311306435

2023-07-18

```
r = getOption("repos")
r["CRAN"] = "http://cran.us.r-project.org"
options(repos = r)

install.packages("DirichletReg")
```

```
## Installing package into 'C:/Users/Yuval-PC/AppData/Local/R/win-library/4.3'
## (as 'lib' is unspecified)
```

```
## package 'DirichletReg' successfully unpacked and MD5 sums checked
```

```
## Warning: cannot remove prior installation of package 'DirichletReg'
```

```
## Warning in file.copy(savedcopy, lib, recursive = TRUE): problem copying
## C:\Users\Yuval-PC\AppData\Local\R\win-library\4.3\00LOCK\DirichletReg\libs\x64\DirichletReg.dll
## to
## C:\Users\Yuval-PC\AppData\Local\R\win-library\4.3\DirichletReg\libs\x64\DirichletReg.dll:
## Permission denied
```

```
## Warning: restored 'DirichletReg'
```

```
##
## The downloaded binary packages are in
##  C:\Users\Yuval-PC\AppData\Local\Temp\RtmpArAAVq\downloaded_packages
```

```
install.packages("scatterplot3d") # Install
```

```
## Installing package into 'C:/Users/Yuval-PC/AppData/Local/R/win-library/4.3'
## (as 'lib' is unspecified)
```

```
## package 'scatterplot3d' successfully unpacked and MD5 sums checked
##
## The downloaded binary packages are in
##  C:\Users\Yuval-PC\AppData\Local\Temp\RtmpArAAVq\downloaded_packages
```

```
install.packages("MASS")
```

```
## Installing package into 'C:/Users/Yuval-PC/AppData/Local/R/win-library/4.3'
## (as 'lib' is unspecified)
```

```
## package 'MASS' successfully unpacked and MD5 sums checked
```

```
## Warning: cannot remove prior installation of package 'MASS'
```

```
## Warning in file.copy(savedcopy, lib, recursive = TRUE): problem copying
## C:\Users\Yuval-PC\AppData\Local\R\win-library\4.3\00LOCK\MASS\libs\x64\MASS.dll
## to C:\Users\Yuval-PC\AppData\Local\R\win-library\4.3\MASS\libs\x64\MASS.dll:
## Permission denied
```

```
## Warning: restored 'MASS'
```

```
##
## The downloaded binary packages are in
##  C:\Users\Yuval-PC\AppData\Local\Temp\RtmpArAAVq\downloaded_packages
```

```
install.packages("MCMCprecision")
```

```
## Installing package into 'C:/Users/Yuval-PC/AppData/Local/R/win-library/4.3'
## (as 'lib' is unspecified)
```

```
## package 'MCMCprecision' successfully unpacked and MD5 sums checked
```

```
## Warning: cannot remove prior installation of package 'MCMCprecision'
```

```
## Warning in file.copy(savedcopy, lib, recursive = TRUE): problem copying
## C:\Users\Yuval-PC\AppData\Local\R\win-library\4.3\00LOCK\MCMCprecision\libs\x64\MCMCprecision.dll
## to
## C:\Users\Yuval-PC\AppData\Local\R\win-library\4.3\MCMCprecision\libs\x64\MCMCprecision.dll:
## Permission denied
```

```
## Warning: restored 'MCMCprecision'
```

```
##
## The downloaded binary packages are in
##  C:\Users\Yuval-PC\AppData\Local\Temp\RtmpArAAVq\downloaded_packages
```

```
install.packages("ggpubr")
```

```
## Installing package into 'C:/Users/Yuval-PC/AppData/Local/R/win-library/4.3'
## (as 'lib' is unspecified)
```

```
## package 'ggpubr' successfully unpacked and MD5 sums checked
##
## The downloaded binary packages are in
##  C:\Users\Yuval-PC\AppData\Local\Temp\RtmpArAAVq\downloaded_packages
```

```
library(gridExtra)
library(ggpubr)
```

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

```
library(cowplot)
```

```
##
## Attaching package: 'cowplot'
```

```
## The following object is masked from 'package:ggpubr':
##
##     get_legend
```

```
require(MCMCprecision)
```

```
## Loading required package: MCMCprecision
```

```
library(Formula)
library(DirichletReg)
```

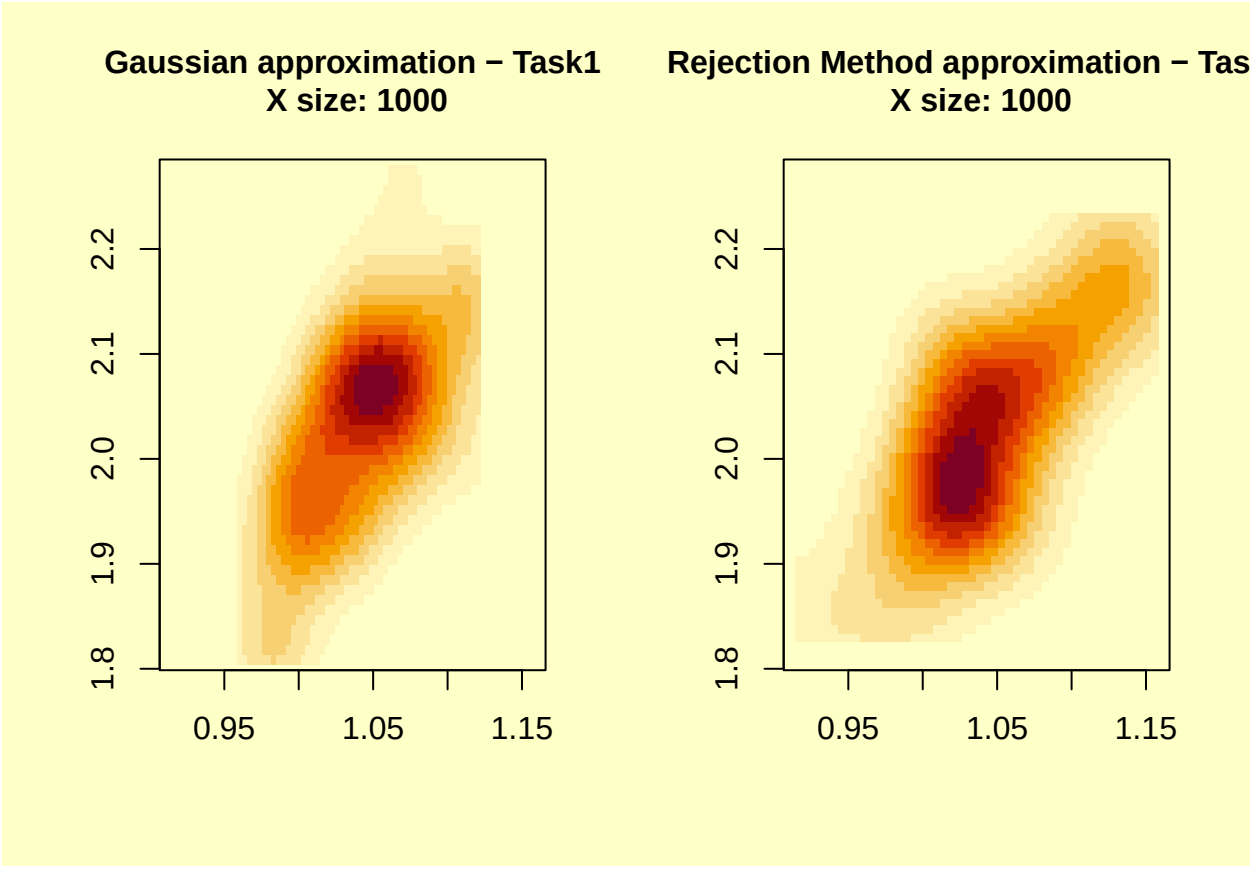
```
##
## Attaching package: 'DirichletReg'
```

```
## The following object is masked from 'package:MCMCprecision':
##
##     rdirichlet
```

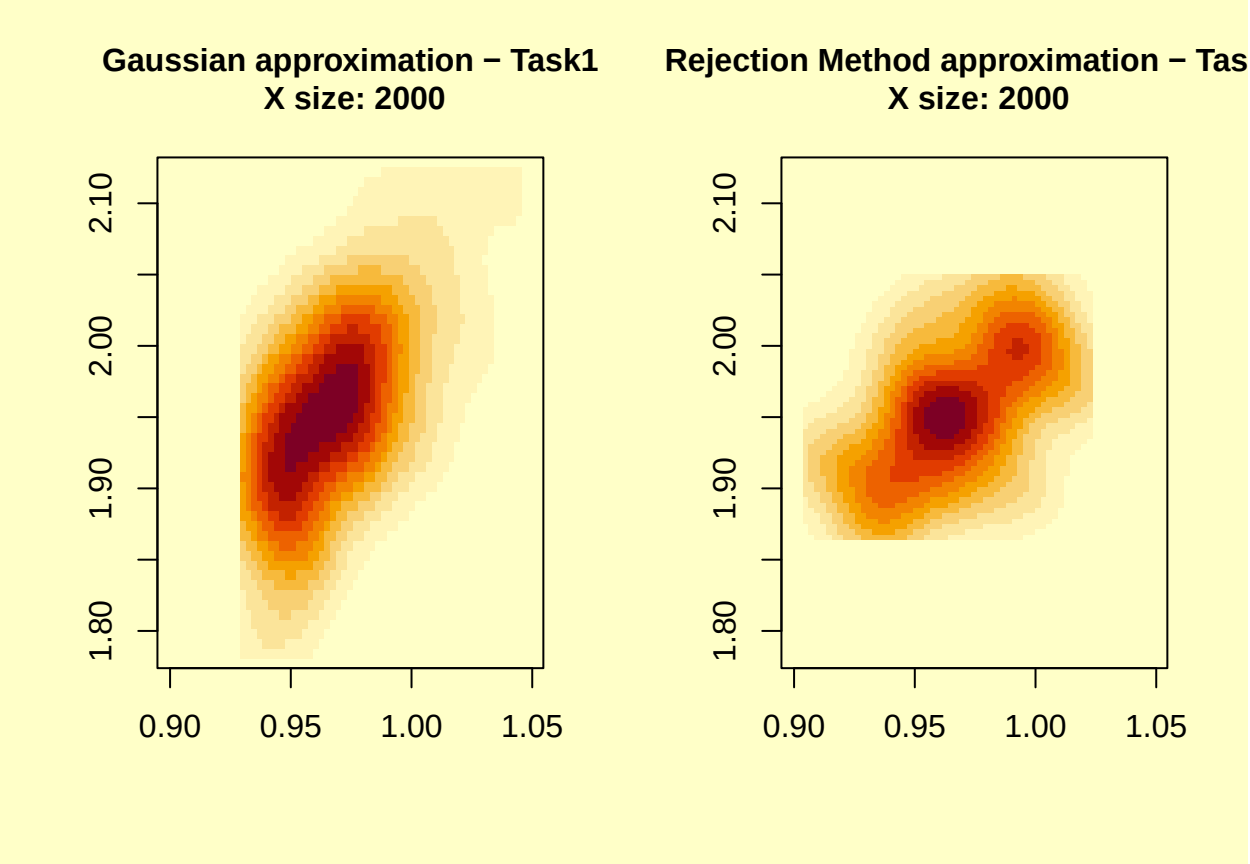
```r
library("scatterplot3d") # load
library(MASS)
```

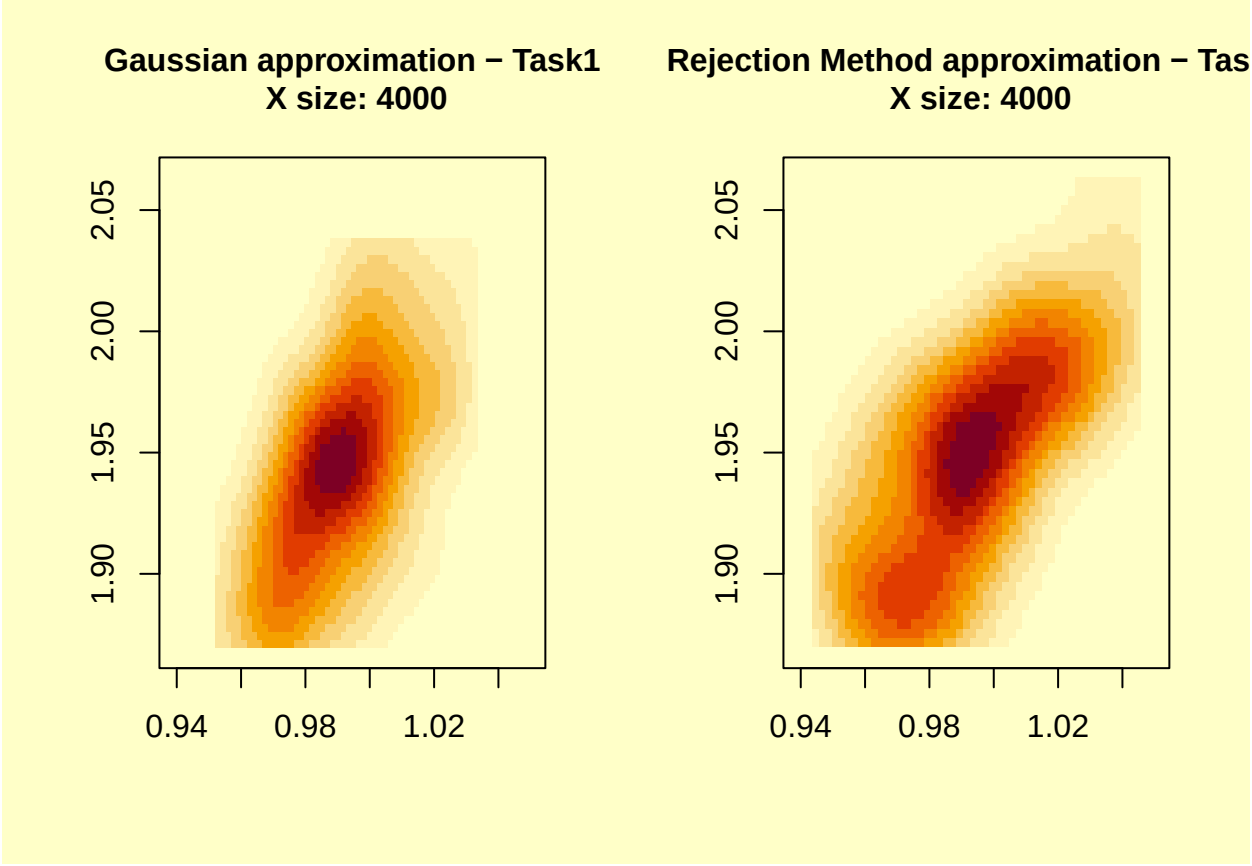
Question 1

Question 2



Question 3

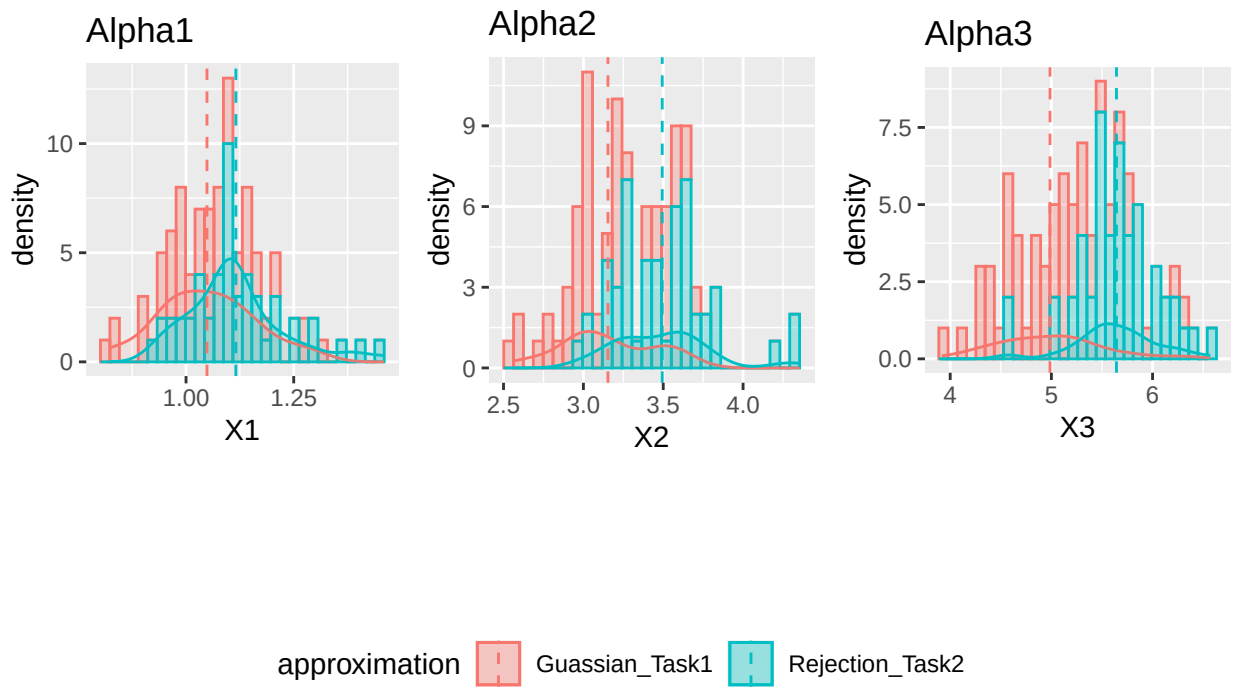

Gaussian approximation − Task1
X size: 2000
Rejection Method approximation − Tas
X size: 2000
2.10
2.00
1.90
1.80
0.90
0.95
1.00
1.05



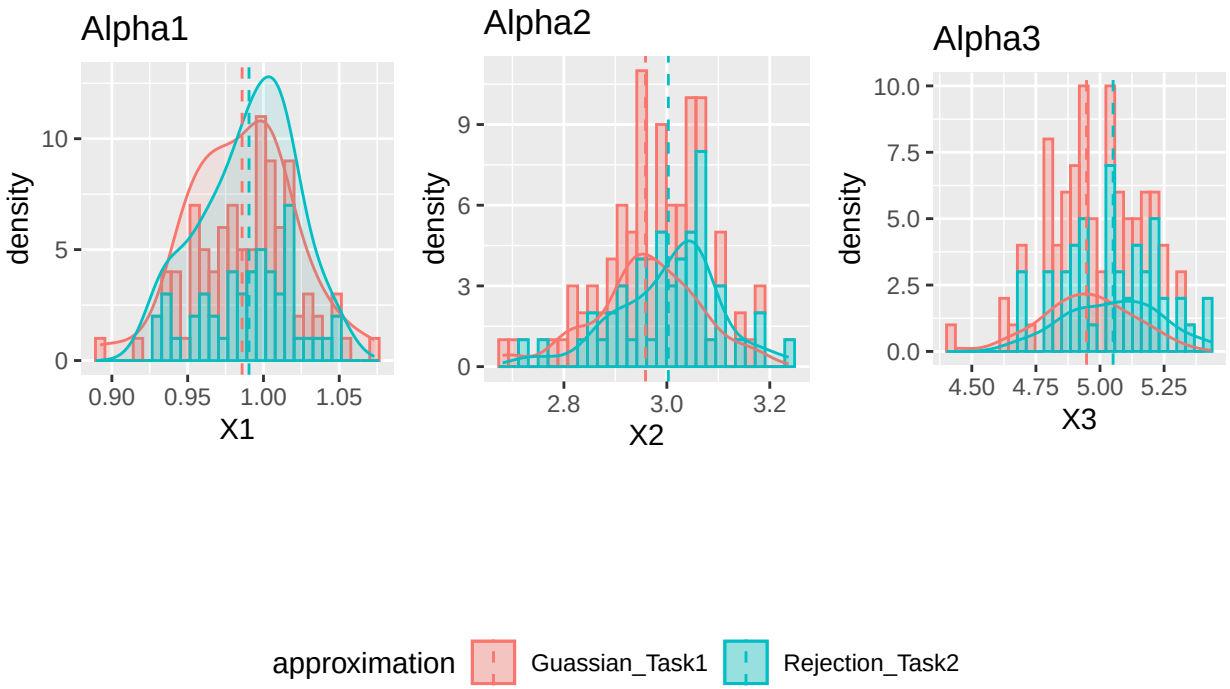

```
rates <- c(1,3,5)
X <- rdirichlet(1000, rates)
q1_alphas <- q1(50, X, rates)
q2_alphas <- q2(50, X, rates)$Alpha
q1_df <- data.frame(q1_alphas)
q1_df$approximation <- "Guassian_Task1"
q2_df <- data.frame(q2_alphas)
q2_df$approximation <- "Rejection_Task2"
df <- rbind(q1_df, q2_df)
```

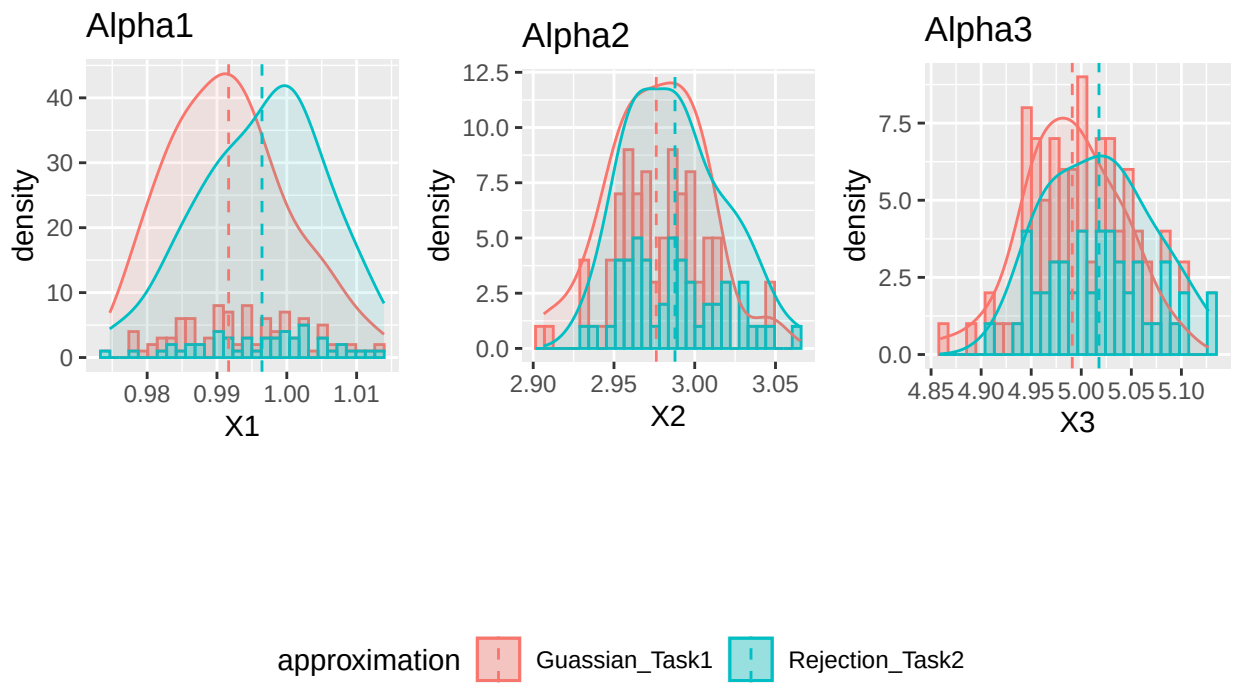
```
## Warning: package 'ggplot2' is in use and will not be installed

## Warning: package 'gridExtra' is in use and will not be installed

## Installing package into 'C:/Users/Yuval-PC/AppData/Local/R/win-library/4.3'
## (as 'lib' is unspecified)

## package 'plyr' successfully unpacked and MD5 sums checked

## Warning: cannot remove prior installation of package 'plyr'

## Warning in file.copy(savedcopy, lib, recursive = TRUE): problem copying
## C:\Users\Yuval-PC\AppData\Local\R\win-library\4.3\00LOCK\plyr\libs\x64\plyr.dll
## to C:\Users\Yuval-PC\AppData\Local\R\win-library\4.3\plyr\libs\x64\plyr.dll:
## Permission denied

## Warning: restored 'plyr'

##
## The downloaded binary packages are in
```

```
##  C:\Users\Yuval-PC\AppData\Local\Temp\RtmpArAAVq\downloaded_packages
##
## Attaching package: 'plyr'
## The following object is masked from 'package:ggpubr':
##
##     mutate
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```




```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```

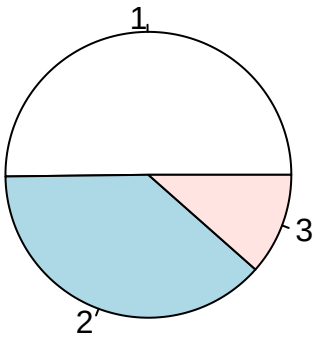

Alpha1
density
10
5
0
0.90
0.95
1.00
1.05
X1
Alpha2
density
9
6
3
0
2.8
3.0
3.2
X2
Alpha3
density
10.0
7.5
5.0
2.5
0.0
4.50
4.75
5.00
5.25
X3
approximation
Guassian_Task1
Rejection_Task2



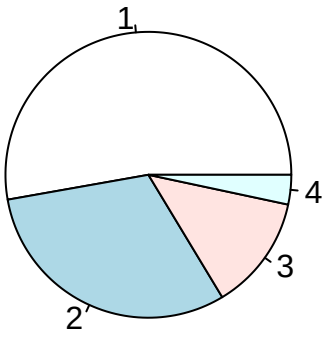
Question 4

```
Q3_non_zeros <- rowSums(Q3 >= 0.001)
Q4_non_zeros <- rowSums(Q4 >= 0.001)
par(mfrow=c(1,2))
pie(table(Q3_non_zeros), main="Q3 non zero elements count")
pie(table(Q4_non_zeros), main="Q4 non zero elements count")
```

Q3 non zero elements count



Q4 non zero elements count




```
# Decide how many clusters to look at
n_clusters <- 10

# Initialize total within sum of squares error: wss
wss_Q3 <- matrix(nrow=n_clusters, ncol=3)
wss_Q4 <- matrix(nrow=n_clusters, ncol=3)

set.seed(123)

# Look over 1 to n possible clusters
for (i in 1:n_clusters) {
  print(i)
  # Fit the model: km.out
  km_out_Q3 <- kmeans(Q3, centers = i, nstart = 100)
  km_out_Q4 <- kmeans(Q4, centers = i, nstart = 100)
  # Save the within cluster sum of squares
  wss_Q3[i,1] <- i
  wss_Q4[i,1] <- i
  wss_Q3[i,2] <- km_out_Q3$tot.withinss
  wss_Q4[i,2] <- km_out_Q4$tot.withinss
  wss_Q3[i,3] <- "Q3"
  wss_Q4[i,3] <- "Q4"
}
```

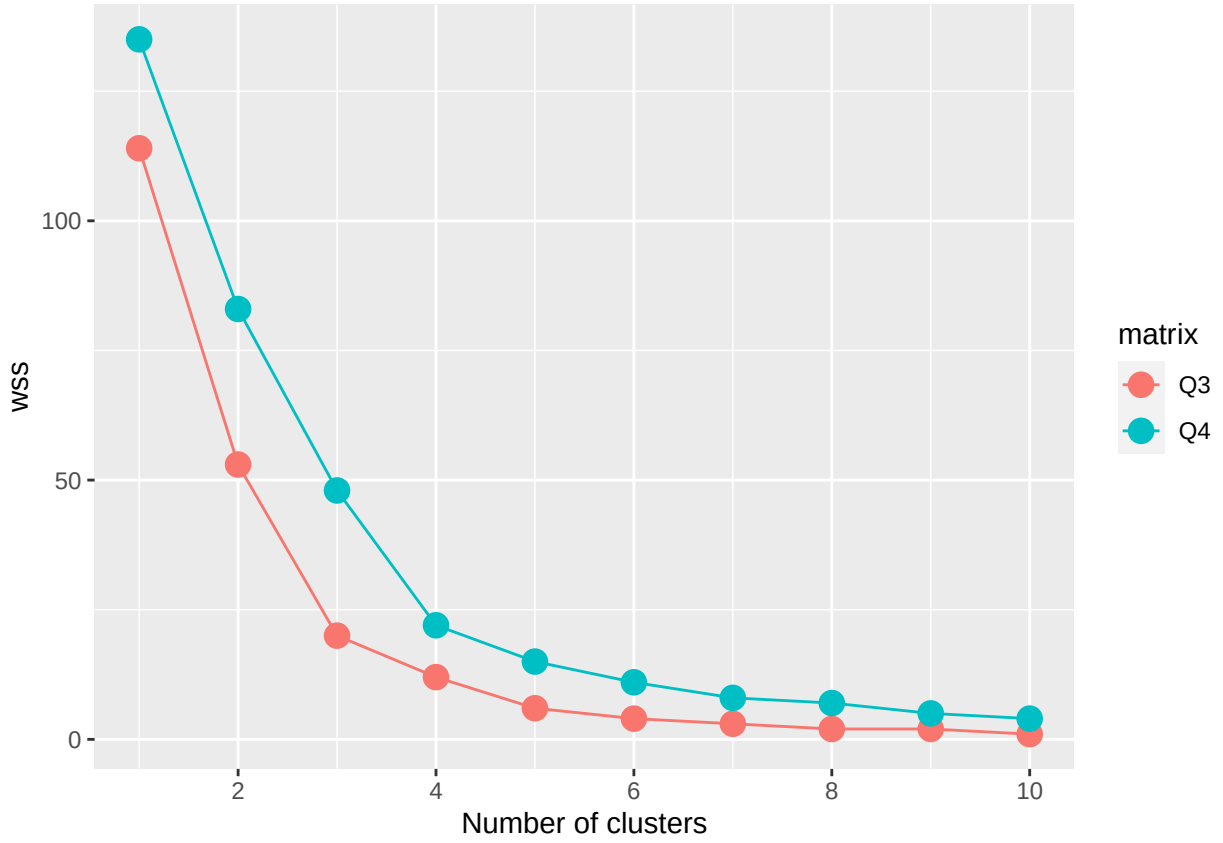
```
## [1] 1
## [1] 2
## [1] 3
```

```
## [1] 4
## [1] 5
## [1] 6
## [1] 7
## [1] 8
## [1] 9
## [1] 10
```

```
# Produce a scree plot
concated_matrix <- rbind(wss_Q3, wss_Q4)
wss_df <- data.frame(clusters = as.integer(concated_matrix[,1]),
                     wss = as.integer(concated_matrix[,2]),
                     matrix = concated_matrix[,3])
print(wss_df)
```

```
##    clusters wss matrix
## 1         1 114     Q3
## 2         2  53     Q3
## 3         3  20     Q3
## 4         4  12     Q3
## 5         5   6     Q3
## 6         6   4     Q3
## 7         7   3     Q3
## 8         8   2     Q3
## 9         9   2     Q3
## 10       10   1     Q3
## 11        1 135     Q4
## 12        2  83     Q4
## 13        3  48     Q4
## 14        4  22     Q4
## 15        5  15     Q4
## 16        6  11     Q4
## 17        7   8     Q4
## 18        8   7     Q4
## 19        9   5     Q4
## 20       10   4     Q4
```

```
scree_plot <- ggplot(wss_df, aes(x = clusters, y = wss, color = matrix)) +
    geom_point(size = 4)+
    geom_line() +
    scale_x_continuous(breaks = c(2, 4, 6, 8, 10)) +
    xlab('Number of clusters')
scree_plot
```




```
install.packages('ggtern')
```

```
## Installing package into 'C:/Users/Yuval-PC/AppData/Local/R/win-library/4.3'
## (as 'lib' is unspecified)
```

```
## package 'ggtern' successfully unpacked and MD5 sums checked
##
## The downloaded binary packages are in
##  C:\Users\Yuval-PC\AppData\Local\Temp\RtmpArAAVq\downloaded_packages
```

```
library('ggtern')
```

```
## Registered S3 methods overwritten by 'ggtern':
##   method           from
##   grid.draw.ggplot ggplot2
##   plot.ggplot      ggplot2
##   print.ggplot     ggplot2
```

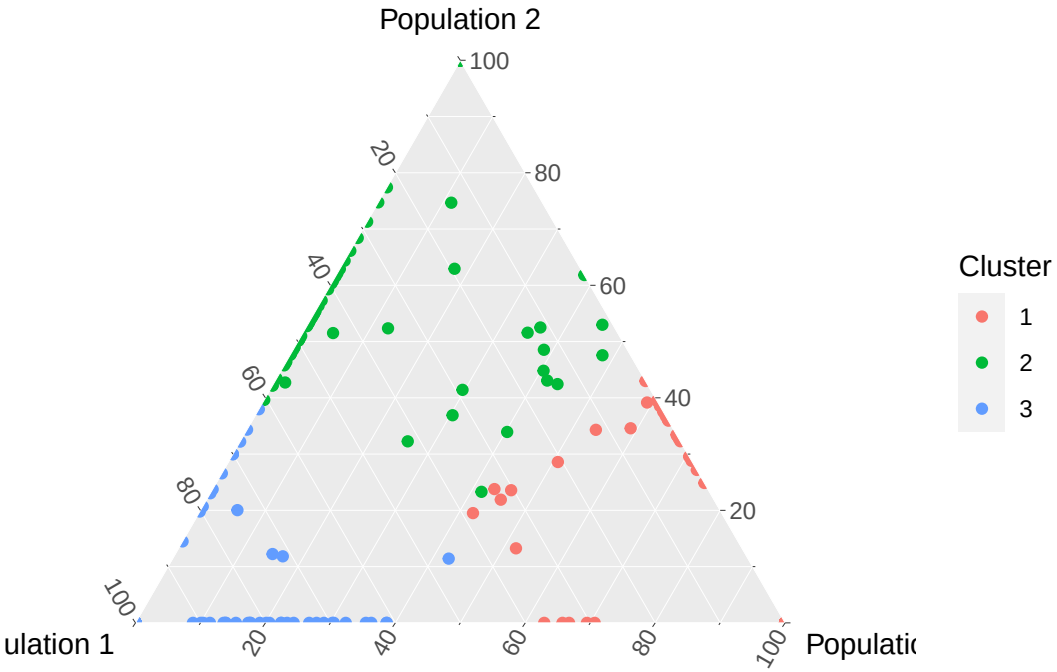
```
## --
## Remember to cite, run citation(package = 'ggtern') for further info.
## --
```

```
##
## Attaching package: 'ggtern'
```

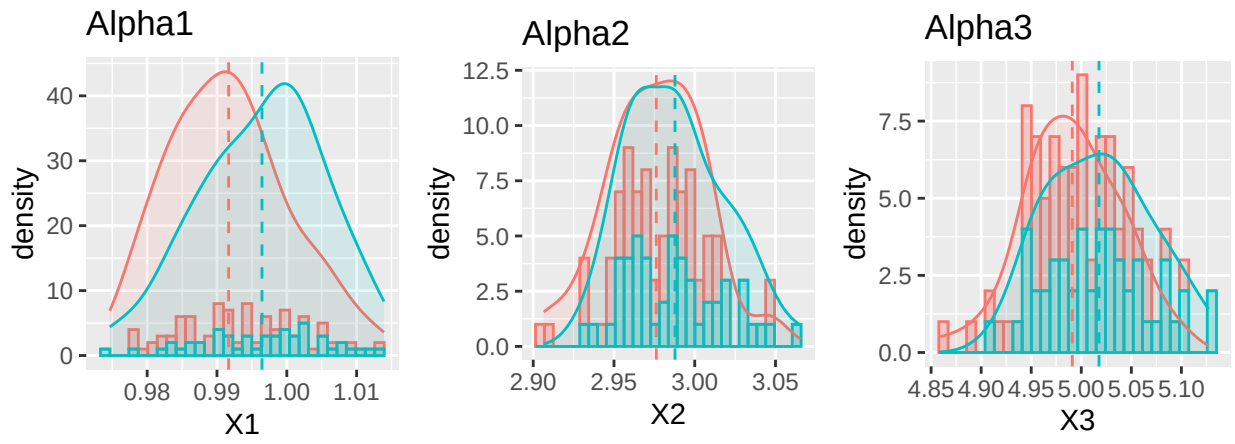
```
## The following objects are masked from 'package:ggplot2':
##
##     aes, annotate, ggplot, ggplot_build, ggplot_gtable, ggplotGrob,
##     ggsave, layer_data, theme_bw, theme_classic, theme_dark,
```

```
##     theme_gray, theme_light, theme_linedraw, theme_minimal, theme_void
## The following objects are masked from 'package:gridExtra':
##
##     arrangeGrob, grid.arrange
```

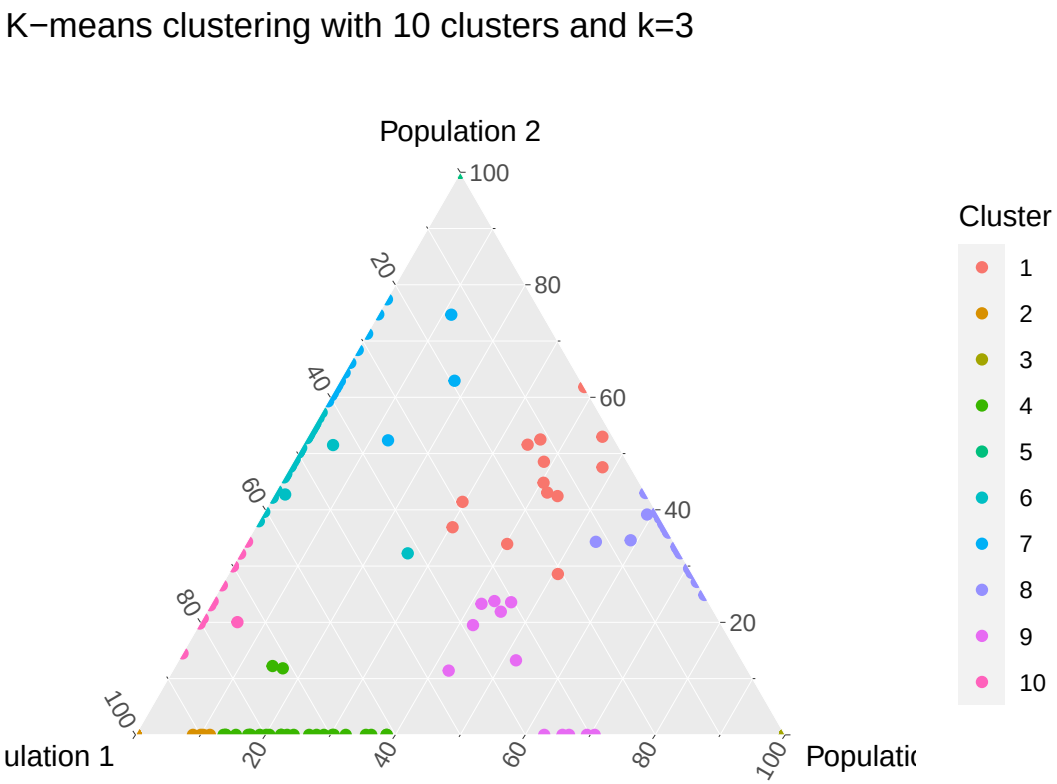
```r
clusters <- kmeans(Q3, centers = 3, nstart = 100)$cluster
clusters <- as.factor(clusters)
Q3_clusters_df <- data.frame(Q3, clusters)
# p1 <- ggplot(Q3_clusters_df, aes(x = V1, color=clusters)) +
#   geom_density(alpha=0.1)+
#    theme(aspect.ratio = 1) +
#   labs(title = "Alpha1 clusters")
# p2 <- ggplot(Q3_clusters_df, aes(x = V2, color=clusters)) +
#   geom_density(alpha=0.1)+
#    theme(aspect.ratio = 1) +
#   labs(title = "Alpha2 clusters")
# p3 <- ggplot(Q3_clusters_df, aes(x = V3, color=clusters)) +
#   geom_density(alpha=0.1)+
#    theme(aspect.ratio = 1) +
#   labs(title = "Alpha2 clusters")
# combined <- ggarrange(p1, p2, p3, ncol=3, nrow=1, common.legend = TRUE, legend="bottom")

ggtern(data = Q3_clusters_df, aes(x = V1, y = V2, z = V3, color = clusters)) +
  geom_point() +
  labs(title = "K-means clustering with 3 clusters and k=3",
       x = "Population 1",
       y = "Population 2",
       z = "Population 3",
       color = "Cluster")
```




```
print(combined)
```




```
clusters <- kmeans(Q3, centers = 10, nstart = 100)$cluster
clusters <- as.factor(clusters)
Q3_clusters_df <- data.frame(Q3, clusters)
ggtern(data = Q3_clusters_df, aes(x = V1, y = V2, z = V3, color = clusters)) +
  geom_point() +
  labs(title = "K-means clustering with 10 clusters and k=3",
       x = "Population 1",
       y = "Population 2",
       z = "Population 3",
       color = "Cluster")
```




```
install.packages("factoextra")
```

```
## Installing package into 'C:/Users/Yuval-PC/AppData/Local/R/win-library/4.3'
## (as 'lib' is unspecified)
```

```
## package 'factoextra' successfully unpacked and MD5 sums checked
##
## The downloaded binary packages are in
##  C:\Users\Yuval-PC\AppData\Local\Temp\RtmpArAAVq\downloaded_packages
```

```
install.packages("cluster")
```

```
## Installing package into 'C:/Users/Yuval-PC/AppData/Local/R/win-library/4.3'
## (as 'lib' is unspecified)
```

```
## package 'cluster' successfully unpacked and MD5 sums checked
##
## The downloaded binary packages are in
##  C:\Users\Yuval-PC\AppData\Local\Temp\RtmpArAAVq\downloaded_packages
```

```
install.packages("magrittr")
```

```
## Installing package into 'C:/Users/Yuval-PC/AppData/Local/R/win-library/4.3'
## (as 'lib' is unspecified)
```

```
## package 'magrittr' successfully unpacked and MD5 sums checked
```

```
## Warning: cannot remove prior installation of package 'magrittr'
```

```
## Warning in file.copy(savedcopy, lib, recursive = TRUE): problem copying
```

```
## C:\Users\Yuval-PC\AppData\Local\R\win-library\4.3\00LOCK\magrittr\libs\x64\magrittr.dll
## to
## C:\Users\Yuval-PC\AppData\Local\R\win-library\4.3\magrittr\libs\x64\magrittr.dll:
## Permission denied
## Warning: restored 'magrittr'
##
## The downloaded binary packages are in
##  C:\Users\Yuval-PC\AppData\Local\Temp\RtmpArAAVq\downloaded_packages
```

```
install.packages("dendextend")
```

```
## Installing package into 'C:/Users/Yuval-PC/AppData/Local/R/win-library/4.3'
## (as 'lib' is unspecified)
## package 'dendextend' successfully unpacked and MD5 sums checked
##
## The downloaded binary packages are in
##  C:\Users\Yuval-PC\AppData\Local\Temp\RtmpArAAVq\downloaded_packages
```

```
library("cluster")
library("factoextra")
```

```
## Welcome! Want to learn more? See two factoextra-related books at https://goo.gl/ve3WBa
```

```
library("magrittr")
```

```
##
## Attaching package: 'magrittr'
## The following object is masked from 'package:tidyr':
##
##     extract
```

```
library("dendextend")
```

```
##
## ---------------------
## Welcome to dendextend version 1.17.1
## Type citation('dendextend') for how to cite the package.
##
## Type browseVignettes(package = 'dendextend') for the package vignette.
## The github page is: https://github.com/talgalili/dendextend/
##
## Suggestions and bug-reports can be submitted at: https://github.com/talgalili/dendextend/issues
## You may ask questions at stackoverflow, use the r and dendextend tags:
##   https://stackoverflow.com/questions/tagged/dendextend
##
##  To suppress this message use:  suppressPackageStartupMessages(library(dendextend))
## ---------------------
##
## Attaching package: 'dendextend'
## The following object is masked from 'package:ggpubr':
##
##     rotate
## The following object is masked from 'package:stats':
```

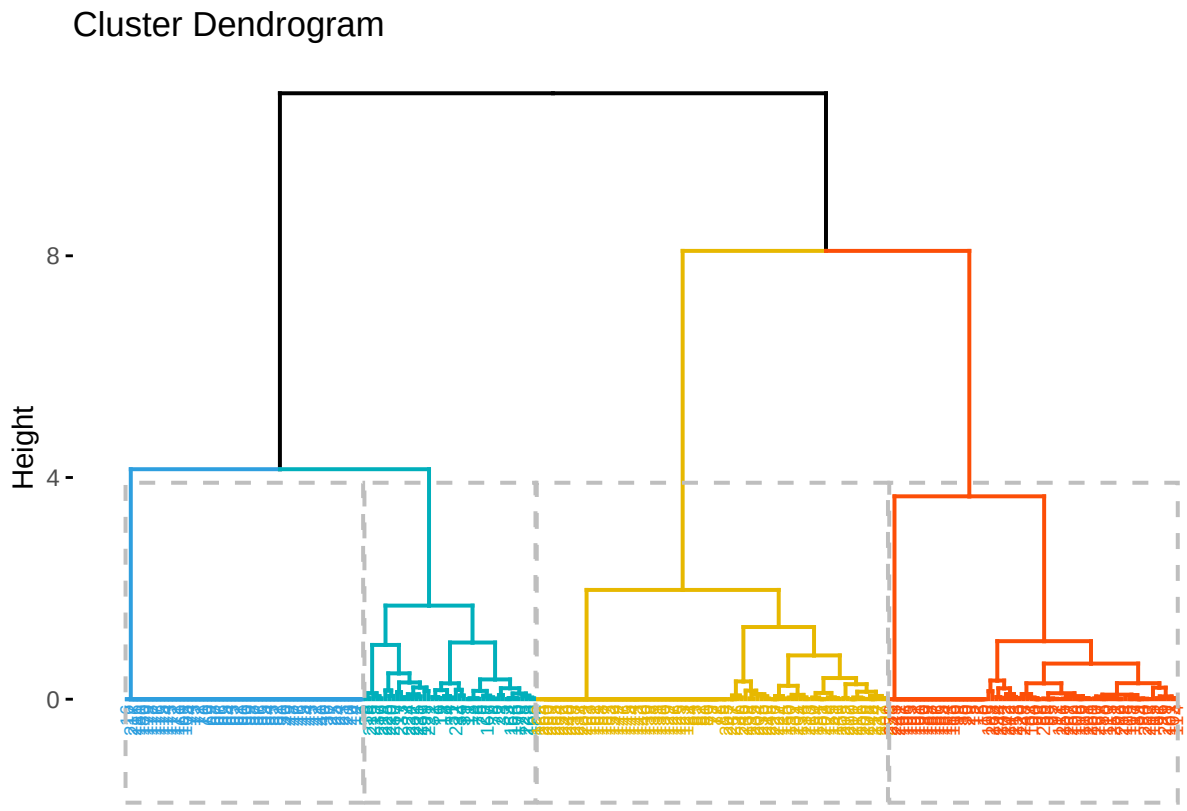
```
##
##     cutree
```

```
res.dist <- get_dist(Q3, stand = TRUE, method = "pearson")

fviz_dist(res.dist,
   gradient = list(low = "#00AFBB", mid = "white", high = "#FC4E07"))
```


```
res.hc <- Q3 %>%
  dist(method = "euclidean") %>% # Compute dissimilarity matrix
  hclust(method = "ward.D2")     # Compute hierachical clustering

# Visualize using factoextra
# Cut in 4 groups and color by groups
fviz_dend(res.hc, k = 4, # Cut in four groups
          cex = 0.5, # label size
          k_colors = c("#2E9FDF", "#00AFBB", "#E7B800", "#FC4E07"),
          color_labels_by_k = TRUE, # color labels by groups
          rect = TRUE # Add rectangle around groups
          )
```

```
## Warning: The `<scale>` argument of `guides()` cannot be `FALSE`. Use "none" instead as
## of ggplot2 3.3.4.
## i The deprecated feature was likely used in the factoextra package.
##   Please report the issue at <https://github.com/kassambara/factoextra/issues>.
## This warning is displayed once every 8 hours.
## Call `lifecycle::last_lifecycle_warnings()` to see where this warning was
```

```
## generated.
```




```
install.packages("fpc")
```

```
## Installing package into 'C:/Users/Yuval-PC/AppData/Local/R/win-library/4.3'
## (as 'lib' is unspecified)
```

```
## package 'fpc' successfully unpacked and MD5 sums checked
##
## The downloaded binary packages are in
##  C:\Users\Yuval-PC\AppData\Local\Temp\RtmpArAAVq\downloaded_packages
```

```
install.packages("dbscan")
```

```
## Installing package into 'C:/Users/Yuval-PC/AppData/Local/R/win-library/4.3'
## (as 'lib' is unspecified)
```

```
## package 'dbscan' successfully unpacked and MD5 sums checked
##
## The downloaded binary packages are in
##  C:\Users\Yuval-PC\AppData\Local\Temp\RtmpArAAVq\downloaded_packages
```

```
library("fpc")
library("dbscan")
```

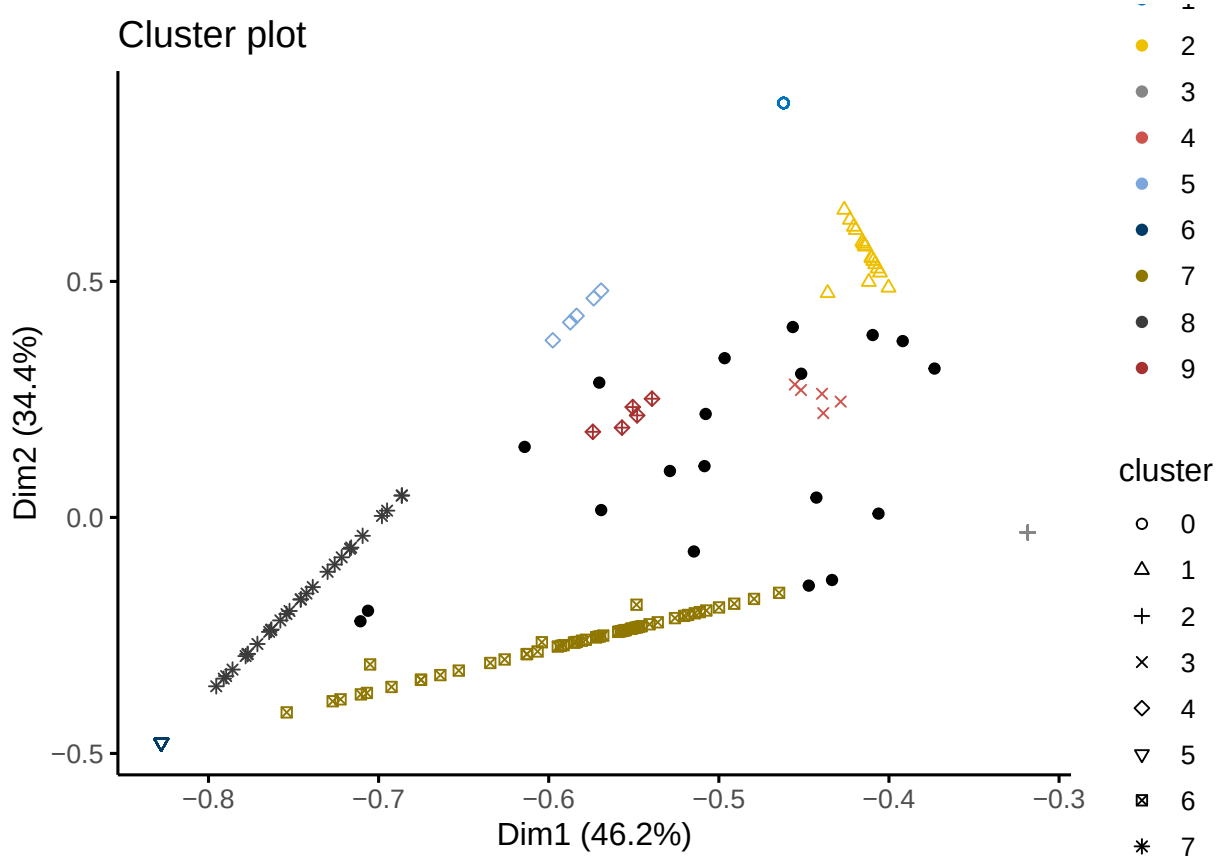
```
##
## Attaching package: 'dbscan'
```

```
## The following object is masked from 'package:fpc':
##
```

```
##     dbscan
```

```
## The following object is masked from 'package:stats':
##
##     as.dendrogram
```

```
set.seed(123)
db <- fpc::dbscan(Q3, eps = 0.08, MinPts = 5)

# Plot DBSCAN results
library("factoextra")
fviz_cluster(db, data = Q3, stand = FALSE,
             ellipse = FALSE, show.clust.cent = FALSE,
             geom = "point",palette = "jco", ggtheme = theme_classic())
```




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

```
## Installing package into 'C:/Users/Yuval-PC/AppData/Local/R/win-library/4.3'
## (as 'lib' is unspecified)
```

```
## package 'kernlab' successfully unpacked and MD5 sums checked
```

```
## Warning: cannot remove prior installation of package 'kernlab'
```

```
## Warning in file.copy(savedcopy, lib, recursive = TRUE): problem copying
## C:\Users\Yuval-PC\AppData\Local\R\win-library\4.3\00LOCK\kernlab\libs\x64\kernlab.dll
## to
## C:\Users\Yuval-PC\AppData\Local\R\win-library\4.3\kernlab\libs\x64\kernlab.dll:
## Permission denied
```

```
## Warning: restored 'kernlab'
```

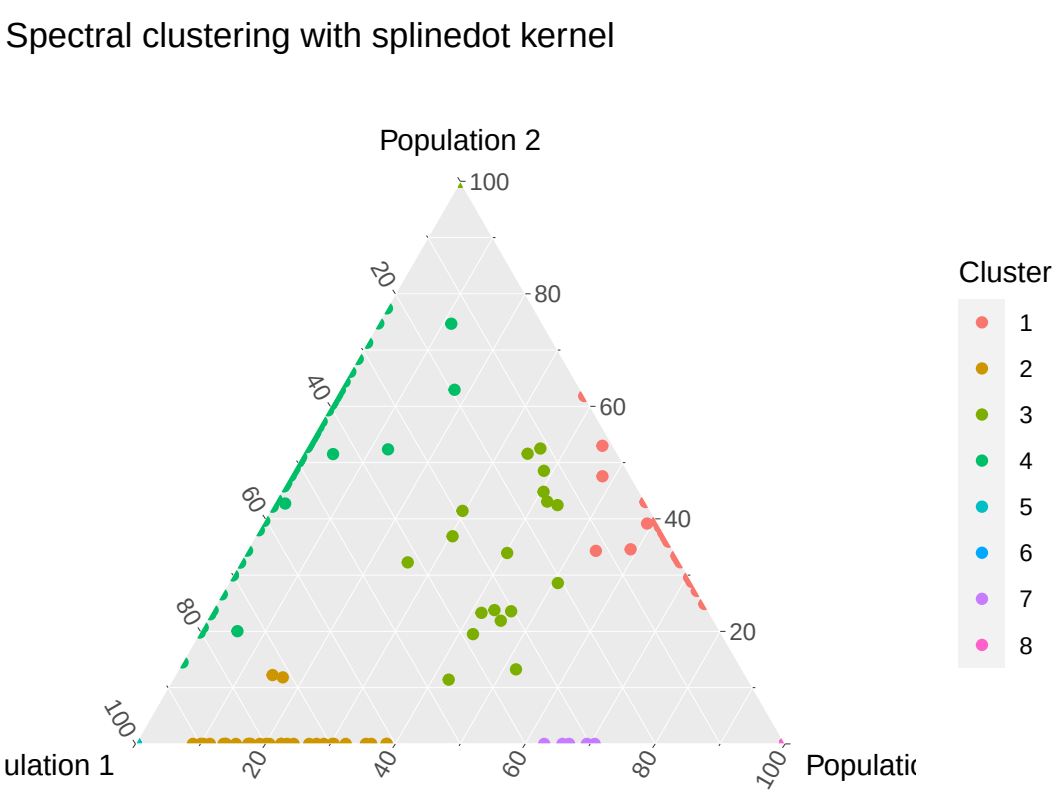
```
##
## The downloaded binary packages are in
##  C:\Users\Yuval-PC\AppData\Local\Temp\RtmpArAAVq\downloaded_packages
```

```
library(kernlab)
```

```
##
## Attaching package: 'kernlab'
```

```
## The following object is masked from 'package:ggplot2':
##
##     alpha
```

```
set.seed(127)
clusters <- specc(Q3, centers = 8, scale=TRUE, kernel="splinedot")
clusters <- as.factor(clusters)
Q3_clusters_df <- data.frame(Q3, clusters)
g <- ggtern(data = Q3_clusters_df, aes(x = V1, y = V2, z = V3, color = clusters)) +
  geom_point() +
  labs(title = "Spectral clustering with splinedot kernel",
       x = "Population 1",
       y = "Population 2",
       z = "Population 3",
       color = "Cluster")
print(g)
```



```r
install.packages("GGally")
```

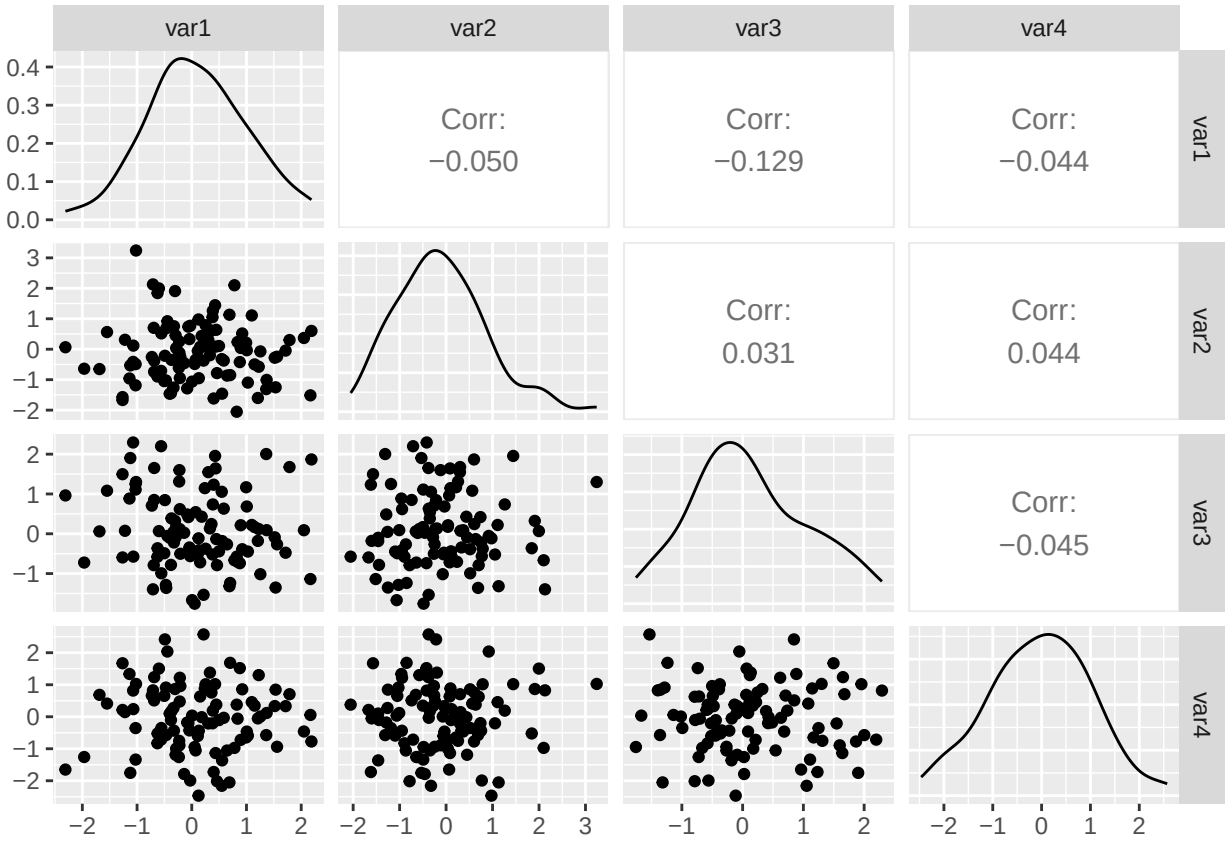
```
## Installing package into 'C:/Users/Yuval-PC/AppData/Local/R/win-library/4.3'
## (as 'lib' is unspecified)
```

```
## package 'GGally' successfully unpacked and MD5 sums checked
##
## The downloaded binary packages are in
##  C:\Users\Yuval-PC\AppData\Local\Temp\RtmpArAAVq\downloaded_packages
```

```r
library(GGally)
```

```
## Registered S3 method overwritten by 'GGally':
##   method from
##   +.gg   ggplot2
```

```r
# Generate some sample data with four variables
set.seed(123)
n <- 100
data <- data.frame(
  var1 = rnorm(n),
  var2 = rnorm(n),
  var3 = rnorm(n),
  var4 = rnorm(n)
)

# Create the scatterplot matrix
ggpairs(data)
```




```
# clusters <- as.factor(clusters)
# Q4_clusters_df <- data.frame(Q4, clusters)
```

```
install.packages(c("klaR", "scatterplot3d"))
```

```
## Warning: package 'scatterplot3d' is in use and will not be installed
```

```
## Installing package into 'C:/Users/Yuval-PC/AppData/Local/R/win-library/4.3'
## (as 'lib' is unspecified)
```

```
## package 'klaR' successfully unpacked and MD5 sums checked
##
## The downloaded binary packages are in
##  C:\Users\Yuval-PC\AppData\Local\Temp\RtmpArAAVq\downloaded_packages
```

```
install.packages("haven")
```

```
## Installing package into 'C:/Users/Yuval-PC/AppData/Local/R/win-library/4.3'
## (as 'lib' is unspecified)
```

```
## package 'haven' successfully unpacked and MD5 sums checked
##
## The downloaded binary packages are in
##  C:\Users\Yuval-PC\AppData\Local\Temp\RtmpArAAVq\downloaded_packages
```

```
library(haven)
library(klaR)

library(kernlab)
```

```
set.seed(132)
clusters <- specc(Q4, centers = 8, scale=TRUE, kernel="splinedot")
colors = c("#FF0000", "#808000", "#00FF00", "#00FFFF", "#008080", "#0000FF", "#FF00FF", "#800080")
par(mfrow=c(2,3))
for (angle in seq(0,150,30)){
  print(angle)
  quadplot(Q4,
           main=paste("spectral clustering angle:",toString(angle)),
           angle = angle,
           labelcol = "black",
           col=colors[c(clusters)],
           pch=19,
           lwd=2,
           cex=1,
           legend.control = list(plot=FALSE))
}
```

```
## [1] 0
## [1] 30
## [1] 60
## [1] 90
## [1] 120
## [1] 150
```