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Math 6358

Homework 2

1a.

W	6	7	8	9	10	11	12	13	14	15	16	17	18
P(W)	1/35	1/35	2/35	3/35	4/35	4/35	5/35	4/35	4/35	3/35	2/35	1/35	1/35

1b. E(W) = 6*(1/35) + 7*(1/35) + 8*(2/35) + 9*(3/35) + 10*(4/35) + 11*(4/35) + 12*(5/35) + 13*(4/35) + 14*(4/35) + 15*(3/35) + 16*(2/35) + 17*(1/35) + 18*(1/35) = **12**

1c. Var(W) =
((6-12)^2*(1/35)+(7-12)^2*(1/35)+(8-12)^2*(2/35)+(9-12)^2*(3/35)+(10-12)^2*(4/35)+(11-12)^2*(4/35)+(12-12)^2*(5/35)+(13-12)^2*(4/35)+(14-12)^2*(4/25)+(15-12)^2*(3/35)+(16-12)^2*(2/35)+(17-12)^2*(1/35)+(18-12)^2*(1/35)) = **8.18 ≈ 8**

2a. P(X=x) = $\binom{20}{x}0.70^{x}0.30^{20-x}$, x= 1,2,…,20

2b. P(X>10) = 1 - pbinom(10,20,0.7) *not including 10*

[1] **0.9520381**

2c. P(6≤X≤10) = pbinom(10,20,0.7) - pbinom(5,20,0.7)

[1] **0.04791896**

2d. E(X) = np = 20*0.7

[1] **14**

SD(X) = sqrt(20*0.7*0.3)

[1] **2.04939**

2e. If 18 are sold, then between 2-10 chain driven models are sold.

P(2≤X≤10) = pbinom(10,20,0.7) - pbinom(1,20,0.7)

[1] **0.0479619**

3a. $p = 0.5$; $P(7 \leq X \leq 18)$ = pbinom(18,25,0.5) - pbinom(6,25,0.5)

[1] **0.9853667**

3b. $p = 0.8$; $P(7 \leq X \leq 18)$ = pbinom(18,25,0.8) - pbinom(6,25,0.8)

[1] **0.2199647**

3c. *when $X \leq 7$ **or** $X \geq 18$ is $P(X \leq 7) \cup P(X \geq 18)$* = pbinom(7,25,0.5) + (1-pbinom(17,25,0.5))

[1] **0.04328525**

3d. $p=0.6$; $P(8 \leq X \leq 17)$ = pbinom(17,25,0.6) - pbinom(7,25,0.6)

[1] **0.8452428**

$p=0.8$; $P(8 \leq X \leq 17)$ = pbinom(17,25,0.8) - pbinom(7,25,0.8)

[1] **0.1091228**

3e. Try: $P(X \leq 6) \cup P(X \geq 19)$ = pbinom(6,25,0.5) *including 6* + (1-pbinom(18,25,0.5))
including 19

[1] 0.0146333 *still greater than 0.01*

Try: $P(X \leq 5) \cup P(X \geq 20)$ = pbinom(5,25,0.5) + (1-pbinom(19,25,0.5))

[1] **0.004077315 *less than 0.01, so the decision rule chosen is $P(X \leq 5) \cup P(X \geq 20)$***

4. $p= 0.005$; $n=400$

repeated trials and independent, so assume Bernoulli

$P(X=x) = \binom{400}{x} 0.005^{x} (1-0.005)^{400-x}$, $x= 1,2,\ldots,400$

$P(X=1) = \binom{400}{1} 0.005^{1} (1-0.005)^{400-1}$ = dbinom(1,400,0.005)

[1] **0.2706694**

$P(X \leq 3)$ = pbinom(3,400,0.005) *including 3*

[1] **0.8575767**

5. B = X – 120 if X > 120 and B = 0 otherwise.

Profit: 250t – 500B

a)
```
passengers <- function(t){
  profit <- NULL
  for(i in 1:10000) {
  x <- rbinom(1,t,0.85)
  B <- max(x-120,0)
  profit[i] <- 250*t - 500*B
   }
   return(profit)
 }
```

b)
```
set.seed(12345) #set random seed to reproduce results
t <- 140:150
avg <- numeric(0)
for (i in 1:length(t)){
  avg[i] <- mean(passengers(t[i]))
  cat("The average profit for t=", t[i], "is", avg[i], "\n")
}
cat("The largest average profit of", max(avg), "is for t=", t[which.max(avg)], "\n")
```

output:

```
The average profit for t= 140 is 34400.65
The average profit for t= 141 is 34433.45
The average profit for t= 142 is 34469.4
The average profit for t= 143 is 34429.15
The average profit for t= 144 is 34415.45
The average profit for t= 145 is 34369.7
The average profit for t= 146 is 34254
The average profit for t= 147 is 34143.6
The average profit for t= 148 is 34012.1
The average profit for t= 149 is 33846.6
The average profit for t= 150 is 33658.25
```

```
> cat("The largest average profit of", max(avg), "is for t=", t[which.max(avg)], "\n")
```

The largest average profit of 34469.4 is for t= 142