Homework #8 - Stat 202

1.125 Acidity of rainwater. The Normal quantile plot in Figure 1.32 (page 66) shows that the acidity (pH) measurements for rainwater samples in Exercise 1.36 are approximately Normal. How well do these scores satisfy the 68–95–99.7 rule? To find out, calculate the mean $\bar{x}$ and standard deviation s of the observations. Then calculate the percent of the 105 measurements that fall between

$\bar{x} - s$ and $\bar{x} + s$ and compare your result with 68%. Do the same for the intervals covering two and three standard deviations on either side of the mean. (The 68–95–99.7 rule is exact for any theoretical Normal distribution. It will hold only approximately for actual data.) ACIDRAIN

The remaining exercises for this section require the use of software that will make Normal quantile plots.

1.152 Density of the earth. We expect repeated careful measurements of the same quantity to be approximately Normal. Make a Normal quantile plot for Cavendish's measurements in Exercise 1.42 (page 27). Are the data approximately Normal? If not, describe any clear deviations from Normality. EARTHDENSITY

1.153 Three varieties of flowers. The study of tropical flowers and their hummingbird pollinators (Exercise 1.86, page 49) measured lengths for three varieties of *Heliconia* flowers. We expect that such biological measurements will have roughly Normal distributions. HELICONIA

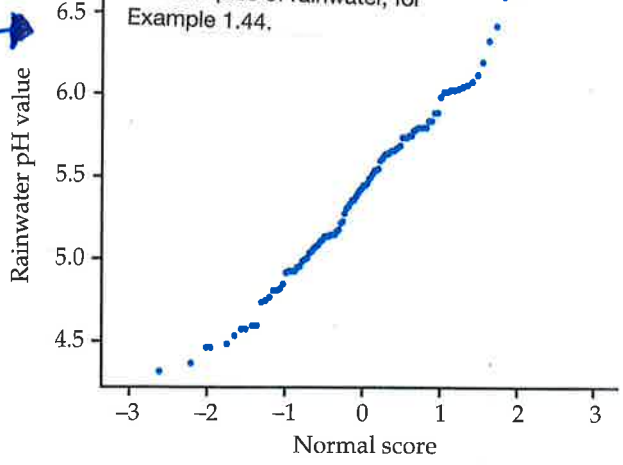
(a) Make Normal quantile plots for each of the three flower varieties. Which distribution is closest to Normal?

(b) The other two distributions show the same kind of mild deviation from Normality. In what way are these distributions non-Normal?

1.154 Use software to generate some data. Use software to generate 200 observations from the standard Normal distribution. Make a histogram of these observations. How does the shape of the histogram compare with a Normal density curve? Make a Normal quantile plot of the data. Does the plot suggest any important deviations from Normality? (Repeating this exercise several times is a good way to become familiar with how histograms and Normal quantile plots look when data actually are close to Normal.)

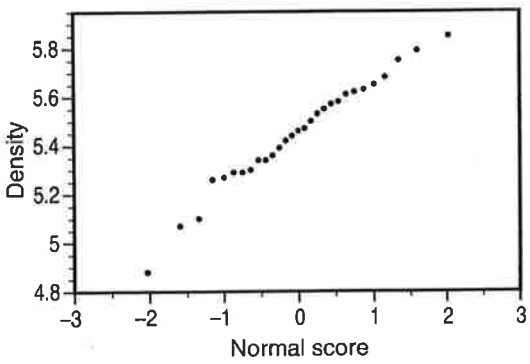
1.155 Use software to generate more data. Use software to generate 200 observations from the uniform distribution described in Exercise 1.116. Make a histogram of these observations. How does the histogram compare with the density curve in Figure 1.34? Make a Normal quantile plot of your data. According to this plot, how does the uniform distribution deviate from Normality?

FIGURE 1.32 Normal quantile plot of the acidity (pH) values of 105 samples of rainwater, for Example 1.44.



Solution to 1.152: (other solutions on back)

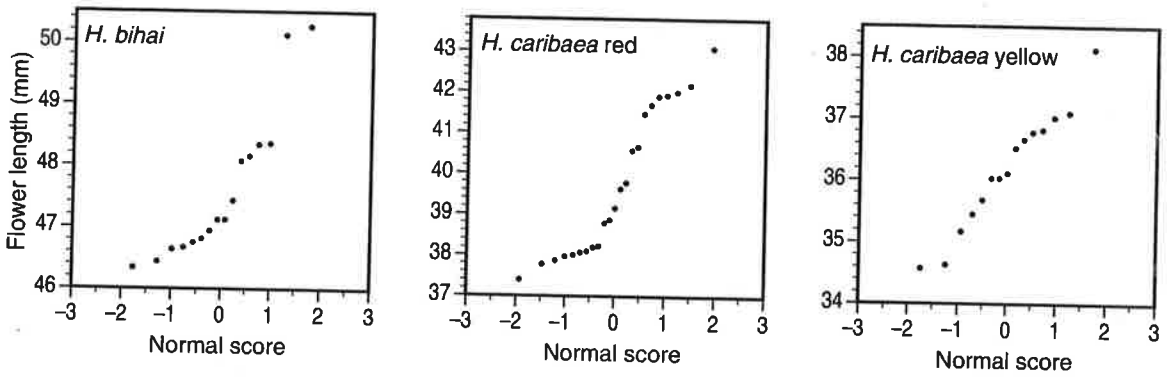
1.152. See also the solution to Exercise 1.42. The plot suggests no major deviations from Normality, although the three lowest measurements do not quite fall in line with the other points.



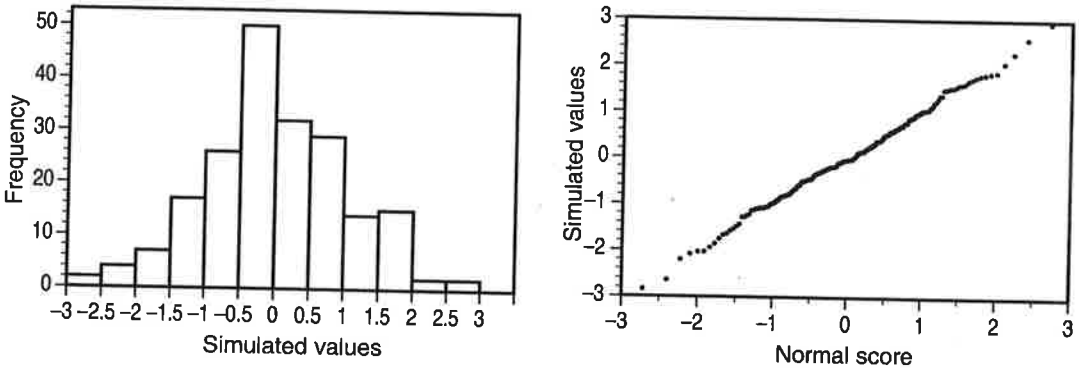
Rest of Solutions

1.125. The mean and standard deviation are $\bar{x} = 5.4256$ and $s = 0.5379$. About 67.62% (71/105 $\doteq$ 0.6476) of the pH measurements are in the range $\bar{x} \pm s = 4.89$ to 5.96. About 95.24% (100/105) are in the range $\bar{x} \pm 2s = 4.35$ to 6.50. All (100%) are in the range $\bar{x} \pm 3s = 3.81$ to 7.04.

1.153. **(a)** All three quantile plots are below; the yellow variety is the nearest to a straight line. **(b)** The other two distributions are slightly right-skewed (the lower-left portion of the graph is somewhat flat); additionally, the *bihai* variety appears to have a couple of high outliers.



1.154. Shown are a histogram and quantile plot for one sample of 200 simulated $N(0, 1)$ points. Histograms will vary slightly but should suggest a bell curve. The Normal quantile plot shows something fairly close to a line but illustrates that, even for actual Normal data, the tails may deviate slightly from a line.



1.155. Shown are a histogram and quantile plot for one sample of 200 simulated uniform data points. Histograms will vary slightly but should suggest the density curve of Figure 1.34 (but with more variation than students might expect). The Normal quantile plot shows that, compared to a Normal distribution, the uniform distribution does not extend as low or as high (not surprising, since all observations are between 0 and 1).