Order-of-Magnitude Estimation
Baby Weight (Level 3)

The Question

How many babies are born in the US each year with a weight greater than 10 pounds?

Background

The US population is continually changing, with a large number of babies born each day. Some of these are heavier than average, but how many?

Guiding Questions

Here are some things you may need to consider:

- How many women are there?
- What is the typical range in ages during which women have children?
- What is the average and spread (standard deviation) in baby weights?
- Do you know any people who know others with babies over 10 pounds?

The Solution

First we need to estimate the number of babies born each year. If there are about 150 million women in the US (roughly half the population), their ages are distributed uniformly, the typical age for women to have children is between 20 and 30 years old, the average life span is 100 years (rounded up), and 75% of women have children, then during a year the number of new babies is:

$$N_{\text{babies}} = 1.5 \times 10^8 \times \frac{10}{100} \times 0.75 = 1 \times 10^7 \tag{1}$$

Now, this is over the 10 year childbearing period, so dividing by 10 we get $N_{\text{babies}} = 1 \times 10^6$. An average baby weight is around 7 pounds, with a standard deviation around 2 pounds. So a 10 pound baby is roughly two standard deviations from the mean, meaning that about 1% of babies are either above 10 pounds (1% is about half of 3%, the number of babies

more or less than two standard deviations from the mean weight). Taking one percent of the total number of babies per year:

$$N_{¿10\text{lbs}} = 0.01 \times 1 \times 10^6 = 1 \times 10^4 \tag{2}$$

There are about 10 thousand babies born over 10 pounds each year.

Another way to approach this, if you have access to a reasonable sized group of people who know others who have had children, is to poll them. For example, in our workshop, of the 10 or so people there, we estimated that each of them knew about 100 babies (total over their lifespan). This is 1000 babies, and about 3 people know of a 10 pound baby, or about 1%. Another way to get the birth rate is to assume the population is steady state, so the birth rate is just the current population divided by the average population:

$$N_{\text{babies}} = \frac{3 \times 10^8}{100} = 3 \times 10^6 \tag{3}$$

If 1% of these babies are over ten pounds, we get 30 thousand babies. This is only a factor of three different from the previous estimate.

Education Standards

This OoM Estimation problems meets the following standards in **bold**:
Next Generation Science Standards (NGSS)*:*

- Physical Sciences
  - Matter & Its Interactions
  - Motion and Stability: Forces and Interactions
  - Energy
  - Waves and Their Applications in Technologies for Information Transfer
- Life Sciences
  - From Molecules to Organisms: Structures and Processes
  - Ecosystems: Interactions, Energy, and Dynamics
  - Heredity: Inheritance and Variation of Traits
  - **Biological Evolution: Unity and Diversity**
- Earth and Space Sciences
  - Earth's Place in the Universe
  - Earth's Systems
  - Earth and Human Activity
- Engineering, Technology, and Applications of Science
  - Engineering Design

Common Core Standards (CSS)*:*

- **Counting & Cardinality**
- **Operations & Algebraic Thinking**
- **Numbers & Operations in Base Ten**
- **Number & Operations — Fractions**
- **Measurement & Data**
- Geometry
- Ratios & Proportional Relationships
- The Number System
- Expressions & Equations
- Functions
- **Statistics & Probability**