PS8-Onishi

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1 $\hat{\beta}_{\mathbf{OLS}}$ from the closed form solution

Although the estimates from $(X'Y)^{-1}XY$ are not exactly the true values of beta, it is extremely close.

2 $\hat{\beta}_{\mathbf{OLS}}$ from L-BFGS vs Nelder-Mead

The $\hat{\beta}_{\text{OLS}}$ differ between these two methods. The $\hat{\beta}_{\text{OLS}}$ calculated by the L-BFGS algorithm came very close. In comparison to this, $\hat{\beta}_{\text{OLS}}$ calculated by the Nelder-Mead method got close in some, and did not in others. Overall, the L-BFGS algorithm was able to generate more accurate estimates.

Table 1: Comparison of $\hat{\beta}$ Estimates

	β_{true}	$\hat{\beta}_{\text{L-BFGS}}$	$\hat{\beta}_{\text{Nelder-Mead}}$
1	1.50	1.50	1.49
2	-1.00	-0.99	-0.88
3	-0.25	-0.25	-0.25
4	0.75	0.74	1.08
5	3.50	3.50	3.33
6	-2.00	-2.00	-2.00
7	0.50	0.50	1.30
8	1.00	1.00	0.10
9	1.25	1.26	1.40
10	2.00	2.00	2.15

3 $\hat{\beta}_{\mathbf{OLS}}$ from the linear model function (lm())

The linear model function in R performed well. It was comparable to both the analytical approach and the L-BFGS algorithm. In fact, these values were identical to 7 decimal places.
Relative to the ”ground truth”, $\hat{\beta}_{\text{OLS}}$ from the linear model function is not far off.

Table 2: $\hat{\beta}_{\mathrm{OLS}}$ via lm()

	$\hat{\beta}_{\mathrm{OLS}}$ estimates
X1	1.501
	(0.002)
X2	-0.991
	(0.003)
X3	-0.247
	(0.003)
X4	0.744
	(0.003)
X5	3.504
	(0.003)
X6	-1.999
	(0.003)
X7	0.502
	(0.003)
X8	0.997
	(0.003)
X9	1.256
	(0.003)
X10	1.999
	(0.003)
Num.Obs.	1e+05
R2	0.971
R2 Adj.	0.971
AIC	144993.2
BIC	145097.9
Log.Lik.	-72485.615
RMSE	0.50