

EXP.NO.: 05

**PERFORM DIMENSIONALITY REDUCTION OPERATION
USING PCA, KPCA & SV**

AIM

To perform dimensionality reduction using Principal Component Analysis (PCA), Kernel PCA (KPCA), and Singular Value Decomposition (SVD) on the *mtcars* dataset.

TOOLS REQUIRED

- RStudio / R environment
- stats package (for PCA & SVD) – comes built-in with R
- kernlab package (for Kernel PCA)
- ggplot2 package (for visualization)
- ggfortify package (for enhanced PCA biplot)

ALGORITHM

- Install and load required packages (stats, kernlab, ggplot2, ggfortify).
- Load the mtcars dataset and standardize it using scale().
- Apply PCA using prcomp() and examine variance using summary().
- Visualize PCA using autoplot() with variable loadings labeled.
- Apply Kernel PCA (kpca()) with RBF kernel and visualize first two components using ggplot2.
- Perform Singular Value Decomposition (svd()) and plot the first two left singular vectors using ggplot2.
- Compare and interpret results from PCA, Kernel PCA, and SVD.

CODING

```
install.packages("ggplot2")
```

```
install.packages("kernlab")
```

```
install.packages("ggfortify")
```

```
library(ggplot2)
```

```
library(kernlab)
```

```
library(ggfortify)
```

```
data(mtcars)
```

```
df <- scale(mtcars)
```

```
pca_result <- prcomp(df, scale. = TRUE)
```

```
summary(pca_result)
```

```
autoplot(pca_result, data = as.data.frame(df),  
  loadings = TRUE,  
  loadings.label = TRUE,  
  loadings.colour = "blue",  
  loadings.label.size = 4,  
  main = "PCA Biplot - mtcars (Enhanced)")
```

```
kpca_result <- kpca(~., data = as.data.frame(df), kernel = "rbfdot")
```

```
kpca_df <- as.data.frame(rotated(kpca_result))  
kpca_df$Car <- rownames(df)
```

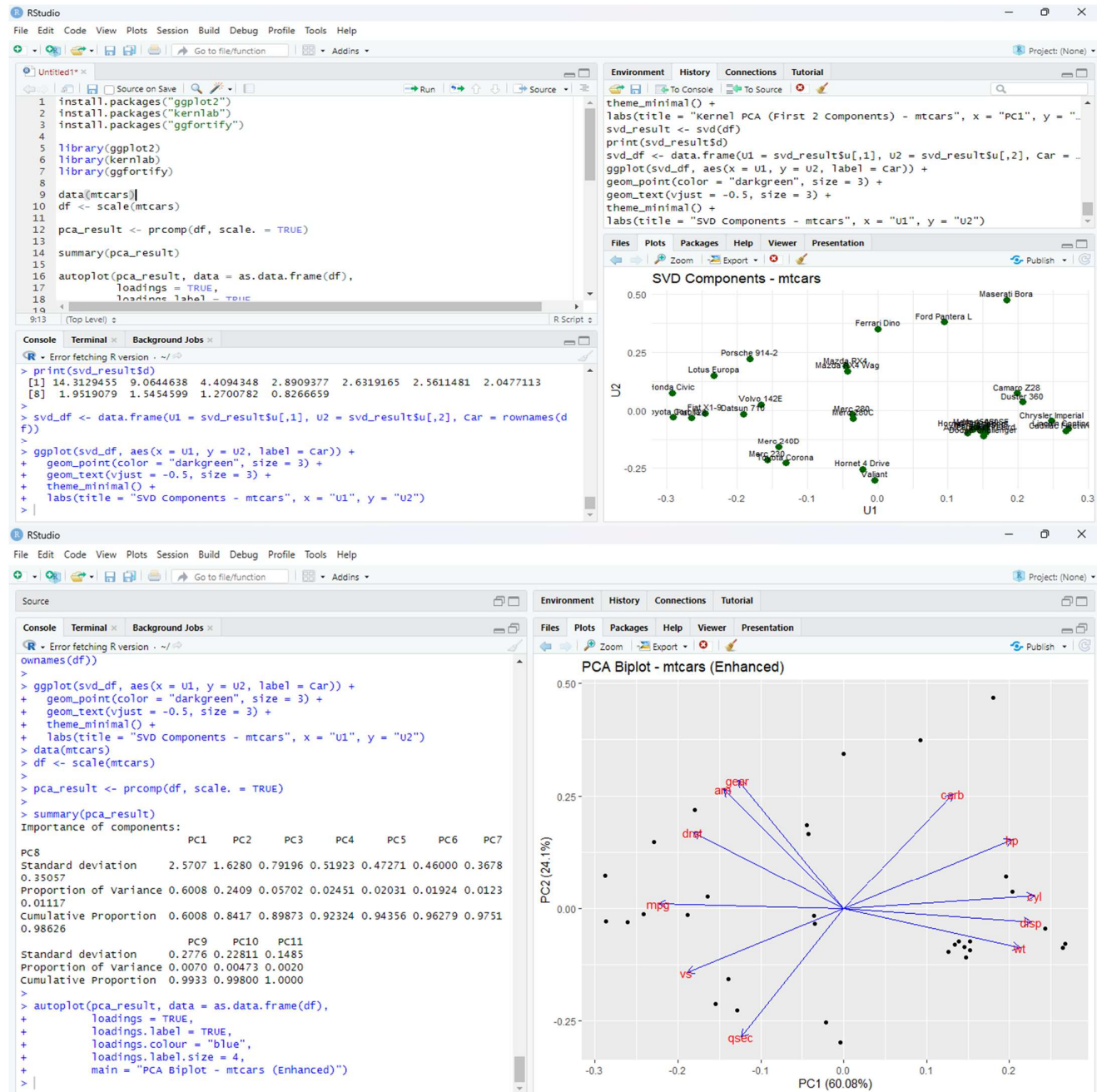
```
ggplot(kpca_df, aes(x = V1, y = V2, label = Car)) +  
  geom_point(color = "steelblue", size = 3) +  
  geom_text(vjust = -0.5, size = 3) +  
  theme_minimal() +  
  labs(title = "Kernel PCA (First 2 Components) - mtcars", x = "PC1", y = "PC2")
```

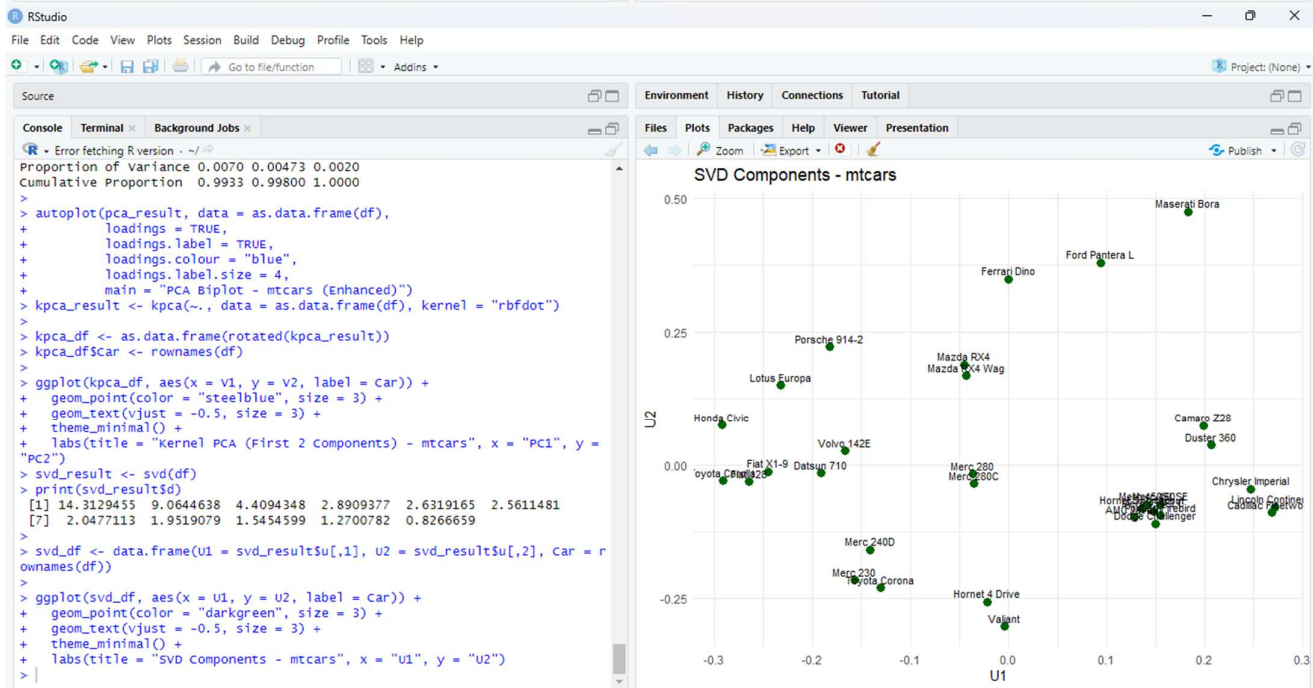
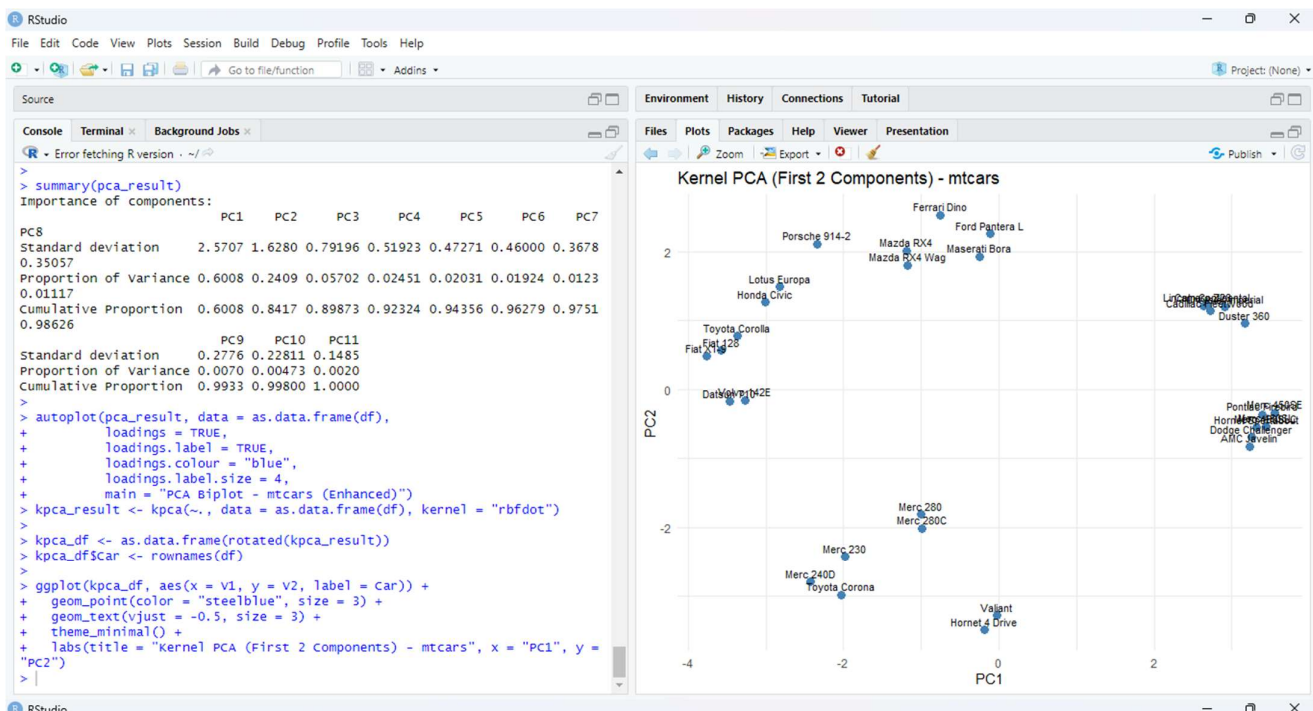
```
svd_result <- svd(df)  
print(svd_result$d)
```

```
svd_df <- data.frame(U1 = svd_result$u[,1], U2 = svd_result$u[,2], Car = rownames(df))
```

```
ggplot(svd_df, aes(x = U1, y = U2, label = Car)) +  
  geom_point(color = "darkgreen", size = 3) +  
  geom_text(vjust = -0.5, size = 3) +  
  theme_minimal() +  
  labs(title = "SVD Components - mtcars", x = "U1", y = "U2")
```

OUTPUT





RESULT

Thus successfully completed dimensionality reduction on the *mtcars* dataset. The reduced components effectively preserved major variance and improved visualization.