Sleep Log

February 5, 2025

1 Background

A particular individual sometimes has difficulty falling asleep, and sometimes awakens during the night repeatedly or for significant amounts of time. Upon consulting a sleep doctor and having his sleep monitored, he was told told that his sleep patterns were characteristic of a normal sleeper who spends too much time in bed. The doctor's hypothesis is that a typical human needs a certain amount of sleep per night (which may vary across humans), so if the human is habitually given much more time in bed, they will just sleep less efficiently. The subject was instructed to keep a sleep log for several weeks, find the average amount of actual total sleep time (TST), add about half an hour, and that was the amount of time he should regularly spend in bed trying to sleep.

Other factors may also be involved in sleep patterns and quality. Exercise is supposed to help with sleep. Alcohol is supposed to decrease the amount of time it takes to fall asleep, but also decrease the quality of sleep, leading to more frequent awakenings during the night. The subject's mother read somewhere that calcium-magnesium supplements taken at dinnertime are supposed to help one fall asleep faster and sleep better. Staying up later than typical may decrease the time to fall asleep. The quantity and/or quality of the previous night's sleep could affect the current night.

2 Analysis Objectives

- According to the doctor, how much time (TBT) should the subject spend in bed trying to sleep?
- Is the sleep doctor's hypothesis of a fixed amount of required sleep reasonable, given this dataset?
- Do calcium–magnesium supplements help with either falling asleep or staying asleep during the night?
- Do any other factors affect sleep patterns?

3 Data

The data can be found in the file `sleep.txt`. This is the subject's sleep log, recorded over the course of several months (excluding trips out of town and the days immediately after returning). In this file, you will find the following variables:

Date Recorded the morning after arising.

Bedtime Recorded as a four-digit number where the first two are the number of hours past noon and the last two are the number of minutes past that, e.g., a bedtime of 11:30PM is recorded as 1130, a bedtime of 1:05AM is recorded as 1305.

TTS Time To Sleep, the number of minutes it took to fall asleep.

TST Total Sleep Time, the total number of minutes spent asleep.

TBT Total Bed Time, the total number of minutes spent in bed attempting to sleep.

Alc An indicator for the consumption of alcohol later than the end of dinner.

Cal An indicator for the consumption of a calcium-magnesium supplement with dinner.

Run The number of miles run that day.

Note that there may be measurement error in the TTS and TST variables, but since it's not clearly biased in either direction, ignore possible measurement errors for the sake of this problem.

4 Assignment

- Conduct an exploratory data analysis for class on **Monday Febuary 10**. It may be useful to experiment with frequentist models at this stage in your analysis. Begin preparing your project slide deck by describing this analysis, highlighting any issues you encountered and unresolved questions you may have, and summarizing your preliminary inferences and discoveries. Be prepared to share these in class.

- *Add* to your project slides *about* five slides describing progress on your Bayesian analysis, highlighting assumptions, shortcomings and obstacles you have encountered (if any). Turn in your full set of slides (EDA + model–based analysis) and be prepared to present these in class **Monday February 19**.

- Describe your analysis in a formal report of up to four pages (writing and display equations); all tables and figures should appear in a separate appendix and be referenced by name in the main text. Your report should highlight all relevant aspects of your analysis (exploratory and modeling) and include graphical and numerical summaries that aid in communicating your results. You may also include code and other supporting material in the supplemental appendix. Due in class **Monday February 19**.