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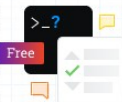
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## Regression function - conditional mean

Asked 7 years, 4 months ago Active 7 years, 4 months ago Viewed 3k times

I am trying to understand the statistical fundamentals behind linear regression, and i have never been able to intuitively understand the following; really would appreciate if someone could give an intuitive explanation:

The regression function is the conditional mean of  $Y$  over  $X$ , e.g.  $E[Y|X]$ .

Instinctively - i am trying to average the  $y$ -values over a set of  $x$ -values, but I fail to see how this links to ending up with a linear function, and/or how this links with how you normally would do a regular unconditional average...

Help much appreciated!

functions conditional-probability regression

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edited Apr 3 '14 at 8:57



Avitus

13.1k 1 25 46

asked Apr 3 '14 at 8:36



user1885116

197 1 6

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1 Answer

Assume  $X$  is height and  $Y$  is weight. You take a sample of  $n$  people and you measure these two values, i.e. you have a sample

$$(X_i, Y_i), \quad i = 1, 2, \dots, n$$

You calculate the regression line

$$\mu_{Y|X} = b_0 + b_1 X$$

with  $X$  as predictor and  $Y$  as response variable. Assume know that give a value for  $X$  say  $x = 170$  cm and you calculate the LHS quantity which is the conditional mean of  $Y$  given  $X = 170$ , i.e.  $E[Y|X = 170]$  or equivalently  $\mu_{Y|X=170}$ . Say, it's value is 70kg. It has the following interpretation: *a person that has a height of 170cm, weights in average 70kg*. Or equivalently *the mean weight of persons that are 170cm high is 70kg*. You do not have to take a mean value for different values of  $X$ . But for each  $x$  the mean values of the response  $Y$  is on your regression line.

Another example is  $X$  square meters of an apartment and  $Y$  it's rental price. For any given  $x$  (say f.e.  $x = 100m^2$ ) the regression line will give the average price of all apartments that are  $100m^2$  big.

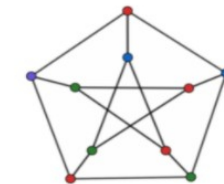
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answered Apr 3 '14 at 8:55



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Thanks - that is helpful. But how does the restriction of a linear regression function play into this? Clearly, if at  $X=160$ , the Y values are 80 and 100 (mean=90), at  $X=170$ , the Y values are 70 and 100 (mean value=85) and at  $X=180$ , the Y values are 100,110 and 120 (mean value =110), then, due to lack of perfect linear character, the regression line will not capture the mean values of the response Y. Let me know your thoughts!



– [user1885116](#) Apr 3 '14 at 9:35


@WDA Yes, these are the sample means, so it is ok if the regression line does not exactly fit them. The regression line gives you a point estimate for the population mean! Of course, another thing is how well your predictor predicts the response variable. Assuming you have a good fit, then there should not be big aberrations of the sample means from the line. On the contrary if your fit is meager then this will be the case as you point! – [Jimmy R.](#) Apr 3 '14 at 9:42

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