Q3,4

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```
library(Hotelling)
```

```
## Loading required package: corpcor
```

Part 3 - 5.18)

a)

```
# This is from the national track records for women data set, table 1.9
## read the table
college = read.table("T5-2.DAT")
## set the column names
colnames(college) = c("SSH", "Verbal", "Science")
head(college)
```

```
##   SSH Verbal Science
## 1 468     41      26
## 2 428     39      26
## 3 514     53      21
## 4 547     67      33
## 5 614     61      27
## 6 501     67      29
```

```
xbar = c(526.29, 54.69, 25.13)
mu = c(500, 50, 30)
S = matrix(c(5808.06, 597.84, 222.03,
               597.84, 126.05, 23.39,
               222.03, 23.39, 23.11),
             nrow=3, ncol=3, byrow=TRUE)
testnull = hotelling.stat(as.matrix(college), t(as.matrix(mu)))
testnull.stat = testnull$statistic
testnull.df = testnull$df
cat("T2: ", testnull.stat)
```

```
## T2:  2.537616
```

```r
cat("\nP-Value: ", qf(0.05, testnull.df[1], testnull.df[2]))
```

```
##
## P-Value:  0.1168349
```

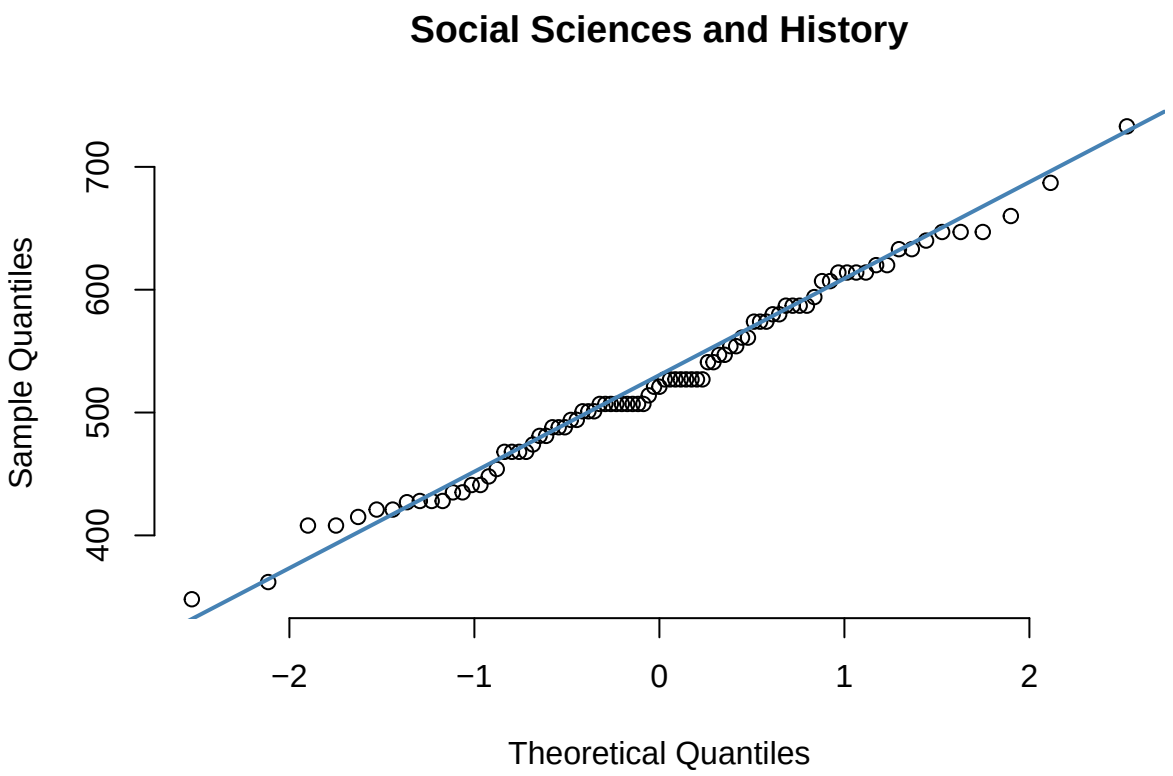
b)

```r
n = length(college$SSH)
for (i in c(0:2)) {
  ME = (S[3^i]/n) * (qt(0.025, n - 1))
  lower = xbar[i + 1] + ME - mu[i + 1]
  upper = xbar[i + 1] - ME - mu[i + 1]
  cat("Ellipsoid Axes Distance X", (i + 1), ": [", lower, ",", upper, "]\n")
}
```

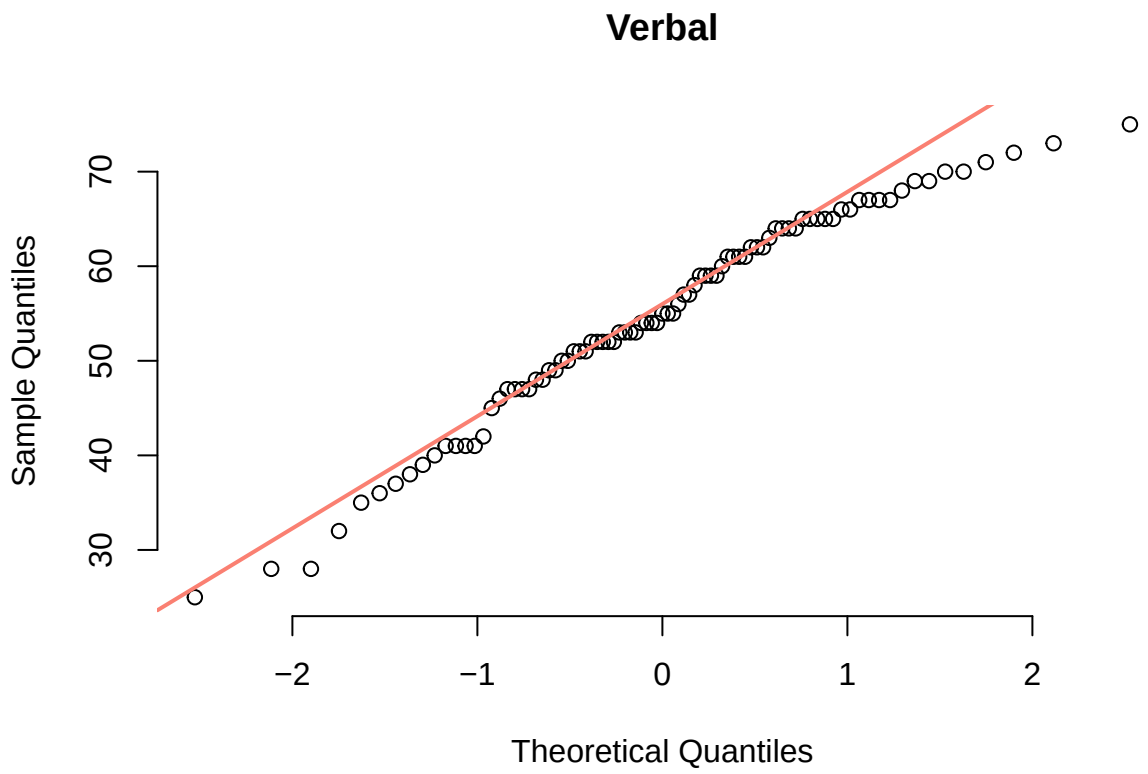
```
## Ellipsoid Axes Distance X 1 : [ -106.4231 , 159.0031 ]
## Ellipsoid Axes Distance X 2 : [ -0.3833452 , 9.763345 ]
## Ellipsoid Axes Distance X 3 : [ -5.398059 , -4.341941 ]
```

c)

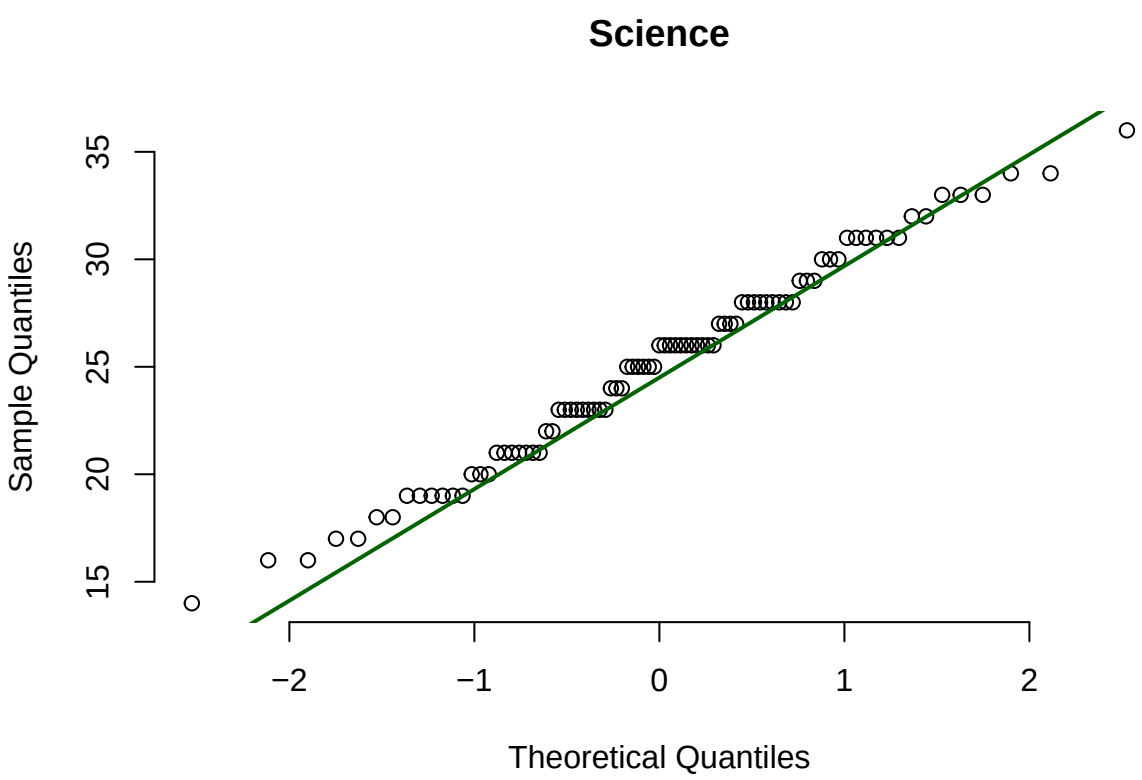
```r
# QQ-plot of Social Science and History
qqnorm(college$SSH,pch = 1, frame = FALSE, main = "Social Sciences and History")
qqline(college$SSH, col = "steelblue", lwd = 2)
```




```r
# QQ-plot of Verbal
qqnorm(college$Verbal,pch = 1, frame = FALSE, main = "Verbal")
qqline(college$Verbal, col = "salmon", lwd = 2)
```




```
# QQ-plot of Social Science and History
qqnorm(college$Science,pch = 1, frame = FALSE, main = "Science")
qqline(college$Science, col = "dark green", lwd = 2)
```



Part 4 - 5.21

```
bmineral = read.table("T1-8.DAT")
colnames(bmineral) = c("Dom Rad", "Rad", "Dom Hum", "Hum", "Dom Ulna", "Ulna")
bmineral
```

```
##    Dom Rad   Rad Dom Hum   Hum Dom Ulna  Ulna
## 1    1.103 1.052   2.139 2.238    0.873 0.872
## 2    0.842 0.859   1.873 1.741    0.590 0.744
## 3    0.925 0.873   1.887 1.809    0.767 0.713
## 4    0.857 0.744   1.739 1.547    0.706 0.674
## 5    0.795 0.809   1.734 1.715    0.549 0.654
## 6    0.787 0.779   1.509 1.474    0.782 0.571
## 7    0.933 0.880   1.695 1.656    0.737 0.803
## 8    0.799 0.851   1.740 1.777    0.618 0.682
## 9    0.945 0.876   1.811 1.759    0.853 0.777
## 10   0.921 0.906   1.954 2.009    0.823 0.765
## 11   0.792 0.825   1.624 1.657    0.686 0.668
## 12   0.815 0.751   2.204 1.846    0.678 0.546
## 13   0.755 0.724   1.508 1.458    0.662 0.595
## 14   0.880 0.866   1.786 1.811    0.810 0.819
## 15   0.900 0.838   1.902 1.606    0.723 0.677
## 16   0.764 0.757   1.743 1.794    0.586 0.541
```

```
## 17   0.733 0.748   1.863 1.869    0.672 0.752
## 18   0.932 0.898   2.028 2.032    0.836 0.805
## 19   0.856 0.786   1.390 1.324    0.578 0.610
## 20   0.890 0.950   2.187 2.087    0.758 0.718
## 21   0.688 0.532   1.650 1.378    0.533 0.482
## 22   0.940 0.850   2.334 2.225    0.757 0.731
## 23   0.493 0.616   1.037 1.268    0.546 0.615
## 24   0.835 0.752   1.509 1.422    0.618 0.664
## 25   0.915 0.936   1.971 1.869    0.869 0.868
```

```
means = colMeans(bmineral)
sds = apply(bmineral,2,sd)
n = length(bmineral$`Dom Rad`)
p = 6
t2 = (((n - 1)* p)/(n - p )) * qf(0.05, p, n - p)
TME = sqrt(sds / n) * sqrt(t2)
lower_T2 =round(means - TME, 3)
upper_T2 =round(means + TME, 3)
B = qt(1-(0.95/(p - 2.64)),(n*p-1)*(n-1)) * sds
lower_B =round(means - B, 3)
upper_B =round(means + B, 3)
data.frame(means, sds, lower_T2, upper_T2, lower_B, upper_B)
```

```
##            means       sds lower_T2 upper_T2 lower_B upper_B
## Dom Rad  0.84380 0.1140245    0.749    0.938   0.778   0.909
## Rad      0.81832 0.1068545    0.727    0.910   0.757   0.880
## Dom Hum  1.79268 0.2834735    1.644    1.941   1.630   1.956
## Hum      1.73484 0.2635991    1.591    1.878   1.583   1.886
## Dom Ulna 0.70440 0.1075566    0.613    0.796   0.643   0.766
## Ulna     0.69384 0.1029521    0.604    0.783   0.635   0.753
```