DUE: \*Monday\* 10/2/23 Noon (Report and Slides)

Instructions:

Outline a modeling approach for the estimated travel time data. Discuss how to

model dependence of the estimated travel times on scenario and other covariates (e.g. summer season, hour of the day, system load), including event/call ID (as each scenario is assessed on each call) and describe how to use this model to compare the scenarios. As we have seen with the mock data, there will likely be numerous events where a load metric does not vary by scenario. Approach this by modeling

* ~~(1) the probability of there being variation/no variation across scenarios (logistic regression if there are covariates like season and time) and~~
* ~~(2) the dependence of the travel times on scenario given that there is variation (using a linear mixed model).~~
* ~~Add to Overleaf doc (latex)~~
* ~~Add a few (<=5) slides to the Google slides document summarizing your section of the report (see below). Link to Google Doc:~~ [~~https://docs.google.com/presentation/d/1yZhci99kUhmjBbrTIK3N\_VziEF0AQ9VllpOp4X3A\_kA/edit?usp=sharing~~](https://docs.google.com/presentation/d/1yZhci99kUhmjBbrTIK3N_VziEF0AQ9VllpOp4X3A_kA/edit?usp=sharing)

Note:

* Covariates: season, hour of the day, day of the week, priority, system load, etc.

Paragraph 1:

* ~~Discuss travel time differ-by-scenario-or-not binary outcome, calculate probability~~
* ~~Model binary outcome with logistic regression model~~
* ~~glm(differ ~ covariates)~~

The initial step in our modeling approach involves discerning whether the estimated travel times exhibit variation across different scenarios. This is crucial as it enables us to identify instances where the travel time is influenced by the scenario in question and those where it remains unaffected. A binary outcome is formulated, where “1” indicates a variation in travel time across scenarios and “0” signifies no variation. This differentiation can be modeled using a logistic regression model, considering the binary nature of the outcome. The model can be expressed as:

glm(differ ~ covariates)

where “differ" is the binary outcome and covariates include factors such as season, hour of the day, day of the week, priority, system load. This model will allow us to calculate the probability of observing a variation in travel times across scenarios, given the covariates. For instance, during peak summer seasons or specific hours of the day, the model could reveal a higher probability of variation in travel times across different scenarios, which could be attributed to factors like increased traffic or road closures.

Paragraph 2:

* ~~Discuss travel time given differ-by-scenario, model with linear mixed model using R package lme4::lmer()~~
* ~~lmer(tt ~ scenario + (1 | eventID) + covariates)~~

Upon identifying instances where travel times exhibit discernible variation across different scenarios, it becomes imperative to model how these times are dependent on the respective scenarios, contingent upon the presence of such variation. The Linear Mixed Model (LMM), particularly utilizing the lme4::lmer() function in R, emerges as a potent tool for this purpose, adeptly managing both fixed and random effects and thereby navigating through the intrinsic variability embedded within the data. The model can be succinctly expressed as:

lmer(tt ~ scenario + (1 | eventID) + covariates)

In this model, “tt” denotes the travel time, serving as the response variable we aim to predict or explain; “scenario” acts as a fixed effect, representing the specific ambulance allocation strategy under scrutiny, and is pivotal in quantifying the impact of different deployment strategies on the travel time; “(1 | eventID)” embodies a random effect, which enables each event to possess its distinct baseline travel time, thereby accommodating the unobserved heterogeneity and intrinsic correlations within each event’s measurements; and “covariates” encompass additional fixed effects, such as the time of day, season, and system load, providing a mechanism to control and adjust for these variables in the model.