Module 3 Homework

Yanhe Wen

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Question 1

choose (b) $\int_1^4 2e^{-2(x-1)}\,dx$

Question 2

```
fx <- function(x) 2^x/factorial(x)*exp(-2)
px1 <- fx(1)
cat("P(X=1) is: ", px1)
```

```
## P(X=1) is:  0.2706706
```

```
px2 <- fx(0) + fx(1) + fx(2) + fx(3)
cat("P(-2<X<4) is: ", px2)
```

```
## P(-2<X<4) is:  0.8571235
```

Question 3

$n = 3, p = 0.25$

Question 4

```
vec4.range <- c(0,1,2)
cat("P(Y<=2) is: ",sum(dbinom(vec4.range, 3, 0.25)))
```

```
## P(Y<=2) is:  0.984375
```

```
Ex4 <- sum(vec4.range*dbinom(vec4.range, 3, 0.25))
cat("E(X) is: ",Ex4)
```

```
## E(X) is:  0.703125
```

```
Var4 <- sum((vec4.range-Ex4)^2*dbinom(vec4.range, 3, 0.25))
cat("Var(Y) is: ",Var4)
```

```
## Var(Y) is:  0.4822655
```

Question 5

```r
fx5 <- function(x) dchisq(x,3)

px5 <- integrate(fx5, lower = 1, upper = 4)$value
cat("P(1<X<4) is ", px5)
```

```
## P(1<X<4) is  0.5397878
```

```r
Ex5 <- integrate(function(x) x*fx5(x), lower = 1, upper = 4)$value
cat("E(X) is ", Ex5)
```

```
## E(X) is  1.239449
```

```r
Var5 <- integrate(function(x) (x-Ex5)^2*fx5(x), lower = 1, upper = 4)$value
cat("Var(X) is: ", Var5)
```

```
## Var(X) is:  0.9825379
```

Monte Carlo Simulation with 100000 samples

```r
mcData5 <- rchisq(100000, 3)
sum <- 0
for(i in 1:100000){
  if(1<mcData5[i]&&mcData5[i]<4) {
    sum = sum + 1
  }
}
pm5 <- sum/100000
print(pm5)
```

```
## [1] 0.53868
```

Yes, it agrees the answer above.

Question 6

$E(Y) = 4 * E(X) + 10 = 30$
$Var(Y) = 4^2 * 10 = 160$
It doesn't follow m = 10

Question 7

(a)

```r
p7a <- pnorm(1.6, 1.6, 0.4) - pnorm(1, 1.6, 0.4)
cat("P(1<X<1.6) is: ", p7a)
```

```
## P(1<X<1.6) is:  0.4331928
```

(b)

```
nsim7 <- 500000
mcData7 <- rnorm(nsim7, 1.6, 0.4)
sum7 <- 0
for (i in 1:500000){
  if(1<=mcData7[i]&&mcData7[i]<=1.6){
    sum7 = sum7 + 1
  }
}
p7b <- sum7/nsim7
cat("The probability is: ", p7b)
```

```
## The probability is:  0.433926
```

(c)

```
p7c <- dbinom(2, 5, p7a)
cat("The exact probablity of 2 out of 5 in values between 1 and 1.6 is: ", p7c)
```

```
## The exact probablity of 2 out of 5 in values between 1 and 1.6 is:  0.3417185
```

Question 8

(a)

```
nsim8 <- 10000000
X <- rf(nsim8, 2, 5)
meanX <- mean(X)
varX <- var(X)
Y <- rf(nsim8, 10, 5)
meanY <- mean(Y)
varY <- var(Y)
```

(b)

Using formula, we get the results showed below:

```
meanXformula <- 5/(5-2)
cat("X mean is: ", meanXformula)
```

```
## X mean is:  1.666667
```

```
varXformula <- 2*5^2*(5+2-2)/(2*(5-2)^2*(5-4))
cat("X variance is: ", varXformula)
```

```
## X variance is:  13.88889
```

```r
meanYformula <- 5/(5-2)
cat("Y mean is: ", meanYformula)
```

```
## Y mean is:  1.666667
```

```r
varYformula <- 2*5^2*(5+10-2)/(10*(5-2)^2*(5-4))
cat("Y variance is: " , varYformula)
```

```
## Y variance is:  7.222222
```

(c)

After running the code from (a), we get:

```r
cat("X mean is: ", meanX)
```

```
## X mean is:  1.665261
```

```r
cat("X variance is: ", varX)
```

```
## X variance is:  13.26515
```

```r
cat("Y mean is: ", meanY)
```

```
## Y mean is:  1.666328
```

```r
cat("Y variance is: ", varY)
```

```
## Y variance is:  7.036259
```

The results are very closed to each other, so the results from (a) agree with the results from (b)