L6 Sept. 9, 2020 page 110; #’s 43, 44, 48, 56

1. Let the random variable *X* have the probability distribution function:



Find:

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1. Given  and ,
   1. Find *Var(Y + 4)*
   2. Find 
   3. Find 

**Sections 3.** **4; The Binomial Probability Distribution**

Consider the experiment where you flip a coin. Heads you win (succeed) tails you lose (fail).

**Def.**

**A Bernoulli experiment** is a single random experiment with two mutually exclusive outcomes, success and failure. The probability of success is *p, P(success) = p,* and the probability of failure is *P(fail) = 1 – p = q.*

(examples: male-female, win-lose, heads-tails, live-die)

**Def 3.6.**

**A Binomial experiment** is a sequence of Bernoulli experiments done *n* times where each Bernoulli experiment is identical and independent from each other. The set of random variables of a binomial experiment, *Y* = {0, 1, 2, … , *n*}, is the number of possible successes observed during the *n* trials.

Example:

Suppose the probability of a seed germinating is 0.8. If we plant 10 seeds and can assume that the germination of one seed is independent from another seed, what is the probability that 7 out of the 10 seeds will germinate?

For the Bernoulli what is i) the probability distribution function, ii) the mean or expected value and iii) the variance?

Define *Y* = 1 for success and *Y* = 0 for a failure with P(*Y* = 1) = *p* and *P*(*Y* = 0) = (1 – *p*) = *q*

1. The probability function : 
2. The mean: 



1. So the variance: 

For the **Binomial distribution**:

1. 
2. The mean: 





 (note: each term has a *np* factor)



Make a change in variable *z = y – 1*, then the equality becomes:





= *np*

Need to find but this is hard to find. Using the above derivation as inspiration where we factor out the y, let us factor out *y(y – 1).* Consider

 or



So





Make a change in variable *z = y – 2*, then the equality becomes:





= 

Which means  , and







= *npq*

Example:

1. Let *Y =* number of days of rain in a 30 day period. (#36)
   1. Does *Y* have a binomial distribution?
   2. If so, what is *n* and *p*?
2. The probability that a patient recovers from a stomach disease is .8. Suppose 20 people are known to have contracted this disease. Use Appendix 3 on page 839 the find the probability that :
   1. exactly 14 recover?
   2. at least 10 recover?
   3. at least 14 but not more than 18 recover?
   4. at most 16 recover?