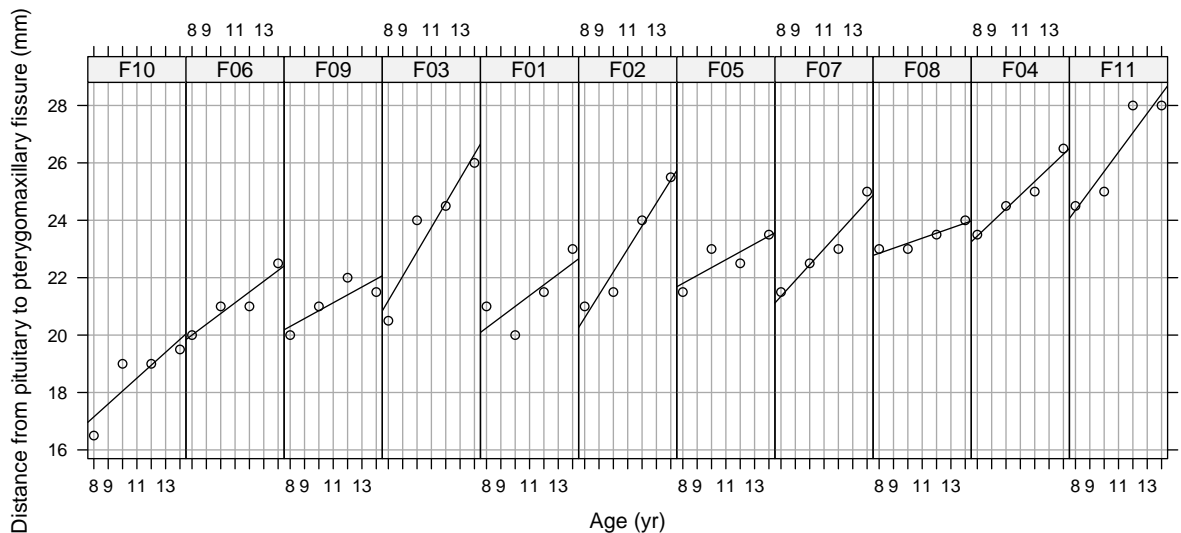


These exercises use data sets from the MEMSS package that you installed for the previous set of exercises.

1. Check the structure of documentation, structure and a summary of the `Orthodont` data set.
  - (a) Create an `xyplot` of the `distance` versus `age` by `Subject` for the female subjects only. You can use the optional argument `subset = Sex == "Female"` in the call to `xyplot` to achieve this. Use the optional argument `type = c("g", "p", "r")` to add reference lines to each panel.
  - (b) Enhance the plot by choosing an aspect ratio for which the typical slope of the reference line is around  $45^\circ$ . You can set it manually (something like `aspect = 4`) or with an automatic specification (`aspect = "xy"`). Change the layout so the panels form one row (`layout = c(11,1)`).
  - (c) Order the panels according to increasing response at age 8. This is achieved with the optional argument `index.cond` which is a function of arguments `x` and `y`. In this case you could use `index.cond = function(x,y) y[x == 8]`. Add meaningful axis labels. Your final plot should be like



- (d) Fit a linear mixed model to the data for the females only with random effects for the intercept and for the slope by subject, allowing for correlation of these random effects within subject. Relate the fixed effects and the random effects' variances and covariances to the variability shown in the figure.
  - (e) Produce a “caterpillar plot” of the random effects for intercept and slope. Does the plot indicate correlated random effects?
  - (f) Consider what the Intercept coefficient and random effects represents. What will happen if you center the ages by subtracting 8 (the baseline year) or 11 (the middle of the age range)?
  - (g) Repeat for the data from the male subjects.
2. Produce a model for both the female and the male subjects allowing for differences by sex in the fixed-effects for intercept (probably with respect to the centered age range) and slope.