Biostatistics 140.623
Third Term, 2017-2018

Laboratory Exercise 2

The National Medical Expenditure Survey (NMES) data set (`nmes_pro2.dta`) will be used for this exercise to:

- Use logistic regression to **estimate the prevalence (average risk) of having a major smoking caused disease (mscd)** (lung cancer, chronic obstructive pulmonary disease, heart disease, stroke and others) as a function of smoking status (ever smoke), age, gender and education variables using the NMES data.
- **Construct propensity scores** based on the predicated probability of having a mscd as a function of smoking status (ever smoke), age, gender and education variables.
- Use linear regression to **estimate total medical expenditures** as a function of mscd and the propensity to have a mscd.

Variables are:
age in years,
age1 = age;
age2 = 0 if age ≤ 65; age2 = (age- 65) if age > 65

male (0 = female, 1=male),
evermsk (0=no, 1=yes)
educate (1 = College graduate, 2 = Some college, 3 = High school graduate, 4 = Other)
mscd (Major smoking caused disease) (0 = None, 1 = Any)
med_exp (total medical expenditures in dollars)

1. After investigating a number of models, the following model was selected:

```
. mkspline age1 65 age2 = age, marginal
. logit mscd  eversmk age1 age2 male age1_male age2_male i.educate

Iteration 0:   log likelihood = -4118.7742
Iteration 1:   log likelihood = -3733.9407
Iteration 2:   log likelihood = -3656.8518
Iteration 3:   log likelihood = -3655.6148
Iteration 4:   log likelihood = -3655.6105
Iteration 5:   log likelihood = -3655.6105

Logistic regression                             Number of obs     =     11,684
                                                LR chi2(9)        =     926.33
                                                Prob > chi2       =     0.0000
Log likelihood = -3655.6105                     Pseudo R2         =     0.1125

------------------------------------------------------------------------------
        mscd |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     eversmk |   .6596425   .0692907     9.52   0.000     .5238352    .7954497
        age1 |   .0925176   .0085052    10.88   0.000     .0758477    .1091874
        age2 |  -.0373021   .0130109    -2.87   0.004     -.062803   -.0118011
        male |  -.6079009   .7157477    -0.85   0.396    -2.010741    .7949388
```

```
   age1_male |   .0158599   .0119308     1.33   0.184    -.0075241    .0392439
   age2_male |  -.0384532   .0187993    -2.05   0.041    -.0752993   -.0016072
             |
     educate |
          2  |   .3086858   .1239864     2.49   0.013     .0656769    .5516948
          3  |    .200918   .1032204     1.95   0.052    -.0013903    .4032263
          4  |  -.0339619   .1123525    -0.30   0.762    -.2541687    .1862449
             |
       _cons |    -8.5067   .5194764   -16.38   0.000    -9.524855   -7.488545
------------------------------------------------------------------------------

. predict propensity
(option pr assumed; Pr(mscd))
(1964 missing values generated)
```

2. Write out the model and interpret the coefficients: (**Please do this on your own; the interpretations are posted in the answer key. We will not go through this in lab.**)

logit (Pr(mscd=1) =
log(odds of mscd) = $\beta_0 + \beta_1$eversmk $+\beta_2$age1 $+ \beta_3$age2 $+\beta_4$male $+ \beta_5$age1_male $+ \beta_6$age2_male
$+\beta_7$educ2 $+ \beta_8$educ3 $+\beta_9$educ4

$\beta_0 =$

$\beta_1 =$

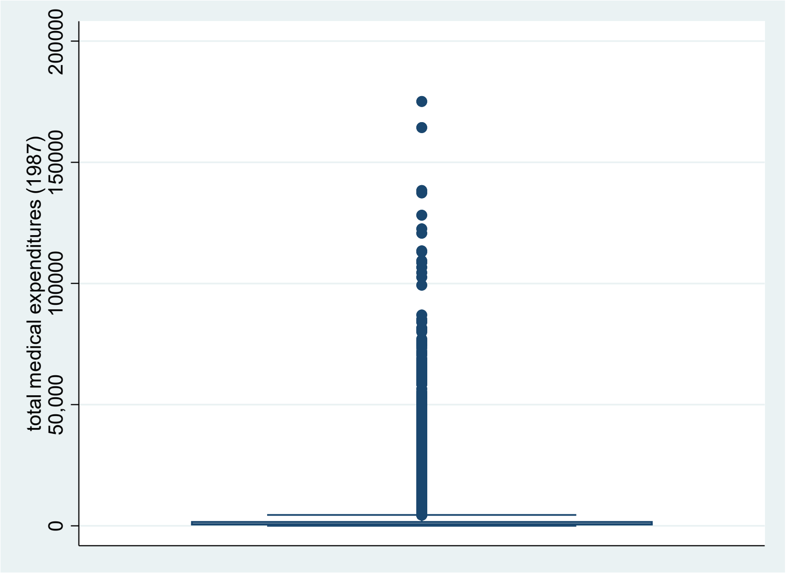
Males:

Females:

3. What other Stata command could be employed to obtain the results in Step 1?

4. Next we will plan to compare the **mean annual medical expenditures** for persons with a major smoking caused disease (mcsd) to otherwise similar persons without such a disease using propensity scores to create balance on measured potential confounders. The predicted probability that a person has a mscd, from Step 1, is the **propensity score** to be used here.

5. What do you observe from the box plot of medical expenditures?

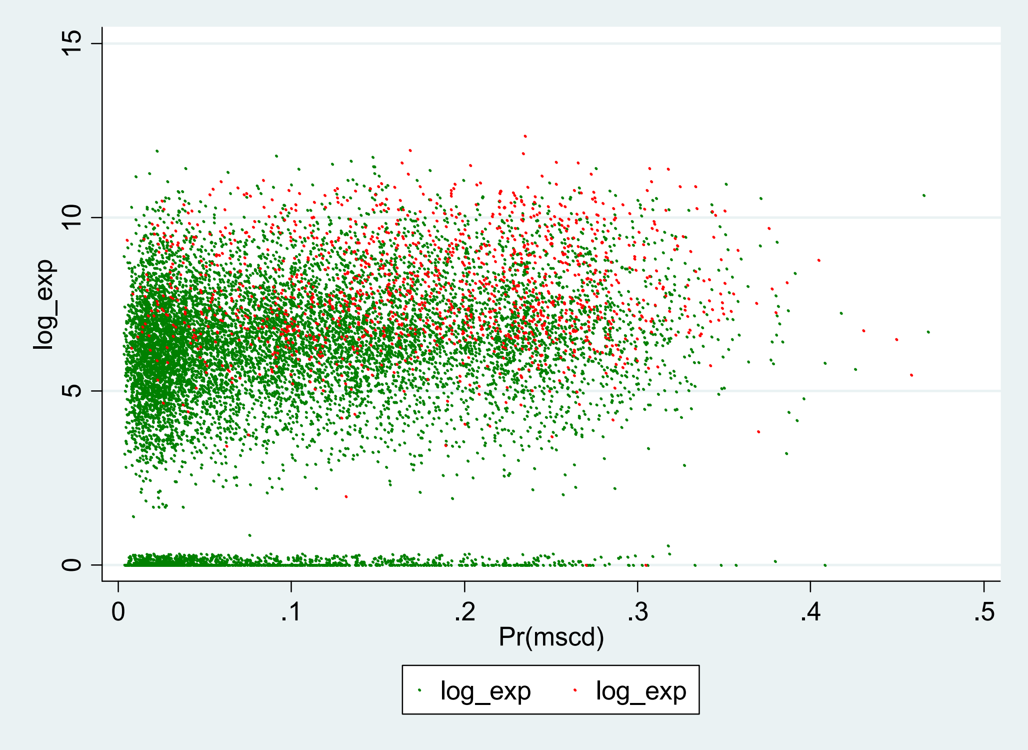


```
. gen newmed_exp=med_exp
. replace newmed_exp= 1 if med_exp==0
(1540 real changes made)

. gen log_exp =log(newmed_exp)
```

6. The following is a plot of log medical expenditures against propensity score using a different color and or symbol for persons with a mscd than for persons without. What do you observe?

```
. twoway (scatter log_exp propensity if mscd==0, mcolor(green) msymbol(point)
jitter(3)) (scatter log_exp propensity if mscd==1, mcolor(red) msymbol(point)
jitter(3))
```



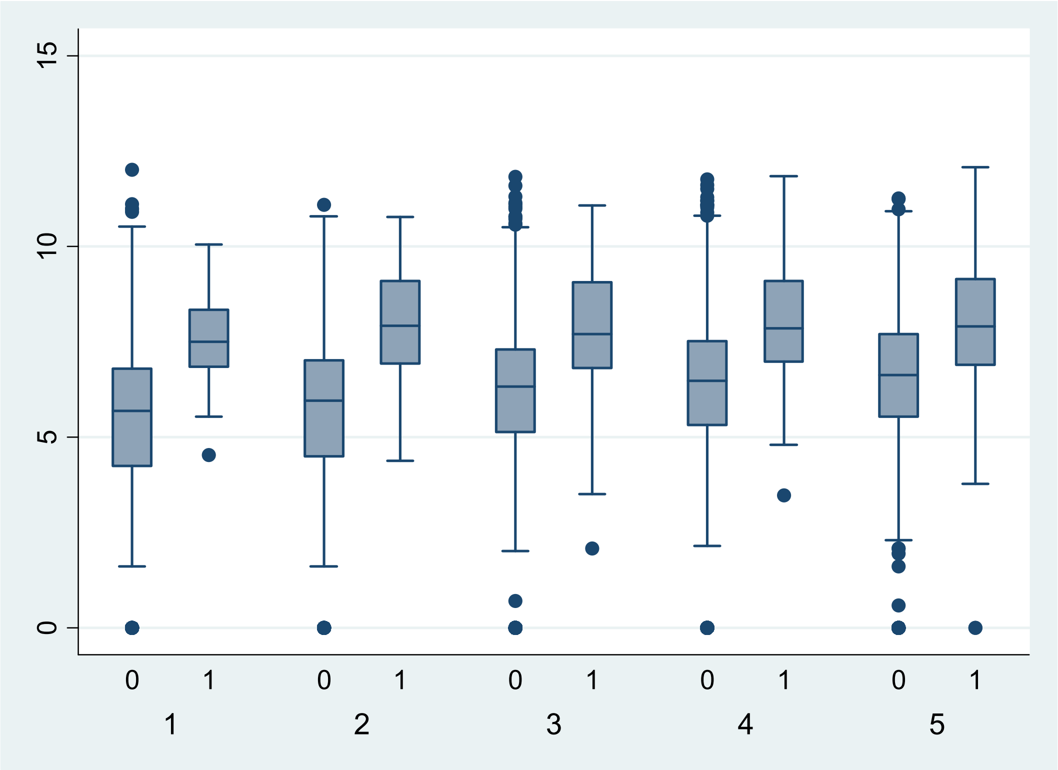
7. The following plot shows side-by-side boxplots of log medical expenditures: for persons without and with a mscd for each of the 5 quintiles of propensity score. Comment on any apparent "effect" of having a major smoking caused disease on expenditures.

To create quintiles of propensity scores:

```
. xtile prop_cat = propensity, nq(5)
```

To graph side-by-side boxplots of the log of expenditures by mscd status for each quintile:

```
.graph box log_exp, medtype(line) over(mscd) over(prop_cat)
```



8. Regress medical expenditures on mscd and the propensity score quintile indicators.

```
. regress med_exp mscd i.prop_cat

      Source |       SS           df       MS      Number of obs   =    11,684
-------------+----------------------------------   F(5, 11678)     =    180.05
       Model |  5.1324e+10         5  1.0265e+10   Prob > F        =    0.0000
    Residual |  6.6577e+11    11,678  57010733.5   R-squared       =    0.0716
-------------+----------------------------------   Adj R-squared   =    0.0712
       Total |  7.1710e+11    11,683  61379413.7   Root MSE        =    7550.5

------------------------------------------------------------------------------
     med_exp |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        mscd |   5652.406   229.2906    24.65   0.000     5202.958    6101.854
             |
    prop_cat |
          2  |    123.763    220.573     0.56   0.575     -308.597     556.123
          3  |   793.5605   221.1443     3.59   0.000     360.0806     1227.04
          4  |   1454.296   221.4173     6.57   0.000     1020.281     1888.31
          5  |   1836.683   227.8009     8.06   0.000     1390.155     2283.21
             |
       _cons |   1249.791   154.9751     8.06   0.000      946.014    1553.568
------------------------------------------------------------------------------
```

Interpret the mscd coefficient as if for a public health journal.

9. Perform a “standard” regression of medical expenditure on mscd and the demographic variables. How does this compare to Step 8?

```
. regress med_exp mscd eversmk age1 age2 age1_male age2_male i.educate

      Source |       SS           df       MS      Number of obs   =    11,684
-------------+----------------------------------   F(9, 11674)     =    104.49
       Model |  5.3461e+10         9  5.9401e+09   Prob > F        =    0.0000
    Residual |  6.6363e+11    11,674  56847235.7   R-squared       =    0.0746
-------------+----------------------------------   Adj R-squared   =    0.0738
       Total |  7.1710e+11    11,683  61379413.7   Root MSE        =    7539.7

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     med_exp |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        mscd |    5620.38   228.8799    24.56   0.000     5171.737    6069.023
     eversmk |   166.8353    149.327     1.12   0.264    -125.8706    459.5412
        age1 |   40.95212   9.582915     4.27   0.000       22.168    59.73623
        age2 |   72.92796   23.37429     3.12   0.002     27.11044    118.7455
   age1_male |   .6295556   3.084042     0.20   0.838    -5.415682    6.674793
   age2_male |  -44.70696    27.7978    -1.61   0.108    -99.19529    9.781368
             |
     educate |
          2  |   163.7601   262.9847     0.62   0.533    -351.7338    679.2541
          3  |   116.2333   213.2358     0.55   0.586    -301.7445    534.2112
          4  |   204.4395   244.6546     0.84   0.403    -275.1244    684.0035
             |
       _cons |  -800.9706    536.937    -1.49   0.136    -1853.457    251.5156
------------------------------------------------------------------------------
```

10. Repeat Steps 8 and 9 by using the outcome of log medical expenditures (which would be more appropriate for this analysis). How do the results compare? How would you interpret the mscd coefficient?

```
. regress log_exp mscd i.prop_cat

      Source |       SS           df       MS      Number of obs   =    11,684
-------------+----------------------------------   F(5, 11678)     =    275.90
       Model |  8170.49158         5  1634.09832   Prob > F        =    0.0000
    Residual |  69167.1291    11,678  5.92285744   R-squared       =    0.1056
-------------+----------------------------------   Adj R-squared   =    0.1053
       Total |  77337.6207    11,683  6.61967138   Root MSE        =    2.4337

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     log_exp |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        mscd |   1.925092    .073905    26.05   0.000     1.780226    2.069958
             |
    prop_cat |
          2  |   .2008472   .0710951     2.83   0.005     .0614889    .3402055
          3  |   .6959708   .0712793     9.76   0.000     .5562515      .83569
          4  |   .9512833   .0713672    13.33   0.000     .8113916    1.091175
          5  |   1.151389   .0734248    15.68   0.000     1.007464    1.295314
             |
       _cons |   5.126914   .0499516   102.64   0.000        5.029    5.224827
------------------------------------------------------------------------------
```

```
. regress log_exp mscd eversmk age1 age2 age1_male age2_male i.educate

      Source |       SS           df       MS      Number of obs   =    11,684
-------------+----------------------------------   F(9, 11674)     =    201.88
       Model |   10415.586         9  1157.28734   Prob > F        =    0.0000
    Residual |  66922.0347    11,674  5.73257107   R-squared       =    0.1347
-------------+----------------------------------   Adj R-squared   =    0.1340
       Total |  77337.6207    11,683  6.61967138   Root MSE        =    2.3943

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     log_exp |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
        mscd |   1.917341   .0726821    26.38   0.000     1.774872     2.05981
     eversmk |   .0905658   .0474197     1.91   0.056    -.0023847    .1835163
        age1 |   .0486666   .0030431    15.99   0.000     .0427015    .0546316
        age2 |  -.0176438   .0074226    -2.38   0.017    -.0321934   -.0030942
   age1_male |  -.0104514   .0009794   -10.67   0.000    -.0123711   -.0085317
   age2_male |   .0343218   .0088274     3.89   0.000     .0170187    .0516249
             |
     educate |
          2  |  -.0694155   .0835123    -0.83   0.406    -.2331135    .0942826
          3  |  -.5009005   .0677143    -7.40   0.000    -.6336318   -.3681692
          4  |  -.8517726   .0776915   -10.96   0.000    -1.004061   -.6994843
             |
       _cons |   3.471328   .1705074    20.36   0.000     3.137105    3.805551
------------------------------------------------------------------------------
```

11. Summarize your findings from the propensity score analysis and the standard regression as if for a public health journal. Be numerate. Give the strengths and weaknesses of each approach.