### Approximations and errors

**ARITHMETICA**

01

### **Absolute errors and relative errors**

Whenever a measurement or estimation of a quantity is made, an error is made. We

distinguish two types of errors:

The absolute error, ε, is defined as the positive difference between the real value, $\overbar{x}$, of a

certain magnitude and the estimated value, x*i*.

ε = | $\overbar{x}$ – x*i* |

Sometimes the absolute error appears behind the estimated value and preceded by the ± sign,

indicating the margin in which the real value is found.

The relative error, ε*r*, is defined as the quotient of the absolute error and the real value, $\overbar{x}$, of the magnitude. It can express in % or in as much as 1.

$$ε\_{r}=\frac{\left|\overbar{x}-x\_{i}\right|}{\overbar{x}}$$

Example: it has been estimated that there are 160 coins in a purse, but counting them one by one has found that there really are only 156.

Absolute error: ε = | 156 - 160 | = 4 coins

Relative error: $ε\_{r}=\frac{4}{156}=0.026=2.6\%$

Calculate the absolute error that is committed when estimating 15 minutes a time interval that really lasts 16 and a half minutes.

**1**

It is estimated that in an anthill there are 2,000 ants, with an error of 15%. What is the maximum number of ants expected in the anthill? And the minimum?

**2**

The distance from Earth to the Moon has been calculated and a result of 385,000 km has been obtained. However, a laser has determined that the actual distance is 357,000 km. What is the relative error that has been made in performing the calculations?

**3**

It is estimated that the height of a building is between 18.5 m and 19.1 m. What are the absolute and relative errors of this estimate?

**4**

The volume of a deposit is estimated at 357.5 L, with a margin of error of half a liter. What is the relative error of this estimate?

**5**

Juana will receive a bonus of € 150 this month, which is added to her salary, stipulated at € 1,200. Juana calculates that this bonus represents an increase in her income of 15%. What error do she make when estimating?

**6**

 A plate scale has a maximum precision of 1/4 kg. This scale is used to weigh a certain amount of nuts, to make a cake, and you get a reading of 6 kg and a quarter. What can we expect to be the real weight of the nuts? What is the percent error?

**7**

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