Homework #4
BSTA 519 – Fall 2021
Applied Longitudinal Data Analysis
Due – Monday 11/1/2021 by midnight

Covariance Pattern Models

Dental Growth data

Source: Table 1 (page 214) of Potthoff and Roy (1964).
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The data are from a study of dental growth measurements of the distance (mm) from the center of the pituitary gland to the pteryomaxillary fissure were obtained on 11 girls and 16 boys at ages 8, 10, 12, and 14.

Variable List:

ID, Gender, Age 8 Response, Age 10 Response, Age 12 Response, Age 14 Response.

Note: Response is measurements of the distance (in millimeters) from the center of the pituitary to the pteryomaxillary fissure.

The data is provided in the file *dental.txt*.

1.1. On a single graph, construct a time plot that displays the mean distance (mm) vs. age (in years)) for boys and girls. Describe the time trends for boys and girls.

1.2. Provide the estimated covariance and correlation matrix from the data, and describe how the variance and correlation change over time.

1.3. Use the response profile model (saturated model for the mean response) as the maximal model for the mean, fit the following models for covariance:
  i.   Unstructured covariance
  ii.   Compound symmetry
  iii. Heterogeneous Compound symmetry
  iv.   Autoregressive(1)
  v.   Heterogeneous autoregressive(1)
  vi.   Toeplitz
  vii. Heterogeneous Toeplitz

  Based on the results from these models, do the following:

  a. Based on the estimated unstructured covariance, describe how the variance and correlation change over time. Do you see similar pattern to what you saw in 1.2?

b. Provide the estimated covariance matrix and estimated correlation matrix for covariance pattern models ii to vii, and qualitatively summarize the major differences among these estimated covariance and correlation matrices.

c. Compared to the unstructured covariance, do the compound symmetry. heterogeneous compound symmetry and Toeplitz models provide adequate fit? Perform the relevant tests and interpret your results.

d. Do the heterogeneous compound symmetry and Toeplitz provide a better fit than the compound symmetry model? Perform the relevant test and show your results.

e. Compare the performance of heterogeneous compound symmetry, heterogeneous autoregressive (1) and heterogeneous Toeplitz models.

f. Choose a model for the covariance pattern that adequately fits the data.

1.4 Given the choice of model for the covariance from 1.3.f, and still use the response profile as the mean model, determine whether the pattern of change over time is different for boys and girls.

1.5 Given the choice of model for the covariance from 1.3.f, fit a linear trend model, and determine whether the change over time is different for boys and girls. Does the linear trend seem to be adequate to describe the pattern of change in the two groups?

1.6 Based on results from 1.4 and 1.5, what conclusions can you draw about gender differences in patterns of dental growth?