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Fall 2016 MSAN 604: Quiz 5

Thursday November 30th, 2016

Question 1

Smoothing methods, such as the Holt-Winters methodology, are commonly used to model and forecast univariate time series.

(a) For which types of time series is single vs. double vs. triple exponential smoothing appropriate? Explain.

- Single exponential smoothing is appropriate for modeling a time series with no trend and no seasonality ✓

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- Double exponential smoothing is appropriate for modeling and forecasting a time series with trend but no seasonality. ✓

- Triple exponential smoothing is appropriate for modeling and forecasting a time series with both trend and seasonality. ✓

(b) In parts (i) – (iii) below write α, β or γ into the first space (whichever is appropriate) and write either "more" or "less" into the second space (whichever is appropriate).

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i. Larger values of α make the *level* recursion less smooth ✓

ii. Smaller values of β make the *trend* recursion more smooth ✓

iii. Larger values of γ make the *seasonal* recursion less smooth ✓

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Question 2

(a) In the context of multivariate time series, explain what is meant by *exogenous* and *endogenous* variables.

When several variables are available with one considered to be more important than the others (i.e., a response), the other variables are call exogenous if they influence the response but the response doesn't influence them. If all variables influence eachother then other of the variables are called endogenous.

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(b) In the context of multivariate time series, explain the distinction between ARIMAX and vector autoregression models. Be sure to indicate when one is to be preferred over the other.

- An ARIMAX model accounts for the dependence of the response on the exogenous variables and ignores any possible influnce the response has on them.

- A VAR model is not uni-directional; it simultaneously accounts for the dependencies between all variables (endogenous)

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- An ARIMAX model is appropriate if you believe a uni-directional relationship exist between one variable and all others and VAR is appropriate if all variables are influence by every other one.

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(c) Suppose three time series $\{Y_{1,t}\}$, $\{Y_{2,t}\}$ and $\{Y_{3,t}\}$ are observed and a VAR model is fit to this data, with output shown below.

```
VAR Estimation Results:
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Estimated coefficients for equation Y1:
=======================================
Call:
Y1 = Y1.11 + Y2.11 + Y3.11 + const

      Y1.11       Y2.11       Y3.11       const
 0.94785467  0.04471752  0.01896115 -0.62981778


Estimated coefficients for equation Y2:
=======================================
Call:
Y2 = Y1.11 + Y2.11 + Y3.11 + const

       Y1.11        Y2.11        Y3.11        const
-0.006215883  0.946775900  0.049482241  1.707780452


Estimated coefficients for equation Y3:
=======================================
Call:
Y3 = Y1.11 + Y2.11 + Y3.11 + const

       Y1.11        Y2.11        Y3.11        const
 0.003835914 -0.029944489  1.016780263  1.504933670
```

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i. What is the order, p, of this VAR model?

$p=1$ ✓

ii. Using the output above write down the equations that explicitly state the dependence between these three variables. Please round coefficients to two decimal places.

$$Y_{1,t} = -0.63 + 0.95\,Y_{1,t-1} + 0.05\,Y_{2,t-1} + 0.02\,Y_{3,t-1}$$ ✓

$$Y_{2,t} = 1.71 - 0.01\,Y_{1,t-1} + 0.95\,Y_{2,t-1} + 0.05\,Y_{3,t-1}$$ ✓

$$Y_{3,t} = 1.51 + 0.00\,Y_{1,t-1} - 0.03\,Y_{2,t-1} + 1.02\,Y_{3,t-1}$$ ✓