Quantifying Happiness

Time Needed: 4 hours

Supplies:

- Microsoft Excel or Google Sheets
- A projector and sound for showing a short video in class
- Duke TIP Math Happiness Ranking Rubric
- World Happiness Report 2017 video (2:33 minutes)
- Duke TIP Math Happiness Ranking Video: Using spreadsheets to define formulas and repeat calculations (3:23)
- Gapminder.org information

See the end of this lesson for mathematics standards correspondence.

Content Objectives: Students will know:

- The definition of absolute variables, relative variables, and of a metric
- Procedures for computing a weighted average

Skill Objectives: Students will be able:

- To convey reasoned decisions for choosing one metric over another
- To describe how to convert an absolute variable to a relative variable
- To use spreadsheets to compute weighted averages
- To convey the interpretation of calculations and quantitative reasoning to a lay audience

Essential Understandings: Students will understand:

- The importance of relative variables and standardization when making comparisons among units of analysis
- That spreadsheets are tools for organizing data and for computing formulas repeatedly
- That the quantification of real-life phenomena inevitably has limitations

Essential Questions: Students will explore:

- What is happiness, and how can one quantify it?
- In the processes of quantification and ranking, what is gained, and what is lost?

- How do we convey complex information to a general audience?

Activities

Pre-work

This lesson should follow one where you have taught how to compute weighted averages.

- Ask students to answer the following reflective questions before the next lesson:
    - How do you define happiness? Write your definition in 3-5 sentences.
    - What are the signs that people in a country are, on "average," happy? Write down at least five signs. (Note: we will later use the term "metric" to formally describe these signs.)
    - Ask students—after having written answers for the questions above—watch the video linked below in preparation for the next lesson:
- Using spreadsheets to define formulas and repeat calculations (length of 3:23)

Introduction (10 minutes)

Begin the lesson by posing the Essential Questions to students. You might even take an informal poll regarding whether they believe America is in the top five of "happiest countries"—and ask why people predict they would think that.

Explain to students that today they will use their reflections on happiness, as well as their knowledge of weighted average and spreadsheets, to rank a set of 16 countries by how happy its people collectively are. They will later convey this ranking in simple terms in the format of a news article.

To engage students in thinking about what this means, play the video linked below. After watching the video, students will pair up with another person to discuss the questions that follow, so you may want to present students with these questions first so that they can think about them as the video is playing.

- World Happiness Report 2017 (2:33)

Pair Discussions (15)

Questions for students to discuss in pairs:

- What do the makers of the video suggest constitutes happiness? How is this different or not from the "signs" you came up with for happiness?

- Two of the six ways the makers of the Happiness Report measured happiness was through generosity and freedom. What type of variable could you use to measure generosity? To measure freedom?
- From what you know about the top ten happiest countries, can you draw any conclusions about the demographics of the people? If time, you can check out data on the countries using the CIA World Factbook and see if you can find out more about the population by looking at data under People and Society.

The questions above will influence how students move forward in creating their own rankings. It is important that students recognize that quantifying things like "generosity" will inevitably capture some things while losing others. The last question is meant to spark discussion of the Eurocentric nature of the ranking.

Ask student pairs to report in to the larger class, and pose questions as needed to allow pairs to extend and clarify their thinking..

Critique of Happiness Metrics Group Challenge (30-40)

Note to students that before creating their own ranking, they will briefly discuss choices from two hypothetical students who created a ranking. Introduce three terms that will help give them language for critique:

- *Metric*: A means of measuring something. An example is that if I wanted to measure deaths from malaria, I might do this by considering the metric of number of deaths per year from malaria. This number will vary from country to country.
- *Absolute variable:* A quantity that does not account for its relative size in any way. For example, the metric of number of deaths per year from malaria does not account for the size of a country.
- *Relative variable:* A quantity that accounts for its relative size in some way. For example, the metric of number of malaria deaths per year per 1,000 people takes into account that a population's size will influence the number of deaths.

Using the same pairs from before, hand each pair *one* of the lists found on the following page. After five minutes to discuss the prompt associated with the lists, students will group with another pair that had the other list to discuss the answers to their respective prompts.

Contexts of the hypothetical students: Each list represents a hypothetical student's choice of five metrics and associated weighting to capture happiness. Note that the percentages sum to 100. Each student intends to—for a given country—add up these five numbers to assign the country a score. From there, the student will say that the highest score corresponds to the happiest country, and rank countries from there on.

Happiness Metrics and Associated Weighting

List 1	List 2
Number of malaria deaths (20%)	Percentage of females aged 15+ that are employed (10%)
Number of murders (20%)	Overall unemployment rate (20%)
Total carbon emissions (40%)	Murders per 100,000 people (20%)
Acres of forests (5%)	Cell phones per 100 people (30%)
Total population (15%)	Internet users per 100 people (20%)

Contexts of the hypothetical students: Each list represents a hypothetical student's choice of five

Prompts for the pairs to discuss:

- Do these metrics make sense to compare *across* countries?
- Does it make sense to add up these for a given country to assign that country a score?
- Are there small changes—whether in the variables themselves, or the procedure for ranking the countries—that one could make so that this process would make more sense? If so, write out what they would be.

As you circulate and support students, keep these notes in mind:

- The goal here is not for students to agree/disagree with the nature of the student's choices (e.g., choosing to focus on environment in List 1).
- Students should come to see that metrics should be relative, rather than absolute, in order to make reasonable comparisons across countries; this is an issue for List 1.
- Students should come to see that metrics should not be redundant if they are to meaningfully capture the diversity of a construct; this is an issue for List 2.
- Students should note that we cannot simply add these metrics for a given country to come up with a score. Instead, we must consider whether adding or subtracting makes sense, as well as how to change a metric so that the numbers are of the same magnitude. Common means of doing the latter include dividing each data point for a metric by the largest number in that set (to create a number between 0 and 1), as well as ranking the data points from first to last and assigning a points value based on their place within the ranking (e.g., one point for first place, two points for second place, etc.).

Spreadsheet Creation (40 minutes)

The task: Using five metrics of their choice from information found at Gapminder.org, students will work individually to rank the following 16 countries from most happy to least happy. They should make sure that their ranking

- has a weighting scheme such that not all metrics are weighted equally;
- accounts for the absolute/relative variable distinction appropriately; and
- accounts for the size differences in the variables chosen.

Note to students that their homework will involve explaining—in the format of a press release—the ranking, its formulation, and an analysis of the results. Students will need to ensure they save their work using Google Sheets or Microsoft Excel.

- Asia: China, Bangladesh, South Korea, India, Singapore, and Russia
- North America: The United States and Mexico
- South America: Ecuador, Argentina, and Columbia
- Africa: South Africa, The Democratic Republic of the Congo, and Nigeria
- Europe: Finland and Ukraine

Tip for students collecting data: If a student cannot find the metric data for a country in a given year on Gapminder, they might do a Google search for an alternate data source. If that does not work, consider using a different year that Gapminder does have data for that country (e.g., using the year 2014 instead of 2016).

Scrumming it Up (15 minutes)

Once students have taken time to complete their rankings, come together as a class to have at least two students present their work. As students are observing their peers present, have them consider the following questions:

- What makes these rankings different? What makes them similar?
- Is the mathematics used to develop the ranking logical? Why or why not?
- Would a different weighting scheme have made a significant difference in the final ranking?
- Are there regional themes that we see in the data?
- How do you believe a person in one of these countries would feel if they saw this ranking?
- What might be an appropriate set of actions to take in response to receiving a lower happiness ranking? How might these actions help?

A whole-class discussion on those questions (following the second presentation) should serve as a natural way to end the lesson.

Homework (90-120)

There are two parts of homework that students will complete individually: the first involves thinking further about their ranking, and the second involves communicating their results.

Questions for Thinking Further:

- Predict what would happen if you changed your weighting scheme by adjusting at least two of the percentages. Would the ranking likely be different? Produce the new ranking to see how your prediction fared.
- To develop your ranking, you should have adjusted the raw data for a given metric so that it would be comparable with that from other metrics. Can you think of two other ways of doing this adjustment? What are the consequences of each of these approaches?
- Search for information on the happiest and least happiest countries from your in-class ranking. What characteristics of these countries seem to be "making them" happy? Do you see evidence of happiness in the country that was least happy according to your ranking?

Communicating Results Task: Tell students that they will now prepare a 500-700 word, visually-appealing news article, that conveys the ranking itself, how the "experts" made it (i.e., the methodology), and what patterns the public should note as they read through the results. Students will not only describe the process of developing the ranking (in terms appropriate for the general public), but also will give a brief analysis of limitations and of emergent themes from the work.

Tell students, “It is imperative to keep in mind that the general public may not understand all of the mathematics you have done here, so use simple terms that you believe one might find in a news article. If there are limitations of your analysis in capturing happiness, it is important that you convey them.”

Review the Duke TIP Math Happiness Ranking Rubric and discuss the criteria as needed before students attempt the assignment.

Assessment

Students can use the rubric to give feedback on one or more of their peers' articles and you can also use it for your formal grading.

For an extension activity, consider having students find resources on countries’ data (such as using the CIA World Factbook) and extending their analysis.

Mathematics Standards Correlation

Common Core State Standards for Mathematics

Standards for Mathematical Practice
4: Model with mathematics.
5: Use appropriate tools strategically.

Content Standards
High School: Number and Quantity
A.1: Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
A.2: Define appropriate quantities for the purpose of descriptive modeling.
A.3: Choose a level of accuracy appropriate to limitations on measurement when reporting quantities.