

Trip to New York City

Part 3 - FERMI problems

Introduction

Enrico FERMI (1901-1954) was a physicist who built the prototype of a nuclear reactor and worked on the Manhattan Project to develop the first atomic bomb. He also remains famous because of "FERMI problems".

The following document comes from :

https://www.grc.nasa.gov/www/k-12/Numbers/Math/Mathematical_Thinking/fermis_piano_tuner.htm

Fermi's Piano Tuner Problem

As a lecturer, Enrico FERMI used to challenge his classes with problems that, at first glance, seemed impossible. One such problem was that of estimating the number of piano tuners in Chicago given only the population of the city. When the class returned a blank stare at their esteemed professor, he would proceed along these lines:

1. From the almanac, we know that Chicago has a population of about 3 million people.
2. Now, assume that an average family contains four members so that the number of families in Chicago must be about 750,000.
3. If one in five families owns a piano, there will be 150,000 pianos in Chicago.
4. If the average piano tuner
 - (a) serviced four pianos every day of the week for five days
 - (b) rested on weekends, and
 - (c) had a two week vacation during the summer,
5. then in one year (52 weeks) he would service 1,000 pianos. $150,000 / (4 \times 5 \times 50) = 150$, so that there must be about 150 piano tuners in Chicago.

This method does not guarantee correct results; but it does establish a first estimate which might be off by no more than a factor of 2 or 3—certainly well within a factor of, say, 10. We know, for example, that we should not expect 15 piano tuners, or 1,500 piano tuners. (A factor of 10 error, by the way, is referred to as being 'to within cosmological accuracy.' Cosmologists are a somewhat different breed from physicists, evidently!!!)

Some FERMI problems

Choose a problem among the following list, discuss it and estimate a value as an answer.

1. What is the total length of the streets in Manhattan?
2. How many apartments could you build in the Empire State Building?
3. How many spoons could you make with the metal of the Statue of Liberty?
4. How many fast-foods are located in New-York City?
5. How many taxicabs are available at 6PM in Manhattan?
6. If you fill the Madison Square Garden with beer, how many days Homer Simpson will need to drink it?
7. How many cars can be built with the metal of the Chrysler Building?
8. If you receive a dollar for each step you make, how many times do you need to walk around Central Park to be a millionaire?

Your turn to play!

Create a FERMI problem of your own and give it to your classmates (and your teacher!), who will have to solve it.