the independent and dependent variables using the cause and effect of the variables depending on which was dependent or independent. They have created their hypothesis which clearly states the relationship they believe exists between the variables.

# Part 2 – data collection and visualisation

I collected my data using secondary sources from the website ‘GapMinder’ ([gapminder.org](https://www.gapminder.org/)). They collect world data and each of the data points is from countries all over the world.

The data sourced from the GapMinder website was reliable, but not complete. Some countries did not have data for both variables (this was removed when creating my table), and it does not include all the countries there are in the world.

The data is 15 years old, so it is hard to use it as an accurate representation of the current situation. Using data that is more up-to-date means it would be more useful to use to help make informed decisions. The data reflects a global sample but may not take into account other factors affecting a country such as economic factors. The UAE’s poverty rate is 0% which may reflect wealth rather than education alone.

The website does say it collects its data from reputable sources. Years in school were collected by the Institute for Health Metrics and Evaluation which states it’s their mission to provide valid evidence and the poverty data was from GapMinder’s own collected data and their mission is to bust people’s misconceptions using data. Due to these statements, I believe they would collect the data free of bias.

This gives me the data in an Excel spreadsheet, which I have included in Part 3. I collected the average number of years in school for women 25 and older and the percentage of poverty in a country (classed as less than $6.85/day) both collected in 2009 as that was the most up-to-date data for the average number of years in school.

**Well developed:** the student has considered the bias that was in the data collection referencing its reliability, specifically about the age of the data and who collected the data. They also stated that improvements could be made if they had more current data. Further improvement could be made if they were to consider rounding errors, using percentages and the fact that percentages were used as an easy comparison since countries have different populations.

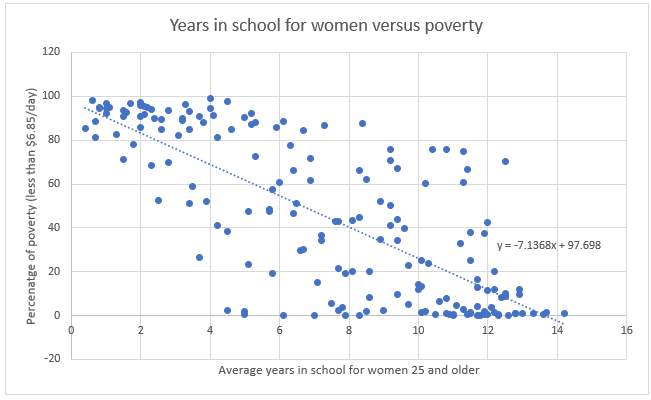
# Part 3 – data visualisation

Table 1 – countries’ average years in school for women 25 years and older and percentage of people in poverty for 2009

|  |  |  |
| --- | --- | --- |
| Country | Average years in school for women 25 years and older | Percentage of people in poverty (under $6.85/day) |
| Afghanistan | 0.4 | 85.5 |
| Albania | 9.4 | 34.4 |
| Algeria | 4.2 | 40.9 |
| Angola | 2.8 | 69.6 |
| Antigua and Barbuda | 12.2 | 11.8 |
| Argentina | 10.1 | 13.3 |
| Armenia | 11.3 | 60.8 |
| Australia | 11.5 | 0.9 |
| Austria | 11 | 0.73 |
| Azerbaijan | 11.3 | 2.73 |
| Bahamas | 10.8 | 7.78 |
| Bahrain | 7.8 | 3.73 |
| Bangladesh | 2.6 | 89.3 |
| Belarus | 11.7 | 16.3 |
| Belgium | 11.9 | 0.37 |
| Belize | 8.3 | 66.2 |
| Benin | 1.6 | 92.5 |
| Bolivia | 6.7 | 30.1 |
| Bosnia and Herzegovina | 7.5 | 5.6 |
| Botswana | 6 | 60.6 |
| Brazil | 7.2 | 34.2 |
| Bulgaria | 12 | 11.3 |
| Burkina Faso | 0.8 | 94.3 |
| Burundi | 2 | 97.3 |
| Cambodia | 3.2 | 89.1 |
| Cameroon | 4.2 | 81.4 |
| Canada | 14.2 | 0.82 |
| Cape Verde | 3.5 | 59.1 |
| Central African Republic | 2.1 | 91.7 |
| Chad | 0.7 | 88.6 |
| Chile | 10.1 | 25.1 |
| China | 6.4 | 66 |
| Colombia | 6.4 | 46.7 |
| Comoros | 2.3 | 68.3 |
| Congo, Dem. Rep. | 4 | 98.9 |
| Congo, Rep. | 5.3 | 88.1 |
| Costa Rica | 8.6 | 20 |
| Cote d'Ivoire | 2 | 85.9 |
| Croatia | 10.8 | 0.87 |
| Cuba | 10.2 | 60.2 |
| Cyprus | 11.8 | 0.2 |
| Czech Republic | 13.3 | 0.88 |
| Denmark | 12.8 | 1.05 |
| Djibouti | 1.8 | 78 |
| Dominican Republic | 7.7 | 42.9 |
| Ecuador | 8.1 | 43.2 |
| Egypt | 5.3 | 72.6 |
| El Salvador | 6.5 | 51.1 |
| Equatorial Guinea | 4.5 | 2.31 |
| Eritrea | 2.1 | 95.4 |
| Estonia | 11.7 | 4.28 |
| Eswatini | 7.3 | 86.7 |
| Ethiopia | 1 | 94.3 |
| Fiji | 9.2 | 41.2 |
| Finland | 12.3 | 0.15 |
| France | 10.5 | 0.38 |
| Gabon | 5.7 | 47.6 |
| Gambia | 2 | 91 |
| Georgia | 12.5 | 70.2 |
| Germany | 12 | 0.28 |
| Ghana | 5.2 | 87.3 |
| Greece | 10.1 | 1.27 |
| Guatemala | 3.9 | 51.9 |
| Guinea | 1 | 92.1 |
| Guinea-Bissau | 1.1 | 95 |
| Guyana | 9.4 | 43.7 |
| Haiti | 3.4 | 84.8 |
| Honduras | 5.7 | 48.4 |
| Hungary | 11.1 | 4.47 |
| India | 3.4 | 93.2 |
| Indonesia | 6.1 | 88.7 |
| Iran | 5.1 | 23.5 |
| Iraq | 3.7 | 26.4 |
| Ireland | 11.5 | 1.52 |
| Israel | 12.5 | 8.93 |
| Italy | 10.2 | 1.79 |
| Jamaica | 10.3 | 23.7 |
| Japan | 12.2 | 1.46 |
| Jordan | 8.6 | 8.36 |
| Kazakhstan | 11.9 | 37.4 |
| Kenya | 5.9 | 86 |
| Kiribati | 9.2 | 75.6 |
| Kuwait | 7 | 0.06 |
| Kyrgyz Republic | 11.4 | 66.4 |
| Lao | 2.6 | 84.8 |
| Latvia | 12.9 | 11.9 |
| Lebanon | 8.5 | 2.09 |
| Lesotho | 8.4 | 87.7 |
| Liberia | 2.2 | 94.9 |
| Lithuania | 12.5 | 10.2 |
| Luxembourg | 11 | 0.22 |
| Madagascar | 4.5 | 97.7 |
| Malawi | 3.3 | 96.1 |
| Malaysia | 7.7 | 21.4 |
| Maldives | 3.4 | 51.3 |
| Mali | 0.8 | 94.8 |
| Marshall Islands | 8.9 | 52 |
| Mauritania | 1.5 | 71 |
| Mauritius | 8.1 | 20.2 |
| Mexico | 7.6 | 43 |
| Moldova | 11.2 | 33.1 |
| Mongolia | 9.2 | 50.2 |
| Montenegro | 10.6 | 6.55 |
| Morocco | 2.5 | 52.6 |
| Mozambique | 1.7 | 96.6 |
| Myanmar | 4.6 | 84.9 |
| Namibia | 6.9 | 71.8 |
| Nepal | 1.3 | 82.6 |
| Netherlands | 11.4 | 0.4 |
| New Zealand | 12.3 | 0.3 |
| Nicaragua | 5.8 | 57.3 |
| Niger | 0.6 | 98 |
| Nigeria | 4.1 | 91.3 |
| North Macedonia | 9.6 | 39.6 |
| Norway | 13.6 | 0.36 |
| Oman | 5 | 0.65 |
| Pakistan | 2.4 | 90 |
| Palestine | 7.9 | 19.4 |
| Panama | 9.7 | 23 |
| Papua New Guinea | 3.2 | 90 |
| Paraguay | 7.2 | 36.4 |
| Peru | 8.3 | 44.8 |
| Philippines | 9.2 | 70.7 |
| Poland | 12.4 | 8.14 |
| Portugal | 7.7 | 2.5 |
| Qatar | 7.9 | 0 |
| Romania | 11.5 | 25.3 |
| Russia | 12.9 | 9.63 |
| Rwanda | 2.8 | 93.6 |
| Samoa | 12 | 42.6 |
| Sao Tome and Principe | 3.8 | 87.9 |
| Saudi Arabia | 5 | 1.76 |
| Senegal | 1.5 | 90.7 |
| Serbia | 10 | 12 |
| Seychelles | 11.7 | 12.7 |
| Sierra Leone | 1.5 | 93.5 |
| Singapore | 6.1 | 0.11 |
| Slovak Republic | 12.1 | 3.92 |
| Slovenia | 11.7 | 0.23 |
| Solomon Islands | 5 | 90.3 |
| Somalia | 1 | 96.5 |
| South Africa | 8.5 | 62.1 |
| South Korea | 11.9 | 2.02 |
| Spain | 9 | 2.21 |
| Sri Lanka | 9.4 | 67.3 |
| St. Lucia | 9.4 | 9.52 |
| Sudan | 3.1 | 82.1 |
| Suriname | 7.1 | 15.2 |
| Sweden | 12.8 | 0.9 |
| Switzerland | 12.6 | 0.27 |
| Syria | 5.1 | 47.6 |
| Taiwan | 10.9 | 0.69 |
| Tajikistan | 10.4 | 75.8 |
| Tanzania | 4 | 94.4 |
| Thailand | 6.6 | 29.9 |
| Timor-Leste | 2 | 95.7 |
| Togo | 2.3 | 93.9 |
| Tonga | 11.5 | 38.1 |
| Trinidad and Tobago | 9.7 | 5.12 |
| Tunisia | 4.5 | 38.2 |
| Turkey | 5.8 | 19.4 |
| Turkmenistan | 10.8 | 75.8 |
| UAE | 8.3 | 0 |
| Uganda | 3.7 | 91 |
| UK | 13 | 0.77 |
| Ukraine | 12.2 | 20.1 |
| Uruguay | 10 | 14 |
| USA | 13.7 | 1.3 |
| Uzbekistan | 11.3 | 74.8 |
| Vanuatu | 6.3 | 77.5 |
| Venezuela | 8.9 | 34.7 |
| Vietnam | 6.9 | 61.7 |
| Yemen | 0.7 | 81.4 |
| Zambia | 5.2 | 92.2 |
| Zimbabwe | 6.7 | 84.2 |

Some countries are missing from this data.

This data has been adapted from [Poverty headcount ratio at $6.85 a day (2017 PPP) (% of population)](https://data.worldbank.org/indicator/SI.POV.UMIC) (World Bank, Poverty and Inequality Platform 2025) and [Global Educational Attainment 1970-2015](https://ghdx.healthdata.org/record/ihme-data/global-educational-attainment-1970-2015) (Institute for Health Metrics and Evaluation 2022).



**Developed:** the data provided has been organised into alphabetical order to make it easier to find data points for individual countries. The student has also removed countries that had missing data. The graph includes units and precise labels (years and percentage), and a title has been provided for the graph.

# Part 4 – data analysis

The relationship between the average years of school for women 25 and older and the percentage of people in poverty has a weak, negative linear relationship. That is, where women who have fewer years of schooling, such as Afghanistan, tend to have higher poverty rates while countries with more schooling, such as Canada, report lower poverty rates.

The relationship between the 2 variables appears to be linear as the data points follow a somewhat downward trend. This linear relationship has been created mainly from the clusters at both the high education, low poverty end and the low education, high poverty end. Because the relationship is weak it does include many outliers, which can be seen in our data. The UAE is an example of an outlier as poverty is at 0% despite education levels being in the middle of the dataset.

The independent variable ranges between 0.4 to 14.2 years of schooling. If the average years of schooling for women increased to **15 years** I estimate the poverty rate would be below 0% based on the line of best fit.

For my line of best fit, I estimate that the -intercept will be 95.

Using 2 points from my data that the line of best fit passes through (6.9, 61.7) and (10.3, 23.7):

So, the equation for the line of best fit is:

For

Using the line of best fit for women having 15 years of schooling, the poverty rate is expected to be -73% which is not possible.

If women did not go to school then we’d expect a poverty rate of about 95%, which is represented by the -intercept of the equation. The gradient tells us that for each extra year that women go to school, we expect the percentage of people in poverty to go down by 11.2%.

**Well developed:** the student identifies the relationship as weak, negative and linear, which shows strength and direction. They also justified why it would make that shape and direction with clusters they observed, and the weakness of the relationship using potential outliers.

The student also used the line of best fit to fit values outside of the data and even stated when it did not make sense in the context. They also explain what the gradient and -intercept mean in the context of years of women in schooling and the percentage of people in poverty.

# Part 5 – limitations of the model

The line of best fit loosely follows the data and doesn’t go through many points, which shows again how weak the relationship is. Many outliers distort the line which may not provide an accurate representation of the relationship or may show that other factors would affect the poverty of people in a country more than the number of years a woman goes to school or their access to education. Many countries deviate from the line due to other external factors influencing poverty such as the economic conditions in the country or long-term war. The points, though clustered, do not show a relationship that matches a nonlinear relationship. If we were to use an exponential graph, more points may lie on the line, but we could not use the line to accurately predict many other countries with any confidence.

The negative correlation is very clear, suggesting that access to education for women significantly impacts poverty. However, the line of best fit only makes sense between -values 0–100%, as you can’t have more than 100% of a population experiencing poverty or less than 0%. Since the number of years of schooling cannot also be less than zero, we cannot use the line of best fit to predict any points to the left of the -axis.

**Well developed:** the student explains factors that create limitations and affect the reliability and accuracy of the line of best fit, including the strength, whether they should have used an exponential instead and when the range of the data does not make sense in the context of the data.

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