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Exploring the United Nations' Human Development Index

The human development index (HDI) is an international index used for comparing human well-being across countries. The activities that follow introduce this index and provide a look at an important method for finding a summary measure of a not readily quantifiable concept. The computational details behind this index provide a way to explore mathematical concepts such as scaling, averages, linear relationships, and logarithms. Further investigations allow use of the index to explore some statistical ideas. Because the activities use real data, they provide another way for students to see the utility of mathematics. To understand the context of the activities, students will be asked to read and think about the input values that are needed to compute such an index.

This department is designed to provide in reproducible formats activities appropriate for students in grades 7–12. The material may be reproduced by classroom teachers for use in their own classes. Readers who have developed successful classroom activities are encouraged to submit manuscripts, in a format similar to "Activities" already published. Of particular interest are activities focusing on the Council's curriculum standards, its expanded concept of basic skills, problem solving and applications, and the uses of calculators and computers. Send submissions to "Activities" by accessing **mt.msubmit.net**.

Another source of activities can be found in NCTM's *Using Activities from the "Mathematics Teacher" to Support Principles and Standards*, edited by Kimberley Girard and Margaret Aukshun (order number 12746; $35.95), which also includes a grid to help teachers choose the activities that best meet the needs of their students.

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Indexes and rating systems are created to help compare movies, cities, colleges, countries, sports teams, and other entities. Some rating systems are categorical, like the system that rates movies as G, PG, PG-13, R, or NC-17. Other systems assign a numerical rating or rank order to the objects being investigated. When an index system is constructed, the people responsible for it generally decide to include some measures and omit others, depending on the primary intent of the index.

The HDI was proposed by the United Nations Development Programme in its *Human Development Report 1990* and has been used in the Development Programme's annual report since 1993. This index replaced the gross domestic product (the value of all new final goods and services produced in a country) as the UN's primary measure of a country's development. The HDI was instituted because researchers recognized that income, commodities, and wealth do not tell the complete story of standard of living and well-being.

THE HDI

The HDI combines measures of health, education, and purchasing power. Health is assessed using life expectancy at birth. Education is evaluated using adult literacy rate (the percentage of adults ages 15 and above who are literate) and school enrollment (the combined primary, secondary, and tertiary—that is, postsecondary—gross enrollment as a percentage, using the total number of students in all these levels of school divided by the total age appropriate population for these levels). Purchasing

power is measured by gross domestic product per capita at purchasing power parity in U.S. dollars. Gross domestic product per capita in a particular year is the value of all new final goods and services produced within a country in that year divided by the average population for the same year. The term *at purchasing power parity in U.S. dollars* means that the gross domestic product is adjusted to account for differences in the prices of goods and services across countries.

Data for the HDI are obtained from a number of international data agencies. Life expectancy estimates, which are five-year averages, are prepared biannually by the United Nations Population Division, which uses data from national population censuses and surveys. Literacy rates are also evaluated using data from national population censuses. (For countries in which primary schooling is provided for all and which no longer collect such data on censuses, a literacy rate of 99 percent is used.) Gross education enrollment ratios are calculated based on data collected from national governments. The gross domestic price per capita at purchasing power parity in U.S. dollars (which we will denote by GDP) data are provided for many countries by the World Bank. For some other countries not covered by the World Bank, estimates for these data are obtained from another international source; for other countries, the needed estimates are obtained from regional and national agencies. The Human Development Report Office (HDRO) strives for timely and uniformly consistent data from all countries and sometimes must use statistical techniques to fill in gaps.

SOME DATA COLLECTION CONSIDERATIONS

Whenever data are used to draw conclusions or compare entities, we need to consider the data collection procedures and be aware of any inconsistencies. Here are a few concerns related to the HDI and the data used in its calculation.

- For some countries, data are not available for one or more of the basic factors of the HDI and must be estimated by the HDRO. These estimations influence the resulting HDI values.
- In general, some of the similar data for different countries are obtained from different sources, which may result in inconsistencies in the data.
- Adult literacy rates are based on self-reported data in many countries, which may cause errors in reporting. Other countries use educational level as a measure of literacy; however, definitions of grade levels differ from country to country.
- Adult literacy rate is based on the percentage of people ages 15 and above who can read and write a basic statement related to everyday life. Some researchers have suggested that the rate should be measured using a scale that allows more than just the current two categories of literate or illiterate.
- The combined gross enrollment ratio does not take into account students who go to other countries for postsecondary education. For smaller countries in which many students go abroad for college, this indicator could be significantly lower than the true value.
- The measure of enrollment ratio does not address educational outcomes, so different definitions of grade levels and other factors can affect the data.
- For countries with the highest HDI values, the human poverty index is computed also. The human poverty index includes additional measures, such as the percentage of the population living below the income poverty line, and contributes additional information.

THE ACTIVITIES

The activities that follow can help students understand how the HDI is calculated, what it measures, and some implications associated with it and other indexes. Because of space considerations, the accompanying worksheets were condensed; students will need to complete them on separate sheets of paper. The worksheets can also be downloaded at home.moravian.edu/users/math/mekbs01/HDI.

The activity on **sheet 1** introduces the computational details of the index and describes how input values are combined to produce a single number that can be used for comparisons across countries. The activity first uses the data for Kuwait to illustrate the calculations and then leads students through a computation of Brazil's most recent index. The activity ends with a discussion question that asks students to consider what other variables might be reasonable to include in an index that measures human well-being.

As an alternative to using the data given in the activity on **sheet 2**, students could be asked to find their own data for two countries from different parts of the world and use it to complete the same questions.

The next activity, on **sheet 3**, encourages students to use technology to look at the HDI for the countries of South America and investigate the effects of small changes in the input data on the relative standings of the countries of South America. This activity's final question asks students to consider what implications this work has for other indexes that rate and rank things, like systems that rank colleges and universities.

The final activity, on **sheet 4**, addresses some statistical issues by looking at how well the HDI correlates with each of the variables used to compute it. In this activity, students also consider

several design questions related to other variables that might be included in an index of well-being.

Because the first activity introduces how the HDI is computed, an algorithm that is needed for the other activities, it should be completed first. It introduces transforming variables to an index value between 0 and 1 and incorporates linear transformations and logarithmic transformations. This activity is appropriate for high school algebra 2 and college algebra students (during or after the study of logarithms) as well as students in a general introductory college quantitative skills or quantitative reasoning course. After the first activity has been completed, any of the other three activities could be introduced. Activity 2 explores the differences between linear and logarithmic transformations in more detail and would be useful in an algebra 2, college algebra, or quantitative reasoning course. Activity 3 encourages the use of a spreadsheet or graphing calculator to practice using the formulas to explore the HDI for the countries of South America, also appropriate for algebra 2, college algebra, and quantitative reasoning students. The fourth activity uses the data provided in activity 3. Activity 3 does not need to be completed to do activity 4, but students will need to use the same basic data. This latter activity is relevant for high school or college statistics students learning about regression lines and correlation coefficients.

These activities introduce students to the idea of an index number, which may be a new concept for many. The activities can help build students' geographical sense as well as introduce them to some of the problems and implications of the algebra and statistics concepts they are studying.

SOLUTIONS

Sheet 1

1. Answers will vary, but students should observe that Kuwait's values are higher for all the provided data except education enrollment, and thus they probably will expect Kuwait's HDI to be higher.

2. Approximately 87.7 percent

3. We could combine the numbers, but they would be meaningless as a single value in the context of HDI.

4. The number in the numerator, life expectancy value minus 25, is in years. The number in the denominator is also in years, and thus their quotient is a "unit-free" number. Unless the LEV is greater than 85, the numerator will always be less than the denominator.

5. 0.763

6. 0.877

7. 0.735

8. 0.792

9. Students' answers will vary but might include ideas such as access to health care measured by number of doctors per person, proportion of people living in poverty, average number of cars or televisions per household, and so on.

Sheet 2

1. Spain: 0.912 Kenya: 0.375

2. Spain: 0.980 Kenya: 0.691

3. Spain: 0.922 Kenya: 0.406

4. Spain: 0.938 Kenya: 0.491

5. Spain's LEI would rise to 0.995, Kenya's to 0.458. The HDIs would change to 0.966 and 0.518, respectively. A 5-year increase in life expectancy results in an LEI increase of 5/60 and an HDI increase of 5/180. Because the contribution of life expectancy is linear, a change in life expectancy of an amount y years results in a

$$\frac{y}{85-25}=\frac{y}{60}$$

change in the LEI and a

$$\frac{1}{3}\cdot\frac{y}{60}=\frac{y}{180}$$

change in the HDI.

6. Spain's EI and HDI would change to 0.913 and 0.916, respectively; Kenya's new figures would be 0.624 and 0.468. The contribution of ALR on the HDI is linear. For this measure, a change of p percent in the ALR results in a change of

$$\frac{2}{3}\cdot\frac{p}{100}=\frac{2p}{300}$$

in the EI and a change of

$$\frac{1}{3}\cdot\frac{2p}{300}=\frac{2p}{900}$$

in the HDI. So, a decrease of 10 percent in the ALR results in a decrease of $2/30 \approx 0.067$ in the EI and a decrease of $2/90 \approx 0.022$ in the HDI.

7. Spain's GDPI would change from 0.922 to 0.952, while its HDI would change from 0.938 to 0.948. Kenya's GDPI would change from 0.406 to 0.687, and its HDI would change from 0.491 to 0.584. Spain's GDPI increased only 0.030, while Kenya's increased 0.281 following a (hypothetical) $5000

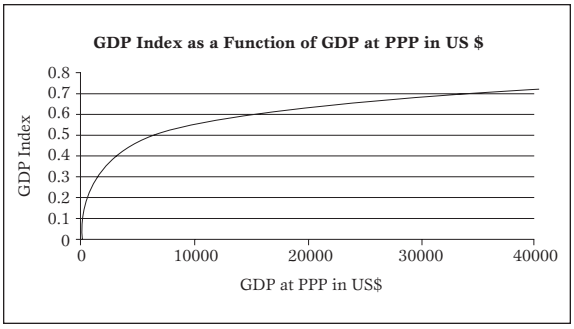

Fig. 1 Answer to activity 2, questions 7 and 8

Table 1

Answer to Activity 3, Question 1

Country	LEI	EI	GDPI	HDI
Argentina	0.827	0.945	0.816	0.863
Chile	0.885	0.908	0.783	0.859
Uruguay	0.843	0.950	0.759	0.851
Brazil	0.763	0.877	0.735	0.792
Colombia	0.793	0.862	0.715	0.790
Venezuela	0.800	0.867	0.685	0.784
Peru	0.753	0.871	0.674	0.766
Ecuador	0.825	0.857	0.614	0.765
Suriname	0.738	0.837	0.698	0.758
Paraguay	0.770	0.853	0.647	0.757
Guyana	0.643	0.897	0.633	0.724
Bolivia	0.657	0.868	0.551	0.692

increase in GDP. **Figure 1** shows this effect. The slope of the curve is greater for smaller values of GDP. Because the GDPI's contribution to the HDI is the index multiplied by 1/3, there is a similar diminishing effect on the HDI of changes in larger GDP values. Logarithms are used to calculate the GDPI because of this diminishing effect.

8. The changes in questions 5 and 6 were the same for both countries because the indexes for life expectancy and education are linear functions. The GDPI is defined using a logarithmic function, so the increase was more for the smaller GDP. See **figure 1**.

Sheet 3

1. See **table 1**.

2. Guyana's HDI increases to 0.805, and the country rises from 11th to 4th place in its ranking among the other South American countries.

3. Bolivia's HDI increases to 0.778, and the country moves from 12th (or last) place to 7th place among the other South American countries.

4. Peru's HDI increases to 0.791, and the country moves from 7th to 5th place.

5. Colombia's HDI increases to 0.805, and the

Table 2

Needed Input Data from 2002

Country	Life Expectancy at Birth	Adult Literacy Rate	Combined Education Enrollment Rate	GDP per Capita at Purchasing Power Parity in US $
Argentina	74.1	97.0	94.0	10,880
Bolivia	63.7	86.7	86.0	2,460
Brazil	68.0	86.4	92.0	7,770
Chile	76.0	95.7	79.0	9,820
Colombia	72.1	92.1	68.0	6,370
Ecuador	70.7	91.0	72.0	3,580
Guyana	63.2	96.5	75.0	4,260
Paraguay	70.7	91.6	72.0	4,610
Peru	69.7	85.0	88.0	5,010
Suriname	71.0	94.0	74.0	6,590
Uruguay	75.2	97.7	85.0	7,830
Venezuela	73.6	93.1	71.0	5,380

Table 3

Change in HDI in South America

Country	HDI 2002 Data	HDI 2004 Data
Argentina	0.854	0.863
Bolivia	0.681	0.692
Brazil	0.775	0.792
Chile	0.839	0.859
Colombia	0.773	0.790
Ecuador	0.735	0.765
Guyana	0.719	0.724
Paraguay	0.751	0.757
Peru	0.753	0.766
Suriname	0.780	0.758
Uruguay	0.833	0.851
Venezuela	0.777	0.784

Note: 2002 data is from the 2004 report, 2004 data from the 2006 report

country moves from 5th place to 4th place. (Colombia switches places with Brazil.)

6. **Table 2** gives the needed input data from 2002. **Table 3** shows how HDI has changed over that period for the countries of South America. Notice that only one country's HDI decreased.

7. Colleges and universities regularly report their *U.S. News and World Report* ranking. Such rankings can change fairly dramatically as a result of a small change in one of the input values, as seen by the calculations in questions 2 through 5 above. At the very least, we should investigate what values go into such an index in order to understand it better.

Sheet 4

Please note that the answers to questions 2 and 7 in this activity may differ slightly if you use HDI values rounded to three decimals to calculate the regression line and correlation coefficient. The solutions given here were obtained using Excel to find the HDI values; more decimal places were kept in the intermediate calculations, with rounding at the end of these calculations. The values obtained using rounded HDI values are indicated in parentheses.

1. The correlation coefficient of each of these quantities with the HDI is positive because, for example, higher levels of GDP have higher GDPI values, and higher GDPI values lead to a higher average as its contribution to the HDI.

2. (*a*) With x = life expectancy and y = HDI, the equation of the least-squares regression line is $y = 0.0107x + 0.0181$ ($y = 0.0107x + 0.0152$).
(*b*) The slope of the regression line is 0.0107, and the intercept is 0.0181 (0.0152).
(*c*) The slope of 0.0107 indicates that for each one-year increase in life expectancy in a country in this part of the world, we would expect, on average, an increase of 0.0107 in the country's HDI.

3. and 4. The correlation coefficient of HDI and GDP is the largest: 0.932. The next largest correlation coefficient is that of HDI and life expectancy: 0.874. The correlation coefficient of HDI and ALR is 0.638, while the correlation coefficient of HDI and EER is 0.348.

5. The correlation coefficient of 0.932 tells us that there is a strong positive correlation between HDI and GDP. Greater values of GDP are associated with greater HDI values. There is also a strong positive relationship between HDI and life expectancy. The relationship between HDI and adult literacy rate is moderately strong, while the relationship between HDI and education enrollment ratio is weak.

6. It is the same: 0.874.

7. This value is 0.937 (0.938); it is slightly greater than the correlation coefficient of GDP and HDI.

8. Answers will vary.

9. Answers will vary but might include some of these: We might want to include infant mortality rate, proportion of children living below the poverty level, proportion of children under 19 who serve in armed services, number of serious childhood illnesses that are prevalent in the country, or other measures specifically addressing the welfare of children.

10. Answers will vary. We could include access to health care, education, and educational and leisure activities for females. We could also measure education attainment and earnings differences between men and women. Number of violent crimes per capita in which females are the victims could also be used.

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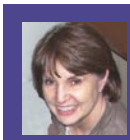

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Calculating the HDI

Four values go into calculating the human development index (HDI) for a particular country. One value is life expectancy at birth. Two other values are related to education. The first is the adult literacy rate—that is, the percentage of adults in the country who are literate. The other measure of education is the combined primary, secondary, and tertiary (that is, postsecondary) education enrollment as a percentage. This is the percentage of all people in the appropriate age groups for primary, secondary, and postsecondary school who are actually enrolled in school.

The final value that goes into computing a country's HDI is the gross domestic product (GDP) per capita at purchasing power parity, given in U.S. dollars. This is the value of all new final goods and services produced within a country in that year divided by the average population for the same year. The term *at purchasing power parity* means that the gross domestic product value is adjusted to account for differences in the prices of goods and services in the various countries.

This activity introduces you to the calculations involved in the HDI. Data for Kuwait are used to illustrate the calculations. Then you are asked to perform the calculations using Brazil's data. The 2004 data used here are available in the United Nations' 2006 report at hdr.undp.org/hdr2006/statistics.

For Kuwait, the life expectancy at birth is 77.1 years, the adult literacy rate is 93.3%, the education enrollment ratio is 73%, and the gross domestic product is $19,384.

For Brazil, the life expectancy at birth is 70.8 years, the adult literacy rate is 88.6%, the education enrollment ratio is 86%, and the gross domestic product is $8,195.

1. Before making any calculations, how do you think these two countries will compare if we use these measures to come up with a single HDI for each country?

To calculate the HDI, first combine the two measures of education using a weighted average, with a two-thirds weight for the adult literacy rate (ALR) and a one-third weight for the education enrollment ratio (EER). The formula for the weighted average to give the education percentage (EP) as a measure of education is

$$\mathrm{EP} = \frac{2}{3} \times \mathrm{ALR} + \frac{1}{3} \times \mathrm{EER}.$$

Kuwait's EP is $$\mathrm{EP}_{\mathrm{Kuwait}} = \frac{2}{3} \times 93.3\% + \frac{1}{3} \times 73\% \approx 86.5\%.$$

2. Use the formula to find the EP for Brazil.

To calculate a single numerical measure of human development, the HDI, we want to combine the measure of health, which is in years, with the measure of education we just found, which is given as a percentage, with the measure of economic well-being, which is given in U.S. dollars.

3. Explain why we cannot directly combine these values with different units (like years, percentages, and dollars) into a single measure.

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One way to combine these values is to convert each of them to an index number with no units associated with it. We can then average these three numbers to obtain the HDI.

To convert life expectancy values to a life expectancy index number, we first identify a reasonable minimum and maximum for each of these values. The United Nations uses 25 as the minimum and 85 as the maximum. Then the life expectancy value (LEV) is converted to a life expectancy index (LEI) using the equation

$$\text{LEI} = \frac{\text{LEV} - 25}{85 - 25}.$$

4. Explain why an index number defined this way will be between 0 and 1 and will not have any units (like years) associated with it.

For Kuwait, with life expectancy of 77.1 years,

$$\text{LEI}_{\text{Kuwait}} = \frac{77.1 - 25}{85 - 25} \approx 0.868.$$

5. Find the life expectancy index for Brazil.

In fact, a value given in any units can be converted to an index using this same approach: First identify a reasonable minimum (min) and maximum (max) for these values and then convert the *value* to an *index* using the equation

$$\text{Index} = \frac{\text{Value} - \text{min}}{\text{max} - \text{min}}.$$

The result is an *index* with no units associated with it.

In a similar way, the education percentage (the weighted average of the adult literacy rate and the education enrollment ratio you computed in question 1) is converted to an index value by using a minimum of 0 (percent) and a maximum of 100 (percent). This gives the education index (EI) in terms of the education percentage (EP) as

$$\text{EI} = \frac{\text{EP} - 0}{100 - 0} = \frac{\text{EP}}{100}.$$

Kuwait's EI is

$$\text{EI}_{\text{Kuwait}} = \frac{86.5 - 0}{100 - 0} = \frac{86.5}{100} = 0.865.$$

6. Find the EI for Brazil.

For the final conversion to an index value, we convert the gross domestic product per capita in US $ (GDP) to an index value. This is done a bit differently from the previous conversions. Here base-ten logarithms are used so that the effect of a larger GDP value is diminished. (Natural logs may be used as well.) The minimum and maximum values used by the United Nations for the GDP are 100 and 40,000, respectively, and the equation to calculate the GDP index value (GDPI) from the GDP is

$$\text{GDPI} = \frac{\log(\text{GDP}) - \log(100)}{\log(40{,}000) - \log(100)}.$$

Kuwait's GDPI is $$\text{GDPI}_{\text{Kuwait}} = \frac{\log(19{,}384) - \log(100)}{\log(40{,}000) - \log(100)} \approx 0.879.$$

7. Find Brazil's GDPI.

Finally, to obtain the HDI for a country, we take the mean or average of the three index values: the LEI, the EI, and the GDPI. That is, we add them and then divide by 3. Kuwait's HDI is

$$\text{HDI}_{\text{Kuwait}} = \frac{0.868 + 0.865 + 0.879}{3} \approx 0.871.$$

8. Find Brazil's HDI and compare it to Kuwait's HDI. Was your prediction in question 1 correct?

9. What other values (other than life expectancy at birth, adult literacy rate, education enrollment ratio, and gross domestic product) might be appropriate to include in an index designed to measure the well-being of people?

Exploring the Formulas

Sheet 2

The table gives the basic data from the 2006 report (2004 data) needed to calculate the HDI for two additional countries: Spain and Kenya.

Country	Life Expectancy at Birth	ALR	Combined EER	GDP per Capita at Purchasing Power Parity in US $
Spain	79.7	99.0	96	25,047
Kenya	47.5	73.6	60	1,140

1. Using a minimum of 25 years and a maximum of 85 years, calculate the LEI for each of these countries, rounded to three decimal places.

Spain:

Kenya:

2. Obtain the EI for each country.

Spain:

Kenya:

3. For each of the countries, convert the GDP per capita to an index (using logarithms).

Spain:

Kenya:

4. Find the HDI for each of the countries.

Spain:

Kenya:

5. Suppose life expectancy in each of these countries increases by 5 years, either because of improvements in health care or because it was misreported. For each country, what is the effect of this change on the life expectancy index and on the HDI?

6. Suppose the adult literacy rate of each country were to decrease by 10 percent. That is, Spain's adult literacy rate would decrease to 89 percent and Kenya's to 63.6 percent. What is the effect of this change on the EI and the HDI?

7. Suppose that each country's GDP were to increase by $5000 (in US $). What impact would that change have on the country's GDPI and on its HDI?

8. Compare your answers to questions 5, 6, and 7. Explain why the differences occurred.

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HDI for the Countries of South America

Sheet 3

1. The table shows the basic data from the 2006 report (2004 data) needed to calculate the HDI for the countries of South America, which are given in alphabetical order. Use a graphing calculator or spreadsheet to compute the LEI, the EI, the GDPI, and the HDI for each of these countries. Then sort the countries in order of decreasing HDI.

Country	Life Expectancy at Birth	ALR	Combined EER	GDP per Capita at Purchasing Power Parity in US $
Argentina	74.6	97.2	89	13,298
Bolivia	64.4	86.7	87	2,720
Brazil	70.8	88.6	86	8,195
Chile	78.1	95.7	81	10,874
Colombia	72.6	92.8	73	7,256
Ecuador	74.5	91	75	3,963
Guyana	63.6	96.5	76	4,439
Paraguay	71.2	93	70	4,813
Peru	70.2	87.7	86	5,678
Suriname	69.3	89.6	72	6,552
Uruguay	75.6	98	89	9,421
Venezuela	73.0	93.0	74	6,043

2. Suppose Guyana's life expectancy is raised from its current level of 63.6 years to that of Chile's (78.1 years). What effect does that have on Guyana's HDI and does it improve Guyana's HDI ranking relative to the other South American countries?

3. Suppose Bolivia's GDP is mistakenly read as $12,720 instead of $2,720. What effect would that mistake have on Bolivia's HDI and ranking among other South American countries?

4. Peru's adult literacy rate is currently 87.7 percent. Suppose this rate increases to 99 percent. What is the effect of this increase on Peru's HDI and ranking among the other countries in the table?

5. Suppose Colombia's combined school enrollment increases from 73 percent to 86 percent (the enrollment of Brazil, which is ranked above Colombia among South American countries). What effect would this change have on Colombia's HDI and ranking among the other South American countries?

6. Investigate how the HDI values of the South American countries have changed from 2002 to 2004. (These data are given in the reports from 2004 and 2006, respectively, and can be found at hdr.undp.org.)

Note that care needs to be taken when comparing changes over the years in a country's HDI. Sometimes these changes reflect modifications in data collection methods, rather than substantive changes.

7. What implication does your work on this activity have for other systems that rank entities, such as systems that rank colleges and universities?

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Regression Line, Correlation Coefficients, and the HDI Sheet 4

In this activity, we will use the countries of South America to investigate how the HDI correlates with the data that is used to compute it. Using the data from the 2006 report (given on **sheet 3**) and a graphing calculator or spreadsheet, compute the three indexes that are averaged to obtain the HDI and then compute the HDI itself.

1. Explain why each of the following correlation coefficients is positive: the correlation coefficient of HDI and life expectancy; the correlation coefficient of HDI and adult literacy rate (ALR); the correlation coefficient of HDI and education enrollment ratio (EER); and the correlation coefficient of HDI and GDP.

2. For the sample of countries (the South American countries) investigated in **sheet 3**,

(*a*) find the equation of the least-squares regression line describing the relationship between HDI and life expectancy

(*b*) identify the slope and intercept of the regression line

(*c*) provide an interpretation of the slope using HDI and life expectancy in your interpretation

3. For the sample of countries investigated in **sheet 3**, find

(*a*) the correlation coefficient of HDI and life expectancy

(*b*) the correlation coefficient of HDI and ALR

(*c*) the correlation coefficient of HDI and EER

(*d*) the correlation coefficient of HDI and GDP

4. Rank the four correlation coefficients you found in question 2 in order from largest to smallest.

5. What does the correlation coefficient of HDI and GDP tell us about the relationship between HDI and GDP for the countries of South America? What do the other correlation coefficients you computed in question 3 tell us?

6. Find the correlation coefficient of the LEI and the HDI. How is this correlation coefficient related to the correlation coefficient of life expectancy and the HDI?

7. Find the correlation coefficient of the GDPI and the HDI. How is this correlation coefficient related to the correlation coefficient of GDP and the HDI?

8. Some researchers have suggested that the correlation coefficient of GDP and HDI indicates that GDP (alone) could be used as an index of human well-being and that the HDI is not needed. What do you think about that suggestion?

9. If we wanted to construct an index to measure specifically the well-being of children, what would we want to include in such an index?

10. How might we incorporate how different countries treat women into an index?

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