



JMP Instructional data set 029

Sleep and Gestation in Mammals

JMP platforms and statistical methods

Multivariate:	Scatterplot matrix; correlation
Graph Builder:	Scatterplot; linear regression (log transformation)
Fit Y by X:	linear regression (log transformation)
Formula Editor:	Creating new variables

Problem statement

Sleep patterns of animals, including humans, has been studied quite extensively. Various hypotheses exist on the factors that most impact the amount of sleep, specifically REM (rapid eye movement) and non-REM sleep that animals experience.



Scientists have hypothesized that the length of the gestation period for an animal is one of the key factors that determines the amount of REM and non-REM sleep mammals experience [1]. To explore this hypothesis, data on the average length of gestation and average daily REM and non-REM sleep for 79 mammalian species was gathered.

Focus of the analyses will be to use linear regression using log transformations to model the relationship between the amount of sleep and gestation period of mammals comparing how closely humans sleep and gestation time are to that relationship.

Data

IDS_29.jmp

Mammal	Species name
Gestation	Average gestation time (in Days)
TST	Average total daily sleep time (in Hours)
NREM	Average amount of Non-Rapid Eye Movement sleep (in Hours)
REM	Average amount of Rapid Eye Movement sleep (in Hours)

Exercises

Create a row state using a unique color for human adult and human baby so all graphs will clearly show the values for these two. Scroll to bottom of data table. Highlight row 80 (Human Adult), right-click and select colors. Choose a color. Repeat for row 81 (Human Baby) and choose a different color.

1. Create a scatterplot matrix showing all possible scatterplots for the three sleep variables along with their correlations. Looking at the plot and the correlation table, which variable (NREM or REM) is most correlated with the total amount of sleep (TST)? Does the human adult or baby stand out much different from the other animals? If so, how? What other animals are closest to this value?

Instructions:

Analyze > Multivariate Methods > Multivariate. Place 'TST', 'NREM', and 'REM' in the Y, Columns. Click OK.

There are 3 possible scatterplots. 6 are shown (3 in the upper right and 3 in the lower left). These are the same just changing the axis the variables are plotted on.

Floating your cursor over any of the data points will display the name of the animal.

2. Create scatterplots of all the sleep variables ('TST', 'NREM', and 'REM') vs. 'Gestation'. Do you feel that a linear equation provides a good description of the relationship between Gestation and the sleep variables? Does the human adult or baby stand out much different from the other animals with regard to the amount of sleep relative to the amount of gestation? If so, how? What other animals are closest to this value?

Instructions:

Graph > Graph Builder. Place 'TST' on the Y axis, and 'Gestation' on the X axis. Deselect the Smoother graph  and choose to display the Line of Fit. 

Choose Redo > Column Switcher under the red triangle. Select 'TST' as the column to switch, and that along with 'NREM' and 'REM' as the Replacement Columns.

Select to display the R^2 , Equation, and F-Test from the Line of Fit controls on the left.

3. Use the Fit Y by X platform to fit linear regression models for each Sleep variable by Gestation. Examine the 'Residual by X Plots' and the 'Residual Normal Quantile Plot' for each. Based upon these graphs and your assessment in Exercise 2, how do you feel about using a linear equation to describe the relationship between Gestation and the Sleep variables?

Instructions:

Analyze > Fit Y by X. Choose 'TST', 'NREM', and 'REM' for the Y, Response.

Choose 'Gestation' for the X, Factor. Click OK.

In the report, Arrange in Rows under the red triangle, and choose 3.

For each, choose Fit Line under the red triangle.

Under the red triangle next to the Linear Fit label for each, choose Plot Residuals.

4. Create a new set of variables that are the $\log_{10}$ of the Gestation and Sleep variables.

Instructions:

Highlight the four variables in the data table. Right-click and choose New Formula Column > Log > Log.

5. Fit linear regression models for each of the new the $\log_{10}$ Sleep variables by $\log_{10}$ Gestation. Compare the scatterplots with the regression equations and the residual plots with those from Exercise 3. Which set do you believe are better models to describe the relationships? Why? Describe what using the $\log_{10}$ variables does for the analysis (hint: look at the shape of the relationship, amount and location of the variation, and the extreme data values)?

Instructions:

Follow all the same steps as in Exercise 3.

Supporting materials

1. Gonfalone, Alain A. "Negative correlations between gestation and sleep duration of mammals" *Animal Physiology*, 2016.
<https://www.dovepress.com/negative-correlation-between-gestation-and-sleep-durations-in-mammals-peer-reviewed-fulltext-article-OAAP>

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