Dice

R Markdown

Question

Consider rolling two fair dice; suppose one die is red and the other is blue. Let

D1 = the outcome of the red die

D2 = the outcome of the blue die

Y = D1 + D2

Concise instructions: Use R to build the pmf (probability mass function) for D1 as a two-column data.frame, and use this table to compute its mean, variance (twice! see details below), and standard deviation. Repeat these steps for D2 and for Y . Use matrix multiplication wherever possible.

```
#1. Build the pmf for D1-----------------------------------------------------------

#possible outcomes.
k=c(1,2,3,4,5,6)

#probability of outcomes.
pk=c(1/6,1/6,1/6,1/6,1/6,1/6)

#build a data.frame.
pmfD1=data.frame(k,pk)
pmfD1
```

```
##   k        pk
## 1 1 0.1666667
## 2 2 0.1666667
## 3 3 0.1666667
## 4 4 0.1666667
## 5 5 0.1666667
## 6 6 0.1666667
```

```
#verify the probabilities add up to one
sum(pmfD1$pk)
```

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

```
#2. Compute the mean----------------------------------------------------------------
mu1=k%*%pk
mu1
```

```
##      [,1]
## [1,]  3.5
```

```
#3. compute variance using the defination-------------------------------------------
var1_1=((k-as.vector(mu1))^2)%*%pk
var1_1
```

```
##          [,1]
## [1,] 2.916667
```

```r
#using the shortcut formula of variance
var1_2=((k^2)%*%pk)-(mu1^2)
var1_2
```

```
##          [,1]
## [1,] 2.916667
```

```r
#4. compute the standard deviation-----------------------------------------------------
sd1=sqrt(var1_1)
sd1
```

```
##          [,1]
## [1,] 1.707825
```

```r
#5. Repeat steps 1-4 for D2-----------------------------------------------------------

k=c(1,2,3,4,5,6)
pk=c(1/6,1/6,1/6,1/6,1/6,1/6)

pmfD2=data.frame(k,pk)
pmfD2
```

```
##   k        pk
## 1 1 0.1666667
## 2 2 0.1666667
## 3 3 0.1666667
## 4 4 0.1666667
## 5 5 0.1666667
## 6 6 0.1666667
```

```r
sum(pmfD2$pk)
```

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

```r
mu2=k%*%pk
mu2
```

```
##      [,1]
## [1,]  3.5
```

```r
var2_1=((k-as.vector(mu2))^2)%*%pk
var2_1
```

```
##          [,1]
## [1,] 2.916667
```

```r
var2_2=((k^2)%*%pk)-(mu2^2)
var2_2
```

```
##          [,1]
## [1,] 2.916667
```

```r
sd2=sqrt(var2_2)
sd2
```

```
##          [,1]
## [1,] 1.707825
```

```r
#5. Repeat steps 1-4 for Y-----------------------------------------------------------
```

```r
#build row and column labels.
myrows <-c(1:6)
mycols <-c(1:6)

#create the full-size matrix and fill its cells with zero.
y <- matrix(0,nrow=6, ncol=6)

#lable our matrix
rownames(y) <- myrows
colnames(y) <- mycols

# "i" will be rows' index, "j" will be columns' index.
for(i in 1:6){
  for(j in 1:6){

    #fill cell[i,j] of matrix.
    y[i,j] <-myrows[i]+mycols[j]


  }
}

#display y.
View(y)

#possible outcomes.
k=c(2:12)

#probability of outcomes:

##build a vector with 12 element of zero.
pk=0*c(1:11)

##fill the vector with probabilities.
for(r in 2:12)
{
  #count the number of occurrence.
  pk[r-1]=(sum(match(y,r,nomatch =0))/36)
}
pk
```

```
##  [1] 0.02777778 0.05555556 0.08333333 0.11111111 0.13888889 0.16666667
##  [7] 0.13888889 0.11111111 0.08333333 0.05555556 0.02777778
```

```r
#build a data.frame.
pmfy=data.frame(k,pk)
pmfy
```

```
##     k         pk
## 1   2 0.02777778
## 2   3 0.05555556
## 3   4 0.08333333
## 4   5 0.11111111
## 5   6 0.13888889
## 6   7 0.16666667
```

```
## 7   8 0.13888889
## 8   9 0.11111111
## 9  10 0.08333333
## 10 11 0.05555556
## 11 12 0.02777778
```

```
#verify the probabilities add up to one
sum(pmfy$pk)
```

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

```
#Compute the mean
mu=pk%*%k
mu
```

```
##      [,1]
## [1,]    7
```

```
#compute variance using the defination
var_1=((k-as.vector(mu))^2)%*%pk
var_1
```

```
##          [,1]
## [1,] 5.833333
```

```
#using the shortcut formula of variance
var_2=((k^2)%*%pk)-(mu^2)
var_2
```

```
##          [,1]
## [1,] 5.833333
```

```
#compute the standard deviation
sd2=sqrt(var_2)
sd2
```

```
##          [,1]
## [1,] 2.415229
```