CH 3.4

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MATH 324 Ch 3.4

Identify Binomial vs Geometric R.V. (Random Variable) - Level 0:

1A)

Geometric Random Variable

1B)

Binominal Random Variable

1C)

Geometric Random Variable

1D)

Binominal Random Variable

1E)

Binominal Random Variable

Basic Binominal R.V. Calculations - Level 1:

choose(x,y)pˆx(1-p)ˆ(n-x)

2A)

```
a <- choose(9,4)*(0.4^4)*(1-0.4)*(9-4) +
  choose(9,5)*(0.4^5)*(1-0.4)*(9-5) +
  choose(9,6)*(0.4^6)*(1-0.4)*(9-6) +
  choose(9,7)*(0.4^7)*(1-0.4)*(9-7) +
  choose(9,8)*(0.4^8)*(1-0.4)*(9-8)

paste0(a)
```

```
## [1] "13.467009024"
```

2B)

```
a <- (choose(9,6)*(0.6^6)*(1-0.6)*(9-6)
+ choose(9,7)*(0.6^7)*(1-0.6)*(9-7)
+ choose(9,8)*(0.6^8)*(1-0.6)*(9-8))

paste0(a)
```

```
## [1] "5.569606656"
```

2C)

```
a <- (choose(11,1)*(0.1^1)*(1-0.1)*(11-1)
      + choose(11,2)*(0.1^2)*(1-0.1)*(11-2)
      + choose(11,3)*(0.1^3)*(1-0.1)*(11-3)
      + choose(11,4)*(0.1^4)*(1-0.1)*(11-4)
      + choose(11,5)*(0.1^5)*(1-0.1)*(11-5)
      + choose(11,6)*(0.1^6)*(1-0.1)*(11-6)
      + choose(11,7)*(0.1^7)*(1-0.1)*(11-7)
      + choose(11,8)*(0.1^8)*(1-0.1)*(11-8)
      + choose(11,9)*(0.1^9)*(1-0.1)*(11-9)
      + choose(11,10)*(0.1^10)*(1-0.1)*(11-10))

paste0("pbinom: ", pbinom(a, 11, 0.1))
```

```
## [1] "pbinom: 1"
```

2D)

```
a <-  choose(7,4)*(0.4^4)*(1-0.4)*(7-4)
paste0("pbinom: ", pbinom(a, 7, 0.4))
```

```
## [1] "pbinom: 0.1586304"
```

Binominal R.V. Problems Level 2-3:

3A)

```
paste0("Expected Value: ", 30*0.25)
```

```
## [1] "Expected Value: 7.5"
```

```
paste0("Standard Deviation: ", sqrt(30*0.25*0.7))
```

```
## [1] "Standard Deviation: 2.29128784747792"
```

3B)

```
print("Probability of people who wants new copies: ")
```

```
## [1] "Probability of people who wants new copies: "
```

```
print("P(|X - 7.5| > 2*2.29 ))")
```

```
## [1] "P(|X - 7.5| > 2*2.29 ))"
```

```
print("P( X > 7.5 + 4.58 or X < 7.5 - 4.58)")
```

```
## [1] "P( X > 7.5 + 4.58 or X < 7.5 - 4.58)"
```

```
print("P(X > 12.08 + P(X <= 2.29)")
```

```
## [1] "P(X > 12.08 + P(X <= 2.29)"
```

```
print("P(X > 12 + P(X < 2)")
```

```
## [1] "P(X > 12 + P(X < 2)"
```

```
paste0(1 - pbinom(12, 30, 0.25) + pbinom(2, 30, 0.25))
```

```
## [1] "0.0321895115632764"
```

3C)

```
print("P(X<=15) - P(X<10)")
```

```
## [1] "P(X<=15) - P(X<10)"
```

```
paste0(pbinom(15, 30, 0.3) - pbinom(9, 30, 0.3))
```

```
## [1] "0.404820968381965"
```

3D)

$200(X) + $120(30-X) = 0 X = 7.5 $80 * X * $3600

```
a <- paste0(80*7.5*3600)
paste0("Total revenue:", a)
```

```
## [1] "Total revenue:2160000"
```

4)

$8.00 for passenger cars $32.00 for large trucks 80% daytime = passenger cars 25 cars cross bridge

```
paste0(25*0.8 , " cars")
```

```
## [1] "20 cars"
```

```
paste0(25-20, "other cars")
```

```
## [1] "5other cars"
```

```
paste0("Expected Toll Revenue: $", 20*8 + 32*5)
```

```
## [1] "Expected Toll Revenue: $320"
```

5A)

At least 5 have no citations

```
print("1 - P(0 Citations)")
```

```
## [1] "1 - P(0 Citations)"
```

```
paste0(1 - 0.5)
```

```
## [1] "0.5"
```

P(X <= 5) = pbinom(5, 10, 0.5)

```
paste0(pbinom(5, 10, 0.5))
```

```
## [1] "0.623046875"
```

5B)

Fewer than half have at least one citation P(X < 5)

```
paste0(pbinom(4, 10, 0.5))
```

```
## [1] "0.376953125"
```

5C)

The number that have at least one citation is between 3 and 8, inclusive P(3 <= X <= 8)

```
paste0((choose(10, 3)*(0.5)^3*(1-0.5)^7) +
         (choose(10, 4)*(0.5)^4*(1-0.5)^6) +
         (choose(10, 5)*(0.5)^5*(1-0.5)^5) +
         (choose(10, 6)*(0.5)^6*(1-0.5)^4) +
         (choose(10, 7)*(0.5)^7*(1-0.5)^3) +
         (choose(10, 8)*(0.5)^8*(1-0.5)^2))
```

```
## [1] "0.9345703125"
```

Geometric R.V Calculations

Formula = (1-p)^x-1 p

6A)

```
paste0("Geometric PDF: ",dgeom(4, 0.7))
```

```
## [1] "Geometric PDF: 0.00567"
```

```
paste0("Geometric CDF: ",pgeom(4, 0.7))
```

```
## [1] "Geometric CDF: 0.99757"
```

6B)

```
a <- ((1-0.7)^4*(0.7))
paste0("F(5): ", a)
```

```
## [1] "F(5): 0.00567"
```

6C)

P(X >= 8) = 1 - P(X <= 7) = 1-(1-(1-p)^x) = (1-p)^x

```
a <- (1-0.7)^7
paste0("P(X >= 8): ", a)
```

```
## [1] "P(X >= 8): 0.0002187"
```

}

Formula = (1-p)^x-1 p ## 7A) E(x) = 1/p

```
paste0("Expected value: ", 1/0.1)
```

```
## [1] "Expected value: 10"
```

7B)

```
a <- (1-0.1)^6
paste0("P(6) = :", a)
```

```
## [1] "P(6) = :0.531441"
```

7C)

```
a <- (1-0.1)^14
paste0("P(X < 15): ", a)
```

```
## [1] "P(X < 15): 0.22876792454961"
```

Optional More Challenging Binomial Problem - Boss Level

9A)

At least one individual with a reservation cannot be accommodated on the trip? P(X = 5) + P(X = 6) 1-0.25 = 0.75

```
a <- choose(6,5)*(0.75)^5*(1-0.75)^(6-5)+choose(6,6)*(0.75)^6*(1-0.75)^(6-6)
paste0("At least one individual with a reservation cannot be accommodated on the trip? ", a)
```

```
## [1] "At least one individual with a reservation cannot be accommodated on the trip? 0.533935546875"
```

9B)

Expected numbers of available seats when shuttle departs Expected value: 1(P(X=3)) + 2(P(X=2)) + 3(P(X=1)) + 4(P(X=0))

```
a <- choose(6,0)*(0.75)^0*(0.25)^(6-0)
b <- choose(6,1)*(0.75)^1*(0.25)^(6-1)
c <- choose(6,2)*(0.75)^2*(0.25)^(6-2)
d <- choose(6,3)*(0.75)^3*(0.25)^(6-3)
e <- 1*a + 2*b + 3*c + 4*d
paste0("Expected numbers of available seats when shuttle departs: ", e)
```

```
## [1] "Expected numbers of available seats when shuttle departs: 0.63525390625"
```

9C)

Probability distribution of the number of reservations given

P(X = 0)

```
a <- 0.1*choose (3,0)*(0.75^0)*(0.25)^(3-0) +
  0.3*choose (4,0)*(0.75^0)*(0.25)^(4-0) +
  0.4*choose (5,0)*(0.75^0)*(0.25)^(5-0) +
  0.2*choose (6,0)*(0.75^0)*(0.25)^(6-0)
paste0("P(X=0): " , a)
```

```
## [1] "P(X=0): 0.003173828125"
```

P(X = 1)

```
a <- 0.1*choose (3,1)*(0.75^1)*(0.25)^(3-1) +
  0.3*choose (4,1)*(0.75^1)*(0.25)^(4-1) +
  0.4*choose (5,1)*(0.75^1)*(0.25)^(5-1) +
  0.2*choose (6,1)*(0.75^1)*(0.25)^(6-1)
paste0("P(X=1): " , a)
```

```
## [1] "P(X=1): 0.03486328125"
```

P(X = 2)

```
a <- 0.1*choose (3,2)*(0.75^2)*(0.25)^(3-2) +
  0.3*choose (4,2)*(0.75^2)*(0.25)^(4-2) +
  0.4*choose (5,2)*(0.75^2)*(0.25)^(5-2) +
  0.2*choose (6,2)*(0.75^2)*(0.25)^(6-2)
paste0("P(X=2): " , a)
```

```
## [1] "P(X=2): 0.147216796875"
```

P(X = 3)

```
a <- 0.1*choose (3,3)*(0.75^3)*(0.25)^(3-3) +
  0.3*choose (4,3)*(0.75^3)*(0.25)^(4-3) +
  0.4*choose (5,3)*(0.75^3)*(0.25)^(5-3) +
  0.2*choose (6,3)*(0.75^3)*(0.25)^(6-3)
paste0("P(X=3): " , a)
```

```
## [1] "P(X=3): 0.3005859375"
```

P(X = 4)

```r
a <- 0.1*choose (3,4)*(0.75^4)*(0.25)^(3-4) +
  0.3*choose (4,4)*(0.75^4)*(0.25)^(4-4) +
  0.4*choose (5,4)*(0.75^4)*(0.25)^(5-4) +
  0.2*choose (6,4)*(0.75^4)*(0.25)^(6-4)
paste0("P(X=4): " , a)
```

```
## [1] "P(X=4): 0.312451171875"
```