BIOS 507 HOMEWORK 5

Due 3/24/2025 by 11:59pm

Directions: Complete all questions. Any R or SAS code used should be attached at the end of the homework. Collaboration is encouraged, but the final product must be your own work.

Problem 1

ABCD Corp is a mid-sized logistics company that prides itself on maintaining high employee satisfaction. Unfortunately, recent surveys indicate that employee job satisfaction levels vary widely depending on workload and job type. To better understand these dynamics the company has conducted a study to examine how weekly work hours influence job satisfaction for each type of employee in the company. The company has two broad categories of employees:

Office Workers : Includes software developers, accountants, marketing specialists, and project managers. These roles are cognitively demanding, requiring problem-solving, meeting deadlines, and long hours of computer-based work.

Manual Laborers Includes warehouse workers, machine operators, and delivery personnel. These employees perform physically demanding tasks such as lifting, operating machinery, and moving goods across warehouses or delivery routes.

The company has collected data on number of hours worked, type of employee, and job satisfaction (0 to 100). The data are stored on Canvas under `ABCD_job_satisfaction.csv`. Note that this is simulated data for this example homework problem and does not represent a real study.

1. Fit a model that captures the relationship between job type and hours worked and the outcome of job satisfaction. Be sure to carry out all the usual steps (EDA, writing the model, etc). Interpret the coefficients, or, if easier, create a plot demonstrating the effects.

2. The company asks you if there is evidence that the job satisfaction for a office worker who works 40 hours per week is different than a manual laborer who works 35 hours per week. Assess this, being sure to provide a confidence interval for the quantity that you report.

3. The company asks you if there is evidence that the job satisfaction for a office worker who works 20 hours per week is different than a manual laborer who works 40 hours per week. Assess this, being sure to provide a confidence interval for the quantity that you report.

Problem 2

Public health researchers are investigating how lifestyle factors like sleep duration and physical activity influence cholesterol levels, and whether this relationship differs based on dietary habits. Cholesterol levels are a key indicator of cardiovascular health, with high levels increasing the risk of heart disease. The study categorizes participants into three dietary patterns: Plant-Based Diets, Balanced Diets, and High-Meat Diet. The hypothesis is that increased sleep and physical activity are generally associated with lower cholesterol levels, but the magnitude of these effects differs based on dietary habits, with plant-based eaters potentially benefiting more due to better metabolic profiles, while high-meat consumers may show a weaker response.

The data are stored on canvas under `diet_sleep_exercise_cholesterol.csv`. Note that this is simulated data for this example homework problem and does not represent a real study.

1. Fit a model (Model 1) that includes all main effects and two-factor interactions.
    - Conduct a test for the presence of the sleep duration $\times$ physical activity interaction.
    - Conduct a test for the presence of the diet $\times$ physical activity interaction.
2. Fit a model (Model 2) that includes all main effects, but only the diet $\times$ physical activity interaction. Create a conditional effects plot based on this model that demonstrates the interaction between physical activity and diet on cholesterol. Be sure to provide a written description of the pattern that you observe.