

# HW6

```
names = c("Climate and Terrain","Housing","Health Care & the Environment",  
          "Crime","Transportation","Education","The Arts","Recreation",  
          "Economics","index")  
data <- read.table("Places_Rated.txt")  
colnames(data) <- names
```

## Q1

### SCALED

```
pca_result = prcomp(data[,][1:9] , scale = TRUE)  
eigen_val = (pca_result$sdev)^2  
eigen_vec = pca_result$rotation  
eigen_val
```

```
## [1] 3.4082918 1.2139762 1.1414791 0.9209178 0.7532849 0.6305619 0.4930477  
## [8] 0.3180385 0.1204021
```

```
eigen_vec
```

##	PC1	PC2	PC3
## Climate and Terrain	0.2064140	0.2178353	-0.689955982
## Housing	0.3565216	0.2506240	-0.208172230
## Health Care & the Environment	0.4602146	-0.2994653	-0.007324926
## Crime	0.2812984	0.3553423	0.185104981
## Transportation	0.3511508	-0.1796045	0.146376283
## Education	0.2752926	-0.4833821	0.229702548
## The Arts	0.4630545	-0.1947899	-0.026484298
## Recreation	0.3278879	0.3844746	-0.050852640
## Economics	0.1354123	0.4712833	0.607314475
##	PC4	PC5	PC6
## Climate and Terrain	0.13732125	-0.3691499	0.37460469
## Housing	0.51182871	0.2334878	-0.14163983
## Health Care & the Environment	0.01470183	-0.1032405	-0.37384804
## Crime	-0.53905047	-0.5239397	0.08092329
## Transportation	-0.30290371	0.4043485	0.46759180
## Education	0.33541103	-0.2088191	0.50216981
## The Arts	-0.10108039	-0.1050976	-0.46188072
## Recreation	-0.18980082	0.5295406	0.08991578
## Economics	0.42176994	-0.1596201	0.03260813
##	PC7	PC8	PC9
## Climate and Terrain	-0.08470577	-0.36230833	0.0013913515
## Housing	-0.23063862	0.61385513	0.0136003402
## Health Care & the Environment	0.01386761	-0.18567612	-0.7163548935
## Crime	0.01860646	0.43002477	-0.0586084614
## Transportation	-0.58339097	-0.09359866	0.0036294527
## Education	0.42618186	0.18866756	0.1108401911
## The Arts	-0.02152515	-0.20398969	0.6857582127
## Recreation	0.62787789	-0.15059597	-0.0255062915
## Economics	-0.14974066	-0.40480926	0.0004377942

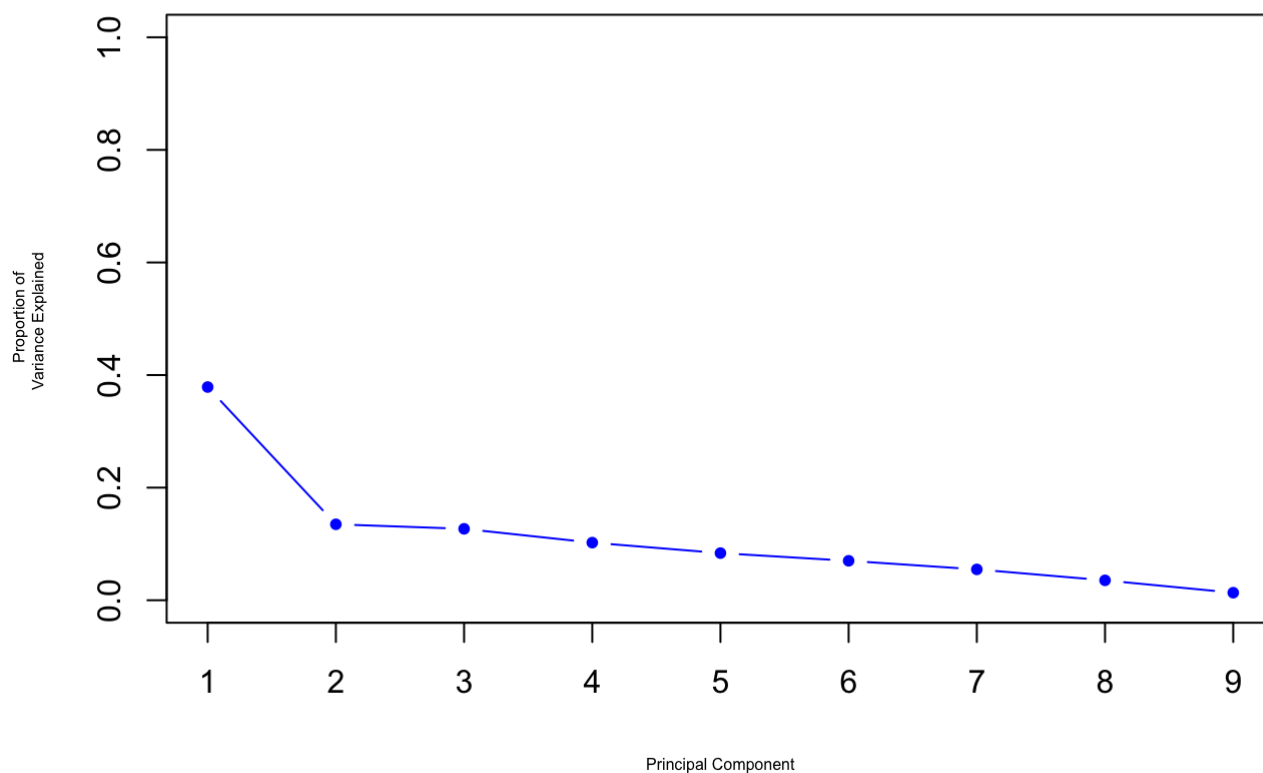
```
pve = eigen_val/sum(eigen_val)
print("Proportion of Variance Explained")
```

```
## [1] "Proportion of Variance Explained"
```

```
print(pve)
```

```
## [1] 0.37869909 0.13488624 0.12683102 0.10232420 0.08369832 0.07006243
## [7] 0.05478308 0.03533761 0.01337801
```

```
plot(pve, xlab=" Principal Component ", ylab=" Proportion of
Variance Explained ", ylim=c(0,1), xaxt="n", type='b', col="blue", cex=1,
pch=20, cex.lab= 0.5)
axis(1, at=c(1:9), labels=c(1:9))
```



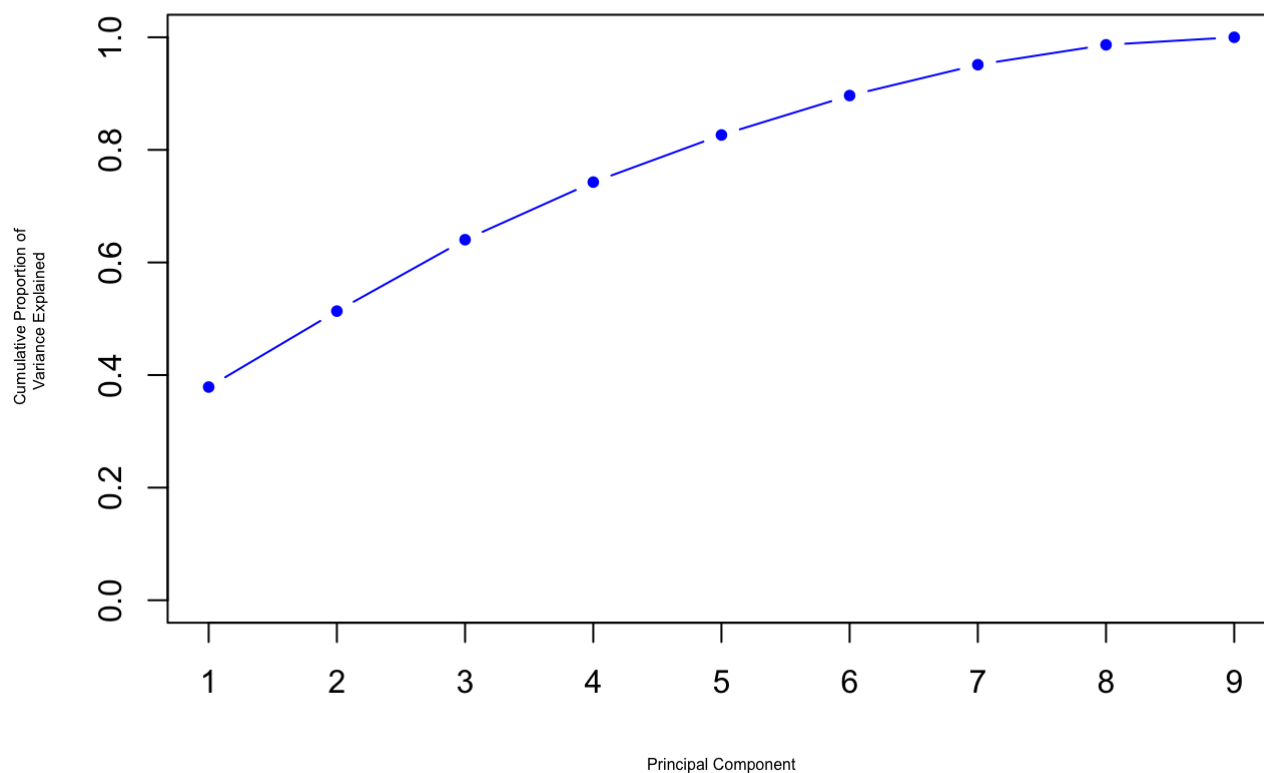
```
cum_pve = cumsum (pve)
print("Cumulative Proportion of Variance Explained")
```

```
## [1] "Cumulative Proportion of Variance Explained"
```

```
print(cum_pve)
```

```
## [1] 0.3786991 0.5135853 0.6404163 0.7427405 0.8264389 0.8965013 0.9512844
## [8] 0.9866220 1.0000000
```

```
plot(cum_pve, xlab=" Principal Component ", ylab=" Cumulative Proportion of
Variance Explained ", ylim=c(0,1), xaxt="n" ,type='b', col="blue", cex=1,
pch=20, cex.lab=0.5)
axis(1, at=c(1:9),labels=c(1:9))
```



## RAW

```
pca_result1 = prcomp(data[,][1:9] , scale = FALSE)
eigen_val1 = (pca_result1$sdev)^2
eigen_vec1 = pca_result1$rotation
eigen_val1
```

```
## [1] 24413668.72 4408004.85 1638039.60 1076355.78 478338.27 240851.80
## [7] 92809.94 66995.90 10962.63
```

```
eigen_vec1
```

##	PC1	PC2	PC3
## Climate and Terrain	0.006416346	-0.015459527	0.006692298
## Housing	0.269142181	-0.937207188	0.082641934
## Health Care & the Environment	0.178318724	0.020539870	-0.027761041
## Crime	0.028134276	0.010901921	-0.037610931
## Transportation	0.149302463	-0.018757344	-0.971531831
## Education	0.025190912	0.001395877	-0.041507669
## The Arts	0.930859522	0.282260587	0.151026851
## Recreation	0.069824043	-0.103848215	-0.149571984
## Economics	0.025130829	-0.173359958	-0.012743344
##	PC4	PC5	PC6
## Climate and Terrain	0.02631066	0.016278231	0.001186617
## Housing	0.17775057	-0.083842278	0.048638182
## Health Care & the Environment	0.02656157	-0.159075722	-0.929492918
## Crime	-0.09903536	0.116013534	0.053976191
## Transportation	0.03839697	-0.146649668	0.092235051
## Education	-0.02163938	-0.106255968	-0.253188491
## The Arts	-0.02775471	0.008673762	0.167554494
## Recreation	-0.06903276	0.954262248	-0.173348306
## Economics	-0.97453606	-0.102240592	-0.005152175
##	PC7	PC8	PC9
## Climate and Terrain	0.08140848	-0.04213801	0.9951449417
## Housing	0.02668780	-0.01211847	-0.0229330011
## Health Care & the Environment	0.13706121	0.24135975	0.0013718748
## Crime	0.94477955	-0.26682693	-0.0876894940
## Transportation	-0.01354542	0.04150769	0.0094188168
## Education	-0.24115526	-0.92915944	-0.0168655619
## The Arts	-0.04296041	-0.01594931	0.0005985854
## Recreation	-0.12711706	-0.01878071	-0.0050315892
## Economics	-0.07016097	0.05439799	0.0327178331

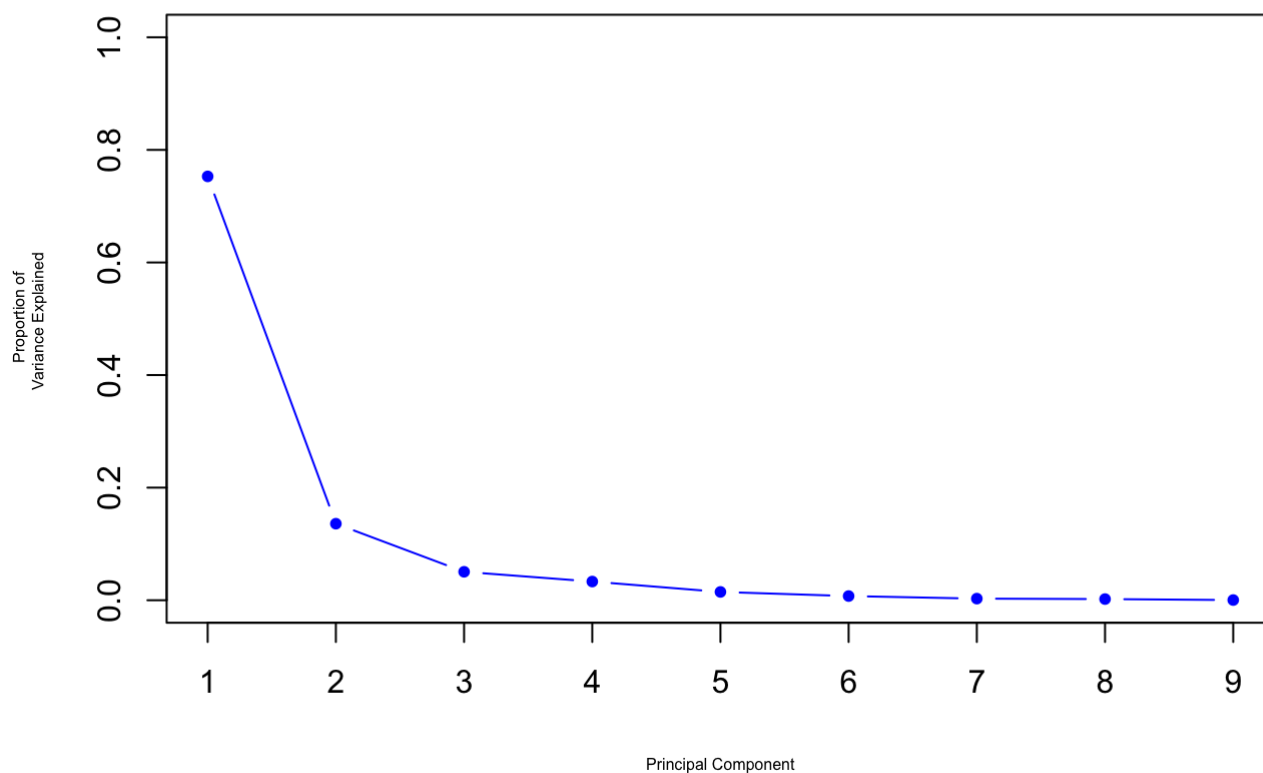
```
pvel = eigen_vall/sum(eigen_vall)
print("Proportion of Variance Explained")
```

```
## [1] "Proportion of Variance Explained"
```

```
print(pvel)
```

```
## [1] 0.752903473 0.135940329 0.050516197 0.033194192 0.014751677 0.007427731
## [7] 0.002862205 0.002066115 0.000338081
```

```
plot(pvel, xlab=" Principal Component ", ylab=" Proportion of
Variance Explained ", ylim=c(0,1), xaxt="n" ,type='b', col="blue", cex=1,
pch=20, cex.lab=0.5)
axis(1, at=c(1:9),labels=c(1:9))
```



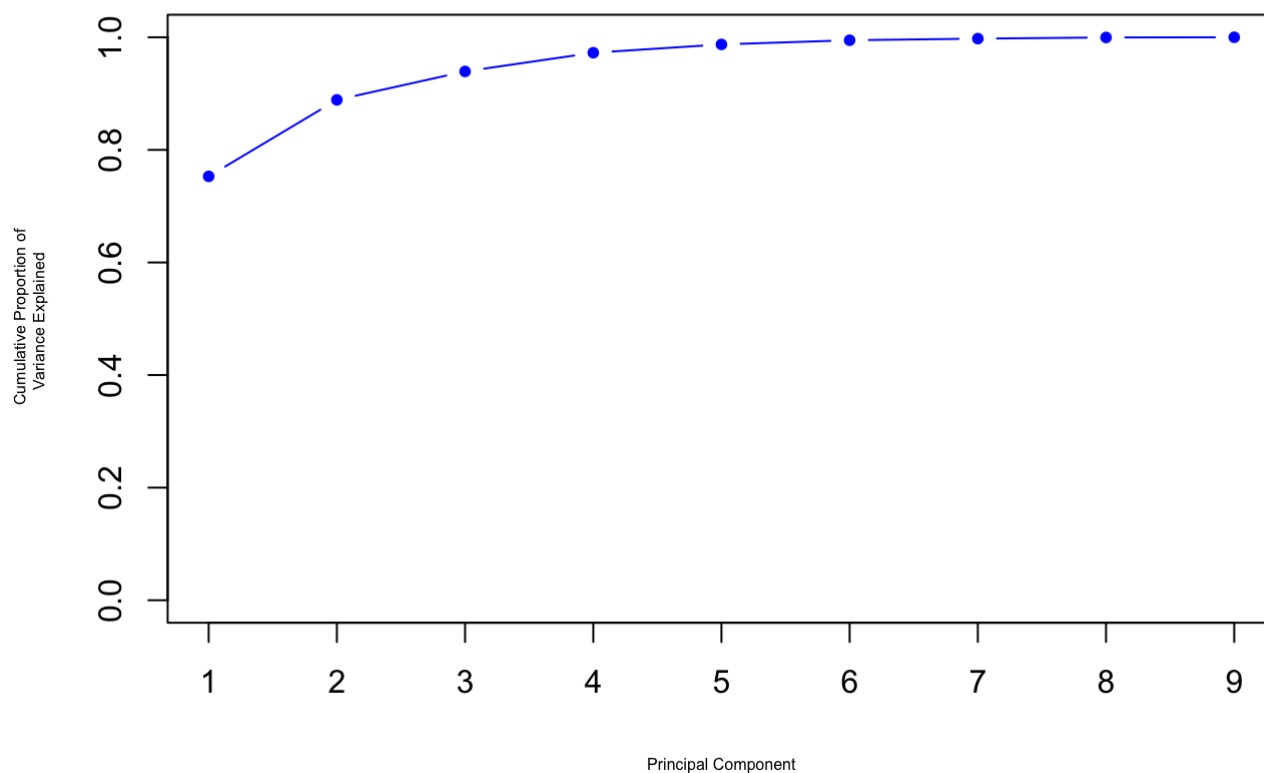
```
cum_pvel = cumsum (pvel)
print("Cumulative Proportion of Variance Explained")
```

```
## [1] "Cumulative Proportion of Variance Explained"
```

```
print(cum_pvel)
```

```
## [1] 0.7529035 0.8888438 0.9393600 0.9725542 0.9873059 0.9947336 0.9975958
## [8] 0.9996619 1.0000000
```

```
plot(cum_pvel, xlab=" Principal Component ", ylab=" Cumulative Proportion of
Variance Explained ", ylim=c(0,1), xaxt="n" ,type='b', col="blue", cex=1,
pch=20, cex.lab=0.5)
axis(1, at=c(1:9),labels=c(1:9))
```



## Q2

```
#choose k = 5
loading_vec = pca_result$rotation[,5]
loading_vec
```

```
##           Climate and Terrain           Housing
##                -0.3691499             0.2334878
## Health Care & the Environment           Crime
##                -0.1032405            -0.5239397
##           Transportation           Education
##                0.4043485            -0.2088191
##           The Arts           Recreation
##                -0.1050976             0.5295406
##           Economics
##                -0.1596201
```

```
library(ggfortify)
```

```
## Loading required package: ggplot2
```

```
PC1 = pca_result$rotation[,1]
PC2 = pca_result$rotation[,2]
d = data.frame(pca_result$rotation)
plot_0 = autoplot(pca_result, data = data, colour = 'black')
plot_0+ theme_grey(base_size = 22)
```

