Regression, Linear, Polynomial & GLM

----from Simple Linear and Polynomial to Generalized Linear Regressions

Simple Linear Regression

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_k x_k$$

Polynomial Regression

add polynomial regressors based on simple linear regression

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \beta_3 x_1^2 + \beta_4 x_2^2 + \beta_5 x_1 x_2 + \ldots$$

Generalized Liner Regression

- **Ordinary Regression (Simple Linear Regression):**

$$Y \sim N(\mu, \sigma)$$

$$\mu = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_k x_k$$

- **Poisson Regression (for counted data)**

$$Y \sim Poisson(\theta)$$

$$log(\theta) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots$$

- **Logistic Regression (for binary data)**

$$Y \sim Bernoulli(p)$$

$$logit(p) = log(\frac{p}{1-p}) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots$$

- **Probit Regression (for binary data)**

$$Y \sim Bernoulli(p)$$

$$probit(p) = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \ldots$$

Note: probit function is the inverse of N(0, 1) cumulative distribution function

Comparison between logit and probit function