ASSIGNMENT

author

12/2/2021

### Question 1

1. A hormone level in humans is believed to be a chi-square distribution. A patient data sample indicates that the variance of the hormone level is 4. What is the standard deviation of the median hormone level in humans? In what proportion of humans is the hormone level less than 1? In what proportion of humans is the hormone level between 1.5 and 3?

### Answer a:

variance <- 4  
std.dev <- 2  
  
##std.dev = 2\* degrees of freedom   
degres\_of\_freedom = std.dev/2  
   
pchisq(1,degres\_of\_freedom)

## [1] 0.6826895

The standard deviation of the median hormone level is 2. 68% of the humans have a hormone level less than 1.

### Answer b:

# P(1.5 < x < 3) = P(x < 3) - P(x < 1.5)   
pchisq(3,2) - pchisq(1.5,2)

## [1] 0.2492364

25% of the humans have a hormone level between 1.5 and 3.

### Question 2

1. Approximate the distribution of the hormone-level in Question 1 above with a log-normal distribution. What are your new answers to the 3 questions asked in Question 1?

### Answer:

dlnorm(1,meanlog=0, sdlog=1)

## [1] 0.3989423

plnorm(3,0,1) - plnorm(1.5,0,1)

## [1] 0.2065992

40% of the humans have a hormone level less than 1 while 21% of the humans have a hormone level between 1.5 and 3.

### Question 3

1. The data below is on vitamin D levels for several patients. A physician wants to know the standard deviations of the mean and median vitamin D levels. What would you tell her? 17 25 17 33 24 15 18 19 14 23 19 23 25 27 21 26 20

### Answer:

VitaminData = c(17,25,17,33,24,15,18,19,14,23,19,23,25,27,21,26,20)  
sd(VitaminData)

## [1] 4.90048

sv <- sd(VitaminData)/sqrt(length(VitaminData))   
sv

## [1] 1.188541

The mean and median vitamin D levels are not equal.

### Question 4

1. Find the “best” Linear Regression model that explains Y in the following dataset: LassoRR\_sysm590\_4K5K70pct.csv. That is, recognize, but ignore multicollinearity and do the usual things to find a Linear Regression model.

library(readr)  
lassoData <- read\_csv("LassoRR\_sysm590\_4K5K70pct.csv")

## Rows: 89 Columns: 34

## -- Column specification --------------------------------------------------------  
## Delimiter: ","  
## dbl (34): X1, X2, X3, X4, X5, X6, X7, X8, X9, X10, X11, X12, X13, X14, X15, ...

##   
## i Use `spec()` to retrieve the full column specification for this data.  
## i Specify the column types or set `show\_col\_types = FALSE` to quiet this message.

##colnames(lassoData)  
  
cor(lassoData)

## X1 X2 X3 X4 X5 X6  
## X1 1.00000000 0.45051520 0.66224448 0.29206170 0.58570053 0.511464155  
## X2 0.45051520 1.00000000 -0.33593164 0.97047630 0.83216547 0.915485318  
## X3 0.66224448 -0.33593164 1.00000000 -0.49094069 -0.09679234 -0.206320135  
## X4 0.29206170 0.97047630 -0.49094069 1.00000000 0.79255753 0.881923579  
## X5 0.58570053 0.83216547 -0.09679234 0.79255753 1.00000000 0.850224136  
## X6 0.51146416 0.91548532 -0.20632013 0.88192358 0.85022414 1.000000000  
## X7 0.60990173 -0.36133510 0.96711862 -0.51045828 -0.15042449 -0.206098832  
## X8 0.61740225 -0.35207509 0.96322305 -0.49934745 -0.13075106 -0.247367267  
## X9 -0.42174742 -0.15627669 -0.31879953 -0.08336540 -0.22789682 -0.191000400  
## X10 -0.28828601 0.43637324 -0.64507168 0.52952603 0.26982407 0.354381502  
## X11 -0.94352283 -0.21634580 -0.83064832 -0.04516295 -0.40024229 -0.316584281  
## X12 -0.91049214 -0.16166549 -0.85091218 0.01365285 -0.35002099 -0.264802876  
## X13 -0.97574618 -0.40848837 -0.70811547 -0.24087011 -0.56136035 -0.488956331  
## X14 0.39610759 0.96006193 -0.38136662 0.94740483 0.88865634 0.896138877  
## X15 0.62671217 -0.37646036 0.99394545 -0.52826234 -0.14732700 -0.244518471  
## X16 0.63094474 -0.37063196 0.99479663 -0.52285372 -0.14191515 -0.238156331  
## X17 -0.18943405 -0.91591894 0.56969993 -0.94129027 -0.77236025 -0.819423022  
## X18 -0.94792418 -0.37864487 -0.70157595 -0.21353211 -0.53064124 -0.451883155  
## X19 0.56461987 -0.33102193 0.87725988 -0.46554790 -0.10884719 -0.240791714  
## X20 0.59693718 -0.37198795 0.95863433 -0.51640440 -0.15114188 -0.267724989  
## X21 0.68845660 -0.28765838 0.98742735 -0.44616774 -0.06709774 -0.155790003  
## X22 0.08607993 -0.06728353 0.16305302 -0.09419831 -0.03078766 -0.006085782  
## X23 0.09181731 -0.02427766 0.13647472 -0.05042335 -0.04000781 -0.040165580  
## X24 0.00204885 -0.09747681 0.06606990 -0.11112327 -0.08117443 -0.125174553  
## X25 0.05903959 -0.06202709 0.11263260 -0.08322978 -0.05726417 -0.066150070  
## X26 -0.06483065 -0.09641094 -0.01767118 -0.10060904 -0.11070965 -0.073010805  
## X27 -0.12977894 -0.06083873 -0.13776980 -0.03530069 -0.09938527 -0.085354667  
## X28 -0.03653159 0.09697019 -0.12872605 0.10472411 0.01210699 0.056122902  
## X29 -0.02556263 -0.10979849 0.02199436 -0.11704014 -0.11118594 -0.119341492  
## X30 0.05295205 0.26815070 -0.14525590 0.30200720 0.21610824 0.231160298  
## X31 -0.04952256 -0.09571982 0.01692000 -0.10029312 -0.09376970 -0.119333876  
## X32 -0.13545661 -0.13595893 -0.05823833 -0.12111437 -0.15246857 -0.132762986  
## X33 0.23621996 0.58405432 -0.26039698 0.56824430 0.62834163 0.597076404  
## Y -0.48039351 0.21952592 -0.69688200 0.33498879 0.02767671 0.087219035  
## X7 X8 X9 X10 X11 X12  
## X1 0.6099017337 0.617402251 -0.42174742 -0.28828601 -0.943522828 -0.91049214  
## X2 -0.3613351008 -0.352075090 -0.15627669 0.43637324 -0.216345801 -0.16166549  
## X3 0.9671186189 0.963223054 -0.31879953 -0.64507168 -0.830648323 -0.85091218  
## X4 -0.5104582778 -0.499347446 -0.08336540 0.52952603 -0.045162947 0.01365285  
## X5 -0.1504244926 -0.130751056 -0.22789682 0.26982407 -0.400242287 -0.35002099  
## X6 -0.2060988321 -0.247367267 -0.19100040 0.35438150 -0.316584281 -0.26480288  
## X7 1.0000000000 0.930760276 -0.29668285 -0.63164784 -0.784508636 -0.80300026  
## X8 0.9307602763 1.000000000 -0.30182027 -0.63340083 -0.786060941 -0.80658817  
## X9 -0.2966828477 -0.301820266 1.00000000 0.16543709 0.417342172 0.38840997  
## X10 -0.6316478426 -0.633400830 0.16543709 1.00000000 0.418474478 0.43494932  
## X11 -0.7845086359 -0.786060941 0.41734217 0.41847448 1.000000000 0.97429064  
## X12 -0.8030002552 -0.806588173 0.38840997 0.43494932 0.974290641 1.00000000  
## X13 -0.6575415156 -0.662125384 0.42875688 0.29996463 0.969846145 0.94522117  
## X14 -0.4140853413 -0.400427431 -0.13449255 0.42613533 -0.159604063 -0.11010669  
## X15 0.9639285790 0.960958062 -0.30482534 -0.65316164 -0.806556116 -0.82937286  
## X16 0.9670086770 0.963183784 -0.30675237 -0.65156594 -0.810928495 -0.83332761  
## X17 0.5866195656 0.580780624 0.03547669 -0.56292195 -0.054329454 -0.10749879  
## X18 -0.6503456433 -0.652126679 0.40659937 0.28116675 0.947026022 0.92303148  
## X19 0.7912362793 0.867723216 -0.27339899 -0.58648159 -0.729266452 -0.75058999  
## X20 0.9271067531 0.996245290 -0.23045020 -0.63275041 -0.769740935 -0.79316358  
## X21 0.9782465448 0.970162916 -0.28866144 -0.62121239 -0.848658361 -0.86551389  
## X22 0.1842446618 0.134438699 -0.03886423 -0.10638130 -0.129411946 -0.13201303  
## X23 0.1052559120 0.127928984 -0.07138755 -0.08206151 -0.113709845 -0.12705810  
## X24 0.0495867102 0.035495121 -0.06967604 0.06566759 0.010302868 -0.02846001  
## X25 0.0794380796 0.104593636 0.02063689 -0.03203817 -0.082083275 -0.08043277  
## X26 -0.0095830344 -0.023359306 -0.05422878 0.09565029 0.063150436 0.03136842  
## X27 -0.1222624167 -0.131626106 0.09735935 0.12631291 0.188303930 0.17033860  
## X28 -0.1328430245 -0.123419443 0.03808471 0.13721108 0.053903430 0.05737897  
## X29 0.0082425875 0.011099498 -0.01533598 -0.01745766 0.049629499 0.02259161  
## X30 -0.1557536686 -0.145328861 -0.05927757 0.17321690 -0.003873268 0.03218057  
## X31 0.0001148214 0.007173122 -0.06585953 0.03178616 0.045844641 0.04608907  
## X32 -0.0061419981 -0.043550575 0.05291111 0.04125891 0.143868937 0.09672692  
## X33 -0.2818311905 -0.279461632 -0.07615775 0.31500195 -0.091786249 -0.05505469  
## Y -0.7131641081 -0.703099993 0.22150550 0.41381903 0.601109906 0.61736582  
## X13 X14 X15 X16 X17 X18  
## X1 -0.97574618 0.39610759 0.6267121701 0.630944740 -0.18943405 -0.947924176  
## X2 -0.40848837 0.96006193 -0.3764603633 -0.370631964 -0.91591894 -0.378644871  
## X3 -0.70811547 -0.38136662 0.9939454507 0.994796632 0.56969993 -0.701575952  
## X4 -0.24087011 0.94740483 -0.5282623359 -0.522853721 -0.94129027 -0.213532110  
## X5 -0.56136035 0.88865634 -0.1473269956 -0.141915152 -0.77236025 -0.530641243  
## X6 -0.48895633 0.89613888 -0.2445184711 -0.238156331 -0.81942302 -0.451883155  
## X7 -0.65754152 -0.41408534 0.9639285790 0.967008677 0.58661957 -0.650345643  
## X8 -0.66212538 -0.40042743 0.9609580616 0.963183784 0.58078062 -0.652126679  
## X9 0.42875688 -0.13449255 -0.3048253372 -0.306752366 0.03547669 0.406599374  
## X10 0.29996463 0.42613533 -0.6531616406 -0.651565944 -0.56292195 0.281166749  
## X11 0.96984615 -0.15960406 -0.8065561157 -0.810928495 -0.05432945 0.947026022  
## X12 0.94522117 -0.11010669 -0.8293728608 -0.833327605 -0.10749879 0.923031476  
## X13 1.00000000 -0.35405979 -0.6763049842 -0.681849447 0.14284849 0.965539036  
## X14 -0.35405979 1.00000000 -0.4250712378 -0.419603851 -0.92458660 -0.325118513  
## X15 -0.67630498 -0.42507124 1.0000000000 0.998004407 0.60672268 -0.670918889  
## X16 -0.68184945 -0.41960385 0.9980044068 1.000000000 0.60215574 -0.676100834  
## X17 0.14284849 -0.92458660 0.6067226783 0.602155743 1.00000000 0.111922519  
## X18 0.96553904 -0.32511851 -0.6709188892 -0.676100834 0.11192252 1.000000000  
## X19 -0.61448157 -0.36554374 0.8969722715 0.892381807 0.53708428 -0.606588349  
## X20 -0.64235527 -0.41954270 0.9572104675 0.959457773 0.59588785 -0.633853105  
## X21 -0.73310555 -0.34102070 0.9830164642 0.984423393 0.52031541 -0.726966863  
## X22 -0.10697498 -0.07491406 0.1617832377 0.164917225 0.10689075 -0.105091373  
## X23 -0.10703907 -0.04331504 0.1363949076 0.135734190 0.05013057 -0.113752520  
## X24 0.02927103 -0.09602000 0.0563595017 0.050377339 0.06961269 0.022397836  
## X25 -0.06016388 -0.11321046 0.1146415038 0.114119215 0.07549501 -0.054091235  
## X26 0.08130337 -0.11711575 -0.0009802174 -0.005829767 0.01959789 0.084669554  
## X27 0.18285213 -0.05534665 -0.1319517401 -0.132242225 -0.01004278 0.174666969  
## X28 0.02995882 0.11438984 -0.1297100200 -0.127752447 -0.10837970 -0.005851634  
## X29 0.06998757 -0.10698652 0.0250426271 0.027675428 0.09596772 0.046227731  
## X30 -0.04928324 0.25060240 -0.1556623394 -0.155011714 -0.28107266 -0.045076774  
## X31 0.05696560 -0.09854201 0.0190253140 0.015692501 0.09505165 0.060647537  
## X32 0.14776546 -0.14881484 -0.0493308482 -0.047853953 0.09455324 0.105578636  
## X33 -0.21541067 0.64996832 -0.2942453087 -0.290637081 -0.62342440 -0.200987626  
## Y 0.52246805 0.21407749 -0.6871988542 -0.690018255 -0.34276765 0.519048403  
## X19 X20 X21 X22 X23  
## X1 0.56461987 0.596937182 0.688456598 0.086079934 0.091817306  
## X2 -0.33102193 -0.371987955 -0.287658383 -0.067283528 -0.024277658  
## X3 0.87725988 0.958634329 0.987427353 0.163053020 0.136474720  
## X4 -0.46554790 -0.516404397 -0.446167737 -0.094198314 -0.050423352  
## X5 -0.10884719 -0.151141882 -0.067097738 -0.030787663 -0.040007813  
## X6 -0.24079171 -0.267724989 -0.155790003 -0.006085782 -0.040165580  
## X7 0.79123628 0.927106753 0.978246545 0.184244662 0.105255912  
## X8 0.86772322 0.996245290 0.970162916 0.134438699 0.127928984  
## X9 -0.27339899 -0.230450199 -0.288661437 -0.038864231 -0.071387554  
## X10 -0.58648159 -0.632750407 -0.621212395 -0.106381295 -0.082061511  
## X11 -0.72926645 -0.769740935 -0.848658361 -0.129411946 -0.113709845  
## X12 -0.75058999 -0.793163584 -0.865513891 -0.132013034 -0.127058103  
## X13 -0.61448157 -0.642355269 -0.733105554 -0.106974979 -0.107039071  
## X14 -0.36554374 -0.419542696 -0.341020703 -0.074914062 -0.043315043  
## X15 0.89697227 0.957210467 0.983016464 0.161783238 0.136394908  
## X16 0.89238181 0.959457773 0.984423393 0.164917225 0.135734190  
## X17 0.53708428 0.595887851 0.520315411 0.106890745 0.050130572  
## X18 -0.60658835 -0.633853105 -0.726966863 -0.105091373 -0.113752520  
## X19 1.00000000 0.865051236 0.850174880 0.110330118 0.156707632  
## X20 0.86505124 1.000000000 0.968095911 0.133755313 0.124250816  
## X21 0.85017488 0.968095911 1.000000000 0.162551839 0.125976476  
## X22 0.11033012 0.133755313 0.162551839 1.000000000 -0.003320347  
## X23 0.15670763 0.124250816 0.125976476 -0.003320347 1.000000000  
## X24 -0.04230047 0.030778532 0.045882456 -0.016933060 -0.070187557  
## X25 0.12855669 0.107189008 0.099096359 -0.024295393 0.354628980  
## X26 0.02009318 -0.027844289 -0.014195330 -0.033183219 -0.067948166  
## X27 -0.12938913 -0.126588448 -0.134093830 -0.024304452 -0.023201015  
## X28 -0.10773770 -0.122797414 -0.126193866 -0.033301353 -0.064345872  
## X29 0.03632356 0.009080255 0.003461880 -0.009818471 0.147271773  
## X30 -0.13888992 -0.152918931 -0.131887380 -0.034588487 -0.021097508  
## X31 -0.02336424 0.002297612 -0.005735119 -0.033931304 -0.060777159  
## X32 -0.08131475 -0.040168274 -0.042700889 -0.034048346 0.101020902  
## X33 -0.26279564 -0.291392101 -0.234736552 -0.052283170 0.017124087  
## Y -0.57530739 -0.700767848 -0.722174652 -0.271136961 0.044550470  
## X24 X25 X26 X27 X28  
## X1 0.002048850 0.059039591 -0.0648306521 -0.12977894 -0.036531590  
## X2 -0.097476813 -0.062027087 -0.0964109372 -0.06083873 0.096970188  
## X3 0.066069904 0.112632598 -0.0176711785 -0.13776980 -0.128726047  
## X4 -0.111123274 -0.083229778 -0.1006090397 -0.03530069 0.104724112  
## X5 -0.081174427 -0.057264174 -0.1107096473 -0.09938527 0.012106987  
## X6 -0.125174553 -0.066150070 -0.0730108052 -0.08535467 0.056122902  
## X7 0.049586710 0.079438080 -0.0095830344 -0.12226242 -0.132843025  
## X8 0.035495121 0.104593636 -0.0233593060 -0.13162611 -0.123419443  
## X9 -0.069676044 0.020636894 -0.0542287778 0.09735935 0.038084707  
## X10 0.065667595 -0.032038165 0.0956502902 0.12631291 0.137211083  
## X11 0.010302868 -0.082083275 0.0631504357 0.18830393 0.053903430  
## X12 -0.028460012 -0.080432774 0.0313684162 0.17033860 0.057378967  
## X13 0.029271030 -0.060163877 0.0813033726 0.18285213 0.029958817  
## X14 -0.096020002 -0.113210462 -0.1171157519 -0.05534665 0.114389838  
## X15 0.056359502 0.114641504 -0.0009802174 -0.13195174 -0.129710020  
## X16 0.050377339 0.114119215 -0.0058297666 -0.13224222 -0.127752447  
## X17 0.069612688 0.075495014 0.0195978909 -0.01004278 -0.108379699  
## X18 0.022397836 -0.054091235 0.0846695536 0.17466697 -0.005851634  
## X19 -0.042300472 0.128556687 0.0200931816 -0.12938913 -0.107737695  
## X20 0.030778532 0.107189008 -0.0278442891 -0.12658845 -0.122797414  
## X21 0.045882456 0.099096359 -0.0141953301 -0.13409383 -0.126193866  
## X22 -0.016933060 -0.024295393 -0.0331832192 -0.02430445 -0.033301353  
## X23 -0.070187557 0.354628980 -0.0679481660 -0.02320102 -0.064345872  
## X24 1.000000000 0.060753723 0.6070227650 0.31100857 -0.005480277  
## X25 0.060753723 1.000000000 0.0999327980 0.15660160 -0.064109150  
## X26 0.607022765 0.099932798 1.0000000000 0.36611040 -0.018222683  
## X27 0.311008567 0.156601600 0.3661104034 1.00000000 -0.018414172  
## X28 -0.005480277 -0.064109150 -0.0182226826 -0.01841417 1.000000000  
## X29 0.214779860 0.139224779 0.2507009917 0.39416156 -0.035126193  
## X30 -0.038948425 -0.058880586 0.0278333279 -0.04639690 -0.048654788  
## X31 0.430158767 -0.003494262 0.4258277514 0.10870359 -0.032286906  
## X32 0.147508298 0.050264672 0.1761043215 0.28896407 -0.052016727  
## X33 -0.075095921 -0.100312011 -0.0892237389 -0.04649657 0.163204282  
## Y -0.023855883 0.360114410 0.0534260665 0.21843201 -0.200026621  
## X29 X30 X31 X32 X33  
## X1 -0.025562632 0.052952046 -0.0495225644 -0.135456610 0.23621996  
## X2 -0.109798485 0.268150700 -0.0957198205 -0.135958931 0.58405432  
## X3 0.021994364 -0.145255904 0.0169199954 -0.058238331 -0.26039698  
## X4 -0.117040140 0.302007196 -0.1002931244 -0.121114373 0.56824430  
## X5 -0.111185943 0.216108237 -0.0937696999 -0.152468567 0.62834163  
## X6 -0.119341492 0.231160298 -0.1193338759 -0.132762986 0.59707640  
## X7 0.008242588 -0.155753669 0.0001148214 -0.006141998 -0.28183119  
## X8 0.011099498 -0.145328861 0.0071731216 -0.043550575 -0.27946163  
## X9 -0.015335978 -0.059277574 -0.0658595324 0.052911110 -0.07615775  
## X10 -0.017457661 0.173216897 0.0317861605 0.041258912 0.31500195  
## X11 0.049629499 -0.003873268 0.0458446408 0.143868937 -0.09178625  
## X12 0.022591607 0.032180574 0.0460890720 0.096726923 -0.05505469  
## X13 0.069987569 -0.049283242 0.0569656034 0.147765461 -0.21541067  
## X14 -0.106986524 0.250602403 -0.0985420065 -0.148814839 0.64996832  
## X15 0.025042627 -0.155662339 0.0190253140 -0.049330848 -0.29424531  
## X16 0.027675428 -0.155011714 0.0156925012 -0.047853953 -0.29063708  
## X17 0.095967719 -0.281072661 0.0950516480 0.094553239 -0.62342440  
## X18 0.046227731 -0.045076774 0.0606475371 0.105578636 -0.20098763  
## X19 0.036323557 -0.138889919 -0.0233642409 -0.081314755 -0.26279564  
## X20 0.009080255 -0.152918931 0.0022976124 -0.040168274 -0.29139210  
## X21 0.003461880 -0.131887380 -0.0057351187 -0.042700889 -0.23473655  
## X22 -0.009818471 -0.034588487 -0.0339313036 -0.034048346 -0.05228317  
## X23 0.147271773 -0.021097508 -0.0607771589 0.101020902 0.01712409  
## X24 0.214779860 -0.038948425 0.4301587666 0.147508298 -0.07509592  
## X25 0.139224779 -0.058880586 -0.0034942624 0.050264672 -0.10031201  
## X26 0.250700992 0.027833328 0.4258277514 0.176104322 -0.08922374  
## X27 0.394161561 -0.046396901 0.1087035880 0.288964075 -0.04649657  
## X28 -0.035126193 -0.048654788 -0.0322869062 -0.052016727 0.16320428  
## X29 1.000000000 -0.059767441 0.0582684645 0.196354854 -0.07488179  
## X30 -0.059767441 1.000000000 -0.0431019183 -0.071692543 0.11226045  
## X31 0.058268464 -0.043101918 1.0000000000 0.024145023 -0.06228359  
## X32 0.196354854 -0.071692543 0.0241450232 1.000000000 -0.11815088  
## X33 -0.074881788 0.112260448 -0.0622835890 -0.118150878 1.00000000  
## Y 0.083956272 0.130899795 0.1986480862 0.045957302 -0.12666909  
## Y  
## X1 -0.48039351  
## X2 0.21952592  
## X3 -0.69688200  
## X4 0.33498879  
## X5 0.02767671  
## X6 0.08721904  
## X7 -0.71316411  
## X8 -0.70309999  
## X9 0.22150550  
## X10 0.41381903  
## X11 0.60110991  
## X12 0.61736582  
## X13 0.52246805  
## X14 0.21407749  
## X15 -0.68719885  
## X16 -0.69001825  
## X17 -0.34276765  
## X18 0.51904840  
## X19 -0.57530739  
## X20 -0.70076785  
## X21 -0.72217465  
## X22 -0.27113696  
## X23 0.04455047  
## X24 -0.02385588  
## X25 0.36011441  
## X26 0.05342607  
## X27 0.21843201  
## X28 -0.20002662  
## X29 0.08395627  
## X30 0.13089979  
## X31 0.19864809  
## X32 0.04595730  
## X33 -0.12666909  
## Y 1.00000000

##Evidence of multicoliniarity given the high correlation among the x variables   
regresults <- lm(Y ~ . ,lassoData)  
summary(regresults)

##   
## Call:  
## lm(formula = Y ~ ., data = lassoData)  
##   
## Residuals:  
## Min 1Q Median 3Q Max   
## -1.8965 -0.6376 -0.1295 0.5936 2.2898   
##   
## Coefficients:  
## Estimate Std. Error t value Pr(>|t|)   
## (Intercept) 2.0000 0.1216 16.449 < 2e-16 \*\*\*  
## X1 -5.5243 6.6909 -0.826 0.412572   
## X2 16.1023 10.2173 1.576 0.120765   
## X3 -18.9555 15.8101 -1.199 0.235689   
## X4 3.5664 7.9247 0.450 0.654455   
## X5 8.6440 4.3023 2.009 0.049438 \*   
## X6 -4.9270 3.7840 -1.302 0.198321   
## X7 -4.2589 16.0387 -0.266 0.791589   
## X8 -23.0779 25.9472 -0.889 0.377653   
## X9 0.5965 2.5380 0.235 0.815066   
## X10 -3.7334 1.7580 -2.124 0.038211 \*   
## X11 -11.0306 9.6162 -1.147 0.256310   
## X12 -11.0497 6.4236 -1.720 0.091023 .   
## X13 14.6671 13.2458 1.107 0.272983   
## X14 4.1514 6.7976 0.611 0.543899   
## X15 15.2585 27.5395 0.554 0.581785   
## X16 11.1094 22.5120 0.493 0.623633   
## X17 13.7868 8.5123 1.620 0.111032   
## X18 -9.8101 5.6207 -1.745 0.086512 .   
## X19 -2.3819 3.8980 -0.611 0.543683   
## X20 0.4249 27.7546 0.015 0.987842   
## X21 -45.0762 36.6060 -1.231 0.223417   
## X22 -9.2720 1.1823 -7.842 1.58e-10 \*\*\*  
## X23 0.5177 1.3168 0.393 0.695750   
## X24 -6.5405 1.7360 -3.768 0.000404 \*\*\*  
## X25 24.8828 1.3191 18.863 < 2e-16 \*\*\*  
## X26 -4.9280 1.8169 -2.712 0.008900 \*\*   
## X27 6.1485 1.4185 4.334 6.27e-05 \*\*\*  
## X28 -14.5910 1.2908 -11.304 5.77e-16 \*\*\*  
## X29 1.0009 1.3340 0.750 0.456262   
## X30 1.6142 1.2571 1.284 0.204505   
## X31 16.0456 1.3878 11.562 2.40e-16 \*\*\*  
## X32 -2.3815 1.3229 -1.800 0.077305 .   
## X33 -25.4367 1.6729 -15.206 < 2e-16 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Residual standard error: 1.147 on 55 degrees of freedom  
## Multiple R-squared: 0.9814, Adjusted R-squared: 0.9703   
## F-statistic: 88.05 on 33 and 55 DF, p-value: < 2.2e-16

From the correlation numbers above, we can see that there is existence of multicolinearity. The best linear regression model that explains Y can be seen at X32 intercept since it has the least significant value.

### Question 5

1. Now, without ignoring multicollinearity for the dataset given you in Question 3, find the “best” model using Ridge Regression.

##Ridge regression  
#Automatically does the ridge regression selecting the best lambda parameter  
library(ridge)  
mod<-linearRidge(Y ~.,data=lassoData,lambda="automatic");   
summary(mod)

##   
## Call:  
## linearRidge(formula = Y ~ ., data = lassoData, lambda = "automatic")  
##   
##   
## Coefficients:  
## Estimate Scaled estimate Std. Error (scaled) t value (scaled)  
## (Intercept) 2.0000 NA NA NA  
## X1 -1.8035 -1.8035 1.7685 1.020  
## X2 5.4181 5.4181 1.4218 3.811  
## X3 -4.8732 -4.8732 1.0522 4.631  
## X4 5.3825 5.3825 1.6066 3.350  
## X5 3.7894 3.7894 1.9754 1.918  
## X6 -0.4564 -0.4564 2.0300 0.225  
## X7 -9.6256 -9.6256 1.6651 5.781  
## X8 -10.8367 -10.8367 1.4303 7.577  
## X9 0.2471 0.2471 1.4003 0.176  
## X10 -2.6922 -2.6922 1.6445 1.637  
## X11 0.3548 0.3548 1.4167 0.250  
## X12 -1.0834 -1.0834 1.8266 0.593  
## X13 1.3516 1.3516 1.1848 1.141  
## X14 3.5996 3.5996 1.7211 2.092  
## X15 -3.2013 -3.2013 0.9570 3.345  
## X16 -3.2502 -3.2502 0.9082 3.579  
## X17 4.9966 4.9966 1.9493 2.563  
## X18 -2.7132 -2.7132 2.0044 1.354  
## X19 1.6967 1.6967 1.9521 0.869  
## X20 -10.9210 -10.9210 1.4446 7.560  
## X21 -9.9383 -9.9383 0.8887 11.183  
## X22 -8.4365 -8.4365 1.3090 6.445  
## X23 0.9010 0.9010 1.3821 0.652  
## X24 -5.0468 -5.0468 1.5460 3.264  
## X25 22.6756 22.6756 1.3755 16.486  
## X26 -4.6499 -4.6499 1.5645 2.972  
## X27 4.7972 4.7972 1.4617 3.282  
## X28 -13.0554 -13.0554 1.3189 9.899  
## X29 1.5880 1.5880 1.3966 1.137  
## X30 1.4110 1.4110 1.3421 1.051  
## X31 14.3150 14.3150 1.4183 10.093  
## X32 -2.0210 -2.0210 1.3588 1.487  
## X33 -22.2113 -22.2113 1.5933 13.940  
## Pr(>|t|)   
## (Intercept) NA   
## X1 0.307822   
## X2 0.000139 \*\*\*  
## X3 3.63e-06 \*\*\*  
## X4 0.000807 \*\*\*  
## X5 0.055071 .   
## X6 0.822095   
## X7 7.43e-09 \*\*\*  
## X8 3.55e-14 \*\*\*  
## X9 0.859920   
## X10 0.101618   
## X11 0.802225   
## X12 0.553099   
## X13 0.253945   
## X14 0.036483 \*   
## X15 0.000823 \*\*\*  
## X16 0.000345 \*\*\*  
## X17 0.010369 \*   
## X18 0.175852   
## X19 0.384767   
## X20 4.04e-14 \*\*\*  
## X21 < 2e-16 \*\*\*  
## X22 1.15e-10 \*\*\*  
## X23 0.514466   
## X24 0.001097 \*\*   
## X25 < 2e-16 \*\*\*  
## X26 0.002956 \*\*   
## X27 0.001031 \*\*   
## X28 < 2e-16 \*\*\*  
## X29 0.255523   
## X30 0.293102   
## X31 < 2e-16 \*\*\*  
## X32 0.136922   
## X33 < 2e-16 \*\*\*  
## ---  
## Signif. codes: 0 '\*\*\*' 0.001 '\*\*' 0.01 '\*' 0.05 '.' 0.1 ' ' 1  
##   
## Ridge parameter: 0.09968971, chosen automatically, computed using 10 PCs  
##   
## Degrees of freedom: model 18.48 , variance 14.67 , residual 22.28