

FINAL EXAM
STAT 572
Spring 1995

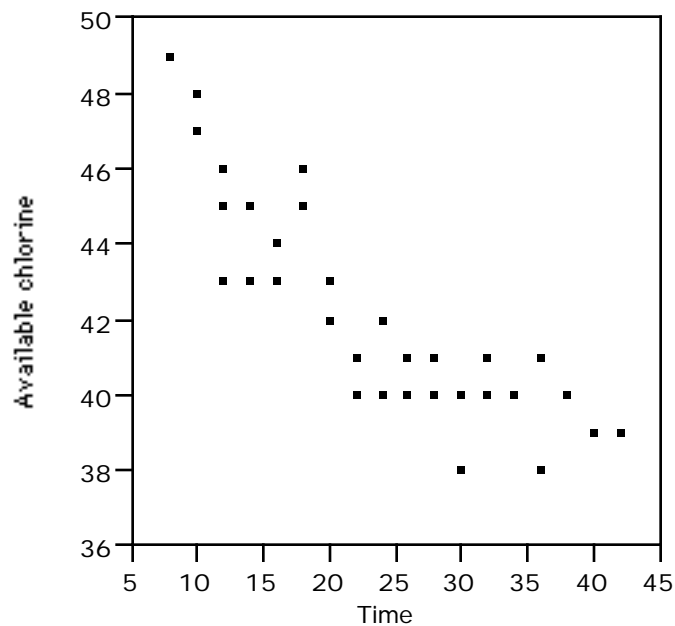
1. The following table shows data on the amount of chlorine in a product as a function of time since manufacture:

Time in weeks	Available chlorine	Time in weeks	Available chlorine
8	49, 49	26	41, 40, 41
10	48, 47, 48, 47	28	41, 40
12	46, 46, 45, 43	30	40, 40, 38
14	45, 43, 43	32	41, 40
16	44, 43, 43	34	40
18	46, 45	36	41, 38
20	42, 42, 43	38	40, 40
22	41, 41, 40	40	39
24	42, 40, 40	42	39

Theoretical considerations lead to a model of the form

$$y = \alpha + (.49 - \alpha)\varepsilon^{-\beta(t-8)} + \varepsilon,$$

where t is the time in weeks and y is the observed amount of available chlorine. A plot of the data appears below.



a) Explain how you would obtain initial values for the parameters [Hint: See what happens when t and > 0] (5 p)

The results of fitting this model in JMP appear below.

Solution				
	SSE	DFE	MSE	RMSE
	50.016796044	42	1.1908761	1.0912727
Parameter	Estimate	ApproxStdErr	Lower CL	Upper CL
a	39.014001641	0.50449679	37.7949135	39.9167409
b	0.1016327092	0.01336021	0.07679523	0.13207624

b) Write the estimated model and plot it approximately in the graph above. (5 p)

c) Is there evidence that either parameter is needed in the model? (5 p)

d) The pure error sum of squares is $SSPE = 23.667$. Do a test of lack of fit of the model.
(5 p)

e) Explain how to construct a confidence interval for the response at $t = 20$. Be careful to define as detailed as possible each term used.(5 p)

2. In an observational study, subjects were exposed to varying levels of rate and volume of air inspired. The response was the occurrence (1) or nonoccurrence (0) of vaso constriction. The data consist of observations on 39 subjects. A logistic regression model was fitted to the data. The results of modeling $P[\text{Response} = 0]$ appear below.

Whole-Model Test				
Model	-LogLikelihood	DF	ChiSquare	Prob>ChiSq
Difference	12.133766	2	24.26753	0.000005
Full	14.886152			
Reduced	27.019918			
RSquare (U)		0.4491		
Observations (or Sum Wgts)		39		

Lack of Fit			
Source	DF	-LogLikelihood	ChiSquare
Lack of Fit	35	14.886152	29.7723
Pure Error	1	0.000000	Prob>ChiSq
Total Error	36	14.886152	0.718416

Parameter Estimates				
Term	Estimate	Std Error	ChiSquare	Prob>ChiSq
Intercept	9.52925907	3.2330834	8.69	0.0032
Volume	-3.8820066	1.4285624	7.38	0.0066
Rate	-2.6490359	0.9141912	8.40	0.0038

Effect Likelihood-Ratio Tests				
Source	Nparm	DF	L-R ChiSquare	Prob>ChiSq
Volume	1	1	19.882518	0.0000
Rate	1	1	17.217074	0.0000

a) Comment on the overall fit of the model and the individual contributions of the regressors. (10 p)

b) Interpret the effect of each regressor on the probability of vaso constriction. (5 p)

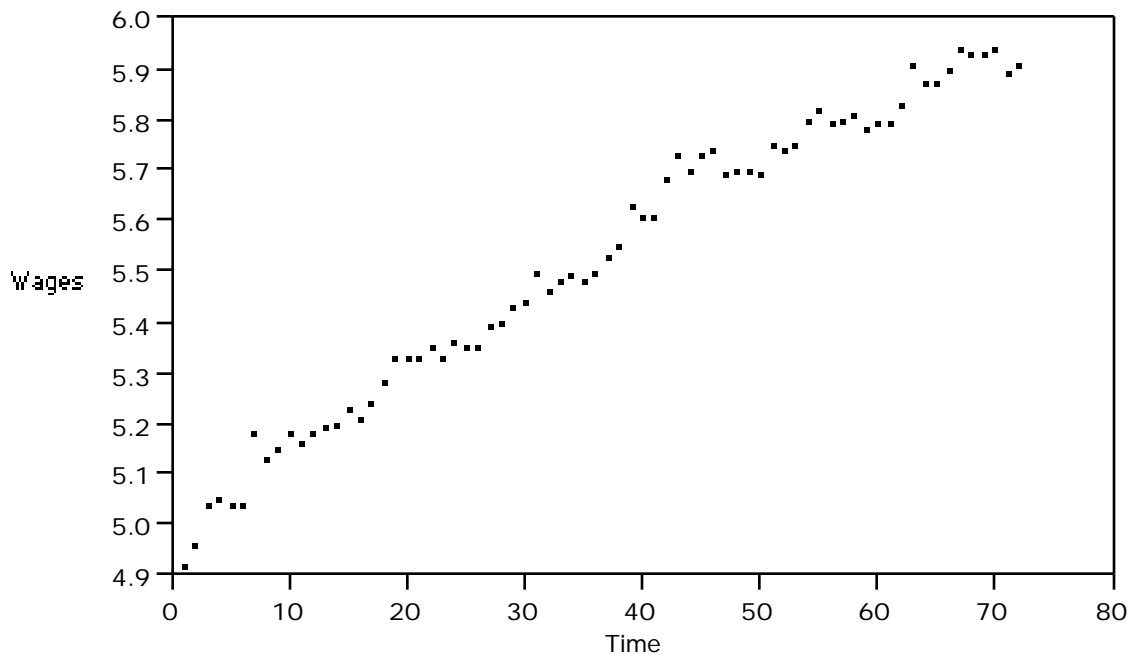
c) Explain why the degrees of freedom for pure error are 1. [Hint: Imagine what the data must look like] (5 p)

d) Estimate the probability of vaso constriction with a volume of 2.00 and a rate of 1.5.
(5 p)

e) Suppose that the variable age is added to the model. The -loglikelihood of the full model decreases to 12.510. Test the significance of age in the model. (5 p)

3. A study was conducted to forecast the hourly wages in the apparel industry. Average hourly wages were obtained from July 1981 to June of 1987 for a total of 72 observations. The data for the last 20 months appear below along with a plot of all 72 months. The results of the SAS analysis of the data appears in the next page.

Time	Hourly Wage
53	5.75
54	5.80
55	5.82
56	5.79
57	5.80
58	5.81
59	5.78
60	5.79
61	5.79
62	5.83
63	5.91
64	5.87
65	5.87
66	5.90
67	5.94
68	5.93
69	5.93
70	5.94
71	5.89
72	5.91



a) Estimate the first order autocorrelation among the residuals and test its significance. (5 p)

b) Write out the model that includes the autoregressive part. (5 p)

c) Forecast the hourly wages for the next two months. (5 p)