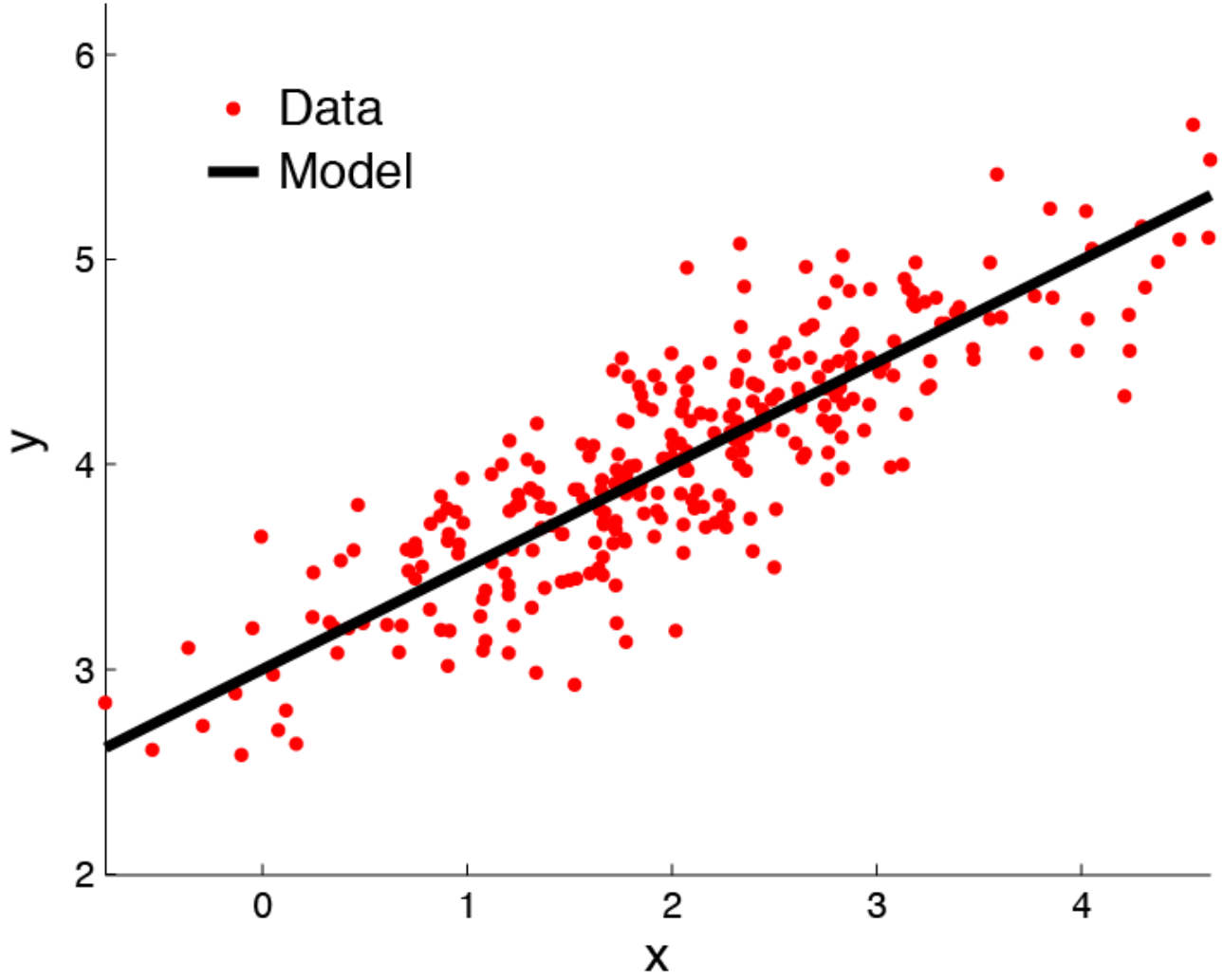
Statistics and Data Analysis in MATLAB

Lecture 3:
Model specification

Kendrick Kay
Washington University in St. Louis
February 21, 2014

Linear model



Model specification

$y = ax + b$

↓

Estimate free parameters

↓

Fitted model

$y = \frac{1}{2}x + 3$

Issues in model building

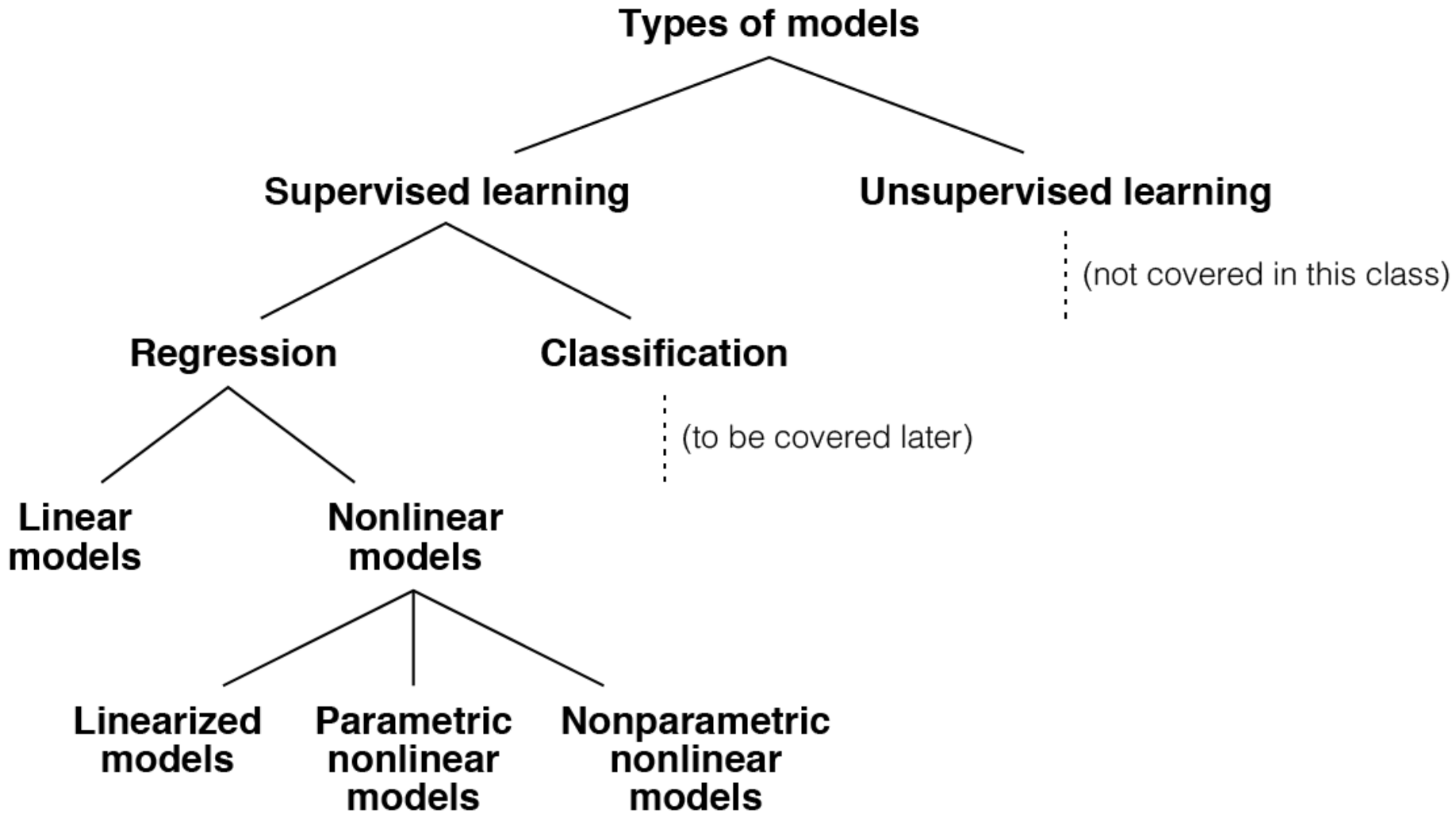
Model specification
(what type of model to use?)

Model fitting
(how do we estimate the model parameters?)

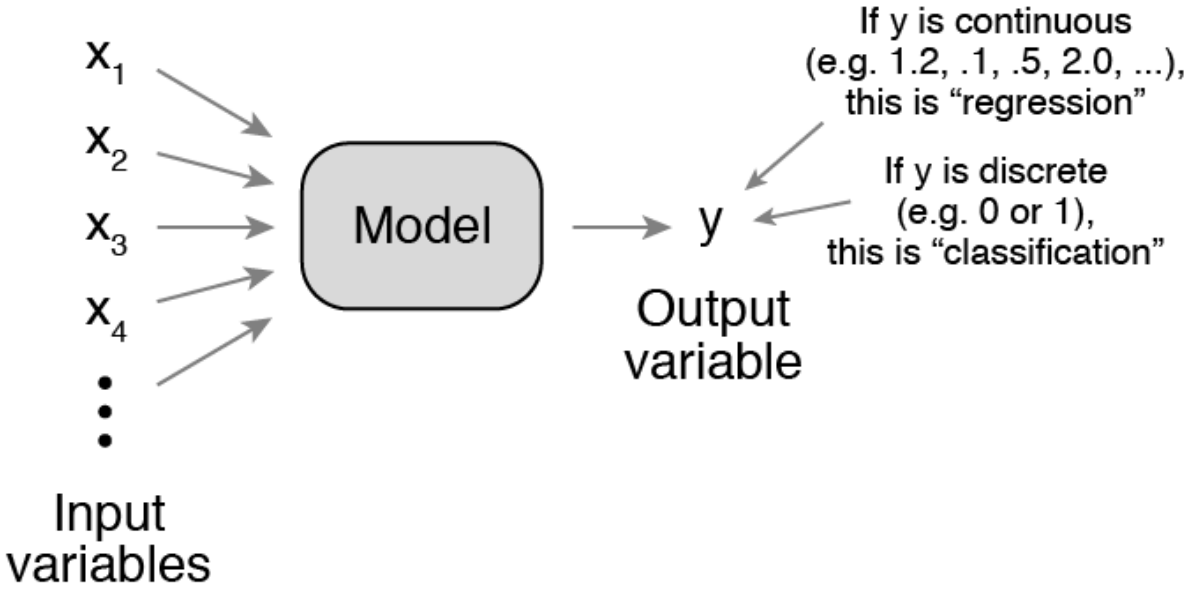
Model accuracy
(how well does the model describe the data?)

Model reliability
(how stable are the parameter estimates?)

Model specification



Supervised learning

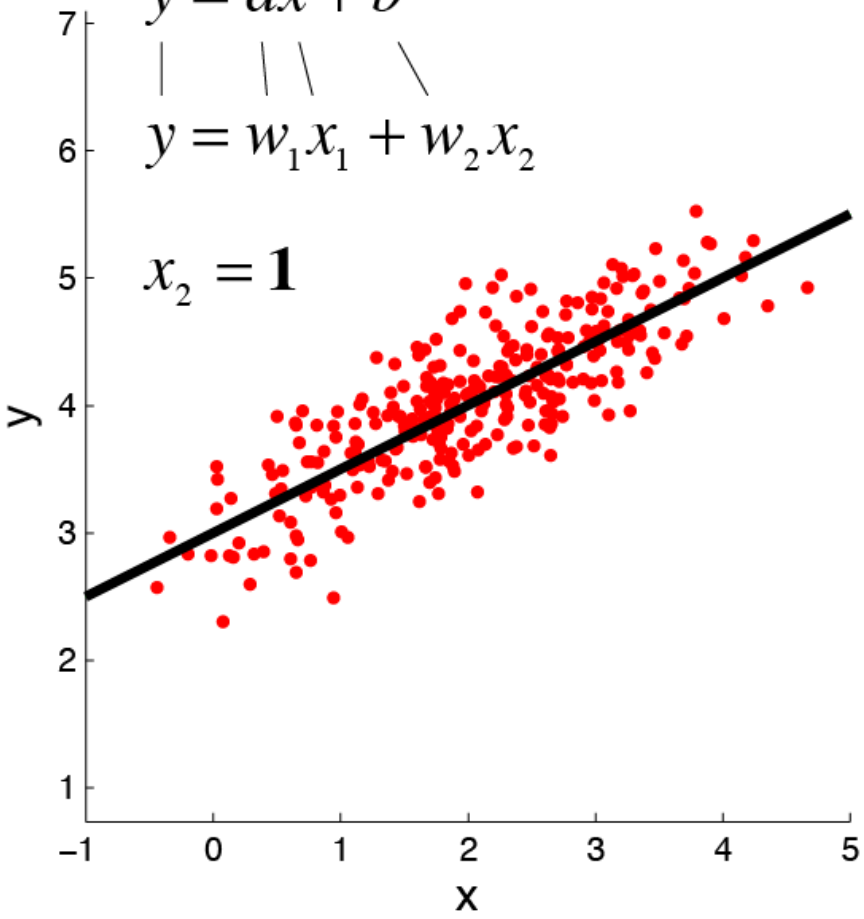


Linear model

$$y = ax + b$$

$$y = w_1 x_1 + w_2 x_2$$

$$x_2 = 1$$

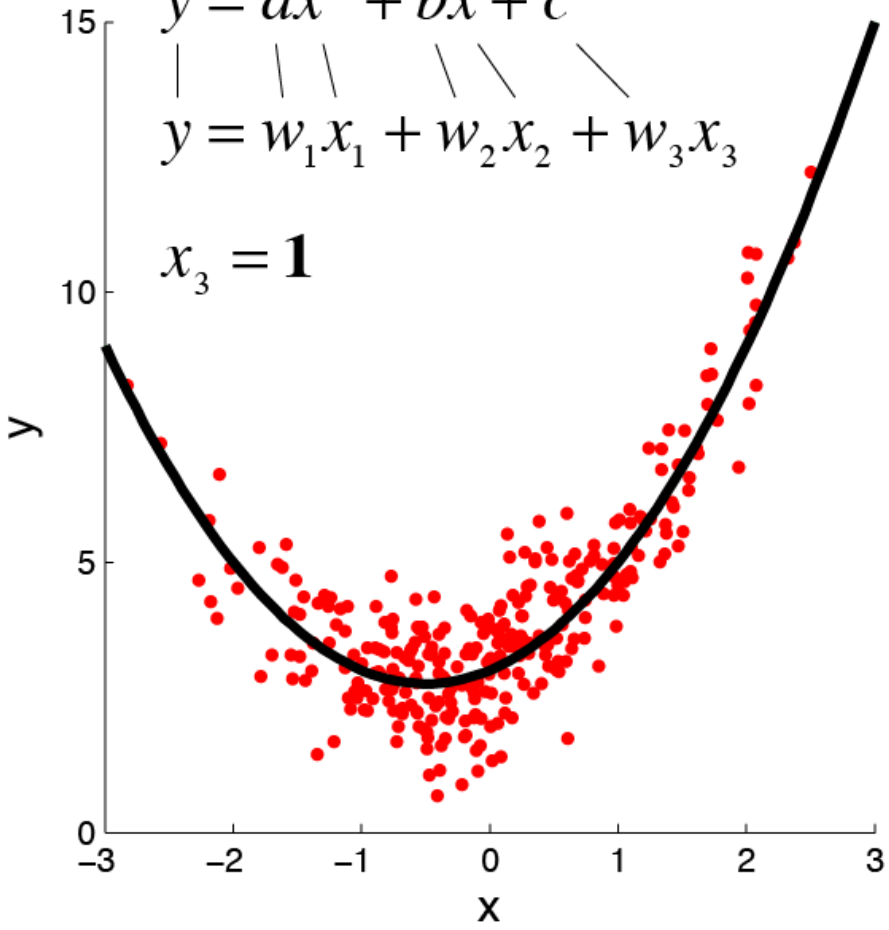


Linearized model

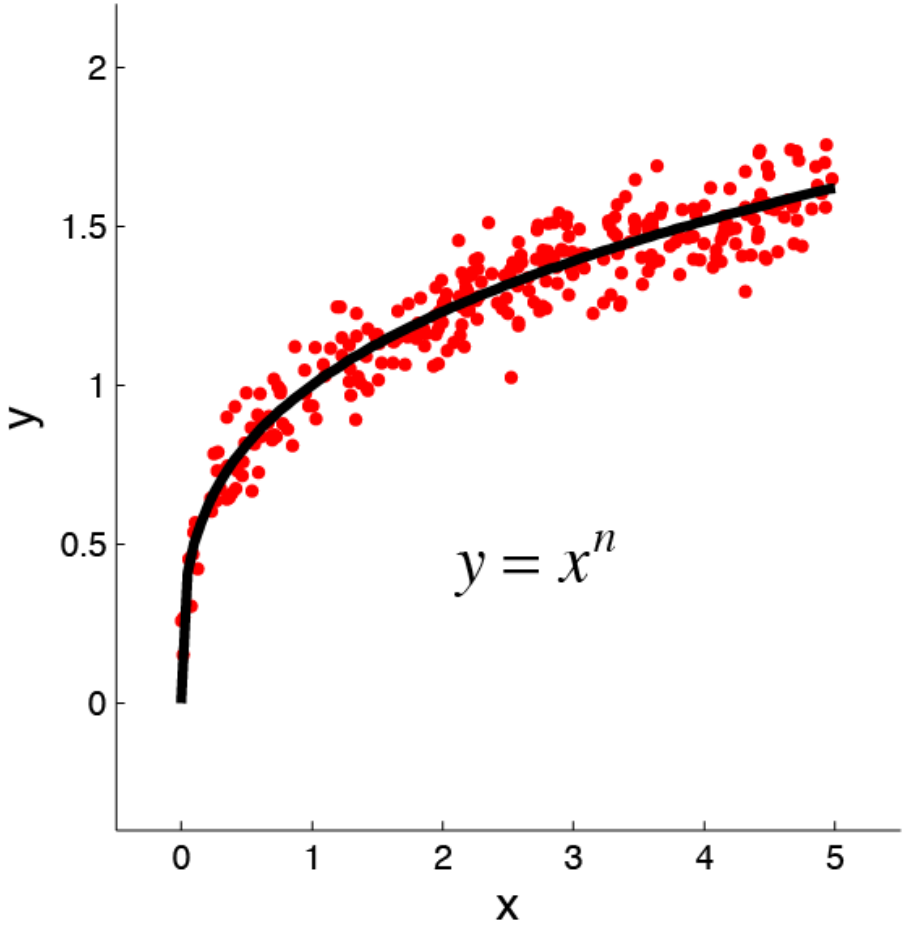
$$y = ax^2 + bx + c$$

$$y = w_1 x_1 + w_2 x_2 + w_3 x_3$$

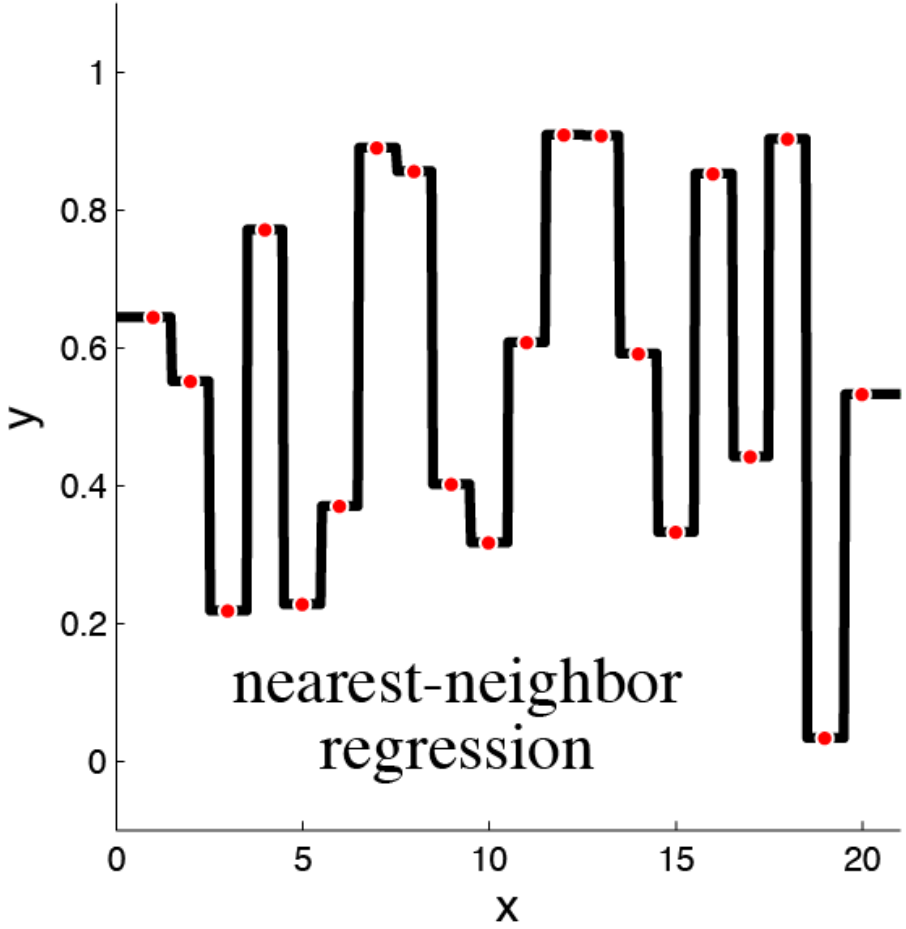
$$x_3 = 1$$



Parametric nonlinear model



Nonparametric nonlinear model

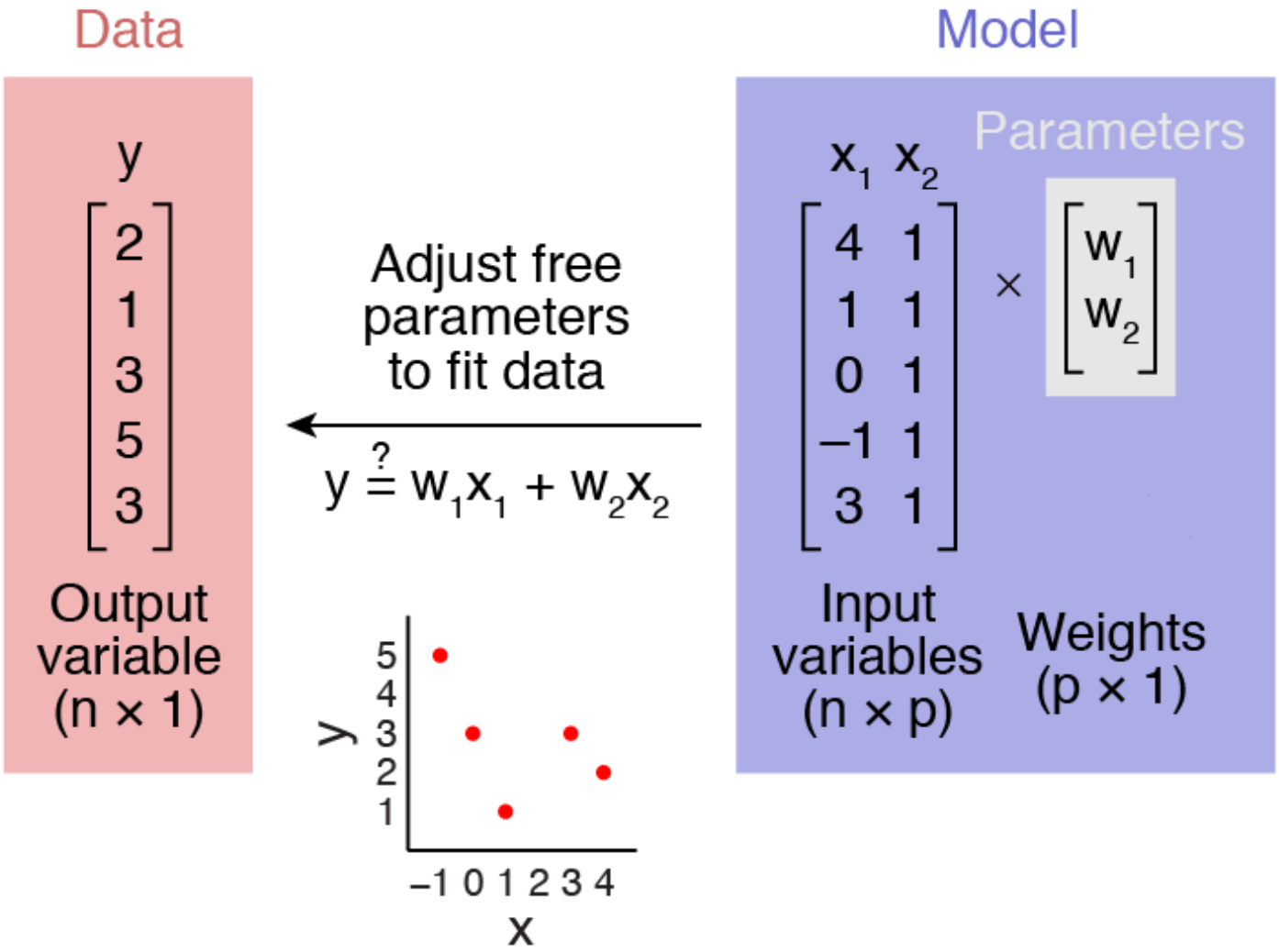


Kendrick Kay, Washington Univ. in St. Louis

Characteristics of different types of models

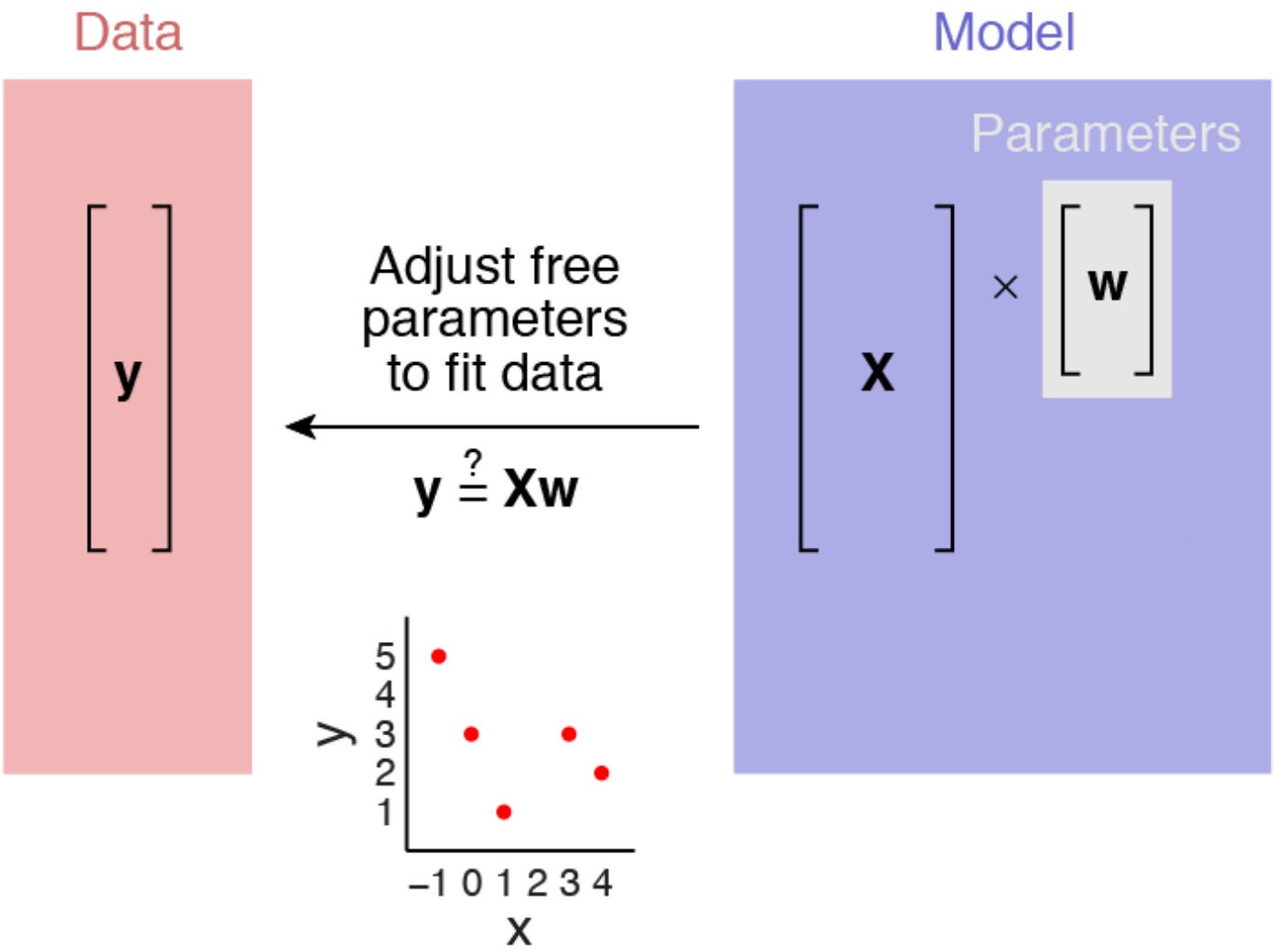
	Linear?	*Parametric?*	*Linear in parameters?*
Linear models	yes	yes	yes
Linearized models	no	yes	yes
Parametric nonlinear models	no	yes	no
Nonparametric nonlinear models	no	no	sometimes

Matrix representation of linear models

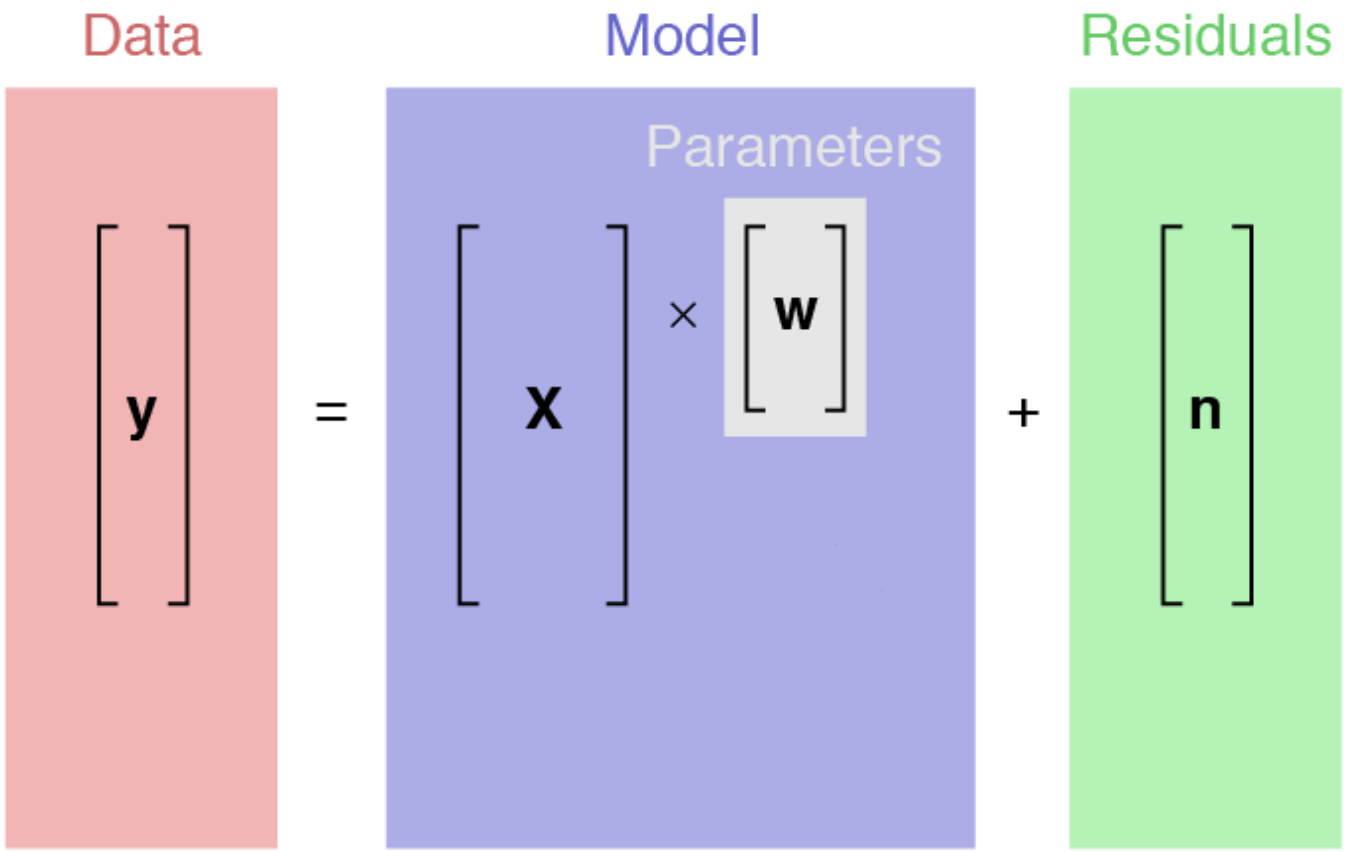


Kendrick Kay, Washington Univ. in St. Louis

Matrix representation of linear models



Matrix representation of linear models



$$\mathbf{y} = \mathbf{X}\mathbf{w} + \mathbf{n}$$