

MidTerm-2

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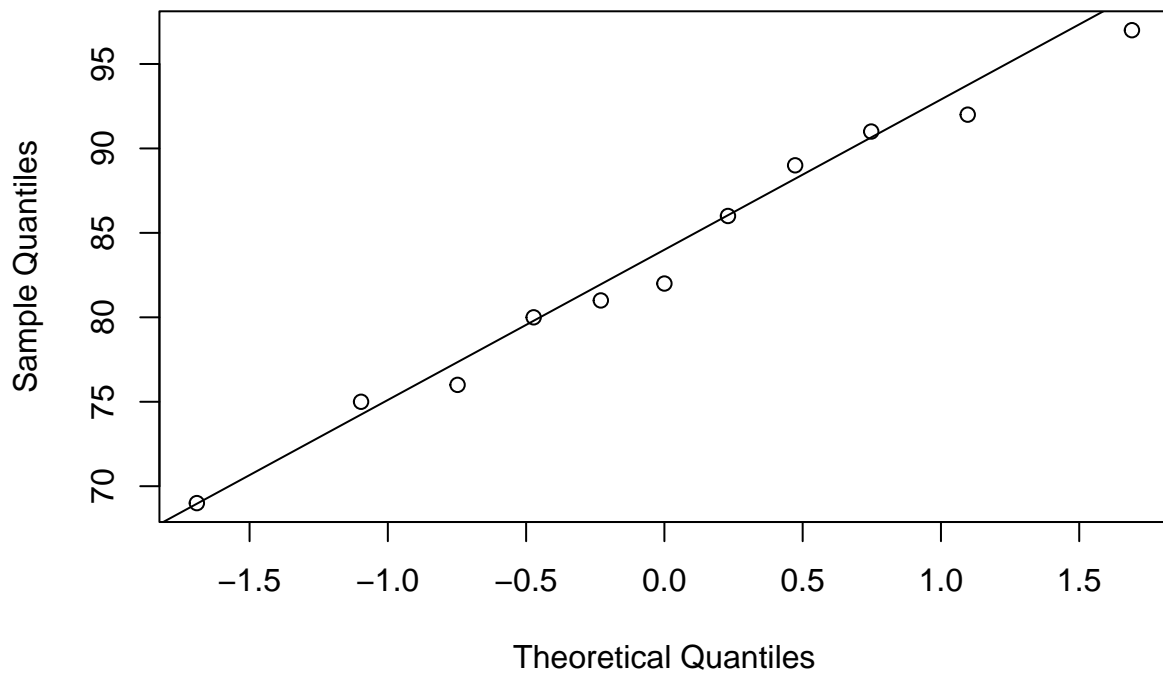
Solution(1)

Part(a)

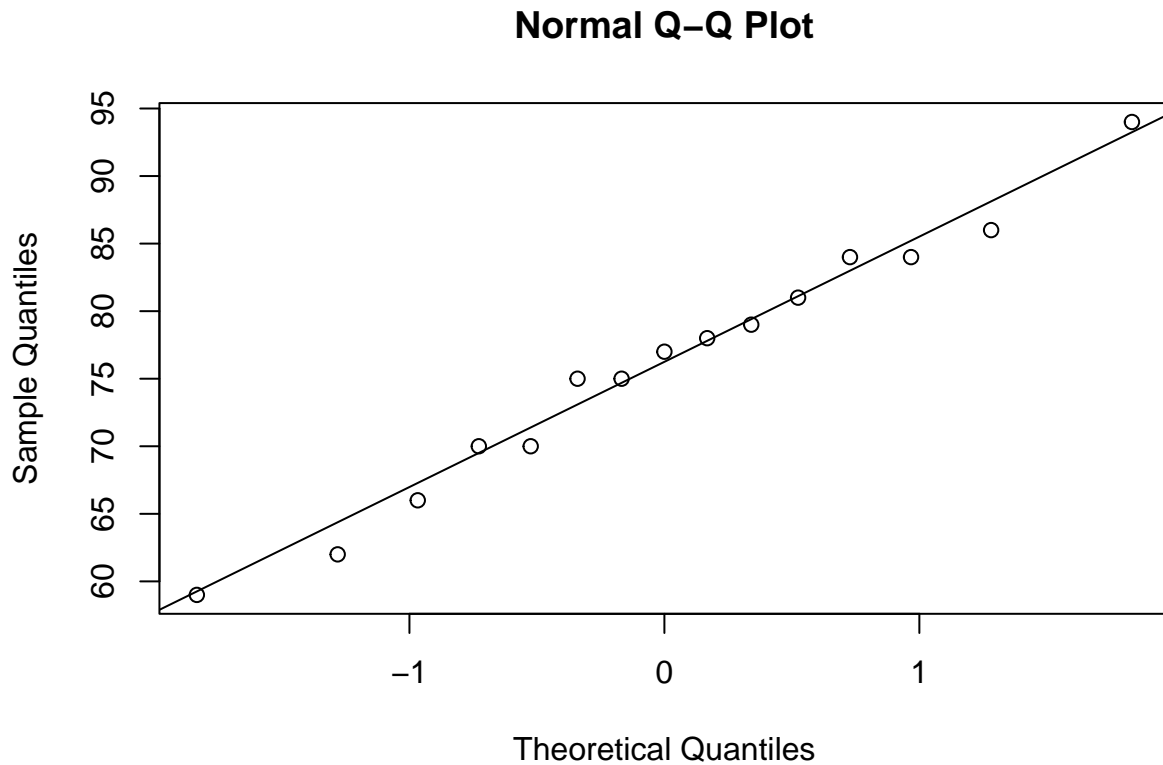
Since give the variances for both school is equal. Checking normality.

```
x<-c(69,75,76,80,81,82,86,89,91,92,97)
y<-c(59,62,66,70,70,75,75,77,78,79,81,84,84,86,94)
qqnorm(x)
qqline(x)
```

Normal Q-Q Plot



```
qqnorm(y)
qqline(y)
```



Conclusion: The data is normally distributed

Null Hypothesis(H_0): $\mu_X = \mu_Y$ (There is no significant difference in the mean satisfaction levels between graduates from State School X and State School Y.)

Alternate Hypothesis(H_a): $\mu_X \neq \mu_Y$ (There is significant difference in the mean satisfaction levels between graduates from State School X and State School Y.)

Part(b)

```
x<-c(69,75,76,80,81,82,86,89,91,92,97)
m<-11
y<-c(59,62,66,70,70,75,75,77,78,79,81,84,84,86,94)
n<-15
alpha<-0.05

xbar<-mean(x)
ybar<-mean(y)
xvar<-var(x)
yvar<-var(y)

# Calculate the pooled variance
```

```
sp2 <- ((m - 1)*xvar + (n - 1)*yvar) / (n + m - 2)
cat("Pooled variance ",sp2)
```

```
## Pooled variance 81.5303
```

```
ttesting <- (xbar - ybar) / sqrt(sp2 * (1/n + 1/m))
cat("T test results",ttesting)
```

```
## T test results 2.079778
```

Part(c)

```
degree_of_freedom<-n + m - 2
pvalue <- 2 * (1 -pt(ttesting,df=degree_of_freedom))
cat("Pvalue",pvalue)
```

```
## Pvalue 0.04839673
```

```
if (pvalue < alpha) {
  cat("The difference between the means is barely significant at the 5% level.\n")
} else {
  cat("The difference between the means is not barely significant at the 5% level.\n")
}
```

```
## The difference between the means is barely significant at the 5% level.
```

Solution(2)

Part(a)

Null Hypothesis:(H0):varx=vary

Alternate Hypothesis:(Ha):varx<vary

Part(b)

```
# Data for Company X and Y
company_X <- c(0.08, 0.09, 0.09, 0.10, 0.10, 0.10, 0.10, 0.11, 0.11, 0.12)
company_Y <- c(0.00, 0.03, 0.04, 0.04, 0.05, 0.05, 0.06, 0.07, 0.08, 0.08)
varx <- var(company_X)
vary <- var(company_Y)

# Calculate the F statistic
F_statistic <- varx / vary
cat("The F test results",F_statistic)
```

```
## The F test results 0.2222222
```

Part(c)

```
# Degrees of freedom
df1 <- length(company_X) - 1
df2 <- length(company_Y) - 1

# Find the critical value for alpha = 0.05 in a one-tailed test
alpha <- 0.05
critical_value <- qf(alpha, df1, df2)
cat("The critical value",critical_value)
```

```
## The critical value 0.3145749
```

Since critical value is greater than f testing results, we reject the null hypothesis and accept that var of company x is less then variance of company y.

Solution(3)

Null Hypothesis(H_0): $\mu=340$

Alternate Hypothesis(H_A): $\mu<340$ ### Part(a)

```
library(pwr)
sigma<-15
munot<-340
alpha<-0.05
muprime<-330
sample<-10
d<-(muprime - munot)/sigma
power<-pwr.t.test(n=sample,d=d,alternative = "less",sig.level =alpha,type = "one.sample")$power
cat("The power of the test",power)
```

```
## The power of the test 0.6184863
```

Part(b)

```
library(pwr)
muprime<-330
munot<-340
alpha<-0.05
sigma<-15
p<-0.8
d<-(muprime - munot)/sigma
sample_size<-pwr.t.test(power=p,d=d,sig.level = alpha,type = "one.sample",alternative = "less")$n
cat("The sample size is given",ceiling(sample_size))
```

```
## The sample size is given 16
```

Solution(4)

Part(a)

Null hypothesis (H_0): The mean well-being score before taking Prozac is equal to the mean well-being score after taking Prozac. Mathematically, $H_0: \mu_d = 0$, where μ_d is the mean difference in well-being scores (after - before). Alternative hypothesis (H_A): The mean well-being score before taking Prozac is different from the mean well-being score after taking Prozac. $H_A: \mu_d \neq 0$

```
bp<-c(3,0,6,7,4,3,2,1,4)
ap<-c(5,1,5,7,10,9,7,11,8)
abp_diff<-c(2,1,1,0,6,6,5,10,4)
alpha<-0.01
xy_diff_bar<-mean(abp_diff)
n<-9
degree_of_freedom <- n -1
sqaure_sum_diff<-sum((abp_diff^2))
square_whole_diff<-(sum(abp_diff)^2)

paired_std_dev<- sqrt((sqaure_sum_diff -(square_whole_diff/n))/degree_of_freedom)
cat("The paired standard deviation",paired_std_dev)
```

```
## The paired standard deviation 3.218868
```

```
ttesting<-xy_diff_bar / (paired_std_dev / sqrt(n))
cat("T paried test results",ttesting)
```

```
## T paried test results 3.624463
```

```
pvalue<-2 * (1- pt(ttesting, df = n - 1))
if (pvalue < alpha) {
  cat("Reject the null hypothesis")
} else {
  cat("Failed to reject the null hypothesis")
}
```

```
## Reject the null hypothesis
```

Part(b)

```
t_crit<-qt(1 -(alpha/2),degree_of_freedom)
cat("T-critical value",t_crit)
```

```
## T-critical value 3.355387
```

```
std_error <- paired_std_dev/sqrt(n)
cat("The standard error",std_error)
```

```
## The standard error 1.072956
```

```
error_margin<-std_error*t_crit
cat("The margin of error",error_margin)
```

```
## The margin of error 3.600183
```

```
lower_limit<-xy_diff_bar-error_margin
uppler_limit<-xy_diff_bar+error_margin
cat("The 99% confidence interval is given by",lower_limit,uppler_limit)
```

```
## The 99% confidence interval is given by 0.2887059 7.489072
```

Solution(5)

Part(a)

Null hypothesis (H0): Physicians who take aspirin are equally likely to suffer heart attacks as those who take a placebo.

Alternative hypothesis (H1): Physicians who take aspirin are less likely to suffer heart attacks than those who take a placebo.

Part(b)

```
# Define the observed frequencies
observed <- matrix(c(104, 10933, 189, 10845), nrow = 2, byrow = TRUE)

# Perform chi-square test
chi_sq_test <- chisq.test(observed)$statistic
cat("Test results",chi_sq_test)
```

```
## Test results 24.42906
```

Part(c)

```
alpha <- 0.05
p_value <- chisq.test(observed)$p.value
cat("Pvalue",p_value)
```

```
## Pvalue 7.709708e-07
```

```
# Compare p-value to alpha
if (p_value < alpha) {
  print("Reject the null hypothesis")
  print("There is evidence to suggest that physicians who take aspirin are less likely to suffer heart a
} else {
  print("Fail to reject the null hypothesis")
  print("There is no evidence to suggest a difference in heart attack rates between physicians who take
}
```

```
## [1] "Reject the null hypothesis"  
## [1] "There is evidence to suggest that physicians who take aspirin are less likely to suffer heart a
```