Technology and Analytics for Usage-Based Auto Insurance (UBI)

Beyond GLMs

Nonparametric Regression

CAS RPM Dallas 2015

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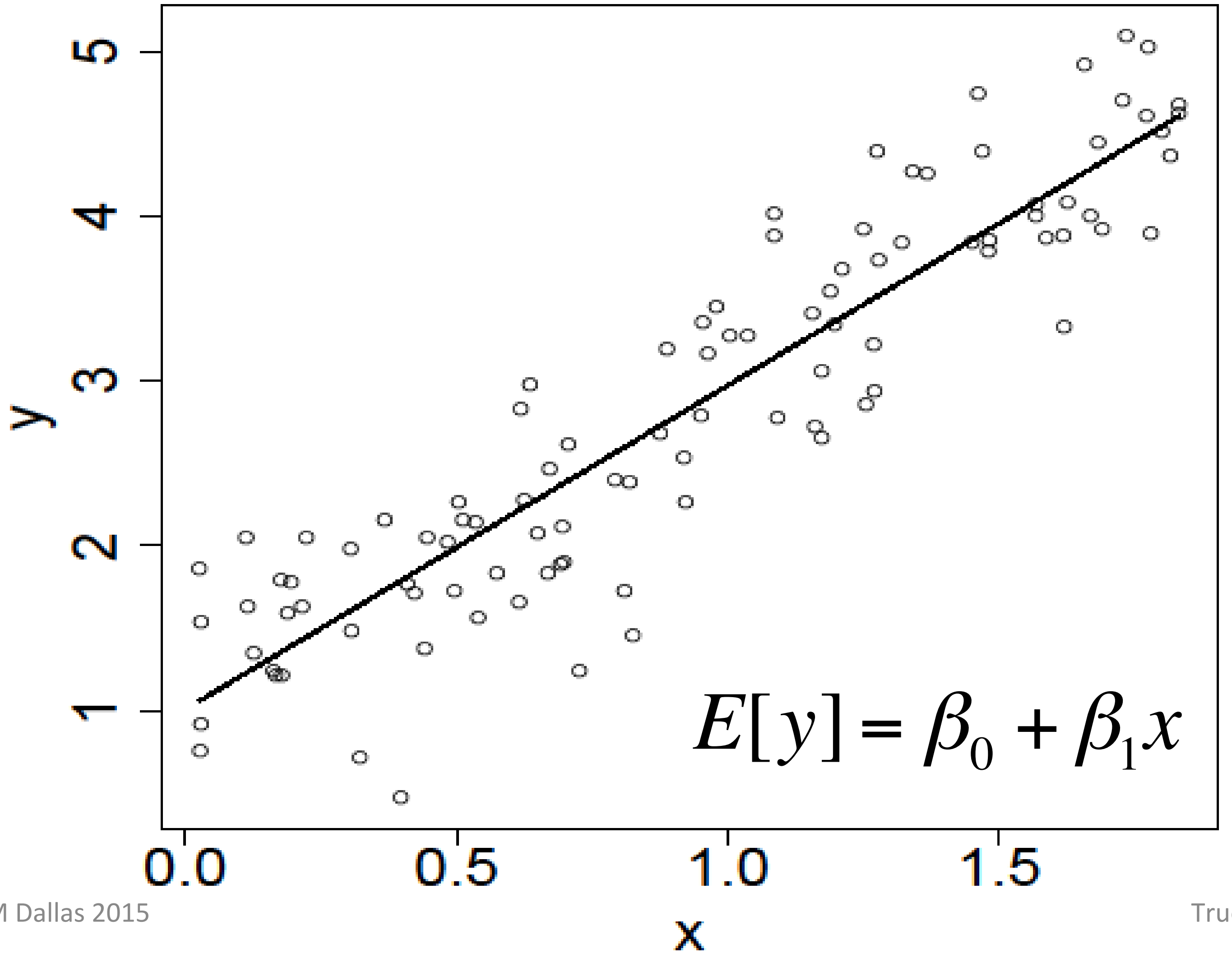
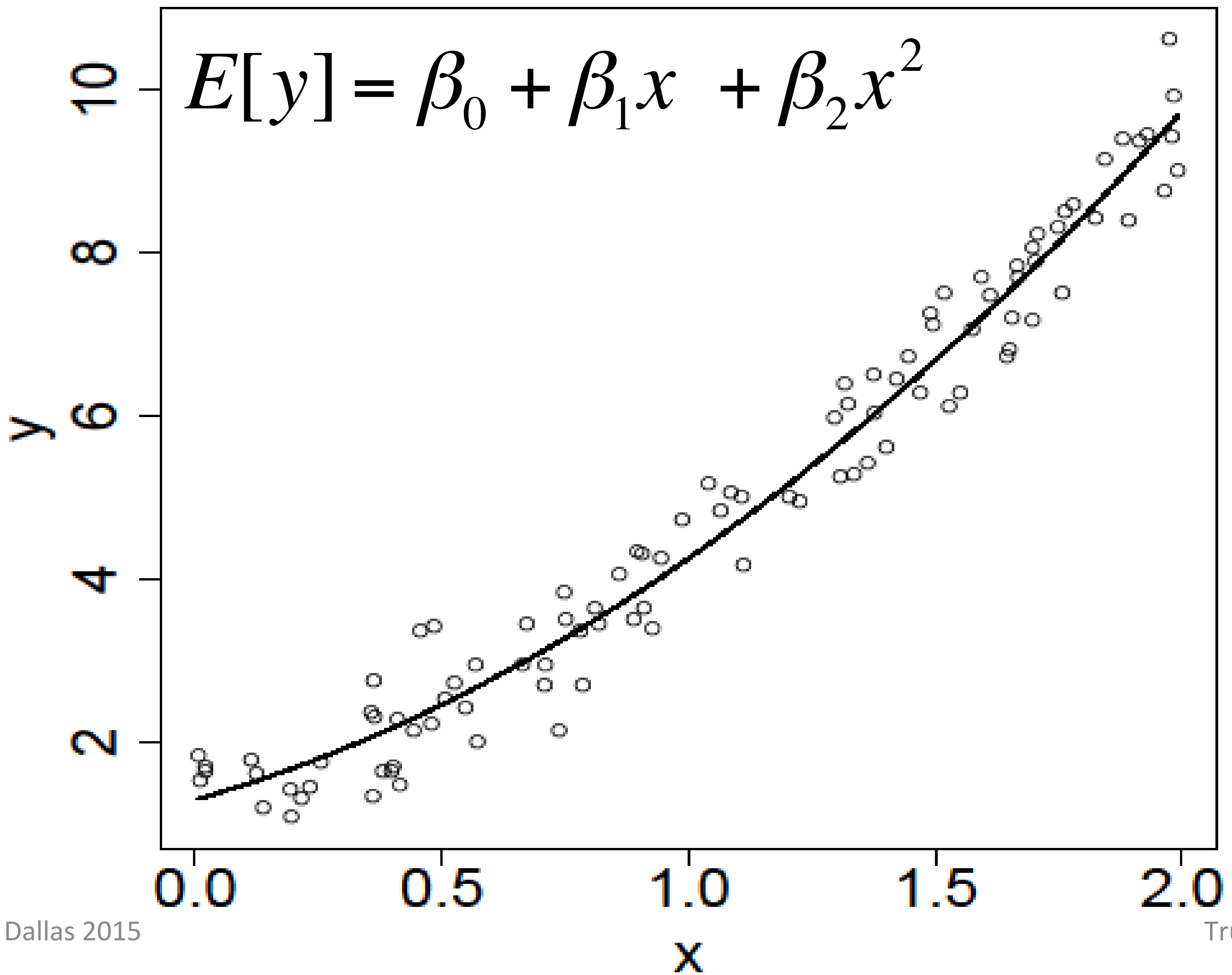
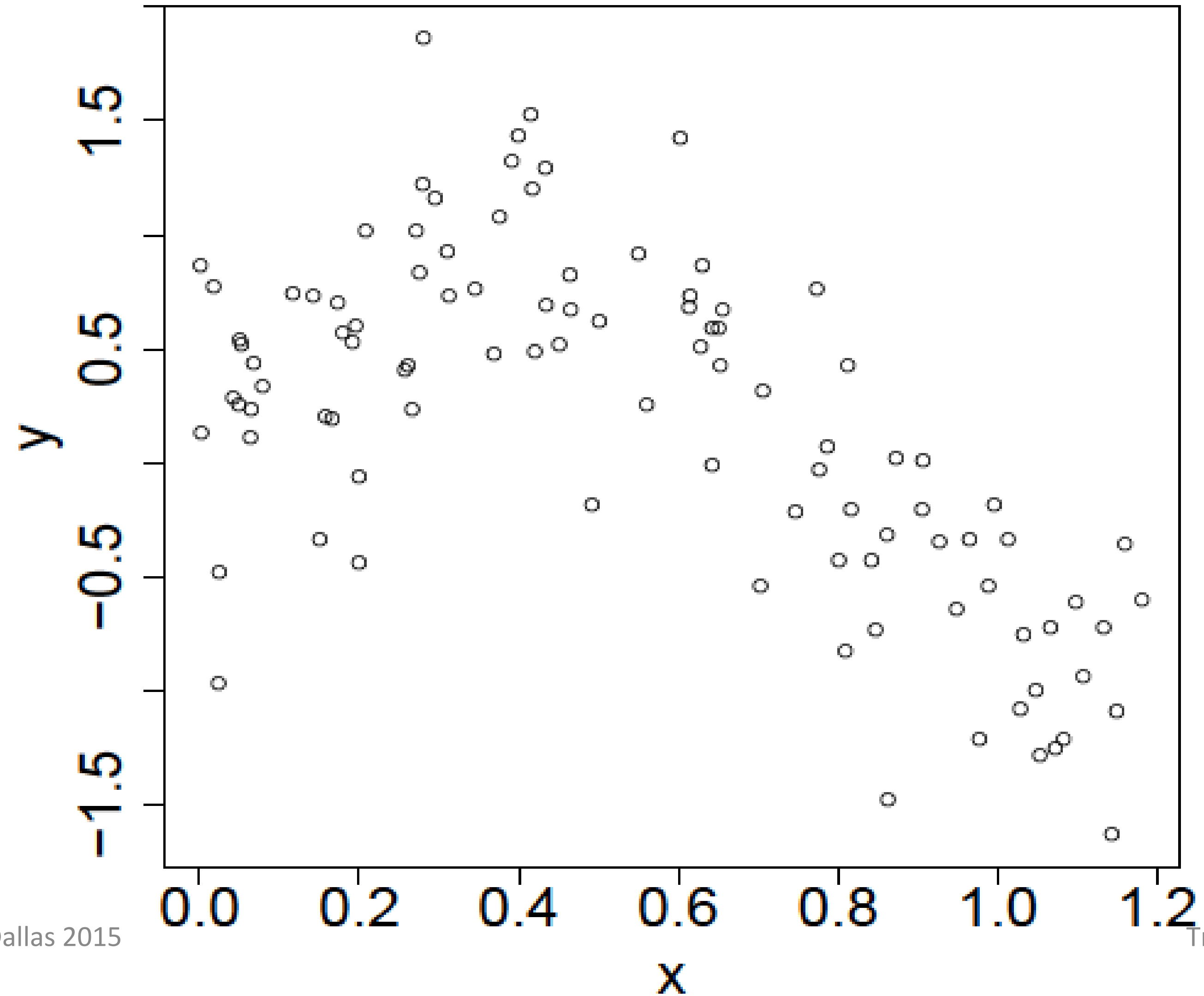
Linear Regression



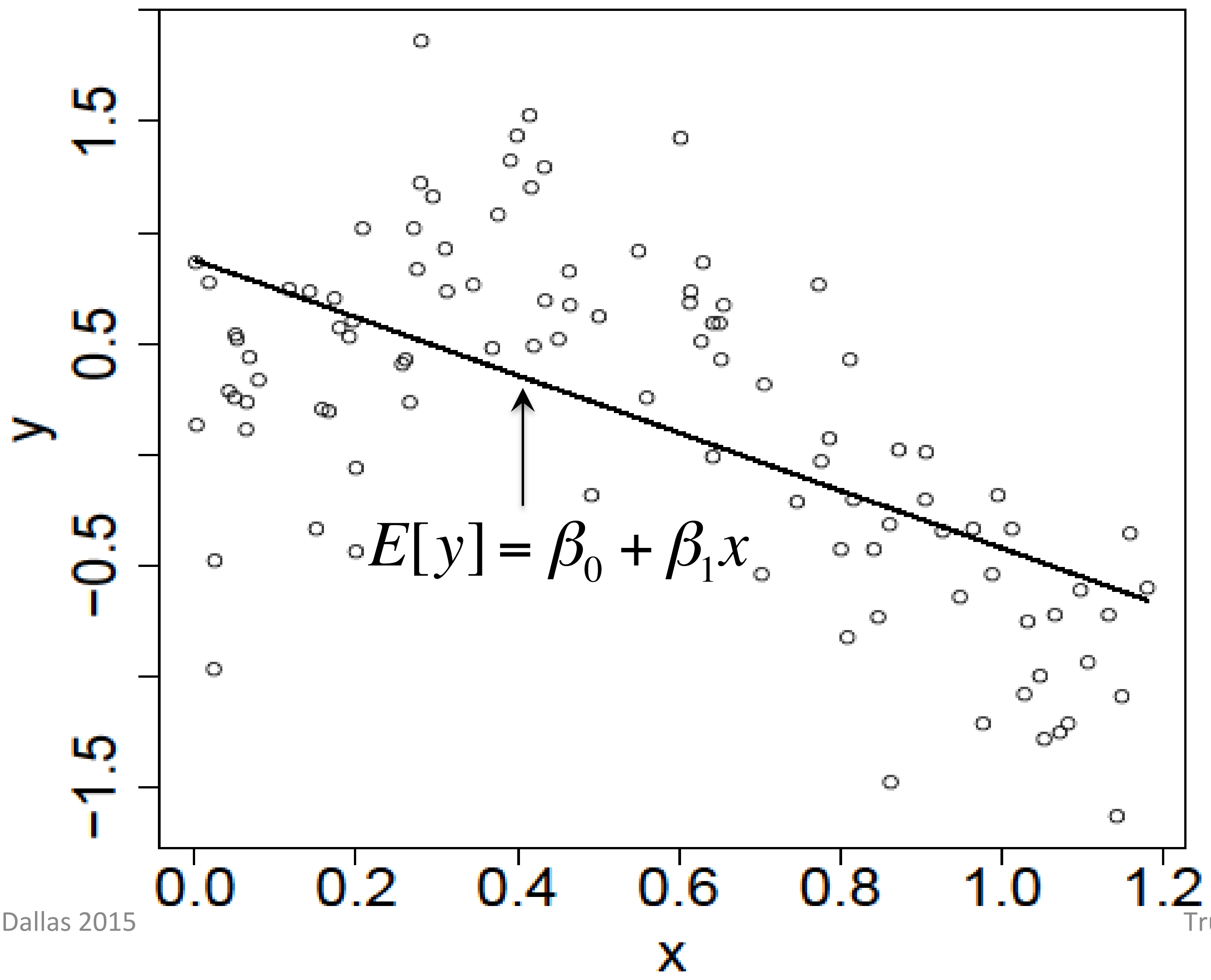
Polynomial Regression



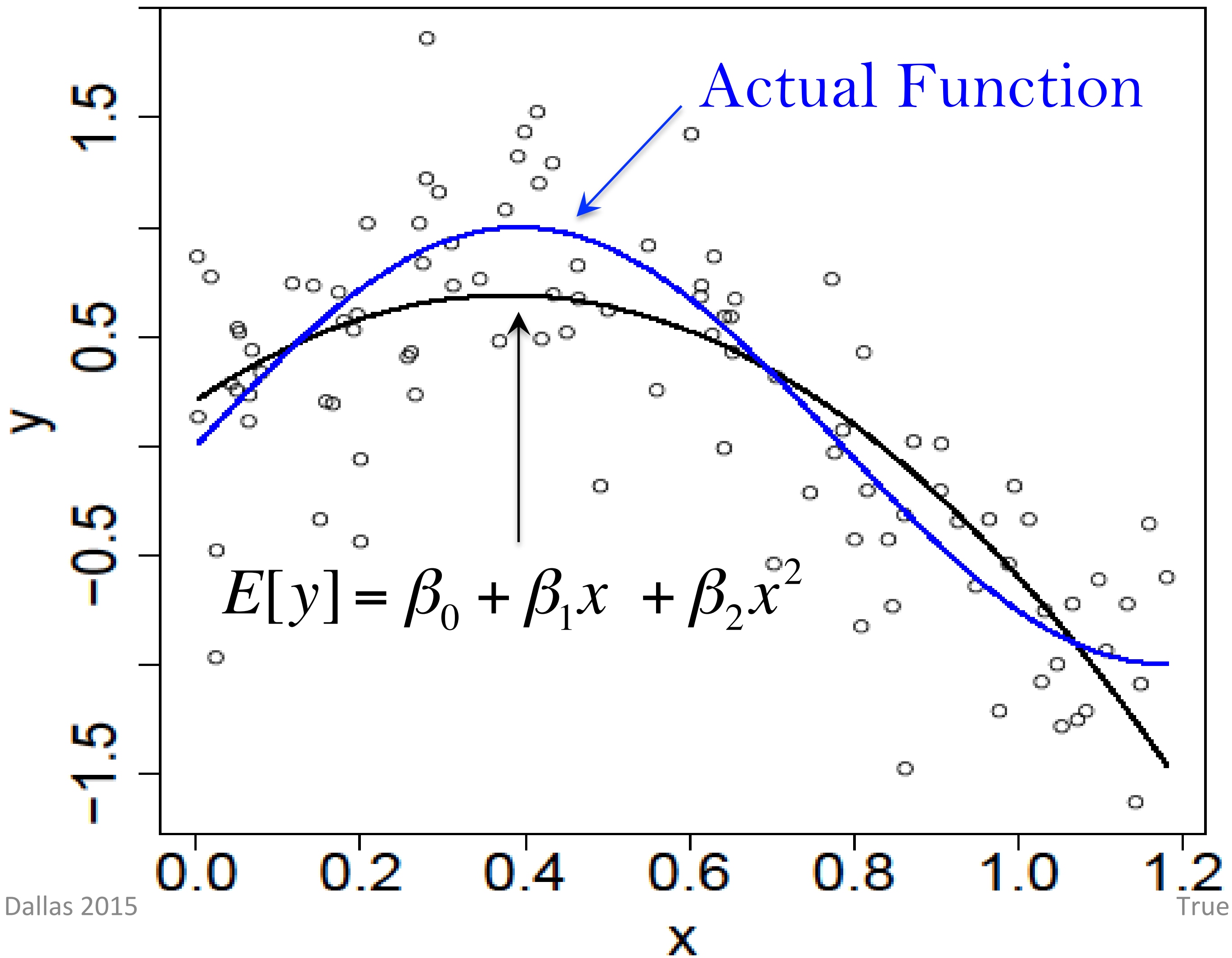
Data



Linear Regression



Polynomial Regression



Nonparametric Regression

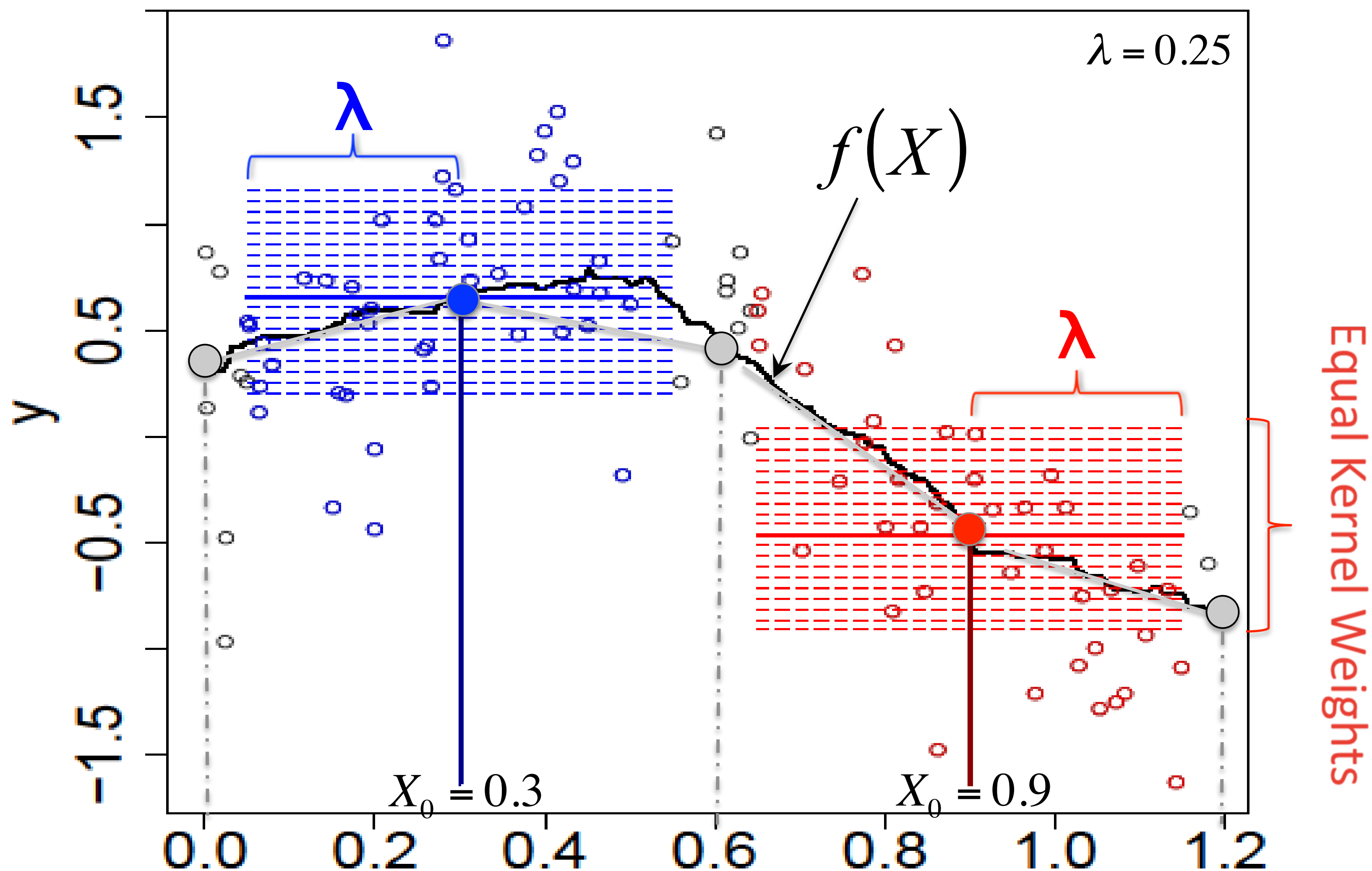
Goal

- Given a scatterplot;
- We want to find a function $f(\mathbf{x})$ that best predicts the dependent variable y

Nonparametric Regression

- Only use data in the neighborhood of X_0
- The neighborhood is set by bandwidth λ
- The regression weights are determined by a kernel function $K_\lambda(X_0, X_i)$
- Unique regression $f(X_0)$ at every X_0

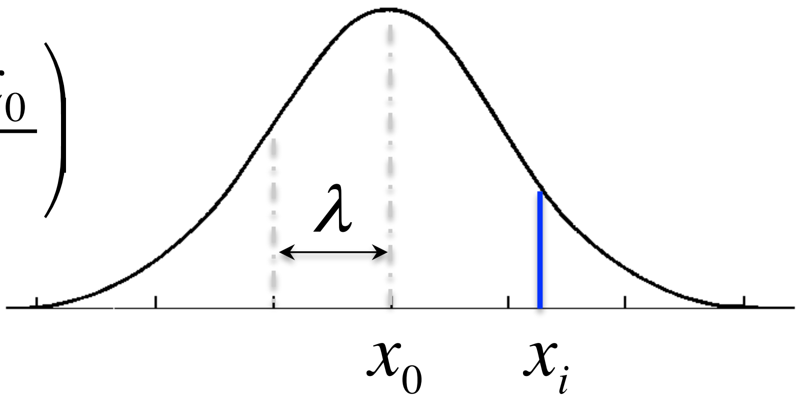
Local Average : Box Kernel



Nonparametric Regression

- The normal density is a popular kernel

$$K_\lambda(x_0, x_i) = \phi\left(\frac{x_i - x_0}{\lambda}\right)$$

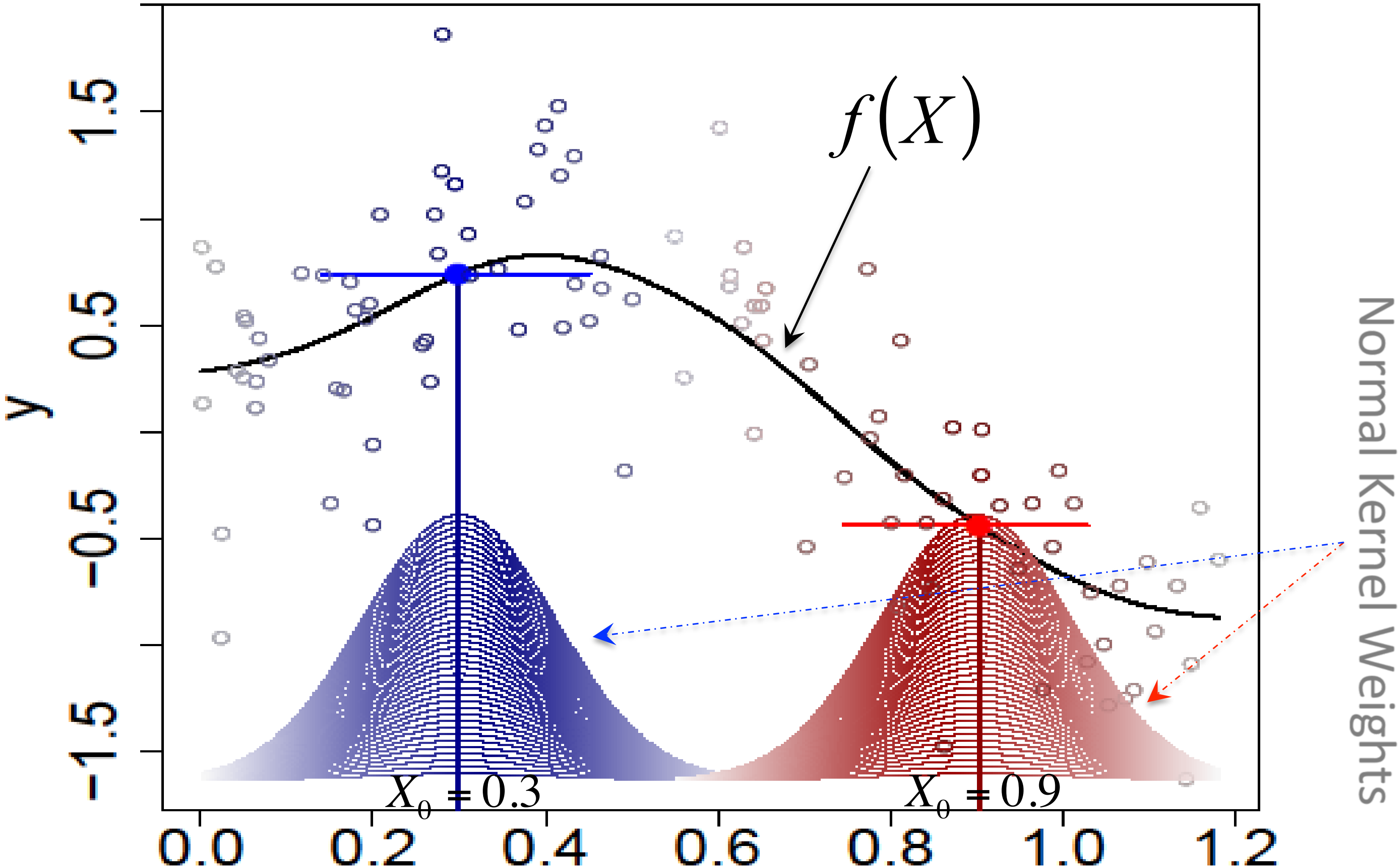


- Nadaraya-Watson kernel-weighted estimate is

$$\hat{f}(x_0) = \sum_{i=1}^{n}\left(\frac{K_\lambda(x_0, x_i)}{\sum_{i=1}^{n} K_\lambda(x_0, x_i)}\right) y_i$$

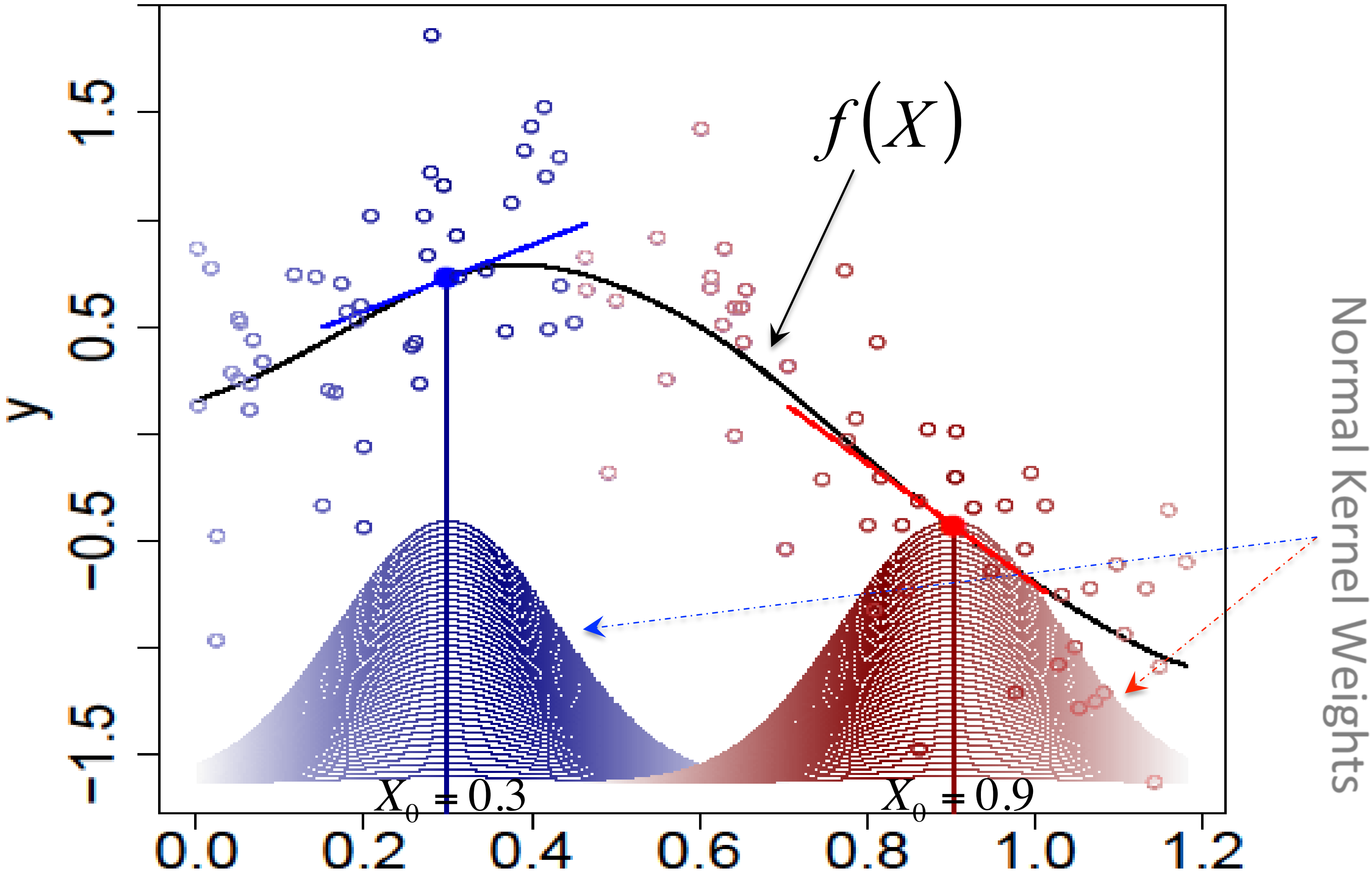
Local Average : Normal Kernel

$$E[y] = \beta_0 \qquad K_\lambda(x_0, x_i) = \phi\left(\frac{x_i - x_0}{\lambda}\right)$$



Local Linear : Normal Kernel

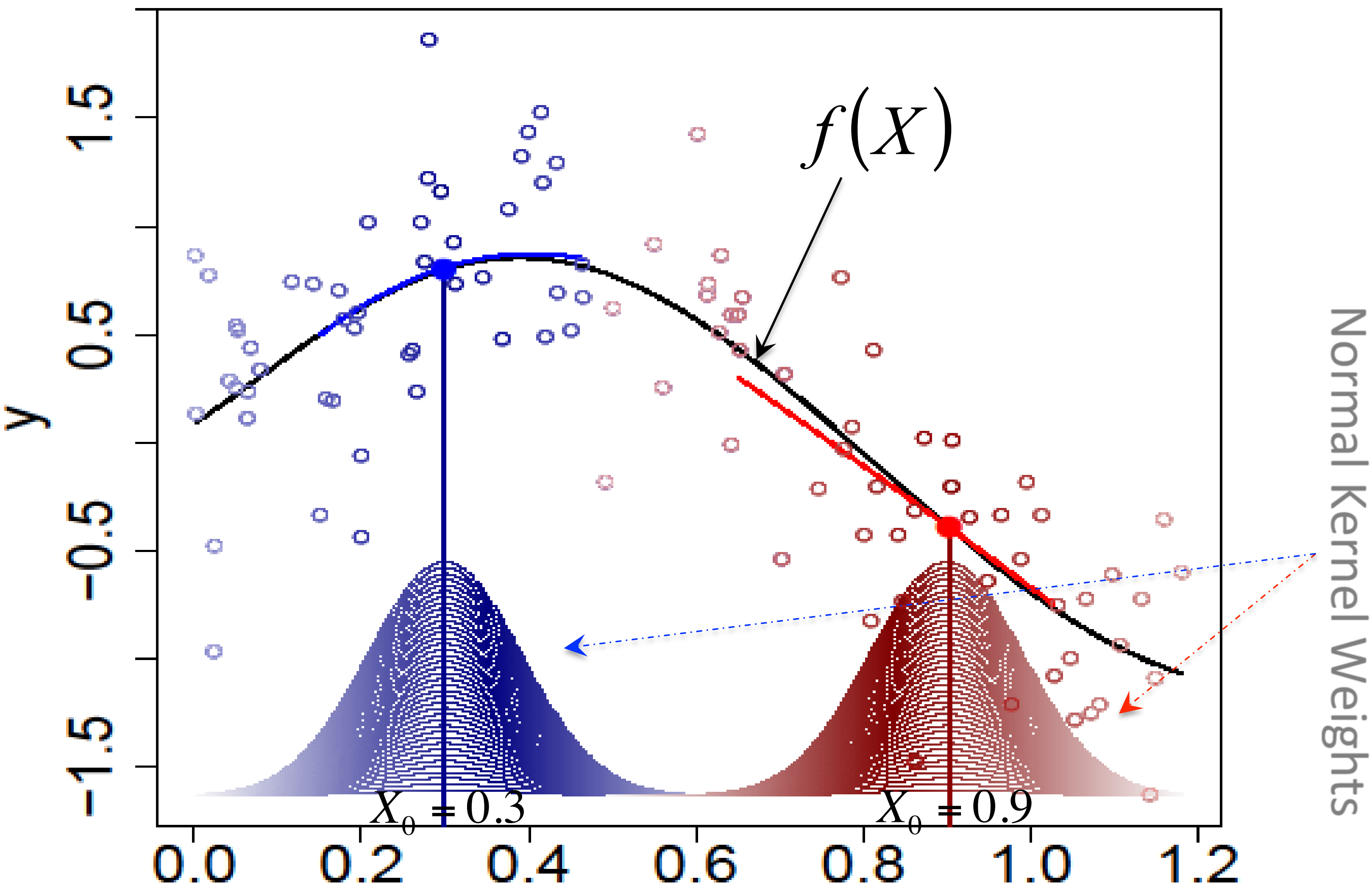
$$E[y] = \beta_0 + \beta_1 x \qquad K_\lambda(x_0, x_i) = \phi\left(\frac{x_i - x_0}{\lambda}\right)$$



Local Quadratic : Normal Kernel

$$E[y] = \beta_0 + \beta_1 x + \beta_2 x^2$$

$$K_\lambda(x_0, x_i) = \phi\left(\frac{x_i - x_0}{\lambda}\right)$$



Nonparametric Regression

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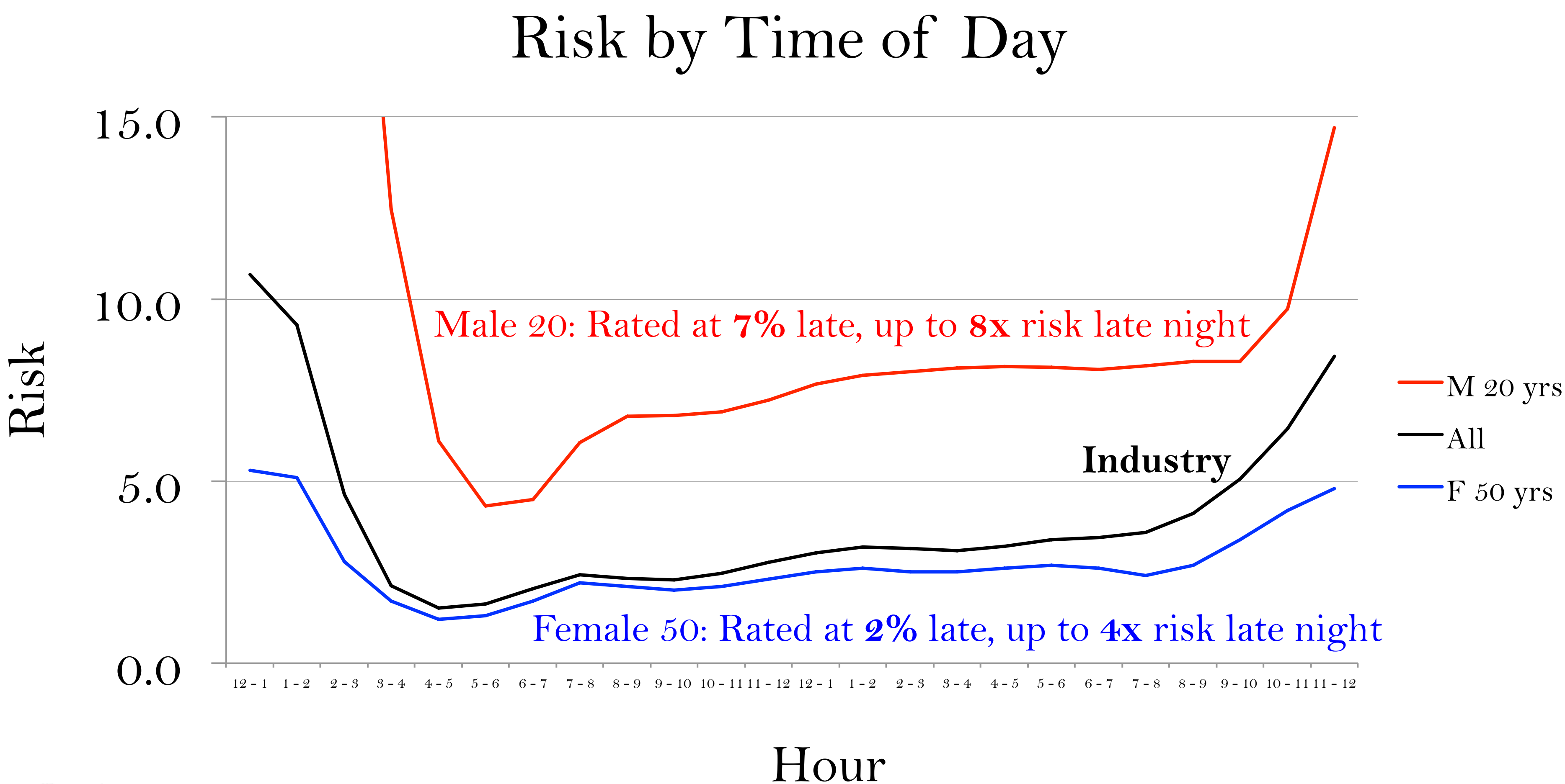
Daytime Discount Analytics™



Mileage Discounts

Typical on-going verified mileage discounts today:

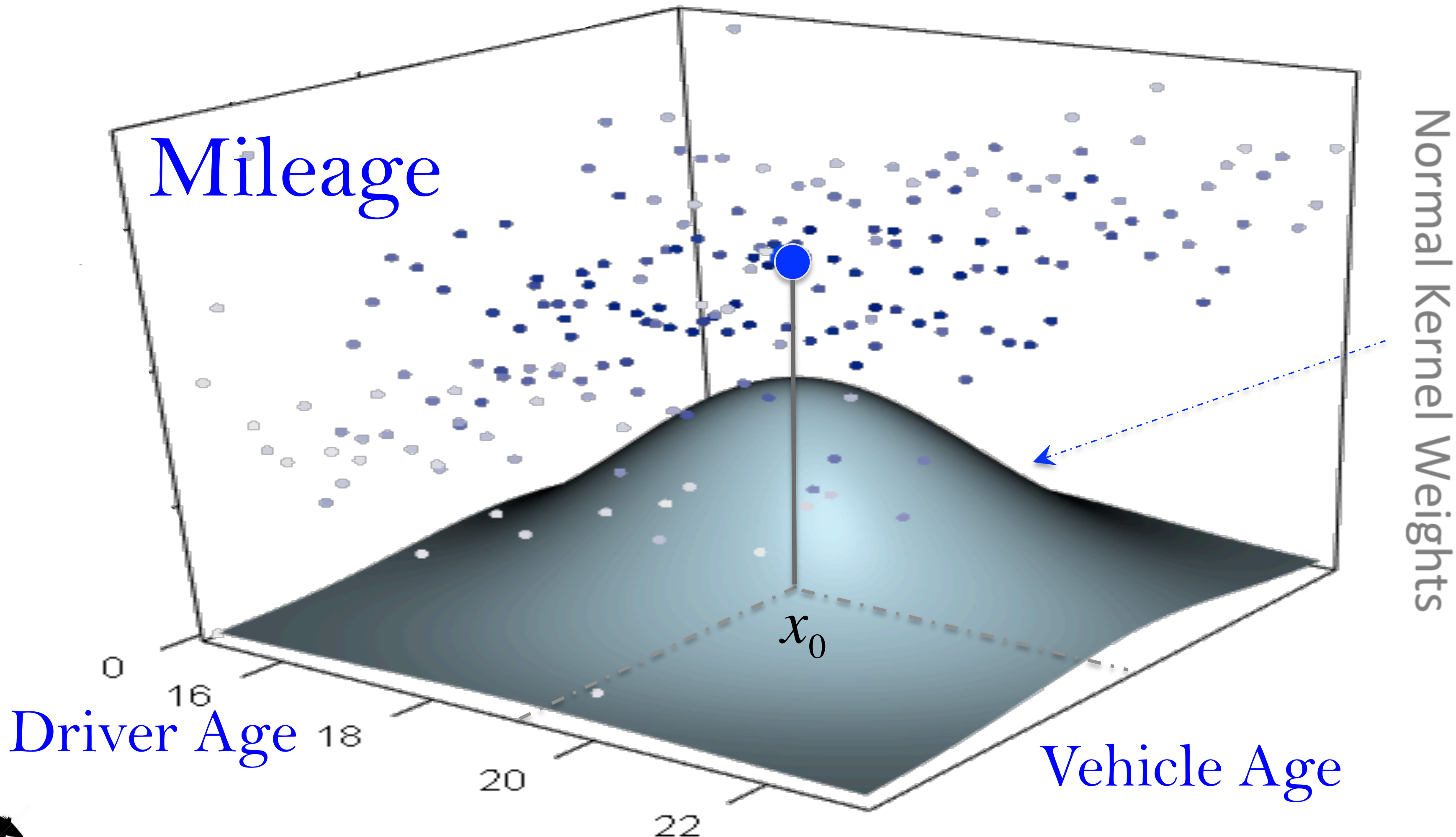
Mileage Up To	Discount
2,500	54%
5,000	39%
7,500	34%
10,000	26%
12,500	18%
15,000	13%
15,000 +	7%

Mileage Discount Analytics™

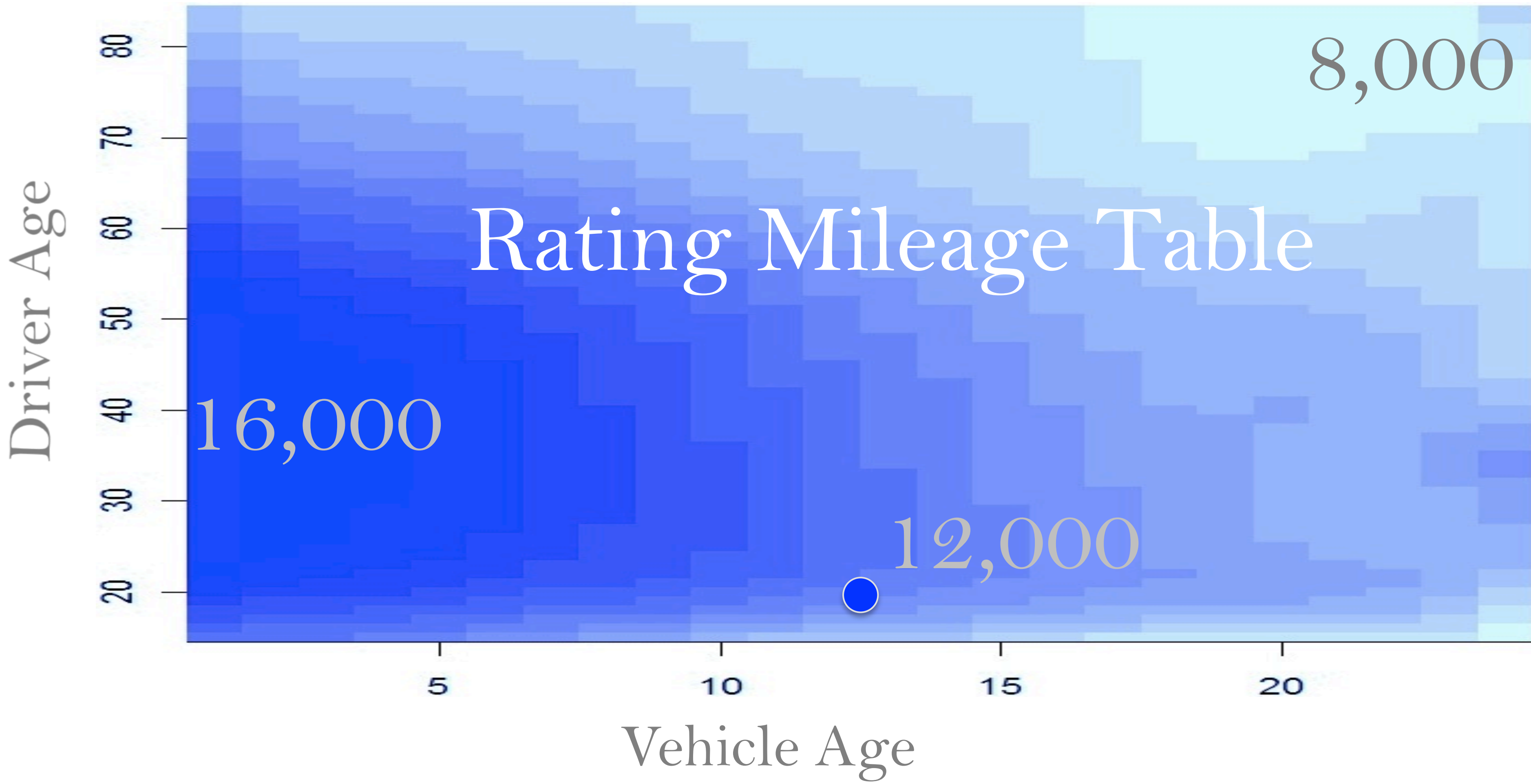
Rating variables with the strongest mileage relationship?

- Driver Age
- Urban vs. Rural
- Vehicle Type
- Driver Gender
- Drivers/Vehicles
- Vehicle Age

Mileage Discount Analytics™



Mileage Discount Analytics™



Mileage Discount Analytics™

$$Max\ Discount \cdot \left(1 - \frac{Mileage}{\boldsymbol{Rating\ Mileage}}\right)$$

Example 1:
(new car and mid-age driver)

$$50\% \cdot \left(1 - \frac{10{,}000}{\mathbf{16,000}}\right) = \mathbf{19\%}$$

Example 2:
(older car)

$$50\% \cdot \left(1 - \frac{10{,}000}{\mathbf{10,000}}\right) = \mathbf{0\%}$$

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Thank You!

Visit True Mileage at Booth #8

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