Final Exam

You have three hours for this exam. The exam is closed book, but you may use the Minitab Help procedure. No scrap paper or notes are permitted. Please do all of your work carefully and check your answers before handing in your work. PLEASE SHOW AS MUCH OF YOUR WORK AS POSSIBLE TO AID IN THE AWARDING OF PARTIAL CREDIT IN THE EVENT OF AN ERROR ON YOUR PART.

Note

Do all five problems.

After you log on to Minitab, you can access the data file (worksheet) by clicking on File and Open Worksheet. Select H:/ECON355/355 Final 04 Data

You might wish to make an outfile to save your results as you go along. This will be a good idea in case your screen freezes. Don't forget to print your results when you are done.

Please do formal tests rather than rules of thumb in answering all questions.
1. (25 points) I found some actual data on women in Peru. We have data on 100 women and would like to find out how certain factors affect whether or not the woman has any children. The data are:

C1 = AGE = Age in years
C2 = EDUCATION = Years of schooling
C3 = HASCHILDREN = 1 if woman has children; 0 if not
C4 = MARRIED = 1 if woman is married; 0 if not

a. Please run a logit to see the effect of age, education and marital status on whether or not a woman has children. Write the logit equation, with the slopes, below.

\[
\ln \left( \frac{\hat{p}}{1-\hat{p}} \right) = -6.404 + 0.284 \text{Age} - .224 \text{Educ} + 4.417 \text{Mar}
\]

b. Which of the independent variables can we be sure have an effect? Formally test at the .05 level and state what you base your answer on.

\[
\begin{align*}
\hat{p} &= .003 < .05 \\
\hat{p} &= .059 < .05 \\
\hat{p} &= .003 < .05
\end{align*}
\]

so reject \( H_0 \) can't reject \( H_0 \) can't be sure has an effect can't be sure has an effect can be sure

c. Suppose that we look at a 22 year old single woman with 11 years of education. What would be the predicted probability of her having a child?

\[
\hat{p} = 0.52
\]

d. Suppose we look at a 25 year old single woman with 10 years of education. What would be the predicted probability of her having a child?

\[
\begin{align*}
\ln \left( \frac{\hat{p}}{1-\hat{p}} \right) &= -6.404 + 2.84(25) - .224(10) + 4.417 (0) \\
\hat{p} &= e^{-6.404 + 7.103} - 2.277 = 0.0975 \\
\hat{p} &= 0.206 \\
\hat{p} &= 1.206(1-\hat{p}) = 1.206 - 0.206 \hat{p} \\
\hat{p} &= 1.206 / 1.206 = 1.206
\end{align*}
\]
2. (30 points)

a. Suppose we look at a model of the U.S. economy;

\[
\begin{align*}
(1) \text{Cons}_t &= A_1 + A_2 \text{GDP}_t + e_{1t} \\
(2) \text{Inv}_t &= B_1 + B_2 \text{Int}_t + e_{2t} \\
(3) \text{GDP}_t &= \text{Cons}_t + \text{Inv}_t + \text{Gov}_t
\end{align*}
\]

a. Is it possible to obtain unbiased estimates of equation (1)? Demonstrate.

b. Is it possible to obtain unbiased estimates of equation (2)? Demonstrate.

Suppose we look at a somewhat different model of the economy:

\[
\begin{align*}
(4) \text{Cons}_t &= A_1 + A_2 \text{GDP}_t + A_3 \text{Cons}_{t-1} + e_{1t} \\
(5) \text{Inv}_t &= B_1 + B_2 \text{Int}_t + B_3 \text{GDP}_t + e_{2t} \\
(6) \text{GDP}_t &= \text{Cons}_t + \text{Inv}_t + \text{Gov}_t
\end{align*}
\]

c. Is it possible to obtain unbiased estimates of equation (4)? Demonstrate.

d. Is it possible to obtain unbiased estimates of equation (5)? Demonstrate.
e. Data for 1971-2003 are given in column C11-C16
C11 = Year = Year
C12 = GDP = GDP (Billions of Dollars, nominal)
C13 = Cons = Consumption "
C14 = Inv = Investment "
C15 = Gov = Government Spending "
C16 = Int = Interest Rate – 3 month Treasury Bills

If one could obtain unbiased estimates for the various coefficients, what technique could you use with Minitab?

2 Stage Least Squares

f. Using this technique, please find unbiased estimates of any coefficients you can in equations (4) and (5). Please write the slopes below.

Stage 1

Const = 2.91 - 0.00060x + 5.12x - 1.05 Cons

Stage 2

Cons = 29.3 + .506 + 3.0 + .85 Int + 1.48 Cons

(4) Const = 6.90 + .209 GDP + 1.723 Cons

(5) Inv = -84.1 + 13.4 Int + 1.58 GDP
3. (30 points) I obtained quarterly data for the United States Economy for the time period 1995.1 (first quarter) through 2002.3 (third quarter). The data are in Columns C25-C27.

C25 = Time = Time Period (Year,Quarter)
C26 = NomGDP = Nominal GDP (Billions of Dollars, NOT seasonally adjusted quarterly, not annual figure.)
C27 = NomInv = Nominal Investment (Billions of Dollars, NOT seasonally adjusted, quarterly, not annual figure)

a. Please run a regression to determine the effect that the level of Nominal GDP has on Nominal Investment. Write the answer below.

\[ \text{Nom Inv} = -16.8 + 1.173 \text{Nom GDP} \]

b. In terms of the variables, explain what the slope tells you.

As nominal GDP rises by $1 billion, we predict investment to rise by $1.173 billion.

c. Is there Auto-correlation present? Please test.

\[ n = 31 \quad k = 1 \]
\[ d = 0.82 \]

Reject Ho if \[ d < d_{0.05} \] is true.

\[ 0.82 < 1.36 \]

rejct

d. If auto-correlation exists, what does it do to the value of the slope? What does it do to the value of the standard error of the slope?

Nothing to the slope, but causes std.

e. What is the predicted value of the level of investment in 2002.3?

\[ \text{Nom Inv} = -16.8 + 1.173 \text{Nom GDP} = -16.8 + 1.173 (460.9) \]
\[ = 447.5 \] Billion

f. What is the value of the residual in 2002.3?

\[ e_t = y_t - \hat{y} = 422.9 - 447.5 = -20.6 \]
g. Please run a regression to determine if the level of investment depends on both the level of GDP and the quarter of the year. Please use the fourth quarter as the omitted quarter. Write the results below.

\[ \text{Nom Inv} = -31.6 + 1.173 \text{ Nom GDP} + 14.0 \text{ First} + 15.3 \text{ Second} + 30.4 \text{ Third} \]

h. Please seasonally adjust the investment data for the last eight quarters; 2000.4-2002.3. Write your answer below. Do NOT use the moving average method.

<table>
<thead>
<tr>
<th>Time</th>
<th>Seasonally Adjusted Investment</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000.4</td>
<td>422.4</td>
</tr>
<tr>
<td>2001.1</td>
<td>403.7</td>
</tr>
<tr>
<td>2001.2</td>
<td>405.4</td>
</tr>
<tr>
<td>2001.3</td>
<td>406.5</td>
</tr>
<tr>
<td>2001.4</td>
<td>397.9</td>
</tr>
<tr>
<td>2002.1</td>
<td>377.1</td>
</tr>
<tr>
<td>2002.2</td>
<td>367.1</td>
</tr>
<tr>
<td>2002.3</td>
<td>405.7</td>
</tr>
</tbody>
</table>

\[ \bar{y} = \frac{14.0 + 15.3 + 30.4 + 59.7}{4} = 14.9 \]

\[ 422.4 - (-14.9) = 437.3 \]
\[ 403.7 - (-14.9) = 418.6 \]
\[ 405.4 - (-14.9) = 420.3 \]
\[ 406.5 - (-14.9) = 421.4 \]

\[ 4.427.3 - (-14.9) = 442.2 \]
\[ 3.777.0 - (-14.9) = 391.9 \]
\[ 3.774.2 - (-14.9) = 393.1 \]
\[ 3.477.9 - (-14.9) = 367.0 \]
\[ 3.422.7 - (-15.3) = 347.4 \]

i. Please look at the regression you ran in part (g). At the .05 level, please see if you can drop any of the statistically significant variables from the model.

\[ H_0: \beta_2 = \beta_3 = 0 \]
\[ H_a: \beta_0 \neq \beta_1 \]

\[ \text{SSR}_R - \text{SSR}_T = 66998 - 65977 = 512.5 \]
\[ s^2 = \frac{512.5}{26} = 19.6923 \]

\[ F = \frac{512.5}{577} = 0.89 < 3.37 = F_{2,26,.05} \]

\[ \text{Hence,} \ \beta_2 = \beta_3 = 0 \text{ cannot be rejected.} \]
4. (13 points) I gathered data on plant and equipment expenditures (investment) in manufacturing and sales in manufacturing for 12 years. The data are in columns 35 and 36

\[ \text{C35} = \text{PlantExp} = \text{Expenditures on Plant and Equipment (Billions of Dollars)} \]
\[ \text{C36} = \text{Sales} = \text{Sales (Billions of Dollars)} \]

a. Gujarati discusses several reasons that lags occur in the real world. Cite two of his reasons.

- Psychological reasons
- Technological reason
- Institutional reason

b. Please run a regression to see how investment in plant and expenditures depends both on the current year’s sales as well as the previous year’s sales. Write your result below.

\[ \text{PlantExp}_t = -15.96 + 1.37 \text{Sales}_t + 0.51 \text{Sales}_{t-1} \]

(c) If the level of sales were to increase by one billion dollars, by how much would investment increase over that year and the next?

\[ \frac{3.7}{+0.51} \]

\[ \frac{3.7}{+0.51} \]

(d) Does this model exhibit the signs of multi-collinearity? Explain.

Yes. Neither variable is significant, but \( R^2 \) is quite high, 98.32%

(e) Please demonstrate whether multi-collinearity exists

\[ R^2 \text{ of Regr of Sales on Sales,} \]

is 97.2%.

\[ r = 0.986 \]

So definitely, multi-collinearity