Math 519 Stochastic Mathematical Modeling

Time Series Homework 2

Homework #5

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**Sheet 1**

i) a graph of the original data (points with no connecting lines) and the fitted curve (straight connecting lines with no points)

**I wasn’t sure why it plotted the line and points offset by 0.5. The High(F) blue dots should be moved to the right by 0.5.**

ii) a graph of the residuals (points with straight connecting lines); comment on remaining patterns, if any.

**There is a sinusoidal trend in the residuals. It is at a higher frequency then the wave in the original figure.**

iii) The resulting equation, like this: f(t) = 40.8+7.1\*sin(2\*pi()\*t/12) + 0.35\*cos(etc)

**y = -7.93 \* sin(t) – 25.10 \* cos(t) + 59.75**

iv) At what time point does the FITTED curve (not the data) hit its maximum? Give it in months, like t=6.137

**Wolfram alpha gives: -5.41577 + 12 \* n for any n. Setting n to 1 gives us a maximum at t = 6.58423**

**Sheet 2**

i) a graph of the original data (blue points with no connecting lines) and the fitted curve (straight connecting lines with no points but open circles that could not avoid)

ii) a graph of the residuals (points with straight connecting lines); comment on remaining patterns, if any.

**There is a down up down up ‘trend’ in this data, and it is at a higher frequency than the residual plot above. The potential ‘trend’ in this residual plot seems less convincing than the one in sheet 1 because this one is more erratic.**

iii) The resulting equation, like this: f(t) = 40.8+7.1\*sin(2\*pi() \* t/12) + 0.35\*cos(etc) + etc + etc

**y = -7.92\*sin (2 \* pi \* t / 12) + -25.1\*cos (2 \* pi \* t / 12) + -0.416\*sin (2 \* pi \* t / 6) + -1.587\*cos (2 \* pi \* t / 6) + 59.75**

iv) At what time point does the FITTED curve (not the data) hit its maximum? Give it in months, like t=6.137

**Wolfram Alpha gave me -5.30893+ 12 \* n, so setting n = 1 we get a max at t = 6.69107.**

v) THE BIG POINT: are the coefficients on the once-a-year terms the same as they were in Problem 1?

**Yes, the coefficients for the sin wave, cosine wave, and the intercept are the same in problems 1 and 2.**

vi) are the twice-a-year waves statistically significant? Look at the P-value column of the regression. If it's below 0.05, then it's stat.sig.

**I did the Linear Regression using the Data Analysis Excel tool. The sin2’s p-value is 0.075968147 and the cos2’s p-value is 0.000294552. The cos2 p-value is certainly statistically significant. The sin2’s p-value is pretty close to statistical significance.**

**Sheet 3**

i) a graph of these data (blue points with no connecting lines) and the fitted curve (straight connecting orange lines with no points (except for open circles that I could not avoid))

ii) a graph of the NEW residuals (points with straight connecting lines); comment on remaining patterns, if any. Are they similar to the residuals in Problem 2.

**The residuals show an up down up down trend that is erratic and somewhat unconvincing as a trend. It looks identical to the residual plot in sheet 2.**

iii) The resulting equation, like this: f(t) = 40.8+7.1\*sin (2\*pi () \* t/12) + 0.35 \* cos (etc) + etc + etc

**y = 0 \* sin (2 \* pi \* t / 12) + 0 \* -cos (2 \* pi \* t / 12)) + -0.416 \* sin (2 \* pi \* t / 6) + -1.587 \* cos (2 \* pi \* t / 6) + 0**

iv) Comment on the resulting offset.

**The offset is so low that it is essentially zero.**

v) Comment on the coefficients for the once-a-year waves.

**The coefficients of the first waves are so low that they are essentially zero.**

vi) Comment on the coefficients for the twice-a-year waves.

**Here are the coefficients of the twice a year waves:**

|  |  |
| --- | --- |
| sin2 coeff | cos2 coeff |
| -0.416666667 | -1.58771324 |

The coefficients are small numbers, but given that every other coefficient is zero (once a year sin and cosine waves and the offset), these are the only coefficients that contribute to the wave’s shape.

**Sheet 4**

i) What do you notice about the coefficients of the two fits? Hit F9 to refresh the data a few times.

**The coefficients are the same.**

ii) What do you notice about the R^2 values for the two fits? Hit F9 to refresh the data a few times.

**The R^2 value for the month average plot is higher (~.99) than the full data set plot (~.94).**

iii) What conclusion can you make about what happens when you average before fitting a wave?

**The coefficients will be the same but the R^2 value will be higher for the averaged data.**

iv) Should you average before fitting a wave? Explain.

**If the sin cos function fits the data reasonably well for all three years, then it is ok to fit the average. Note that the averaged fit will give an elevated R^2 value and does not reflect the fit on the original data points.**

v) (optional) Can you explain why the coefficients for the 3-year and the monthly average relate to each other that way?

**Sheet 5**

i) Graph it

ii) Fit an appropriate function to it. You might need to do this in two stages.

I fit a function using LINEST where I had these variables: offset, linear var, sin var, cos var.

My coefficients:

|  |  |  |  |
| --- | --- | --- | --- |
| COS | SIN | LIN | OFFSET |
| -1.217093733 | -2.48069469 | 0.375323675 | 9.971263555 |

My function:

-1.2\*COS(2\*PI() \* t/12)-2.48\*SIN(2\*PI() \* t)+0.37\*t+9.97

iii) Plot the predicted values on top of the original function

iv) Plot the residuals on their own plot, and comment on any remaining patterns.

There is still a sinusoid trend. The trend seems to have the same frequency as the original sin wave. Maybe I should have fitted the original points with two sin waves and two cosine waves.