STAT 512 Homework 4

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Part A: Panama Canal

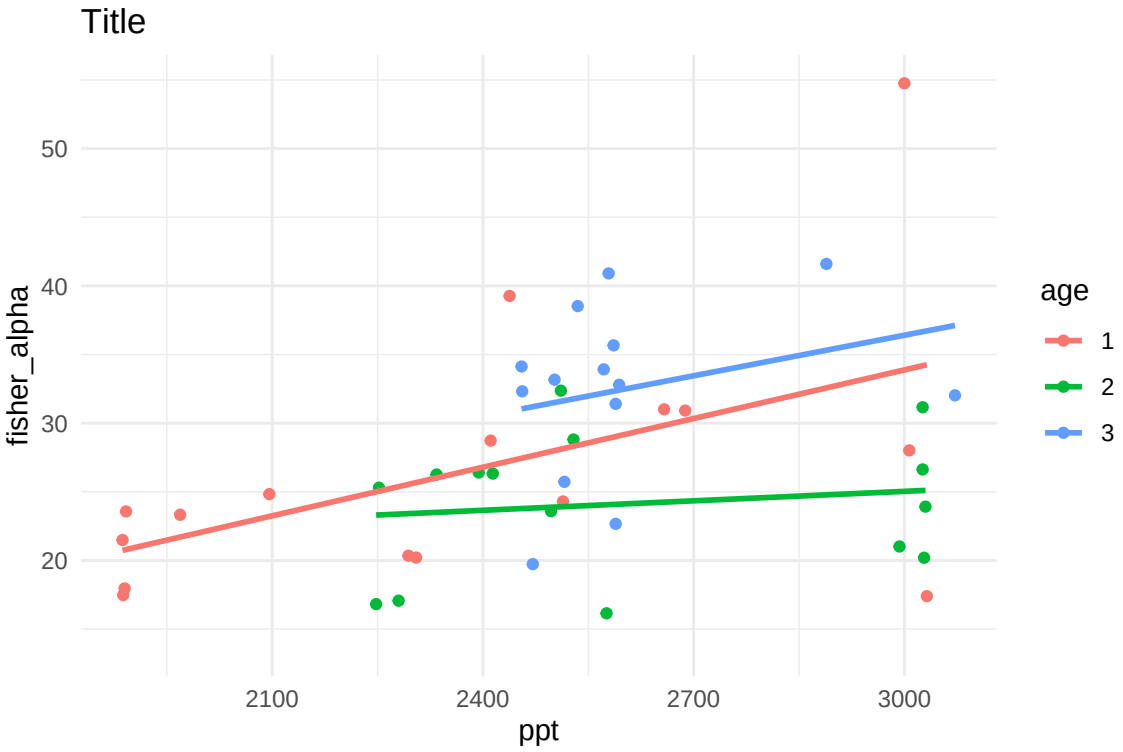
Ott & Longnecker Problem 16.23 describes a study original published in Pyke (2001). Researchers studied the floristic composition of lowland tropical forest in the watershed of the Panama Canal. For this group of question we will work on fitting a model to explain `FisherAlpha` (Y) using `Age` and `Ppt` as predictors. The following characteristics were measured on 45 plots:

- `FisherAlpha`: a biodiversity index
- `Age`: 1 = secondary forest, 2 = mature secondary, 3 = old growth, primary forest
- `Ppt`: annual precipitation (mm)

Note that `Age` should be defined as.factor in R.

Question 1: Plot

Construct a scatterplot of FisherAlpha (Y) vs Ppt (X) for all Age groups on the same plot. Overlay a fitted regression line for each Age group. (2 pts)



Question 2: ANCOVA + Interaction

Fit the ANCOVA model WITH interaction. Include the Type 3 ANOVA table in your assignment. What can we conclude about differences between the slopes for the Age groups? Briefly justify your response.

Note: Continue using the ANCOVA WITH interaction model for questions 3-6.

Question 3:

Consider the diagnostic plots (Resids vs Fitted and QQplot of residuals). You do not need to include these plots in your assignment, but briefly discuss your findings.

Question 4:

For each Age group, provide the estimated intercept, slope (corresponding to Ppt) and p-value corresponding to a test of the slope. (6 pts)

Question 5:

Calculate Tukey adjusted pairwise comparisons of the slopes. What can we conclude about differences between the slopes for the Age groups? Briefly justify your response.

Question 6:

Calculate emmeans for the Age groups at (A) Ppt = 2500 and (B) Ppt = 3000.

Questions 7 and 8 (FisherAlpha continued): Use the ANCOVA WITH interaction model above as the "full" model. But our goal is to choose a model that predicts FisherAlpha.

Question 7:

Based on a backwards elimination approach, which model is preferred? Briefly justify your response. Use $\alpha = 0.05$.

Question 8:

Based on AIC criteria, which model is preferred? Briefly justify your response. Hint: Use `dredge()` from `MuMIn`. Use code something like this:

```
library(MuMIn)
options(na.action = "na.fail")
dredge(FullModel, rank = "AIC")
```

Part B: Body Fat

Return to the Body Fat data from HW2. The data is available from Canvas as "BodyFat.csv". With 3 predictors, there are 8 possible models. Which model would you choose? To identify the model, just state which predictors are included.

Question 9:

Choose a model using "backwards elimination" (hypothesis testing) approach. Use $\alpha = 0.05$. No need to discuss, just state your final model.

Question 10:

Choose a model using "forward selection" (hypothesis testing) approach. Use $\alpha = 0.05$. No need to discuss, just state your final model.

Question 11:

Choose a model using AICC. Hint: Use `dredge()` from `MuMIn`. No need to discuss, just state your final model.

Use code something like this:

```
library(MuMIn)
FullModel <- lm(BodyFat ~ ., data = InData)
options(na.action = "na.fail")
dredge(FullModel)
```

Appendix

```
# load packages
library(tidyverse)
library(janitor)
library(broom)
library(car)
library(emmeans)
library(kableExtra)
# set global options
knitr::opts_chunk$set(fig.width = 6,
                      fig.height = 4,
                      fig.path = "figs/",
                      echo = FALSE,
                      warning = FALSE,
                      message = FALSE)
# read panama data
bio_data <- readr::read_csv("data/ex16-23.txt") %>%
  janitor::clean_names() %>%
  dplyr::select(fisher_alpha, age, ppt) %>%
  dplyr::mutate(age = as.factor(age))
# 1. plot fisher_alpha and ppt by age group
bio_data %>%
  dplyr::group_by(age) %>%
  ggplot2::ggplot(aes(x = ppt, y = fisher_alpha, color = age)) +
  geom_point() +
  geom_smooth(formula = "y ~ x", method = "lm", fill = NA) +
  ggtitle("Title") +
  theme_minimal()
```