The central limit theorem involves two different distributions: (1) the distribution of the *original population* and (2) the distribution of values of $\bar{x}$. As in previous chapters, we use the symbols μ and σ to denote the mean and standard deviation of the original population, but we use the following new notation for the mean and standard deviation of the distribution of $\bar{x}$.

Notation for the Sampling Distribution of $\bar{x}$

If all possible simple random samples of size n are selected from a population with mean μ and standard deviation σ, the mean of the sample means is denoted by $\mu_{\bar{x}}$ and the standard deviation of all sample means is denoted by $\sigma_{\bar{x}}$. ($\sigma_{\bar{x}}$ is called the standard error of the mean.)

Mean of all values of $\bar{x}$: $\mu_{\bar{x}} = \mu$

Standard deviation of all values of $\bar{x}$: $\sigma_{\bar{x}} = \dfrac{\sigma}{\sqrt{n}}$

It's very important to know when the normal distribution can be used and when it cannot be used. See Case 1 and Case 2 in the box on the preceding page.

Applying the Central Limit Theorem

Many practical problems can be solved with the central limit theorem. Example 2 is a good illustration of the central limit theorem because we can see the difference between working with an *individual* value in part (a) and working with the *mean* for a sample in part (b). Study Example 2 carefully to understand the fundamental difference between the procedures used in parts (a) and (b). In particular, note that when working with an *individual* value, we use $z = \frac{x - \mu}{\sigma}$, but when working with the mean $\bar{x}$ for a group of *sample* values, we use $z = \frac{\bar{x} - \mu}{\sigma/\sqrt{n}}$.

Example 2 Designing Elevators

When designing elevators, an obviously important consideration is the weight capacity. An Ohio college student died when he tried to escape from a dormitory elevator that was overloaded with 24 passengers. The elevator was rated for a capacity of 16 passengers with a total weight of 2500 lb. Weights of adults are changing over time, and Table 6-8 shows values of recent parameters (based on Data Set 1 in Appendix B). For the following, we assume a worst-case scenario in which all of the passengers are males (which could easily happen in a dormitory setting). If an elevator is loaded to a capacity of 2500 lb with 16 males, the mean weight of a passenger is 156.25 lb.

Table 6-8 Weights of Adults

	Males	Females
μ	182.9 lb	165.0 lb
σ	40.8 lb	45.6 lb
Distribution	Normal	Normal