Homework for Final

Cao Xin, Haochen

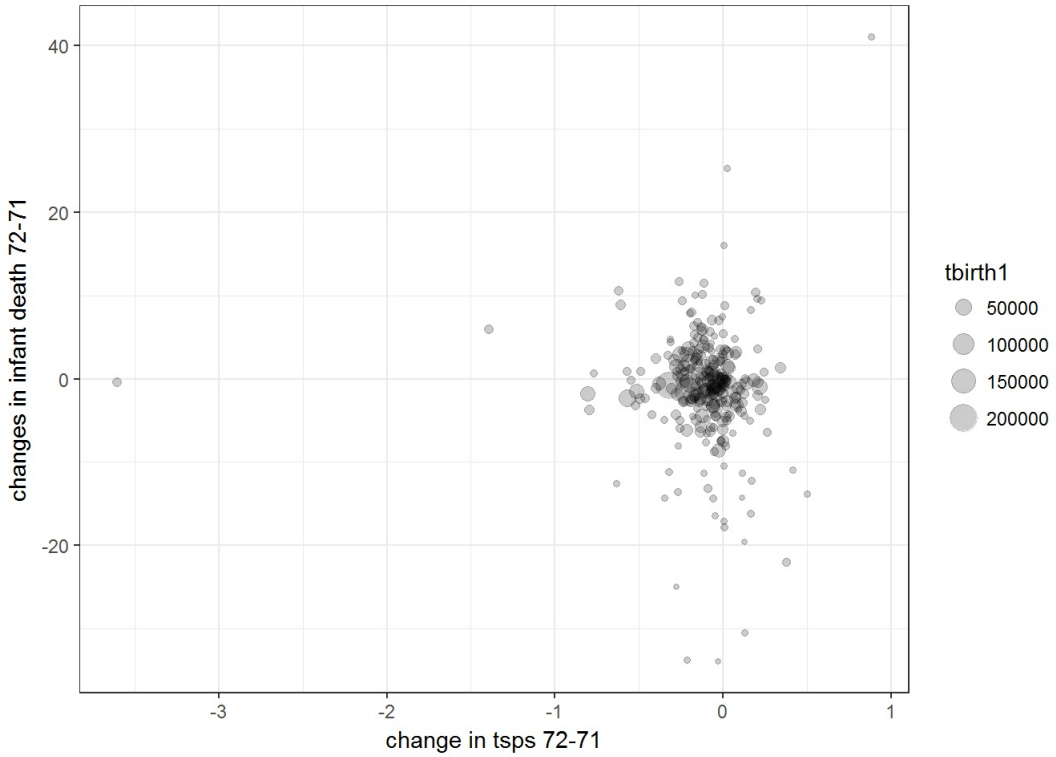
2018.6.8

Preparation

```
### 0.workspace and settings
setwd('G:/R/14.33')
library(ggplot2)
theme_set(theme_bw())
options(digits = 4)

### 1.import my function
source('C:/R/STAT_873/some_stat_functions.R')

### 2.read data
mydata <- read.csv('tspsimr7172.csv')
str(mydata)  #check my data
```

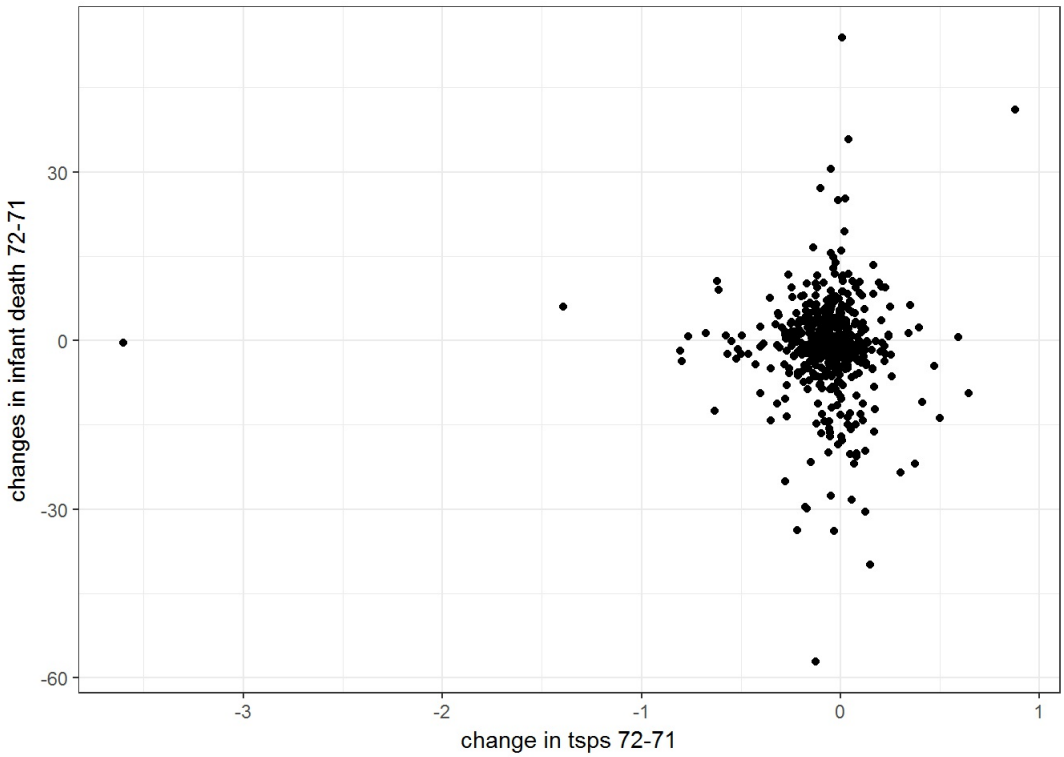
```
## 'data.frame':    501 obs. of  48 variables:
##  $ reg_tsp : int  0 1 0 1 1 0 1 0 1 1 ...
##  $ dimr7271: num  5.6328 -3.8817 0.4841 1.3207 -0.0779 ...
##  $ damtsp1 : num  -0.0764 -0.0417 0.0072 0.343 0.1323 ...
##  $ tbirth1 : int  3366 20760 6533 12275 6536 6280 2668 2792 38573 14160 ...
##  $ dwhite  : num  0.000903 -0.01076 -0.033389 -0.010712 -0.015338 ...
##  $ dothr   : num  2.70e-03 1.65e-04 3.32e-03 2.69e-05 1.87e-03 ...
##  $ dfemale : num  0.05721 0.00537 -0.0047 -0.01343 -0.01052 ...
##  $ dedudad : num  0.4864 0.5915 0.0992 -0.408 -0.4772 ...
##  $ dedumom : num  -2.3518 1.057 0.0642 -0.389 -0.3632 ...
##  $ dmaried : num  -0.03062 -0.02794 -0.01348 -0.00916 -0.01295 ...
##  $ dagemom : num  0.37 -0.279 0.215 -0.286 -0.531 ...
##  $ dpcare0 : num  0.001271 0.000214 0 0.00034 0 ...
##  $ dpcare2 : num  -0.001116 0.000327 -0.002218 0.00043 -0.001199 ...
##  $ dpcare3 : num  -0.00112 -0.0011 -0.00227 -0.00312 0.00065 ...
##  $ dpcare4 : num  0.00 -1.86e-04 3.05e-04 5.37e-05 2.55e-05 ...
##  $ dmedu1  : num  -0.000961 -0.000544 0.002527 0.00026 -0.001174 ...
##  $ dmedu2  : num  -0.001116 -0.000403 -0.003768 -0.001439 0.002188 ...
##  $ dmedu3  : num  1.55e-04 -6.17e-04 1.44e-03 1.81e-05 6.25e-04 ...
##  $ ddedu1  : num  -1.12e-03 -7.24e-05 8.95e-05 7.88e-04 6.25e-04 ...
##  $ ddedu2  : num  0.000155 -0.001175 -0.000912 -0.000446 0.000988 ...
##  $ ddedu3  : num  0 -0.000358 0.002104 -0.000295 -0.0006 ...
##  $ dnhosp1 : num  -0.005117 0.001605 -0.002783 -0.000152 0.002957 ...
##  $ dphys1  : num  0.003537 -0.00051 0.005249 0.000152 0.00064 ...
##  $ dmage1  : num  0.002353 0.003513 0.002047 -0.001448 -0.000319 ...
##  $ dmage2  : num  -0.01316 0.0192 -0.00576 0.03509 0.03757 ...
##  $ dmage3  : num  -0.0227 -0.0169 -0.015 -0.0191 -0.0148 ...
##  $ dmage5  : num  0.01283 -0.00729 -0.00443 -0.00842 -0.01708 ...
##  $ dmage6  : num  0.0078 -0.00524 0.00737 -0.00496 -0.00596 ...
##  $ dmage7  : num  0.002009 -0.000456 0.004399 0.001522 -0.00421 ...
##  $ dagedad : num  0.7183 -0.0418 0.1861 -0.3829 -0.4116 ...
##  $ dtwins  : num  -0.000223 0.001286 -0.009436 -0.003611 -0.004134 ...
##  $ dcare   : num  -2.4577 -1.5288 -0.2049 -0.0565 0.4188 ...
##  $ ddead1  : num  0.00244 -0.00108 -0.00229 0.0024 0.00395 ...
##  $ ddead2  : num  -0.007658 0.000751 0.00164 -0.002289 -0.000868 ...
##  $ dllive  : num  0.000155 -0.000145 0.00273 0.001933 0.002213 ...
##  $ dlterm  : num  0.001271 0 -0.000566 -0.001118 0 ...
##  $ dord2   : num  -0.0322 0.0135 -0.0253 0.0219 -0.0175 ...
##  $ dord3   : num  -0.01325 -0.03407 0.00145 -0.03903 -0.01678 ...
##  $ dpreg1  : num  0 0 -0.000566 -0.001252 0 ...
##  $ dpreg2  : num  0 0.0002 0.001335 0.002111 0.000937 ...
##  $ dpreg3  : num  0.001425 -0.000245 -0.000606 0.000555 0.001275 ...
##  $ dfdth1  : num  0 0 0 -0.000939 0 ...
##  $ dfdth2  : num  0 0 0 0.00042 0 ...
##  $ dfdth3  : num  1.27e-03 9.99e-05 -5.66e-04 -1.17e-03 0.00 ...
##  $ dintrv1 : num  0 0 -0.000566 -0.000313 0 ...
##  $ dintrv2 : num  0 0.0002 0.001335 0.001717 0.000937 ...
##  $ dintrv3 : num  0.000155 -0.000617 -0.000606 0.000859 0.001275 ...
##  $ dpcinc  : num  590 675 504 511 695 ...
```

```
#summary(mydata)

# check a specific group use ggplot
using_data <- subset(mydata, reg_tsp == 1)
figure0 <- qplot(damtsp1, dimr7271, data = using_data,size = tbirth1, alpha = I(1/5),
                 xlab = 'change in tsps 72-71',
                 ylab = 'changes in infant death 72-71')
figure0
```

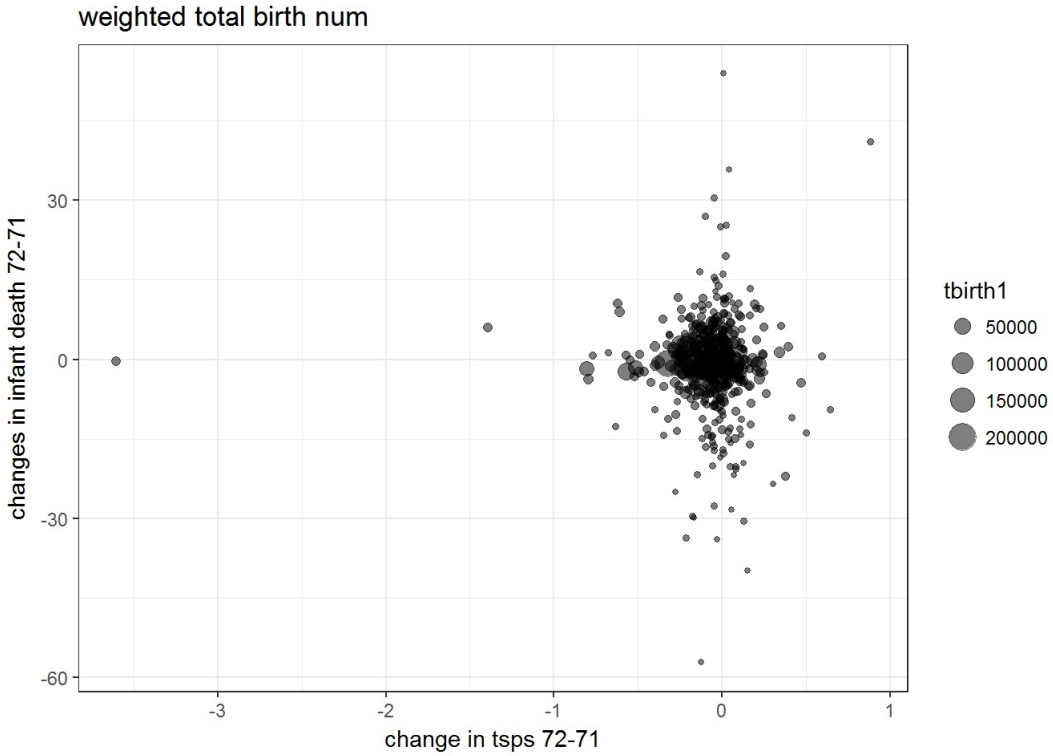


Exploration

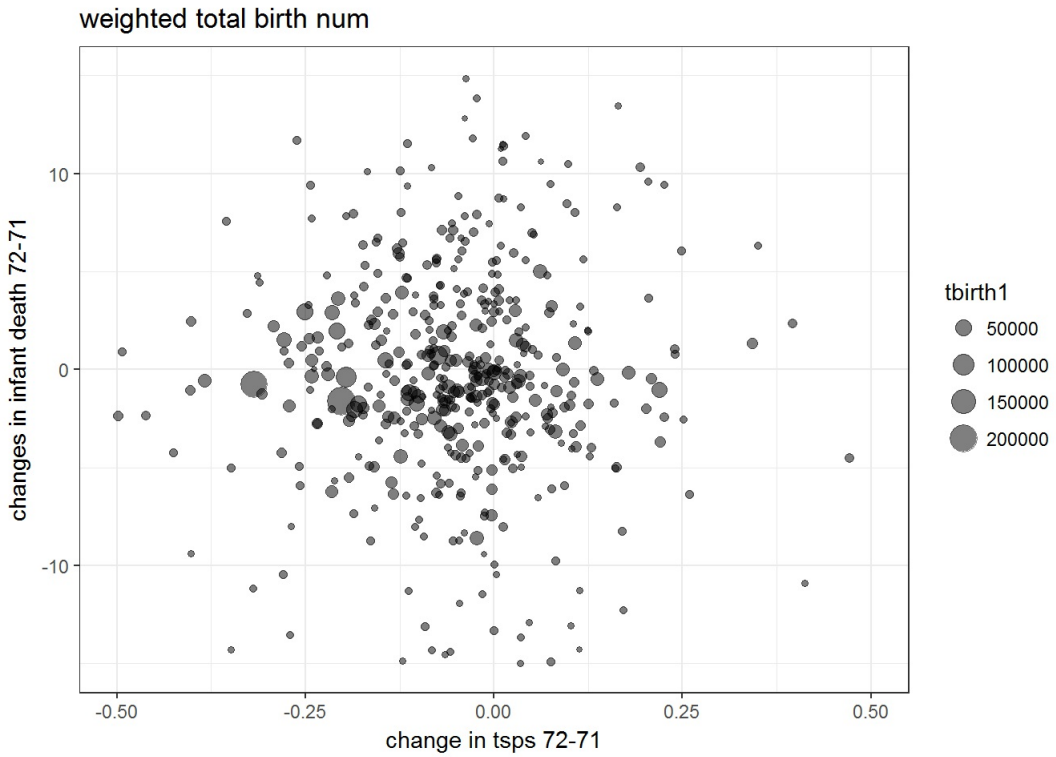
```
### 3.explore data
# graph analysis ------------------------------------------------- ##
library(splines)
# plot variable of interest
figure1 <- qplot(damtsp1, dimr7271, data = mydata,
                 xlab = 'change in tsps 72-71',
                 ylab = 'changes in infant death 72-71')
figure1
```



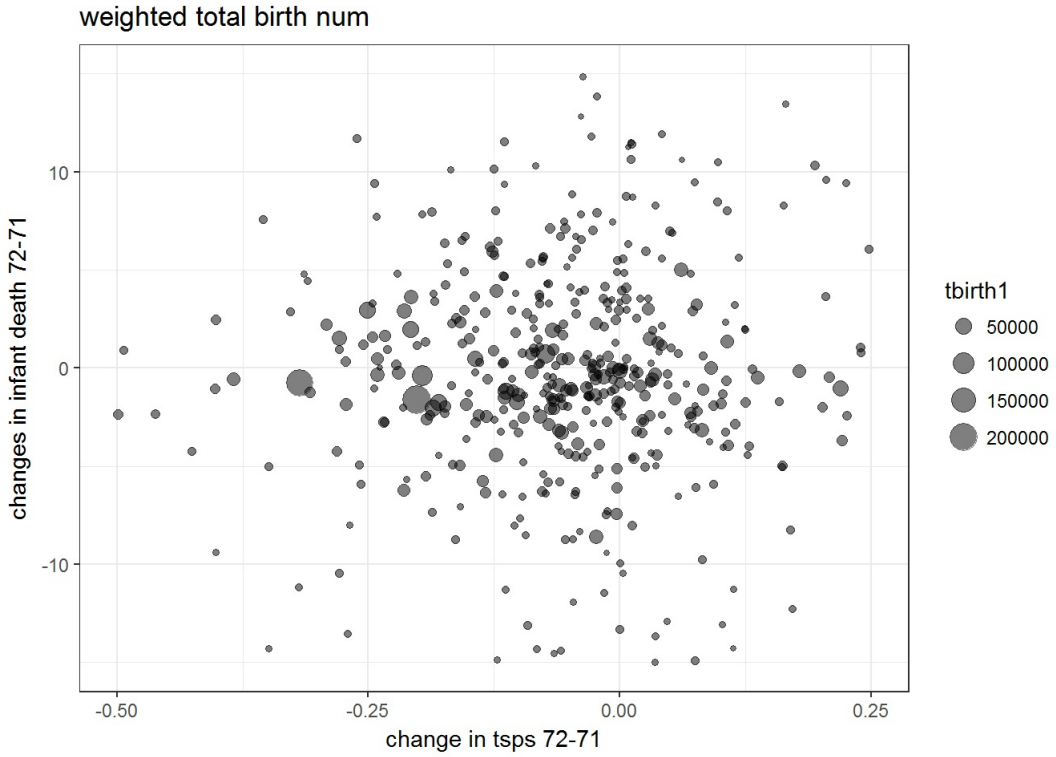

```
# plot with different size
figure2 <- qplot(damtsp1, dimr7271, data = mydata, weight = tbirth1,
                 size = tbirth1, alpha = I(1/2),
                 xlab = 'change in tsps 72-71',
                 ylab = 'changes in infant death 72-71',
                 main = 'weighted total birth num')
figure2
```



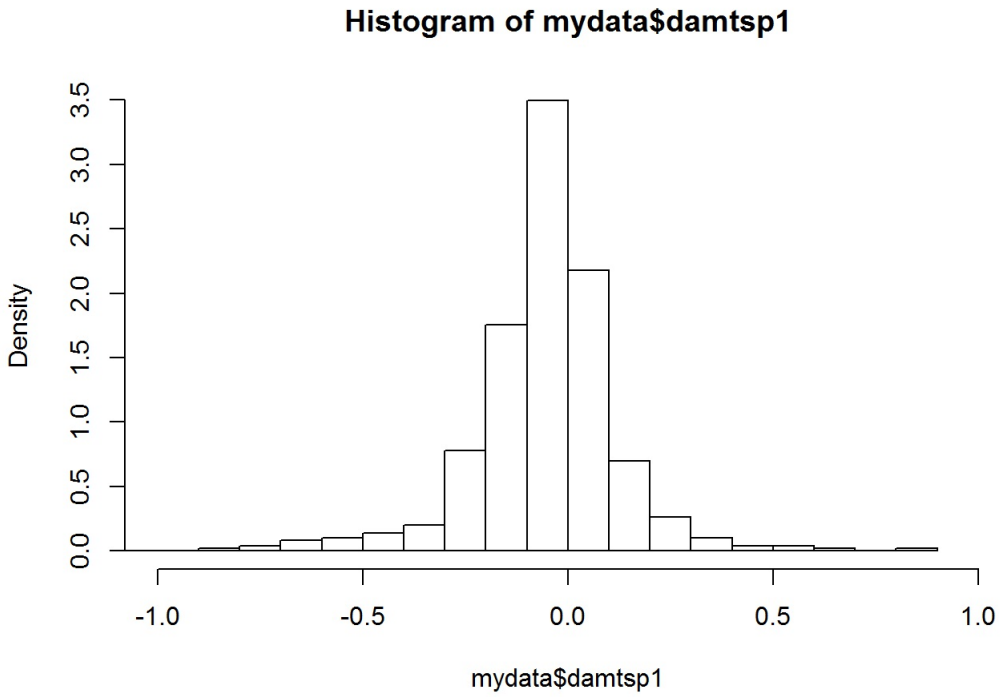

```
# zoom in
last_plot() + xlim(-0.5, 0.5) + ylim(-15, 15)
```



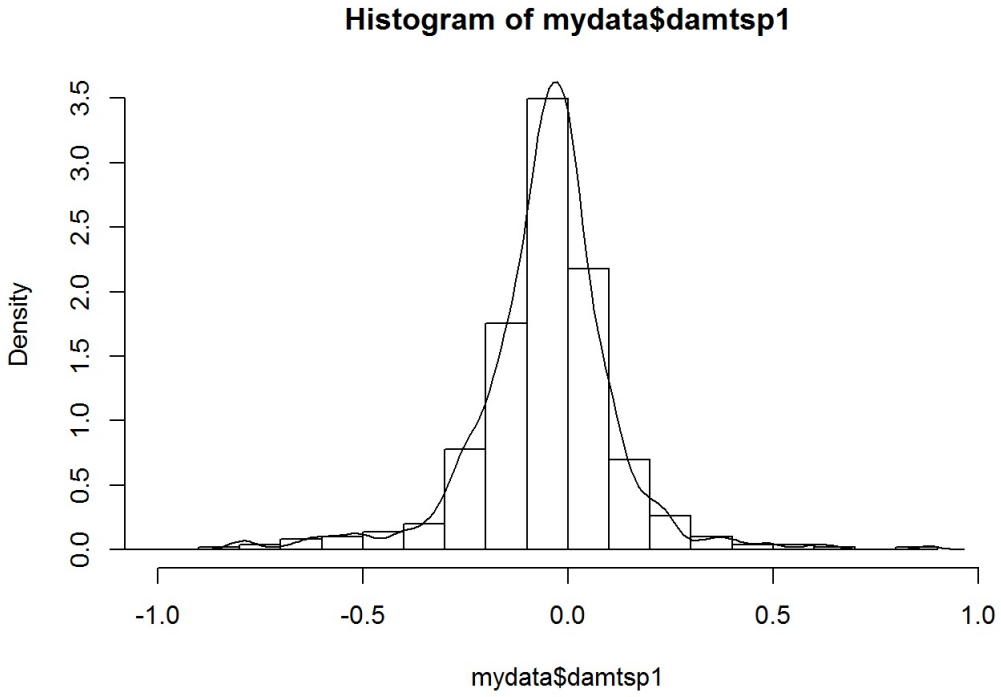

```
last_plot() + xlim(-0.5, 0.25)
```



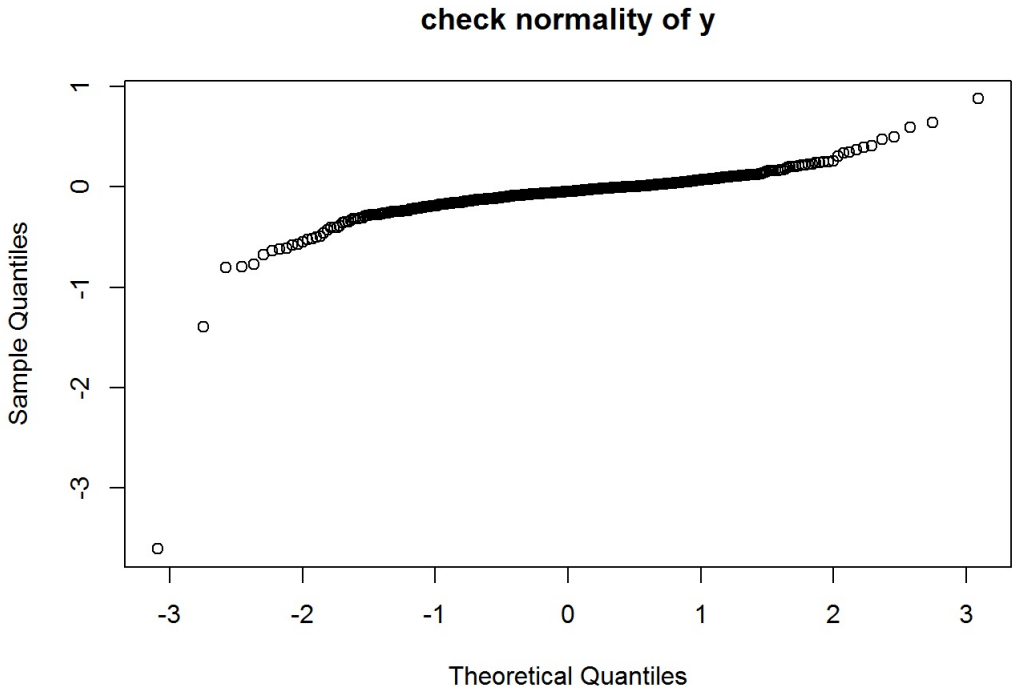

```
# check data distribution -----------------------------------------
# from plot
hist(x = mydata$damtsp1, breaks = 50, prob = TRUE,
     xlim = c(-1, 1))
```



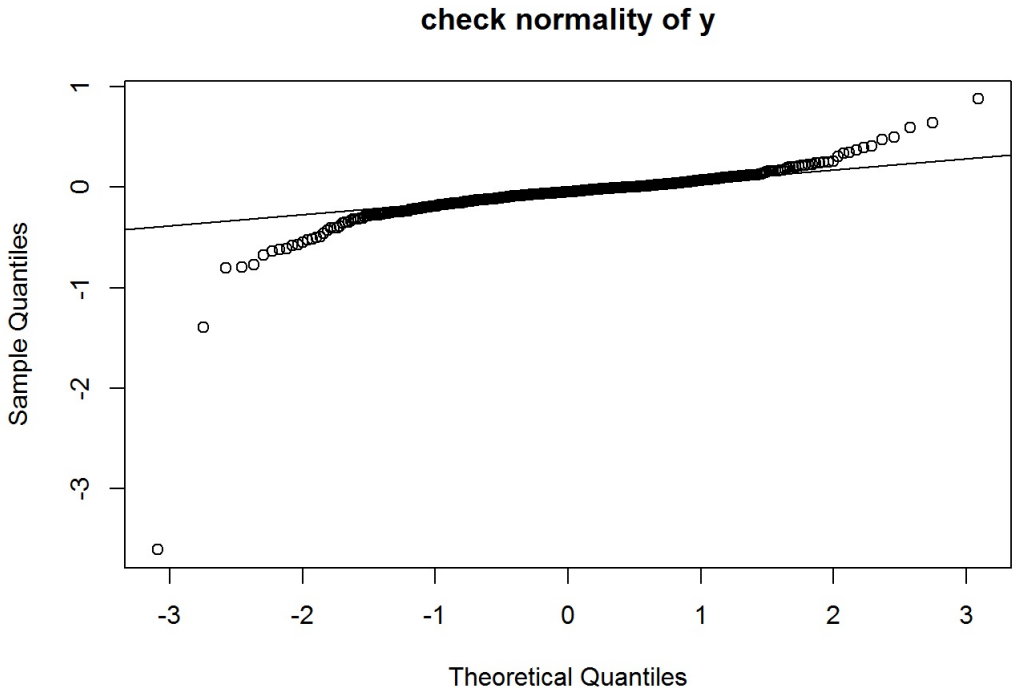

```
lines(density(mydata$damtsp1))
```




```
qqnorm(y = mydata$damtsp1, main = 'check normality of y')
```




```
qqline(y = mydata$damtsp1)
```




```
# from Kolmogorov-Smirnov test
sample_var = Biased_Var(x = mydata$damtsp1)
sample_mean = mean(mydata$damtsp1)
normal_data = dnorm(100, mean = sample_mean, sd = sqrt(sample_var))
ks.test(x = mydata$damtsp1, y = normal_data)
```

```
##
##  Two-sample Kolmogorov-Smirnov test
##
## data:  mydata$damtsp1 and normal_data
## D = 0.66, p-value = 0.8
## alternative hypothesis: two-sided
```

```
# p_value is big, it's good for sake of test goodness of fit

# principle component analysis ------------------------------------
for_pca_data = na.omit(mydata)
pca(df = for_pca_data)
```

```
## Standard deviations (1, .., p=48):
##  [1] 2.35866 2.00973 1.72891 1.61520 1.56649 1.47634 1.36263 1.36006
##  [9] 1.28684 1.24281 1.20095 1.14328 1.10406 1.06203 1.04883 1.00487
## [17] 0.98511 0.97612 0.94041 0.93563 0.91361 0.89802 0.88892 0.83433
## [25] 0.83239 0.80285 0.77841 0.74853 0.73997 0.71077 0.69936 0.66421
## [33] 0.66304 0.60799 0.58378 0.54657 0.51458 0.50842 0.47768 0.41057
## [41] 0.35534 0.31905 0.23322 0.20215 0.15300 0.13980 0.10518 0.09963
##
## Rotation (n x k) = (48 x 48):
##               PC1        PC2        PC3         PC4        PC5        PC6
## reg_tsp   0.04999 -0.0599632  0.031511 -9.477e-05  0.021578 -0.082192
## dimr7271  0.04035  0.0540383 -0.081844  5.203e-03 -0.113725 -0.266470
## damtsp1  -0.04309  0.0791839  0.045671 -6.413e-03  0.006679  0.002741
## tbirth1   0.03957 -0.0205140  0.033287 -4.708e-02  0.001699 -0.093338
## dwhite   -0.02692 -0.0650234 -0.150713  1.748e-01 -0.303822  0.214023
## dothr     0.01871  0.1031554  0.186219 -1.777e-01  0.360468 -0.173590
## dfemale  -0.00491 -0.0002602  0.030818 -1.580e-01  0.139005  0.016691
## dedudad  -0.05681 -0.0404503 -0.096973  7.853e-02  0.125778  0.138924
## dedumom  -0.02312 -0.0610682 -0.081831  7.107e-02  0.148497  0.153625
## dmaried  -0.07994  0.0418438 -0.172052  1.276e-01  0.089428  0.015394
## dagemom   0.25784 -0.2255764  0.197503  2.035e-01  0.168824 -0.029185
## dpcare0  -0.01488  0.1065404  0.001668 -7.360e-02  0.124735 -0.237220
## dpcare2   0.16697  0.0904345 -0.006402  7.169e-02 -0.102262  0.270479
## dpcare3   0.07044  0.1910639 -0.126999 -1.455e-01  0.065118  0.229563
## dpcare4   0.03586  0.1202672  0.072451 -2.343e-01 -0.046096 -0.182468
## dmedu1    0.13313  0.2589533  0.030336 -2.346e-01 -0.071676 -0.005885
## dmedu2    0.23426  0.1390175  0.058495  1.307e-01 -0.098469  0.125538
## dmedu3   -0.07825  0.0783813 -0.282773  4.479e-02  0.300080  0.053039
## ddedu1    0.11429  0.2106030  0.036840 -1.950e-01  0.029284 -0.121479
## ddedu2    0.25196  0.1400584 -0.029777  8.004e-02 -0.167336  0.104850
## ddedu3   -0.10087  0.0602788 -0.241515  6.939e-02  0.289776  0.074868
## dnhosp1  -0.05595  0.1338285  0.101769 -7.291e-02 -0.122735 -0.243954
## dphys1    0.02944 -0.1128960 -0.134229 -2.693e-02  0.075943  0.211529
## dmage1   -0.03696  0.0919528  0.095652 -1.156e-01  0.028154  0.019738
## dmage2   -0.13478  0.0521533  0.109096 -1.744e-01 -0.311016  0.181041
## dmage3   -0.04441  0.0987303 -0.327455  4.078e-02  0.081534 -0.145480
## dmage5    0.18308 -0.1532959  0.268809  1.166e-01  0.034947  0.004485
## dmage6    0.19822 -0.1679691  0.112524  5.339e-02 -0.056523  0.011492
## dmage7    0.01576 -0.0738316  0.066143  7.479e-02  0.030108  0.025112
## dagedad   0.21408 -0.2174906  0.146401  8.327e-02  0.138911 -0.079113
## dtwins    0.06136 -0.0210651  0.028139 -7.780e-02  0.056993 -0.229469
## dcare     0.02697  0.0362056  0.051850 -1.404e-01 -0.070139  0.056652
## ddead1    0.18833 -0.2097321 -0.244024 -1.257e-01  0.031915 -0.007096
## ddead2    0.19719 -0.1876988 -0.039540 -1.279e-01 -0.072461 -0.048901
## dllive    0.23481  0.3581112  0.039815  1.545e-01  0.052151  0.022447
## dlterm    0.23947 -0.1794105 -0.293715 -1.874e-01  0.030397 -0.076223
## dord2    -0.01065  0.2192024 -0.132303  1.233e-01 -0.012287 -0.162073
## dord3     0.27597 -0.1621120  0.089142  2.674e-02  0.084687  0.005972
## dpreg1    0.09584  0.0252830  0.042821 -4.018e-01  0.104020  0.277620
## dpreg2    0.20300  0.0626049 -0.232001  8.971e-04 -0.266097 -0.085192
## dpreg3    0.25016  0.2915416  0.021920  1.854e-01  0.169213 -0.005334
## dfdth1    0.11640 -0.0890054 -0.121249 -3.506e-01  0.058969  0.054031
## dfdth2    0.10137 -0.0923091 -0.307296 -7.177e-02 -0.001264 -0.070978
## dfdth3    0.25736 -0.1087909 -0.145675 -1.094e-01 -0.022177 -0.041986
## dintrv1   0.03287  0.1188799  0.182090 -2.255e-01  0.081657  0.327671
## dintrv2   0.17016  0.1133112 -0.109741  2.179e-02 -0.293066 -0.065827
## dintrv3   0.26170  0.2582791 -0.017020  1.707e-01  0.178284  0.071995
## dpcinc    0.03709  0.0010693  0.050096 -4.511e-02 -0.083226 -0.245771
##                PC7        PC8        PC9       PC10       PC11       PC12
## reg_tsp   0.1111914 -0.041473  0.121473 -0.061103  0.123573 -0.589911
## dimr7271 -0.0059587  0.257115 -0.026178  0.022675 -0.002346  0.125907
## damtsp1  -0.1308561  0.110642 -0.143360  0.157009 -0.058799  0.257748
## tbirth1   0.0706515 -0.042210  0.073971 -0.115742  0.119615 -0.477016
## dwhite    0.0975581  0.218892  0.187655  0.023079 -0.057621  0.025812
## dothr    -0.1518998 -0.118286 -0.158950 -0.061808 -0.014345 -0.037623
## dfemale   0.1068691  0.098699 -0.077713  0.071946 -0.292477 -0.020851
## dedudad  -0.0713997  0.168382 -0.408662  0.237763  0.342066 -0.132550
## dedumom  -0.0785179  0.135034 -0.434034  0.227113  0.246575 -0.182660
```

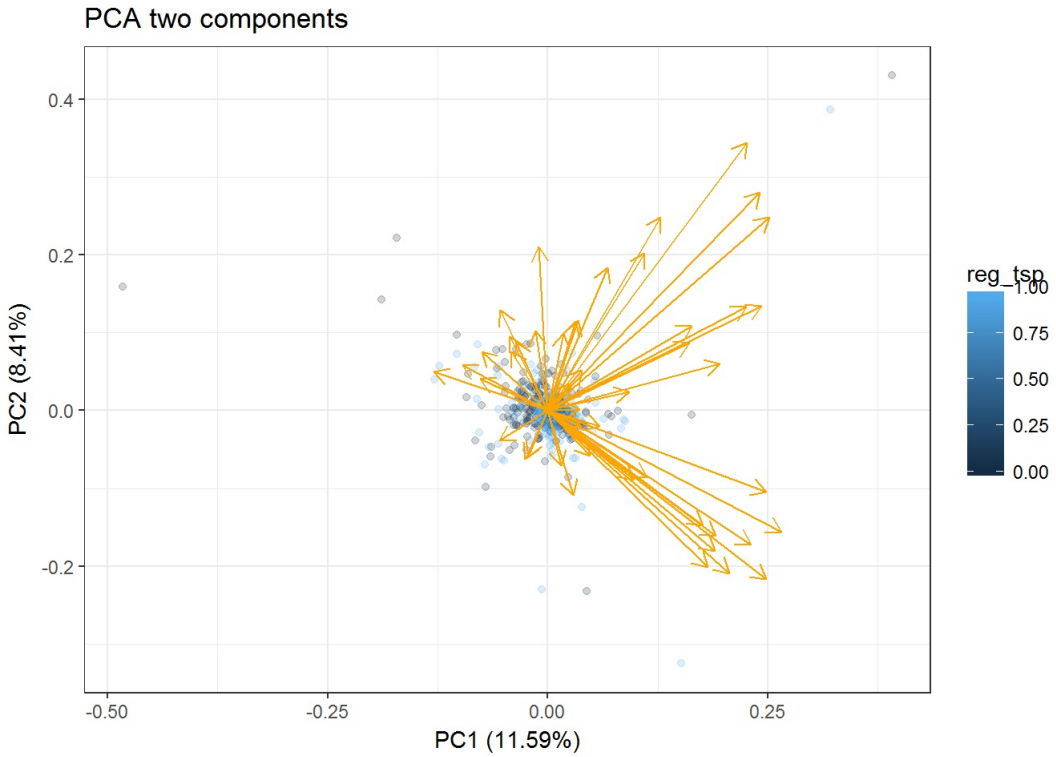
```
## dmaried   0.1117286 -0.009654  0.094224  0.166315 -0.224678 -0.204793
## dagemom   0.1249269  0.059240 -0.032867 -0.079660 -0.063931  0.051346
## dpcare0  -0.0579485 -0.023985 -0.142591  0.147606 -0.224028 -0.044596
## dpcare2   0.1412860  0.097587  0.167738  0.127149  0.032740 -0.024688
## dpcare3   0.1563763 -0.034172 -0.070562 -0.068264 -0.078878 -0.013888
## dpcare4  -0.0385089 -0.219304 -0.136308  0.200134  0.008180  0.055557
## dmedu1    0.1923417 -0.136052 -0.010681  0.105275  0.107107  0.052779
## dmedu2   -0.2184686  0.010349  0.089881  0.201272 -0.135699 -0.089758
## dmedu3    0.3139403 -0.021628  0.008713  0.034547  0.003208  0.086661
## ddedu1    0.1589468 -0.014459 -0.038089  0.048257 -0.205432 -0.109392
## ddedu2   -0.2344770 -0.084653  0.018943  0.223554 -0.047856 -0.044278
## ddedu3    0.2957699 -0.031928  0.077850  0.032454  0.015880  0.136651
## dnhosp1   0.1507314  0.163276  0.080128  0.073796  0.246841  0.060725
## dphys1   -0.1662014 -0.139472 -0.133548 -0.127822 -0.255958 -0.025421
## dmage1   -0.1020975 -0.150744  0.065826 -0.304148  0.222828  0.029473
## dmage2    0.1022589 -0.195295 -0.142298  0.250071 -0.070141 -0.017010
## dmage3   -0.3086399  0.139716  0.113174 -0.108156 -0.031699 -0.072573
## dmage5   -0.0163577 -0.007030  0.078834  0.025211  0.117679 -0.022077
## dmage6    0.0546486 -0.074446 -0.169950  0.010145 -0.038942  0.156833
## dmage7    0.1691588  0.006672 -0.086368 -0.013425 -0.374063 -0.199900
## dagedad   0.2536372  0.113191 -0.123666 -0.002868 -0.115235  0.025975
## dtwins    0.0367425  0.297497  0.116765  0.008657 -0.063449  0.190534
## dcare     0.1596198 -0.223347  0.109405 -0.045553 -0.021057 -0.006708
## ddead1   -0.1216564 -0.087072  0.010910 -0.022651 -0.069399  0.001900
## ddead2    0.0003757 -0.036728  0.078700  0.077560  0.165027  0.001610
## dllive    0.0422236  0.054295 -0.068800 -0.091761  0.028655  0.007276
## dlterm   -0.0632529 -0.078028  0.086311  0.109859  0.014469  0.015583
## dord2    -0.1522884  0.127614 -0.018513 -0.243357 -0.028475 -0.069845
## dord3     0.0504357 -0.025717 -0.017050 -0.106913  0.133685  0.128345
## dpreg1   -0.0412200  0.334333  0.076777 -0.090739  0.033794 -0.034495
## dpreg2    0.1683430  0.010021 -0.306427 -0.257319  0.034329 -0.005597
## dpreg3   -0.0671443 -0.059213  0.087958  0.075518  0.039258  0.016331
## dfdth1    0.0441957  0.294411  0.118397  0.144402  0.068343  0.009990
## dfdth2    0.1085811 -0.277145  0.023801 -0.013610  0.226647  0.054498
## dfdth3   -0.2439170 -0.036214  0.005747  0.026732 -0.162627 -0.040136
## dintrv1  -0.0947049  0.193925 -0.010641 -0.270797 -0.012366 -0.051549
## dintrv2   0.1478425  0.133176 -0.360366 -0.272067 -0.057305 -0.036702
## dintrv3   0.0340080 -0.067756  0.133725  0.101564  0.128469  0.041700
## dpcinc    0.0791172  0.226070  0.065319  0.261543 -0.014621 -0.202303
##                PC13       PC14        PC15       PC16       PC17       PC18
## reg_tsp   0.0246760  0.006156  0.0350057 -0.138155  0.021391  0.085470
## dimr7271 -0.0348820 -0.104379 -0.3892191  0.142198  0.205482 -0.016779
## damtsp1  -0.0551432  0.194446  0.3840080  0.104090  0.223447  0.339219
## tbirth1  -0.1465676  0.117865 -0.0749168  0.004828  0.318035 -0.126506
## dwhite    0.2444232 -0.098437 -0.0292830  0.105894 -0.029216  0.046239
## dothr    -0.1654528 -0.010977  0.0883239 -0.129886 -0.070728 -0.044121
## dfemale   0.1681527 -0.086755  0.2526739 -0.389635  0.326120 -0.105606
## dedudad   0.1376796 -0.121135 -0.0789920  0.010865  0.064237  0.059018
## dedumom   0.1508774 -0.182059 -0.0455697  0.006065 -0.055534  0.132564
## dmaried  -0.0584950 -0.208344  0.1354315  0.157488 -0.353568 -0.046835
## dagemom   0.0238643 -0.008800  0.0649289  0.038141 -0.029402  0.051243
## dpcare0   0.1028596  0.264035 -0.1441940  0.188987 -0.334037 -0.195555
## dpcare2   0.1498762  0.038902 -0.0168064 -0.272596  0.004675 -0.163056
## dpcare3  -0.2043113 -0.136302 -0.0160668 -0.008390  0.073680  0.188342
## dpcare4   0.3063762  0.056449 -0.0908949 -0.183155 -0.171971  0.010633
## dmedu1    0.0780083 -0.080729 -0.0879075  0.098727  0.178278 -0.061129
## dmedu2   -0.0009911 -0.033418  0.0449252 -0.211085 -0.046308 -0.069091
## dmedu3   -0.1103807  0.163823 -0.0112312  0.040158  0.005289 -0.116263
## ddedu1    0.1485919 -0.380130 -0.0003093  0.084067 -0.054587 -0.015997
## ddedu2   -0.0901983  0.139380  0.0957760 -0.065176  0.017060 -0.108392
## ddedu3   -0.0904054  0.025633 -0.1774025 -0.054643  0.022069 -0.014161
## dnhosp1  -0.0110183 -0.190230  0.2822569  0.073789 -0.093721 -0.058922
## dphys1    0.0892412  0.226143 -0.3955477 -0.101712  0.065295  0.122386
## dmage1    0.3263167 -0.047976 -0.0179375  0.141952  0.281421 -0.037130
## dmage2   -0.1067050  0.102834 -0.0626870  0.145809  0.095666 -0.027290
## dmage3    0.0781291 -0.155022 -0.0190109 -0.163098 -0.016276 -0.077350
## dmage5    0.0023379  0.132613 -0.0077347 -0.118930 -0.176978  0.193517
## dmage6   -0.1700206 -0.172846 -0.0769200  0.052776  0.139745 -0.178856
## dmage7    0.4136804  0.110885  0.1182500  0.342606  0.169525  0.046796
## dagedad   0.0160647  0.053150  0.0687162 -0.027505  0.025802  0.041397
## dtwins    0.2318974 -0.012669 -0.2393543 -0.271455  0.032335  0.110240
## dcare    -0.0071222 -0.185547 -0.1389573 -0.119814 -0.192809  0.638958
## ddead1   -0.1002838 -0.190262  0.1311288  0.139685  0.037495  0.077864
## ddead2    0.2120101  0.101953 -0.0864939  0.172723 -0.165157 -0.077394
## dllive    0.0054075  0.073326 -0.0298789  0.023770 -0.001380  0.037945
## dlterm    0.0132824 -0.009286  0.1154496 -0.006034  0.089201  0.057496
```

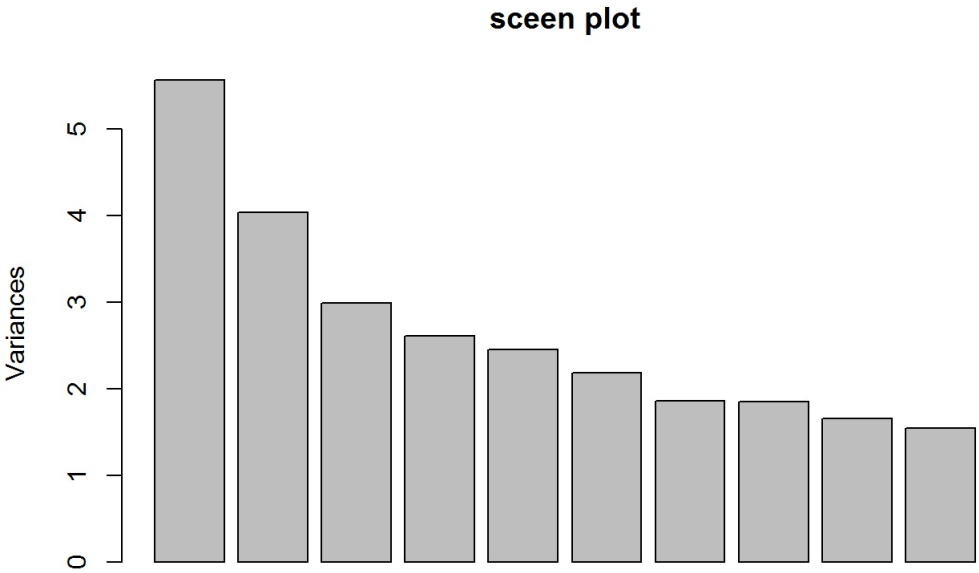
```
## dord2     0.1028937  0.152111  0.1521846  0.165340 -0.012553  0.275713
## dord3    -0.0181915 -0.143573 -0.0610221  0.132142 -0.089707 -0.117955
## dpreg1   -0.0287586  0.139728  0.0386869  0.103325 -0.134345 -0.032311
## dpreg2   -0.0205497  0.131595  0.0928507 -0.128992 -0.100420 -0.029070
## dpreg3    0.0028602 -0.001085 -0.0433959  0.124268  0.106295  0.079377
## dfdth1   -0.0412657  0.189910  0.0864167 -0.005620 -0.005827  0.045787
## dfdth2    0.1678860  0.231954  0.1884601 -0.012194 -0.044774 -0.001056
## dfdth3   -0.1169562 -0.214278 -0.0556727  0.161826  0.088470  0.021886
## dintrv1  -0.0119437 -0.005368 -0.0392720  0.144984 -0.180378 -0.091751
## dintrv2  -0.1216163  0.033611  0.0144586 -0.135423 -0.123944 -0.038682
## dintrv3   0.0512812  0.059794 -0.0373210  0.098972  0.056775  0.022190
## dpcinc   -0.2693197  0.205192 -0.2041783  0.098630  0.105963  0.193284
##                PC19        PC20        PC21       PC22       PC23       PC24
## reg_tsp    0.055322  0.0996367  3.086e-01 -0.062012 -0.201599  0.509352
## dimr7271 -0.352252 -0.1419765  1.067e-01 -0.121496  0.108254  0.105827
## damtsp1  -0.309105  0.1312527 -2.683e-01  0.137347 -0.235755  0.393738
## tbirth1  -0.154257  0.3346634 -4.268e-01  0.251970  0.163536 -0.181435
## dwhite    0.053758  0.2309129  7.589e-03  0.225004 -0.073334 -0.059965
## dothr     0.027565 -0.1641443  3.878e-03 -0.150623 -0.123131 -0.080378
## dfemale  -0.133379 -0.1676857  2.409e-01  0.327878  0.138009 -0.174100
## dedudad  -0.016033  0.0102369  4.114e-05  0.066603  0.060557 -0.012672
## dedumom   0.040728 -0.0051380  1.714e-02  0.002956  0.005643 -0.071024
## dmaried  -0.145418 -0.2695876 -2.933e-02  0.298690 -0.210981 -0.003858
## dagemom  -0.004275  0.0166167 -2.082e-02  0.013995  0.029099  0.012338
## dpcare0  -0.008066  0.1878328  3.371e-02  0.346870  0.044869  0.089967
## dpcare2   0.090668 -0.2597223 -1.639e-01 -0.096692 -0.119602  0.054538
## dpcare3  -0.271379  0.1802570  1.365e-01 -0.168088 -0.093438 -0.144324
## dpcare4   0.065593  0.0867280 -1.269e-01  0.001778  0.206363  0.076865
## dmedu1    0.099994 -0.0492369 -2.084e-01 -0.011127 -0.335017 -0.078407
## dmedu2   -0.178940  0.1137697  1.069e-01 -0.083885  0.248881  0.084871
## dmedu3   -0.058506 -0.0360459  5.387e-02  0.046505  0.130701  0.084167
## ddedu1   -0.043085  0.1789312 -5.050e-02 -0.116885 -0.255778 -0.054403
## ddedu2   -0.033835 -0.0897818 -1.435e-02  0.070071  0.095107  0.025691
## ddedu3   -0.058940  0.0395982  4.112e-02 -0.007968  0.196171  0.100932
## dnhosp1   0.022289  0.0883351  3.345e-02 -0.155854  0.378567 -0.035643
## dphys1    0.058348  0.0094742 -7.039e-02 -0.084687 -0.085325 -0.046269
## dmage1   -0.075980 -0.3361092  1.469e-01  0.333214  0.020816  0.087880
## dmage2    0.090063  0.0818719  2.485e-01  0.004002  0.024488 -0.074095
## dmage3    0.006445 -0.0642670 -3.210e-01 -0.103404  0.042879  0.136068
## dmage5   -0.281741  0.0174499  8.990e-02  0.052527 -0.076345 -0.338850
## dmage6    0.307443  0.0371419  7.223e-02  0.164418  0.030901  0.372189
## dmage7   -0.010044 -0.1052107 -1.338e-01 -0.316498  0.244193 -0.005637
## dagedad   0.100333 -0.0031181 -8.302e-02 -0.125899  0.010403  0.078181
## dtwins    0.035593  0.3042677  1.663e-01  0.114333 -0.160415  0.001372
## dcare     0.027085 -0.1606844 -1.875e-01  0.191621  0.321473  0.150464
## ddead1    0.159695  0.1065349  3.541e-02  0.132178  0.111915 -0.108865
## ddead2   -0.308667 -0.1850238  2.172e-02 -0.110701 -0.086681  0.044204
## dllive    0.066763  0.0008828  4.306e-02  0.053867  0.055725 -0.015264
## dlterm    0.009450  0.0329741  9.312e-02 -0.063583 -0.011807 -0.014918
## dord2     0.286768 -0.0073262  2.162e-01  0.025769 -0.035803 -0.199934
## dord3    -0.061531  0.0104563 -1.399e-01  0.193432 -0.031060 -0.092629
## dpreg1    0.063459 -0.0042180 -2.902e-03  0.013328  0.085394  0.069062
## dpreg2   -0.069429 -0.0443298  9.837e-03  0.025858  0.003211  0.004577
## dpreg3    0.130021  0.0442739  7.138e-02  0.007925  0.036378 -0.028539
## dfdth1    0.272685 -0.0910746 -1.302e-01  0.021358 -0.013168 -0.067831
## dfdth2   -0.134968  0.1188356  1.590e-01 -0.057203 -0.008677  0.010449
## dfdth3   -0.060856 -0.0424632  1.085e-01 -0.028270  0.079551  0.010352
## dintrv1  -0.166054  0.1043540  1.085e-01 -0.001126  0.121805  0.171011
## dintrv2  -0.022127 -0.1225218 -7.113e-02  0.063070 -0.013166  0.010132
## dintrv3   0.062309  0.0367116  3.147e-03  0.023197 -0.001337  0.005775
## dpcinc    0.040357 -0.3050481  8.090e-02  0.070508 -0.004039 -0.061149
##                PC25        PC26       PC27        PC28        PC29       PC30
## reg_tsp    0.110489  0.2361789 -0.119733 -0.1581980 -0.0760284  0.042213
## dimr7271 -0.246551  0.1795101  0.138188 -0.1103873 -0.3741152  0.280349
## damtsp1   0.007911 -0.0299167 -0.183815  0.0839016 -0.0193005  0.028431
## tbirth1  -0.253771 -0.1618124  0.023517  0.0219387  0.0657045  0.040340
## dwhite    0.091872  0.1947405 -0.004546  0.0523930 -0.0361173 -0.045259
## dothr    -0.016752 -0.1808041  0.026112 -0.0445083 -0.1221366  0.031044
## dfemale  -0.116138  0.2809763  0.017330  0.0694830 -0.0928012 -0.226251
## dedudad   0.019499  0.0006693  0.046400  0.0342300  0.0523198 -0.123733
## dedumom  -0.008554 -0.1234659  0.019213 -0.0474881 -0.0803546  0.112560
## dmaried  -0.324780 -0.1175841 -0.062008 -0.0340036  0.1379808  0.311913
## dagemom   0.025306  0.0183285  0.056837  0.0424483  0.0028061  0.047698
## dpcare0   0.326541  0.0123783  0.311706  0.0520810 -0.1781743 -0.049071
## dpcare2  -0.011083 -0.3081600 -0.078444  0.1721118 -0.3140519 -0.022196
## dpcare3   0.141409  0.0392396  0.338156  0.0152780  0.2292207 -0.067054
```

```
## dpcare4  -0.188534  0.2147366 -0.336339 -0.0269401  0.1407449  0.013237
## dmedu1    0.051956  0.0637836 -0.008365 -0.1688846 -0.1541115 -0.070403
## dmedu2    0.120139 -0.1756472  0.076657  0.1371007  0.1701337  0.082894
## dmedu3   -0.048369  0.0349851 -0.141537 -0.1135725 -0.0001874 -0.024985
## ddedu1    0.032802 -0.0055534 -0.031404  0.3360416  0.0136948  0.064745
## ddedu2   -0.019385  0.0279231  0.084048 -0.2800717 -0.0096092  0.104494
## ddedu3    0.129205 -0.1430778 -0.254697  0.0069016  0.0987292 -0.005511
## dnhosp1   0.058110  0.0596121 -0.110564  0.2437959  0.0579929  0.263032
## dphys1   -0.052689  0.2057097 -0.160816  0.3605818  0.0709016  0.332669
## dmage1    0.257969 -0.1691282  0.041481  0.0878421  0.2119890  0.292501
## dmage2   -0.113944 -0.1614154 -0.076464 -0.1007419 -0.0715602  0.016474
## dmage3    0.060953  0.0135861  0.124166  0.0589327 -0.0723717 -0.189054
## dmage5    0.049171  0.0335745 -0.073011  0.0035503 -0.1682353  0.159390
## dmage6   -0.257783 -0.1191405  0.236139  0.2342499  0.0787104 -0.025869
## dmage7    0.127559 -0.1820027  0.018679 -0.1942358 -0.0438298 -0.014534
## dagedad  -0.114609  0.0640092  0.095878  0.0161394  0.0676093  0.065238
## dtwins   -0.058026 -0.4679063 -0.067176 -0.2620220  0.1338819  0.032306
## dcare    -0.049600 -0.0526505  0.220457 -0.0685678 -0.1228950 -0.098588
## ddead1    0.106670 -0.1026401 -0.254451  0.0407448 -0.3003537  0.019139
## ddead2   -0.233739  0.0125047  0.034976  0.0561908  0.3469875 -0.387711
## dllive   -0.025772  0.0305348 -0.057652 -0.0580392  0.0564637  0.003710
## dlterm    0.018138 -0.0421808  0.082059 -0.0261807 -0.0359793  0.090231
## dord2    -0.355024 -0.0400727 -0.003986  0.0627080 -0.0052720 -0.148708
## dord3     0.154068  0.1404738 -0.184651 -0.1011633 -0.0786306 -0.133201
## dpreg1   -0.088918  0.0319717  0.012995 -0.0064096 -0.0236666  0.069037
## dpreg2    0.075083 -0.0868299 -0.032320  0.0004286 -0.0074656  0.047313
## dpreg3   -0.029411  0.0931340 -0.011338 -0.0291907  0.0344137 -0.018864
## dfdth1    0.070491  0.1423317  0.190101 -0.1130373  0.1941429  0.256486
## dfdth2   -0.117595 -0.1435221  0.162684  0.2322412 -0.2347129  0.022144
## dfdth3    0.060777 -0.0562661 -0.269051 -0.1569954  0.1435242 -0.084095
## dintrv1  -0.151932 -0.0923162 -0.156186  0.0810456 -0.2110700 -0.151476
## dintrv2   0.111415  0.0086095 -0.109205 -0.0788187  0.1058206  0.018255
## dintrv3  -0.062737  0.1200822  0.009832  0.0810720 -0.0260319 -0.003706
## dpcinc    0.217315 -0.1085066 -0.155664  0.3778030  0.0206117 -0.234197
##                PC31       PC32       PC33       PC34       PC35       PC36
## reg_tsp    0.071928  0.124813  0.034140 -0.0236907 -0.025694 -0.048055
## dimr7271 -0.017578  0.034983  0.180804 -0.0098919 -0.088058  0.108469
## damtsp1  -0.016153  0.134871  0.012943  0.0004386 -0.045994  0.002638
## tbirth1  -0.053626  0.072716  0.001906  0.0644650 -0.057425  0.058876
## dwhite   -0.089380 -0.082817  0.007408  0.2389856 -0.061835  0.155150
## dothr    -0.007527  0.107405  0.044755  0.0967066 -0.038565  0.254825
## dfemale  -0.014495  0.101536 -0.079365 -0.1186734  0.011921 -0.068390
## dedudad   0.176009  0.019154  0.170766  0.0474577  0.549251  0.178481
## dedumom  -0.203387 -0.030131 -0.239486 -0.0466693 -0.518678 -0.187412
## dmaried   0.226644 -0.034444  0.070023 -0.0659654  0.122093 -0.035623
## dagemom  -0.032224 -0.077804 -0.001944  0.1889489 -0.003462 -0.002382
## dpcare0   0.002357  0.260489 -0.011136  0.1404799 -0.016513 -0.033715
## dpcare2   0.109802  0.320615  0.065557  0.3023816 -0.116429  0.176265
## dpcare3   0.420767  0.016474  0.138821  0.2795756 -0.200975 -0.050841
## dpcare4   0.141783 -0.243778  0.294360  0.2876060 -0.150023  0.065874
## dmedu1    0.031001 -0.036735 -0.033229  0.0153507  0.136855 -0.402312
## dmedu2   -0.100764 -0.005755  0.212143 -0.2512720 -0.083863  0.022237
## dmedu3   -0.092621 -0.115046 -0.343331  0.2361120 -0.077049  0.082347
## ddedu1   -0.358957 -0.150213 -0.030467 -0.1058436  0.025251  0.099561
## ddedu2    0.119575 -0.258764 -0.172714  0.0521936 -0.070385 -0.211876
## ddedu3   -0.229396  0.129977  0.383421 -0.0783407  0.008767 -0.313817
## dnhosp1   0.245025  0.300116 -0.301342  0.0710059  0.053905 -0.174677
## dphys1    0.188139  0.191633 -0.247560 -0.0974241  0.062807 -0.090506
## dmage1   -0.013979 -0.091156  0.066325  0.1228549 -0.071197 -0.016729
## dmage2   -0.031857  0.192481  0.024912 -0.1386880  0.080972 -0.041613
## dmage3    0.050317 -0.048871 -0.025330 -0.0136247  0.127127 -0.340951
## dmage5   -0.193739  0.024670  0.094880  0.2171159  0.241881 -0.366964
## dmage6   -0.004844  0.007486  0.047831  0.1195965  0.035645 -0.226806
## dmage7    0.113685 -0.017205  0.030432 -0.0698346  0.070794 -0.051285
## dagedad   0.064091 -0.137638  0.050729  0.0415675  0.002818 -0.058173
## dtwins    0.217832 -0.031344 -0.197221 -0.1007782  0.050637 -0.009784
## dcare    -0.067310  0.081660 -0.136796 -0.0685727  0.054532  0.070198
## ddead1    0.153150 -0.010593  0.206362 -0.0247573 -0.119621 -0.040312
## ddead2   -0.086897  0.275365 -0.063860 -0.0500281 -0.132050 -0.076999
## dllive   -0.025095  0.032579 -0.031163 -0.0988066  0.073520  0.053787
## dlterm   -0.089649  0.041675 -0.002160  0.1065402  0.058912  0.017009
## dord2    -0.001486  0.172095  0.212473  0.0931052 -0.143223 -0.149697
## dord3     0.319173  0.126918  0.056157 -0.3740962 -0.197672  0.077122
## dpreg1   -0.045986 -0.083202  0.030780 -0.0498628  0.062582 -0.009995
## dpreg2   -0.057321 -0.030602 -0.024158 -0.0734211  0.085676  0.063824
## dpreg3   -0.042352  0.056149 -0.101063 -0.0267172  0.089867  0.112151
```

```
## dfdth1   -0.133650  0.080811  0.148329 -0.1113439 -0.001919  0.074559
## dfdth2    0.076770 -0.243669 -0.063373 -0.1561250  0.099579  0.074941
## dfdth3   -0.161116  0.142068 -0.204251  0.2954895  0.192453  0.121032
## dintrv1   0.045816 -0.198642 -0.071061  0.0312787  0.067910 -0.098389
## dintrv2  -0.091694  0.050370  0.025417 -0.0009129  0.018991 -0.001600
## dintrv3   0.008719  0.002440 -0.028728 -0.1418896  0.012848  0.115510
## dpcinc    0.137534 -0.324747 -0.044802 -0.0181417 -0.066290 -0.013054
##               PC37       PC38      PC39      PC40       PC41      PC42
## reg_tsp   0.053870  0.0119416  0.053182 -0.021753  0.042633  0.002258
## dimr7271  0.020073 -0.0140045  0.037465  0.006802  0.042285  0.007368
## damtsp1   0.027321  0.0265914  0.005919 -0.034093  0.003241  0.012552
## tbirth1  -0.043000 -0.0091854  0.009473 -0.005885 -0.016873  0.003863
## dwhite   -0.221121  0.0001825  0.283680 -0.457478  0.023532 -0.101229
## dothr    -0.166907 -0.0062765  0.387218 -0.453427  0.050070 -0.187227
## dfemale  -0.083339  0.0537710 -0.004255  0.028649  0.033558 -0.018007
## dedudad   0.132737 -0.1904359  0.138436  0.057262 -0.043146  0.000159
## dedumom  -0.140654  0.1342260 -0.101365 -0.010028  0.022344  0.038956
## dmaried  -0.109660  0.0959208 -0.051642 -0.008473 -0.020936 -0.005962
## dagemom  -0.061322  0.0772888  0.225942  0.264448 -0.015983 -0.030925
## dpcare0  -0.057494 -0.0878274 -0.099155  0.077698  0.001285  0.040524
## dpcare2   0.067417 -0.0191458 -0.107724  0.108661 -0.012240  0.133792
## dpcare3   0.040164  0.1114523 -0.071626 -0.008371  0.058698  0.010926
## dpcare4   0.015765  0.1837298 -0.065999 -0.008176 -0.021349  0.018200
## dmedu1   -0.198179 -0.1284736  0.144383  0.095045  0.054128  0.054416
## dmedu2    0.080832 -0.1356934  0.099256 -0.047002  0.014275  0.094672
## dmedu3    0.510489 -0.0932140  0.083409 -0.106170 -0.002221  0.015839
## ddedu1    0.304950 -0.1301241  0.090118  0.050690 -0.045654  0.079179
## ddedu2    0.055087 -0.2929909  0.327183  0.018210 -0.040855  0.007746
## ddedu3   -0.267627 -0.0567263  0.174226 -0.030473 -0.045900  0.046466
## dnhosp1  -0.071384 -0.0459338  0.097759 -0.042372 -0.006422 -0.033935
## dphys1   -0.023929 -0.0712726  0.141081 -0.016950 -0.011368 -0.011572
## dmage1    0.079624 -0.1143319 -0.101133 -0.110348 -0.021584 -0.001790
## dmage2    0.160475  0.0371758 -0.181972 -0.349095 -0.065454 -0.030554
## dmage3    0.164506  0.1609938 -0.176040 -0.344604  0.022620 -0.021499
## dmage5    0.260561  0.1840019 -0.075105 -0.148993  0.065068 -0.027263
## dmage6    0.129858  0.2920401  0.150246 -0.070765  0.060154 -0.025297
## dmage7    0.068481  0.2336046  0.119364 -0.025861  0.010957 -0.080236
## dagedad  -0.150409 -0.5362188 -0.426399 -0.343140 -0.006065  0.132536
## dtwins    0.042525  0.0047964  0.020618  0.017963  0.032421 -0.101400
## dcare     0.018264 -0.0856278  0.066649 -0.014761 -0.013707  0.017028
## ddead1    0.140034 -0.2246437 -0.066658  0.094825  0.312190 -0.353671
## ddead2    0.025976 -0.1417343  0.079797 -0.030034  0.116459 -0.235392
## dllive   -0.053628  0.0964204 -0.031993 -0.064397  0.163061  0.202389
## dlterm   -0.086759  0.0544757 -0.049774  0.018764 -0.744103 -0.097394
## dord2     0.141058 -0.1633689  0.145406  0.047278 -0.105998  0.216913
## dord3     0.190932  0.1043828  0.101458 -0.183518 -0.224295  0.332270
## dpreg1   -0.009248  0.0764722 -0.004821 -0.017068 -0.001357  0.028400
## dpreg2   -0.062261  0.0948433 -0.007478 -0.031176  0.020647 -0.030620
## dpreg3   -0.084965  0.1590909 -0.162324 -0.055580 -0.134057 -0.071744
## dfdth1    0.110811  0.1237282  0.049443  0.011048  0.201265  0.065520
## dfdth2   -0.158812  0.1160705  0.043866 -0.055823  0.221790  0.250359
## dfdth3   -0.191196  0.0555029 -0.119455  0.005790  0.244869  0.347339
## dintrv1  -0.128493 -0.0457106 -0.038115  0.039633 -0.149414 -0.056866
## dintrv2   0.019398  0.0072846 -0.042340  0.036250 -0.080974 -0.262799
## dintrv3  -0.047294  0.0654929 -0.199695  0.021731  0.089775 -0.465871
## dpcinc   -0.054845  0.0872342  0.032833 -0.050438 -0.057262  0.009894
##               PC43       PC44       PC45       PC46       PC47       PC48
## reg_tsp   0.016976 -0.0017310 -0.0099572 -0.0019641  2.966e-03  0.0068550
## dimr7271 -0.006892 -0.0020171 -0.0254470 -0.0250233  6.086e-03  0.0039393
## damtsp1   0.012697 -0.0104124  0.0037542 -0.0080592  3.309e-04 -0.0022148
## tbirth1   0.012116 -0.0062660 -0.0022265 -0.0041322 -3.815e-03 -0.0028279
## dwhite   -0.060776  0.0024948  0.0102036 -0.0103353 -1.228e-02 -0.0146633
## dothr    -0.026744  0.0284447  0.0039413  0.0079682 -7.148e-03 -0.0153577
## dfemale   0.030464 -0.0009976  0.0055896 -0.0050400  8.827e-03 -0.0058211
## dedudad   0.020144  0.0019811  0.0030534  0.0014616 -6.737e-04 -0.0015660
## dedumom  -0.019250  0.0213254 -0.0002266  0.0002453 -4.562e-03  0.0009012
## dmaried  -0.068689  0.0185197 -0.0320987 -0.0306482  2.238e-02 -0.0046405
## dagemom   0.066583 -0.0200048 -0.7235875 -0.0401927  1.005e-01  0.0685402
## dpcare0   0.012612  0.0108176  0.0202206  0.0133682 -6.652e-03  0.0059027
## dpcare2   0.104121 -0.0438704  0.0263245 -0.0137417  7.945e-05 -0.0102149
## dpcare3   0.064562 -0.0194598  0.0048424  0.0090492  8.244e-03  0.0082166
## dpcare4  -0.010067  0.0149145 -0.0338220 -0.0038697  1.952e-02  0.0046969
## dmedu1   -0.364412  0.2065448 -0.0818876 -0.1037497 -6.380e-03  0.0191530
## dmedu2   -0.433530  0.2792127 -0.0888728 -0.1319216 -2.734e-02 -0.0012681
## dmedu3   -0.253266  0.1201712 -0.0342929 -0.0624400 -6.033e-04 -0.0109536
## ddedu1    0.265312 -0.1054539  0.0406468  0.0542725  1.218e-02  0.0100820
```

```
## ddedu2    0.427717 -0.1393615  0.0914631  0.0805079  1.591e-02  0.0072424
## ddedu3    0.265731 -0.0560426  0.0405396  0.0231594  3.110e-03  0.0084263
## dnhosp1   0.018094  0.0101019  0.0009497  0.0106603 -2.724e-03 -0.0077557
## dphys1   -0.032362 -0.0015660 -0.0159504 -0.0170563  5.331e-03 -0.0099414
## dmage1    0.031630  0.0022346 -0.0694248 -0.0062682  6.188e-03 -0.0003667
## dmage2    0.142025 -0.0350325 -0.4374939  0.0279431  5.792e-02  0.0067010
## dmage3    0.081267 -0.0362704 -0.2973591  0.0153048  4.595e-02  0.0087406
## dmage5   -0.013239  0.0199208  0.1904347  0.0104213 -2.395e-02 -0.0226185
## dmage6   -0.041185  0.0206723  0.2402444  0.0248176 -3.307e-02 -0.0180312
## dmage7   -0.008344  0.0225567  0.1754453  0.0217625 -4.633e-02 -0.0317758
## dagedad   0.008884  0.0237997  0.0469137 -0.0092601  2.978e-03 -0.0070404
## dtwins    0.040621  0.0131698  0.0069442 -0.0061637 -1.750e-02 -0.0031735
## dcare     0.005341  0.0273499  0.0043073  0.0051064 -4.496e-03 -0.0038263
## ddead1   -0.125596 -0.2176924  0.0145835 -0.1048918  4.383e-02  0.0441316
## ddead2   -0.026004 -0.1805127 -0.0050530 -0.0673098  5.550e-02  0.0278135
## dllive   -0.308472 -0.6392927 -0.0445379  0.3486644 -5.956e-02 -0.0168035
## dlterm   -0.193531 -0.1325304  0.0224337  0.1877876 -3.741e-02 -0.0244718
## dord2     0.031471  0.2123509 -0.0243838  0.0343595 -1.555e-02 -0.0131407
## dord3     0.096231  0.1250681  0.0218152  0.0316531 -2.950e-02 -0.0278492
## dpreg1    0.043242  0.0199675 -0.0052027 -0.0806753 -3.290e-01  0.6213642
## dpreg2    0.011985  0.1423184  0.1018431  0.0448269  6.093e-01  0.3379833
## dpreg3    0.131882 -0.1187006  0.0889409 -0.7159289  1.370e-01  0.0119070
## dfdth1    0.047222  0.0258847 -0.0274621 -0.0154443  2.323e-01 -0.4232959
## dfdth2    0.098393  0.0118068 -0.0684116 -0.1176862 -2.500e-01 -0.1615961
## dfdth3    0.093439  0.2340404 -0.0027582  0.1111754 -7.139e-02 -0.0351336
## dintrv1  -0.027043  0.0276433  0.0125007  0.0113417  2.582e-01 -0.4453599
## dintrv2   0.062701  0.0437338 -0.0691759 -0.1770601 -5.238e-01 -0.2857532
## dintrv3   0.150673  0.4012392 -0.0179004  0.4442507 -7.518e-02 -0.0052087
## dpcinc   -0.020364 -0.0005880 -0.0039346  0.0181628  8.962e-03 -0.0008527
```






```
# regression analysis ------------------------------------------------ ##
attach(mydata)
# regression with variables of interest:
# infant mortality against air quality
model1 <- lm(dimr7271 ~ damtsp1, data = mydata)
summary(model1)
```

```
##
## Call:
## lm(formula = dimr7271 ~ damtsp1, data = mydata)
##
## Residuals:
##    Min     1Q Median     3Q    Max
## -56.17  -2.92   0.41   4.00  54.84
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)   -0.986      0.424   -2.32    0.021 *
## damtsp1       -0.134      1.692   -0.08    0.937
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 9.18 on 499 degrees of freedom
## Multiple R-squared:  1.26e-05,   Adjusted R-squared:  -0.00199
## F-statistic: 0.00627 on 1 and 499 DF,  p-value: 0.937
```

```
# adding other features
model2 <- lm(dimr7271 ~ damtsp1 + dwhite + dothr + dfemale
             + dedudad + dedumom + dmaried + dagemom + dpcare0
             + dpcare2 + dpcare3 + dpcare4, data = mydata)
summary(model2)
```

```
##
## Call:
## lm(formula = dimr7271 ~ damtsp1 + dwhite + dothr + dfemale +
##     dedudad + dedumom + dmaried + dagemom + dpcare0 + dpcare2 +
##     dpcare3 + dpcare4, data = mydata)
##
## Residuals:
##    Min     1Q Median     3Q    Max
## -45.49  -2.77   0.43   4.12  58.42
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  -0.4449     0.4627   -0.96  0.33673
## damtsp1       0.0933     1.6549    0.06  0.95508
## dwhite       72.0755    20.2468    3.56  0.00041 ***
## dothr         1.2672    36.8264    0.03  0.97256
## dfemale      -1.3054    12.8546   -0.10  0.91916
## dedudad       0.2136     0.6071    0.35  0.72518
## dedumom      -0.7960     0.6774   -1.18  0.24056
## dmaried      -3.4803    12.3159   -0.28  0.77761
## dagemom      -1.2559     0.9849   -1.28  0.20285
## dpcare0      81.1035    38.7828    2.09  0.03704 *
## dpcare2     -10.3806    10.0779   -1.03  0.30352
## dpcare3      -3.5623    10.1376   -0.35  0.72545
## dpcare4      17.4401    24.4480    0.71  0.47598
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 8.87 on 476 degrees of freedom
##   (12 observations deleted due to missingness)
## Multiple R-squared:  0.0595, Adjusted R-squared:  0.0358
## F-statistic: 2.51 on 12 and 476 DF,  p-value: 0.00329
```

```
## Clean Air Act ------------------------------------------- ##
# tsp is a binary variable
# Air quality with tsp
model3 <- lm(damtsp1 ~ reg_tsp, data = mydata)
summary(model3)
```

```
##
## Call:
## lm(formula = damtsp1 ~ reg_tsp, data = mydata)
##
## Residuals:
##    Min     1Q Median     3Q    Max
## -3.498 -0.066  0.013  0.091  0.985
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  -0.0154     0.0157   -0.98     0.33
## reg_tsp      -0.0907     0.0214   -4.24  2.6e-05 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.239 on 499 degrees of freedom
## Multiple R-squared:  0.0348, Adjusted R-squared:  0.0329
## F-statistic:   18 on 1 and 499 DF,  p-value: 2.62e-05
```

```
# adding other features
model3.2 <- lm(damtsp1 ~ reg_tsp + dwhite + dothr + dfemale
               + dedudad + dedumom + dmaried + dagemom + dpcare0
               + dpcare2 + dpcare3 + dpcare4, data = mydata)
summary(model3.2)
```

```
##
## Call:
## lm(formula = damtsp1 ~ reg_tsp + dwhite + dothr + dfemale + dedudad +
##     dedumom + dmaried + dagemom + dpcare0 + dpcare2 + dpcare3 +
##     dpcare4, data = mydata)
##
## Residuals:
##    Min     1Q Median     3Q    Max
## -3.450 -0.069  0.013  0.092  0.936
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept) -0.02400    0.01731   -1.39     0.17
## reg_tsp     -0.08714    0.02206   -3.95    9e-05 ***
## dwhite       0.01968    0.55197    0.04     0.97
## dothr        0.78063    1.00363    0.78     0.44
## dfemale      0.38209    0.34990    1.09     0.28
## dedudad      0.01806    0.01653    1.09     0.27
## dedumom     -0.00648    0.01846   -0.35     0.73
## dmaried     -0.22096    0.33568   -0.66     0.51
## dagemom     -0.02717    0.02684   -1.01     0.31
## dpcare0      0.38761    1.05721    0.37     0.71
## dpcare2     -0.36667    0.27414   -1.34     0.18
## dpcare3      0.12065    0.27638    0.44     0.66
## dpcare4     -0.14430    0.66626   -0.22     0.83
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.242 on 476 degrees of freedom
##   (12 observations deleted due to missingness)
## Multiple R-squared:  0.0514, Adjusted R-squared:  0.0275
## F-statistic: 2.15 on 12 and 476 DF,  p-value: 0.0131
```

```
# infant death with tsp
model4 <- lm(dimr7271 ~ reg_tsp, data = mydata)
summary(model4)
```

```
##
## Call:
## lm(formula = dimr7271 ~ reg_tsp, data = mydata)
##
## Residuals:
##    Min     1Q Median     3Q    Max
## -56.38  -2.77   0.44   4.11  54.62
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)   -0.761      0.604   -1.26     0.21
## reg_tsp       -0.402      0.822   -0.49     0.63
##
## Residual standard error: 9.17 on 499 degrees of freedom
## Multiple R-squared:  0.000479,   Adjusted R-squared:  -0.00152
## F-statistic: 0.239 on 1 and 499 DF,  p-value: 0.625
```

```
# adding other features
model4.2 <- lm(dimr7271 ~ reg_tsp + dwhite + dothr + dfemale
               + dedudad + dedumom + dmaried + dagemom + dpcare0
               + dpcare2 + dpcare3 + dpcare4, data = mydata)
summary(model4.2)
```

```
##
## Call:
## lm(formula = dimr7271 ~ reg_tsp + dwhite + dothr + dfemale +
##     dedudad + dedumom + dmaried + dagemom + dpcare0 + dpcare2 +
##     dpcare3 + dpcare4, data = mydata)
##
## Residuals:
##    Min     1Q Median     3Q    Max
## -45.82  -2.87   0.45   4.24  58.05
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)  -0.0981     0.6348   -0.15  0.87729
## reg_tsp      -0.6339     0.8088   -0.78  0.43356
## dwhite       72.4704    20.2401    3.58  0.00038 ***
## dothr         2.1738    36.8022    0.06  0.95292
## dfemale      -1.3205    12.8304   -0.10  0.91807
## dedudad       0.2044     0.6060    0.34  0.73601
## dedumom      -0.7949     0.6769   -1.17  0.24083
## dmaried      -3.1274    12.3092   -0.25  0.79955
## dagemom      -1.2157     0.9843   -1.24  0.21741
## dpcare0      80.2110    38.7671    2.07  0.03908 *
## dpcare2     -10.3206    10.0526   -1.03  0.30510
## dpcare3      -3.8385    10.1345   -0.38  0.70503
## dpcare4      17.4288    24.4311    0.71  0.47596
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 8.86 on 476 degrees of freedom
##   (12 observations deleted due to missingness)
## Multiple R-squared:  0.0608, Adjusted R-squared:  0.0371
## F-statistic: 2.57 on 12 and 476 DF,  p-value: 0.00266
```

```
## instrumental variable
library('AER')
library('systemfit')

model5 <- ivreg(dimr7271 ~ damtsp1 | reg_tsp, data = mydata)
summary(model5)
```

```
##
## Call:
## ivreg(formula = dimr7271 ~ damtsp1 | reg_tsp, data = mydata)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -55.891  -3.004   0.407   4.215  54.503
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)   -0.692      0.718   -0.96     0.34
## damtsp1        4.432      9.130    0.49     0.63
##
## Residual standard error: 9.24 on 499 degrees of freedom
## Multiple R-Squared: -0.0146, Adjusted R-squared: -0.0166
## Wald test: 0.236 on 1 and 499 DF,  p-value: 0.628
```

```
# adding other features
model5.2 <- ivreg(dimr7271 ~ damtsp1 + dwhite + dothr + dfemale
                  + dedudad + dedumom + dmaried + dagemom + dpcare0
                  + dpcare2 + dpcare3 + dpcare4 | dwhite + dothr + dfemale
                  + dedudad + dedumom + dmaried + dagemom + dpcare0
                  + dpcare2 + dpcare3 + dpcare4 + reg_tsp, data = mydata)
summary(model5.2)
```

```
##
## Call:
## ivreg(formula = dimr7271 ~ damtsp1 + dwhite + dothr + dfemale +
##     dedudad + dedumom + dmaried + dagemom + dpcare0 + dpcare2 +
##     dpcare3 + dpcare4 | dwhite + dothr + dfemale + dedudad +
##     dedumom + dmaried + dagemom + dpcare0 + dpcare2 + dpcare3 +
##     dpcare4 + reg_tsp, data = mydata)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -44.882  -3.211   0.327   4.246  57.985
##
## Coefficients:
##             Estimate Std. Error t value Pr(>|t|)
## (Intercept)   0.0765     0.8248    0.09   0.9261
## damtsp1       7.2749     9.4697    0.77   0.4427
## dwhite       72.3273    20.6460    3.50   0.0005 ***
## dothr        -3.5052    38.0550   -0.09   0.9267
## dfemale      -4.1002    13.5988   -0.30   0.7632
## dedudad       0.0730     0.6453    0.11   0.9099
## dedumom      -0.7478     0.6935   -1.08   0.2814
## dmaried      -1.5200    12.8122   -0.12   0.9056
## dagemom      -1.0180     1.0506   -0.97   0.3330
## dpcare0      77.3911    39.8349    1.94   0.0526 .
## dpcare2      -7.6531    10.8677   -0.70   0.4816
## dpcare3      -4.7163    10.4441   -0.45   0.6518
## dpcare4      18.4785    24.9633    0.74   0.4595
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 9.04 on 476 degrees of freedom
## Multiple R-Squared: 0.0223,  Adjusted R-squared: -0.00231
## Wald test: 2.46 on 12 and 476 DF,  p-value: 0.00395
```

```
### 3. end
detach(mydata)
#q()
```

Conclusion:

No evidence show significant effects of low air quality increasing infant mortality.

Reference:

Chay, Kenneth, and Michael Greenstone. (2003). “Air Quality, Infant Mortality and the Clean Air Act of 1970.”