question 2

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```
library(tidyverse)
```

```
## -- Attaching packages ----------------------------------------------------------------------- tidy
```

```
## v ggplot2 3.1.0     v purrr   0.2.5
## v tibble  1.4.2     v dplyr   0.7.8
## v tidyr   0.8.2     v stringr 1.3.1
## v readr   1.1.1     v forcats 0.3.0
```

```
## -- Conflicts -------------------------------------------------------------------------- tidyverse_
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
```

```
cancer_data = read_csv("./breast-cancer-1.csv")
```

```
## Warning: Missing column names filled in: 'X33' [33]
```

```
## Parsed with column specification:
## cols(
##   .default = col_double(),
##   id = col_integer(),
##   diagnosis = col_character(),
##   X33 = col_character()
## )
```

```
## See spec(...) for full column specifications.
```

```
## Warning in rbind(names(probs), probs_f): number of columns of result is not
## a multiple of vector length (arg 1)
```

```
## Warning: 569 parsing failures.
## row # A tibble: 5 x 5 col     row col   expected   actual     file                    expected   <int
## ... ................. ... ........................................................ ........ .....
## See problems(...) for more details.
```

classical Newton Raphson

```
logisticstuff <- function(x, y, betavec) {
  u <- x %*% betavec[1:31]
  expu <- exp(u)
  loglik = vector(mode = "numeric", 569)
  for(i in 1:569)
    loglik[i] = y[i]*u[i] - log(1 + expu[i])
  loglik_value = sum(loglik)
  # Log-likelihood at betavec
  p <- expu / (1 + expu)
  # P(Y_i=1|x_i)
  grad = vector(mode = "numeric", 31)
  #grad[1] = sum(y - p)
```

```
  for(i in 1:31)
    grad[i] = sum(t(x[,i])%*%(y - p))
  Hess <- -t(x)%*%p%*%t(1-p)%*%x
  # gradient at betavec
  #unit_vec = vector(mode = "numeric", 32)
  #unit_vec[1] = sum(t(p)%*%(1-p))
  #for (j in 2:31){
    #unit_vec[j] = sum(x[,j-1]*p*(1-p))
  #}
  #Hess = unit_vec
  #for(i in 2:31){
    #Hess = rbind(Hess, x[,i-1]%*%unit_vec)
  #}
# Hessian at betavec
  return(list(loglik = loglik, grad = grad, Hess = Hess))
}
```

Newton-Raphson process

```
NewtonRaphson <- function(x, y, logisticstuff, start, tol=1e-10, maxiter = 200) {
  i <- 0
  cur <- start
  stuff <- logisticstuff(x, y, cur)
  res <- c(0, stuff$loglik, cur)
  prevloglik <- -Inf      # To make sure it iterates
  #while(i < maxiter && abs(stuff$loglik - prevloglik) > tol && stuff$loglik > -Inf)
  while(i < maxiter && abs(stuff$loglik - prevloglik) > tol)
 {
    i <- i + 1
    prevloglik <- stuff$loglik
    prev <- cur
    cur <- prev - solve(stuff$Hess) %*% stuff$grad
    stuff <- logisticstuff(x, y, cur)        # log-lik, gradient, Hessian
    res <- rbind(res, c(i, stuff$loglik, cur))
    # Add current values to results matrix
}
  return(res)
}
```

Using data to get answer

```
intercept = rep(1, 569)
central = function(x){
  x = (x-mean(x))/sd(x)
  return(x)
}
x = cancer_data[,3:32] %>%
  apply(2, central) %>%
  cbind(intercept, .) %>%
  as.matrix()
#colnames(x) = NULL
y = as.vector(ifelse(cancer_data$diagnosis=="M",1,0))  # response variables
beta = rep(1,31)
#ans1 = NewtonRaphson(x, y, logisticstuff, beta)
# Error in solve.default(stuff$Hess) : singular
```

gradient descent

```
gradient <- function(x, y, logisticstuff, start, tol=1e-5, maxiter = 200){
  i <- 0
  cur <- start
  beta_len <- length(start)
  stuff <- logisticstuff(x, y, cur)
  res <- c(0, stuff$loglik,cur)
  prevloglik <- -Inf # To make sure it iterates
  #while(i <= maxiter && abs(stuff$loglik - prevloglik) > tol)
  while(i <= maxiter && abs(stuff$loglik - prevloglik) > tol && stuff$loglik > -Inf)
    { i <- i + 1
    prevloglik <- stuff$loglik
    prev <- cur
    cur <- prev + (diag(beta_len)/10)%*%(stuff$grad)
    #cur = prev + t(stuff$grad)%*%(stuff$grad)
    stuff <- logisticstuff(x, y, cur) # log-lik, gradient, Hessian
    res <- rbind(res, c(i, stuff$loglik, cur))}
  return(round(res,2))
}
ans2 <- gradient(x, y, logisticstuff, beta)
ans2
```

```
##     [,1]   [,2] [,3] [,4]   [,5] [,6]   [,7] [,8]  [,9]  [,10]   [,11]
## res    0   0.00    0    0    0.0    0   0.00    0   0.0   0.00    0.00
##        1 -29.66    0    0 -155.8    0 -57.32    0 -35.4 -38.03 -117.09
##        2   -Inf    0    0   -Inf    0   0.00    0   0.0   0.00    0.00
##       [,12] [,13]  [,14]  [,15] [,16]  [,17] [,18] [,19] [,20] [,21] [,22]
## res   -5.10     0   0.00  -0.05   0.0   0.00 -0.46  0.00     0  0.00     0
##        0.00     0 -78.68   0.00 -78.2 -28.11  0.00 -6.95     0 -2.16     0
##     -112.33     0   0.00 -17.46   0.0   0.00 -1.79  0.00     0  0.00     0
##     [,23]  [,24] [,25] [,26]  [,27]  [,28] [,29] [,30] [,31] [,32]  [,33]
## res     0   0.00     0     0   0.00   0.00     0     0     0     0   0.00
##         0 -55.71     0     0 -34.57 -14.34     0     0     0     0 -52.19
##         0   0.00     0     0   0.00   0.00     0     0     0     0   0.00
##     [,34] [,35] [,36] [,37] [,38] [,39]   [,40] [,41]   [,42]  [,43]
## res     0     0     0     0  0.00   0.0   -5.59 -0.05  -13.04  -0.02
##         0     0     0     0 -6.21 -15.3    0.00 -6.42    0.00 -23.92
##         0     0     0     0  0.00   0.0 -167.50  0.00 -202.68   0.00
##      [,44] [,45] [,46] [,47] [,48]  [,49] [,50]  [,51]  [,52]  [,53] [,54]
## res   0.00  0.00 -2.86     0     0   0.00  0.00   0.00   0.00   0.00  0.00
##     -38.46 -3.19  0.00     0     0 -22.83 -0.43 -26.55 -18.81 -23.67 -5.19
##       0.00  0.00 -3.56     0     0   0.00  0.00   0.00   0.00   0.00  0.00
##     [,55]  [,56] [,57] [,58] [,59]  [,60] [,61] [,62] [,63]  [,64] [,65]
## res     0  -5.54  0.00     0  0.00   0.00     0 -0.01 -0.02   0.00 -0.01
##         0   0.00 -0.33     0 -3.93 -25.24     0  0.00  0.00 -58.81  0.00
##         0 -84.44  0.00     0  0.00   0.00     0  0.00  0.00   0.00  0.00
##      [,66] [,67] [,68] [,69]   [,70]  [,71] [,72]  [,73] [,74]  [,75]
## res   0.00  0.00     0  0.00  -31.97   0.00     0  -9.27  0.00  -4.02
##     -10.35 -0.04     0 -6.43    0.00 -11.83     0   0.00 -3.78  -1.69
##       0.00  0.00     0  0.00 -419.18   0.00     0 -23.20  0.00 -30.15
##     [,76] [,77] [,78]  [,79]  [,80] [,81] [,82]   [,83] [,84]  [,85] [,86]
## res  0.00     0 -0.42   0.00   0.00   0.0 -0.19   -7.68     0   0.00  0.00
##     -9.21     0  0.00 -22.71 -71.79  -4.9  0.00    0.00     0 -23.72 -0.03
```

```
##      0.00     0  0.00   0.00   -Inf   0.0  0.00 -135.23  -Inf   0.00  0.00
##     [,87] [,88] [,89] [,90]  [,91]  [,92] [,93]  [,94]  [,95]  [,96] [,97]
## res     0  0.00     0 -0.18  -6.20   0.00 -0.16   0.00   0.00   0.00     0
##         0 -5.57     0  0.00   0.00 -29.23 -0.01 -40.27 -18.46 -11.08     0
##         0  0.00     0  0.00 -91.33   0.00 -7.02   0.00   0.00   0.00     0
##     [,98] [,99] [,100] [,101] [,102] [,103] [,104] [,105] [,106] [,107]
## res     0     0      0   0.00  -2.11      0   0.00      0      0   0.00
##         0     0      0 -10.39   0.00      0 -29.71      0      0 -66.87
##         0     0      0   0.00 -57.25      0   0.00      0      0   0.00
##     [,108] [,109] [,110] [,111] [,112] [,113]  [,114] [,115] [,116] [,117]
## res  -0.74   0.00   0.00   0.00      0  -4.86  -20.86  -1.06      0      0
##       0.00 -23.63 -14.08  -0.01      0   0.00    0.00   0.00      0      0
##       0.00   0.00   -Inf   0.00      0  -4.70 -255.23   0.00      0      0
##     [,118] [,119] [,120] [,121] [,122] [,123] [,124] [,125] [,126] [,127]
## res  -0.01   0.00   0.00      0      0      0    0.0   0.00   0.00    0.0
##       0.00 -12.28 -31.22      0      0      0  -61.6  -0.04  -0.02  -31.6
##       0.00   0.00   0.00      0      0      0   -Inf   0.00   0.00    0.0
##     [,128] [,129]  [,130] [,131] [,132] [,133] [,134] [,135] [,136]
## res  -3.03      0   -8.09      0      0  -0.01      0   0.00      0
##       0.00      0    0.00      0      0   0.00      0 -24.22      0
##     -44.96      0 -107.96      0      0   0.00      0   0.00      0
##      [,137] [,138] [,139] [,140] [,141] [,142] [,143] [,144] [,145] [,146]
## res   -7.83   0.00    0.0   0.00      0      0      0      0   0.00   0.00
##        0.00  -0.01   -4.6 -25.28      0      0      0      0  -6.89  -3.56
##     -153.15   0.00    0.0   0.00      0      0      0      0   0.00   0.00
##     [,147] [,148] [,149] [,150] [,151] [,152]  [,153]  [,154] [,155]
## res  -2.06   0.00  -5.88  -0.01   0.00  -0.02  -12.41  -52.68      0
##       0.00 -69.41   0.00  -2.61 -33.43  -0.76    0.00    0.00      0
##       0.00   0.00  -1.30   0.00   0.00   0.00 -122.95 -600.13      0
##     [,156] [,157] [,158] [,159] [,160] [,161] [,162] [,163] [,164] [,165]
## res  -0.04   0.00   0.00   0.00   0.00   0.00  -2.87      0      0  -0.17
##       0.00  -2.11  -3.18 -48.08  -6.79 -12.62   0.00      0      0   0.00
##       0.00   0.00   0.00   0.00   0.00   0.00   0.00      0      0   0.00
##     [,166] [,167] [,168] [,169] [,170] [,171] [,172]  [,173] [,174] [,175]
## res      0   0.00      0  -0.01      0   0.00      0   -5.58    0.0      0
##          0 -49.39      0   0.00      0 -31.15      0    0.00  -20.9      0
##          0   0.00      0   0.00      0   0.00      0 -100.60    0.0      0
##     [,176] [,177] [,178] [,179] [,180] [,181] [,182] [,183] [,184] [,185]
## res   0.00      0  -18.5   0.00   0.00   0.00      0      0  -0.06      0
##      -0.59      0    0.0 -11.75 -58.08  -6.06      0      0   0.00      0
##       0.00      0 -140.0   0.00   0.00   0.00      0   -Inf   0.00      0
##     [,186] [,187] [,188] [,189] [,190] [,191]  [,192] [,193] [,194] [,195]
## res  -3.90      0  -3.95   0.00   0.00   0.00    0.00      0   0.00   0.00
##       0.00      0   0.00  -3.88  -2.19 -10.77 -142.22      0  -0.02 -35.67
##     -43.67      0 -39.19   0.00   0.00   0.00    0.00      0   0.00   0.00
##     [,196] [,197] [,198] [,199] [,200] [,201] [,202] [,203] [,204] [,205]
## res   0.00   0.00   0.00  -0.01      0      0   0.00  -0.01      0   0.00
##     -31.64 -14.25 -36.85   0.00      0      0  -0.64   0.00      0 -22.27
##       0.00   0.00   0.00  -2.38      0      0   0.00   0.00      0   0.00
##     [,206] [,207] [,208] [,209] [,210] [,211] [,212] [,213] [,214] [,215]
## res  -0.06  -3.59      0  -0.64  -5.04   0.00      0   0.00      0    0.0
##       0.00   0.00      0   0.00   0.00 -37.67      0  -4.74      0  -99.6
##       0.00 -30.69      0 -29.49 -70.35   0.00      0   0.00   -Inf    0.0
##     [,216] [,217] [,218] [,219] [,220] [,221] [,222] [,223] [,224] [,225]
```

```
## res    0.0   0.00  -2.85      0      0      0   0.00      0      0      0
##      -29.3 -32.47   0.00      0      0      0  -6.61      0      0      0
##        0.0   0.00  -0.02      0      0      0   0.00      0      0      0
##     [,226] [,227] [,228] [,229] [,230] [,231] [,232] [,233] [,234] [,235]
## res   0.00   0.00      0   0.00    0.0   0.00      0   0.00    0.0      0
##     -21.79 -18.88      0  -5.41   -7.7 -50.45      0 -28.52  -36.2      0
##       0.00   0.00      0   0.00    0.0   0.00      0   0.00    0.0      0
##     [,236] [,237] [,238] [,239] [,240] [,241] [,242] [,243]  [,244] [,245]
## res      0   0.00      0      0  -0.22      0   0.00      0  -12.57   0.00
##          0 -23.22      0      0 -17.23      0 -16.46    -29    0.00 -21.11
##          0   0.00      0      0   0.00      0   0.00      0 -161.80   0.00
##     [,246] [,247] [,248] [,249] [,250] [,251] [,252] [,253] [,254] [,255]
## res      0  -0.15   0.00  -3.32   0.00      0      0   0.00   0.00  -0.03
##          0   0.00 -18.08   0.00  -2.04      0      0  -9.22 -10.43   0.00
##          0   0.00   0.00 -77.98   0.00      0      0   0.00   0.00   0.00
##     [,256] [,257] [,258] [,259] [,260] [,261] [,262]  [,263] [,264]
## res      0  -0.13      0    0.0   0.00      0      0   -5.86      0
##          0  -4.73      0  -72.2 -67.89      0      0    0.00      0
##          0   0.00      0    0.0   -Inf      0      0 -132.28      0
##      [,265] [,266] [,267] [,268] [,269] [,270] [,271] [,272] [,273] [,274]
## res  -13.31  -0.01      0  -0.02   0.00   0.00  -1.97   0.00      0      0
##        0.00   0.00      0   0.00 -13.06  -3.93   0.00 -49.81      0      0
##     -211.44   0.00      0   0.00   0.00   0.00   0.00   0.00      0      0
##     [,275] [,276] [,277] [,278] [,279] [,280] [,281] [,282] [,283] [,284]
## res      0  -0.37  -0.21   0.00  -3.16   0.00   0.00      0      0      0
##          0   0.00   0.00  -3.07   0.00 -44.98 -16.24      0      0      0
##          0 -30.93   0.00   0.00 -77.33   0.00   0.00      0      0      0
##     [,285] [,286] [,287] [,288] [,289] [,290] [,291]  [,292] [,293] [,294]
## res   0.00      0   0.00  -0.43   0.00 -10.13      0  -23.64  -0.04  -0.01
##      -7.87      0 -20.59   0.00 -21.26   0.00      0    0.00 -18.31   0.00
##       0.00      0   0.00   0.00   0.00 -38.34      0 -203.15   0.00   0.00
##     [,295] [,296] [,297] [,298]  [,299] [,300] [,301] [,302] [,303] [,304]
## res   0.00   0.00   0.00      0  -11.07   0.00      0      0      0   0.00
##      -8.24  -8.67 -21.67      0   -0.06 -43.12      0      0      0  -4.66
##       0.00   0.00   0.00      0 -214.91   0.00      0      0      0   0.00
##     [,305] [,306] [,307] [,308] [,309] [,310] [,311] [,312] [,313] [,314]
## res      0      0   0.00   0.00      0   0.00   0.00   0.00   0.00      0
##          0      0  -7.61 -25.25      0 -43.58 -33.83  -7.52 -51.49      0
##          0      0   0.00   0.00      0   0.00   0.00   0.00   0.00      0
##     [,315] [,316] [,317] [,318] [,319]  [,320] [,321] [,322] [,323] [,324]
## res   0.00  -0.06    0.0   0.00      0  -17.26   0.00  -0.38  -0.01      0
##      -0.51   0.00  -33.6 -21.61      0    0.00  -6.29   0.00   0.00      0
##       0.00   0.00    0.0   0.00      0 -193.48   0.00   0.00   0.00      0
##     [,325] [,326] [,327] [,328] [,329] [,330] [,331] [,332] [,333] [,334]
## res      0   0.00   0.00   0.00   0.00      0   0.00      0  -0.24      0
##          0 -10.77  -8.92 -22.59 -25.32      0 -26.25      0   0.00      0
##          0   0.00   0.00   0.00   0.00      0   0.00      0   0.00      0
##     [,335] [,336] [,337] [,338] [,339] [,340] [,341] [,342] [,343] [,344]
## res   0.00   0.00      0      0      0      0      0  -0.91      0      0
##     -11.77 -15.56      0      0      0      0      0   0.00      0      0
##       0.00   0.00      0      0      0      0      0 -11.98      0      0
##     [,345] [,346] [,347] [,348] [,349] [,350] [,351] [,352] [,353] [,354]
## res      0      0  -0.08    0.0   0.00      0      0   0.00   0.00      0
##          0      0   0.00  -11.8 -20.86      0      0 -16.45 -93.11      0
```

```
##          0      0   0.00    0.0   0.00      0      0   0.00   0.00   -Inf
##     [,355] [,356] [,357] [,358] [,359] [,360] [,361] [,362] [,363] [,364]
## res   0.00      0  -0.05  -5.81   0.00      0      0    0.0   0.00   0.00
##      -2.73      0   0.00   0.00 -29.67      0      0  -41.3 -21.87  -5.37
##       0.00      0   0.00 -47.79   0.00      0      0    0.0   0.00   0.00
##     [,365] [,366] [,367] [,368] [,369] [,370] [,371] [,372] [,373] [,374]
## res  -0.01   0.00      0      0   0.00      0      0   0.00   0.00      0
##     -36.25 -25.69      0      0 -11.44      0      0  -3.59 -27.59      0
##       0.00   0.00      0      0   0.00      0      0   0.00   0.00      0
##     [,375] [,376] [,377]  [,378] [,379] [,380] [,381] [,382] [,383] [,384]
## res      0   0.00  -0.10  -16.49   0.00      0   0.00  -0.08      0      0
##          0 -20.88  -2.39    0.00 -46.64      0 -79.99   0.00      0      0
##          0   0.00   0.00 -196.58   0.00      0   0.00   0.00      0      0
##     [,385] [,386] [,387] [,388] [,389] [,390] [,391] [,392] [,393] [,394]
## res  -0.76   0.00  -2.02      0   0.00  -1.52   0.00      0      0   0.00
##       0.00  -9.39   0.00      0 -33.35   0.00 -12.11      0      0  -5.46
##       0.00   0.00 -74.27      0   0.00   0.00   0.00      0      0   0.00
##     [,395] [,396] [,397] [,398] [,399] [,400] [,401] [,402] [,403] [,404]
## res      0   0.00   0.00  -0.06      0   0.00   0.00   0.00   0.00   0.00
##          0  -0.03 -26.94  -1.12      0  -0.25  -2.07 -21.43 -13.02  -0.04
##          0   0.00   0.00   0.00      0   0.00   0.00   0.00   0.00   0.00
##     [,405] [,406] [,407] [,408] [,409] [,410] [,411] [,412] [,413] [,414]
## res   0.00   0.00      0   0.00  -0.02      0   0.00    0.0   0.00      0
##      -9.82  -9.53      0 -34.57   0.00      0  -6.71  -19.5  -0.15      0
##       0.00   0.00      0   0.00   0.00      0   0.00    0.0   0.00      0
##     [,415]  [,416] [,417] [,418] [,419] [,420] [,421] [,422]  [,423]
## res  -1.59   -1.67      0  -0.09   0.00      0    0.0      0  -13.28
##     -10.91    0.00      0   0.00  -2.15      0   -5.5      0    0.00
##       0.00 -107.76      0   0.00   0.00      0    0.0      0 -162.87
##     [,424] [,425] [,426] [,427] [,428] [,429] [,430] [,431] [,432] [,433]
## res      0  -0.04  -0.29   0.00  -0.03   0.00   0.00   0.00   0.00  -0.68
##          0  -0.01   0.00  -6.93   0.00  -0.01  -5.22 -27.73 -57.23   0.00
##          0   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00   0.00
##     [,434] [,435] [,436] [,437] [,438] [,439] [,440] [,441] [,442] [,443]
## res      0      0   0.00  -0.03   0.00   0.00    0.0   0.00  -0.98      0
##          0      0 -27.68   0.00 -12.05 -15.63  -31.5 -29.28   0.00      0
##          0      0   0.00   0.00   0.00   0.00    0.0   0.00   0.00      0
##     [,444] [,445] [,446] [,447] [,448] [,449] [,450] [,451] [,452] [,453]
## res   0.00      0  -0.58  -0.07      0   0.00   0.00      0   -0.1      0
##     -24.69      0   0.00   0.00      0 -25.55 -26.02      0    0.0      0
##       0.00      0   0.00   0.00      0   0.00   0.00      0    0.0      0
##     [,454] [,455] [,456] [,457] [,458] [,459] [,460] [,461] [,462] [,463]
## res   0.00   0.00   0.00   0.00  -0.86    0.0      0    0.0      0      0
##      -1.06  -3.03 -22.91 -34.65  -0.01  -36.5    -41  -11.5      0      0
##       0.00   0.00   0.00   0.00   0.00    0.0      0    0.0      0   -Inf
##     [,464] [,465] [,466]  [,467] [,468] [,469] [,470]  [,471] [,472]
## res   0.00   0.00   0.00   -7.50  -0.06      0   0.00   -9.93      0
##     -45.18  -2.84 -28.48    0.00   0.00      0 -43.95    0.00      0
##       0.00   0.00   0.00 -103.75   0.00      0   0.00 -113.59      0
##     [,473] [,474] [,475] [,476] [,477] [,478] [,479] [,480] [,481] [,482]
## res   0.00   0.00   0.00      0   0.00  -0.01   0.00      0   0.00   0.00
##     -12.48 -26.94 -26.17      0  -3.19 -13.28 -33.75      0 -50.02 -11.32
##       0.00   0.00   0.00      0   0.00   0.00   0.00      0   0.00   0.00
##     [,483] [,484] [,485] [,486]  [,487] [,488] [,489] [,490]  [,491]
```

```
## res   0.00      0   0.00  -0.01  -16.58   0.00      0      0   -6.37
##     -40.03      0 -23.02  -1.52    0.00 -43.45      0      0    0.00
##       0.00      0   0.00   0.00 -196.12   0.00      0      0 -102.81
##     [,492] [,493] [,494] [,495] [,496] [,497] [,498] [,499] [,500] [,501]
## res   0.00   0.00      0      0   0.00   0.00  -0.39   0.00      0      0
##     -25.71 -68.18      0      0 -16.76 -27.61   0.00 -17.96      0      0
##       0.00   0.00      0      0   0.00   0.00 -14.01   0.00      0      0
##     [,502] [,503] [,504] [,505]  [,506]  [,507] [,508] [,509] [,510]
## res   0.00   0.00  -0.03      0  -16.07  -18.55  -0.01  -1.24    0.0
##      -6.65 -49.41   0.00      0    0.00    0.00   0.00   0.00  -23.4
##       0.00   0.00   0.00      0 -238.17 -227.50   0.00   0.00    0.0
##     [,511] [,512] [,513] [,514] [,515]  [,516] [,517] [,518] [,519] [,520]
## res   0.00      0   0.00   0.00   0.00   -6.02      0      0      0  -0.89
##     -44.42      0 -29.28 -21.07 -18.68    0.00      0      0      0   0.00
##       0.00      0   0.00   0.00   0.00 -103.29      0      0      0  -5.15
##     [,521] [,522] [,523] [,524] [,525] [,526] [,527] [,528] [,529] [,530]
## res  -0.02  -3.31      0   0.00  -0.23      0      0  -0.01   0.00  -5.46
##       0.00   0.00      0 -13.63   0.00      0      0 -13.32 -18.26   0.00
##       0.00  -9.64      0   0.00   0.00      0      0   0.00   0.00 -23.50
##     [,531] [,532] [,533] [,534] [,535] [,536] [,537] [,538]  [,539] [,540]
## res      0      0   0.00   0.00      0      0      0  -0.01  -10.32      0
##          0      0  -0.06 -28.65      0      0      0  -2.24    0.00      0
##          0      0   0.00   0.00      0      0      0   0.00 -108.37      0
##     [,541] [,542] [,543] [,544] [,545] [,546] [,547] [,548] [,549] [,550]
## res  -4.99  -0.02  -7.92   0.00   0.00   0.00   0.00      0      0      0
##       0.00   0.00   0.00 -35.43 -35.98  -0.15 -20.74      0      0      0
##       0.00   0.00 -86.92   0.00   0.00   0.00   0.00      0      0      0
##     [,551] [,552] [,553] [,554] [,555] [,556] [,557] [,558] [,559] [,560]
## res   0.00   0.00      0   0.00      0   0.00  -0.03      0   0.00  -0.18
##      -0.23  -8.97      0 -31.04      0 -16.72   0.00      0  -0.15   0.00
##       0.00   0.00      0   0.00      0   0.00   0.00      0   0.00   0.00
##     [,561] [,562] [,563] [,564] [,565] [,566] [,567] [,568] [,569] [,570]
## res  -0.63  -0.92   0.00   0.00      0      0      0      0   0.00   0.00
##       0.00  -0.38 -35.51 -39.01      0      0      0      0  -7.47 -10.12
##       0.00   0.00   0.00   0.00      0      0      0      0   -Inf   0.00
##     [,571] [,572] [,573] [,574] [,575] [,576] [,577] [,578] [,579] [,580]
## res   1.00   1.00   1.00   1.00   1.00   1.00   1.00   1.00   1.00   1.00
##      -1.34   4.49   2.90   4.11   4.13  -2.22  -3.07  -1.26   0.83  -2.54
##     -10.19  11.81   9.21  12.79  11.61  18.08  20.33  19.76  19.95  15.18
##     [,581] [,582] [,583] [,584] [,585] [,586] [,587] [,588] [,589] [,590]
## res   1.00   1.00   1.00   1.00   1.00   1.00   1.00   1.00   1.00   1.00
##      -7.05   1.44  -1.67   0.90   2.19  -4.51  -6.75  -5.84  -4.63  -3.00
##      11.12  13.80   4.10  14.22  11.86   6.11  12.60   9.08  13.53   6.71
##     [,591] [,592] [,593] [,594] [,595] [,596] [,597] [,598] [,599] [,600]
## res   1.00   1.00   1.00   1.00   1.00   1.00   1.00   1.00   1.00   1.00
##      -8.20   4.55   3.55   4.10   4.09  -0.49  -1.42  -0.89   1.24   1.10
##       7.18  13.98  10.98  14.92  13.13  19.40  20.34  20.14  21.24  16.12
##     [,601]
## res   1.00
##      -3.94
##      17.46
```