b. For the Richter scale, assume that the magnitude of the energy from an earthquake is first measured, then the logarithm (base 10) of the value is computed. Based on this description of the Richter scale and the result from part (a), what is the distribution of the original measurements before their logarithms are computed?

c. Given that the magnitudes in Data Set 16 result from computing logarithms (base 10), construct the normal quantile plot of the original magnitudes before logarithms are applied. Do the original values appear to be from a population with a normal distribution?

23. Lognormal Distribution The following are the values of net worth (in thousands of dollars) of the members of the executive branch of the current U.S. government. Test these values for normality, then take the logarithm of each value and test for normality. What do you conclude?

82490	27650	26652	21454	11494	10463	7291	5613	3784	3671	3466	3435	3395
3044	2287	1332	1305	878	872	783	556	463	397	145	27	

6-7 Normal as Approximation to Binomial

Key Concept This section presents a method for using a normal distribution as an approximation to a binomial probability distribution, so that some problems involving proportions can be solved by using a normal distribution. Here are the two main points of this section:

- For a proportion p, if the conditions $np \geq 5$ and $nq \geq 5$ are both satisfied, then probabilities from a binomial probability distribution can be approximated reasonably well by using a normal distribution with these parameters: $\mu = np$ and $\sigma = \sqrt{npq}$.
- Because a binomial probability distribution typically uses only whole numbers for the random variable x, but the normal approximation is continuous, we use a "continuity correction" with a whole number x represented by the interval from $x - 0.5$ to $x + 0.5$.

Brief Review In Section 5-3 we noted that a *binomial probability distribution* has (1) a fixed number of trials; (2) trials that are independent; (3) trials that are each classified into two categories commonly referred to as *success* and *failure;* (4) trials with the property that the probability of success remains constant. Section 5-3 also introduced the following notation.

Notation

$n =$ the fixed number of trials

$x =$ the specific number of successes in n trials

$p =$ probability of *success* in *one* of the n trials

$q =$ probability of *failure* in *one* of the n trials (so $q = 1 - p$)

Rationale for Using Normal Approximation Instead of providing a theoretical derivation proving that a normal distribution can approximate a binomial distribution, we simply demonstrate it with an illustration involving this situation: In 431 professional football games that went to overtime, the teams that won the coin toss went on to win 235 games (based on data from "The Overtime Rule in the National Football League: Fair or Unfair?" by Gorgievski et al., *MathAMATYC Educator,* Vol. 2, No. 1). If we assume that the coin toss is fair, the probability of winning the game after winning the coin toss should be 0.5. With $p = 0.5$ and $n = 431$ games, we get a binomial probability