

FINAL EXAM
STAT 572
Spring 1994

1. A doctoral student in finance wants to investigate the relationship between some financial variables and the probability of bankruptcy. The student compiled financial information on 46 firms. 21 of the firms went bankrupt after a two year period and the rest were financially sound at the end of the same period. The student fitted a logistic regression model using three financial ratios as regressors and the response as the probability of bankruptcy. The results of the analysis were:

Term	Estimate	log likelihood
Intercept	-5.072	-31.711
Ratio1	5.797	-21.850
Ratio2	3.292	-14.302
Ratio3	-2.931	-13.770

Note: The log likelihood was computed in a sequential way (intercept, intercept+Ratio1, etc.)

a) Run a likelihood ratio test for the whole model (all three regressors).

b) Test the significance of Ratio3 in the model.

c) Interpret the sign of the coefficient of Ratio2.

d) Estimate the probability that a firm go bankrupt in two years if the following information is know about it: Ratio1 = .45, Ratio2 = 1.00, and Ratio3 = .50.

2. An experiment was run to investigate the rate at which certain algae grew with time. Two independent samples were taken from the same material. The response is a measure of the algae density. The data appear below.

Day	Rep 1	Rep 2
1	0.74	0.638
2	1.251	1.144
3	2.432	2.058
4	3.054	2.451
5	3.545	2.836
6	4.213	3.296
7	4.57	3.594
8	4.833	3.79
9	5.074	3.898
10	5.268	4.028
11	5.391	4.15
12	5.427	4.253
13	5.549	4.314
14	4.594	4.446

It is known that the growth follows an asymptotic model of the form:

$$y = \alpha(1 - \exp[-\beta x]) + \epsilon.$$

This model was fitted to the data and the results appear in the following page.

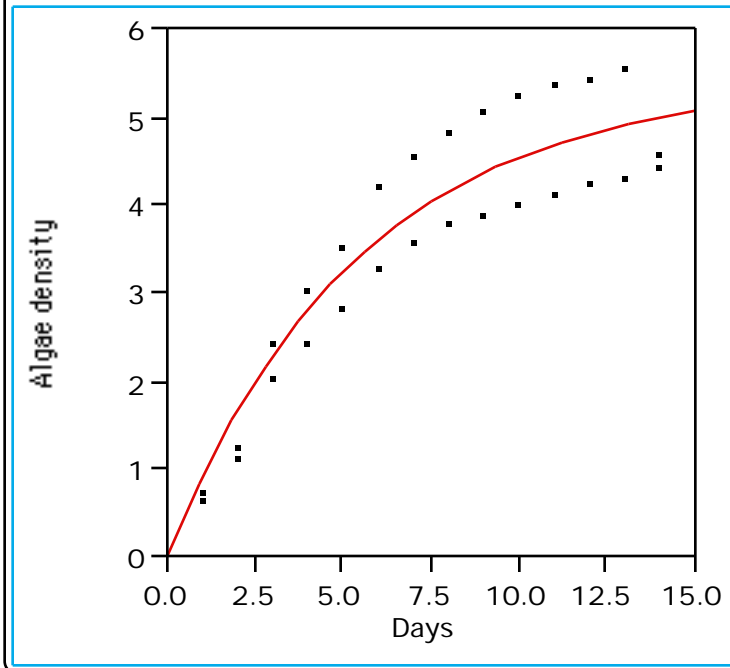
a) Write out the fitted model.

b) Are the parameters in the model significant? Explain

Solution

	SSE	DFE	MSE	RMSE
	6.8453458526	26	0.2632825	0.5131106
Parameter	Estimate	ApproxStdErr	Lower CL	Upper CL
a	5.4168562886	0.37298806	4.80975907	6.36822651
b	0.1818786571	0.02990715	0.12830119	0.24624088

Graph



c) Carry out a test for lack of fit for this model. [Hint: $\sum_{i=1}^2 (x_i - \bar{x})^2 = \frac{1}{2} (x_1 - x_2)^2$]

d) Estimate the mean density for day 15 and explain as detailed as possible how to construct a 95% confidence interval for the true mean.

A similar experiment was run using a different "culture." The results of the fitting of the same model appear below.

Solution				
	SSE	DFE	MSE	RMSE
	0.2188252474	26	0.0084164	0.0917407
Parameter	Estimate	ApproxStdErr	Lower CL	Upper CL
a	5.0240069456	0.11139665	4.81308684	5.26703833
b	0.1316726388	0.00567821	0.12037039	0.14337586

e) Test whether the asymptotes of the two models are the same. [Hint: Improvise a little here using some statistical common sense]

3. The manager of a large department store is interested in investigating the effect of advertising expenditures on actual sales. He knows that, regardless of advertisement expenditure, sales depend heavily on the season of the year. He hires you to look at data and help him understand this effect. Sales and advertising expenditure data are available for several years. A sample of data would look like:

Quarter	Advertisement Expenditure	Sales
1	459	1783
2	420	1640
3	480	1800
4	460	1930

a) Draw a picture of the situation in which there is an effect of expenditures and also of quarter. Assume that there is no effect of year and that the effect of expenditures is the same for all quarters.

b) Set up an equation that would allow you to model these effects and also predict future sales based on quarter and advertising expenditures. Carefully define every term in your model.