

Do We Grow in Our Sleep?

This example is modified from the text

Mathematics for the Life Sciences

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Question: Does an individual's height change overnight?

Overall objectives:

1. Illustrate quantitative concepts of basic descriptive statistics, bar charts, scatter plots, regression utilizing personal data
2. Develop a data set that is easily understood, is multivariate, has potential multiple causal factors, illustrates problems with sampling and outlier effects

Specific learning objectives:

1. Develop hypotheses before collecting data and use exploratory analysis to evaluate these and other possible hypotheses
2. Graph multivariate data in several ways and in particular partition the data set according to different factors
3. Look carefully at data sets for “bad” data and outliers
4. Simple data descriptors (measures of central tendency and dispersion) may not be adequate data descriptors
5. Obtain experience with a standard software tool (R) that has become prevalent in biological sciences.
6. Illustrate the importance of IRB (Institutional Review Board) approval for experiments dealing with human subjects.

Background for class and data collection:

First step is to have pair and share groups in class consider what factors might affect the amount (or whether it occurs at all) of their height change overnight.

Second step is to have pair and share groups make one or more hypotheses about height change overnight based upon the factors they considered might affect it.

Third step is to collect data from participants. For this example data set the participants collected data over 4 nights each and provided the raw data in files that were then combined across all participants. Ideally the measurements to be taken include all factors the pair and share groups considered potentially important in affecting height change. For this example, we use a dataset that had students make measurements on themselves twice a day for 4 days and then submit the results to the instructor. The measurements taken were height (in millimeters) just before going to sleep at night and just after waking up in the morning, how many hours of sleep occurred that night and the age of the individual.

Procedures were given for taking the measurements:

Tape a paper ruler on the wall so that the zero edge is below the top of your head and measure (using another ruler) the height to the zero edge in millimeters from the floor. Stand in front of the ruler and use a book or other flat, hard surface placed on top of your head to determine your height. A ruler that is available on-line was suggested as appropriate to print out and tape to the wall. Students are informed that the observations of most concern are the difference in heights between evening and morning, not in the precise height (so do not worry if the overall height is not correct to the millimeter). Since each student in the class will be collecting his or her own measurement, it is important that the formatting of results be uniform. In compiling the results, use the following format, with spaces between each measurement:

Day	Student	Gender	Age	Height at night	Hours of Sleep	Height in morning
#	ID#	(1 = female, 2 = male)	(in years)	(mm)	(hours)	(mm)

The data were compiled and concatenated from all students by the instructors, de-identified (e.g. removed the student ID numbers), the day numbers were removed (e.g. all observations were assumed independent of day), and a single file was produced with the final entry in each row consisting of the differences in height (morning – night). The final data set then had headers:

Gender Age HtNight HrsSleep HtMorn HtDiff

Class analysis of the data:

This could be done in a lab or in a large class setting with guidance from instructor. The complete R-script has 9 steps which students could go through individually, in groups, or as part of a single large class session.