We will compare an exact binomial probability with that obtained by a normal approximation. We consider the tossing of 20 coins and want to know the probability that five coins or less were heads. If *X* is the number of heads, then we want to find the value:

P(*X* = 0) + P(*X* = 1) + P(*X* = 2) + P(*X* = 3) + P(*X* = 4) + P(*X* = 5).

The [use of the binomial formula](http://statistics.about.com/od/Formulas/a/Binomial-Table-For-N-2-To-6.htm) for each of these six probabilities shows us that the probability is 2.0695%. We will now see how close our normal approximation will be to this value.

Checking the conditions, we see that both *np* and *np*(1 - *p*) are equal to 10. This shows that we can use the normal approximation in this case. We will utilize a normal distribution with mean of *np* = 20(0.5) = 10 and a [standard deviation](http://statistics.about.com/od/Glossary/g/Standard-Deviation.htm) of (20(0.5)(0.5))0.5 = 2.236.

To determine the probability that *X* is less than or equal to 5 we need to find the *z*-score for 5 in the normal distribution that we are using. Thus *z* = (5 – 10)/2.236 = -2.236. By consulting a table of *z*-scores we see that the probability that *z* is less than or equal to -2.236 is 1.267%. This differs from the actual probability, but is within 0.8%.