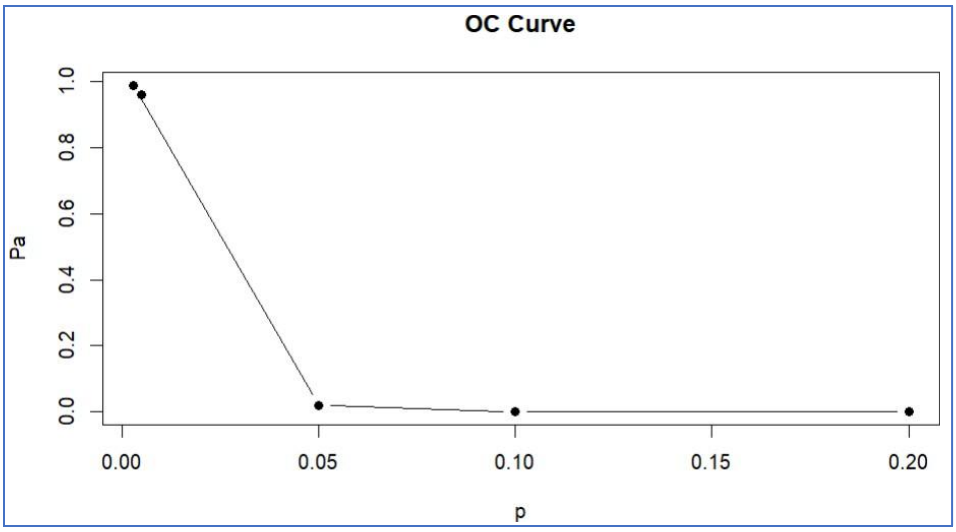
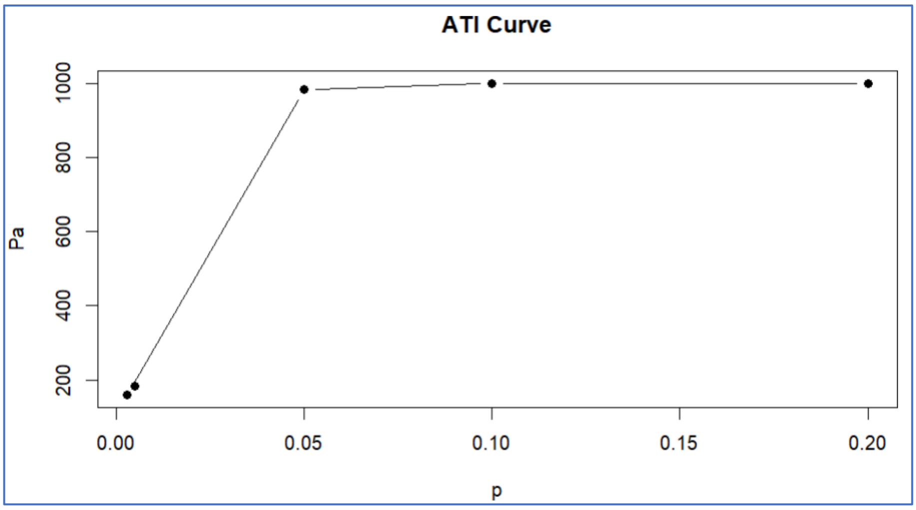
Practical – 3: Acceptance Sampling

Q.1) Draw O.C. curve for the single sampling plan with N=1000, n=150 and c = 2. Plot the ATI and AOQ curves for the above plan. Also Obtain the values of AOQL. Use the p values as 0.005, 0.003,0.05,0.1 and 0.2 to draw the O.C. curve.

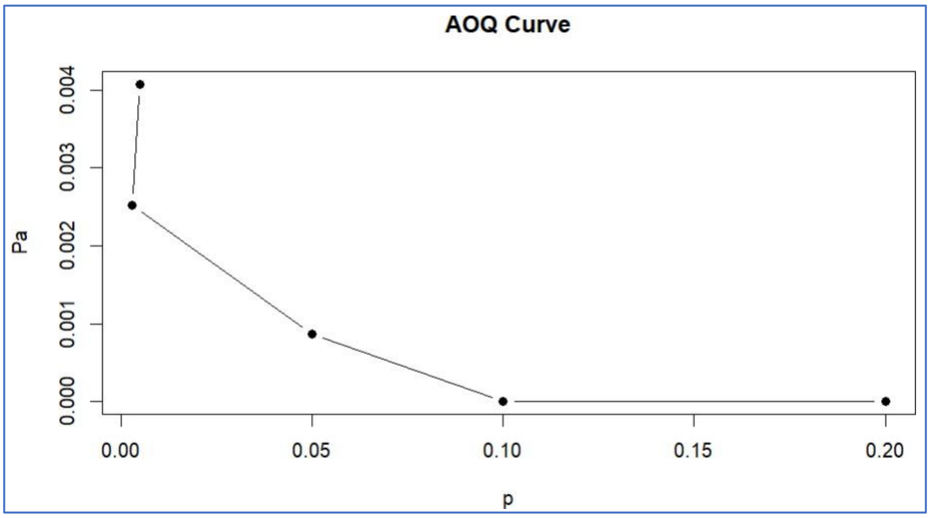
```
> N<-1000
> n<-150
> c<-2
> p<-c(0.005,0.003,0.05,0.1,0.2)
> oc<-round(ppois(2,lambda = n*p),4)
> #OC curve
> oc
[1] 0.9595 0.9891 0.0203 0.0000 0.0000
> plot(p, oc, type="b", pch=16, main="OC Curve", xlab="p", ylab="Pa")
```




```
> #ATI curve
> ATI<-n*oc+(1-oc)*N
> ATI
[1]  184.425  159.265  982.745 1000.000 1000.000
> plot(p, ATI, type="b", pch=16, main="ATI Curve", xlab="p", ylab="Pa")
```

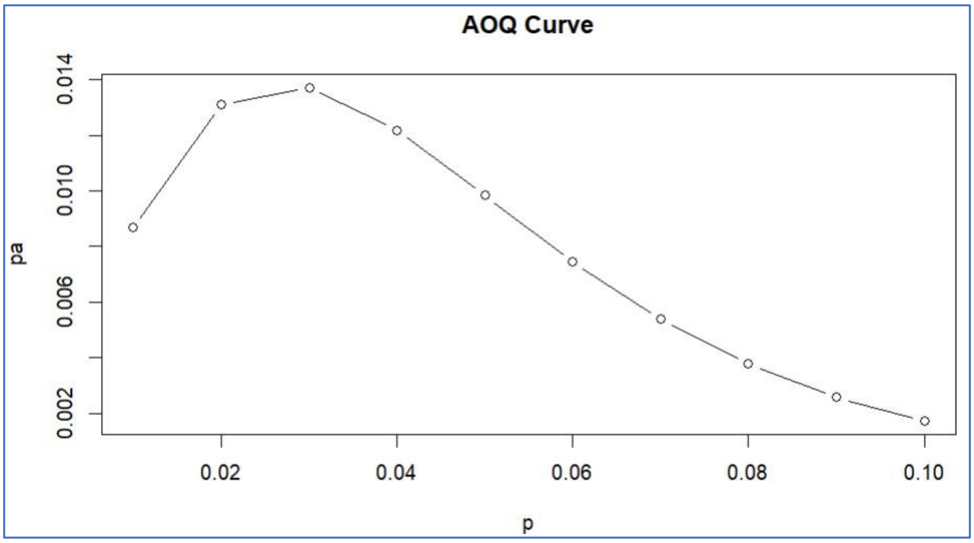



```
> #AQI curve
> AOQ<-(((N-n)/N)*p)*oc
> AOQ
[1] 0.004077875 0.002522205 0.000862750 0.000000000 0.000000000
> plot(p, AOQ, type="b", pch=16, main="AOQ Curve", xlab="p", ylab="Pa")
```



<u>Q.2)</u> A manufacturer inspects a product lot using n = 60 and c = 1 under a rectifying inspection plan. • If the defect rate is 4%, calculate the Average Outgoing Quality (AOQ). • Find the AOQL (Maximum AOQ value across defect levels 1% to 10%). • Visualize the AOQ Curve in R.

```
> n<-60

> c<-1

> N<-5000

> p_val<-seq(0.01,0.10, by=0.01)

> p_val

 [1] 0.01 0.02 0.03 0.04 0.05 0.06 0.07 0.08 0.09 0.10

> Pa<-ppois(c,lambda = n*p_val)

> Pa

 [1] 0.87809862 0.66262727 0.46283689 0.30844104 0.19914827 0.12568912 0.07797700

 [8] 0.04773253 0.02890612 0.01735127

> AOQ_2<-(p_val*(Pa))*(N-n)/N

> AOQ_2

 [1] 0.008675614 0.013093515 0.013718485 0.012189590 0.009837925 0.007450851 0.005392889

 [8] 0.003772779 0.002570332 0.001714305

> AOQL<-max(AOQ_2)

> AOQL

[1] 0.01371849

> plot(p_val,AOQ_2, type="b", main="AOQ Curve", xlab="p", ylab="pa")
```



<u>Q.3)</u> Find the producer's risk and consumer's risk for the following single sampling plans:

a. N=100, n=20, c=1, p=0.005 and LTFD(pt) = 0.1

b. N=1500, n=100, c=3, p=0.01 and LTFD(pt) = 0.2

c. N=250, n=40, c=2, p=0.03 and LTFD(pt) = 0.15

```
> #Producers risk = d = 1-Pa(Pt)
> #Consumers risk = p = Pa(Pt)
> #a
> N=1000
> n=20
> c=1
> p=0.001
> pt=0.1
> pa<-ppois(c,lambda = n*p)
> pa
[1] 0.9998026
> pr<-1-(pa*pt)
> pr
[1] 0.9000197
> cr<-pa*pt
> cr
[1] 0.09998026
> #b
> N=1500
> n=100
> c=3
> p=0.01
> pt=0.2
> pa1<-ppois(c,lambda = n*p)
> pa1
[1] 0.9810118
```

```
> pr1<-1-(pa1*pt)
> pr1
[1] 0.8037976
> cr1<-pa1*pt
> cr1
[1] 0.1962024
> #c
> N=250
> n=40
> c=2
> p=0.03
> pt=0.15
> pa2<-ppois(c,lambda = n*p)
> pa2
[1] 0.8794871
> pr2<-1-(pa2*pt)
> pr2
[1] 0.8680769
> cr2<-pa2*pt
> cr2
[1] 0.1319231
```

Q.4) **For a sampling plan with N = 1200, n = 64 and c=1, determine the probability of acceptance of the lot with**

a) 0.5% defective

b) 0.8% defective

c) 1% defective

d) 2% defective

e) 4% defective

f) 10% defective

Draw an OC (Operating Characteristic) curve. Also plot ATI (Average Total Inspection) and AOQ (Average Outgoing Quality) curves.

```
> N <- 1200
> n <- 64
> c <- 1
> p <- c(0.005, 0.008, 0.01, 0.02, 0.04, 0.10)
```

#Defective Fractions (p):

(a) **0.5% defective** → p=0.005

(b) **0.8% defective** → p=0.008

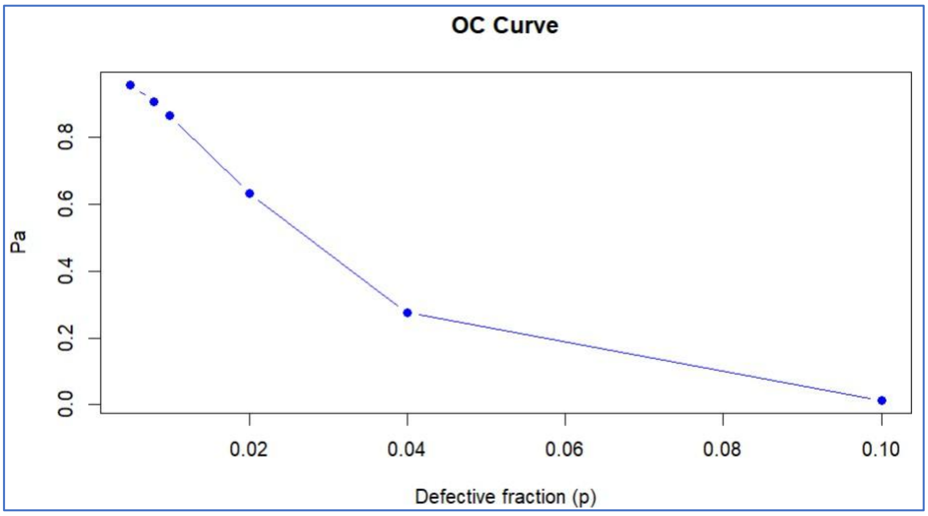
(c) **1% defective** → p=0.01

(d) **2% defective** → p=0.02

(e) **4% defective** → p=0.04

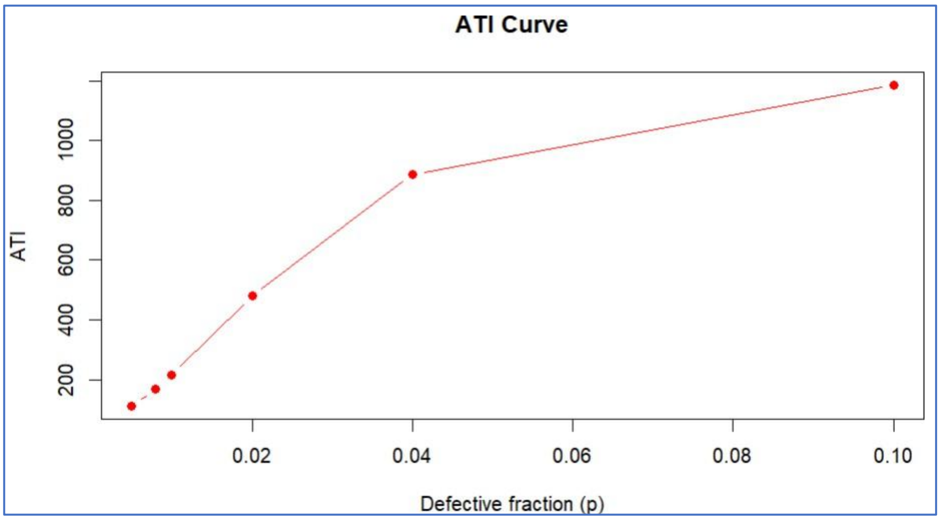
(f) **10% defective** → p=0.10

```
> Pa <- round(ppois(c, lambda = n * p), 4)
> Pa
[1] 0.9585 0.9061 0.8648 0.6339 0.2752 0.0123
> #OC (Operating Characteristic) Curve
> plot(p, Pa, type="b", pch=16, col="blue", main="OC Curve", xlab="Defective fraction (p)", ylab="Pa")
```

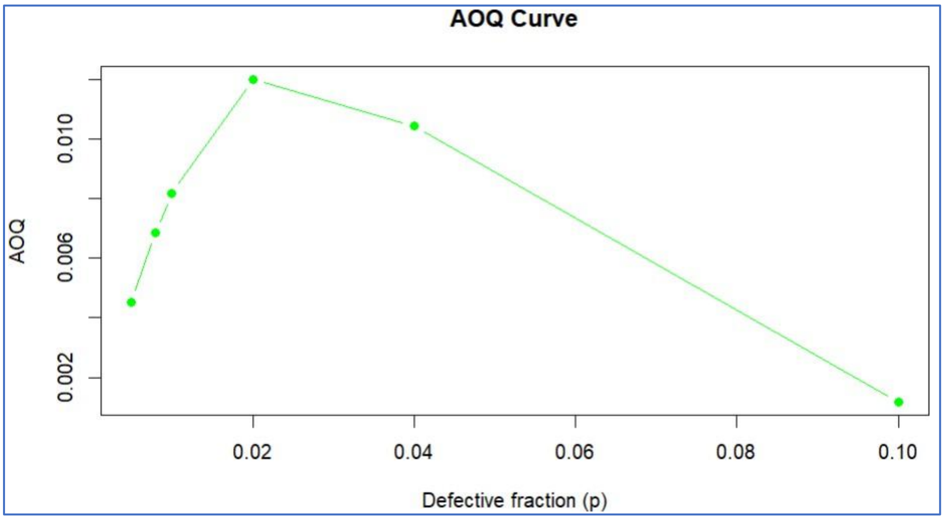



```
> ATI <- n * Pa + (1 - Pa) * N
> ATI
[1]  111.1440  170.6704  217.5872  479.8896  887.3728 1186.0272
> # Plot ATI Curve
```

```
> plot(p, ATI, type="b", pch=16, col="red", main="ATI Curve", xlab="Defective fraction (p)", ylab="ATI")
```




```
> AOQ <- (((N - n) / N) * p) * Pa

> AOQ

[1] 0.004536900 0.006862197 0.008186773 0.012001840 0.010420907 0.001164400

> # Plot AOQ Curve

> plot(p, AOQ, type="b", pch=16, col="green", main="AOQ Curve", xlab="Defective fraction (p)", ylab="AOQ")
```



<u>Q.5)</u> A bicycle manufacturer has a contract with a brace supplier to supply braces to support headlights. Braces are shipped in lot of 3000. Suppose the bicycle manufacturer decides to sample 15 braces randomly from the lot and accept the lot if the number of defectives does not exceed 1. In the lot supplied by the brace supplier, 2% of the items are defective. What is the probability that the bicycle manufacturer will accept the lot? (Use Binomial distribution to solve). What is the probability that an error of the first type will occur? If instead of 2%, the proportion defective is actually 12% which is not acceptable to the bicycle manufacturer. What is the probability of committing an error of the second type?

```
> n <- 15
> c <- 1
> #Case 1: p = 0.02 (2% defective)
> p1 <- 0.02
> Pa1 <- pbinom(c, size=n, prob=p1)
> alpha <- 1 - Pa1
> #Case 2: p = 0.12 (12% defective)
> p2 <- 0.12
> Pa2 <- pbinom(c, size=n, prob=p2)
> beta <- Pa2
> #Results
> cat("Probability of acceptance (Pa) for 2% defectives:", Pa1, "\n")
Probability of acceptance (Pa) for 2% defectives: 0.9646617
> cat("Type I error (Producer's Risk α):", alpha, "\n")
Type I error (Producer's Risk α): 0.03533831
> cat("Probability of acceptance (Pa) for 12% defectives:", Pa2, "\n")
Probability of acceptance (Pa) for 12% defectives: 0.4476022
> cat("Type II error (Consumer's Risk β):", beta, "\n")
Type II error (Consumer's Risk β): 0.4476022
```