If the process is continued indefinitely, the mean of the sample proportions will be 0.5. Also, the bottom portion of Table 6-5 shows that the distribution of the sample proportions is approximately a normal distribution.

Interpretation

Based on the actual sample results shown in the bottom portion of Table 6-5, we can describe the sampling distribution of the sample proportion by the histogram at the bottom of Table 6-5. The actual sampling distribution would be described by a histogram based on all possible samples, not the 10,000 samples included in the histogram, but the number of trials is large enough to suggest that the true sampling distribution of sample proportions is approximately a normal distribution.

The results of Example 4 allow us to observe the following two important properties of the sampling distribution of the proportion.

Behavior of Sample Proportions

1. Sample proportions *target* the value of the population proportion. (That is, the mean of the sample proportions is the population proportion. The expected value of the sample proportion is equal to the population proportion.)
2. The distribution of sample proportions tends to approximate a normal distribution.

Estimators: Unbiased and Biased

The preceding examples show that sample means, variances, and proportions tend to *target* the corresponding population parameters. More formally, we say that sample means, variances, and proportions are *unbiased estimators*. See the following two definitions.

DEFINITIONS

An **estimator** is a statistic used to infer (estimate) the value of a population parameter.

An **unbiased estimator** is a statistic that targets the value of the population parameter in the sense that the sampling distribution of the statistic has a mean that is equal to the mean of the corresponding parameter.

Unbiased Estimators These statistics are unbiased estimators. That is, they each target the value of the corresponding population parameter:

- Mean $\bar{x}$
- Variance s^2
- Proportion $\hat{p}$

Biased Estimators These statistics are biased estimators. That is, they do *not* target the value of the corresponding population parameter:

- Median
- Range
- Standard deviation s*

Important Note:* The sample standard deviations do not target the population standard deviation σ, but the bias is relatively small in large samples, so **s is often used to estimate σ even though s is a biased estimator of σ.