Second Midterm Exam

You must answer all the questions. The exam is closed book and closed notes you may use calculators.

You must show your work to receive full credit

1. We are interested in the determinants of a worker's monthly wage. We run the following regression of the log of monthly wage on hours worked per week, experience, education, tenure, age, IQ, Knowledge of the working world, number of siblings and birth order. (Assumptions 1-4 Hold)

\[
\begin{align*}
\text{reg } & \log \text{ wage } \text{ hours exper educ tenure age iq kww sibs brthord} \\
\text{Source} & | \text{ SS } | \text{ df } | \text{ MS } | \text{ F(9, 842) } | \text{ Prob > F} | \text{ R-squared } | \text{ Adj R-squared } | \text{ Root MSE} \\
\text{Model} & | 30.0050024 | 9 | 3.33388916 | 24.03 | 0.0000 | 0.2044 | 0.1959 | 0.37247 \\
\text{Residual} & | 116.811062 | 842 | 0.138730478 | | | | \\
\text{Total} & | 146.816065 | 851 | 0.172521815 | | | | \\
\end{align*}
\]

| l_wage | Coef. | Std. Err. | t | P>|t| | (95% Conf. Interval) |
|--------|-------|-----------|---|------|----------------------|
| hours | -.0042903 | .0018116 | XXXXX | XXXXX | -.0078461 | -.0007345 |
| exper | .0085699 | .0039621 | XXXXX | XXXXX | .0007931 | .0163468 |
| educ | .0455352 | .0079986 | XXXXX | XXXXX | .0298357 | .0612348 |
| tenure | .0104108 | .0026302 | XXXXX | XXXXX | .0052484 | .0155739 |
| age | .0056566 | .0054308 | XXXXX | XXXXX | .0026931 | .0103468 |
| iq | .0042692 | .0017055 | XXXXX | XXXXX | .0013804 | .0073801 |
| kww | .006703 | .0021873 | XXXXX | XXXXX | .0024099 | .0109962 |
| sibs | .0015559 | .0071812 | XXXXX | XXXXX | .0026931 | .0103468 |
| brthord | -.01545 | .010049 | XXXXX | XXXXX | -.0350874 | -.0041874 |
| cons | 5.329364 | 1.974056 | XXXXX | XXXXX | 4.914899 | 5.716829 |

a. Conduct a 2-sided test at the 5% level to determine if a person’s age affects their wage. (Please draw a picture)

\[H_0:\]

\[H_A:\]
b. Please conduct a one-sided test at the 5% level to see if experience is a
determinant of wage. State the null and alternative hypothesis. Given how you
set up your alternative hypothesis would a large negative coefficient on
\( \hat{B}_{\text{exp}} \) lead you to reject the null? Why or why not?

\[ H_0 : \]
\[ H_A : \]

c. How much does one additional year of experience increase a worker's monthly
wage?

d. Compute and interpret the 2-sided P-value for the impact of birth order on
wage. (Please include a picture)
e. We are interested in determining if our two measures of how much attention the individual got as a child are important determinants of wage. Please test if birth order and number of siblings are jointly significant at the 5% level. Does attention a person got as a child as measured by these two variables impact wage?

\[
\text{reg l_wage hours exper educ tenure age iq kww if brthord != . & sibs != .}
\]

\[
\begin{array}{lrrrr}
\text{Source} & \text{SS} & \text{df} & \text{MS} & \text{Number of obs} = 852 \\
\hline
\text{Model} & 29.5846491 & ? & 4.22637844 & \text{Prob > F} = 0.0000 \\
\text{Residual} & 117.231415 & 844 & 0.138899781 & \text{R-squared} = 0.0215 \\
\hline
\text{Total} & 146.816065 & 851 & 0.172521815 & \text{Root MSE} = 0.37269 \\
\end{array}
\]

\[
\begin{array}{lrrrr}
\text{l_wage} & \text{Coef.} & \text{Std. Err.} & \text{t} & \text{P>|t|} & [95\% \text{ Conf. Interval}] \\
\hline
\text{hours} & -.0042183 & .0018122 & -2.33 & 0.020 & -.0077751 \text{ to } -.0006614 \\
\text{exper} & .0469369 & .0079574 & 5.90 & 0.000 & .0313184 \text{ to } .0625549 \\
\text{educ} & .0105374 & .0026306 & 4.01 & 0.000 & .0053741 \text{ to } .0157007 \\
\text{tenure} & .0105374 & .0026306 & 4.01 & 0.000 & .0053741 \text{ to } .0157007 \\
\text{age} & .0043594 & .001071 & 4.07 & 0.000 & .0022573 \text{ to } .0064615 \\
\text{iq} & .0068725 & .0021549 & 3.19 & 0.001 & .0026429 \text{ to } .0111021 \\
\text{kww} & 5.269771 & .1921801 & 27.42 & 0.000 & 4.892564 \text{ to } 5.646978 \\
\text{cons} & 5.269771 & .1921801 & 27.42 & 0.000 & 4.892564 \text{ to } 5.646978 \\
\end{array}
\]

2. We wish to see if prison crowding results in more violence. We get data from the federal government and run the following regression.

\[
\text{Log(violent incidents) = 2.34 + 1.012 log(Prisoner_population) + ???? security_level - .12 weight_room}
\]

\[
\begin{array}{lrrrr}
\text{Obs} = 92 & R^2 = .32 \\
\end{array}
\]

a. What do you expect the sign of the parameter on security level to be if 5 is maximum security and 1 is minimum security? Why do you expect it to have that particular sign?
b. Does crowding result in more violent incidents than we would expect just due to the larger number of inmates? Please conduct a one sided test at the 5% level of the null hypothesis that \( \beta_{\text{population}} = 1 \). (State both your null and your alternative)

\[
H_0 : \\
H_A : 
\]

c. Please interpret your findings from Part B.

d. Please interpret the R-Squared in this regression.

e. Do prisons with weight rooms have more or less violence? Please test this at the 5% level (two sided test).
f. Is the reduction in violence associated with having a weight room practically significant?

g. If assumption 3 fails so the $E(u|\text{prisoner\_pop, sec\_level, weight\_room}) \neq 0$. Can we still be sure that adding a weight room to a prison will reduce violence? Why or why not?

**Extra Credit:** We have been hired to estimate the impact of smoking on productivity. We run our regression and are told that the estimates are insufficiently precise. The

$$Var(\hat{B}_j) = \frac{\sigma^2}{SST_j(1 - R^2_j)}$$

What can we do to reduce it?

**Useful Formulas**

\[
F = \frac{(SSR_{r} - SSR_{wr})/q}{SSR_{wr}/(n-k-1)}
\]

\[
F = \frac{(R^2_{wr} - R^2_{r})/q}{(1 - R^2_{r})/(n-k-1)}
\]