# hw2

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## Problem 1

### (i)

**N = 20, 30, 50, 75, 100, respectively**

```
## [1] 5.955987e-01 9.401122e-02 2.305229e-04 1.826106e-08 5.431127e-13
```

### (ii)

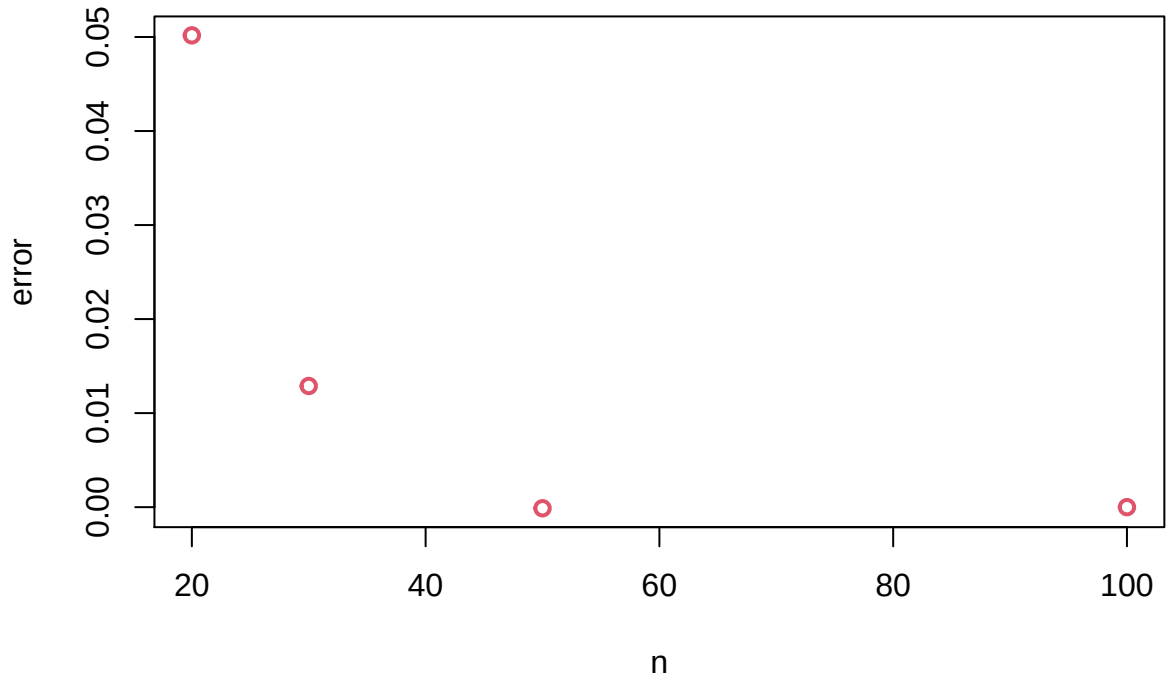
**N = 20, 30, 50, 75, 100, respectively**

```
## [1] 5.454243e-01 8.112525e-02 3.470073e-04 1.475701e-07 4.557597e-11
```

### (iii)

```
## [1] 5.955987e-01 9.401122e-02 2.305229e-04 5.431127e-13
```

```
## [1] 5.454243e-01 8.112525e-02 3.470073e-04 4.557597e-11
```

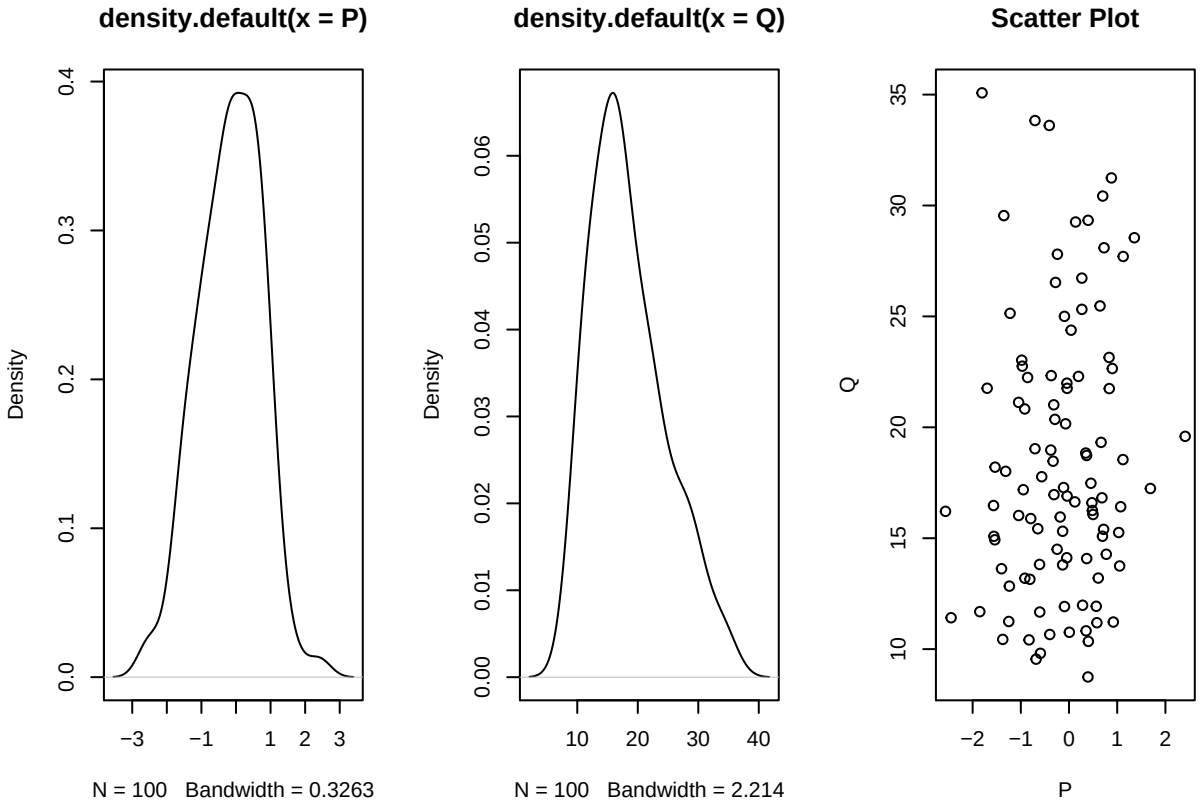



**(iv)**

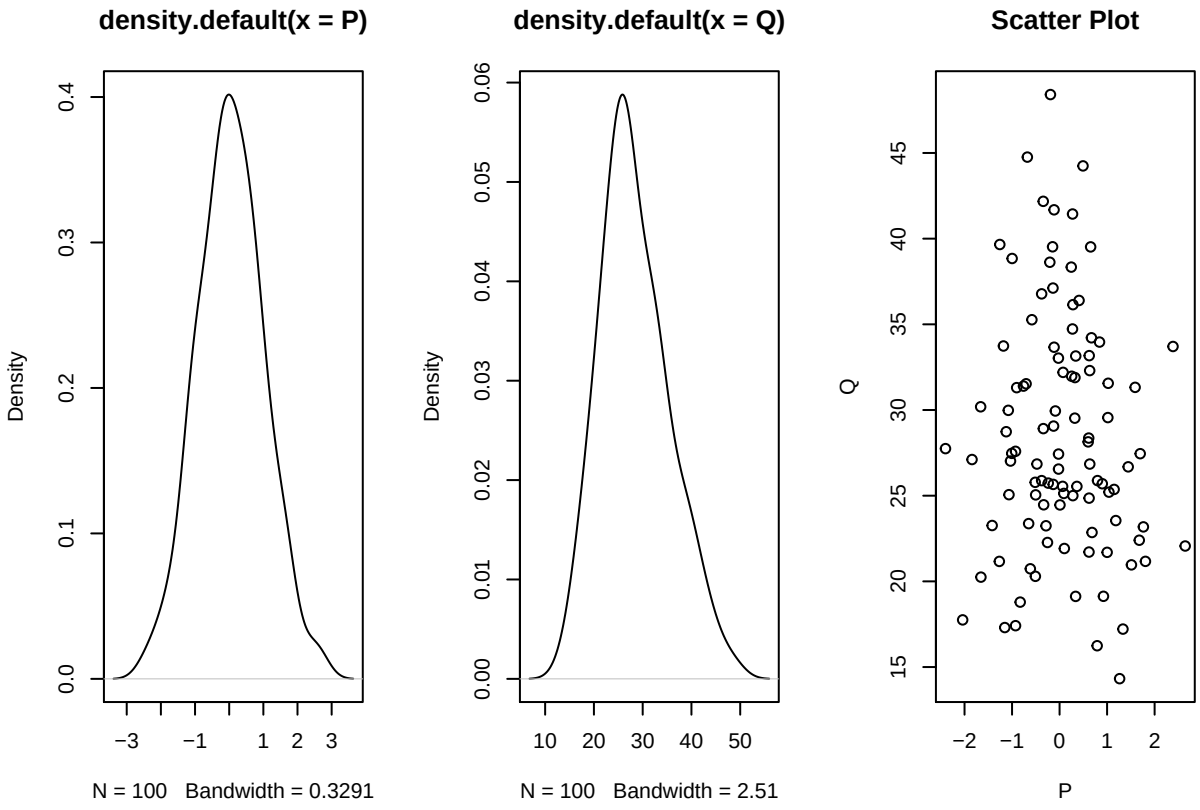
The error plots shows that as N gets greater the error decreases, and when N=50 the approximation holds up well because the error is low.

## Problem 2

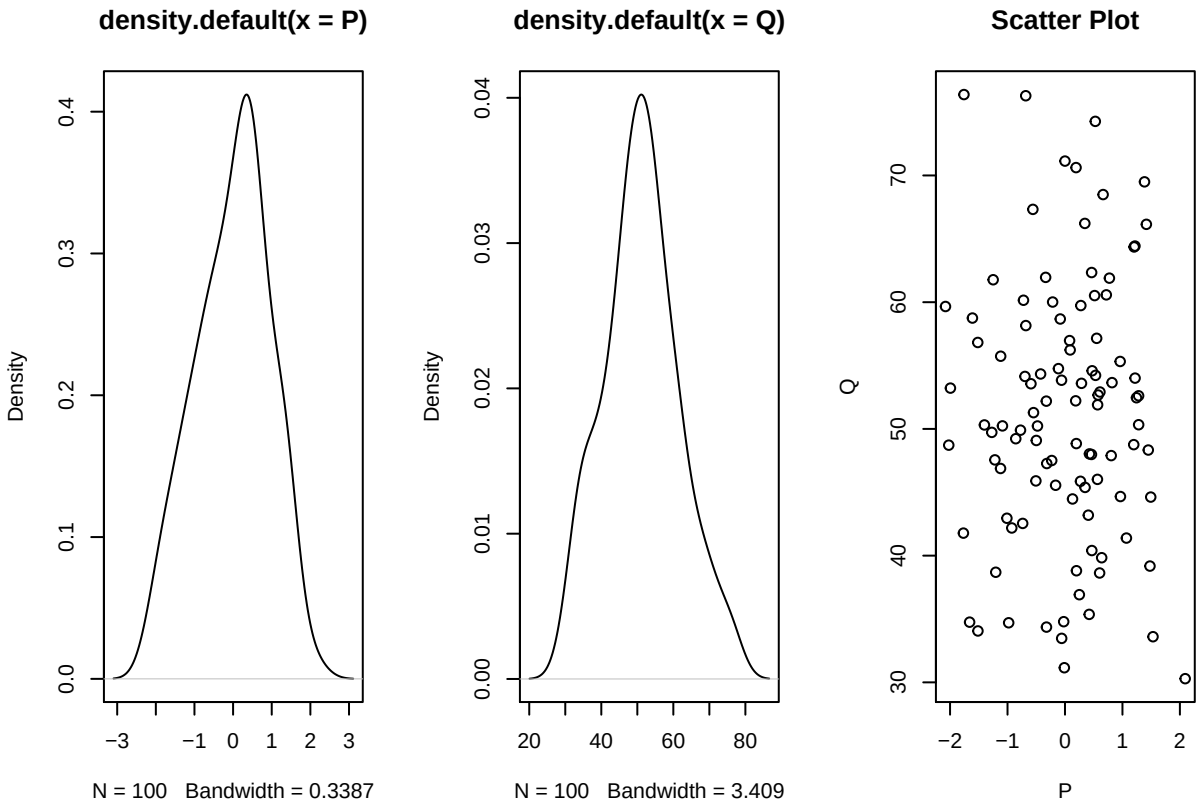
(i)


density.default(x = P)
Density
N = 100 Bandwidth = 0.3263
density.default(x = Q)
Density
N = 100 Bandwidth = 2.214
Scatter Plot
Q
P

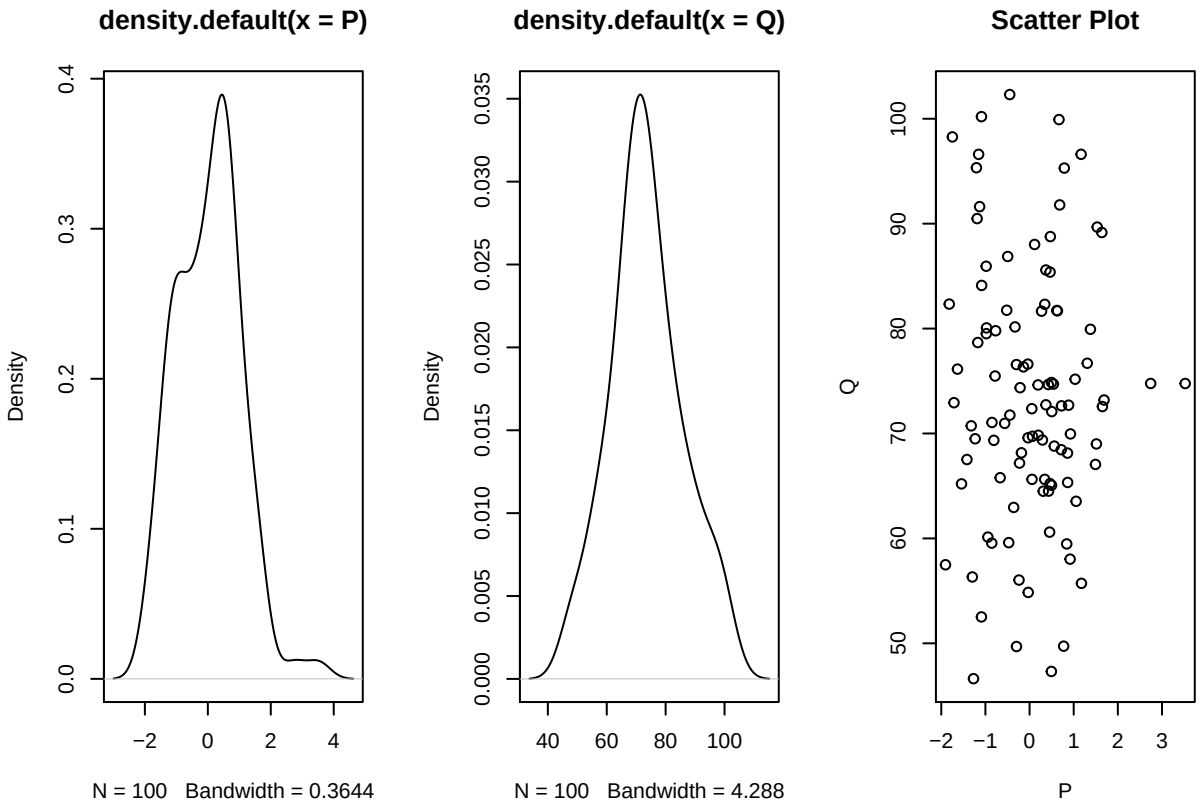
(ii)


density.default(x = P)
Density
N = 100 Bandwidth = 0.3291
density.default(x = Q)
Density
N = 100 Bandwidth = 2.51
Scatter Plot
Q
P

(iii)


density.default(x = P)
Density
N = 100 Bandwidth = 0.3387
density.default(x = Q)
Density
N = 100 Bandwidth = 3.409
Scatter Plot
Q
P

## (iv)




## (v)

The plots of x average - 2 are symmetrical and therefore follows normal distribution. The plots of (n - 1) is right skewed and therefore follows chi square distribution.

## (v1)

The scatter plot shows that there is no association between them, therefore they are independently distributed.

## Problem 3

$E(x) = np$

$E(X+Y) = E(X) + E(Y)$

$Y \begin{cases} P(Y=1) = P \\ P(X=0) = 1-P \end{cases}$

$E(x) = n\,E(Y) = \boxed{np}$

$E(Y) = p + (1-p)\cdot 0 = p$

## Problem 4

$$E[x] = \frac{1}{\sqrt{n}} \frac{\Gamma(\frac{n+1}{2})}{\Gamma(1/2)\Gamma(n/2)} \int_{-\infty}^{+\infty} x\left(1 + \frac{x^2}{n}\right)^{-\frac{n+1}{2}} dx$$

given that $n$ is greater than 1 so it is defined, the integral on the right evaluates to 0.

Therefore, $E[x] = 0$