```
> soybean <- na.omit(soybean_df)
> nrow(soybean)
[1] 562
> head(soybean)
                Class date plant.stand precip temp hail crop.hist area.dam sever seed.tmt germ plant.growth leaves
1 diaporthe-stem-canker    6           0      2    1    0         1        1     1        0    0            1      1
2 diaporthe-stem-canker    4           0      2    1    0         2        0     2        1    1            1      1
3 diaporthe-stem-canker    3           0      2    1    0         1        0     2        1    2            1      1
4 diaporthe-stem-canker    3           0      2    1    0         1        0     2        0    1            1      1
5 diaporthe-stem-canker    6           0      2    1    0         2        0     1        0    2            1      1
6 diaporthe-stem-canker    5           0      2    1    0         3        0     1        0    1            1      1
  leaf.halo leaf.marg leaf.size leaf.shread leaf.malf leaf.mild stem lodging stem.cankers canker.lesion fruiting.bodies
1         0         2         2           0         0         0    1       1            3             1              1
2         0         2         2           0         0         0    1       0            3             1              1
3         0         2         2           0         0         0    1       0            3             0              1
4         0         2         2           0         0         0    1       0            3             0              1
5         0         2         2           0         0         0    1       0            3             1              1
6         0         2         2           0         0         0    1       0            3             0              1
  ext.decay mycelium int.discolor sclerotia fruit.pods fruit.spots seed mold.growth seed.discolor seed.size shriveling
1         1        0            0         0          0           4    0           0             0         0          0
2         1        0            0         0          0           4    0           0             0         0          0
3         1        0            0         0          0           4    0           0             0         0          0
4         1        0            0         0          0           4    0           0             0         0          0
5         1        0            0         0          0           4    0           0             0         0          0
6         1        0            0         0          0           4    0           0             0         0          0
  roots
1     0
2     0
3     0
4     0
5     0
6     0
> preproc <- preProcess(soybean[, -1], method = c("center", "scale"))
> soybean[, -1] <- predict(preproc, soybean[, -1])
> set.seed(123)
```

```
> testing_data <- soybean[-splitIndex, ]
> nrow(testing_data)
[1] 110
> head(testing_data)
                Class       date plant.stand     precip       temp       hail  crop.hist   area.dam    sever
1  diaporthe-stem-canker  1.3586630  -0.7864439  0.5799624 -0.2411884 -0.5398468 -0.8970066 -0.5709737 0.447054
5  diaporthe-stem-canker  1.3586630  -0.7864439  0.5799624 -0.2411884 -0.5398468  0.1255445 -1.4723422 0.447054
16          charcoal-rot  0.7560043  -0.7864439 -2.2298555  1.3724766  1.8490814  1.1480957  1.2317634 0.447054
19          charcoal-rot -0.4493132  -0.7864439 -2.2298555  1.3724766 -0.5398468  0.1255445  0.3303949 0.447054
26 rhizoctonia-root-rot -1.6546307   1.2692839  0.5799624 -1.8548534 -0.5398468  1.1480957 -0.5709737 2.122016
28 rhizoctonia-root-rot -1.0519719   1.2692839  0.5799624 -1.8548534 -0.5398468  0.1255445 -0.5709737 0.447054
     seed.tmt       germ plant.growth     leaves leaf.halo leaf.marg leaf.size leaf.shread leaf.malf  leaf.mild
1  -0.8486412 -1.33723184      1.76827  0.3518229 -1.361203  1.385862  1.249163  -0.4534777 -0.196845 -0.2613796
5  -0.8486412  1.19742008      1.76827  0.3518229 -1.361203  1.385862  1.249163  -0.4534777 -0.196845 -0.2613796
16  0.7847025  1.19742008      1.76827  0.3518229 -1.361203  1.385862  1.249163  -0.4534777 -0.196845 -0.2613796
19 -0.8486412  1.19742008      1.76827  0.3518229 -1.361203  1.385862  1.249163  -0.4534777 -0.196845 -0.2613796
26 -0.8486412  1.19742008      1.76827 -2.8372815 -1.361203  1.385862  1.249163  -0.4534777 -0.196845 -0.2613796
28 -0.8486412 -0.06990588      1.76827 -2.8372815 -1.361203  1.385862  1.249163  -0.4534777 -0.196845 -0.2613796
       stem    lodging stem.cankers canker.lesion fruiting.bodies  ext.decay  mycelium int.discolor  sclerotia
1  1.002672  3.5155259    1.5289869     0.1077633       2.3032912  1.7768891 -0.103789    -0.335347 -0.1919237
5  1.002672 -0.2839463    1.5289869     0.1077633       2.3032912  1.7768891 -0.103789    -0.335347 -0.1919237
16 1.002672 -0.2839463   -0.7126408     1.9430043      -0.4333888 -0.5617799 -0.103789     4.151915  5.2011325
19 1.002672 -0.2839463   -0.7126408     1.9430043      -0.4333888 -0.5617799 -0.103789     4.151915  5.2011325
26 1.002672 -0.2839463    0.0345684     0.1077633      -0.4333888  1.7768891 -0.103789    -0.335347 -0.1919237
28 1.002672 -0.2839463    0.0345684     0.1077633      -0.4333888  1.7768891 -0.103789    -0.335347 -0.1919237
   fruit.pods fruit.spots       seed mold.growth seed.discolor  seed.size shriveling      roots
1  -0.5102642    1.984213 -0.4333888  -0.3190288    -0.3087825 -0.2372565 -0.2063872 -0.1364185
5  -0.5102642    1.984213 -0.4333888  -0.3190288    -0.3087825 -0.2372565 -0.2063872 -0.1364185
16 -0.5102642    1.984213 -0.4333888  -0.3190288    -0.3087825 -0.2372565 -0.2063872 -0.1364185
19 -0.5102642    1.984213 -0.4333888  -0.3190288    -0.3087825 -0.2372565 -0.2063872 -0.1364185
26  3.1506098    1.984213 -0.4333888  -0.3190288    -0.3087825 -0.2372565 -0.2063872 -0.1364185
28  3.1506098    1.984213 -0.4333888  -0.3190288    -0.3087825 -0.2372565 -0.2063872 -0.1364185
```

```
> soybean_df <- read.csv("D:\\S5\\ML\\exp5\\Soybean.csv")
> nrow(soybean_df)
[1] 683
> head(soybean_df)
                Class date plant.stand precip temp hail crop.hist area.dam sever seed.tmt germ plant.growth leaves
1 diaporthe-stem-canker    6           0      2    1    0         1        1     1        0    0            1      1
2 diaporthe-stem-canker    4           0      2    1    0         2        0     2        1    1            1      1
3 diaporthe-stem-canker    3           0      2    1    0         1        0     2        1    2            1      1
4 diaporthe-stem-canker    3           0      2    1    0         1        0     2        0    1            1      1
5 diaporthe-stem-canker    6           0      2    1    0         2        0     1        0    2            1      1
6 diaporthe-stem-canker    5           0      2    1    0         3        0     1        0    1            1      1
  leaf.halo leaf.marg leaf.size leaf.shread leaf.malf leaf.mild stem lodging stem.cankers canker.lesion fruiting.bodies
1         0         2         2           0         0         0    1       1            3             1              1
2         0         2         2           0         0         0    1       0            3             1              1
3         0         2         2           0         0         0    1       0            3             0              1
4         0         2         2           0         0         0    1       0            3             0              1
5         0         2         2           0         0         0    1       0            3             1              1
6         0         2         2           0         0         0    1       0            3             0              1
  ext.decay mycelium int.discolor sclerotia fruit.pods fruit.spots seed mold.growth seed.discolor seed.size shriveling
1         1        0            0         0          0           4    0           0             0         0          0
2         1        0            0         0          0           4    0           0             0         0          0
3         1        0            0         0          0           4    0           0             0         0          0
4         1        0            0         0          0           4    0           0             0         0          0
5         1        0            0         0          0           4    0           0             0         0          0
6         1        0            0         0          0           4    0           0             0         0          0
  roots
1     0
2     0
3     0
4     0
5     0
6     0
> sum(is.na(soybean_df))
[1] 2337
```

```
> splitIndex <- createDataPartition(soybean$Class, p = 0.8, list = FALSE)
> training_data <- soybean[splitIndex, ]
> nrow(training_data)
[1] 452
> head(training_data)
                Class       date plant.stand     precip       temp       hail  crop.hist  area.dam    sever   seed.tmt
2 diaporthe-stem-canker  0.1533456  -0.7864439 0.5799624 -0.2411884 -0.5398468  0.1255445 -1.472342 2.122016  0.7847025
3 diaporthe-stem-canker -0.4493132  -0.7864439 0.5799624 -0.2411884 -0.5398468 -0.8970066 -1.472342 2.122016  0.7847025
4 diaporthe-stem-canker -0.4493132  -0.7864439 0.5799624 -0.2411884 -0.5398468 -0.8970066 -1.472342 2.122016 -0.8486412
6 diaporthe-stem-canker  0.7560043  -0.7864439 0.5799624 -0.2411884 -0.5398468  1.1480957 -1.472342 0.447054 -0.8486412
7 diaporthe-stem-canker  0.7560043  -0.7864439 0.5799624 -0.2411884 -0.5398468  0.1255445 -1.472342 0.447054  0.7847025
8 diaporthe-stem-canker  0.1533456  -0.7864439 0.5799624 -0.2411884  1.8490814 -0.8970066 -1.472342 0.447054 -0.8486412
       germ plant.growth    leaves leaf.halo leaf.marg leaf.size leaf.shread leaf.malf  leaf.mild     stem    lodging
2 -0.06990588      1.76827 0.3518229 -1.361203  1.385862  1.249163  -0.4534777 -0.196845 -0.2613796 1.002672 -0.2839463
3  1.19742008      1.76827 0.3518229 -1.361203  1.385862  1.249163  -0.4534777 -0.196845 -0.2613796 1.002672 -0.2839463
4 -0.06990588      1.76827 0.3518229 -1.361203  1.385862  1.249163  -0.4534777 -0.196845 -0.2613796 1.002672 -0.2839463
6 -0.06990588      1.76827 0.3518229 -1.361203  1.385862  1.249163  -0.4534777 -0.196845 -0.2613796 1.002672 -0.2839463
7 -1.33723184      1.76827 0.3518229 -1.361203  1.385862  1.249163  -0.4534777 -0.196845 -0.2613796 1.002672  3.5155259
8  1.19742008      1.76827 0.3518229 -1.361203  1.385862  1.249163  -0.4534777 -0.196845 -0.2613796 1.002672 -0.2839463
  stem.cankers canker.lesion fruiting.bodies ext.decay  mycelium int.discolor  sclerotia fruit.pods fruit.spots
2    1.528987     0.1077633       2.303291  1.776889 -0.103789    -0.335347 -0.1919237 -0.5102642    1.984213
3    1.528987    -0.8098572       2.303291  1.776889 -0.103789    -0.335347 -0.1919237 -0.5102642    1.984213
4    1.528987    -0.8098572       2.303291  1.776889 -0.103789    -0.335347 -0.1919237 -0.5102642    1.984213
6    1.528987    -0.8098572       2.303291  1.776889 -0.103789    -0.335347 -0.1919237 -0.5102642    1.984213
7    1.528987     0.1077633       2.303291  1.776889 -0.103789    -0.335347 -0.1919237 -0.5102642    1.984213
8    1.528987     0.1077633       2.303291  1.776889 -0.103789    -0.335347 -0.1919237 -0.5102642    1.984213
       seed mold.growth seed.discolor  seed.size shriveling      roots
2 -0.4333888  -0.3190288    -0.3087825 -0.2372565 -0.2063872 -0.1364185
3 -0.4333888  -0.3190288    -0.3087825 -0.2372565 -0.2063872 -0.1364185
4 -0.4333888  -0.3190288    -0.3087825 -0.2372565 -0.2063872 -0.1364185
6 -0.4333888  -0.3190288    -0.3087825 -0.2372565 -0.2063872 -0.1364185
7 -0.4333888  -0.3190288    -0.3087825 -0.2372565 -0.2063872 -0.1364185
8 -0.4333888  -0.3190288    -0.3087825 -0.2372565 -0.2063872 -0.1364185
```