Countries: Read in the data from the file `countries.data` using the `dget` command. These data include information on 150 countries from 1991 to 2004, including the following variables:

- `gdp`: gross domestic product

- `pop`: population

- `polity`: a measure of political openness, constant across years

- `conf`: a measure of how much military conflict a country is involved in

Note that these data aren't randomly sampled. However, they do provide a good exercise for evaluating model assumptions.

1. Plot the data and evaluate the assumptions in the hierarchical normal model as a model for population. Specifically, evaluate the normality of the $\epsilon_{i,j}$'s and the normality of the μ_j's, and the constant variance assumption via Levene's test and a fitted versus residual plot.

2. Identify a simple transformation such that the assumptions are approximately met. Redo part 1 for the transformed data.

3. Obtain MLEs for μ, σ^2 and τ^2 in the hierarchical normal model for the transformed data.

4. Think of a way to evaluate the assumption of within-group independence of the $\{\epsilon_{i,j}\}'s$. Present an argument numerically or graphically for or against the assumption of independence of the residuals under this model.

5. On your transformed scale, fit a linear regression model of population as a function of year. By doing this, you will obtain an intercept $\hat{\alpha}_j$ and a slope $\hat{\beta}_j$ for each country j. Summarize these fits as follows:

   (a) Make histograms of the $\hat{\alpha}_j$'s and the $\hat{\beta}_j$'s. Also make a scatterplot of $\hat{\alpha}_j$ versus $\hat{\beta}_j$.

(b) Report the (sample) mean and standard deviation of the $\hat{\alpha}_j$'s and the $\hat{\beta}_j$'s, and also their covariance.

(c) Report the top 5 and bottom 5 countries in terms of population growth.

(d) Write a paragraph or two describing worldwide population growth during this period, based on your calculations.

(e) Examining the within-country residuals, decide if the assumption of within-country residual independence has more, less or about the same plausibility as it did for the hierarchical normal model in 4.