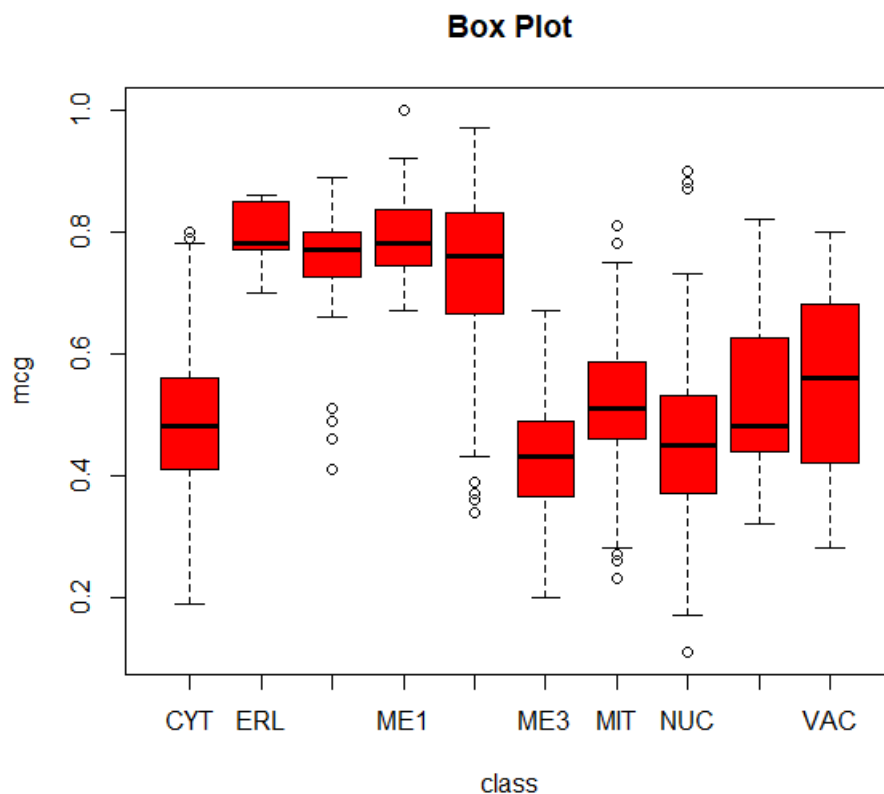12.1

1. a. Perform ANOVA test on the discriminant analysis scores of nuclear localization signals of both nuclear and non-nuclear proteins by class variables (Target).

```
a. > summary(anv)
b.             Df Sum Sq Mean Sq F value Pr(>F)
c. yeast$nuc    1  0.084 0.08370   4.463 0.0348 *
d. Residuals 1482 27.790 0.01875
e. ---
f. Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

b. Which class is significantly different from others?

Box Plot

```
> anv1<-aov(yeast$gvh~yeast$class)
> summary(anv1)
            Df Sum Sq Mean Sq F value Pr(>F)
yeast$class    9  7.021  0.7801   72.98 <2e-16 ***
Residuals   1474 15.754  0.0107
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

The pink colour highlighted groups are significantly different from others

```
> TukeyHSD(anv1)
  Tukey multiple comparisons of means
    95% family-wise confidence level

Fit: aov(formula = yeast$gvh ~ yeast$class)

$`yeast$class`
                diff          lwr          upr      p adj
ERL-CYT   0.302496760  0.155211318  0.449782203 0.0000000
EXC-CYT   0.247353903  0.189928699  0.304779107 0.0000000
ME1-CYT   0.287087669  0.235410402  0.338764937 0.0000000
ME2-CYT   0.133634015  0.085303840  0.181964191 0.0000000
ME3-CYT   0.020005963 -0.009828297  0.049840222 0.5101062
MIT-CYT   0.063734465  0.037820332  0.089648599 0.0000000
NUC-CYT  -0.013372704 -0.035324784  0.008579377 0.6482966
POX-CYT   0.038496760 -0.036316825  0.113310346 0.8332070
VAC-CYT   0.056496760 -0.005217387  0.118210908 0.1061882
EXC-ERL  -0.055142857 -0.211754255  0.101468541 0.9831874
ME1-ERL  -0.015409091 -0.170005391  0.139187209 0.9999995
ME2-ERL  -0.168862745 -0.322372620 -0.015352870 0.0181028
ME3-ERL  -0.282490798 -0.431217255 -0.133764341 0.0000001
MIT-ERL  -0.238762295 -0.386752221 -0.090772369 0.0000159
NUC-ERL  -0.315869464 -0.463217249 -0.168521679 0.0000000
POX-ERL  -0.264000000 -0.427788121 -0.100211879 0.0000163
VAC-ERL  -0.246000000 -0.404234358 -0.087765642 0.0000409
ME1-EXC   0.039733766 -0.034459686  0.113927219 0.7974178
ME2-EXC  -0.113719888 -0.185622143 -0.041817633 0.0000266
ME3-EXC  -0.227347940 -0.288374258 -0.166321623 0.0000000
MIT-EXC  -0.183619438 -0.242828143 -0.124410733 0.0000000
NUC-EXC  -0.260726607 -0.318311520 -0.203141693 0.0000000
POX-EXC  -0.208857143 -0.300678714 -0.117035572 0.0000000
VAC-EXC  -0.190857143 -0.272360299 -0.109353987 0.0000000
ME2-ME1  -0.153453654 -0.220854100 -0.086053208 0.0000000
ME3-ME1  -0.267081707 -0.322733278 -0.211430136 0.0000000
MIT-ME1  -0.223353204 -0.277005386 -0.169701022 0.0000000
NUC-ME1  -0.300460373 -0.352315056 -0.248605690 0.0000000
POX-ME1  -0.248590909 -0.336931652 -0.160250166 0.0000000
VAC-ME1  -0.230590909 -0.308151532 -0.153030286 0.0000000
ME3-ME2  -0.113628052 -0.166186241 -0.061069863 0.0000000
MIT-ME2  -0.069899550 -0.120335871 -0.019463229 0.0005098
NUC-ME2  -0.147006719 -0.195526550 -0.098486888 0.0000000
POX-ME2  -0.095137255 -0.181562672 -0.008711838 0.0179490
VAC-ME2  -0.077137255 -0.152509107 -0.001765402 0.0398801
MIT-ME3   0.043728502  0.010590915  0.076866090 0.0012662
NUC-ME3  -0.033378666 -0.063519190 -0.003238142 0.0167022
POX-ME3   0.018490798 -0.059121250  0.096102845 0.9991117
VAC-ME3   0.036490798 -0.028587566  0.101569161 0.7500198
NUC-MIT  -0.077107169 -0.103373316 -0.050841022 0.0000000
POX-MIT  -0.025237705 -0.101428841  0.050953431 0.9890620
VAC-MIT  -0.007237705 -0.070614772  0.056139362 0.9999983
POX-NUC   0.051869464 -0.023066780  0.126805708 0.4618685
VAC-NUC   0.069869464  0.008006679  0.131732248 0.0131041
VAC-POX   0.018000000 -0.076563116  0.112563116 0.9998588
```