Signal detection theory

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A psychological model: Signal detection theory

$$\mathcal{M}_{sdt} : \begin{cases} \delta \sim N(1,1) & \beta \sim N(0,1) \\ \phi_h = \Phi(\delta/2 - \beta) & \phi_f = \Phi(-\delta/2 - \beta) \\ h \sim B(\phi_h, n_s) & f \sim B(\phi_f, n_n) \end{cases}$$

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```
model {
    d ~ dnorm(1, 1)
    b ~ dnorm(0, 1)

    phih <- phi( d / 2 - b)
    phif <- phi(-d / 2 - b)

    h ~ dbin(phih, sigtrials)
    f ~ dbin(phif, noistrials)
 }
```

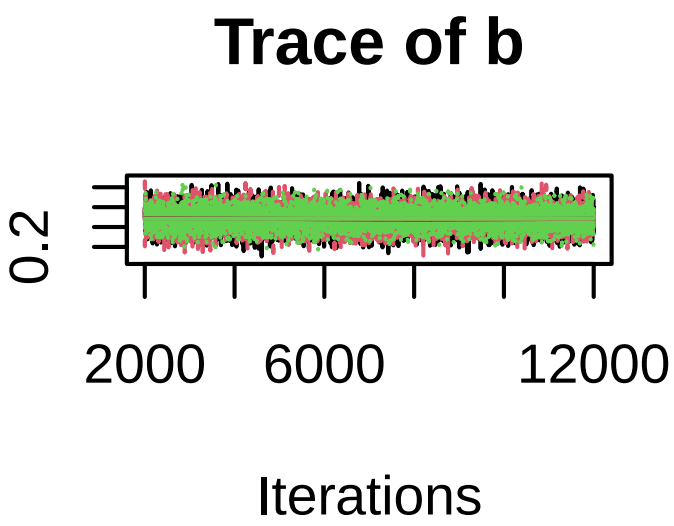
Signal detection theory ~ implementation

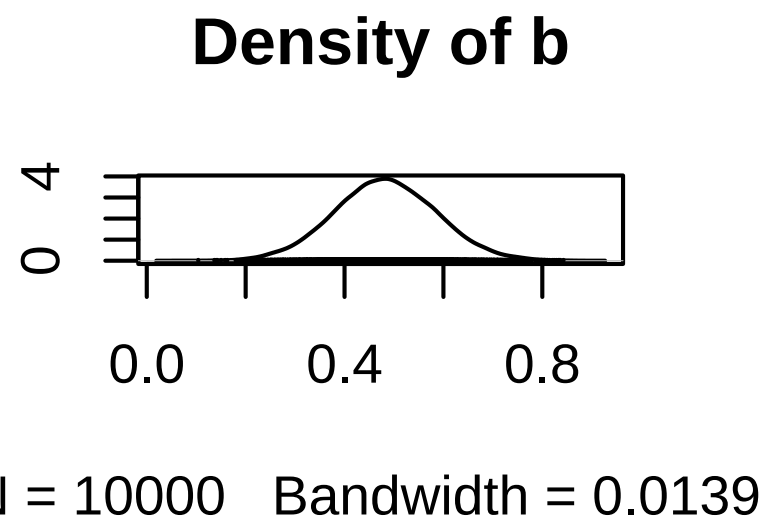
```
library(rjags)
data <- list( h = 60 ,  sigtrials  = 100 ,
              f = 11 ,  noistrials = 100 )
modelString = "
    model {
        d ~ dnorm(1, 1)
        b ~ dnorm(0, 1)

        phih <- phi( d / 2 - b)
        phif <- phi(-d / 2 - b)

        h ~ dbin(phih, sigtrials)
        f ~ dbin(phif, noistrials)
     }
"
```

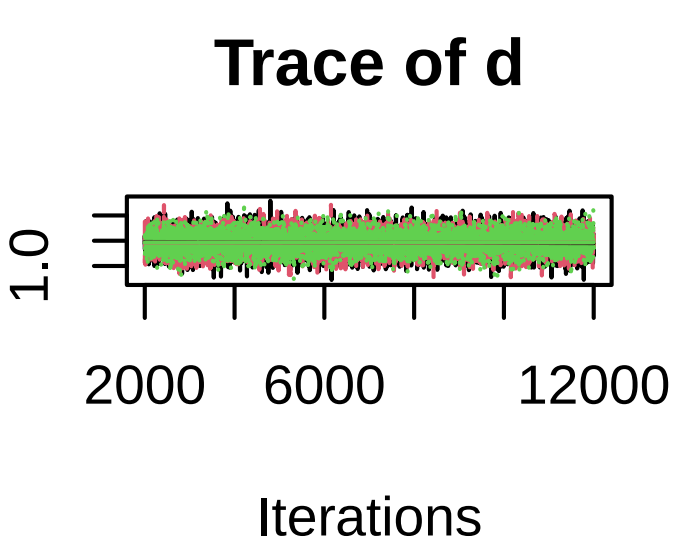
Signal detection theory ~ implementation

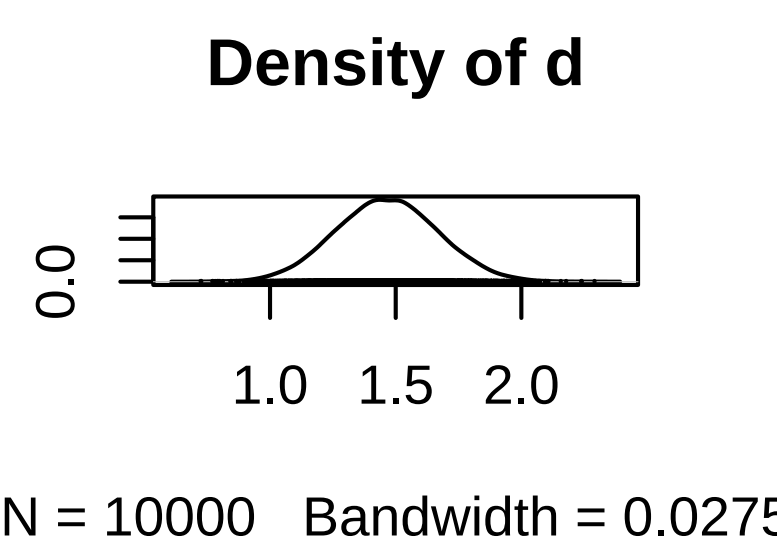
```
writeLines( modelString , con = "sdt.txt" )

jagsModel = jags.model( file     = "sdt.txt" ,
                        data     =     data  ,
                        n.chains =        3  ,
                        n.adapt  =     1000  )
set.seed(0)
update( jagsModel , n.iter = 1000 )  # burn-in

samples = coda.samples( jagsModel ,
                        variable.names = c("d", "b") ,
                        n.iter         =      10000 )
```

Signal detection theory ~ results









Signal detection theory ~ summary statistics

```
summary(samples)$statistics
```

```
##        Mean        SD     Naive SE Time-series SE
## b 0.4831641 0.1035147 0.0005976422   0.0007923464
## d 1.4660096 0.2038841 0.0011771255   0.0016408567
```

```
summary(samples)$quantiles
```

```
##        2.5%       25%      50%       75%     97.5%
## b 0.2799827 0.4131269 0.482196 0.5526179 0.6884915
## d 1.0710899 1.3263457 1.465063 1.6026530 1.8658863
```

Signal detection theory ~ convergence

```
effectiveSize(samples)
```

```
##         b         d
## 17112.68 15441.89
```

```
gelman.diag(samples)
```

```
## Potential scale reduction factors:
##
##   Point est. Upper C.I.
## b          1          1
## d          1          1
##
## Multivariate psrf
##
## 1
```