Hypothesis Question

Is there a relationship between literacy rates and total fertility rates in different countries throughout the world?

Background Information

The world's population has doubled since 1960, and it has quadrupled since the beginning of the 20th century. This dramatic increase has been the result of hugely decreased rates of mortality around the world made possible by availability of antibiotics, vaccines and pesticides for farming.[1] After the Second World War, many developed countries (especially the victors of the war) experienced what is known as the "Baby Boom". This phenomenon resulted in high population growth rates. Since the mid-1960s however, fertility rates in the developed Western world have declined rather sharply. For example, Canada's fertility rate in 1960 was 3.8 and that of the United States was 3.6 whereas today the rates are 1.7 and 1.9 respectively.[2] Most developed nations have fertility rates today that are lower than the replacement rate of 2.1 (the rate to replace each parent, taking into account premature deaths and couples unable to have children[3]). Although the population growth rates of developed nations have declined in recent decades, developing nations continue to maintain high population growth rates. This is because as developing nations struggle to complete their demographic transitions to full economic and social development, death rates typically decline sharply, but fertility rates do not. Historically, the death rates fall faster than fertility rates during transition.[4] So, far fewer people are dying, but people continue to have many children. This problem is the root of the widely held fear that the developing world could experience a Malthusian collapse resulting from a persistent population explosion. This

[1] "Population Dynamics," *The Environment Literacy Council*, 14 May 2003, <http://www.enviroliteracy.org/subcategory.php?id=30&print=1>.
[2] Elza Berquo, "Women and Population Policies (Part 2 of 9)," *Contemporary Women's Issues Collection*, 1 January 1993, 14 May 2003, <http://www.elibrary.ca/s/edumarkca/>.
[3] "Population Dynamics," *The Environment Literacy Council*, 14 May 2003, <http://www.enviroliteracy.org/subcategory.php?id=30&print=1>.
[4] Elza Berquo, "Women and Population Policies (Part 2 of 9)," *Contemporary Women's Issues Collection*, 1 January 1993, 14 May 2003, <http://www.elibrary.ca/s/edumarkca/>.

would include the starvation and death of billions and billions of people because there is not enough food available to feed everyone. Many argue that this is already taking place because tens of thousands die from malnutrition every day. Although the actual population growth rates of many of the world's poorest countries are declining, their populations will continue to grow significantly due to high fertility rates and population momentum. This means that since large portions of these populations are young, they will soon reach childbearing age and will contribute to the increasing world population over the next couple of decades.[5] There are a number of reasons why couples continue to have many children and therefore why fertility rates of developing countries remain so high, this study will examine one main reason, education, with some focus on other factors such as use of contraceptives and age at marriage.

Education, particularly of girls and women, is vital in curbing unsustainable population expansion. In 1995, of the 1.4 billion children aged 6 – 17 in the world, 428 million, mostly in the developing world, were not enrolled in school. Even more shocking is the fact that 236 million, well over half, of these children were girls.[6] It is therefore evident that a significant gender gap exists in many developing regions of the world in terms of educating young people. The education of girls and women is related to fertility rates. Increasing the number of girls who complete both primary school and some secondary school education will decrease fertility rates. This is because secondary schooling will delay a young girl's marriage, shorten her fertile span and increase her awareness of her rights and the health of herself and her family.[7] If a woman is more educated and aware of her own worth, she will become a more active decision maker in her relationship, she will be less likely to be influenced by pressure from her spouse and family and she will voice her opinions on what she has learned about family planning. She will also be more confident to use various social, community and health services that are available for her. She will also be more aware of and interested in many

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[5] "Population Dynamics," *The Environment Literacy Council*, 14 May 2003, <http://www.enviroliteracy.org/subcategory.php?id=30&print=1>.
[6] "Women and Development, Vol. 25," *WIN News*, 1 January 1999, 14 May 2003. <http://www.elibrary,ca/s/edumarkca/>.
[7] "Human Population: Fundamentals of Growth, The Status of Women," *Population Reference Bureau*, 2003, 15 May 2003, <http://www.prb.org/Content/NavigationMenu/PRB/Educators/Human_Population/Women/The_Status_Of_Women.htm>.

opportunities outside of being a wife and mother.[8] These things in turn will also decrease fertility rates because historically it has been proved that more educated people have less children because they are more involved with their occupations, they do not rely as heavily on their children to provide for them in old age and they desire more materialistic things (for example, they choose to buy a car instead of raising another child).

Much has to be done in order to educate women in the poorest countries of the world and in turn, reduce dangerously high fertility rates in those regions. Governments all over the world, not just in the nations where high fertility rates are a particular problem, must commit to improving the status of women worldwide. Included in the Cairo Programme of Action developed in 1994, are calls for universal access to education, greater employment opportunities for women and the end to discrimination against women.[9] Governments must also commit to providing greater access to methods of birth control and family planning services for women and families in developing countries.

Definition of Variables:

Literacy Rate: The percentage of a population aged 15 years and older (or between another specified age range) who are able to read and write with understanding a short message about their everyday life in any language.[10]

Total Fertility Rate: The average number of children that a woman will have in her fertile years (usually assumed to be between ages 15 and 45, but can be measured by

[8] S. Sadik, "Chapter Four: Benefits of Educating Girls," *United Nations Educational, Scientific and Cultural Organization*, 15 May 2003, <http://www.unesco.org/bangkok/ips/rechpec/pubs/poped_manuals/girl1chap4.htm>.
[9] "Human Population: Fundamentals of Growth, The Status of Women," *Population Reference Bureau*, 2003, 15 May 2003, <http://www.prb.org/Content/NavigationMenu/PRB/Educators/Human_Population/Women/The_Status_Of_Women.htm>.
[10] Unknown author. *United Nations Educational, Scientific and Cultural Organization*, 17, May 2003. <http://www.uis.unesco.org/i_pages/indspec/TecSpe_literacy.htm>.

entire lifetime), assuming that the birth rate of her region does not change over that period.[11]

Birth Rate: The number of births in a country or region for every thousand people in the population.[12]

Average Age of Women at First Marriage: This indicates the average age of a country's population of women when they are married for the first time.

Secondary School Enrollment: This is a percentage of a specific age group that is enrolled in secondary school. This does not mean that they graduate or even stay in school until the end of the year, it is strictly enrollment. The rates may be over 100% because they might include out-of-age group enrollment.[13]

Contraceptive Use: This is a percentage of women in a population, in this study married women aged 15 to 49 years, who use any method of contraception on a fairly regular basis.

Procedure

I have always been interested in global issues, especially those concerning developing countries. I had learned in another course (world issues) that high fertility rates were contributing to most of the problems facing the developing world. I had also completed a previous statistics project for this course that strengthened my interest in investigating correlations between different population statistics. So I decided to investigate the relationship between literacy rates and total fertility rates because I knew that there were distinct differences between the rates of developed and developing countries. I

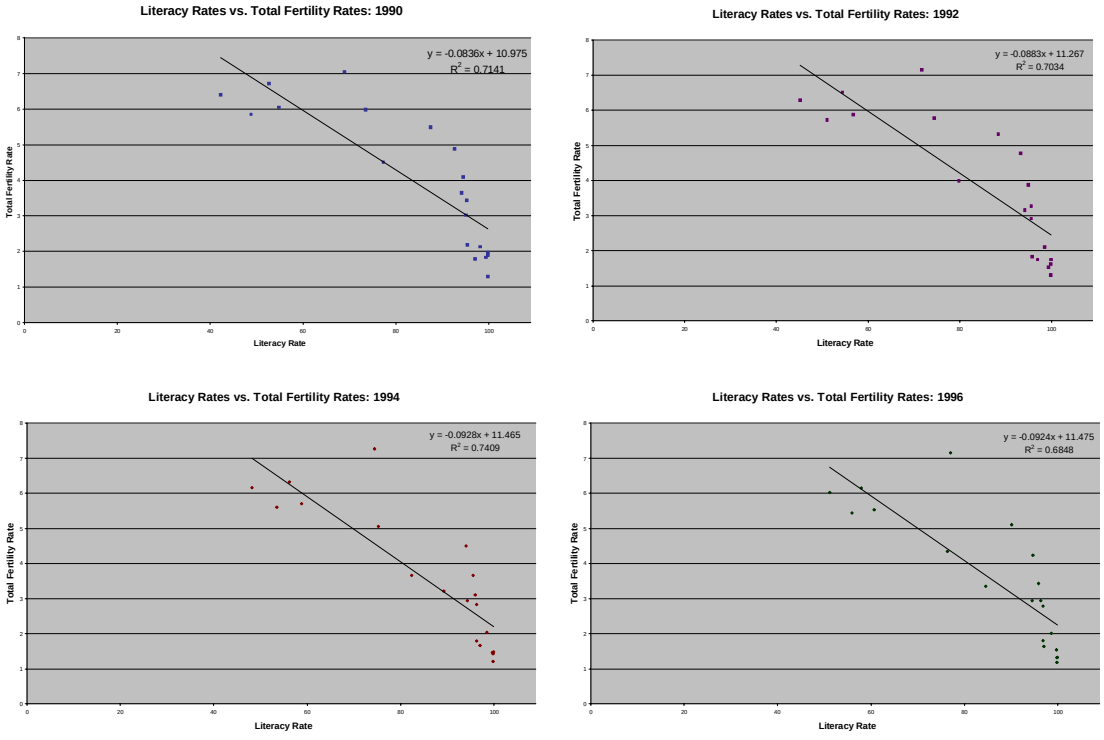
[11] Bruce Clark and John Wallace, *Global Connections: Canadian and World Issues* (Toronto: Prentice Hall, 2003) 57.
[12] Bruce Clark and John Wallace, *Global Connections: Canadian and World Issues* (Toronto: Prentice Hall, 2003) 55.
[13] "Women and Development, Vol. 25," *WIN News*, 1 January 1999, 14 May 2003. <http://www.elibrary,ca/s/edumarkca/>.

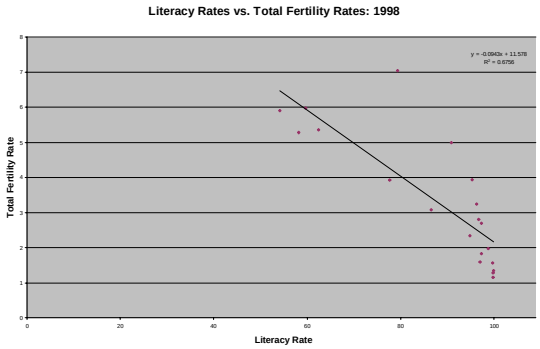
developed a hypothesis question and then an answer soon after. I chose 20 countries and seven specific years to study. I chose countries of many different levels of social and economic development so that I could really investigate the issues, seeing where the problems are worse, and where they are improving. I then began to collect the raw data for my study. Data was gathered over several days using the internet. At first it was very difficult to find data for the right countries and years that are the focus of this study. However, once I came across a number of good databases, it was much easier. Once I had collected enough data on literacy rates and total fertility rates, I began to use Microsoft EXCEL to compile the raw data into comprehensible data tables. It took quite some time to enter in some data, and some was easier to cut and paste if it was in the proper format on the original source. Then the raw data was graphed and correlated with other measures. Once I began making actual graphs, I began to think of other statistics that I could bring in to further my analysis. I went back to the internet and found more statistics on measures such as Average Age of Women at First Marriage, and Contraceptive Use. With these statistics, I made even more data tables and even more graphs. I then calculated correlation coefficients, means, medians, modes and standard deviations of the data for which these calculations would produce meaningful numbers. When I was unsure of a certain calculation because I thought maybe I entered the wrong array or the data table was inconsistent, I often checked the numbers I obtained from EXCEL using my TI-83 Plus graphing calculator. However, entering all of the data all over again into my calculator was tedious, so I just used the calculator to check my methods, not every single calculation. I also used Fathom to create different data tables and histograms. After I had completed all of my graphs, I began my analysis and written report. I used many print sources obtained from various search engines on the internet to gain background information on this topic. I also used these sources in my written report to support my findings and conclusions.

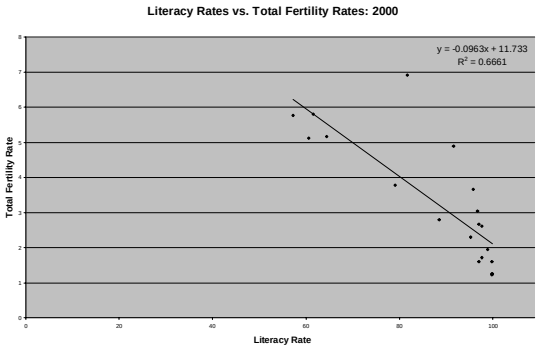
Results / Analyses of Graphs

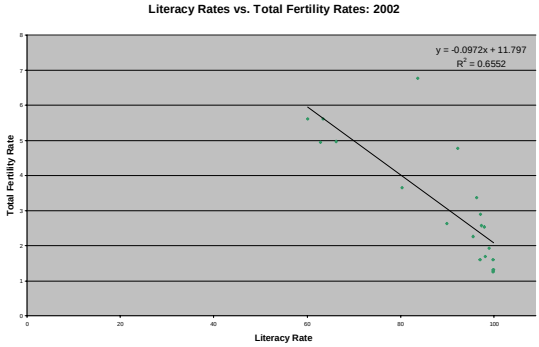
My first set of seven graphs show the correlation between literacy rates and total fertility rates of 20 different countries around the world (See **Appendix A**). Each of the seven

graphs depicts a different year (1990, 1992, 1994, 1996, 1998, 2000, and 2002). The correlation coefficients range from -0.86077 to -0.80947. These values show a strong negative correlation between literacy rates and total fertility rates, proving my original hypothesis that and inverse relationship exists between these two variables. If a country has more educated citizens, then it will have a lower fertility rate. The R^2 values ranged from 0.6552 to 0.7409. These coefficients of determination were not as high as I had expected them to be, but they do show that a great deal of the variation in total fertility rates is due to variation in literacy rates. The seven graphs in chronological succession show a general decrease in the mean total fertility rate and increase in the mean literacy rate. This means that on a global scale, people are more educated and women are giving birth to fewer children. This is true for most of the countries in my study, with a few exceptions of countries that have not entered demographic transition and have not begun to experience declining fertility rates such as Gambia and the Democratic Republic of Congo.

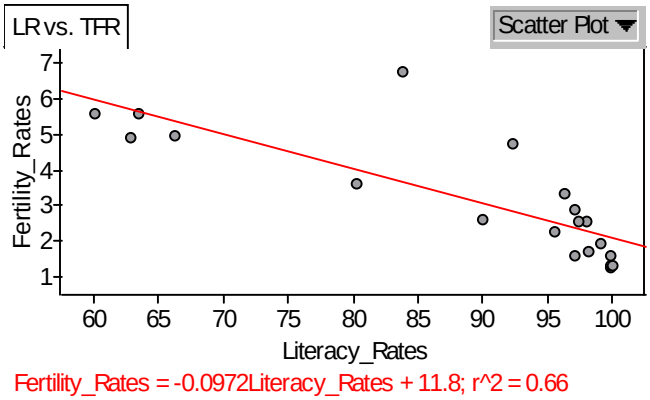






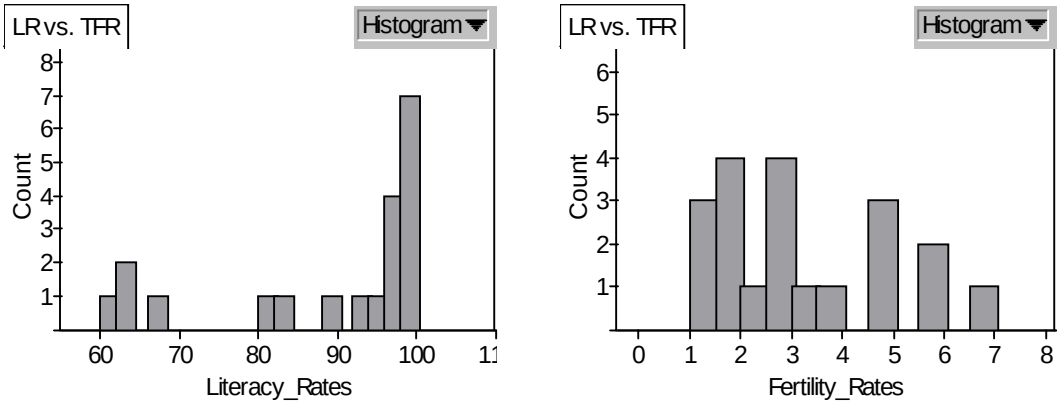


I also made a scatter plot in Fathom using the literacy rates and total fertility rates data for 2002 alone (See **Appendix B**). This scatter plot shows a similar negative correlation. The mean is 3.1635, which shows that on a global scale, populations are increasing greatly and fertility rates are much higher than the replacement rate of 2.1.



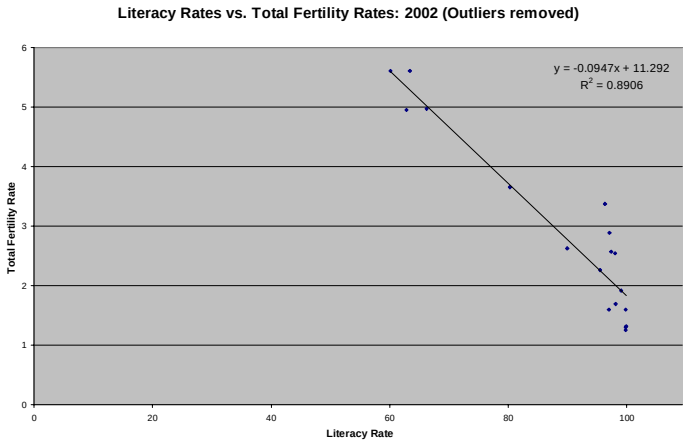
I also used Fathom to generate histograms of the literacy rates and total fertility rates data from 2002. The histogram of the literacy rates interesting shows two clear groups of levels of literacy. On the left hand side of the graph are the poorer countries, a cluster of nations with low literacy rates. To the far right of the graph is another, larger cluster of countries with very high literacy rates. This is encouraging because it shows that most

countries in the world have fairly high literacy rates, especially compared to the lower rates of the past years. There is also a small cluster of countries in the middle range of literacy rates. These countries represent those well into their demographic transition from being underdeveloped to being fully socially and economically developed. Their literacy will continue to rise significantly in the near future. The histogram of the total fertility rates shows that most countries have fertility rates between 1.0 and 3.0, with some others in the 4.5 to 7.0 range. Because my sample size of 20 countries is fairly small, there are many bins without any countries that fall into the range (ex. 4.0–4.5). This graph shows that most developed nations have fertility rates just below the replacement rate and most developing countries have rates which vary from 3.0 to 7.0 depending on the specifics of the country (availability of food, health services, societal norms, state of the economy).

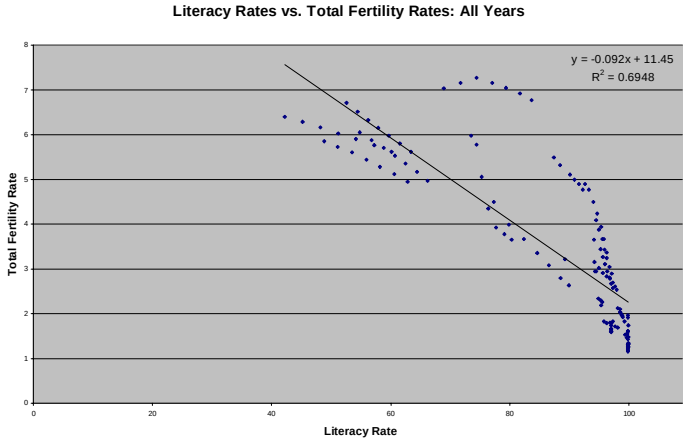


I then created a correlation between the data from 2002 of Literacy rates and Total fertility rates with the outliers removed (See **Appendix C**). Although the two points that I removed (Democratic Republic of Congo and Namibia) may not have been true outliers when their distances from the interquartile range in comparison to the size of the interquartile range were actually calculated, I took them out in order to improve my correlation by a great deal. This is indeed what happened because my correlation coefficient improved from –0.81 to –0.94. This improvement shows that literacy rates and total fertility rates are very directly related for most countries in my study. Both Namibia and the Democratic Republic of Congo have fairly high literacy rates and high fertility rates. This could be because the people of the nation are just recently starting to become more educated and the increased literacy rates are a recent phenomenon. If this

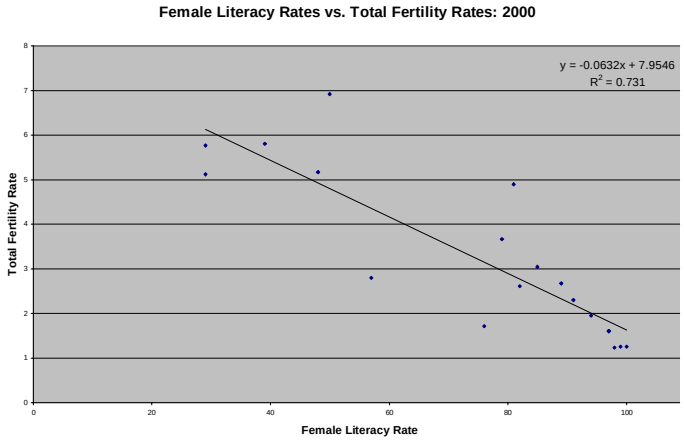
is the case, then the lower fertility rates which result from high literacy rates have yet to become apparent. In the near future, we can expect that the fertility rates of these two countries will begin to decline significantly.



My next graph is a compilation of the entire set of Literacy rate and Total fertility rate data for each of the seven years and 20 countries (See **Appendix D**). This final graph was sufficiently convincing, with a correlation coefficient of -0.83356 and a coefficient of determination of 0.6948. The mean, median and mode of the total fertility rate data represent the global measures accurately because I used an equal number of countries from different levels of development around the world. The mean is 3.53, this is higher than the mean of the 2002 data calculated using Fathom because it factors all of the data from the seven years of my study. Since fertility rates were significantly higher 12 years ago than they are today, the mean of all the data is brought up. The other mean from the 2002 data which used the most recent and lowest values of all the combined data, was much lower, demonstrating gradually declining fertility rates around the world.

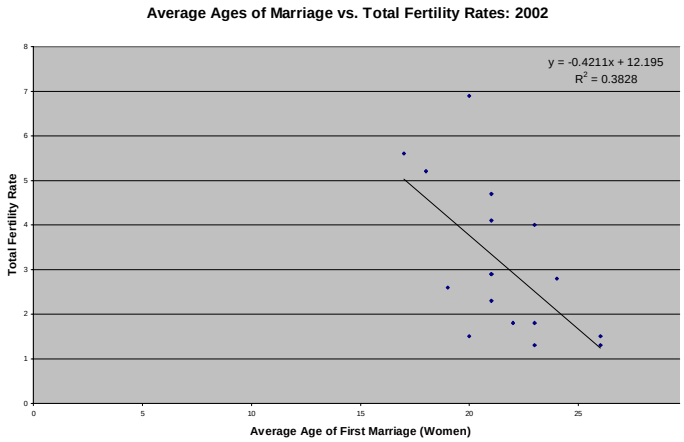


After reading much of the information contained in the print sources that I gathered for my study, I realized that it might be more accurate to correlate the Literacy rates of just females with Total fertility rates (See **Appendix E**). This is because a change in the percentage of the literate women of a country affects the total fertility rate more than a change in the percentage literate men. This new correlation was done using only data from the year 2000 and showed a strong negative correlation. The correlation coefficient was -0.85, slightly higher than the correlation coefficient calculated using literacy rates of both sexes. This proves that the relationship between literacy among females and total fertility rates is more direct than the relationship between literacy rates of both sexes and fertility rates.

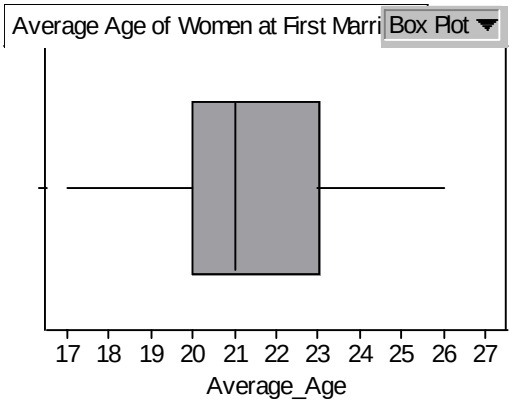


My next graph is a correlation of Average age of women at first marriage and Total fertility rates (See **Appendix F**). This data was not available for all of the 20 countries of my study, only 17 of them. This graph only depicts the relationship in the year 2002. Although it has been widely accepted that the later a women gets married, the fewer children she has because her reproductive span is shortened, my correlation was not as strong as I had expected. The correlation coefficient was only -0.62, a moderate negative correlation. The R^2 of 0.38 was also quite low. Later ages of marriage contribute to lower fertility rates because if a woman delays the age at which she is married, she is subsequently delaying her age at her first pregnancy, and if she does this then she delays all other pregnancies. This will probably reduce the number of children she has because

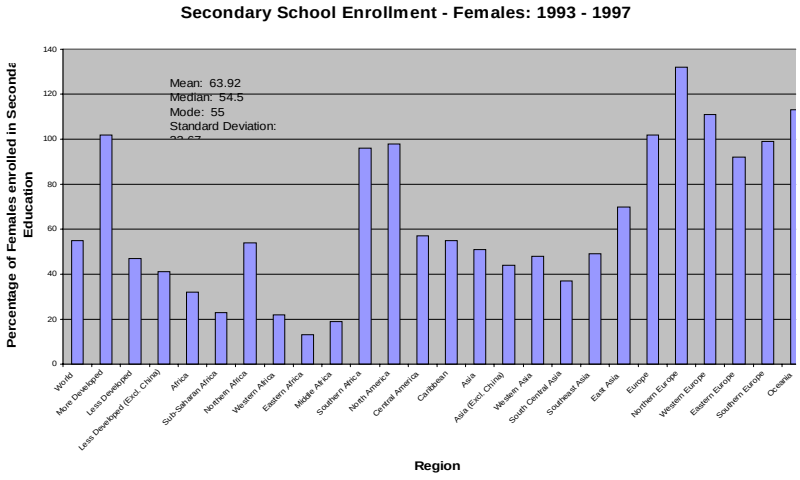
she will stop having children at a certain age no matter how many children she already has or does not have. Also, if she is married later, she is probably doing something else with her life such as education or work, and she probably has other interests outside of having children and raising a family.



I also made a box and whisker plot of the Average age of women at first marriage data sing Fathom (See **Appendix G**). This graph shows a median of 21 years old. There are no visible outliers on this graph, which is good because outliers can distort my conclusions, especially since my sample size for this graph is even smaller because three countries did not have data on this variable. This plot also shows that 50% of the average ages fall between about 20 and 23 years old. The distance between 20 and 21, between Q1 and the median is the shortest with the most countries falling in this range. That means that this range is the most popular time to get married on a global scale.

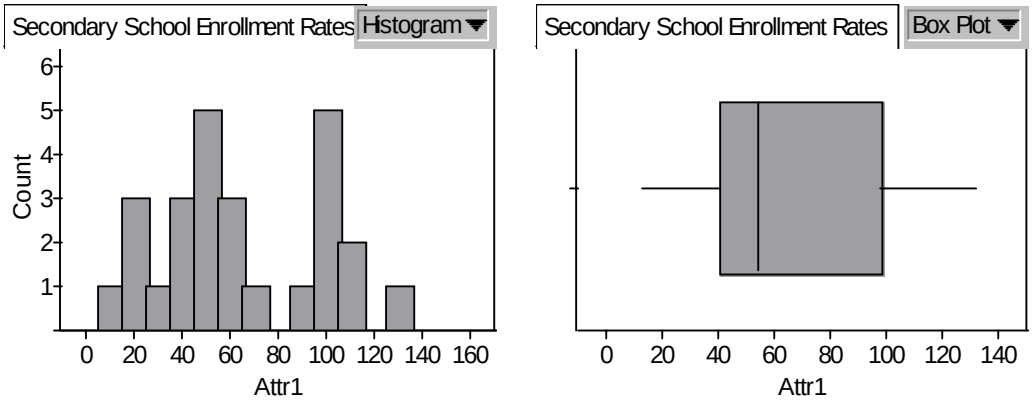


I then made a bar graph of the secondary school enrollment rates of females from different regions around the world from 1993 to 1997 (See **Appendix H**). These regions are very general and cover many more people of the world than the 20 countries that I used for most of the rest of my study. Some of the enrollment rates (which are a percentage of females in a specific age range that are enrolled in secondary education) are greater than 100 because they include enrollments from ages outside of the specific range. The graph shows that the highest rates of enrollment exist in the more developed regions of the world such as Europe, Oceania and North America. Surprising, Southern Africa also has a very high enrollment rate. This may be a statistical error on the part of the database that I obtained these numbers from, or it may be the actual result of many young girls in southern Africa attending secondary schools. The average of the nations within this region could have been positively skewed by South Africa, which probably has a higher rate of enrollment than its neighbouring countries due to its large wealthy white population. The lowest rates exist in the rest of Africa and parts of Asia where girls face many barriers to enrolling and staying in school. These barriers include traditional notions present in some societies that imply that it is more economically beneficial and appropriate to send sons to school rather than daughters. Another barrier is poverty in the developed world and limited resources among individual families and larger communities.[14]



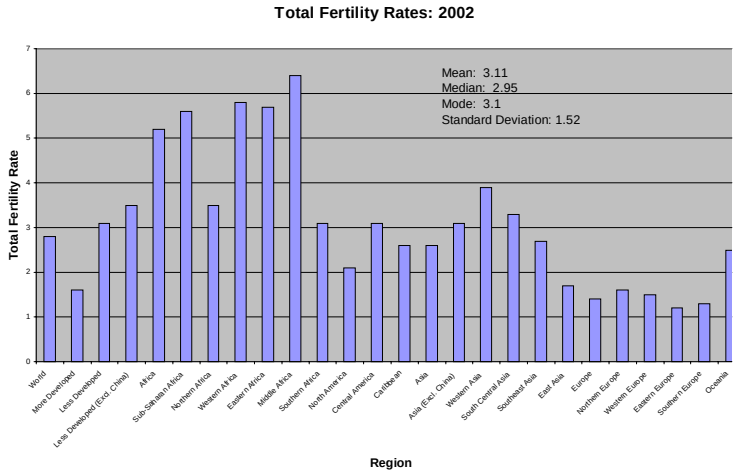
[14] "Women and Development, Vol. 25," *WIN News*, 1 January 1999, 14 May 2003. <http://www.elibrary,ca/s/edumarkca/>.

I used Fathom to make a histogram and a box and whisker plot of the secondary school enrollment rates data (See **Appendix I**). The histogram looked like two smaller histograms in one with two clear clusters of countries. The developed countries are clustered in the right of the graph, with higher rates of school enrollment. The left of the graph contains the poorer countries with dishearteningly low levels of secondary school enrollment. This second cluster can even be furthered divided into two groups, with the very poorest countries having rates between about 5% and 30%, and the more progressive developing countries having rates between about 30% and 70%. This histogram shows that many young people around the world face many barriers to further their education and governments must commit to broadening the education of young people in the developing world. The box and whisker plot shows the same thing, with a concentrated section between Q1 and the median, where the two cluster of developing countries' rates land.

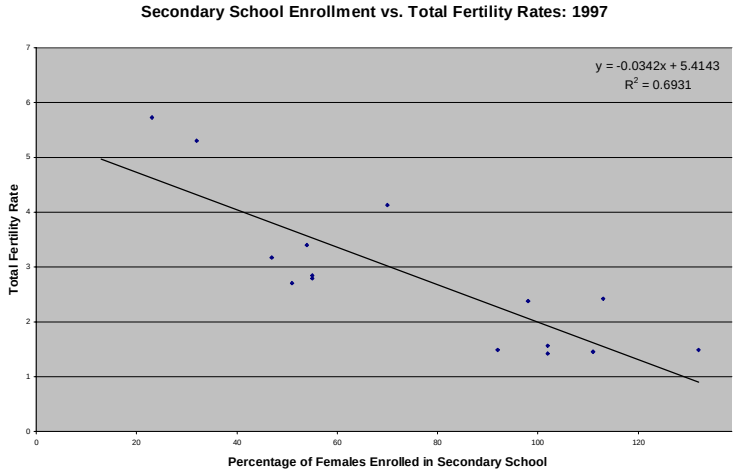


To contrast with the secondary school enrollment bar graph, I made a graph of the total fertility rates of the same regions of the world (See **Appendix H**). However, this graph shows data from 2002, not 1993-1997 like the enrollment graph. The graph's high points and low points are basically the opposite of the high and low points of the enrollment graph. The highest fertility rates are of most African regions and the lowest are of North America, Europe, Oceania and Southern Africa. The mean total fertility rate of this graph in 3.11, which is slightly lower than the other global mean obtained in the graph. This makes sense since the other mean factored in fertility rates from 1990 through to the present day. Since most fertility rates were higher in the past years than they are today, it would bring up that mean. This mean, on the other hand, was calculated using strictly the

rates of the regions of the world in 2002. It can therefore be expected that the mean total fertility rate would be lower as fertility rates are declining around the world.

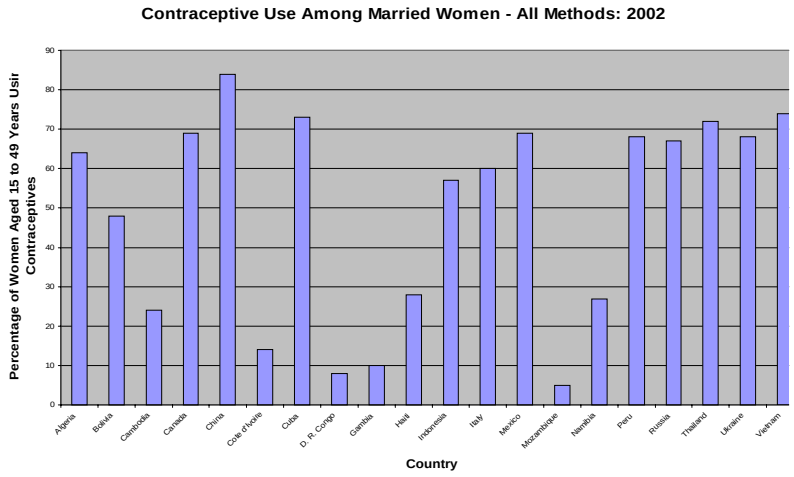


I then correlated the two variables using data from only 1997 (See **Appendix H**). However, data wasn't available for every region from 1997 since I had to look to a new database, which did not have exactly corresponding regions of the world. This scatter plot showed a strong negative correlation with a correlation coefficient of -0.83 and a coefficient of determination of 0.69. This proves that if the more educated women are, the more likely they will seek better jobs that require more commitment, earn more money, and have fewer children.

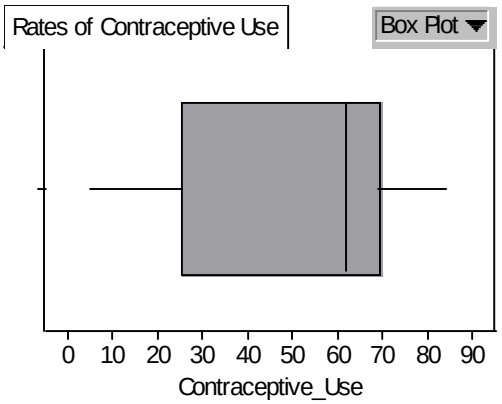


My final graph was a bar graph of contraceptive use among married women aged 15 to 49 years old (See **Appendix J**). These values were expressed as a percentage of married

women using any method of contraception. The lowest rates were in the least developed countries of the study such as those in Africa as well as Cambodia and Haiti. Most of the rest of the countries has similar rates which were much higher. This shows that women in less developed countries do not have adequate access to methods of birth control and family planning, so they end up having many more children. The countries with low rates of contraceptive use are the same as the countries with low literacy rates, low average ages at first marriage and high fertility rates, because less educated women are less aware of the family planning services available to them and more likely to marry young and have many children. The data was negatively skewed by the low rates of the least developed countries because the mean is about 50 and the mode is 69 (reflecting the much higher rates of most of the countries in the study).



I made a box and whisker plot of this same data (See **Appendix K**) which shows that most rates of contraceptive use fall between about 25% and 68%. The range smallest range containing the most rates is between the mean and Q3. This shows that globally, people have fairly high access and rates of use to methods of contraception, with some room for improvement. Many countries still have very low rates of contraceptive use however, and these are the countries contributing the most to the problem of population explosion in the developing world. These countries must be provided with better access to family planning and health care services, including birth control methods. There are no visible outliers on this graph.



Hypothesis Answer

This study intends to show that there exists an inverse relationship between literacy rates and total fertility rates throughout the world. The higher the literacy rate, the lower the fertility rate. This statement holds true in both developed and developing countries.

Conclusions

After completing this study, it can be concluded that literacy rates have a direct effect on total fertility rates. The inverse relationship between these two variables is a strong negative correlation. The more educated people are, the fewer children they will choose to have. The graphs of my study show considerable correlations between literacy rates and total fertility rates, along with additional strong relationships between other factors such as secondary school enrollment rates, average ages at first marriage and contraceptive use rates with total fertility rates. Many of the correlation coefficients and R^2 values were not as convincing as I had originally expected. This can be attributed to the fact that my study only included 20 countries for some graphs and less than 30 global regions for other graphs. Using a large sample size of countries would provide a stronger correlation closer to –1. However, my thesis is still proved with confidence using only 20 countries.

It can now be said that educated people have fewer children. This is especially true for women since they are the ones who are actually giving birth to the children and,

for the most part, the ones who are raising the children in the important first five years of life. Average age at first marriage, rate of contraceptive use and rate of secondary school enrollment of a region also correlate well with total fertility rates. If women attend school for a longer amount of time, they are more likely to pursue interests outside of having a family, including marrying at a later age, getting a well-paying job and taking advantage of the health and social services available to them. More educated women also play a more significant role in the decision making of a household, so they may actively decide to have fewer children because they are aware of the benefits of smaller families.

The status of women around the world, and particularly in the developing world, needs to be improved. Girls need more opportunities to become educated and women need easier access to family planning services and methods of contraception. More schools should be built in the poorest countries with the help of developed nation's governments and more female teachers should be employed to act as role models. Equal opportunity programs should be implemented in the developing world as they have been in the developed world in order to give women more prospects in the job field.

Evaluation

Assumptions:

Many assumptions were made in completing this study. I assumed that I entered all of my obtained data into the computer programs / graphing calculator correctly without error. If I did make an error, it would translate into errors in my graphs and calculations. It would change my line of best fit (possibly by a lot if I made more than one mistake because I did not use a huge number of data points for most graphs) and skew my calculations. This could in turn lead me to false conclusions.

I am also making assumptions about the sources from which I obtained all of my raw data. Since I believe that the sources I used are reliable, I am not too worried about inaccurate data, but it is possible that the sources I used published false information. This would also lead me to make inaccurate conclusions. I chose the sources I did because I knew that if I used unreliable sources for my raw data, my own study would not be as credible.

One important assumption made not as much by me as by professional demographers and statisticians concerns fertility rates. A fertility rate is defined as the number of children a woman has in her fertile years *assuming* that current birth rates remain stable in this period. However, this is not always true as birth rates tend to change, especially changes in levels of social and economic development. Therefore, the entire concept of total fertility rates incorporates a major assumption. However, it is safe to say that birth rates do not change so significantly over one woman's lifetime that it would greatly skew any one study and affect the use of the measurement as an accurate statistic to describe a nation or region.

Finally, I am assuming that the relationship between literacy rates and total fertility rates in a cause and effect relationship. I am assuming that levels of education directly affect how many children women give birth to on average in one region. This relationship must not be a common-cause relationship, reverse cause-and-effect relationship, accidental or presumed relationship. If the relationship between literacy rates and total fertility rates is one of these types then my entire study can be dismissed as meaningless.

Limitations:

This study had a handful of limitations based on the raw data. Since it was difficult to find data for certain countries (i.e. Canada) the accurate analysis portion of my study was hindered. Since many developed countries do not publish current statistics on literacy rates because they are almost 100% and fairly stable, my choice of countries for this study was limited. I had originally intended to use Sweden as one of my focus countries because I knew they would have very high literacy rates. However, I could not use this country because I could not find any current literacy rate values. It was also difficult to produce convincing graphs at times when I found tables on the internet for female literacy rates for example, with values missing for certain countries (i.e. Cambodia). This happened with other graphs too. This is because not every country has statistics on every single variable, especially if the variable has no significance for the state of the country. For example, Canada does not have easily accessible data for literacy rates because they are so high and illiteracy is not a major problem facing

Canadians. So for many graphs I did not have as many data points as I would have liked because the appropriate information is unavailable. This limits the credibility of my conclusions because my sample is decreased. As a result of the virtually non-existent literacy rate data for Canada, I had to assume that the rate has not changed since 1986. This assumption enabled me to use this value from the CIA World Factbook for every year. However, this value could be invalid today, because the literacy rate has likely changed slightly since 1986. In addition, the quality of my conclusions is weakened due to the fact that the one Canadian literacy rate (97%) was not exact to any decimal values, where all of my other literacy rate data points are.

Another limitation of my raw data was with the Literacy rate data for the graphs of the seven years. All of the literacy rate data for these graphs was obtained from the United Nations Statistics Division, and the values were a percentage of the population who could read and write between the ages of 15 and 24 years. I could not find any other source that had all the countries and all the years I was focusing on in one table, so I decided to use the literacy rates of ages 15-24. This affected my correlations because a woman can have a baby outside of this age range. It would have been more appropriate to have literacy rates for ages 15 and above. However, it can be argued that this age range is the prime for having children, so it would not have made a huge difference if I had obtained data for ages 15 and above because on average, not many people do have children before age 15 or after age 24. My graph would have shown a strong negative correlation with maybe a slightly different line of best fit if I had used literacy rates of ages 15 and above.

For my Secondary School Enrollment rates versus Fertility rates scatter plot, my graph was limited by a small number of data points. Since the source that I obtained my enrollment rate data from (Population Reference Bureau DataFinder) had fertility rates from only 2002, I had to look to a different source. I found fertility rates for 1997 from the U.S. Bureau of the Census International Data Base, but it did not have exactly corresponding world regions to choose from. However, some regions did match up with those of the PRB DataFinder, so I was able to make a scatter plot. In addition, some regions, such as South America did not have available data for these two measures. So I

was limited in that I was not able to obtain a mean total fertility rate or secondary school enrollment rate of the entire world, only of the regions with available data.

Another limitation of my study concerned the use of the Contraceptive Use variable. The data I found pertained to the rate of use of any method of contraception of *married* women between the ages of 15 and 49. While this is an appropriate age range because women rarely have children before the age of 15 or after the age of 49, it only accounts for the married women of the world. Generally on a global level, women are married when they give birth to children. However, many women give birth outside of wedlock and this trend is increases along side increasing levels of economic and social development.

Suggestions for Improvement:

I could remove some of these limitations if I had more time to look for accurate data. I'm sure there is data available for all the different population statistics of all the countries (except Canada) and regions for all the years I was looking for out there somewhere, its just a matter of knowing where to go and be able to go there to obtain that data. In some cases, it is not worth the trouble for such a small issue when my hypothesis can be proved with similar confidence if I just use a different country, region or format. I know that if I paid for access to certain websites and studies published on the internet (i.e. StatsCan), I would be able to obtain more accurate statistical data for my study. However, I do not think it is worth it because I know that the data I ended up with came from reliable and updated sources and my graphs and conclusions are accurate.

Overall, I am very confident with the quality of my procedure and my conclusions. I believe that I found data from reliable sources, organized this data into appropriate tables and produced many meaningful graphs. My arguments are supported by credible outside written sources and I think that my written analysis is quite in-depth. I am very happy with the final product of this study!

Possibilities for Extension of the Analysis:

The main way in which this study could be extended is by adding more countries to the list of 20 that I studied. Usually credible and accurate studies have upwards of 100

samples, so I would have liked to use many more countries. Studying more countries would give more evidence to my hypothesis and arguments. More countries would probably also produce a stronger correlation, because outliers would have less of an effect on the line of best fit and correlation coefficient. However, I was limited by time and availability of raw data. I also needed to keep my project small enough that it could prove my thesis clearly and concisely to my audience. If I had used a much large group of countries, then my audience could have become easily confused and lost in the numbers of the project. I need to keep them interested and I want them to understand my topic and its implications during the 20 minutes of my presentation.

I could also extend my analysis by studying more variables such as life expectancies, percentage of GDP spent on education expenditures and the United Nations Human Development Index. These factors could have been graphed and correlated to further my hypothesis that more educated people have fewer children. I could have examined how the education of young people (especially young women) is hindered by the government of their nation using statistics on the percentage of GDP spent on education. The UN Human Development Index could have been correlated with total fertility rates to produce a statement that in places where the general standard of living is better (including health, education, economy and social services), fertility rates are generally low. Using even more outside variables besides literacy rates and total fertility rates in this study could give more confirmation of my original thesis and the arguments stemming from it.

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