Culminating Project

Teen Pregnancy

Mathematics of Data Management, Grade 12 - MDM 4U

May 2003

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Part 1: Selecting a Topic and Finding Data

When attempting to select a project topic, I decided that it was best to choose a topic that not only interested me, but was a current issue. Taking into consideration my interest in a future career in medicine, I decided to research further into a current topic in that field.

When creating a mind map, I narrowed my topic down to researching something in the medical field because I wanted to study something that I am going to continue with in University. I also knew that I wanted to research a current issue.

After viewing several sites with shocking information, teen pregnancy became my study of interest. As for finding a question, I decided for the time being to keep it open and look at the factors affecting teen pregnancy.

Question: What are the factors that affect teen pregnancy?

Part 2: Researching My Topic

I began looking for Canadian Data, after finding a small amount of information that was a little outdated, I decided to maintain most of my data from American statistics. A large contributor to my information was **www.teenpregnancy.org/america/statistics.asp**. This website allowed me to view the number of teen pregnancies in each state broken down into several factors such as age, race/ethnicity, the rates of pregnancies, and changes in these rates throughout several years.

The websites used to find my data will be stated throughout this report.

After finding this American data and comparing the number of pregnancies in a state to the total population of the state, I decided to try and find the most recent data I could for Canada in order to compare with the American data I had previously located. I found this data at **www.statcan.ca/english/freepub/82-221-XIE/01002/tables/html/411.htm**. To obtain this data I had to first go to the Statistics Canada Website and search for data with the search keywords "Teen Pregnancy".

When I found this data, I realized that it was extremely difficult to see the relationship between these two countries without also comparing it to the world data. I found a table showing several countries' birthrates which also included Canada and the United States, and decided to see how these two countries compare to the rest of the world.

After these were examined I decided to look further into the Canadian data that I had found. And look at the different outcomes such as births, legal abortions, estimated miscarriages, and the total number of pregnancies. I also chose to compare results between these outcomes.

As a final step, I wanted to observe if the number of teen pregnancies have changed over time in Canada.

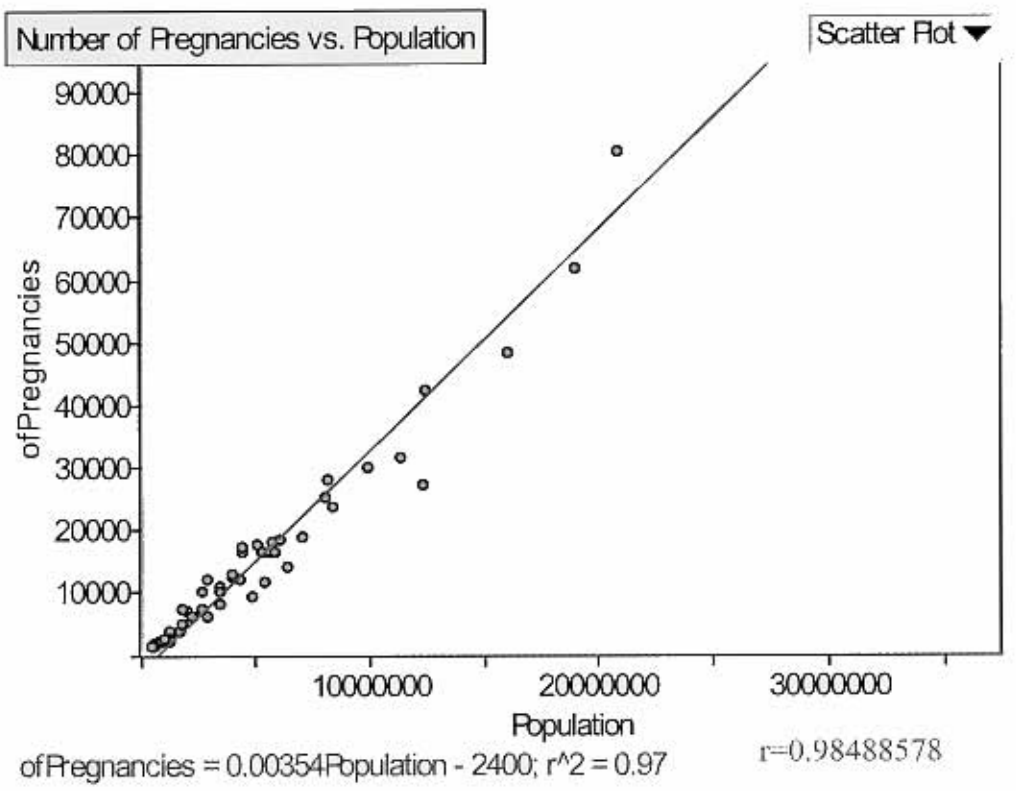
Part 3: Analyzing the Data

Part 3a: Does the population affect the number of pregnancies?

I – Pregnancies in the United States of America

The first part of the data I chose to analyze was the American statistics. By taking the number of pregnancies in a state and comparing it to the population of the state, I was able to see if there was a trend in the data.

The data uses a target population. It takes the data from the whole population, not just a sample of it. If the data was collected as a sample, many factors would be overlooked and the data would be very inaccurate. For example, if the researchers had taken a poll in the number of pregnancies for California, they would find a large amount of pregnancies. If it had been stated that this figure was a representation of the other states, it would be very inaccurate because California has a large population compared to the other states, there would obviously be a larger amount of pregnancies than a smaller state such as Hawaii or Alaska.



Graph 3.1 – State Population vs. Number of Pregnancies

population of a state and the number of pregnancies in each state in the year 2002. The independent (Explanatory) variable is the population of the state, and the dependent (Response) variable is the number of pregnancies in that state.

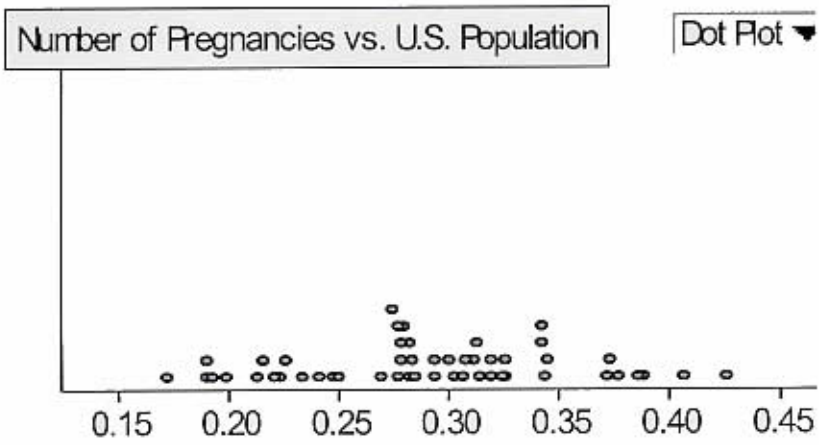
Number of Pregnancies vs. U.S. Population	Summary Table
⇩	⇨
NumberPregnancies	17515.6 11745 126300 1210 875780
Population	5616996.9 4026890.5 33871648 493782 280849847

S1 = mean
S2 = median
S3 = max
S4 = min
S5 = sum

Summary Table 3.1 – State Population vs. Number of Pregnancies

Problems:

I found that the information in this graph was gathered through surveys, interviews, and site visits. The surveys were conducted on the web, via the mail, and over the phone between December 2001 and May 2002 with leaders from each state. The information was gathered from a wide variety of people including representatives from Governors' offices, state legislators, representatives from executive branch agencies including health, education, welfare, workforce, and social services; and state-wide non-profit and private organizations addressing teen pregnancy prevention. The survey included questions on state-wide or state-initiated teen pregnancy prevention policies, programs, and activities. This form that they chose to operate the data collection was a smart form for receiving a large amount of data, but still has the possibility of bias affecting the results. When a survey is circulated, especially one with questions as personal and perhaps embarrassing as pregnancy, it has the possibility of containing data that is inaccurate, Response Bias could have occurred. Despite the fact that the survey could be anonymous, a teen could feel shamed or embarrassed at admitting she is a teen mother, or even that she had an abortion and deliberately give a false answer resulting in erroneous data.



When looking at the frequency values for this data, I found that the data was very consistent and very close together, within 0.25264721% of each other, proving that throughout the United States, the population affects the number of pregnancies almost unvaryingly throughout the study.

II - Pregnancies in Canada

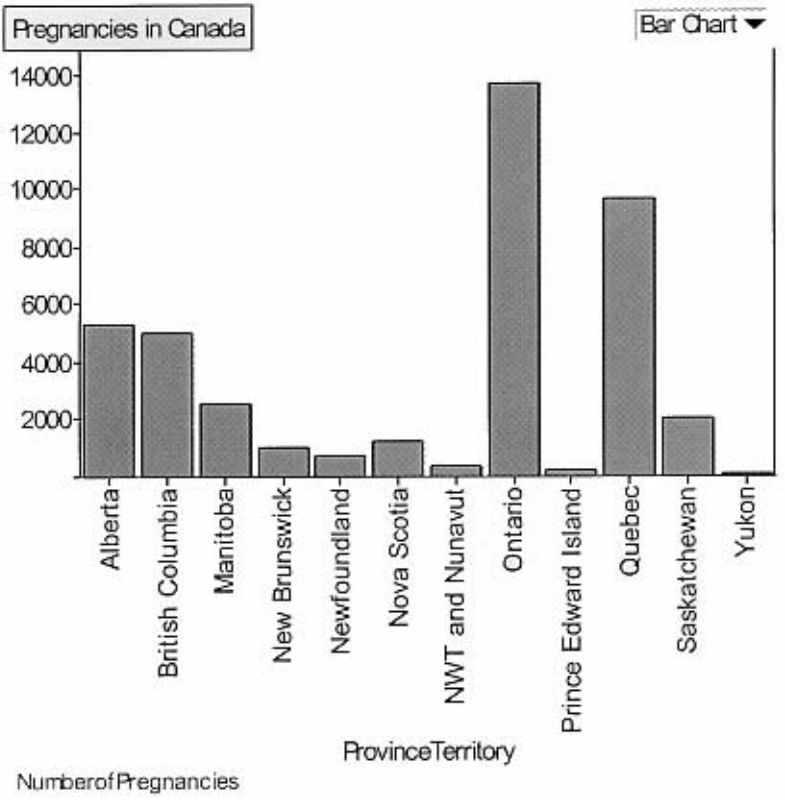
I wanted to determine if there was a similar relationship between the number of pregnancies in Canada and the population of the province/territory. I proceeded to add the following chart into Fathom.

Pregnancies in Canada

	ProvinceTerritory	NumberofPregnancies
1	Canada	41588
2	Newfoundland	662
3	Prince Edward Isl...	181
4	Nova Scotia	1236
5	New Brunswick	955
6	Quebec	9619
7	Ontario	13748
8	Manitoba	2518
9	Saskatchewan	2036
10	Alberta	5246
11	British Columbia	5000
12	Yukon	61
13	NWT (including Nu...	315

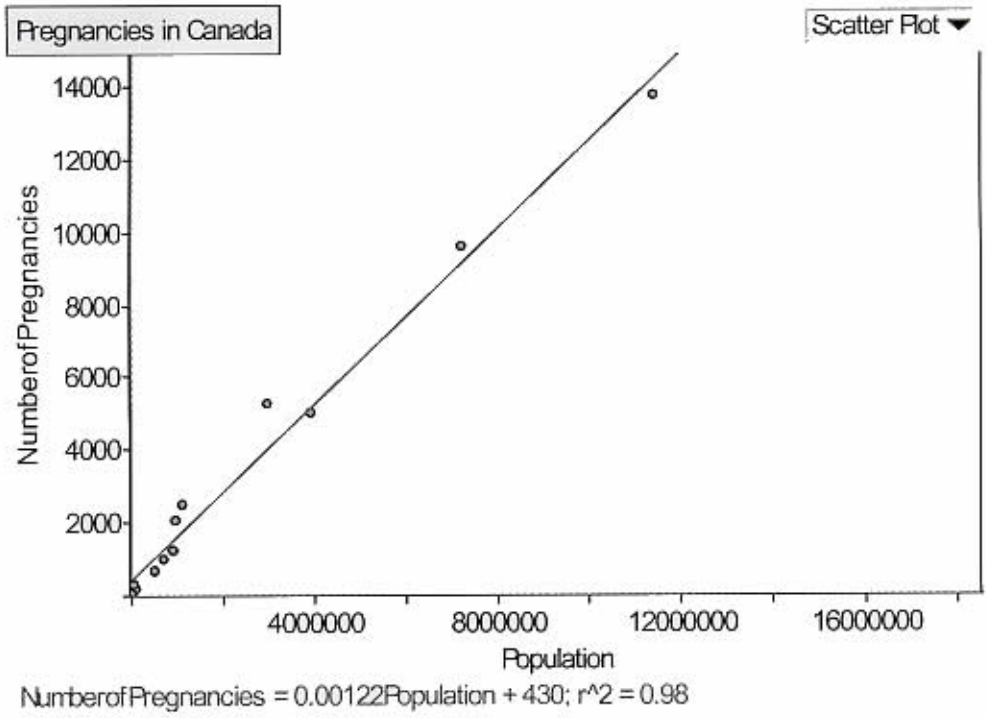
This data also uses a target population. It too takes the data from the whole population, not just a sample of it. If the data was collected as a sample, many factors would be overlooked and the data would be very inaccurate.

At first, I simply wanted to look at what province or territory had the greatest number of pregnancies, but I realized that provinces such as Ontario and Quebec had extremely large numbers of pregnancies compared to the rest.



This data shows in detail of the province/territory the number of teenage pregnancies in Canada. Several conclusions can be drawn from this graph, but many will contain bias and not be an accurate description of the data. When looking at this graph, we become aware that the majority of the teenage pregnancies in Canada come from the contributions of Ontario and Quebec. However, this graph does not take into consideration the population of the provinces/territories, causing Ontario and Quebec to seem like outliers.

I came to the conclusion that I had to graph them the same way I did for the American data. Before I did this, I predicted that based on my previous results, the population of the province would have a great impact on the number of pregnancies there were in that province.



When placed on a scatter plot with the population of the province, we can observe that not only is there a strong correlation between population and the number of pregnancies, Ontario and Quebec fit into the trend and are not outliers.

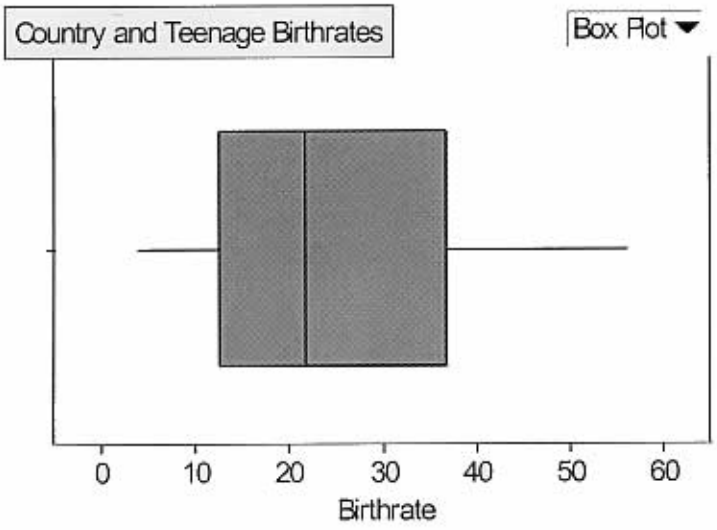
Conclusion

I concluded that Canada did follow the same trend that the United States data did, with a correlation of .989949, the number of pregnancies increase as the population increases.

Part 3c: Does the country resided in play a factor in the number of births?

After finding a data table outlining the teenage birthrates for the larger countries, I wanted to observe if the country that one lives in affects the number of teenage births. I was also interested to see how Canada and the Untied States compared to this data and where they stood in the overall standings of birthrates.

Next, I graphed these birthrates to see how consistent these birthrates were and to see if there were any outliers.



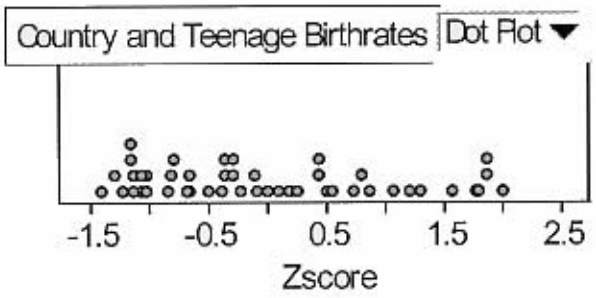
This graph shows the relationship between each country and its birthrates (per 1000 women, age 15-19). It shows that the data is relatively consistent and there are no severe outliers affecting the data.

When looking at the specific points in the box-and-whiskers diagram, it was observed that Armenia has the highest teenage birthrate out of all the countries with a birthrate of 56.2 and has the highest z-score of 2.00034. This means that Armenia is the least consistent with all the other countries along with Belgium who has the lowest birthrate of 9.1 and a z-score of -1.06186. I also found that despite the rather large number of pregnancies in Canada, it is the closest to the median with a z-score of .00801378 and we can conclude that Canada's teenage birthrate is consistent with the rest of the world, whereas U.S. is considered one of the highest birthrates next to Armenia, illustrating that their teenage birthrates are above normal and should act to slow them down.

Using the original data found, I proceeded to add another column into the table which looked at a measure of the number of standard deviations the data is from the average, the Z-score. In order to avoid having to go through and calculate each individual Z-score I created a formula in which Fathom could calculate it for me. I changed the formula for the column to read:

$$\frac{\text{(Birthrate – mean(Birthrate))}}{\text{popStdDev(Birthrate)}}$$

I decided to graph these Z-scores to see how consistent the data was.



Country and Teenage Birthrates

Birthrate	25.432609
	21.6
	3.9
	15.381116
	236.57872
	12.5
	36.7
	15.551078
	241.83602
	15.551078
	241.83602

S1 = mean Birthrate
S2 = median Birthrate
S3 = min Birthrate
S4 = popStdDev Birthrate
S5 = popVariance Birthrate
S6 = Q1 Birthrate
S7 = Q3 Birthrate
S8 = sampleStdDev Birthrate
S9 = sampleVariance Birthrate
S10 = stdDev Birthrate
S11 = variance Birthrate

When calculating the standard deviation (how far the data is different from the mean) of this data, I found that it was fairly low and revealed that the birthrates of countries are at a fairly reasonable and consistent rate with a couple exceptions, which proves that the country lived in is a factor affecting the rates of teen pregnancy.

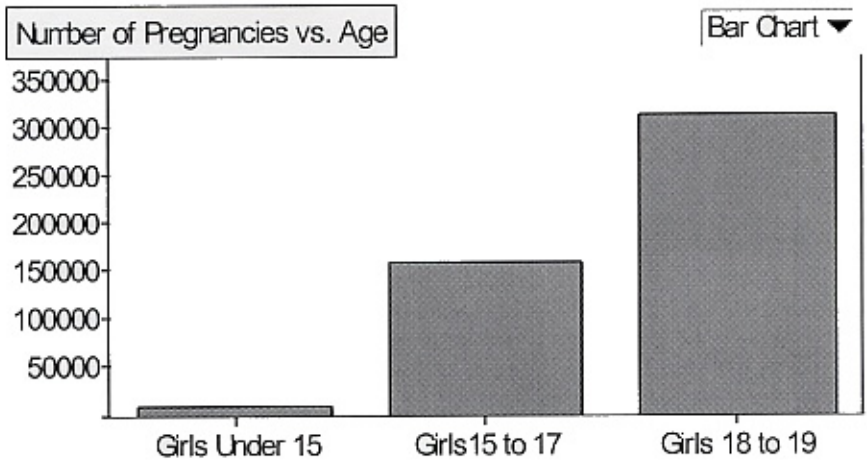
Part 3d: How does the age of a teenager affect teen pregnancy?

I wanted to see what age group contributed the most pregnancies to the total number of pregnancies in a country. I grouped the data I had already used from Part 3a (Does the population affect the number of pregnancies?, I – Pregnancies in the United States of America)

Number of Pregnancies vs. Age

	Country	Age	NumberofPregnancies
1	United States	Girls Under 15	8519
2		Girls15 to 17	157209
3		Girls 18 to 19	311781

I then graphed this data into a bar chart to see in which age division the majority of the pregnancies occurred.



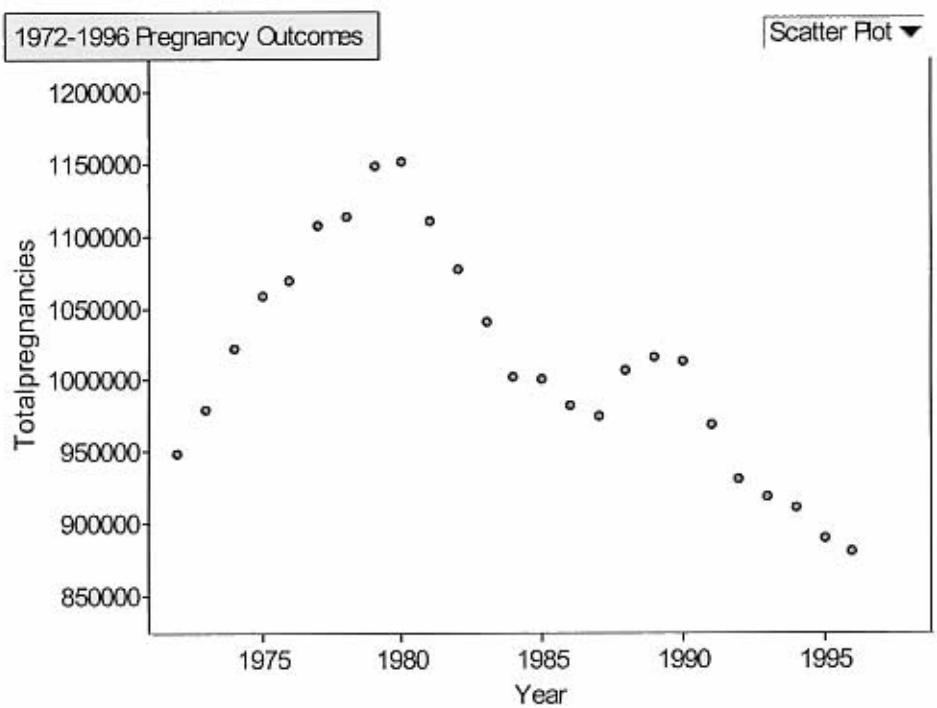
After graphing, I found the majority of the pregnancies in the United States fall into the "Girls 18-19" group. There appears to be a strong correlation between age and number of pregnancies, as girls get older, the number of pregnancies increase. This could be explained by the maturing reproductive tendencies of the female because some girls that are under 15 are unable to get pregnant, but it does not explain the large increase

between "Girls 15-17" and "Girls 18-19". If a girl between the ages of 15 and 17 is almost as likely to get pregnant as a girl over 17, then what is the reason for this large increase? This increase can be explained by an Extraneous Variable, the increasing amount of pressure to have sexual intercourse from either the male in the relationship or even the peers of the girl. When you are under 15, there is not a great deal of pressure placed on a girl to have sex. As age increases, so does the pressure. Friends may look down on the girl and claim that "everyone's doing it". If the girl believes them, then she is at a higher risk of teen pregnancy than when she was between the ages of 15 and 17.

Part 3e: Pregnancy Outcomes In Canada

I began to think about the definition of a teen pregnancy and realized that not all of these pregnancies result in the birth of a child. I wanted to see the trends in outcomes such as the number of births, abortions, and miscarriages and compare them with the trends in the total number of pregnancies. When these outcomes were graphed I found several different trends within them.

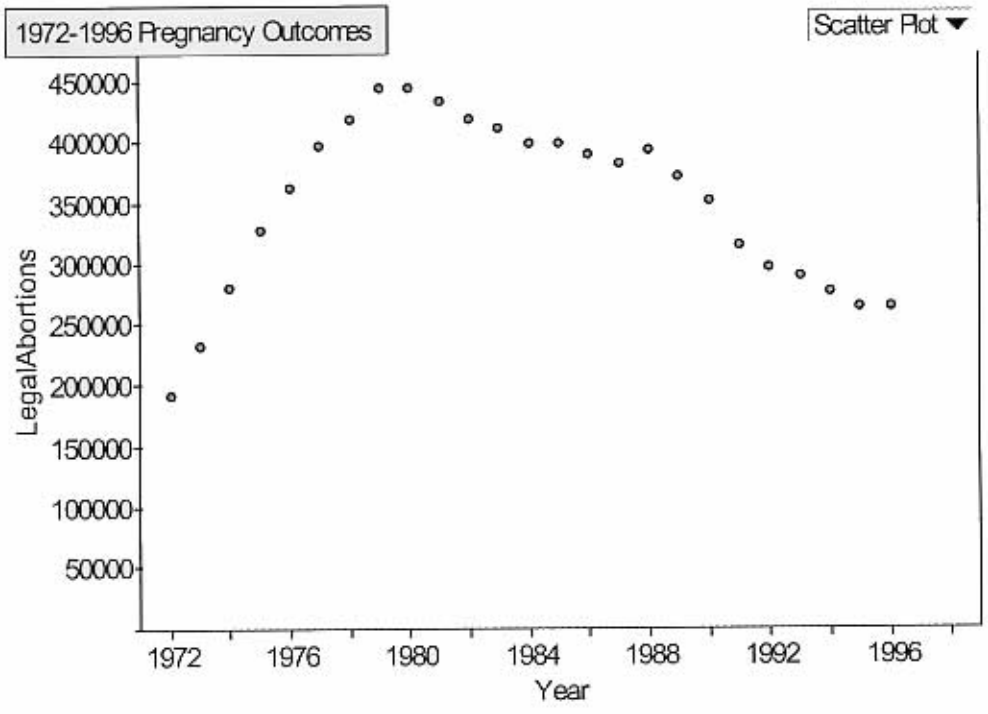
Graph 3e.i



In this graph showing the number of total pregnancies over time (Graph 3e.i), I found it interesting that the correlation was not linear. Most importantly, I found that the number of teen pregnancies is on a decline, but could be expected to go up. Right now, the decline could be a result of the ever-increasing public awareness of the conflicts, struggles and hard work it is to be a parent at a young age. Communities are increasing advertising, school programs and support lines and education about these risks which are taken when becoming a parent at a young age. The decline is mostly based on the

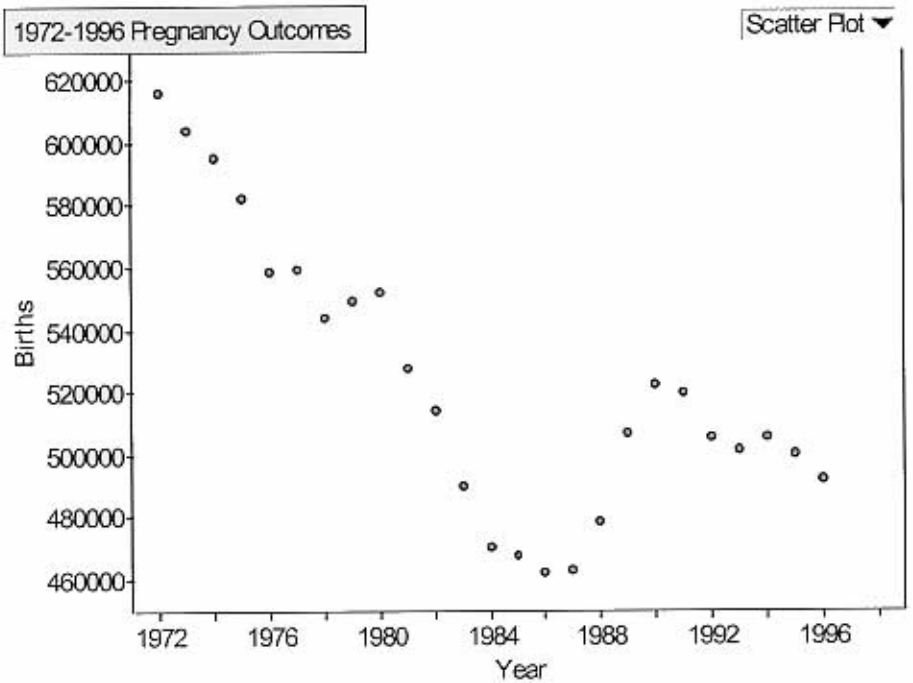
resources available to teens today. The choices they have for birth-control are endless, it's a surprise these numbers are still as high as they are today.

Graph 3e.ii



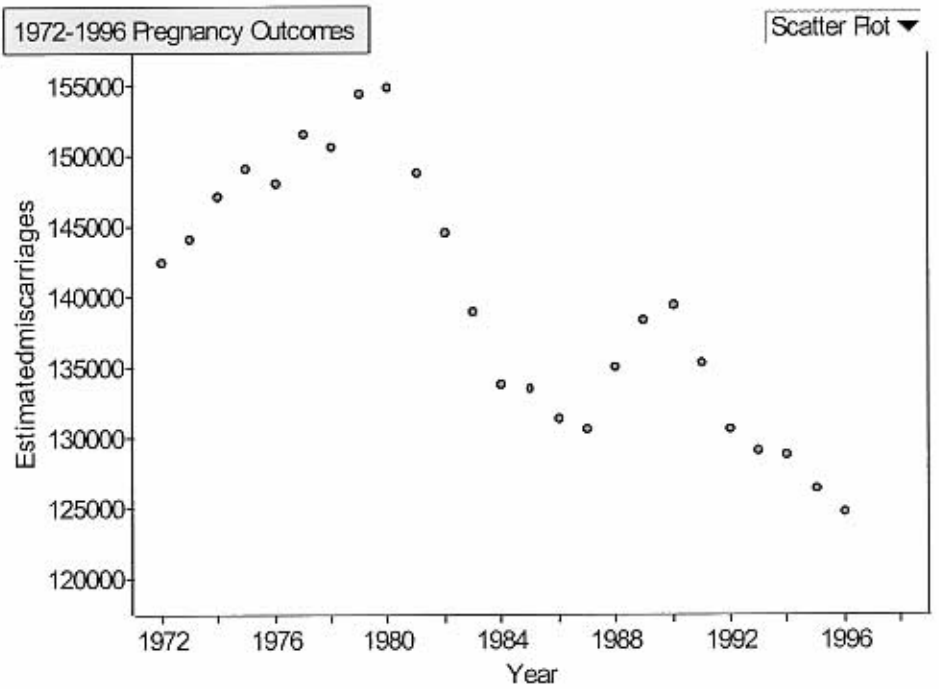
In this graph showing legal abortions (Graph 3e.ii), we can see that when they were first introduced, a large increase resulted, but now they begin to drop. We can base this drop on the awareness and better means of birth control, without the emergency abortion.

Graph 3e.iii



In this graph showing the number of births over time (Graph 3e.iii), we see that they were on a large decline and until recently began to rise and then begins to fall again. This is most likely a result of the topic of the previous graph, Legal Abortions. When abortions came into play, the birthrate dropped very quickly but we see them begin to rise again. I believe this is because the controversy on whether or not abortions should be allowed, greatly affect teenagers decisions when it comes to deciding whether or not to keep the child, and many decided not to have an abortion because some of their beliefs or beliefs that have been imposed on them by parents or friends.

Graph 3e.iv



In this graph showing estimated miscarriages (Graph 3e.v, we can see that the number of miscarriages was on a steady incline but began to drop and is now the lowest rates it has been. This could be a result of our increase in scientific technology as well as our understanding of how the baby develops and the amazing discoveries made by doctors, allowing women to take care of their babies as well as themselves during the pregnancy.

Extrapolating Within These Outcomes

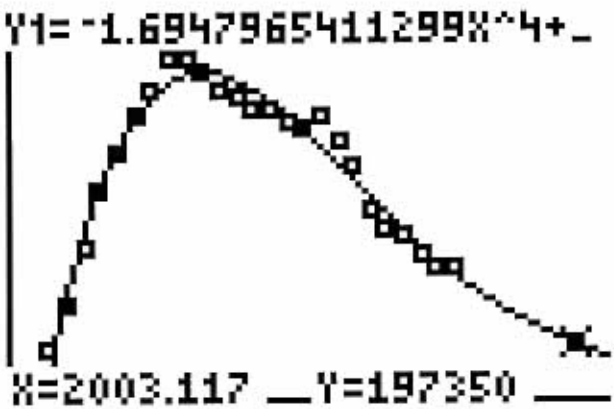
All these factors affect the birthrates in some form and many affect each other. By graphing the correlation, we can extrapolate and find many useful pieces of information that may give us an estimate on the rates and conditions within the next few years.

When using the virtual graphing calculator TI-83, I was able to graph these on the calculator and use the lines of best fit. I decided that since my data was not as recent, I could use these lines to see what the figures these outcomes would give us today in 2003.

Extrapolating using Graph 3e.1 – Number of Pregnancies Over Time

When entering this data into the graphing calculator, I found that the line of best fit would occur when using the QuarticReg calculation. After graphing this line, I was then able to use the trace button to then extrapolate and estimate the number of pregnancies that were likely to occur in 2003. The total number was approximately 300 770 total pregnancies in the year 2003. I think this is a fairly reasonable estimate because the teen pregnancy awareness is being emphasized greatly and teenagers are beginning to realize the possible consequences of unprotected sex. There is also large amounts and new, improved birth control methods available for teenagers to make use of if they feel they are ready to become sexually active. This explains the significantly lower number of pregnancies.

Extrapolating using Graph 3e.ii – Legal Abortions Over Time



Again, the line that fit this graph was the QuarticReg calculation. Using the trace button on the graphing calculator, I was able to determine that the number of legal abortions in the year 2003 would be approximately 206 187.

Extrapolating using Graph 3e.iii – Number of Births Over Time

I found that the estimated number of births in 2003 would be approximately 69 798. However I do not feel that this is an accurate representation because in the raw data in the table, the number of births were always greater than the number of abortions, although possible, it most likely will not occur in this fashion.

Extrapolating using Graph 3e.iv – Number of Miscarriages Over Time

In 2003, the estimated number of miscarriages would be 33 685. This number makes sense that it is the lowest of every year because the increase in the technology and understanding of how both the baby and the mother grow and develop throughout the course of the pregnancy. Not only are doctors aware of this, the mothers are as well. They understand that they must take care of not only the baby during pregnancy, but themselves to ensure that there are no problems.

I wanted to see if these estimates were a reasonable view at what the figures would be like today. I studied the chart I had and noticed that the columns Births, Legal Abortions, and Estimated Miscarriages, all added up to the total pregnancies (or within 0.001%) of the total). I came to the conclusion that if my estimated values are correct, they should add up to the estimated total number of pregnancies.

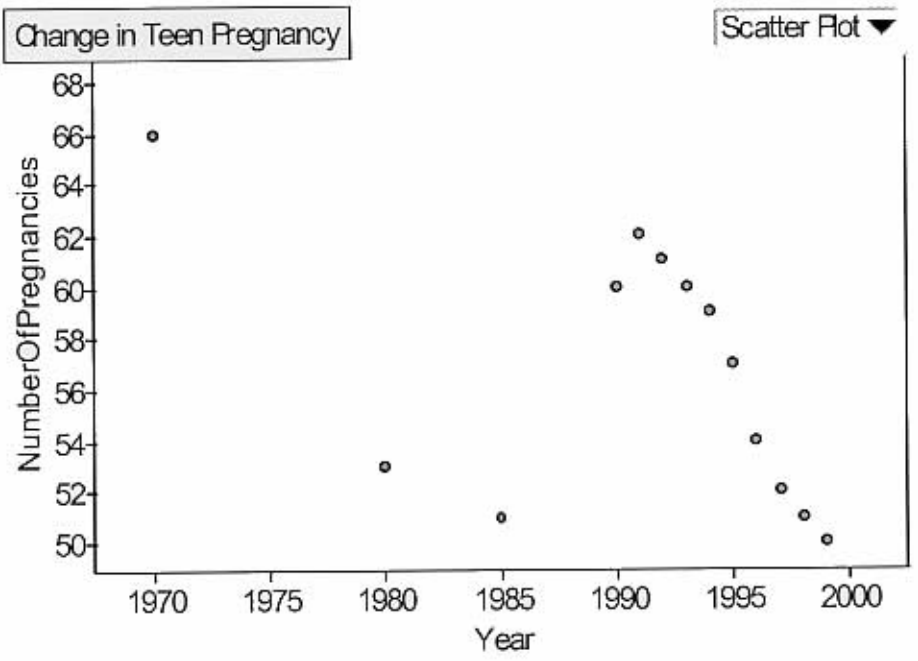
	Estimated Number of Births	= 69 798
+	Estimated Number of Legal Abortions	=2 06 187
+	Estimated Number of Miscarriages	= 33 685
		309 670

Estimated Total Number of Pregnancies = 300 770

The estimated number of births, legal abortions and miscarriages all added up to be very close to my estimated total number of pregnancies, therefore I can conclude that my approximate values for the year 2003 are a fairly accurate description of today's teenage pregnancy outcomes. However, it is possible that these estimates are not entirely correct because the data does not follow a perfect line of best fit, therefore it is difficult to judge when there will be a sudden change in the direction of the data unless you have exact numbers of the other outcomes.

Part 3f – Change in Teen Pregnancy

I wanted to look at how teen pregnancy rates have changed over the past 30 years and find reasons for this drop.



This graph shows an exceptionally large decrease in pregnancies from 1970 to 2000. The number of teen pregnancies per thousand has dropped from 66 to 50. This can be explained by extraneous variables. We can theorize that perhaps the access to abortions and emergency birth control had contributed greatly to the drop because the ability to undergo an abortion, almost anonymously, increased, and the ability to have literally almost thousands of birth control products and a large increase in the variety of birth control available.

This decrease could also be explained by the amount of awareness that has been created in today's society. Not only are Canadian teenagers endlessly hearing in health classes the consequences of unprotected sexual intercourse at a young age, it has become almost a popular topic of discussion on television shows, as well as commercials talking about individual teen parent's personal struggles with a child.

Part 4: Project Conclusion

So what are the factors that affect teen pregnancy? We can definitely come to the conclusion that the population has the greatest affect on the amount of teen pregnancies that will occur. We can see that this factor would affect every area. Another factor we can conclude is that the majority of these pregnancies falls into the 18 to 19 age range. This can be a result of the pressure most teens are feeling to have sexual intercourse.

We are also seeing that the number of pregnancies are decreasing in Canada, and the outcomes associated with them are also decreasing. When we start extrapolating on these graphs, we can see that these are continually decreasing showing that Canada creating awareness through media sources such as commercials, posters, and our health system, is very affective in our rates. If we continue to use these effective sources, these rates will maintain this decreasing pattern.

I found that there are several factors which play a great deal in determining the number of pregnancies there are in various regions. However, Canada can be seen as a representative as the rest of the world. I found when creating a box-and-whiskers diagram that we are very close to the median number of births throughout the world. In order to lower the rates in other countries, they can look at what we have done to lower our rates. Canada, as a country are continuing to lower our rates and with the current awareness from the media, we have been successful. With the growing technology, I predict that these rates will continue to lower and hopefully the rest of the world will look at us as an example and proceed to follow the pattern.

I have learned a great deal while creating this project. Taking this course before going into the medical field in University has enabled me to not only learn more about a topic that has interested me but also let me use several techniques which I will have to make use of in University through several research assignments and essays. However, it is still disappointing to see that teen pregnancy continues to be an issue today with the endless options of birth control and the amount of awareness that has been created. However, I feel that if we continue to make youth in society aware of these consequences of pregnancy at such an early age, then we can lower the rates to a minimum.