Example 4.2: Data and WinBUGs Code for See et al. (2006) Study 1

See K., Fox C., & Rottenstreich Y., 2006. Between ignorance and truth: Partition dependence and learning in judgment under uncertainty. Journal of Experimental Psychology: Learning, Memory and Cognition, 32, 13851402.

Data

N.B.: Several 'rogue' cases in the DV had to be dealt with. There were several cases with values greater than 1 that appear to be typographical errors, and these were re-coded to what seemed to be the most likely true values (e.g., 30 was recoded to .3). Several cases with a value of 0 were recoded to .0005.

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list(N = 267, R = structure(.Data = c(1, 0, 0, 0, 1, 0, 0, 0, 1), .Dim =
c(3, 3)), x1 = c(-1.79176, -0.69315, -1.79176, -1.79176, -1.79176, -
1.79176, -1.79176, -1.79176, -0.69315, -0.69315), x2 = structure(.Data =
c(-1.098612289,-1.098612289,-1.900958761,-1.900958761,-1.900958761,-
2.197224577,-2.197224577,-1.516347489,-0.619039208,-0.405465108,-
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0.35,0.25,0.1,0.15,0.1,0.2,0.15,0.4,0.25,0.5,0.1,0.05,0.08,0.3,0.1,0.05,0.1
,0.5,0.4,0.25,0.05,0.1,0.1,0.2,0.05,0.15,0.2,0.3,0.25,0.3,0.5,0.1,0.15,0.15
,0.15,0.25,0.25,0.33,0.4,0.2,0.15,0.18,0.15,0.15,0.2,0.09,0.1,0.4,0.3,0.22,
0.35,0.1,0.08,0.06,0.15,0.2,0.2,0.45,0.2,0.25,0.26,0.12,0.12,0.17,0.01,0.14
,0.17,0.3,0.35,0.45,0.2,0.08,0.1,0.15,0.2,0.2,0.35,0.3,0.45,0.7,0.6,0.4,0.3
,0.65,0.2,0.5,0.3,0.65,0.75,0.15,0.3,0.1,0.2,0.15,0.1,0.05,0.35,0.55,0.15,0
.25,0.3,0.2,0.15,0.2,0.15,0.15,0.1,0.25,0.4,0.18,0.25,0.19,0.17,0.18,0.1,0.
16,0.18,0.35,0.37,0.25,0.15,0.15,0.2,0.2,0.25,0.3,0.3,0.4,0.65,0.25,0.2,0.2
,0.14,0.1,0.15,0.18,0.11,0.65,0.3,0.15,0.4,0.15,0.1,0.3,0.25,0.05,0.1,0.25,
0.35,0.35,0.3,0.15,0.1,0.1,0.35,0.2,0.3,0.4,0.4,0.45,0.25,0.15,0.01,0.05,0.
05,0.1,0.25,0.15,0.5,0.12,0.33,0.13,0.12,0.14,0.15,0.12,0.12,0.33,0.33,0.15
,0.2,0.08,0.06,0.1,0.05,0.1,0.11,0.5,0.3,0.14,0.1,0.2,0.14,0.2,0.14,0.3,0.2
5,0.4,0.4,0.2,0.25,0.2,0.2,0.15,0.18,0.2,0.25,0.4,0.4,0.37,0.21,0.11,0.12,0
.08,0.12,0.27,0.48,0.29,0.6,0.18,0.33,0.15,0.12,0.14,0.15,0.15,0.14,0.33,0.
33,0.2,0.3,0.2,0.15,0.15,0.1,0.1,0.15,0.4,0.4,0.4,0.15,0.33,0.2,0.1,0.1,0.2
,0.3,0.25,0.5,0.15,0.2,0.25,0.15,0.3,0.15,0.08,0.08,0.08,0.35,0.1,0.1,0.2,0
.25,0.3,0.1,0.1,0.1,0.4,0.5,0.3,0.25,0.1,0.2,0.2,0.1,0.15,0.4,0.25,0.5,0.15
,0.2,0.2,0.2,0.15,0.1,0.15,0.2,0.3,0.3,0.1,0.28,0.12,0.08,0.2,0.2,0.15,0.18
,0.35,0.4,0.4,0.39,0.4,0.2,0.05,0.3,0.5,0.19,0.43,0.5,0.16,0.3,0.35,0.7,0.4
5,0.2,0.35,0.25,0.7,0.2,0.23,0.45,0.2,0.1,0.1,0.15,0.2,0.05,0.28,0.35,0.15,
0.2,0.1,0.1,0.1,0.15,0.2,0.2,0.5,0.3,0.25,0.2,0.03,0.2,0.16,0.1,0.22,0.15,0
.33,0.5,0.12,0.25,0.09,0.2,0.15,0.15,0.09,0.12,0.25,0.35,0.2,0.2,0.05,0.000
5,0.15,0.2,0.65,0.2,0.15,0.65,0.15,0.25,0.13,0.07,0.07,0.18,0.15,0.15,0.3,0
.45,0.2,0.5,0.15,0.2,0.12,0.1,0.08,0.15,0.4,0.22,0.2,0.4,0.05,0.05,0.05,0.3
5,0.15,0.3,0.2,0.4,0.3,0.1,0.05,0.3,0.05,0.05,0.15,0.15,0.5,0.4,0.35,0.25,0
.1,0.2,0.18,0.28,0.14,0.15,0.2,0.45,0.1,0.15,0.1,0.1,0.12,0.12,0.08,0.2,0.4
,0.45,0.2,0.4,0.1,0.1,0.3,0.05,0.1,0.3,0.3,0.3,0.3,0.3,0.2,0.2,0.2,0.2,0.1,
0.05,0.15,0.33,0.65,0.35,0.15,0.25,0.35,0.15,0.05,0.02,0.2,0.45,0.4,0.2,0.2
,0.2,0.05,0.05,0.2,0.25,0.5,0.4,0.35,0.4,0.2,0.25,0.1,0.4,0.2,0.2,0.25,0.5,
0.45,0.15,0.2,0.25,0.15,0.15,0.1,0.2,0.6,0.25,0.2,0.4,0.1,0.2,0.15,0.2,0.25
,0.1,0.4,0.2,0.25,0.35,0.15,0.2,0.15,0.15,0.15,0.15,0.35,0.3,0.999,0.2,0.66
,0.999,0.999,0.999,0.66,0.999,0.6,0.2,0.35,0.3,0.2,0.08,0.1,0.09,0.05,0.22,
0.5,0.15,0.15,0.2,0.4,0.15,0.3,0.15,0.05,0.1,0.2,0.6,0.2,0.2,0.1,0.1,0.2,0.
1,0.5,0.3,0.4,0.3,0.2,0.25,0.35,0.3,0.1,0.2,0.05,0.1,0.4,0.5,0.23,0.1,0.12,
0.07,0.1,0.08,0.18,0.2,0.4,0.4,0.25,0.5,0.25,0.15,0.2,0.3,0.1,0.1,0.3,0.1,0
.05,0.3,0.04,0.1,0.08,0.2,0.45,0.3,0.2,0.6,0.2,0.5,0.02,0.25,0.3,0.4,0.3,0.
1,0.1,0.4,0.3,0.2,0.05,0.15,0.15,0.2,0.15,0.15,0.4,0.4,0.65,0.75,0.12,0.2,0
.2,0.12,0.25,0.4,0.3,0.3,0.25,0.3,0.1,0.15,0.25,0.05,0.15,0.4,0.5,0.3,0.15,
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.1,0.45,0.4,0.3,0.2,0.1,0.1,0.1,0.15,0.1,0.15,0.2,0.6,0.3,0.4,0.05,0.2,0.1,
0.01,0.25,0.1,0.1,0.4,0.4,0.45,0.3,0.1,0.15,0.2,0.4,0.05,0.35,0.2,0.4,0.1,0
.05,0.15,0.15,0.25,0.3,0.35,0.55,0.35,0.2,0.25,0.1,0.15,0.15,0.25,0.15,0.1,
0.4,0.4,0.05,0.25,0.1,0.4,0.1,0.15,0.15,0.1,0.5,0.35,0.03,0.03,0.03,0.04,0.
03,0.01,0.03,0.03,0.04,0.02,0.2,0.4,0.1,0.2,0.1,0.15,0.3,0.3,0.25,0.3,0.3,0
.1,0.35,0.1,0.15,0.1,0.4,0.2,0.75,0.15,0.1,0.25,0.22,0.2,0.13,0.5,0.23,0.1,
0.35,0.4,0.2,0.2,0.1,0.15,0.15,0.25,0.3,0.2,0.4,0.4,0.25,0.08,0.15,0.08,0.1
2,0.1,0.22,0.2,0.26,0.6,0.35,0.3,0.17,0.2,0.2,0.15,0.15,0.4,0.45,0.3,0.13,0
.33,0.13,0.13,0.14,0.14,0.15,0.15,0.33,0.33,0.15,0.2,0.18,0.15,0.25,0.05,0.

```
15,0.2,0.45,0.3,0.5,0.3,0.2,0.4,0.05,0.2,0.2,0.2,0.45,0.5,0.65,0.45,0.1,0.0
005,0.15,0.3,0.1,0.05,0.35,0.3,0.1,0.25,0.2,0.1,0.2,0.15,0.15,0.2,0.5,0.2,0
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.22,0.08,0.4,0.43,0.2,0.35,0.05,0.15,0.18,0.2,0.2,0.2,0.15,0.5,0.15,0.25,0.
15,0.25,0.3,0.3,0.1,0.15,0.2,0.3,0.14,0.35,0.17,0.16,0.14,0.13,0.07,0.16,0.
45,0.2,0.2,0.33,0.2,0.1,0.1,0.1,0.1,0.2,0.33,0.33,0.22,0.25,0.1,0.1,0.1,0.2
,0.15,0.2,0.4,0.35,0.2,0.45,0.2,0.2,0.2,0.1,0.25,0.25,0.65,0.3,0.3,0.1,0.1,
0.2,0.1,0.2,0.1,0.1,0.5,0.4,0.25,0.23,0.33,0.33,0.1,0.1,0.1,0.1,0.37,0.4,0.
25,0.3,0.05,0.2,0.2,0.15,0.1,0.15,0.4,0.3,0.5,0.25,0.2,0.1,0.05,0.05,0.1,0.
15,0.25,0.5,0.24,0.2,0.18,0.19,0.2,0.15,0.1,0.18,0.5,0.3,0.3,0.33,0.06,0.16
,0.2,0.3,0.55,0.16,0.4,0.25,0.3,0.3,0.05,0.2,0.1,0.2,0.1,0.05,0.4,0.3,0.1,0
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4,0.3,0.3,0.4,0.1,0.2,0.05,0.1,0.2,0.1,0.25,0.35,0.2,0.4,0.13,0.13,0.17,0.1
8,0.18,0.25,0.45,0.2,0.31,0.28,0.26,0.07,0.08,0.1,0.29,0.12,0.31,0.36,0.4,0
.2,0.3,0.2,0.2,0.3,0.2,0.3,0.6,0.4,0.15,0.12,0.1,0.05,0.15,0.15,0.2,0.15,0.
45,0.43,0.4,0.5,0.05,0.05,0.05,0.5,0.2,0.1,0.3,0.35,0.15,0.25,0.15,0.15,0.1
6,0.2,0.18,0.1,0.5,0.25,0.15,0.3,0.15,0.15,0.2,0.15,0.15,0.15,0.3,0.4,0.25,
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0.14,0.33,0.33,0.05,0.2,0.1,0.2,0.3,0.2,0.0005,0.05,0.4,0.4,0.3,0.2,0.05,0.
05,0.1,0.05,0.1,0.3,0.3,0.5,0.15,0.3,0.2,0.15,0.1,0.15,0.15,0.05,0.3,0.3,0.
2,0.4,0.12,0.1,0.15,0.1,0.15,0.2,0.25,0.35,0.2,0.4,0.2,0.15,0.1,0.1,0.1,0.1
,0.4,0.2,0.3,0.2,0.1,0.2,0.2,0.2,0.05,0.1,0.4,0.3,0.5,0.15,0.1,0.1,0.3,0.1,
0.1,0.0005,0.3,0.55,0.2,0.35,0.12,0.2,0.2,0.15,0.15,0.14,0.3,0.4,0.2,0.25,0
.2,0.15,0.05,0.05,0.15,0.2,0.4,0.4,0.2,0.35,0.3,0.3,0.2,0.15,0.25,0.2,0.2,0
.3,0.1,0.25,0.1,0.15,0.3,0.15,0.1,0.35,0.4,0.35,0.35,0.6,0.15,0.1,0.2,0.3,0
.3,0.25,0.37,0.3,0.05,0.3,0.2,0.2,0.1,0.3,0.07,0.23,0.25,0.4,0.25,0.5,0.15,
0.1,0.1,0.1,0.3,0.08,0.65,0.1,0.35,0.2,0.4,0.07,0.13,0.13,0.13,0.1,0.23,0.6
,0.2,0.25,0.2,0.15,0.1,0.1,0.05,0.3,0.35,0.35,0.15,0.3,0.1,0.1,0.2,0.15,0.2
,0.15,0.3,0.4,0.25,0.35,0.1,0.05,0.05,0.45,0.1,0.1,0.25,0.4,0.1,0.25,0.15,0
.1,0.2,0.2,0.17,0.15,0.4,0.4,0.65,0.15,0.05,0.1,0.15,0.05,0.05,0.1,0.55,0.3
,0.35,0.33,0.05,0.35,0.1,0.15,0.15,0.15,0.33,0.33,0.15,0.25,0.2,0.15,0.2,0.
1,0.1,0.2,0.2,0.5,0.18,0.4,0.12,0.15,0.1,0.1,0.15,0.1,0.4,0.25,0.18,0.2,0.1
4,0.12,0.23,0.08,0.05,0.15,0.22,0.45,0.45,0.45,0.2,0.25,0.24,0.1,0.25,0.35,
0.25,0.6,0.23,0.46,0.14,0.12,0.26,0.1,0.1,0.4,0.45,0.15,0.3,0.3,0.1,0.1,0.1
,0.2,0.1,0.2,0.5,0.2,0.35,0.3,0.3,0.2,0.15,0.6,0.2,0.0005,0.4,0.5,0.2,0.25,
0.15,0.2,0.15,0.15,0.1,0.0005,0.25,0.5,0.28,0.15,0.05,0.13,0.08,0.1,0.4,0.1
5,0.35,0.5,0.3,0.1,0.2,0.2,0.1,0.05,0.1,0.05,0.4,0.03,0.2,0.25,0.15,0.1,0.2
,0.15,0.2,0.15,0.4,0.35,0.4,0.35,0.25,0.2,0.3,0.45,0.2,0.35,0.35,0.2,0.1,0.
3,0.2,0.3,0.15,0.3,0.05,0.1,0.4,0.3,0.2,0.33,0.15,0.15,0.0005,0.15,0.2,0.15
,0.33,0.33), .Dim = c(267,10)))
```

Model 0

```
# This model reproduces See’s original regression model, but differs
# insofar as it uses beta regression and allows for random intercepts
# in the location submodel.
# The DV x1 is the partition prime (either ln(1/2) or ln(1/6)), and
# x2 is ln(true odds) of the jth stimulus for each subject.  Note that
# while it’s fixed for the “target” stimuli it’s random for the rest.
#
# To run this model, delete the string
# R = structure(.Data = c(1, 0, 0, 0, 1, 0, 0, 0, 1), .Dim = c(3, 3)),
# from the first line in the data above.
#
model
{
## Main routine
for(i in 1:N){
  for(j in 1:10){

m[i,j] <- beta0 + u[i] + beta1*x1[j] + beta2*x2[i,j]
disp[i,j] <- -delta0
```

```
E[i,j] <- exp(m[i,j])/(1+exp(m[i,j]))
phi[i,j] <- exp(disp[i,j])
a[i,j] <- E[i,j]*phi[i,j]
b[i,j] <- (1-E[i,j])*phi[i,j]
p[i,j] ~ dbeta(a[i,j], b[i,j])
  }
u[i] ~ dnorm(0,taub1)
}
## location and dispersion
mu0 <- exp(beta0)/(1+exp(beta0))
mu1 <- exp(beta1)/(1+exp(beta1))
mu2 <- exp(beta2)/(1+exp(beta2))
phi0 <- exp(-delta0)
## Priors
beta0 ~ dnorm(0.0, 1.0E-6)
beta1 ~ dnorm(0.0, 1.0E-6)
beta2 ~ dnorm(0.0, 1.0E-6)
delta0 ~ dnorm(0.0, 1.0E-6)
sigb1 ~ dunif(0,100)
taub1 <- 1/(sigb1*sigb1)
}

# Inits for 2-chain model
# Note that these leave out the 267 initial values for the
# random effects u-terms. However, BUGs seems to do a reasonable
# job of generating them.
list(beta0 = 0.0, beta1 = 0.1, beta2 = 0.1, delta0 = 0.1)
list(beta0 = 0.1, beta1 = 0.0, beta2 = 0.1, delta0 = 0.1)
```

Recommended burn-in = 5000 iterations, recommended estimation = 5000 more iterations.

Model 1

```
# This model reproduces See’s original regression model, but differs
# insofar as it uses beta regression and allows for random coefficients
# in the location submodel. These random effects are independent.
#
# To run this model, delete the string
# R = structure(.Data = c(1, 0, 0, 0, 1, 0, 0, 0, 1), .Dim = c(3, 3)),
# from the first line in the data above.
#
model
{
## Main routine
for(i in 1:N){
  for(j in 1:10){
m[i,j] <- beta0 + u[i,1] + (beta1 + u[i,2])*x1[j] + (beta2 + u[i,3])*x2[i,j]
disp[i,j] <- -delta0
E[i,j] <- exp(m[i,j])/(1+exp(m[i,j]))
phi[i,j] <- exp(disp[i,j])
a[i,j] <- E[i,j]*phi[i,j]
b[i,j] <- (1-E[i,j])*phi[i,j]
p[i,j] ~ dbeta(a[i,j], b[i,j])
  }
u[i,1] ~ dnorm(0,taub1)
u[i,2] ~ dnorm(0,taub2)
u[i,3] ~ dnorm(0,taub3)
}
## location and dispersion
mu0 <- exp(beta0)/(1+exp(beta0))
mu1 <- exp(beta1)/(1+exp(beta1))
mu2 <- exp(beta2)/(1+exp(beta2))
```

```
phi0 <- exp(-delta0)
## Priors
beta0 ~ dnorm(0.0, 1.0E-6)
beta1 ~ dnorm(0.0, 1.0E-6)
beta2 ~ dnorm(0.0, 1.0E-6)
delta0 ~ dnorm(0.0, 1.0E-6)
sig1 ~ dunif(0,100)
taub1 <- 1/(sig1*sig1)
sig2 ~ dunif(0,100)
taub2 <- 1/(sig2*sig2)
sig3 ~ dunif(0,100)
taub3 <- 1/(sig3*sig3)
}

# Inits for 2-chain model
# Note that these leave out the 267x3 initial values for the
# random effects u-terms. However, BUGs seems to do a reasonable
# job of generating them.
list(beta0 = 0.0, beta1 = 0.1, beta2 = 0.1, delta0 = 0.1, sig1 = 1.0, sig2 = 1.0,
sig3 = 0.5)
list(beta0 = 0.1, beta1 = 0.0, beta2 = 0.1, delta0 = 0.1, sig1 = 0.5, sig2 = 1.0,
sig3 = 1.0)
```

Recommended burn-in = 5000 iterations, recommended estimation = 5000 more iterations.

Model 2

```
# This model reproduces See's original regression model, but differs
# insofar as it uses beta regression and allows for random coefficients
# in the location submodel. These random effects are correlated.
#
# To run this model, make sure the string
# R = structure(.Data = c(1, 0, 0, 0, 1, 0, 0, 0, 1), .Dim = c(3, 3)),
# is in the first line in the data above.
#
model
{
## Main routine
for (j in 1:3) {
mu[j] <- 0.0
}
for(i in 1:N){
  for(j in 1:10){
m[i,j] <- beta0 + u[i,1] + (beta1 + u[i,2])*x1[j] + (beta2 +
u[i,3])*x2[i,j]
disp[i,j] <- -delta0
E[i,j] <- exp(m[i,j])/(1+exp(m[i,j]))
phi[i,j] <- exp(disp[i,j])
a[i,j] <- E[i,j]*phi[i,j]
b[i,j] <- (1-E[i,j])*phi[i,j]
p[i,j] ~ dbeta(a[i,j], b[i,j])
  }
u[i,1:3] ~ dmnorm(mu[], Omega[ , ])
}
## location and dispersion
mu0 <- exp(beta0)/(1+exp(beta0))
mu1 <- exp(beta1)/(1+exp(beta1))
mu2 <- exp(beta2)/(1+exp(beta2))
phi0 <- exp(-delta0)
## Priors
beta0 ~ dnorm(0.0, 1.0E-6)
```

```
beta1 ~ dnorm(0.0, 1.0E-6)
beta2 ~ dnorm(0.0, 1.0E-6)
delta0 ~ dnorm(0.0, 1.0E-6)
Omega[1 : 3 , 1 : 3]  ~ dwish(R[,], 3)
Sigma[1 : 3 , 1 : 3] <- inverse(Omega[,])
}

# Inits for 2-chain model
# Note that these leave out the 267x3 initial values for the
# random effects u-terms. However, BUGs seems to do a reasonable
# job of generating them.
list(beta0 = 0.0, beta1 = 0.1, beta2 = 0.1, delta0 = 0.1)
list(beta0 = 0.1, beta1 = 0.0, beta2 = 0.1, delta0 = 0.1)
```

Recommended burn-in = 5000 iterations, recommended estimation = 5000 more iterations.

Model with Random Intercept in Dispersion Submodel

```
#
# To run this model, delete the string
# R = structure(.Data = c(1, 0, 0, 0, 1, 0, 0, 0, 1), .Dim = c(3, 3)),
# from the first line in the data above.
#
model
{
## Main routine
for(i in 1:N){
  for(j in 1:10){
m[i,j] <- beta0 + beta1*x1[j] + beta2*x2[i,j]
disp[i,j] <- -delta0 + v[i]
E[i,j] <- exp(m[i,j])/(1+exp(m[i,j]))
phi[i,j] <- exp(disp[i,j])
a[i,j] <- E[i,j]*phi[i,j]
b[i,j] <- (1-E[i,j])*phi[i,j]
p[i,j] ~ dbeta(a[i,j], b[i,j])
  }
v[i] ~ dnorm(0,tauv)
}
## location and dispersion
mu0 <- exp(beta0)/(1+exp(beta0))
mu1 <- exp(beta1)/(1+exp(beta1))
mu2 <- exp(beta2)/(1+exp(beta2))
phi0 <- exp(-delta0)
## Priors
beta0 ~ dnorm(0.0, 1.0E-6)
beta1 ~ dnorm(0.0, 1.0E-6)
beta2 ~ dnorm(0.0, 1.0E-6)
delta0 ~ dnorm(0.0, 1.0E-6)
sigv ~ dunif(0,100)
tauv <- 1/(sigv*sigv)
}

# Inits for 2-chain model
# Note that these leave out the 267 initial values for the
# random effects v-terms. However, BUGs seems to do a reasonable
# job of generating them.
list(beta0 = 0.0, beta1 = 0.1, beta2 = 0.1, delta0 = 0.1, sigv = 1.0)
list(beta0 = 0.1, beta1 = 0.0, beta2 = 0.1, delta0 = 0.1, sigv = 0.5)
```

This model takes longer than the others to converge.
Recommended burn-in = 10000 iterations, recommended estimation = 10000 more iterations.