

Reagan: linear regression with AR(1) disturbances.

Ninety-six monthly observations on presidential job approval ratings for Ronald Reagan are modeled via linear regression, with a correction for first-order serial correlation among the disturbances. Note the marginal model for the first observation, and the conditioning on the lagged observation for months 2 through 96. A uniform prior over the stationary $(-1,1)$ interval is employed for the residual AR(1) parameter.

```
model {  
  mu[1] <- b[1] + b[2]*infl[1] + b[3]*unemp[1]  
  app[1] ~ dnorm(mu[1], tau.u)  
  
  for (t in 2:96){          ## loop over obs 2 to T  
    mu[t] <- b[1]*(1-rho)  
    + b[2]*(infl[t] - rho*infl[t-1])  
    + b[3]*(unemp[t] - rho*unemp[t-1])  
    += b[4]*(irancontra[t] - rho*irancontra[t-1])  
    + rho*app[t-1];  
    app[t] ~ dnorm(mu[t], tau.e);  
  }  
  
  sigma.e <- 1/tau.e          ## convert precision to variance  
  sigma.u <- sigma.e/(1+pow(rho,2)) ## regression error variance  
  tau.u <- 1/sigma.u  
  
  ## priors  
  rho ~ dunif(-1,1);          ## uniform prior on stationary interval  
  b[1:3] ~ dmnorm(b0[, , B0[ , ]]); ## multivariate Normal prior  
  tau.e ~ dgamma(.05, .05);    ## vague prior on sigma  
}
```

Data:

```
list(app=c(51, 55, 60, 67, 68, 59, 58, 60, 56, 54, 55, 49, 47, 47, 46, 43, 45, 44, 42, 42, 42, 42, 43, 41, 35, 40, 41, 41, 46, 47, 42, 43,  
47, 49, 53, 54, 55, 56, 54, 54, 53, 54, 56, 57, 54, 58, 61, 59, 64, 60, 56, 52, 55, 58, 63, 65, 60, 63, 65, 63, 64, 64, 63, 62, 68, 64, 63,  
61, 61, 63, 63, 47, 48, 40, 47, 48, 51, 53, 49, 49, 49, 49, 49, 49, 50, 51, 50, 48, 48, 54, 53, 54, 51, 57, 64),  
infl=c(11.7948717948718, 11.3924050632911, 10.6117353308365, 10.1359703337454, 9.79192166462668, 9.6969696969697,  
10.7748184019371, 10.8173076923077, 10.9654350417163, 10.271546635183, 9.57943925233646, 8.91203703703702,  
8.25688073394495, 7.61363636363637, 6.88487584650115, 6.62177328843996, 6.9119286510591, 7.18232044198894,  
6.55737704918034, 5.9652928416486, 4.94092373791624, 5.03211991434689, 4.47761194029852, 3.82571732199788,  
3.70762711864407, 3.48468848996832, 3.59028511087645, 4.00000000000000, 3.44108446298228, 2.47422680412372,  
2.35897435897436, 2.45649948822926, 2.76356192425793, 2.75229357798166, 3.16326530612245, 3.78710337768680,  
4.29009193054135, 4.6938775510204, 4.89296636085628, 4.55465587044535, 4.33467741935483, 4.32595573440644,  
4.30861723446894, 4.29570429570432, 4.28286852589641, 4.26587301587302, 4.15430267062316, 4.04339250493095,  
3.52595494613126, 3.60623781676415, 3.79008746355685, 3.58180058083253, 3.57487922705315, 3.66441658630665,  
3.45821325648417, 3.35249042145593, 3.2473734479465, 3.23501427212178, 3.51377018043686, 3.79146919431279,  
3.97350993377483, 3.19849482596426, 2.15355805243445, 1.58878504672897, 1.67910447761195, 1.76744186046511,  
1.67130919220055, 1.57553290083410, 1.75763182238668, 1.56682027649770, 1.28440366972478, 1.18721461187214,  
1.45586897179253, 2.00546946216955, 2.93308890925756, 3.77184912603494, 3.76146788990825, 3.83912248628884,  
4.01826484018266, 4.37956204379564, 4.36363636363637, 4.44646098003629, 4.61956521739131, 4.42238267148014,  
4.12556053811659, 3.84271671134941, 3.82902938557434, 3.90070921985817, 3.9787798408488, 3.9612676056338,  
4.12642669007901, 4.02097902097902, 4.18118466898953, 4.25716768027802, 4.24242424242425, 4.40795159896283),
```

```
unemp=c(7.5, 7.4, 7.4, 7.2, 7.5, 7.5, 7.2, 7.4, 7.6, 7.9, 8.3, 8.5, 8.6, 8.9, 9, 9.3, 9.4, 9.6, 9.8, 9.8, 10.1, 10.4, 10.8, 10.8, 10.4, 10.4,
10.3, 10.2, 10.1, 10.1, 9.4, 9.5, 9.2, 8.8, 8.5, 8.3, 8, 7.8, 7.8, 7.7, 7.4, 7.2, 7.5, 7.5, 7.3, 7.4, 7.2, 7.3, 7.3, 7.2, 7.2, 7.3, 7.2, 7.4, 7.4,
7.1, 7.1, 7.1, 7, 7, 6.7, 7.2, 7.2, 7.1, 7.2, 7.2, 7, 6.9, 7, 7, 6.9, 6.6, 6.6, 6.6, 6.6, 6.3, 6.3, 6.2, 6.1, 6, 5.9, 6, 5.8, 5.7, 5.7, 5.7, 5.4,
5.6, 5.4, 5.4, 5.6, 5.4, 5.3, 5.3), b0=c(0, 0, 0), B0= structure(.Data= c(0.00001, 0, 0, 0, 0.00001, 0, 0, 0, 0.00001), .Dim=c(3, 3)))
```

Initial values:

```
list(b=c(80,0,0),rho=0.0,tau.e=.01)
```

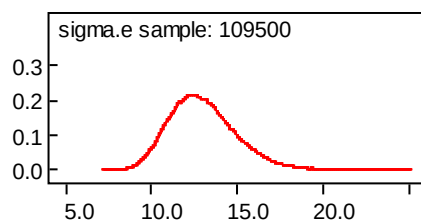
Results:

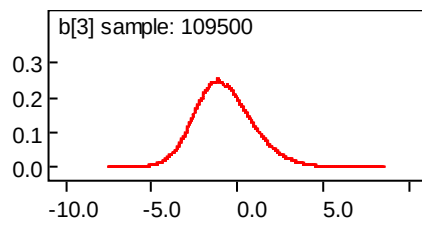
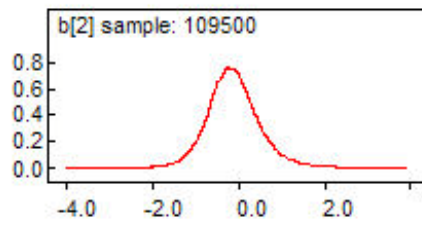
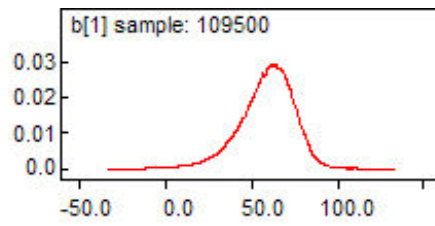
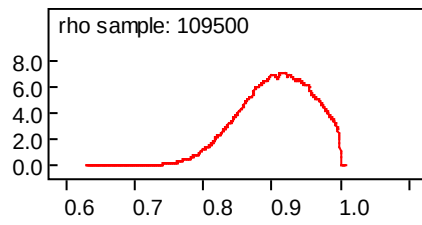
node	mean	sd	MC error	2.5%	median	97.5%	start	sample
b[1]	58.87	15.36	0.2088	24.35	60.34	84.86	11001	10000
b[2]	-0.1243	0.598	0.006841	-1.232	-0.1471	1.178	11001	10000
b[3]	-0.7827	1.68	0.0228	-3.845	-0.8752	2.796	11001	10000
rho	0.9047	0.05272	7.46E-4	0.7926	0.9083	0.9912	11001	10000
sigma.e	13.0	1.937	0.01833	9.719	12.83	17.32	11001	10000

node	mean	sd	MC error	2.5%	median	97.5%	start	sample
b[1]	58.63	15.64	0.183	22.53	60.36	85.36	501	9500
b[2]	-0.1179	0.617	0.005937	-1.241	-0.1515	1.259	501	9500
b[3]	-0.7618	1.687	0.01979	-3.788	-0.8975	2.937	501	9500
rho	0.9059	0.05248	6.695E-4	0.7948	0.9103	0.9913	501	9500
sigma.e	12.97	1.938	0.01994	9.725	12.81	17.34	501	9500

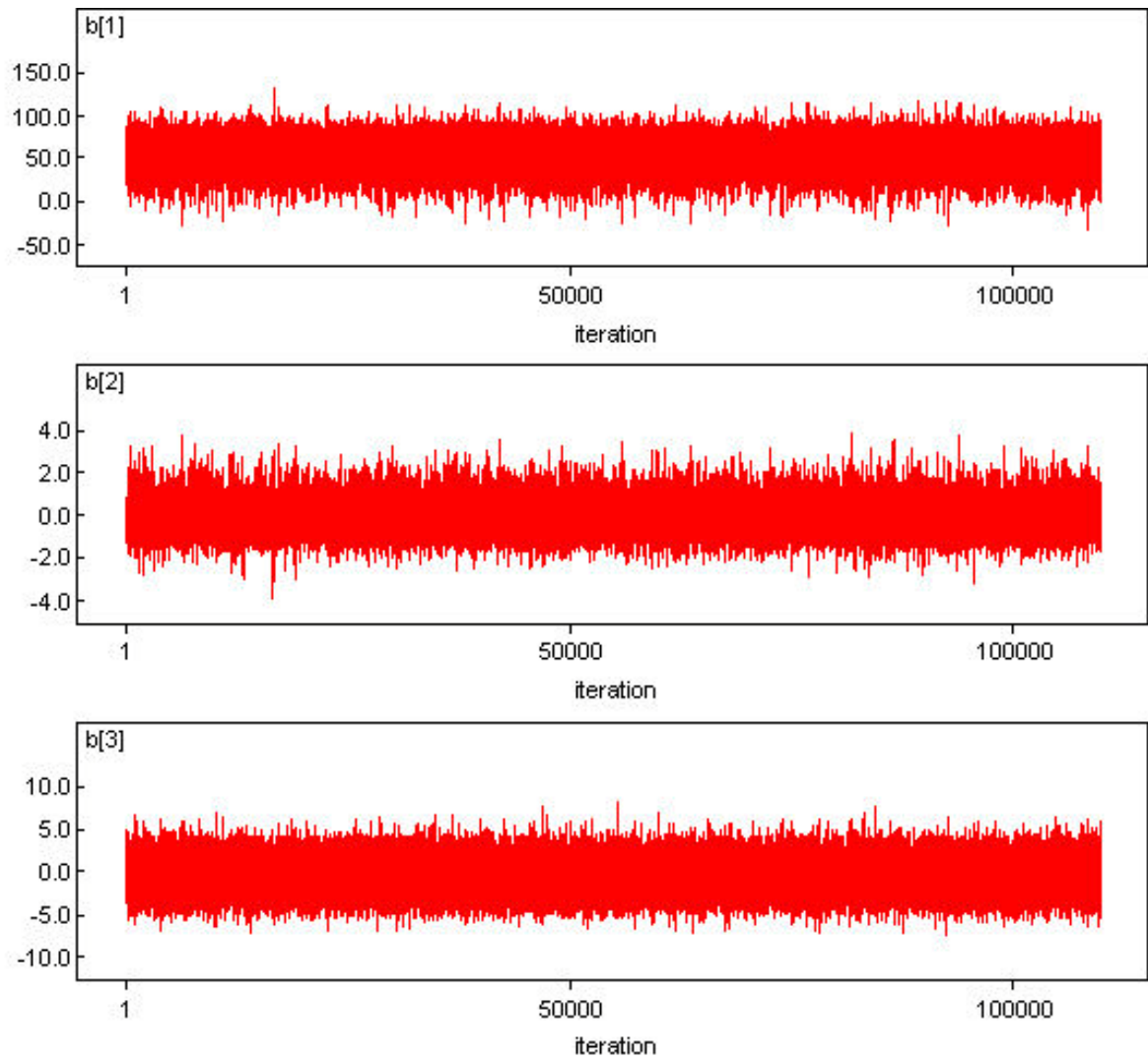
node	mean	sd	MC error	2.5%	median	97.5%	start	sample
b[1]	58.74	15.53	0.05892	23.2	60.36	85.06	501	109500
b[2]	-0.1224	0.603	0.001994	-1.24	-0.1511	1.206	501	109500
b[3]	-0.7692	1.69	0.006114	-3.809	-0.8866	2.869	501	109500
rho	0.905	0.05269	2.325E-4	0.7942	0.9088	0.9912	501	109500
sigma.e	12.98	1.949	0.00648	9.709	12.79	17.31	501	109500

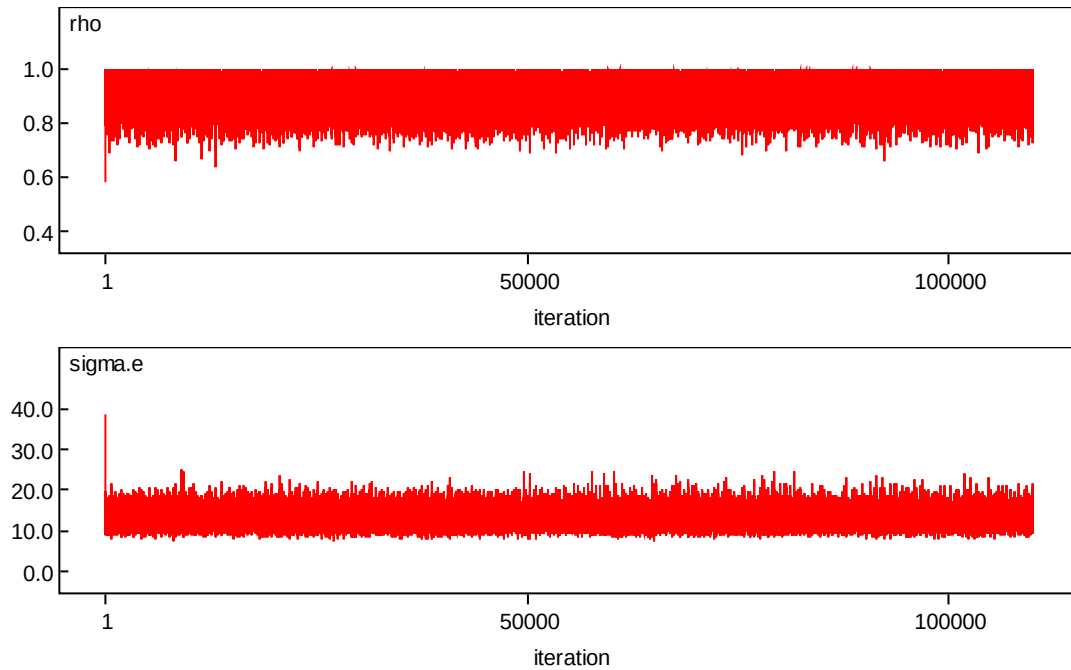
DENSITY PLOTS





HISTORY PLOTS





TWO CHAINS

node	mean	sd	MC error	2.5%	median	97.5%	start	sample
b[1]	58.75	15.59	0.04607	22.94	60.4	85.04	501	201000
b[2]	-0.1231	0.6024	0.001424	-1.243	-0.1519	1.2	501	201000
b[3]	-0.771	1.697	0.004962	-3.804	-0.8838	2.875	501	201000
rho	0.905	0.05278	1.732E-4	0.7927	0.9087	0.9916	501	201000
sigma.e	12.97	1.948	0.004609	9.696	12.79	17.29	501	201000

