Week6:

- 11. Write the equation that defines a process ARMA(0,1)(0,1)12 with parameters $\theta_{12} = 0.8$ and $\theta_1 = 0.6$ and find the ACF of the process.
- 12. Write the equation that defines a process ARMA(1,0)(1,0)4 with parameters $\phi_4 = 0.8$ and $\phi_1 = 0.6$ and find the PACF of the process.
- 13. Suppose that you want to analyze a given time series data with the correlogram of Figure 1. According to this information, what is the best model for this time series? Justify your answer.

| Autocorrelation | Partial Correlation | AC | PAC | Q-Stat | Prob |
|-----------------|---------------------------------------|-----------|----------|--------|-------|
| | | 1 -0.444 | 4 -0.444 | 22.515 | 0.000 |
| ון ו | | 2 0.028 | 3 -0.211 | 22.608 | 0.000 |
| 1 1 | יםי | 3 0.019 | 5 -0.083 | 22.634 | 0.00 |
| יםי | | 4 -0.097 | 7 -0.155 | 23.728 | 0.00 |
| 1 p 1 | 1 1 | 5 0.094 | 4 -0.027 | 24.779 | 0.00 |
| יםי | י םי | 1 | 3 -0.118 | 26.176 | 0.00 |
| יםי | יםי | 1 | 3 -0.075 | 26.400 | 0.00 |
| יםי | 1 1 | 1 | 6 -0.003 | 26.561 | 0.00 |
| יו | I I I I I I I I I I I I I I I I I I I | 9 0.040 | | 26.755 | 0.00 |
| יןי | יוףי | 10 -0.030 | | 26.913 | 0.00 |
| י ף י | | 11 0.118 | | 28.651 | 0.00 |
| | | | 4 -0.367 | 49.305 | 0.00 |
| · 🗖 | י םי | 13 0.259 | | 57.870 | 0.00 |
| יני | יםי | 1 | 7 -0.049 | 58.049 | 0.00 |
| 1 () | ווי | | 5 -0.037 | 58.213 | 0.00 |
| · • | | | 7 -0.023 | 59.213 | 0.00 |
| ·□ · | יםי | | 0 -0.077 | 61.134 | 0.00 |
| · 🗖 | | 18 0.253 | | 69.727 | 0.00 |
| – – | ' <u> </u> ' | 19 -0.176 | | 73.950 | 0.00 |
| 1 | ן יםי | | -0.071 | 74.249 | 0.00 |
| 1 1 1 | 1 1 | 21 0.056 | | 74.690 | 0.00 |
| יםי | וןיין | 22 -0.056 | | 75.134 | 0.00 |
| 1 🛛 1 | | 23 0.053 | | 75.530 | 0.00 |
| | יםי | 24 0.039 | | 75.753 | 0.00 |
| יםי | יםי | | 4 -0.109 | 77.318 | 0.00 |
| | | 1 | 3 -0.020 | 78.342 | 0.00 |
| 101 | <u>'</u> ¶' | 1 | 5 -0.090 | 78.644 | 0.00 |
| | | | 5 -0.029 | 78.676 | 0.00 |
| | | 29 0.087 | | 79.838 | 0.00 |
| | ון יו | 30 -0.210 | 0 -0.027 | 86.688 | 0.00 |

Week 7:

- 14. Are the following processes stationary/causal? Are the following processes invertible? Justify your answers. Consider that $\varepsilon_t \sim WN(0, \sigma_{\epsilon}^2)$.
 - a. $y_t = \varepsilon_t + 0.8 \varepsilon_{t-1} \varepsilon_{t-2}$
 - b. $y_t = 0.6 y_{t-1} + 0.4 y_{t-2} + \varepsilon_t$
 - c. $y_t = (1 0.7L + 0.3L^2) \varepsilon_t$
- 15. Consider the process ARMA(1,1) with $\phi = 0.8$ and $\theta = 0.5$ and with mean equal to 10.
 - a. Formulate the equation that defines the process

Week 8:

- 16. For the following processes identify the orders of the autoregressive and moving average part and write the ARMA representation without the lag operator:
 - i. $Y_t = (1 0.5L)\varepsilon_t$
 - ii. $(1 + 0.8L)Y_t = (1 1.2L)\varepsilon_t$
 - iii. $(1 0.7L + 0.4L^2)Y_t = (1 1.2L)\varepsilon_t$
 - iv. $(1 + 0.8L)Y_t = (1 0.7L + 0.4L^2 + L^3)\varepsilon_t$
- 17. Consider the following models where $\varepsilon_t \sim WN(0, \sigma_{\epsilon}^2)$:
 - i. $Y_t = Y_{t-1} + \varepsilon_t 1.5\varepsilon_{t-1}$
 - ii. $Y_t=0.8Y_{t-1}+\epsilon_t-0.5\epsilon_{t-1}$
 - iii. $Y_t = 1.1Y_{t-1} + 0.8Y_{t-1} + \epsilon_t 1.7\epsilon_{t-1} + 0.72\epsilon_{t-2}$
 - iv. $Y_t = 0.6Y_{t-1} + \epsilon_t 1.2\epsilon_{t-1} + 0.2\epsilon_{t-2}$
 - a) Verify if Y_t is stationary and invertible.
 - b) Characterize the behavior of the ACF and PACF.

18. In the following figure you may find the ACF and PACF of four time series.

| Autocorrelation | Partial Correlation | AC | PAC | Q-Stat | Prob |
|-----------------|---------------------|--|---|--|--|
| | | 1 0.877 | 0.877 | 103.76 | 0.000 |
| | · • | 2 0.673 | | 165.34 | 0.000 |
| · 💻 | I | 3 0.524 | | 203.04 | 0.000 |
| · 💻 | 1 10 | 4 0.430 | | 228.61 | 0.000 |
| · 💻 | 1 1 | 5 0.357 | | 246.34 | 0.000 |
| | q + | 6 0.254 | | 256.14 | 0.000 |
| : P | 1 11 | 7 0.159 | | 259.72 | 0.000 |
| | 1 11 | 8 0.075 | | 260.53 | 0.000 |
| 140 | 1 20 | 9 0.010 | | 260.54 261.15 | 0.000 |
| | 1 36 | 11 -0.121 | | 263.30 | 0.000 |
| | | 12 -0.161 | -0.133 | 267.13 | 0.000 |
| - , | | 13 -0.207 | | 273.53 | 0.000 |
| | | 14 -0.252 | | 283.06 | 0.000 |
| | | 16 -0.303 | -0.127 | 296.95 | 0.000 |
| I | 1 1 | 16 -0.340 | 0.033 | 314.58 | 0.000 |
| - · | 100 | 17 -0.350 | -0.076 | 333.44 | 0.000 |
| | 1 1 | 18 -0.332 | | 350.53 | 0.000 |
| | 1 10 | 19 -0.305 | | 365.06 | 0.000 |
| | 1 1 1 | 20 -0.291 | | 378.48 | 0.000 |
| - · | 1 1 | 21 -0.274 | | 390.41 | 0.000 |
| • • | 1 1 | 22 -0.230 | | 398.95 | 0.000 |
| 9 1 | 1 11 | 23 -0.162 | | 403.23 | 0.000 |
| 191 | | 24 -0.099 | | 404.85 | 0.000 |
| | <u></u> | 25 -0.062 | | 405.48 | 0.000 |
| | | 26 -0.0/1 | | 405.31 407.51 | 0.000 |
| 111 | | 28 -0.055 | | 408.03 | 0.000 |
| | 1 16 | 29 -0.008 | | 408.04 | 0.000 |
| 111 | | 30 0.033 | | 40B.22 | 0.000 |
| 1.0 | | 31 0.051 | | 408.68 | 0.000 |
| - i fi | e - | 32 0.033 | | 40B.87 | 0.000 |
| 1 1 | | 33 -0.008 | -0.102 | 408.88 | 0.000 |
| 10 | 1 1 | 34 -0.031 | 0.075 | 409.05 | 0.000 |
| 10 | | 35 -0.033 | | 409.25 | 0.000 |
| | | | | 409.35 | 0.000 |
| (| (a) Time s | series | | 403.35 | |
| | (a) Time s | eries | x_t | | |
| Autocorrelation | Partial Correlation | eries | x_t pac | 0-Stat | Prob |
| Autocorrelation | | AC 1 0.452 | <i>x</i> t PAC | 0-Stat 107.40 | Prob |
| Autocorrelation | Partial Correlation | AC 1 0.452 2 -0.040 | x_t pac | 0-Stat | Prob |
| Autocorrelation | Partial Correlation | AC 1 0.452 2 -0.040 3 -0.017 4 -0.028 | <i>x</i> _t PAC 0.462 -0.322 0.221 -0.204 | 0-Stat 107.40 108.19 108.33 108.72 | Prob 0.000 0.000 0.000 0.000 |
| Autocorrelation | Partial Correlation | AC 1 0.452 2 -0.040 3 -0.017 4 -0.028 5 -0.058 | <i>x</i> _t PAC 0.462 -0.322 0.221 -0.204 0.095 | D-Stat 107.40 108.19 108.33 108.72 110.45 | Prob 0.000 0.000 0.000 0.000 0.000 |
| Autocorrelation | Partial Correlation | AC 1 0.452 2 -0.040 3 -0.017 4 -0.028 5 -0.058 6 -0.031 | <i>x</i> _t PAC 0.462 0.221 -0.204 0.095 -0.080 | 0-Stat 107.40 108.19 108.33 108.72 110.45 110.92 | Prob 0.000 0.000 0.000 0.000 0.000 0.000 |
| Autocorrelation | Partial Correlation | AC 1 0.452 2 -0.040 3 -0.017 4 -0.028 5 -0.058 6 -0.051 7 0.041 | Xt PAC 0.462 -0.322 0.221 -0.204 0.095 -0.080 0.125 | 0-Stat 107.40 108.19 108.33 108.72 110.45 110.45 110.92 111.77 | Pmb 0.000 0.000 0.000 0.000 0.000 0.000 0.000 |
| Autocorrelation | Partial Correlation | AC 1 0.452 2 -0.040 3 -0.017 4 -0.028 5 -0.058 6 -0.031 7 0.041 8 0.033 | <i>x</i> _t PAC 0.462 -0.322 0.221 -0.204 0.095 -0.080 0.425 -0.096 | D-Stat 107.40 108.19 108.33 108.72 110.45 110.92 111.77 111.23 | Prob 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 |
| Autocorrelation | Partial Correlation | AC 1 0.452 2 -0.040 3 -0.017 4 -0.028 5 -0.058 6 -0.051 7 0.041 | Xt PAC 0.462 -0.322 0.221 -0.204 0.095 -0.080 0.125 | 0-Stat 107.40 108.19 108.33 108.72 110.45 110.45 110.92 111.77 | Pmb 0.000 0.000 0.000 0.000 0.000 0.000 0.000 |
| Autocorrelation | Partial Correlation | AC 2 -0.440 2 -0.402 2 -0.041 5 -0.058 6 -0.031 7 0.041 8 0.033 9 0.023 10 0.028 11 -0.018 | <i>x</i> _t PAC 0.462 -0.322 0.221 -0.204 0.095 -0.080 0.125 -0.096 0.116 -0.080 0.026 | 0-Stat 107.40 108.33 108.72 110.45 110.92 110.72 112.33 112.61 113.20 | Pmb 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 |
| Autocorrelation | Partial Correlation | AC 1 0.462 2 -0.040 3 -0.917 4 -0.028 5 -0.058 5 -0.058 5 -0.058 5 -0.058 0 -0.033 9 0.023 11 -0.018 11 -0.018 12 -0.074 | <i>x</i> _t PAC 0.462 -0.322 0.221 -0.204 0.095 -0.096 0.126 -0.096 0.116 -0.096 0.026 -0.096 0.116 -0.026 -0.026 -0.026 -0.026 -0.000 0.025 -0.0000 | 0-Stat 107.40 108.19 108.72 110.45 110.92 111.77 112.33 112.61 113.20 113.20 113.20 113.20 114.00 | Prob 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 |
| Autocorrelation | Partial Correlation | AC 1 0.462 2 -0.400 3 -0.017 4 -0.028 6 -0.058 6 -0.031 7 0.041 8 0.033 9 0.023 10 0.028 11 -0.018 11 -0.018 12 -0.040 13 -0.017 13 -0.017 14 -0.028 15 -0.058 15 -0.058 10 -0.058 11 -0.058 11 -0.058 12 -0.074 13 -0.058 13 -0.058 13 -0.058 14 -0.058 15 -0.058 | <i>x</i> _t PAC 0.462 -0.322 0.224 0.095 -0.096 0.125 -0.096 0.116 -0.080 0.126 -0.080 0.116 -0.090 0.116 -0.090 0.116 -0.104 -0.090 0.116 -0.104 -0.104 -0.104 -0.104 -0.090 0.116 -0.104 -0.045 -0.104 -0 | D-Stat 107.40 108.33 108.72 110.45 110.45 111.77 112.33 113.03 113.03 115.00 116.49 | Prob 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 |
| Autocorrelation | Partial Correlation | AC 2 -0.040 3 -0.017 4 -0.028 5 -0.058 5 -0.058 5 -0.058 5 -0.058 5 -0.058 1 -0.041 8 0.033 9 0.023 10 0.028 11 -0.018 12 -0.074 13 -0.031 14 -0.015 | <i>X</i> _t PAC 0.462 -0.322 -0.204 0.025 -0.096 0.116 -0.080 0.116 -0.080 0.026 -0.103 0.103 0.104 | D-Stat 107.40 108.19 108.72 110.45 110.92 111.77 112.33 112.61 113.20 116.00 116.00 116.40 116.60 | Pmb 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 |
| Autocorrelation | Partial Correlation | AC 2 -0.040 3 -0.017 4 -0.028 5 -0.058 6 -0.031 7 0.041 8 0.023 10 0.028 11 -0.018 11 -0.018 11 -0.018 11 -0.018 12 -0.074 13 -0.051 15 -0.070 | <i>X</i> t PAC 0.462 -0.322 -0.204 0.025 -0.095 -0.095 0.125 -0.096 0.116 -0.080 0.026 -0.098 0.116 -0.020 0.026 -0.103 0.025 -0.030 | 0-Stat 107.40 108.19 108.33 108.72 110.45 110.92 111.77 112.33 112.61 113.20 116.00 116.00 116.49 116.18 | Prob 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 |
| | Partial Correlation | AC 2 -0.040 3 -0.017 4 -0.028 5 -0.058 5 -0.058 5 -0.058 5 -0.058 5 -0.058 1 -0.041 8 0.033 9 0.023 10 0.028 11 -0.018 12 -0.074 13 -0.031 14 -0.015 | <i>X</i> _t PAC 0.462 -0.322 -0.204 0.025 -0.096 0.116 -0.080 0.116 -0.080 0.026 -0.103 0.103 0.104 | D-Stat 107.40 108.39 108.39 108.72 110.45 111.45 111.45 112.61 113.20 116.00 116.49 116.60 116.49 116.62 119.18 119.18 120.22 | Pmb 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 |
| | Partial Correlation | AC 2 -0.400 3 -0.017 4 -0.028 5 -0.058 6 -0.031 7 0.041 8 0.033 10 0.028 11 -0.018 12 -0.074 13 -0.018 15 -0.076 15 -0.076 15 -0.076 15 -0.078 15 -0. | xt PAC 0.221 0.221 0.224 0.095 0.095 0.096 0.116 0.0080 0.102 0.028 0.0028 0.013 0.028 0.013 0.015 | D-Stat 107.40 108.19 108.33 108.72 110.45 110.92 111.61 113.03 113.20 116.00 116.62 119.18 119.18 120.22 121.28 | Prob 0.000 |
| | Partial Correlation | AC 1 0.462 2 -0.040 3 -0.017 4 -0.028 5 -0.058 6 -0.031 7 0.041 8 0.023 9 0.023 10 0.026 11 -0.018 12 -0.074 13 -0.031 14 -0.016 15 -0.070 15 -0.045 18 0.045 19 0.049 | 22t PAC 0.462 0.221 0.221 0.020 0.026 0.125 0.090 0.0125 0.090 0.0125 0.090 0.0125 0.001 0.020 0.0125 0.001 0. | 0-Stat 107.40 108.19 108.33 108.72 110.45 110.45 110.45 110.45 110.45 110.22 111.03 112.03 114.09 116.09 116.09 116.49 116.42 119.18 120.22 121.28 125.38 | Prob 0.000 |
| | Partial Correlation | AC 2 -0.404 3 -0.017 4 -0.228 5 -0.058 5 -0.058 5 -0.058 5 -0.058 5 -0.058 5 -0.058 5 -0.058 1 -0.028 11 -0.018 12 -0.074 13 -0.021 11 -0.018 12 -0.045 15 -0.070 15 -0.078 15 -0.0 | 2 xt PAC 0.462 0.322 0.032 0.095 0.095 0.095 0.005 0.0026 0.0105 0.0026 0.010 0.025 0.002 0.002 0.002 0.003 0.002 0.003 0. | 0-Stat 107.40 108.19 108.33 108.72 110.45 110.92 111.05 112.61 113.03 113.03 113.03 114.09 116.49 116.49 116.49 116.49 116.49 116.49 116.49 116.28 120.22 121.28 120.23 122.53 125.38 | Prob 0.000 |
| | Partial Correlation | AC 1 0.4422 2 -0.040 3 -0.017 4 -0.028 5 -0.058 6 -0.031 7 0.041 8 0.023 9 0.023 10 0.028 11 -0.018 12 -0.074 13 -0.031 14 -0.018 15 -0.058 16 -0.054 18 0.045 19 0.059 21 0.054 21 0.054 | 2 xt PAC 0.452 0.224 -0.224 0.224 0.224 0.224 0.080 0.125 0.090 0.125 0.090 0.125 0.090 0.016 0.000 0.016 0.039 0.051 0.061 0.061 0.065 0.06 | D-Stat 107,40 108,19 108,33 108,72 110,85 110,85 111,87 112,61 114,67 114,07 115,02 11 | Prob 0.0000 0.000 0.000 0.000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.000000 |
| | Partial Correlation | AC 1 0.462 2 -0.040 3 -0.917 4 -0.028 5 -0.058 6 -0.031 7 0.041 8 0.033 9 0.023 10 0.028 11 -0.018 12 -0.074 13 -0.031 14 -0.016 15 -0.058 10 0.028 10 0.028 1 | Xt PAC 0.402 -0.322 -0.221 -0.204 0.125 -0.080 0.126 -0.080 0.116 0.026 -0.098 0.116 0.026 -0.098 0.116 0.026 0.016 0.026 0.016 0.026 0.016 0.026 0.026 0.016 0.026 0.006 0.005 | D-Stat 107.40 108.19 108.72 110.872 110.872 110.872 110.872 110.82 110.82 110.82 113.20 115.20 115.10 116.00 120.0 | Prob 0.0000 |
| | Partial Correlation | AC 2 -0.040 3 -0.017 4 -0.028 5 -0.058 6 -0.031 7 0.041 8 0.033 10 0.028 11 -0.018 12 -0.074 13 -0.031 13 -0.031 14 -0.018 15 -0.058 15 -0.058 18 0.045 18 0.045 19 0.089 20 0.054 21 0.011 22 0.022 23 0.018 | Xt PAC 0.442 0.221 0.224 0.095 -0.098 0.116 0.0452 -0.098 0.125 -0.098 0.125 0.024 0.021 0.025 0.0 | D-Stat 107.40 108.13 108.33 108.72 110.45 111.23 112.61 115.20 116.00 116.02 116.00 116.02 116.01 116.02 116.10 116.23 127.23 127.24 | Prob 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.000000 |
| | Partial Correlation | AC 2 - 0.440 2 - 0.401 3 -0.017 4 -0.028 6 -0.058 6 -0.058 6 -0.051 9 0.023 11 -0.018 12 -0.074 13 -0.031 13 -0.031 14 -0.016 15 -0.076 15 -0.070 15 -0.075 19 0.0425 19 0.0425 19 0.045 19 0.045 19 0.045 19 0.045 19 0.045 19 0.045 19 0.045 19 0.045 10 0.011 20 0.022 10 0.011 20 0.022 10 0.011 20 0.022 10 0.011 20 0.025 10 0.015 10 0.015 1 | <i>x</i> _t PAC 0.462 0.221 0.221 0.095 0.095 0.095 0.095 0.008 0.025 0.014 0.025 0.014 0.025 0.014 0.005 0.014 0.014 0.014 0.014 0.005 0.014 0.014 0.005 0.005 0.014 0.005 0.0 | D-Stat 107,40 108,13 108,72 110,45 111,23 112,61 115,20 116,20 116,20 116,20 116,20 116,20 116,20 127,25 127,25 127,25 127,25 127,26 127,25 127,26 127,25 127,26 127,25 12 | Prob 0.000 |
| Autocorrelation | Partial Correlation | AC 1 0.462 2 -0.040 3 -0.017 4 -0.028 5 -0.058 6 -0.031 7 0.041 13 -0.021 7 0.041 13 -0.023 11 -0.018 11 -0.018 15 -0.070 16 -0.002 17 0.045 18 0.045 18 0.045 18 0.045 18 0.045 18 0.045 19 0.089 20 0.054 21 0.011 22 0.022 23 0.018 24 -0.007 26 0.031 26 0.031 27 0.045 27 0.045 27 0.045 27 0.045 27 0.045 28 0.031 20 0.054 20 0.054 | 2 xt PAC 0.462 -0.322 0.221 0.221 0.224 0.096 0.125 -0.096 0.126 -0.080 0.126 -0.080 0.126 -0.080 0.137 0.038 0.016 -0.081 0.015 -0.096 0.016 -0.080 0.016 -0.001 | D-Stat 107.40 108.33 108.73 110.65 110.95 110.65 111.65 111.65 111.65 111.65 111.65 111.65 111.65 111.65 111.65 112.53 125.38 125.74 125.74 127.74 17.74 17.74 17.74 17.74 17.74 | Prab 0.000 0 |
| | Partial Correlation | AC 1 0.4492 2 -0.440 3 -0.017 4 -0.028 6 -0.058 6 -0.031 7 0.041 8 0.033 10 0.028 11 -0.018 12 -0.045 13 -0.071 13 -0.031 14 -0.018 15 -0.076 15 -0.077 15 -0.0 | 2 t t PAC 0.462 -0.224 -0.224 0.0221 -0.204 0.021 -0.080 0.126 0.021 -0.080 0.226 0.021 0.021 0.028 0.010 0.028 0.010 0.029 0.005 0. | D-Stat 107.40 106.19 106.33 108.72 110.45 110.45 111.26 111.20 116.00 116.49 115.00 116.49 115.00 127.25 127.05 127.05 127.05 127.05 127.05 127.41 127.96 130.60 127.25 131.20 | Prab 0.0000 0.000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 |
| | Partial Correlation | AC 1 0.462 2 -0.040 3 -0.017 4 -0.028 5 -0.058 6 -0.031 7 0.041 8 0.023 9 0.023 10 0.028 11 -0.018 11 -0.018 12 -0.074 13 -0.031 12 -0.074 13 -0.031 14 -0.016 15 -0.058 10 0.025 10 0.025 10 0.025 10 0.054 21 0.011 22 0.074 10 0.054 23 0.018 20 0.054 21 0.011 22 0.022 23 0.018 4 -0.007 25 0.031 26 0.031 27 0.034 28 -0.032 28 -0.032 29 -0.032 20 -0.032 28 -0.032 29 -0.032 20 - | <i>x</i> _t PAC 0.462 -0.322 0.221 -0.204 0.026 -0.080 0.126 -0.098 0.028 -0.098 0.028 -0.098 0.028 -0.098 0.028 -0.098 0.026 -0.098 0.0116 -0.080 0.026 -0.098 0.026 -0.098 0.016 -0.080 0.026 -0.098 0.026 -0.098 0.005 -0.005 -0.005 | D-Stat 107,40 108,13 108,33 108,72 110,85 110,85 110,85 111,87 112,83 113,03 113,03 113,03 113,03 113,03 114,62 119,18 120,22 121,28 125,38 125,38 125,39 125,39 127,44 12 | Prob 0.0000 0.000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 |
| Autocorrelation | Partial Correlation | AC 2 -0.400 3 -0.017 4 -0.028 5 -0.058 6 -0.031 7 0.041 8 0.033 9 0.023 10 0.028 11 -0.018 12 -0.074 13 -0.031 10 0.028 11 -0.018 12 -0.074 13 -0.031 14 -0.016 15 -0.058 19 0.045 19 0.045 19 0.045 19 0.045 19 0.045 19 0.045 19 0.045 19 0.045 20 0.054 21 -0.044 21 0.041 22 0.022 23 0.048 24 -0.007 25 0.031 26 0.071 27 0.034 26 0.0171 27 0.034 28 0.002 29 0.022 20 0.055 20 0 | 2 xt PAC 0.462 -0.021 -0.096 0.126 -0.096 0.016 0.026 -0.096 0.016 0.026 -0.096 0.026 0.016 0.026 0.016 0.026 0.026 0.016 0.026 0.016 0.026 0.005 | D-Stat 107.40 108.19 108.19 108.52 110.45 110.45 111.20 115.00 116.00 116.00 116.22 127.25 127.41 127.96 130.20 131.20 | Prob 0.0000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.0000 |
| | Partial Correlation | AC 1 0.4422 2 -0.040 3 -0.017 4 -0.028 5 -0.058 6 -0.031 7 0.041 8 0.023 10 0.028 11 -0.018 12 -0.074 13 -0.031 14 -0.018 15 -0.058 10 -0.058 20 0.054 21 0.011 22 0.022 3 0.018 24 -0.077 25 0.031 25 0.031 25 0.031 26 0.032 20 0.054 21 0.012 20 0.024 20 0.034 26 0.031 26 0.031 27 0.034 28 0.028 30 0.035 29 0.028 30 0.035 20 0.034 26 0.031 27 0.034 28 0.028 30 0.035 20 0.034 20 0.035 20 0.035 | 2 t PAC 0.4422 -0.3224 -0.204 0.0095 -0.080 0.125 -0.080 0.125 -0.080 0.125 -0.080 0.0125 0.024 0.024 0.024 0.025 0.020 0.0115 -0.020 0.051 0.025 0.055 0.020 0.055 0.025 0.055 0.025 0.055 0.025 0.055 0.025 0.055 0.025 0.055 0.055 0.025 0.055 0 | D-Stat 107.40 108.19 108.33 108.72 110.82 110.82 111.82 113.20 115.20 115.20 115.20 115.20 127.25 125.38 126.93 127.41 127.41 127.41 127.41 127.41 127.43 131.20 | Prob 0.0000 0.000 0.0000 |
| Autocorrelation | Partial Correlation | AC 2 -0.400 3 -0.017 4 -0.028 5 -0.058 6 -0.031 7 0.041 8 0.033 9 0.023 10 0.028 11 -0.018 12 -0.074 13 -0.031 10 0.028 11 -0.018 12 -0.074 13 -0.031 14 -0.016 15 -0.058 19 0.045 19 0.045 19 0.045 19 0.045 19 0.045 19 0.045 19 0.045 19 0.045 20 0.054 21 -0.044 21 0.041 22 0.022 23 0.048 24 -0.007 25 0.031 26 0.071 27 0.034 26 0.0171 27 0.034 28 0.002 29 0.022 20 0.055 20 0 | 2 xt PAC 0.462 -0.021 -0.096 0.126 -0.096 0.026 -0.096 0.026 -0.096 0.026 -0.096 0.026 0.016 0.026 0.005 | D-Stat 107.40 108.19 108.19 108.52 110.45 110.45 111.20 115.00 116.00 116.00 116.22 127.25 127.41 127.96 130.20 131.20 | Prob 0.0000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.000 0.0000 |
| Autocorrelation | Partial Correlation | AC 2 -0.404 3 -0.017 4 -0.228 5 -0.058 5 -0.058 5 -0.058 5 -0.058 5 -0.058 5 -0.058 5 -0.058 5 -0.058 5 -0.058 10 0.028 11 -0.018 12 -0.045 15 -0.070 15 -0.072 10 0.045 19 0.045 20 0.055 30 -0.055 30 -0.055 30 -0.055 31 -0.054 32 -0.015 30 -0.055 31 -0.054 32 -0.015 30 -0.055 31 -0.054 32 -0.015 30 -0.055 31 -0.054 32 -0.015 30 -0.055 31 -0.055 3 | 2 t t PAC 0.462 0.221 0.221 0.221 0.224 0.224 0.224 0.025 0.020 0.125 0.020 0.0125 0.020 0.0104 0.020 0.0104 0.020 0.0104 0.020 0.001 0.005 0.01 0.005 0.01 0.005 0.01 0.005 0.01 0.005 0.01 0.005 0.01 0.005 0.01 0.005 0.01 0.005 0.01 0.00 0.02 0.02 0.02 0.02 0.02 0.02 | D-Stat 107.40 108.79 108.73 110.85 110.872 110.872 110.872 110.872 110.872 111.201 118.00 118.00 118.00 118.00 118.00 118.00 118.00 118.00 127.25 127.41 127.95 127.44 127.95 127.45 | Prob 0.0000 0.0000 0.0000 0.0000 0.000000 |
| | Partial Correlation | AC 2 - 0,440 2 - 0,040 3 -0,017 4 -0,028 6 -0,058 6 -0,058 6 -0,058 1 0,028 11 -0,028 6 -0,031 7 0,041 12 -0,074 13 -0,031 14 -0,016 15 -0,076 15 -0,070 15 -0, | 2 t t PAC 0.462 0.322 0.221 0.221 0.095 0.095 0.095 0.095 0.095 0.0112 0.0125 0.010 0.0125 0.010 0.026 0.010 0.026 0.010 0.026 0.010 0.026 0.010 0.026 0.010 0.026 0.010 0.026 0.005 | D-Stat 107.40 108.19 108.79 110.45 110.85 110.85 110.85 111.261 115.03 116.00 116.00 116.00 116.00 116.02 118.62 127.28 122.28 123.22 134.84 133.20 134.22 134.22 134.22 134.22 134.23 134.2 | Prob 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.00000 0 |
| Autocorrelation | Partial Correlation | AC 2 -0.404 3 -0.017 4 -0.228 5 -0.058 5 -0.058 5 -0.058 5 -0.058 5 -0.058 5 -0.058 5 -0.058 5 -0.058 5 -0.058 10 0.028 11 -0.018 12 -0.045 15 -0.070 15 -0.072 10 0.045 19 0.045 20 0.055 30 -0.055 30 -0.055 30 -0.055 31 -0.054 32 -0.015 30 -0.055 31 -0.054 32 -0.015 30 -0.055 31 -0.054 32 -0.015 30 -0.055 31 -0.054 32 -0.015 30 -0.055 31 -0.055 3 | 2 t t PAC 0.462 0.221 0.221 0.221 0.224 0.224 0.224 0.025 0.020 0.125 0.020 0.0125 0.020 0.0104 0.020 0.0104 0.020 0.0104 0.020 0.001 0.005 0.01 0.005 0.01 0.005 0.01 0.005 0.01 0.005 0.01 0.005 0.01 0.005 0.01 0.005 0.01 0.005 0.01 0.00 0.02 0.02 0.02 0.02 0.02 0.02 | D-Stat 107.40 108.79 108.73 110.85 110.872 110.872 110.872 110.872 110.872 111.201 118.00 118.00 118.00 118.00 118.00 118.00 118.00 118.00 127.25 127.41 127.95 127.44 127.95 127.45 | Prob 0.0000 0.0000 0.0000 0.0000 0.000000 |

 Autocometation
 Partial Convelation
 AC
 PAC
 Q-Stat
 Prob

 1
 0.869
 0.869
 579.63
 0.000

 1
 2
 0.760
 0.023
 677.12
 0.000

 1
 3
 0.661
 0.077
 882.02
 0.000

 1
 3
 0.661
 0.077
 882.02
 0.000

 1
 5
 0.460
 0.043
 1.058.9
 0.000

 1
 7
 0.322
 0.001
 128.52
 0.001
 128.52
 0.000

 1
 7
 0.322
 0.001
 138.55
 0.000

 1
 1
 0.221
 0.001
 138.55
 0.000

 1
 1
 0.102
 0.117
 1.443.8
 0.000

 1
 1
 0.112
 0.114
 0.455
 0.000

 1
 1
 0.120
 0.131
 140.20
 0.000

 1
 1
 0.147
 0.043
 14845
 0.000

 1
 0

(b) Time series y_t

| Autocorrelation | Partial Correlation | | AC | PAC | Q-Stat | Prob |
|-----------------|---|----------|--------|--------|--------|-------|
| ų. | Ļ | 1 | 0.678 | 0.678 | 231.05 | 0.000 |
| | 1 I I I I I I I I I I I I I I I I I I I | 2 | 0.516 | 0.105 | 365.1B | 0.000 |
| · | | 3 | | -0.235 | 398.87 | 0.000 |
| ·P | - P | 4 | 0.178 | 0.091 | 414.82 | 0.000 |
| ų. | <u>q</u> . | 5 | | -0.091 | 415.59 | 0.000 |
| | 1 | 6 | 0.035 | 0.057 | 416.22 | 0.000 |
| ų. | l ll | 7 | 0.020 | 0.054 | 416.42 | 0.000 |
| 19 | l (l' | 8 | 0.012 | -0.073 | 416.50 | 0.000 |
| ų. | 1 P | .9 | 0.029 | 0.072 | 416.91 | 0.000 |
| -P | P | 10 | 0.061 | 0.055 | 418.82 | 0.000 |
| - P | 111 | 11 | | -0.021 | 421.49 | 0.000 |
| 1 | i p | 12 | 0.099 | 0.072 | 426.62 | 0.000 |
| (P | () (| 13 | | -0.052 | 429.27 | 0.000 |
| (P | 111 | 14 | | -0.018 | 430.79 | 0.000 |
| 11 | 11 | 15 | | -0.015 | 430.79 | 0.000 |
| | 111 | 16 | -0.013 | | 430.87 | 0.000 |
| 91 | 111 | | -0.052 | | 432.27 | 0.000 |
| 91 | 11 | | -0.053 | | 433.71 | 0.000 |
| q · | | | -0.076 | | 435.70 | 0.000 |
| 91 - | 9 | | -0.052 | 0.035 | 438.12 | 0.000 |
| q. | | | -0.072 | | 440.84 | 0.000 |
| | · P | 22 | -0.016 | 0.073 | 440.9B | 0.000 |
| 1 | 41 | 23 | -0.017 | | 441.13 | 0.000 |
| 1 | 1 | 24 | 0.034 | 0.025 | 441.73 | 0.000 |
| 12 | 11 | 25 | 0.024 | 0.005 | 442.03 | 0.000 |
| 12 | | 26 | | -0.013 | 442.92 | 0.000 |
| 12 | 11 | 27 | 0.021 | 0.012 | 443.15 | 0.000 |
| 2 | P | 28 | 0.056 | 0.078 | 444.82 | 0.000 |
| 12 | | 29 | | -0.042 | 445.54 | 0.000 |
| 2 | 11 | 30 | 0.047 | 0.022 | 446.73 | 0.000 |
| 12 | 1 | 31 | 860.0 | 0.025 | 447.4B | 0.000 |
| 2 | | 32 | 0.054 | 0.007 | 449.07 | 0.000 |
| 2 | | 33 | 0.069 | 0.075 | 451.64 | 0.000 |
| 12 | | 34 35 | 0.104 | 0.029 | 457.51 | 0.000 |
| -P | | 30 | 0.141 | 0.059 | 468.1B | 0.000 |

(c) Time series w_t

(d) Time series z_t

According to the previous figures identify an appropriate ARMA model for each series. Justify.

- 19. Consider the following estimation outputs for a fitted model on a prince index (IPI).
 - b. Write the estimated model in equation form.
 - c. Comment on the residuals distribution.
 - d. Is the proposed model acceptable?

