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Final Exam: TIME SERIES ANALYSIS (SS 2005)

Task 1

1-1) Suppose, you want to fit a univariate ARMA(p,q) model for a stochastic process $\{y_t\}_t$. What are the necessary properties of the stochastic process in order to fit such a model if you can (as you do in a real world application) only observe one realization of the process? **(5)**

1-2) Consider the following stochastic process:

$$y_t = \phi y_{t-1} + \varepsilon_t$$

where $\varepsilon_t \sim N(0,1)$. Show, that for $|\phi| < 1$ the impact of the time t shock ε_t on the value of the process j periods ahead y_{t+j} goes to zero if j gets large. What is the dynamic multiplier in this context? **(8)**

Task 2

Discuss the following statements:

2-1) If a MA(q) process is invertible one should not estimate the process with conditional maximum likelihood techniques. **(3)**

2-2) For a non-stationary Gaussian process $\{Y_t\}$, all sample moments converge in probability to expectations. **(3)**

2-3) An MA(2) process $y_t = c + \theta_1\varepsilon_{t-1} + \theta_2\varepsilon_{t-2} + \varepsilon_t$ is said to be stationary, if all θ_q are less than one in absolute value. **(3)**

2-4) Solely the MA part of an ARMA(p,q) process determines whether the process is stationary. **(3)**

2-5) If you want to explore the dynamics of three I(1) variables it is always the best strategy to estimate a vector equilibrium correction model (VECM). **(5)**

Task 3

You are interested to model the effects of Swiss Monetary policy. You consider the following Swiss variables for your analysis: the consumer price index (CPI) in logs, the log GDP in 1990 Swiss francs, the log money stock M1 variable, and the quarterly average of three month Swiss franc LIBOR rate of interest. Your task is to suggest an appropriate econometric model for the variables mentioned above.

3-1) First, you asses by an appropriate Dickey/Fuller test specification whether the series are non-stationary. For the level of CPI this results in a τ-value of -1.65, for the GDP we have a τ-value of -0.63. The p-value of a Dickey/Fuller test for M1 is 0.54 and for the LIBOR we calculate a p-value of 0.14. What would you conclude from these test statistic results? **(8)**

3-2) You want to check whether the series are cointegrated. For that purpose you conduct Johansen's cointegration test using EVIEWS and test the hypotheses that there exist up to $(n-1)$ relations in the system. You receive the following EVIEWS output. Identify the number of cointegrating relations. Explain how you arrive at your conclusion. **(8)**

Table 1: Johansen Test

Sample(adjusted): 1975:2 2002:1

Unrestricted Cointegration Rank Test

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	5 Percent Critical Value	1 Percent Critical Value
None *	0.208896	51.45943	47.21	54.46
At most 1	0.106353	26.15228	29.68	35.65
At most 2	0.072215	14.00834	15.41	20.04
At most 3 *	0.053280	5.913227	3.76	6.65

*(**) denotes rejection of the hypothesis at the 5%(1%) level

Trace test indicates 1 cointegrating equation(s) at the 5% level

Trace test indicates no cointegration at the 1% level

3-3) Based on the Dickey/Fuller and Johansen test results suggest two alternatives to model Swiss monetary policy. Formulate the model specifications and discuss the associated implicit assumptions. **(5)**

Task 4

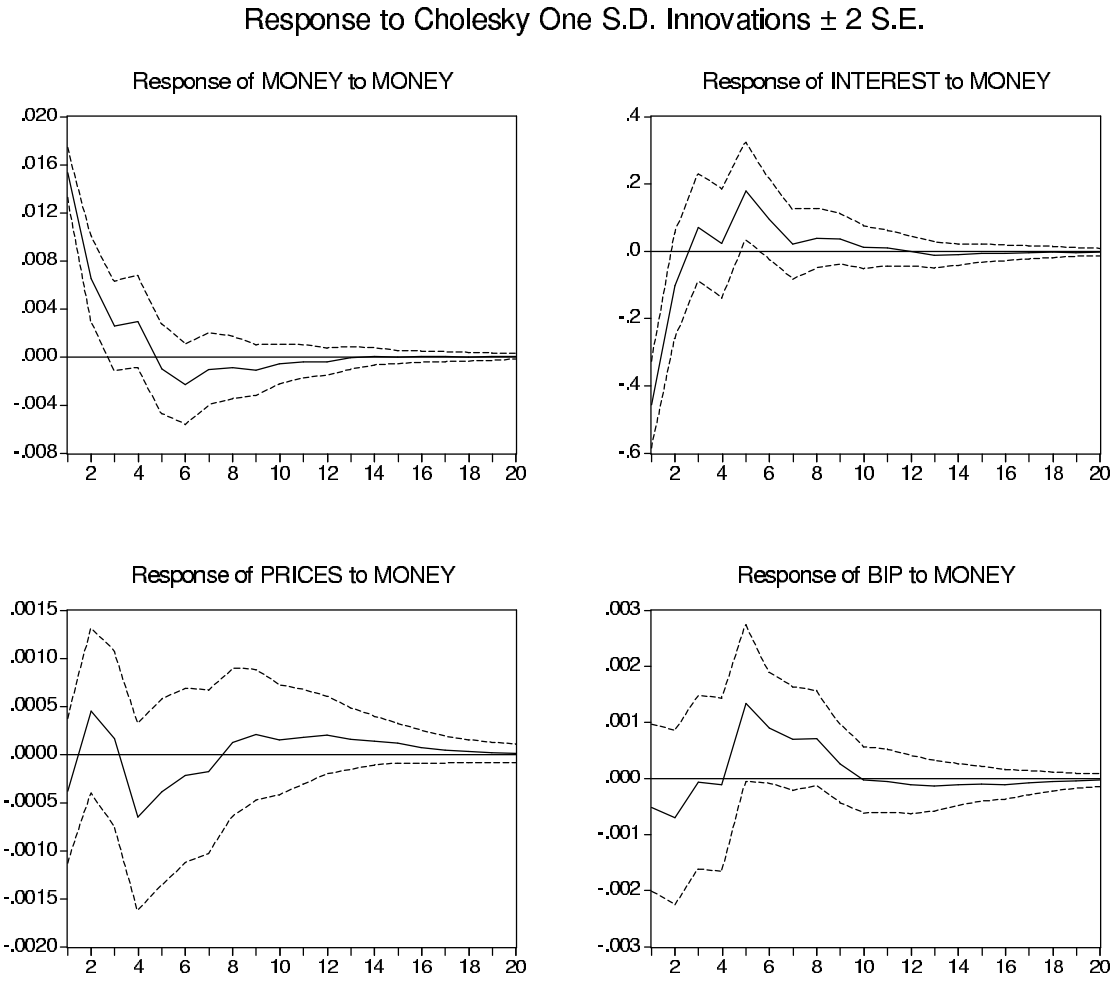
Suppose you want to estimate the Swiss Monetary policy of **Task 3** by a structural VAR model. The following Cholesky ordering is given: money, interest rate, prices, GDP.

4-1) What are the economic implications of this Cholesky ordering? **(8)**

4-2) Write down explicitly the system equations of the structural VAR in primitive form with four lags (do not write out all the lags extensively) implied by this Cholesky ordering. **(8)**

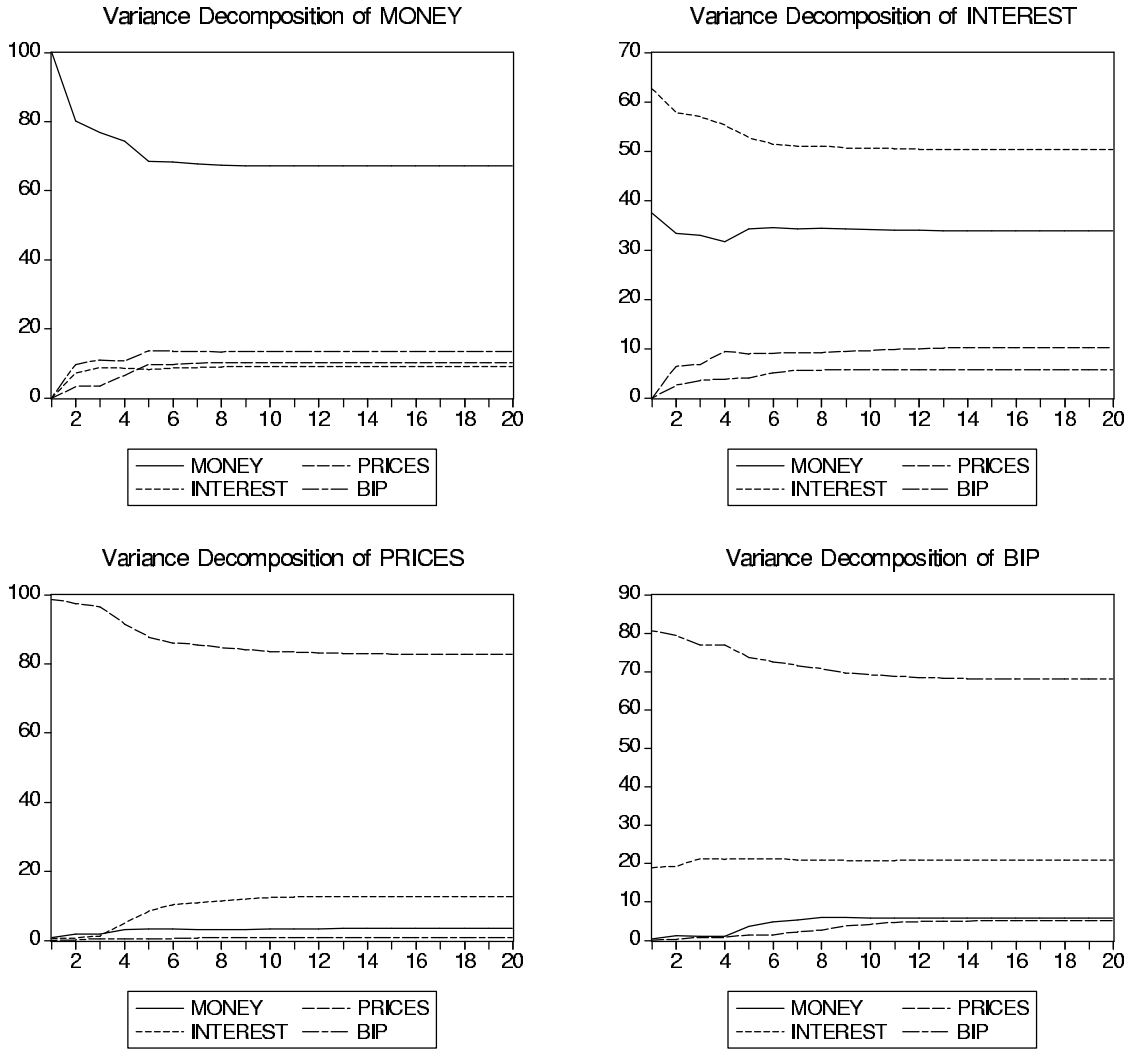
4-3) Figure **??** depicts the impulse response functions for the estimated VAR model with 95% confidence intervals. Which of the variables are significantly effected by a monetary shock and at which horizon? **(8)**

Figure 1: Impulse Response Functions



4-4) Interpret the variance decomposition plots depicted in Figure **??**. **(8)**

Figure 2: Variance Decomposition



Task 5

You want to analyze the interdependence between South East Asian stock markets. For this purpose you estimate a VAR model with EViews for the returns of five stock markets over the sample period from 1/01/1985 to 4/29/1999: Hong Kong, Japan, Singapore, Korea and Thailand.

In order to determine the lag length using Akaike and Schwarz-Bayes Information criteria (AIC and SBC) you estimate the VAR in standard form with nine different lag lengths (the same in each equation). Column two of Table **??** reports the maximum value of the respective joint log-likelihood functions and column three and four contain the associated AIC and SBC value.

5-1) Which specification would you prefer when looking at the Akaike (AIC) and the Schwarz-

Table 2: Selection Criteria
VAR Lag Order Selection Criteria
Endogenous variables: Hong Kong, Japan, Singapore, Korea, Thailand
Exogenous variables: C
Included observations: 3729

Lag	max. Likelihood	AIC	SBC
0	51769.00	-27.76294	-27.75460
1	52053.11	-27.90191	-27.85184
2	52116.53	-27.92251	-27.83072
3	52191.60	-27.94937	-27.81585
4	52249.00	-27.96675	-27.79150
5	52274.33	-27.96693	-27.74995
6	52288.08	-27.96089	-27.70219
7	52308.92	-27.95866	-27.65823
8	52331.59	-27.95741	-27.61526

Bayes criterion, respectively? Explain why the Akaike and the Schwarz-Bayes Information criteria select two different models. **(3)**

5-2) Compute a likelihood ratio test between the two optimal models selected by AIC and SBC. Which model would you choose according to your result? **(5)**

Task 6

6-1) You want to estimate a univariate ARMA model for the seasonally adjusted log-GDP series. Looking at the correlogram of the series in figure **??** reveals the following picture. Can you estimate the model properly? If not, explain why and suggest a different strategy. **(5)**

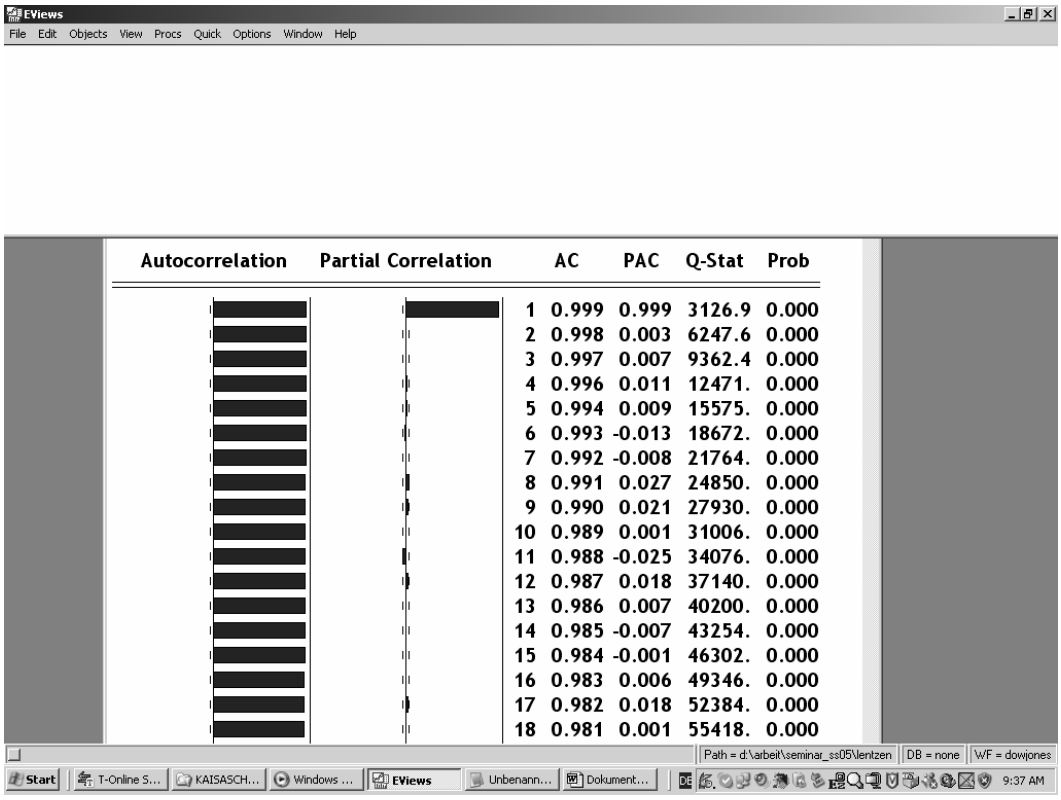
6-2) A researcher has estimated a model that delivers the following output in EViews ("BIPNSA" is the variable name for the seasonally adjusted GDP in the EViews workfile):

Table 3: Estimation output
Dependent Variable: DLOG(BIPNSA)
Method: Least Squares
Date: 09/30/05 Time: 11:29
Sample(adjusted): 1974:4 2001:4
Included observations: 109 after adjusting endpoints
Convergence achieved after 3 iterations

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.0094	0.0015	6.3424	0.0000
AR(1)	0.2883	0.0945	3.0524	0.0029
AR(2)	0.1584	0.0948	1.6714	0.0976

Write down explicitly the equation that was estimated and interpret the significance of the parameter estimates. **(5)**

Figure 3: Correlogram



6-3) The residuals of the estimated model still exhibit significant autocorrelation. Does this fact disturb you and if yes, how do you go about this problem? **(5)**

6-4) Use the lag operator notation to formulate an equation for the following stochastic processes: **(6)**

- AR(1)
- ARMA(2,3)
- ARIMA(1,1,1)