

Machine Learning

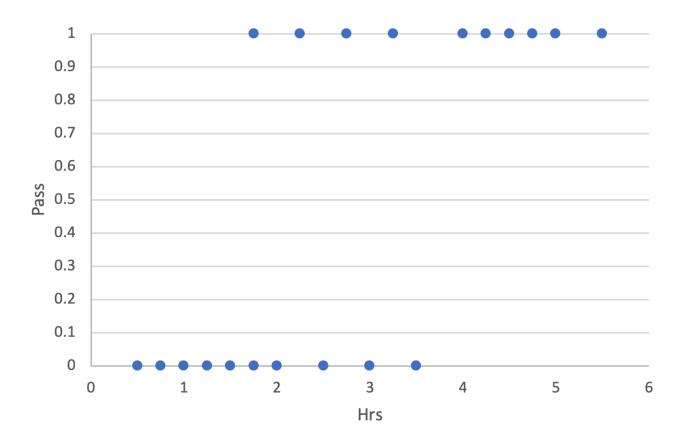
Logistic Regression

Linear Regression for Classification? greatlearning Learning for Life



- How likely is a student to pass if he/she studies for 5 hrs?
 - Using data from 20 students
- Classification problem! Can use linear regression?

Hrs	Pass?
0.5	0
0.75	0
1	0
1.25	0
1.5	0
1.75	0
1.75	1
2	0
2.25	1
2.5	0
2.75	1
3	0
3.25	1
3.5	0
4	1
4.25	1
4.5	1
4.75	1
5	1
5.5	1



Instead can we fit a curve?



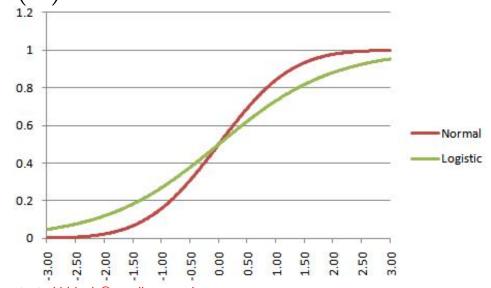
- Regression fits y = a + bx
- Instead why not fit?

$$y = f(a + bx)$$

• Common choices for f()

Logistic Regression: $y = \frac{1}{1 + e^{-(a+bx)}}$

• Probit Regression: $y=\Phi(x)$



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The Logit function



- Logit function: $y = \frac{1}{1 + e^{-(a+bx)}}$
- Equivalent to thinking of $\log\left(\frac{y}{1-y}\right) = a + bx$

Finding the best fit logic curve?

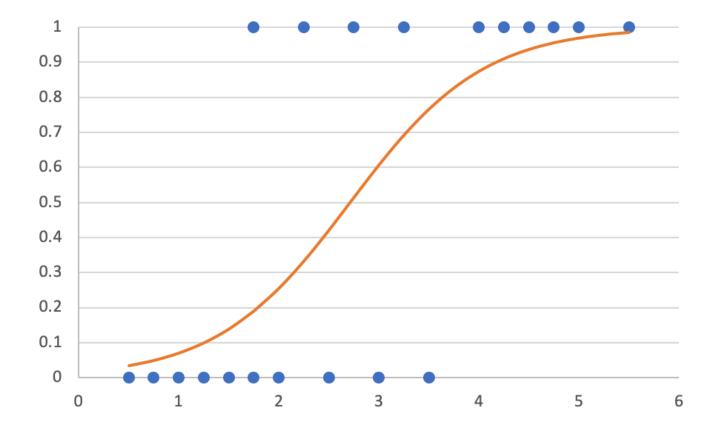


- Linear regression minimized sum of squared residuals. This unfortunately will not work in logistic regression!
- Instead we choose to minimize the "Log Loss" or "Cross-Entropy"

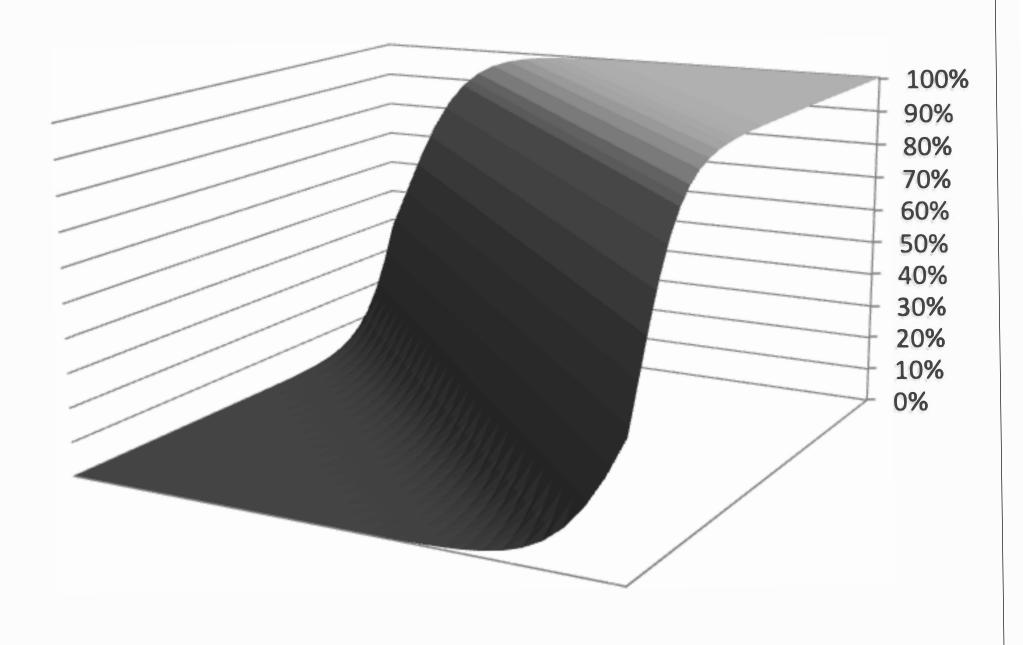
$$-y \log(\hat{y}) - (1-y) \log(1-\hat{y})$$



How likely is a student to pass if he/she studies for 5 hrs?







Logistic Reg - Pros and Cons



- Advantages
 - A classification model that does give probabilities
 - Easily extended to multiple classes (multinomial regression)
 - Quick to train and very fast at classifying unknown records
- Disadvantages
 - Constructs linear boundaries
 - Assumes that variables are independent (eg. does not include interaction terms)
 - Interpretation of coefficients is difficult