Introduction to Linear Regression

Reading Assignment

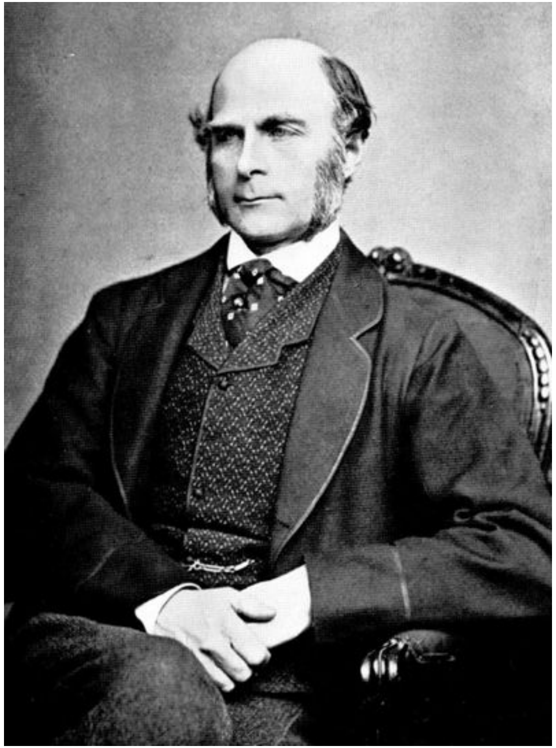
Chapters 2 & 3 of

Introduction to Statistical Learning

By Gareth James, et al.

History

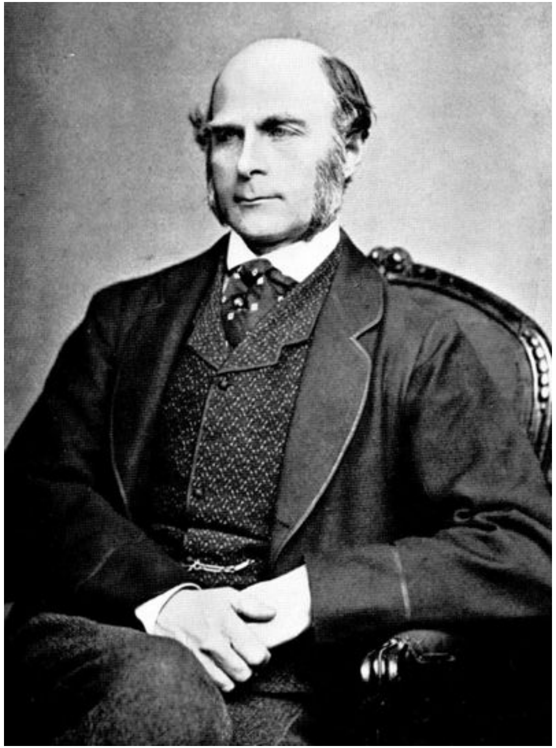
This all started in the 1800s with a guy named Francis Galton. Galton was studying the relationship between parents and their children. In particular, he investigated the relationship between the heights of fathers and their sons.



History

What he discovered was that a man's son tended to be roughly as tall as his father.

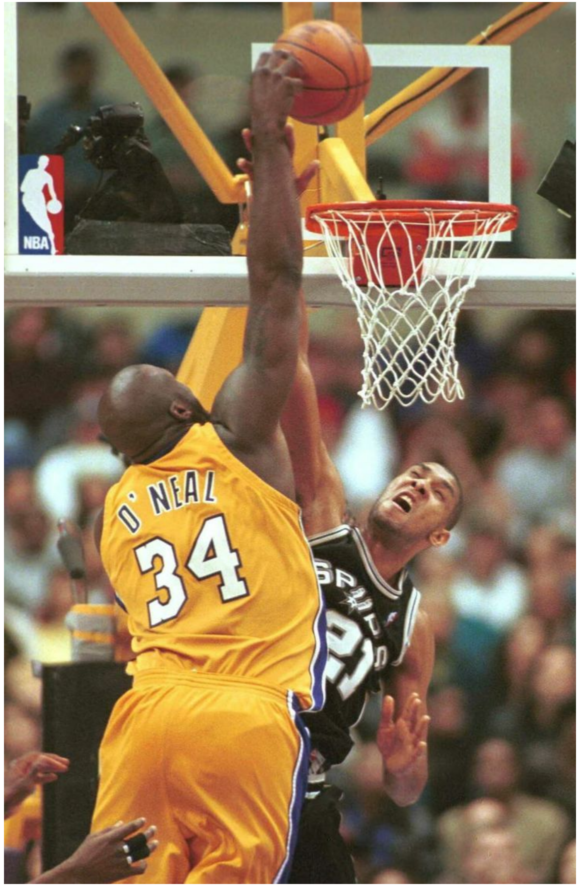
However Galton's breakthrough was that the son's height **tended to be closer to the overall average** height of all people.



Example

Let's take Shaquille O'Neal as an example. Shaq is really tall:7ft 1in (2.2 meters).

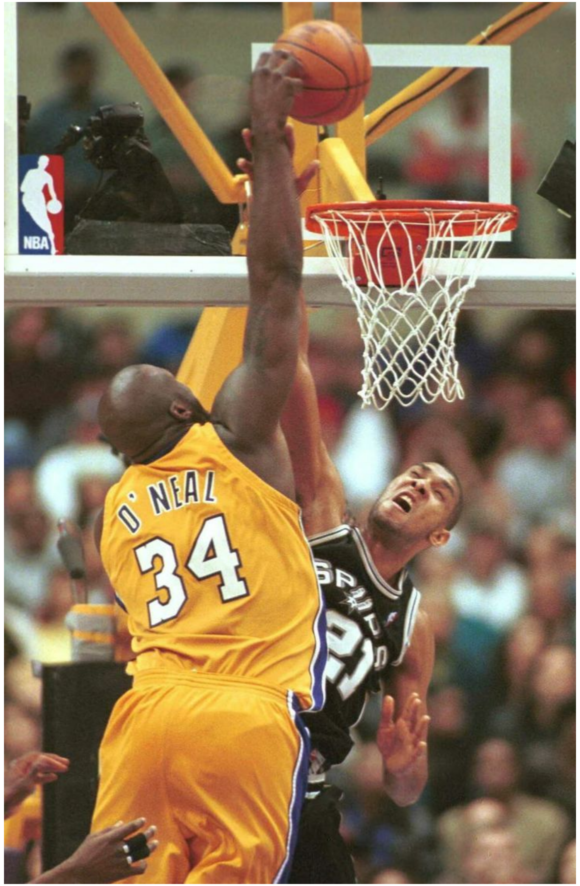
If Shaq has a son, chances are he'll be pretty tall too. However, Shaq is such an anomaly that there is also a very good chance that his son will be **not be as tall as Shaq**.



Example

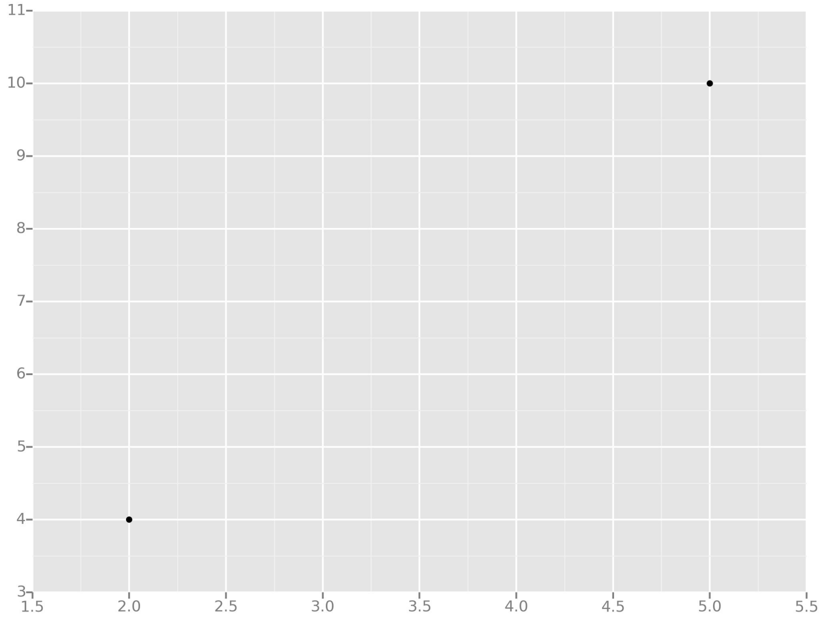
Turns out this is the case: Shaq's son is pretty tall (6 ft 7 in), but not nearly as tall as his dad.

Galton called this phenomenon **regression**, as in "A father's son's height tends to regress (or drift towards) the mean (average) height."



Example

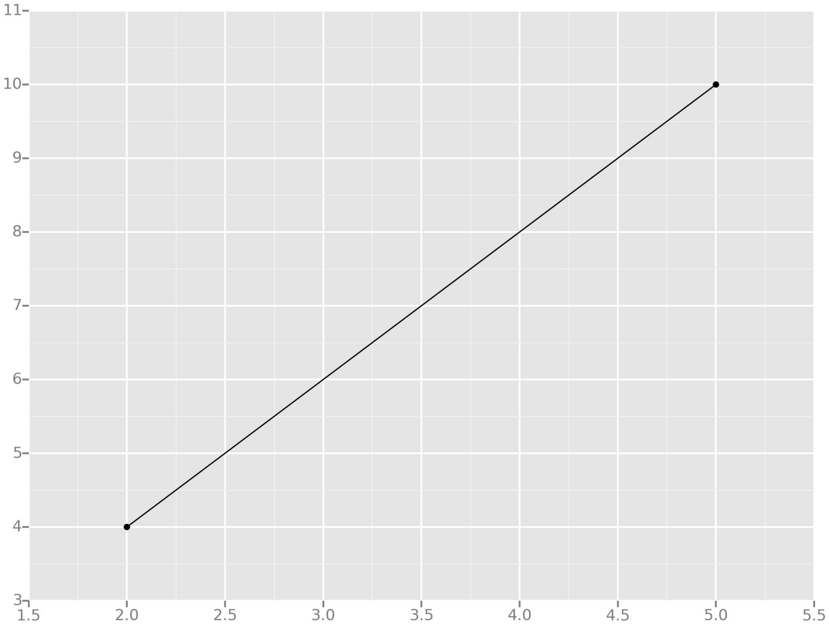
Let's take the simplest possible example: calculating a regression with only 2 data points.



Example

All we're trying to do when we calculate our regression line is draw a line that's as close to every dot as possible.

For classic linear regression, or "Least Squares Method", you only measure the closeness in the "up and down" direction

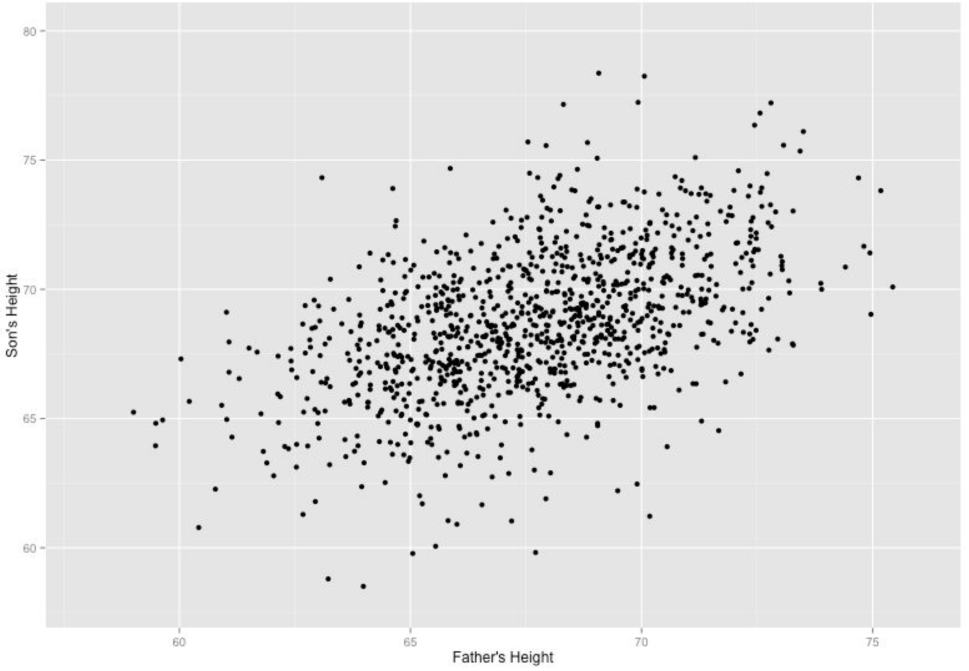


PIERIAN DATA

Example

Now wouldn't it be great if we could apply this same concept to a graph with more than just two data points?

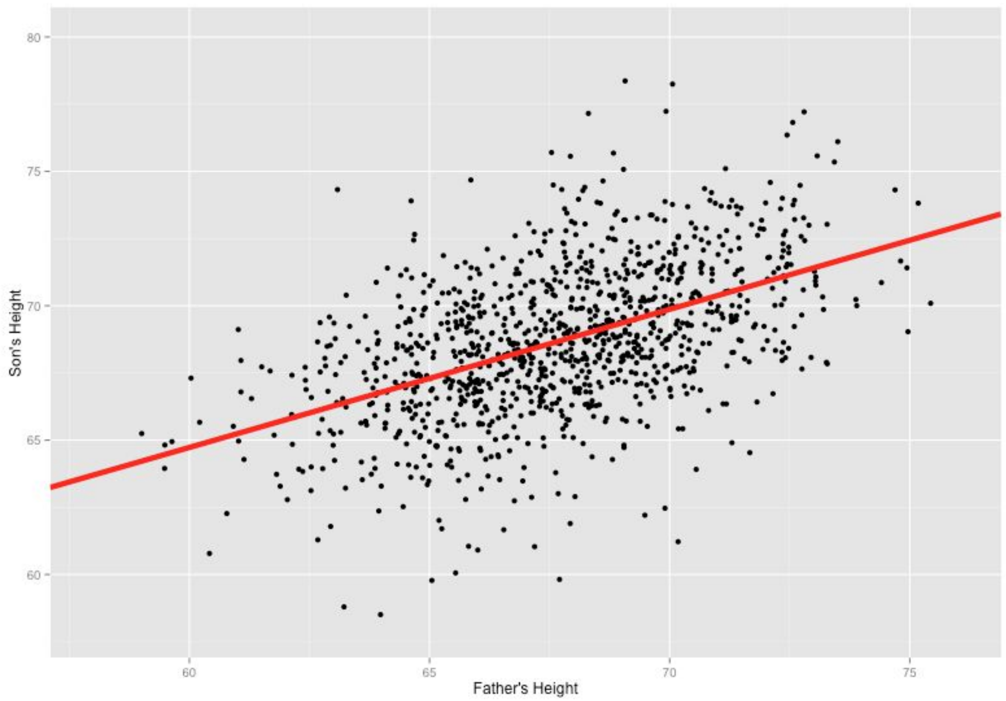
By doing this, we could take multiple men and their son's heights and do things like tell a man how tall we expect his son to be...before he even has a son!



Example

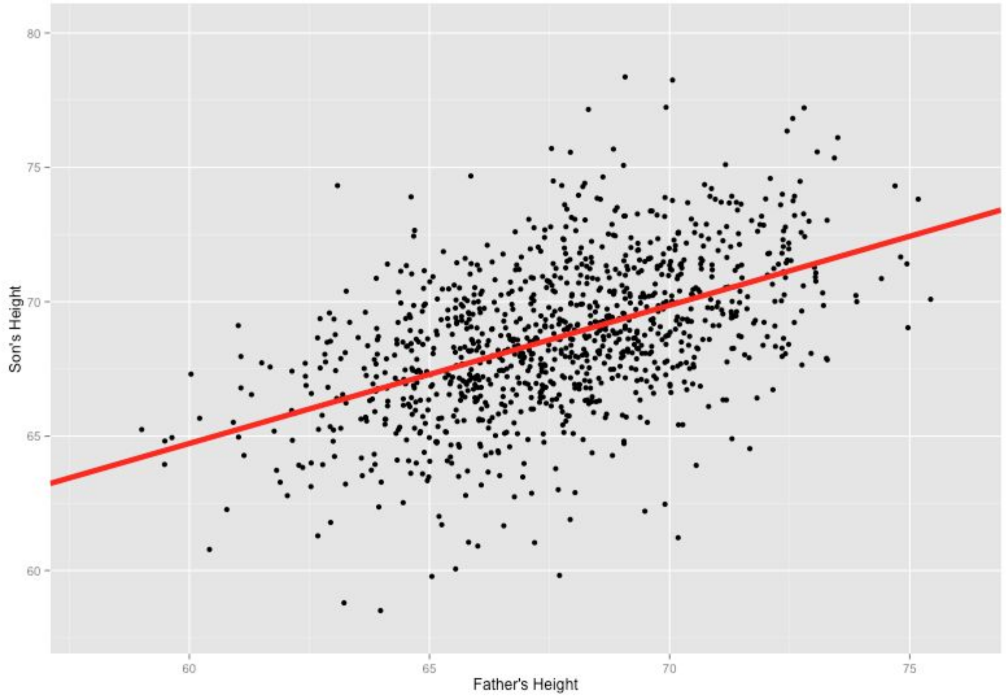
Our goal with linear regression is to **minimize the vertical distance** between all the data points and our line.

So in determining the **best line**, we are attempting to minimize the distance between **all** the points and their distance to our line.



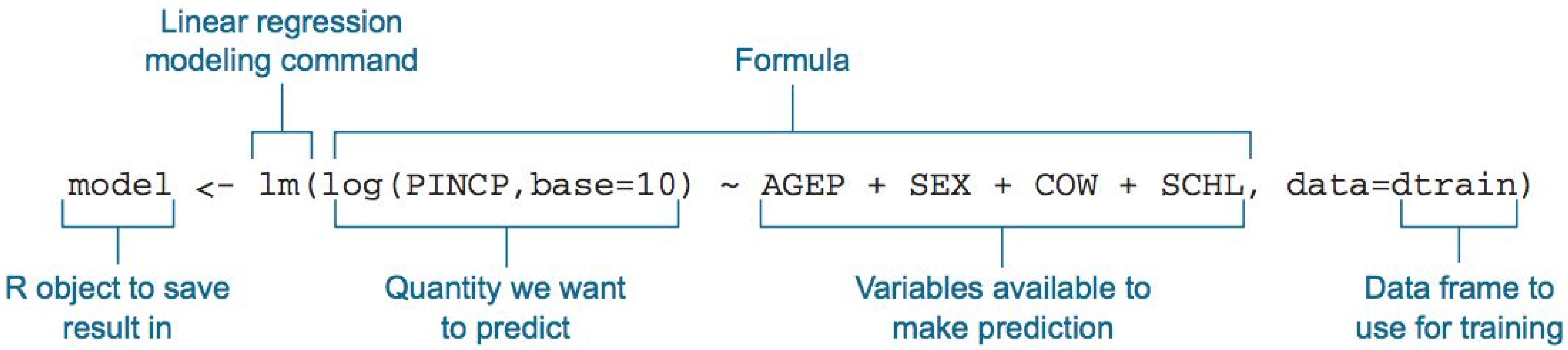
Example

There are lots of different ways to minimize this, (sum of squared errors, sum of absolute errors, etc), but all these methods have a general goal of minimizing this distance.

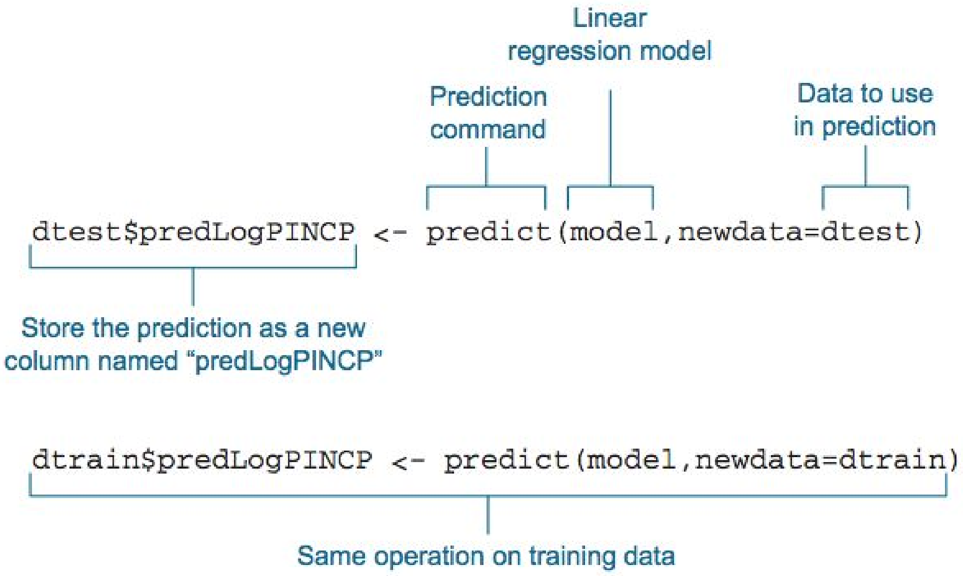


Using R for Linear Regression

Formulas in R take the form (y ~ x). To add more predictor variables, just use the + sign. i.e.(y ~ x + z).



Using R for Linear Regression



Example with R

Let's go to RStudio and begin to explore an example, then you’ll have a project to test your understanding!