Linear Regression

Art Tay

Gradient Derivation

a)

$$
\begin{aligned}
\frac{\partial}{\partial\beta_0}\left[\frac{1}{2m}\sum_{i=0}^{m}(\beta_0+\beta_1x^{(i)}-y^{(i)})^2\right] &= \frac{\partial}{\partial\beta_0}\left[\frac{1}{2m}\sum_{i=0}^{m}(\beta_0+\beta_1x^{(i)}-y^{(i)})^2\right] \\
&= \frac{1}{2m}\sum_{i=0}^{m}\left[2(\beta_0+\beta_1x^{(i)}-y^{(i)})\cdot 1\right] \\
&= \frac{1}{m}\sum_{i=0}^{m}\beta_0+\beta_1\frac{1}{m}\sum_{i=0}^{m}x^{(i)}-\frac{1}{m}\sum_{i=0}^{m}y^{(i)} \\
&= \beta_0+\beta_1\bar{x}-\bar{y}
\end{aligned}
$$

b)

$$
\begin{aligned}
\frac{\partial}{\partial\beta_1}\left[\frac{1}{2m}\sum_{i=0}^{m}(\beta_0+\beta_1x^{(i)}-y^{(i)})^2\right] &= \frac{1}{2m}\sum_{i=0}^{m}\frac{\partial}{\partial\beta_1}\left[(\beta_0+\beta_1x^{(i)}-y^{(i)})^2\right] \\
&= \frac{1}{2m}\sum_{i=0}^{m}\left[2x^{(i)}(\beta_0+\beta_1x^{(i)}-y^{(i)})\right] \\
&= \frac{1}{m}\sum_{i=0}^{m}\left[\beta_0x^{(i)}+\beta_1{x^{(i)}}^2-x^{(i)}y^{(i)}\right] \\
&= \beta_0\frac{1}{m}\sum_{i=0}^{m}x^{(i)}+\beta_1\frac{1}{m}\sum_{i=0}^{m}{x^{(i)}}^2-\frac{1}{m}\sum_{i=0}^{m}x^{(i)}y^{(i)} \\
&= \beta_0\bar{x}+\beta_1\bar{x^2}-\bar{x}y
\end{aligned}
$$

Linear Regression by Gradient Decent

Linear Model on Airbnb Data