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Department of Economics

UCLA

Economics 144

Economic Forecasting

Spring, 2024

Midterm Exam
May 9, 2024 by 10:45AM

For full credit on an analytical problem, you need to show all your work and the formula(s) used. For programming/analysis related problems, please make sure to include the respective code you wrote. You are not allowed to work with anyone on the exam. Your submitted midterm exam solutions must reflect your own work, otherwise it will be considered academic dishonesty. Please make sure to upload only one document in either PDF or HTML format that includes your R code.

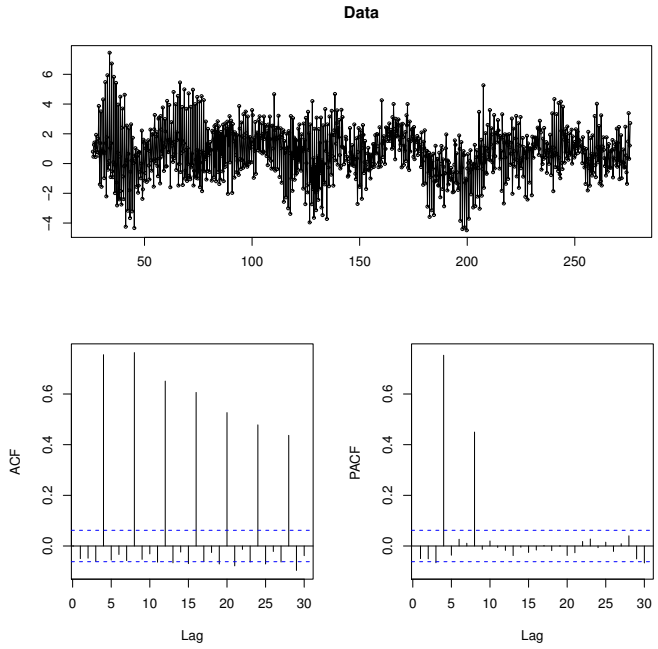
The exam time is from 9:30AM - 10:45AM. Please upload your exam solution through the upload link available on the course website. If there are any technical issues, you need to take a screen shot of your computer screen with the time stamp, and email me directly the screen shot along with your exam solution.

First Name	
Last Name	
UCLA ID #	

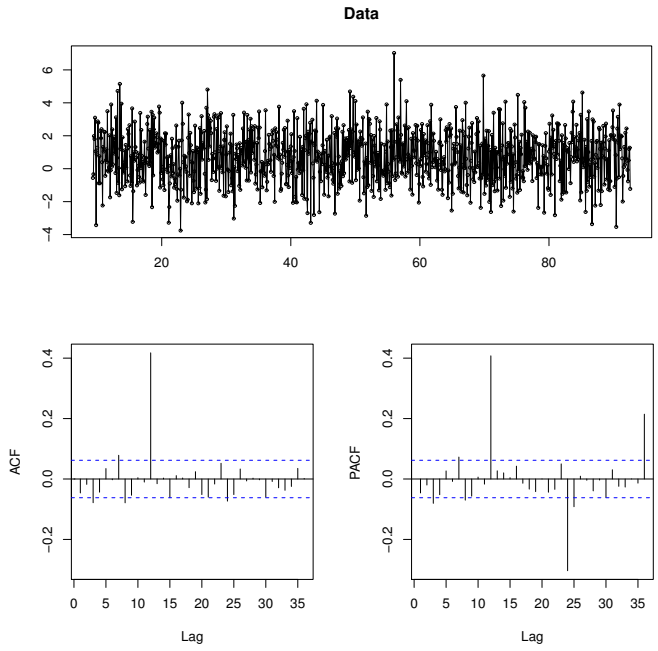
There are 7 questions in total.

Part I: Analytical/Conceptual Questions (50%)

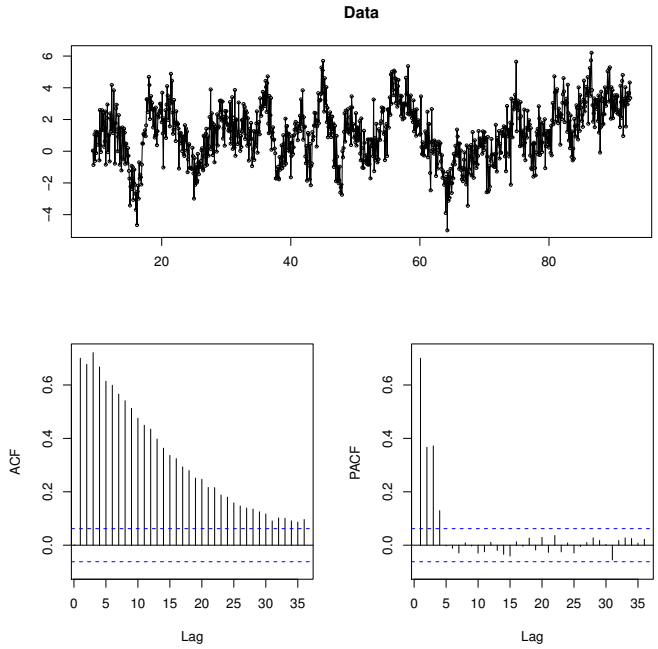
1.(10%) (a) The `tsdisplay` plot below is based on quarterly observations. Which model fit would you recommend for these observations. Explain your answer in detail.



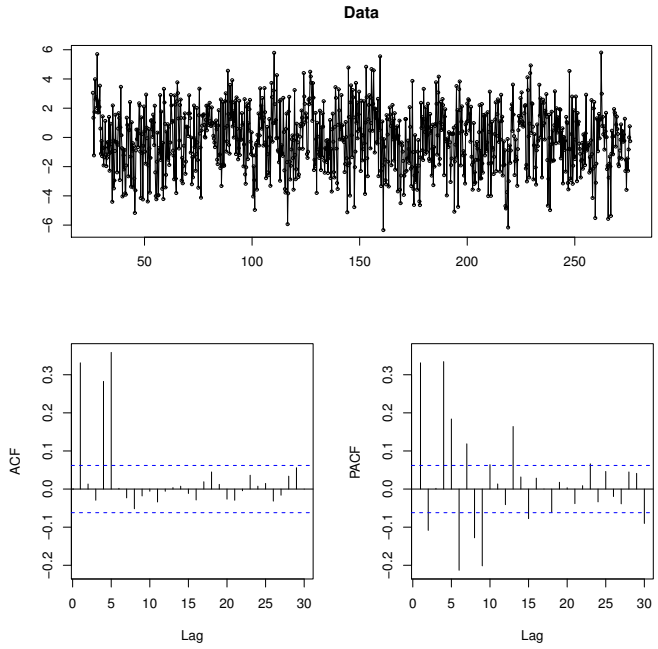
(b) The `tsdisplay` plot below is based on monthly observations. Which model fit would you recommend for these observations. Explain your answer in detail.



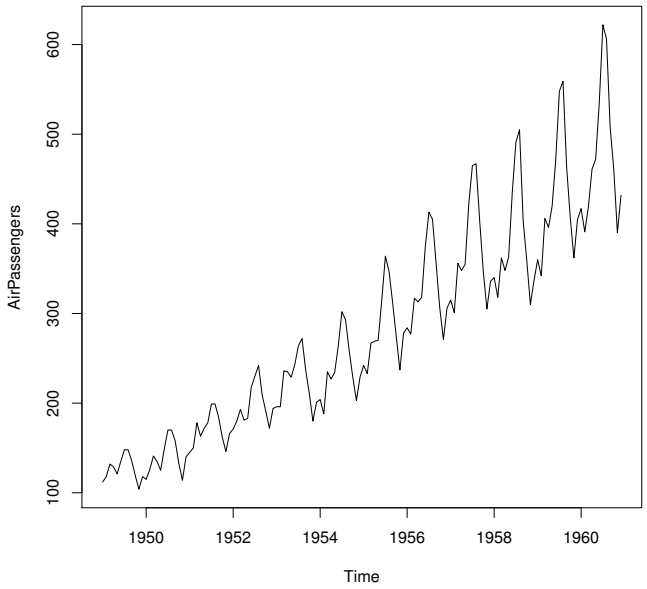
(c) The `tsdisplay` plot below is based on monthly observations. Which model fit would you recommend for these observations. Explain your answer in detail.



(d) The `tsdisplay` plot below is based on quarterly observations. Which model fit would you recommend for these observations. Explain your answer in detail.



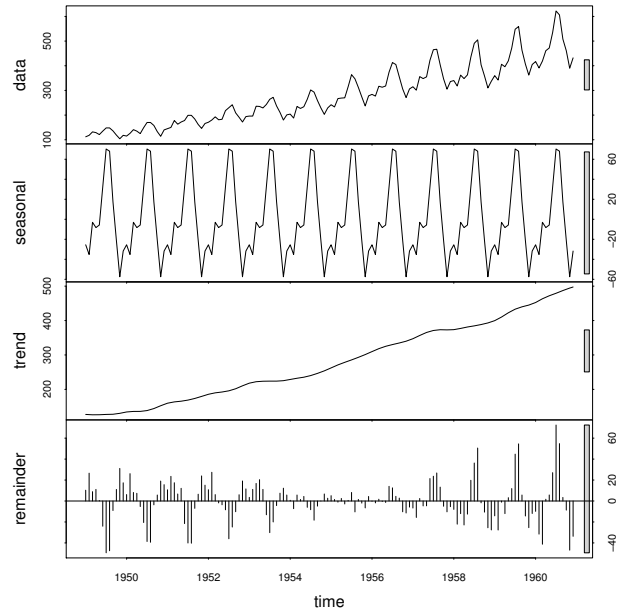
2.(10%) The plot below shows the number of international passengers per month on an airline in the United States for the period 1946-1960.



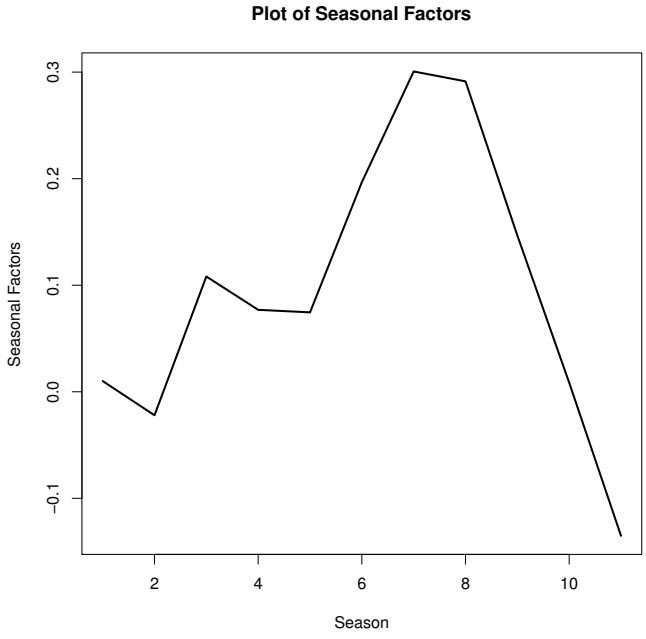
(a) If you had to choose between an AR(p) and an MA(q) model for this data set, which one would you choose and why?

(b) Are the data covariance stationary? If so, explain why, if not, how would you transform it to a covariance stationary series?

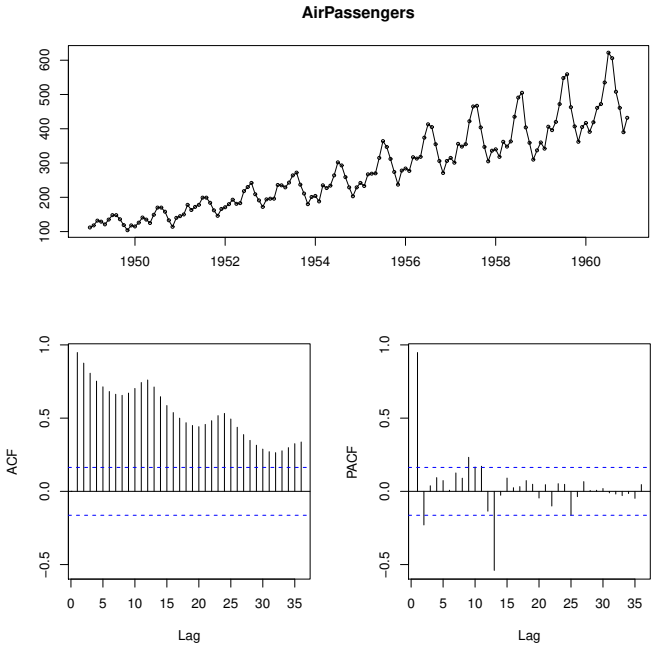
(c) Below we show the `stl` plot of the data. In terms of trend, seasonality, and cycles, briefly discuss which components you would include and why.



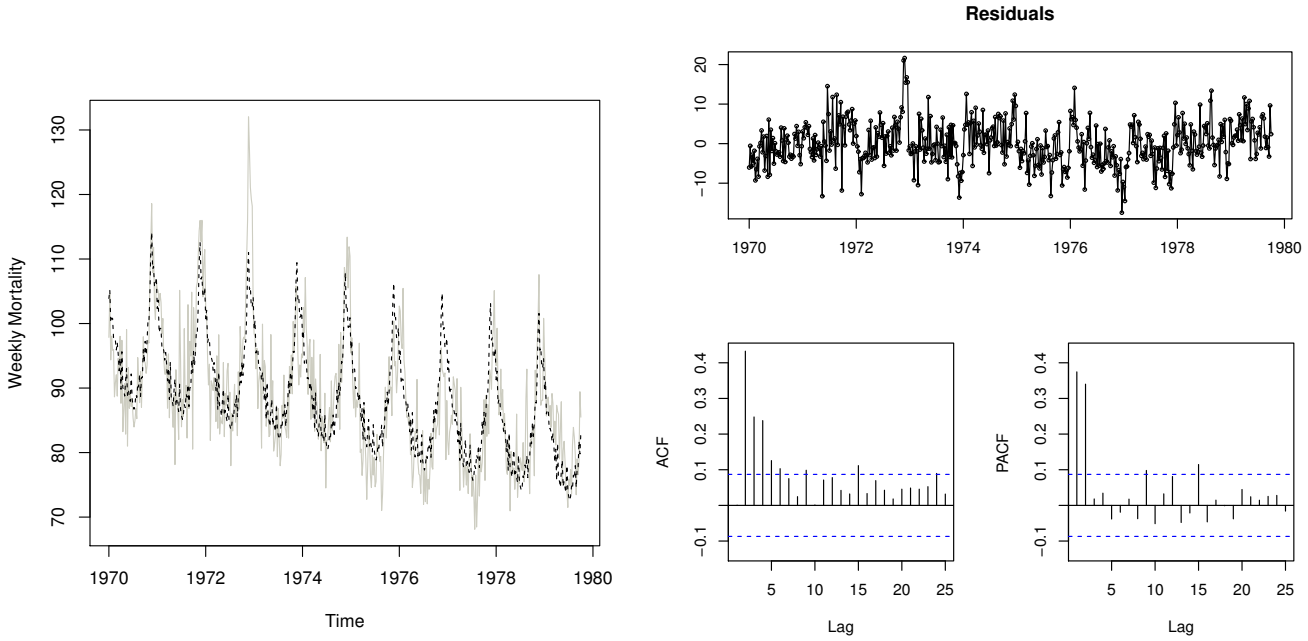
(d) Comment on the seasonal factors plot below.



(e) Based on the `tsdisplay` plot below for the data, what model would you propose?



3.(10%) For this problem the data consist of the average weekly cardiovascular mortality in Los Angeles County from 1970-1979 as shown in the left-figure below. We then fit a model with trend and seasonality components to the data (left-figure, the dashed line), and plot the respective residuals (right-figure), and the ACF and PACF of the residuals (two bottom-right plots).



(a) Based on the plots above, how would you improve the model fit?

(b) Does the original data series seem to be covariance stationary? If so, how can you tell? If not, why not and what would you recommend to make it covariance stationary.

(c) Does the residuals plot show any serial correlation? Explain your answer in detail.

(d) Suppose you use `auto.arima` to fit a model to the original data series, and you get the following output:

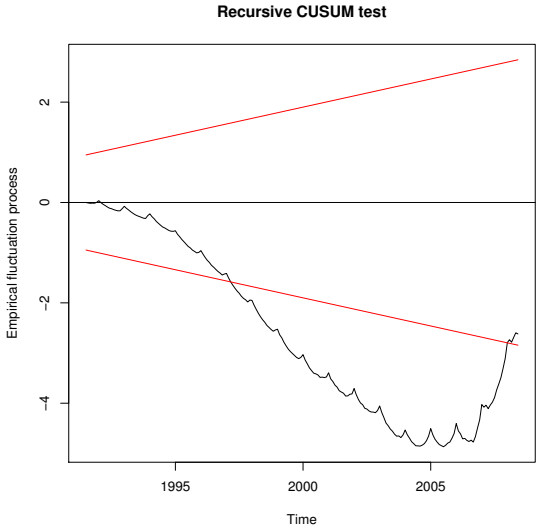
ARIMA(2,1,1)(2,0,2)[52]

Coefficients:

	ar1	ar2	ma1	sar1	sar2	sma1	sma2
	0.3285	0.2939	-0.9822	0.2424	0.4687	-0.2648	-0.2758
s.e.	0.0480	0.0422	0.0119	0.0632	0.0628	0.0753	0.0882

Provide a detailed interpretation of the ARIMA model suggested by R. Make sure to comment on any trend, seasonality, and/or cycles if appropriate.

4.(10%) (a) Based on the CUSUM plot below, what can you conclude about the model used to fit the data?



(b) From the list of four time-series processes below, which ones are expected to exhibit a deterministic cycle?

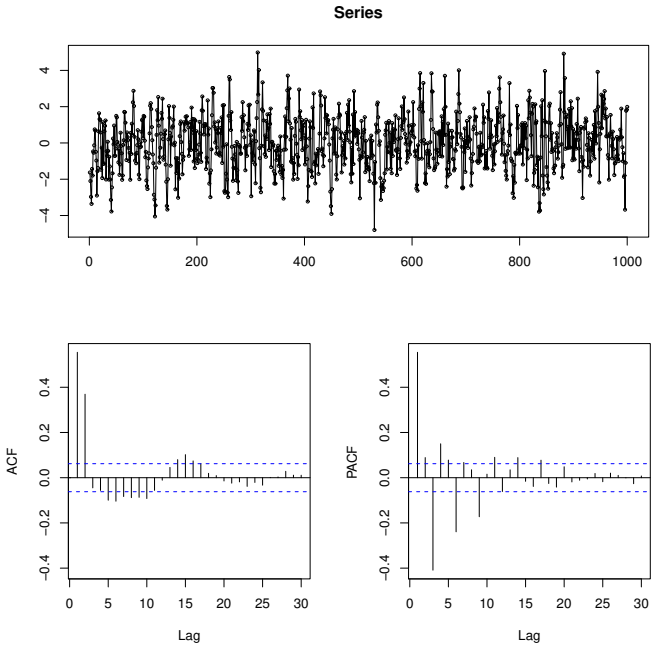
I. $Y_t = 20.5\sin(t-1) + \varepsilon_t$

II. $Y_t = 100Y_{t-10} + \varepsilon_t$

III. $Y_t = 0.25Y_{t-1} + 0.25Y_{t-2} + \varepsilon_t$

IV. $Y_t = t + 0.01 + \varepsilon_t$

(c) What model would you fit to the series based on the figure below?



5.(10%) For this problem we will look at monthly milk production in pounds per cow from January 1962 to December 1975. A 'linear trend + seasonality' model is fit to the data (the $y-$intercept is not included). The table below shows the summary statistics from the fit. In the figure below we show the relevant diagnostic plots.

	Estimate	Std. Error	t value	Pr(>|t|)
trend	1.7278	0.0257	67.11	0.0000
season1	590.5782	4.7698	123.82	0.0000
season2	551.0647	4.7808	115.27	0.0000
season3	643.5512	4.7920	134.30	0.0000
season4	658.3949	4.8032	137.07	0.0000
season5	719.3814	4.8146	149.42	0.0000
season6	691.0108	4.8261	143.18	0.0000
season7	641.2116	4.8377	132.55	0.0000
season8	598.9124	4.8494	123.50	0.0000
season9	556.3275	4.8612	114.44	0.0000
season10	559.8140	4.8731	114.88	0.0000
season11	528.8006	4.8851	108.25	0.0000
season12	565.5014	4.8972	115.47	0.0000

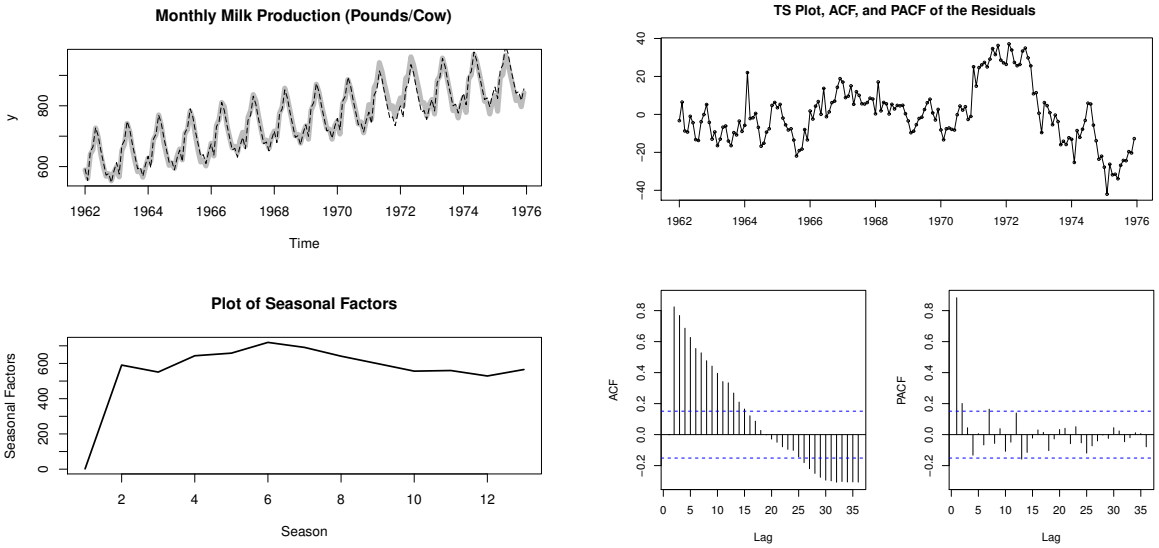


Fig. 1.— Data (top-left -gray line), fit (top-left -dashed line), seasonal factors (bottom-left), the residuals (top-right) and the ACF and PACF of the residuals (bottom-right).

(a) Discuss the results from the summary statistics table.

(b) Interpret the seasonal factors plot.

(c) After filtering the trend and seasonal components, do you believe that there might be cycles unaccounted for in your model? Explain your answer.

(d) Is the series (original data) covariance stationary? Explain your answer.

(e) Based on the ACF and PACF pots, would you recommend improving the model? If so, how? If not, why not?

Part II: Data Analysis/Programming Questions (50%)

6.(25%) For this problem we will work with the US GDP percent change. To load the data, follow the two commands below:

```
library(Quandl)
gdp_diff <- Quandl("FRED/GDP", type="ts", transform="rdiff")
```

(a) Provide a brief descriptive analysis of your data that includes the start and end dates, frequency, and relevant statistical summaries.

(b) Show the respective ACF and PACF plots and discuss what they suggest about the data.

(c) Fit a linear trend with seasonal (based on the frequency) dummy variables, and comment on the fit. Make sure to overlay the fit on the series.

(d) Compute and plot a 10 step ahead forecast using your model from (c).

(e) Plot the seasonal factors from your model in (c) and comment on the plot.

(f) Fit an ARMA + S-ARMA to the data and comment on the fit.

(g) Compute and plot a 10 step ahead forecast using your model from (f).

(h) Which model is better, (c) or (f), why?

7.(25%) For this problem we will work with the monthly spot price for black pepper from 10/1973 to 04/1996. To load and plot the data, follow the three commands below:

```
library(AER)
data("PepperPrice")
plot(PepperPrice[,1])
```

(a) Show and discuss (in terms of an MA and AR process) the respective `tsdisplay` plot.

(b) Show a plot of your data after performing an additive seasonal adjustment to it. Discuss your results.

(c) For the seasonally adjusted series, using the tools discussed in class, identify and fit an appropriate model to the cycles. Discuss the overall fit.

(d) Using your estimated model in part (c) provide a 12 step ahead forecast. Discuss your forecast.

(e) In part (b) you applied an additive seasonal adjustment to your data, comment on whether a multiplicative seasonal adjustment would have been better.