MA 2611 Lab 3

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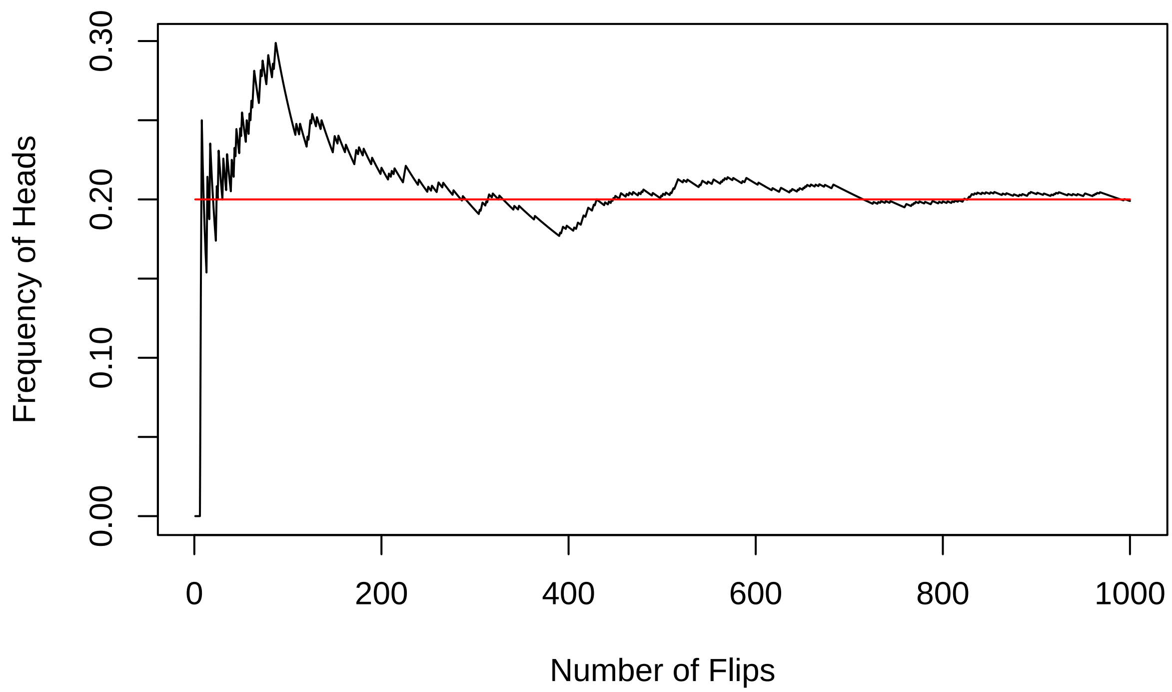
1. Consider an unfair coin with a chance of 0.2 to get heads and 0.8 to get tails.

a. For 3 independent coin flips, what are the possible outcomes for heads and tails and their relative frequencies?

HHH = .008, HHT = .032, HTT = .128, TTT = .512, TTH = .032, THH = .032, THT = .128, HTH = .032

b. For 1000 independent coin flips, draw a line plot to visualize how the relative frequency converges for the probability of landing heads up.

```
coin.1000 = sample(c(0,1),1000,replace=T,prob = c(0.8,0.2))
heads.1000 = cumsum(coin.1000==1)
heads.prop = heads.1000/(1:1000)
plot(1:1000, heads.prop, type="l", xlab="Number of Flips",
ylab="Frequency of Heads")
lines(1: 1000, rep(0.2, 1000), col="red")
```



2. Assume a random variable X follows a discrete distribution, where the possible values of X are {0, 2, 4, 6} with the respective probabilities {0.3, 0.2, 0.2, 0.3}.

a. Calculate P(X >= 3) and P(X <= 4)
   P(X >= 3) = (0.2 + 0.3) = **0.5** P(X <= 4) = (0.3 + 0.2 + 0.2) = **0.7**
b. Calculate the expected value of X
   E(X) = 0(0.3) + 2(0.2) + 4(0.2) + 6(0.3) = **3**
c. Calculate the standard deviation of X
   SD = **2.41**
d. Generate a sample of 1000 values of X and see how close the sample frequencies, the sample mean, and the sample standard deviation are to the calculated values in parts (b) and (c).

```
x = sample(c(0,2,4,6),1000,replace=T,prob = c(0.3,0.2,0.2,0.3))
table(x)/1000
```

```
## x
##     0     2     4     6
## 0.298 0.221 0.192 0.289
```

```
mean(x)
```

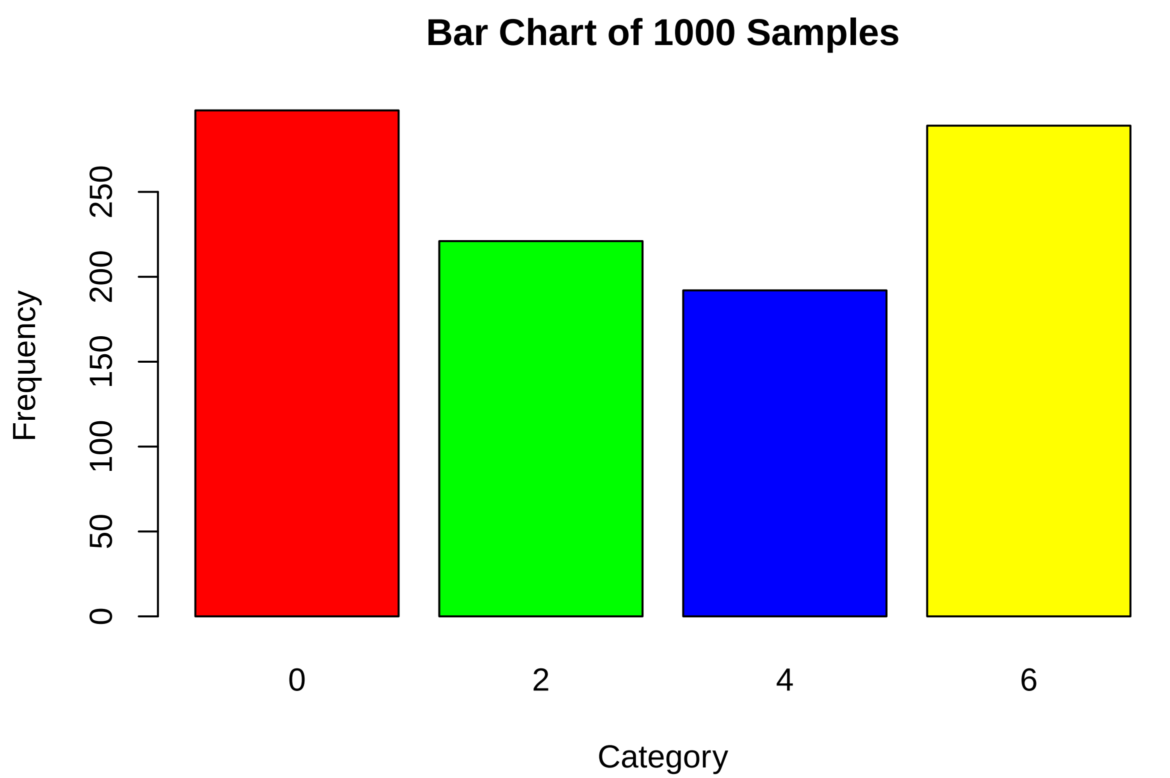
```
## [1] 2.944
```

```
sd(x)
```

```
## [1] 2.387166
```

e. Create a barplot using the sample of X from part (d) using different colors to distinguish different values. Label the axes and add a title to the plot.

```
z = table(x)
names(z)<-c("0","2","4","6")
barplot(z,main="Bar Chart of 1000 Samples",
col=c("red","green","blue","yellow"),
xlab="Category",ylab="Frequency")
```



3. Let a discrete random variable Y following a binomial distribution:
   Y ~ Binomial(8, 0.5)

```
Y = rbinom(1000,8,0.5)
```

a. Calculate P(Y=5)

```
sum(Y==5)/1000
```

```
## [1] 0.211
```

b. Calculate P(Y<3) and P(Y>6)

```
sum(Y<3)/1000
```

```
## [1] 0.143
```

```
sum(Y>6)/1000
```

```
## [1] 0.029
```

c. Generate a sample of 20000 values of Y and create a barplot of the distribution using different colors to distinguish different values. Label the axes and add a title to the plot.

```
Y = rbinom(20000,8,0.5)
barplot(main="Distribution of 20000 Values",table(Y),xlab="Category",ylab="Frequency",
col=c("red","orange","yellow","green","blue",
"purple", "violet", "pink", "white"))
```