Introduction to Econometrics (Econ 107)
Drake University, Spring 2006
William M. Boal

Signature: ______________________

Printed name: ______________________

MIDTERM EXAMINATION #4 VERSION A
"Time Series"
April 25, 2006

INSTRUCTIONS: This exam is closed-book, closed-notes. You may use a calculator for this exam, but not a graphing calculator or a calculator with alphabetical keys. Point values for each question are noted in brackets. Tables of the t distribution chi-square distribution are attached.

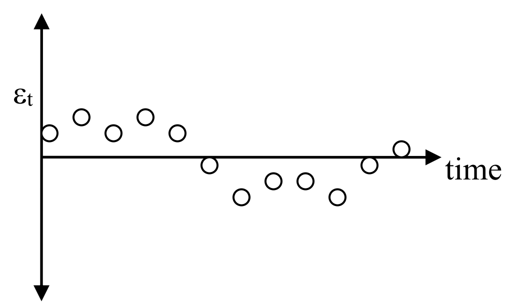
NOTATION: In this exam, $\hat{\beta}_j$ denotes the least-squares coefficient estimators of the line $y_t = \beta_1 + \beta_2 x_{t2}, +\ldots+ \beta_K x_{tK} + \varepsilon_t$. The least-squares fitted value is denoted $\hat{y}_t$. The least-squares residual is denoted $\hat{\varepsilon}_t$. The sample size is denoted T. The true or population value of the variance of the unobserved error term ε_t is denoted σ^2. The (unbiased) least-squares estimator of σ^2 is denoted $\hat{\sigma}^2$. The sample mean of y is denoted $\bar{y}$.

I. MULTIPLE CHOICE: Circle the one best answer to each question. Feel free to use margins for scratch work [3 pts each—33 pts total]

(1) Which is not a static model?
a. $y_t = 0.3 + 0.6\, x_t + \varepsilon_t$.
b. $y_t = 7.6 + 2.1\, x_{t,2} + 4.3\, x_{t,3} + \varepsilon_t$.
c. $y_t = 4.6 - 2.1\, x_t + \varepsilon_t$.
d. $y_t = 6.2 + 4.1\, x_{t-1} + \varepsilon_t$.

(2) In the time-series model
$$y_t = \beta_1 + \beta_2 x_{t,2} + \beta_3 x_{t,3} + \varepsilon_t ,$$
"strict exogeneity of regressors" means
a. $E(\varepsilon_t) = 0$.
b. $E(\varepsilon_t|x_{t,2},x_{t,3}) = 0$.
c. $E(\varepsilon_t|X) = 0$.
d. $E(X) = 0$.
e. $Var(\varepsilon_t) = \sigma^2$, a constant.

(3) The time series ε_t graphed below is
a. positively serially-correlated.
b. negatively serially-correlated.
c. serially uncorrelated.
d. Cannot be determined from the information given.



(4) Consider the time-series regression model
$$y_t = \beta_1 + \beta_2 x_{t,2} + \beta_3 x_{t,3} + \varepsilon_t .$$
If the data are stationary and weakly dependent, and the regressors are contemporaneously exogenous:
$$E(\varepsilon_t| x_{t,2}, x_{t,3}) = 0,$$
then the least squares estimators for the β coefficients
a. will be biased.
b. will be inconsistent.
c. will have large standard errors.
d. cannot be computed.
e. None of the above.

(5) Under the null hypothesis of no serial correlation, the Durbin-Watson test statistic is close to
a. minus one.
b. zero.
c. one.
d. two.
e. four.

(6) If the Durbin-Watson statistic equals 1.4, then an estimate of the autocorrelation parameter $\rho = Corr(\varepsilon_t, \varepsilon_{t-1})$ is
a. 0.2
b. 0.3
c. 0.4.
d. 0.6.
e. 1.4.

(7) By definition, if the random process u_t has a unit root,
a. $E(u_t) = 1$.
b. $Var(u_t) = 1$.
c. it does not tend to revert back to its mean.
d. $u_t = 1$.
e. the square root of $u_t = 1$.

(8) If y_t and x_t are two independent random walks with drift, then a regression of y_t on x_t will typically produce
a. a valid t statistic for the coefficient of x_t .
b. an excessively small (in absolute value) t-statistic for the coefficient of x_t.
c. an excessively large (in absolute value) t-statistic for the coefficient of x_t.
d. an R-square value close to zero.

(9) To test whether y_t and x_t are cointegrated, we apply a Dickey-Fuller test to
a. x_t .
b. y_t .
c. both x_t and y_t .
d. $y_t - \beta x_t$.

(10) Compared to the standard normal distribution, the Dickey-Fuller distribution is
a. virtually identical.
b. shifted to the right on the real number line.
c. shifted to the left on the real number line.
d. more concentrated around zero.

(11) Suppose we estimate the following pair of regression equations:

$$gdp_t = \alpha_1 + \alpha_2\, gdp_{t-1} + \alpha_3\, msupply_{t-1} + \varepsilon_{yt}$$
$$msupply_t = \beta_1 + \beta_2\, msupply_{t-1} + \beta_3\, gdp_{t-1} + \varepsilon_{zt}$$

If we reject the hypothesis that $\alpha_3 = 0$, then we conclude that
a. gdp "Granger-causes" msupply.
b. msupply "Granger-causes" gdp.
c. both of the above.
d. none of the above.

II. PROBLEMS: Please write your answers in the boxes on this question sheet.

(1) [Finite distributed lag: 9 pts] Suppose we have estimated the time-series model

$$y_t = 4.5 + 3.7\, x_t + 2.5\, x_{t-1} + 0.8\, x_{t-2} + \varepsilon_t \,.$$

a. Is this a *static* model or a *dynamic* model?

b. Compute the impact propensity (also called the "impact multiplier" or "short-run effect").

c. Compute the long-run propensity (also called the "long-run multiplier" or "long-run effect").

(2) [Breusch-Godfrey test: 12 pts] Suppose we have estimated the regression

$$y_t = \beta_1 + \beta_2\, x_{t,2} + \beta_3\, x_{t,3} + \beta_4\, y_{t-1} + \varepsilon_t$$

using 61 annual observations, but we fear that ε_t might be serially correlated. Accordingly, we have used the residuals to estimate the auxiliary regression.

$$\hat{\varepsilon}_t = \alpha_1 + \alpha_2 x_{t,2} + \alpha_3 x_{t,3} + \alpha_4 y_{t-1} + \alpha_5 \hat{\varepsilon}_{t-1} + \nu_t$$

where ν_t denotes the error term in the auxiliary regression. (Note that this auxiliary regression must be estimated on observations 2 through 61 of the original data.) The R^2 value from this auxiliary regression is 0.08 . Test the null hypothesis of no serial correlation at 5% significance. Give the value of the test statistic, its degrees of freedom, the critical point, and your conclusion (whether you can reject the null hypothesis).

Degrees of freedom = _____

Value of test statistic = _______________ Critical point = ____________________

Reject null hypothesis? ______________________.

(3) [Quasi-differencing: 16 pts] Suppose we wish to estimate the time-series regression model

$$y_t = \beta_1 + \beta_2\, x_{t,2} + \beta_3\, x_{t,3} + u_t \,.$$

However, we believe the error term is serially correlated, following the AR(1) process

$$u_t = 0.4\, u_{t-1} + \varepsilon_t \,,$$

where ε_t is an independent, identically-distributed random error term. We need to transform the data to eliminate the serial correlation. The table below shows the first three observations on y_t, x_{2t}, and x_{3t}. Compute transformed values of the second and third observations using the Cochrane-Orcutt method.

Obs.	Raw data			Transformed data			
t	y_t	x_{2t}	x_{3t}	y_t	Replacement for intercept	x_{2t}	x_{3t}
1	25	10	5				
2	30	15	10				
3	32	18	7				

(4) [Random walk: 15 pts] Consider the following random-walk process with drift:

$$u_t = 4.7 + u_{t-1} + \varepsilon_t .$$

where ε_t denotes an independent, identically-distributed series with $E(\varepsilon_t) = 0$ and $Var(\varepsilon_t) = 4$. Assume $u_0 = 0$.

a. Find a formula in terms of *t* for $E(u_t)$.

b. Find a formula in terms of *t* for $Var(u_t)$.

c. Is u_t a *stationary* process or a *nonstationary* process?

d. Compute $E(\Delta u_t)$.

e. Compute $Var(\Delta u_t)$.

(5) [Forecasting: 9 pts] Suppose we have estimated the following AR(2) model.

$$y_t = 23.4 + 0.6\, y_{t-1} - 0.2\, y_{t-2} + \varepsilon_t .$$

where ε_t denotes an independent, identically-distributed series with $E(\varepsilon_t) = 0$ and $Var(\varepsilon_t) = \sigma^2$, constant. In our data set, $y_{T-1} = 50$ and $y_T = 40$. Compute the following forecast values.

a. Compute the forecast of y_{T+1}.

b. Compute the forecast of y_{T+2}.

c. Compute the limit of the forecast y_{T+h} as h approaches infinity.
[Hint: this is the unconditional mean of the process.]

III. CRITICAL THINKING [6 pts] Suggest a pair of prices in the real world that economic reasoning suggests might be cointegrated. Explain why you think the pair might be cointegrated.

[end of exam]