ERRATA and ADDENDA

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Experimentation: An Introduction to Measurement Theory and Experiment Design
D. C. Baird, Third Edition, 1995, Englewood Cliffs, NJ: Prentice Hall

Page 23: Addendum -- Note at the very bottom of the page that if z = x/y (e.g., a = 1 and b = -1 in equation $z = x^a y^b$), then

$$\frac{\partial z}{z} = \frac{\partial x}{x} - \frac{\partial y}{y}$$

This solution is important for understanding the concept presented on pages 97-98.

Page 35: Erratum -- The standard deviation given in equation (3-2) should be written as follows:

$$\sigma = \sqrt{\frac{\Sigma(\bar{x} - x_i)^2}{N}}$$

where σ is taken as the population standard deviation (universe standard deviation as stated by Baird). By convention, population statistics are always written using lower-case Greek letters. Sample statistics of a population are always written using lower-case English letter. So, s, would represent the standard deviation of a sample of the population (c.f., page 45 of text). Note that the equation for a sample standard deviation is similar to the above equation, with the exception of N-1 in the denominator. See page 44, equation (3-6). Sample standard deviations are always larger than population standard deviations.

Page 44: Addendum -- The wording on the top of page 44 is atrocious. The author has a very roundabout way of saying that equation (3-6) represents the sample standard deviation. Equation (3-6) appears in conformance with the above naming convention.

Page 97: Addendum -- Given the relationship,

$$g = \frac{4\pi^2 \ell}{T^2}$$

then the relative error in g (see addendum for page 23) would be given by:

$$\frac{\partial g}{g} = \frac{\partial \ell}{\ell} - 2\frac{\partial T}{T}$$

Now, a relative error of 1% in both ℓ and T^2 could result in a relative error of 3% in g as a worst-case scenario when relative errors in ℓ and T^2 are in opposite directions. That is,

$$\frac{\partial g}{g} = -0.01 - 2(0.01) = -0.03 = -3\% \quad \text{or} \quad \frac{\partial g}{g} = +0.01 - 2(-0.01) = +0.03 = +3\%$$

If the relative errors of ℓ and T^2 are in the same direction, then the relative error in g would be less than ±3% in this particular case due to the negative sign. When absolute errors are summed, that's when maximum possible error is achieved.

Page 101: Addendum -- When reaching the bottom of the page, you might find the following relationship helpful:

$$M^0 L^1 T^{-1} = M^{a+b} L^{a-b} T^{-2a}$$

from which one derives the following simultaneous equations by comparing the exponents of like terms:

$$\begin{aligned} 0 &= a + b \\ 1 &= a - b \\ -1 &= -2a \end{aligned}$$

Each student will develop his or her own method for performing dimensional analysis. I personally like to use physical units instead of terms such as *M, L,* and *T.* I might have written the above equation substituting kg for *M,* m for *L,* and s for *T.*

Chapter 6: Addendum -- Function finding using graphical analysis can be done either of two ways. First, a person might choose to first "linearize the data" and then use a straight-line graphical analysis. That is, if one chooses to plot ℓ versus T^2 for a pendulum, one might end up with a straight line of data points to which linear regression might be applied. Second, a person might choose to do a non-linear regression after plotting ℓ versus *T.*

One needs to be very careful when trying to interpret the correlation coefficient. Upon first reading of this chapter one might get the impression that one can use the correlation coefficient to compare experimental and theoretical results. This is not so. The only purpose behind the correlation coefficient is to determine if there is any degree of relationship between two variables. When one is attempting to determine the degree to which experimental and theoretical models correspond (e.g., whether or not there is a statistically significant difference between an experimental model and experimental data), one should use χ-square analysis.

Percent error and percent difference are two things that might have been treated in Chapter 6, but were not. Consider the following definitions for percent error and percent difference where *E* represents the experimental value and *T* represents the theoretical value:

$$\%\_error = \frac{|E - T|}{T} * 100$$

$$\%\_difference = \frac{|E_1 - E_2|}{\frac{1}{2}(E_1 + E_2)} * 100 = \frac{2|E_1 - E_2|}{E_1 + E_2} * 100$$

Note that the percent difference is merely the difference between to experimental values divided by the average of the two values.