This is a WinBUGS program for the artificial example in Chapter 13, Section 13.6.

Model: Nonlinear Structural Equation Model with Exponential Family, nonignorable missing data, and Fixed Covariates (fc2)
Data Set Names: YO2.dat, IR.dat, and fc2.dat
Sample Size: N=500

```
model {
    for(i in 1:N){
        #structural equation model
        xi[i,1:2]~dmnorm(zero2[1:2],phi[1:2,1:2])
        eta[i]~dnorm(etamu[i],psd)
        etamu[i]<-ubeta*x2[i,1]+gam[1]*xi[i,1]+gam[2]*xi[i,2]+gam[3]*xi[i,1]*xi[i,2]
        dthat[i]<-eta[i]-etamu[i]

        #missingness mechanism model
        for(j in 1:P){
            IR[i,j]~dbern(pi[i,j])
            logit(pi[i,j])<-b[1]+b[2]*z[i,1]+b[3]*z[i,2]+b[4]*z[i,3]+b[5]*z[i,4]+b[6]*z[i,5]
                           +b[7]*z[i,6]+b[8]*z[i,7]+b[9]*z[i,8]+b[10]*z[i,9]
        }

        #measurement equation model
        for(j in 1:P){
            z[i,j]~dbin(pb[i,j],5)
            logit(pb[i,j])<-mu[i,j]
        }
        mu[i,1]<-uby[1]+eta[i]
        mu[i,2]<-uby[2]+lam[1]*eta[i]
        mu[i,3]<-uby[3]+lam[2]*eta[i]
        mu[i,4]<-uby[4]+xi[i,1]
        mu[i,5]<-uby[5]+lam[3]*xi[i,1]
        mu[i,6]<-uby[6]+lam[4]*xi[i,1]
        mu[i,7]<-uby[7]+xi[i,2]
        mu[i,8]<-uby[8]+lam[5]*xi[i,2]
        mu[i,9]<-uby[9]+lam[6]*xi[i,2]
    }# end of i

    for(i in 1:2){zero2[i]<-0}

    #priors on loadings and coefficients
    for (i in 1:P){ uby[i]~dnorm(0.8,4.0) }

    lam[1]~dnorm(0.6,4.0)        lam[2]~dnorm(0.6,4.0)
    lam[3]~dnorm(0.7,4.0)        lam[4]~dnorm(0.7,4.0)
    lam[5]~dnorm(0.6,4.0)        lam[6]~dnorm(0.6,4.0)

    ubeta~dnorm(0.6,4.0)

    var.gam<-4.0*psd
    gam[1]~dnorm(0.5,var.gam)  gam[2]~dnorm(0.5,var.gam)     gam[3]~dnorm(0.5,var.gam)

    b[1]~dnorm(-4.0,4.0)    b[2]~dnorm(0.5,4.0)
```

```
    b[3]~dnorm(0.5,4.0)      b[4]~dnorm(0.5,4.0)
    b[5]~dnorm(0.5,4.0)      b[6]~dnorm(0.5,4.0)
    b[7]~dnorm(0.5,4.0)      b[8]~dnorm(-1.5,4.0)
    b[9]~dnorm(-1.0,4.0)     b[10]~dnorm(-1.0,4.0)

    #priors on precisions
    psd~dgamma(10,8)
    sgd<-1/psd
    phi[1:2,1:2]~dwish(R[1:2,1:2], 8)
    phx[1:2,1:2]<-inverse(phi[1:2,1:2])

} #end of model
```

Data

```
list(N=500, P=9,
    R=structure(.Data=c(5.0,2.5,2.5,5.0),.Dim=c(2,2)),
    z=structure(.Data=c(paste YO2.dat here),.Dim=c(500,9)),
    IR=structure(.Data=c(paste IR.dat here),.Dim=c(500,9)),
    x2=structure(.Data=c(paste fc2.dat here),.Dim=c(500,1)))
```

Three different initial values

```
list(
    b=c(-4.0, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, -1.5, -1.0, -1.0),
    uby=c(0.8,0.8,0.8,0.8,0.8,0.8,0.8,0.8,0.8),
    ubeta=0.6,
    lam=c(0.6,0.6,0.7,0.7,0.6,0.6),
    gam=c(0.5,0.5,0.5),
    psd=1.4,
    phi=structure(
        .Data=c(1.3333,   -0.6667,   -0.6667,   1.3333),
        .Dim=c(2,2)))

list(
    b=c(-3.0, 0.5, 0.5, 0.5, 0.5, 0.5, 0.5, -0.5, -2.0, -2.0),
    uby=c(1.0,1.0,1.0,1.0,1.0,1.0,1.0,1.0,1.0),
    ubeta=1.0,
    lam=c(1.0,1.0,1.0,1.0,1.0,1.0),
    gam=c(1.0,1.0,1.0),
    psd=1.0,
    phi=structure(
        .Data=c(2.0, -1.0, -1.0, 2.0),
        .Dim=c(2,2)))

list(
    b=c(0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0),
    uby=c(0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0,0.0),
    ubeta=0.0,
    lam=c(0.0,0.0,0.0,0.0,0.0,0.0),
    gam=c(0.0,0.0,0.0),
    psd=0.36,
    phi=structure(
        .Data=c(0.6, -0.2, -0.2, 0.6),
        .Dim=c(2,2)))
```