OpenBUGS working steps Initial view

OpenBUGS

The Three Input Windows: Commands, Data and Initials

OpenBUGS

File Edit Attributes Tools Info Model Inference Doodle Map Text Window Examples Manuals Help

Initials.txt

```
list(N0=14958.000000000000000,Delta0=257.881,beta=2.97,lambda=0.34,delta=0.56)
```

Commands.txt

```
model{
  for(i in 1:M) {
    aux1[i]<-log(Delta[i])-log(Delta0)
    aux2[i]<-(-lambda-delta)/aux1[i]-log(N0)
    V[i]<-aux1[i]*(log(N[i])-log(N0))
    aux3[i]<-delta/(beta*aux1[i])
    aux4[i]<-(-1/beta)
    logN[i]<-(-log(N[i]))
    logN[i]~dgev(aux2[i],aux3[i],aux4[i])
  }
  for (s in 1:ns){
    Deltasigma[s]<-minDelta+(s-1)*(maxDelta-minDelta)/(ns-1)
  }
  for (s in 1:ns){
    for (p in 1:np){
      N01[s,p]<-N0*exp((lambda+delta)/log(Deltasigma[s]/Delta0)
      +delta/log(Deltasigma[s]/Delta0)*(1-pow(-log(percentiles[p]),1/beta)))
    }
  }
  N0~dunif(minN0,maxN0)
  Delta0~dunif(minDelta,maxDelta)
  beta~dunif(minbeta,maxbeta)
  lambda~dunif(minlambda,maxlambda)
  delta~dunif(mindelta,maxdelta)
}
```

Specification Tool

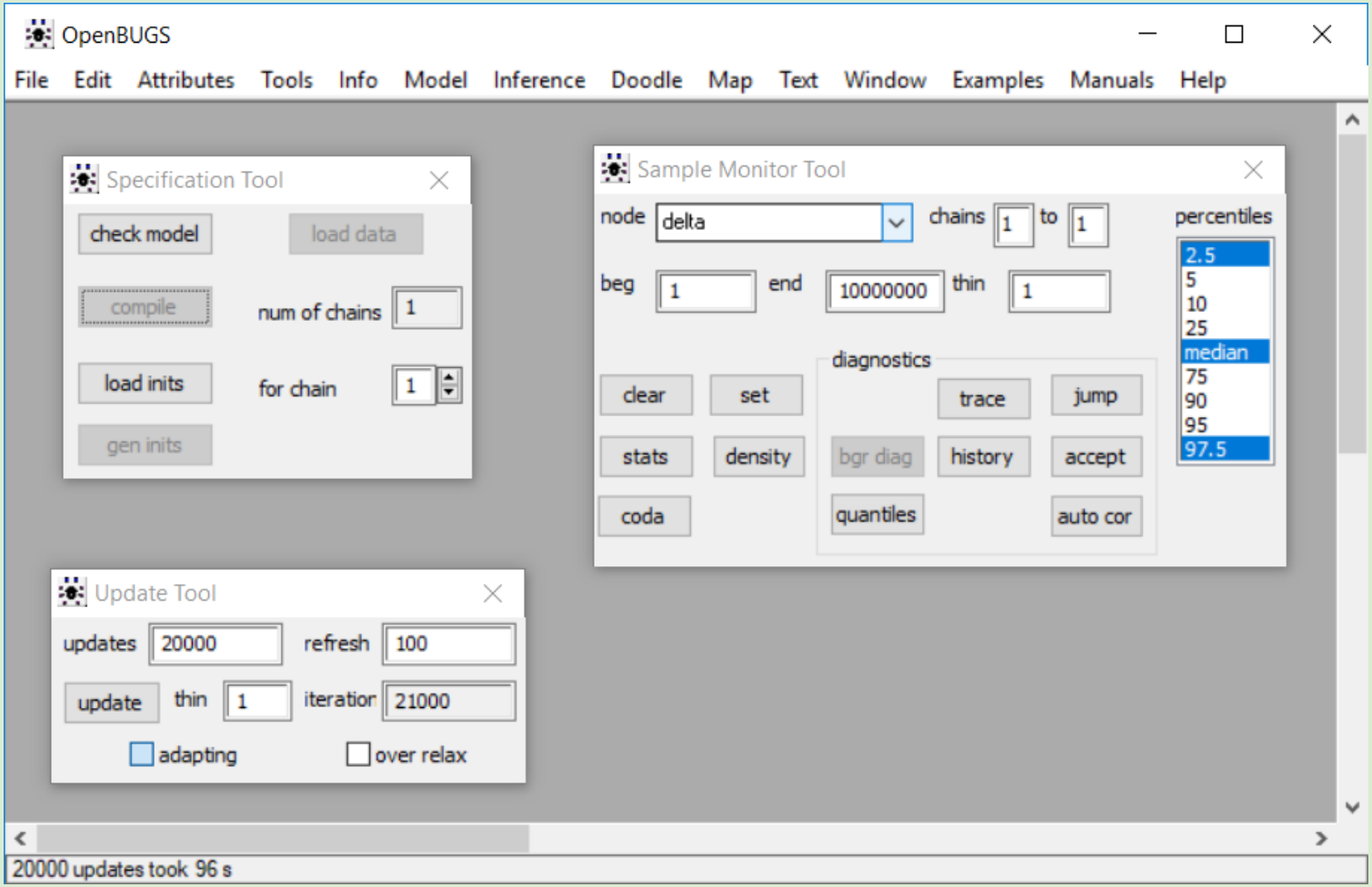
check model | load data | compile | num of chains 1 | load inits | for chain 1 | gen inits

Data.txt

```
list(M=360,ns=50,np=5,minlambda=0.113333,maxlambda=0.68,
minDelta=206.305,maxDelta=309.457,minbeta=1.98,maxbeta=4.455,
mindelta=0.28,maxdelta=0.84,
minN0=10470.599999999999000,maxN0=22437000,
percentiles=c(0.01,0.10,0.5,0.90,0.99),
Delta=c(
385,385,385,385,385,385,385,385,385,385,385,385,385,385,385,385,385,385,385,385,385,
380,380,380,380,380,380,380,380,380,380,380,380,380,380,380,380,380,380,380,380,380,
375,375,375,375,375,375,375,375,375,375,375,375,375,375,375,375,375,375,375,375,375,
370,370,370,370,370,370,370,370,370,370,370,370,370,370,370,370,370,370,370,370,370,
365,365,365,365,365,365,365,365,365,365,365,365,365,365,365,365,365,365,365,365,365,
360,360,360,360,360,360,360,360,360,360,360,360,360,360,360,360,360,360,360,360,360,
355,355,355,355,355,355,355,355,355,355,355,355,355,355,355,355,355,355,355,355,355,
350,350,350,350,350,350,350,350,350,350,350,350,350,350,350,350,350,350,350,350,350,
345,345,345,345,345,345,345,345,345,345,345,345,345,345,345,345,345,345,345,345,345,
340,340,340,340,340,340,340,340,340,340,340,340,340,340,340,340,340,340,340,340,340,
335,335,335,335,335,335,335,335,335,335,335,335,335,335,335,335,335,335,335,335,335,
330,330,330,330,330,330,330,330,330,330,330,330,330,330,330,330,330,330,330,330,330,
325,325,325,325,325,325,325,325,325,325,325,325,325,325,325,325,325,325,325,325,325,
320,320,320,320,320,320,320,320,320,320,320,320,320,320,320,320,320,320,320,320,320,
320,320,320,320,315,315,315,315,315,315,315,315,315,315,315,315,315,315,315,315,315,
315,315,315,315,315,315,310,310,310,310,310,310,310,310,310,310,310,310,310,310,310,
310,310,310,310,310,310,305,305,305,305,305,305,305,305,305,305,305,305,305,305,305,
305,300,300,300,300,300,300,300,300,300,300,295,295,295,295,295,295,290,290,285),
N=c( 51000, 57000, 60000, 67000, 68000, 69000, 75000, 76000, 82000, 83000,
87000, 95000, 106000, 109000, 111000, 119000, 122000, 128000, 132000, 140000,
59000, 66000, 69000, 80000, 87000, 90000, 97000, 98000, 99000, 100000, 107000,
109000, 117000, 118000, 125000, 128000, 132000, 158000, 177000, 186000, 65000,
71000, 78000, 84000, 89000, 93000, 98000, 103000, 105000, 109000, 113000,
118000, 124000, 131000, 147000, 156000, 171000, 182000, 199000, 220000, 83000,
98000, 100000, 104000, 110000, 111000, 122000, 125000, 132000, 136000, 141000,
143000, 146000, 155000, 165000, 194000, 200000, 201000, 251000, 318000, 89000,
105000, 108000, 118000, 119000, 121000, 130000, 133000, 152000, 164000, 170000,
181000, 182000, 192000, 199000, 211000, 238000, 273000, 324000, 398000, 117000,
127000, 141000, 151000, 162000, 173000, 181000, 186000, 192000, 198000, 203000,
```

This figure shows **the model, the data and the initials windows**, which are used by the Specification tool.

Working Tools



Tools used to work with OpenBUGS: (a) **Specification tool** to specify the model, data and the initial values, (b) **Sample Monitor tool** to include nodes to be monitored and later consult the results (statistics, densities, quantiles, etc.), and (c) **Update tool** to initialize simulations and generating the posterior samples after initialization.

The BPR travel time function

The BPR Travel Time Function

The BPR travel time function in dimensionless terms is the following:

$$t^* = \frac{t}{t_0} = \left[1 + \alpha \left(\frac{v + \gamma v_r}{c}\right)^\beta\right]$$

where t and t_0 are the actual and free travel times, respectively, v and v_r are the flows in the given and reverse directions, c is the capacity, and α, β and γ are dimensionless parameters.

Note that **the formula can be written in dimensionless form**:

$$t^* = \frac{t}{t_0} = \left[1 + \alpha \left(\frac{v}{c} + \gamma \frac{v_r}{c}\right)^\beta\right] = \left[1 + \alpha \left(v^* + \gamma v_r^*\right)^\beta\right],$$

where $v^* = v/c$ and $v_r^* = v_r/c$.

In the existing literature, these parameters take values in the following ranges:

$$\begin{aligned} \alpha &\sim [0.15, 0.84] \\ \beta &\sim [1.4, 11] \\ \gamma &\sim [0.0, 0.20] \end{aligned}$$

Converting The BPR To A Random Model

in order to **convert the deterministic BPR to a random model**, we assume that the parameters **α, β and γ are random variables**. In addition we assume that the formula provides the mean of a normal random variable.

In statistical notation, our model becomes:

$$t^* \sim N(\mu, \sigma)$$

$$\mu = \left[1 + \alpha \left(\frac{v + \gamma v_r}{c}\right)^{\beta}\right]$$

$$\alpha \sim U[0.05, 0.84]$$

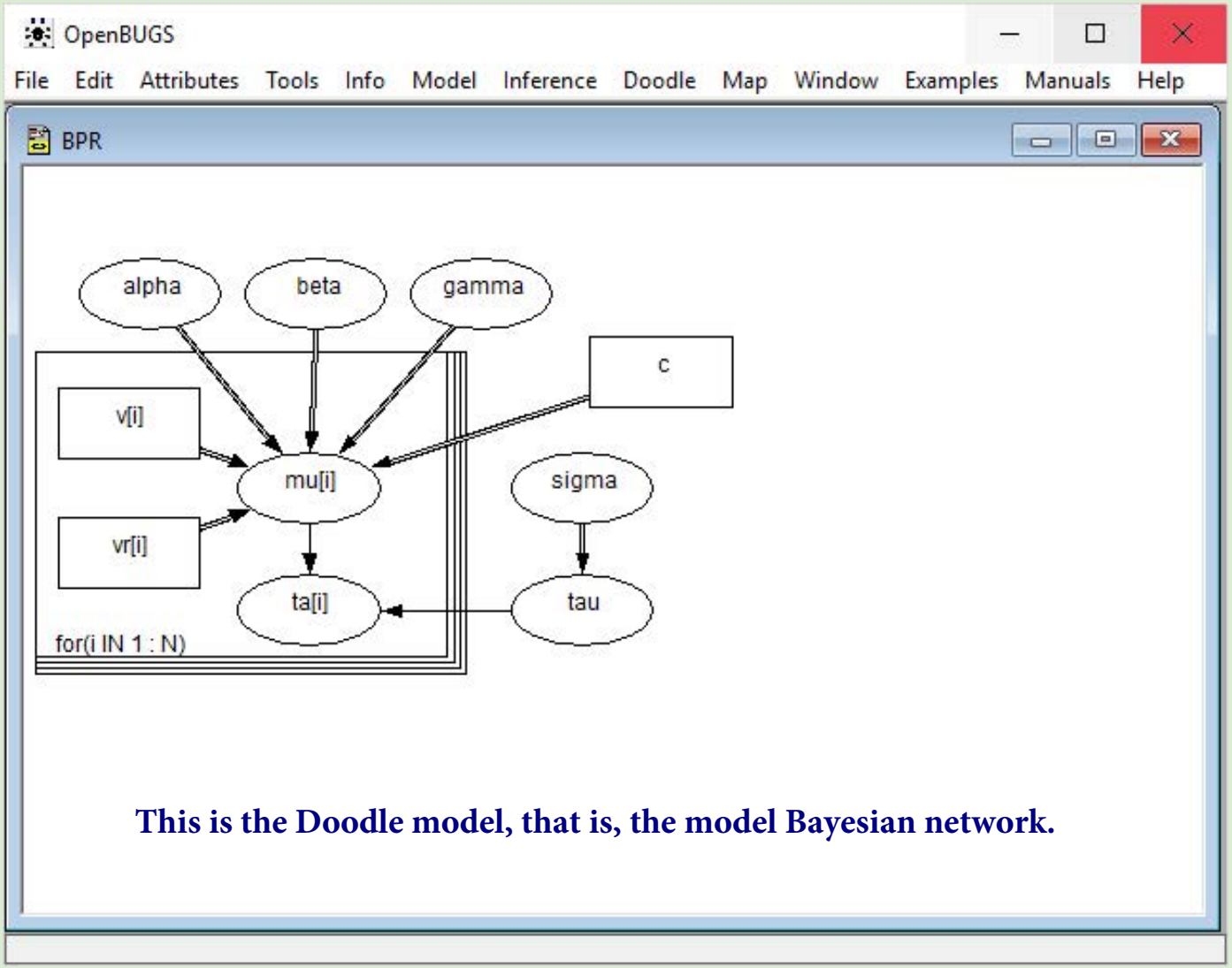
$$\beta \sim U[2, 6]$$

$$\gamma \sim U[0.05, 0.2]$$

$$\sigma \sim G[0.001, 0.001]$$

Note that to simplify **we initially assume that the capacity c is deterministic and that the random variables α, β, γ and σ are independent**. However, they should be considered as dependent random variables.

The BPR Doodle Model



This Bayesian network describes the dependence structure of all variables involved.

As indicated, its structure reveals that α, β, γ and σ are independent.