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Homework 6

Part A
Estimation for data year 81

```
                Estimate Std. Error  t value  Pr(>|t|)
(Intercept):1  3.8077394  0.1909268  19.9435 < 2.2e-16 ***
(Intercept):2  0.3878269  0.1855553   2.0901   0.03662 *
educ:1        -0.3570751  0.0149644 -23.8616 < 2.2e-16 ***
educ:2        -0.0754138  0.0138104  -5.4607 4.790e-08 ***
exper:1        1.0955657  0.0603814  18.1441 < 2.2e-16 ***
exper:2        2.0864348  0.0564818  36.9400 < 2.2e-16 ***
expersq:1     -0.1248613  0.0104908 -11.9020 < 2.2e-16 ***
expersq:2     -0.2044507  0.0094642 -21.6026 < 2.2e-16 ***
black:1        1.0067840  0.0627344  16.0484 < 2.2e-16 ***
black:2        0.4338390  0.0627611   6.9125 4.879e-12 ***
```

Estimation for data year 87

```
                Estimate Std. Error  t value  Pr(>|t|)
(Intercept):1  3.8077394  0.1909268  19.9435 < 2.2e-16 ***
(Intercept):2  0.3878269  0.1855553   2.0901   0.03662 *
educ:1        -0.3570751  0.0149644 -23.8616 < 2.2e-16 ***
educ:2        -0.0754138  0.0138104  -5.4607 4.790e-08 ***
exper:1        1.0955657  0.0603814  18.1441 < 2.2e-16 ***
exper:2        2.0864348  0.0564818  36.9400 < 2.2e-16 ***
expersq:1     -0.1248613  0.0104908 -11.9020 < 2.2e-16 ***
expersq:2     -0.2044507  0.0094642 -21.6026 < 2.2e-16 ***
black:1        1.0067840  0.0627344  16.0484 < 2.2e-16 ***
black:2        0.4338390  0.0627611   6.9125 4.879e-12 ***
```

According to the two results, the coefficients for year 81 and 87 are not meaningfully different.

Part B&C

```
                Estimate Std. Error  t value  Pr(>|t|)
(Intercept):1  5.1515519  0.2282348  22.5713 < 2.2e-16 ***
(Intercept):2  1.8583230  0.2257486   8.2318 < 2.2e-16 ***
educ:1        -0.5473739  0.0189537 -28.8796 < 2.2e-16 ***
educ:2        -0.2555556  0.0182413 -14.0097 < 2.2e-16 ***
exper:1        0.7699565  0.0633138  12.1610 < 2.2e-16 ***
exper:2        1.8238206  0.0585207  31.1654 < 2.2e-16 ***
expersq:1     -0.1153747  0.0107128 -10.7698 < 2.2e-16 ***
expersq:2     -0.1956538  0.0095773 -20.4288 < 2.2e-16 ***
black:1        0.8773806  0.0656222  13.3702 < 2.2e-16 ***
black:2        0.3384600  0.0649310   5.2126 1.877e-07 ***
y82:1          0.9871298  0.0928663  10.6296 < 2.2e-16 ***
y82:2          0.5624964  0.0936880   6.0039 1.953e-09 ***
y83:1          1.3835914  0.1035336  13.3637 < 2.2e-16 ***
y83:2          1.2257324  0.0998515  12.2756 < 2.2e-16 ***
y84:1          1.5872132  0.1155479  13.7364 < 2.2e-16 ***
y84:2          1.4265200  0.1095937  13.0164 < 2.2e-16 ***
```

```
y85:1          2.0525935  0.1307155  15.7028 < 2.2e-16 ***
y85:2          1.6629944  0.1243068  13.3781 < 2.2e-16 ***
y86:1          2.6528468  0.1513582  17.5269 < 2.2e-16 ***
y86:2          2.0295849  0.1447250  14.0237 < 2.2e-16 ***
y87:1          2.7272648  0.1701078  16.0326 < 2.2e-16 ***
y87:2          1.9956392  0.1622285  12.3014 < 2.2e-16 ***
```

Based on the above results, the time dummies should be kept in the model because all the variables are statistically significant. This will allow us toe control for change in time trend.

Part D

As indicated above the time dummies will allows us to control for time trend and autocorrelation. There certainly exist autocorrelation across different variables. For example, an individual experience would increase each year and its initial value will corelate with its future increased value and same goes for education.

Part E

For year == 81

When educ == 12

```
           0          1         2
1 0.03199082 0.04897495 0.9190342
```

When educ == 16

```
           0          1         2
1 0.08689896 0.01489626 0.8982048
```

So the change in the probability in 1981 of being employed (j = 2) for a black man with five years of experience when educ increases from 12 to 16 is -0.0208294

For year == 87

When educ == 12

```
            0          1         2
1 0.004241625 0.09929262 0.8964658
```

When educ == 16

```
           0          1        2
1 0.01255278 0.03290325 0.954544
```

So the change in the probability in 1981 of being employed (j = 2) for a black man with five years of experience when educ increases from 12 to 16 is 0.0580782

Part F

Yes, they are different from one another. The probability of being employed decreased when edu increases for year 81 but the probability of being employed increased when educ increases for year 87.
To test whether they are equal to one another, we can

1) Derive the distribution of prediction
2) Derive the distribution of the difference
3) Check if the two predictions calculated are the same by testing the null hypothesis that suggest zero difference between the two predictions (two-way test)

Part G

You can run a regression with isolated interaction terms using exper*year and expersq*year. The regression result is shown below:

```
t test of coefficients:

                    Estimate Std. Error  t value  Pr(>|t|)
(Intercept):1       5.093508   0.231121  22.0383 < 2.2e-16 ***
(Intercept):2       1.721362   0.229970   7.4852 7.389e-14 ***
educ:1             -0.560162   0.019276 -29.0607 < 2.2e-16 ***
educ:2             -0.266490   0.018505 -14.4008 < 2.2e-16 ***
exper:1             0.653184   0.079764   8.1889 2.765e-16 ***
exper:2             1.764385   0.073964  23.8548 < 2.2e-16 ***
expersq:1          -0.105660   0.016889  -6.2561 4.014e-10 ***
expersq:2          -0.196450   0.015468 -12.7000 < 2.2e-16 ***
black:1             0.902105   0.066476  13.5705 < 2.2e-16 ***
black:2             0.366270   0.065878   5.5599 2.728e-08 ***
y82:1               1.219250   0.099608  12.2405 < 2.2e-16 ***
y82:2               0.834386   0.105786   7.8875 3.213e-15 ***
y83:1               1.630235   0.110482  14.7557 < 2.2e-16 ***
y83:2               1.506665   0.111745  13.4830 < 2.2e-16 ***
y84:1               1.855849   0.123271  15.0550 < 2.2e-16 ***
y84:2               1.722675   0.121931  14.1282 < 2.2e-16 ***
y85:1               2.345073   0.139090  16.8601 < 2.2e-16 ***
y85:2               1.977394   0.136682  14.4671 < 2.2e-16 ***
y86:1               2.967836   0.160267  18.5181 < 2.2e-16 ***
y86:2               2.367644   0.156765  15.1031 < 2.2e-16 ***
y87:1               3.495651   0.228375  15.3066 < 2.2e-16 ***
y87:2               2.996462   0.214030  14.0002 < 2.2e-16 ***
I(exper * y81):1    2.503562   0.460372   5.4381 5.436e-08 ***
I(exper * y81):2    2.462329   0.445297   5.5296 3.242e-08 ***
I(expersq * y81):1 -0.535728   0.271800  -1.9710 0.0487312 *
I(expersq * y81):2 -0.568146   0.265648  -2.1387 0.0324686 *
I(exper * y87):1   -0.692891   0.185125  -3.7428 0.0001824 ***
I(exper * y87):2   -0.879534   0.169975  -5.1745 2.303e-07 ***
I(expersq * y87):1  0.092150   0.030077   3.0638 0.0021875 **
I(expersq * y87):2  0.119240   0.027589   4.3221 1.552e-05 ***
```

A failure to reject the null doesn't imply that the marginal effect of experience has not changed over time as there is a clear correlation between the variables each year.