Result - 5/12

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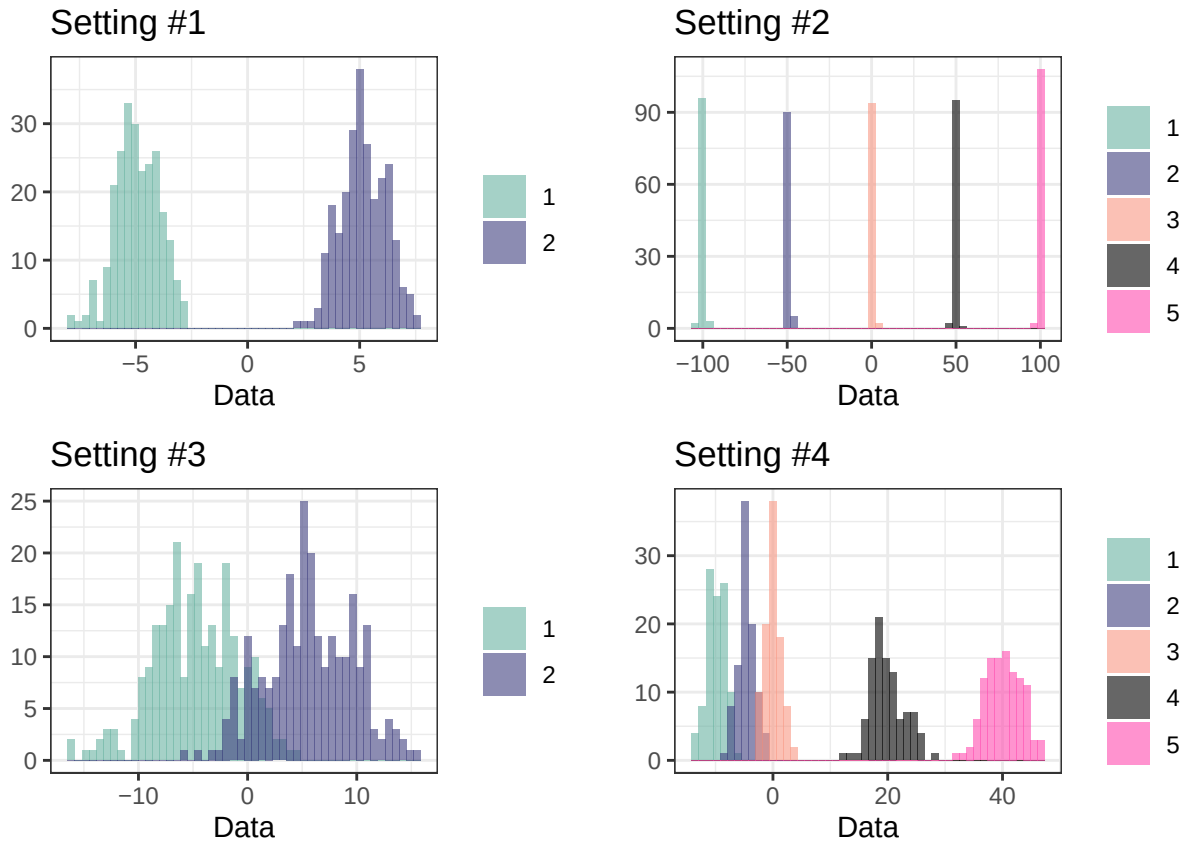
(0) The simulated data

For the entire analysis in this report, there are 4 settings. The first two setting is the same as those I previously used last time (Result - 3/8). The setting #3 and #4 are the new settings. Below are the histogram showing the simulated data in each setting.




```
n_unique <- function(vec){
  length(unique(vec))
}
```

Setting 1

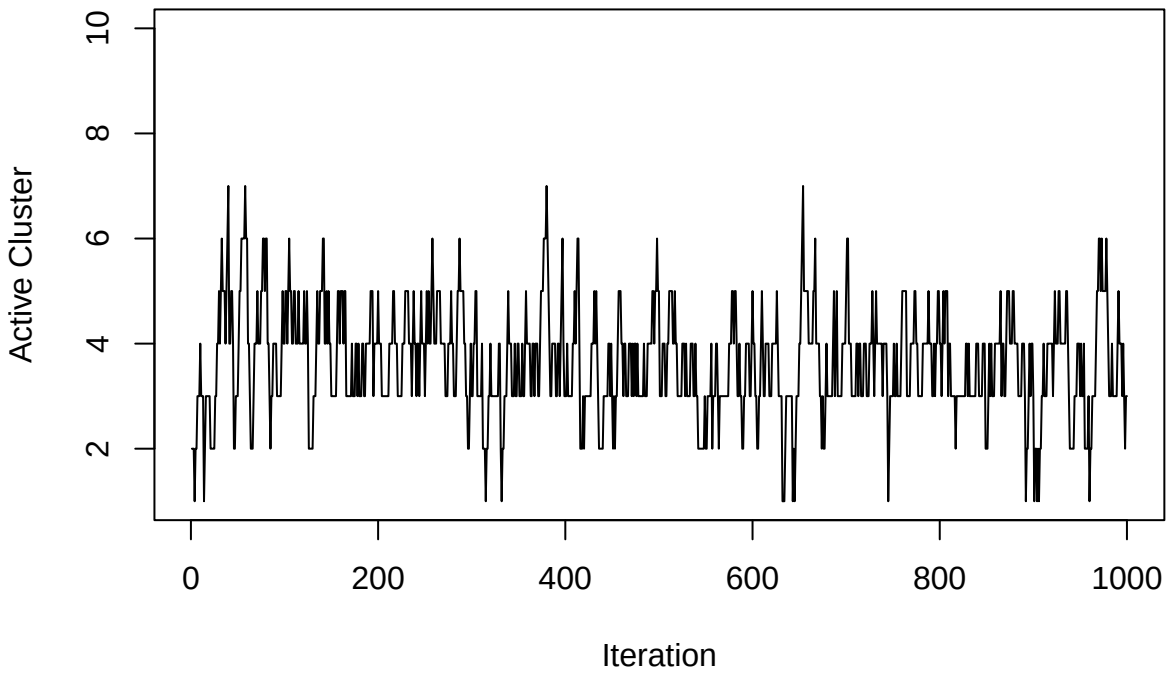
```
### Setting 1
K <- 10
iter <- 1000

ci_init <- sample(1:1, 500, replace = TRUE)
xi_vec <- rep(0.01, K)
mu0_vec <- rep(0, K)
a_sigma_vec <- rep(1, K)
b_sigma_vec <- rep(1, K)
lambda_vec <- rep(1, K)
a_theta <- 1
b_theta <- 1
sm_iter <- 10

set.seed(seed_val)
start_time <- Sys.time()
result1 <- SFDM_model(iter, K, ci_init, xi_vec, scale(data_sim_1), mu0_vec,
                      a_sigma_vec, b_sigma_vec, lambda_vec, a_theta, b_theta,
                      sm_iter, 250)
Sys.time() - start_time
```

```
## Time difference of 19.98542 secs
```

```
table(ci_actual_1, salso(result1$iter_assign[-(1:500), ], maxNClusters = K))
```

```
##
## ci_actual_1   1   2
##           1 246   0
##           2   0 254
```

```
plot(1:iter, apply(result1$iter_assign, 1, n_unique), type = "l",
     ylim = c(1, K), xlab = "Iteration", ylab = "Active Cluster")
```




```
mean(apply(result1$iter_assign, 1, n_unique))
```

```
## [1] 3.646
```

```
result_status <- factor(result1$sm_status)
levels(result_status) <- c("Reject", "Accept")
result_sm <- factor(result1$split_or_merge)
levels(result_sm) <- c("Merge", "Split")
table(result_status, result_sm)
```

```
##              result_sm
## result_status Merge Split
##        Reject   544    63
##        Accept    14   379
```

```
rbind(data.frame(data_sim_1, ci_actual_1,
                 ci_result = as.numeric(salso(result1$iter_assign[-(1:500), ], maxNClusters = K))) %>%
        group_by(ci_actual_1) %>%
        summarise(q = quantile(data_sim_1)) %>%
        rename(cluster = ci_actual_1) %>%
        mutate(type = "Actual", status = paste0("Q", c(0, 1, 2, 3, 4))) %>%
        pivot_wider(names_from = status, values_from = q),
      data.frame(data_sim_1, ci_actual_1,
                 ci_result = as.numeric(salso(result1$iter_assign[-(1:500), ], maxNClusters = K))) %>%
```

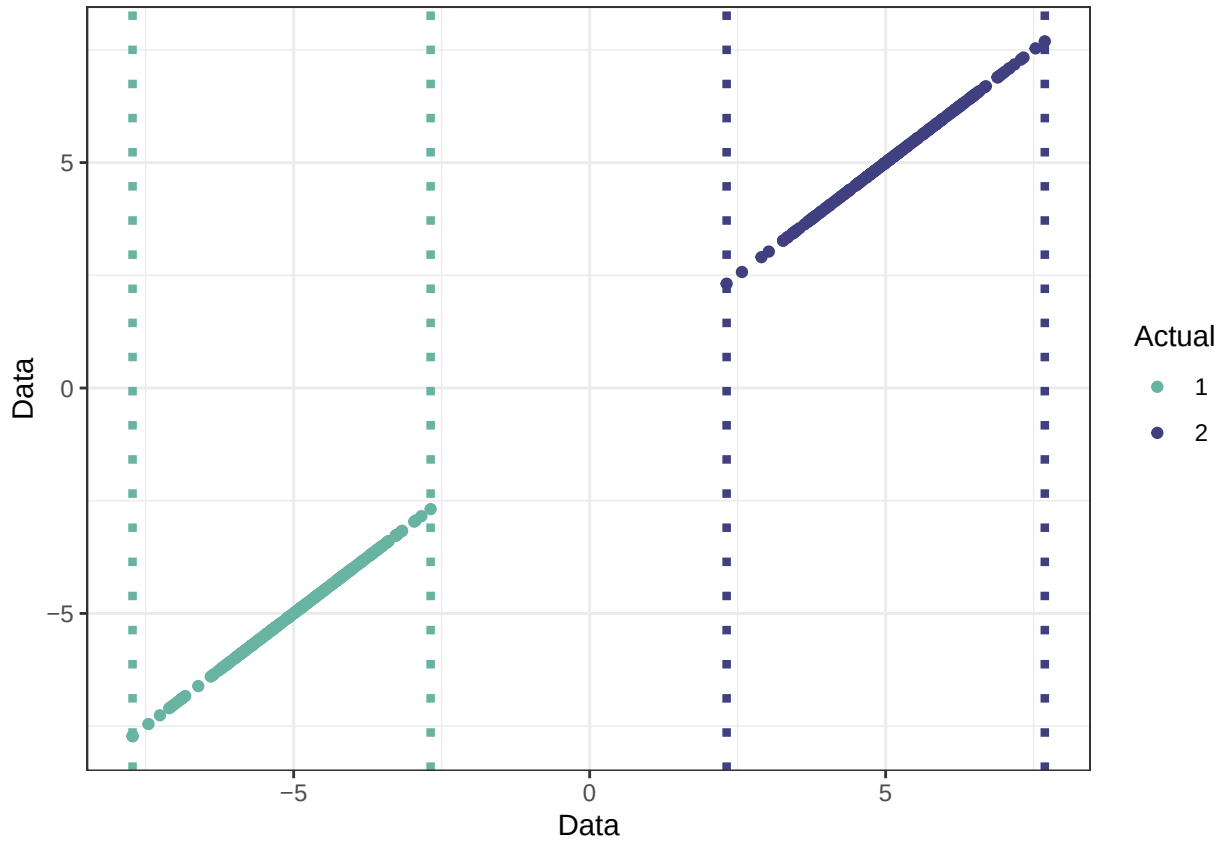
```
        group_by(ci_result) %>%
        summarise(q = quantile(data_sim_1)) %>%
        rename(cluster = ci_result) %>%
        mutate(type = "Model", status = paste0("Q", c(0, 1, 2, 3, 4))) %>%
        pivot_wider(names_from = status, values_from = q))
```

```
## `summarise()` has grouped output by 'ci_actual_1'. You can override using the
## `.groups` argument.
## `summarise()` has grouped output by 'ci_result'. You can override using the
## `.groups` argument.
```

```
## # A tibble: 4 x 7
## # Groups:   cluster [2]
##   cluster type      Q0    Q1    Q2    Q3    Q4
##     <dbl> <chr>  <dbl> <dbl> <dbl> <dbl> <dbl>
## 1       1 Actual -7.72 -5.59 -4.94 -4.21 -2.69
## 2       2 Actual  2.31  4.52  5.13  5.94  7.69
## 3       1 Model  -7.72 -5.59 -4.94 -4.21 -2.69
## 4       2 Model   2.31  4.52  5.13  5.94  7.69
```

```
ci_result_1 <- as.numeric(salso(result1$iter_assign[-(1:500), ], maxNClusters = K))


data.frame(data_sim_1, ci_actual_1, ci_result_1) %>%
  ggplot(aes(x = data_sim_1, y = data_sim_1, col = factor(ci_actual_1))) +
  geom_point() +
  theme_bw() +
  scale_color_manual(values=c("#69b3a2", "#404080")) +
  geom_vline(xintercept = quantile(data_sim_1[ci_result_1 == 1], c(0, 1)),
             linetype = "dotted", color = "#69b3a2", size = 1.5) +
  geom_vline(xintercept = quantile(data_sim_1[ci_result_1 == 2], c(0, 1)),
             linetype = "dotted", color = "#404080", size = 1.5) +
  labs(col = "Actual", x = "Data", y = "Data")
```

```
## Warning: Using `size` aesthetic for lines was deprecated in ggplot2 3.4.0.
## i Please use `linewidth` instead.
```



Setting 2

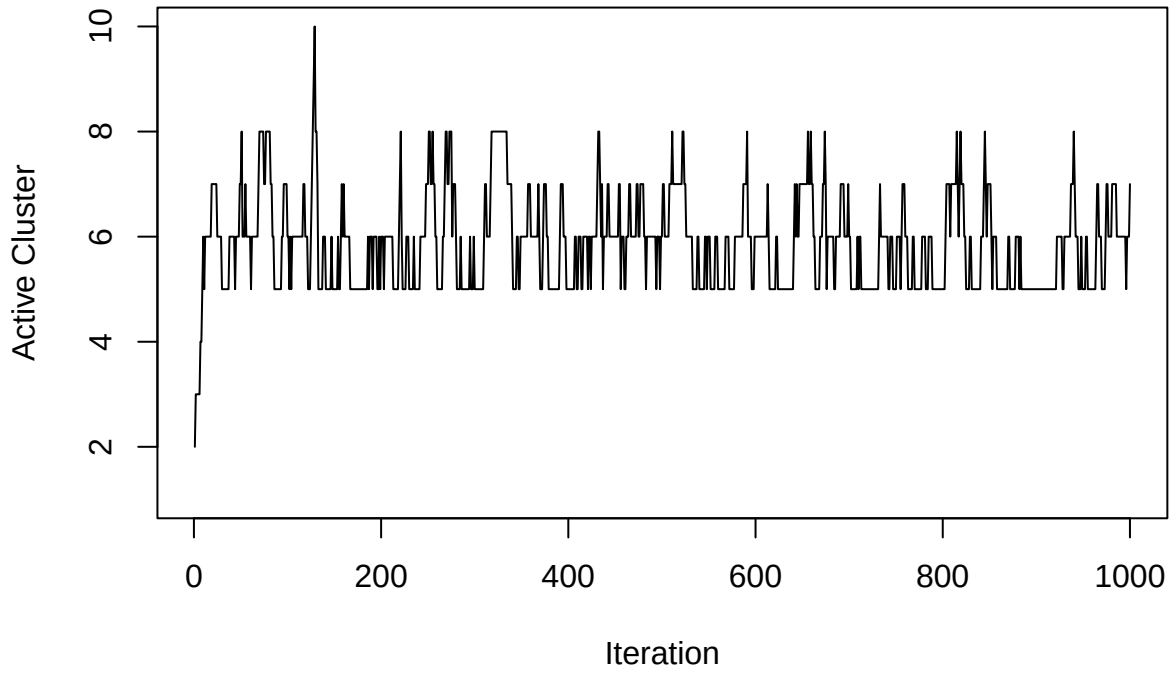
```
### Setting 2
K <- 10
iter <- 1000

ci_init <- rep(1, 500)
xi_vec <- rep(0.01, K)
mu0_vec <- rep(0, K)
a_sigma_vec <- rep(100, K)
b_sigma_vec <- rep(1, K)
lambda_vec <- rep(0.01, K)
a_theta <- 1
b_theta <- 4
sm_iter <- 10

set.seed(seed_val)
start_time <- Sys.time()
result2 <- SFDM_model(iter, K, ci_init, xi_vec, scale(data_sim_2), mu0_vec,
                      a_sigma_vec, b_sigma_vec, lambda_vec, a_theta, b_theta,
                      sm_iter, 250)
Sys.time() - start_time
```

```
## Time difference of 12.62208 secs
```

```
table(ci_actual_2, salso(result2$iter_assign[-(1:500), ], maxNClusters = K))
```

```
##
## ci_actual_2   1   2   3   4   5
##           1   0 101   0   0   0
##           2   0   0   0  95   0
##           3   0   0   0   0  96
##           4   0   0  98   0   0
##           5 110   0   0   0   0
```

```
plot(1:iter, apply(result2$iter_assign, 1, n_unique), type = "l",
     ylim = c(1, K), xlab = "Iteration", ylab = "Active Cluster")
```




```
mean(apply(result2$iter_assign, 1, n_unique))
```

```
## [1] 5.855
```

```
result_status <- factor(result2$sm_status)
levels(result_status) <- c("Reject", "Accept")
result_sm <- factor(result2$split_or_merge)
levels(result_sm) <- c("Merge", "Split")
table(result_status, result_sm)
```

```
##              result_sm
## result_status Merge Split
##        Reject   808    19
##        Accept     1   172
```

Setting 3

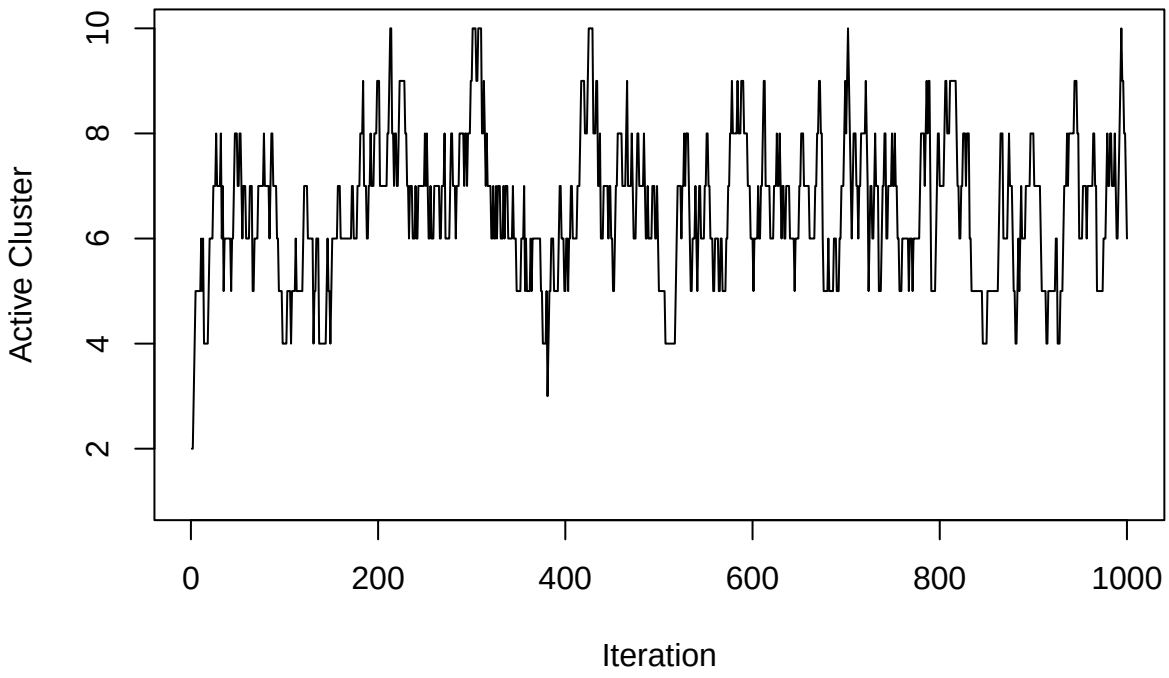
```
### Setting 3
K <- 10
iter <- 1000
ci_init <- rep(1:1, 500)
xi_vec <- rep(0.01, K)
mu0_vec <- rep(0, K)
a_sigma_vec <- rep(100, K)
b_sigma_vec <- rep(10, K)
lambda_vec <- rep(10, K)
a_theta <- 1
b_theta <- 1
sm_iter <- 10

set.seed(seed_val)
start_time <- Sys.time()
result3 <- SFDM_model(iter, K, ci_init, xi_vec, scale(data_sim_3), mu0_vec,
                      a_sigma_vec, b_sigma_vec, lambda_vec, a_theta, b_theta,
                      sm_iter, 250)
Sys.time() - start_time
```

```
## Time difference of 18.05905 secs
```

```
table(ci_actual_3, salso(result3$iter_assign[-(1:500), ], maxNClusters = K))
```

```
##
## ci_actual_3   1   2
##           1 236  10
##           2  46 208
```

```
plot(1:iter, apply(result3$iter_assign, 1, n_unique), type = "l",
     ylim = c(1, K), xlab = "Iteration", ylab = "Active Cluster")
```




```
mean(apply(result3$iter_assign, 1, n_unique))
```

```
## [1] 6.554
```

```
result_status <- factor(result3$sm_status)
levels(result_status) <- c("Reject", "Accept")
result_sm <- factor(result3$split_or_merge)
levels(result_sm) <- c("Merge", "Split")
table(result_status, result_sm)
```

```
##              result_sm
## result_status Merge Split
##        Reject   691    21
##        Accept     0   288
```

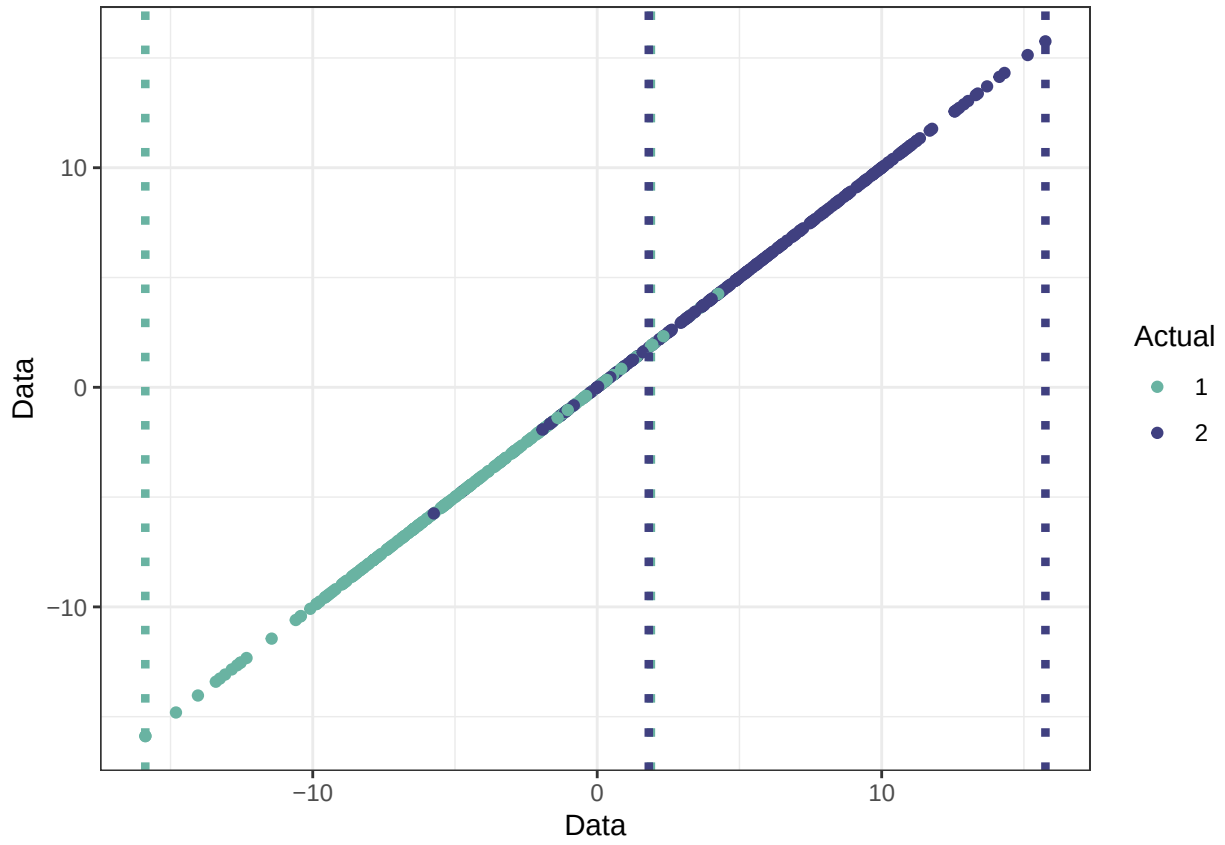
```
rbind(data.frame(data_sim_3, ci_actual_3,
                 ci_result = as.numeric(salso(result3$iter_assign[-(1:500), ], maxNClusters = K))) %>%
        group_by(ci_actual_3) %>%
        summarise(q = quantile(data_sim_3)) %>%
        rename(cluster = ci_actual_3) %>%
        mutate(type = "Actual", status = paste0("Q", c(0, 1, 2, 3, 4))) %>%
        pivot_wider(names_from = status, values_from = q),
      data.frame(data_sim_3, ci_actual_3,
                 ci_result = as.numeric(salso(result3$iter_assign[-(1:500), ], maxNClusters = K))) %>%
```

```
        group_by(ci_result) %>%
        summarise(q = quantile(data_sim_3)) %>%
        rename(cluster = ci_result) %>%
        mutate(type = "Model", status = paste0("Q", c(0, 1, 2, 3, 4))) %>%
        pivot_wider(names_from = status, values_from = q))
```

```
## `summarise()` has grouped output by 'ci_actual_3'. You can override using the
## `.groups` argument.
## `summarise()` has grouped output by 'ci_result'. You can override using the
## `.groups` argument.
```

```
## # A tibble: 4 x 7
## # Groups:   cluster [2]
##   cluster type       Q0    Q1    Q2    Q3    Q4
##     <dbl> <chr>   <dbl> <dbl> <dbl> <dbl> <dbl>
## 1       1 Actual -15.9  -7.38 -4.78 -1.84  4.25
## 2       2 Actual  -5.74  3.08  5.52  8.74 15.8
## 3       1 Model  -15.9  -6.96 -4.23 -1.20  1.89
## 4       2 Model    1.81  4.22  6.04  9.33 15.8
```

```
ci_result_3 <- as.numeric(salso(result3$iter_assign[-(1:500), ], maxNClusters = K))

data.frame(data_sim_3, ci_actual_3, ci_result_3) %>%
  ggplot(aes(x = data_sim_3, y = data_sim_3, col = factor(ci_actual_3))) +
  geom_point() +
  theme_bw() +
  scale_color_manual(values=c("#69b3a2", "#404080")) +
  geom_vline(xintercept = quantile(data_sim_3[ci_result_3 == 1], c(0, 1)),
             linetype = "dotted", color = "#69b3a2", size = 1.5) +
  geom_vline(xintercept = quantile(data_sim_3[ci_result_3 == 2], c(0, 1)),
             linetype = "dotted", color = "#404080", size = 1.5) +
  ## geom_vline(xintercept = quantile(data_sim_3[ci_result_3 == 3], c(0, 1)),
  ##            linetype = "dotted", color = "red", size = 1.5) +
  labs(col = "Actual", x = "Data", y = "Data")
```



Setting 4

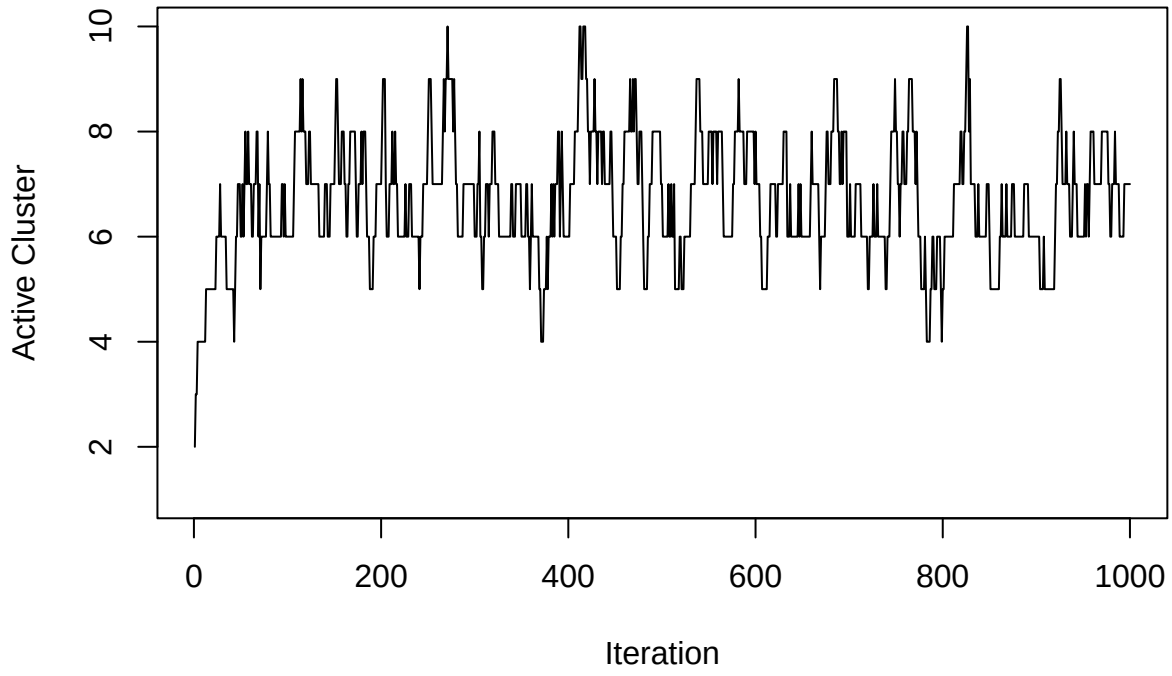
```
### Setting 4
K <- 10
iter <- 1000

ci_init <- rep(1, 500)
xi_vec <- rep(0.01, K)
mu0_vec <- rep(0, K)
a_sigma_vec <- rep(100, K)
b_sigma_vec <- rep(1, K)
lambda_vec <- rep(1, K)
a_theta <- 1
b_theta <- 1
sm_iter <- 10

set.seed(seed_val)
start_time <- Sys.time()
result4 <- SFDM_model(iter, K, ci_init, xi_vec, scale(data_sim_4), mu0_vec,
                      a_sigma_vec, b_sigma_vec, lambda_vec, a_theta, b_theta,
                      sm_iter, 250)
Sys.time() - start_time
```

```
## Time difference of 13.40409 secs
```

```
table(ci_actual_4, salso(result4$iter_assign[-(1:500), ], maxNClusters = K))
```

```
##
## ci_actual_4   1   2   3   4
##           1   0 101   0   0
##           2   0  61   0  34
##           3   0   0   0  96
##           4   0   0  98   0
##           5 110   0   0   0
```

```
plot(1:iter, apply(result4$iter_assign, 1, n_unique), type = "l",
     ylim = c(1, K), xlab = "Iteration", ylab = "Active Cluster")
```




```
mean(apply(result4$iter_assign, 1, n_unique))
```

```
## [1] 6.686
```

```
result_status <- factor(result4$sm_status)
levels(result_status) <- c("Reject", "Accept")
result_sm <- factor(result4$split_or_merge)
levels(result_sm) <- c("Merge", "Split")
table(result_status, result_sm)
```

```
##              result_sm
## result_status Merge Split
##        Reject   767    14
##        Accept     3   216
```

```
rbind(data.frame(data_sim_4, ci_actual_4,
                 ci_result = as.numeric(salso(result4$iter_assign[-(1:500), ], maxNClusters = K))) %>%
        group_by(ci_actual_4) %>%
        summarise(q = quantile(data_sim_4)) %>%
        rename(cluster = ci_actual_4) %>%
        mutate(type = "Actual", status = paste0("Q", c(0, 1, 2, 3, 4))) %>%
        pivot_wider(names_from = status, values_from = q),
      data.frame(data_sim_4, ci_actual_4,
                 ci_result = as.numeric(salso(result4$iter_assign[-(1:500), ], maxNClusters = K))) %>%
        group_by(ci_result) %>%
        summarise(q = quantile(data_sim_4)) %>%
        rename(cluster = ci_result) %>%
        mutate(type = "Model", status = paste0("Q", c(0, 1, 2, 3, 4))) %>%
        pivot_wider(names_from = status, values_from = q))
```

```
## `summarise()` has grouped output by 'ci_actual_4'. You can override using the
## `.groups` argument.
## `summarise()` has grouped output by 'ci_result'. You can override using the
## `.groups` argument.
```

```
## # A tibble: 9 x 7
## # Groups:   cluster [5]
##   cluster type       Q0      Q1      Q2     Q3    Q4
##     <dbl> <chr>   <dbl>   <dbl>   <dbl>  <dbl> <dbl>
## 1       1 Actual -13.6  -11.1   -9.97   -8.59  -6.35
## 2       2 Actual  -8.15  -5.49  -4.77   -3.80  -1.09
## 3       3 Actual  -2.94  -0.972 -0.0204  0.829  3.59
## 4       4 Actual  12.6   17.9   19.4    21.8   28.1
## 5       5 Actual  31.9   38.3   40.1    42.4   46.5
## 6       1 Model   31.9   38.3   40.1    42.4   46.5
## 7       2 Model  -13.6  -10.4   -8.53   -5.69  -4.41
## 8       3 Model   12.6   17.9   19.4    21.8   28.1
## 9       4 Model   -4.26  -2.39  -0.586   0.507  3.59
```

```
ci_result_4 <- as.numeric(salso(result4$iter_assign[-(1:500), ], maxNClusters = K))

data.frame(data_sim_4, ci_actual_4, ci_result_4) %>%
  ggplot(aes(x = data_sim_4, y = data_sim_4, col = factor(ci_actual_4))) +
  geom_point() +
  theme_bw() +
  ## scale_color_manual(values=c("#69b3a2", "#404080")) +
  geom_vline(xintercept = quantile(data_sim_4[ci_result_4 == 1], c(0, 1)),
             linetype = "dotted", color = "#69b3a2", size = 1.5) +
  geom_vline(xintercept = quantile(data_sim_4[ci_result_4 == 2], c(0, 1)),
             linetype = "dotted", color = "#404080", size = 1.5) +
  geom_vline(xintercept = quantile(data_sim_4[ci_result_4 == 3], c(0, 1)),
             linetype = "dotted", color = "red", size = 1.5) +
  geom_vline(xintercept = quantile(data_sim_4[ci_result_4 == 4], c(0, 1)),
```

```
            linetype = "dotted", color = "orange", size = 1.5) +
labs(col = "Actual", x = "Data", y = "Data")
```