

Problem Set 8

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Q4.

Table 1: True Parameters

	true_beta
X1	1.50
X2	-1.00
X3	-0.25
X4	0.75
X5	3.50
X6	-2.00
X7	0.50
X8	1.00
X9	1.25
X10	2.00

Q5.

The estimates obtained from matrix algebra with an error term are extremely close. If you round off to two decimal places, they are actually the same as the true parameter values in Table 1.

Table 2: Matrix Algebra

	beta_hat_ols
X1	1.50058
X2	-0.99562
X3	-0.24865
X4	0.74719
X5	3.50177
X6	-1.99944
X7	0.50113
X8	0.99874
X9	1.25283
X10	1.99938

Q6.

Table 3: Gradient Descent

	gd_beta
X1	1.50058
X2	-0.99562
X3	-0.24865
X4	0.74719
X5	3.50177
X6	-1.99944
X7	0.50113
X8	0.99874
X9	1.25283
X10	1.99938

Q7.

Yes, the answers differ, but only very slightly. The answers only seem to differ in the 4th decimal place or beyond, and both estimates are extremely close to the true parameter values.

Table 4: L-BFGS OLS

	l.bfgs_ols
X1	1.50058
X2	-0.99562
X3	-0.24865
X4	0.74719
X5	3.50177
X6	-1.99944
X7	0.50113
X8	0.99874
X9	1.25283
X10	1.99938

Table 5: Nelder-Mead OLS

	nm_ols
X1	1.50072
X2	-0.99578
X3	-0.24882
X4	0.74731
X5	3.50201
X6	-1.99947
X7	0.50098
X8	0.99887
X9	1.25269
X10	1.99957

Q8.

Table 6: L-BFGS MLE

	betahat
X1	1.50058
X2	-0.99562
X3	-0.24865
X4	0.74719
X5	3.50177
X6	-1.99944
X7	0.50113
X8	0.99874
X9	1.25283
X10	1.99938

Q9.

The linear model function gives us almost exactly the same estimates as matrix algebra. When looking closely at the numbers in RStudio, only a couple of the estimates have any difference at all, which may be attributable to rounding. Both estimates come very close to the real values, only overestimating or underestimating at a small margin.

lm() Function Estimates:

	(1)
X1	1.501*** (0.002)
X2	−0.996*** (0.002)
X3	−0.249*** (0.002)
X4	0.747*** (0.002)
X5	3.502*** (0.002)
X6	−1.999*** (0.002)
X7	0.501*** (0.002)
X8	0.999*** (0.002)
X9	1.253*** (0.002)
X10	1.999*** (0.002)
Num.Obs.	100 000
R2	0.991
R2 Adj.	0.991
AIC	144 993.2
BIC	145 097.9
Log.Lik.	−72 485.615
RMSE	0.50
+ p < 0.1, * p < 0.05, ** p < 0.01, *** p < 0.001	