22
17
28
27.5
94.5

excellent!

Name: ____________________

Final Exam
Economics 427. Economic Forecasting
Prof. Byron Gangnes
December 11, 2007

- Make sure your name is on the exam. Write all answers on the exam sheets.
- Carefully read the instructions for each question.
- The weight of each section in your grade is indicated by the points.

Section I. (22 points) Matching! Please write the letter of the item from column b that matches the concept in column a:

	Column a	Column b
c	1. Density forecast	a. running total of recursive residuals
g	2. Unbiased	b. Infinite unconditional variance
i	3. White noise	c. for normal variables, forecast both mean and variance
e	4. Covariance stationary	d. most general single-equation model
f	5. VAR	e. zero mean, constant variance, autocov. not a function of calendar time
h	6. Impulse response	f. multivariate regression model
k	7. Mincer-Zarnowitz regression	g. zero-mean forecast error
? b	8. Random walk	h. effects of shocks on a system
? d	9. Transfer function model	i. zero mean, constant variance, no serial correlation
j	10. Chain rule of forecasting	j. used to forecast AR processes
? a	11. CUSUM statistic	k. tests whether errors are forecastable

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Section II. (18 points)
Define each of the concepts below and briefly explain the rationale for its use:

1. Granger causality test

$5\frac{1}{2}$

We use Granger causality in a multi variate setting. We test the null hypothesis that X "doesn't cause" Y or rather X "has no information useful in predicting Y. Clearly if we can reject this null hypothesis then we can use Y and its lags to ~~predict~~ forecast X. In the VAR setting these tests will come in a pair asking also if Y doesn't cause X. Essentially we are testing whether the coefficients on lags of the dependent variable are different from zero.

2. Impulse response function

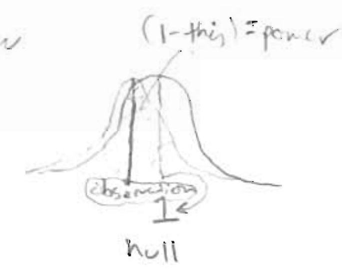
6

Impulse response also comes up in the multi-variate setting. This function examines the response of X to an "impulse" in Y, that is how does an innovation in Y affect X over time. For example we saw in Starts vs Completions, an innovation in Starts doesn't manifest in Completions immediately, but only after a lag of 6-16 months (peaking at around a year). This function allows us to see the relationship of one variable to another over time.

3. Augmented Dickey-Fuller test

$5\frac{1}{2}$

The Augmented Dickey-Fuller test is used to examine the null hypothesis that a series has a unit root. This test helps guide the forecaster when choosing to work in levels or differences. In essence this test is a regression of Δy on lag x of y. This test has a different distribution than the t-statistic called the Dickey-Fuller distribution because the t-statistic's null assumes a zero, whereas the D-F dist. will assume a 1 (the unit root). Problems arise, however because the power of this test is very low



Section III. (30 points) Analytical. Show all your work on this page (use the back if necessary). Consider the following ARMA(1,1) process:

$$y_t = \phi y_{t-1} + \varepsilon_t + \theta\varepsilon_{t-1}, \qquad \varepsilon_t = WN(0,\sigma^2)$$

1. Derive the moving average representation by recursively substituting lagged *y*. (Hint: you really only need to substitute once for this question.)

8

$y_t = \phi y_{t-1} + \varepsilon_t + \theta\varepsilon_{t-1}$, $y_{t-1} = \phi y_{t-2} + \varepsilon_{t-1} + \theta\varepsilon_{t-2}$, $y_t - y_{t-1} = (1-\phi L)y_t = (1-\theta L)\varepsilon_t$

$y_t = \phi(\phi y_{t-2} + \varepsilon_{t-1} + \theta\varepsilon_{t-2}) + \varepsilon_t + \theta\varepsilon_{t-1}$

$y_t = \phi^2 y_{t-2} + \phi\varepsilon_{t-1} + \phi\theta\varepsilon_{t-2} + \varepsilon_t + \theta\varepsilon_{t-1}$

$y_t = \dfrac{(1-\theta L)}{(1-\phi L)}\varepsilon_t$

and so on...

2. Based on your result from part 1, write down expressions for the 1-step-ahead and 2-step-ahead forecast errors under the optimal forecasts. (Remember that the forecast error will be the part of y_t that is unknown at time T.) Are the errors serially correlated? Explain.

7

$h=1$

actual: $y_{t+1} = \phi y_t + \varepsilon_{t+1} + \theta\varepsilon_{t-1+1}$

optimal forecast: $y_{t+1} = \phi y_t + 0 + \theta\varepsilon_t$

f'cast error = actual − optimal

$= \varepsilon_{t+1}$

$h=2$

$y_{t+2} = \phi y_{t+1} + \varepsilon_{t+2} + \theta\varepsilon_{t-1+2}$

actual: $y_{t+2} = \phi(\phi y_t + \varepsilon_{t+1} + \theta\varepsilon_t) + \varepsilon_{t+2} + \theta\varepsilon_{t-1+2}$

optimal f'cast $y_{t+2} = \phi^2 y_t + 0 + \theta\phi\varepsilon_t + 0 + 0$

f'cast error $= \phi\varepsilon_{t+1} + \varepsilon_{t+2} + \theta\varepsilon_{t+1}$

Yes! serial correlation occurs due to shared ε_{t+1} terms with weight $(\phi+\theta)$ — ?

3. What are the forecast error variances for the 1-step-ahead and 2-step-ahead cases? Would the variances grow without bound for h-step ahead forecasts as h gets large? (You don't have to derive the h-step ahead algebra.)

6

$h=1$

f'cast error variance is

$var(\varepsilon_{t+1}) = \sigma^2$

$h=2$

f'cast error variance is

$var(\phi\varepsilon_{t+1} + \varepsilon_{t+1} + \theta\varepsilon_{t+1}) =$

$(\phi^2 + 1 + \theta^2)\sigma^2$

not quite $(\phi+1+\theta)^2$ ~~$\phi^2+1^2+\theta^2$~~

~~not quite $(\phi+\theta)^2 \neq \phi^2+\theta^2$~~

if this is a covariance stationary process, then, the error variance should not grow w/o bound

4. How would the h-step ahead forecast error variance differ if the process has a unit root?

6 + 2

If a unit root were present then the variance would grow without bound as we can quickly extrapolate from the h=2 variances where we imagine $h \to \infty$ and the variances looking something like $(\phi^N + \phi\theta^Q + 1 \cdot \theta \ldots)$ something like this. If, for example $\phi = 1$, or > 1, then any exponential operation will not reduce its size, allowing it to collect to infinity...

Section IV. (30 points) Application of Univariate Modeling. A candidate model of US real consumption is reported on pages 6 to 10. Review these model results and answer the following questions. TIME is a time trend. The data is seasonally adjusted.

1. What features of the data are evident in the time series plots and related statistics that should be captured by a model? Is there other evidence that would be useful in formulating a modeling strategy?

8

good

There is a clear trend upwards that is seen in the level times series and in the >1 mean differences. The correlogram shows very slow damping in the autocorrelation indicating the series migh not be stationary. (or have high order AR) The dlog of the series clearly has some cyclicality that might be modeled. Because partial auto correlation does not cycle, MAs seem unlikely.
I would want to check for unit roots via Dickey-Fuller but because of the low power of the test → I would model in δ and levels and compare some in-sample errors between the models.

2. Evaluate the in-sample characteristics of the candidate model. Assess its apparent ability to capture features of the underlying data. What criteria could you use to select the appropriate number of lags of the dependent variable to include? ?

7

The constant and time variables are not significant at the 95% confidence interval. Neither is the 2nd lag. However R^2 + R^2 adjusted indicate that this model explains alot of variation .99. Positive indicators also include a Durbin Watson that is around 2, indicating no (or little) first order serial correlation. The F-stat is high w/ pvalue very low, near zero indicating that at least one variable is significant (of course the first lag). Since the coefficient on the first lag is >1, this, along with the (small) time variable drive the forecast upwards. So it does capture trend. I would look at the correlogram to see if I should add more lags (in particular the Autocorrellogram). I am also weary of using lags that are not significant in the regression. But since resids are not normal (J-B rejects null) we can't trust these p-values from the regression. The resids look like they have some cyclicality and there is some volatility in the early part of the time series.

I: b: [illegible]

6 + 2

3. Is there evidence of any problems with the model that could affect the reliability of the parameter estimates? Explain. How would you address these concerns?

We can see from the correlogram and normality test that resids have some auto-correlation (after lag 1) and are not normally distributed (due to kurtosis primarily, it seems). The usual response is to use some ARMA terms to remove the correlation. As for non-normality due to kurtosis, I don't see any big 'spikes that can be dummied.

I would try some ARMA combinations from (3,3) down to see what I could get from the resids. I do this because even though Bartlett bands are not exceeded in most lags, there is clear correlation (p-val near zero) from lags 1-3. While CUSUM is within bounds, recursive resids are not, occasionally. Parameter estimation indicates that all parameters begin with error bands encompassing zero (nothing seems significant at first). The parameter with the most significance (lag 1) seems unstable moving nearly outside original error bands. Clearly lag 2 seems centered on zero insignificant.

great

4. Assess the out-of-sample forecast performance of the model. Considering the characteristics of the data, do you think we can trust that the true error bands are really this narrow? Explain.

4

The out of sample clearly over forecasts. I would say this is linked to our >1 coefficient on the first lag. Even if there was a negative innovation, the model will want to move upwards and the limited dynamics of the model (with low time trend + second lag coefficient) would not do well to carry lower consumption into the future. Because the parameters were so unstable, particularly the most significant parameter (lag 1), I would think that this model's error bands are too narrow. It doesn't incorporate this parameter instability. Also, this model is quite small which could bring those bands in closer. However despite the fact this model does perform within confidence intervals. I would want to compare this to a δlog model w/ constant (to capture trend) to see how it fares.