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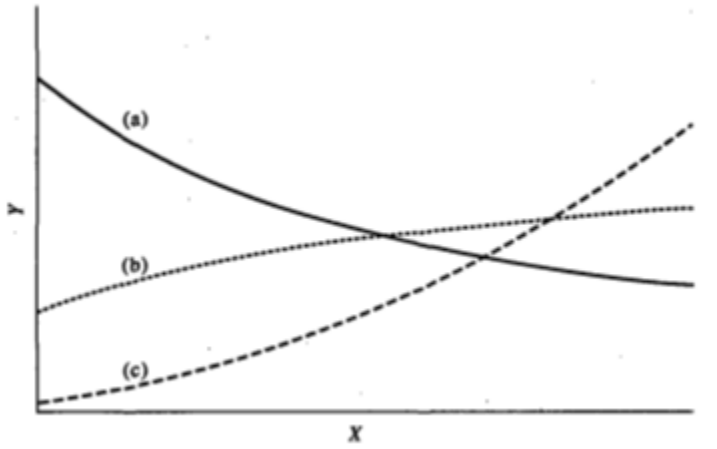
Making Sense of Biostatistics: Nonlinear Regression

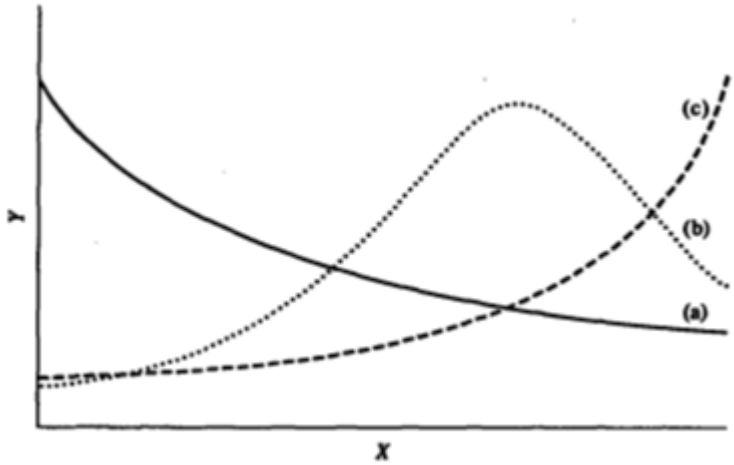
By Melissa Pressman

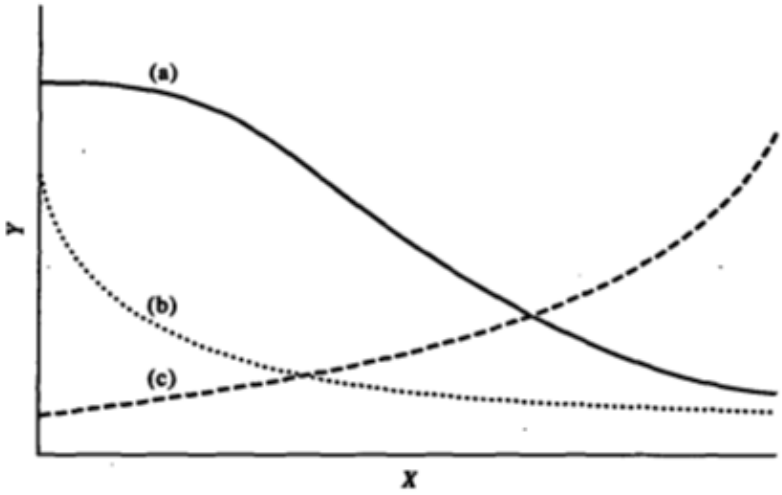
Simple and multiple linear regression models can predict many relationships between response and predictor variables. However, straight lines do not adequately model many biological and clinical systems, so nonlinear regression models are required.[1] Some common nonlinear functions are presented below.[2]

Simple Curves

Simple curves (which do not cross themselves) can be positive, negative or humped. These curve functions can be used, for example, for modeling the concentration (Y) of a drug in the bloodstream over time or the rate of a chemical reaction (Y) over time.

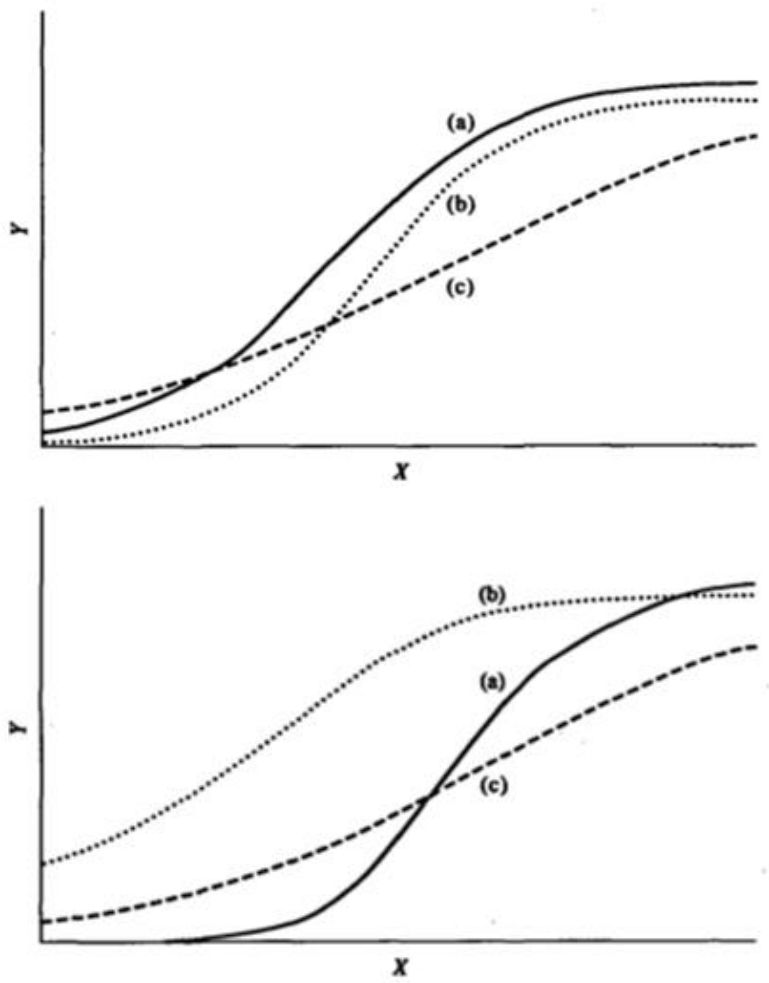






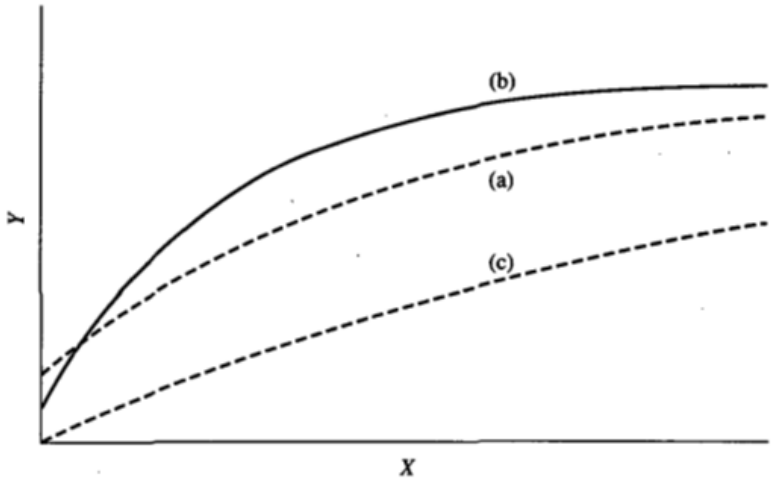
Sigmoidal Curves

A special class of simple curves are sigmoidal (s-shaped). Sigmoidal curves are used in applications with bioassays, signal detection, economics and other models demonstrating growth.



Curves that Level Off

Another special class of simple curves levels off when the independent variable (Y) steadily increases or decreases with the independent variable (X), and the rate of that increase or decrease approaches zero. This type of curve is used to model, for example, rate-limiting reactions.



Conclusion

There are many other nonlinear models. The trick is to find a model that (a) fits the data set and (b) has a scientific basis for explaining the data set. Without that scientific basis, the model may fail with other data sets of the same type. On the other hand, if a particular model works for multiple data sets of the same type, there may very well be a scientific basis that can be discovered.

Some nonlinear regression functions can be reformulated as linear regression functions by applying transformations.[3]

Calculations for nonlinear regression are complicated and require the use of a computer. Most statistical packages include the ability to perform these calculations and linear transformations.

References

1. http://en.wikipedia.org/wiki/Nonlinear_regression
2. http://www.stat.colostate.edu/regression_book/chapter9.pdf
3. http://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=9&ved=0CFcQFjAI&url=http%3A%2F%2Fwww.statsci.org%2Fsmyth%2Fpubs%2Feoe_nr.pdf&ei=4-4_VbfmDNCBygTa1oDIAw&usg=AFQjCNEJOfBAhrnodmFhGaXsBEy5bbNlyg

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