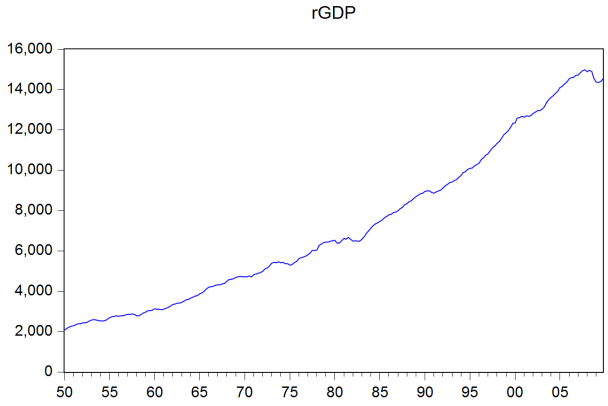
Homework 6

Eco 4306 Economic and Business Forecasting
Spring 2018
Due: Thursday, March 29, before the class

Problem 1

(a) The plot of the real GDP shows that it is growing over time and appears to be fluctuating around an exponential trend. Thus it seems reasonable to estimate a model $\log rGDP_t = \beta_0 + \beta_1 t + u_t$.

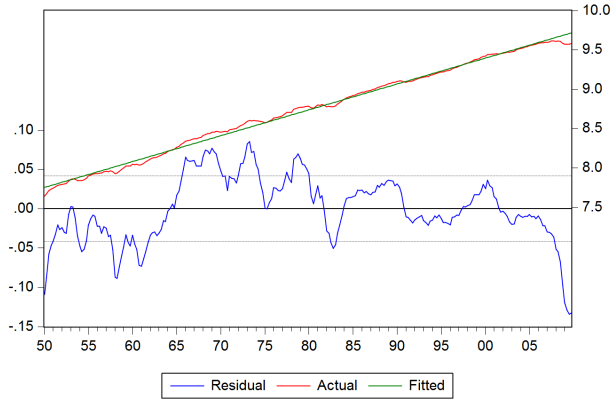


Dependent Variable: LOG(RGDP)
Method: Least Squares
Date: 04/05/18 Time: 17:55
Sample: 1950Q1 2009Q4
Included observations: 240

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7.652593	0.005778	1324.332	0.0000
@TREND	0.008226	3.89E-05	211.5913	0.0000

R-squared	0.994712	Mean dependent var	8.734316
Adjusted R-squared	0.994690	S.D. dependent var	0.572618
S.E. of regression	0.041727	Akaike info criterion	-3.507048
Sum squared resid	0.414388	Schwarz criterion	-3.478042
Log likelihood	422.8457	Hannan-Quinn criter.	-3.495360
F-statistic	44770.87	Durbin-Watson stat	0.053231
Prob(F-statistic)	0.000000		

(b) The actual, fitted, residuals graph, and also the correlogram for residuals are shown below.



Date: 04/05/18 Time: 17:55
Sample: 1950Q1 2009Q4
Included observations: 240

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob
		1	0.938	0.938	213.75	0.000
		2	0.860	-0.160	394.34	0.000
		3	0.781	-0.039	543.90	0.000
		4	0.706	-0.014	666.43	0.000
		5	0.640	0.033	767.61	0.000
		6	0.591	0.088	854.40	0.000
		7	0.552	0.011	930.24	0.000
		8	0.513	-0.032	996.10	0.000
		9	0.482	0.046	1054.5	0.000
		10	0.447	-0.053	1105.1	0.000
		11	0.409	-0.028	1147.6	0.000
		12	0.378	0.051	1184.0	0.000
		13	0.359	0.072	1216.9	0.000
		14	0.346	0.029	1247.7	0.000
		15	0.336	-0.011	1276.8	0.000
		16	0.323	-0.031	1303.8	0.000
		17	0.302	-0.051	1327.6	0.000
		18	0.277	-0.010	1347.8	0.000
		19	0.251	-0.006	1364.4	0.000
		20	0.229	0.029	1378.2	0.000
		21	0.211	0.010	1390.0	0.000
		22	0.199	0.019	1400.6	0.000
		23	0.191	-0.008	1410.3	0.000
		24	0.185	0.014	1419.4	0.000

Residuals do not show any systematic pattern but they are very persistent. The slowly decaying ACF and the large and significant lags 1 and 2 in the PACF imply that residuals in the model in (a) are not white

noise, and an AR(2) model should be used for innovations, so that

$$\log rGDP_t = \beta_0 + \beta_1 t + u_t$$
$$u_t = \phi_1 u_{t-1} + \phi_2 u_{t-2} + \varepsilon_t$$

(c) The results for the modified model are below.

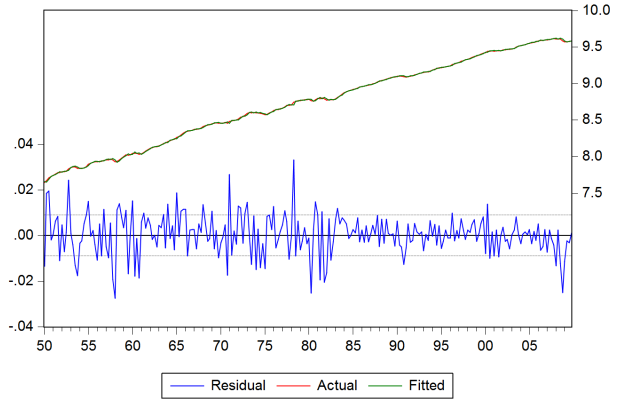
Dependent Variable: LOG(RGDP)
Method: ARMA Maximum Likelihood (OPG - BHHH)
Date: 04/05/18 Time: 17:55
Sample: 1950Q1 2009Q4
Included observations: 240
Convergence achieved after 16 iterations
Coefficient covariance computed using outer product of gradients

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	7.630601	0.035870	212.7278	0.0000
@TREND	0.008213	0.000338	24.28694	0.0000
AR(1)	1.389366	0.053992	25.73282	0.0000
AR(2)	-0.410225	0.054558	-7.519009	0.0000
SIGMASQ	7.71E-05	5.67E-06	13.60706	0.0000

R-squared	0.999764	Mean dependent var	8.734316
Adjusted R-squared	0.999760	S.D. dependent var	0.572618
S.E. of regression	0.008874	Akaike info criterion	-6.574422
Sum squared resid	0.018508	Schwarz criterion	-6.501908
Log likelihood	793.9306	Hannan-Quinn criter.	-6.545204
F-statistic	248701.5	Durbin-Watson stat	2.107250
Prob(F-statistic)	0.000000		

Inverted AR Roots	.96	.43

Residuals are no longer showing any systematic patterns, large persistence, or significant linear dependence, and thus appear to be white noise.



Date: 04/05/18 Time: 17:55
Sample: 1950Q1 2009Q4
Included observations: 240
Q-statistic probabilities adjusted for 2 ARMA terms

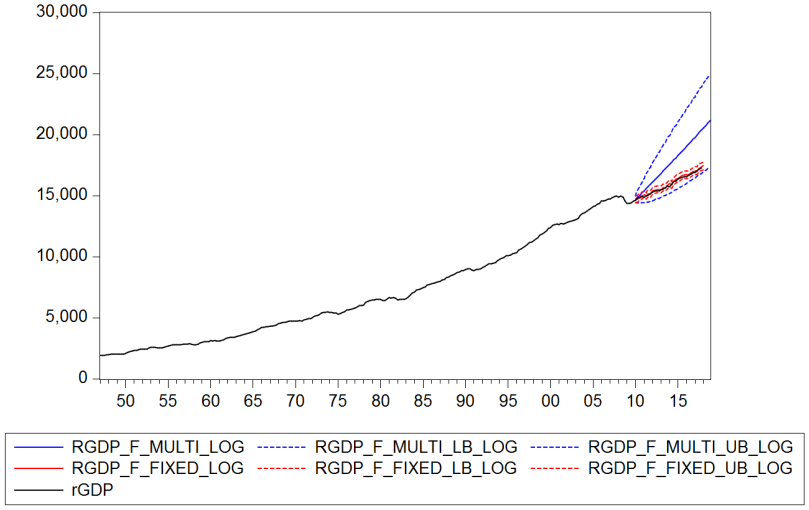
Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob*
		1	-0.061	-0.061	0.9058	
		2	0.065	0.062	1.9504	
		3	-0.006	0.002	1.9589	0.162
		4	0.005	0.001	1.9654	0.374
		5	-0.107	-0.108	4.8137	0.186
		6	0.031	0.019	5.0515	0.282
		7	0.011	0.028	5.0844	0.406
		8	-0.075	-0.077	6.4747	0.372
		9	0.089	0.080	8.4564	0.294
		10	0.066	0.076	9.5573	0.297
		11	0.011	0.012	9.5856	0.385
		12	-0.102	-0.111	12.228	0.270
		13	-0.070	-0.105	13.492	0.262
		14	0.017	0.047	13.567	0.329
		15	-0.055	-0.027	14.337	0.351
		16	0.092	0.077	16.526	0.282
		17	0.026	0.033	16.703	0.337
		18	0.022	0.006	16.826	0.397
		19	-0.031	-0.035	17.085	0.449
		20	0.047	0.006	17.680	0.477
		21	-0.106	-0.080	20.649	0.357
		22	0.023	0.049	20.790	0.410
		23	-0.055	-0.036	21.614	0.422
		24	0.040	0.036	22.053	0.457

*Probabilities may not be valid for this equation specification.

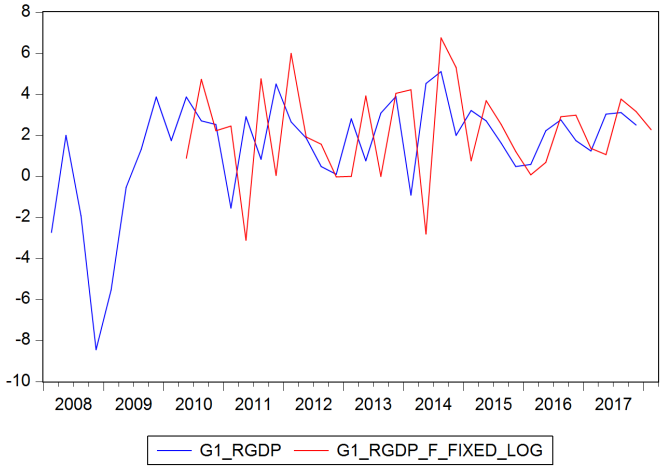
(e) The multistep forecast for period 2010Q1-2018Q1 is shown below; the RMSE for this forecast is 1844.72.

(f) The fixed scheme sequence of one step ahead forecasts for period 2010Q1-2018Q1 is shown below; the RMSE for this fixed scheme forecast is 102.21.

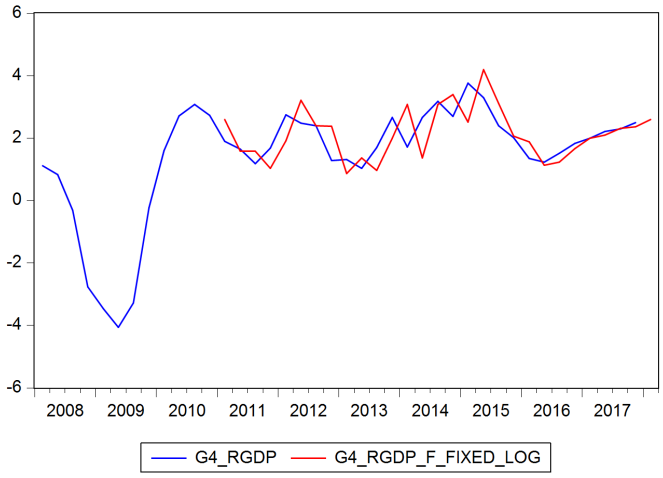
(g) The fixed scheme yields a lower RMSE than the multistep forecast, which is also visible in the two plots - the confidence interval of the fixed scheme forecast is narrower, and the forecast is closer to the center of the confidence interval since the forecast is more closely aligned with actual data. The deterministic trend modle predicts that after a large negative shock the time series will recover and over time get back to the original trend. This is the reason why the multistep forecast is so different from the actual data - U.S. Real GDP did not get back to the original trend after 2008 recession, which appears to have a permanent effect on its level.



(h) Figure below shows the quarter-over-quarter growth rate for the actual real GDP and the forecast. The forecast for 2018Q1 is 2.3%.



(i) Figure below shows the year-over-year growth rate for the actual real GDP and the forecast. The forecast for 2018Q1 is 2.6%.



(j) As of April 5, 2018, the GDPNow Federal Bank of Atlanta forecast for 2018Q1 is 2.3%. The average forecast in the Wall Street Journal Economic Forecasting Survey is 2.5%, minimum 1.8%, maximum 4.5%.