STA 138 Discussion 2 Solutions

Fall 2020

1. Suppose that $Y \sim \text{Binomial}(120, 0.2)$.
   (a) $P(Y \leq 30) \approx 0.9279$
   (b) $P(Y \geq 24) \approx 0.5364$
   (c) $P(Y \geq 25) \approx 0.4457$
2. Suppose that $Y \sim \text{Hypergeometric}(80, 20, 20)$
   (a) $P(Y = 4) \approx 0.205$
   (b) $P(Y \leq 3) \approx 0.1873$
   (c) $P(Y \leq 10) \approx 0.9992$
   (d) $P(4 \leq Y \leq 6) \approx 0.6285$
3. Suppose that $Y \sim \text{Poisson}(9)$
   (a) $P(Y > 8) \approx 0.5443$
   (b) $P(3 \leq Y \leq 15) \approx 0.9717$
4. Suppose that $(Y_1, Y_2, \ldots, Y_{10}) \sim \text{Multinomial}(10, 0.1, 0.1, \ldots, 0.1)$.
   (a) The marginal distribution of Y_1 is $\text{Binomial}(10, 0.1)$, so using this we find $P(Y_1 = 10) = (0.1)^{10} \approx 0$
   (b) Dividing this event into 10 mutually exclusive events, where the i-th, $i = 1, \cdots, 10$ event is that all 10 subjects are assigned to the i-th category, we get ≈ 0
   (c) Using the multinomial assignment of probabilities, we get ≈ 0.00036
   (d) Dividing this event up into the three resulting possible assignments of the two remaining subjects to the categories 9 and 10, and using the multinomial assignment of probabilities, we get ≈ 0.00073

Code Appendix

```r
## 1.(a)
p1a <- pbinom(30,120,0.2)
## 1.(b)
p1b <- 1-pbinom(24-1,120,0.2)
## 1.(c)
p1c <- 1-pbinom(25-1,120,0.2)
## 2.(a)
p2a <- dhyper(4,20,80-20,20)
## 2.(b)
p2b <- phyper(3,20,80-20,20)
## 2.(c)
p2c <- phyper(10,20,80-20,20)
## 2.(d)
p2d <- phyper(6,20,80-20,20) - phyper(3,20,80-20,20)
## 3.(a)
p3a <- 1-ppois(8,9)
## 3.(b)
p3b <- ppois(15,9)-ppois(2,9)
## 4.(a)
p4a <- dbinom(10,10,0.1)
## 4.(b)
p4b <- 10*dbinom(10, 10, 0.1)
## 4.(c)
p4c <- dmultinom(rep(1,10), prob=rep(0.1,10))
## 4.(d)
p4d <- (dmultinom(rep(1,10), prob=rep(0.1,10))
        + dmultinom(c(rep(1,8),2,0), prob=rep(0.1,10))
        + dmultinom(c(rep(1,8),0,2), prob=rep(0.1,10)))
```