**1.1** To compare the earthquake and explosion signals, plot the data displayed in Figure 1.7 on the same graph using dierent colors or dierent line types and comment on the results. (The R code in Example 1.11 may be of help on how to add lines to existing plots.)

**1.2** Consider a signal-plus-noise model of the general form *x*t = *s*t + wt , where wt isGaussianwhitenoisewithw2 =1.Simulateandplot*n*=200observationsfrom each of the following two models.

(a) *x*t =*s*t +wt,for*t*⇢=1,...,200,where

*s*t= 0, 10exp{(t100)}cos(2⇡*t*/4),

Hint:

s = c(rep(0,100), 10\*exp(-(1:100)/20)\*cos(2\*pi\*1:100/4)) x = s + rnorm(200) plot.ts(x)

20

*t*=1,...,100 *t* = 101,...,200.

(b) *x*t = *s*t + wt , for *t*⇢= 1, . . . , 200, where

*s*t= 0, 10exp{(t100)}cos(2⇡*t*/4),

(c) Compare the general appearance of the series (a) and (b) with the earthquake series and the explosion series shown in Figure 1.7. In addition, plot (or sketch) and compare the signal modulators (a) exp{*t*/20} and (b) exp{*t*/200}, for *t* = 1, 2, . . . , 100.

*Section 1.2*

**1.3** (a) Generate *n* = 100 observations from the autoregression *x*t = .9*x*t2 + wt

with w = 1, using the method described in Example 1.10. Next, apply the moving average filter

vt = (*x*t + *x*t1 + *x*t2 + *x*t3)/4

to *x*t , the data you generated. Now plot *x*t as a line and superimpose vt as a dashed line. Comment on the behavior of *x*t and how applying the moving average filter changes that behavior. [*Hints:* Use v = filter(x, rep(1/4, 4), sides = 1) for the filter and note that the R code in Example 1.11 may be of help on how to add lines to existing plots.]

200

*t*=1,...,100 *t* = 101,...,200.

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* (b)  Repeat (a) but with  *x*t = cos(2⇡*t*/4).
* (c)  Repeat (b) but with added N(0, 1) noise,

*x*t =cos(2⇡*t*/4)+wt. (d) Compare and contrast (a)–(c); i.e., how does the moving average change each

series.

*Section 1.3*

**1.4** Show that the autocovariance function can be written as (*s*,*t*)=E[(*x*s μs)(*x*t μt)]=E(*x*s*x*t)μsμt,

where E[*x*t] = μt.

**1.5** For the two series, *x*t , in Problem 1.2 (a) and (b):

(a) Compute and plot the mean functions μx (*t*), for *t* = 1, . . . , 200.

b) Calculate the autocovariance functions, x (*s*, *t*), for *s*, *t* = 1, . . . , 200.

**1.20** (a) Simulate a series of *n* = 500 Gaussian white noise observations as in Exam- ple 1.8 and compute the sample ACF, ⇢ˆ(*h*), to lag 20. Compare the sample ACF you obtain to the actual ACF, ⇢(*h*). [Recall Example 1.19.]

(b) Repeat part (a) using only *n* = 50. How does changing *n* aect the results?

**1.21** (a) Simulate a series of *n* = 500 moving average observations as in Example 1.9 and compute the sample ACF, ⇢ˆ(*h*), to lag 20. Compare the sample ACF you obtain to the actual ACF, ⇢(*h*). [Recall Example 1.20.]

(b) Repeat part (a) using only *n* = 50. How does changing *n* aect the results?