Mindset Manipulation Experiment 2 Bayes Supplement

RW Hass

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Notes on the Supplement

This was designed to illustrate our compliance with recommendations of van de Schoot, et al (2020). Importantly, that tutorial utilizes the advanced tools made possible by `rjags` and `rstan`. Some of the information is particular to the MCMC methods used by `rstan`, and we tried our best to produce information that was relevant given the `BayesFactor` package's limited capabilities. The data and the underlying RMarkdown for this and the second experiment are available here.

Packages used: `psych`, `car`, `dplyr`, `BayesFactor`

session info:

```
## - Session info ---------------------------------------------------------------
##  setting  value
##  version  R version 4.3.2 (2023-10-31)
##  os       macOS Sonoma 14.6
##  system   aarch64, darwin20
##  ui       X11
##  language (EN)
##  collate  en_US.UTF-8
##  ctype    en_US.UTF-8
##  tz       America/New_York
##  date     2024-08-01
##  pandoc   3.2.1 @ /opt/homebrew/bin/ (via rmarkdown)
##
## - Packages -------------------------------------------------------------------
##  package      * version    date (UTC) lib source
##  abind          1.4-5      2016-07-21 [1] CRAN (R 4.3.0)
##  BayesFactor  * 0.9.12-4.7 2024-01-24 [1] CRAN (R 4.3.1)
##  cachem         1.1.0      2024-05-16 [1] CRAN (R 4.3.3)
##  car          * 3.1-2      2023-03-30 [1] CRAN (R 4.3.0)
##  carData      * 3.0-5      2022-01-06 [1] CRAN (R 4.3.0)
##  cli            3.6.3      2024-06-21 [1] CRAN (R 4.3.3)
##  coda         * 0.19-4.1   2024-01-31 [1] CRAN (R 4.3.1)
##  colorspace     2.1-0      2023-01-23 [1] CRAN (R 4.3.0)
##  devtools       2.4.5      2022-10-11 [1] CRAN (R 4.3.0)
##  digest         0.6.36     2024-06-23 [1] CRAN (R 4.3.3)
##  dplyr        * 1.1.4      2023-11-17 [1] CRAN (R 4.3.1)
##  ellipsis       0.3.2      2021-04-29 [1] CRAN (R 4.3.0)
##  evaluate       0.24.0     2024-06-10 [1] CRAN (R 4.3.3)
##  fansi          1.0.6      2023-12-08 [1] CRAN (R 4.3.1)
##  fastmap        1.2.0      2024-05-15 [1] CRAN (R 4.3.3)
##  forcats      * 1.0.0      2023-01-29 [1] CRAN (R 4.3.0)
##  fs             1.6.4      2024-04-25 [1] CRAN (R 4.3.1)
```

```
##  generics       0.1.3      2022-07-05 [1] CRAN (R 4.3.0)
##  ggplot2      * 3.5.1      2024-04-23 [1] CRAN (R 4.3.1)
##  glue           1.7.0      2024-01-09 [1] CRAN (R 4.3.1)
##  gtable         0.3.5      2024-04-22 [1] CRAN (R 4.3.1)
##  hms            1.1.3      2023-03-21 [1] CRAN (R 4.3.0)
##  htmltools      0.5.8.1    2024-04-04 [1] CRAN (R 4.3.1)
##  htmlwidgets    1.6.4      2023-12-06 [1] CRAN (R 4.3.1)
##  httpuv         1.6.15     2024-03-26 [1] CRAN (R 4.3.1)
##  knitr          1.48       2024-07-07 [1] CRAN (R 4.3.3)
##  later          1.3.2      2023-12-06 [1] CRAN (R 4.3.1)
##  lattice        0.22-6     2024-03-20 [1] CRAN (R 4.3.1)
##  lifecycle      1.0.4      2023-11-07 [1] CRAN (R 4.3.1)
##  lubridate    * 1.9.3      2023-09-27 [1] CRAN (R 4.3.1)
##  magrittr       2.0.3      2022-03-30 [1] CRAN (R 4.3.0)
##  Matrix       * 1.6-5      2024-01-11 [1] CRAN (R 4.3.1)
##  MatrixModels   0.5-3      2023-11-06 [1] CRAN (R 4.3.1)
##  memoise        2.0.1      2021-11-26 [1] CRAN (R 4.3.0)
##  mime           0.12       2021-09-28 [1] CRAN (R 4.3.0)
##  miniUI         0.1.1.1    2018-05-18 [1] CRAN (R 4.3.0)
##  mnormt         2.1.1      2022-09-26 [1] CRAN (R 4.3.0)
##  munsell        0.5.1      2024-04-01 [1] CRAN (R 4.3.1)
##  mvtnorm        1.2-5      2024-05-21 [1] CRAN (R 4.3.3)
##  nlme           3.1-165    2024-06-06 [1] CRAN (R 4.3.3)
##  pbapply        1.7-2      2023-06-27 [1] CRAN (R 4.3.0)
##  pillar         1.9.0      2023-03-22 [1] CRAN (R 4.3.0)
##  pkgbuild       1.4.4      2024-03-17 [1] CRAN (R 4.3.1)
##  pkgconfig      2.0.3      2019-09-22 [1] CRAN (R 4.3.0)
##  pkgload        1.4.0      2024-06-28 [1] CRAN (R 4.3.3)
##  profvis        0.3.8      2023-05-02 [1] CRAN (R 4.3.0)
##  promises       1.3.0      2024-04-05 [1] CRAN (R 4.3.1)
##  psych        * 2.4.6.26   2024-06-27 [1] CRAN (R 4.3.3)
##  purrr        * 1.0.2      2023-08-10 [1] CRAN (R 4.3.0)
##  R6             2.5.1      2021-08-19 [1] CRAN (R 4.3.0)
##  Rcpp           1.0.12     2024-01-09 [1] CRAN (R 4.3.1)
##  readr        * 2.1.5      2024-01-10 [1] CRAN (R 4.3.1)
##  remotes        2.5.0      2024-03-17 [1] CRAN (R 4.3.1)
##  rlang          1.1.4      2024-06-04 [1] CRAN (R 4.3.3)
##  rmarkdown      2.27       2024-05-17 [1] CRAN (R 4.3.3)
##  rstudioapi     0.16.0     2024-03-24 [1] CRAN (R 4.3.1)
##  scales         1.3.0      2023-11-28 [1] CRAN (R 4.3.1)
##  sessioninfo    1.2.2      2021-12-06 [1] CRAN (R 4.3.0)
##  shiny          1.8.1.1    2024-04-02 [1] CRAN (R 4.3.1)
##  stringi        1.8.4      2024-05-06 [1] CRAN (R 4.3.1)
##  stringr      * 1.5.1      2023-11-14 [1] CRAN (R 4.3.1)
##  tibble       * 3.2.1      2023-03-20 [1] CRAN (R 4.3.0)
##  tidyr        * 1.3.1      2024-01-24 [1] CRAN (R 4.3.1)
##  tidyselect     1.2.1      2024-03-11 [1] CRAN (R 4.3.1)
##  tidyverse    * 2.0.0      2023-02-22 [1] CRAN (R 4.3.0)
##  timechange     0.3.0      2024-01-18 [1] CRAN (R 4.3.1)
##  tzdb           0.4.0      2023-05-12 [1] CRAN (R 4.3.0)
##  urlchecker     1.0.1      2021-11-30 [1] CRAN (R 4.3.0)
##  usethis        2.2.3      2024-02-19 [1] CRAN (R 4.3.1)
##  utf8           1.2.4      2023-10-22 [1] CRAN (R 4.3.1)
##  vctrs          0.6.5      2023-12-01 [1] CRAN (R 4.3.1)
```

```
##  withr          3.0.0      2024-01-16 [1] CRAN (R 4.3.1)
##  xfun           0.45       2024-06-16 [1] CRAN (R 4.3.3)
##  xtable         1.8-4      2019-04-21 [1] CRAN (R 4.3.0)
##  yaml           2.3.9      2024-07-05 [1] CRAN (R 4.3.3)
##
##  [1] /Library/Frameworks/R.framework/Versions/4.3-arm64/Resources/library
##
## ------------------------------------------------------------------------------
```

Descriptive statistics and correlation (correlations not used in manuscript)

```
# r.out <- corr.test(d[,c("JoanScore","DTScore","DTFlu","Fixed","Growth","CSE")])
# desc.out <- describe(d[,c("JoanScore","DTScore","DTFlu","Fixed","Growth","CSE")])

# per group
describeBy(d[,c("JoanScore","DTScore","DTFlu","Fixed","Growth","CSE")], group = d$Condition)
```

```
##
##  Descriptive statistics by group
## group: Fixed
##           vars  n mean   sd median trimmed  mad min max range  skew kurtosis
## JoanScore    1 55 2.85 0.73   3.00    2.82 1.48 2.0   4   2.0  0.22    -1.15
## DTScore      2 53 2.82 0.72   2.86    2.82 0.64 1.0   5   4.0  0.04     0.63
## DTFlu        3 55 6.60 3.41   6.00    6.40 2.97 0.0  17  17.0  0.63     0.45
## Fixed        4 55 3.13 1.05   3.25    3.14 1.48 1.0   5   4.0 -0.06    -1.15
## Growth       5 55 3.52 0.87   3.50    3.55 0.74 1.5   5   3.5 -0.32    -0.66
## CSE          6 55 3.37 0.95   3.33    3.39 0.99 1.0   5   4.0 -0.37    -0.19
##             se
## JoanScore 0.10
## DTScore   0.10
## DTFlu     0.46
## Fixed     0.14
## Growth    0.12
## CSE       0.13
## ------------------------------------------------------------
## group: Growth
##           vars  n mean   sd median trimmed  mad min  max range  skew kurtosis
## JoanScore    1 56 2.68 0.90   3.00    2.65 1.48 1.0  5.0   4.0  0.36    -0.55
## DTScore      2 56 2.79 0.59   2.75    2.79 0.46 1.5  4.5   3.0  0.26     0.47
## DTFlu        3 56 7.98 3.76   7.50    7.63 3.71 2.0 17.0  15.0  0.82    -0.02
## Fixed        4 56 2.60 0.92   2.42    2.58 0.86 1.0  5.0   4.0  0.38    -0.59
## Growth       5 56 3.98 0.57   4.00    3.98 0.37 2.5  5.0   2.5 -0.15    -0.44
## CSE          6 56 3.18 1.03   3.33    3.20 0.99 1.0  5.0   4.0 -0.21    -0.90
##             se
## JoanScore 0.12
## DTScore   0.08
## DTFlu     0.50
## Fixed     0.12
## Growth    0.08
## CSE       0.14
```

Bayesian Estimation for Hypotheses 1 and 2

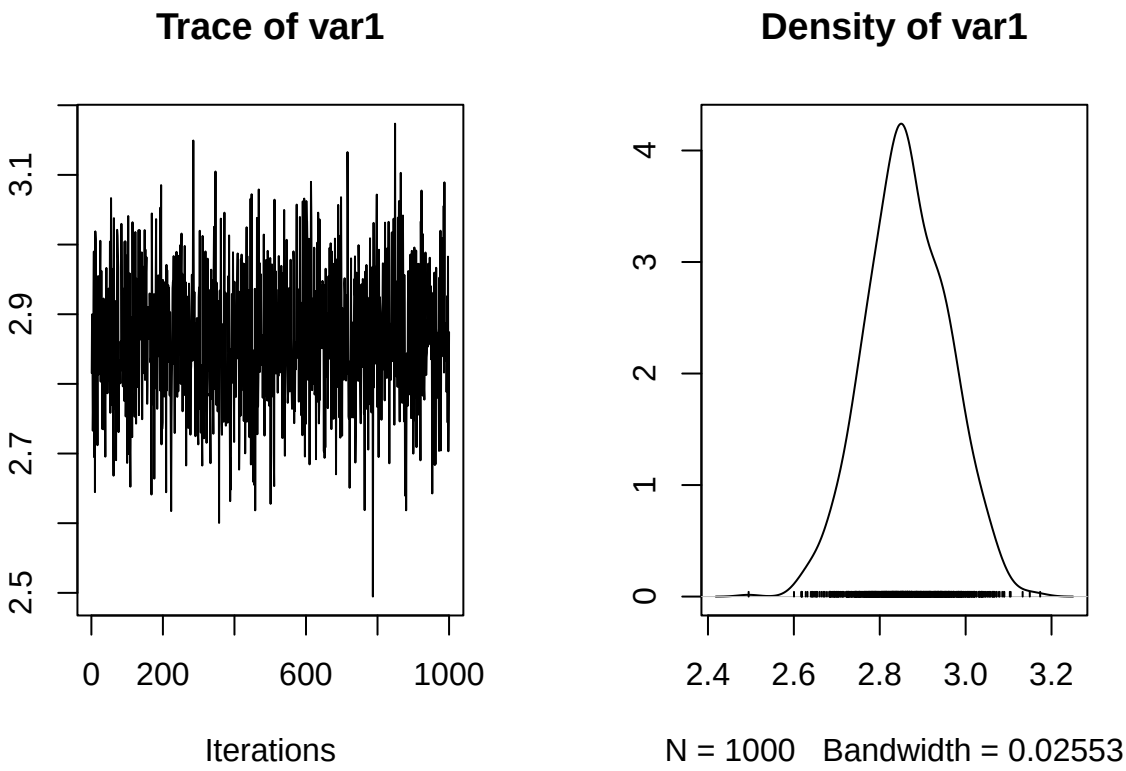
Note, the following sections follow the same layout of Supplement 1, and more info on the checks are available there.

Fixed Mindset

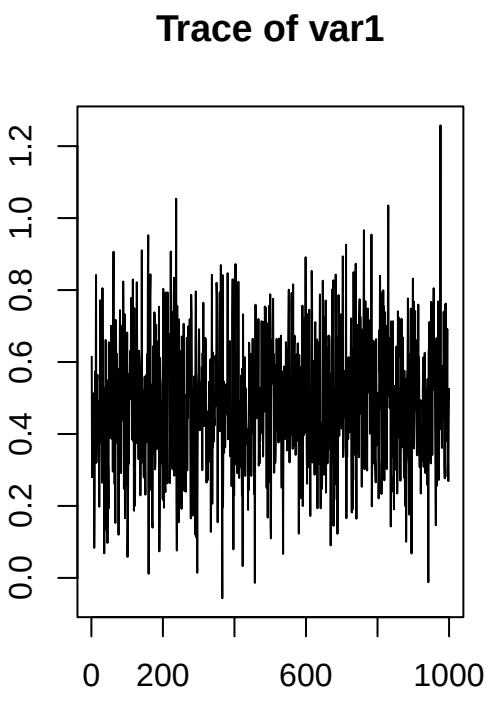
```
# default is rscale = medium or sqrt(2)/2
ttestBF(formula = Fixed ~ Condition, data = d)
```

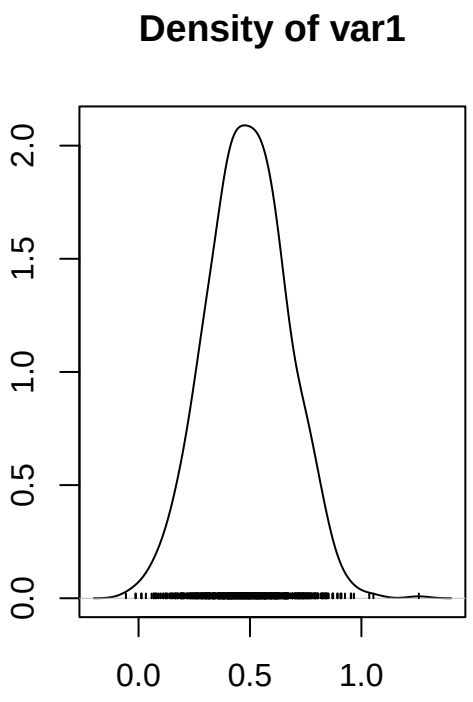
```
## Bayes factor analysis
## --------------
## [1] Alt., r=0.707 : 6.569093 ±0%
##
## Against denominator:
##   Null, mu1-mu2 = 0
## ---
## Bayes factor type: BFindepSample, JZS
```

```
fixedpost <- ttestBF(formula = Fixed ~ Condition, data = d, posterior = TRUE, iterations = 1000)
plot(fixedpost[,"mu"])
```




```
plot(fixedpost[,"beta (Fixed - Growth)"])
```





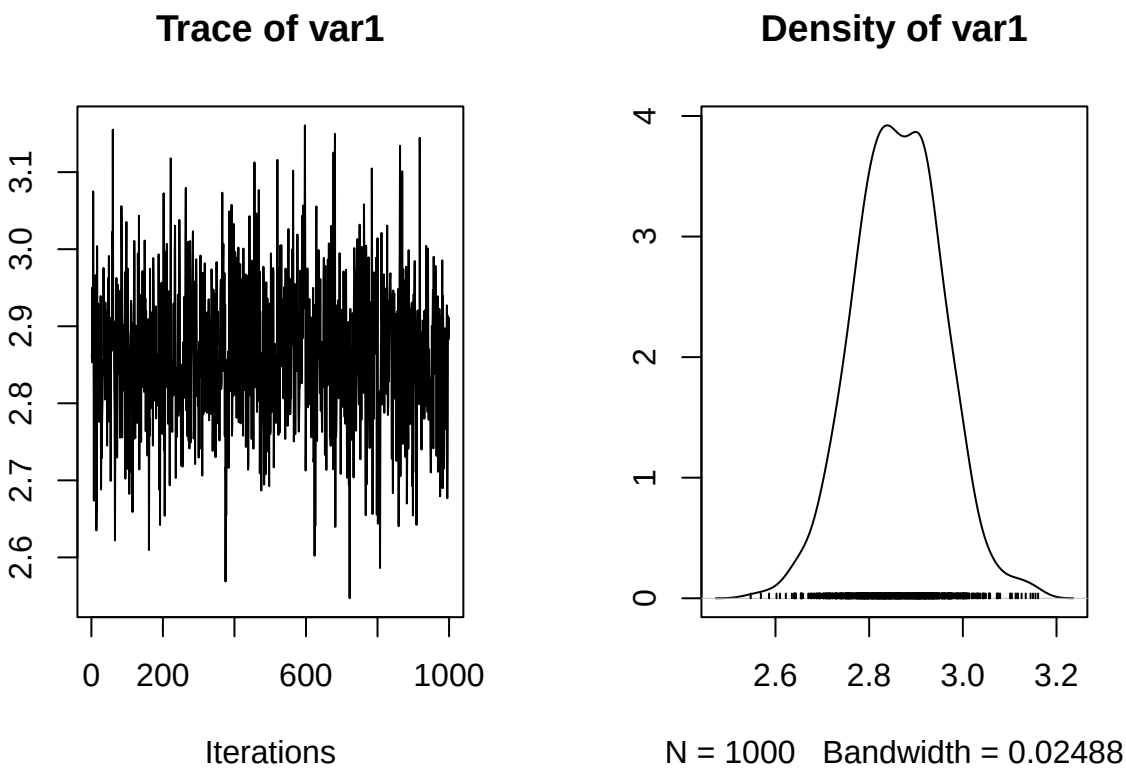

```
quantile(fixedpost[,"beta (Fixed - Growth)"], probs = c(.025, .5, .975))
```

```
##      2.5%       50%     97.5%
## 0.1394619 0.4874589 0.8344100
```

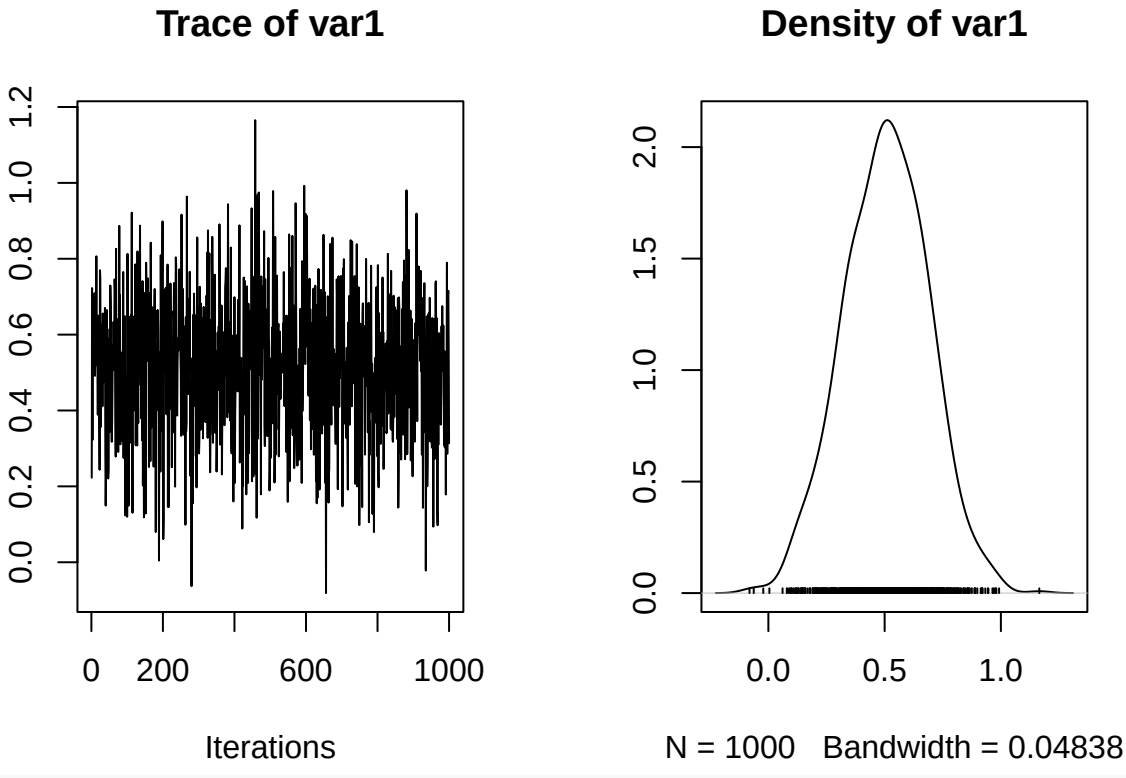
```
### with wide rscale = wide or 1
ttestBF(formula = Fixed ~ Condition, data = d, rscale = "wide")
```

```
## Bayes factor analysis
## --------------
## [1] Alt., r=1 : 5.574359 ±0%
##
## Against denominator:
##   Null, mu1-mu2 = 0
## ---
## Bayes factor type: BFindepSample, JZS
```

```
fixedpost.w <- ttestBF(formula = Fixed ~ Condition, data = d, rscale = "wide", posterior = TRUE, iterati
plot(fixedpost.w[,"mu"])
```




```
plot(fixedpost.w[,"beta (Fixed - Growth)"])
```



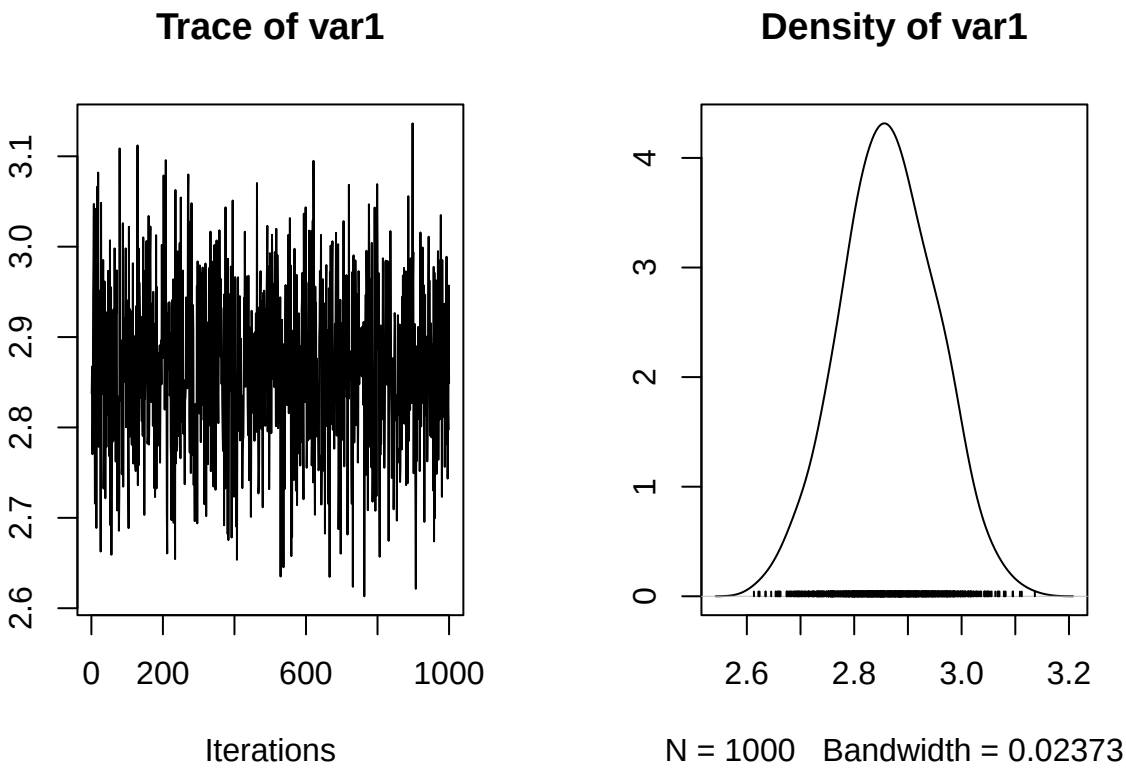

```
quantile(fixedpost.w[,"beta (Fixed - Growth)"], probs = c(.025, .5, .975))
```

```
##      2.5%       50%     97.5%
## 0.1440049 0.5086717 0.8577710
```

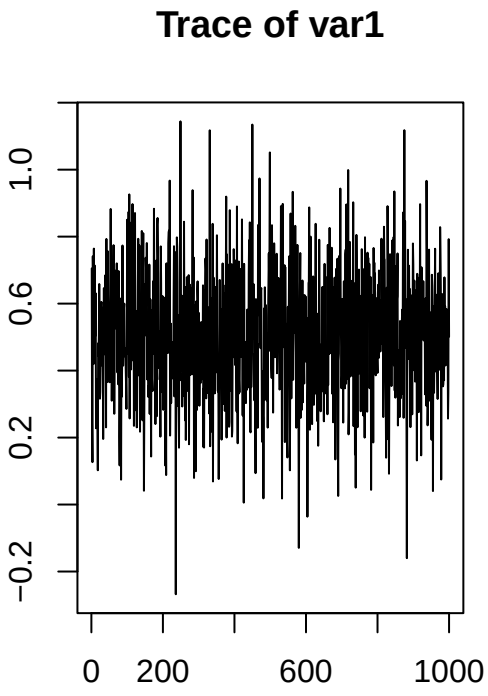
```
### with ultrawide rscale = ultrawide or sqrt(2)
ttestBF(formula = Fixed ~ Condition, data = d, rscale = "ultrawide")
```

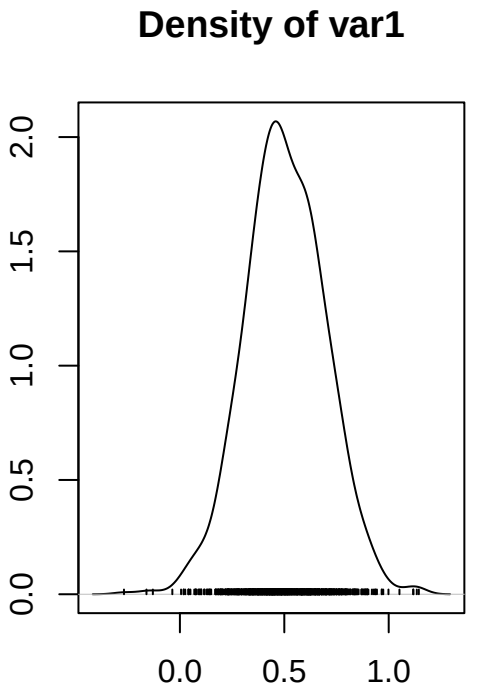
```
## Bayes factor analysis
## --------------
## [1] Alt., r=1.414 : 4.42181 ±0.01%
##
## Against denominator:
##   Null, mu1-mu2 = 0
## ---
## Bayes factor type: BFindepSample, JZS
```

```
fixedpost.uw <- ttestBF(formula = Fixed ~ Condition, data = d, rscale = "ultrawide", posterior = TRUE, i
plot(fixedpost.uw[,"mu"])
```




```
plot(fixedpost.uw[,"beta (Fixed - Growth)"])
```

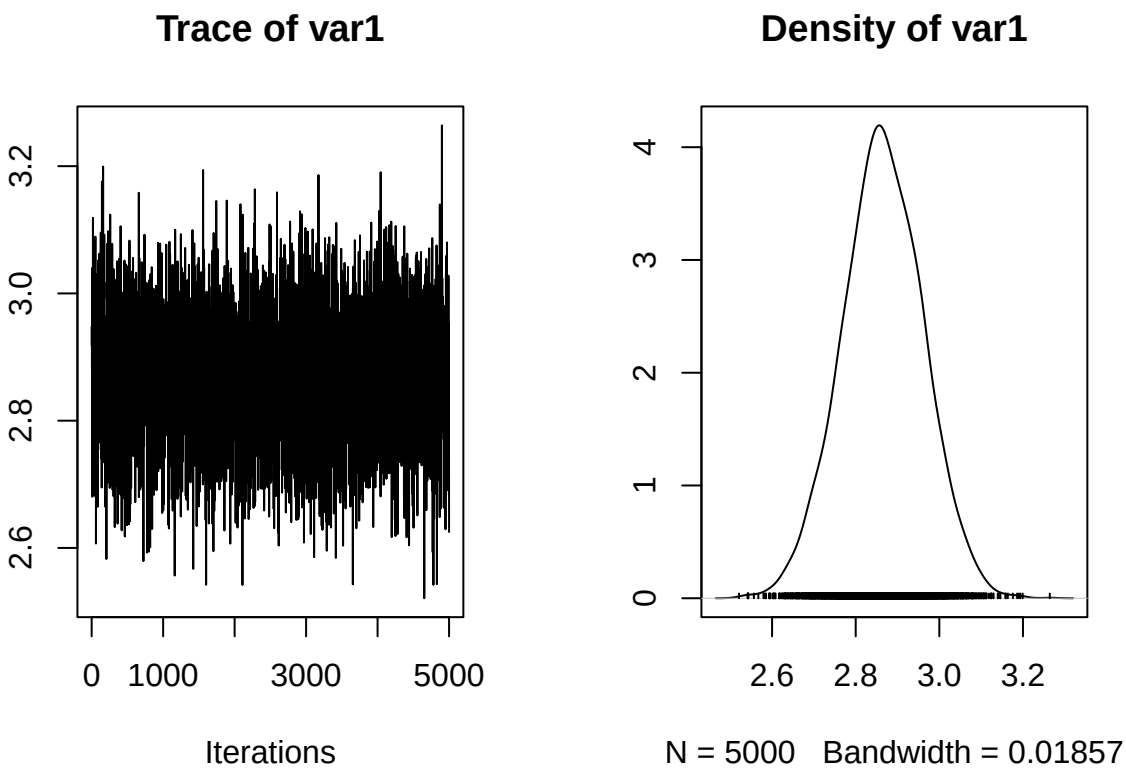




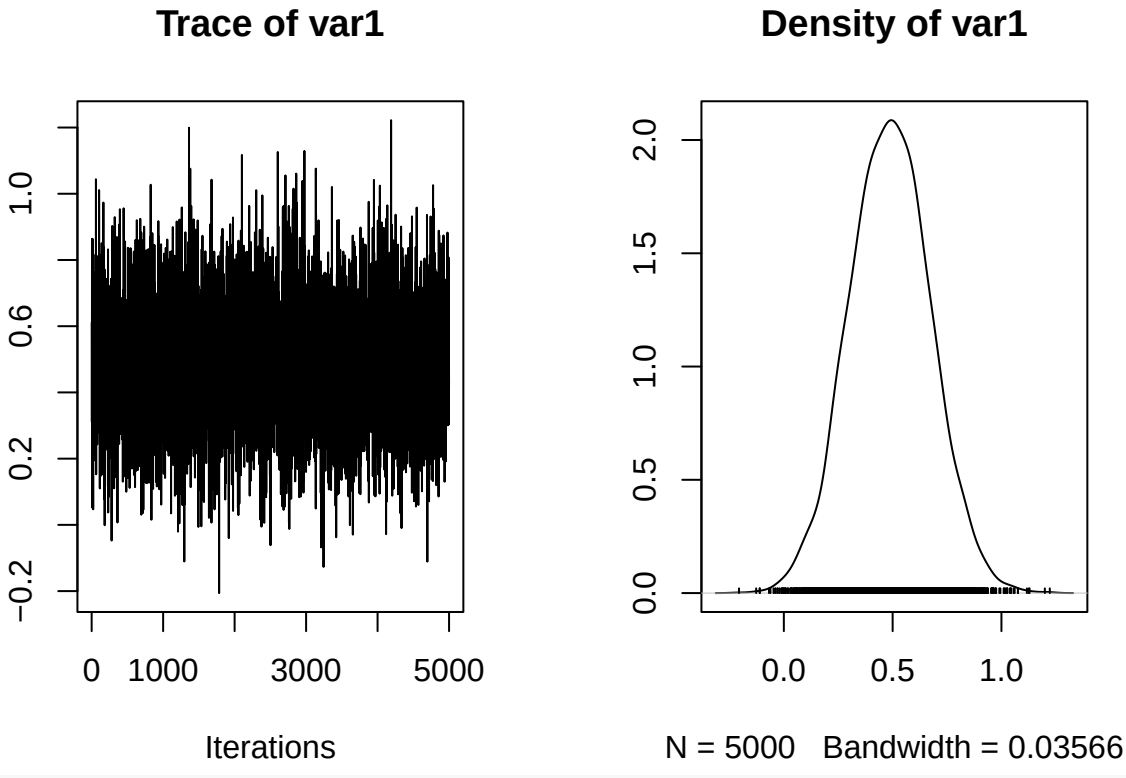

```
quantile(fixedpost.uw[,"beta (Fixed - Growth)"], probs = c(.025, .5, .975))
```

```
##      2.5%       50%     97.5%
## 0.1263479 0.4986083 0.8826288
```

```
### More iterations
fixedpost.check <- ttestBF(formula = Fixed ~ Condition, data = d, posterior = TRUE, iterations = 5000)
plot(fixedpost.check[,"mu"])
```




```
plot(fixedpost.check[,"beta (Fixed - Growth)"])
```




```
quantile(fixedpost.check[,"beta (Fixed - Growth)"], probs = c(.025, .5, .975))
```

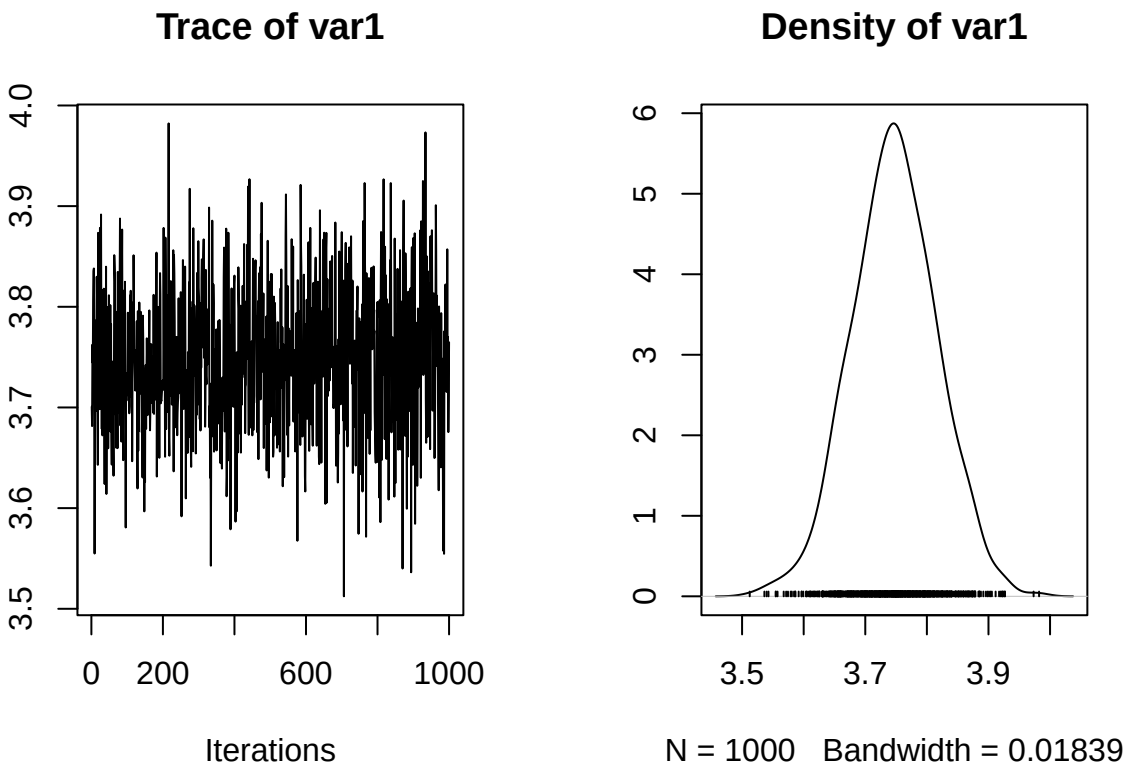
```
##      2.5%       50%     97.5%
## 0.1269584 0.4884059 0.8476794
```

Growth Mindset as outcome

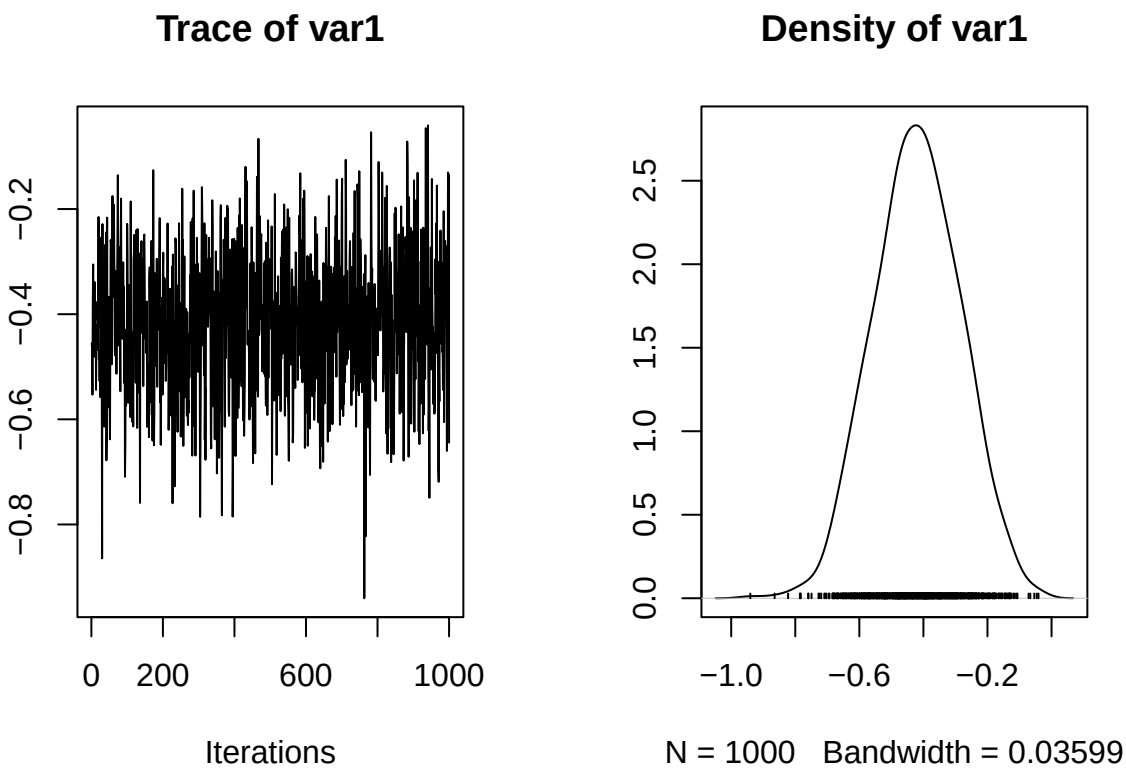
```
## default / medium
ttestBF(formula = Growth ~ Condition, data = d)
```

```
## Bayes factor analysis
## --------------
## [1] Alt., r=0.707 : 21.44464 ±0%
##
## Against denominator:
##   Null, mu1-mu2 = 0
## ---
## Bayes factor type: BFindepSample, JZS
```

```
gpost <- ttestBF(formula = Growth ~ Condition, data = d, posterior = TRUE, iterations = 1000)
plot(gpost[,"mu"])
```




```
plot(gpost[,"beta (Fixed - Growth)"])
```



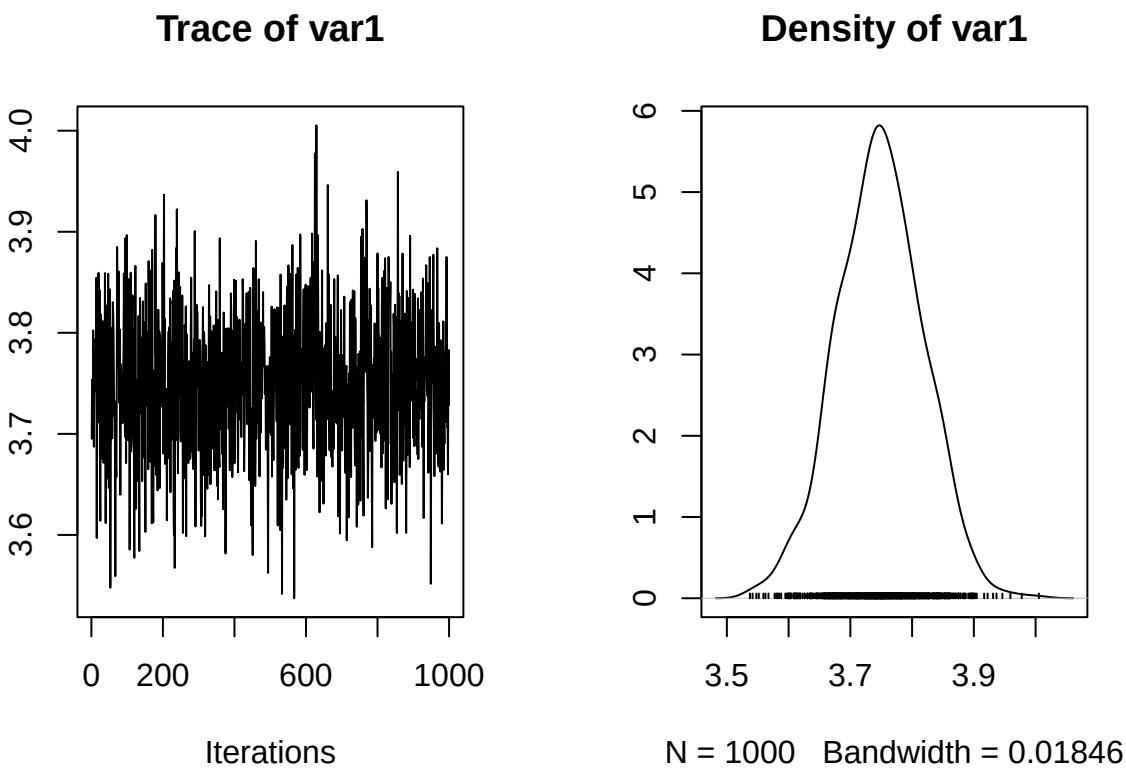

```
quantile(gpost[,"beta (Fixed - Growth)"], probs = c(.025, .5, .975))
```

```
##       2.5%        50%      97.5%
## -0.6733249 -0.4188110 -0.1560531
```

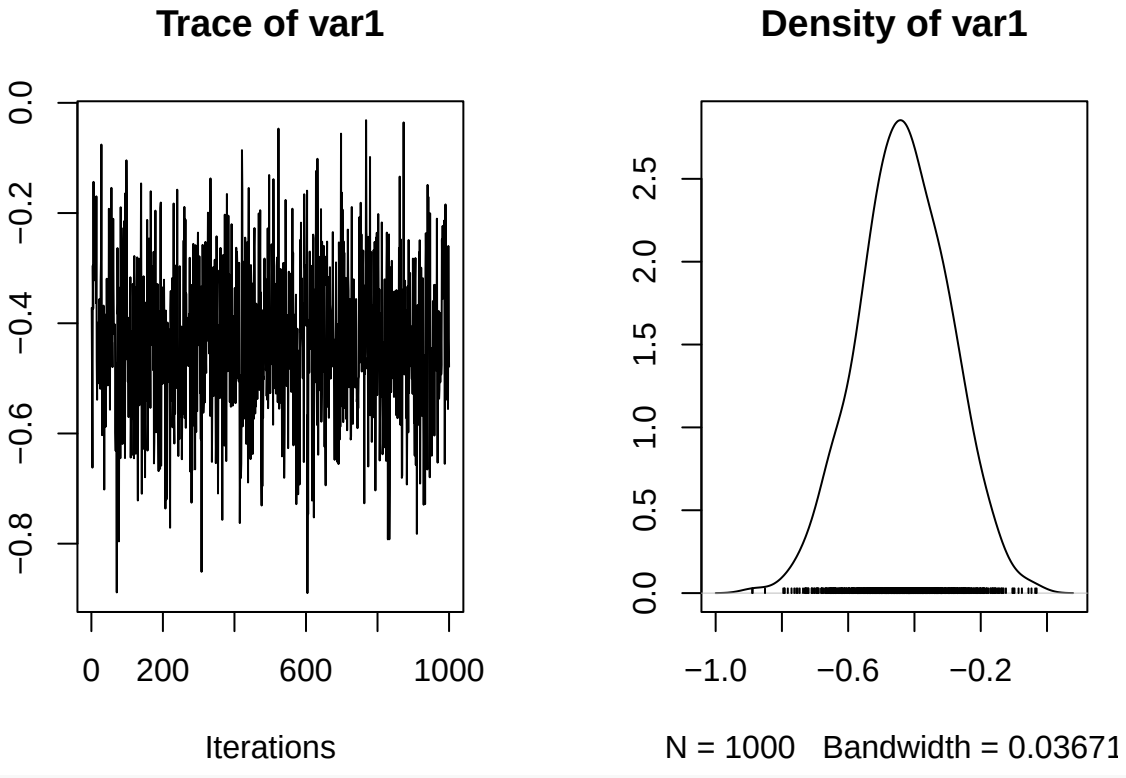
```
# Wide

ttestBF(formula = Growth ~ Condition, data = d, rscale = "wide")
```

```
## Bayes factor analysis
## --------------
## [1] Alt., r=1 : 18.94251 ±0%
##
## Against denominator:
##   Null, mu1-mu2 = 0
## ---
## Bayes factor type: BFindepSample, JZS
```

```
gpost.w <- ttestBF(formula = Growth ~ Condition, data = d, rscale = "wide", posterior = TRUE, iterations
plot(gpost.w[,"mu"])
```




```
plot(gpost.w[,"beta (Fixed - Growth)"])
```



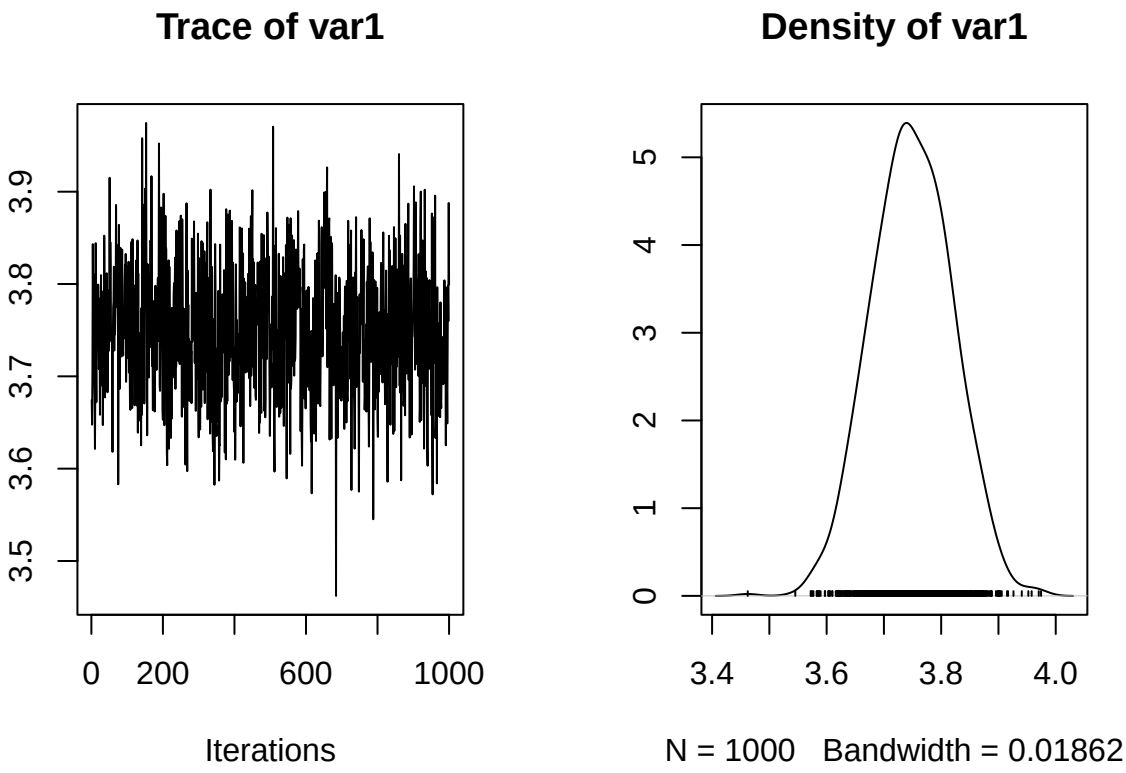

```
quantile(gpost.w[,"beta (Fixed - Growth)"], probs = c(.025, .5, .975))
```

```
##       2.5%        50%      97.5%
## -0.7034592 -0.4325637 -0.1653726
```

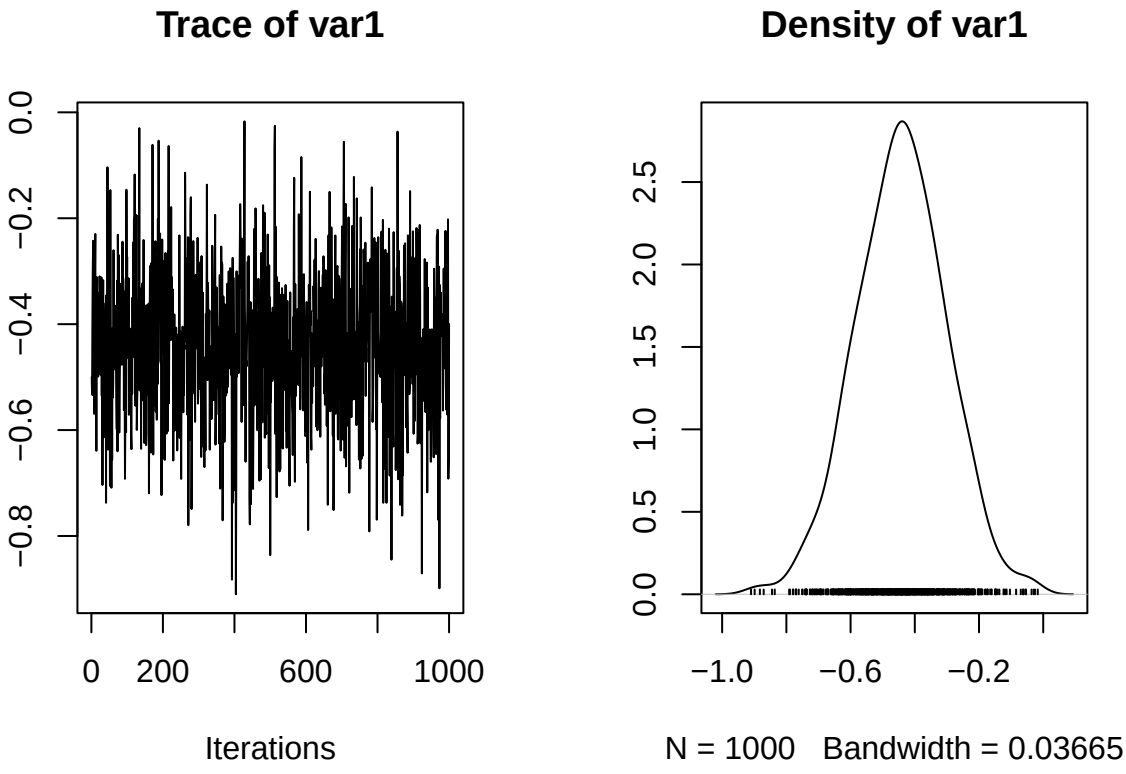
```r
# UltraWide

ttestBF(formula = Growth ~ Condition, data = d, rscale = "ultrawide")
```

```
## Bayes factor analysis
## --------------
## [1] Alt., r=1.414 : 15.46237 ±0%
##
## Against denominator:
##   Null, mu1-mu2 = 0
## ---
## Bayes factor type: BFindepSample, JZS
```

```r
gpost.uw <- ttestBF(formula = Growth ~ Condition, data = d, rscale = "ultrawide", posterior = TRUE, ite
plot(gpost.uw[,"mu"])
```



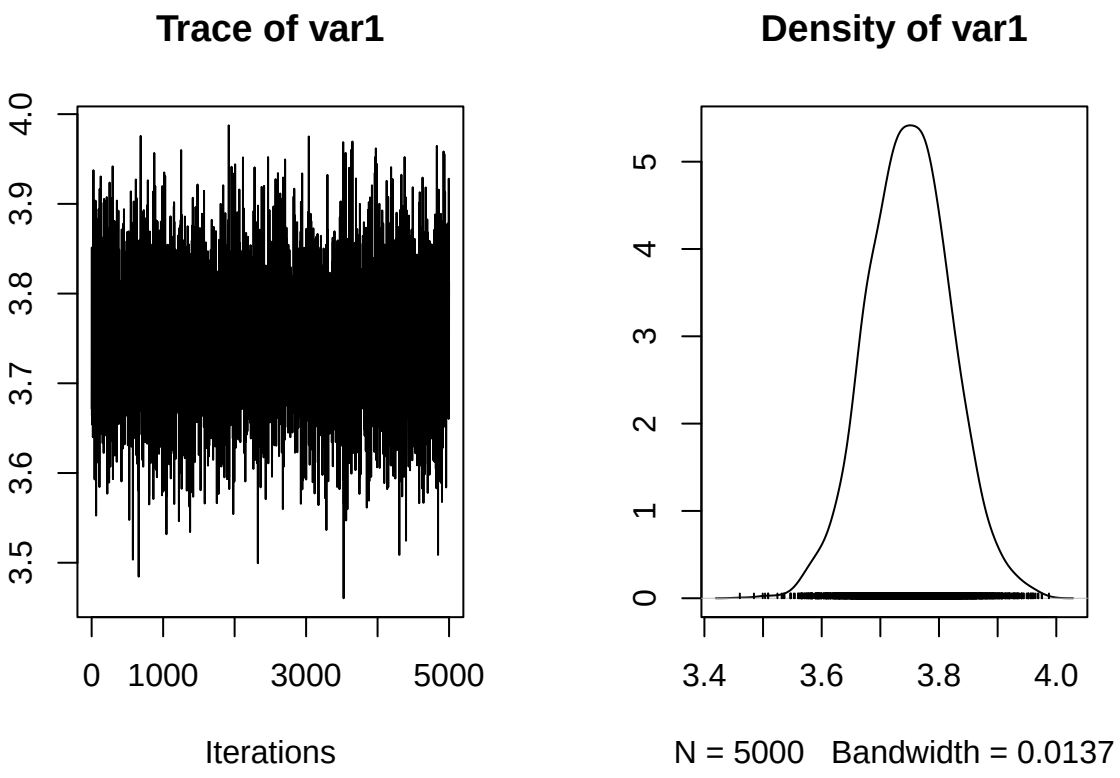

```r
plot(gpost.uw[,"beta (Fixed - Growth)"])
```



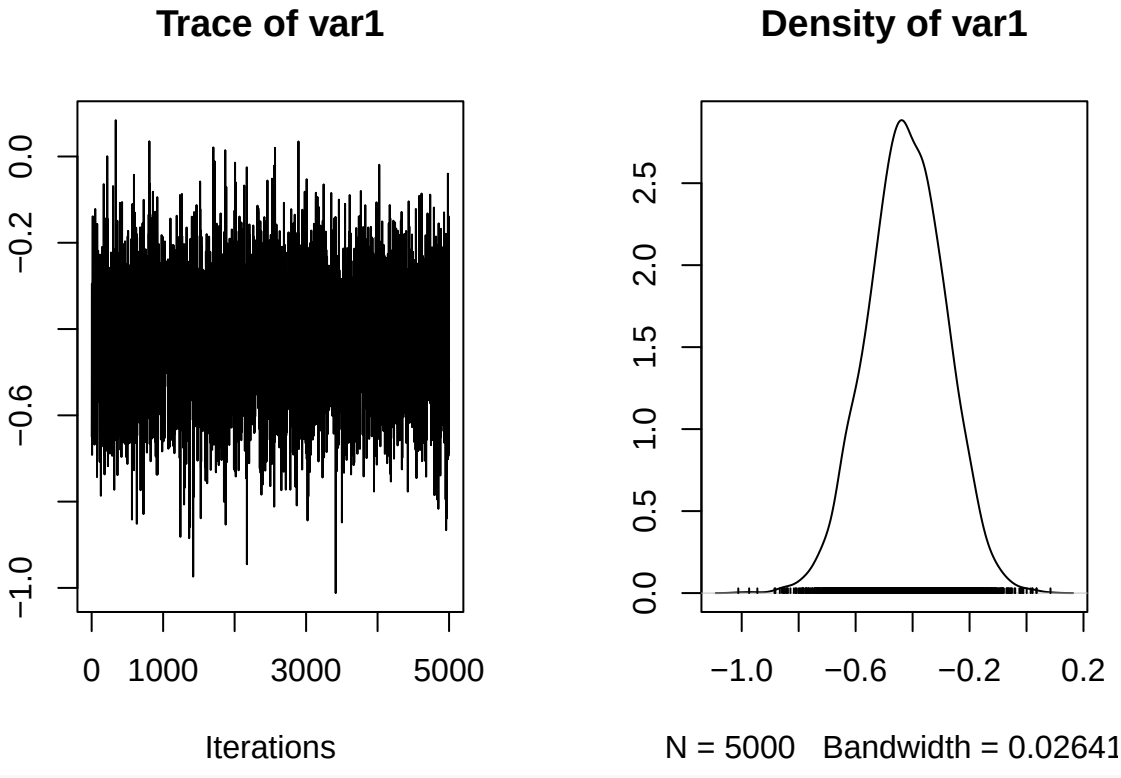

```
quantile(gpost.uw[,"beta (Fixed - Growth)"], probs = c(.025, .5, .975))
```

```
##       2.5%        50%      97.5%
## -0.7228277 -0.4413185 -0.1727467
```

```
### More iterations
gpost.check <- ttestBF(formula = Growth ~ Condition, data = d, posterior = TRUE, iterations = 5000)
plot(gpost.check[,"mu"])
```




```
plot(gpost.check[,"beta (Fixed - Growth)"])
```




```
quantile(gpost.check[,"beta (Fixed - Growth)"], probs = c(.025, .5, .975))
```

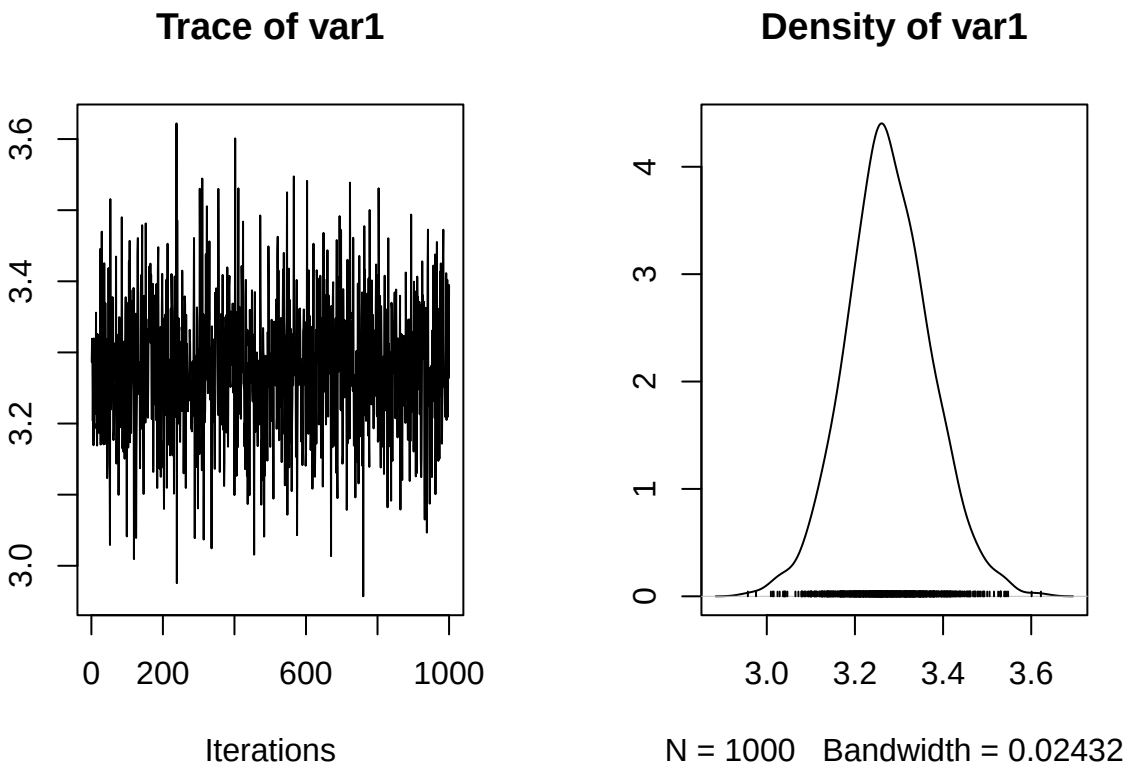
```
##       2.5%        50%      97.5%
## -0.6918381 -0.4225028 -0.1643170
```

Creative Self-efficacy as outcome

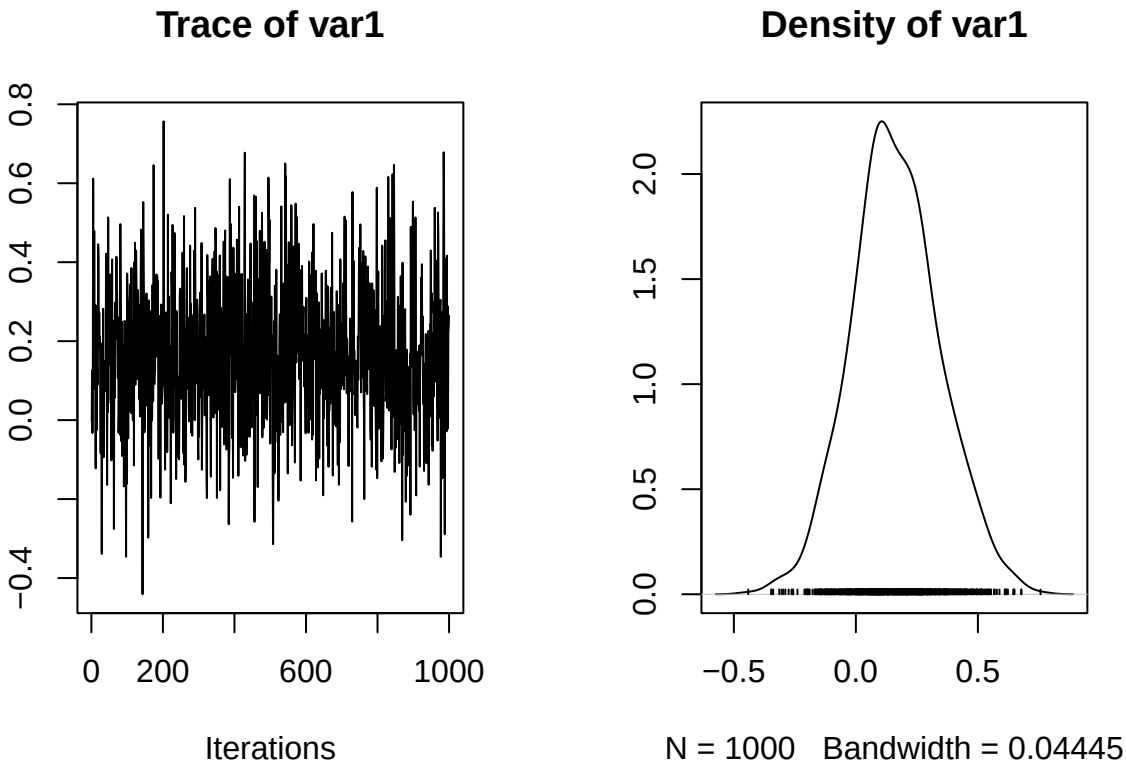
```
## Default / medium
ttestBF(formula = CSE ~ Condition, data = d)
```

```
## Bayes factor analysis
## --------------
## [1] Alt., r=0.707 : 0.3184985 ±0.02%
##
## Against denominator:
##   Null, mu1-mu2 = 0
## ---
## Bayes factor type: BFindepSample, JZS
```

```
csepost <- ttestBF(formula = CSE ~ Condition, data = d, posterior = TRUE, iterations = 1000)
plot(csepost[,"mu"])
```




```
plot(csepost[,"beta (Fixed - Growth)"])
```



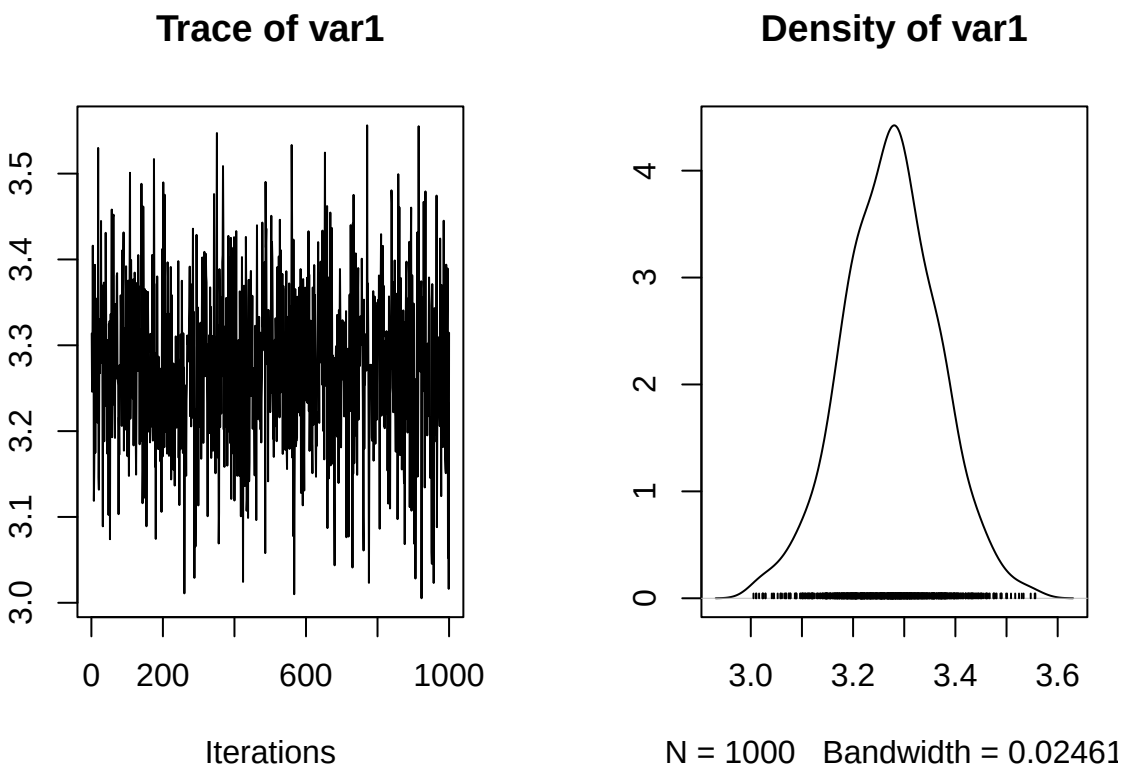

```
quantile(csepost[,"beta (Fixed - Growth)"], probs = c(.025, .5, .975))
```

```
##       2.5%        50%      97.5%
## -0.1679336  0.1584152  0.5259200
```

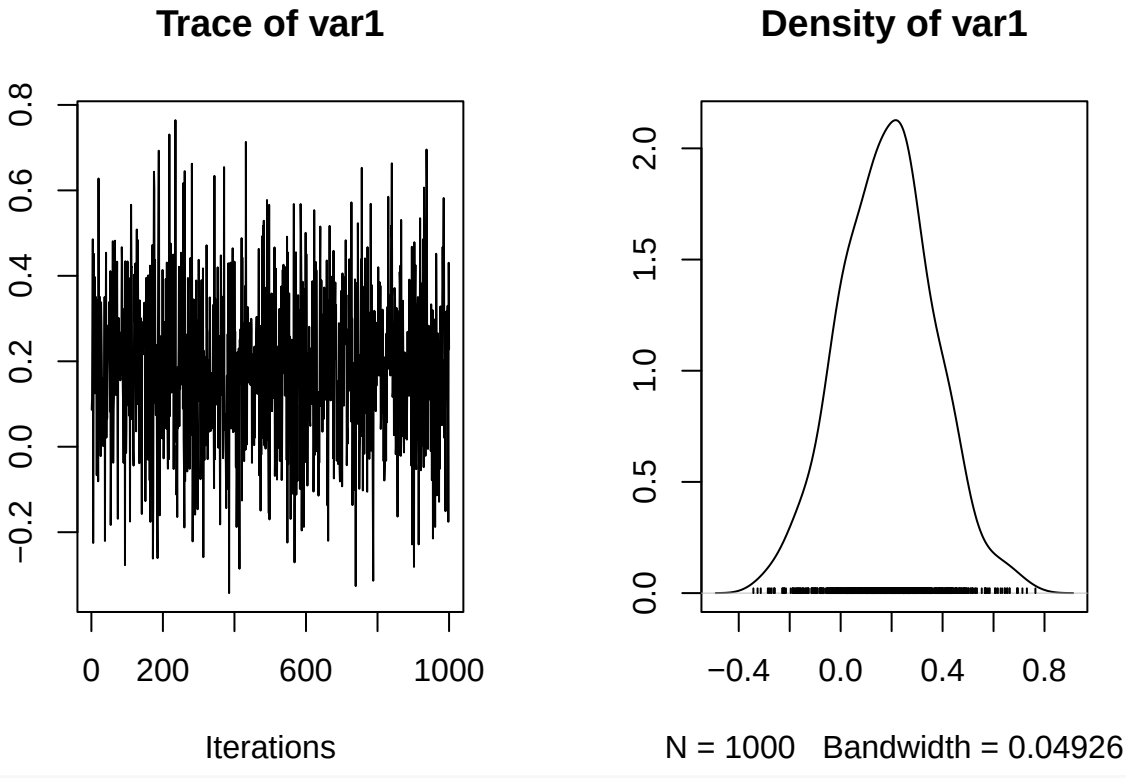
```
# Wide
ttestBF(formula = CSE ~ Condition, data = d, rscale = "wide")
```

```
## Bayes factor analysis
## --------------
## [1] Alt., r=1 : 0.2374207 ±0.06%
##
## Against denominator:
##   Null, mu1-mu2 = 0
## ---
## Bayes factor type: BFindepSample, JZS
```

```
csepost.w <- ttestBF(formula = CSE ~ Condition, data = d, rscale = "wide", posterior = TRUE, iterations
plot(csepost.w[,"mu"])
```




```
plot(csepost.w[,"beta (Fixed - Growth)"])
```



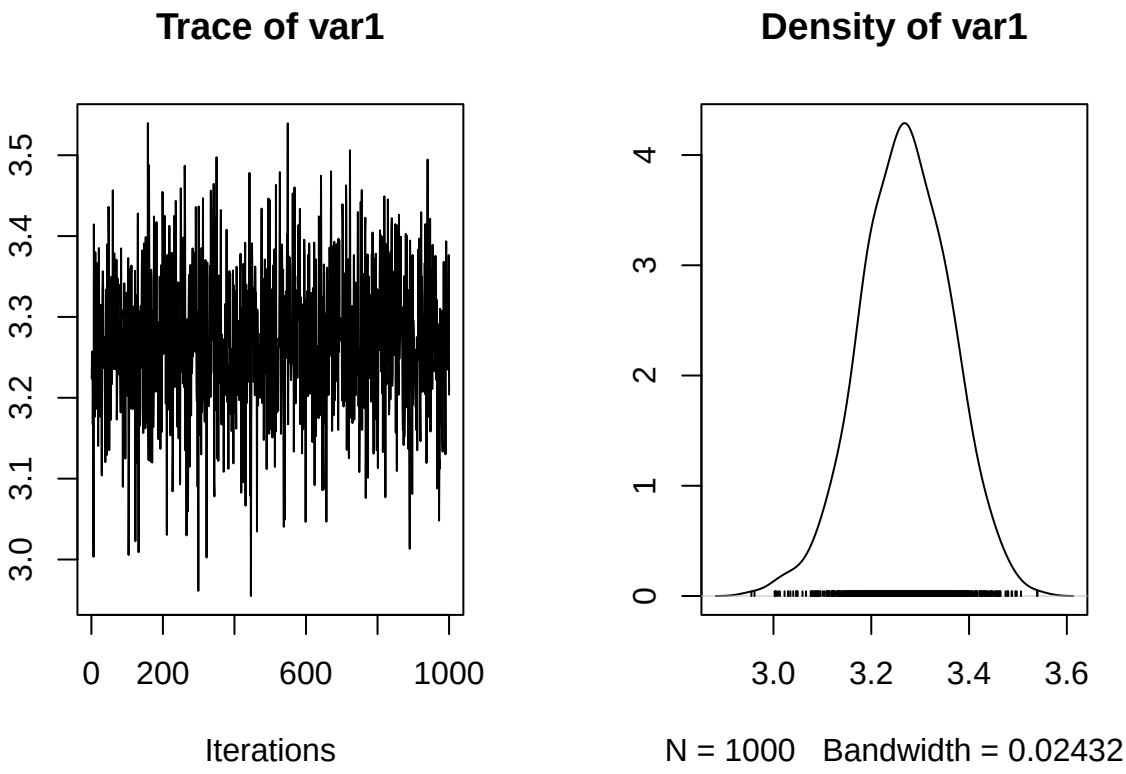

```
quantile(csepost.w[,"beta (Fixed - Growth)"], probs = c(.025, .5, .975))
```

```
##       2.5%        50%      97.5%
## -0.1760123  0.1823150  0.5662757
```

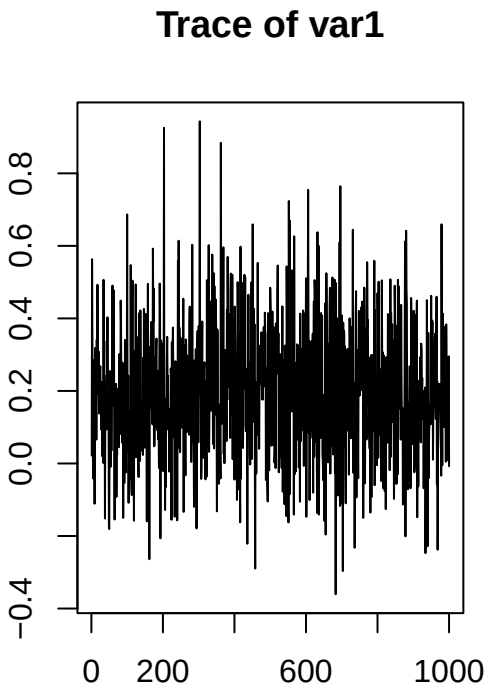
```r
# ultra Wide
ttestBF(formula = CSE ~ Condition, data = d, rscale = "ultrawide")
```

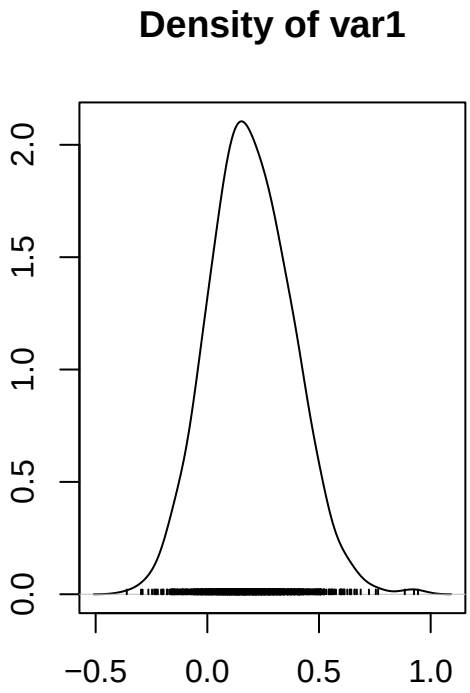
```
## Bayes factor analysis
## --------------
## [1] Alt., r=1.414 : 0.173071 ±0.1%
##
## Against denominator:
##   Null, mu1-mu2 = 0
## ---
## Bayes factor type: BFindepSample, JZS
```

```r
csepost.uw <- ttestBF(formula = CSE ~ Condition, data = d, rscale = "ultrawide", posterior = TRUE, itera
plot(csepost.uw[,"mu"])
```




```r
plot(csepost.uw[,"beta (Fixed - Growth)"])
```

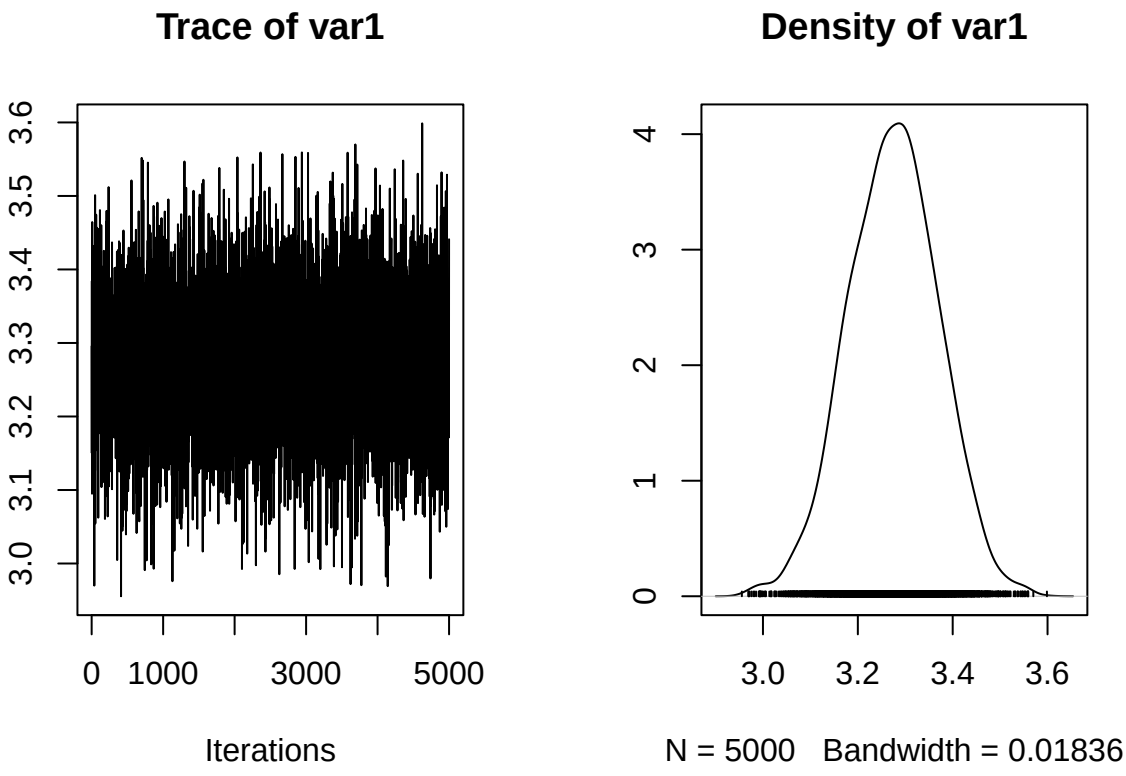




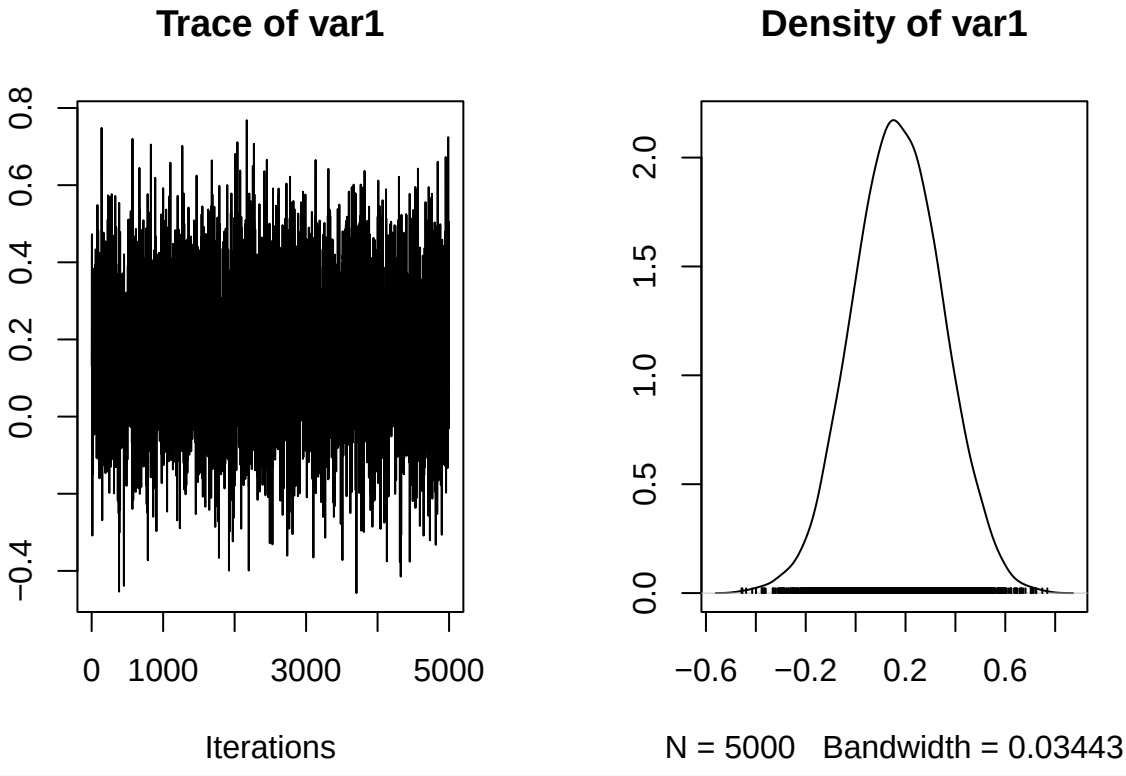

```
quantile(csepost.uw[,"beta (Fixed - Growth)"], probs = c(.025, .5, .975))
```

```
##       2.5%        50%      97.5%
## -0.1499714  0.1867698  0.5634292
```

```
### more iterations
csepost.check <- ttestBF(formula = CSE ~ Condition, data = d, posterior = TRUE, iterations = 5000)
plot(csepost.check[,"mu"])
```




```
plot(csepost.check[,"beta (Fixed - Growth)"])
```




```
quantile(csepost.check[,"beta (Fixed - Growth)"], probs = c(.025, .5, .975))
```

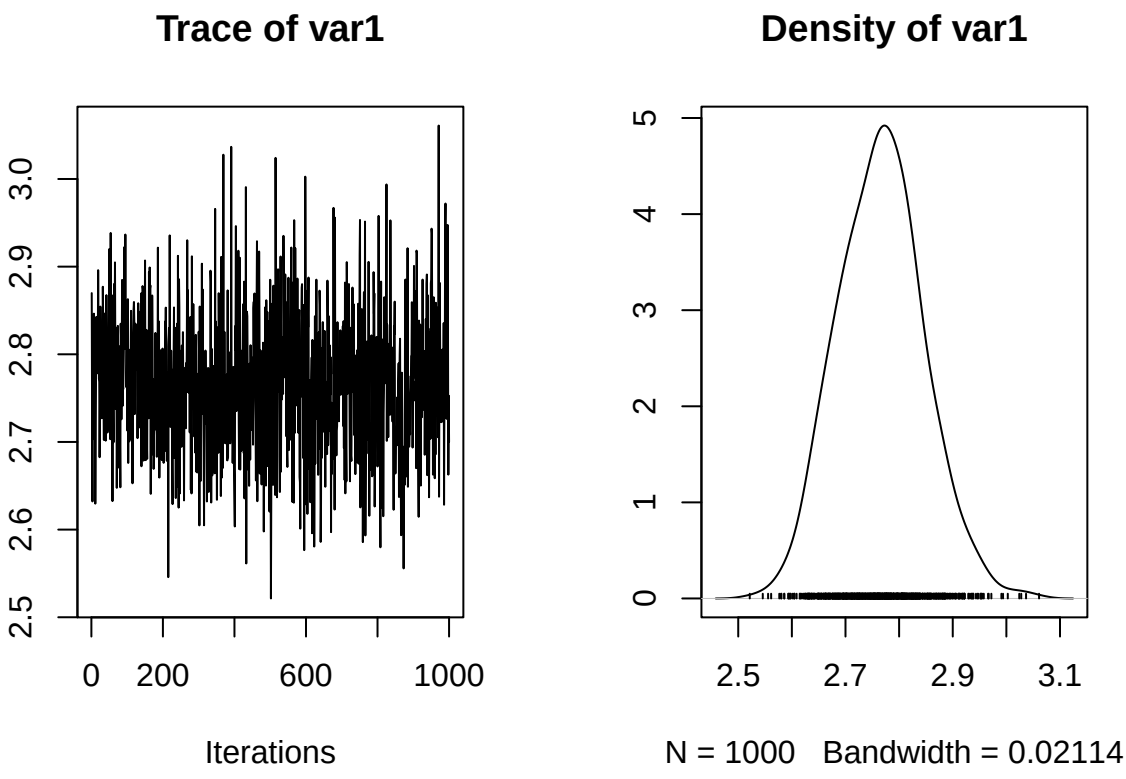
```
##       2.5%        50%      97.5%
## -0.1781354  0.1673873  0.5169461
```

Joan's problem ratings

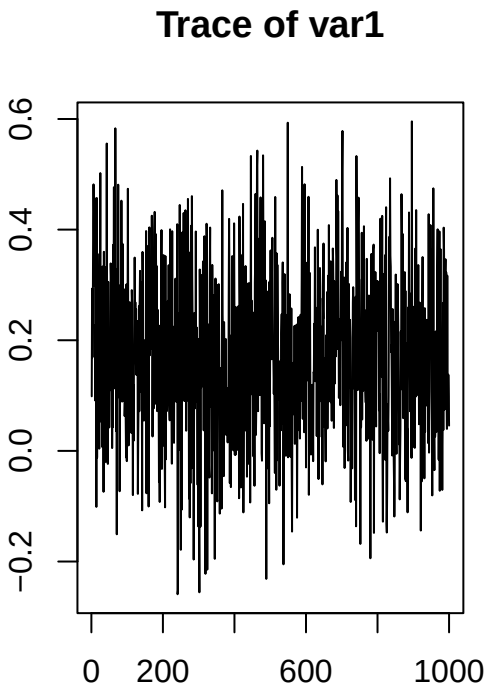
```
# default / medium
ttestBF(formula = JoanScore ~ Condition, data = d)
```

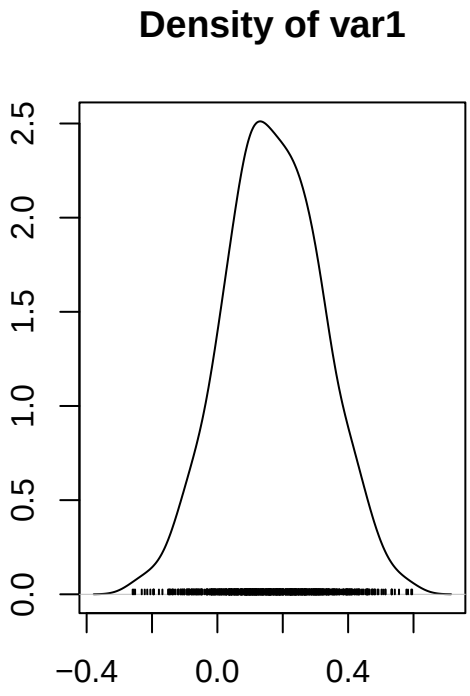
```
## Bayes factor analysis
## --------------
## [1] Alt., r=0.707 : 0.3574592 ±0.02%
##
## Against denominator:
##   Null, mu1-mu2 = 0
## ---
## Bayes factor type: BFindepSample, JZS
```

```
joanpost <- ttestBF(formula = JoanScore ~ Condition, data = d, posterior = TRUE, iterations = 1000)

plot(joanpost[,"mu"])
```




```
plot(joanpost[,"beta (Fixed - Growth)"])
```





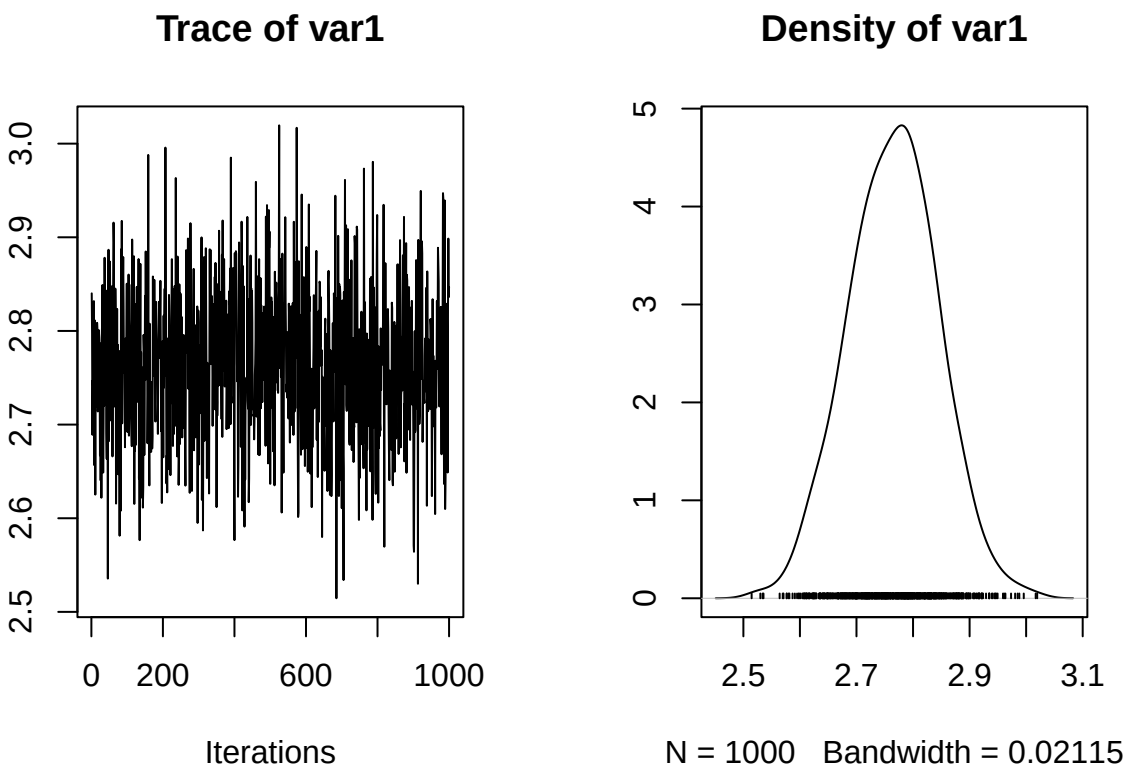

```
quantile(joanpost[,"beta (Fixed - Growth)"], probs = c(.025, .5, .975))
```

```
##       2.5%        50%      97.5%
## -0.1186595  0.1673654  0.4605831
```

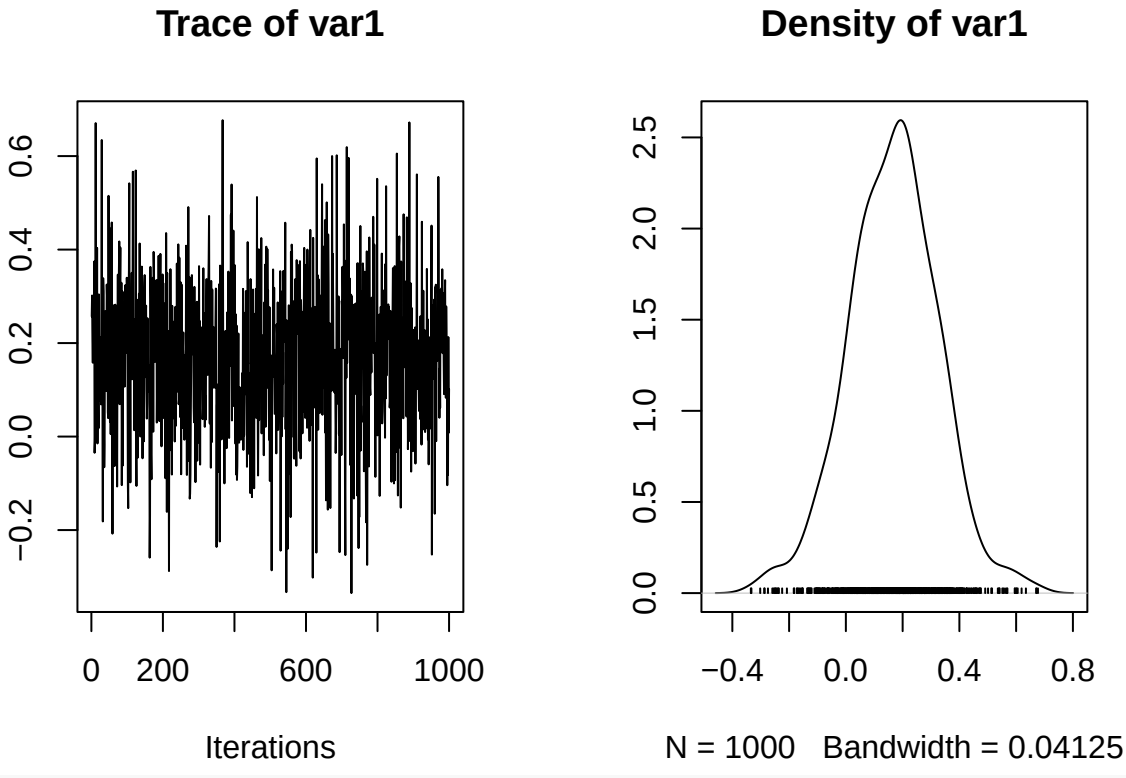
```
# wide
ttestBF(formula = JoanScore ~ Condition, data = d, rscale = "wide")
```

```
## Bayes factor analysis
## --------------
## [1] Alt., r=1 : 0.2680115 ±0.05%
##
## Against denominator:
##   Null, mu1-mu2 = 0
## ---
## Bayes factor type: BFindepSample, JZS
```

```
joanpost.w <- ttestBF(formula = JoanScore ~ Condition, data = d, rscale = "wide", posterior = TRUE, ite

plot(joanpost.w[,"mu"])
```




```
plot(joanpost.w[,"beta (Fixed - Growth)"])
```



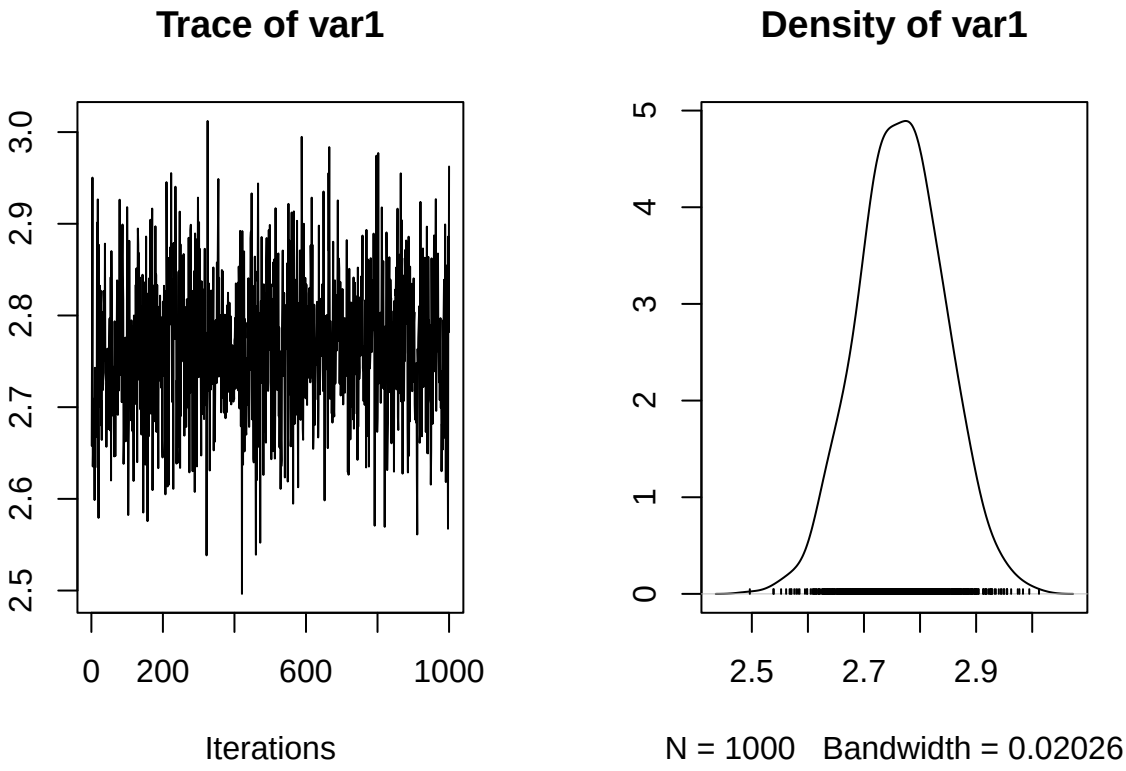

```
quantile(joanpost.w[,"beta (Fixed - Growth)"], probs = c(.025, .5, .975))
```

```
##       2.5%        50%      97.5%
## -0.1531376  0.1739365  0.4720155
```

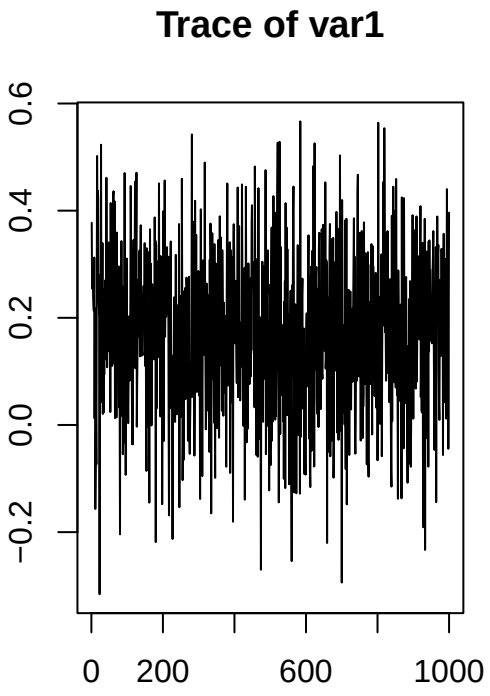
```
# ultrawide
ttestBF(formula = JoanScore ~ Condition, data = d, rscale = "ultrawide")
```

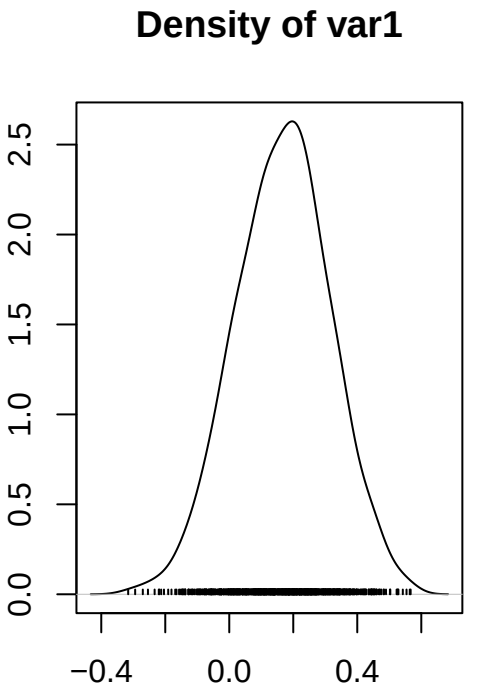
```
## Bayes factor analysis
## --------------
## [1] Alt., r=1.414 : 0.1960675 ±0.09%
##
## Against denominator:
##   Null, mu1-mu2 = 0
## ---
## Bayes factor type: BFindepSample, JZS
```

```
joanpost.uw <- ttestBF(formula = JoanScore ~ Condition, data = d, rscale = "ultrawide", posterior = TRU

plot(joanpost.uw[,"mu"])
```




```
plot(joanpost.uw[,"beta (Fixed - Growth)"])
```

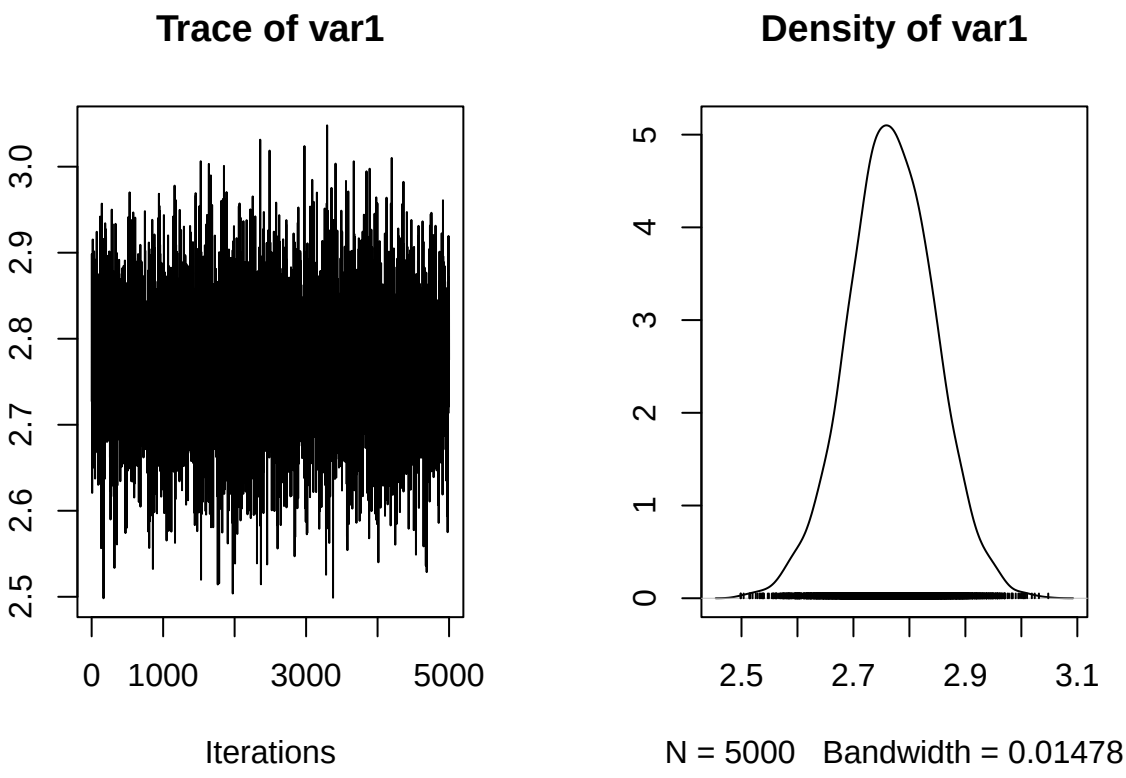




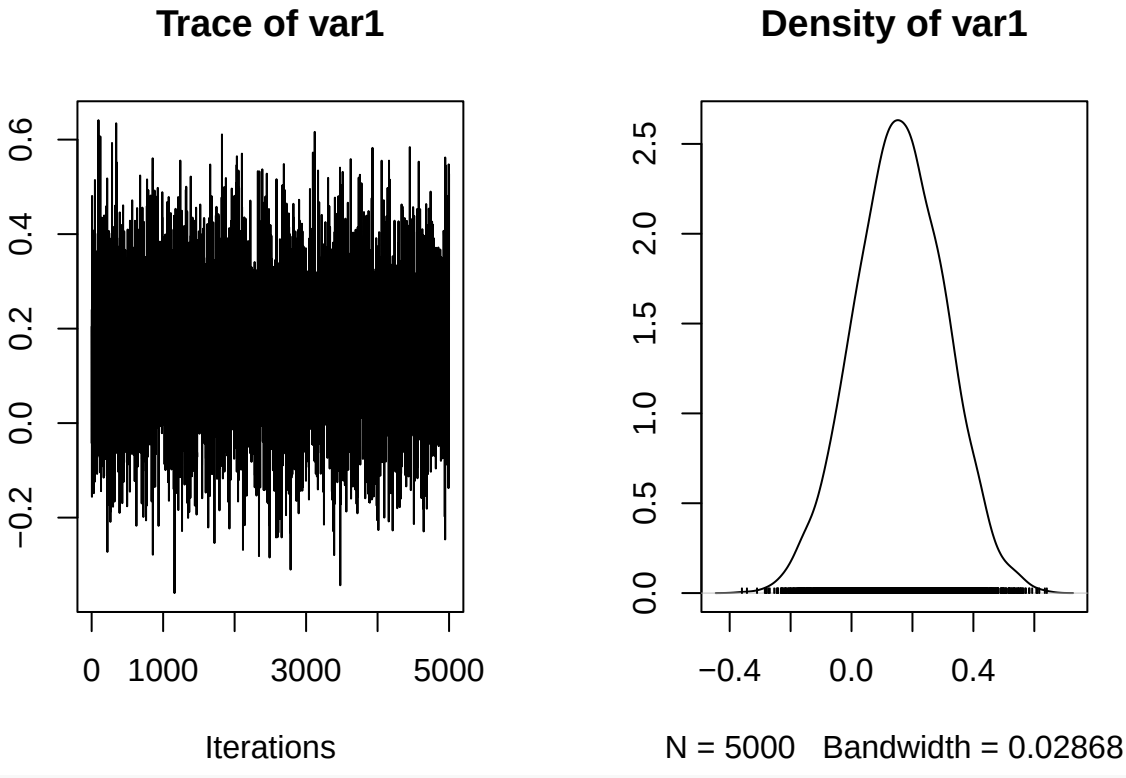

```
quantile(joanpost.uw[,"beta (Fixed - Growth)"], probs = c(.025, .5, .975))
```

```
##       2.5%        50%      97.5%
## -0.1274836  0.1734112  0.4507211
```

```
### more iterations
joanpost.check <- ttestBF(formula = JoanScore ~ Condition, data = d, posterior = TRUE, iterations = 500

plot(joanpost.check[,"mu"])
```




```
plot(joanpost.check[,"beta (Fixed - Growth)"])
```




```
quantile(joanpost.check[,"beta (Fixed - Growth)"], probs = c(.025, .5, .975))
```

```
##       2.5%        50%      97.5%
## -0.1395923  0.1578671  0.4416287
```

Divergent thinking

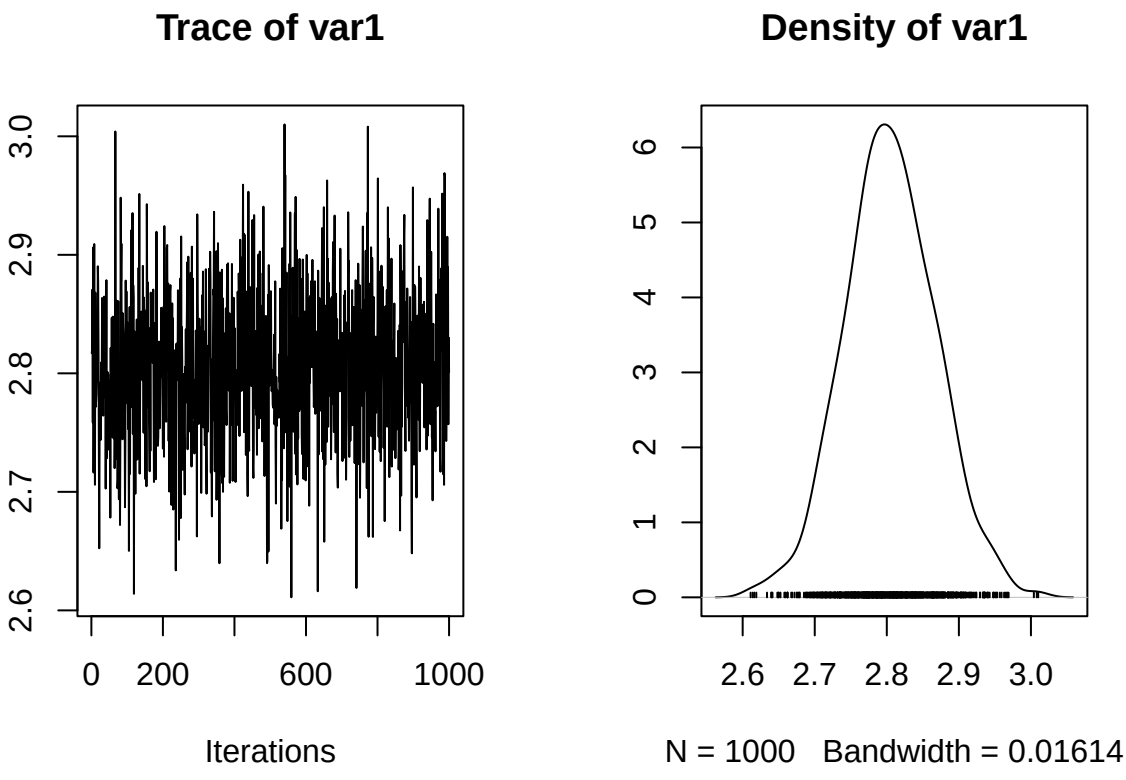
note, two participants failed to respond to the DT prompts (row 17 and 25) and were not included in this analysis

Divergent Thinking Originality

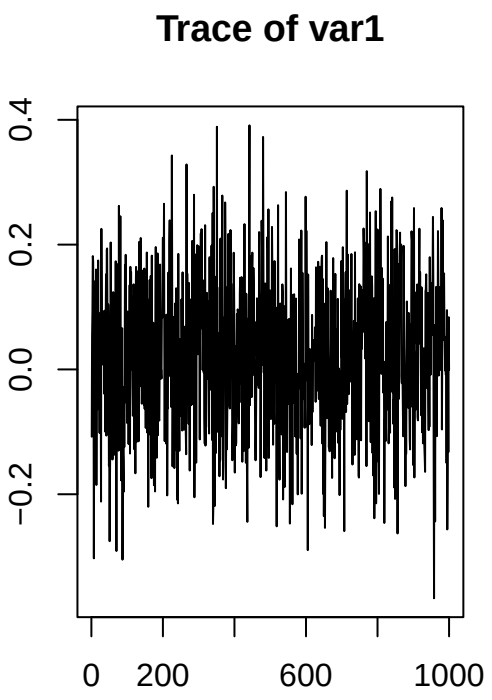
```
## first make the subset data
dt.subset <- na.omit(d[,c("DTScore","DTFlu","Condition")])

## DT originality ratings

# Default / medium
ttestBF(formula = DTScore ~ Condition, data = dt.subset)
```

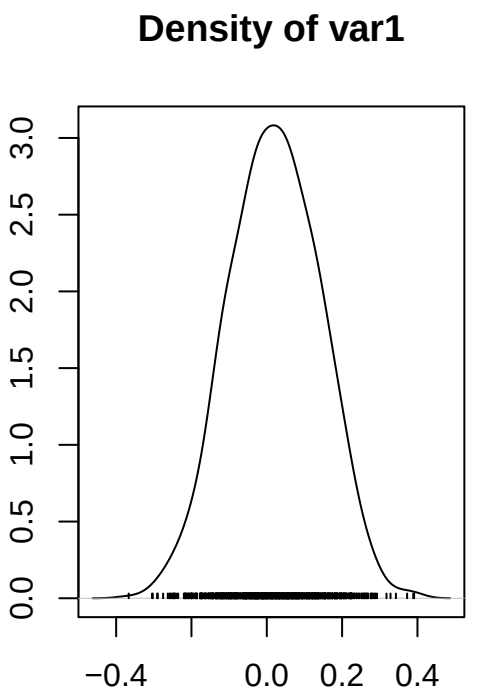
```
## Bayes factor analysis
## --------------
## [1] Alt., r=0.707 : 0.2056849 ±0.03%
##
## Against denominator:
##   Null, mu1-mu2 = 0
## ---
## Bayes factor type: BFindepSample, JZS
```

```
dtpost <- ttestBF(formula = DTScore ~ Condition, data = dt.subset, posterior = TRUE, iterations = 1000)

plot(dtpost[,"mu"])
```




```
plot(dtpost[,"beta (Fixed - Growth)"])
```





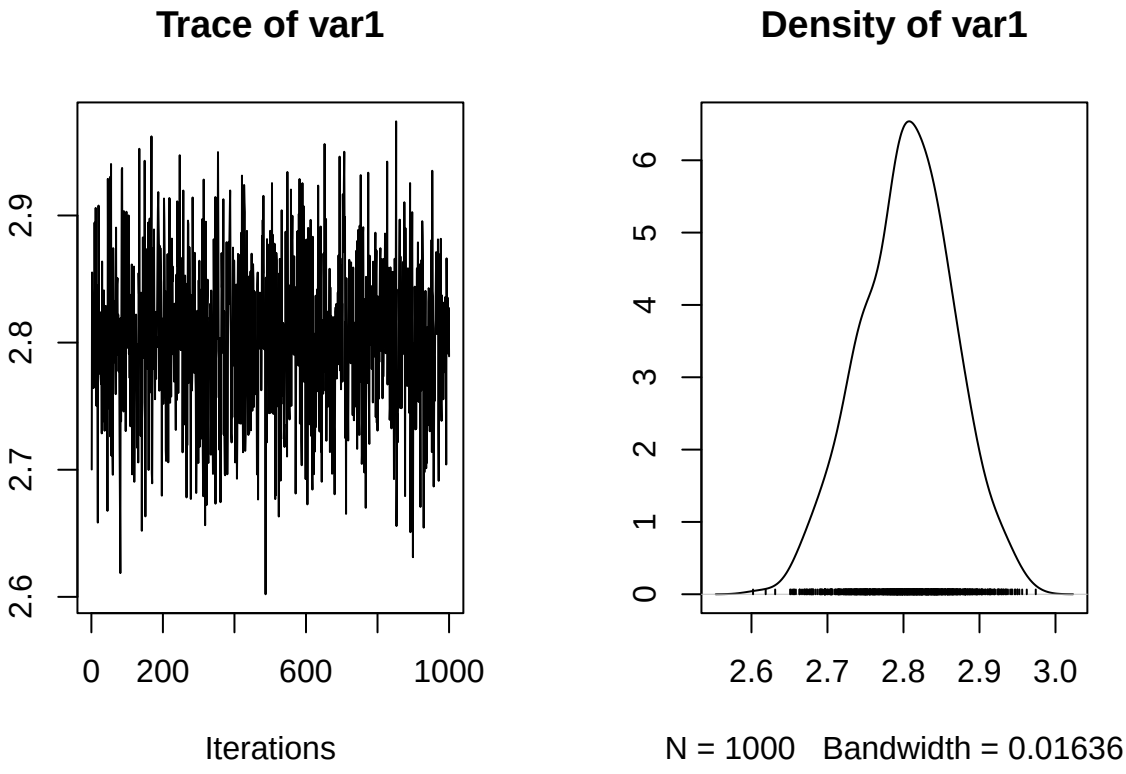

```
quantile(dtpost[,"beta (Fixed - Growth)"], probs = c(.025, .5, .975))
```

```
##        2.5%         50%       97.5%
## -0.20890209  0.02049619  0.24566789
```

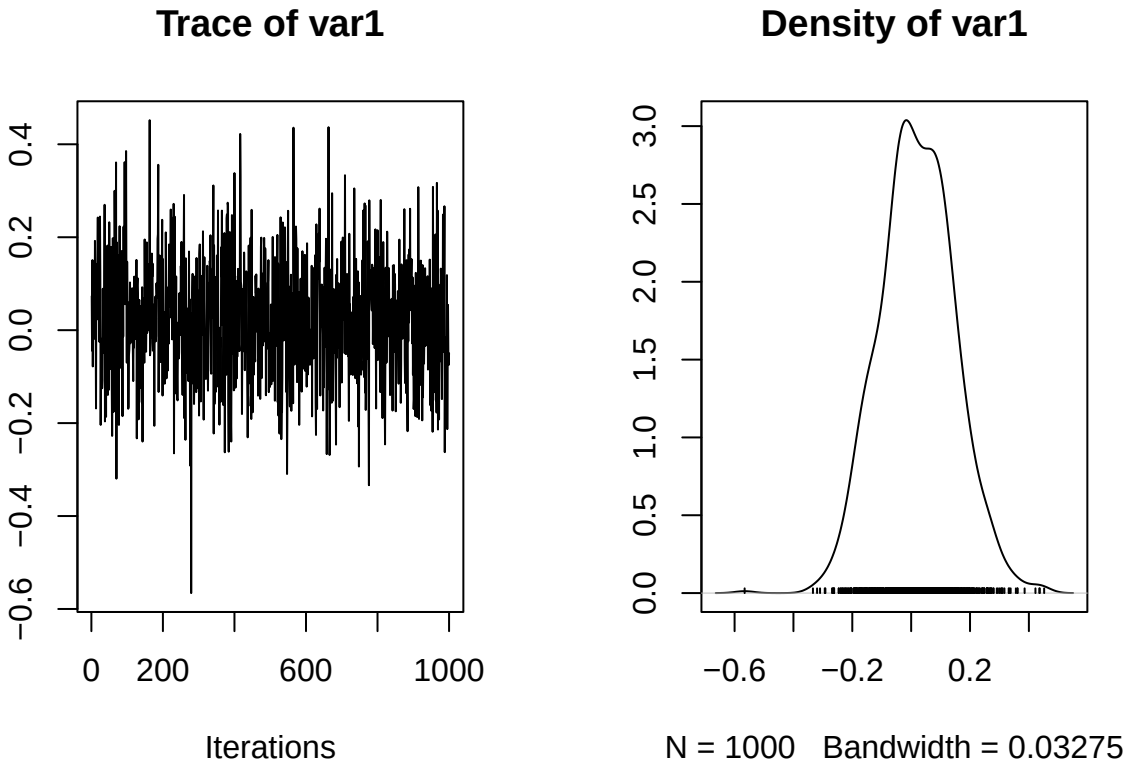
```
# wide
ttestBF(formula = DTScore ~ Condition, data = dt.subset, rscale = "wide")
```

```
## Bayes factor analysis
## --------------
## [1] Alt., r=1 : 0.1498916 ±0.08%
##
## Against denominator:
##   Null, mu1-mu2 = 0
## ---
## Bayes factor type: BFindepSample, JZS
```

```
dtpost.w <- ttestBF(formula = DTScore ~ Condition, data = dt.subset, rscale = "wide", posterior = TRUE,

plot(dtpost.w[,"mu"])
```




```
plot(dtpost.w[,"beta (Fixed - Growth)"])
```



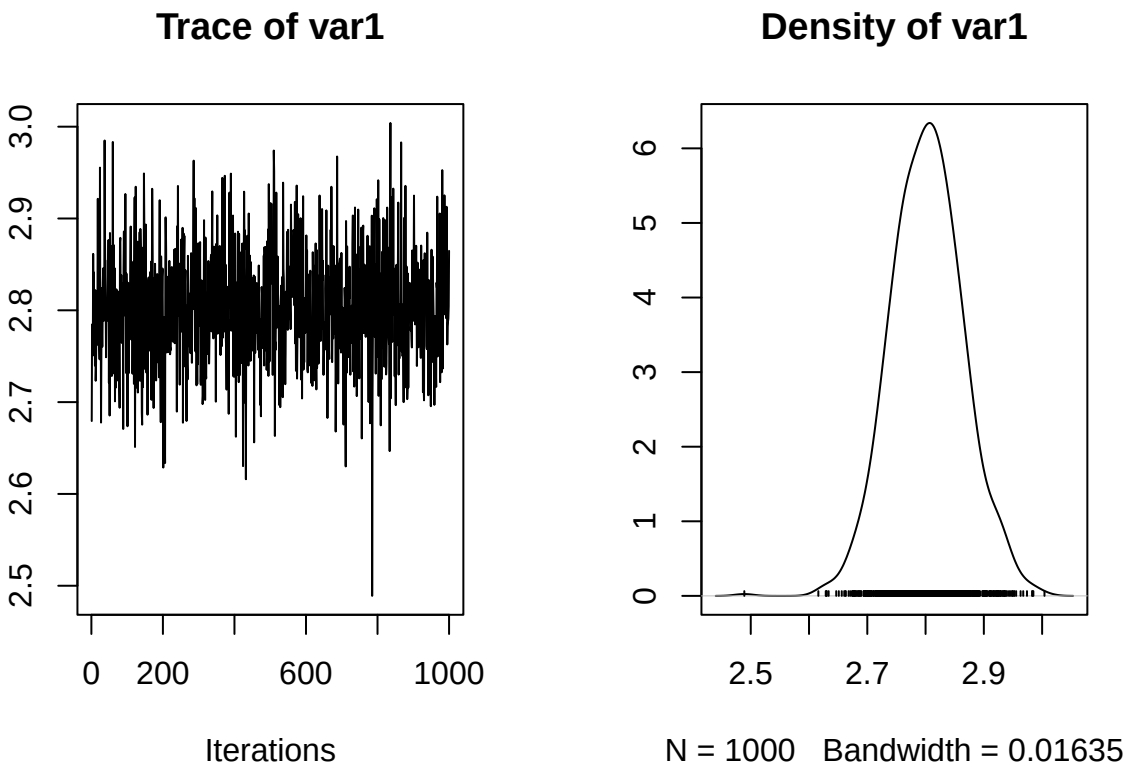

```
quantile(dtpost.w[,"beta (Fixed - Growth)"], probs = c(.025, .5, .975))
```

```
##       2.5%        50%      97.5%
## -0.2174833  0.0188377  0.2685011
```

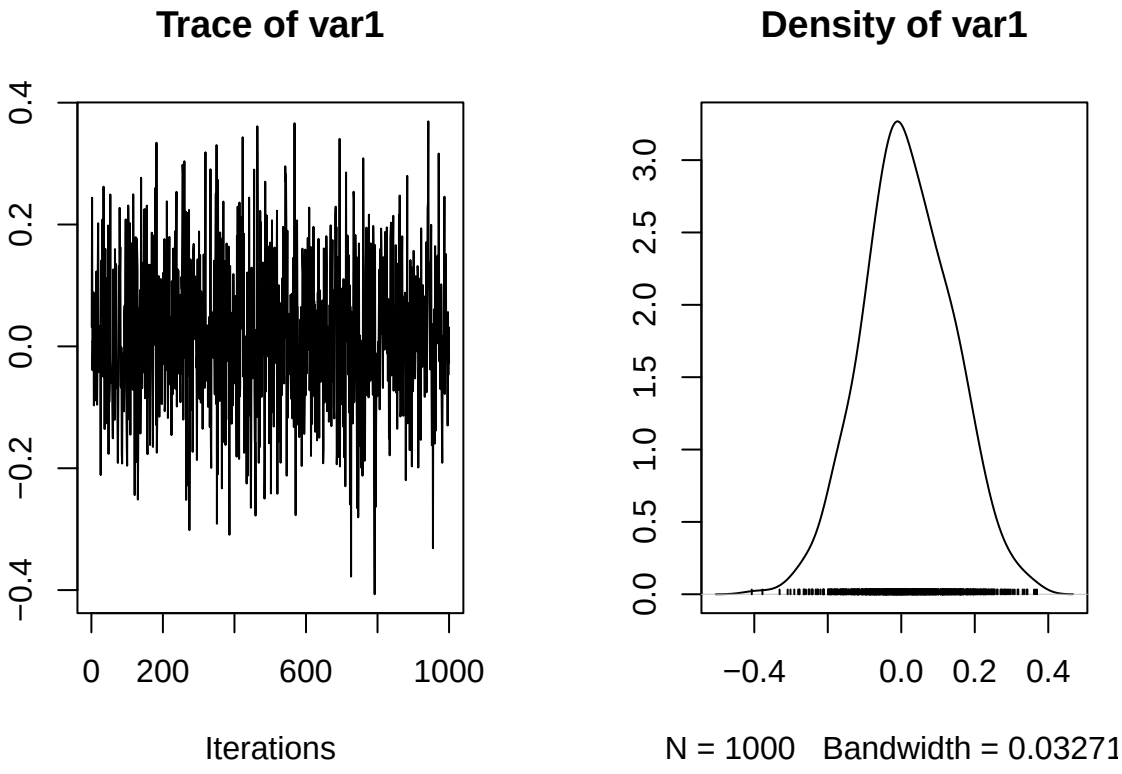
```
# ultra wide
ttestBF(formula = DTScore ~ Condition, data = dt.subset, rscale = "ultrawide")
```

```
## Bayes factor analysis
## --------------
## [1] Alt., r=1.414 : 0.1077728 ±0.15%
##
## Against denominator:
##   Null, mu1-mu2 = 0
## ---
## Bayes factor type: BFindepSample, JZS
```

```
dtpost.uw <- ttestBF(formula = DTScore ~ Condition, data = dt.subset, rscale = "ultrawide", posterior =

plot(dtpost.uw[,"mu"])
```



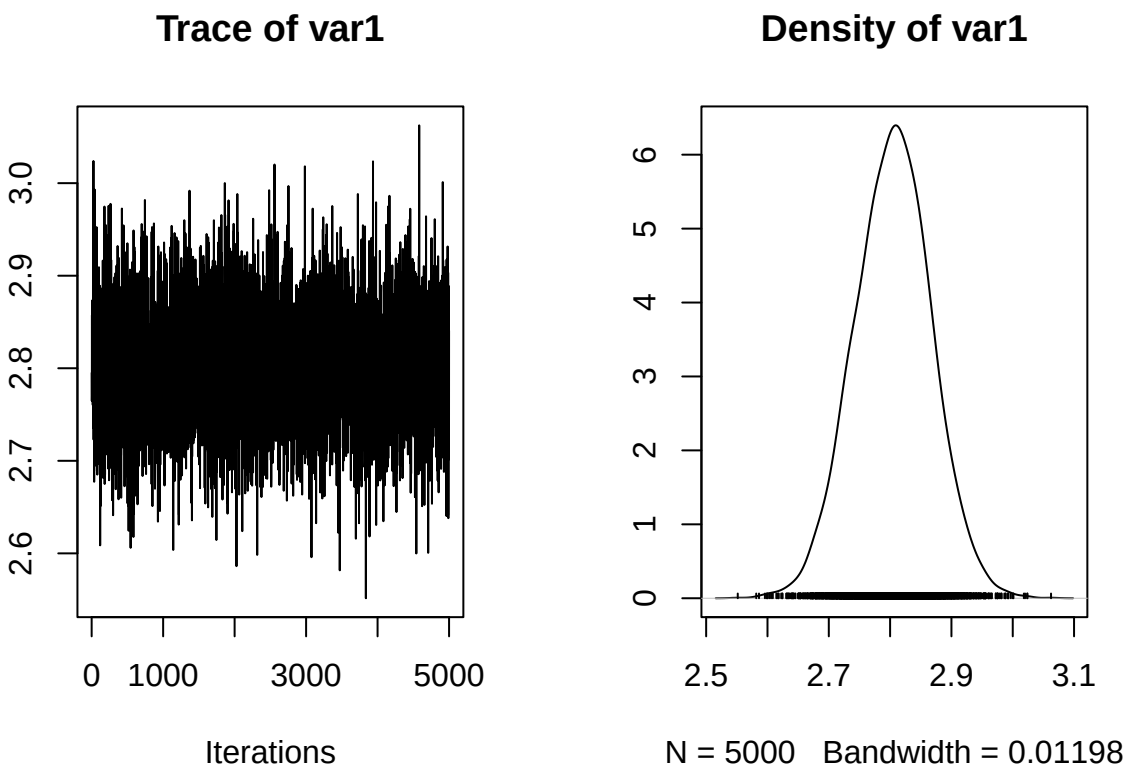

```
plot(dtpost.uw[,"beta (Fixed - Growth)"])
```



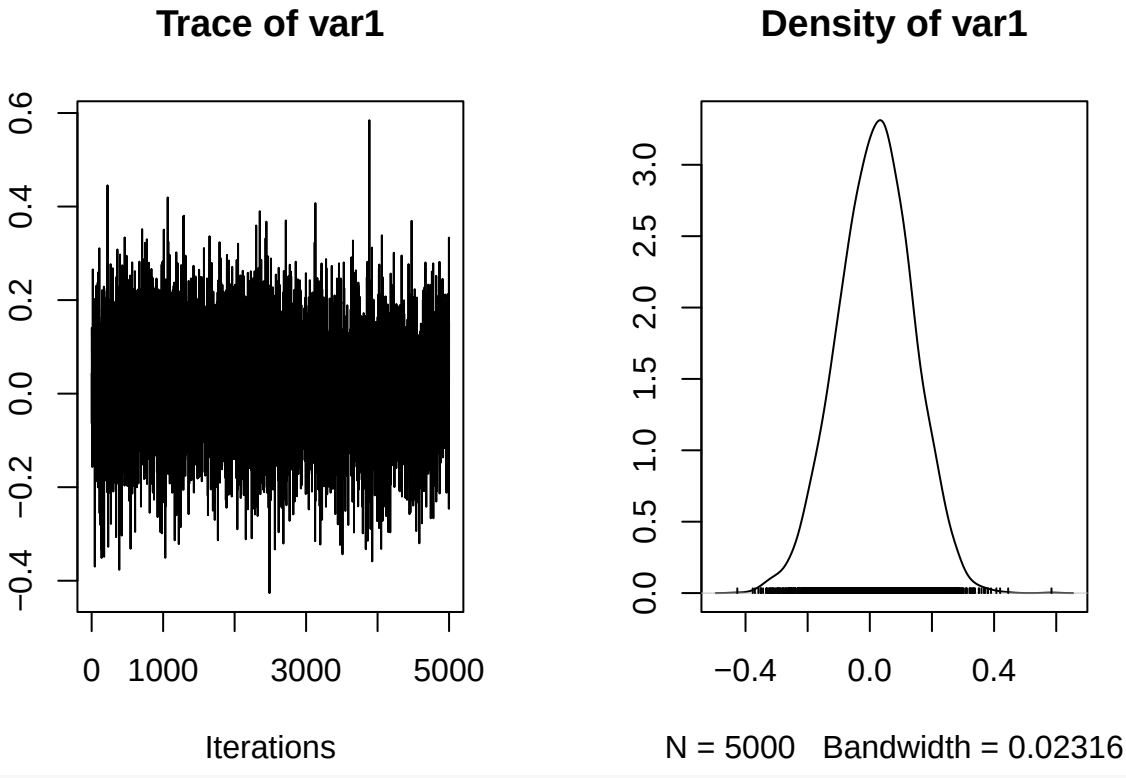

```
quantile(dtpost.uw[,"beta (Fixed - Growth)"], probs = c(.025, .5, .975))
```

```
##        2.5%         50%       97.5%
## -0.21249611  0.01019647  0.25403206
```

```
# More iterations
dtpost.check <- ttestBF(formula = DTScore ~ Condition, data = dt.subset, posterior = TRUE, iterations =

plot(dtpost.check[,"mu"])
```




```
plot(dtpost.check[,"beta (Fixed - Growth)"])
```




```
quantile(dtpost.check[,"beta (Fixed - Growth)"], probs = c(.025, .5, .975))
```

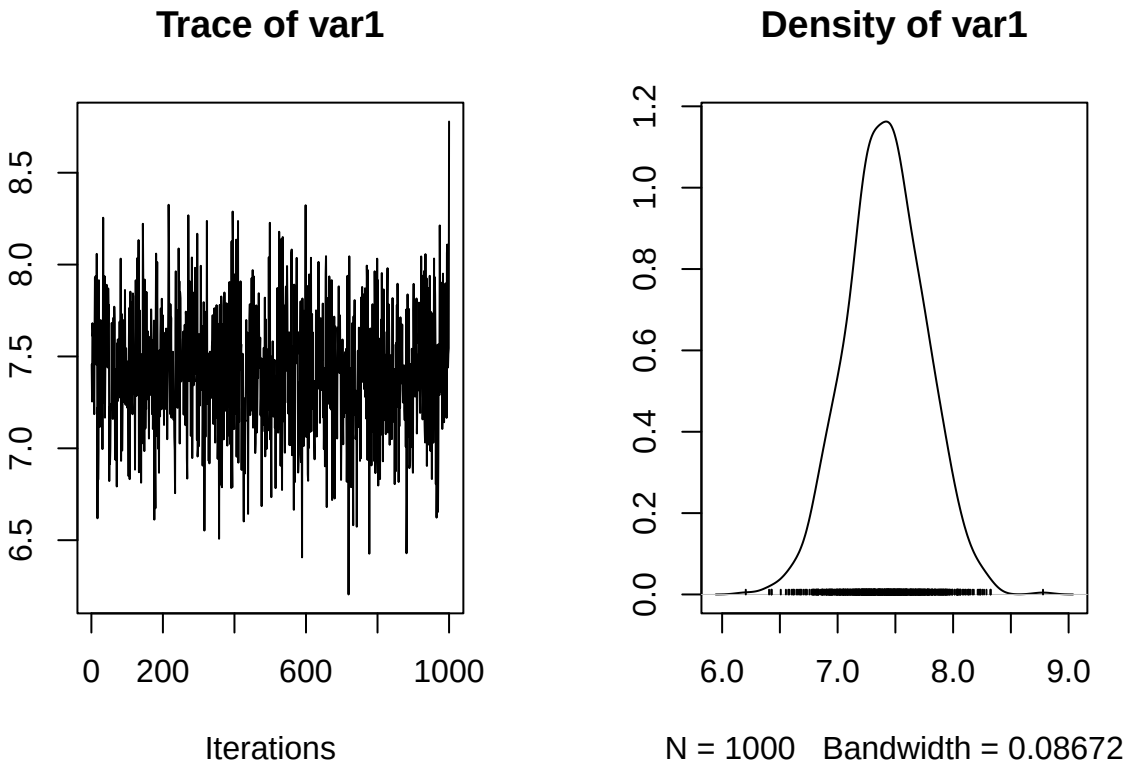
```
##        2.5%         50%       97.5%
## -0.21780014  0.02103769  0.24612178
```

DT fluency

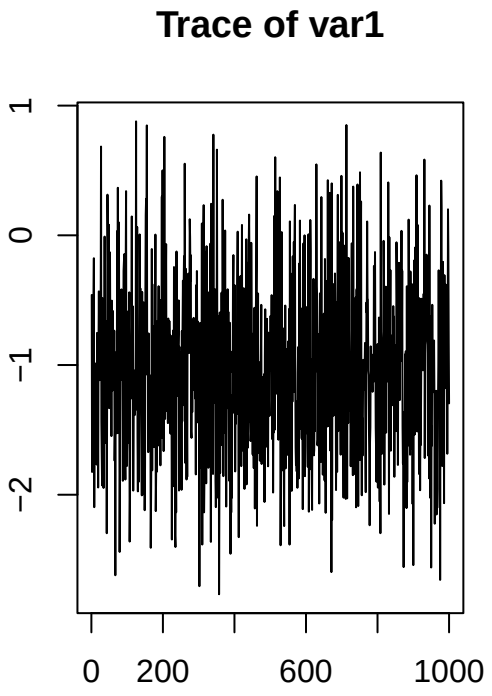
```
# default / medium
ttestBF(formula = DTFlu ~ Condition, data = dt.subset)
```

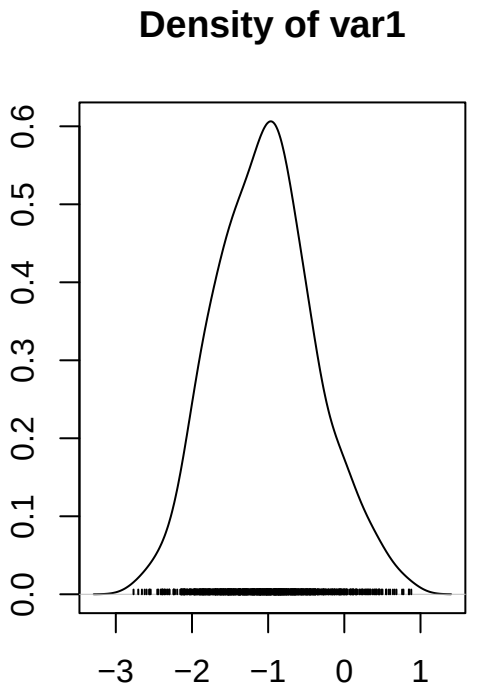
```
## Bayes factor analysis
## --------------
## [1] Alt., r=0.707 : 0.7210424 ±0.02%
##
## Against denominator:
##   Null, mu1-mu2 = 0
## ---
## Bayes factor type: BFindepSample, JZS
```

```
flupost <- ttestBF(formula = DTFlu ~ Condition, data = dt.subset, posterior = TRUE, iterations = 1000)

plot(flupost[,"mu"])
```




```
plot(flupost[,"beta (Fixed - Growth)"])
```





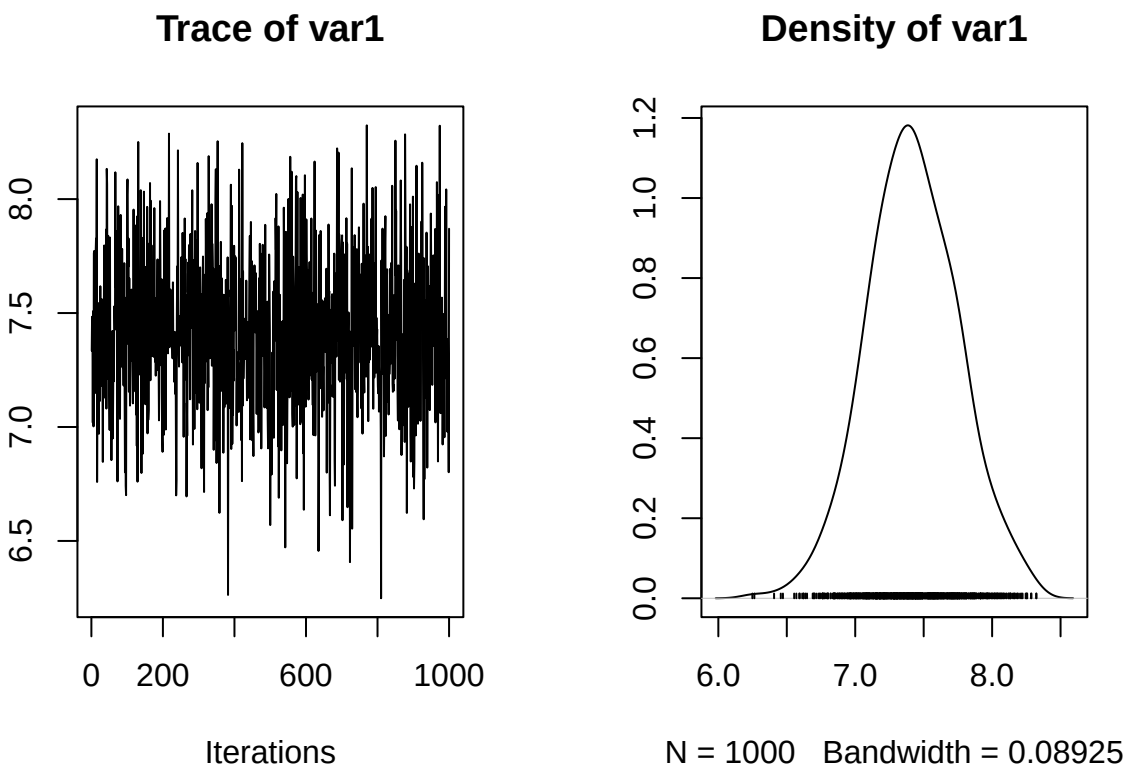

```
quantile(flupost[,"beta (Fixed - Growth)"], probs = c(.025, .5, .975))
```

```
##       2.5%        50%      97.5%
## -2.2237639 -1.0404673  0.3412296
```

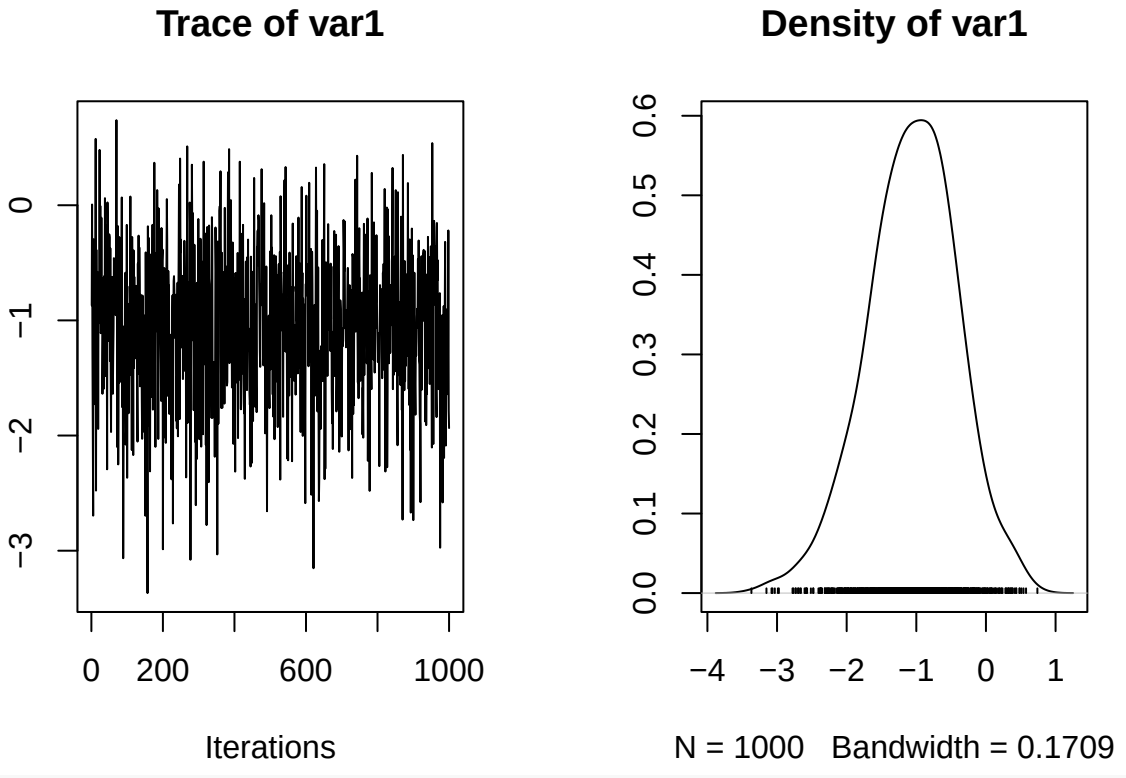
```
# wide

ttestBF(formula = DTFlu ~ Condition, data = dt.subset, rscale = "wide")
```

```
## Bayes factor analysis
## --------------
## [1] Alt., r=1 : 0.5596128 ±0.03%
##
## Against denominator:
##   Null, mu1-mu2 = 0
## ---
## Bayes factor type: BFindepSample, JZS
```

```
flupost.w <- ttestBF(formula = DTFlu ~ Condition, data = dt.subset, rscale = "wide", posterior = TRUE, i

plot(flupost.w[,"mu"])
```




```
plot(flupost.w[,"beta (Fixed - Growth)"])
```



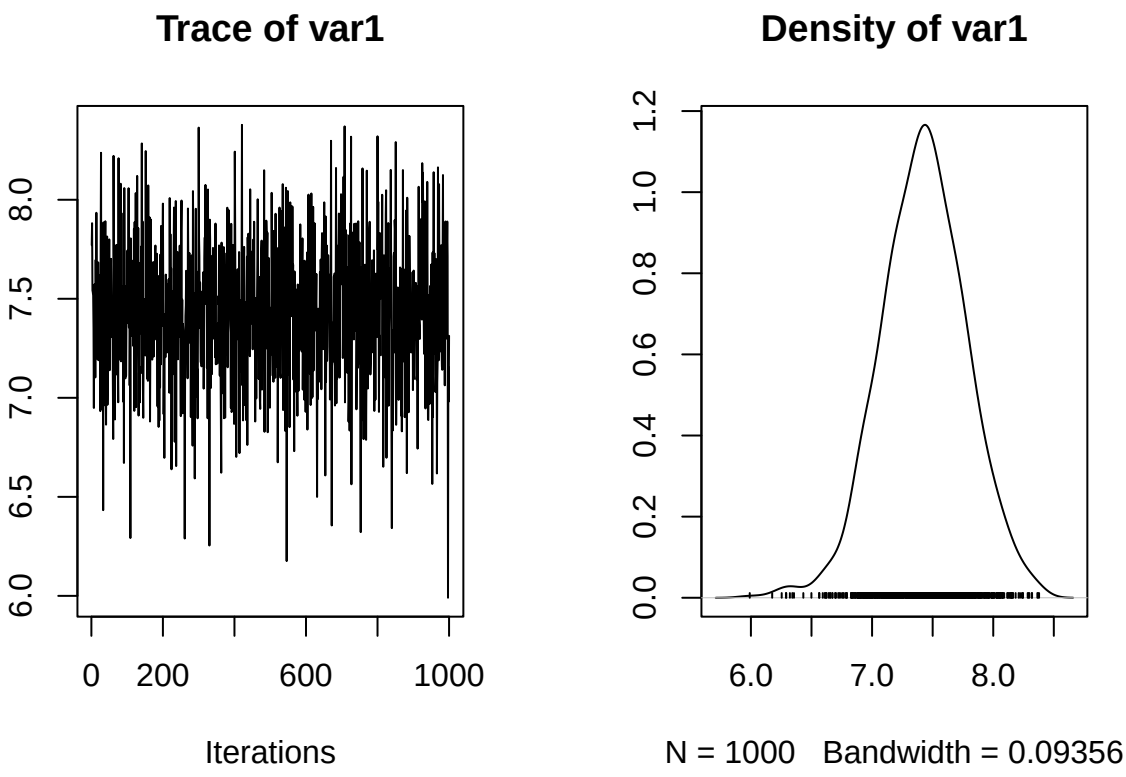

```
quantile(flupost.w[,"beta (Fixed - Growth)"], probs = c(.025, .5, .975))
```

```
##       2.5%        50%      97.5%
## -2.3803232 -1.0393014  0.1930067
```

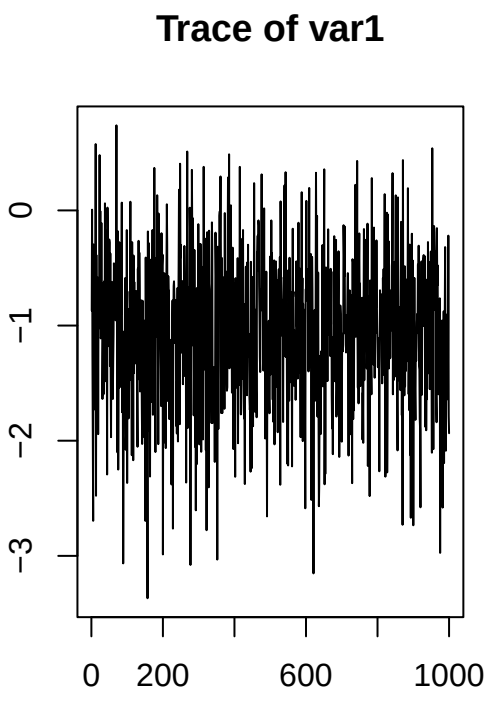
```r
# ultrawide

ttestBF(formula = DTFlu ~ Condition, data = dt.subset, rscale = "ultrawide")
```

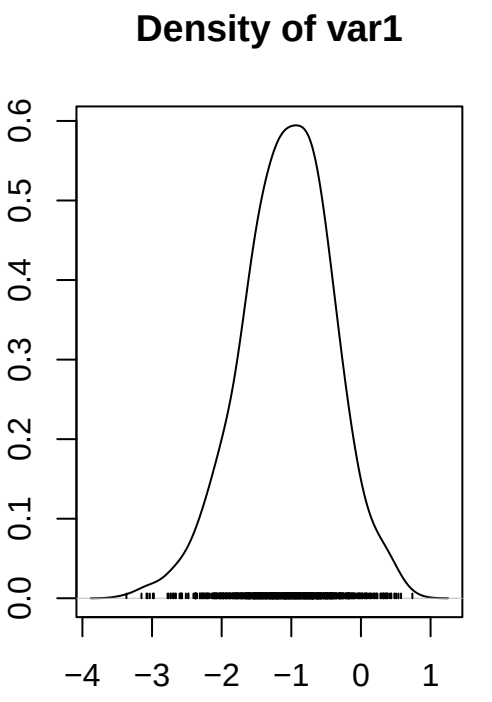
```
## Bayes factor analysis
## --------------
## [1] Alt., r=1.414 : 0.4183677 ±0.05%
##
## Against denominator:
##   Null, mu1-mu2 = 0
## ---
## Bayes factor type: BFindepSample, JZS
```

```r
flupost.uw <- ttestBF(formula = DTFlu ~ Condition, data = dt.subset, rscale = "ultrawide", posterior = 

plot(flupost.uw[,"mu"])
```




```r
plot(flupost.w[,"beta (Fixed - Growth)"])
```

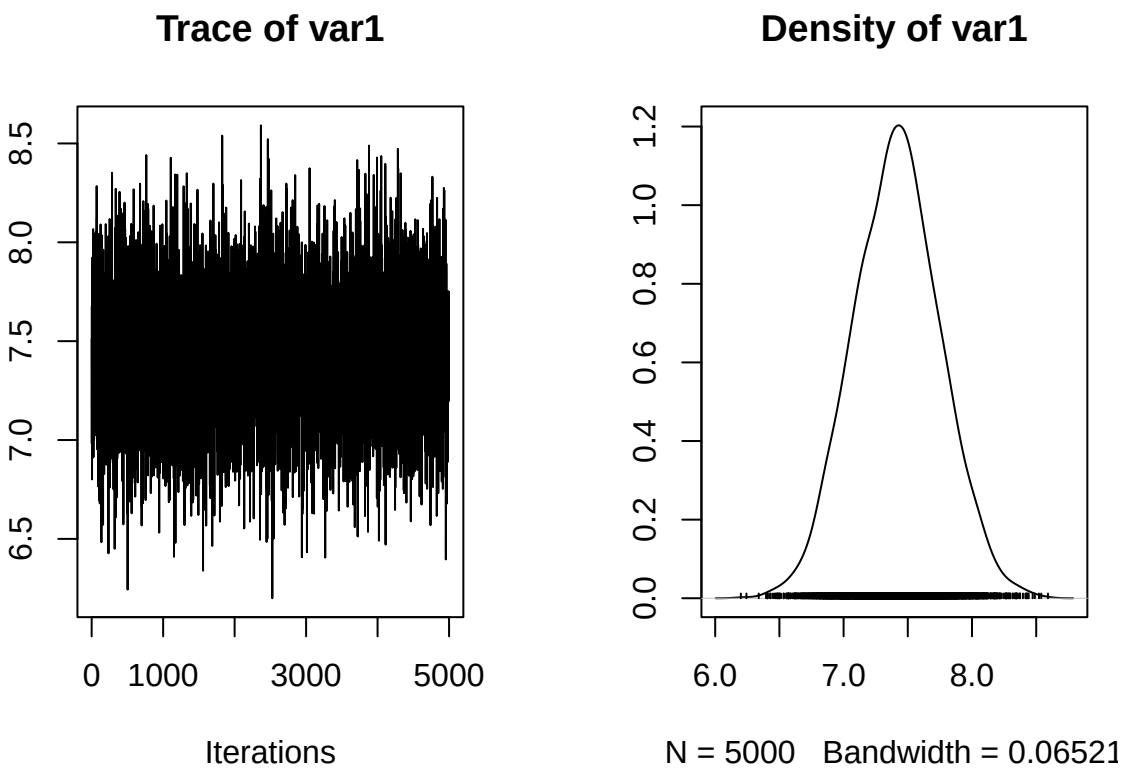




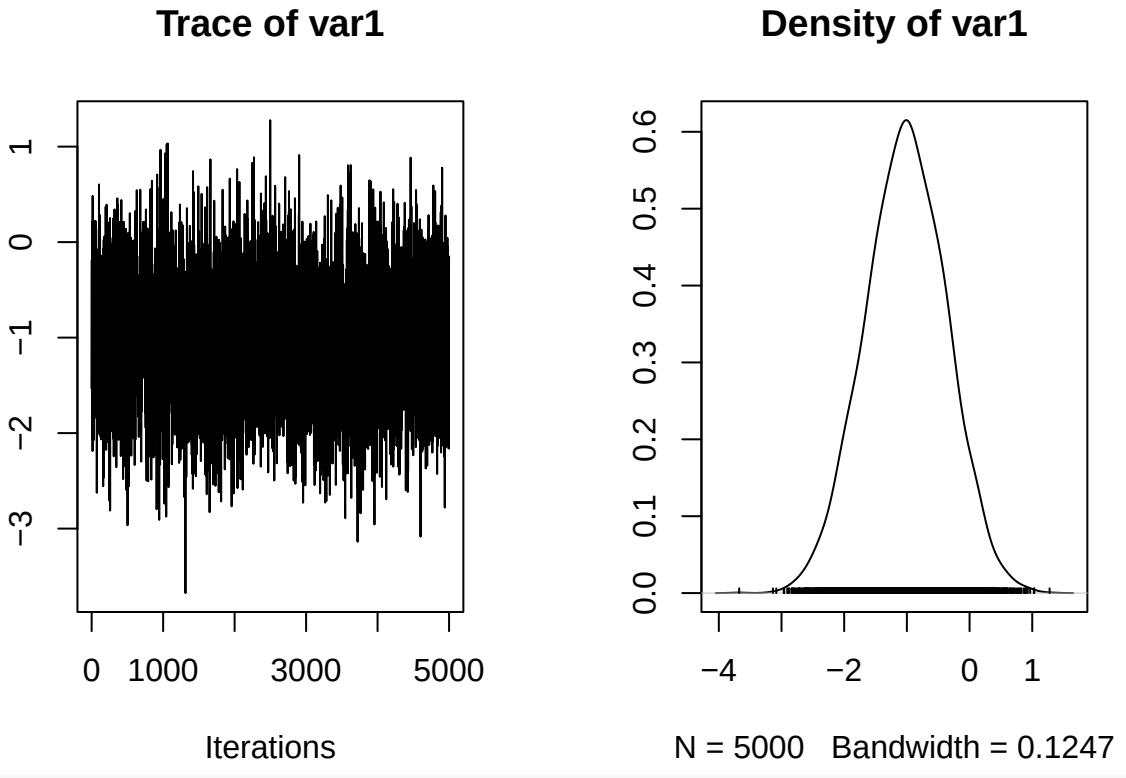

```
quantile(flupost.uw[,"beta (Fixed - Growth)"], probs = c(.025, .5, .975))
```

```
##       2.5%        50%      97.5%
## -2.4107607 -1.1280036  0.0965674
```

```
## More iterations
flupost.check <- ttestBF(formula = DTFlu ~ Condition, data = dt.subset, posterior = TRUE, iterations = 5

plot(flupost.check[,"mu"])
```




```
plot(flupost.check[,"beta (Fixed - Growth)"])
```




```
quantile(flupost.check[,"beta (Fixed - Growth)"], probs = c(.025, .5, .975))
```

```
##      2.5%       50%     97.5%
## -2.300783 -1.011913  0.212568
```

Cohen's D for all effects

```
# effect sizes
cohen.d(Fixed ~ Condition, data = d)
```

```
## Call: cohen.d(x = Fixed ~ Condition, data = d)
## Cohen d statistic of difference between two means
##       lower effect upper
## Fixed -0.92  -0.54 -0.16
##
## Multivariate (Mahalanobis) distance between groups
## [1] 0.54
## r equivalent of difference between two means
## Fixed
## -0.26
```

```
cohen.d(Growth ~ Condition, data = d)
```

```
## Call: cohen.d(x = Growth ~ Condition, data = d)
## Cohen d statistic of difference between two means
##        lower effect upper
## Growth  0.24   0.63  1.01
##
## Multivariate (Mahalanobis) distance between groups
## [1] 0.63
## r equivalent of difference between two means
## Growth
##    0.3
```

```
cohen.d(CSE ~ Condition, data = d)
```

```
## Call: cohen.d(x = CSE ~ Condition, data = d)
## Cohen d statistic of difference between two means
##     lower effect upper
## CSE -0.57  -0.19  0.18
##
## Multivariate (Mahalanobis) distance between groups
## [1] 0.19
## r equivalent of difference between two means
##  CSE
## -0.1
```

```
cohen.d(JoanScore ~ Condition, data = d)
```

```
## Call: cohen.d(x = JoanScore ~ Condition, data = d)
## Cohen d statistic of difference between two means
##           lower effect upper
## JoanScore -0.59  -0.22  0.16
##
## Multivariate (Mahalanobis) distance between groups
## [1] 0.22
## r equivalent of difference between two means
## JoanScore
##     -0.11
```

```
cohen.d(DTScore ~ Condition, data = dt.subset)
```

```
## Call: cohen.d(x = DTScore ~ Condition, data = dt.subset)
## Cohen d statistic of difference between two means
##         lower effect upper
## DTScore -0.41  -0.03  0.34
##
## Multivariate (Mahalanobis) distance between groups
## [1] 0.033
## r equivalent of difference between two means
## DTScore
##   -0.02
```

```
cohen.d(DTFlu ~ Condition, data = dt.subset)
```

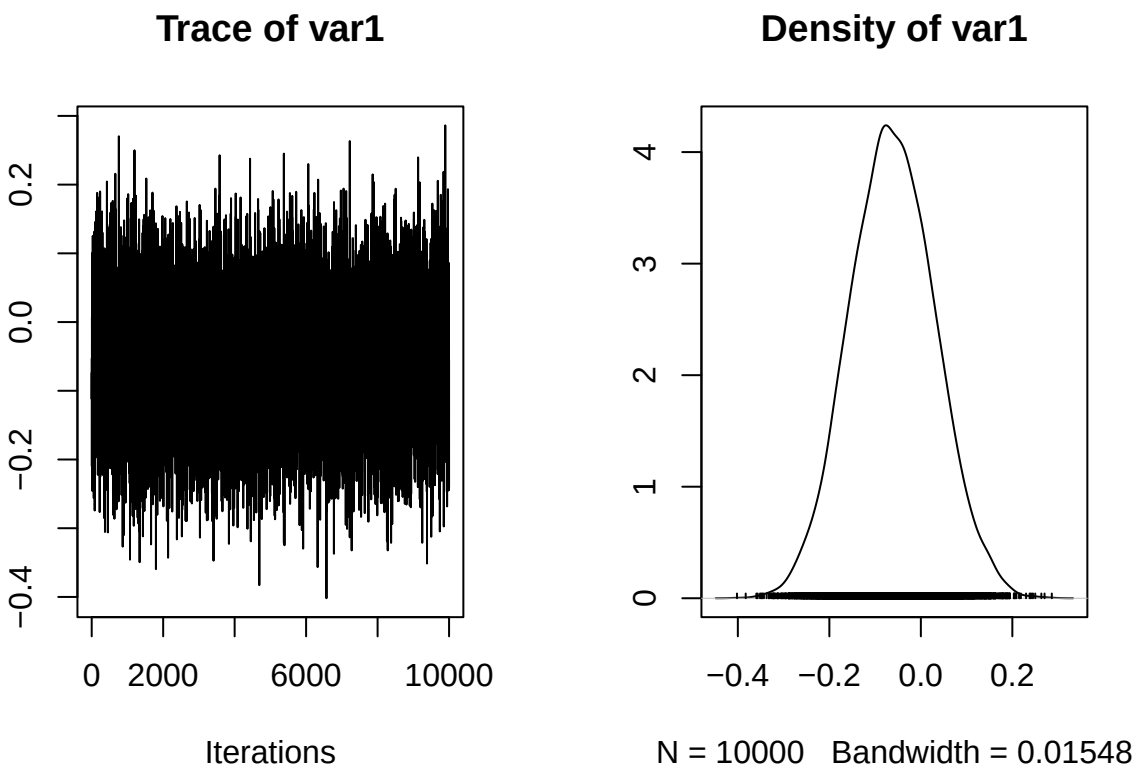
```
## Call: cohen.d(x = DTFlu ~ Condition, data = dt.subset)
## Cohen d statistic of difference between two means
##       lower effect upper
## DTFlu -0.05   0.33   0.7
##
## Multivariate (Mahalanobis) distance between groups
## [1] 0.33
## r equivalent of difference between two means
## DTFlu
##  0.16
```

Hypothesis 3 and 4

```
# correlations from BF including posterior

# hypothesis 3
samp3 <- correlationBF(y = d$JoanScore, x = d$Fixed, posterior = T, iterations = 10000)
```

```
## Independent-candidate M-H acceptance rate: 98%
```

```
plot(samp3[,"rho"])
```



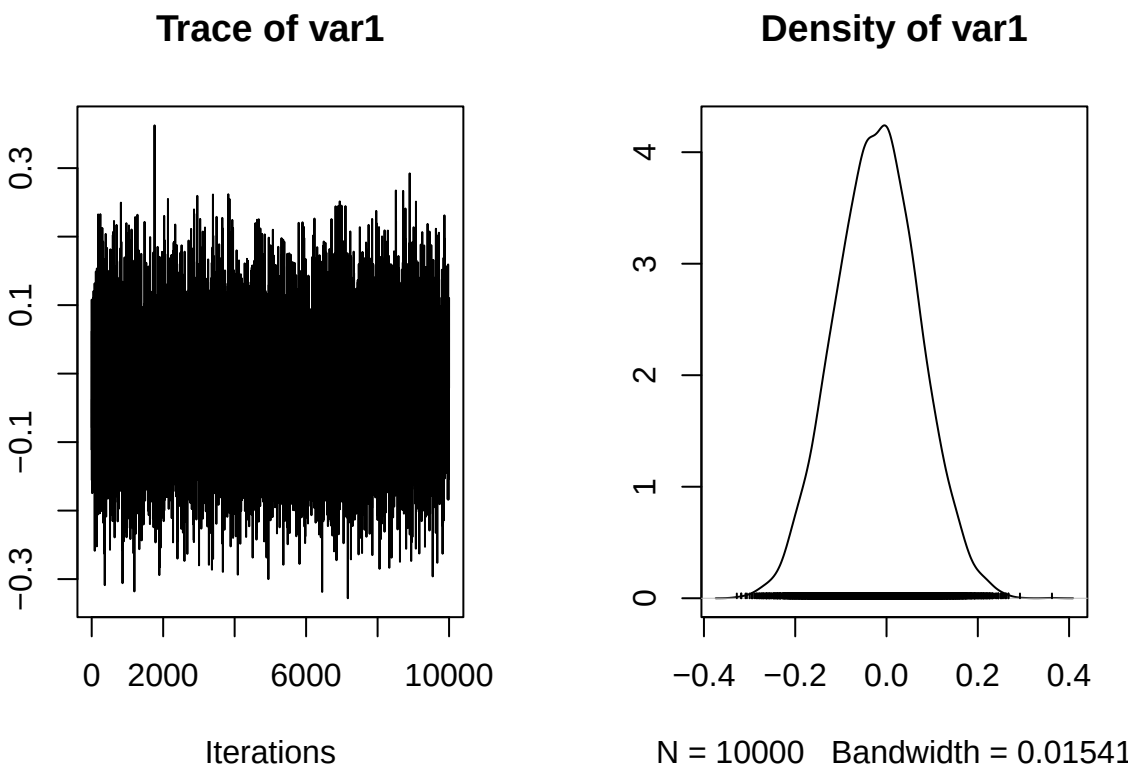

```
summary(samp3)
```

```
##
## Iterations = 1:10000
## Thinning interval = 1
## Number of chains = 1
## Sample size per chain = 10000
##
## 1. Empirical mean and standard deviation for each variable,
##    plus standard error of the mean:
##
##          Mean      SD  Naive SE Time-series SE
## rho  -0.06171 0.09215 0.0009215      0.0009824
## zeta -0.06232 0.09328 0.0009328      0.0009943
##
## 2. Quantiles for each variable:
##
##         2.5%     25%      50%       75%  97.5%
## rho  -0.2396 -0.1253 -0.06311 0.0005138 0.1213
## zeta -0.2444 -0.1259 -0.06320 0.0005138 0.1219
```

```
# hypothesis 4
samp4 <- correlationBF(y = d$DTFlu, x = d$CSE, posterior = T, iterations = 10000)
```

```
## Independent-candidate M-H acceptance rate: 98%
```

```
plot(samp4[,"rho"])
```




```
summary(samp4)
```

```
##
## Iterations = 1:10000
## Thinning interval = 1
## Number of chains = 1
## Sample size per chain = 10000
##
## 1. Empirical mean and standard deviation for each variable,
##    plus standard error of the mean:
##
##          Mean      SD  Naive SE Time-series SE
## rho  -0.02098 0.09175 0.0009175      0.0009560
## zeta -0.02116 0.09255 0.0009255      0.0009644
##
## 2. Quantiles for each variable:
##
##         2.5%      25%      50%     75%  97.5%
## rho  -0.1999 -0.08383 -0.02064 0.04139 0.1587
## zeta -0.2026 -0.08403 -0.02064 0.04142 0.1601
```

For checking multiple choice answers

```
McheckF <- d[d$Condition == "Fixed",c("Condition","Q12","Q20")]
table(McheckF$Q12) / nrow(McheckF)
```

```
##
##         1         2         3
## 0.2727273 0.6181818 0.1090909
```

```r
table(McheckF$Q20) / nrow(McheckF)
```

```
##
##          1          2          3
## 0.05454545 0.76363636 0.18181818
```

```r
McheckG <- d[d$Condition == "Growth",c("Condition","Q21","Q11")]
table(McheckG$Q21) / nrow(McheckG)
```

```
##
##          1          2          3
## 0.89285714 0.07142857 0.03571429
```

```r
table(McheckG$Q11) / nrow(McheckG)
```

```
##
##          1          2          3
## 0.92857143 0.01785714 0.05357143
```