# Evaluating Factors Influencing Commute Speeds to UBC

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## Objective

Given that a significant number of students commute to the University of British Columbia (UBC) campus by either car or bus, this experiment aims to analyze the factors influencing commute speeds (in km/h). The primary objective is to identify and evaluate key variables that may impact the average speed of students' commutes, providing insights into potential patterns or factors affecting their travel. Data collection is restricted to these days, as all participants commute on these days, ensuring consistency and completeness in the dataset.

## Experimental Design

The experimental design is structured as a $3 \times 2 \times 2 \times 2 \times 3$ factorial design, incorporating four independent factors and one blocking factor. This design offers a comprehensive approach to investigating how various factors influence commute times to the University of British Columbia (UBC) campus on selected weekdays. The factors and their levels are as follows: Weekdays (3 levels), including Tuesday, Wednesday, and Thursday; Commute Method (2 levels), either Bus or Car; Peak Hour (2 levels), defined as Peak Hour (Yes) or Off-Peak (No); and Weather Condition (2 levels), categorized as Normal weather or Adverse weather (Rainy/Snowy). To ensure consistency and reduce variability across individual subjects, a blocking factor is applied, with subjects considered in 3 levels. With three subjects serving as blocks, the experimental setup involves a total of $3 \times 2 \times 2 \times 2 \times 3 = 72$ observations.

## Response Variable

The response variable for this experiment is the average commute speed, measured in kilometers per hour (km/h). To accurately capture this, participants will systematically record three key data points for each commute: total distance traveled (in kilometers), departure time, and arrival time. The driving distance between each participant's starting point and the UBC campus will be determined using Google Maps, ensuring consistency and accuracy. Participants will also note the exact departure and arrival times for each commute, allowing for a precise calculation of travel time. To compute average speed (km/h):

$$Time\ Difference = (arrival\ hour - departure\ hour) + (arrival\ minutes - departure\ minutes)/60$$

$$Average\ Speed\ (km/h) = Distance\ (km)\ /\ Time\ Difference$$

## Tentative Experimental Plan

Following the collection of experimental observations over an anticipated period of three weeks, we will proceed to data analysis. The data will be organized into a structured table, where treatments and blocks are represented in columns, and individual observations are arranged in rows. An initial analysis will involve conducting ANOVA tests, accompanied by hypothesis testing, to determine the statistical significance of the observed effects. If significant results are identified, we will set up contrasts to further investigate specific differences, allowing for a detailed assessment and comparison of both individual and interaction effects of the treatments. We anticipate that weather conditions and peak hours will have substantial effects on commute speeds, potentially leading to pronounced differences in the results. The mode of transportation (bus or car) is expected to have a moderate influence, whereas the day of the week is not anticipated to significantly impact commute speeds. Furthermore, we do not expect notable variability across blocks, as they primarily serve to control for individual differences rather than contribute to treatment effects. Throughout the process, we will consider potential refinements and adjustments to the analysis as insights develop.