Exercises on manipulating means and standard deviations

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1. Show that for any data set $\{x_i\}_{i=1}^n$,

a. $\displaystyle\sum_{i=1}^{n}(x_i - \bar{x}) = 0.$

b. $\displaystyle s^2 = \frac{1}{n-1}\left(\sum_{i=1}^{n} x_i^2 - \frac{1}{n}\left(\sum_{i=1}^{n} x_i\right)^2\right).$

2. Prove that if a data set $\{x_i\}_{i=1}^n$ has mean $\bar{x}$ and standard deviation s_x, then

a. if $y_i = x_i + h$, then $\bar{y} = \bar{x} + h$ and $s_y = s_x$;

b. if $y_i = cx_i$, then $\bar{y} = c\bar{x}$ and $s_y = cs_x$;

c. if $z_i = \frac{x_i - \bar{x}}{s_x}$, then $\bar{z} = 0$ and $s_z = 1$.

3. A sample of 20 resistors yielded a mean value of $44.6\,\Omega$ and a standard deviation of $1.3\,\Omega$.

a. If one more resistor of $52\,\Omega$ is added to the sample, what are the mean and standard deviation of the 21 resistors?

b. If the original sample of 20 resistors is combined with a sample of 10 resistors that had a mean of $48.3\,\Omega$ and standard deviation of $1.9\,\Omega$, calculate the mean and standard deviation of the combined sample of 30 resistors.