

Final Exam

ST565 Winter 2014

Thursday 20th March 2014

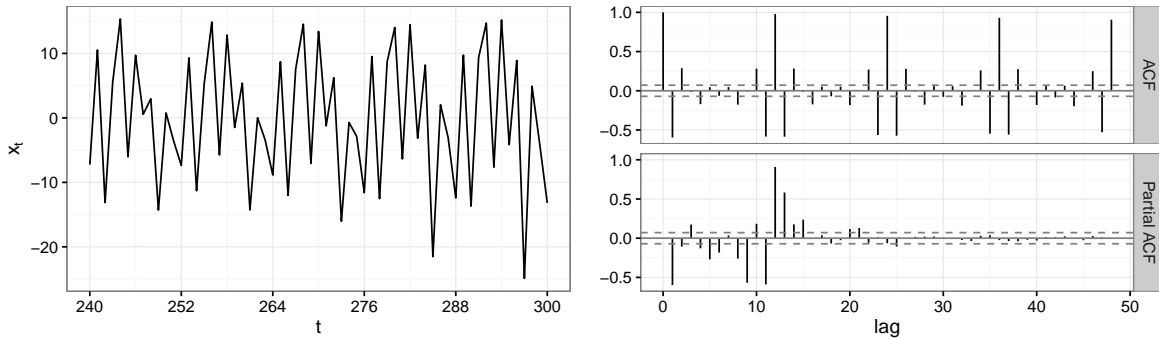
Name: _____

- You have 110 minutes to complete the exam.
- There are 4 questions, answer all of the questions.

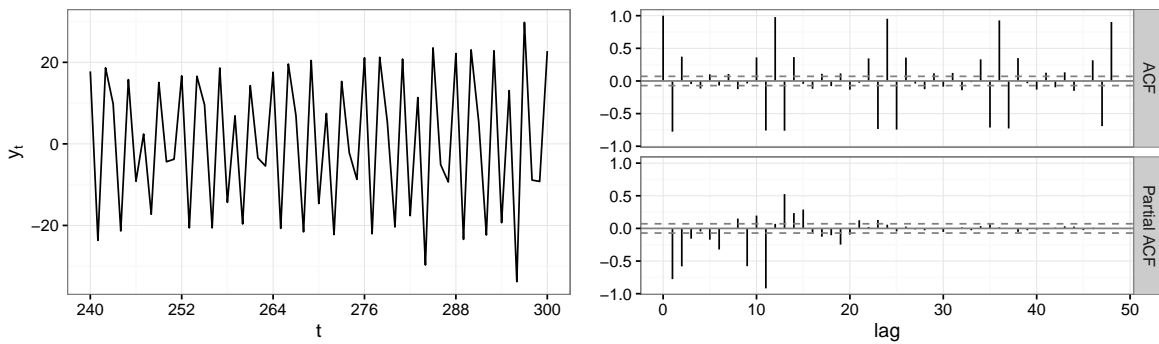
Question	Points	Out of
1		5
2		5
3		5
4		5
Total		20

- The following plots show time series plots, and ACF/PACF plots for a single **monthly** time series: undifferenced (x_t), differenced once ($y_t = x_t - x_{t-1}$), and differenced seasonally ($v_t = x_t - x_{t-12}$). **Using the plots, suggest a SARIMA model for the data, x_t .** Include your reasoning.

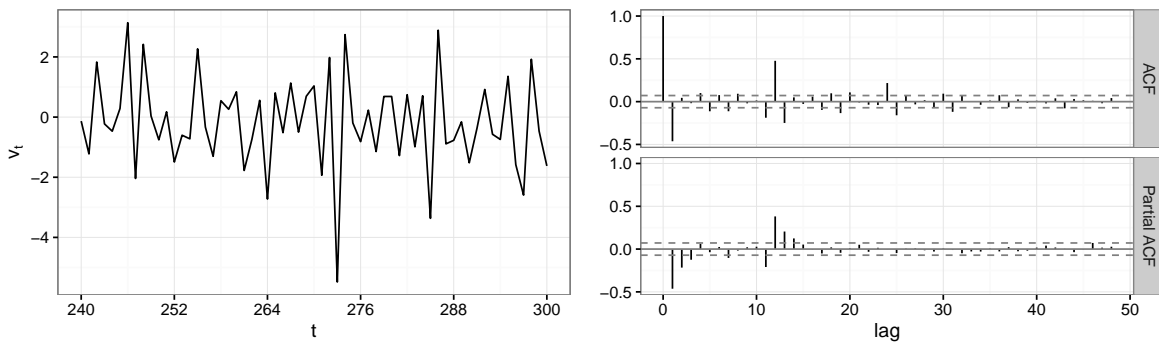
Undifferenced, x_t



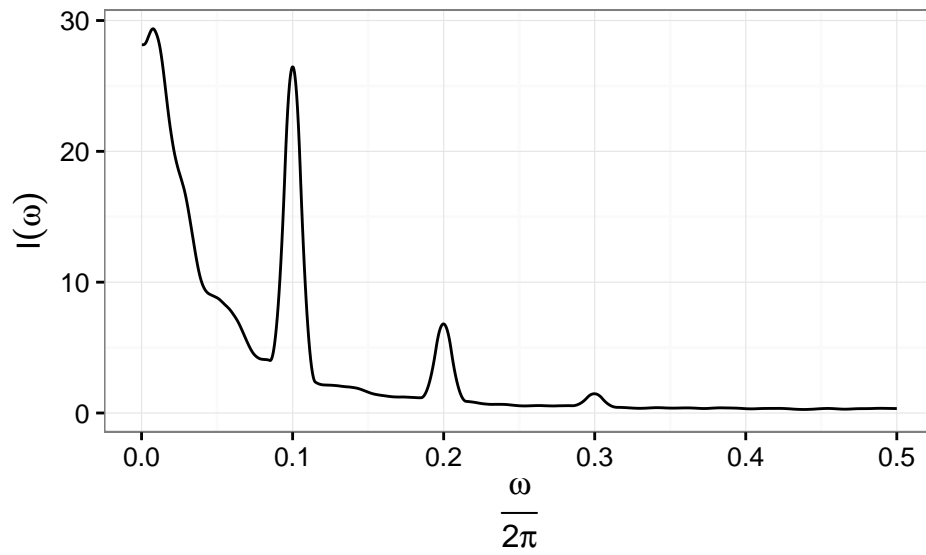
Differenced once, $y_t = x_t - x_{t-1}$



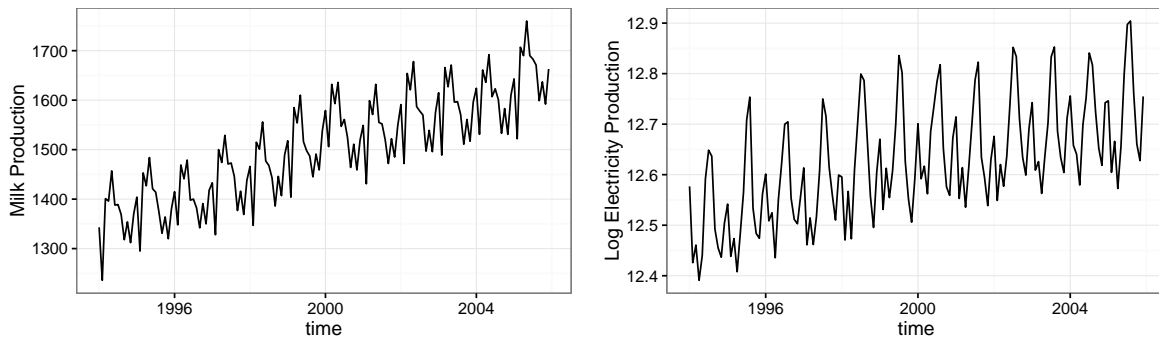
Differenced seasonally, $v_t = x_t - x_{t-12}$



2. The following is a periodogram from an observed time series x_t , $t = 1, \dots, 5000$. **Suggest a model for x_t , and describe what features you might see in a time series plot of x_t .**



3. Below are time series plots of milk production per cow and log electricity production in the United States from 1994 to 2005.



A lactose intolerant researcher is interested in the relationship between the two and fits a regression of log electricity production on milk production per cow and gets the following output from R:

```
summary(lm(log_elec ~ milk))

##
## Call:
## lm(formula = log_elec ~ milk)
##
## Residuals:
##      Min       1Q   Median       3Q      Max
## -0.17386 -0.06666 -0.01961  0.06003  0.21276
##
## Coefficients:
##              Estimate Std. Error t value Pr(>|t|)
## (Intercept)  1.175e+01  1.136e-01 103.441 < 2e-16 ***
## milk         5.812e-04  7.534e-05   7.714 1.95e-12 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 0.09481 on 142 degrees of freedom
## Multiple R-squared:  0.2953, Adjusted R-squared:  0.2904
## F-statistic: 59.51 on 1 and 142 DF,  p-value: 1.949e-12

exp( 100 * 5.812e-04) * 100

## [1] 105.9842
```

They conclude:

There is extremely convincing evidence that milk production is associated with electricity production. A one hundred unit increase in milk production per cow is associated with a 6% increase in median electricity production. To reduce electricity needs we should just drink less milk!

What is wrong with the researcher's approach? What would you suggest they do?

4. You have been put in charge of collecting air samples at a remote forest site in the Cascades. Each day you drive two hours from your accommodation to the site and take samples at noon. You can save a lot of time calibrating the sampling equipment if you know the temperature at the site before you leave your accommodation, however the weather station at the site isn't wireless, so your only option is to guess what the temperature is given what you know before you leave.

At the time you leave your accommodation, you know the temperature at your accommodation today, and the temperature of the site yesterday as well as past values for both. **Discuss how you might go about building a model to forecast:**

- today's temperature at the site,
- tomorrow's temperature at the site, and
- the temperature at the site on Jan 27 2015

Mention what ideas you might explore and how you would explore them, as well as how your approach (or forecasts) might differ between the three time horizons.