A new statistic in a binomial experiment:

Sample Proportion $\rightarrow$ $\hat{p} = \dfrac{x}{n}$ ← # of successes, ← # of trials

This is different from p:

p = population proportion = probability of success,

$\hat{p}$ = the statistic that estimates the parameter p.

Review for Binomial Exper:
$\mu = E(x) = np$
$\sigma^2 = Var(x) = npq$

Each x corresponds to a $\hat{p} = \frac{x}{n}$ so they have the same probabilities. They are both binomial.

But binomial probabilities are appx. normal if $np \geq 10$ & $nq \geq 10$.

$$E(\hat{p}) = E\left(\frac{x}{n}\right) = E\left(\frac{1}{n} \cdot x\right) = \frac{1}{n}\left(E(x)\right) = \frac{1}{n} \cdot np = p$$

So $\hat{p}$ is an unbiased estimator of p.

Also

$$Var(\hat{p}) = Var\left(\frac{x}{n}\right) = Var\left(\frac{1}{n} \cdot x\right) = \frac{1}{n^2} Var(x)$$
$$= \frac{1}{n^2} \cdot npq$$
$$= \frac{pq}{n}$$

So the standard deviation is the square root of variance

$$\sigma_{\hat{p}} = \sqrt{\frac{pq}{n}} = \text{standard error of } \hat{p} \text{ values.}$$