

Order-of-Magnitude Estimation

Club Count (Level 2)

The Question

How many amateur astronomy clubs in the US have their own observatory?

Background

There are numerous astronomy clubs scattered throughout the country, of varying size and participation depending on where they are located. Most of these rely on members bringing and sharing their personal telescopes to events for all members of the club to use. But some have the luxury of their own dedicated observatories! How many such clubs are there?

Guiding Questions

Here are some things you may need to consider:

- How many towns are there in the US?
- How big does a town need to be to host a club? Two clubs? More?
- How likely is it that a club can afford (and has a place for) its own observatory?

The Solution

We first need to determine the number of towns in the US. We can estimate this by dividing the number of people by the typical population of a town:

$$N_{\text{town}} = \frac{N_{\text{people}}}{N_{\text{people/town}}} = \frac{3 \times 10^8}{3 \times 10^4} = 10^4 \text{ towns} \quad (1)$$

We can estimate that maybe 10% of these towns are large enough to host an astronomy club (f_{size}), and of these 25% actually do (f_{astro}). Finally, only 20% of these are able to own their own observatory (f_{observ}). Therefore:

$$N_{\text{observatories}} = N_{\text{towns}} \times f_{\text{size}} \times f_{\text{astro}} \times f_{\text{observ}} = 10^4 \times 0.1 \times 0.25 \times 0.2 = 50. \quad (2)$$

You can check your answer here: <http://www.go-astronomy.com/astro-club-search.htm>.

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**