**Solution 1**

1. Probability Distribution of X: Poisson Distribution.

How it satisfies: Poisson distribution is generally used to model the number of successes per unit area or time (here Cars arrival is the occurrence/success)

> dpois(5,6.7)

[1] 0.1384904

> ppois(5,6.7)

[1] 0.3406494

**Solution 2**

> 1-punif(37,30,40)

[1] 0.3

> punif(32,30,40)

[1] 0.2

> punif(38,30,40) - punif(34,30,40)

[1] 0.4

**Solution 3**

**Solution 4**

> pexp(6,rate = 1/5)

[1] 0.6988058

> pexp(5,rate = 1/5) - pexp(3,rate = 1/5)

[1] 0.1809322

**Solution 5**

> dbinom(25,400,.07)

[1] 0.06867971

> pbinom(24,400,.07)

[1] 0.2511457

> pbinom(25,400,.07) - pbinom(20,400,.07)

[1] 0.2541306

**Solution 6**

> x<-rpois(100,3)

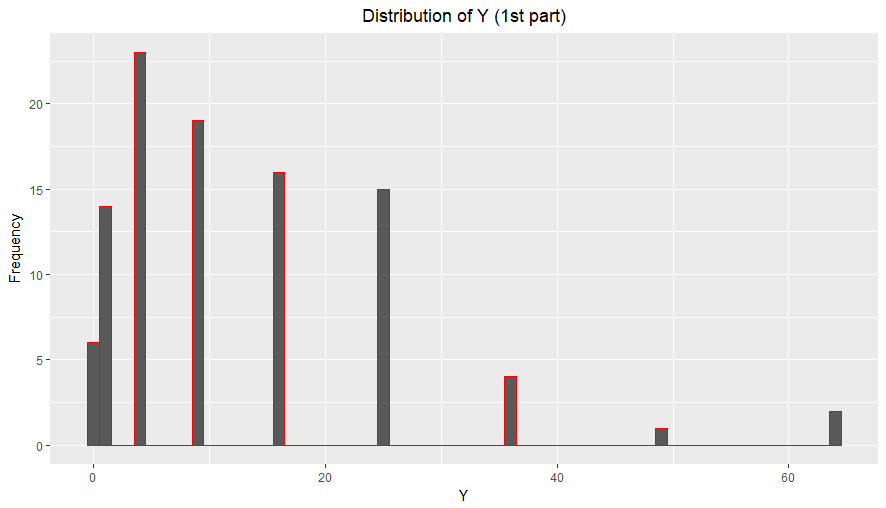
> y<-x^2

> dat<-data.frame(x,y)

> g<-ggplot(data = dat,aes(x=dat$y))+geom\_histogram(binwidth = 1,col = "red")

> g<-g+ggtitle("Distribution of Y")+theme(plot.title = element\_text(hjust=0.5))+xlab("Y")+ylab("Frequency")

> g



> dt<-data.frame(y\_bar=0,sd=0) #Initializing an empty data frame

> for (i in 1:1000) { #looping 1000 times to store y\_bar in dt

+ x<-rpois(100,3)

+ y<-x^2

+ y\_bar<-mean(y)

+ sd<-sd(y)

+ dt<-rbind(dt,cbind(y\_bar,sd))

+ }

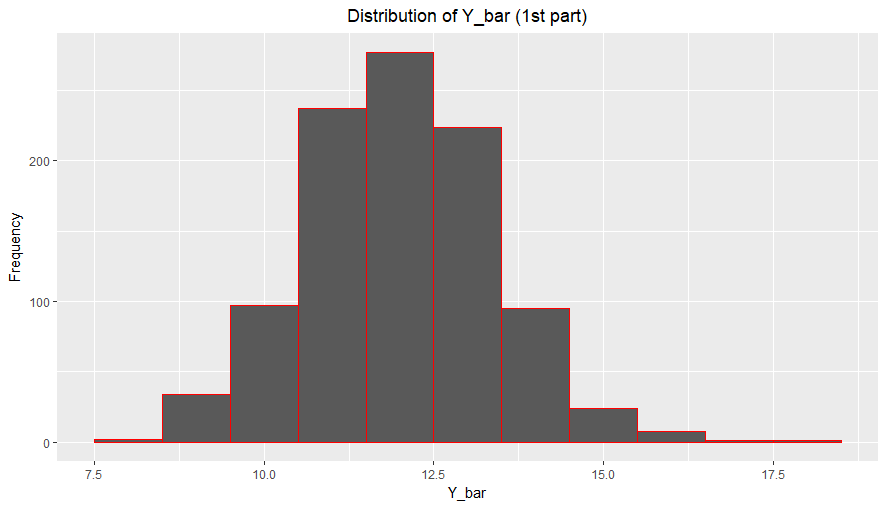
> dt<-data.frame(dt[2:1001,])

> g<-ggplot(data = dt,aes(x=dt$y))+geom\_histogram(binwidth = 1,col = "red")

> g<-g+ggtitle("Distribution of Y\_bar")+theme(plot.title = element\_text(hjust=0.5))+xlab("Y\_bar")+ylab("Frequency")

> g

Histogram below (normally shaped) is generated from random variable X (poisson distributed)



> u\_bar<-mean(dt$y\_bar)

> dt$z<-with(dt, (dt$y\_bar - u\_bar)/(dt$sd/10))

>

> mean\_z<-mean(dt$z)

> sd\_z<-sd(dt$z)

> g<-ggplot(data = dt,aes(x=dt$z))+geom\_histogram(binwidth = 1,col = "red")

> g<-g+ggtitle("Distribution of Z & Fitted normal curve")+theme(plot.title = element\_text(hjust=0.5))+xlab("Z")+ylab("Frequency")

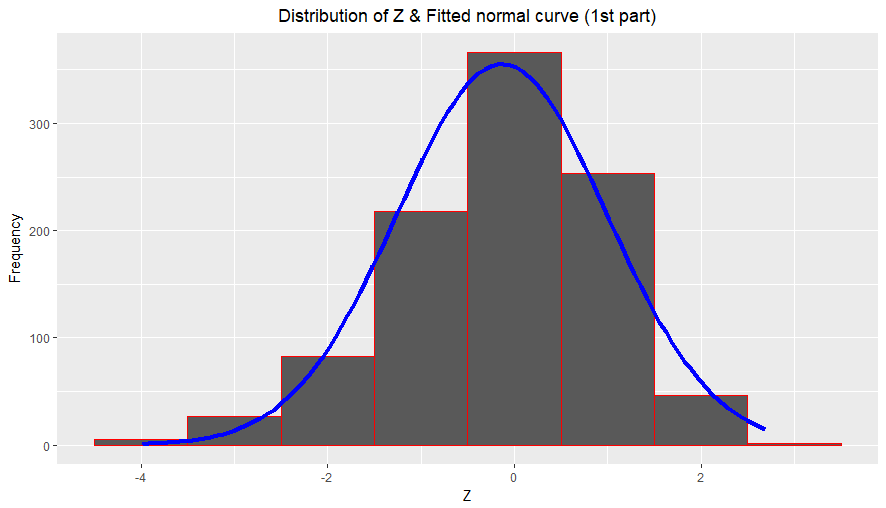
> g<-g+stat\_function(fun = function(x,mean\_z,sd\_z){

+ dnorm(x=x,mean\_z,sd\_z)\*1000},

+ args = c(mean = mean\_z, sd = sd\_z)

+ ,size = 1.5,col = "blue")

> g



> x<-rexp(100,1/3)

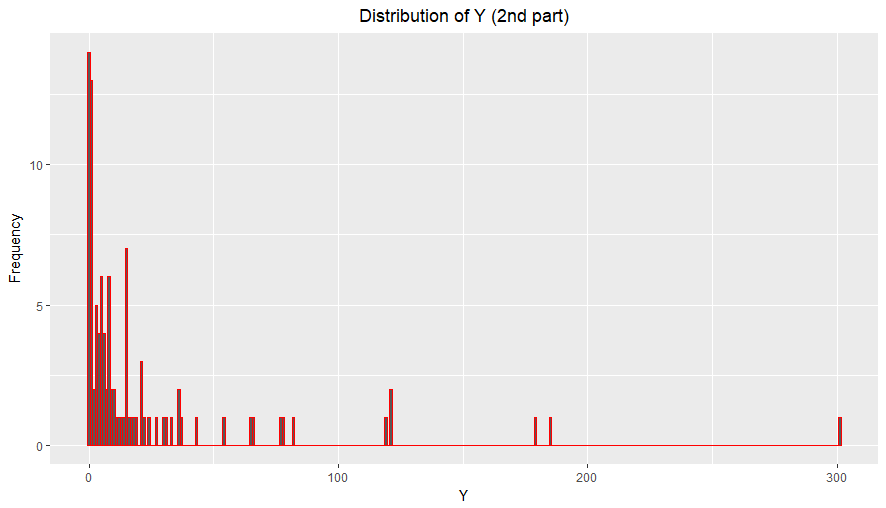
> y<-x^2

> dat<-data.frame(x,y)

> g<-ggplot(data = dat,aes(x=dat$y))+geom\_histogram(binwidth = 1,col = "red")

> g<-g+ggtitle("Distribution of Y (2nd part)")+theme(plot.title = element\_text(hjust=0.5))+xlab("Y")+ylab("Frequency")

> g



> dt<-data.frame(y\_bar=0,sd=0) #Initializing an empty data frame

> for (i in 1:1000) { #looping 1000 times to store y\_bar in dt

+ x<-rpois(100,3)

+ y<-x^2

+ y\_bar<-mean(y)

+ sd<-sd(y)

+ dt<-rbind(dt,cbind(y\_bar,sd))

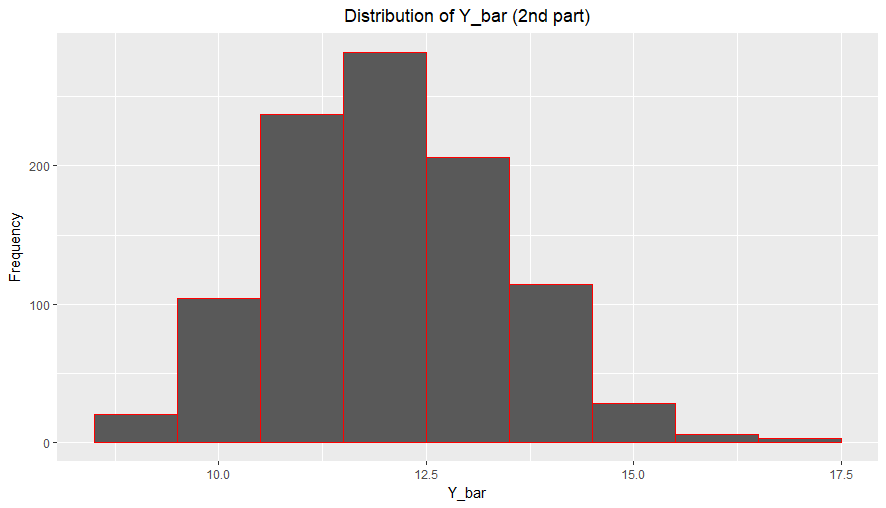
+ }

> dt<-data.frame(dt[2:1001,])

> g<-ggplot(data = dt,aes(x=dt$y))+geom\_histogram(binwidth = 1,col = "red")

> g<-g+ggtitle("Distribution of Y\_bar (2nd part)")+theme(plot.title = element\_text(hjust=0.5))+xlab("Y\_bar")+ylab("Frequency")

> g



> u\_bar<-mean(dt$y\_bar)

> dt$z<-with(dt, (dt$y\_bar - u\_bar)/(dt$sd/10))

> mean\_z<-mean(dt$z)

> sd\_z<-sd(dt$z)

> g<-ggplot(data = dt,aes(x=dt$z))+geom\_histogram(binwidth = 1,col = "red")

> g<-g+ggtitle("Distribution of Z & Fitted normal curve (2nd part)")+theme(plot.title = element\_text(hjust=0.5))+xlab("Z")+ylab("Frequency")

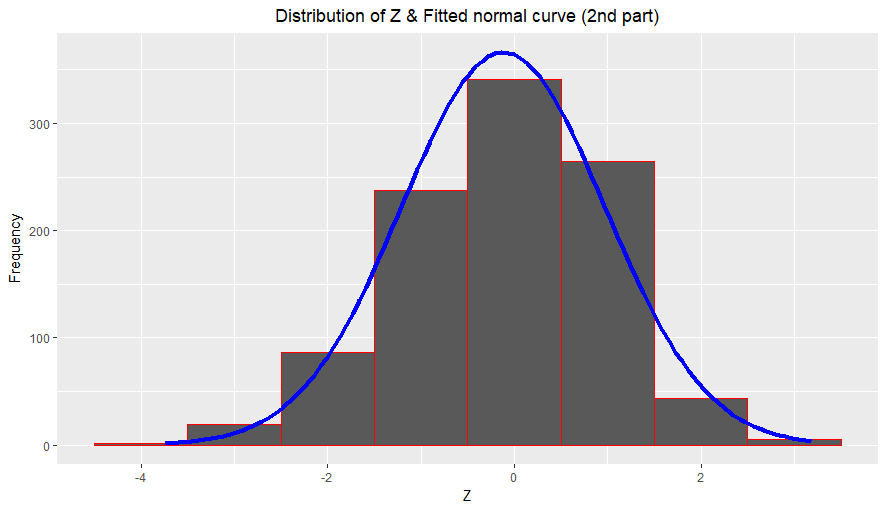
> g<-g+stat\_function(fun = function(x,mean\_z,sd\_z){

+ dnorm(x=x,mean\_z,sd\_z)\*1000},

+ args = c(mean = mean\_z, sd = sd\_z)

+ ,size = 1.5,col = "blue")

> g



**Comment:**

1. Normal curve fit very good on both the distribution in part 1 & part 2
   1. It implies that whatever is our X (exponential or poison), the distribution of the mean of (where Y = X2) is normally distributed.
2. Mean of for both the distributions is roughly 12