UNST 125g   fall 2011
food audit

1   introduction

As we discussed fall term, food production and distribution are closely related to sustainability, social, and ecological justice. We left the term with the idea that different food sources have different ecological costs and dietary benefits and with an introduction to the challenges that lie ahead for a planet with 7 billion human inhabitants (The Future of Food, 2009). Just sustainability requires us to balance nutritional needs of those people with the ecological costs of producing optimal diets.

The objectives of this assignment are to more fully appreciate the types, amounts, and sources of the foods you eat relative to people living elsewhere in the world as well as the ecological footprint associated with your food choices, and to gain experience collecting and analyzing data. Here, much of the data processing has been prepared for you. Later in the term you will be more on your own.

2   data

The data for this assignment come from several sources. First, you were asked to collect data about your own eating for 5 days over the winter break. Those data will be converted into mean annual values and compared with global data on diet composition and the ecological footprints associated with those diets. The global food audit data are from the World Health Organization's (WHO) Global Environment Monitoring System (GEMS) database (`http://www.who.int/foodsafety/chem/gems/en/`). The mean diets were determined using data collected over a five year period, from 1997 to 2001. The long data collection interval allows variations related to seasons and market-driven variations in food consumption patters to be averaged.

The Ecological Footprint data and analysis methodology we will use in this exercise were developed by the Center for Sustainable Economy, a consulting group that in addition to other ecological and conservation services, helps non-profits, government agencies, and for-profit businesses develop and evaluate organizational sustainability programs (`http://www.myfootprint.org/`, `http://www.sustainable-economy.org/`). The Human Development Index (HDI) we will use is from the UN Development Program (`http://hdr.undp.org/en/statistics/hdi/`).

An *ecological footprint* is a metric used to evaluate the demands placed on ecosystems by human resource usage (Rees, 1992; Wackernagel and Rees, 1996). At its simplest, an ecological footprint is the amount of land required to support a particular individual, city, or country with a particular lifestyle. Lifestyle in this analysis would be defined by diet, consumer goods, services, housing, energy sources and usage, and waste management (primarily greenhouse gas emissions). The footprint is a global quantity because the production and trade of commodities and the pollution generated by human activities are not confined within the borders of individual countries but are themselves global. The ecological capacity of the planet is calculated according to ecosystem services (food production,

carbon sequestration in forests, and so on) in individual nations. Viewed with such a metric, the Earth as a whole has a certain human *carrying capacity*, a number of people who can be supported in a particular lifestyle. Because modern developed-world lifestyles place higher demands on ecosystems, Earth's carrying capacity is smaller than it would be if all people lived less resource-intensive lifestyles. A world with 7 billion inhabitants thus requires individuals and nations to make choices that lower their individual footprint size so that more people can fit in the available ecological capacity.

The ecological footprint calculated provided in this exercise considers four sources of demand on ecosystems: fossil carbon use for home energy and transportation; food production, processing, and transportation; housing; and goods and services. You can read more about the details of the analysis at the FAQ at `http://myfootprint.org`. Capacity is reported in hectares. A hectare is a metric unit of area, 10000 square meters, used in measurements of land area. One hectare is about 2.47 acres.

The Human Development Index is a metric that represents both social and economic development, at a national level, in one value. The fundamental indicators combined into the index value are health, educational attainment, and standard of living. Each country is assigned a rank along a development scale (from 0 to 1) for each indicator and the three values are combined to form the HDI. The indicator is described in more detail at the UNDP Human Development Reports website. Here, we use year 2000 data because they are the closest in time to the ecological footprint evaluation.
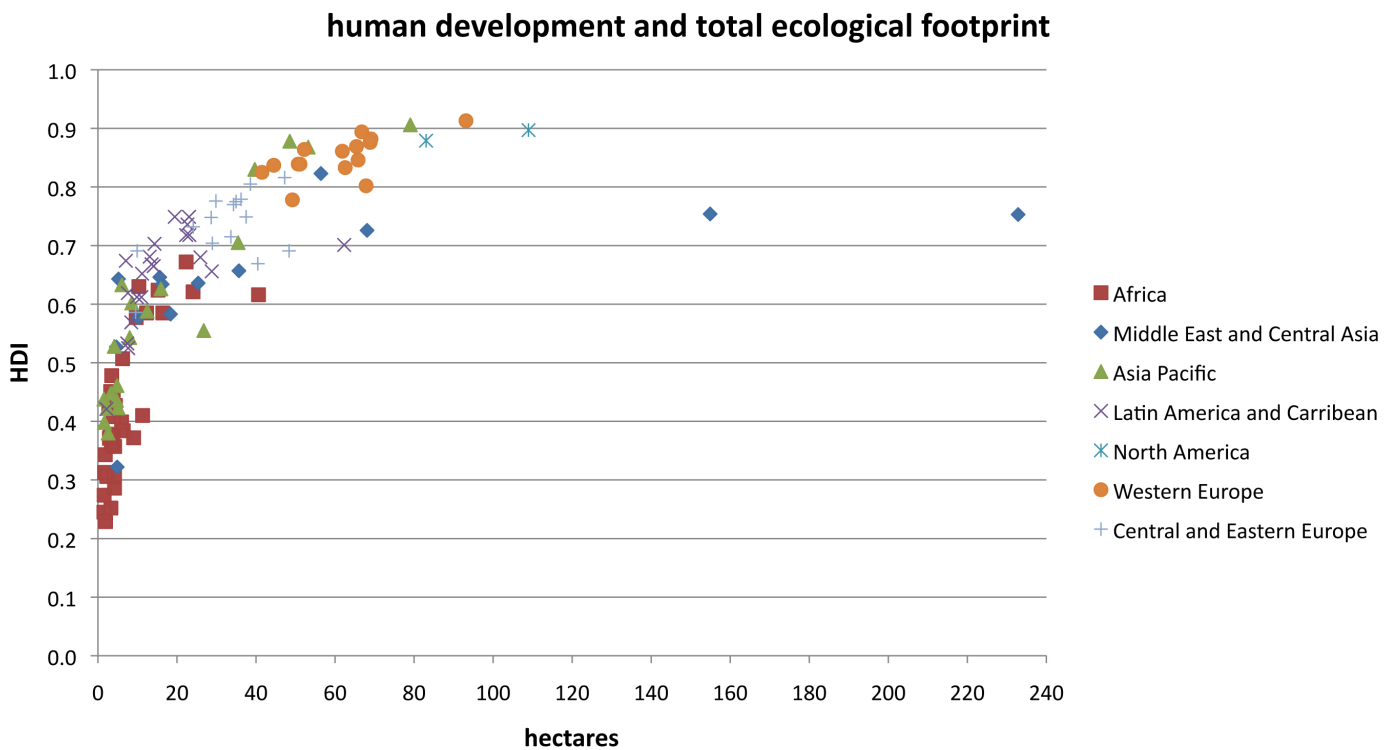

Figure 1: Human Development Index and ecological footprint of nations, grouped by region. Lifestyles in developed nations place, in general, heavier burdens on Earth's ecosystems than do lifestyles in the developing world.

3   analysis

3.1   introduction

Download the Excel workbook foodaudit.xls at the class website and examine the various worksheets and their contents. The first tab, labelled **audit**, is where you will enter your daily food records. The spreadsheet is set up to calculate annual totals and daily averages for you. Calculations performed in the **food** worksheet also allow you to compare your food consumption with typical consumption for other regions of the world. That comparison begins in column **R**, where your food audit data are combined into categories that match the WHO GEMS database categories.

The **eco footprint** entries on this worksheet (starting at **R22**) are food-only, as computed for you in the **EcoFootGlobal** worksheet. Your food ecological footprint is computed in the **EcoFootprint** worksheet using the data you enter in the **audit** worksheet. If you enter additional information in the Ecological Footprint worksheet, the value reported on the audit page will reflect that information as well.

Click on the **GEMSFood** tab to see the primary data for the country groups used by the WHO. Countries are grouped according to similarities in diet. Thus, Argentina, Australia, Canada, Chile, New Zealand, the USA, and Uruguay are grouped together in a non-Europe, European style food consumption group. A map of all the groups is at the GEMS website
http://www.who.int/foodsafety/chem/gems/en/index1.html.

Sustainability requires a global mean ecological footprint that when multiplied by the population size, fits within the available ecological area of the planet. According to the analysis made by the Center for Sustainable Economy, there are 15.71 *renewable* global hectares available per person yet we demand, as a global community 21.91 hectares per person. It is important to recognize that some people in some countries live below that footprint while others live above it.

3.2   part 1

Please complete the following steps and answer the associated questions. Save the spreadsheet with your data, you will use it again later.

1. Enter your 5 days of food audit data in the appropriate spaces in the **audit** worksheet. Create a bar chart—clustered columns or stacked columns will be the easiest to interpret–to display your personal audit (column **U**) together with the national cluster groups. It is very important to label the chart so that any viewer can understand it. Think about this carefully as you create your chart. Save the chart and include it with the answers you turn in with this assignment.

2. Which country group diet is most similar to your diet? Is this what you expected? Do you think your result would be different if you had collected data about your own diet for a longer period of time or at a different time of year?

3. Compare the typical diet patterns in the various country groups. What patterns do you see? For example, which country groups eat relatively more and relatively less meat? Which country groups eat relatively more and relatively fewer vegetables?

3.3 part 2

4. Collect an additional 5 days of data for your personal food audit and add them to your food audit spreadsheet. The simplest way to add new data is to insert new columns into your existing spreadsheet. Click on the column label **H**, the fifth day in your original data set, and choose **Column** in the **Insert** menu. One column will be inserted immediately to the left of the column you selected (it will now be column I). Repeat this procedure to insert a total of 5 new columns. If you follow this procedure, all of the formulas in the rest of the spreadsheet will adjust automatically. Copy the day five data to the new day five column and enter your new data in the remaining columns.

   Create a chart showing your personal food audit for the 10 days of data. Use the vertical axis for the amount of each food grouping (grams per day) and the horizontal axis for the food groupings (vegetables, fruits, starchy roots, total cereals, nuts & legumes, total dairy, eggs, total meat, total fish, sugars, vegetable fat, stimulants).

5. Recreate the regional food audit chart you prepared for question (1) using your improved personal food audit.

6. Create a bar chart to compare your *food* ecological footprint with the food footprints of country cluster groups. Is your food footprint above or below the global average? How does your diet compare with the various country groups and with the United States-only average footprint?

3.4 part 3

7. Compare your diet audit result with results of everybody else in your mentor section. Are the diet profiles similar?

8. Combine the diet audit data for everybody in your mentor section using the Excel workbook titled foodaudit_group.xls from the class website. Create a chart to show the average consumption of the different food categories in your group. The average, or mean, gives us a measure of your group overall but it does not tell us anything about the range of diet patterns in your group. We need some simple statistics to do that.

   Standard deviation is a measure of the typical difference of the individual values from the mean for the whole group. The larger the standard deviation, the more different the original data are from the mean. The mean value $\overline{X}$ is the sum of the observations X_i divided by the number of observations, N:

$$\overline{X} = \frac{\sum_{i=1}^{n} X_i}{N} \tag{1}$$

   and the standard deviation s is the root of the summed squares of the differences between the observations and the mean divided by the number of observations:

$$s = \sqrt{\frac{\sum_{i=1}^{n} \left(X_i - \overline{X}\right)^2}{N}} \tag{2}$$

   A built-in function in Excel, STDEV, will calculate this value for you.

   Dividing the standard deviation by the root of the number of observations gives you a value that can be used to plot standard error bars on your chart. The bars are an easy way to show the variability in your data. Calculating the standard errors requires a few steps.

(a) Use STDEV to calculate the standard deviation for each group of daily data for each food audit category. Set this calculation up in a spreadsheet cell that makes sense. For example, you might enter the equation =STDEV(D6:M17) in cell N6; the equation =STDEV(D18:M29) in cell N18; and so on.

(b) Use the standard deviations to compute the standard error in a cell that makes sense, probably in the cell right next to the one containing the standard deviation. For example, you might enter the formula =N6/SQRT(COUNT(D6:M17)). The Excel function COUNT counts the number of cells with entries in them.

(c) What you have produced now are the standard errors for the daily food audit data for your entire group in the original units (ounces). The next step is to use these data to add error bars to your chart. To draw the full range you will draw half of the error bar above and half below the mean. This, in turn, means you need to divide the standard error in half. If you have made your chart using metric units—which is advisable—you will need to convert from ounces to grams. Again, set the calculations up in a new cell so that you can keep track of them. Room has been provided in the spreadsheet for you to do this.

Once you have calculated the standard errors in the appropriate units and divided them by 2, return to your mean food audit chart. Select the data series by clicking on the bars in the chart. This will allow you to choose **Data Series** in the **Format** menu, where you have the opportunity to add error bars to the data in your chart. Save the chart in a slide (Powerpoint or as a pdf) that can be viewed in class.

9. Create a chart to compare your group data—column Z—with the country cluster groups and save the chart in a slide (Powerpoint or as a pdf) that can be viewed in class.

4   references

BBC. (2009). The Future of Food: Sustainability and Security, `http://stats.lib.pdx.edu/proxy.php?url=http://digital.films.com/PortalPlaylists.aspx?aid=6059&xtid=41992`.

Rees, W. E. (1992). Ecological footprints and appropriated carrying capacity: what urban economics leaves out. *Environment and Urbanisation*, 4(2), 121130.

Wackernagel, M. and W.E. Rees. 1996. Our Ecological Footprint. New Society Publishers,