

Test 3 M349R Fall 2020 (60% of Exam 3) ***Make you have 5 problems (Good luck!)***

Name: \_\_\_\_\_

UTeid: \_\_\_\_\_

[1] A math student, Eva, conducted a study on college basketball players. She asked players to continually perform three different activities as quickly as they could: layups (jumping, one-handed shot), free-throw shots (standing shot from fixed distance), and running drills. After performing each activity for five minutes, Eva recorded the player's heart rate in beats per minute (bpm). She had five players, and she made each of them do all three activities on three different days. The days and order of activities were randomized for each player.

[a] Did Eva conduct an experiment or an observational study? Explain your answer. (6 pts)

[b] Describe: (3 pts each)

Units:

Factor(s):

Treatments:

Response variable:

[c] Is Eva's study balanced? (6 pts)

- a. Yes.
- b. No.
- c. There is no way to tell from the information given.
- d. This question is nonsensical.

[d] In an ANOVA model, a large  $F$  statistic is an indication that (choose all that apply) (6 pts)

- a. group-to-group variation and unit-to-unit variation are approximately equal
- b. group-to-group variation is large compared to unit-to-unit variation
- c. the experiment was randomized
- d. we can conclude cause and effect
- e. the sum of squares is large

[e] Multiple comparisons are a way to control (choose all that apply) (6 pts)

- a. Type I error rate
- b. Type II error rate
- c. both Type I and Type II error rate
- d. neither Type I nor Type II error rate

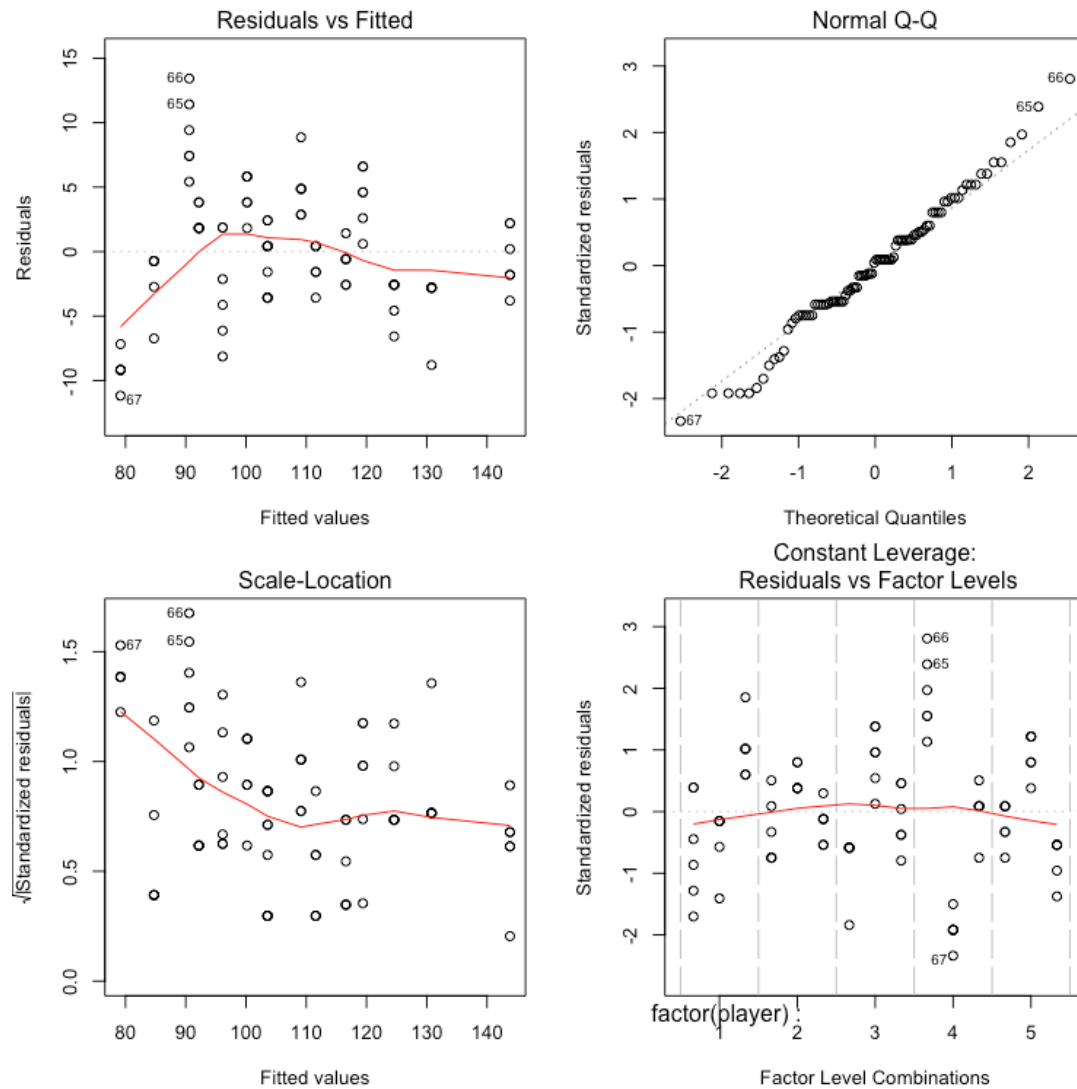
[f] A student, Eva, conducted a study on college basketball players. She asked players to continually perform three different activities as quickly as they could. After performing each activity for five minutes, Eva recorded the player's heart rate in beats per minute (bpm). She had five players, and she made each of them do all three activities on three different days. The days and order of activities were randomized for each player. Eva wants to see if heart rate depends on activity and player. Write down the theoretical model that Eva will fit. (6 pts)

[g] Continue with Eva's work. Discuss the conditions for the ANOVA model and how well you think the conditions are met for this model based on the residual plots and other information given. The plots are on the next page. (12 pts)

```
model4 <- aov(rate ~ factor(player) + factor(activity), data=Eva)
summary(model4)
```

```
##              Df Sum Sq Mean Sq F value    Pr(>F)
## factor(player)  4  17744    4436    178.9   <2e-16 ***
## factor(activity) 2   8943    4472    180.3   <2e-16 ***
## Residuals      83   2058     25
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
plot(model4) #plots on the next page
```

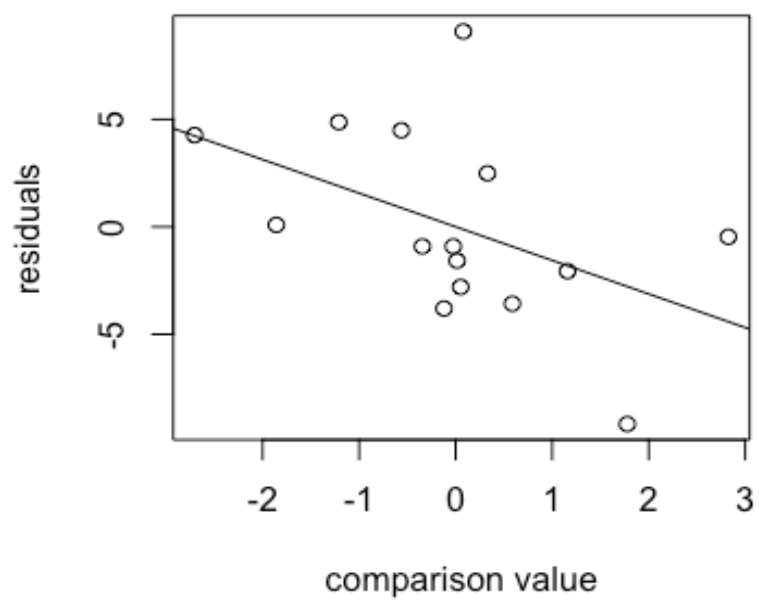


[h] Eva is wondering if it would make more sense to use a reexpression of her response (heart rate), so she makes a Tukey plot for nonadditivity, seen below. What reexpression of the response variable (if any) is indicated by this plot? (6 pts)

```
plot(model.resid~comp.value, ylab="residuals", xlab="comparison value")
Tukey <- lm(model.resid~comp.value); Tukey

##
## Call:
## lm(formula = model.resid ~ comp.value)
##
## Coefficients:
## (Intercept)    comp.value
## 0.000         -1.564

abline(reg=Tukey)
```



**[2] Problem 2 (Overlays)**

A study of two surgical methods compare recovery times, in days, for two treatments, the standard and the new method. Three randomly chosen patients got the new treatment; the remaining three patients got the standard. Here are the results:

New procedure 16, 20, 24

Standard 28, 33, 35

[a] Fit a one-way additive model “days = treatment + error” and write a conclusion (14 points)

[b] For the data above decompose the response value as a sum of grand mean + treatment effects + residuals. (14 points)

16	28
20	33
24	35

=


+

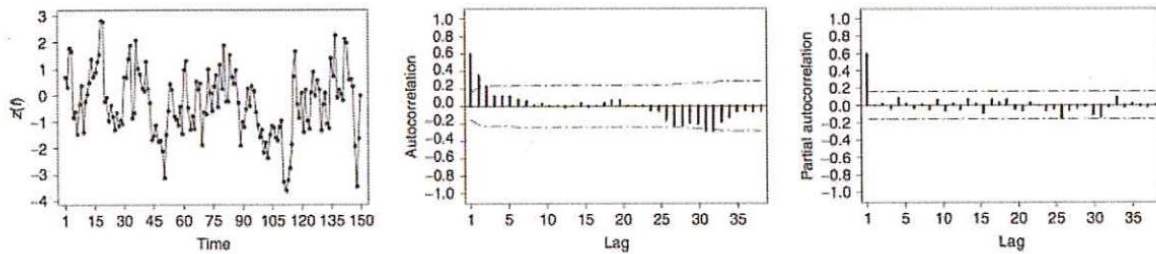

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Make sure (double check) that the sum of square residuals and the sum of square treatment effects is the same as the Anova table from part [a]

### Problem 3

Part [a] (4 points for explain the process of reading correlograms and 2 points for backshift notation)

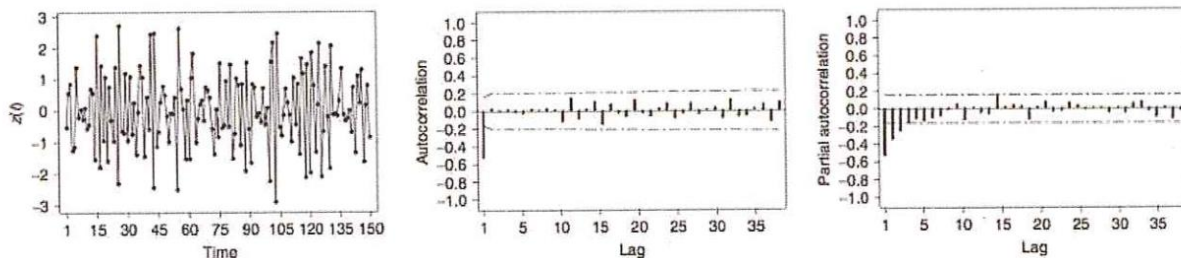
For the time series plot and corresponding ACF and PACF plots below, determine the orders  $p$  and  $q$  of a tentative ARMA( $p, q$ ) model that can be used for this data



Explain how you picked an Arima model:

Part [b] (4 points for explain the process of reading correlograms and 2 points for backshift notation)

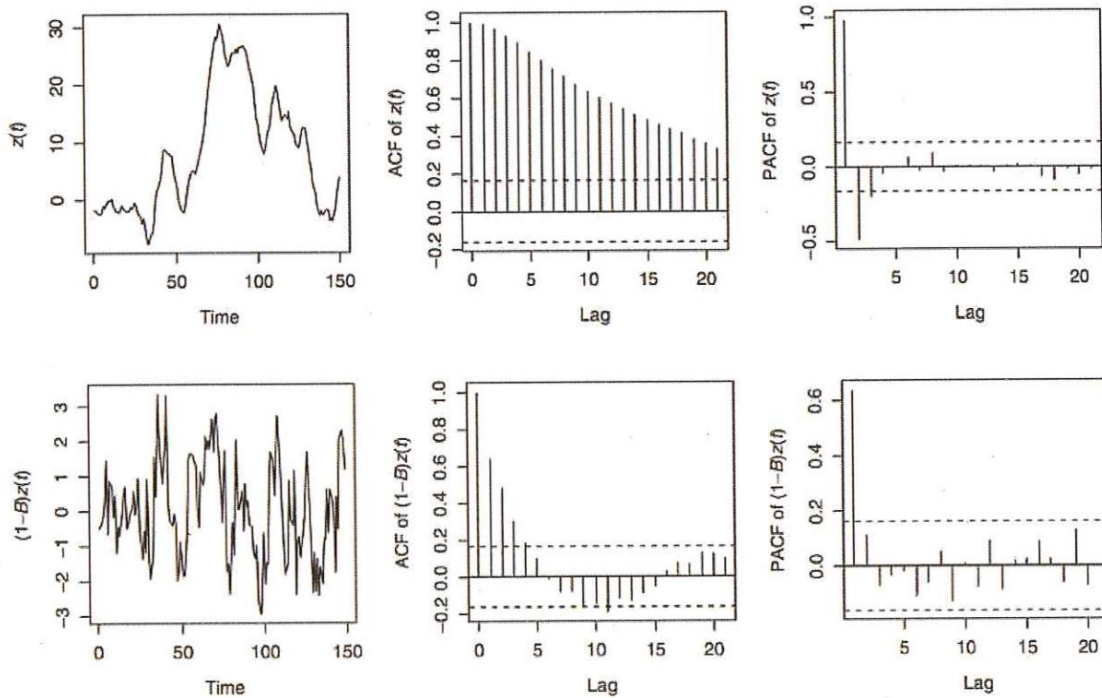
For the time series plot and corresponding ACF and PACF plots below, determine the orders  $p$  and  $q$  of a tentative ARMA( $p, q$ ) model that can be used for this data



Explain how you picked an Arima model:

Part [c] (4 points for explain the process of reading correlograms and 2 points for backshift notation)

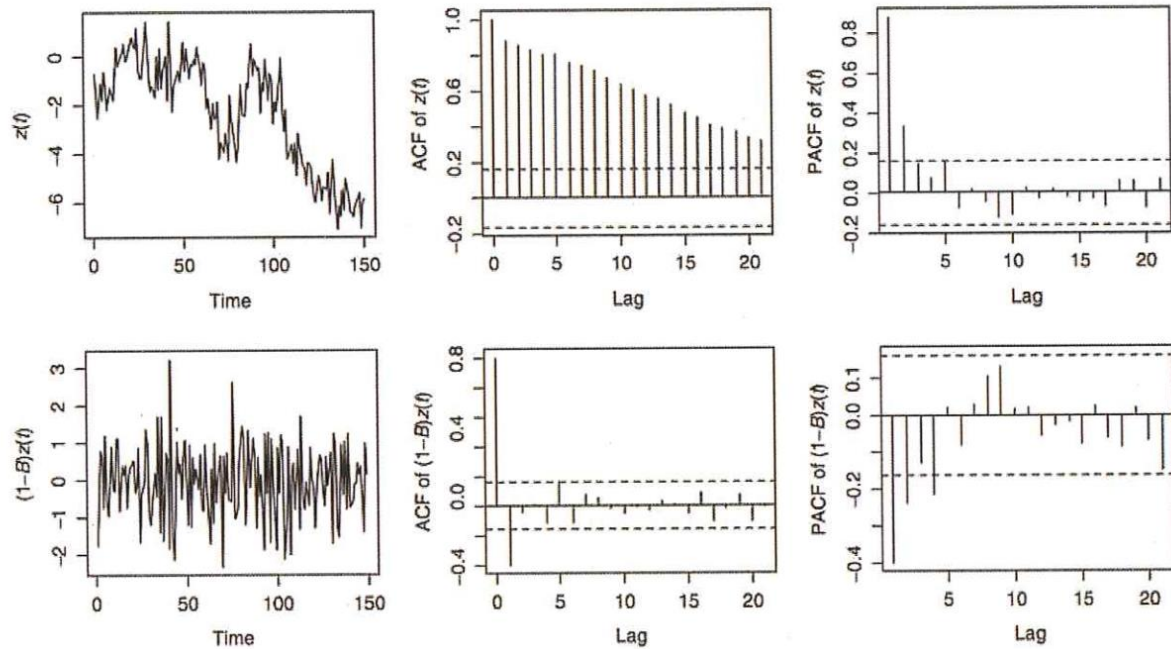
Time series plot of a data set and its first difference together with corresponding ACF and PACF plots are given below. Determine the orders  $p, d$ , and  $q$  of a tentative  $ARIMA(p, d, q)$  model that can be used for this data.



Explain how you picked an Arima model:

Part [d] (4 points for explain the process of reading correlograms and 2 points for backshift notation)

Time series plot of a data set and its first difference together with corresponding ACF and PACF plots are given below. Determine the orders  $p, d$ , and  $q$  of a tentative  $ARIMA(p, d, q)$  model that can be used for this data.

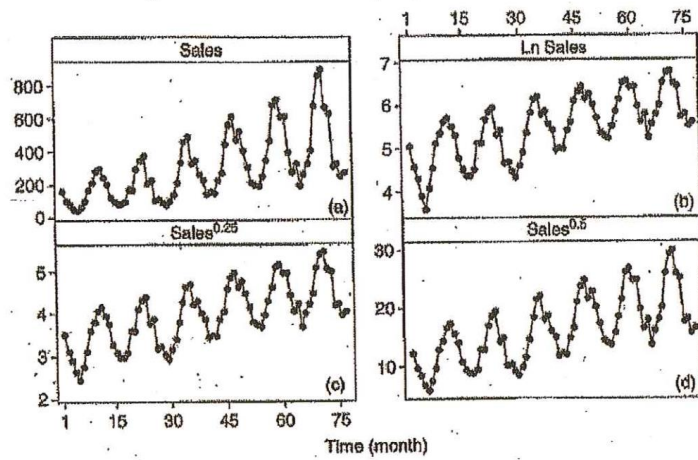


Explain how you picked an Arima model:

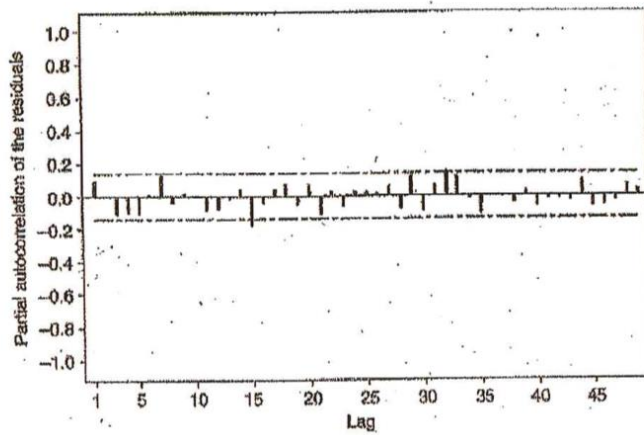
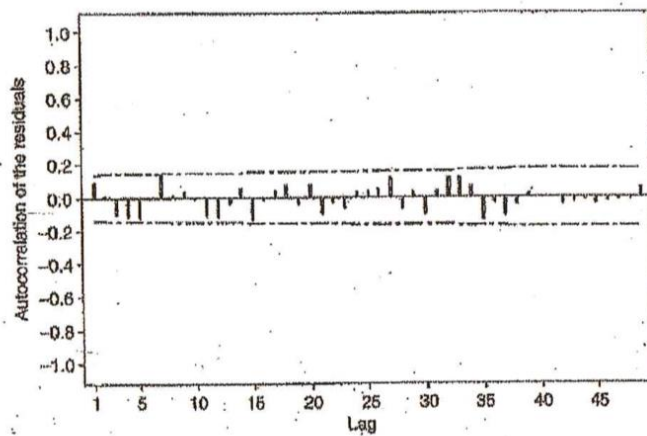


# Problem 4

Why is the time series analyst looking at the graphs below. Explain in the context of Box Jenkins Methodology. (6 pts)



Why is the time series analyst looking at the graphs below. Explain in the context of Box Jenkins Methodology. (6 pts)



Problem 5 (36 points)

Go to the data set “series” under announcements in Canvas and use the four steps of Arima Nonseasonal Modeling in order to forecast ten periods (ten units). For full credit explain in detail each step in essay format and copy-and-paste every pertinent graph and R output after each explanation (make it flow like an essay).

(N.B) No auto.arima, but your reasoning. *Enjoy the break! We had fun.*