# ESS 575 Homework 1

### Due 1/20/2017

Please prepare a one-paragraph description of an important, nonlinear model. The model should predict a single response variable (i.e., a $y$) as a function of one or more predictor variables (i.e., $x$) and parameters. Nonlinear models are those that contain exponents, reciprocals, products, and powers of the $x$.[1] For now, please avoid dynamic models. These are models that explicitly involve time, most often expressed as difference or differential equations. The logistic equation is an example of a dynamic model. You may use t the document processor of your choice for this assignment. All future assignments must be prepared in R Markdown..

Using the code below (Algorithm 1) as a template, provide a .pdf showing the shape of the predictions of the model and the generating equation. You may need to explore the R `text()` function and `plotmath`[2] to understand and use this code. Send me a zip file containing 1) the .pdf file containing the plot (alone) and 2) the R code you used to produce it, and 3) a paragraph describing what the model predicts and the observations that are needed to make the prediction. If the model's parameters have a biological interpretation, please describe what the parameters represent and specify their units. Briefly discuss why the model is important in your field.

An example of what you should send me (along with .pdf of plot and R code) is shown below. Be sure your plot contains:

1. Axis labels with units
2. The equation for the model
3. A title
4. Your name

[1] A model is linear if its second derivative is equal to 0. There are two semantic traditions about linear and non-linear models that can create confusion. Statisticians apply the linearity rule to the parameters in a model, such that $y = \beta_0 + \beta_1 x + \beta_2 x^2$ is linear because it is linear in its parameters (i.e., the $\beta's$). However, theoretical ecologists and mathematicians would classify this model as non-linear because the the non-linearity in the predictor variable $x$.

[2] Do `?plotmath` at the R prompt.

**Example of assigned paragraph and plot (also send .pdf file for plot)**

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### Model of Herbivore Functional Response

This model describes the functional response of mammalian herbivores feeding in patches where plants are concentrated in space (Figure 1). It is important because it provides a mechanistic explanation for a fundamental process in herbivore foraging ecology, the regulation of instantaneous intake rate. It predicts the eating rate of the animal ($y$, mass/time) based on bite mass ($x$, mass). Parameters are the maximum rate of food processing in the mouth ($R_{max}$ mass/time) and the average cropping time ($h$, time). See Spalinger and Hobbs (1992) and Gross et al. (1993).

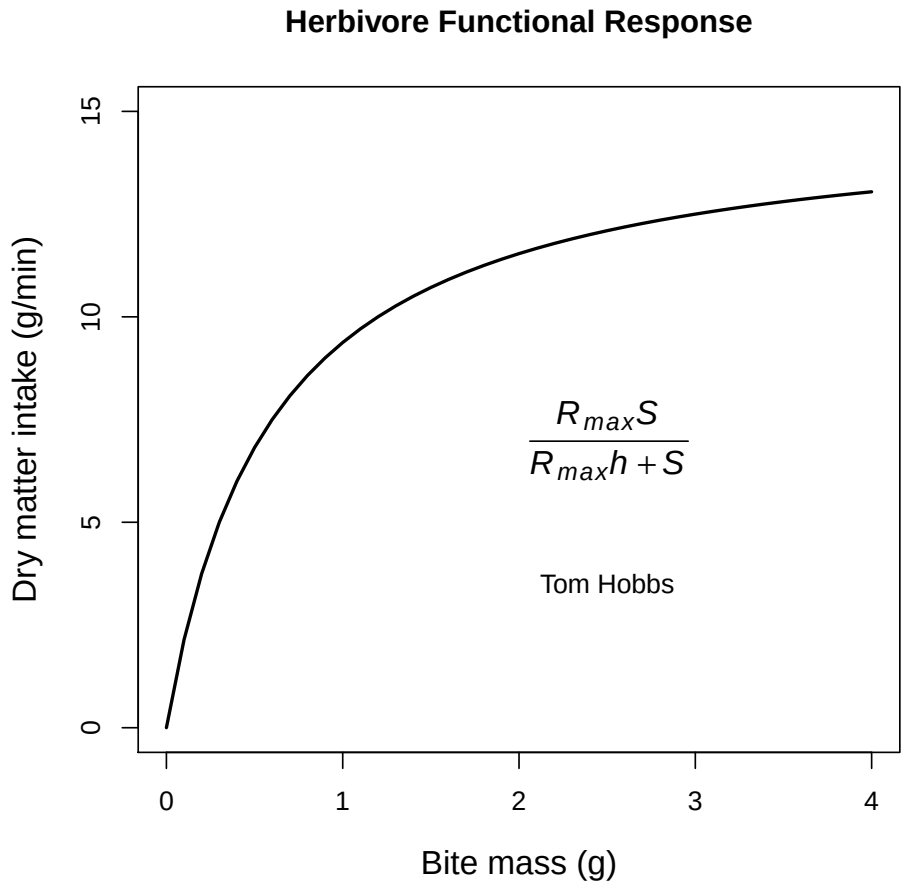


*Figure 1:* Model of functional response of large herbivores feeding in patches where plants are concentrated in space.

**R Code 1** Template for producing plots for first assignment. The R script is available on the class GitHub.

```
#Example plotting code.R
h=.04
Rmax=15
#set up a sequence for the range of the independent variable
S=seq(0,4,.1)
I=S*Rmax/(h*Rmax+S)
#remove comment in next line
#and change path to you computer when
#you are ready to produce pdf.
#Must also uncomment dev.off() below
#pdf(file="/my_path/Example_plot.pdf", width = 6 ,height = 6)
plot(S,I ,typ="l", ylab="Dry matter intake (g/min)",
xlab = "Bite mass (g)", ylim=c(0,15), cex.lab=1.25,
lwd=2, main="Herbivore Functional Response")
text(2.5, 7, expression (frac(R[max]*S,R[max]*h+S)),
cex=1.25)
#dev.off()
```

## Literature Cited

Gross, J. E., L. A. Shipley, N. T. Hobbs, D. E. Spalinger, and B. A. Wunder, 1993. Functional response of herbivores in food-concentrated patches - tests of a mechanistic model. *Ecology* **74**:778–791.

Spalinger, D. E. and N. T. Hobbs, 1992. Mechanisms of foraging in mammalian herbivores: new models of functional response. *The American Naturalist* **140**:325–348.