Economics 421/521
Winter 2008
Midterm 2

**Answer SIX of the following questions (if you answer all seven, the score in the
middle will be dropped):**

1. Suppose that the true model is:

$$Y_t^* = \beta_0 + \beta_1 X_t^* + v_t$$

However, data on X_t^* and Y_t^* are not available. Instead, you use

$$Y_t = Y_t^* + w_t$$
$$X_t = X_t^* + w_t$$

Notice that the two variables have the same measurement error. Does OLS of Y on a
constant and on X, i.e. OLS with Y* and X* replaced by Y and X, produce a consistent
estimate of the slope coefficient? If not, what is the large sample bias? Assume that w_t is
independent of all other variables in the model.

2. (a) You estimate the following model:

$$Y_i = -3.86 + .692 X_{i2} + 11.8 X_{i3} + u_i, \quad N=70, \quad R^2 = .61$$
$$\quad (1.03) \ (.520) \qquad (2.77)$$

The Durbin-Watson statistic is 1.62. Use a Durbin-Watson test to check for the presence
of positive autocorrelation. A table of critical values is attached to the exam.
(b) Give a step-by-step account of how to perform the Breusch-Godfrey test for higher
order serial correlation.

3. (a) Define the following terms: (i) inconsistency, (ii) reduced form, (iii) exogenous or
predetermined variable, and (iv) endogenous variable. (b) When should we use Durbin's
h-test and why do we need to use it?

4. (a) What is a valid instrument? (b) When a right-hand side variable is correlated with
the error term, OLS estimates are inconsistent. Show that the use of an instrumental
variable can eliminate the inconsistency.

5. Consider the following model of supply and demand:

$$Q_t = a + bP_t + cY_t + dX_t + u_t \qquad \text{Demand curve}$$
$$Q_t = g + hP_t + kF_t + v_t \qquad \text{Supply curve}$$

Give a graphical and intuitive explanation for why the demand equation is exactly identified and the supply equation is over identified. The endogenous variables are price (P) and quantity (Q), and the exogenous variables are income (Y), the price of a substitute (X), and pounds of fertilizer (F).

6. (a) Find the reduced form for the following model (the endogenous variables are Y, C, and NX, and the exogenous variables are I, G, T, and P):

$$Y_t = C_t + I_t + G_t + NX_t$$
$$C_t = a + b(Y_t - T_t) + u_t$$
$$NX_t = f + gY_t + hP_t + v_t$$

(b) For the model

$$Q_t = a_0 + a_1 P_t + a_2 Y_t + a_3 X_t + a_4 Z_t + u_t$$
$$P_t = b_0 + b_1 Q_t + b_2 Y_t + b_3 W_t + v_t$$
$$Y_t = c_0 + c_1 P_t + c_2 W_t + w_t$$

Determine whether each equation under, exactly, or over identified? Assume that Q, P, and Y are endogenous, and the constant, X, Z, and W are exogenous.

7. In this model, S is sales, A is advertising, and u_S and u_A are error terms:

$$S = \beta_1 + \beta_2 A + u_S$$
$$A = \alpha_1 + \alpha_2 S + u_A$$

Show that estimating β_2 by OLS results in simultaneity bias.