ECON3150/4150: Introductory Econometrics – Re-take Exam Spring 2024

Be brief and to the point and always motivate your answers. All sub-questions have equal weight.

```
# Results to Question 1.
# salary                    1990 salary, thousands $
# pcsalary                  % change salary, 89-90
# sales                     1990 firm sales, millions $
# roe                       return on equity (roe), 88-90 avg
# pcroe                     % change roe, 88-90
# ros                       return on firm's stock (ros), 88-90
# manuf                     =1 if firm sector = manufacturing
# finance                   =1 if firm sector = finance
# consprod                  =1 if firm sector = consumer product
# utility                   =1 if firm sector = transport. or utilties
# lsalary                   natural log of salary
# lsales                    natural log of sales
```

```
##                   mean           SD        min          max   N
## salary   1281.1196172 1.372345e+03 223.000000 14822.000000 209
## pcsalary   13.2822967 3.263392e+01 -61.000000   212.000000 209
## sales    6923.7932823 1.063327e+04 175.199997 97649.898438 209
## roe        17.1842105 8.518509e+00   0.500000    56.299999 209
## pcroe      10.8004784 9.721940e+01 -98.900002   977.000000 209
## ros        61.8038278 6.817705e+01 -58.000000   418.000000 209
## manuf       0.3205742 4.678178e-01   0.000000     1.000000 209
## finance     0.2200957 4.153057e-01   0.000000     1.000000 209
## consprod    0.2870813 4.534861e-01   0.000000     1.000000 209
## utility     0.1722488 3.785031e-01   0.000000     1.000000 209
## lsalary     6.9503861 5.663741e-01   5.407172     9.603868 209
## lsales      8.2922648 1.013161e+00   5.165928    11.489144 209
```

```
##                           reg1           reg2          reg3           reg4
## Dependent Var.:        lsalary        lsalary       lsalary        lsalary
##
## lsales          0.257 (0.032)  0.244 (0.034) 0.275 (0.030)  0.257 (0.032)
## finance                        0.124 (0.081)                0.158 (0.083)
## consprod                       0.239 (0.091)                0.181 (0.096)
## utility                       -0.353 (0.071)               -0.283 (0.073)
## roe                                          0.018 (0.003)  0.011 (0.004)
## Constant         4.82 (0.271)   4.89 (0.290)  4.36 (0.260)   4.59 (0.287)
## _______________ ______________ ______________ _____________ ______________
## S.E. type       Heteros.-rob. Heterosk.-rob. Heteros.-rob. Heterosk.-rob.
## R2                    0.21082        0.33556       0.28199        0.35687
## Observations              209            209           209            209
```

```
# Results to Question 1i.
wald(reg2, keep="finance|consprod|utility", vcov="iid")
var(predict(reg2))/var(ceosal1$lsalary)
```

1. We are interested in understanding the determinants of CEO salaries using the dataset and regression models in the R-output above:

   a. Interpret the size of the coefficient on `lsales` in the 1st results column (`reg1`).

   b. Construct and interpret the 99% confidence interval for the coefficient on `lsales` in `reg1`.

   c. Interpret the coefficient on `finance` in the 2nd column (`reg2`). Is this estimate significant at the 1% level?

   d. Sales in manufacturing are 1,7 billion USD. Use `reg2` to compute the average CEO salary in manufacturing in USD.

   e. Suppose sales in manufacturing increase by 17 million. Use `reg2` to compute the new average CEO salary in USD. What do you need to assume for this to be a good prediction?

   f. Perform a joint two-sided F-test (assuming homoskedasticity) of the null-hypothesis that CEO salaries do not differ across sectors in the 4th results column (`reg4`). Do you reject the null hypothesis at the 5% level?

   g. Explain why the coefficient on `finance` in larger in the `reg4` compared to `reg2`.

   h. How would the coefficients in `reg4` change if both salary **and** sales were measured in single USD (instead of thousands and millions USD respectively)?

   i. What two numbers (rounded to 3 decimals) does the R-code above in the output (marked Question 1i.) produce?

   j. You are interesting in testing whether the effect of `roe` on log(salary) is decreasing as `roe` increases. What is the regression specification that you would estimate?

   k. Write the R-code that implements the estimation proposed in 1j.

```
# Dataset for exercise 2:
# firm time  productivity
# A      0     105
# A      1     125
# A      2     185
# B      0      80
# B      1     105
# B      2     112.5
# C      0      97.5
# C      1     107.5
# C      2     165
```

2. Suppose we are interested in evaluating the impact of a new training program on workers' productivity. Consider the following simplified scenario where we have 3 years of data for three different firms: Firm A, which implemented a training program after period t=1, and two other firms B and C which did not implement any training program. The dataset above reports average productivity for all workers in each firm:

   a. Based on the table above, do you think we can compare the outcome for firm A in period t=2 to that of the two other firms to estimate the causal effect of the training on productivity?

   b. An alternative approach is difference-in-differences (DID). Discuss the key assumption of this approach in the context of this application, and evaluate it based on the averages provided for Firms A, B, and C.

   c. Compute the DID estimate of the training program using the data above.

   d. Explain how you would set up the data (sample and variable definitions) and what specification you would estimate in a regression analysis that investigates the key assumption of the DID approach.

   e. Explain how you would set up the data (sample and variable definitions) and what specification you would estimate in a regression analysis that estimates the causal effect of the training program using the DID approach.

Critical Values for the $F_{m,\infty}$ Distribution

```
## Rows denote degrees of freedom (m), and columns significance level (%)

##          10%     5%     1%

##
##  1 :  2.7055 3.8415 6.6349
##  2 :  2.3026 2.9957 4.6052
##  3 :  2.0838 2.6049 3.7816
##  4 :  1.9449 2.3719 3.3192
##  5 :  1.8473 2.2141 3.0173
##  6 :  1.7741 2.0986 2.8020
##  7 :  1.7167 2.0096 2.6393
##  8 :  1.6702 1.9384 2.5113
##  9 :  1.6315 1.8799 2.4073
##  10 :  1.5987 1.8307 2.3209
##  11 :  1.5705 1.7886 2.2477
##  12 :  1.5458 1.7522 2.1847
##  13 :  1.5240 1.7202 2.1299
##  14 :  1.5046 1.6918 2.0815
##  15 :  1.4871 1.6664 2.0385
##  16 :  1.4714 1.6435 2.0000
##  17 :  1.4570 1.6228 1.9652
##  18 :  1.4439 1.6038 1.9336
##  19 :  1.4318 1.5865 1.9048
##  20 :  1.4206 1.5705 1.8783
##  21 :  1.4102 1.5557 1.8539
##  22 :  1.4006 1.5420 1.8313
##  23 :  1.3916 1.5292 1.8104
##  24 :  1.3832 1.5173 1.7908
##  25 :  1.3753 1.5061 1.7726
##  26 :  1.3678 1.4956 1.7554
##  27 :  1.3608 1.4857 1.7394
##  28 :  1.3541 1.4763 1.7242
##  29 :  1.3478 1.4675 1.7099
##  30 :  1.3419 1.4591 1.6964
```

The Cumulative Standard Normal Distribution Function, $\Pr(Z \leq z)$

```
## Rows denote 1st decimal value of z, and columns 2nd decimal value of z

## So for example, P(Z ⩽ 0.22) = 0.5871

##            0      1      2      3      4      5      6      7      8      9
## 0.0 : 0.5000 0.5040 0.5080 0.5120 0.5160 0.5199 0.5239 0.5279 0.5319 0.5359
## 0.1 : 0.5398 0.5438 0.5478 0.5517 0.5557 0.5596 0.5636 0.5675 0.5714 0.5753
## 0.2 : 0.5793 0.5832 0.5871 0.5910 0.5948 0.5987 0.6026 0.6064 0.6103 0.6141
## 0.3 : 0.6179 0.6217 0.6255 0.6293 0.6331 0.6368 0.6406 0.6443 0.6480 0.6517
## 0.4 : 0.6554 0.6591 0.6628 0.6664 0.6700 0.6736 0.6772 0.6808 0.6844 0.6879
## 0.5 : 0.6915 0.6950 0.6985 0.7019 0.7054 0.7088 0.7123 0.7157 0.7190 0.7224
## 0.6 : 0.7257 0.7291 0.7324 0.7357 0.7389 0.7422 0.7454 0.7486 0.7517 0.7549
## 0.7 : 0.7580 0.7611 0.7642 0.7673 0.7704 0.7734 0.7764 0.7794 0.7823 0.7852
## 0.8 : 0.7881 0.7910 0.7939 0.7967 0.7995 0.8023 0.8051 0.8078 0.8106 0.8133
## 0.9 : 0.8159 0.8186 0.8212 0.8238 0.8264 0.8289 0.8315 0.8340 0.8365 0.8389
## 1.0 : 0.8413 0.8438 0.8461 0.8485 0.8508 0.8531 0.8554 0.8577 0.8599 0.8621
## 1.1 : 0.8643 0.8665 0.8686 0.8708 0.8729 0.8749 0.8770 0.8790 0.8810 0.8830
## 1.2 : 0.8849 0.8869 0.8888 0.8907 0.8925 0.8944 0.8962 0.8980 0.8997 0.9015
## 1.3 : 0.9032 0.9049 0.9066 0.9082 0.9099 0.9115 0.9131 0.9147 0.9162 0.9177
## 1.4 : 0.9192 0.9207 0.9222 0.9236 0.9251 0.9265 0.9279 0.9292 0.9306 0.9319
## 1.5 : 0.9332 0.9345 0.9357 0.9370 0.9382 0.9394 0.9406 0.9418 0.9429 0.9441
## 1.6 : 0.9452 0.9463 0.9474 0.9484 0.9495 0.9505 0.9515 0.9525 0.9535 0.9545
## 1.7 : 0.9554 0.9564 0.9573 0.9582 0.9591 0.9599 0.9608 0.9616 0.9625 0.9633
## 1.8 : 0.9641 0.9649 0.9656 0.9664 0.9671 0.9678 0.9686 0.9693 0.9699 0.9706
## 1.9 : 0.9713 0.9719 0.9726 0.9732 0.9738 0.9744 0.9750 0.9756 0.9761 0.9767
## 2.0 : 0.9772 0.9778 0.9783 0.9788 0.9793 0.9798 0.9803 0.9808 0.9812 0.9817
## 2.1 : 0.9821 0.9826 0.9830 0.9834 0.9838 0.9842 0.9846 0.9850 0.9854 0.9857
## 2.2 : 0.9861 0.9864 0.9868 0.9871 0.9875 0.9878 0.9881 0.9884 0.9887 0.9890
## 2.3 : 0.9893 0.9896 0.9898 0.9901 0.9904 0.9906 0.9909 0.9911 0.9913 0.9916
## 2.4 : 0.9918 0.9920 0.9922 0.9925 0.9927 0.9929 0.9931 0.9932 0.9934 0.9936
## 2.5 : 0.9938 0.9940 0.9941 0.9943 0.9945 0.9946 0.9948 0.9949 0.9951 0.9952
## 2.6 : 0.9953 0.9955 0.9956 0.9957 0.9959 0.9960 0.9961 0.9962 0.9963 0.9964
## 2.7 : 0.9965 0.9966 0.9967 0.9968 0.9969 0.9970 0.9971 0.9972 0.9973 0.9974
## 2.8 : 0.9974 0.9975 0.9976 0.9977 0.9977 0.9978 0.9979 0.9979 0.9980 0.9981
## 2.9 : 0.9981 0.9982 0.9982 0.9983 0.9984 0.9984 0.9985 0.9985 0.9986 0.9986
```