

# Introduction to Business Analytics Assignment

There are four problems for you to solve in this assignment, and you must solve **all four** of them. You can get altogether 40 points and you need at least 20 points to pass. Please note that:

- You must use Excel to answer these questions. Please clearly define and label all the parameters.
- You must conduct all the calculations using Excel or its built-in functions. That is, for every numerical result you input into your Excel sheet, I need to be able to check which formula or Excel function you have used.
- Upon completion, please upload all four questions in **one** Excel file onto Moodle.
- You must finish the assignment **individually**.
- Please also include your **name and matriculation number** in your submission.

The deadline for submission is **Sunday, the 20<sup>th</sup> of October, at midnight**. Please be advised:

- Any late submission after the deadline has passed will not be considered.
- No retake is available for the assignment.

## Question 1 (10 points)

The worksheet *President's Inn Guest Database* in the Excel file provides a list of customers, names and types of the rooms they occupied, arrival and departure dates, number of occupants, and daily rate for a small bed-and-breakfast inn during one month. Note that the **Daily Rate** given in the worksheet only apply to up to 2 guests; additional guests must pay an *additional* \$20 per person per day for meals. Guests staying for seven days or more receive a 10% discount.

1. Please first calculate, for each order, the **Adjusted Daily Rate** that includes the extra costs on meals for additional guests.
2. Calculate the **Number of Days Stayed** for each order.
3. Determine the **Total Costs** for each order.
4. Please write a simple query that will retrieve the **Overall No. of Orders** and **Total Sales Revenue** for *any* input **Room Name** (not **Room Type**). In other words, by typing any room name into cell N2, its **Overall No. of Orders** and **Total Sales Revenue** are returned in cells O2 and P2, respectively.

## Question 2 (6 points)

A company sells a product with a one-week shelf life. The weekly data on the number of units sold in the last three years (*i.e.*, 156 weeks) can be found in the worksheet *Sales Volume* in the given Excel file. Your task is to forecast the sales volume for the next week (*i.e.*, Week 157).

Please first **identify** the underlying pattern in the given data. If the data exhibits only a horizontal pattern, please forecast the sales volume for Week 157 using the following two methods:

- Moving Average Forecast (with  $k = 4, 5$  and  $6$ )
- Exponential Smoothing (with  $\alpha = 0.25, 0.5$  and  $0.75$ )

Please **evaluate** the above methods using the error metric of Mean Square Error (MSE) and **identify** the optimal forecast on the sales volume for Week 157.

### Question 3 (10 points)

A producer of various kinds of batteries has been producing “D” size batteries with an average life expectancy of 87 hours. Due to an improved production process, management believes that there has been an increase in the life expectancy of their “D” size batteries. A sample of 36 batteries showed an average life of 88.5 hours. Assume from past information that it is known that the standard deviation of the population is 9 hours. At a level of significance of 0.01, can the management’s belief be supported based on the data we have?

To answer the above question, please do the following:

1. Formulate the null and alternative hypotheses for this application.
2. Compute the value of the test statistic.
3. Calculate the  $p$ -value.
4. Calculate the critical value.
5. Based on the  $p$ -value and critical value, what is your conclusion, and why?

### Question 4 (14 points)

The Flamingo Grill is an upscale restaurant. To help plan an advertising campaign for the coming season, Flamingo’s management team hired the advertising firm of Haskell & Johnson (HJ). The management team requested HJ’s recommendation concerning how the advertising budget should be distributed across television, radio, and newspaper advertisements. The budget has been set at \$279,000.

In a meeting with Flamingo’s management team, HJ consultants provided the following information about the industry exposure effectiveness rating per ad, their estimate of the number of potential new customers reached per ad, and the cost for each ad.

Advertising Media	Exposure Rating per Ad	New Customers per Ad	Cost per Ad
Television	90	4000	\$10,000
Radio	25	2000	\$3,000
Newspaper	10	1000	\$1,000

The exposure rating is viewed as a measure of the value of the ad to both existing customers and potential new customers. It is a function of such things as image, message recall, visual and audio appeal, and so on. As expected, the more expensive television advertisement has the highest exposure effectiveness rating along with the greatest potential for reaching new customers.

At this point, the HJ consultants pointed out that the data concerning exposure and reach were only applicable to the first few ads in each medium. For television, HJ stated that the exposure rating of 90 and the 4000 new customers reached per ad were reliable for the first 10 television ads. After 10 ads, the benefit is expected to decline. For planning purposes, HJ recommended reducing the exposure rating to 55 and the estimate of the potential new customers reached to 1500 for any television ads beyond 10. For radio ads, the preceding data are reliable up to a

maximum of 15 ads. Beyond 15 ads, the exposure rating declines to 20 and the number of new customers reached declines to 1200 per ad. Similarly, for newspaper ads, the preceding data are reliable up to a maximum of 20; the exposure rating declines to 5 and the potential number of new customers reached declines to 800 for additional ads.

Flamingo's management team accepted maximizing the total exposure rating, across all media, as the objective of the advertising campaign. Because of management's concern with attracting new customers, management stated that the advertising campaign must reach at least 100,000 new customers. To balance the advertising campaign and make use of all advertising media, Flamingo's management team also adopted the following guidelines.

- Use at least twice as many radio advertisements as television advertisements.
- Use no more than 20 television advertisements.
- The television budget should be at least \$140,000.
- The radio advertising budget is restricted to a maximum of \$99,000.
- The newspaper budget is to be at least \$30,000.

Based on the guidelines given above, please develop and solve a linear programming model to determine how the \$279,000 advertising budget should be allocated among television, radio, and newspaper advertising.

**IMPORTANT:** Please ensure that you do not delete the inputs in Excel Solver after completing the task. Before grading Question 4, I will remove the optimal solution returned by Excel on your worksheet and then re-run Solver to verify the result. If your Solver setup is missing, I will not be able to check your work, and you will receive no points for this question.