

Unit 4 – Bernoulli and Binomial
Self Evaluation Quiz
SOLUTIONS

1. According to a recent poll in 2002, 41% of US citizens approved of the job President Bush was doing at that time. Assume that this proportion was actually true for the whole of the US population.

(a) Suppose a simple random sample of 10 citizens was selected. What is the probability that a majority (more than 5) approved of the job that President Bush was doing?

Answer: .18

Solution:

Define X is the number of approve. We need to find $P(X > 5)$.

Recall that binomial distribution is given by

$P(X = x) = \binom{n}{x} p^x (1-p)^{n-x}$, where p is the population parameter for the probability of success, n is the number of trials and x is the number of successes.

We have, $p=0.41$, $n=10$ and $x>5$.

$$\begin{aligned} P(X > 5) &= P(x=6) + P(X=7) + P(x=8) + P(X=9) + P(x=10) \\ &= \binom{10}{6} (0.41)^6 (1-0.41)^{10-6} + \binom{10}{7} (0.41)^7 (1-0.41)^{10-7} + \binom{10}{8} (0.41)^8 (1-0.41)^{10-8} + \\ &+ \binom{10}{9} (0.41)^9 (1-0.41)^{10-9} + \binom{10}{10} (0.41)^{10} (1-0.41)^{10-10} \\ &= 0.1834 \end{aligned}$$

(b) Suppose a simple random sample of 50 citizens was selected. What is the probability that a majority (more than 25) approved of the job that President Bush was doing?

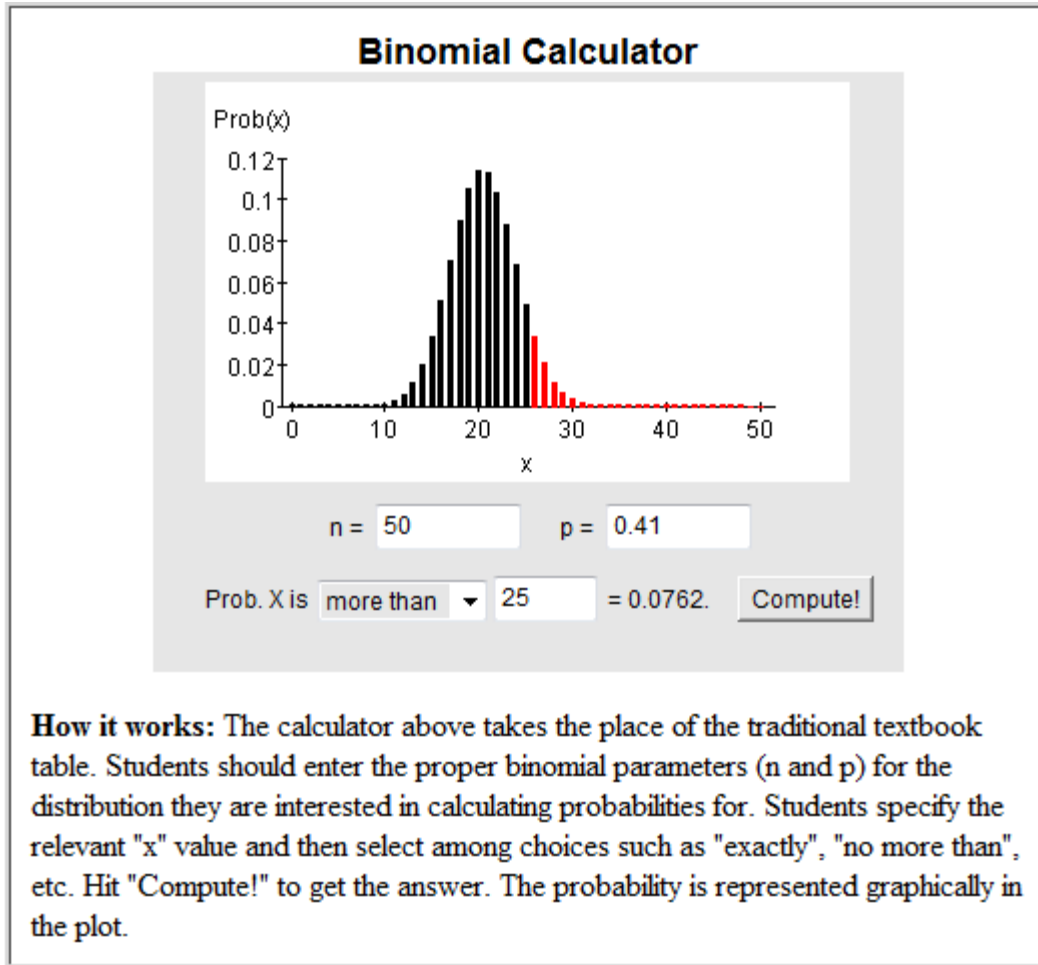
Answer: .08

Solution:

$$P(X > 25) = 0.0761$$

This result can be obtained as in part (a). A more practical approach would be to use a probability calculator applet on <http://www.stat.tamu.edu/~west/applets/binomialdemo.html>

Here is a snapshot of the result using the above website:



Also notice that the peak corresponds to the mean $= np = 50 \cdot 0.41 \approx 21$.

2. The probability that a person suffering from a migraine headache will obtain relief from a particular drug is 0.9. Three randomly selected sufferers from migraine headache are given the drug. Find the probability that the number obtaining relief will be 2 or 3.

Answer: .97

Solution:

$$P(X \geq 2) = P(x=2) + P(x=3) = 0.9720$$

$$P(X \geq 2) = \binom{3}{2} (0.9)^2 (1-0.9)^{3-2} + \binom{3}{3} (0.9)^3 (1-0.9)^{3-3} = 0.9720$$

3. A home security system has a 80% reliability rate, meaning that it goes off 80% of the time when there is a burglary. Suppose that 12 homes equipped with this system experience an attempted burglary. What is the probability that more than 7 alarms go off?

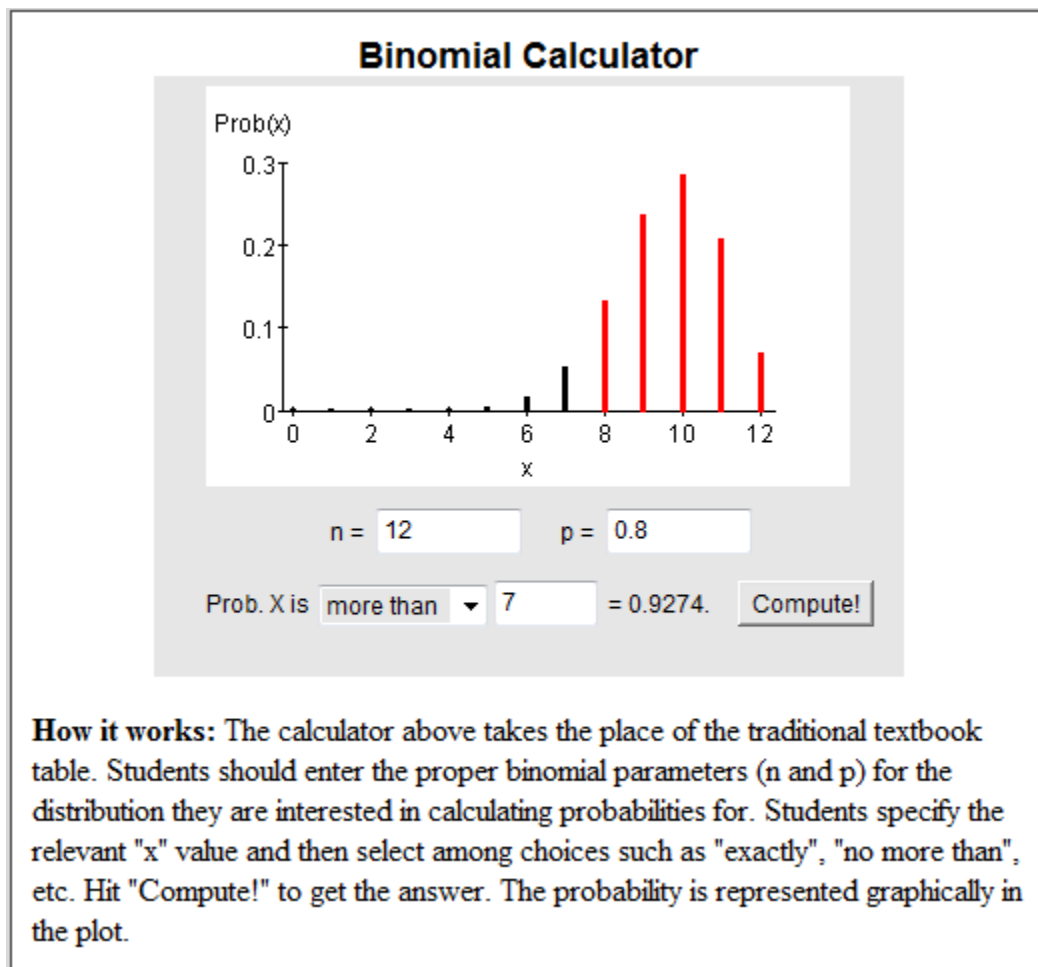
Answer: .93

Solution:

$$P(X>7) = 0.9274$$

$$P(X>7) = P(X=8) + P(X=9) + P(X=10) + P(X=11) + P(X=12)$$

Use the Java applet given here <http://www.stat.tamu.edu/~west/applets/binomialdemo.html>



4. (*Source: Virtual Lab*). The common form of hemophilia is due to a defect on the X chromosome (one of the two chromosomes that determine gender). We will let “h” denote the defective gene, linked to hemophilia, and H the corresponding normal gene. Women have two X chromosomes, and “h” is recessive. Thus, a woman with gene type HH is normal, a woman with gene type “hH” or “Hh” is free of disease but is a carrier; and a woman with gene type “hh” has the disease. A man has only one X chromosome (the other sex chromosome, the Y chromosome, plays no role in the disease). A man with gene type h has hemophilia and a man with gene type H is healthy.

Mother XX	Father X
HH – Normal	H - Normal
Hh – Carrier	h - Hemophilia
hH – Carrier	
hh - Hemophilia	

(a) Suppose that a mother is a carrier and the father is healthy. They have a son. What is the probability that the son will have hemophilia? Will be healthy?

Answer: $\Pr[\text{son is hemophiliac}] = .5$ $\Pr[\text{son is healthy}] = .5$

Solution:

If child is a son, then father contributed a Y chromosome. The Y plays no role in disease. Thus son’s chances of H and h are both 0.5

(b) Suppose that a mother is a carrier and the father has hemophilia. They have a daughter. What is the probability that the daughter will have hemophilia? Will be a carrier?

Answer: $\Pr[\text{daughter is hemophiliac}] = .5$ $\Pr[\text{daughter is carrier}] = .5$

Solution:

If child is a daughter, then father contributed an X chromosome. If it is known that the father is a hemophiliac, then we know he contributed an h with probability 1. If the mother is a carrier, then she is hH (or other way around) plays no role in disease. Thus daughter is hh or hH, each with probability .5