Transfer function model.

$$Y(t) = \mu + \sum_u a(t-u)\, X(u) + \varepsilon(t)$$

$$dZ_Y(\lambda) = A(\lambda)\, dZ_X(\lambda) + dZ_\varepsilon(\lambda)$$

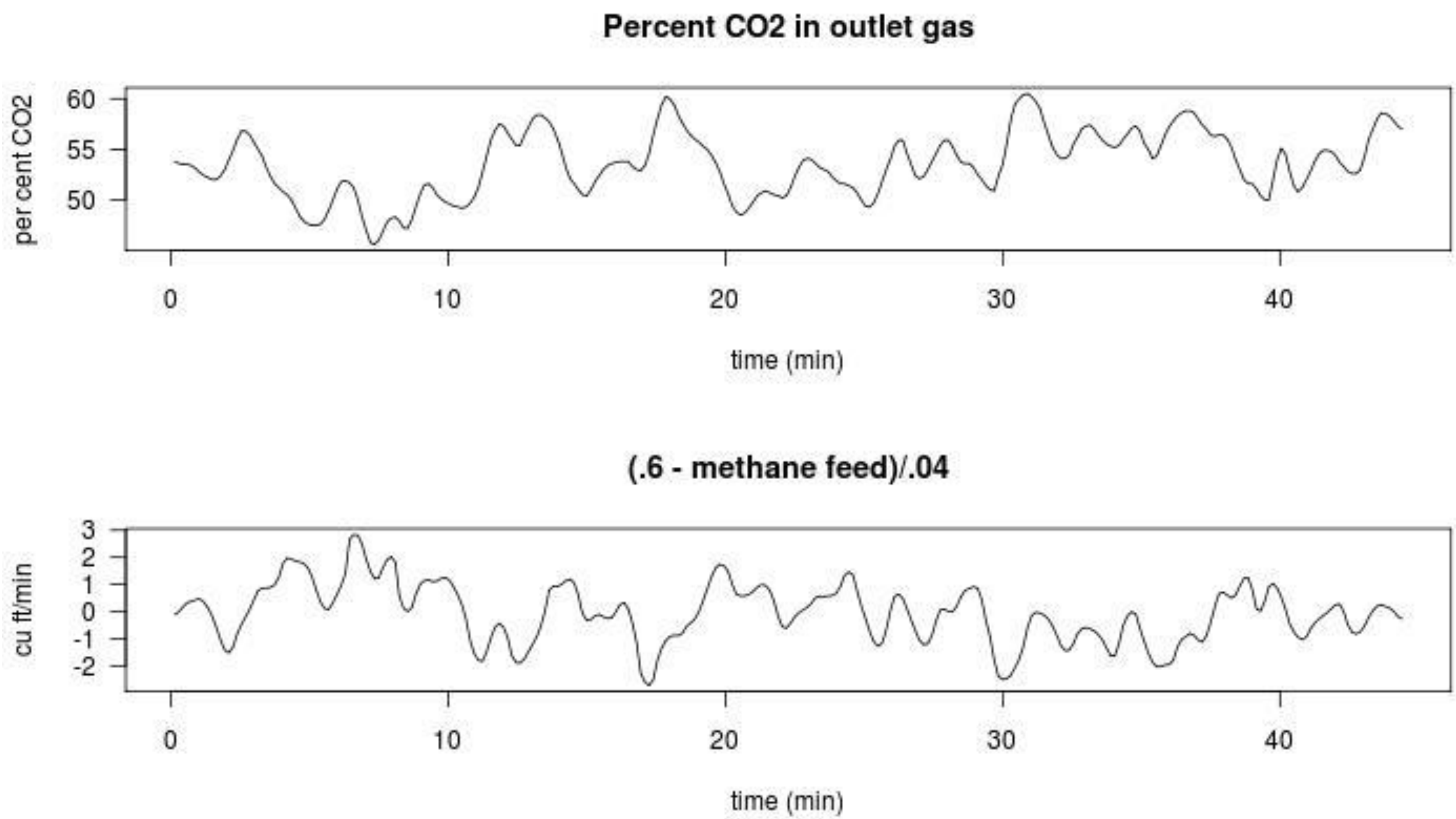
$$Y(t) = \int \exp\{it\lambda\} dZ_Y(\lambda)$$

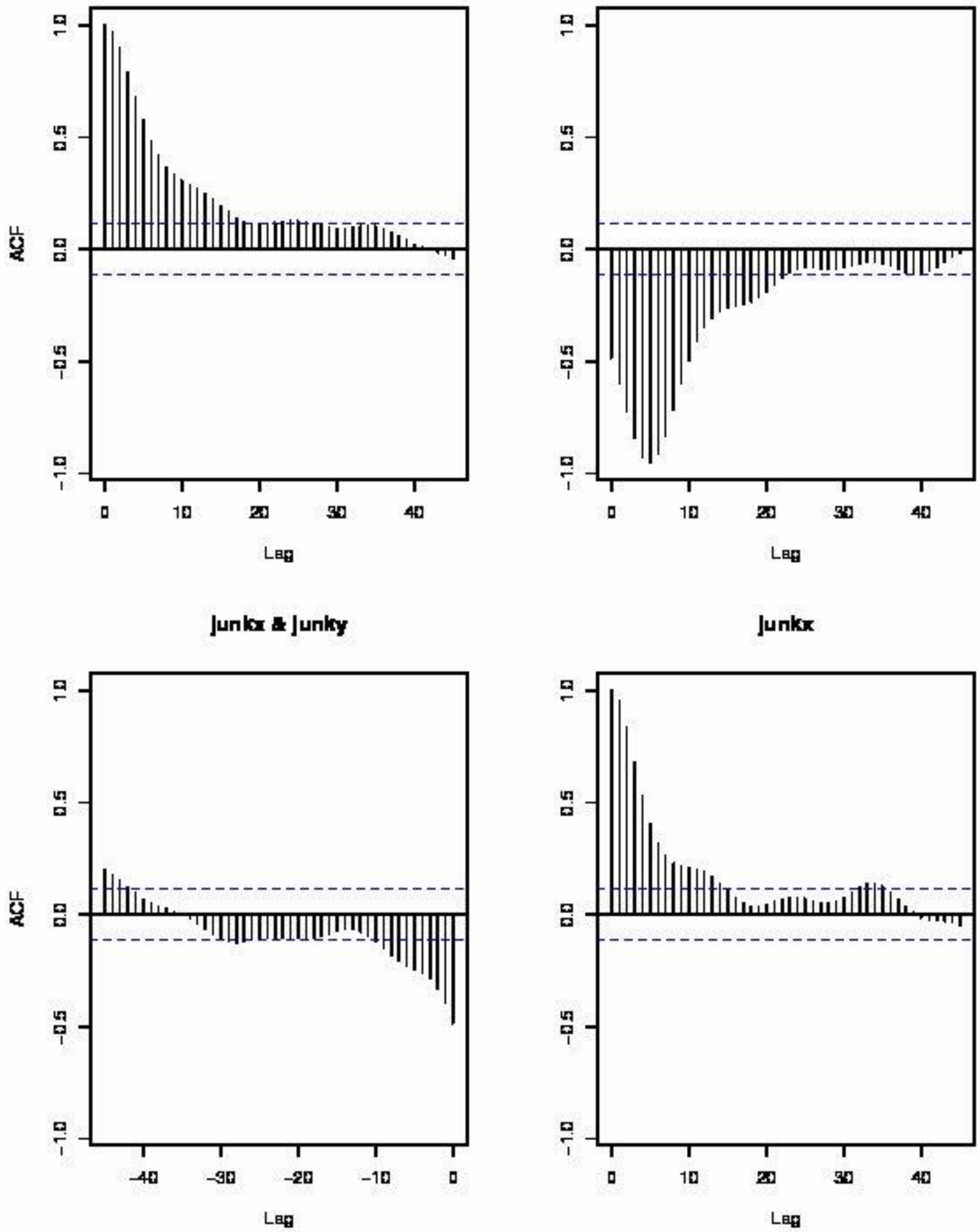
Gas furnace data - Box & Jenkins

Sampling interval 9 sec., observations for 296 pairs of data points

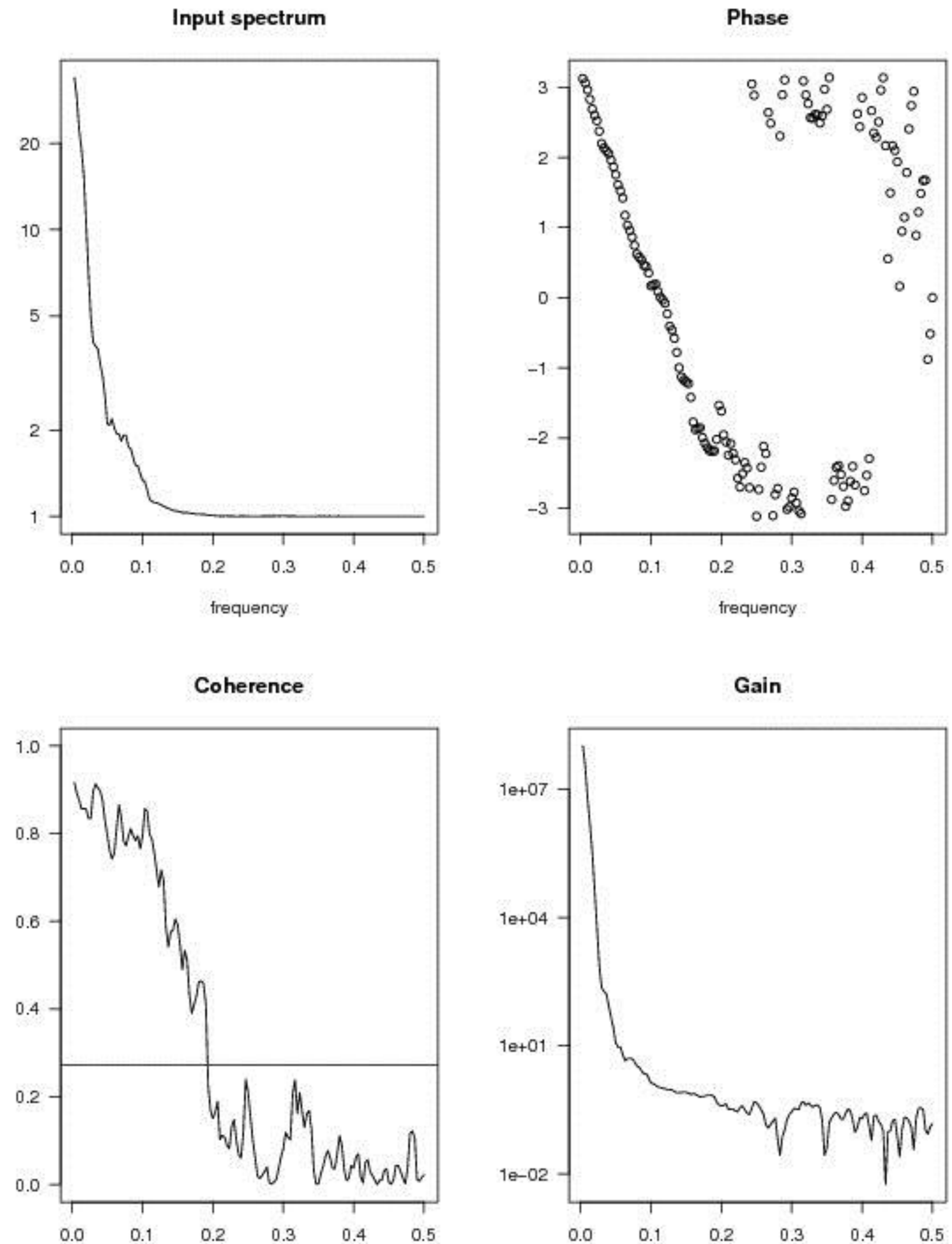
X: 0.60 of input - 0.04 (input gas rate in cuft/min)

Y: % CO_2 in outlet gas


Percent CO2 in outlet gas
per cent CO2
60
55
50
0
10
20
30
40
time (min)
(.6 - methane feed)/.04
cu ft/min
3
2
1
0
-1
-2
0
10
20
30
40
time (min)



ACF
Lag
Lag
Junkx & Junky
Junkx
ACF
Lag
Lag


Input spectrum
20
10
5
2
1
0.0
0.1
0.2
0.3
0.4
0.5
frequency
Phase
3
2
1
0
−1
−2
−3
0.0
0.1
0.2
0.3
0.4
0.5
frequency
Coherence
1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.1
0.2
0.3
0.4
0.5
Gain
1e+07
1e+04
1e+01
1e−02
0.0
0.1
0.2
0.3
0.4
0.5

Time side inference.

Comparing alternate models. Supose there are J

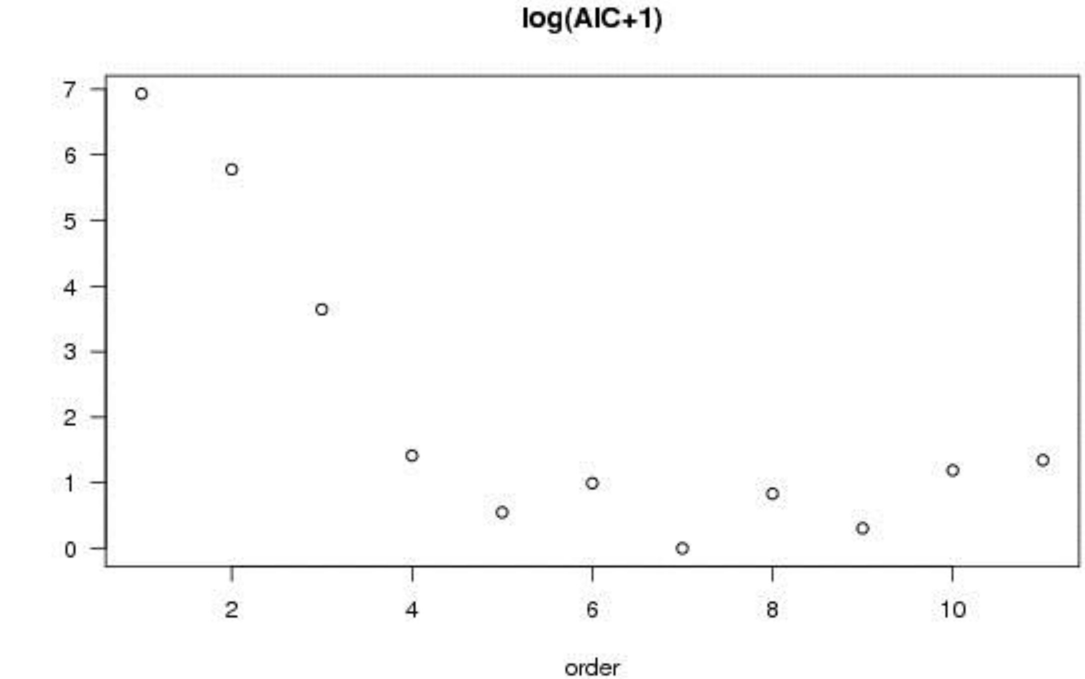
$AIC_j = -2 \log L(\hat{G}_j) + 2 s_j$

s_j is the number of paremeters in G_j

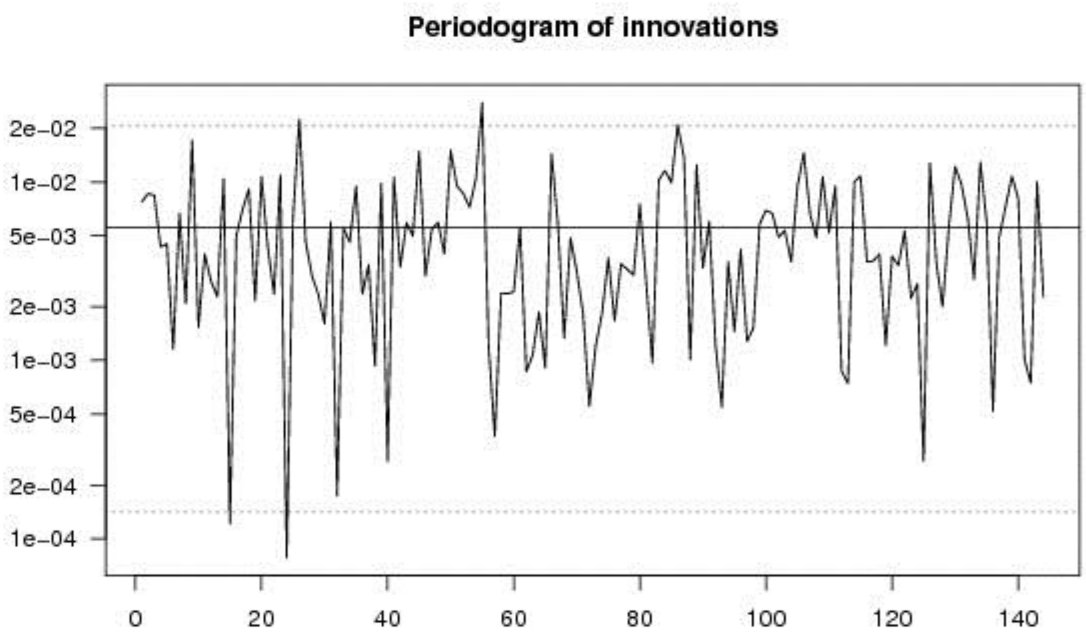
There is also

$\boldsymbol{B}IC_j = -2 \log L(\hat{G}_j) + s_j \log n_j$

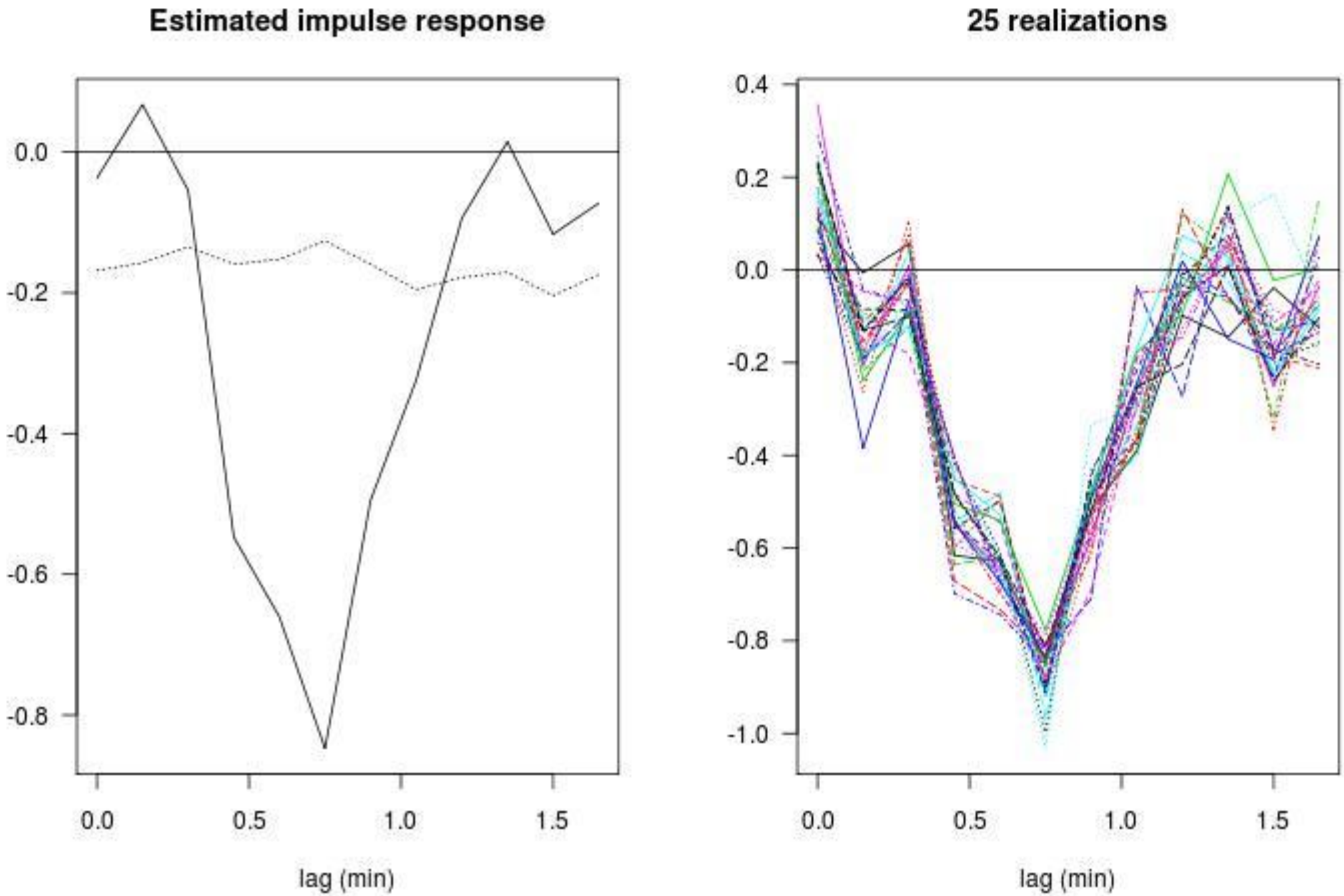
Fundamental contributions of statistics



log(AIC+1)
7
6
5
4
3
2
1
0
2
4
6
8
10
order



Periodogram of innovations
2e−02
1e−02
5e−03
2e−03
1e−03
5e−04
2e−04
1e−04
0
20
40
60
80
100
120
140



bootstrap-like