

MTH/BIO 415 - Spring 2007

HomeWork/LAB #1: Due February 5 Big Hearted Mammals

By this point, everyone should have constructed a model that relates the Rest-Pulse Rate of a mammal to the mass of the mammal. Mathematically, this model is simply a statement of *proportionality* which relates the pulse rate P to the mass, M , in the form:

$$P \propto M^\gamma$$

Now that we have this model of biological reality, we would like to (a) see if it is consistent with available data, (b) see what (if any) predictions can be made from it (c) think, in light of the data, about the assumptions that went into the model and improvements that one might make to the model.

Consider the following questions:

1. Model Comparison/Testing:

Consider the following data relating heart rates to mass for a range of mammals: Rest Pulse vrs Mass

Mammal	mass (kilograms)	pulse (beats per minute)
Mouse	0.017	500
Hamster	0.103	347
Guinea Pig	0.437	269
Rabbit	1.34	251
Opussum	2.2-3.2	187
Seal	20-25	100
Goat	33	81
Swine	100	60-80
Horse	390-440	34-55
Elephant	2,000-3,000	25-50

Compare the predictions of your model to the data graphically. What is the 'best' way to do this?

Hint: Remember your model only predicts how Pulse Rate scales with Mass. In other words, all you have predicted is the EXPONENT of the mass. What is the 'best' way to find the exponent of the data?

2. Model Predictions: Combine your model and the data to make a prediction for the rest-pulse of a Texas, Long-Horned Sheep with mass 50 kilograms.

3. Model Evaluation: Go back over your modeling procedure and CAREFULLY list each and every assumption that you have made. Make value judgments on how good/bad each assumption is. Can you dream up situations where the assumptions might be very bad?

4. Model Critique:

Judge your model! Is it any good at predicting the trends in the data? Is it at all useful? Is it better at predicting the data for some animals than for others? Explain. In light of your evaluation of the model assumptions, make some 'excuses' for why the model fails in comparison to some parts of the data. What assumptions might you change?

MATLAB SCRIPTS: A possibly helpful MatLab function `liner.m` is available for download at <http://wiener.math.csi.cuny.edu/~poje/MathBio415>. Just go there and then click on the file to download.

This MatLab function returns the slope m and y -intercept b of the 'best-fit' line through the data: $y = mx + b$.