**MSBA444 EXAM – I Due: Nov. 22nd , 2022**

Note: Please upload your final report on Canvas by Tuesday, Nov. 22nd. Your report should include not just the final answer but should show the process you went through to derive it. Upload all supporting material (R/EXCEL files) to Canvas.

In preparing your report, you may follow following outline:

1. Brief Problem description
2. Your answers and conclusions (Managerial Summary)
3. Details of the Methodology/Analysis you used to derive your answers and conclusions.
4. Attach relevant printout of your model (EXCEL or R file) and outputs as an Appendix.

Your report should be complete so that I need to go to your uploaded files only as an exception.

Note: **This is an individual exam!!** You should not discuss any aspect of the exam with fellow students, or share any computer input or output files. **Receiving or offering help** in an exam is against the school’s academic integrity policies – any violation can result in serious consequences. Also note that searching internet for the solution to the problem is also violates school’s academic integrity policies. If you need any clarification about integrity policies or about the exam, feel free to contact me. You can stop by my office or send me an email.

In taking this examination, I agree to abide by the honesty and academic integrity values of the Weatherhead School of Management and Case Western Reserve University.

Signature:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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

**Include signed copy of this page as the cover sheets for your exam report**

1. 15

2. 15

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**PROBLRM 1**: (15 Points)

A national Pharmacy (like CVS) buys prescription drugs from the manufacturers (say at cost *c*) and resell it to customers and some price *p*. Whenever the manufacturer changes the cost of a drug, the pharmacy will like to reprice these drugs accordingly. Currently this is a subjective manual process but the company have hired you as a consultant to come up with a pricing model to make the repricing process more efficient. Rather than using PRICE as the dependent variable, the company will like you to use Gross Margin (defined as (PRICE-COST)/PRICE) as the dependent variable. Note that, from predicted Gross Margin (GM), one can compute the PRICS as COST/ (1-GM). The company think that the two key factors which influence the Gross Margin are COST and whether the product needs refrigeration not.

The EXCEL file “REVCO\_GM.XLSX” provides information about a sample of 100 drugs – Their COST, whether they need Refrigeration or not (REF?), and current Gross Margin (GM). Use SPSS to develop a linear or nonlinear regression model (try stepwise regression) to estimate Gross Margin as a function of COST and whether product needs refrigeration or not.

1. Use Stepwise regression to develop a regression model. Interpret the meaning of all regression coefficients.
2. What is R2 and Standard Error of this model? Interpret these values in the output. How well does your model fit the gross margin of the pricing of current products?
3. Identify any potential outliers and discuss how you will treat them.
4. Perform residual analysis to check if all assumptions of Linear Regression seems to be valid. If not, take appropriate action and repeat Step (a)-Step (d).
5. The manufacturer has just increased the COST of a product to $6.50. This product needs Refrigeration. Based on your eventual regression model, what is your estimate for Gross Margin? Price?

**PROBLEM 2: (15 Points)**

A chain operates a hotel in a large metropolitan area. You have been asked to develop a model that could be used to obtain short-term forecasts (up to 1 year) of the number of occupied rooms in the hotel. These forecasts are needed by various professional staff to assist in decisions regarding hiring additional help, ordering materials and supplies that have long delivery lead times, etc. Consider the monthly occupancy rate (daily average during a month) for last 15 years (January 2008 to December 2021) given in EXCEL file (HOTEL\_occupancy.csv).

1. Develop an appropriate Exponential Smoothing Model(s) by using following steps:
   1. Plot your data to determine what Exponential Smoothing Models (you may think of more than one model) may be appropriate.
   2. Use R to determine the “best” exponential smoothing model among the models you identified in part (a). Discuss why you selected this model.
   3. Use your eventual model to forecast demand for next 12 months (January 2022 to December 2022).
2. Suppose the management has not given you enough time to build an ARIMA model for this problem in a systematic way. Take an easy way out and use auto.arima (use max for p, d, q, P, D, Q as 10 instead of 5 used in class example. Also use max.order as 10) to let R derive the best ARIMA model for the time series. Based on (p, d, q) and (P,D,Q) determined by auti.arima, what is your forecasting model? Compare Mean % Error, Mean Absolute % Error, RMSE (Root Mean Square Error), and other indicators of this model to the exponential smoothing models from part (i). Which model will you use? What forecasts will you recommend?