# Q1

Huiyan Li

4/18/2020

# Assignment 2: Question 1

## A) Suppose we decide to collect 30 observations (n = 30). Calculate Power of this test.

```
n = 30
sigma_square = 16
sigma = sqrt(sigma_square)
alpha = 0.05
mu_null = 5
mu_alpha = 4
significance = alpha
```

$Z_0 = \frac{\overline{X}-\mu_0}{\sigma/\sqrt{n}}$
$\overline{X} = Z_\alpha * \sigma/\sqrt{n} + \mu_0$
$\overline{X} = Z_{0.05} * (4/\sqrt{30}) + 5$
$\overline{X} = -1.644854 * 0.73029674334 + 5$
$\overline{X} = 3.79876848$
$Power = P[\overline{X} < 3.79876848$ Under the $H_\alpha]$

$P[Z \leq \frac{\overline{X}-\mu_\alpha}{\sigma/\sqrt{n}}] = 1 - P[Z > \frac{3.79876848-4}{4/\sqrt{30}}] = 1 - pnorm(-0.27554760696) = 1 - 0.3914478 = 0.6085521$
$Power = 0.6085521$

```
sigma = sqrt(sigma_square)
x_bar = qnorm(significance) * (sigma / sqrt(n)) + mu_null
probability = (x_bar - mu_alpha) / (sigma / sqrt(n))
power = 1 - pnorm(probability)
power
```

```
## [1] 0.6085521
```

## 1.B) Suppose we want to ensure that the power is 80%. What should be the sample size? (n=?)

- $P = \frac{\overline{X}-\mu_0}{\sigma/\sqrt{n}}$
- $n = (\frac{p*\sigma}{\overline{X}-\mu_\alpha})^2 = (\frac{qnorm(1-0.8)*4}{3.79876848-4})^2 = (16.72941)^2 = 279.8732$

```
power = 0.8
reverse_probability = qnorm(1 - 0.8)
estimated_n = ((reverse_probability * sigma)/ (x_bar - mu_alpha))**2
estimated_n
```

```
## [1] 279.874
```