Class\_10\_markdown

fna.data <- “data/WisconsinCancer.csv”

fna.data <- "data/WisconsinCancer.csv"  
wisc.df <- read.csv("WisconsinCancer.csv")

wisc.data <- as.matrix(wisc.df[,3:32])  
head(wisc.data)

## radius\_mean texture\_mean perimeter\_mean area\_mean smoothness\_mean  
## [1,] 17.99 10.38 122.80 1001.0 0.11840  
## [2,] 20.57 17.77 132.90 1326.0 0.08474  
## [3,] 19.69 21.25 130.00 1203.0 0.10960  
## [4,] 11.42 20.38 77.58 386.1 0.14250  
## [5,] 20.29 14.34 135.10 1297.0 0.10030  
## [6,] 12.45 15.70 82.57 477.1 0.12780  
## compactness\_mean concavity\_mean concave.points\_mean symmetry\_mean  
## [1,] 0.27760 0.3001 0.14710 0.2419  
## [2,] 0.07864 0.0869 0.07017 0.1812  
## [3,] 0.15990 0.1974 0.12790 0.2069  
## [4,] 0.28390 0.2414 0.10520 0.2597  
## [5,] 0.13280 0.1980 0.10430 0.1809  
## [6,] 0.17000 0.1578 0.08089 0.2087  
## fractal\_dimension\_mean radius\_se texture\_se perimeter\_se area\_se  
## [1,] 0.07871 1.0950 0.9053 8.589 153.40  
## [2,] 0.05667 0.5435 0.7339 3.398 74.08  
## [3,] 0.05999 0.7456 0.7869 4.585 94.03  
## [4,] 0.09744 0.4956 1.1560 3.445 27.23  
## [5,] 0.05883 0.7572 0.7813 5.438 94.44  
## [6,] 0.07613 0.3345 0.8902 2.217 27.19  
## smoothness\_se compactness\_se concavity\_se concave.points\_se symmetry\_se  
## [1,] 0.006399 0.04904 0.05373 0.01587 0.03003  
## [2,] 0.005225 0.01308 0.01860 0.01340 0.01389  
## [3,] 0.006150 0.04006 0.03832 0.02058 0.02250  
## [4,] 0.009110 0.07458 0.05661 0.01867 0.05963  
## [5,] 0.011490 0.02461 0.05688 0.01885 0.01756  
## [6,] 0.007510 0.03345 0.03672 0.01137 0.02165  
## fractal\_dimension\_se radius\_worst texture\_worst perimeter\_worst area\_worst  
## [1,] 0.006193 25.38 17.33 184.60 2019.0  
## [2,] 0.003532 24.99 23.41 158.80 1956.0  
## [3,] 0.004571 23.57 25.53 152.50 1709.0  
## [4,] 0.009208 14.91 26.50 98.87 567.7  
## [5,] 0.005115 22.54 16.67 152.20 1575.0  
## [6,] 0.005082 15.47 23.75 103.40 741.6  
## smoothness\_worst compactness\_worst concavity\_worst concave.points\_worst  
## [1,] 0.1622 0.6656 0.7119 0.2654  
## [2,] 0.1238 0.1866 0.2416 0.1860  
## [3,] 0.1444 0.4245 0.4504 0.2430  
## [4,] 0.2098 0.8663 0.6869 0.2575  
## [5,] 0.1374 0.2050 0.4000 0.1625  
## [6,] 0.1791 0.5249 0.5355 0.1741  
## symmetry\_worst fractal\_dimension\_worst  
## [1,] 0.4601 0.11890  
## [2,] 0.2750 0.08902  
## [3,] 0.3613 0.08758  
## [4,] 0.6638 0.17300  
## [5,] 0.2364 0.07678  
## [6,] 0.3985 0.12440

Q1.. What type of object is returned from the read.csv() function? data frame

Q2. How many observations (i.e. patients) are in this dataset? 569

Q3. How many of the observations have a malignant diagnosis? 212

Q4. How many variables/features in the data are suffixed with \_mean? there are 10

nrow(wisc.data)

## [1] 569

table(wisc.df$diagnosis)

##   
## B M   
## 357 212

colnames(wisc.df)

## [1] "id" "diagnosis"   
## [3] "radius\_mean" "texture\_mean"   
## [5] "perimeter\_mean" "area\_mean"   
## [7] "smoothness\_mean" "compactness\_mean"   
## [9] "concavity\_mean" "concave.points\_mean"   
## [11] "symmetry\_mean" "fractal\_dimension\_mean"   
## [13] "radius\_se" "texture\_se"   
## [15] "perimeter\_se" "area\_se"   
## [17] "smoothness\_se" "compactness\_se"   
## [19] "concavity\_se" "concave.points\_se"   
## [21] "symmetry\_se" "fractal\_dimension\_se"   
## [23] "radius\_worst" "texture\_worst"   
## [25] "perimeter\_worst" "area\_worst"   
## [27] "smoothness\_worst" "compactness\_worst"   
## [29] "concavity\_worst" "concave.points\_worst"   
## [31] "symmetry\_worst" "fractal\_dimension\_worst"  
## [33] "X"

grep("\_mean",colnames(wisc.df),value = T)

## [1] "radius\_mean" "texture\_mean" "perimeter\_mean"   
## [4] "area\_mean" "smoothness\_mean" "compactness\_mean"   
## [7] "concavity\_mean" "concave.points\_mean" "symmetry\_mean"   
## [10] "fractal\_dimension\_mean"

length(grep("\_mean",colnames(wisc.df)))

## [1] 10

## Enter Principal Component Analysis

First we need ot check whether our input dara should be scaled or not…

first we need to look at the mean value and standard deviation of the columns, if they are close then we do not need to use scale. If they are not…we need to scale!

colMeans(wisc.data)

## radius\_mean texture\_mean perimeter\_mean   
## 1.412729e+01 1.928965e+01 9.196903e+01   
## area\_mean smoothness\_mean compactness\_mean   
## 6.548891e+02 9.636028e-02 1.043410e-01   
## concavity\_mean concave.points\_mean symmetry\_mean   
## 8.879932e-02 4.891915e-02 1.811619e-01   
## fractal\_dimension\_mean radius\_se texture\_se   
## 6.279761e-02 4.051721e-01 1.216853e+00   
## perimeter\_se area\_se smoothness\_se   
## 2.866059e+00 4.033708e+01 7.040979e-03   
## compactness\_se concavity\_se concave.points\_se   
## 2.547814e-02 3.189372e-02 1.179614e-02   
## symmetry\_se fractal\_dimension\_se radius\_worst   
## 2.054230e-02 3.794904e-03 1.626919e+01   
## texture\_worst perimeter\_worst area\_worst   
## 2.567722e+01 1.072612e+02 8.805831e+02   
## smoothness\_worst compactness\_worst concavity\_worst   
## 1.323686e-01 2.542650e-01 2.721885e-01   
## concave.points\_worst symmetry\_worst fractal\_dimension\_worst   
## 1.146062e-01 2.900756e-01 8.394582e-02

round(apply(wisc.data,2,sd),2)

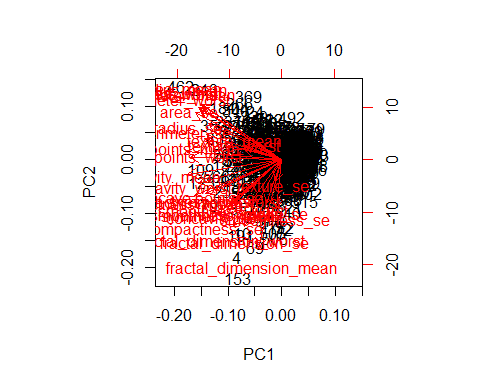
## radius\_mean texture\_mean perimeter\_mean   
## 3.52 4.30 24.30   
## area\_mean smoothness\_mean compactness\_mean   
## 351.91 0.01 0.05   
## concavity\_mean concave.points\_mean symmetry\_mean   
## 0.08 0.04 0.03   
## fractal\_dimension\_mean radius\_se texture\_se   
## 0.01 0.28 0.55   
## perimeter\_se area\_se smoothness\_se   
## 2.02 45.49 0.00   
## compactness\_se concavity\_se concave.points\_se   
## 0.02 0.03 0.01   
## symmetry\_se fractal\_dimension\_se radius\_worst   
## 0.01 0.00 4.83   
## texture\_worst perimeter\_worst area\_worst   
## 6.15 33.60 569.36   
## smoothness\_worst compactness\_worst concavity\_worst   
## 0.02 0.16 0.21   
## concave.points\_worst symmetry\_worst fractal\_dimension\_worst   
## 0.07 0.06 0.02

wisc.pr <- prcomp(wisc.data,scale = T)

summary(wisc.pr)

## Importance of components:  
## PC1 PC2 PC3 PC4 PC5 PC6 PC7  
## Standard deviation 3.6444 2.3857 1.67867 1.40735 1.28403 1.09880 0.82172  
## Proportion of Variance 0.4427 0.1897 0.09393 0.06602 0.05496 0.04025 0.02251  
## Cumulative Proportion 0.4427 0.6324 0.72636 0.79239 0.84734 0.88759 0.91010  
## PC8 PC9 PC10 PC11 PC12 PC13 PC14  
## Standard deviation 0.69037 0.6457 0.59219 0.5421 0.51104 0.49128 0.39624  
## Proportion of Variance 0.01589 0.0139 0.01169 0.0098 0.00871 0.00805 0.00523  
## Cumulative Proportion 0.92598 0.9399 0.95157 0.9614 0.97007 0.97812 0.98335  
## PC15 PC16 PC17 PC18 PC19 PC20 PC21  
## Standard deviation 0.30681 0.28260 0.24372 0.22939 0.22244 0.17652 0.1731  
## Proportion of Variance 0.00314 0.00266 0.00198 0.00175 0.00165 0.00104 0.0010  
## Cumulative Proportion 0.98649 0.98915 0.99113 0.99288 0.99453 0.99557 0.9966  
## PC22 PC23 PC24 PC25 PC26 PC27 PC28  
## Standard deviation 0.16565 0.15602 0.1344 0.12442 0.09043 0.08307 0.03987  
## Proportion of Variance 0.00091 0.00081 0.0006 0.00052 0.00027 0.00023 0.00005  
## Cumulative Proportion 0.99749 0.99830 0.9989 0.99942 0.99969 0.99992 0.99997  
## PC29 PC30  
## Standard deviation 0.02736 0.01153  
## Proportion of Variance 0.00002 0.00000  
## Cumulative Proportion 1.00000 1.00000

biplot(wisc.pr)



(wisc.pr)

## Standard deviations (1, .., p=30):  
## [1] 3.64439401 2.38565601 1.67867477 1.40735229 1.28402903 1.09879780  
## [7] 0.82171778 0.69037464 0.64567392 0.59219377 0.54213992 0.51103950  
## [13] 0.49128148 0.39624453 0.30681422 0.28260007 0.24371918 0.22938785  
## [19] 0.22243559 0.17652026 0.17312681 0.16564843 0.15601550 0.13436892  
## [25] 0.12442376 0.09043030 0.08306903 0.03986650 0.02736427 0.01153451  
##   
## Rotation (n x k) = (30 x 30):  
## PC1 PC2 PC3 PC4  
## radius\_mean -0.21890244 0.233857132 -0.008531243 0.041408962  
## texture\_mean -0.10372458 0.059706088 0.064549903 -0.603050001  
## perimeter\_mean -0.22753729 0.215181361 -0.009314220 0.041983099  
## area\_mean -0.22099499 0.231076711 0.028699526 0.053433795  
## smoothness\_mean -0.14258969 -0.186113023 -0.104291904 0.159382765  
## compactness\_mean -0.23928535 -0.151891610 -0.074091571 0.031794581  
## concavity\_mean -0.25840048 -0.060165363 0.002733838 0.019122753  
## concave.points\_mean -0.26085376 0.034767500 -0.025563541 0.065335944  
## symmetry\_mean -0.13816696 -0.190348770 -0.040239936 0.067124984  
## fractal\_dimension\_mean -0.06436335 -0.366575471 -0.022574090 0.048586765  
## radius\_se -0.20597878 0.105552152 0.268481387 0.097941242  
## texture\_se -0.01742803 -0.089979682 0.374633665 -0.359855528  
## perimeter\_se -0.21132592 0.089457234 0.266645367 0.088992415  
## area\_se -0.20286964 0.152292628 0.216006528 0.108205039  
## smoothness\_se -0.01453145 -0.204430453 0.308838979 0.044664180  
## compactness\_se -0.17039345 -0.232715896 0.154779718 -0.027469363  
## concavity\_se -0.15358979 -0.197207283 0.176463743 0.001316880  
## concave.points\_se -0.18341740 -0.130321560 0.224657567 0.074067335  
## symmetry\_se -0.04249842 -0.183848000 0.288584292 0.044073351  
## fractal\_dimension\_se -0.10256832 -0.280092027 0.211503764 0.015304750  
## radius\_worst -0.22799663 0.219866379 -0.047506990 0.015417240  
## texture\_worst -0.10446933 0.045467298 -0.042297823 -0.632807885  
## perimeter\_worst -0.23663968 0.199878428 -0.048546508 0.013802794  
## area\_worst -0.22487053 0.219351858 -0.011902318 0.025894749  
## smoothness\_worst -0.12795256 -0.172304352 -0.259797613 0.017652216  
## compactness\_worst -0.21009588 -0.143593173 -0.236075625 -0.091328415  
## concavity\_worst -0.22876753 -0.097964114 -0.173057335 -0.073951180  
## concave.points\_worst -0.25088597 0.008257235 -0.170344076 0.006006996  
## symmetry\_worst -0.12290456 -0.141883349 -0.271312642 -0.036250695  
## fractal\_dimension\_worst -0.13178394 -0.275339469 -0.232791313 -0.077053470  
## PC5 PC6 PC7 PC8  
## radius\_mean -0.037786354 0.0187407904 -0.1240883403 0.007452296  
## texture\_mean 0.049468850 -0.0321788366 0.0113995382 -0.130674825  
## perimeter\_mean -0.037374663 0.0173084449 -0.1144770573 0.018687258  
## area\_mean -0.010331251 -0.0018877480 -0.0516534275 -0.034673604  
## smoothness\_mean 0.365088528 -0.2863744966 -0.1406689928 0.288974575  
## compactness\_mean -0.011703971 -0.0141309489 0.0309184960 0.151396350  
## concavity\_mean -0.086375412 -0.0093441809 -0.1075204434 0.072827285  
## concave.points\_mean 0.043861025 -0.0520499505 -0.1504822142 0.152322414  
## symmetry\_mean 0.305941428 0.3564584607 -0.0938911345 0.231530989  
## fractal\_dimension\_mean 0.044424360 -0.1194306679 0.2957600240 0.177121441  
## radius\_se 0.154456496 -0.0256032561 0.3124900373 -0.022539967  
## texture\_se 0.191650506 -0.0287473145 -0.0907553556 0.475413139  
## perimeter\_se 0.120990220 0.0018107150 0.3146403902 0.011896690  
## area\_se 0.127574432 -0.0428639079 0.3466790028 -0.085805135  
## smoothness\_se 0.232065676 -0.3429173935 -0.2440240556 -0.573410232  
## compactness\_se -0.279968156 0.0691975186 0.0234635340 -0.117460157  
## concavity\_se -0.353982091 0.0563432386 -0.2088237897 -0.060566501  
## concave.points\_se -0.195548089 -0.0312244482 -0.3696459369 0.108319309  
## symmetry\_se 0.252868765 0.4902456426 -0.0803822539 -0.220149279  
## fractal\_dimension\_se -0.263297438 -0.0531952674 0.1913949726 -0.011168188  
## radius\_worst 0.004406592 -0.0002906849 -0.0097099360 -0.042619416  
## texture\_worst 0.092883400 -0.0500080613 0.0098707439 -0.036251636  
## perimeter\_worst -0.007454151 0.0085009872 -0.0004457267 -0.030558534  
## area\_worst 0.027390903 -0.0251643821 0.0678316595 -0.079394246  
## smoothness\_worst 0.324435445 -0.3692553703 -0.1088308865 -0.205852191  
## compactness\_worst -0.121804107 0.0477057929 0.1404729381 -0.084019659  
## concavity\_worst -0.188518727 0.0283792555 -0.0604880561 -0.072467871  
## concave.points\_worst -0.043332069 -0.0308734498 -0.1679666187 0.036170795  
## symmetry\_worst 0.244558663 0.4989267845 -0.0184906298 -0.228225053  
## fractal\_dimension\_worst -0.094423351 -0.0802235245 0.3746576261 -0.048360667  
## PC9 PC10 PC11 PC12  
## radius\_mean -0.223109764 0.095486443 -0.04147149 0.051067457  
## texture\_mean 0.112699390 0.240934066 0.30224340 0.254896423  
## perimeter\_mean -0.223739213 0.086385615 -0.01678264 0.038926106  
## area\_mean -0.195586014 0.074956489 -0.11016964 0.065437508  
## smoothness\_mean 0.006424722 -0.069292681 0.13702184 0.316727211  
## compactness\_mean -0.167841425 0.012936200 0.30800963 -0.104017044  
## concavity\_mean 0.040591006 -0.135602298 -0.12419024 0.065653480  
## concave.points\_mean -0.111971106 0.008054528 0.07244603 0.042589267  
## symmetry\_mean 0.256040084 0.572069479 -0.16305408 -0.288865504  
## fractal\_dimension\_mean -0.123740789 0.081103207 0.03804827 0.236358988  
## radius\_se 0.249985002 -0.049547594 0.02535702 -0.016687915  
## texture\_se -0.246645397 -0.289142742 -0.34494446 -0.306160423  
## perimeter\_se 0.227154024 -0.114508236 0.16731877 -0.101446828  
## area\_se 0.229160015 -0.091927889 -0.05161946 -0.017679218  
## smoothness\_se -0.141924890 0.160884609 -0.08420621 -0.294710053  
## compactness\_se -0.145322810 0.043504866 0.20688568 -0.263456509  
## concavity\_se 0.358107079 -0.141276243 -0.34951794 0.251146975  
## concave.points\_se 0.272519886 0.086240847 0.34237591 -0.006458751  
## symmetry\_se -0.304077200 -0.316529830 0.18784404 0.320571348  
## fractal\_dimension\_se -0.213722716 0.367541918 -0.25062479 0.276165974  
## radius\_worst -0.112141463 0.077361643 -0.10506733 0.039679665  
## texture\_worst 0.103341204 0.029550941 -0.01315727 0.079797450  
## perimeter\_worst -0.109614364 0.050508334 -0.05107628 -0.008987738  
## area\_worst -0.080732461 0.069921152 -0.18459894 0.048088657  
## smoothness\_worst 0.112315904 -0.128304659 -0.14389035 0.056514866  
## compactness\_worst -0.100677822 -0.172133632 0.19742047 -0.371662503  
## concavity\_worst 0.161908621 -0.311638520 -0.18501676 -0.087034532  
## concave.points\_worst 0.060488462 -0.076648291 0.11777205 -0.068125354  
## symmetry\_worst 0.064637806 -0.029563075 -0.15756025 0.044033503  
## fractal\_dimension\_worst -0.134174175 0.012609579 -0.11828355 -0.034731693  
## PC13 PC14 PC15 PC16  
## radius\_mean 0.01196721 0.059506135 -0.051118775 -0.15058388  
## texture\_mean 0.20346133 -0.021560100 -0.107922421 -0.15784196  
## perimeter\_mean 0.04410950 0.048513812 -0.039902936 -0.11445396  
## area\_mean 0.06737574 0.010830829 0.013966907 -0.13244803  
## smoothness\_mean 0.04557360 0.445064860 -0.118143364 -0.20461325  
## compactness\_mean 0.22928130 0.008101057 0.230899962 0.17017837  
## concavity\_mean 0.38709081 -0.189358699 -0.128283732 0.26947021  
## concave.points\_mean 0.13213810 -0.244794768 -0.217099194 0.38046410  
## symmetry\_mean 0.18993367 0.030738856 -0.073961707 -0.16466159  
## fractal\_dimension\_mean 0.10623908 -0.377078865 0.517975705 -0.04079279  
## radius\_se -0.06819523 0.010347413 -0.110050711 0.05890572  
## texture\_se -0.16822238 -0.010849347 0.032752721 -0.03450040  
## perimeter\_se -0.03784399 -0.045523718 -0.008268089 0.02651665  
## area\_se 0.05606493 0.083570718 -0.046024366 0.04115323  
## smoothness\_se 0.15044143 -0.201152530 0.018559465 -0.05803906  
## compactness\_se 0.01004017 0.491755932 0.168209315 0.18983090  
## concavity\_se 0.15878319 0.134586924 0.250471408 -0.12542065  
## concave.points\_se -0.49402674 -0.199666719 0.062079344 -0.19881035  
## symmetry\_se 0.01033274 -0.046864383 -0.113383199 -0.15771150  
## fractal\_dimension\_se -0.24045832 0.145652466 -0.353232211 0.26855388  
## radius\_worst -0.13789053 0.023101281 0.166567074 -0.08156057  
## texture\_worst -0.08014543 0.053430792 0.101115399 0.18555785  
## perimeter\_worst -0.09696571 0.012219382 0.182755198 -0.05485705  
## area\_worst -0.10116061 -0.006685465 0.314993600 -0.09065339  
## smoothness\_worst -0.20513034 0.162235443 0.046125866 0.14555166  
## compactness\_worst 0.01227931 0.166470250 -0.049956014 -0.15373486  
## concavity\_worst 0.21798433 -0.066798931 -0.204835886 -0.21502195  
## concave.points\_worst -0.25438749 -0.276418891 -0.169499607 0.17814174  
## symmetry\_worst -0.25653491 0.005355574 0.139888394 0.25789401  
## fractal\_dimension\_worst -0.17281424 -0.212104110 -0.256173195 -0.40555649  
## PC17 PC18 PC19 PC20  
## radius\_mean 0.202924255 0.1467123385 0.22538466 -0.049698664  
## texture\_mean -0.038706119 -0.0411029851 0.02978864 -0.244134993  
## perimeter\_mean 0.194821310 0.1583174548 0.23959528 -0.017665012  
## area\_mean 0.255705763 0.2661681046 -0.02732219 -0.090143762  
## smoothness\_mean 0.167929914 -0.3522268017 -0.16456584 0.017100960  
## compactness\_mean -0.020307708 0.0077941384 0.28422236 0.488686329  
## concavity\_mean -0.001598353 -0.0269681105 0.00226636 -0.033387086  
## concave.points\_mean 0.034509509 -0.0828277367 -0.15497236 -0.235407606  
## symmetry\_mean -0.191737848 0.1733977905 -0.05881116 0.026069156  
## fractal\_dimension\_mean 0.050225246 0.0878673570 -0.05815705 -0.175637222  
## radius\_se -0.139396866 -0.2362165319 0.17588331 -0.090800503  
## texture\_se 0.043963016 -0.0098586620 0.03600985 -0.071659988  
## perimeter\_se -0.024635639 -0.0259288003 0.36570154 -0.177250625  
## area\_se 0.334418173 0.3049069032 -0.41657231 0.274201148  
## smoothness\_se 0.139595006 -0.2312599432 -0.01326009 0.090061477  
## compactness\_se -0.008246477 0.1004742346 -0.24244818 -0.461098220  
## concavity\_se 0.084616716 -0.0001954852 0.12638102 0.066946174  
## concave.points\_se 0.108132263 0.0460549116 -0.01216430 0.068868294  
## symmetry\_se -0.274059129 0.1870147640 -0.08903929 0.107385289  
## fractal\_dimension\_se -0.122733398 -0.0598230982 0.08660084 0.222345297  
## radius\_worst -0.240049982 -0.2161013526 0.01366130 -0.005626909  
## texture\_worst 0.069365185 0.0583984505 -0.07586693 0.300599798  
## perimeter\_worst -0.234164147 -0.1885435919 0.09081325 0.011003858  
## area\_worst -0.273399584 -0.1420648558 -0.41004720 0.060047387  
## smoothness\_worst -0.278030197 0.5015516751 0.23451384 -0.129723903  
## compactness\_worst -0.004037123 -0.0735745143 0.02020070 0.229280589  
## concavity\_worst -0.191313419 -0.1039079796 -0.04578612 -0.046482792  
## concave.points\_worst -0.075485316 0.0758138963 -0.26022962 0.033022340  
## symmetry\_worst 0.430658116 -0.2787138431 0.11725053 -0.116759236  
## fractal\_dimension\_worst 0.159394300 0.0235647497 -0.01149448 -0.104991974  
## PC21 PC22 PC23 PC24  
## radius\_mean -0.0685700057 -0.07292890 -0.0985526942 -0.18257944  
## texture\_mean 0.4483694667 -0.09480063 -0.0005549975 0.09878679  
## perimeter\_mean -0.0697690429 -0.07516048 -0.0402447050 -0.11664888  
## area\_mean -0.0184432785 -0.09756578 0.0077772734 0.06984834  
## smoothness\_mean -0.1194917473 -0.06382295 -0.0206657211 0.06869742  
## compactness\_mean 0.1926213963 0.09807756 0.0523603957 -0.10413552  
## concavity\_mean 0.0055717533 0.18521200 0.3248703785 0.04474106  
## concave.points\_mean -0.0094238187 0.31185243 -0.0514087968 0.08402770  
## symmetry\_mean -0.0869384844 0.01840673 -0.0512005770 0.01933947  
## fractal\_dimension\_mean -0.0762718362 -0.28786888 -0.0846898562 -0.13326055  
## radius\_se 0.0863867747 0.15027468 -0.2641253170 -0.55870157  
## texture\_se 0.2170719674 -0.04845693 -0.0008738805 0.02426730  
## perimeter\_se -0.3049501584 -0.15935280 0.0900742110 0.51675039  
## area\_se 0.1925877857 -0.06423262 0.0982150746 -0.02246072  
## smoothness\_se -0.0720987261 -0.05054490 -0.0598177179 0.01563119  
## compactness\_se -0.1403865724 0.04528769 0.0091038710 -0.12177779  
## concavity\_se 0.0630479298 0.20521269 -0.3875423290 0.18820504  
## concave.points\_se 0.0343753236 0.07254538 0.3517550738 -0.10966898  
## symmetry\_se -0.0976995265 0.08465443 -0.0423628949 0.00322620  
## fractal\_dimension\_se 0.0628432814 -0.24470508 0.0857810992 0.07519442  
## radius\_worst 0.0072938995 0.09629821 -0.0556767923 -0.15683037  
## texture\_worst -0.5944401434 0.11111202 -0.0089228997 -0.11848460  
## perimeter\_worst -0.0920235990 -0.01722163 0.0633448296 0.23711317  
## area\_worst 0.1467901315 0.09695982 0.1908896250 0.14406303  
## smoothness\_worst 0.1648492374 0.06825409 0.0936901494 -0.01099014  
## compactness\_worst 0.1813748671 -0.02967641 -0.1479209247 0.18674995  
## concavity\_worst -0.1321005945 -0.46042619 0.2864331353 -0.28885257  
## concave.points\_worst 0.0008860815 -0.29984056 -0.5675277966 0.10734024  
## symmetry\_worst 0.1627085487 -0.09714484 0.1213434508 -0.01438181  
## fractal\_dimension\_worst -0.0923439434 0.46947115 0.0076253382 0.03782545  
## PC25 PC26 PC27 PC28  
## radius\_mean -0.01922650 -0.129476396 -0.131526670 2.111940e-01  
## texture\_mean 0.08474593 -0.024556664 -0.017357309 -6.581146e-05  
## perimeter\_mean 0.02701541 -0.125255946 -0.115415423 8.433827e-02  
## area\_mean -0.21004078 0.362727403 0.466612477 -2.725083e-01  
## smoothness\_mean 0.02895489 -0.037003686 0.069689923 1.479269e-03  
## compactness\_mean 0.39662323 0.262808474 0.097748705 -5.462767e-03  
## concavity\_mean -0.09697732 -0.548876170 0.364808397 4.553864e-02  
## concave.points\_mean -0.18645160 0.387643377 -0.454699351 -8.883097e-03  
## symmetry\_mean -0.02458369 -0.016044038 -0.015164835 1.433026e-03  
## fractal\_dimension\_mean -0.20722186 -0.097404839 -0.101244946 -6.311687e-03  
## radius\_se -0.17493043 0.049977080 0.212982901 -1.922239e-01  
## texture\_se 0.05698648 -0.011237242 -0.010092889 -5.622611e-03  
## perimeter\_se 0.07292764 0.103653282 0.041691553 2.631919e-01  
## area\_se 0.13185041 -0.155304589 -0.313358657 -4.206811e-02  
## smoothness\_se 0.03121070 -0.007717557 -0.009052154 9.792963e-03  
## compactness\_se 0.17316455 -0.049727632 0.046536088 -1.539555e-02  
## concavity\_se 0.01593998 0.091454968 -0.084224797 5.820978e-03  
## concave.points\_se -0.12954655 -0.017941919 -0.011165509 -2.900930e-02  
## symmetry\_se -0.01951493 -0.017267849 -0.019975983 -7.636526e-03  
## fractal\_dimension\_se -0.08417120 0.035488974 -0.012036564 1.975646e-02  
## radius\_worst 0.07070972 -0.197054744 -0.178666740 4.126396e-01  
## texture\_worst -0.11818972 0.036469433 0.021410694 -3.902509e-04  
## perimeter\_worst 0.11803403 -0.244103670 -0.241031046 -7.286809e-01  
## area\_worst -0.03828995 0.231359525 0.237162466 2.389603e-01  
## smoothness\_worst -0.04796476 0.012602464 -0.040853568 -1.535248e-03  
## compactness\_worst -0.62438494 -0.100463424 -0.070505414 4.869182e-02  
## concavity\_worst 0.11577034 0.266853781 -0.142905801 -1.764090e-02  
## concave.points\_worst 0.26319634 -0.133574507 0.230901389 2.247567e-02  
## symmetry\_worst 0.04529962 0.028184296 0.022790444 4.920481e-03  
## fractal\_dimension\_worst 0.28013348 0.004520482 0.059985998 -2.356214e-02  
## PC29 PC30  
## radius\_mean 2.114605e-01 0.7024140910  
## texture\_mean -1.053393e-02 0.0002736610  
## perimeter\_mean 3.838261e-01 -0.6898969685  
## area\_mean -4.227949e-01 -0.0329473482  
## smoothness\_mean -3.434667e-03 -0.0048474577  
## compactness\_mean -4.101677e-02 0.0446741863  
## concavity\_mean -1.001479e-02 0.0251386661  
## concave.points\_mean -4.206949e-03 -0.0010772653  
## symmetry\_mean -7.569862e-03 -0.0012803794  
## fractal\_dimension\_mean 7.301433e-03 -0.0047556848  
## radius\_se 1.184421e-01 -0.0087110937  
## texture\_se -8.776279e-03 -0.0010710392  
## perimeter\_se -6.100219e-03 0.0137293906  
## area\_se -8.592591e-02 0.0011053260  
## smoothness\_se 1.776386e-03 -0.0016082109  
## compactness\_se 3.158134e-03 0.0019156224  
## concavity\_se 1.607852e-02 -0.0089265265  
## concave.points\_se -2.393779e-02 -0.0021601973  
## symmetry\_se -5.223292e-03 0.0003293898  
## fractal\_dimension\_se -8.341912e-03 0.0017989568  
## radius\_worst -6.357249e-01 -0.1356430561  
## texture\_worst 1.723549e-02 0.0010205360  
## perimeter\_worst 2.292180e-02 0.0797438536  
## area\_worst 4.449359e-01 0.0397422838  
## smoothness\_worst 7.385492e-03 0.0045832773  
## compactness\_worst 3.566904e-06 -0.0128415624  
## concavity\_worst -1.267572e-02 0.0004021392  
## concave.points\_worst 3.524045e-02 -0.0022884418  
## symmetry\_worst 1.340423e-02 0.0003954435  
## fractal\_dimension\_worst 1.147766e-02 0.0018942925

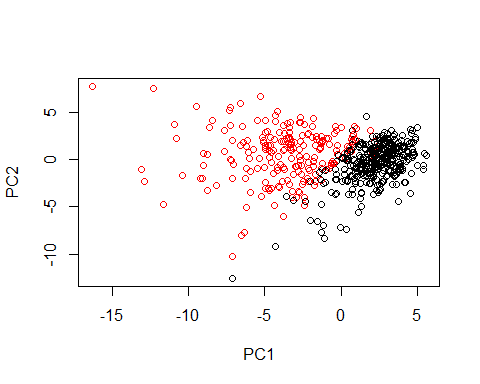
“now that is one huge pile of crap”

attributes(wisc.pr)

## $names  
## [1] "sdev" "rotation" "center" "scale" "x"   
##   
## $class  
## [1] "prcomp"

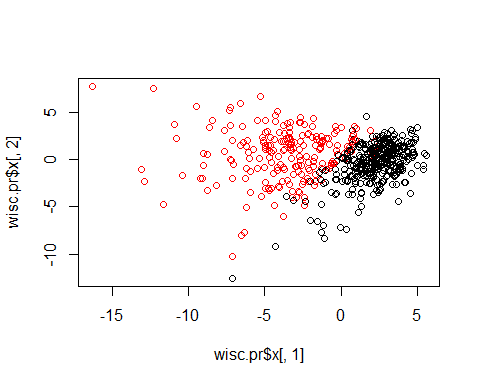
we want the $x component to make our pca plot

plot(wisc.pr$x[,1:2],col=wisc.df$diagnosis)

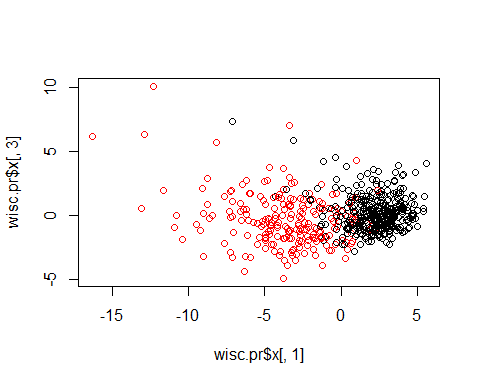


We want the $x component to make our PCA plot!

plot(wisc.pr$x[,1], wisc.pr$x[,2], col=wisc.df$diagnosis)



plot(wisc.pr$x[,1], wisc.pr$x[,3], col=wisc.df$diagnosis)

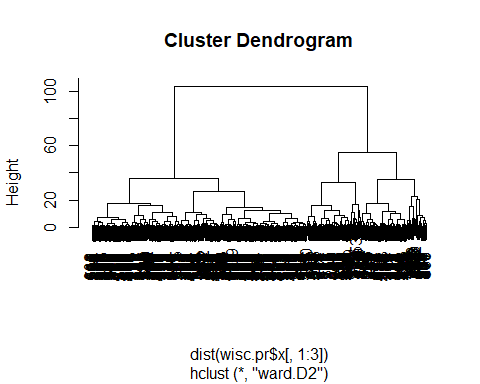


data.scaled <- scale(wisc.data)

data.dist <- dist(data.scaled)

wisc.clust <- hclust((data.dist))

wisc.pr.hc <- hclust(dist(wisc.pr$x[,1:3]),method = "ward.D2")  
plot(wisc.pr.hc)



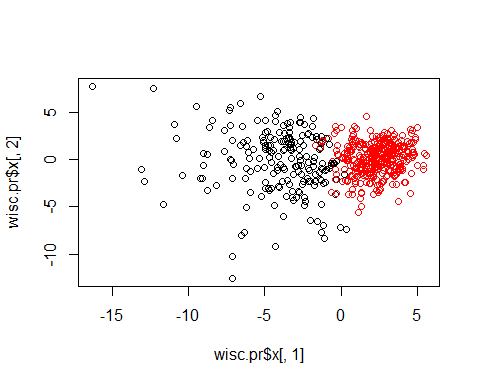
grps <- cutree(wisc.pr.hc,k=2)  
table(grps)

## grps  
## 1 2   
## 203 366

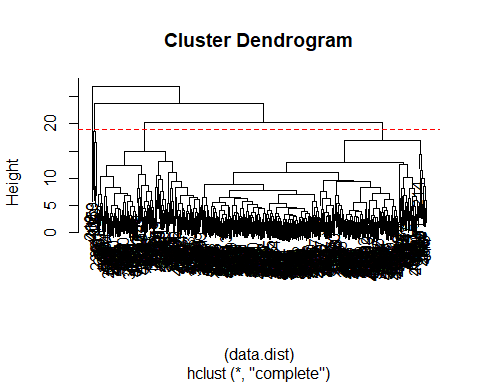
table(grps,wisc.df$diagnosis)

##   
## grps B M  
## 1 24 179  
## 2 333 33

plot(wisc.pr$x[,1],wisc.pr$x[,2],col = grps)



plot(wisc.clust)  
abline(h=19,col = "red" ,lty=2)



wisc.hclust.clusters

wisc.hclust.clusters <- cutree((wisc.clust),k=4)

##Section 7

new <- read.csv("new\_samples.csv")  
npc <- predict(wisc.pr, newdata=new)  
npc

## PC1 PC2 PC3 PC4 PC5 PC6 PC7  
## [1,] 2.576616 -3.135913 1.3990492 -0.7631950 2.781648 -0.8150185 -0.3959098  
## [2,] -4.754928 -3.009033 -0.1660946 -0.6052952 -1.140698 -1.2189945 0.8193031  
## PC8 PC9 PC10 PC11 PC12 PC13 PC14  
## [1,] -0.2307350 0.1029569 -0.9272861 0.3411457 0.375921 0.1610764 1.187882  
## [2,] -0.3307423 0.5281896 -0.4855301 0.7173233 -1.185917 0.5893856 0.303029  
## PC15 PC16 PC17 PC18 PC19 PC20  
## [1,] 0.3216974 -0.1743616 -0.07875393 -0.11207028 -0.08802955 -0.2495216  
## [2,] 0.1299153 0.1448061 -0.40509706 0.06565549 0.25591230 -0.4289500  
## PC21 PC22 PC23 PC24 PC25 PC26  
## [1,] 0.1228233 0.09358453 0.08347651 0.1223396 0.02124121 0.078884581  
## [2,] -0.1224776 0.01732146 0.06316631 -0.2338618 -0.20755948 -0.009833238  
## PC27 PC28 PC29 PC30  
## [1,] 0.220199544 -0.02946023 -0.015620933 0.005269029  
## [2,] -0.001134152 0.09638361 0.002795349 -0.019015820

plot(wisc.pr$x[,1],wisc.pr$x[,2], col=wisc.df$diagnosis)  
points(npc[,1], npc[,2], col="blue", pch=16, cex=3)  
text(npc[,1], npc[,2], c(1,2), col="white")

