Life Expectancy

An annotated exemplar for Bivariate Data

This report relates to the expected lifespans of people at birth for various countries across the world.

I have chosen to focus on the relationship between the life expectancy for males and females for each country. I will be using 2009 figures from the World Health Organisation.

Life expectancy is the average number of years that is likely to be lived by a group of individuals. I will be using life expectancy at birth, so of all the people born in 2009 in that country and of that sex how long the mean age is expected to when they die.

Life expectancy is a widely used measure of the health of a population. It is difficult to compare measures of "health" since different countries have different medical systems and different abilities to measure them accurately. Age at death is a simple statistic that all countries can measure and has no difference due to social issues.

In general, the higher the life expectancy the healthier the population. This is mostly the result of better food and elementary health care – as we will see later, expensive Western hospital care makes only a small amount of difference.

I use the World Health Organisation statistics because that organisation takes great care to ensure that all countries use the same methods.

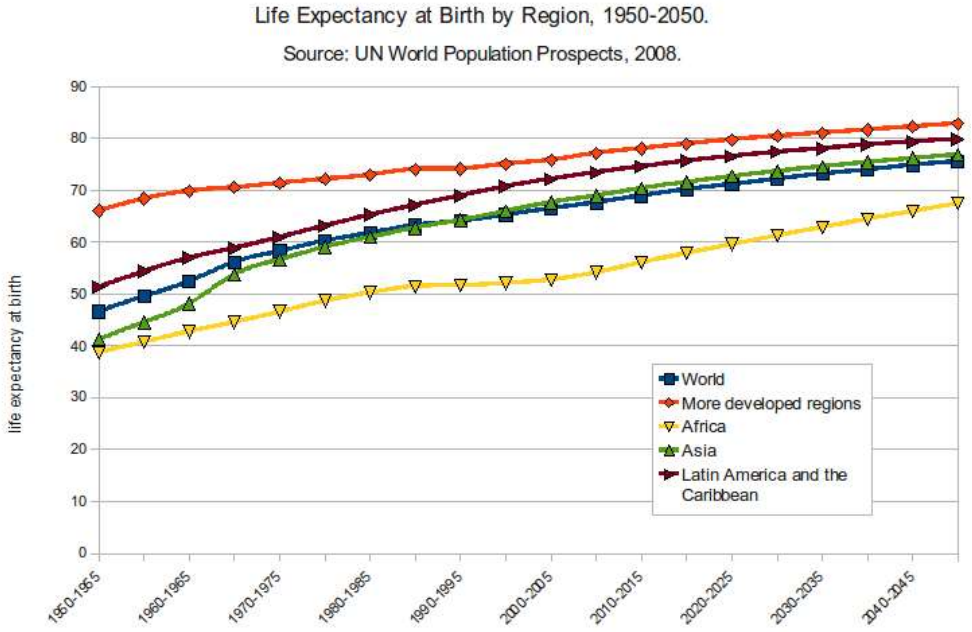
> Explanation to put the data into a context. It should **not** be an essay. While it is good to do this at the front that does not mean that the later analysis should ignore the context.

There are two features of the data that are of interest to people – the life expectancies themselves and the differences between males and females. Some charity organisations target their work based on such data, because it highlights societies where work needs to concentrate on specifically male or female issues, and not just health in general.

> A reason why someone might use the analysis is required. Bring it up again at your conclusion.

Long Term Trends

In general life expectancies have been rising throughout the world for the last few decades:



Source Wikipedia

MAN vs MATHS 2025

Because of this we cannot compare countries at different times, – we need all the data to be from the same time to make an even comparison. Even though we have more up to date data for some countries I have to use the first date for which I have most countries.

A few countries are missing, but no particular geographical area is absent and since similar neighbours are present for the missing ones the overall trend will not be affected.

> Explain any choices made, and especially any exclusions. (In this case a much more complete data set can be found, so this analysis is deficient in missing too many countries.)

Sources used for life expectancy:

Simple explanation of life expectancy:
http://blogs.worldbank.org/opendata/what-does-life-expectancy-birth-really-mean

Fuller definitions of life expectancy:
https://en.wikipedia.org/wiki/Life_expectancy

United Nations report on aging:
http://www.un.org/esa/population/publications/WPA2009/WPA2009-report.pdf

Why men die younger:
http://www.health.harvard.edu/newsletter_article/mars-vs-venus-the-gender-gap-in-health
http://onlinelibrary.wiley.com/doi/10.1111/1467-9566.00124/pdf

Some examples of claims that there is a different value placed on women's health than men's:
http://ncronline.org/blogs/just-catholic/womens-lives-matter
http://www.theguardian.com/global-development-professionals-network/2013/mar/26/empower-women-end-poverty-developing-world
http://www.globalissues.org/article/166/womens-rights

Pacific Health:
http://www.stats.govt.nz/browse_for_stats/people_and_communities/pacific_peoples/pacific-progress-health/overall-health.aspx

> Every important source of **different** information used should be cited.
>
> But do **not** make a huge list of sites that are basically saying the same thing. Often a few examples are enough.
>
> You do not need to use formal citations and footnotes like an academic paper. That can wait to university. Just list the source (full book name, link to web page or citation of a personal interview) and a brief note of what it adds to contextual knowledge.

Data used

The data was from http://www.who.int/gho/publications/world_health_statistics/en/.

> Do not print out the data itself – the purpose of your analysis is to prevent someone having to read it all.

> While the report doesn't need to be a book length, it is considered good form to break reports into clearly separate sections (introduction, each separate analysis, conclusion) to help readers keep their place. So I'm going to start a new page since I'm starting an entirely different portion of my report.

MAN vs MATHS 2025

Problem

I wonder if there some consistent relationship between male and female life expectancy across the world.

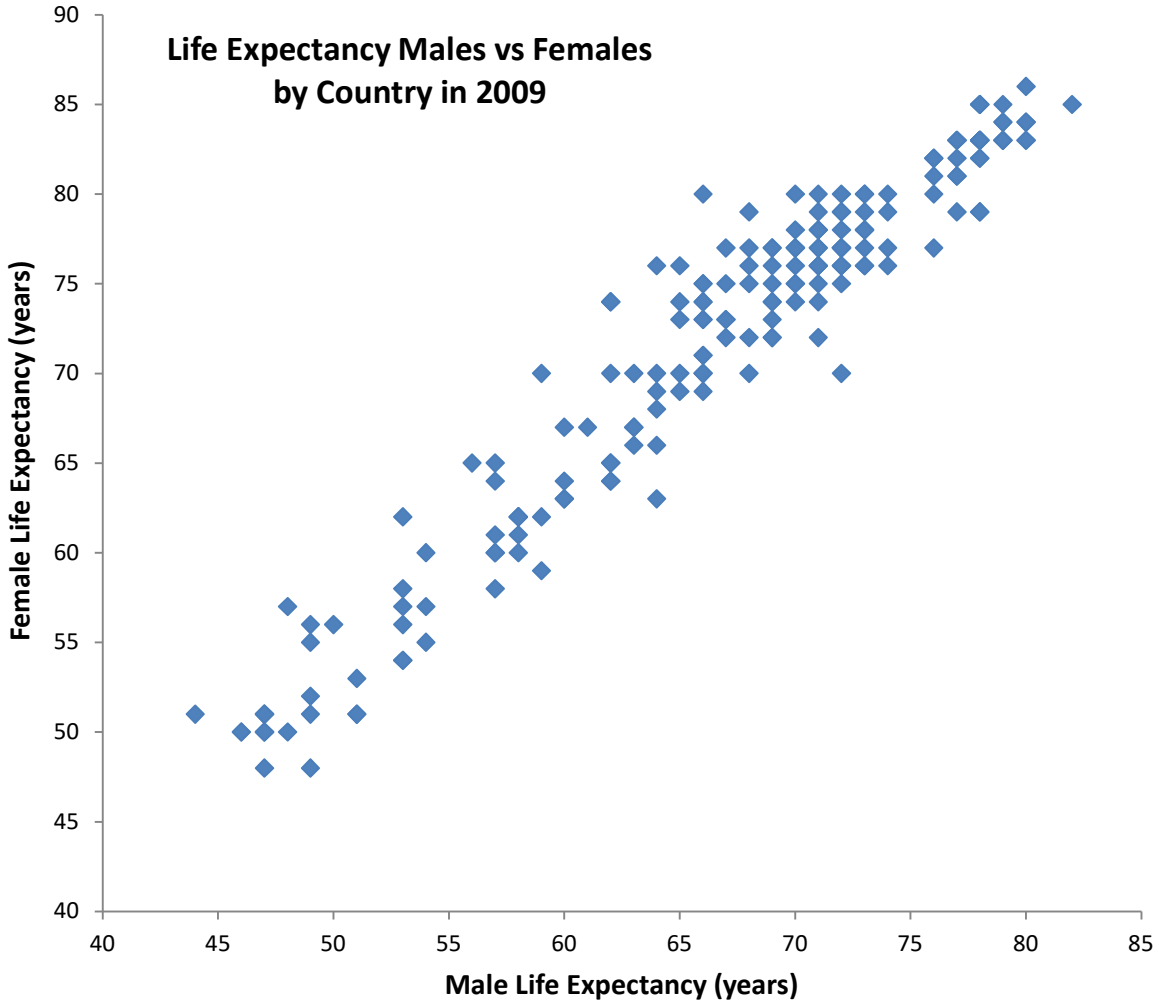
Some people argue that in much of the world men's lives are valued more highly than women's lives (https://scholarship.law.duke.edu/cgi/viewcontent.cgi?article=1205&context=djglp).

If so, we should be able to see any countries that deviate strongly from the usual pattern.

A purpose for the investigation.

Analysis

The graph below shows my relationship:



You might think the relationship doesn't do very much, but this is not a problem. Do not search to find the most "interesting" series to get M or E – odd things happening are just as likely to trip you up as give you better comments. Provided you can find some features to discuss, plain graphs are fine.

I have made the explanatory variable that of male life expectancy because it is sometimes stated that men's lives are valued more than women's in some countries. If this is true the relationship will be driven more by how long men live.

Explain why you have chosen one variable as the explanatory. Sometimes, such as here, it might be argued that it doesn't make a great deal of difference. If so, then say that, don't just leave it out.

MAN vs MATHS 2025

Relationship

Looking at the graph there is a clear strong positive relationship between the life expectancy of men and that of women. The relationship looks to be linear – that is as the life expectancy of men grows that of women grows at a constant rate.

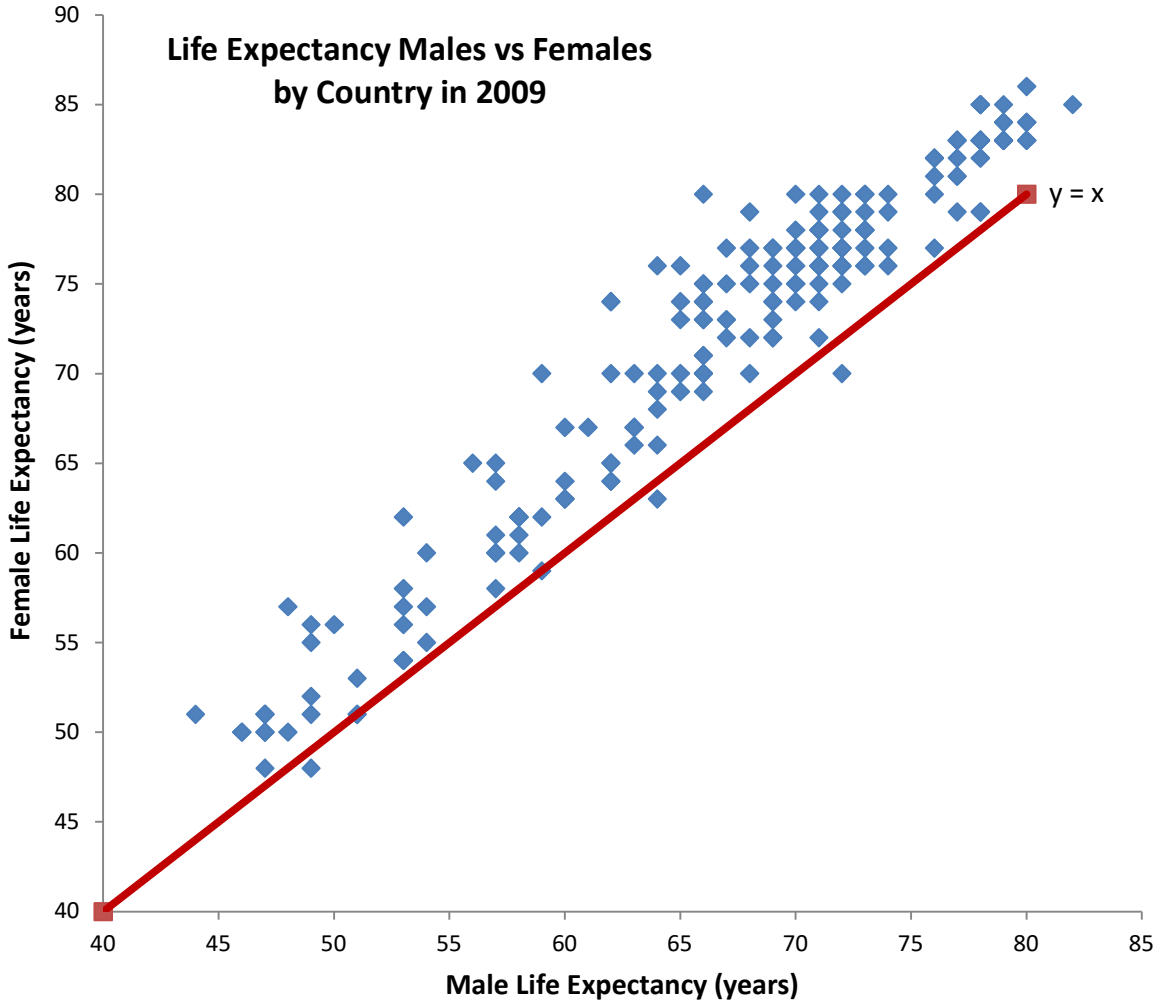
Lead in with what you see. Avoid the temptation to go straight to numbers.

That means that there is a strong relationship between how long the average males live in a country with how long the average females live.

The bottom left corner is poor countries, such as Malawi and Chad. The top right is rich countries like New Zealand and Japan. In between generally the poorer the country the more it is towards the bottom left.

What the relationship means.

There are no major outliers. That is, there are no countries where men live long lives and women don't, or where women live long lives and men don't. However there is some variation and it is interesting to see how that might come about.



I have added the line $y = x$ to the same graph above. In countries above this line the women live longer than the men, and in countries below the line men live longer.

The three countries below the line are the Central African Republic (49, 48), Tuvalu (64, 63) and Tonga (72, 70).

MAN vs MATHS 2025

The Central African Republic has been politically unstable with a lot of violence and has a lot of HIV, which may cause early deaths of women over men.

Tuvalu and Tonga both have very high obesity rates, which may affect women differently from men.

> Always put numbers into a context. Don't overdo the reasons – just give one and move on without a lot of speculating. This is a Maths assessment, not Social Studies.

However the point furthest from the line is Nuie at (66, 80) which also has a high obesity rate, so it can't be just that. I cannot explain why Nuie is so different from its Pacific neighbours.

> You can't explain everything. Don't try to.

Belarus (64, 76), Ukraine (62, 74) and Russia (62, 74) are others where the men die a lot younger than the women. In their case it is a long-know feature that the men in those countries tend to take very risky behaviour when young and to drink very heavily, and this is known to cause their life expectancy to be much lower than for their women. Other similar countries (all ex-Soviet) like Poland, Moldova and Kyrgyzstan show a similar but less strong relationship.

> It is nice to find a pattern that can be explained though.

Some Arabic countries that are considered to be particularly bad on women's issues are very close to the $y = x$ line, as expected – Kuwait and Qatar are at (78, 79).

Saudi Arabia is missing from this data set but from a similar data set I found it would be plotted at (72, 75) which is not what would be predicted. Korea is often alleged to be particularly sexist, but is at (77, 83)

My research shows little evidence that countries who are said to be particularly sexist have worse life expectancies than other countries. If these countries are particularly favourable to men over women it is not reflected in their life expectancy.

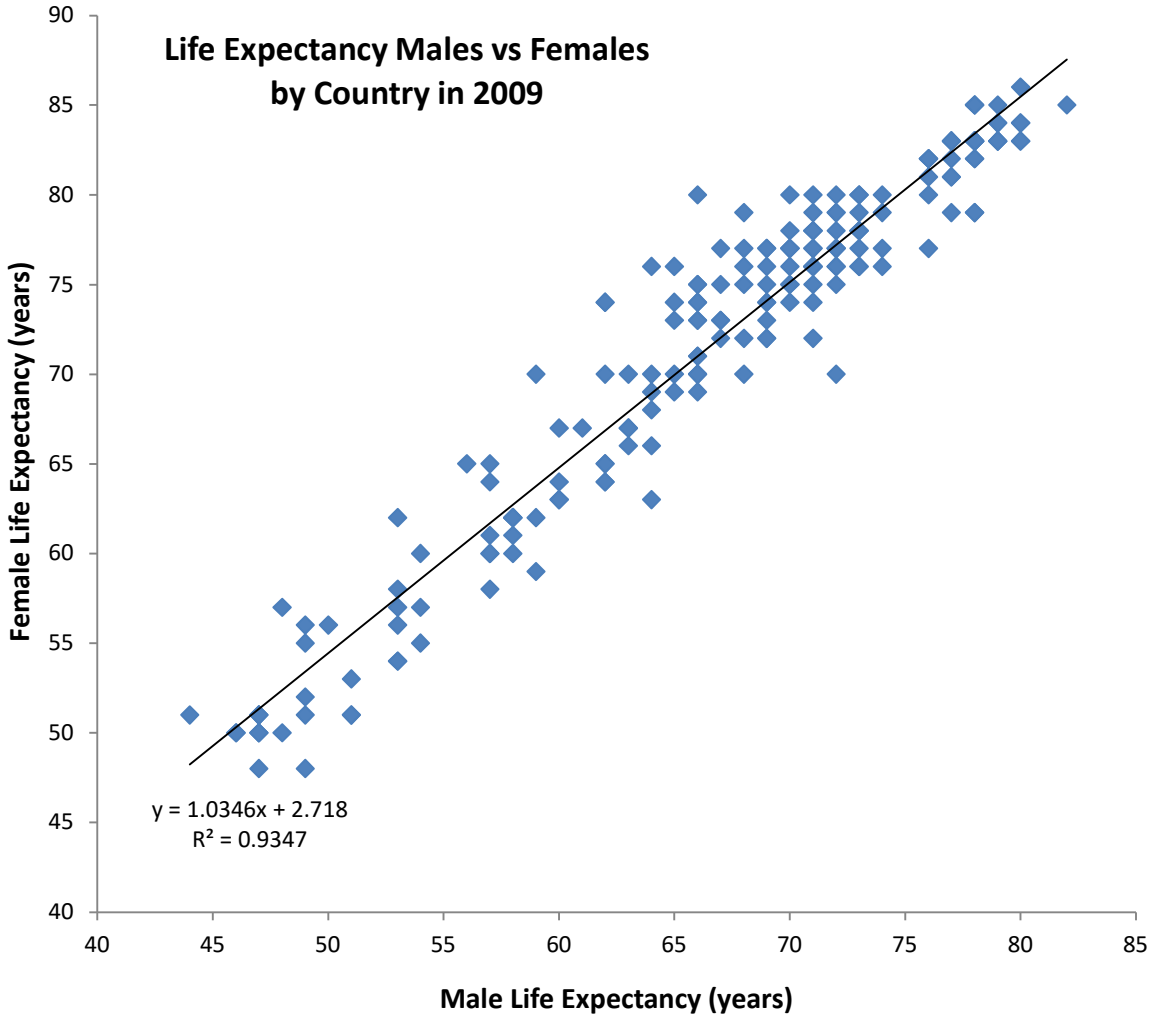
> Excellence level thinking : what countries would you expect where, and what does it mean when they aren't where you expect them.
>
> Again, don't overdo speculation. Just say that your data does or does not suggest a particular relationship. And **never** cross from relationship to cause (reason).

Numerical Analysis

I have plotted the graph with the line of best fit. The line fits quite well, but towards the end values there are clearly more values under than over, especially for lower values, and in the middle there are slightly more over than under. That suggests a gentle curve would be a better fit. However the linear fit is good enough for me to feel that the values calculated from it are useful.

Is a linear model the best model?

For excellence actually fitting a suitable curve would be helpful. A parabola would imply a downward curve at some point, so an log/exponential would be nicer.



Correlation Coefficient

The r value is 0.967 which means that it is an extremely strong positive correlation.

This means that we should be able to predict the life span of women in a country from the life span of men with good accuracy.

The equation of the line of best fit is $y = 1.0346x + 2.718$.

So if men live 70 years, then we would predict women to live 1.0346 × 70 + 2.718 = 75 years

You must show you can make a prediction. Show your calculations.

The scatter along the graph is about 5 years either side of the line of best fit. So if a country with a male life expectancy of 70 had a female life expectancy of less than 70 or more than 80 it would be a reason to investigate what is causing it to be so far from predicted.

MAN vs MATHS 2025

Correlation does mean causation, and it is unlikely that men living longer cause women to live longer. The obvious hidden variable is the wealth of society, and I have discussed earlier how all the top right countries are rich and all the bottom left are poor. Wealthy societies have better disease control, better diets, better medical facilities (especially when young) and happier lives. This all leads to longer life spans.

Discuss the possible reasons for the correlation.

Gradient

The gradient of the line of best fit is 1.0346. That means for ever year of extra life expectancy the males in the country have, the women have in general 1.03.

So women live longer than men, on average, and that difference tends to increase as life expectancy increases.

The gradient will have a meaning.

The + 2.718 in the formula means that on average across the world women live nearly three years longer than men. Looking at the data we can see that this is largely caused by the big clump of values at 65-75 male life expectancy. At the ends the difference is less.

A conclusion therefore might be that as the world gets wealthier and the poor countries move up that the difference in life expectancy might increase (as we lose the bottom left) but then as it gets wealthier still and we move to the top right that the difference may narrow again.

This is speculation, but it shows **thinking** about the relationship more than just taking the numbers from the program.

Conclusion

You need a conclusion, which you use to repeat your main points clearly. Don't start adding any new material here – if you think of something else for your analysis, go back

There is an extremely strong positive correlation between the life expectancy of men and women across the world. Women tend to live about three years longer on average, being a bit more in medium wealth countries and a bit less in very poor or rich ones.

In no country do they differ by more than about five years from this pattern.

Even in countries supposedly that are extremely sexist the relationship still tends to hold. There are a couple of very-male oriented countries, such as Qatar, where women live only about as long as men, but in several traditionally macho countries, such as Belarus and Russia, the relationship is very much in favour of women.

I do not think that the relationship between the life expectancy of men and women can be used to show that men's lives are valued more than women's. If anything it would be that the pattern across the world is remarkably similar regardless of the nature of the societies involved. What is vastly more important is wealth – it is the key driver to life expectancy.

The overall report here is 7 pages, but that is made longer by the annotations and generous spacing. This is more than sufficient: precise explanations with clear graphs and precise discussion of the numerical values is more important than length.

MAN vs MATHS 2025