Figure 5. The one dimensional histogram: The histogram of the image in (a) may be represented as a table (b) or as a plot (c).

\[ \sum_0 h(v) = n_a \quad \text{(TOTAL NO. OF PIXELS)} \]

Often the histogram is normalized:

\[ H(v) = \frac{h(v)}{n_a} \quad \text{NUMBER OF PIXELS FOR A GIVEN INTENSITY, } v \]

\( H(v) \) is analogous to the probability density function of statistics, and may be considered as the probability of a pixel having value \( v \). In this case,

\[ \sum_0 H(v) = 1 \]

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Figure 4.10  Histograms corresponding to four basic image types.  

See Fig. 3.15, p. 90, 2nd Edition.
For two bands and a specified area, we may also compute a two dimensional table \( h(v,w) \) giving the number of pixels having value \( v \) in the first band and value \( w \) in the second. This is called the two dimensional histogram, or sometimes the scatterplot or scatterdia gram, of the two bands. Examples are shown in Figure 6. The domain of \( h(v,w) \) is the rectangular region of the plane bounded by \((0,v_{\text{max}})\) and \((0,w_{\text{max}})\). For 8 bit pixels, this is the region \((0,255) \times (0,255)\).

Figure 6. The two dimensional histogram \( h(v,w) \): in (a), the plot is shown in perspective with \( h(v,w) \) the height at point \((v,w)\), and in (b), \( h(v,w) \) is given by the color in the two dimensional \( v \times w \) plane. For the example bands shown in (c), the 2d histogram is given in (d).
Not a true Probability Density Function

FIGURE 5.2 Some important probability density functions.
FIGURE 5.3 Test pattern used to illustrate the characteristics of the noise PDFs shown in Fig. 5.2.
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**FIGURE 5.4** Images and histograms resulting from adding Gaussian, Rayleigh, and gamma noise to the image in Fig. 5.3.
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Figure 5.4 (Continued) Images and histograms resulting from adding exponential, uniform, and impulse noise to the image in Fig. 5.3.