1. (15 points) Ch 17 problem 2. 3 points each part.

2. Bernoulli 2.

a) These may be considered Bernoulli trials. There are only two possible outcomes, getting a 6 and not getting a 6. The probability of getting a 6 is constant at 1/6. The rolls are independent of one another, since the outcome of one die roll doesn’t affect the other rolls.

b) These are not Bernoulli trials. There are more than two possible outcomes for eye color.

c) These are not Bernoulli trials. This is because the 37 dolls returned to stores cannot be viewed as a random sample of independent observations.

d) These are not Bernoulli trials. The trials are not independent, since the probability of picking a council member with a particular political affiliation changes depending on who has already been picked. The 10% condition is not met, since the sample of size 4 is more than 10% of the population of 19 people.

e) These are not Bernoulli trials. 481 students from ONE local high school can not be viewed as a RANDOM sample from the population.

2. (10 points) Ch 17 problem 8. 5 points each part.

8. Chips.

The selection of chips may be considered Bernoulli trials. There are only two possible outcomes (fail testing and pass testing). Provided that the chips selected are a representative sample of all chips, the probability that a chip fails testing is constant at 2%. The trials are not independent, since the population of chips is finite, but we won’t need to sample more than 10% of all chips.

Let $X =$ the number of chips required until the first bad chip. The appropriate model is $Geom(0.02)$.

a) $P(X = 5) = (0.98)^4(0.02) = 0.0184$ (Four good chips, then a bad one.)

b) $P(1 \leq X \leq 10) = (0.02) + (0.98)(0.02) + (0.98)^2(0.02) + \ldots + (0.98)^9(0.02) = 0.183$

(Use the geometric model on a calculator or computer for this one!)

**Alternative solution to part b)**

\[
 n = 10, \quad p = 0.02 \\
 X : \text{number of bad chips observed} \\
 P(X \geq 1) = 1 - P(X = 0) = 1 - (0.98)^{10} \approx 0.183
\]
3. (10 points) Ch 17 problem 26

1 points on identify binomial distribution
4 points on finding mean and standard deviation
1 points on checking np>10 and nq>10 conditions.
4 points on Normal calculation.

26. No-shows.

Let \( X \) = the number of passengers that show up for the flight of \( n = 275 \) passengers.

**Binom(275, 0.95):**

\[
E(X) = np = 275(0.95) = 261.25 \text{ passengers.}
\]

\[
SD(X) = \sqrt{npq} = \sqrt{275(0.95)(0.05)} \approx 3.61 \text{ passengers.}
\]

Since \( np = 261.25 \) and \( nq = 13.75 \) are both greater than 10, Binom(275, 0.95) may be approximated by the Normal model, \( N(261.25, 3.61) \).

Alternative solutions:
a) \( P(X > 265) \)
b) Set \( X \) as number of passengers that do not show up. Binom(275, 0.05). Use normal to find \( P(X<10) \) or \( P(X<=9) \)
4. (20 points) Ch 17 problem 34
Part a) 3 points
Part b) 3 points
Part c) 4 points
Part d) 4 points
Part e) 6 points

Consider possible alternative solutions as in the previous problem.

34. Rickets.

The selection of these children may be considered Bernoulli trials. There are only two possible outcomes, vitamin D deficient or not vitamin D deficient. Recent research indicates that 20% of British children are vitamin D deficient. (The probability of not being vitamin D deficient is therefore 80%.) Provided the students at this school are representative of all British children, we can consider the probability constant. The trials are not independent, since the population of British children is finite, but the children at this school represent fewer than 10% of all British children.

a) Let \( X \) = the number of students tested before finding a student who is vitamin D deficient. Use \( Geom(0.2) \) to model the situation.

\[ P(\text{First vitamin D deficient child is the eighth one tested}) = P(X = 8) = (0.8)^7 (0.2) = 0.042 \]

b) \( P(\text{The first ten children tested are okay}) = (0.8)^{10} = 0.107 \)

c) \( E(X) = \frac{1}{p} = \frac{1}{0.2} = 5 \) kids.

d) Let \( Y \) = the number of children who are vitamin D deficient out of 50 children. Use \( Binom(50, 0.2) \).

\[ E(Y) = np = 50(0.2) = 10 \text{ children.} \]

\[ SD(Y) = \sqrt{npq} = \sqrt{50(0.2)(0.8)} = 2.83 \text{ children.} \]

e) Using \( Binom(320, 0.2) \):

\[ E(Y) = np = 320(0.2) = 64 \text{ children.} \]

\[ SD(Y) = \sqrt{npq} = \sqrt{320(0.2)(0.8)} \approx 7.16 \text{ children.} \]

Since \( np = 64 \) and \( nq = 256 \) are both greater than 10, \( Binom(320,0.2) \) may be approximated by the Normal model, \( N(64, 7.16) \).

\[ P(Y \leq 50) = P(z < -1.955) = 0.0253 \]

According to the Normal model, the probability that no more than 50 out of 320 children have the vitamin D deficiency is approximately 0.0253.
5. (10 points) Ch 18 problem 8
Check conditions: 3 points
Mean: 2 points
Standard deviation: 3 points
Describing the distribution: 2 points.

8. Smoking.

10% condition: 50 people are selected at random, and 50 is less than 10% of all people.

Success/Failure condition: \( np = 13.2 \) and \( nq = 36.8 \) are both greater than 10.

The sampling distribution model is Normal, with:

\[
\mu_p = p = 0.264 \\
\sigma(p) = \sqrt{\frac{pq}{n}} = \sqrt{\frac{(0.264)(0.736)}{50}} = 0.062
\]

There is an approximate chance of 68% that between 20.2% and 32.6% are smokers, an approximate chance of 95% that between 14.0% and 38.8% are smokers, and an approximate chance of 99.7% that between 7.8% and 45.0% are smokers.

6. (10 points) Ch 18 problem 16
Check conditions: 2 points. Calculation: 8 points.
“Pretty sure” may have different meaning to different students. Student need to select their own level of “pretty sure” and work with that level.


10% condition: We will assume that the 180 customers are representative of all customers, and represent less than 10% of all potential customers.

Success/Failure condition: \( np = 36 \) and \( nq = 144 \) are both greater than 10.

Therefore, the sampling distribution model for \( \hat{p} \) is Normal, with:

\[
\mu_p = p = 0.20 \\
\sigma(\hat{p}) = \sqrt{\frac{pq}{n}} = \sqrt{\frac{(0.20)(0.80)}{180}} = 0.0298
\]

Answers may vary. We will use 2 standard deviations above the expected proportion of customers who order the steak special to be “pretty sure”.

\[
\mu_p + 2 \left( \sqrt{\frac{pq}{n}} \right) = 0.20 + 2(0.0298) = 0.2596
\]

Since 180(0.2596) = 46.728, the chef needs at least 47 steaks on hand.
7. (20 points) Ch 18 problem 28
Part a) 4 points
Part b) 4 points
Part c) 6 points
Part d) 6 points

For part d), the probability is less than 0.0001 but not "essentially zero".

28. Potato chips.

a) According to the Normal model, only about 4.78% of the bags sold are underweight.

b) \[ P(\text{none of the 3 bags are underweight}) = (1 - 0.0478)^3 = 0.863. \]

c) Random sampling condition: Assume that the 3 bags can be considered a representative sample of all bags.

Independence assumption: It is reasonable to think that the weights of these bags are mutually independent.

10% condition: The 3 bags certainly represent less than 10% of all bags.

The mean weight is \( \mu = 10.2 \) ounces, with standard deviation \( \sigma = 0.12 \) ounces. Since the distribution of weights is believed to be Normal, we can model the sampling distribution of \( \bar{y} \) with a Normal model, with \( \mu_y = 10.2 \) ounces and standard deviation

\[ \sigma(\bar{y}) = \frac{0.12}{\sqrt{3}} = 0.069 \text{ ounces}. \]

According to the Normal model, the probability that the mean weight of the 3 bags is less than 10 ounces is approximately 0.0019.

d) For 24 bags, the standard deviation of the sampling distribution model is

\[ \sigma(\bar{y}) = \frac{0.12}{\sqrt{24}} = 0.024 \text{ ounces}. \]

Now, an average of 10 ounces is over 8 standard deviations below the mean of the sampling distribution model. The probability of this happening is essentially 0.