

Order-of-Magnitude Physics – Problem Set 1

Due in class.

Do any 1 of the problems + the last question (make up your own question).

You are free to do more if you like; answers will be graded.

Guidelines:

- If a question is ill-defined, it is your responsibility to define it.
- Please cite any resources used. If you get the information off the web, cite the website.

Quote of the week:

“I believe it is preferable in environmental analysis to develop relatively simple, analytically tractable models, rather than complex ones requiring truckloads of parameters. The advantage of being able to ‘tinker’ mentally with a simple, penetrable model, and thus explore the consequences of a variety of assumptions, outweighs in most cases the greater realism that might be attained with a complex model.” — John Harte, from the Preface of *Consider a Spherical Cow*

Problem 1. Thalassaemia

As reported by Judith Tan of Singapore’s Straits Times, Dec 7 2005:

Thalassaemia is an inherited blood disorder. Those who have thalassaemia-major have a shortage of hemoglobin and need a blood transfusion every month to stay alive. Victims do not live past childhood unless they receive a bone marrow transplant.

Those who have thalassaemia-minor carry the gene but do not express it. They can pass the gene to their children but otherwise lead normal lives. The rules for passing the gene are the usual ones: if both parents have thalassaemia-minor, their children have a 25% chance of having thalassaemia-major, a 50% chance of having thalassaemia-minor and a 25% chance of not carrying the gene at all. If only 1 parent has thalassaemia-minor, offspring have a 50% chance of having thalassaemia-minor and 50% chance of not carrying the gene at all.

Worldwide, about 10^5 children are born each year with thalassaemia-major.

What is the probability that you have thalassaemia-minor?

Problem 2. Put Your Money Where Your Mouth Is

Estimate the sizes (in dollars) of the following enterprises in the United States:

- U.S. Government
- K–12 Education
- Entertainment (excluding sports)
- Sports
- Restaurant Industry

Problem 3. Proposition 13

Proposition 13, written into California’s State Constitution in 1978 as Article 13A, limits property taxes to 1% of the assessed value of the property. The assessed value of the property can only change when the property changes ownership. Otherwise, the assessed value remains locked at whatever its value was in 1975. These property taxes are collected by local town and city governments.

Prior to Prop 13, the property tax rate averaged 3%.

Prop 13 has been blamed by some people for a variety of problems in California, perhaps most notably the decline in quality of K–12 education. Before Prop 13, California ranked among the nation’s top 5 states for achievement in K–12. Today the state is ranked among the bottom 10 (47th, to be exact).

Put aside the never-ending debate of whether Prop 13 really is to blame for California’s decline into ignorance and incompetence, and just ask two questions: How much money derived purely from city property taxes is spent per child for education in Berkeley today? In an alternate universe where Prop 13 did not pass and things stayed as they were in 1978, how much more would it spend today?

Problem 4. The Slow and the Furious

How much rubber is liberated by cars each year driving down Highway 80 from Berkeley to the Maze?

Problem 5. Ask Your Own Question

Ask an OOM question of your own. You don’t have to answer it.