Fermi Project Write Up

Scott Kobos

For this project, we were instructed to perform a calculation to estimate to our best ability a number that we would have little to no way of knowing the exact figures for. This was done to further our understanding of Fermi calculations and approximation. For this calculation, I estimated the percent of the human population that makes up Earth's mass. I found the mass of the human population to be about 1.2×10^{12}lbs, or 5.3×10^{11}kg, which is about 8.8×10^{-12} percent of the Earth's total mass.

To begin the process of making this estimation, I needed to find two values, first, the mass of the Earth, and second, a rough figure for the human population. For the Earths mass, Google gave me an answer of 5.9736×10^{24}kg, and for the human population, Google gave me 7.6 billion people. From there I made the assumption for the mass of the average individual by taking the average of what I thought would be the low end of 5 pounds, and the high end of 300 pounds. I took 5 pounds to be the low end because I was born at around 7 pounds, and as a twin I split a bit with my brother, so I figured we were the smaller side of things, but not the smallest. For the high end, I assumed 300 pounds because the largest person I have ever see was one of my old coaches and this man was 6'7 and built like a double-wide trailer and was just a hair under 300 pounds, and while I realize there are plenty of athletes that weigh more, out of 7.6 billion people I figured they would be an insignificant group.

In[5]:=

$$\text{Quantity}\left[\left(\frac{\left((7.6 * 10^{9})\ \left(\frac{(300+5)}{2}\right)\ (.454)\right)}{(5.9736 * 10^{24})}\right) * 100,\ \text{"Percent"}\right]$$

Out[5]= $8.80852 \times 10^{-12}\,\%$

This screenshot from Mathematica shows my formula for this estimation. The 7.6 billion people times the average weight of 152.5 pounds, multiplied by .454 to convert from pounds to kilograms, then divided by the total mass of the Earth of 5.9736×10^{24}kg, we get that the human race makes up 8.8×10^{-12} percent of the mass of Earth.

While an exact value for the weight of the human population isn't readily available, I Googled the average weight of a person to be 62kg (137 pounds), a figure found by the London School of Hygiene and Tropical Medicine in 2012. I also found the most up to date figure of the human population to be 7,650,381,300 according to Worldometers. As can be seen in the Mathematica screenshot below, that would give us a weight of 4.74×10^{11}kg, and a percentage of 7.94×10^{-12}. Then, performing a percent error calculation I found that my estimation was 10.8%, which is shockingly accurate for an estimation.

In[7]:=

$$\text{Quantity}\left[\left(\frac{((8.8 * 10^{-12}) - (7.94 * 10^{-12}))}{(7.94 * 10^{-12})}\right) * 100,\ \text{"Percent"}\right]$$

Out[7]= $10.8312\,\%$

While working to improve my understanding of the Fermi calculation and estimation, I estimated the percent mass the human population contributes to the total mass of Earth and did so much more accurately than I would have predicted. At roughly 8 trillionths of a percent of Earth's total mass, it is hard to understand how little that really is. To put in perspective, the area of one trillion-dollar bills would be about the size of the state of Delaware, so as large as that is, we are that small of a percent of the Earth's total mass.