Computer Exercise 2 Answers: Determinants and Multicolinearity

```
. reg cost q q2  if _n<11, nocons

      Source |       SS       df       MS              Number of obs =      10
-------------+------------------------------           F(  2,     8) =    9.79
       Model |  2.45207913     2  1.22603956           Prob > F      =  0.0071
    Residual |  1.00215589     8  .125269486           R-squared     =  0.7099
-------------+------------------------------           Adj R-squared =  0.6373
       Total |  3.45423501    10  .345423501           Root MSE      =  .35393
------------------------------------------------------------------------------
       costs |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           q |   10.00407   3.100237     3.23   0.012      2.85491    17.15323
          q2 |   -36.3137    18.3049    -1.98   0.083    -78.52488    5.897482


. corr q q2 if _n<11
(obs=10)
             |        q       q2
-------------+------------------
           q |   1.0000
          q2 |   0.9623   1.0000

. mkmat q q2 if e(sample), mat(X)

. matrix list X

X[10,2]
         q     q2
 r1    .02  .0004
 r2    .03  .0009
 r3    .04  .0016
 r4    .04  .0016
 r5    .05  .0025
 r6    .09  .0081
 r7    .11  .0121
 r8    .13  .0169
 r9    .13  .0169
r10    .22  .0484

. matrix XpX=X'*X
. matrix list XpX

symmetric XpX[2,2]
            q         q2
 q      .1094
q2     .01739  .00313814

. matrix dX=det(XpX)

. matrix list dX

symmetric dX[1,1]
          c1
r1  .0000409
```

```
. reg cost q q2  if _n<12, nocons

      Source |       SS       df       MS              Number of obs =      11
-------------+------------------------------           F(  2,     9) =   12.19
       Model |  3.56435923     2  1.78217962           Prob > F      =  0.0027
    Residual |  1.31551179     9  .146167977           R-squared     =  0.7304
-------------+------------------------------           Adj R-squared =  0.6705

       Total |  4.87987103    11  .443624639           Root MSE      =  .38232
------------------------------------------------------------------------------
       costs |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           q |   7.597686   2.917844     2.60   0.029     .9970639    14.19831
          q2 |   -16.4953   14.41379    -1.14   0.282    -49.10156    16.11097
------------------------------------------------------------------------------

. corr q q2 if _n<12
(obs=11)
             |        q       q2
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           q |   1.0000
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. mkmat q q2 if e(sample), mat(X)

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 r1    .02  .0004
 r2    .03  .0009
 r3    .04  .0016
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 r5    .05  .0025
 r6    .09  .0081
 r7    .11  .0121
 r8    .13  .0169
 r9    .13  .0169
r10    .22  .0484
r11    .25  .0625

. matrix XpX=X'*X

. matrix list XpX

symmetric XpX[2,2]
            q         q2
 q      .1719
q2    .033015  .00704439

. matrix dX=det(XpX)

. matrix list dX

symmetric dX[1,1]
           c1
r1  .00012094
```

```
. reg cost q q2 , nocons

      Source |       SS       df       MS              Number of obs =     145
-------------+------------------------------           F(  2,   143) = 1440.72
       Model |   77015.686     2   38507.843           Prob > F      =  0.0000
    Residual |  3822.11936   143  26.7281074           R-squared     =  0.9527
-------------+------------------------------           Adj R-squared =  0.9521
       Total |  80837.8053   145  557.502106           Root MSE      =  5.1699

------------------------------------------------------------------------------
       costs |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
           q |   .4499231   .0272048    16.54   0.000     .3961475    .5036986
          q2 |   .0019086    .000258     7.40   0.000     .0013985    .0024187
------------------------------------------------------------------------------

. mkmat q q2 if e(sample), mat(X)

. matrix XpX=X'*X

. matrix list XpX

symmetric XpX[2,2]
            q         q2
 q  189762.11
q2   18002565  2.109e+09

. matrix dX=det(XpX)

. matrix list dX

symmetric dX[1,1]
           c1
r1  7.618e+13
```

Now invert the (X'X) matrix and compare your estimates of $(X'X)^{-1}$ from the three regressions.
What do you see?

```
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          q2 |   -36.3137    18.3049    -1.98   0.083    -78.52488    5.897482
------------------------------------------------------------------------------

. mkmat q q2 if e(sample), mat(X)
. matrix XpX=X'*X

. matrix x1=syminv(XpX)

. matrix list x1
symmetric x1[2,2]
             q          q2
 q   76.726359
q2  -425.17905   2674.7894


. reg cost q q2  if _n<12, nocons

      Source |       SS       df       MS              Number of obs =      11
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    Residual |  1.31551179     9  .146167977           R-squared     =  0.7304
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       Total |  4.87987103    11  .443624639           Root MSE      =  .38232
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          q2 |   -16.4953   14.41379    -1.14   0.282    -49.10156    16.11097
------------------------------------------------------------------------------

. mkmat q q2 if e(sample), mat(X)
. matrix XpX=X'*X

. matrix x1=syminv(XpX)

. matrix list x1
symmetric x1[2,2]
             q          q2
 q   58.246782
q2  -272.98567   1421.3611
```

```
. reg cost q q2  , nocons

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       Model |  77015.686      2  38507.843            Prob > F      =  0.0000
    Residual | 3822.11936    143  26.7281074           R-squared     =  0.9527
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       Total | 80837.8053    145  557.502106           Root MSE      =  5.1699

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       costs |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
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          q2 |   .0019086    .000258     7.40   0.000     .0013985    .0024187
------------------------------------------------------------------------------

. mkmat q q2 if e(sample), mat(X)

. matrix XpX=X'*X

. matrix x1=syminv(XpX)

. matrix list x1

symmetric x1[2,2]
             q           q2
 q   .00002769
q2  -2.363e-07   2.491e-09
```

Since the variance of the OLS estimates for variable i are formed by multiplying the iith element on the main diagonal of $(X'X)^{-1}$ by s^2 (or, in practice, the unbiased estimate s^2 = RSS/N=k which is given by the value highlighted inn the Stata output above)

Can see that the variance of the OLS estimates also gets smaller as the degree of multicolinearity falls