

Biomedical Instrumentation and Measurement

□ Average:

❖ Arithmetic mean (算數平均數)

✓ It is called simply the mean

$$\bar{X} = \frac{X_1 + X_2 + X_3 \dots + X_n}{n}$$

$$\bar{X} = \frac{125}{28} = 4.46$$

❖ Median (中間值)

✓ It is middle value in the data set

$$X_{mid} = mid[X_1, X_2, X_3 \dots, X_n]$$

$$X_{mid} = \frac{4 + 5}{2} = 4.5$$

❖ Mode

✓ It is defined as the most frequentl occurring value

$$X_{mode} = 5$$

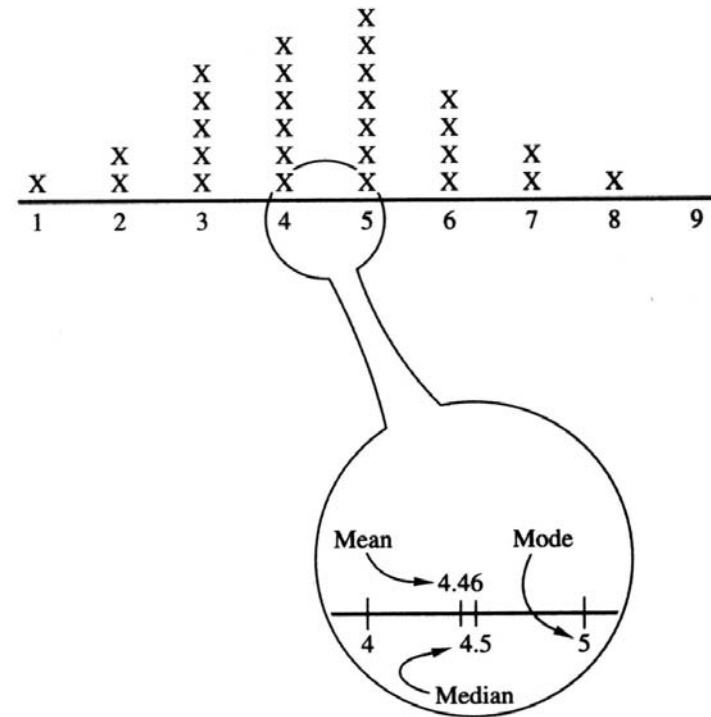


Figure 3-1

Data distribution (X chart) for 28 data values.

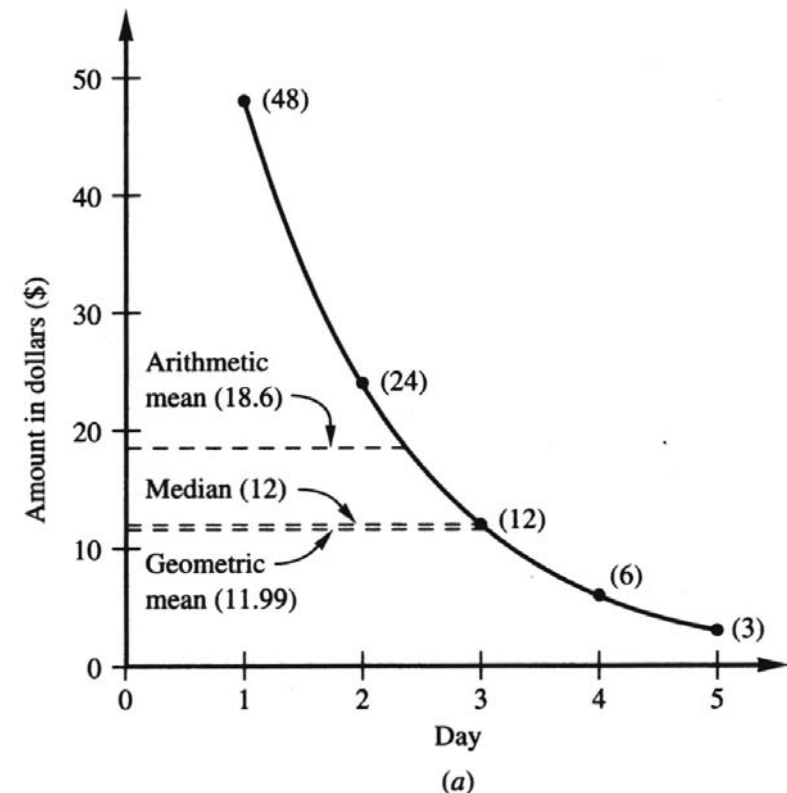
Source: Carr, J. J., *Elements of Electronic Instrumentation and Measurement*, (EEIM), Prentice Hall (Englewood Cliffs, N.J., 1996). Subsequent source notes will specify EEIM only.

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- When the data is perfectly symmetrical(對稱), then the mean, median, and mode are the same number
- But in other situation the mean is not useful, especially if one or two data points have very large or very small values compared with the rest of the data
- ☛ The data is highly asymmetrical(不對稱)

TABLE 3-6 TABULATION OF GEOMETRIC MEAN (EXAMPLE)

Day	Amount (\$)	Amt spent	Amt remaining
1	48	24	24
2	24	12	12
3	12	6	6
4	6	3	3
5	3	1.50	1.50



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□ The data is highly asymmetrical(不對稱)

- ❖ Geometric mean (幾何平均)
- ❖ Harmonic mean (H.M.) (調和平均)

☛ Arithmetic mean (算數平均數)

$$\bar{X} = \frac{48 + 24 + 12 + 6 + 3}{5} = 18.6$$

☛ Geometric mean (幾何平均)

$$\begin{aligned} & \frac{\log 48 + \log 24 + \log 12 + \log 6 + \log 3}{5} \\ & = \frac{5.395}{5} = 1.079 \end{aligned}$$

$$X_{geo} = \log^{-1}(1.079) = 11.99$$

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2	24	12	12
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□ The logarithmic chart will translate to straighten

$$X_{\log} = \log[X_n]$$

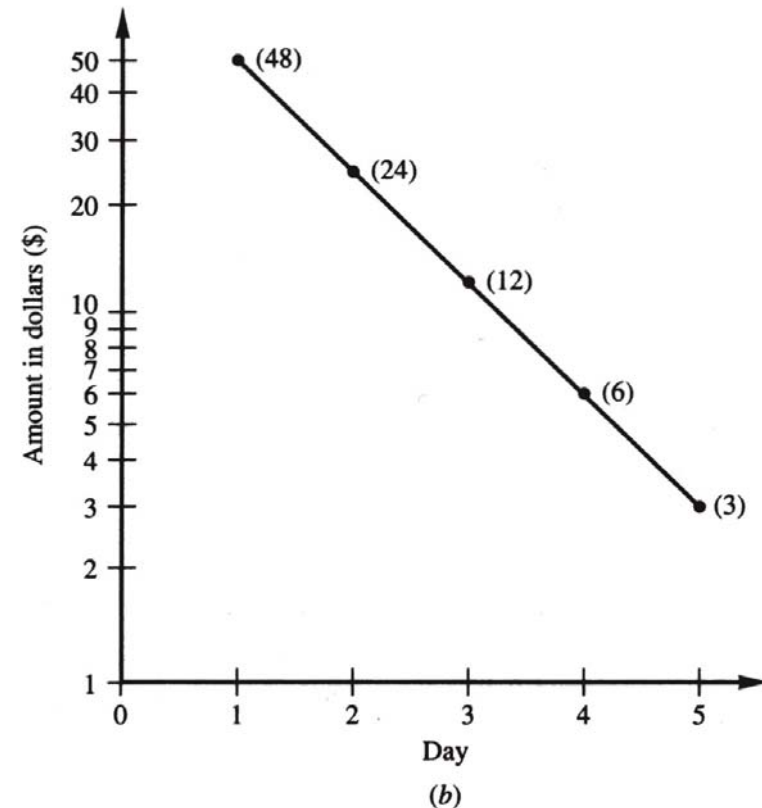
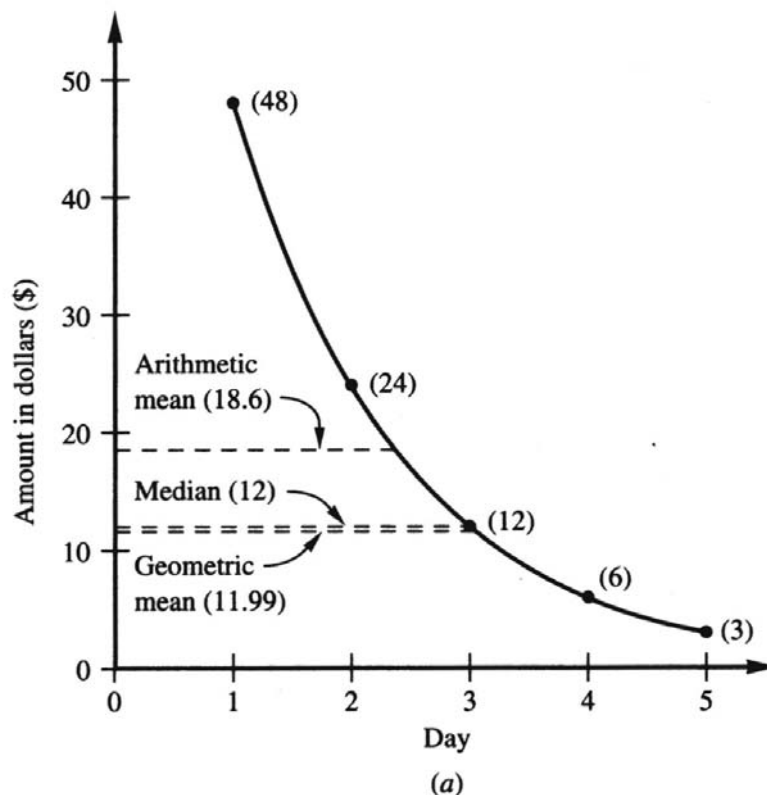


Figure 3-2
(a) Linear graph of data, (b) semilogarithmic graph of same data. Source: EEIM.

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□ H.M. reflects the fact that it is the reciprocal (倒數) of the mean of the reciprocals of the data

☛ Arithmetic mean (算數平均數)

$$\bar{X} = \frac{2.29 + 1.98 + 1.56 + 2.04}{4}$$

$$= \frac{7.87}{4} = 1.9675$$

☛ Harmonic mean (H.M.) (調和平均)

$$X_{H.M.} = \frac{1}{\left(\frac{1}{2.29} + \frac{1}{1.98} + \frac{1}{1.56} + \frac{1}{2.04} \right)} = 1.929$$

TABLE 3-7 TABULATION OF HARMONIC MEAN (EXAMPLE)

Week	Price (\$/doz)
1	2.29
2	1.98
3	1.56
4	2.04

$$X_{H.M.} = \frac{1}{\left(\frac{1}{X_1} + \frac{1}{X_2} + \frac{1}{X_3} + \dots + \frac{1}{X_n} \right)}$$