TI-83/84 Users

Chapter 4 Project: Fertility Rates in Developing Countries

Name _____ Name _____

Background: The negative impacts of a world population surging past 6 billion people have fallen most heavily on nations whose economies are less industrialized. These so-called "developing" countries, with population growth rates often exceeding 3% annually, face an uphill task meeting essential human needs such as housing, clean water, nutrition and basic health care.

In recent years, population growth rates have fallen remarkably in many developing countries because of declining fertility rates. Slower population growth helps protect the environment by easing demands on natural resources such as water, wood, soil and fish, and by lessening migration into overcrowded cities. In this project, you will explore several factors that influence fertility rates.

Data:
The data that you will examine in this project are from a Johns Hopkins School of Public Health Report titled *Why Family Planning Matters*, published in 1999. This report has data on numerous population variables for 139 developing countries. For this project, you will examine 6 of these variables: family planning through the use of contraception, economic wealth, women's age at marriage, infant mortality, female education, and total fertility rate. In the report, only 81 of the 139 countries have data for all 6 of these categories. The data for those 81 countries are provided on the attached 2-page data sheet.

More specific definitions of the variables are as follows:

CONTR	Percentage of couples using contraception as a family planning option. Source: United Nations.
GDP	Gross Domestic Product is the total output of goods and services per capita in 1997 U.S. dollars. GDP is a commonly-used indicator of economic wealth.
MEDAG	The median age of women at first marriage. The median is the number that lies in the middle of a data set when the data are arranged in order. Sources: U.S. Agency for International Development's Demographic and Health Surveys and United Nations.
MORT	Number of infant deaths (0 to exactly 5 years of age) per 1,000 live births. Source: UNICEF
SCHO	The percentage of females enrolled in secondary school. Source: UNICEF
TFR	Total Fertility Rate is the average number of children a woman would have during childbearing years (ages 15 to 49) at current birth rates. Source: Population Reference Bureau.

1. Examining Total Fertility Rate (TFR) data

a) The Total Fertility Rate for a country is the average number of children a woman will have during her reproductive lifetime. Scan the 81 TFR data values on your 2-page data sheet to find the minimum and maximum TFRs. Which countries have those rates?

b) The **replacement rate** is the TFR necessary to keep the long-term population constant. In theory, the replacement rate is 2.0—just enough children are born to grow up and replace the parents. In reality, the worldwide replacement rate is about 2.1 because some children do not live to reach breeding age. Of the 81 developing countries listed, how many have TFRs at or below the worldwide replacement rate? What percentage of the countries is that number?

c) Suppose a particular country has a replacement rate of 2.5. What can you conclude about the population characteristics of that country?

The birth rate is defined as the number of live births each year for every 1,000 individuals in the population. TFRs and birth rates are highly correlated: countries with high birth rates tend to have high TFRs, and those with low birth rates have low TFRs. Similarly, the death rate (number of deaths per 1,000 individuals) is highly correlated with childhood mortality.

d) Using TFRs as a proxy (substitute) for birth rates, and childhood mortality rates (MORT) as a proxy for death rates, find 3 developing countries, from the list of 81, that will fit each stage of the **demographic transition**. (See *Science in Depth* article in

Chapter 4.) If you think that there are no countries that fit a particular stage, write "none."

stage	countries *(list 3 for each stage)*
1	
2	
3	
4	

e) Briefly explain how you chose countries for each stage above:

2. TFR vs. Contraception – Straightedge Method

a) Examined the scatterplot of the (CONTR, TFR) data which is provided with this project. Is there an overall trend in the data? Explain.

b) Use the Straightedge Method to find the line that best approximates the scatterplot's data. Write the equation of the line using appropriate variables, and using 3 decimal places for the slope.

c) Give an interpretation of what the slope of the line means. In your interpretation, comment specifically about the numerical value of the slope.

d) Interpret the meaning of the TFR (vertical) intercept:

e) Find and interpret the meaning of the CONTR (horizontal) intercept.

f) List one country that falls very close to, or exactly on, your hand-drawn line. What are the (CONTR, TFR) coordinates for that country? Check that these coordinates fit the equation produced through the straightedge method.

g) The percentage of Brazil's couples that use contraception as a family planning method is 77%. Use this percentage and the linear equation to find Brazil's *predicted* TFR.

h) The **TFR deviation** is the actual value minus the predicted value. Determine the deviation for Brazil's TFR. Find and label the point on the scatterplot corresponding to Brazil. Explain what the TFR deviation represent on the graph.

i) Which country has the *largest negative* TFR deviation? Mark that country on the scatterplot. What is the value of the TFR deviation?

Before you begin the next set of questions, your instructor will help you download the 6 lists (CONTR, GDP, etc) into your calculator. Go through the following steps to view these files in the data editor of your calculator.

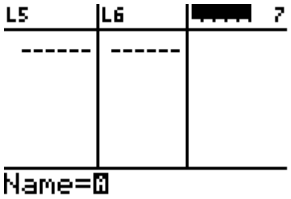
1. Select **LIST** (2nd STAT) **> NAMES** and scroll downwards. You should see the 6 files for this project below L6. *(There may be additional files such as RESID).*



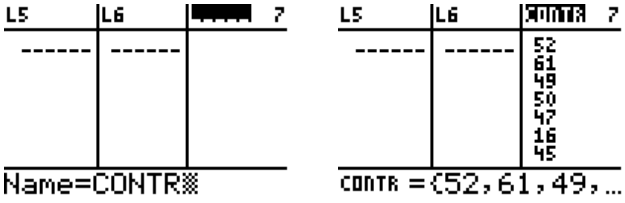
2. Select **STAT** > **5:SetUpEditor** and press **ENTER**.

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SetUpEditor
            Done
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3. Go to **STAT** > **1: EDIT** and scroll to the right and up to highlight L6. Press the right arrow once again, and you should create a new un-named list. Press **ENTER** and the cursor will move to the bottom, flashing after **NAME** = .



4. Without moving the position of the cursor, go to **LIST > NAMES**, scroll down to select the CONTR file and press **ENTER**. Press **ENTER** once again and the contraception data will be visible in the window.



5. To view the GDP data on your calculator, highlight CONTR and then press the right arrow to get a new unnamed list. Go to **LIST > NAMES** and select GDP. Press **ENTER**, and the GDP data will be pasted into its own column.

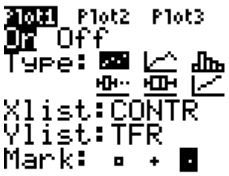
6. Repeat the procedure above to view the MEDAG, MORT, SCHO and TFR lists. Paste the data sets in the same order as they are presented on the 2-page data sheet.

7. Once finished, scan through the 6 data sets to ensure that there are 81 entries in each list. You might also check that the first and last numbers in each list match those on the data sheet.

Words of caution: Do not sort any of the individual lists CONTR, GDP,…TFR. The numbers cannot be "unsorted" back to their original positions.

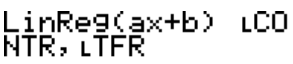
3. TFR vs. Contraception – Least Squares Regression

To ensure that the data is loaded correctly, create a scatterplot of the (CONTR, TFR) data on the calculator. In **STATPLOT**, you will need to set up Plot1 as shown below. To paste CONTR and TFR under Xlist and Ylist, respectively, select the files from **LIST > NAMES**.



Go to **WINDOW** and adjust Xmin, Xmax, Xscl, Ymin, Ymax, and Yscl to match the scatterplot included with this project. To view the data, press **GRAPH**. Compare the TI-83/84 scatterplot with the printed scatterplot included with the project – are they similar?

Now find the calculator's best-fitting regression line through the (CONTR, TFR) data. Be sure to paste the list names CONTR and TFR onto the command line (separated by a comma) after you select LinReg. See below. *Note: the small* L *will automatically appear when you paste the names onto the homescreen.*



a) What is the best fitting regression equation?

b) What is the correlation coefficient? Is a country's percent contraceptive use a good predictor of its TFR? Explain

c) Summarize your results by listing the slope and *y*-intercept for each equation. Use 3 decimal places of precision.

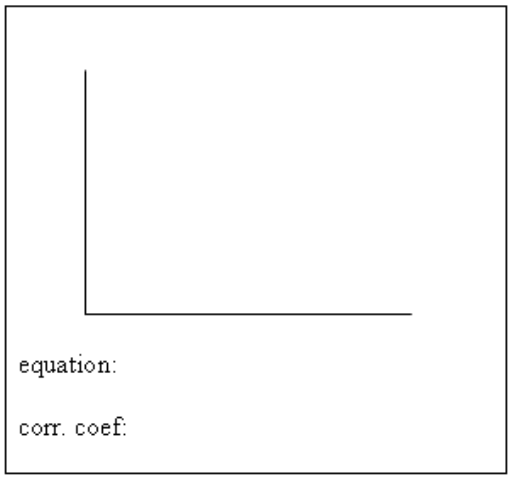
	slope	y-intercept
Straightedge		

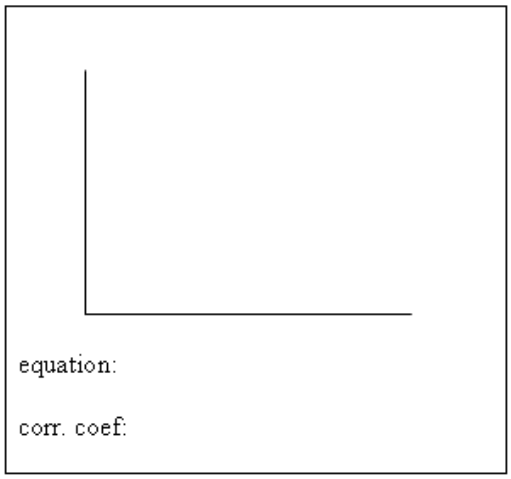
Least Squares Regression		

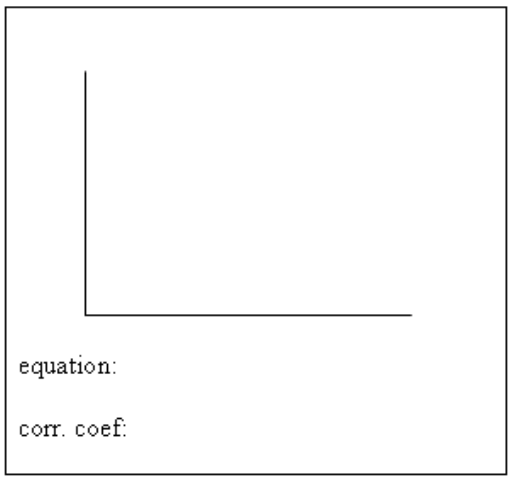
4. Exploratory Data Analysis

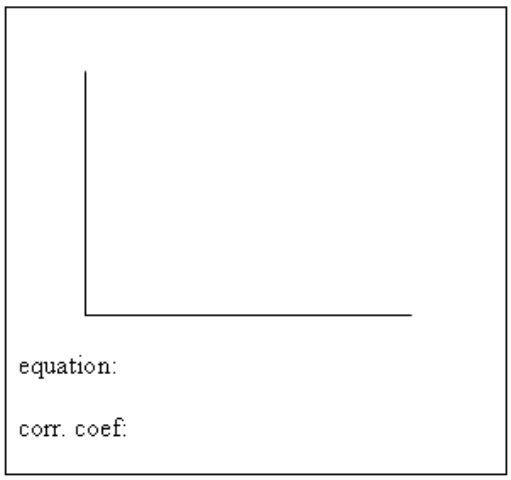
You've found that, among developing countries, percent contraceptive use is a very good predictor of TFR. Are there other variables that explain TFR equally as well? To find out, use your calculator to plot *y* = TFR against each of the other *x* variables (GDP, MEDAG, MORT, and SCHO). *See the previous section for instructions on how to set up scatterplots on your calculator. Instead of adjusting window dimensions manually, just select* ***Zoom > 9:ZoomStat*** *for each.*

a) Make a "thumbnail" sketch of each scatterplot in the table below to show the general shape of the data. Label the axes, but don't be concerned with scales. Finally, compute and record the regression equations and correlation coefficients. *Again, revisit the previous section for directions on how to calculate regression lines.*









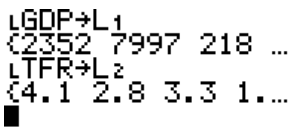
b) Compare the correlation coefficients. Which of the four independent variables does the best job in predicting TFR? How does that variable compare with percent contraception use in explaining TFR?

c) Which of these 4 variables does the poorest job in predicting TFR? Explain.

5. Removing the effect of outliers

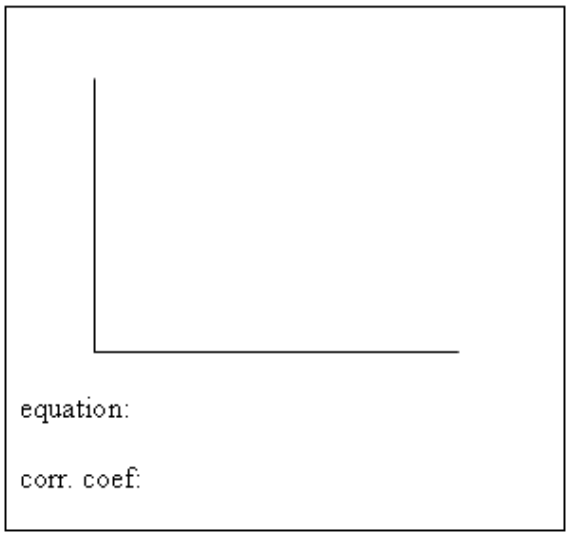
a) In the previous section you should have found that the scatterplot of the (GDP, TFR) data was highly skewed by several **outliers**. Outliers are data points that do not fit the general trend. Go back to the (GDP, TFR) scatterplot and determine the **4 most significant outliers.** Which countries are those outliers?

On your data sheet, circle the GDP and TFR values of these 4 outlier countries. You would like to remove these outliers to better examine whether there is a pattern amongst the remaining (GDP, TFR) data. But you might need the outlier values at a later time. The solution is to store a copy of the GDP data in L1, and the TFR data in L2. This can be accomplished on the homescreen by using the **STO→** button. See below. Do this now.



Now press **STAT > 1:EDIT** and scroll down through L1. When you come to an outlier value, press **DELETE** once. Repeat to remove the outlier values from L2 that are paired with the deleted values in L1. When finished, check that there are 77 values in both L1 and L2.

b) On your calculator, make a scatterplot of the revised (GDP, TFR) data that excludes the 4 outliers. *Be sure to select **Zoom > 9:ZoomStat** to readjust the axes.* Then find the regression line and correlation coefficient. Sketch and record below. Remember to label axes.

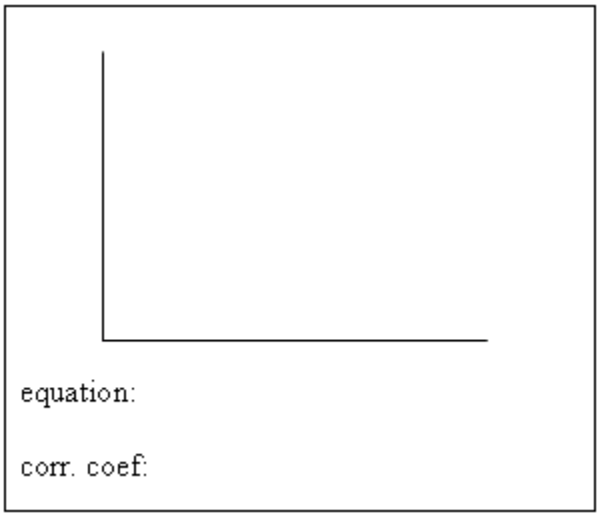


c) How well did removing the outliers improve the linear nature of the scatterplot?

6. Cause and Effect

a) Examine the results again from question 4 on Exploratory Data Analysis. How well does SCHO, the percentage of females in secondary school, predict the TFR for a country?

b) Let's swap the order of these variables, so that total fertility rate is plotted on the horizontal axis, and percent schooling is on the vertical axis. Make a scatterplot of the (TFR, SCHO) data on your calculator. Also find the regression equation and correlation coefficient. Record below, labeling appropriately.



c) How well do the TFR values predict the percentage of females that are enrolled in secondary school?

d) If a country reports that its total fertility rate is 4.8, what percentage of females would you predict to be enrolled in secondary school.

e) With regards to developing countries, some claim that an increase in female education causes a lower TFR; others claim that a lower TFR causes an increase in education. Expound on these cause and effect ideas, giving a few reasons why each might be true.

More schooling lowers TFRs:

Lower TFRs result in more schooling: