**Compare Exact Probability to Normal Approximation**

If you toss 20 coins, what is the probability that five coins or less will be heads. If *X* is the number of heads, then we want to find the value:

**Exact Probability Using the Binomial Formula** P( X = x ) = nCx ⋅ ( p )x ⋅ ( 1-p)n-x

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

**Approximate Probability Using the Normal Distribution**

μ = np =

σ = =

z =

**The difference between the exact probability and the approximate probability is \_\_\_\_\_\_\_\_.**

1. When can the normal distribution be used to approximate the binomial distribution?
2. For overseas flights, an airline has three different choices on its dessert menu—ice cream, apple pie, and chocolate cake. Based on past experience the airline feels that each dessert is equally likely to be chosen.
   1. If a random sample of four passengers is selected, what is the probability that at least two will choose ice cream for dessert?
   2. If a random sample of 21 passengers is selected, what is the probability that at least two will choose ice cream for dessert?
3. Based upon past experience, 40% of all customers at Miller’s Automotive Service Station pay for their purchases with a credit card. If a random sample of three customers is selected, what is the probability that
   1. None pay with a credit card?
   2. Two pay with a credit card?
   3. At least two pay with a credit card?
   4. Not more than two pay with a credit card?

If a random sample of 200 customers is selected, what is the approximate probability that

1. At least 75 pay with a credit card?
2. Not more than 70 pay with a credit card?
3. Between 70 and 75 customers, inclusive, pay with a credit card?
4. A multiple choice test consists of 40 questions and each question has four answers from which to choose. If a student guess every answer, use the normal approximation to the binomial distribution to find the probability that the student will
   1. Get exactly 5 questions correct?
   2. Get more than 15 questions correct?
   3. Will pass?
5. A baseball player's batting average is 0.275. Use the normal approximation to the binomial distribution to find the probability of getting 20 or more hits in the next 100 times at bat.
6. The probability that a person is right handed is 85%. Use the normal approximation to the binomial distribution to find the probability that in a group of 100 people, between 70 and 90 are right handed.
7. The probability that a tire manufactured will be defective is 3%. Use the normal approximation to the binomial distribution to find the probability that with a random group of 350 tires, no more than 5 tires are defective?
8. If the failure rate of first year Calculus students is 30%, Use the normal approximation to the binomial distribution to find the probability that 6 or fewer students in a class of 35 will fail.
9. If 75% of all Canadian families have one or more cars, use the normal approximation to the binomial distribution to find the probability that in a random sample of 100 families, between 65 and 80 families have one or more cars?
10. A machine produces glass jars of which 11% are defective. Use the normal approximation to the binomial distribution to find the probability that in a random sample of 1000 jars, between 105 and 115 jars will be defective?
11. A computer is used to simulate the rolling of a die 5000 times. Use the normal approximation to the binomial distribution to find the probability that in this simulation
12. More than 1000 ones will be rolled?
13. More than 3300 prime numbers will be rolled?