

Some maths problems for the average citizen

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Abstract

We have been always surprised by the inability of many students to adequately treat some problems of everyday life that only require of elementary mathematics (meanwhile they can solve problems with a much more complicated background). Obviously, the reason is that they haven't been trained in facing these sorts of problems. We shall give an overview of some of the typical mathematical problems that an average citizen needs to know how to face. In most of them a CAS helps (avoiding the tedious computations), but cannot solve the problem by itself. But we believe that CAS can be key in the process of experimenting with these problems in order to achieve the necessary skills for solving them in real life.

Keywords

Basic Mathematics, Curriculum, CAS

1 Introduction

The first author has taught at the School of Statistics, the School of Education and the School of Mathematics of the Universidad Complutense de Madrid for more than 25 years. His students have ranged from freshmen to Ph.D. students.

The second author has been a mathematics high school teacher for more than 35 years. He has also taught maths at different schools of the Universidad de Extremadura.

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An example is percentages. The first author is now teaching a subject entitled "Elementary mathematics with computer" to 2nd year pedagogy degree students (in it, elementary mathematical problems are treated using CAS and DGS). While most of these students could calculate a discount on a price, not all could correctly solve a similar problem: write a computer program that, given the total diameters of two tires, decides whether the new tire differs by more than 3 % w.r.t. the old one (the obstacle was mathematical, not computer related). Moreover, they were not sure if adding a tax plus a discount to a price (both expressed as percentages) did commute. Meanwhile, they use SPSS in complicated statistical studies regarding pedagogical issues.

In ancient cultures mathematical research was mainly focused on topics with a direct application: plane geometry (for surveying and architecture) and astronomy (for religious reasons and navigation), although this knowledge was not intended for the average citizen. But these interests have been changing in the last thousand years.

Many of the problems that could now be of "general interest" have an economical background, and many require the use of elementary physics (mainly physical units). Some examples can be found afterwards.

2 Some of the examples detected

Examples of some of the topics that we have detected that could be labeled as *important* for an average citizen (*essential skills*) follow. We have only included situations that we believe are not correctly covered (in practice) by the Spanish educational system.

Economy:

- Do you save money if you change your present (perfectly working) refrigerator by an A++ one?
- According to your present telephone invoice, should you migrate to another company with a completely different way to bill the phone calls that looks much cheaper?
- Should you change your present car (in its midlife) by a much more ecological new hybrid for economical reasons?
- Are low consumption bulbs worth their higher price?

Nevertheless, there are many other mathematical topics related to real life situations. Some examples follow.

Divisibility:

- My living room is $5.40m \times 4.20m$ and I would like to cover the floor with tiles but I don't have a tile cutting machine. Which is the maximum tile size that I can use?

Dilating areas and volumes and scales:

- This frustoconical drinking glass looks a bit too small. I'll buy this other one that is 1.3 times higher and wider. It is just a bit bigger than the other one, right?
- The rooms in this house floor plan look huge. Is the furniture represented in the house floor plan at the correct scale?

Derivatives (or increments):

- I can find in a local newspaper that "Unemployment has decreased its growth" meanwhile another paper (of a different political tendency) publishes the same day that "Unemployment has grown". Can we be assured that at least one of them is lying?

Combinatorics:

- In a certain lottery there are 100 numbers. The probability to win if I buy one day one number is 1%. If I buy a ticket today and a ticket tomorrow the probability to win is $1\%+1\%=2\%$. OK?

Cardinal of the union / Probability of the union:

- In this class there is 45% males and 30% people from Andalusia. Do you agree that one way or another we cover 75% of the students?

Negative exponential:

- Why should I take antibiotics (and many other drugs) following a strict dosage schedule?
- I know that Carbon-14 is an unstable isotope of Carbon, but how does Carbon-14 dating work?

Correlation:

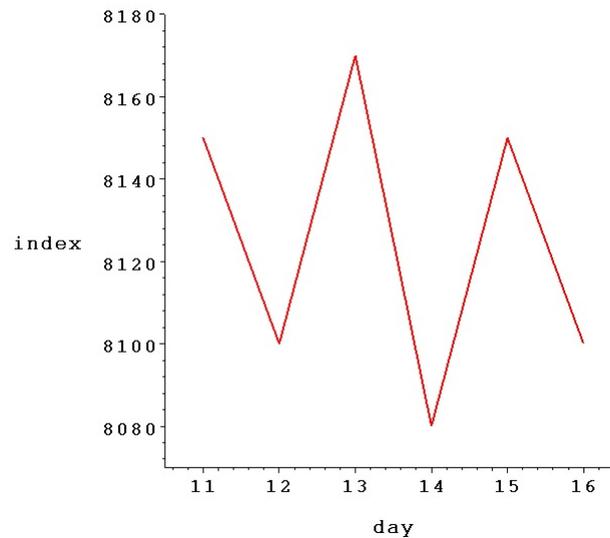
- There is no "functional relation" between the height and weight of people, but is there any other kind of "relation"?

Normal distribution:

- How can shops decide which shoe sizes should they have in stock?
- For what range of student IQ is the curriculum designed?

Interpretation of graphic representations:

- In the figure below the evolution of a certain stock exchange index along one week is represented. It reflects huge economical movements, doesn't it?



Partial ordering:

- According to a Spanish saying: “All comparisons are obnoxious” (“Todas las comparaciones son odiosas”).

3 Remark

Once the first draft of this Extended Abstract was already prepared, one of the main Spanish newspapers published an impressive report about the failures in elementary mathematics (and other subjects) of students with a degree in Primary School Teaching during their competitive recruitment examinations in the Madrid region¹. The exercise with the worst results (7.09% of the answers were correct) was an elementary example about time, weight and area unit conversion.

4 Conclusions

Taking into account that most citizens are not mathematicians, we believe that this sort of topics/problems, closer to everyday life, should be included into the curricula in order to provide a “more useful” mathematics education.

Moreover, the computations required by many of these problems can be bypassed using a CAS (a CAS can even carry units along with the computations).

An issue to be discussed is whether it would be better to treat these topics/problems within the traditional curricula or in separate workshops.

¹Pilar Álvarez, Maestros suspensos en primaria (in Spanish). El País, March 13th 2013 http://sociedad.elpais.com/sociedad/2013/03/13/actualidad/1363202478_209351.html.

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