Chapter 21 Figures From

MATHEMATICAL METHODS for Scientists and Engineers

Donald A. McQuarrie

For the Novice Acrobat User or the Forgetful

When you opened this file you should have seen a slightly modified cover of the book *Mathematical Methods for Scientists and Engineers* by Donald A. McQuarrie, a menu bar at the top, some index markers at the left hand margin, and a scroll bar at the right margin.

Select the **View** menu item in the top menu and be sure **Fit in Window** and **Single Page** are selected. Select the **Window** menu item and be sure **Bookmarks** and **Thumbnails** ARE NOT selected.

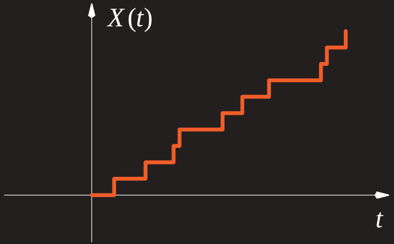
You can and probably should make the top menu bar disappear by pressing the function key F9. Pressing this key (F9) again just toggles the menu bar back on. You may see another tool bar that is controlled by function key F8. Press function key F8 until the tool bar disappears.

In the upper right hand corner margin of the window containing this text you should see a few small boxes. DO NOT move your mouse to the box on the extreme right and click in it; your window will disappear! Move your mouse to the second box from the right and click (or left click); the window containing this text should enlarge to fill the screen. Clicking again in this box will shrink the window; clicking again will return the display to full screen.

The prefered means of navigation to any desired figure is controlled by the scroll bar in the column at the extreme right of the screen image. Move your mouse over the scroll bar slider, click, and hold the mouse button down. A small window will appear with the text "README (2 of 27)". Continuing to hold down the mouse button and dragging the button down will change the text in the small window to something like "21.4 (7 of 27)". Releasing the mouse button at this point moves you to Figure 21.4 of Chapter 21. The (7 of 27) indicates that Figure 21.4 resides on page 7 of the 27 pages of this document.

ANIMATIONS

There are no animations in this chapter at this time.



$X(t)$
t

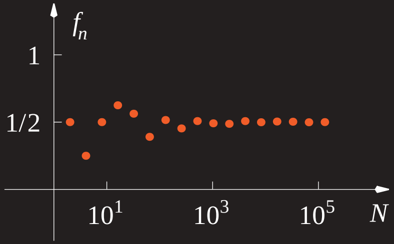


Figure 21.1
A computer simulation of the tossing of a fair coin. The graph shows the ratio of the number of heads to the number of tosses as a function of N, the number of tosses.

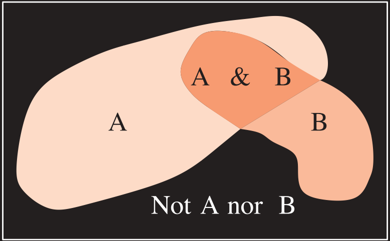


Figure 21.2
A Venn diagram, which illustrates the probability space of the outcomes of A and B.

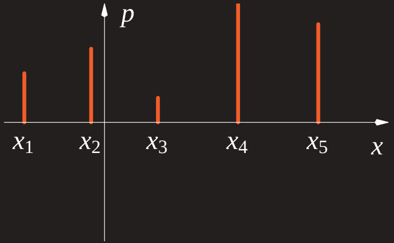


Figure 21.3
The discrete probability frequency function, or prabability density, $p(x_j)$= Prob$\{X = x_j\}$.

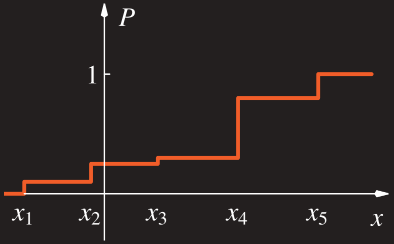


Figure 21.4
A cumulative distribution function $P(x) = \text{Prob}\{X \le x_j\}$ corresponding to the frequency function shown in Figure 20.3.

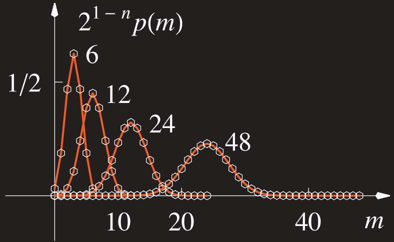


Figure 21.5
The binomial distribution plotted against m for several values of n (6, 12, 24, 48). Note that the distribution becomes increasingly bell-sphaped as n increases.

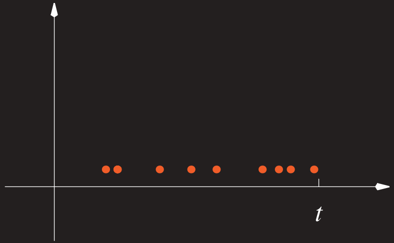


Figure 21.6
n points distributed randomly over the interval $(0, t)$.

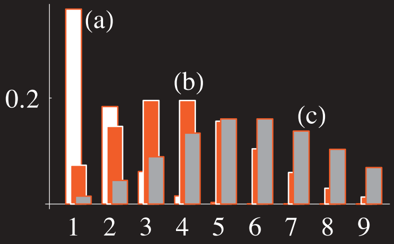


Figure 21.7
The Poisson distribution plotted against m for several values of (a) $a = 1.0$ (white), (b) $a = 4.0$ (color), (c) $a = 6.0$ (gray).

Figure 21.8
(a) A Gaussian distribution with zero mean and unit variance. (b) The corresponding cumulative distribution function.

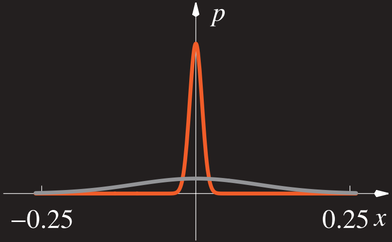


Figure 21.9
A gaussian distribution with zero mean and $\sigma = 0.01$ (color) and 0.10 (gray).

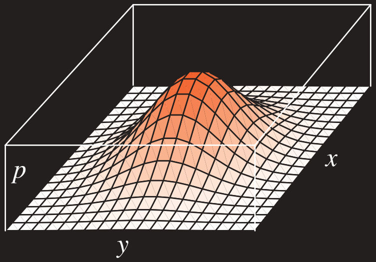


Figure 21.10
A two-dimensional Gaussian distribution plotted against x and y for $\mu_x = \mu_y = 0$ and $\sigma_x = \sigma_y = 1$.

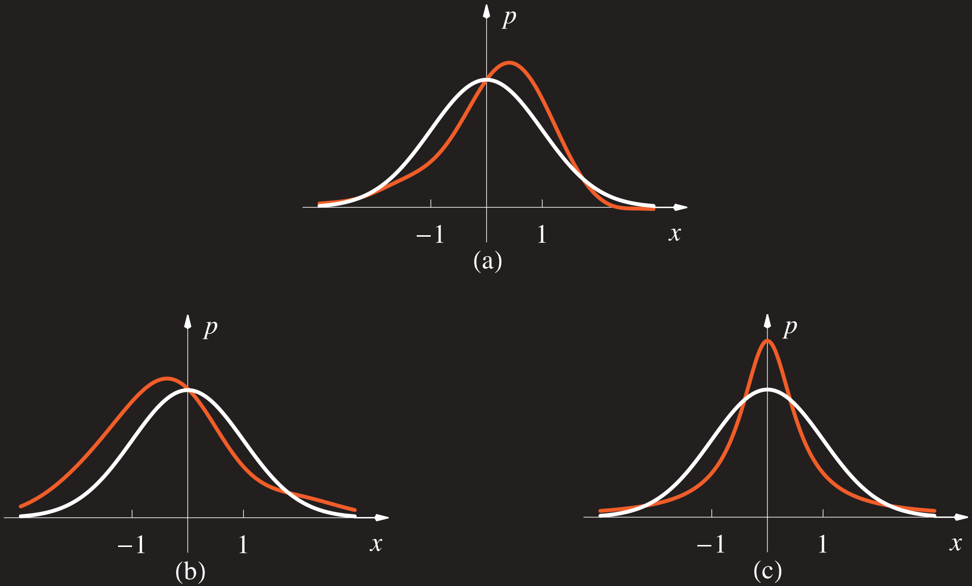


Figure 21.11
An illustration of (a) a distribution skewed to the high side of the mean, (b) a distribution skewed to the low side, and (c) a distribution with a high degree of peakedness.

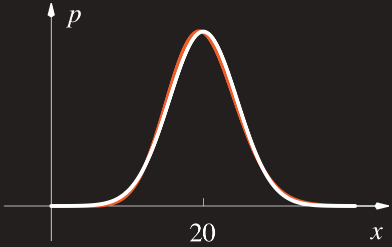


Figure 21.12
The envelope of a Poisson distribution with $a = 20$ compared to a normal distribution with $\mu = 20$ and $\sigma^2 = 20$.

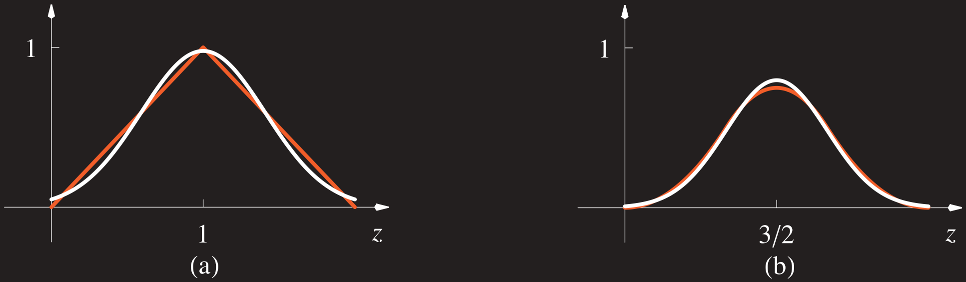


Figure 21.13
The exact density function (color) and its Gaussian approximation (black) for the sum of (a) two independent uniformly distributed random variables and (b) three independent uniformly distributed random variables.

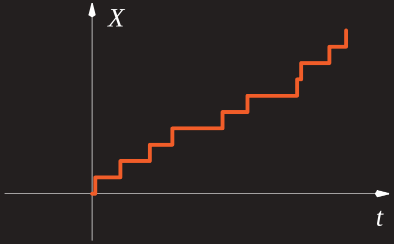


Figure 21.14
A computer generated illustration of a counting process.

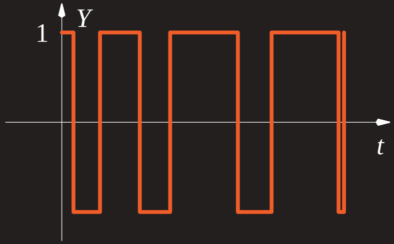


Figure 21.15
A semirandom telegraph signal. Notice that $Y(0) = 1$.

abbabbbbb**a**aaaabaaaaa

baaaaaabb**a**babbaabaaa

aaaaaabab**a**abaaabbbaa

abaabaaaa**a**baaaaabaaa

bbaababaa**b**aaababaaba

aaababaab**a**abaaaabbba

aaaaaaaaabababbbabaa $\rightarrow \dfrac{b}{a} = \dfrac{6}{14}$

baaabaaaa**b**bbaaaaabba

aabbbaaab**a**bbbabaaaaa

abbaaaaaa**a**aababbaaab

aaaabbbaa**b**baaaaaaaaa

abbabbaab**a**babaaaaaba

abaabaaaa**b**aaababaaba

abbabaaba**a**baaaabbaaa

aababbbaa**a**abbabbbbaa

baabaaaaa**a**baaabaabaa

baaabaaaa**a**abaaabbbaa

aaabaaabb**b**ababaabaab

baaababaa**a**baaaaabaaa

aaabbaaab**b**abbaabbaab

$\uparrow$

$$\frac{b}{a} = \frac{7}{13}$$

t $\rightarrow$

Figure 21.16
A pictorial guide to the difference between a time average and an ensemble average.

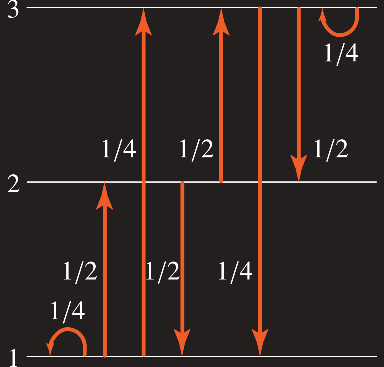


Figure 21.17

A three-state Markov chain with a transition matrix given by Equation 8.

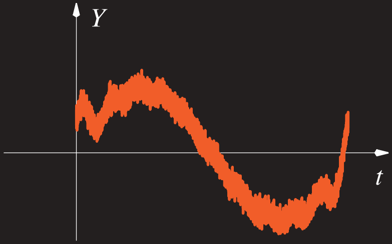


Figure 21.18

A trace of a continuous random process.

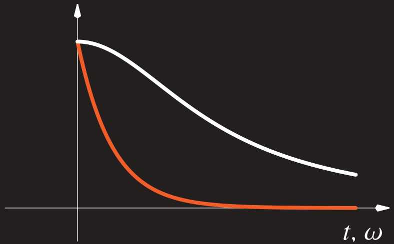


Figure 21.19
An exponetially decaying autocorrelation function (color) and its associated Lorentzian power spectrum (white). In both cases, λ is taken as unity.

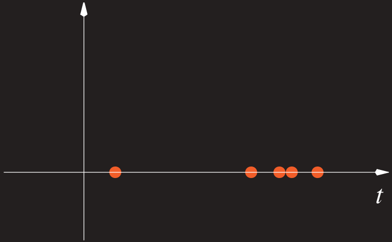


Figure 21.20
An illustration of the instants of time at which certain events occur.

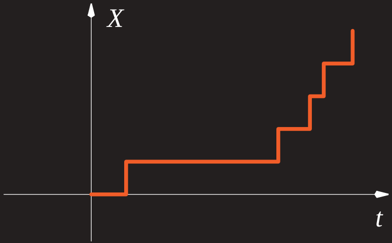


Figure 21.21
A plot of $X(t)$, the number of events that occur in time t for the Poisson process shown in Figure 21.21.

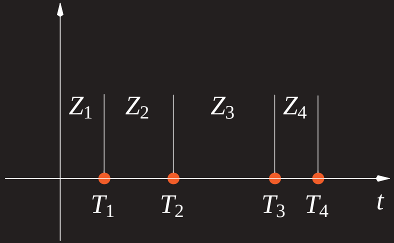


Figure 21.22

The arrival times T_1, T_2,... and the interarrival times Z_1, Z_2,... of a Poisson process.

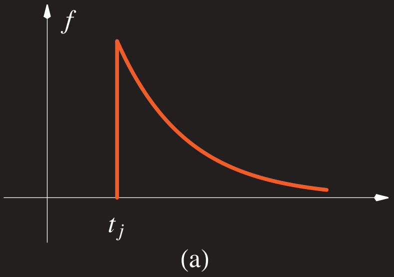


Figure 21.23
The possible responses of a measuring device to the arrival of a charge at time t_j. (a) An exponentially decaying function and (b) a triangular shaped function.

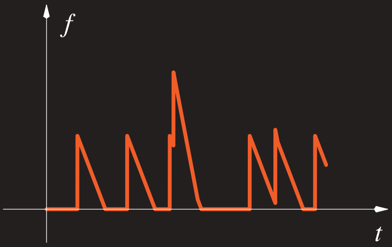


Figure 21.24
A typical recording of shot noise with the type of responses shown in Figure 21.23b. The arrival times are randomly distributed.