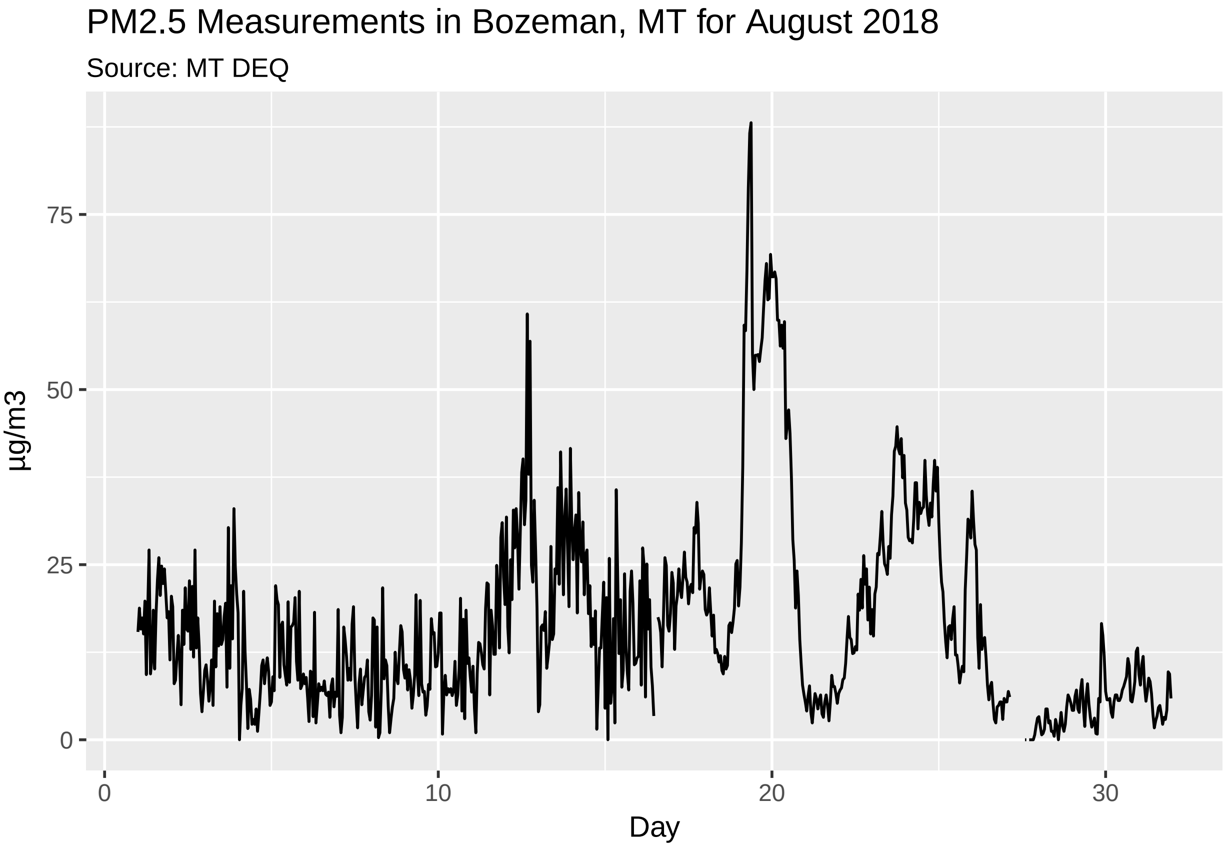
STAT 436 / 536 - Lecture 5

September 12, 2018

Forecasting Strategies

Consider an hourly time series of particulate matter less than 2.5 micrometers from Bozeman, MT in August of 2018.



- What information would be useful to predict the PM2.5 measurments on September 1? How about the PM2.5 measurements for tomorrow?

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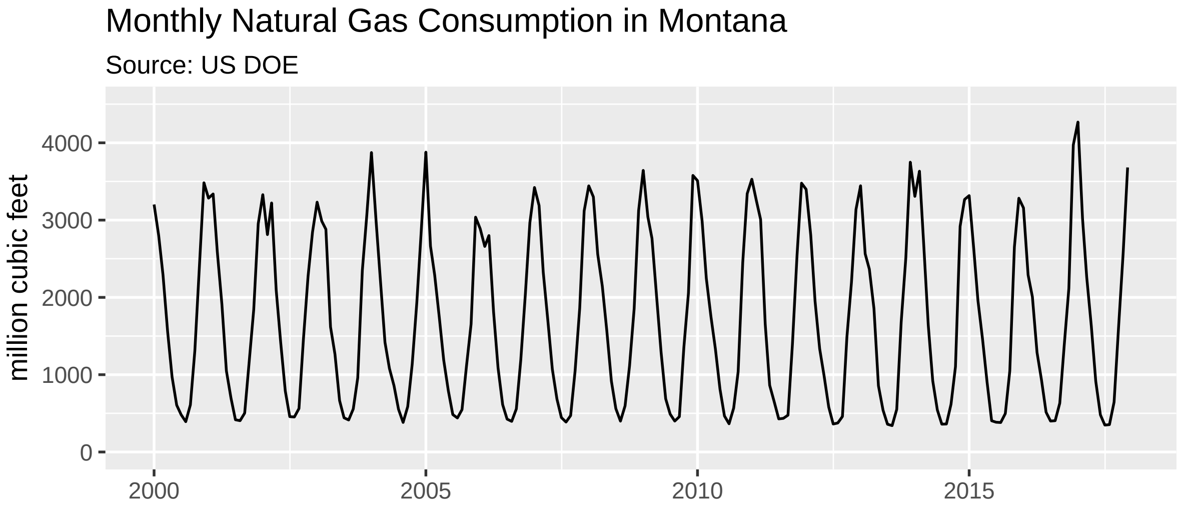
Leading Variables and Associated Variables

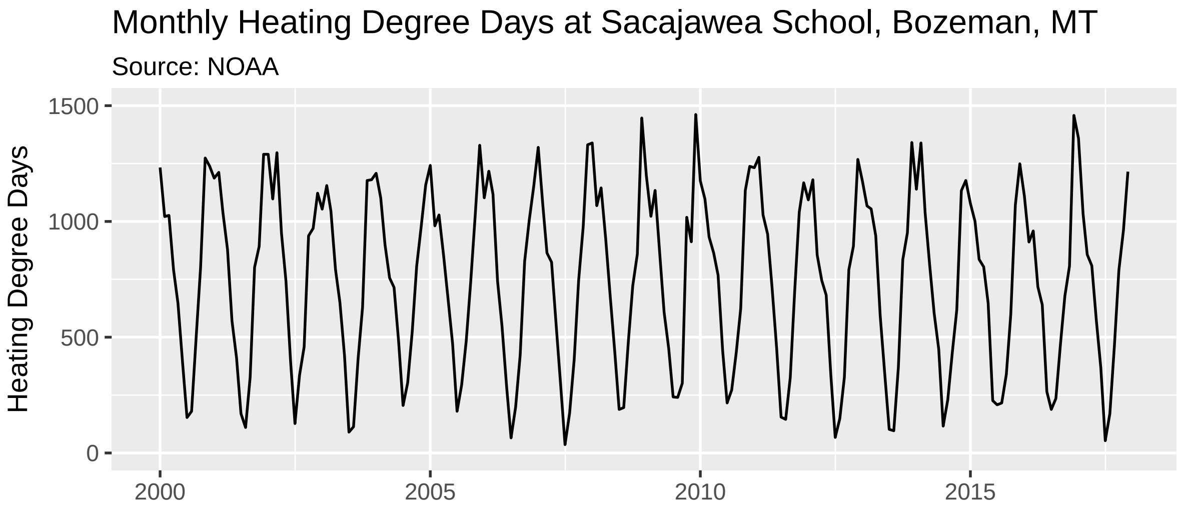
- In some situations another variable may be useful informing our forecasts. A common example of this is in the housing industry where building approvals would be a *leading indicator* of building activity.

- Consider natural gas consumption and heating degree days (HDD).

- What do you assume is the relationship between the heating degree days during a given month and the reported natural gas consumption?


Monthly Natural Gas Consumption in Montana

Source: US DOE


Monthly Heating Degree Days at Sacajawea School, Bozeman, MT

Source: NOAA

Cross-Correlation

- Suppose two times series models, say x and y, are stationary with a constant mean and variance. The variables, x and y, may be serially correlated, perhaps with different time lags.

- The cross covariance function can be written as:

- Q: Is the cross-correlation function symmetric? In other words, does $\gamma_k(x, y) = \gamma_k(y, x)$?

- The sample cross-correlation function (ccf) can be written as

- Similarly to single variable autocorrelation calculations, sample based computations can be made:
  - Sample cross covariance:

  - Sample cross correlation:

- Note the cross correlation and cross covariance functions are defined on the de-seasonalized and de-trended time series, so it will not capture similar patterns in those structures. See HW2 Q1 for a demonstration.

```r
acf(ts.union(ts.weather,ts.consumption))
```

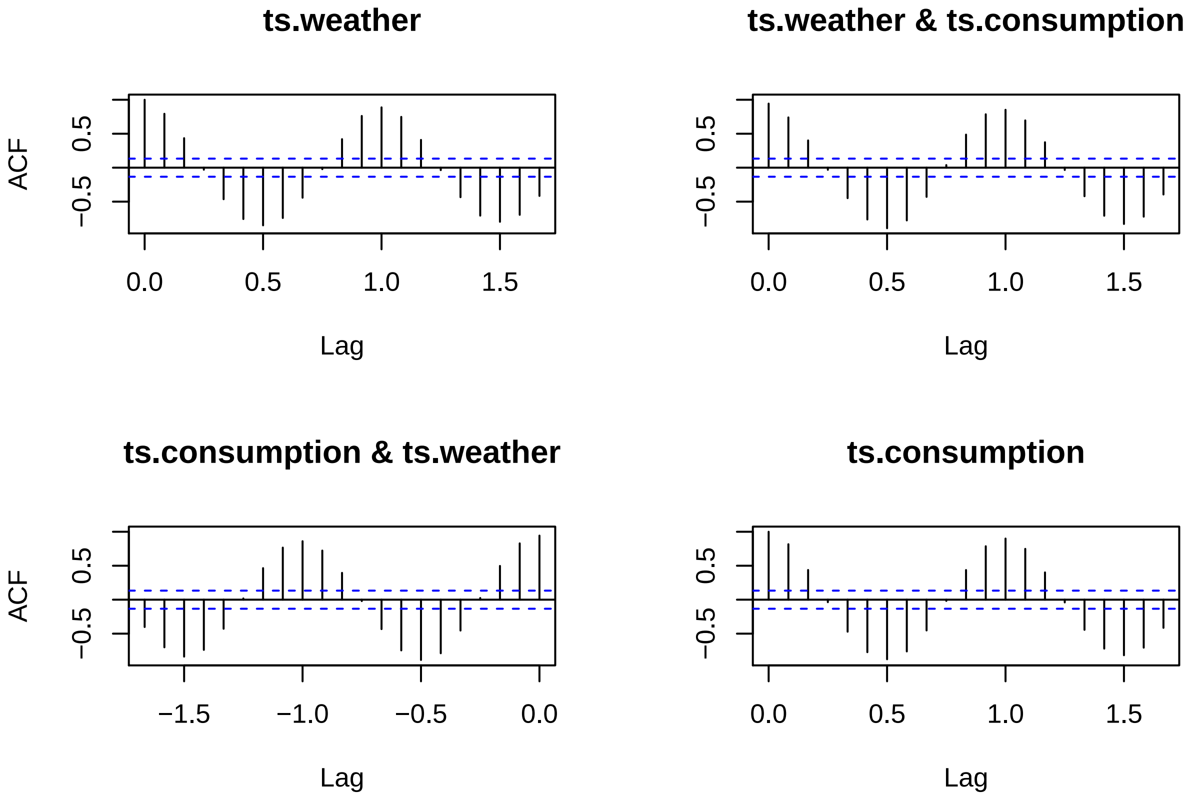


Figure 1: No Decomposition of the Time Series

```r
hdd.random <- decompose(ts.weather)$random %>% window(start=c(2001,1), end = c(2016,12))
gas.random <- decompose(ts.consumption)$random %>% window(start=c(2001,1), end = c(2016,12))
acf(ts.union(hdd.random,gas.random))
```

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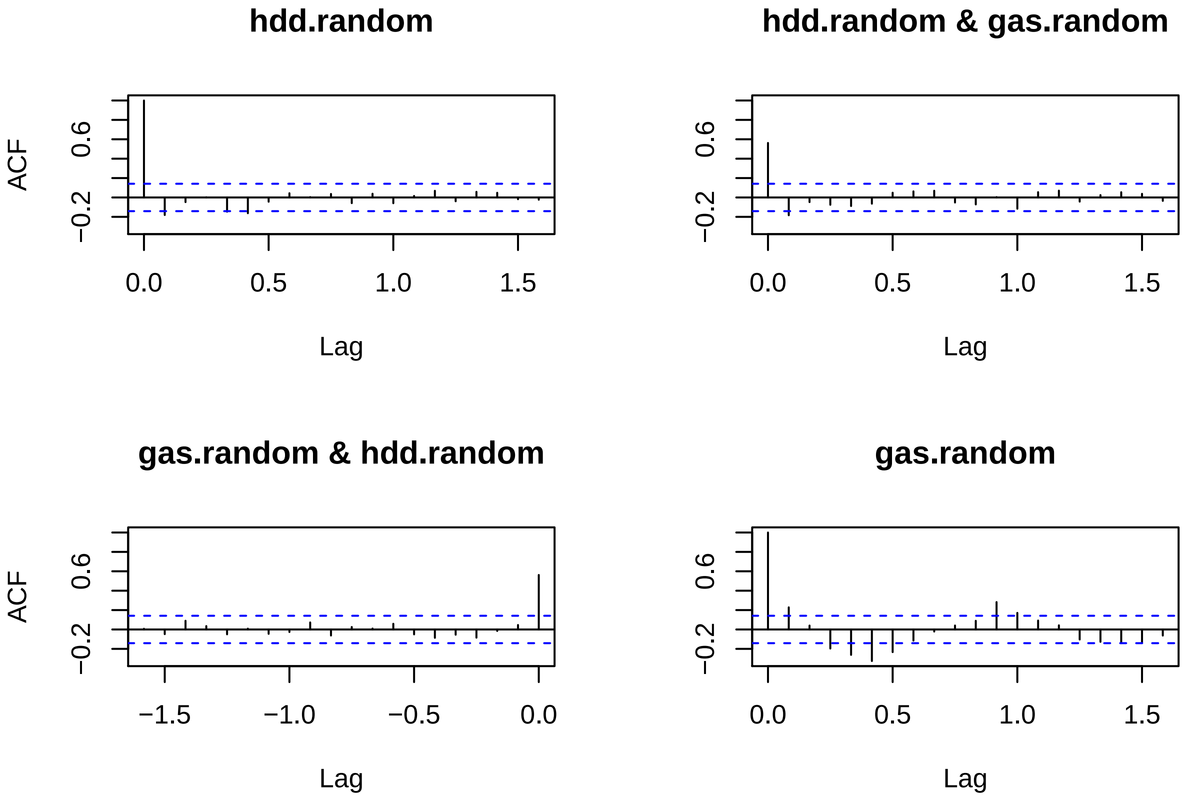

Figure 2: Using the decomposed random component