

HW Question Week 1

STA2101F 2021

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(a) Fit the linear model `resist ~ x1 + x2 + x3 + x4`. Extract the X matrix using the `model.matrix` function. How have the levels of the factors been coded?

Model 1	
(Intercept)	2.368e+02 (s.e. = 1.477e+01) t = 1.603e+01, p = 5.645e-09
x1+	2.576e+01 (s.e. = 1.321e+01) t = 1.950e+00, p = 7.708e-02
x2+	-6.989e+01 (s.e. = 1.321e+01) t = -5.291e+00, p = 2.561e-04
x3+	4.359e+01 (s.e. = 1.321e+01) t = 3.300e+00, p = 7.083e-03
x4+	-1.449e+01 (s.e. = 1.321e+01) t = -1.097e+00, p = 2.962e-01
Num.Obs.	16
R2	0.800
R2 Adj.	0.727
AIC	156.2
BIC	160.8
Log.Lik.	-72.091
F	10.971

(Intercept)	x1+	x2+	x3+	x4+
1	0	0	0	0
1	1	0	0	0
1	0	1	0	0
1	1	1	0	0
1	0	0	1	0
1	1	0	1	0
1	0	1	1	0
1	1	1	1	0
1	0	0	0	1
1	1	0	0	1
1	0	1	0	1
1	1	1	0	1
1	0	0	1	1
1	1	0	1	1
1	0	1	1	1
1	1	1	1	1

- is coded as 0 and + is coded as 1.

(b) Compute the correlation between the columns of the X matrix. Why are there some missing values?

	(Intercept)	x1+	x2+	x3+	x4+
(Intercept)	1	NA	NA	NA	NA
x1+	NA	1	0	0	0
x2+	NA	0	1	0	0
x3+	NA	0	0	1	0
x4+	NA	0	0	0	1

The standard deviation of the Intercept column is zero, so the correlation coefficient between it and all other columns is not calculable.

(c) What difference in resistance is expected when moving from the low to the high level of x_1 ?

From Model 1 in the table above, we can expect an increase of 25.762 when moving from the low to the high level of x_1 .

(d) Refit the model without x_4 and examine the regression coefficients and standard errors. What stayed the same and what changed? How is this related to the correlation matrix of X ?

	Model 1	Model 2
(Intercept)	2.368e+02 (s.e. = 1.477e+01, t = 1.603e+01, p = 5.645e-09)	2.295e+02 (s.e. = 1.332e+01, t = 1.723e+01, p = 7.883e-10)
x1+	2.576e+01 (s.e. = 1.321e+01, t = 1.950e+00, p = 7.708e-02)	2.576e+01 (s.e. = 1.332e+01, t = 1.934e+00, p = 7.705e-02)
x2+	-6.989e+01 (s.e. = 1.321e+01, t = -5.291e+00, p = 2.561e-04)	-6.989e+01 (s.e. = 1.332e+01, t = -5.246e+00, p = 2.056e-04)
x3+	4.359e+01 (s.e. = 1.321e+01, t = 3.300e+00, p = 7.083e-03)	4.359e+01 (s.e. = 1.332e+01, t = 3.272e+00, p = 6.677e-03)
x4+	-1.449e+01 (s.e. = 1.321e+01, t = -1.097e+00, p = 2.962e-01)	
Num.Obs.	16	16
R2	0.800	0.778
R2 Adj.	0.727	0.722
AIC	156.2	155.8
BIC	160.8	159.7
Log.Lik.	-72.091	-72.921
F	10.971	13.991

The estimated coefficients for **x1**, **x2**, and **x3** do not change. This is expected because the correlation matrix of X shows zero correlation between each pair of **xi**.

The standard errors, t-values, and p-values for **xi** change slightly (increasing, magnitude decreasing, and decreasing, respectively). The intercept estimate decreases slightly, and the corresponding standard error decreases, t-value increases in magnitude, and p-value decreases.