

UNIVERSITY OF TECHNOLOGY SYDNEY

School of Mathematical and Physical Sciences

37457 Advanced Bayesian Methods

SOLUTIONS TO

ASSIGNMENT 8 (OPTIONAL)

1.(a) The leave-one-out (LOO) information Criteria Values are Subject Markov chain Monte Carlo variability. Therefore various runnings of cheeseLOOana.R will lead to different output. One running led to the output:

model number	LOO information Criterion
1	88.01
2	79.97
3	65.09
4	69.39
5	66.35
6	70.31
7	60.03
8	62.76

Based on this output, Model 7 has the lowest LOO information criterion and, hence, is selected. It is the model with predictors 1, x_2 (H2S) and x_3 (lactic).

1(b) A correct version of the script
`cheese LOOanaWithInteract111s.R`
 is on the subject web-site
 under the

Files for Assignment Solutions
 heading. One running of this
 script led to the output:

model number	LOO information criterion
1	87.94
2	79.44
3	64.53
4	69.43
5	65.93
6	70.43
7	60.60
8	62.98
9	67.93
10	71.14
11	62.75
12	64.06
13	63.90
14	64.77
15	65.69
16	65.85
17	65.23
18	67.45

Based on this output, none of the new interaction models have LOO information Criterion value that is lower than the value for Model 7. So none of the new interaction models improve upon the first set of models.

2. (a) A correct version of the script

`stacklossLOOanaWithInteracs.R`

is on the subject web-site under the

Files for Assignment Solutions heading. One running of this script led to the output in the upper half of the next page:

model number	Loo information criterion
1	63.31
2	28.79
3	34.48
4	61.23
5	19.92
6	24.40
7	36.25
8	19.93
9	18.01
10	32.73
11	39.14
12	19.88
13	21.40
14	21.66
15	20.86
16	22.15
17	24.06
18	23.94

Based on this output, the selected model is

$$y_i | \beta_0, \beta_1, \beta_3, \beta_{12}, \sigma^2$$

$$\stackrel{\text{ind.}}{\sim} N(\beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} + \beta_3 x_{3i} + \beta_{12} x_{1i} x_{2i}, \sigma^2)$$

that is, the selected model is the one that includes air flow, water temperature and acid concentration as main effects PLUS an interaction between air flow and water temperature.

2(b) Individually, each of air flow, water temperature and acid concentration impact mean stack loss. Also, air flow and water temperature combine to have an additional impact on mean stack loss.

3(a) Since the leaving-out-one (LOO) Criterion values depend on Markov chain Monte Carlo samples, the values are subject to change between different runnings of the R scripts.

One running of them led to the table:

model number	LOO information criterion
1	-149.93
2	-182.17
3	-304.13

3(b) The third model with random intercepts and slopes and a quadratic fixed effect term is justified since it leads to a lower LOO information criterion value.

4. A correct version of the script
wolfcampPlaneLOOana.R
is on the subject web-site under the

Files for Assignment Solutions heading. Note again that different runnings of these LOO scripts leads to different answers. One running of them led to the table near the top of the next page.

model	LOO information criterion
plane	-64.25
bivariate penalized spline	-92.31

As is apparent from this table, the bivariate Bayesian penalized spline model improves upon the Bayesian planar model in terms of having a lower LOO information criterion value.

