1. You have data on the natural log of hourly wages, (LWAGE), age, measured in years, (AGE), a dummy variable, (FEMALE), that takes the value 1 if female 0 otherwise, the product of FEMALE and AGE, FEMALE*AGE, years of work in the current job, TENURE, and its square, TENURE2.

You estimate the following regressions:

```
(1) reg lhw age female femage tenure tenure2

      Source |       SS       df       MS              Number of obs =    3005
-------------+------------------------------           F(  5,  2299) =   60.48
       Model |  100.000000     5   16.808223           Prob > F      =  0.0000
    Residual |  600.000000  2999  .277909507           R-squared     =  0.1429
-------------+------------------------------           Adj R-squared =  0.1443
       Total |  700.000000  3004  .313782583           Root MSE      =  .52717

------------------------------------------------------------------------------
         lhw |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         age |   .0042398   .0014985     2.83   0.005     .0013012    .0071784
      female |  -.0200000   .0500000    -0.40   0.745    -.1860868    .1331442
      femage |  -.0100000   .0020022    -5.00   0.000    -.0098752   -.0020224
      tenure |   .0060000   .0006000    10.00   0.000     .0021002    .0033886
     tenure2 |  -.0005000   .0001000    -5.00   0.000    -.0007000   -.0003000
       _cons |   1.764674   .0596079    29.60   0.000     1.647783    1.881564
```

```
(2) reg lhw age female femage

      Source |       SS       df       MS              Number of obs =    3005
-------------+------------------------------           F(  3,  2301) =   65.24
       Model |  50.0000000     3  18.8903724           Prob > F      =  0.0000
    Residual |  650.000000  3001  .289562779           R-squared     =  0.0714
-------------+------------------------------           Adj R-squared =  0.0772
       Total |  700.000000  3004  .313782583           Root MSE      =  .53811

------------------------------------------------------------------------------
         lhw |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         age |   .0084819   .0014144     6.00   0.000     .0057082    .0112556
      female |   -.049775    .082544    -0.60   0.547    -.2116433    .1120934
      femage |  -.0056949   .0020203    -2.82   0.005    -.0096568   -.0017331
       _cons |   1.762608   .0586584    30.05   0.000     1.647579    1.877637
------------------------------------------------------------------------------
```

i) After how many years of work in the current job will the (log of) wages be maximised?

(4 marks)

ii) Test the hypothesis that the coefficients on TENURE and TENURE2 are jointly significant in the model

(6 marks)

iii) What would be the effect for the OLS estimates in equation (1) of omitting the variable FEMALE from the regression?

(6 marks)

iv) Outline how you would test the hypothesis that the specification of the variables on the right hand side of (1) were correct

(9 marks)

2. Given the following model estimated with annual data over the period 1950-1999

$$GDP_t = b_0 + b_1 Investment_t + u_t$$

you suspect the presence of measurement error in the estimate of the annual level of GDP (measured in £billion).

ie $GDP_t^{observed} = GDP_t^{true} + e_t$

where e is a (random) error term

i) Outline the consequences of this type of measurement error for OLS estimation

(6 marks)

ii) given your answer to part i) and the following information, calculate the impact of measurement error in this case

$Var(u) = 2$ $Var(e) = 2$
$Var(GDP^{true}) = 0.2$ $Var(GDP^{observed}) = 0.5$
$Var(Investment^{true}) = 0.1$ $Var(Investment^{observed}) = 2$
$Cov(GDP^{true}, Investment^{true}) = 0.3$ $Cov(GDP^{true}, Investment^{observed}) = 0.2$
$Cov(e, u) = 0$ $E(u) = 0$ $E(e) = 0$

(5 marks)

You are now given new information that says that it is the right hand side variable (Investment) that is instead measured with error

ie $Investment^{observed} = Investment^{true} + w$
$GDP_t^{observed} = GDP_t^{true}$

where w is a random error

iii) Find the true (unobserved) OLS estimate of the effect of investment on the level of GDP in the absence of measurement error

(4 marks)

d) the actual OLS estimate given this type of measurement error

(4 marks)

e) Why do the results change like this?

(6 marks)

3. Given the following house price and inflation equations

$$House\_Prices_t = a_0 + a_1 Inflation_t + u_t \quad (1)$$
$$Inflation_t = b_0 + b_1 House\_Prices_t + b_2 Interest\_Rates_t + b_3 Money\_Supply_t + e_t \quad (2)$$

a) What would happen if you estimated (1) or (2) by OLS and why?

(5 marks)

b) Find the order condition for identification of equations (1) and (2) and say which, if any, instruments, you would use in each case

(8 marks)

c) What would be the most efficient solution in equation (1) ?

(4 marks)

d) Outline the form of the test to use to check on the endogeneity of any one of the right hand side variables in an equation

(8 marks)

TURN OVER

4.

i) What do you understand by the term autocorrelation?

(3 marks)

ii) What can cause it?

(4 marks)

iii) What are the consequences for OLS estimation?

(3 marks)

iv) Given the following information from a regression of the model

$$Investment_t = b_0 + b_1 Investment_{t-1} + b_2 GNP_t + b3 Interest\_rates_t + u_t$$

```
. reg invest invest1 GNP interest

      Source |       SS       df       MS              Number of obs =      29
-------------+------------------------------           F(  3,    25) =   48.69
       Model |  1324.46636     3  441.488785           Prob > F      =  0.0000
    Residual |  226.700416    25  9.06801664           R-squared     =  0.8539
-------------+------------------------------           Adj R-squared =  0.8363
       Total |  1551.16677    28  55.3988133           Root MSE      =  3.0113
------------------------------------------------------------------------------
      invest |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
     invest1 |   .4749651   .1736102     2.74   0.011     .1174081    .8325221
         GNP |   .4141392   .1509537     2.74   0.011     .1032442    .7250342
    interest |  -.2460615   .1169471    -2.10   0.046    -.4869186   -.0052043
       _cons |   5.412312    2.29867     2.35   0.027     .6781121    10.14651

Durbin-Watson Statistic =  1.589473.

Durbin-Watson h-statistic:  .3989117  t =  1.405329

Breusch-Godfrey LM test for autocorrelation
---------------------------------------------------------------------------
    lags(p)  |          chi2               df
-------------+-------------------------------------------------------------
       1     |          2.298               1
H0: no serial correlation
```

test for the presence of 1st order autocorrelation in the residuals

(6 marks)

v) Which of the test statistics do your prefer and why?

(4 marks)

vi) Outline the Feasible GLS solution to the problem of autocorrelation

(5 marks)

END OF TEST