Name _____

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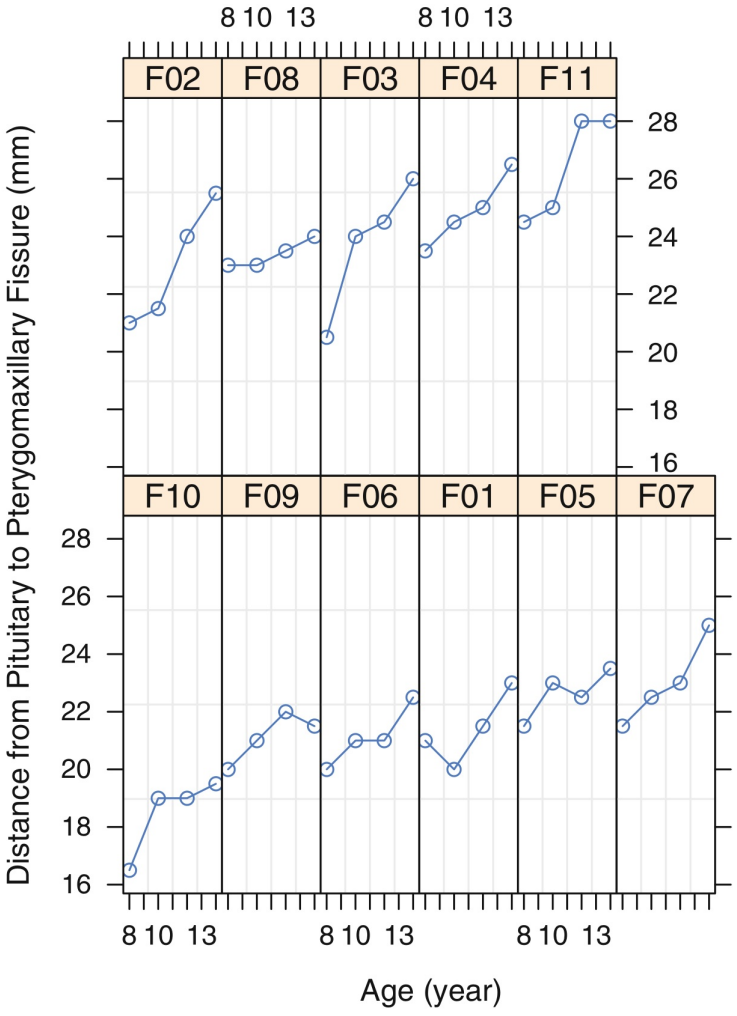
Reading Quiz for Sheather Section 10.1

We consider the orthodontic growth data discussed by Sheather: Potthoff and Roy (1964) first reported a data set from a study undertaken at the Department of Orthodontics from the University of North Carolina Dental School. Investigators followed the growth of 27 children (16 males and 11 females). At ages 8, 10, 12 and 14 investigators measured the distance (in millimeters) from the center of the pituitary to the pterygomaxillary fissure, two points that are easily identified on x-ray exposures of the side of the head. A plot of Distance vs Age for each female child in the data set is shown below. We are interested in a model for Distance as a function of Age.



The questions for you to answer appear on the back of this page.

1. A researcher proposes the following model for this data:

$$\begin{aligned} \text{Distance}_{ij} &= \beta_0 + \beta_1 \cdot \text{Age}_j + \epsilon_{ij}, \\ i &= 1, \ldots, 11 \text{ (for child } i\text{)} \\ j &= 1, \ldots, 4 \text{ (for Age } j\text{: Age}_1 = 8, \text{Age}_2 = 10, \text{Age}_3 = 12, \text{Age}_4 = 14) \\ \epsilon_{ij} &\overset{indep}{\sim} N(0, \sigma^2) \end{aligned}$$

Without even fitting the model to the data, suggest a reason that this model might be inadequate for the girls' data shown on the front side of this quiz.

2. A second researcher argues that the model should be:

$$\begin{aligned} \text{Distance}_{ij} &= \beta_{0i} + \beta_{1i} \cdot \text{Age}_j + \epsilon_{ij}, \\ i &= 1, \ldots, 11 \text{ (for child } i\text{)} \\ j &= 1, \ldots, 4 \text{ (for Age } j\text{: Age}_1 = 8, \text{Age}_2 = 10, \text{Age}_3 = 12, \text{Age}_4 = 14) \\ \epsilon_{ij} &\overset{indep}{\sim} N(0, \sigma^2) \end{aligned}$$

(a) Carefully describe how this model differs from the model in question #1.

(b) Again, without fitting the model to the data, offer a possible reason this model might not be appropriate for the girls' data on the front side of this quiz, either.