Project Report - Analyzing Educational Data

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2024-10-24

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Introduction (Daniel)

For this project, we will be analyzing educational data. We are interested in understanding the predictors of student performance as measured by exam scores. We will be using a publicly available dataset from Kaggle that contains information about students and their exam scores.

Table 1: Variable Summary for the Educational Data

Variable Name	Variable Type	Description
Hours_Studied	numeric	Hours Studied
Attendance	numeric	Attendance
Parental_Involvement	factor	Parental Involvement
Access_to_Resources	factor	Access to Resources
Extracurricular_Activities	factor	Extracurricular Activities
Sleep_Hours	numeric	Sleep Hours
Previous_Scores	numeric	Previous Scores
Motivation_Level	factor	Motivation Level
Internet_Access	factor	Internet Access
Tutoring_Sessions	numeric	Tutoring Sessions

Variable Name	Variable Type	Description
Family_Income	factor	Family Income
Teacher_Quality	factor	Teacher Quality
School_Type	factor	School Type
Peer_Influence	factor	Peer Influence
Physical_Activity	numeric	Physical Activity
Learning_Disabilities	factor	Learning Disability
Parental_Education_Level	factor	Parental Education Level
Distance_from_Home	factor	Distance from Home
Gender	factor	Gender
Exam_Score	numeric	Exam Score

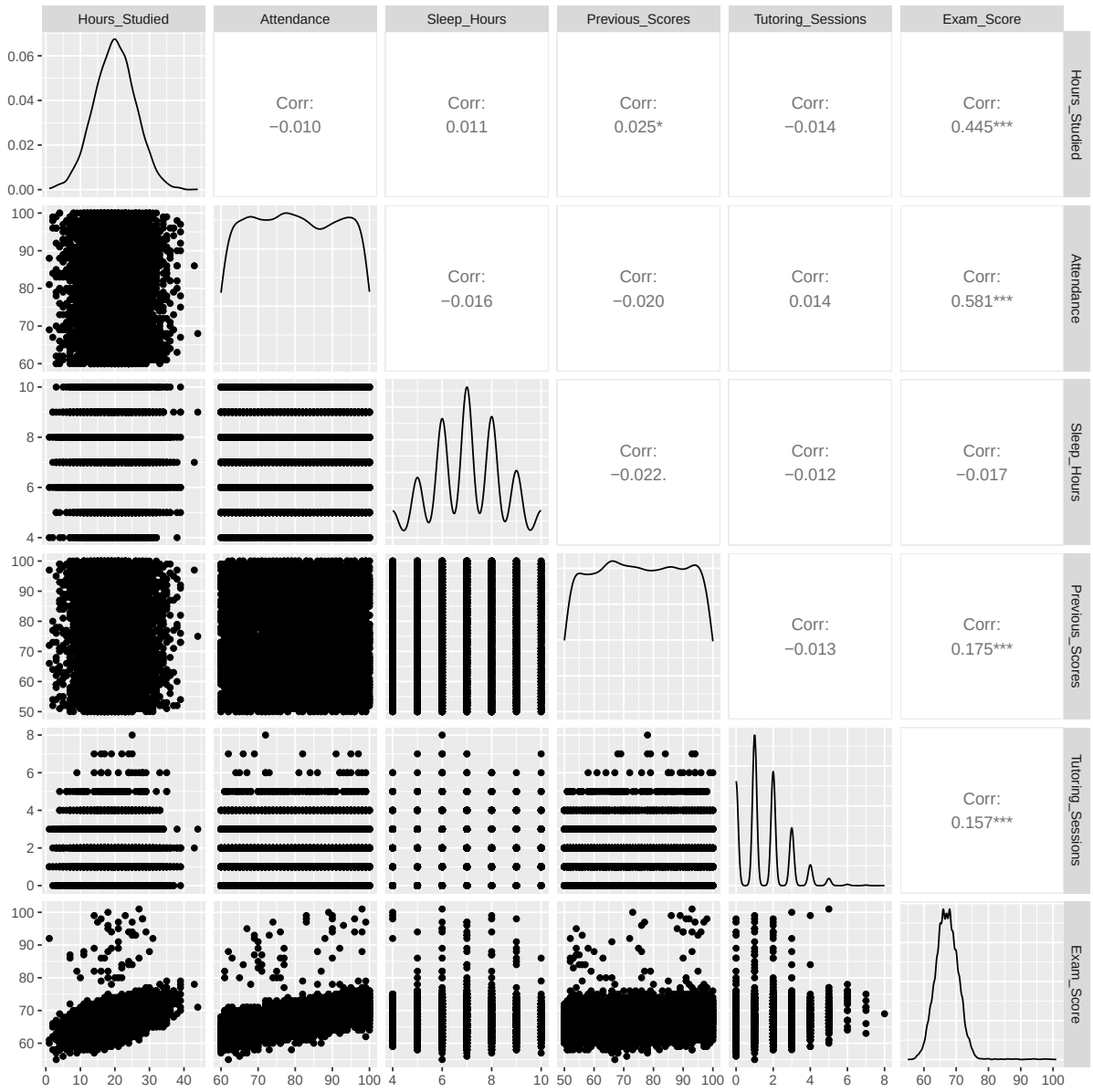
Now, we want to further explore a specific hypothesis about a subset of predictor variables. Suppose we maintain that the following variables are significant predictors:

- Hours Studied
- Attendance
- Sleep Hours
- Previous Scores
- Tutoring Sessions

We can formalize this question as follows:

- $H_0 : \beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = 0$
- H_A : At least one of the coefficients is not equal to zero

Before we begin our analysis, let us take a look at the dependencies across these data:



Part 1: Linear Regression Analysis (Daniel)

Part 2: Principal Component Analysis (Aristofanis)

Part 3: Non-linear Regression Analysis (Jizhou)

Conclusion

Code Appendix

```
# Set up knit environment
knitr::opts_chunk$set(echo = F)
knitr::opts_chunk$set(error = F)
knitr::opts_chunk$set(warning = F)
knitr::opts_chunk$set(message = F)

# Load necessary packages
library(tidyverse)
library(kableExtra)
library(knitr)
library(ggplot2)
library(naniar)
library(gtsummary)
library(GGally)

# Load the data
educ_dta <- read_csv("student_performance.csv") %>%
  mutate(
    Parental_Involvement = as.factor(Parental_Involvement),
    Access_to_Resources = as.factor(Access_to_Resources),
    Extracurricular_Activities = as.factor(Extracurricular_Activities),
    Motivation_Level = as.factor(Motivation_Level),
    Internet_Access = as.factor(Internet_Access),
    Family_Income = as.factor(Family_Income),
    Teacher_Quality = as.factor(Teacher_Quality),
    School_Type = as.factor(School_Type),
    Peer_Influence = as.factor(Peer_Influence),
    Learning_Disabilities = as.factor(Learning_Disabilities),
    Parental_Education_Level = as.factor(Parental_Education_Level),
    Distance_from_Home = as.factor(Distance_from_Home),
    Gender = as.factor(Gender)
  )

# Summary table
table_summary <- tibble(
  "Variable Name" = colnames(educ_dta),
  "Variable Type" = sapply(educ_dta, class),
  "Description" = c(
    "Hours Studied", #1
    "Attendance", #2
```

```
    "Parental Involvement", #3
    "Access to Resources", #4
    "Extracurricular Activities", #5
    "Sleep Hours", #6
    "Previous Scores", #7
    "Motivation Level", #8
    "Internet Access", #9
    "Tutoring Sessions", #10
    "Family Income", #11
    "Teacher Quality", #12
    "School Type", #13
    "Peer Influence", #14
    "Physical Activity", #15
    "Learning Disability", #16
    "Parental Education Level", #17
    "Distance from Home", #18
    "Gender", #19
    "Exam Score" #20
  )
)

# Display the table
knitr::kable(table_summary, caption = "Variable Summary for the Educational Data")

pred_var <- c("Hours_Studied",
              "Attendance",
              "Sleep_Hours",
              "Previous_Scores",
              "Tutoring_Sessions")

pred_dta <- educ_dta %>%
  dplyr::select(all_of(pred_var), "Exam_Score")

GGally::ggpairs(pred_dta)
```