

**OPRE 6398 Prescriptive Analytics
Homework 5**

**Due 4/01/19
(11:59 p.m.)**

Note: 1. Your homework submission must be typewritten.

1. Show only the solutions and do not copy the problems in the submission.

1. Read Reading 8 and 9.
2. (10 pts) Club Warehouse (commonly referred to as CW) sells various computer products at bargain prices by taking telephone, Internet, and fax orders directly from customers. Reliable information on the aggregate quarterly demand for the past five quarters is available and has been summarized below:

Year	Quarter	Demand (units)

2015	3	1,356,800
	4	1,545,200
2016	1	1,198,400
	2	1,168,500
	3	1,390,000

Let the third quarter of 2015 be Period 1, the fourth quarter of 2015 be Period 2, and so on. Apply each of the following methods to predict the demand for CW's products in the fourth quarter of 2016. Be sure to carry four decimal places for irrational numbers.

- (1) Naïve.
 - (2) Three-quarter simple moving average.
 - (3) Five-quarter weighted moving average with weights of 0.05, 0.15, 0.4, 0.3, and 0.1.
 - (4) Simple exponential smoothing with a smoothing constant of 0.8 and a forecasted demand of 1,146,400 units for the first quarter of 2016.
3. (20 pts) The partial productivity of labor (output per hour of all persons) for the U.S. manufacturing industry in each of the 10 years from 2003 to 2012 has been summarized below (Year 2009 = 100.0):

Year		2003	2004	2005	2006	2007	2008	2009	2010	2011	2012

Productivity		84.0	88.6	93.8	97.1	102.9	107.0	100.0	110.2	116.2	118.2

- (1) Use a computer software program (e.g., Excel) to plot the historical data from 2003 to 2012 and show the graph. Based on the graph plotted, which of the forecasting methods discussed in Chapter 11 would be most appropriate for this problem and why?
- (2) Apply the method selected in (1) to provide a forecast of the partial productivity of labor for the years of 2013. Be sure to carry four decimal places for irrational numbers, if any.
- (3) What does the slope of the line obtained in (2) mean in this problem?

4. (20 pts) Air pollution control specialists in the DFW area monitor the amount of ozone, carbon dioxide, and nitrogen dioxide in the air on a monthly basis. The data collected for the past four years are summarized below.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec

2012	170	180	205	230	240	315	360	290	240	240	230	195

2013	180	205	215	245	265	330	400	335	260	270	255	220

2014	195	210	230	280	290	390	420	330	290	295	280	250

2015	215	225	240	305	310	440	410	335	315	320	305	275

- (1) Use a computer software program (e.g., Excel) to plot the time series and comment on the data pattern exhibited, if any.
 - (2) Which forecasting method would be most appropriate for predicting the level of air pollution in the future and why?
 - (3) Based your findings in (2) above, forecast the monthly air pollution levels in 2016.
5. (25 pts) As part of a social responsibility policy, Small Time Enterprise (STE) in Sherman, TX, runs a retraining program for workers displaced from positions in the firm's various businesses. The erratic nature of the displaced employees' training requirements has made it difficult for STE's educational administrator to predict the staff needed for the program. Nevertheless, she has collected the data given in the accompanying table:

Month no.	1	2	3	4	5	6
No. of hours	5,100	4,900	5,200	5,000	4,700	5,300

Three forecasting methods are being considered: naïve, 3-month simple moving average, and simple exponential smoothing with $\alpha = 0.2$ and an initial forecast of 5,100 hours for Month 1. Be sure to carry four decimal places for irrational numbers.

- (1) Use each of the three approaches to develop forecasts for appropriate past periods and then compute the forecast errors.
 - (2) Which of the three methods is most reliable based on the MAD criterion and why?
 - (3) Based on your findings in (2) above, provide a forecast of the time requirement in Month 7.
 - (4) Compute the MSE for each of the three forecasting models discussed above to determine which of them provides the most accurate forecast.
6. (25 pts) During the past five hours, the Port of Baltimore in Maryland unloaded large quantities of grain from ships and relevant data are summarized in the table below:

Hour	Quantity unloaded (tons)
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1	1,703
2	1,720
3	1,649
4	1,686
5	1,718

- (1) Use the naïve approach to develop a forecast of the tonnage of grain unloaded in each hour up to the 5th hour.
- (2) Repeat (1) above by using the 2-hour simple moving average method.
- (3) Which of the two forecasting techniques is more accurate based on MAD? Be sure to carry four decimal places for irrational numbers.
- (4) Which of the two forecasting techniques is more accurate based on MSE? Be sure to carry four decimal places for irrational numbers.
- (5) Are your conclusions in (3) and (4) consistent? If not, what can be done to determine which of the two techniques should be used to provide future forecasts of quantities to be unloaded at the port?