# Template families

## Contents



```
require(MASS)
require(rstan)
options(mc.cores = parallel::detectCores())
rstan_options(auto_write = TRUE)
source("readGrowclust.R")
```

## Read in catalog from *Cochran et al.* [2018]

```
s = readGrowclust("allCat_cc7_bs10_wTemplate.txt")
```

## Function for my version of the interevent time distribution of *Saichev and Sornette* [2007]

```
dSS2007.krd = function(t, p, loglambda.c, n, DEBUG=FALSE) {

  lambda.c = 10^loglambda.c

  if (DEBUG) print(c(p, lambda.c, n))
```

```
  if (p <= 1 || p >= 3 || lambda.c <= 0 || n < 0 || n > 1) return(rep(0, length(t)))

  d = (1-n) + n*(1 + t/(lambda.c))^(-p+1)
  d = d*d
  d = d - n/(lambda.c)*(1-p)*(1 + t/(lambda.c))^(-p)
  d = d*exp( -(1-n)*t - (n*lambda.c/(2-p))*((1 + t/(lambda.c))^(-p+2) - 1))

  d[t<0] = 0

  return(d)
}
dSS2007.krd.ln = function(tau, ...) {dSS2007.krd(exp(tau), ...) * exp(tau)} # the pdf for the log of th
dtplot = 10^seq(-15, 5, length=1000)
dtauplot = log(dtplot)
```

## Find the families

```
fids = sort(unique(s$parent))

nev.in.fam = tapply(s$parent, s$parent, length)
```

## Make plots like their Fig. 3

### First the time-consuming fitting of the *Saichev and Sornette* [2007] distributions

First try using `fitdistr()`. Trying three different optimization methods. Note that sometimes when `fitdistr()` fails, the optimization worked but then failed when trying to calculate the Hessian for the standard error measures.

```
fitdistr.time = Sys.time()
fuse = which(nev.in.fam > 100)
fSS = fSS.SANN = fSS.BFGS = Cv = meandt = NULL

for (f in fuse) {
  i.f = match(f, fuse)
  ev.use = which(s$parent == fids[f])

  dt = diff(s$t0numeric[ev.use])
  meandt[i.f] = mean(dt)
  dt = dt/meandt[i.f]

  fSS[[i.f]] <- try(fitdistr(dt, dSS2007.krd, start=list(p=1.2, loglambda.c=log10(1/meandt[i.f]), n=0.5
                             method="Nelder-Mead", DEBUG=FALSE), silent=TRUE)
  fSS.SANN[[i.f]] <- try(fitdistr(dt, dSS2007.krd, start=list(p=1.2, loglambda.c=log10(1/meandt[i.f]),
                         method="SANN", DEBUG=FALSE), silent=TRUE)
  fSS.BFGS[[i.f]] <- try(fitdistr(dt, dSS2007.krd, start=list(p=1.2, loglambda.c=log10(1/meandt[i.f]),
                         method="BFGS", DEBUG=FALSE), silent=TRUE)

  Cv[i.f] = sd(dt)/mean(dt)
```

```
}
fitdistr.time = Sys.time() - fitdistr.time
```

### Then extract the estimates (and the found max likelihood)

```
p = sapply(fSS, function(f){ifelse(attr(f, 'class') == "try-error", NA, f$est["p"])})
p.SANN = sapply(fSS.SANN, function(f){ifelse(attr(f, 'class') == "try-error", NA, f$est["p"])})
p.BFGS = sapply(fSS.BFGS, function(f){ifelse(attr(f, 'class') == "try-error", NA, f$est["p"])})


n = sapply(fSS, function(f){ifelse(attr(f, 'class') == "try-error", NA, f$est["n"])})
n.SANN = sapply(fSS.SANN, function(f){ifelse(attr(f, 'class') == "try-error", NA, f$est["n"])})
n.BFGS = sapply(fSS.BFGS, function(f){ifelse(attr(f, 'class') == "try-error", NA, f$est["n"])})

loglambda.c = sapply(fSS, function(f){ifelse(attr(f, 'class') == "try-error", NA, f$est["loglambda.c"])
loglambda.c.SANN = sapply(fSS.SANN, function(f){ifelse(attr(f, 'class') == "try-error", NA, f$est["logla
loglambda.c.BFGS = sapply(fSS.BFGS, function(f){ifelse(attr(f, 'class') == "try-error", NA, f$est["logla

l = sapply(fSS, function(f){ifelse(attr(f, 'class') == "try-error", NA, f$loglik)})
l.SANN = sapply(fSS.SANN, function(f){ifelse(attr(f, 'class') == "try-error", NA, f$loglik)})
l.BFGS = sapply(fSS.BFGS, function(f){ifelse(attr(f, 'class') == "try-error", NA, f$loglik)})
```

Nelder-Mead, SANN, and BFGS "worked" for 44, 116, 46 of the families, respectively (out of 130 total families). And took 44 secs seconds.

### Stan

Since `fitdist()` had trouble with many of the families (and estimated errors in the parameters are probably meaningless), let's also try MCMC via Stan. The Stan program is:

```
writeLines(readLines("dSS2007.krd.stan"))
```

```
## functions {
## // log of pdf at a single interevent times t given the parameters p, loglambdac, and n
## // I can't get stan to work with a function that returns the sum of the log densities
## // for a vector of interevent times...
##   real dSS2007_krd_lpdf(real t, real p, real loglambdac, real n) {
##
##     real lambdac = 10^loglambdac;
##     real d;
##     real ld;
##
##     if (p <= 1) reject("p cannot be <= 1");
##     if (n < 0 || n > 1) reject("n must be between 0 and 1");
##
##     d = (1-n) + n*(1 + t/(lambdac))^(-p+1);
##     d = d * d;
##     d = d - n/(lambdac)*(1-p)*(1 + t/(lambdac))^(-p);
##
##     ld = log(d);
##
##     ld = ld - (1-n)*t - (n*lambdac/(2-p))*((1 + t/(lambdac))^(-p+2) - 1);
```

```
##
##     return(ld);
##   }
##
## // unnormalized prior for p: flat from 1 to p1, then exponential decay with const. s0
## // I've mostly been using p1 = 1.5 and s0 = 0.3
##   real p_prior_lpdf(real p, real p1, real s0) {
##
##     if (p <= 1) reject("p cannot be <= 1");
##
##     if (p <= p1) return(0);
##     else return(-(p - p1)/s0);
##   }
## }
##
##
## data {
##   int N;      // number of interevent times
##   real t[N];  // normalized interevent times
## }
##
## parameters {
##   real<lower=1, upper=3> p;  // Omori p-value
##   real loglambdac;  // log10(lambda * c), where lambda is mean event rate, and c is modified-Omori c
##   real<lower=0, upper=1> n;  // branching ratio (and aftershock fraction)
## }
##
## model {
##   p ~ p_prior(1.5, 0.3);
##   loglambdac ~ normal(-3.4, 5); // should transform and put a prior directly on c
##   for (i in 1:N) t[i] ~ dSS2007_krd(p, loglambdac, n);
## }
```

Note the prior on $p$ (as of this writing, flat from 1 to 1.5 then exponentially decaying at higher values). I also added a weak prior on `loglambdac` ($\log_{10}(\bar{\lambda}c)$) to avoid some pathological behavior. I've tried using stronger priors on `loglambdac` to see if that would help with some of the convergence issues, but it didn't (and haven't thought about whether this would be justified in any case).

Just using the default number of chains, iterations, starting points, etc. And also, not checking for convergence, mixing, etc. yet.

```
stan.time = rep(NA, length(fuse))
f.stan =  NULL

for (f in fuse) {
  i.f = match(f, fuse)
  stan.time[i.f] = Sys.time()
  ev.use = which(s$parent == fids[f])

  dt = diff(s$t0numeric[ev.use])
  meandt[i.f] = mean(dt)
  dt = dt/meandt[i.f]

  if (i.f == 1)
#    f.stan[[i.f]] = stan(file="dSS2007.krd.stan", data=list(N=length(dt), t=dt), open_progress=FALSE)
```

```
    f.stan[[i.f]] = stan(file="dSS2007.krd.fixedloglambdac.stan",
                         data=list(N=length(dt), t=dt, lambdabar=1/meandt[i.f]), open_progress=FALSE)
  else
#    f.stan[[i.f]] = stan(fit=f.stan[[i.f-1]], data=list(N=length(dt), t=dt), open_progress=FALSE)
    f.stan[[i.f]] = stan(fit=f.stan[[i.f-1]], data=list(N=length(dt), t=dt, lambdabar=1/meandt[i.f]), o

  stan.time[i.f] = Sys.time() - stan.time[i.f]
}
```

Stan took 1125 seconds.

Extract the modes, means, and CIs (note that CIs are 68%!).

```
p.stan.median = loglambdac.stan.median = n.stan.median = rep(NA, length(fuse))
p.stan.mode = loglambdac.stan.mode = n.stan.mode = rep(NA, length(fuse))
p.stan.mean = loglambdac.stan.mean = n.stan.mean = rep(NA, length(fuse))
pCI.stan = loglambdacCI.stan = nCI.stan = matrix(NA, nrow=length(fuse), ncol=2)

for (f in fuse) {
  i.f = match(f, fuse)

  dt_sim = extract(f.stan[[i.f]], permute=TRUE)

  # mode
  p.stan.mode[i.f] = dt_sim$p[which.max(dt_sim$lp__)]
#  loglambdac.stan.mode[i.f] = dt_sim$loglambdac[which.max(dt_sim$lp__)]
  n.stan.mode[i.f] = dt_sim$n[which.max(dt_sim$lp__)]

  # mean
  p.stan.mean[i.f] = mean(dt_sim$p)
#  loglambdac.stan.mean[i.f] = mean(dt_sim$loglambdac)
  n.stan.mean[i.f] = mean(dt_sim$n)

  # median
  p.stan.median[i.f] = median(dt_sim$p)
#  loglambdac.stan.median[i.f] = median(dt_sim$loglambdac)
  n.stan.median[i.f] = median(dt_sim$n)

  # CIs
  alpha = 0.32 # 68% CIs
  pCI.stan[i.f,] = quantile(dt_sim$p, probs=c(alpha/2, 1-alpha/2))
#  loglambdacCI.stan[i.f,] = quantile(dt_sim$loglambdac, probs=c(alpha/2, 1-alpha/2))
  nCI.stan[i.f,] = quantile(dt_sim$n, probs=c(alpha/2, 1-alpha/2))

  c = 90 # seconds, needs to match in dSS2007.krd.fixedloglambdac.stan
  loglambdac.stan.mode[i.f] = loglambdac.stan.median[i.f] = loglambdac.stan.mean[i.f] =
    log10((1/meandt[i.f]) * c)
}
```

Extract some measures of convergence/mixing/performance/etc.

```
bfmi = sapply(f.stan, get_bfmi)
n_div = sapply(f.stan, get_num_divergent)
rhat = apply(t(sapply(f.stan, function(f){summary(f)$summary[,"Rhat"]})), 1, max)
n_eff = apply(t(sapply(f.stan, function(f){summary(f)$summary[,"n_eff"]})), 1, min)
```

Stan docs imply that `bfmi` $< 0.3$, `n_div` more than a few, `rhat` $< 1.1$, or `n_eff` $< 1/10$ total number of sampling interations (so 400 in this case - total number of sampling iterations is 4 chains x 1000/chain = 4000) would indicate problems.

- Fail `bfmi` test: 0/520
- Fail `n_div` test: 0/130
- Fail `rhat` test: 0/130
- Fail `n_eff` test: 4/130

## Finally make plots

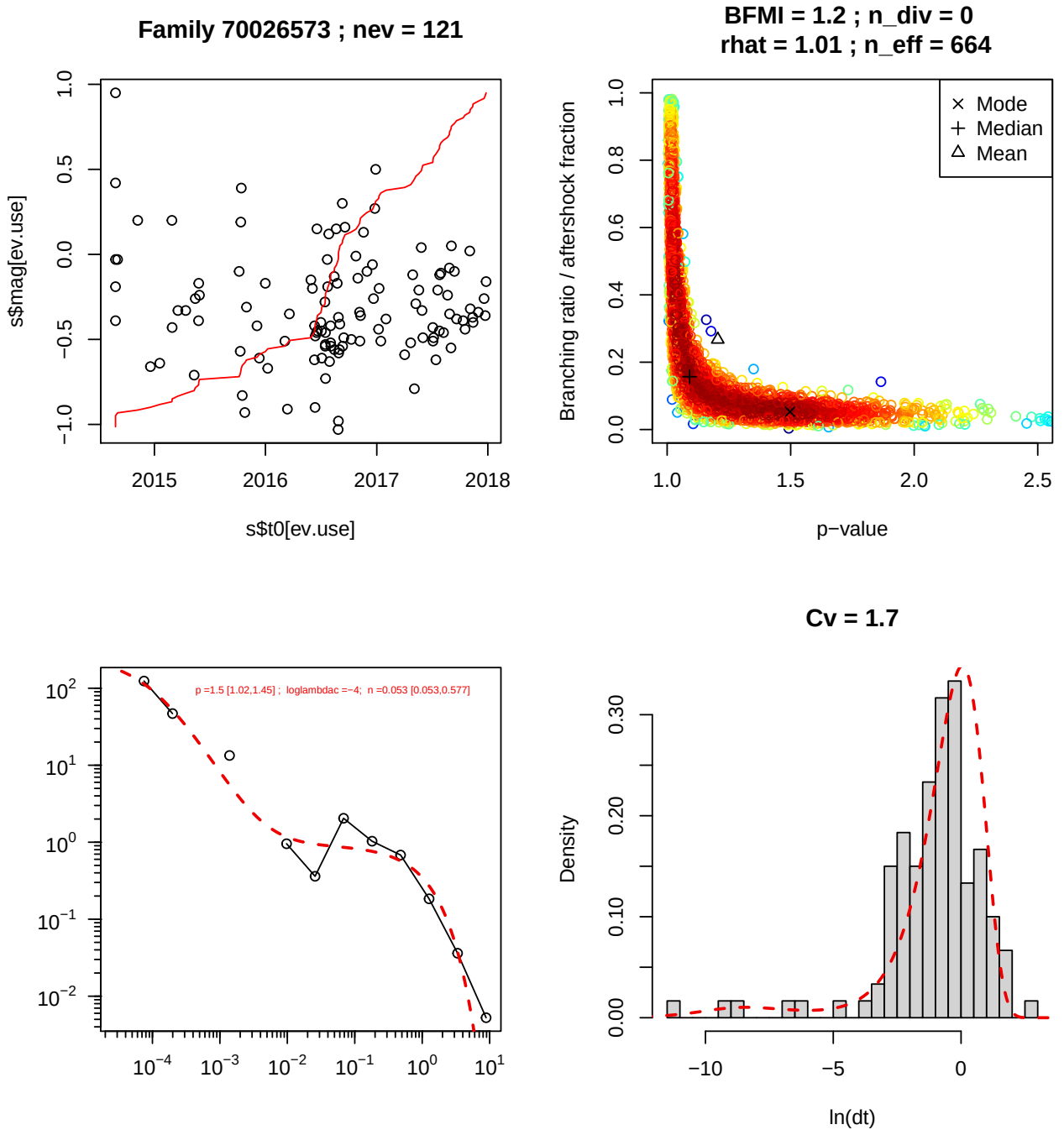
Like their Fig. 3 with *Saichev and Sornette* [2007] fits (and estimated parameters) added in. And replaced upper, right location plot with Stan parameter space plot.

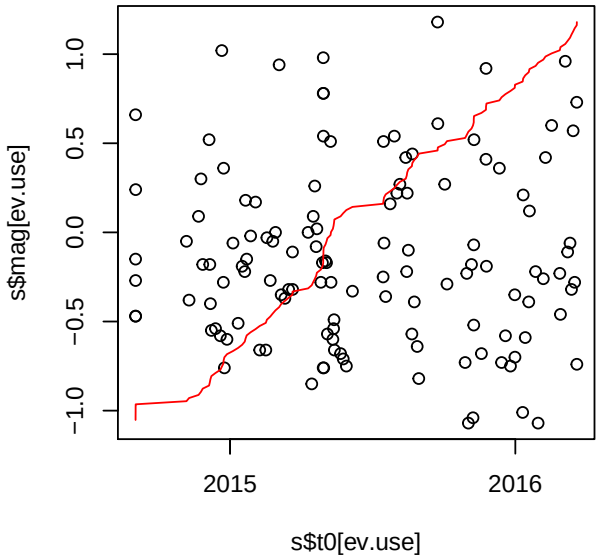
```
mkTimeMagCumNumberPlot = function(s, ev.use, fam) {
  plot(s$t0[ev.use], s$mag[ev.use], main=paste("Family", fam, "; nev =", length(ev.use)))
  lines(s$t0[ev.use], (1:length(ev.use)) * diff(range(s$mag[ev.use])) / length(ev.use) + min(s$mag[ev.us
        col="red")
}

mkLocationPlot = function(s, ev.use, ev.plot) {
   plot(s$utmx[ev.plot]/1e3, s$utmy[ev.plot]/1e3, col=gray(0.3), cex=0.3, asp=1)
   points(s$utmx[ev.use]/1e3, s$utmy[ev.use]/1e3, col="red3", cex=0.3)
}

mkLogHist = function(s, ev.use, fam, fSS,
                     p.stan, pCI.stan, loglambdac.stan, n.stan, nCI.stan) {
  dt = diff(s$t0numeric[ev.use])
  dt = dt/mean(dt)

  loghist(dt, nbr=15)
  if (attr(fSS, 'class') != "try-error") {
    lines(dtplot, dSS2007.krd(dtplot, p=fSS$est["p"], loglambda.c=fSS$est["loglambda.c"],
                              n=fSS$est["n"]), col="orange3", lwd=2)
    text(10^par("usr")[2], 10^par("usr")[4], adj=c(1.1,1.5),
         labels=paste(names(fSS$est), "=", format(fSS$est, digits=3), collapse="; "),
         cex=0.5, col="orange3")
  }
  lines(dtplot, dSS2007.krd(dtplot, p=p.stan, loglambda.c=loglambdac.stan,
                            n=n.stan), col="red2", lwd=2, lty="dashed")
  text(10^par("usr")[2], 10^par("usr")[4], adj=c(1.1,3.5),
       labels=paste("p =", format(p.stan, digits=3), " [", format(pCI.stan[1], digits=3), ",", format(pC
                    ";  loglambdac =", format(loglambdac.stan, digits=2),
                    ";  n =", format(n.stan, digits=2), " [", format(nCI.stan[1], digits=2), ",", forma
       cex=0.5, col="red2")

}

mkHistOfLn = function(s, ev.use, fam, fSS,
                      p.stan, pCI.stan, loglambdac.stan, n.stan, nCI.stan) {
  dt = diff(s$t0numeric[ev.use])
  dt = dt/mean(dt)

  h = hist(log(dt), breaks=25, main=paste("Cv =", format(sd(dt), digits=2)), probability=TRUE,
```

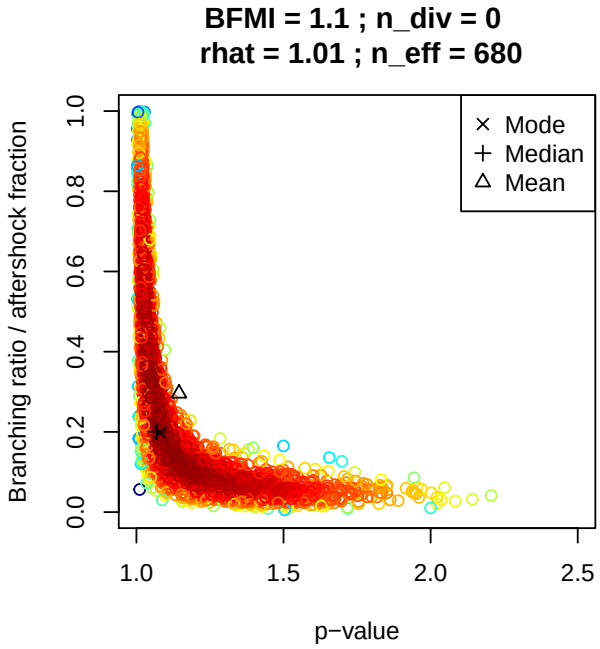
```
           xlab="ln(dt)")
  if (attr(fSS, 'class') != "try-error") {
    lines(dtauplot, dSS2007.krd.ln(dtauplot, p=fSS$est["p"],
                                   loglambda.c=fSS$est["loglambda.c"], n=fSS$est["n"]),
          col="orange3", lwd=2)
#    text(par("usr")[2], par("usr")[4], adj=c(1.1,1.5),
#         labels=paste(names(fSS$est), "=", format(fSS$est, digits=2), collapse="; "), cex=0.5)
  }
  lines(dtauplot, dSS2007.krd.ln(dtauplot, p=p.stan, loglambda.c=loglambdac.stan,
                            n=n.stan), col="red2", lwd=2, lty="dashed")
}

mkMCMCParamSpacePlot = function(f.stan, bfmi, n_div, rhat, n_eff) {
  dt_sim = extract(f.stan, permute=TRUE)
  palette(jet(100))
  col = 1 + 99*(dt_sim$lp__ - min(dt_sim$lp__))/diff(range(dt_sim$lp__))
  plot(dt_sim$p, dt_sim$n, col=col, xlim=c(1, 2.5), ylim=c(0,1), xlab="p-value",
       ylab="Branching ratio / aftershock fraction",
       main=paste("BFMI =", format(bfmi, digits=2), "; n_div =", n_div, "\n",
                  "rhat =", format(rhat, digits=3), "; n_eff =", format(n_eff, digits=0)))

  mode = which.max(dt_sim$lp__)
  points(dt_sim$p[mode], dt_sim$n[mode], pch=4)
  points(median(dt_sim$p), median(dt_sim$n), pch=3)
  points(mean(dt_sim$p), mean(dt_sim$n), pch=2)
  legend("topright", c("Mode", "Median", "Mean"), pch=c(4,3,2))

}

mkFourPanelPlot = function(s, ev.use, ev.plot, fam, bfmi, n_div, rhat, n_eff,
                           fSS, f.stan, p.stan, pCI.stan,
                           loglambdac.stan, n.stan, nCI.stan) {
  par(mfrow=c(2,2))

  mkTimeMagCumNumberPlot(s, ev.use, fam)

#  mkLocationPlot(s, ev.use, ev.plot)

  mkMCMCParamSpacePlot(f.stan, bfmi, n_div, rhat, n_eff)

  mkLogHist(s, ev.use, fam, fSS, p.stan, pCI.stan,
            loglambdac.stan, n.stan, nCI.stan)

  mkHistOfLn(s, ev.use, fam, fSS, p.stan, pCI.stan,
             loglambdac.stan, n.stan, nCI.stan)

}
```

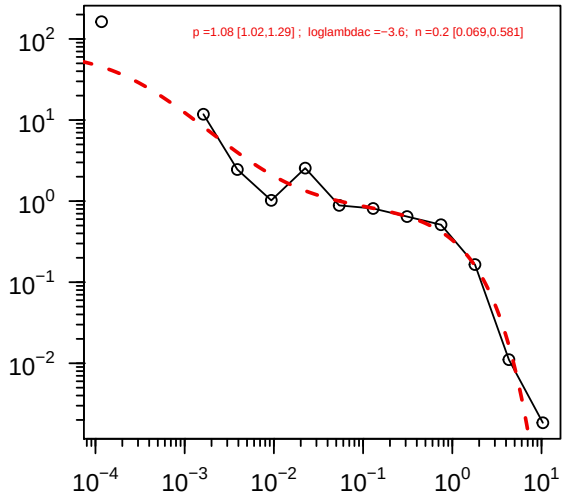
```
ev.plot = sample(1:length(s$t0), 1000) # plot just a sample of all seismicity

par(mfrow=c(2,2))
for (f in fuse) {
  i.f = match(f, fuse)
  ev.use = which(s$parent == fids[f])
```

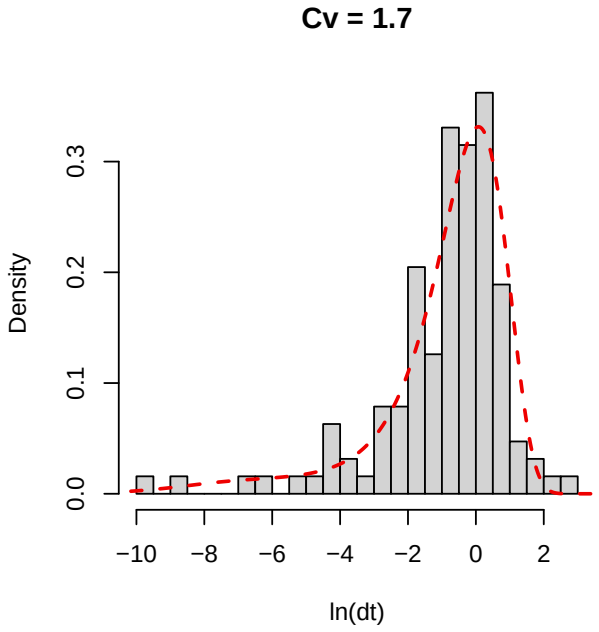
```
  mkFourPanelPlot(s, ev.use, ev.plot, fids[f], bfmi[i.f], n_div[i.f], rhat[i.f], n_eff[i.f],
                  fSS[[i.f]], f.stan[[i.f]],
                  p.stan.mode[i.f], pCI.stan[i.f,], loglambdac.stan.mode[i.f],
                  n.stan.mode[i.f], nCI.stan[i.f,])

  cat("\r\n\r\n") # to try to get figures to not end up side-by-side
}
```

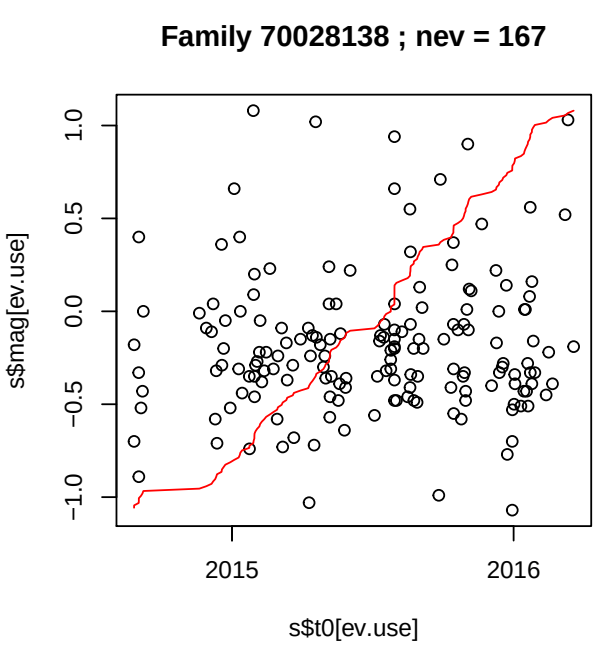


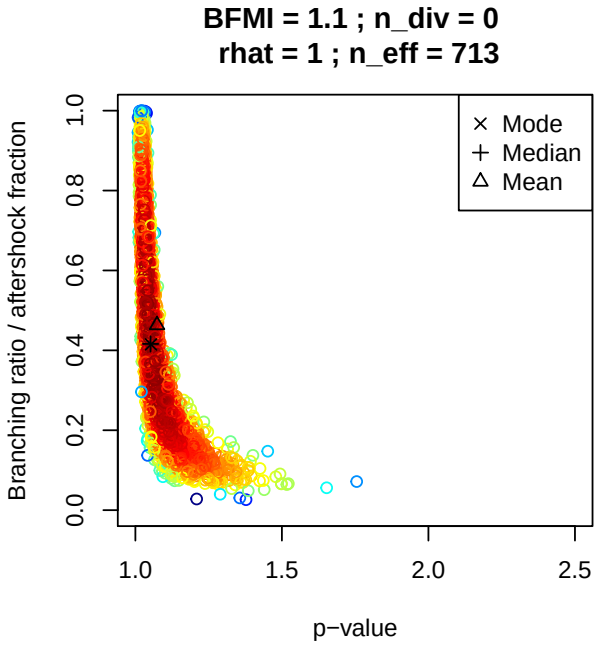

Family 70028123 ; nev = 128
s$mag[ev.use]
1.0
0.5
0.0
−0.5
−1.0
2015
2016
s$t0[ev.use]

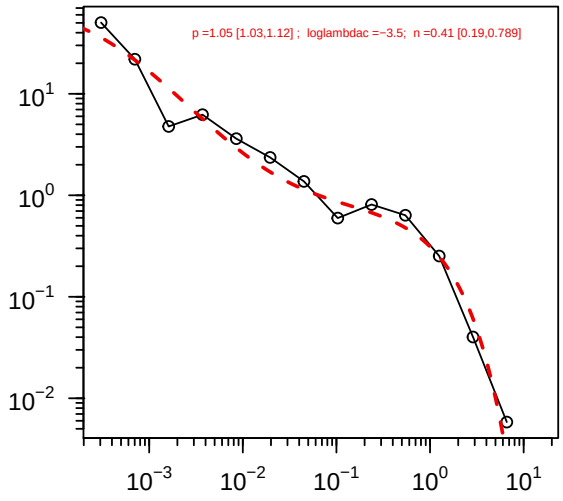

BFMI = 1.1 ; n_div = 0
rhat = 1.01 ; n_eff = 680
Mode
Median
Mean
Branching ratio / aftershock fraction
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5
p−value

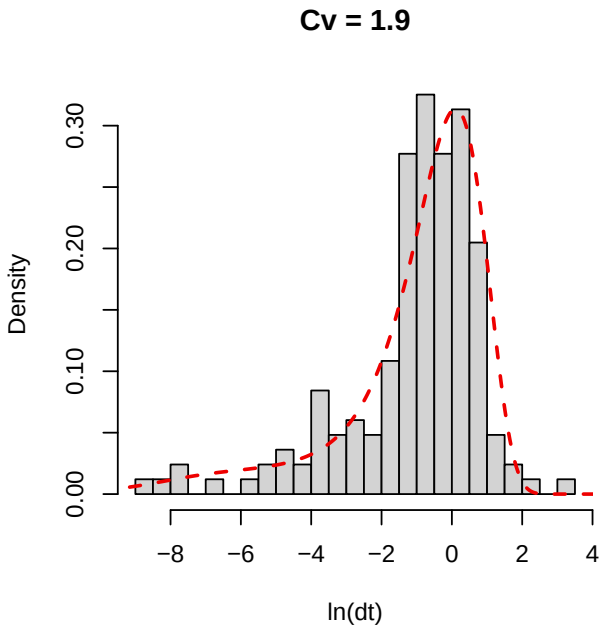

p =1.08 [1.02,1.29] ; loglambdac =−3.6; n =0.2 [0.069,0.581]
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

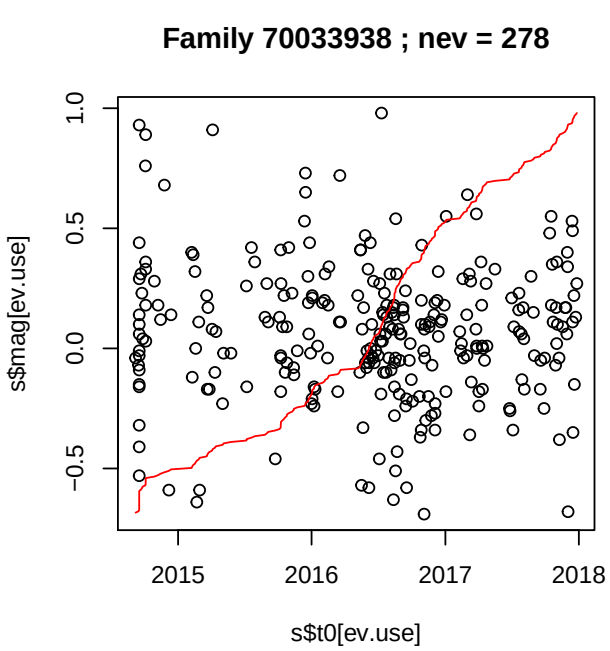

Cv = 1.7
Density
0.0
0.1
0.2
0.3
−10
−8
−6
−4
−2
0
2
ln(dt)

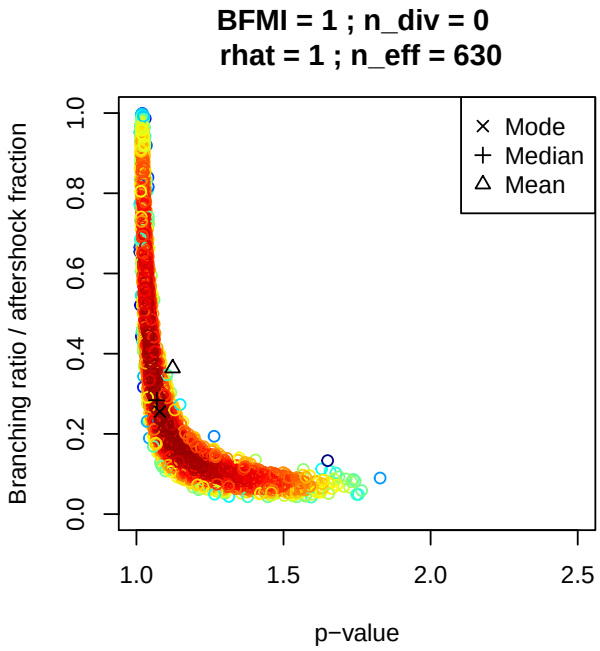

Family 70028138 ; nev = 167
s$mag[ev.use]
1.0
0.5
0.0
−0.5
−1.0
2015
2016
s$t0[ev.use]

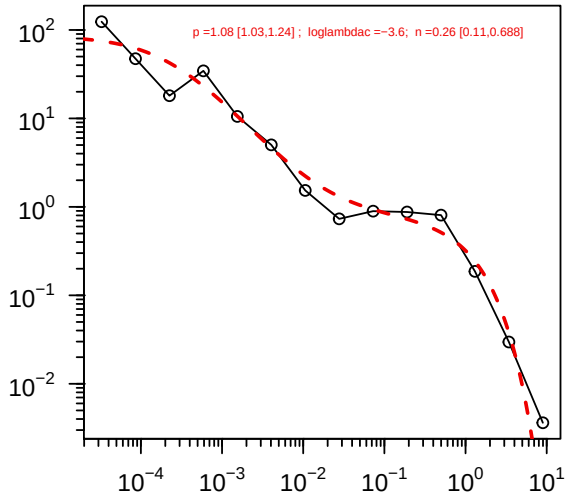

BFMI = 1.1 ; n_div = 0
rhat = 1 ; n_eff = 713
Mode
Median
Mean
Branching ratio / aftershock fraction
1.0
0.8
0.6
0.4
0.2
0.0
1.0
1.5
2.0
2.5
p−value

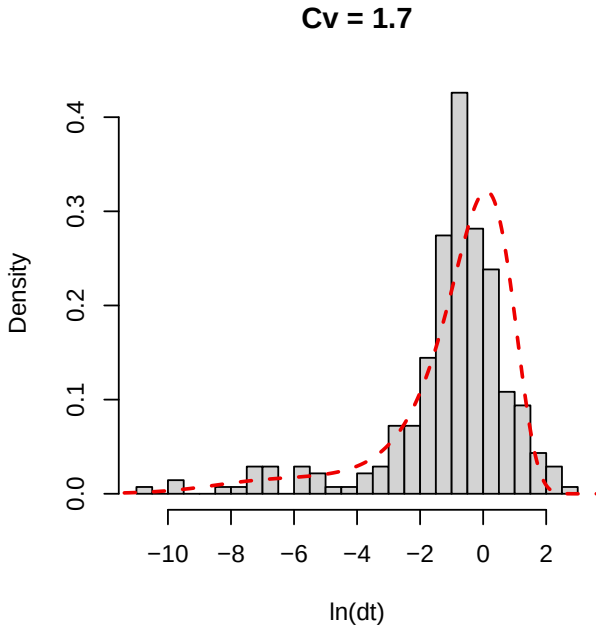

p =1.05 [1.03,1.12] ; loglambdac =−3.5; n =0.41 [0.19,0.789]
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

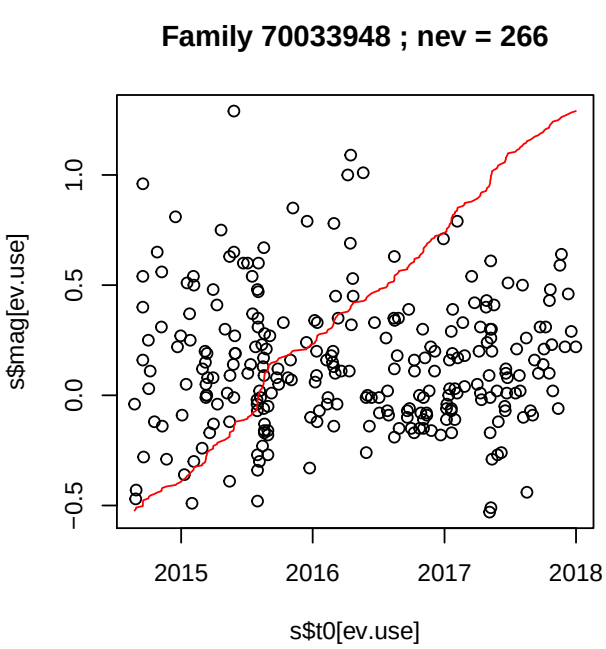

Cv = 1.9
Density
0.30
0.20
0.10
0.00
−8
−6
−4
−2
0
2
4
ln(dt)

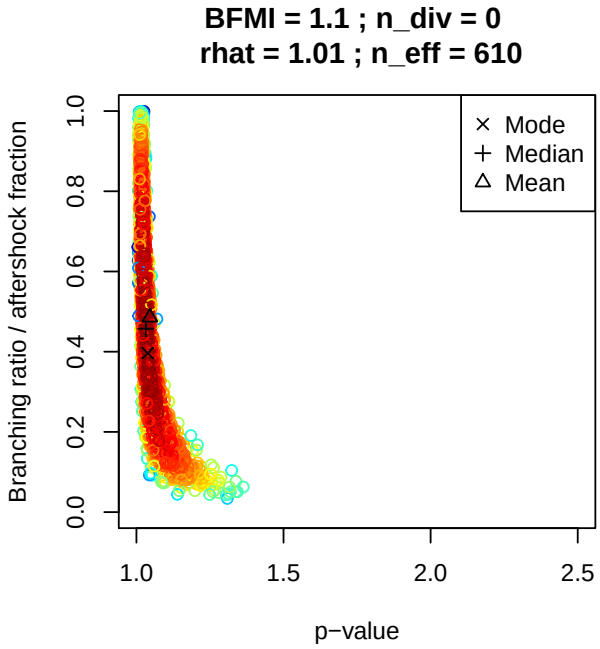

Family 70033938 ; nev = 278
s$mag[ev.use]
s$t0[ev.use]
2015
2016
2017
2018
−0.5
0.0
0.5
1.0

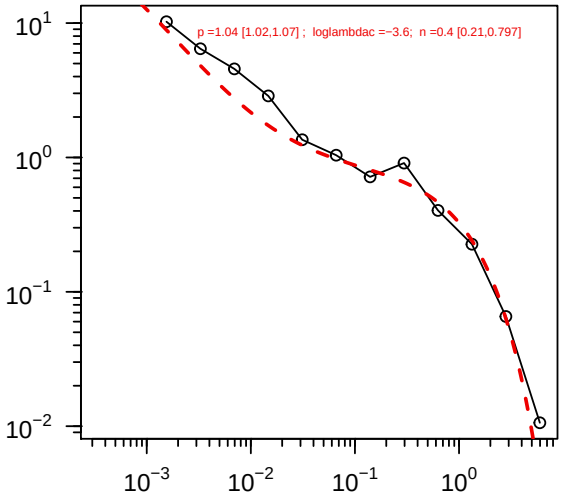

BFMI = 1 ; n_div = 0
rhat = 1 ; n_eff = 630
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
1.0
1.5
2.0
2.5
0.0
0.2
0.4
0.6
0.8
1.0

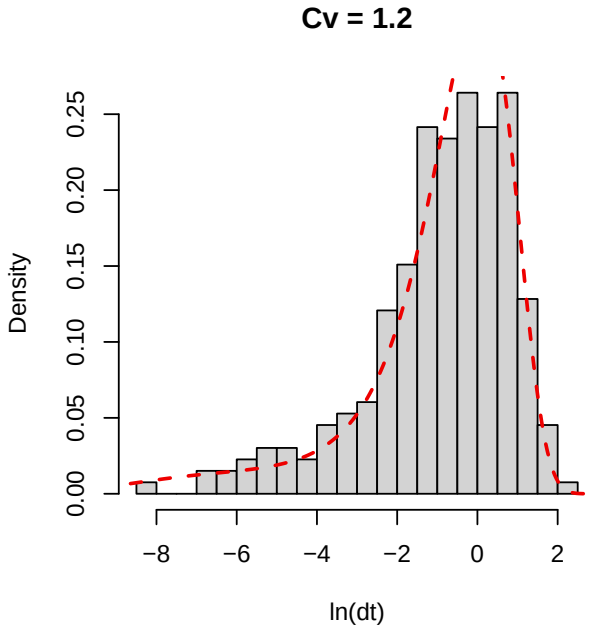

p =1.08 [1.03,1.24] ; loglambdac =−3.6; n =0.26 [0.11,0.688]
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

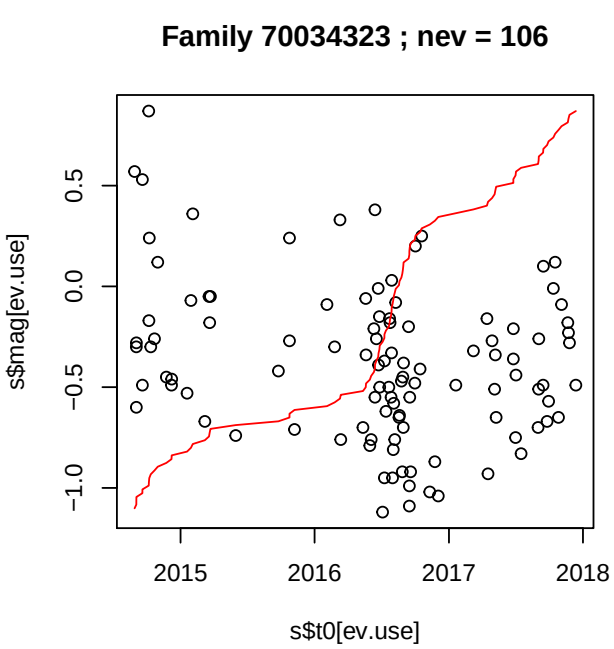

Cv = 1.7
Density
ln(dt)
0.0
0.1
0.2
0.3
0.4
−10
−8
−6
−4
−2
0
2

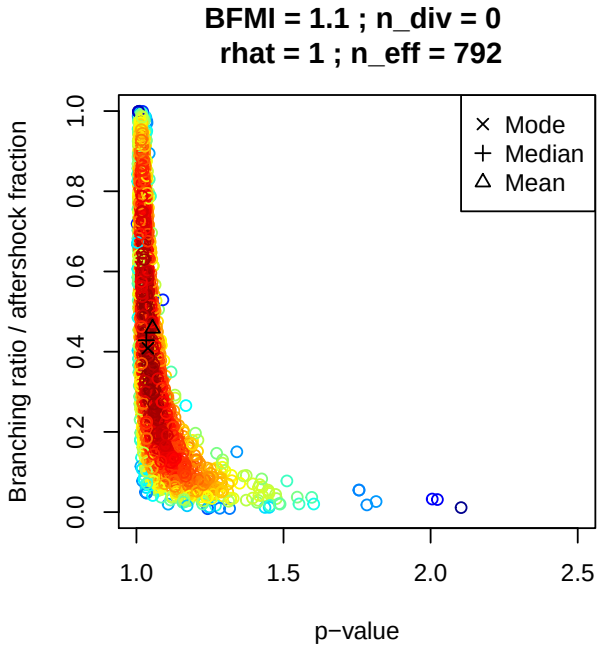

Family 70033948 ; nev = 266
s$mag[ev.use]
s$t0[ev.use]
2015
2016
2017
2018
−0.5
0.0
0.5
1.0

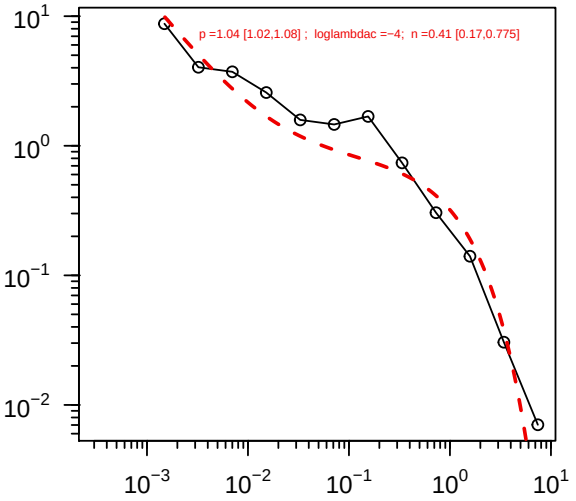

BFMI = 1.1 ; n_div = 0
rhat = 1.01 ; n_eff = 610
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
1.0
1.5
2.0
2.5
0.0
0.2
0.4
0.6
0.8
1.0

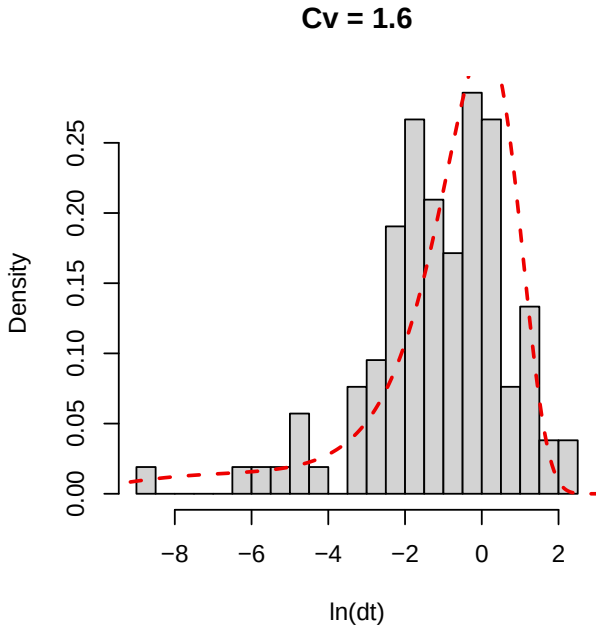

p =1.04 [1.02,1.07] ; loglambdac =−3.6; n =0.4 [0.21,0.797]
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$

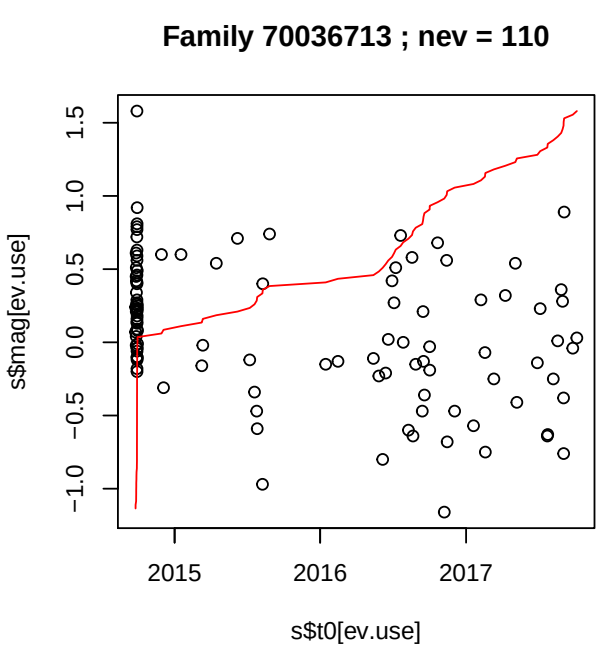

Cv = 1.2
Density
ln(dt)
0.00
0.05
0.10
0.15
0.20
0.25
−8
−6
−4
−2
0
2

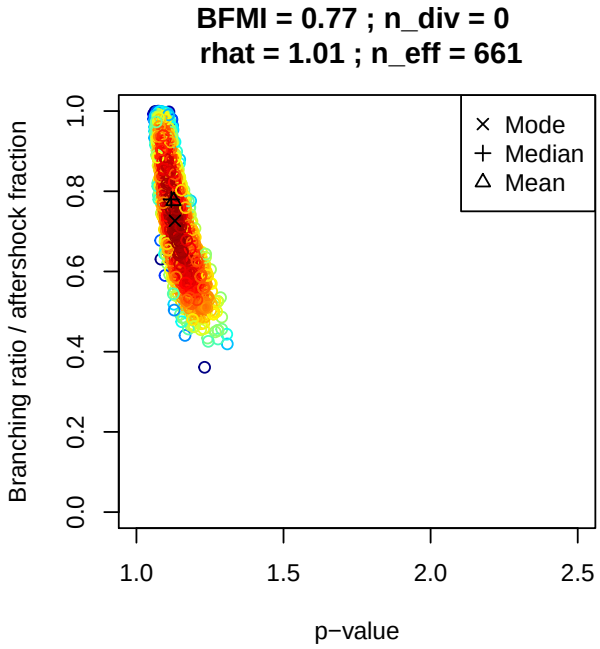

Family 70034323 ; nev = 106
s$mag[ev.use]
s$t0[ev.use]
2015
2016
2017
2018
−1.0
−0.5
0.0
0.5

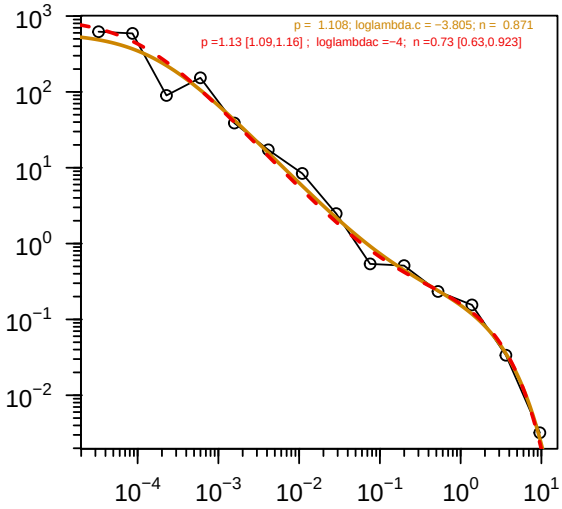

BFMI = 1.1 ; n_div = 0
rhat = 1 ; n_eff = 792
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
1.0
1.5
2.0
2.5
0.0
0.2
0.4
0.6
0.8
1.0

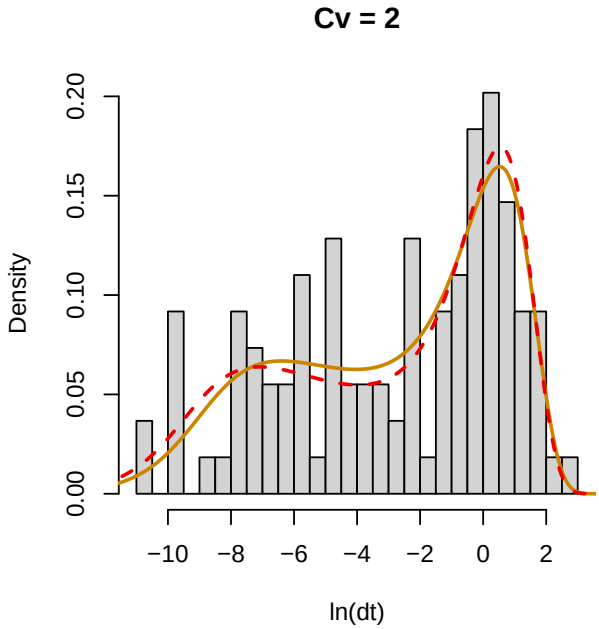

p =1.04 [1.02,1.08] ; loglambdac =−4; n =0.41 [0.17,0.775]
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

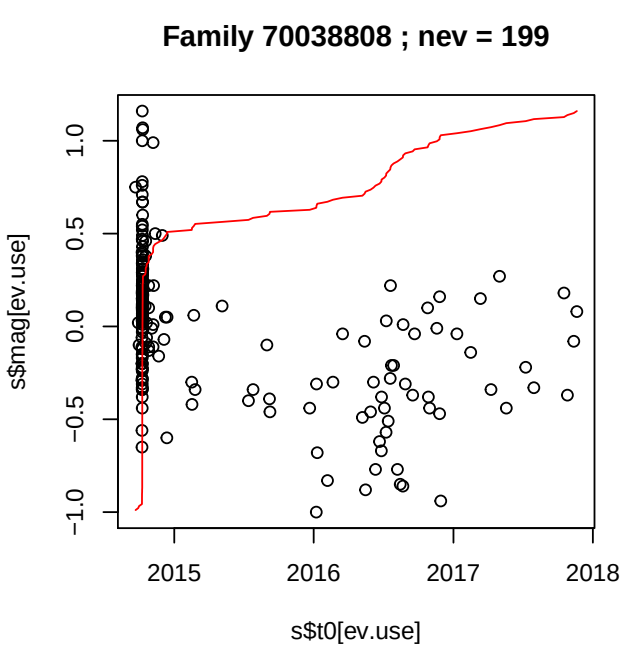

Cv = 1.6
Density
ln(dt)
−8
−6
−4
−2
0
2
0.00
0.05
0.10
0.15
0.20
0.25

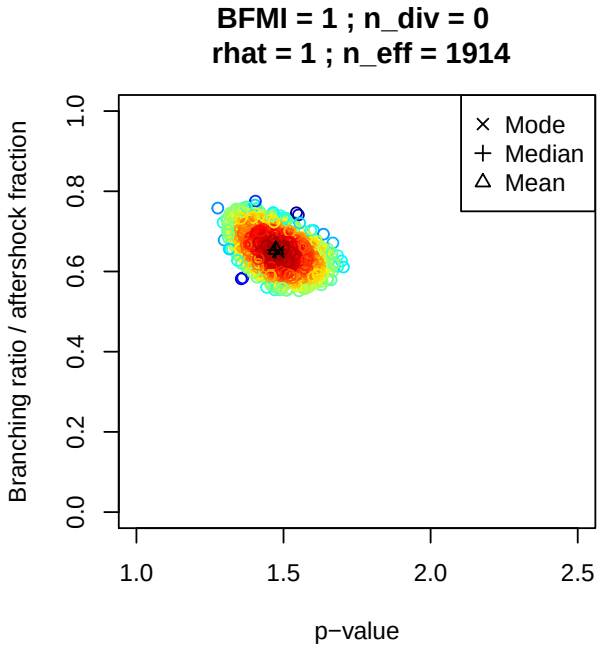

Family 70036713 ; nev = 110
s$mag[ev.use]
s$t0[ev.use]
2015
2016
2017
−1.0
−0.5
0.0
0.5
1.0
1.5

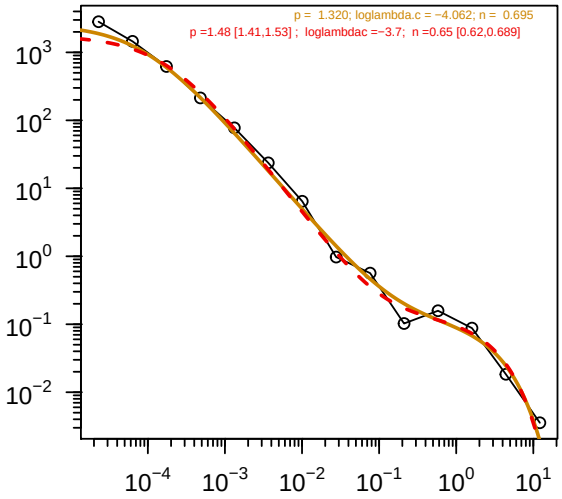

BFMI = 0.77 ; n_div = 0
rhat = 1.01 ; n_eff = 661
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5

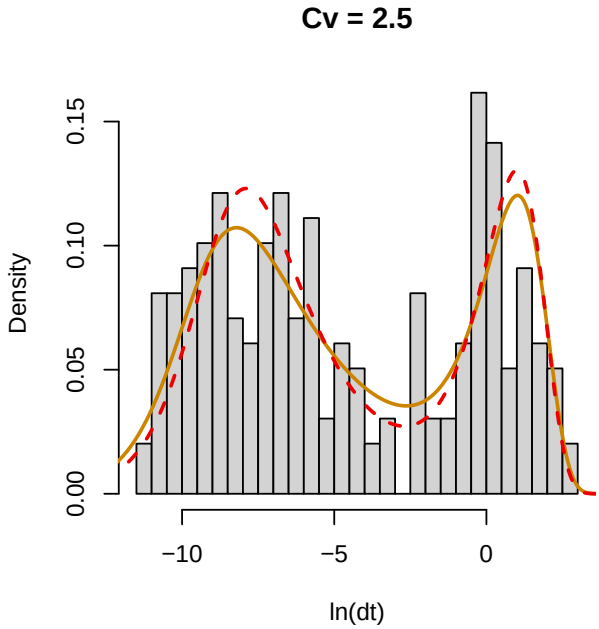

p = 1.108; loglambda.c = −3.805; n = 0.871
p =1.13 [1.09,1.16] ; loglambdac =−4; n =0.73 [0.63,0.923]
$10^{3}$
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

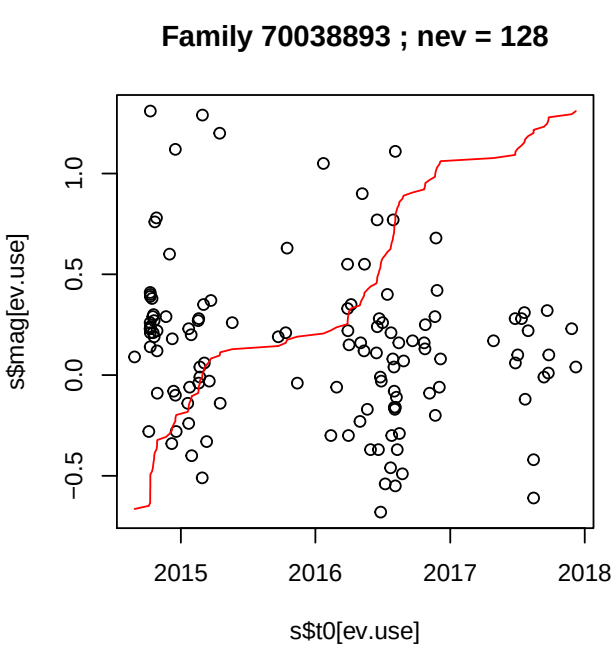

Cv = 2
Density
ln(dt)
0.00
0.05
0.10
0.15
0.20
−10
−8
−6
−4
−2
0
2

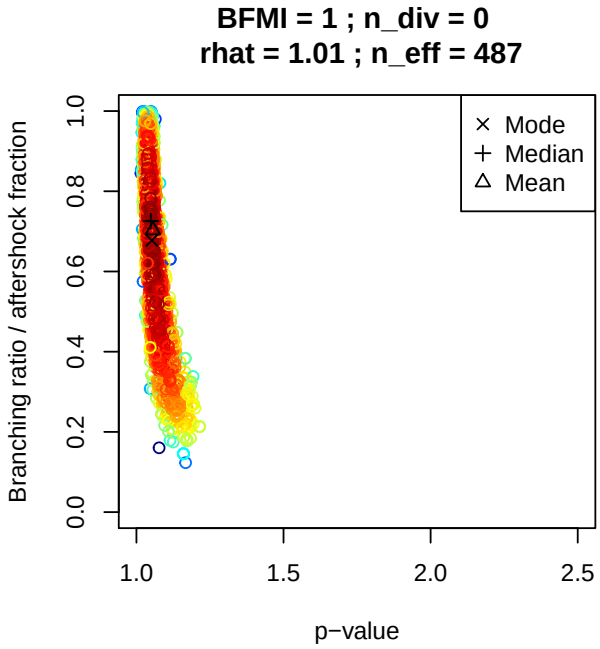

Family 70038808 ; nev = 199
s$mag[ev.use]
s$t0[ev.use]
2015
2016
2017
2018
1.0
0.5
0.0
−0.5
−1.0

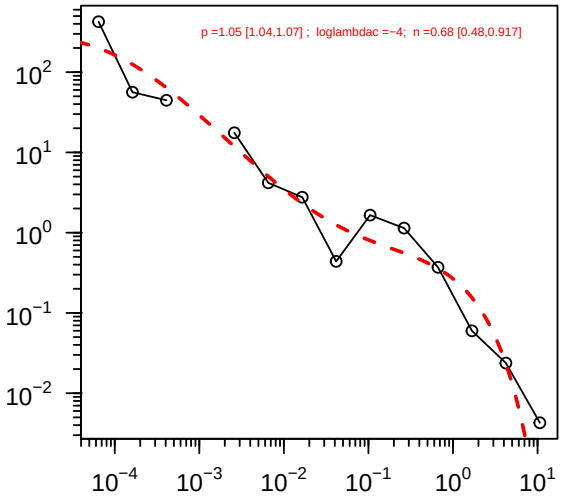

BFMI = 1 ; n_div = 0
rhat = 1 ; n_eff = 1914
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
1.0
1.5
2.0
2.5
0.0
0.2
0.4
0.6
0.8
1.0

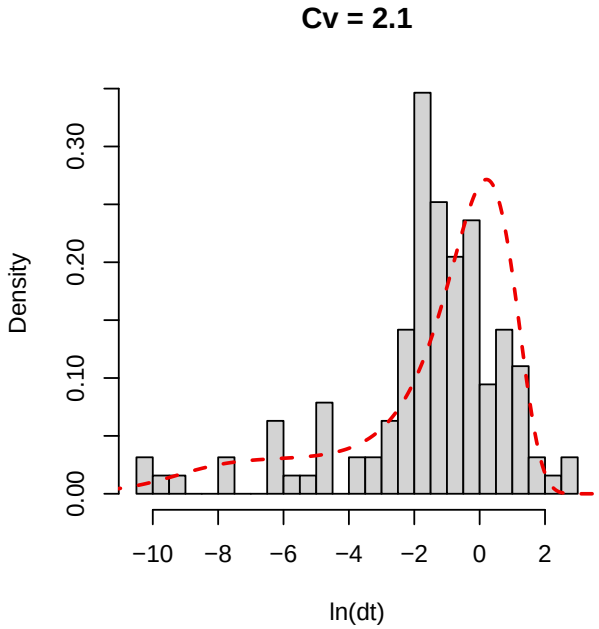

p = 1.320; loglambda.c = −4.062; n = 0.695
p =1.48 [1.41,1.53] ; loglambdac =−3.7; n =0.65 [0.62,0.689]
$10^{3}$
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

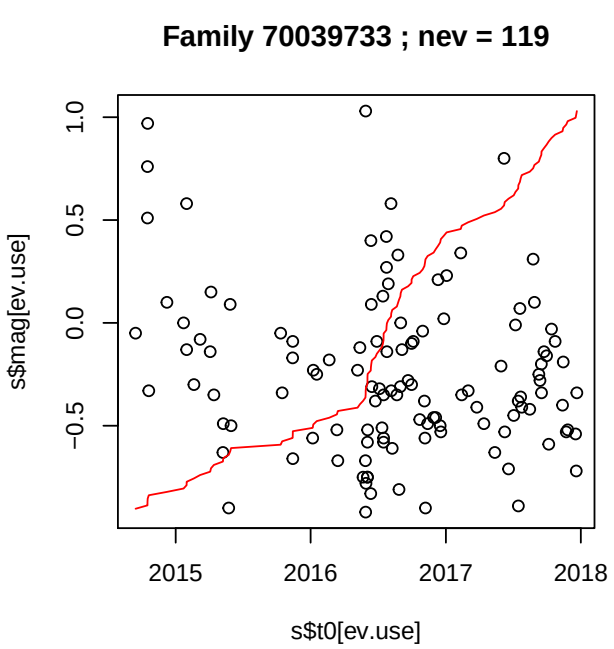

Cv = 2.5
Density
ln(dt)
0.00
0.05
0.10
0.15
−10
−5
0

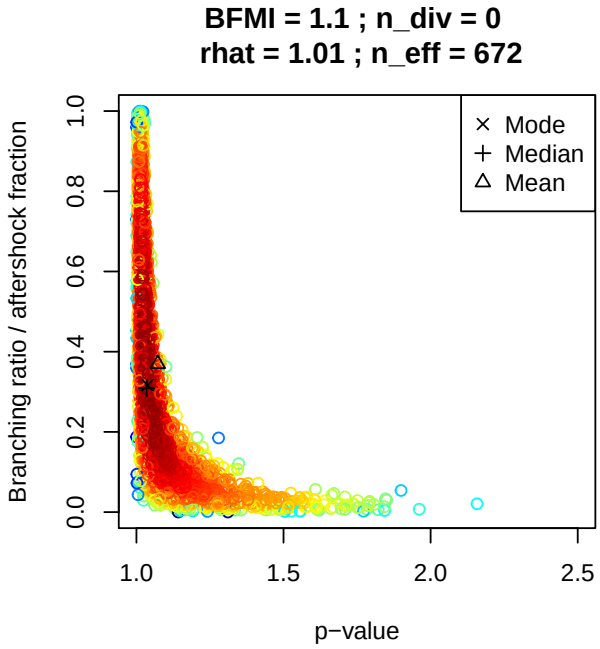

Family 70038893 ; nev = 128
s$mag[ev.use]
s$t0[ev.use]
2015
2016
2017
2018
−0.5
0.0
0.5
1.0

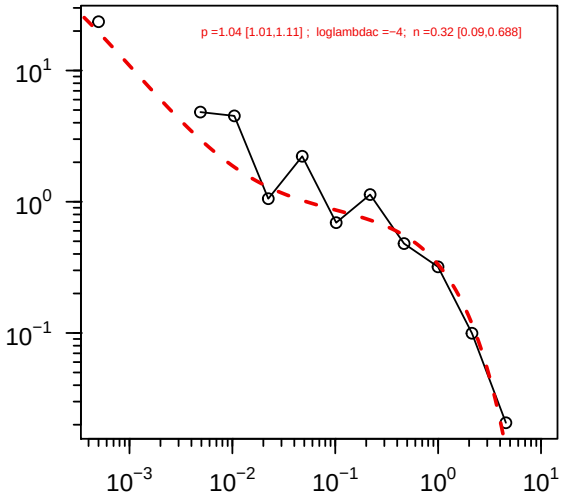

BFMI = 1 ; n_div = 0
rhat = 1.01 ; n_eff = 487
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
1.0
1.5
2.0
2.5
0.0
0.2
0.4
0.6
0.8
1.0

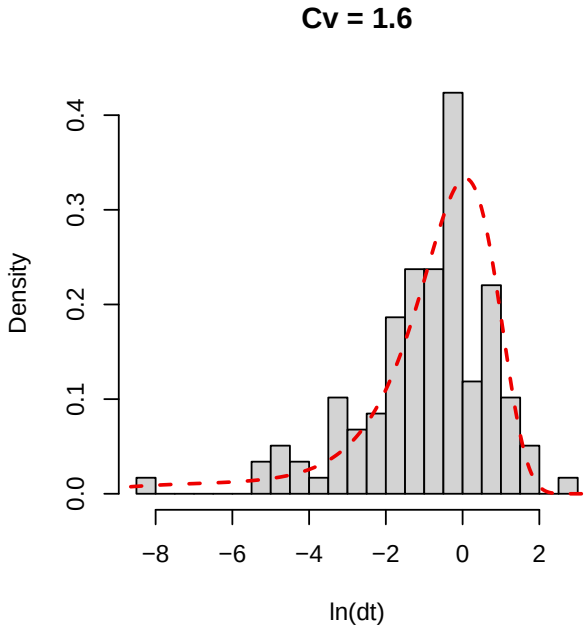

p =1.05 [1.04,1.07] ; loglambdac =−4; n =0.68 [0.48,0.917]
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

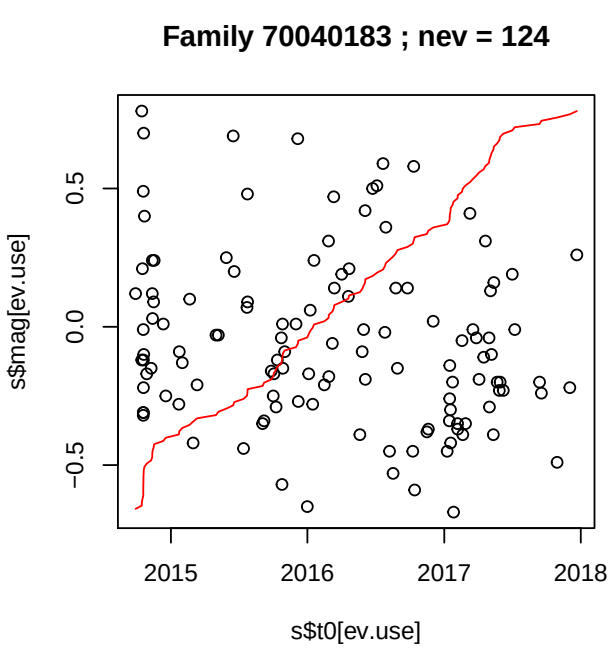

Cv = 2.1
Density
ln(dt)
0.00
0.10
0.20
0.30
−10
−8
−6
−4
−2
0
2

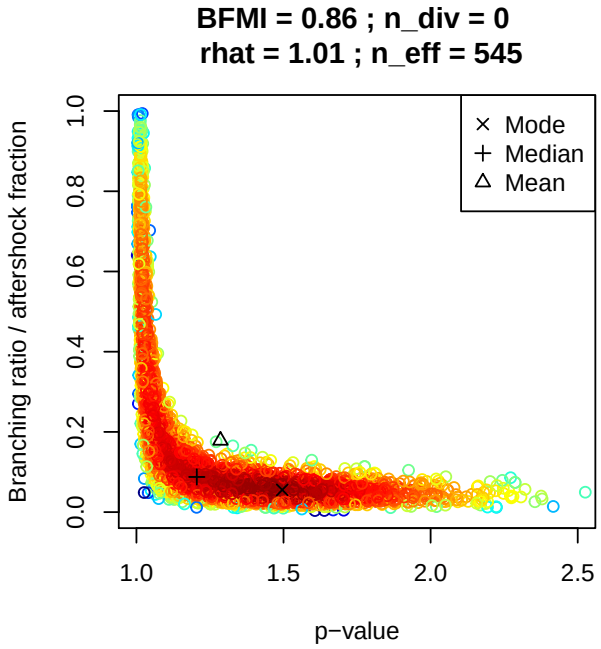

Family 70039733 ; nev = 119
s$mag[ev.use]
s$t0[ev.use]
2015
2016
2017
2018
−0.5
0.0
0.5
1.0

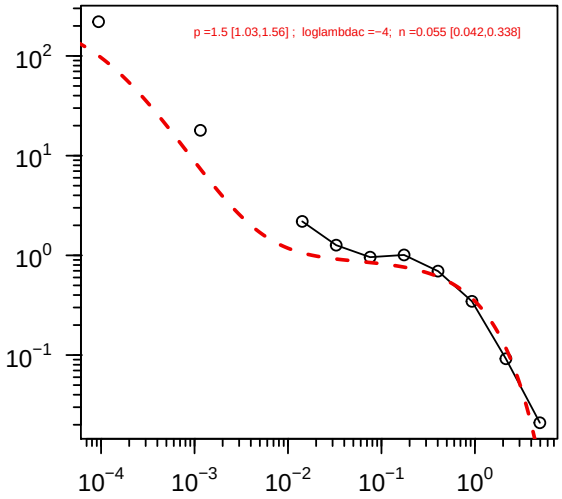

BFMI = 1.1 ; n_div = 0
rhat = 1.01 ; n_eff = 672
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
1.0
1.5
2.0
2.5
0.0
0.2
0.4
0.6
0.8
1.0

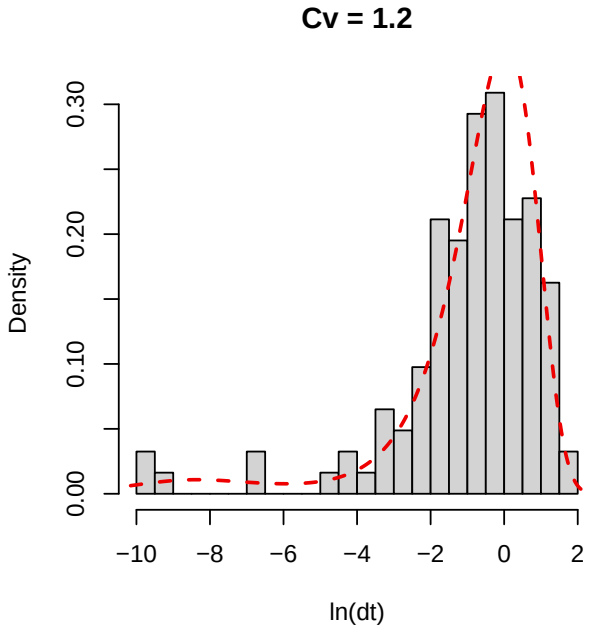

p =1.04 [1.01,1.11] ; loglambdac =−4; n =0.32 [0.09,0.688]
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

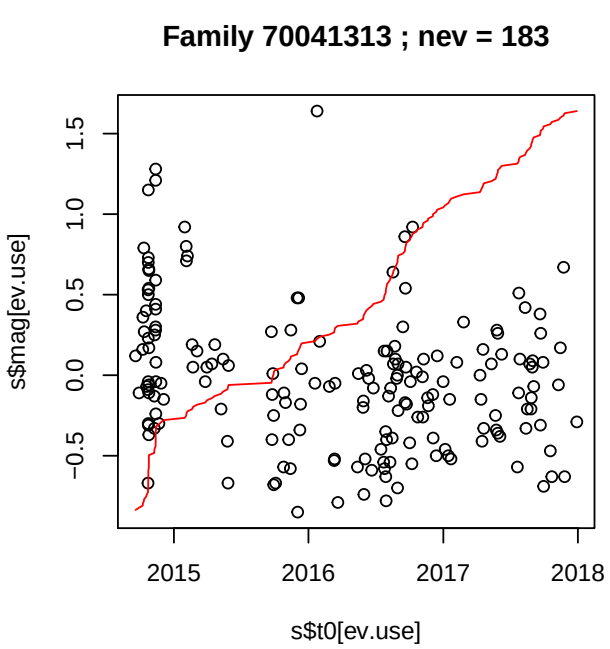

Cv = 1.6
Density
ln(dt)
−8
−6
−4
−2
0
2
0.0
0.1
0.2
0.3
0.4

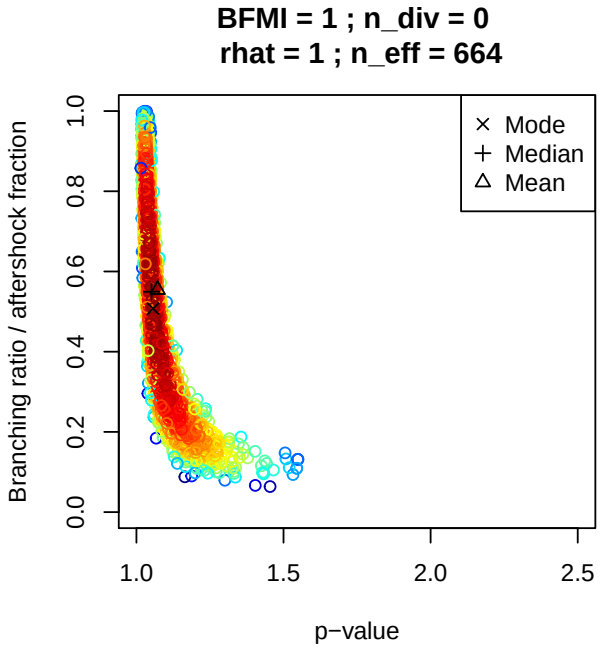

Family 70040183 ; nev = 124
s$mag[ev.use]
s$t0[ev.use]
−0.5
0.0
0.5
2015
2016
2017
2018

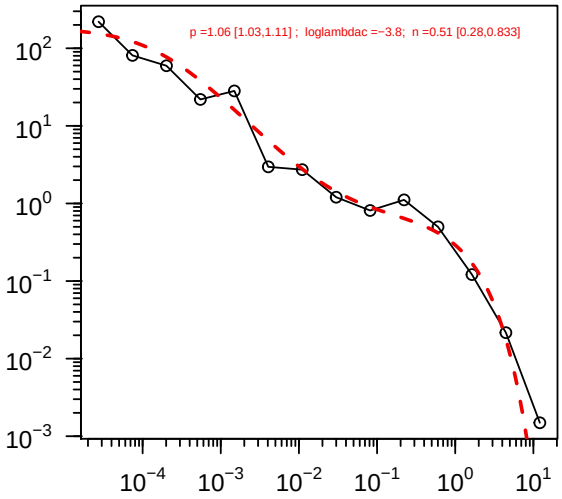

BFMI = 0.86 ; n_div = 0
rhat = 1.01 ; n_eff = 545
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5

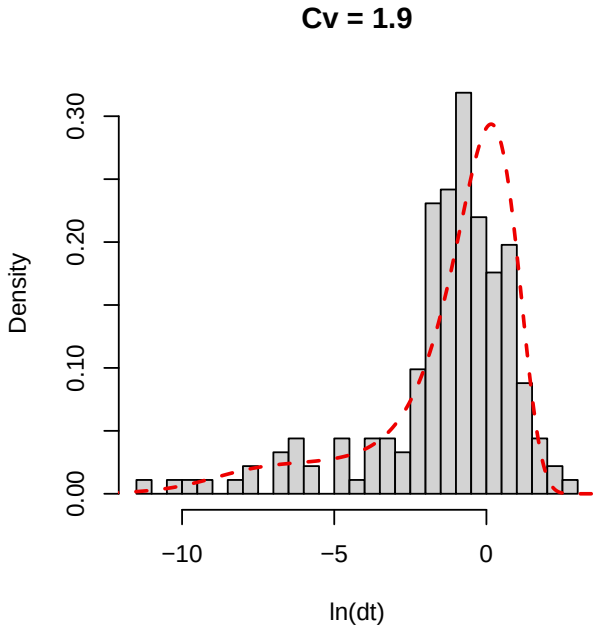

p =1.5 [1.03,1.56] ; loglambdac =−4; n =0.055 [0.042,0.338]
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$

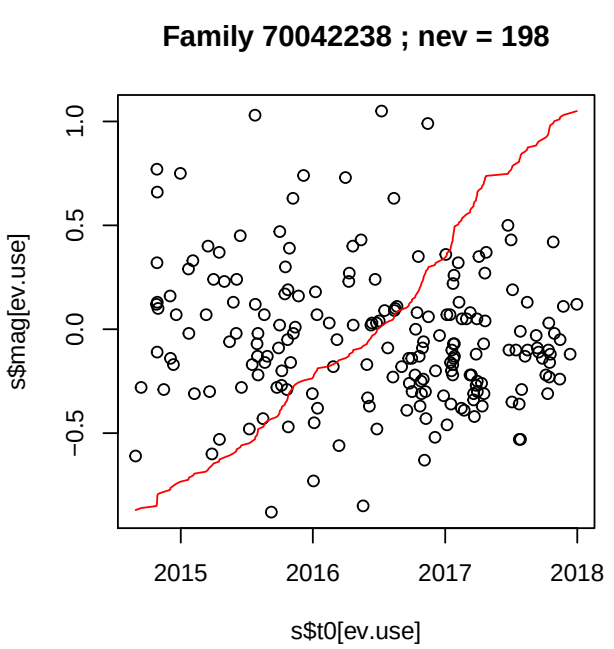

Cv = 1.2
Density
ln(dt)
0.00
0.10
0.20
0.30
−10
−8
−6
−4
−2
0
2

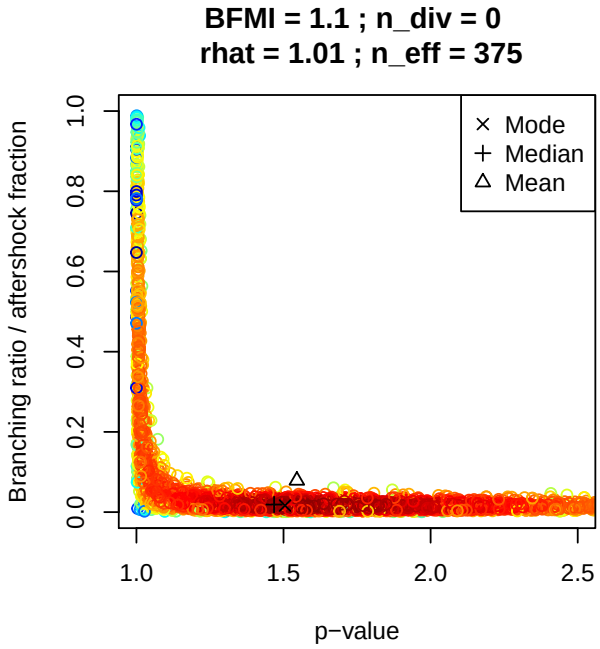

Family 70041313 ; nev = 183
s$mag[ev.use]
s$t0[ev.use]
2015
2016
2017
2018
−0.5
0.0
0.5
1.0
1.5

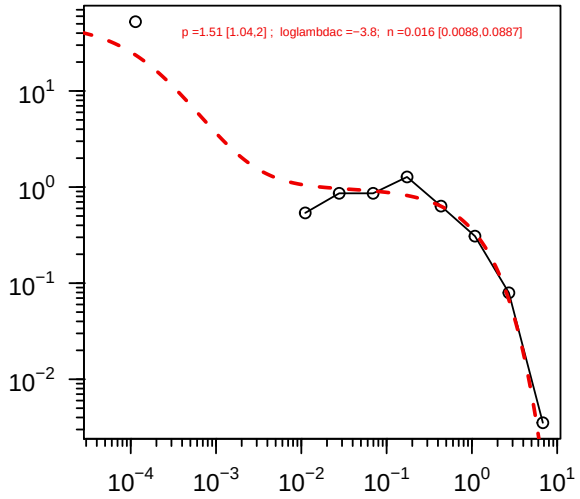

BFMI = 1 ; n_div = 0
rhat = 1 ; n_eff = 664
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5

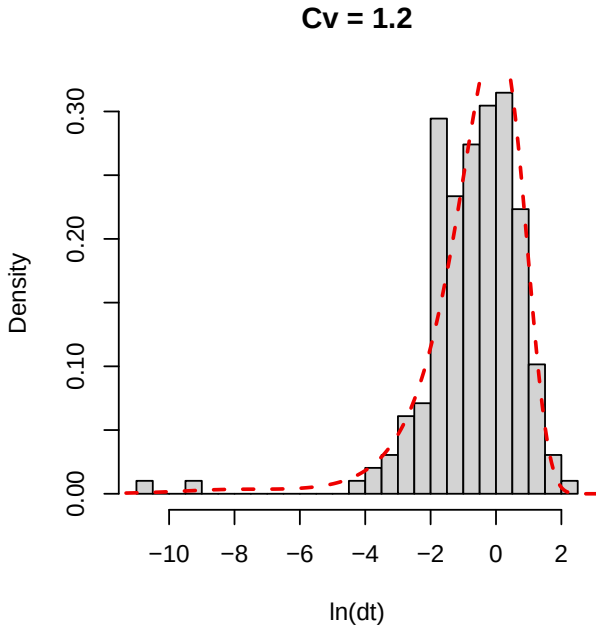

p =1.06 [1.03,1.11] ; loglambdac =−3.8; n =0.51 [0.28,0.833]
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-3}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

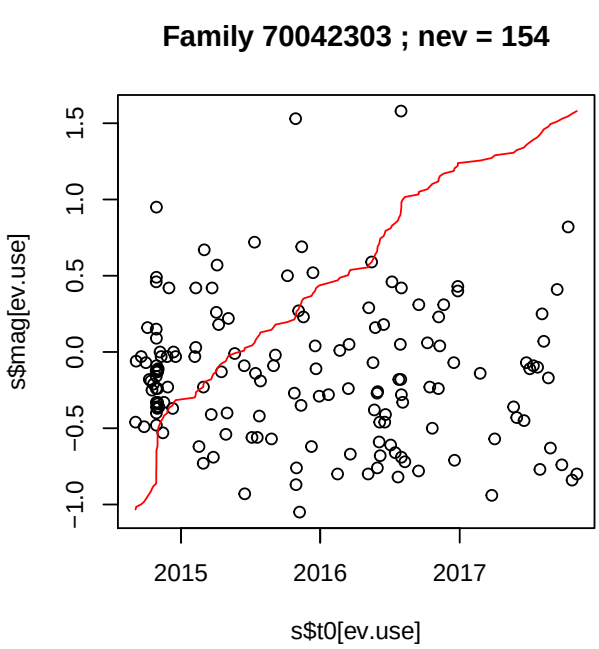

Cv = 1.9
Density
ln(dt)
0.00
0.10
0.20
0.30
−10
−5
0

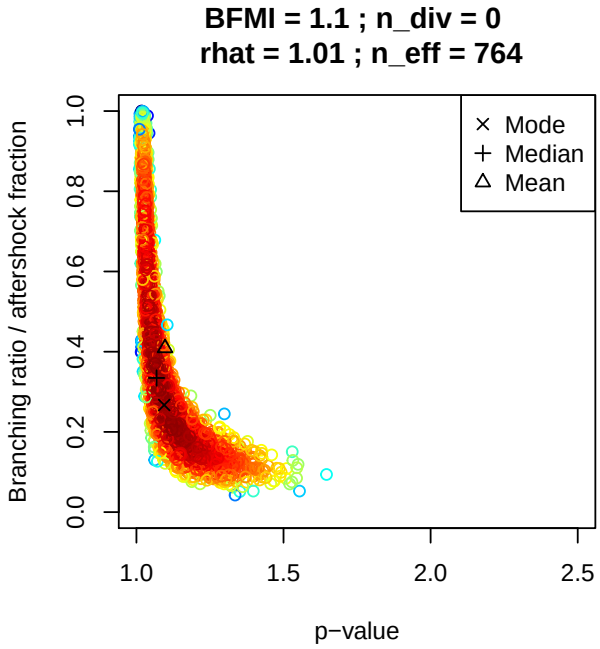

Family 70042238 ; nev = 198
s$mag[ev.use]
s$t0[ev.use]
2015
2016
2017
2018
−0.5
0.0
0.5
1.0

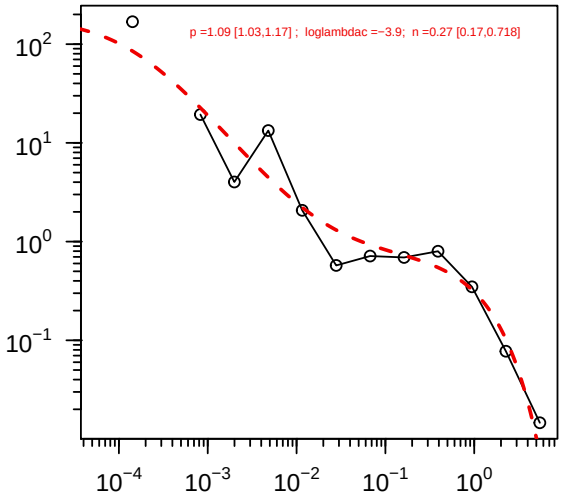

BFMI = 1.1 ; n_div = 0
rhat = 1.01 ; n_eff = 375
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
1.0
1.5
2.0
2.5
0.0
0.2
0.4
0.6
0.8
1.0

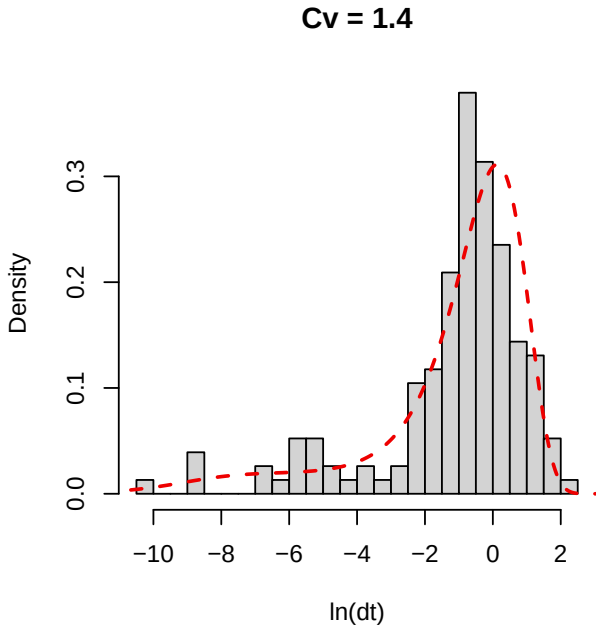

p =1.51 [1.04,2] ; loglambdac =−3.8; n =0.016 [0.0088,0.0887]
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

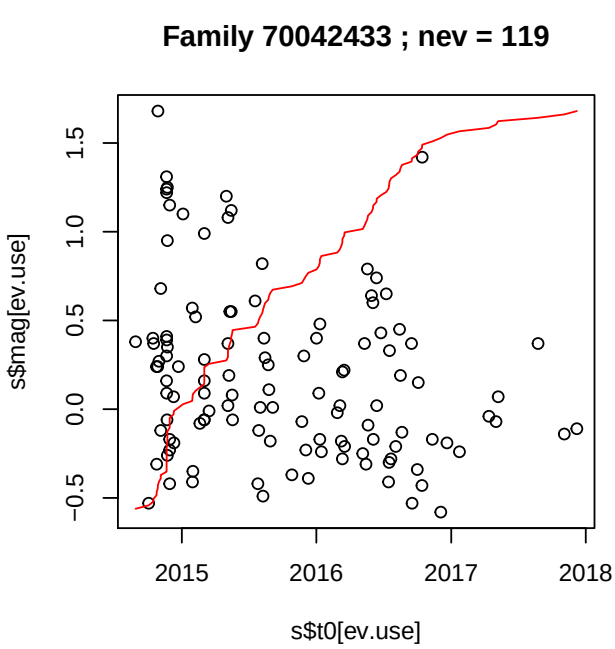

Cv = 1.2
Density
ln(dt)
−10
−8
−6
−4
−2
0
2
0.00
0.10
0.20
0.30

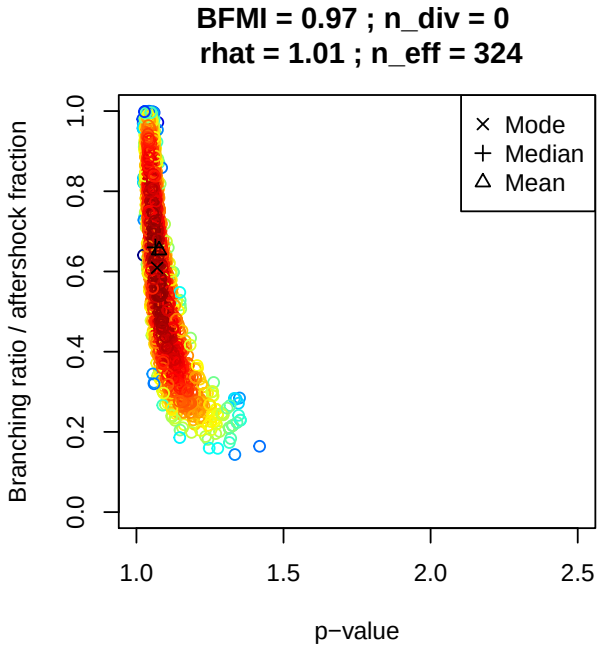

Family 70042303 ; nev = 154
s$mag[ev.use]
s$t0[ev.use]
2015
2016
2017
−1.0
−0.5
0.0
0.5
1.0
1.5

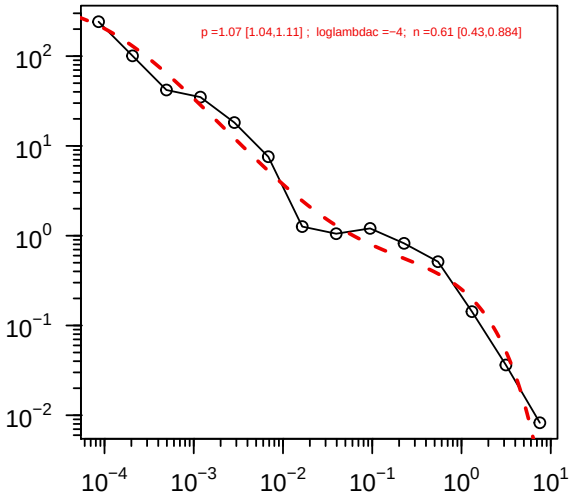

BFMI = 1.1 ; n_div = 0
rhat = 1.01 ; n_eff = 764
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5

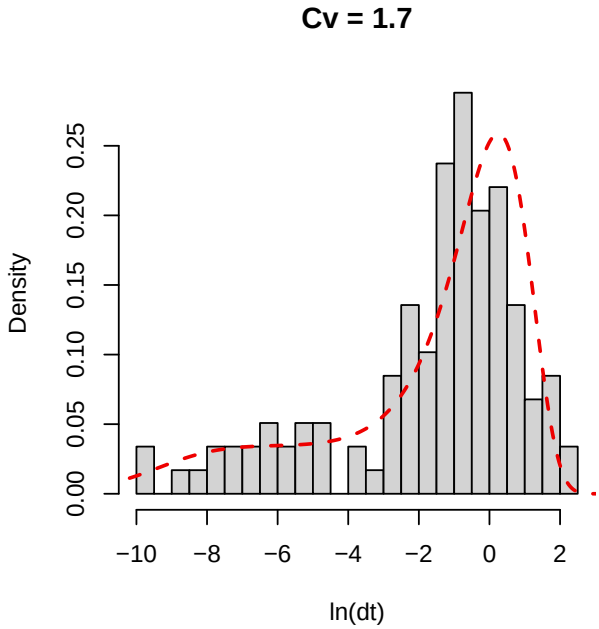

p =1.09 [1.03,1.17] ; loglambdac =−3.9; n =0.27 [0.17,0.718]
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$

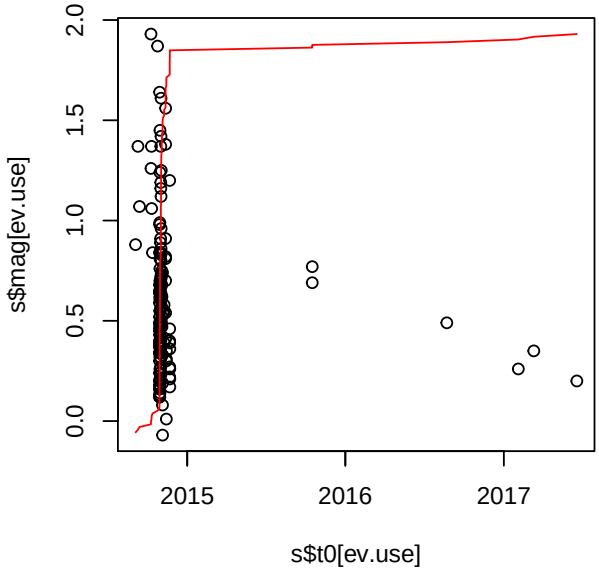

Cv = 1.4
Density
ln(dt)
0.0
0.1
0.2
0.3
−10
−8
−6
−4
−2
0
2

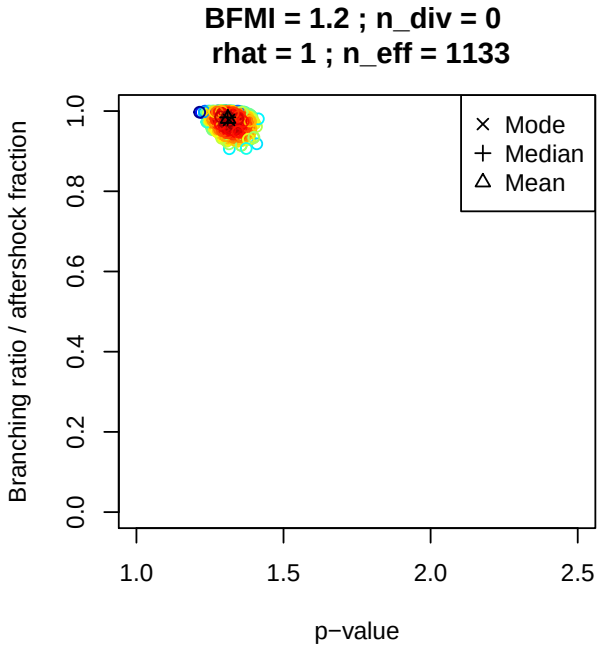

Family 70042433 ; nev = 119
s$mag[ev.use]
s$t0[ev.use]
2015
2016
2017
2018
−0.5
0.0
0.5
1.0
1.5

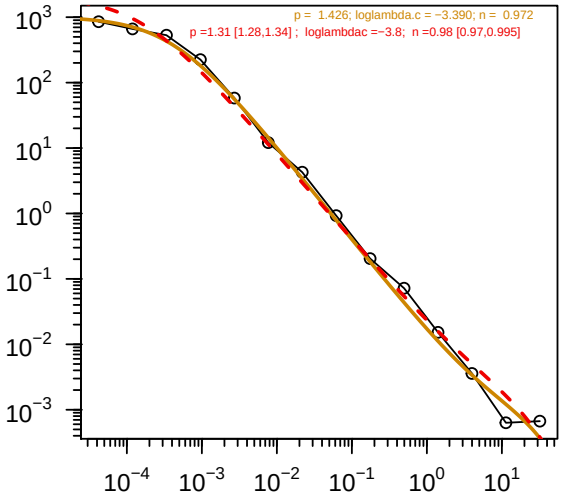

BFMI = 0.97 ; n_div = 0
rhat = 1.01 ; n_eff = 324
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
1.0
1.5
2.0
2.5
0.0
0.2
0.4
0.6
0.8
1.0

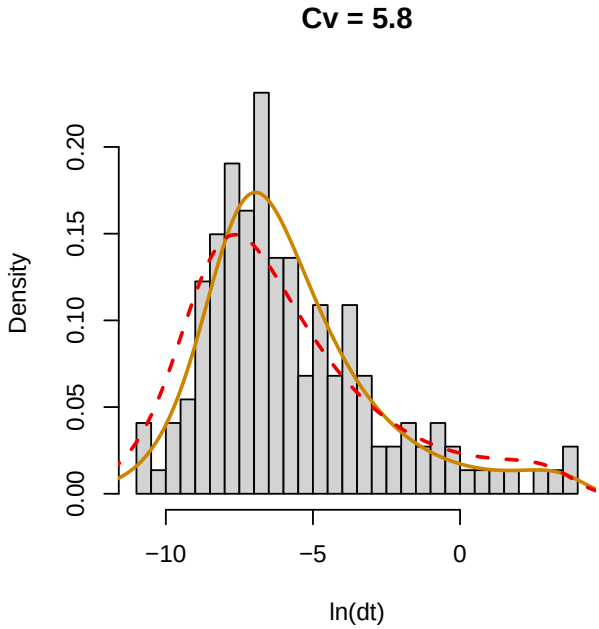

p =1.07 [1.04,1.11] ; loglambdac =−4; n =0.61 [0.43,0.884]

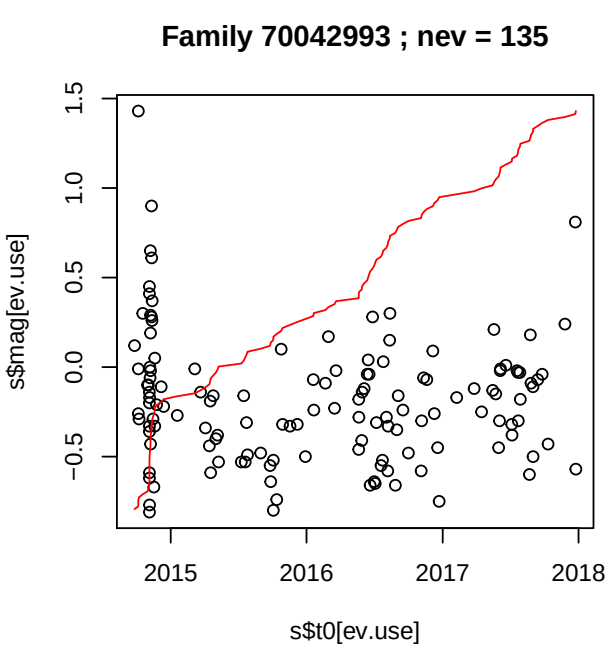

Cv = 1.7
Density
ln(dt)
−10
−8
−6
−4
−2
0
2
0.00
0.05
0.10
0.15
0.20
0.25

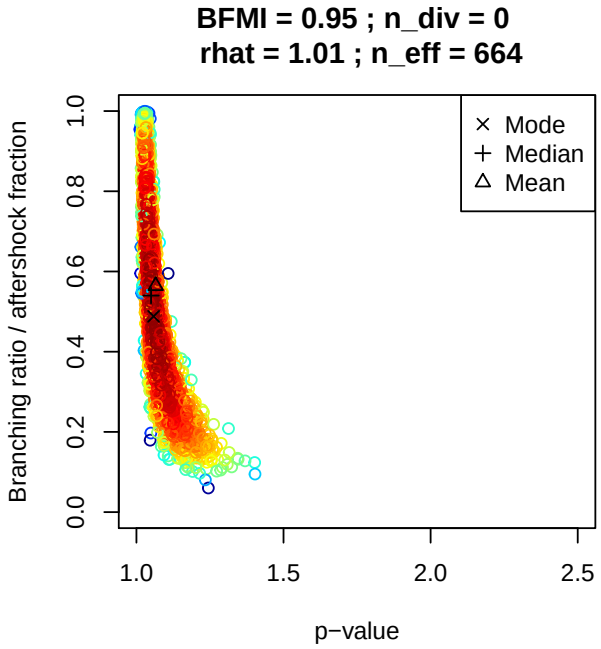

Family 70042683 ; nev = 148
s$mag[ev.use]
s$t0[ev.use]
0.0
0.5
1.0
1.5
2.0
2015
2016
2017

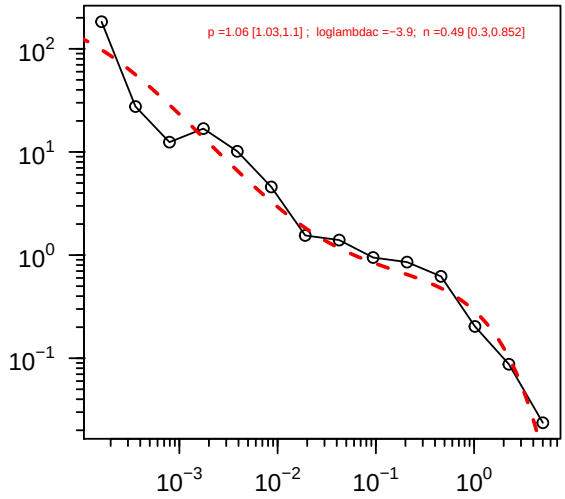

BFMI = 1.2 ; n_div = 0
rhat = 1 ; n_eff = 1133
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5

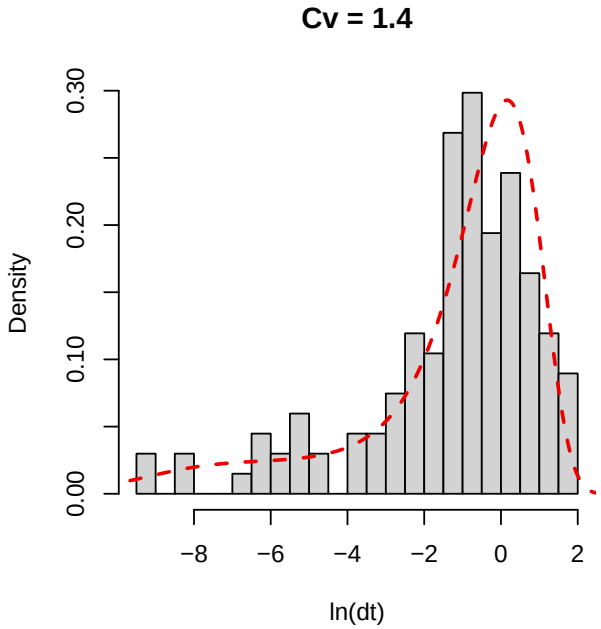

p = 1.426; loglambda.c = −3.390; n = 0.972
p =1.31 [1.28,1.34] ; loglambdac =−3.8; n =0.98 [0.97,0.995]

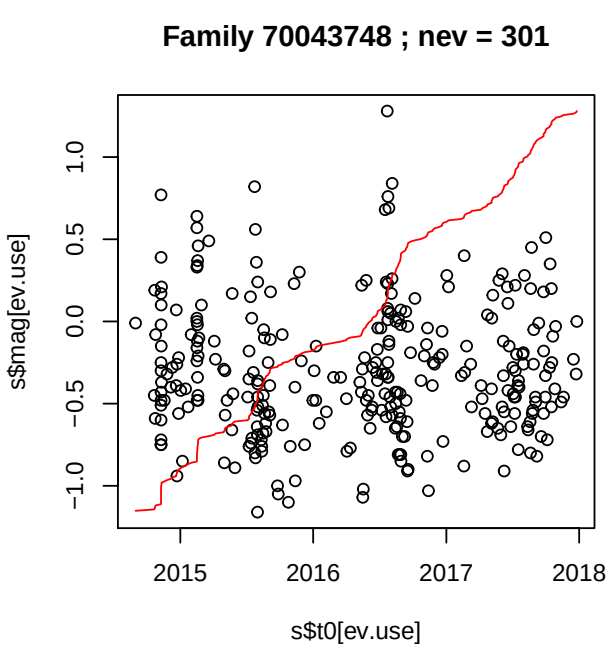

Cv = 5.8
Density
ln(dt)
0.00
0.05
0.10
0.15
0.20
−10
−5
0

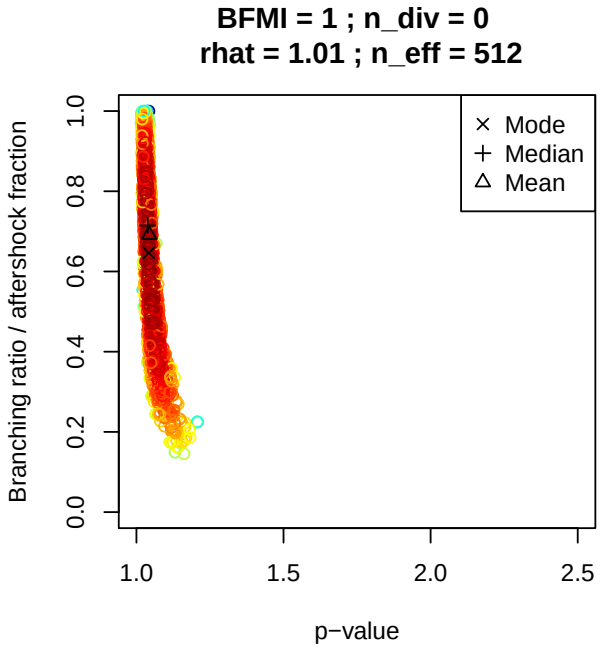

Family 70042993 ; nev = 135
s$mag[ev.use]
s$t0[ev.use]
2015
2016
2017
2018
−0.5
0.0
0.5
1.0
1.5

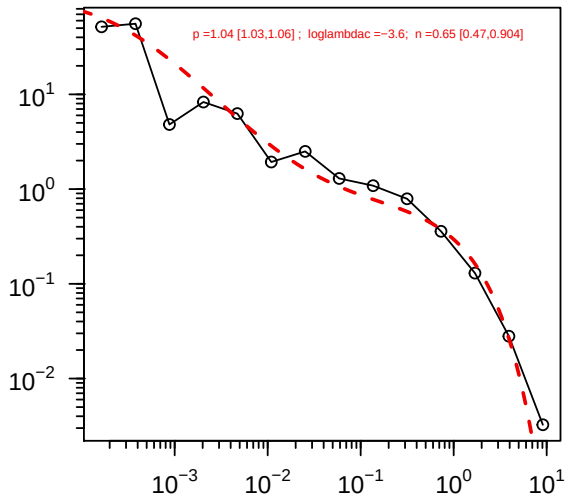

BFMI = 0.95 ; n_div = 0
rhat = 1.01 ; n_eff = 664
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5

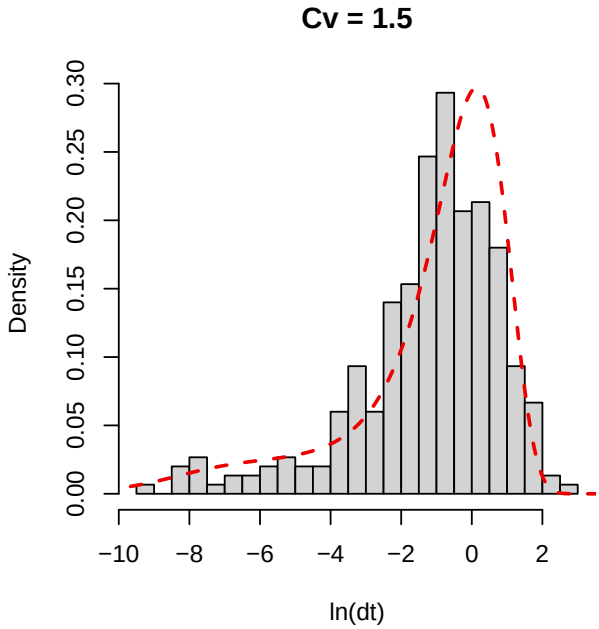

p =1.06 [1.03,1.1] ; loglambdac =−3.9; n =0.49 [0.3,0.852]
$10^2$
$10^1$
$10^0$
$10^{-1}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^0$

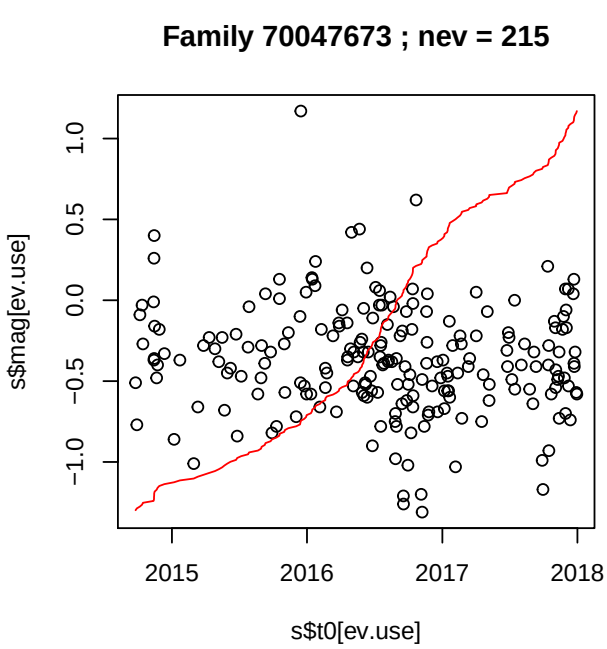

Cv = 1.4
Density
ln(dt)
0.00
0.10
0.20
0.30
−8
−6
−4
−2
0
2

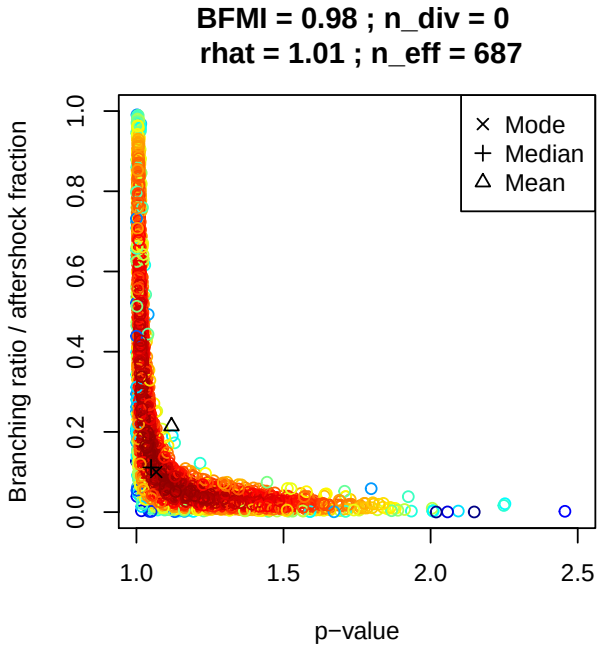

Family 70043748 ; nev = 301
s$mag[ev.use]
1.0
0.5
0.0
−0.5
−1.0
2015
2016
2017
2018
s$t0[ev.use]

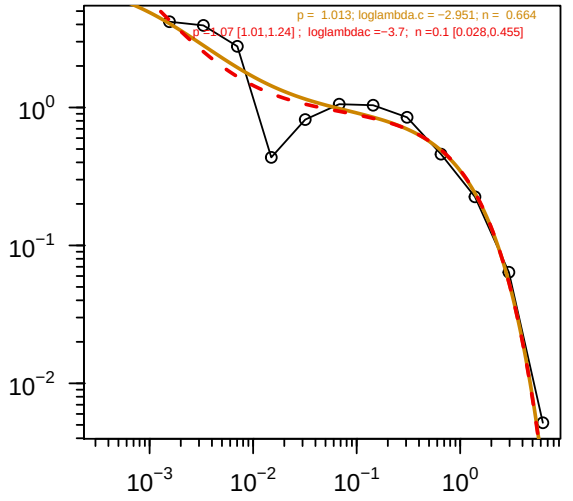

BFMI = 1 ; n_div = 0
rhat = 1.01 ; n_eff = 512
Mode
Median
Mean
Branching ratio / aftershock fraction
1.0
0.8
0.6
0.4
0.2
0.0
1.0
1.5
2.0
2.5
p−value

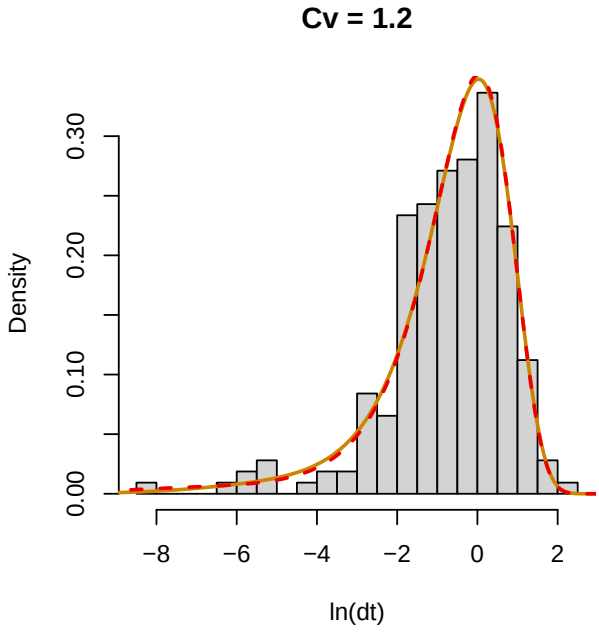

p =1.04 [1.03,1.06] ; loglambdac =−3.6; n =0.65 [0.47,0.904]
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

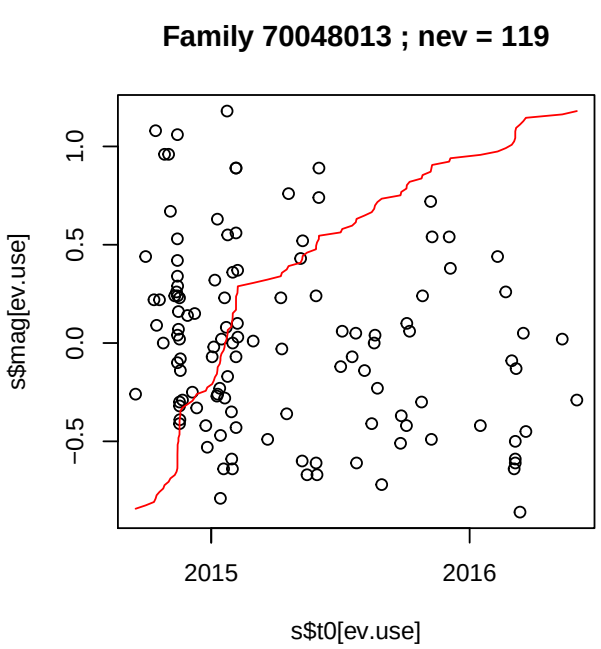

Cv = 1.5
Density
0.30
0.25
0.20
0.15
0.10
0.05
0.00
−10
−8
−6
−4
−2
0
2
ln(dt)

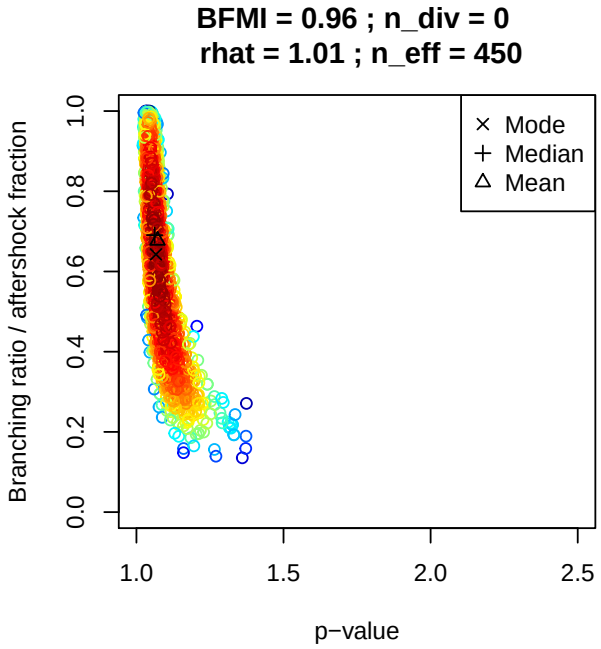

Family 70047673 ; nev = 215
s$mag[ev.use]
s$t0[ev.use]
2015
2016
2017
2018
−1.0
−0.5
0.0
0.5
1.0

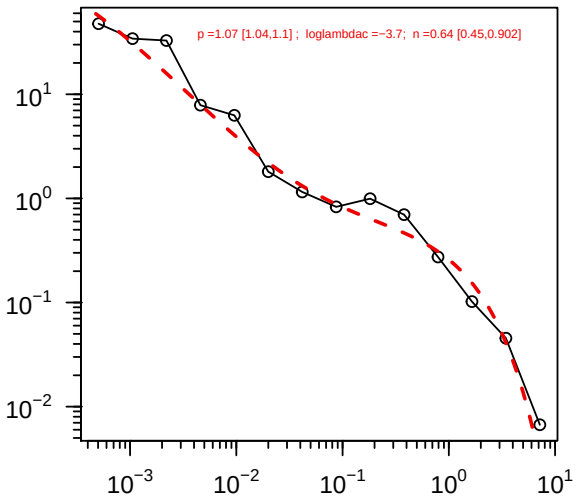

BFMI = 0.98 ; n_div = 0
rhat = 1.01 ; n_eff = 687
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5

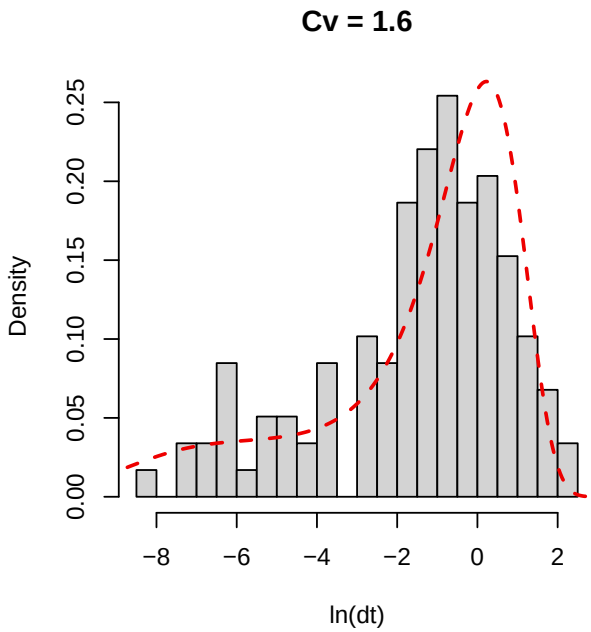

p = 1.013; loglambda.c = −2.951; n = 0.664
p = 1.07 [1.01,1.24] ; loglambdac =−3.7; n =0.1 [0.028,0.455]
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$

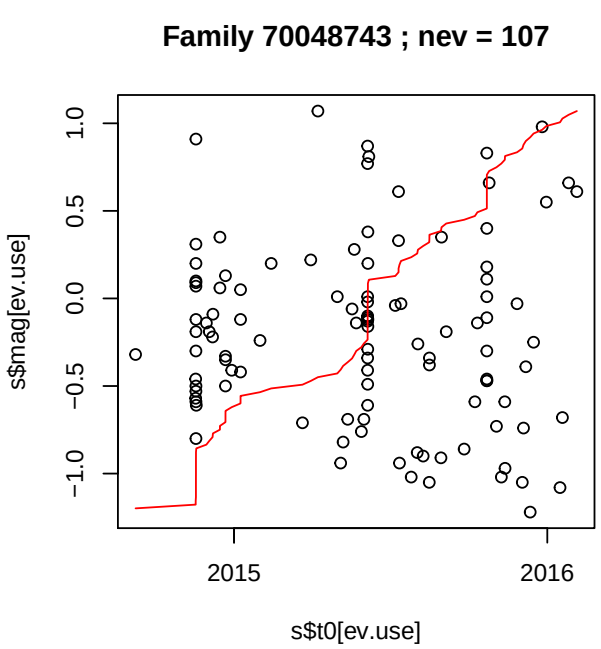

Cv = 1.2
Density
ln(dt)
0.00
0.10
0.20
0.30
−8
−6
−4
−2
0
2

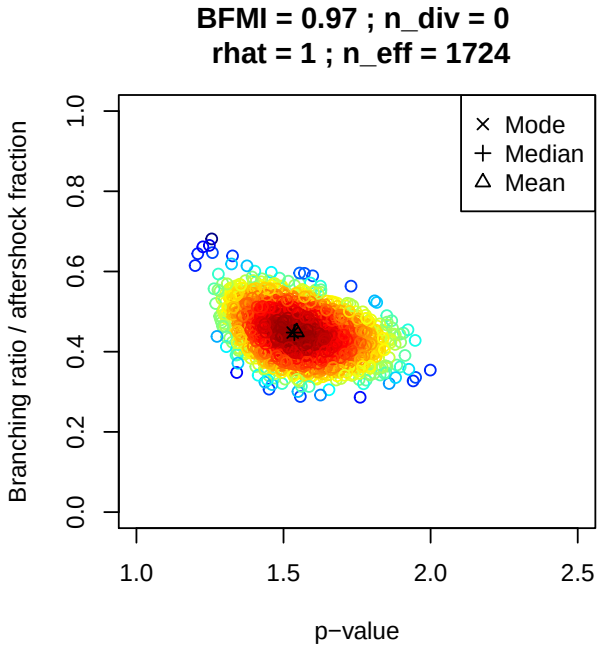

Family 70048013 ; nev = 119
s$mag[ev.use]
1.0
0.5
0.0
−0.5
2015
2016
s$t0[ev.use]

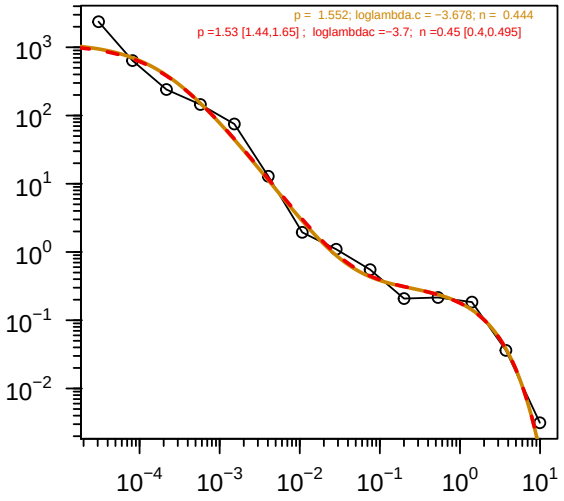

BFMI = 0.96 ; n_div = 0
rhat = 1.01 ; n_eff = 450
Mode
Median
Mean
Branching ratio / aftershock fraction
1.0
0.8
0.6
0.4
0.2
0.0
1.0
1.5
2.0
2.5
p−value

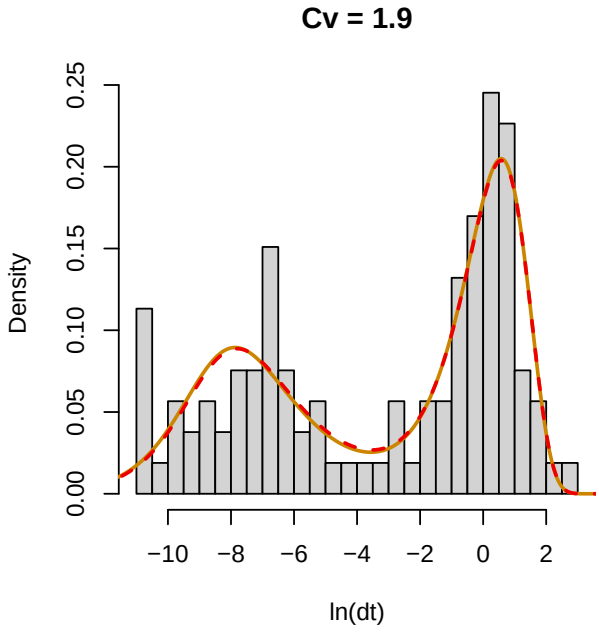

p =1.07 [1.04,1.1] ; loglambdac =−3.7; n =0.64 [0.45,0.902]
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

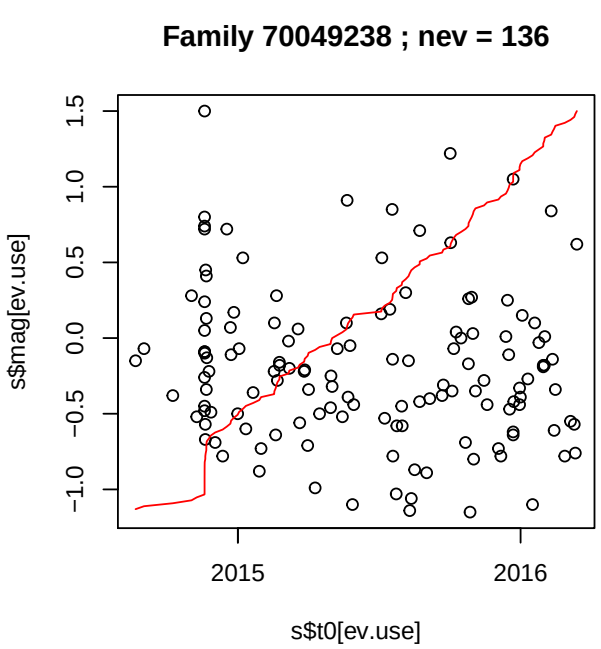

Cv = 1.6
Density
0.25
0.20
0.15
0.10
0.05
0.00
−8
−6
−4
−2
0
2
ln(dt)

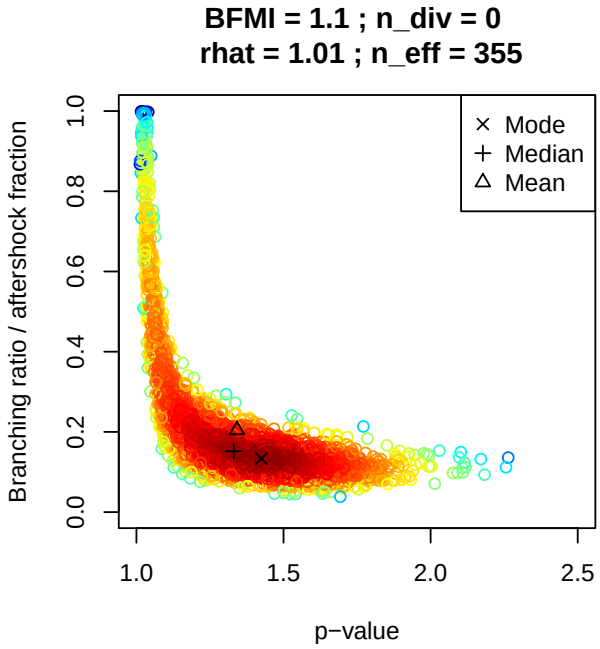

Family 70048743 ; nev = 107
s$mag[ev.use]
1.0
0.5
0.0
−0.5
−1.0
2015
2016
s$t0[ev.use]

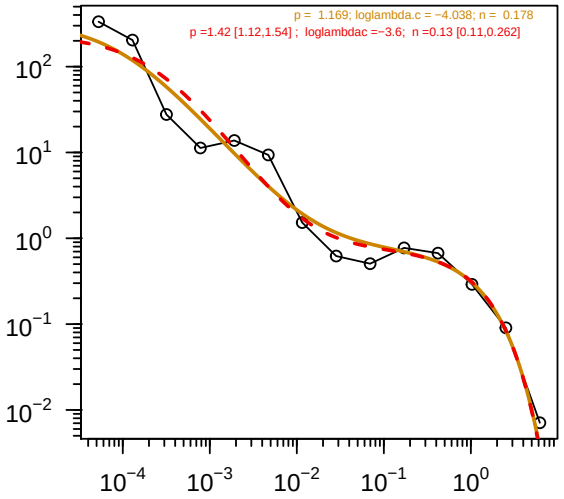

BFMI = 0.97 ; n_div = 0
rhat = 1 ; n_eff = 1724
Mode
Median
Mean
Branching ratio / aftershock fraction
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5
p−value

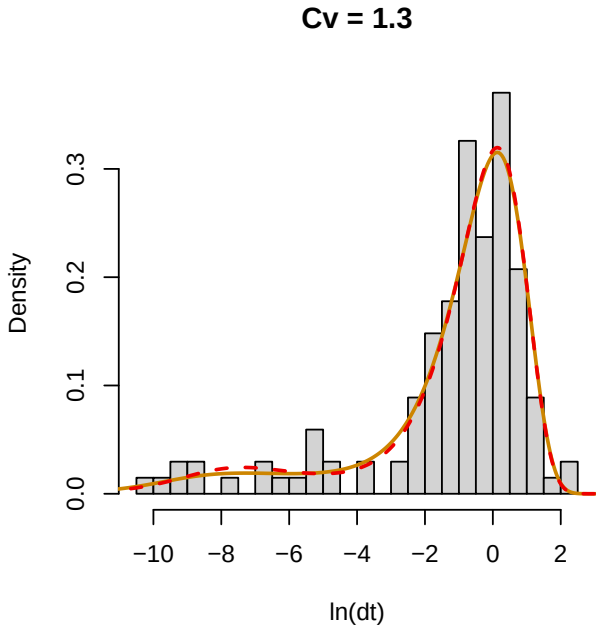

p = 1.552; loglambda.c = −3.678; n = 0.444
p =1.53 [1.44,1.65] ; loglambdac =−3.7; n =0.45 [0.4,0.495]
$10^3$
$10^2$
$10^1$
$10^0$
$10^{-1}$
$10^{-2}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^0$
$10^1$

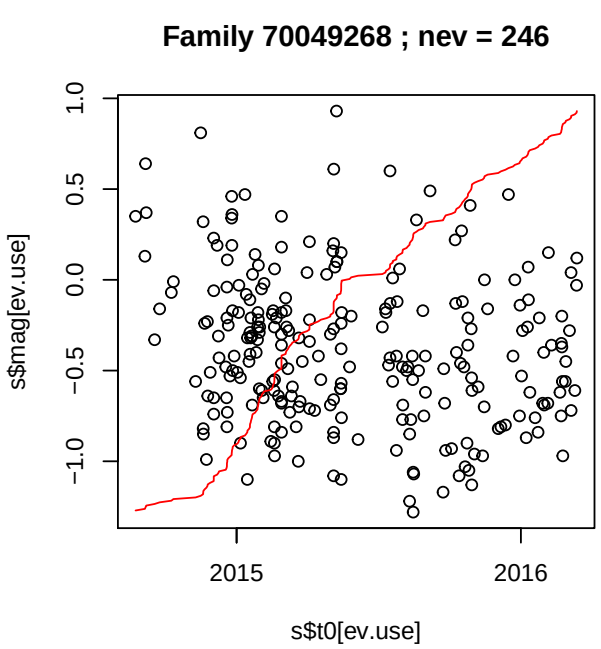

Cv = 1.9
Density
0.00
0.05
0.10
0.15
0.20
0.25
−10
−8
−6
−4
−2
0
2
ln(dt)

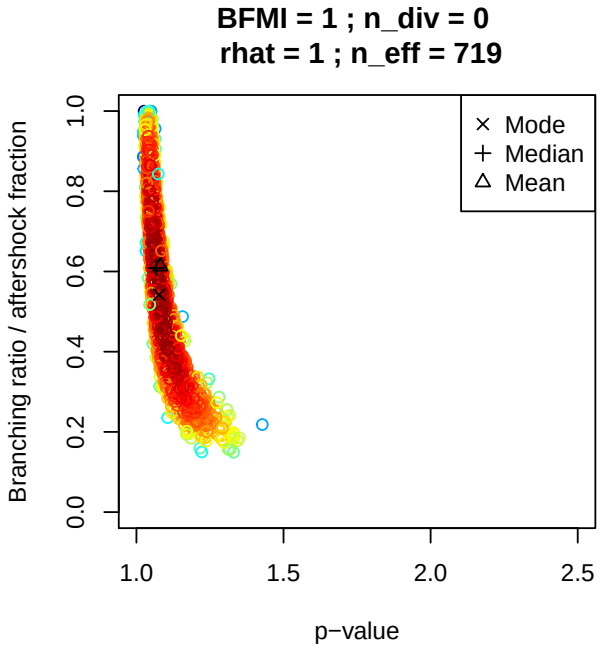

Family 70049238 ; nev = 136
s$mag[ev.use]
s$t0[ev.use]
2015
2016
−1.0
−0.5
0.0
0.5
1.0
1.5

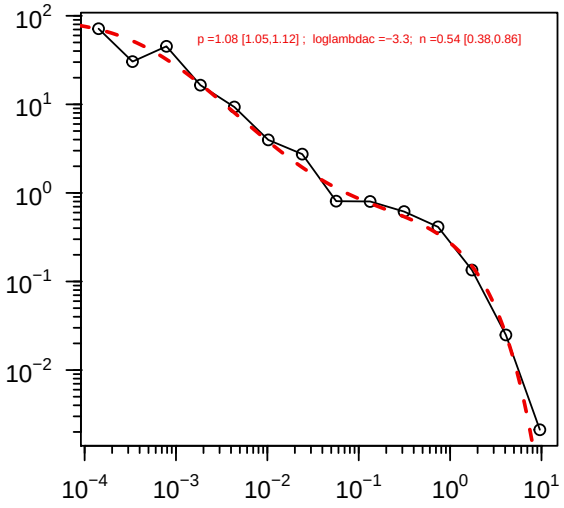

BFMI = 1.1 ; n_div = 0
rhat = 1.01 ; n_eff = 355
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5

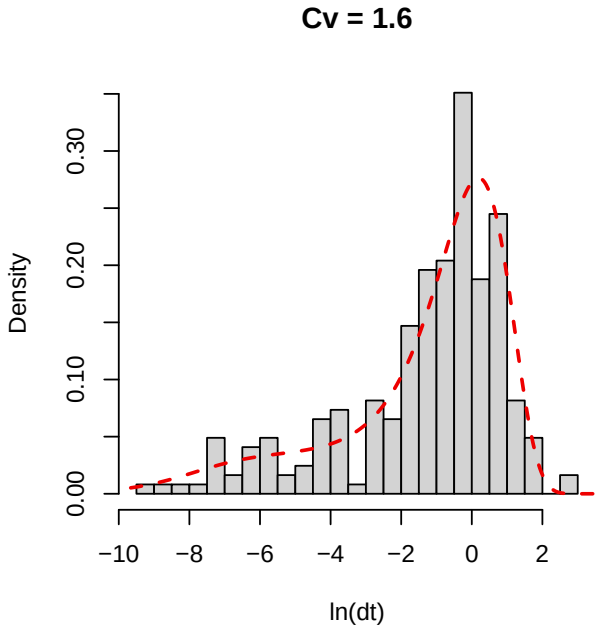

p = 1.169; loglambda.c = −4.038; n = 0.178
p =1.42 [1.12,1.54] ; loglambdac =−3.6; n =0.13 [0.11,0.262]
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$

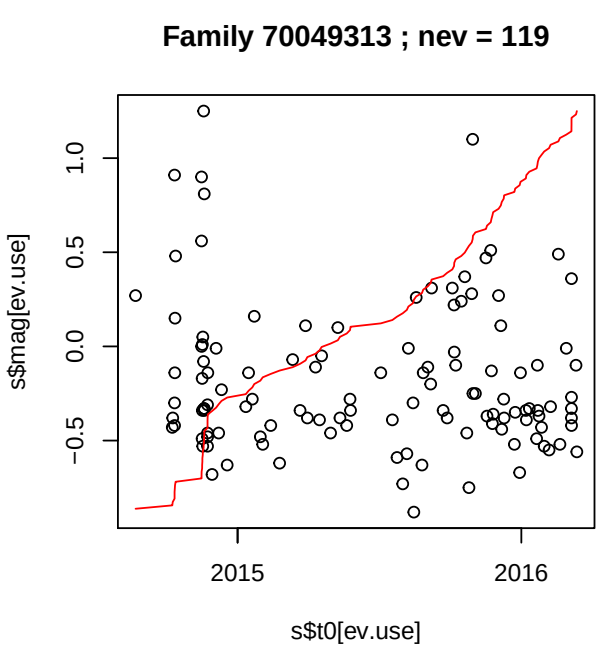

Cv = 1.3
Density
ln(dt)
0.0
0.1
0.2
0.3
−10
−8
−6
−4
−2
0
2

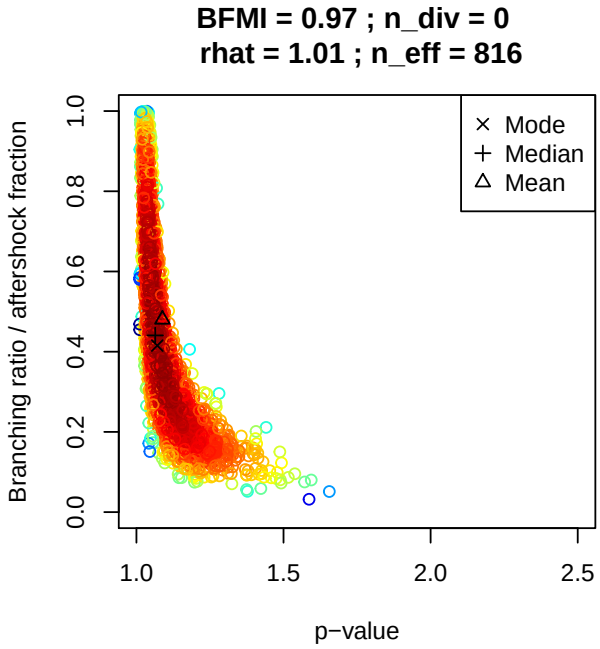

Family 70049268 ; nev = 246
s$mag[ev.use]
1.0
0.5
0.0
−0.5
−1.0
2015
2016
s$t0[ev.use]

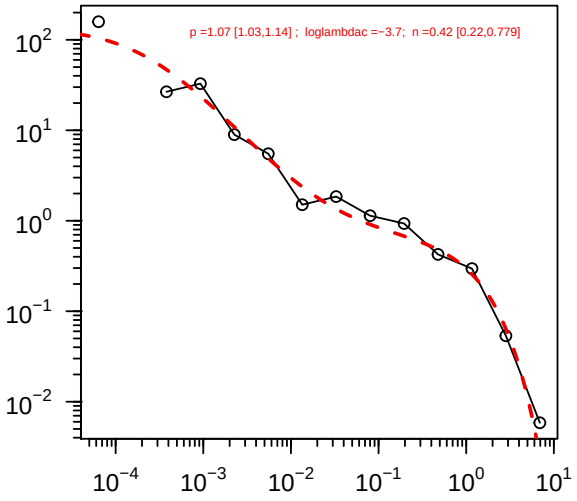

BFMI = 1 ; n_div = 0
rhat = 1 ; n_eff = 719
Mode
Median
Mean
Branching ratio / aftershock fraction
1.0
0.8
0.6
0.4
0.2
0.0
1.0
1.5
2.0
2.5
p−value

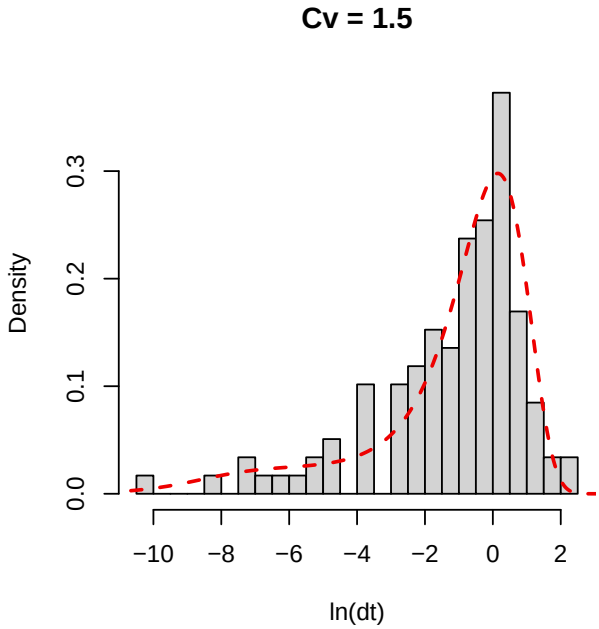

p =1.08 [1.05,1.12] ; loglambdac =−3.3; n =0.54 [0.38,0.86]
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

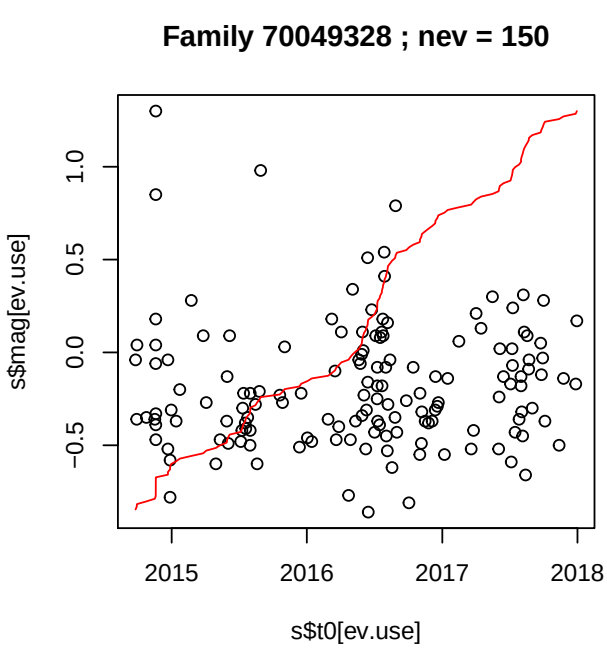

Cv = 1.6
Density
0.30
0.20
0.10
0.00
−10
−8
−6
−4
−2
0
2
ln(dt)

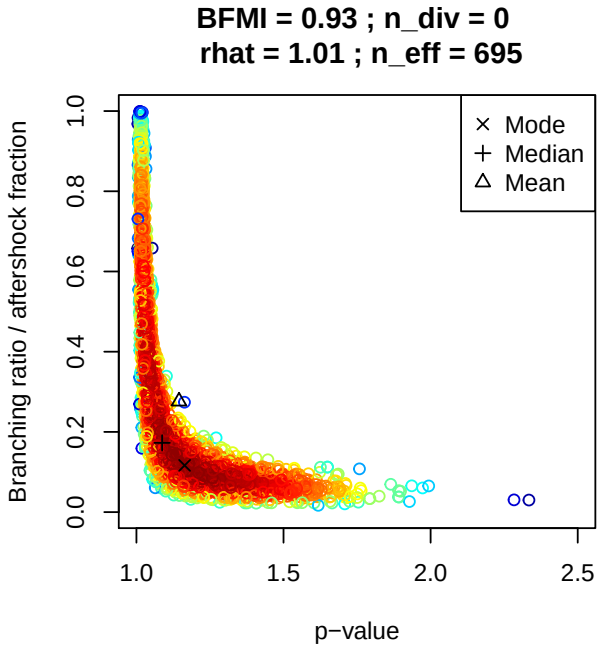

Family 70049313 ; nev = 119
s$mag[ev.use]
s$t0[ev.use]
2015
2016
1.0
0.5
0.0
−0.5

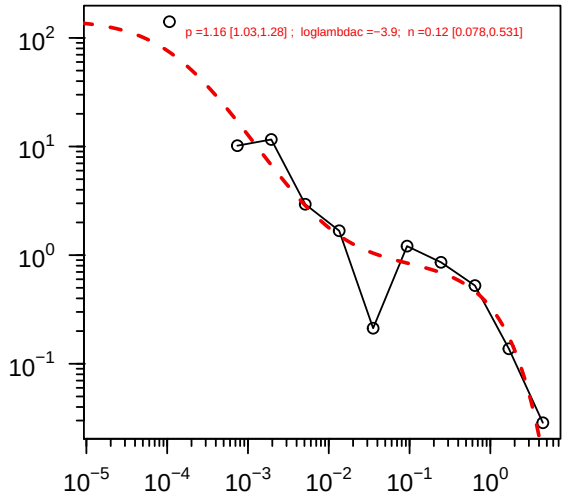

BFMI = 0.97 ; n_div = 0
rhat = 1.01 ; n_eff = 816
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
1.0
1.5
2.0
2.5
0.0
0.2
0.4
0.6
0.8
1.0

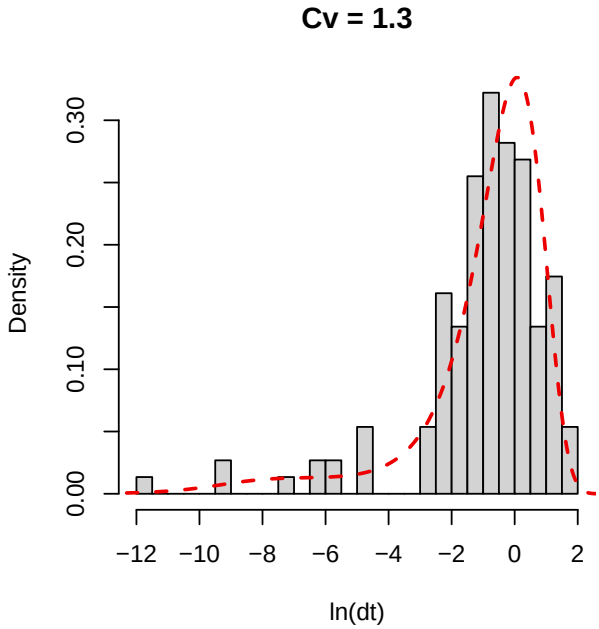

p =1.07 [1.03,1.14] ; loglambdac =−3.7; n =0.42 [0.22,0.779]
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

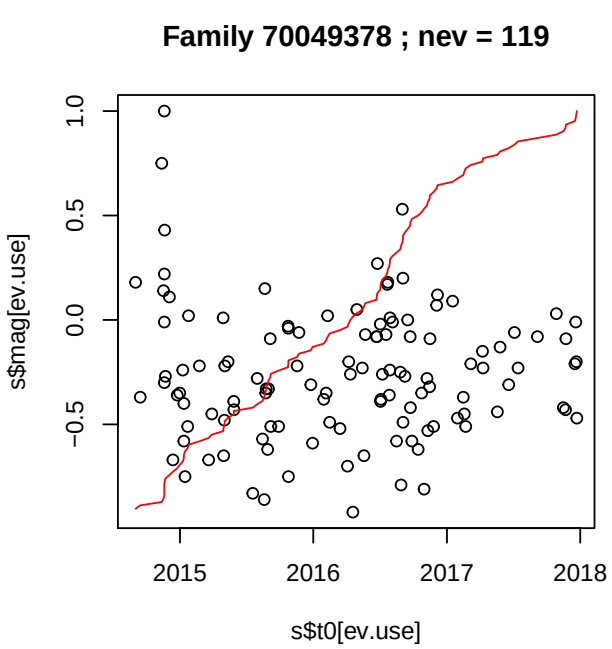

Cv = 1.5
Density
ln(dt)
0.0
0.1
0.2
0.3
−10
−8
−6
−4
−2
0
2

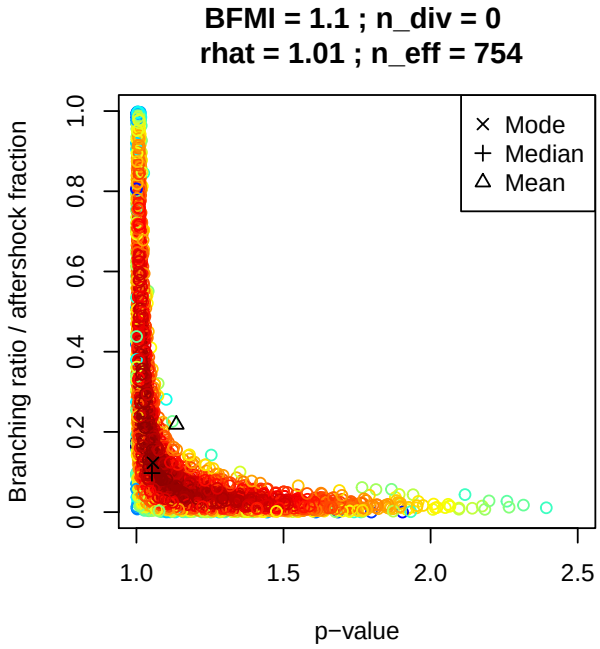

Family 70049328 ; nev = 150
s$mag[ev.use]
s$t0[ev.use]
2015
2016
2017
2018
−0.5
0.0
0.5
1.0

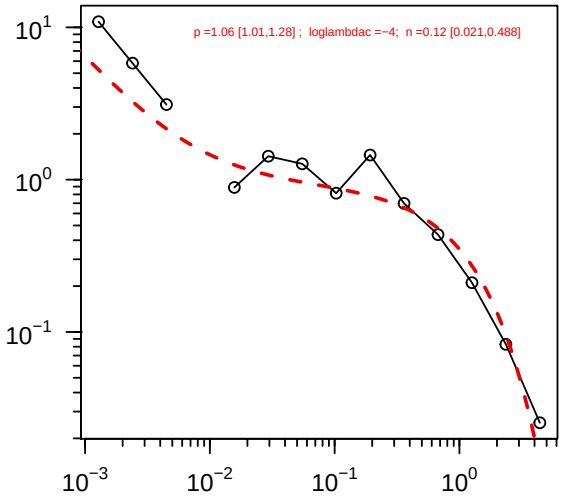

BFMI = 0.93 ; n_div = 0
rhat = 1.01 ; n_eff = 695
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
1.0
1.5
2.0
2.5
0.0
0.2
0.4
0.6
0.8
1.0

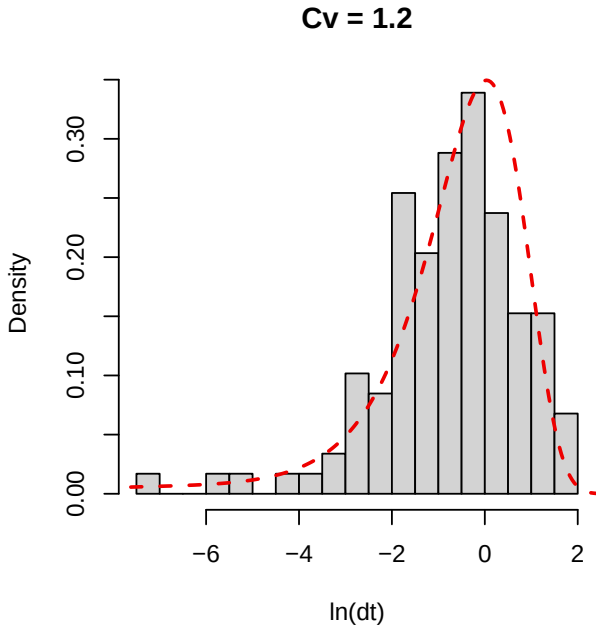

p =1.16 [1.03,1.28] ; loglambdac =−3.9; n =0.12 [0.078,0.531]
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-5}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$

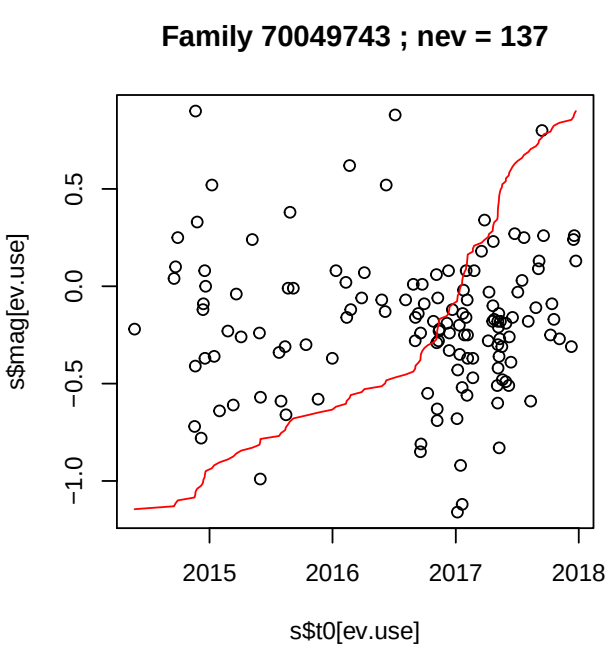

Cv = 1.3
Density
ln(dt)
0.00
0.10
0.20
0.30
−12
−10
−8
−6
−4
−2
0
2

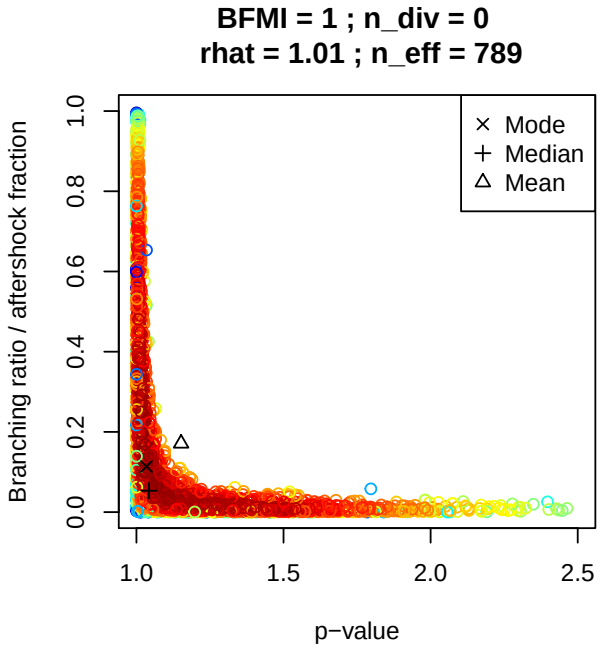

Family 70049378 ; nev = 119
s$mag[ev.use]
s$t0[ev.use]
2015
2016
2017
2018
1.0
0.5
0.0
−0.5

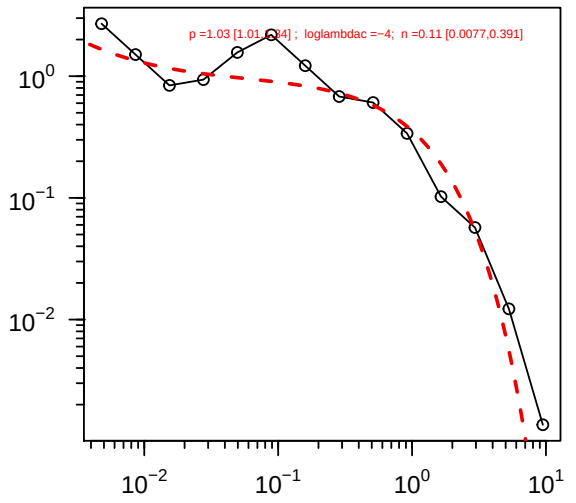

BFMI = 1.1 ; n_div = 0
rhat = 1.01 ; n_eff = 754
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
1.0
1.5
2.0
2.5
0.0
0.2
0.4
0.6
0.8
1.0

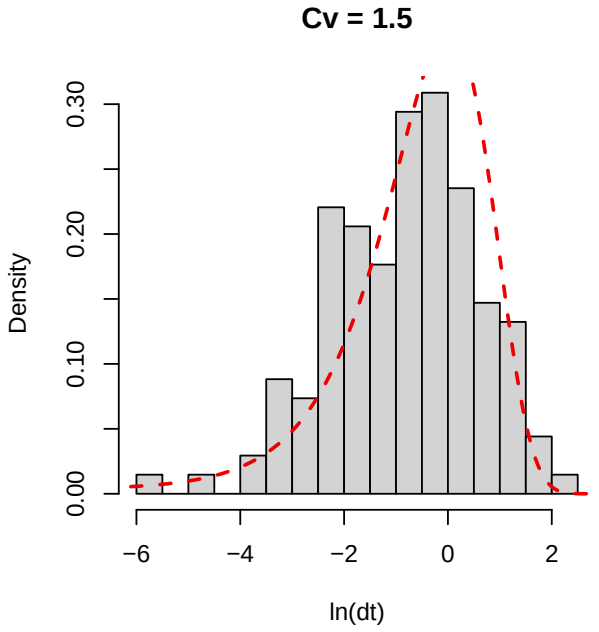

p =1.06 [1.01,1.28] ; loglambdac =−4; n =0.12 [0.021,0.488]
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$

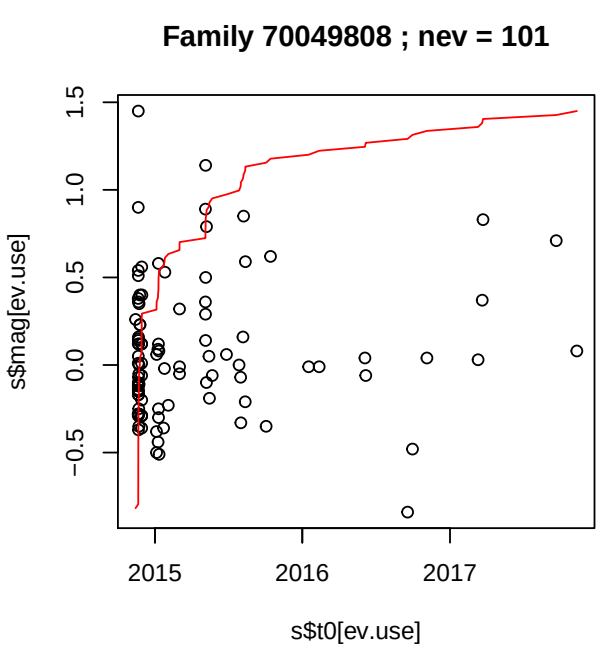

Cv = 1.2
Density
ln(dt)
0.00
0.10
0.20
0.30
−6
−4
−2
0
2

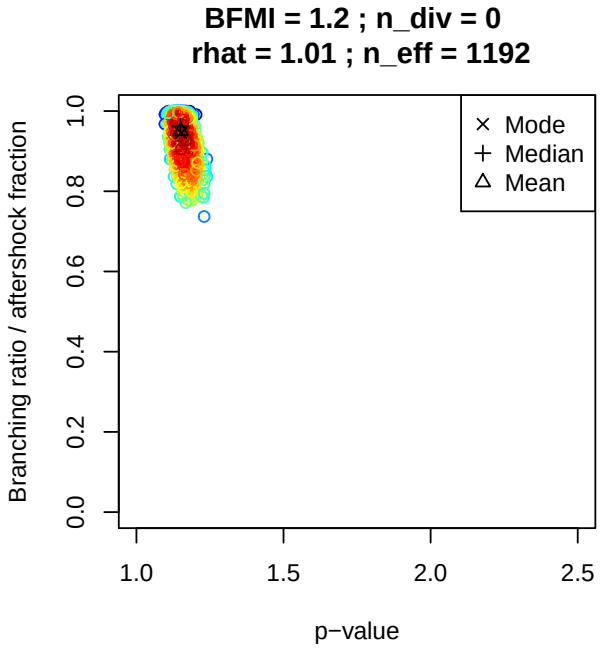

Family 70049743 ; nev = 137
s$mag[ev.use]
s$t0[ev.use]
−1.0
−0.5
0.0
0.5
2015
2016
2017
2018

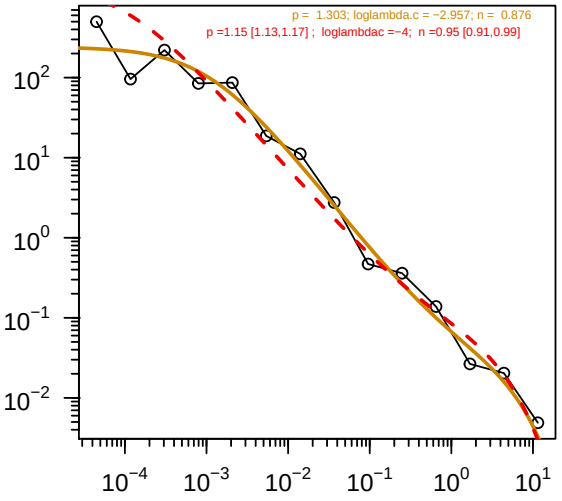

BFMI = 1 ; n_div = 0
rhat = 1.01 ; n_eff = 789
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5

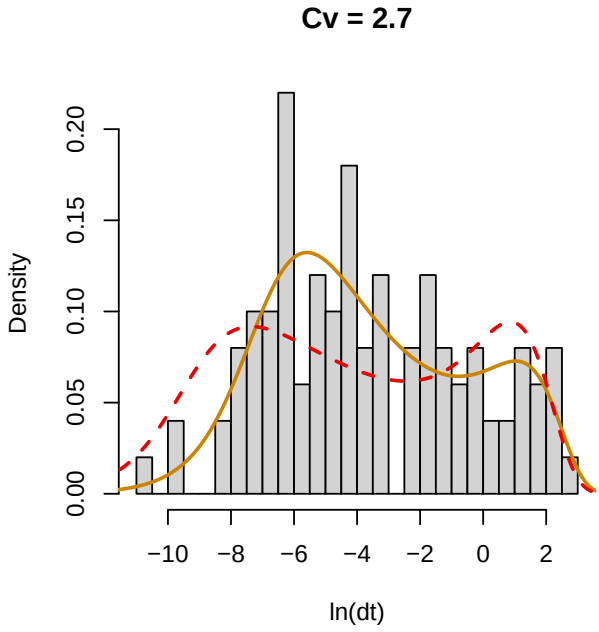

p =1.03 [1.01,1.04] ; loglambdac =−4; n =0.11 [0.0077,0.391]
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

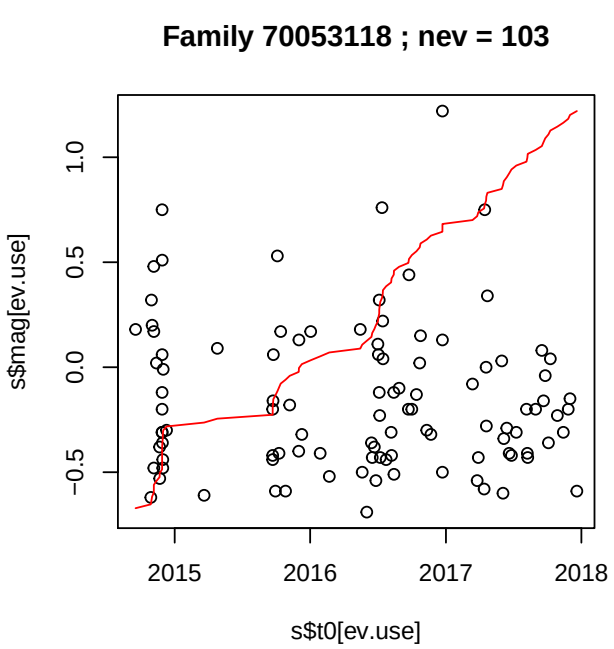

Cv = 1.5
Density
ln(dt)
0.00
0.10
0.20
0.30
−6
−4
−2
0
2

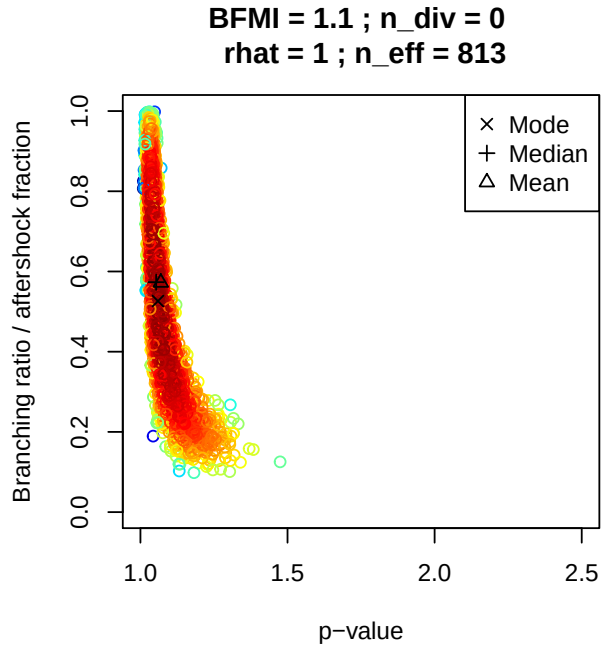

Family 70049808 ; nev = 101
s$mag[ev.use]
s$t0[ev.use]
2015
2016
2017
−0.5
0.0
0.5
1.0
1.5

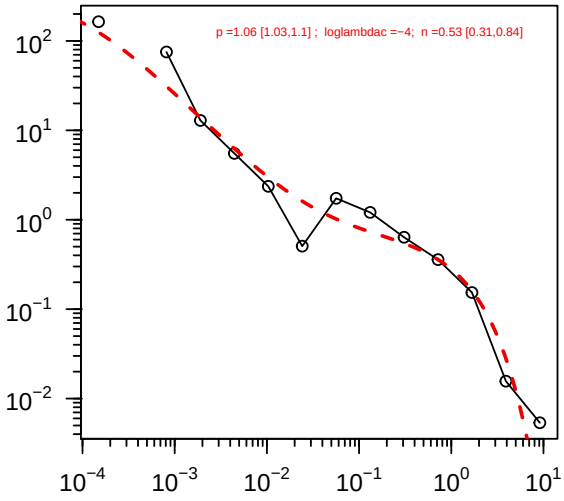

BFMI = 1.2 ; n_div = 0
rhat = 1.01 ; n_eff = 1192
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5

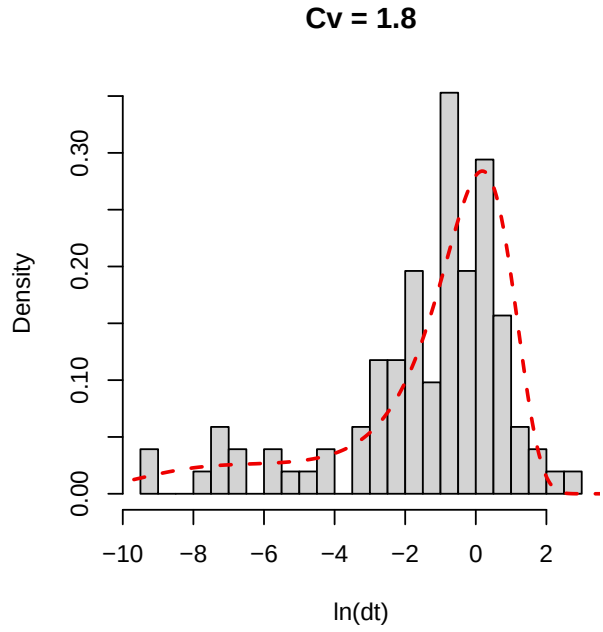

p = 1.303; loglambda.c = −2.957; n = 0.876
p =1.15 [1.13,1.17] ; loglambdac =−4; n =0.95 [0.91,0.99]
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

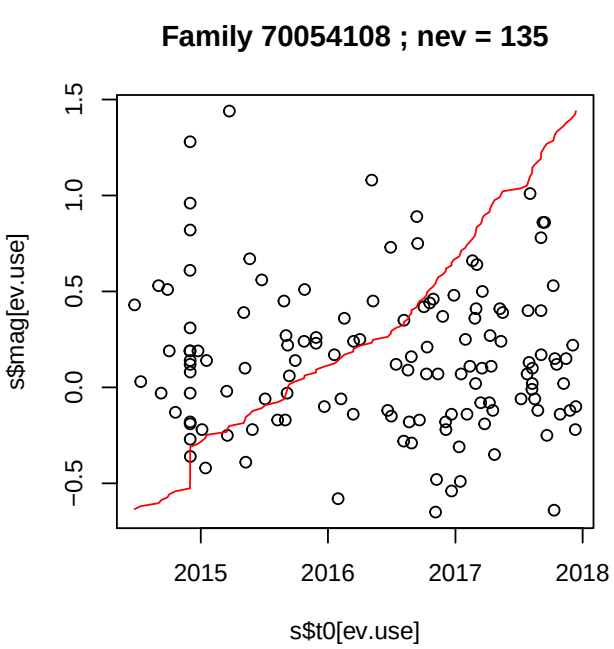

Cv = 2.7
Density
ln(dt)
0.00
0.05
0.10
0.15
0.20
−10
−8
−6
−4
−2
0
2

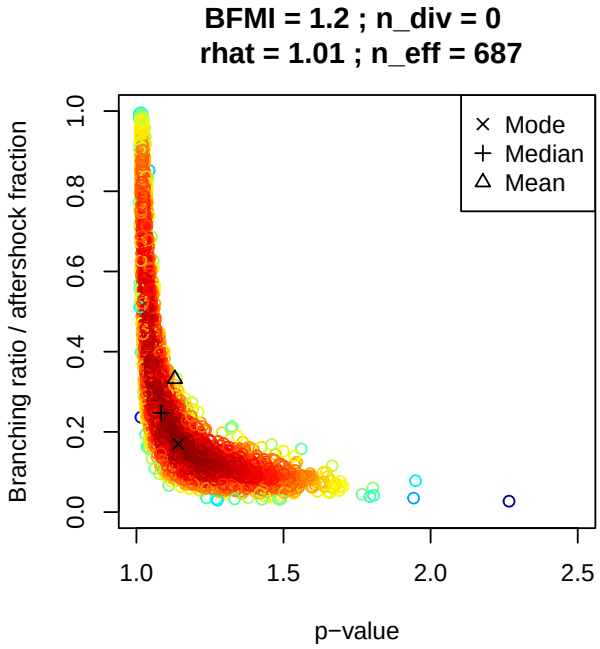

Family 70053118 ; nev = 103
s$mag[ev.use]
1.0
0.5
0.0
−0.5
2015
2016
2017
2018
s$t0[ev.use]

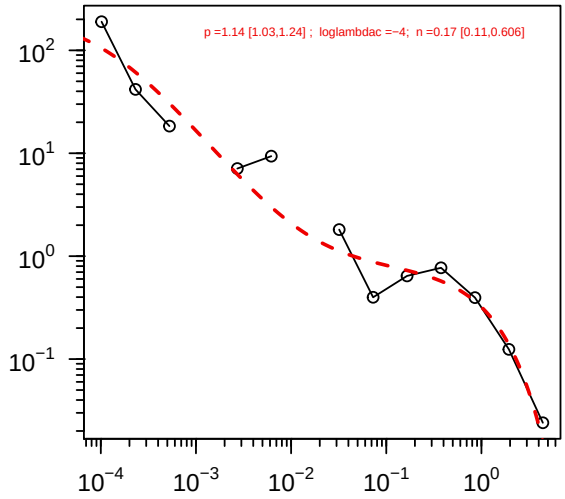

BFMI = 1.1 ; n_div = 0
rhat = 1 ; n_eff = 813
Mode
Median
Mean
Branching ratio / aftershock fraction
1.0
0.8
0.6
0.4
0.2
0.0
1.0
1.5
2.0
2.5
p−value

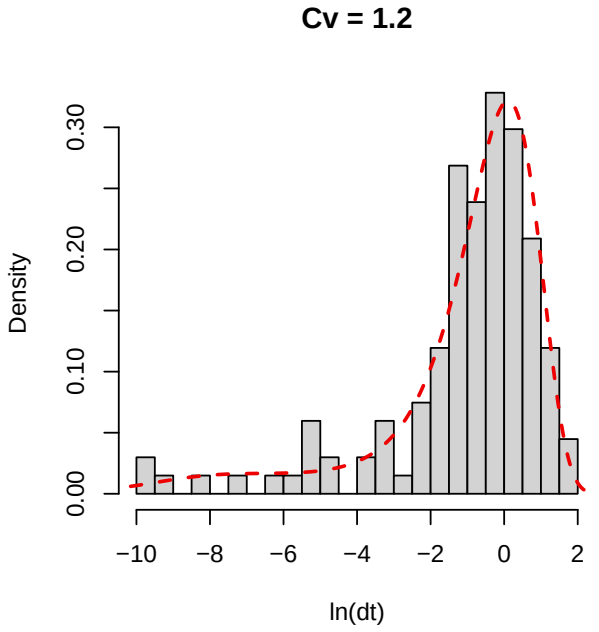

p =1.06 [1.03,1.1] ; loglambdac =−4; n =0.53 [0.31,0.84]
$10^2$
$10^1$
$10^0$
$10^{-1}$
$10^{-2}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^0$
$10^1$

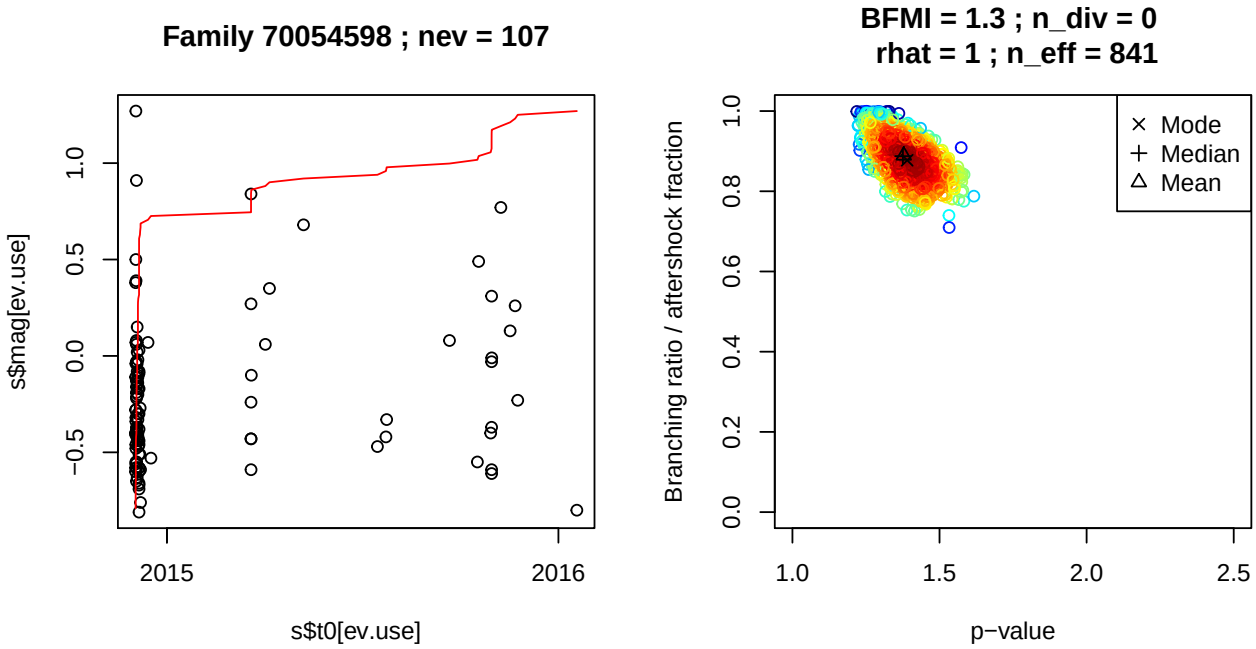

Cv = 1.8
Density
0.30
0.20
0.10
0.00
−10
−8
−6
−4
−2
0
2
ln(dt)

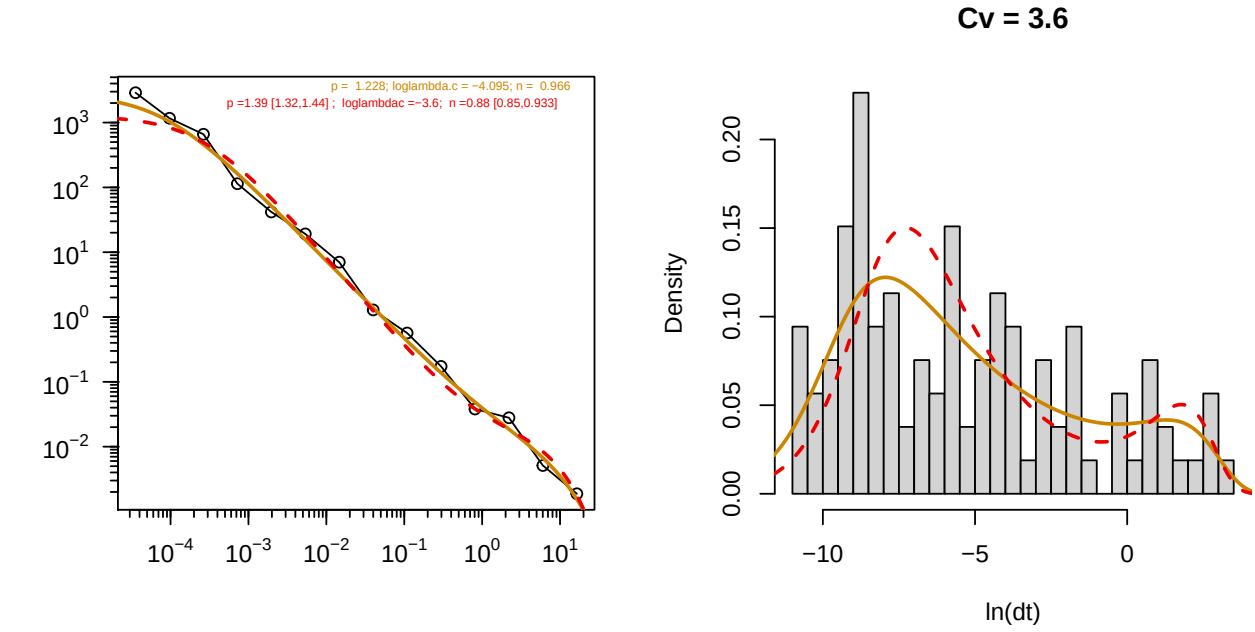

Family 70054108 ; nev = 135
s$mag[ev.use]
s$t0[ev.use]
2015
2016
2017
2018
−0.5
0.0
0.5
1.0
1.5

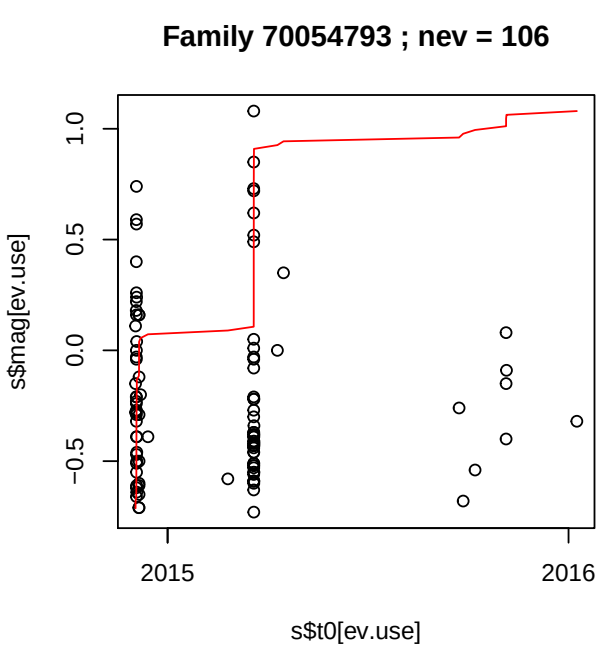

BFMI = 1.2 ; n_div = 0
rhat = 1.01 ; n_eff = 687
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
1.0
1.5
2.0
2.5
0.0
0.2
0.4
0.6
0.8
1.0

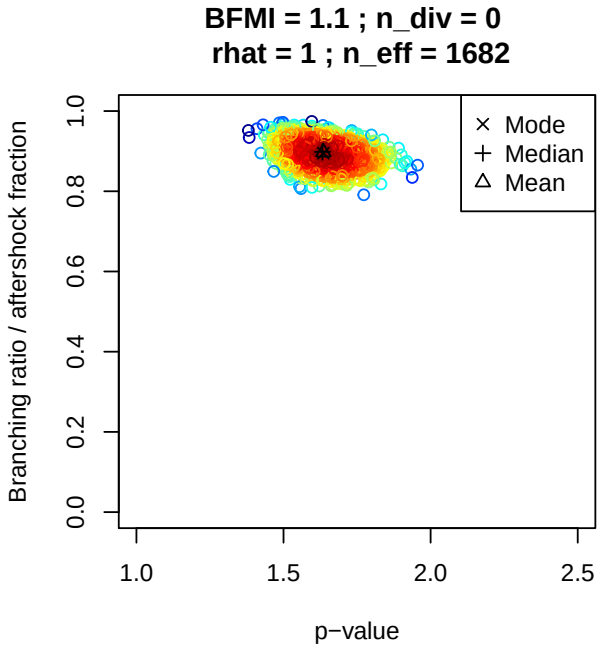

p =1.14 [1.03,1.24] ; loglambdac =−4; n =0.17 [0.11,0.606]
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$

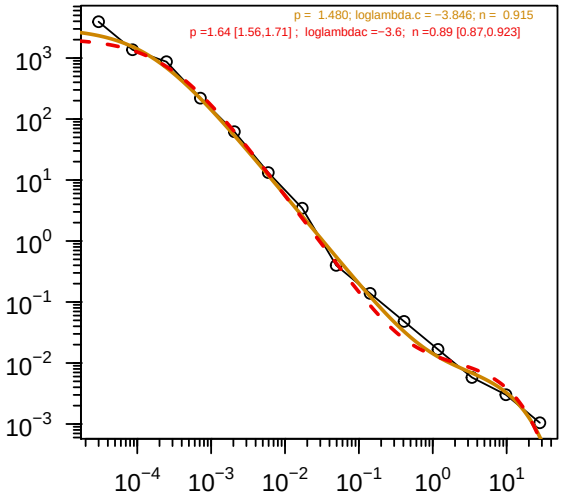

Cv = 1.2
Density
ln(dt)
0.00
0.10
0.20
0.30
−10
−8
−6
−4
−2
0
2

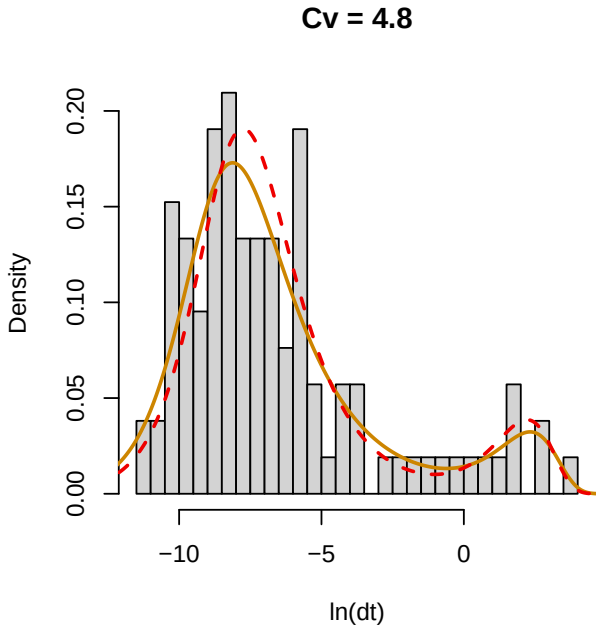

Family 70054598 ; nev = 107
s$mag[ev.use]
1.0
0.5
0.0
−0.5
2015
2016
s$t0[ev.use]
BFMI = 1.3 ; n_div = 0
rhat = 1 ; n_eff = 841
Branching ratio / aftershock fraction
1.0
0.8
0.6
0.4
0.2
0.0
× Mode
+ Median
△ Mean
1.0
1.5
2.0
2.5
p−value

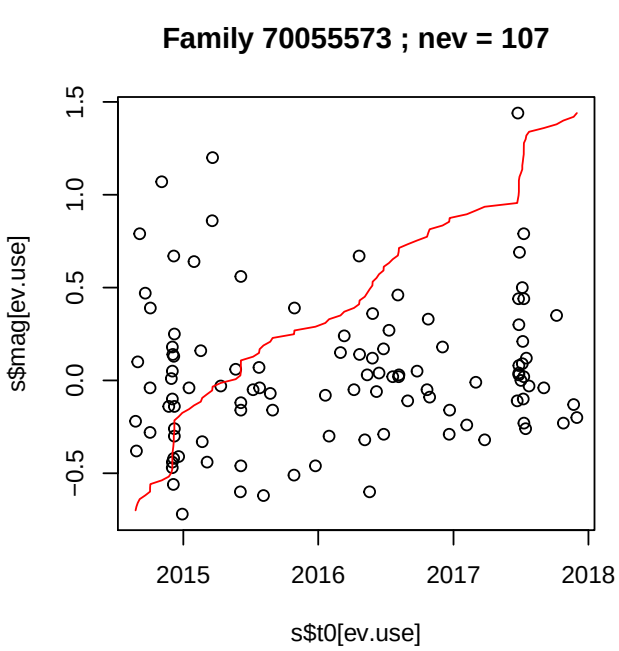

p = 1.228; loglambda.c = −4.095; n = 0.966
p =1.39 [1.32,1.44] ; loglambdac =−3.6; n =0.88 [0.85,0.933]
$10^3$
$10^2$
$10^1$
$10^0$
$10^{-1}$
$10^{-2}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^0$
$10^1$
Cv = 3.6
Density
0.20
0.15
0.10
0.05
0.00
−10
−5
0
ln(dt)

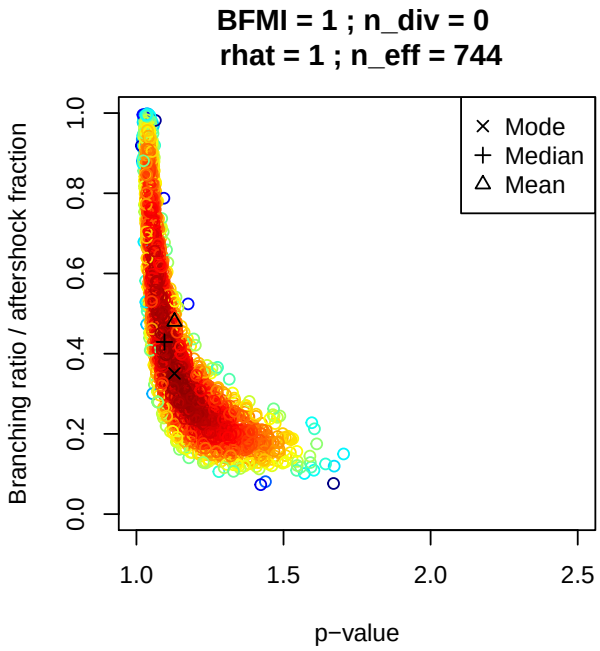

Family 70054793 ; nev = 106
s$mag[ev.use]
1.0
0.5
0.0
−0.5
2015
2016
s$t0[ev.use]

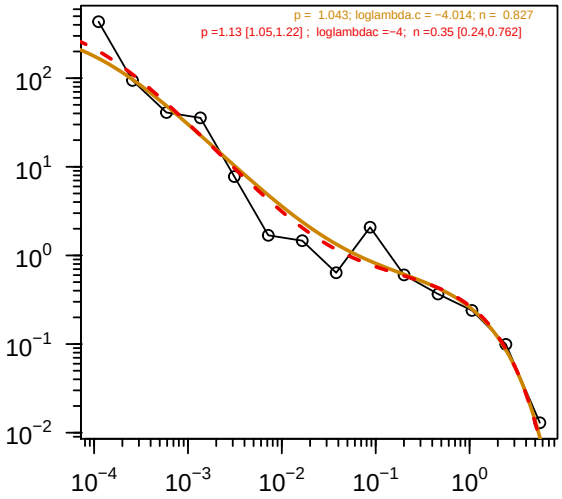

BFMI = 1.1 ; n_div = 0
rhat = 1 ; n_eff = 1682
Mode
Median
Mean
Branching ratio / aftershock fraction
1.0
0.8
0.6
0.4
0.2
0.0
1.0
1.5
2.0
2.5
p−value

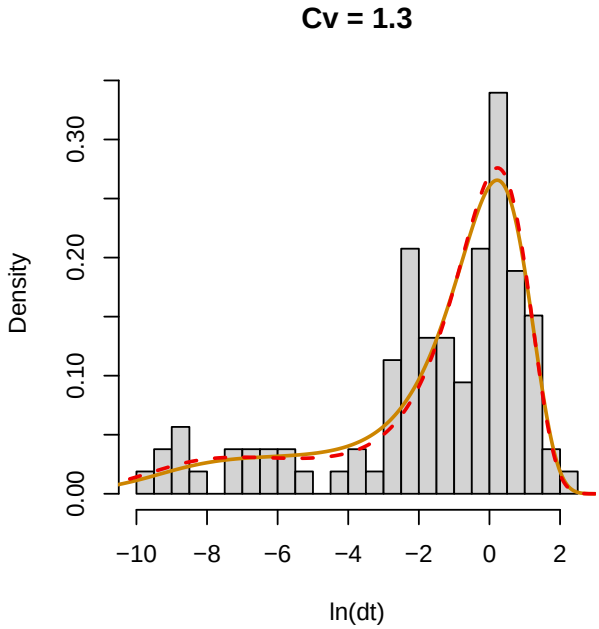

p = 1.480; loglambda.c = −3.846; n = 0.915
p =1.64 [1.56,1.71] ; loglambdac =−3.6; n =0.89 [0.87,0.923]
$10^3$
$10^2$
$10^1$
$10^0$
$10^{-1}$
$10^{-2}$
$10^{-3}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^0$
$10^1$

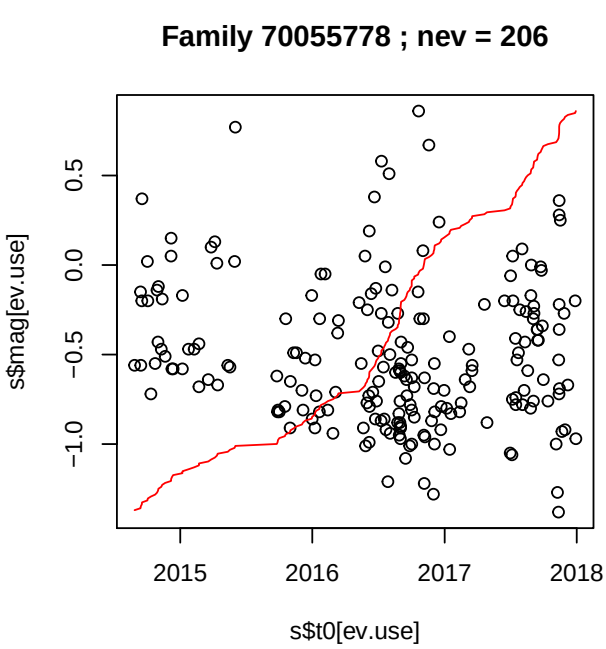

Cv = 4.8
Density
0.20
0.15
0.10
0.05
0.00
−10
−5
0
ln(dt)

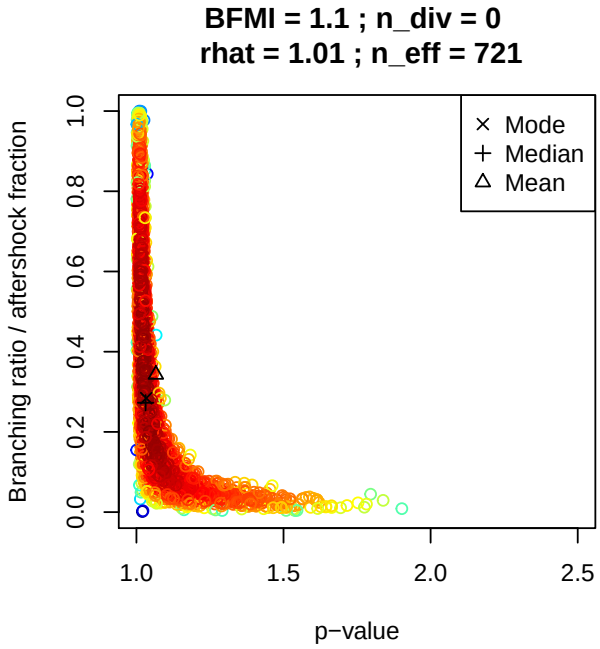

Family 70055573 ; nev = 107
s$mag[ev.use]
s$t0[ev.use]
2015
2016
2017
2018
−0.5
0.0
0.5
1.0
1.5

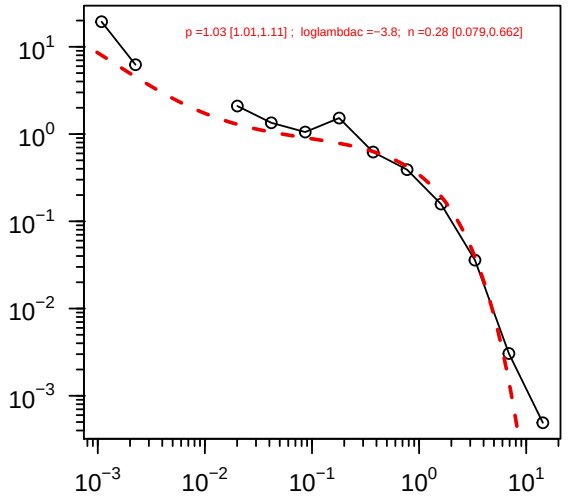

BFMI = 1 ; n_div = 0
rhat = 1 ; n_eff = 744
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5

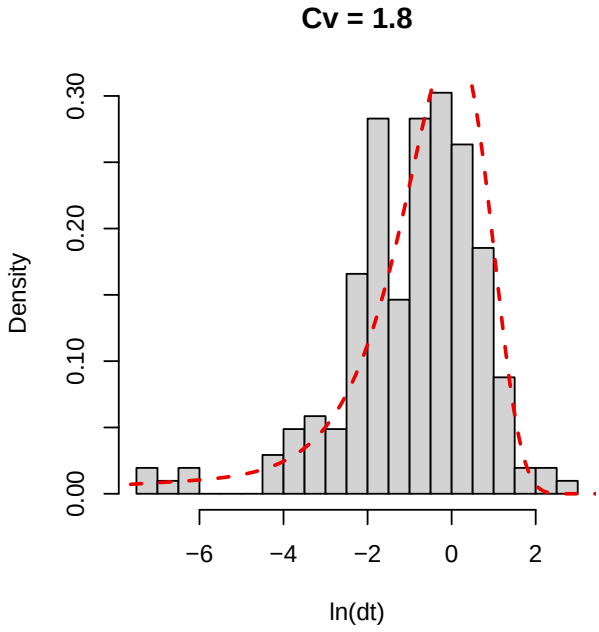

p = 1.043; loglambda.c = −4.014; n = 0.827
p =1.13 [1.05,1.22] ; loglambdac =−4; n =0.35 [0.24,0.762]
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$

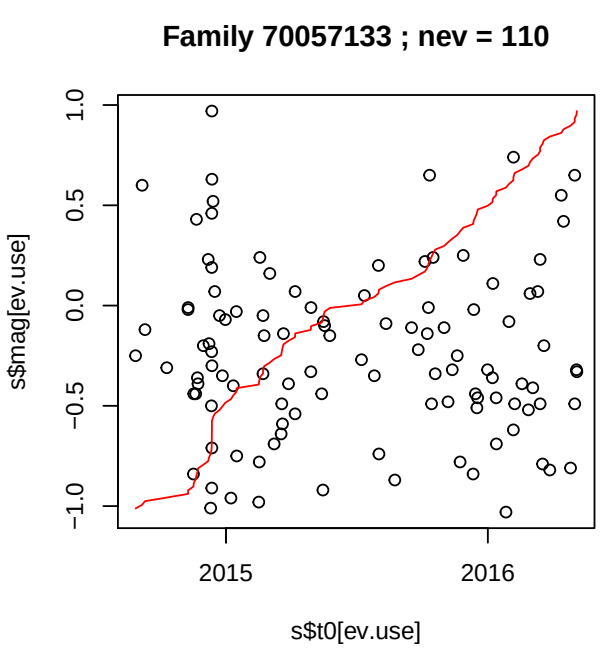

Cv = 1.3
Density
ln(dt)
0.00
0.10
0.20
0.30
−10
−8
−6
−4
−2
0
2

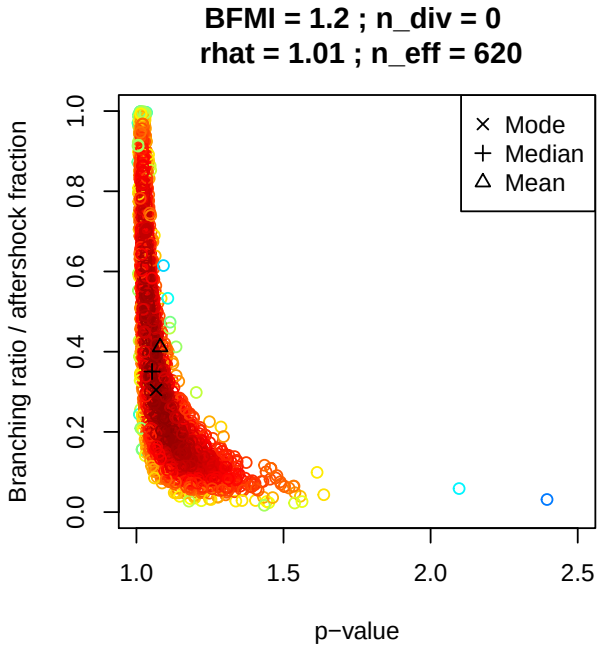

Family 70055778 ; nev = 206
s$mag[ev.use]
s$t0[ev.use]
2015
2016
2017
2018
0.5
0.0
−0.5
−1.0

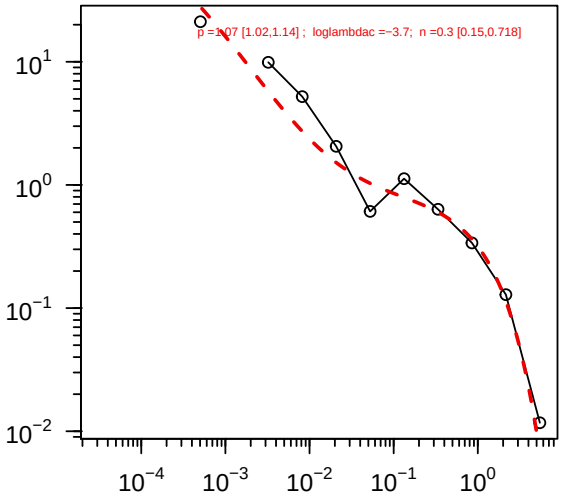

BFMI = 1.1 ; n_div = 0
rhat = 1.01 ; n_eff = 721
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
1.0
1.5
2.0
2.5
0.0
0.2
0.4
0.6
0.8
1.0

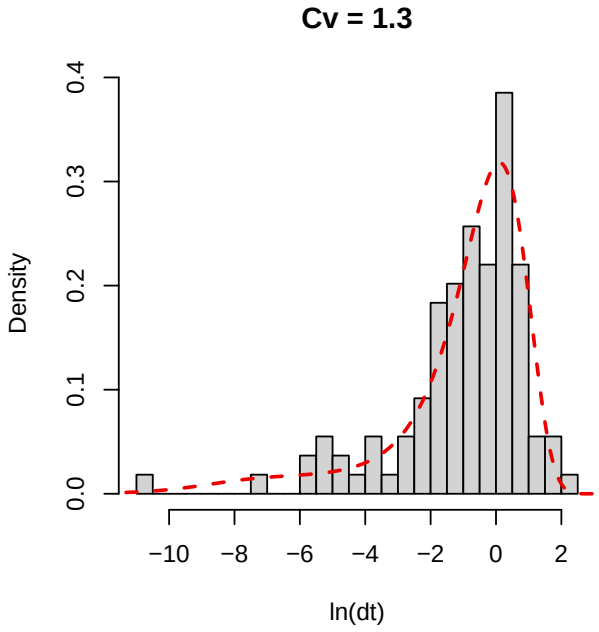

p =1.03 [1.01,1.11] ; loglambdac =−3.8; n =0.28 [0.079,0.662]
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-3}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

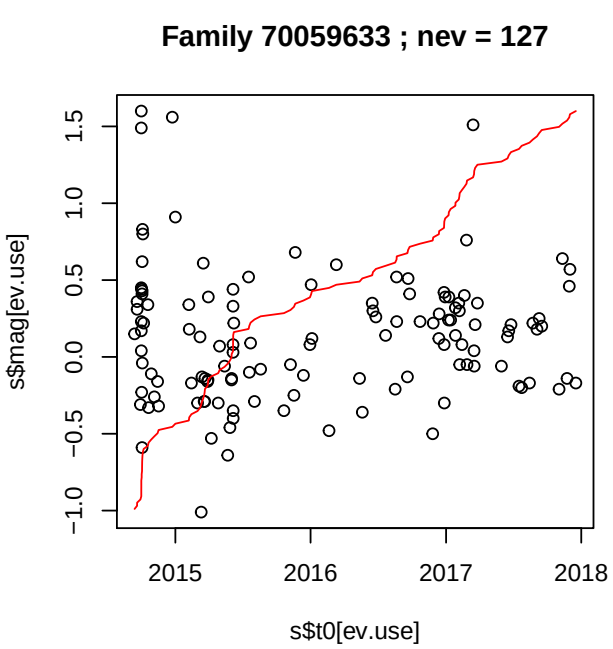

Cv = 1.8
Density
ln(dt)
0.00
0.10
0.20
0.30
−6
−4
−2
0
2

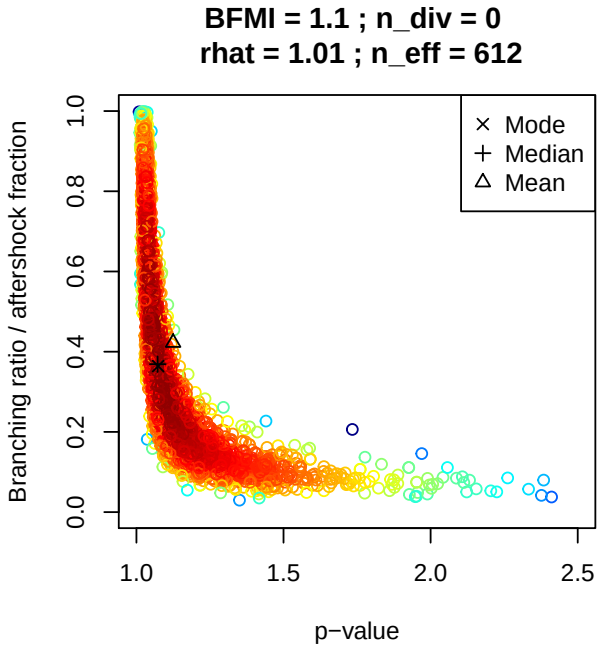

Family 70057133 ; nev = 110
s$mag[ev.use]
s$t0[ev.use]
2015
2016
1.0
0.5
0.0
−0.5
−1.0

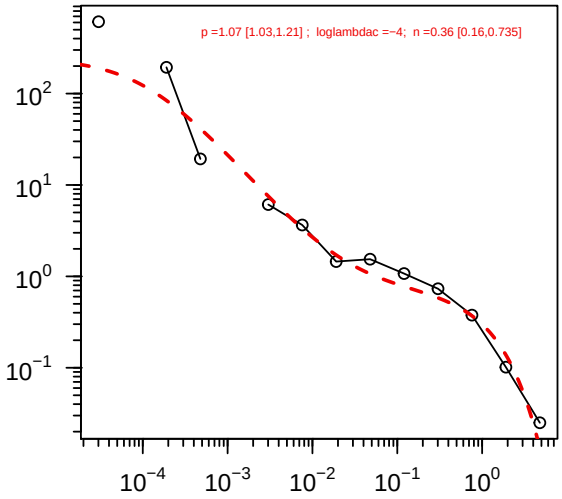

BFMI = 1.2 ; n_div = 0
rhat = 1.01 ; n_eff = 620
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
1.0
1.5
2.0
2.5
0.0
0.2
0.4
0.6
0.8
1.0

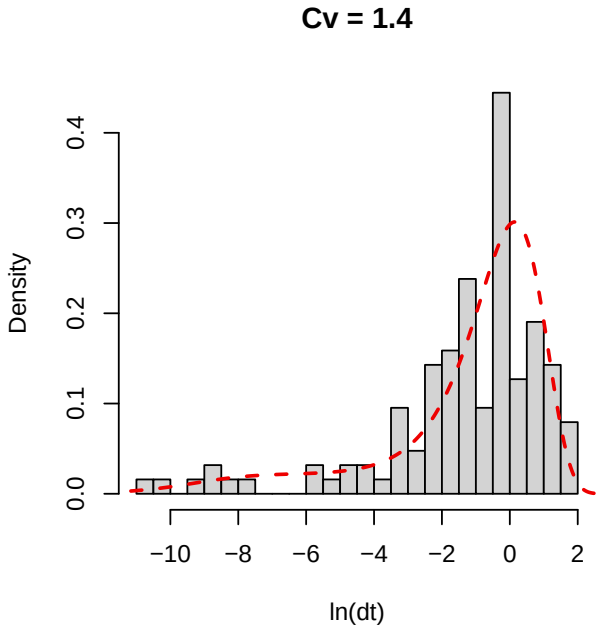

p =1.07 [1.02,1.14] ; loglambdac =−3.7; n =0.3 [0.15,0.718]
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$

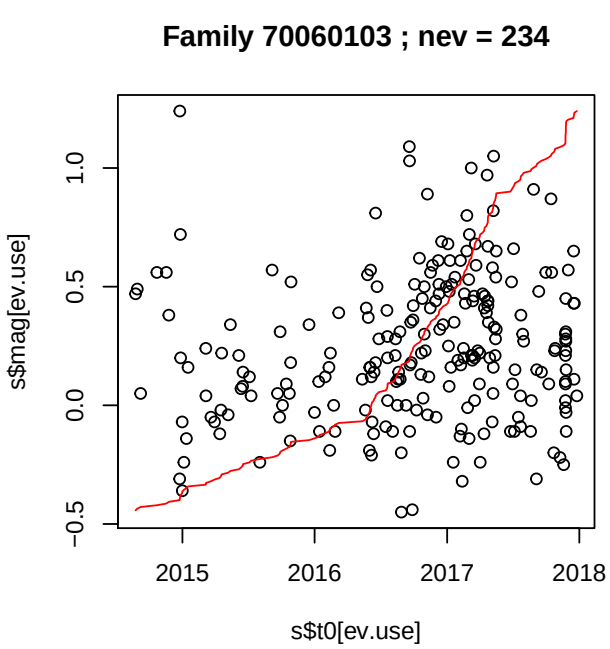

Cv = 1.3
Density
ln(dt)
0.0
0.1
0.2
0.3
0.4
−10
−8
−6
−4
−2
0
2

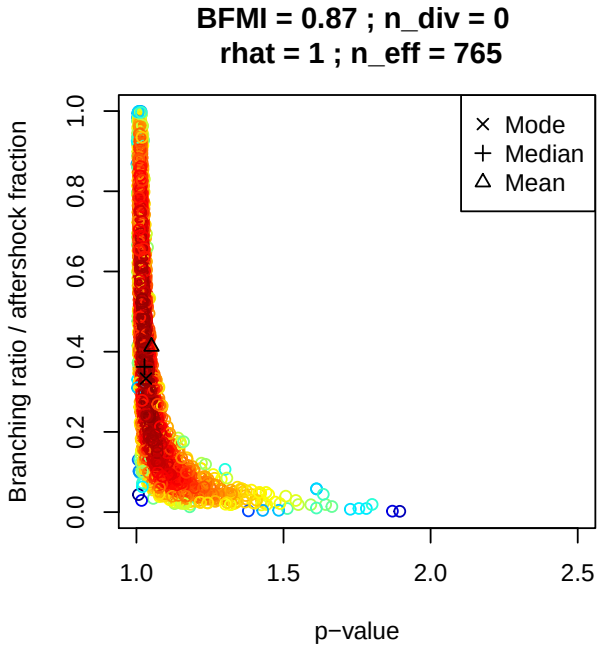

Family 70059633 ; nev = 127
s$mag[ev.use]
s$t0[ev.use]
2015
2016
2017
2018
−1.0
−0.5
0.0
0.5
1.0
1.5

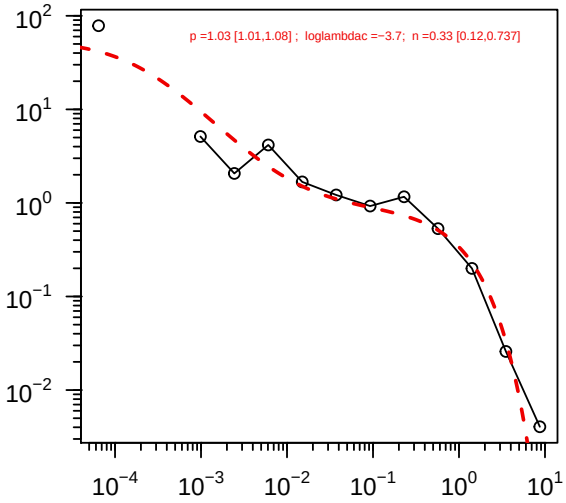

BFMI = 1.1 ; n_div = 0
rhat = 1.01 ; n_eff = 612
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5

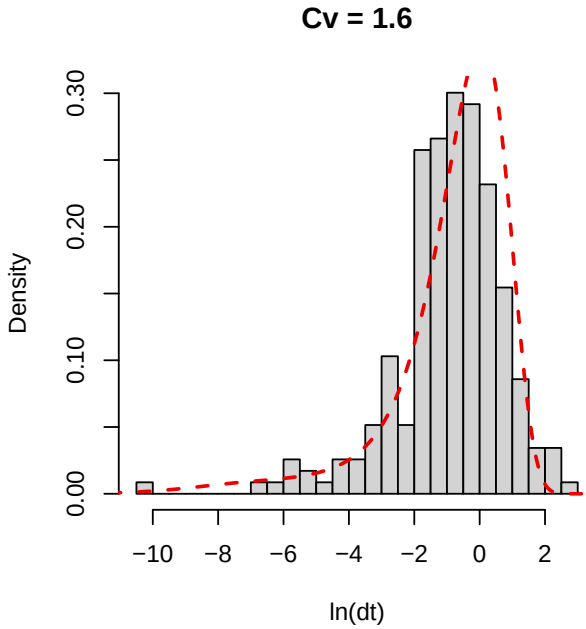

p =1.07 [1.03,1.21] ; loglambdac =−4; n =0.36 [0.16,0.735]
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$

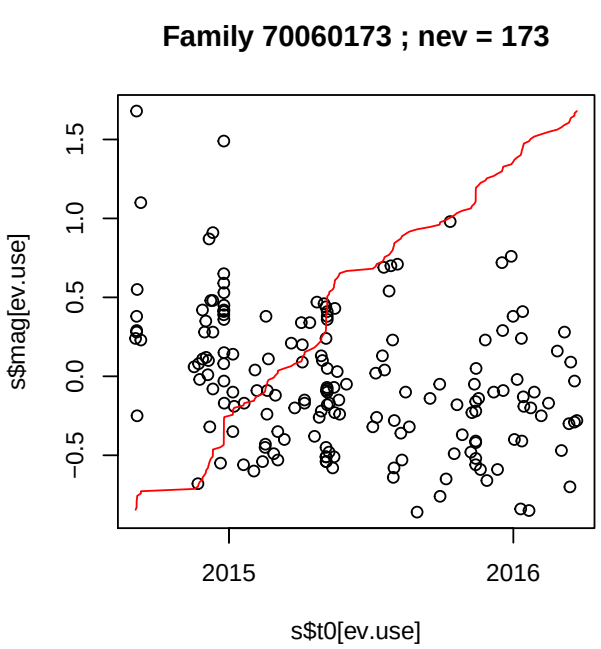

Cv = 1.4
Density
ln(dt)
0.0
0.1
0.2
0.3
0.4
−10
−8
−6
−4
−2
0
2

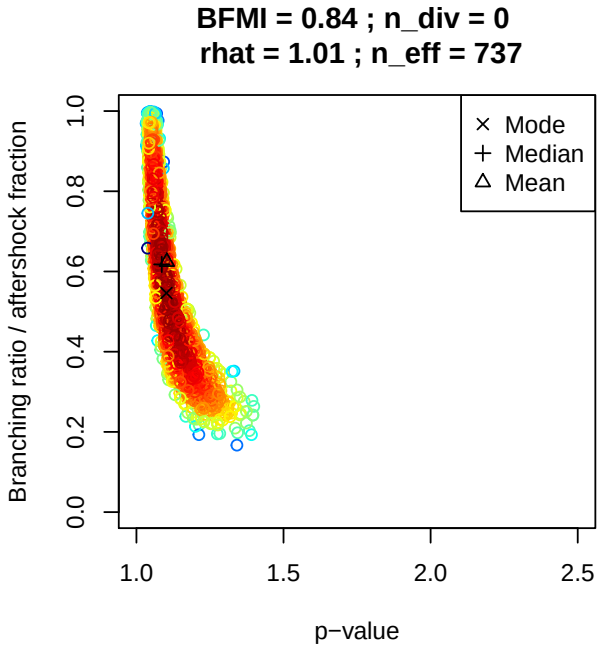

Family 70060103 ; nev = 234
s$mag[ev.use]
s$t0[ev.use]
2015
2016
2017
2018
−0.5
0.0
0.5
1.0

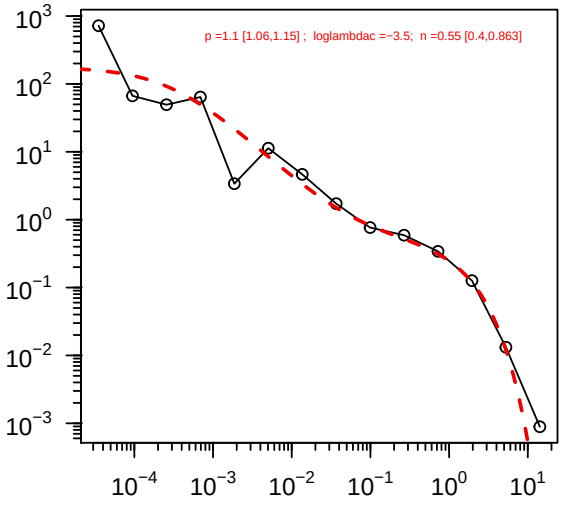

BFMI = 0.87 ; n_div = 0
rhat = 1 ; n_eff = 765
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
1.0
1.5
2.0
2.5
0.0
0.2
0.4
0.6
0.8
1.0

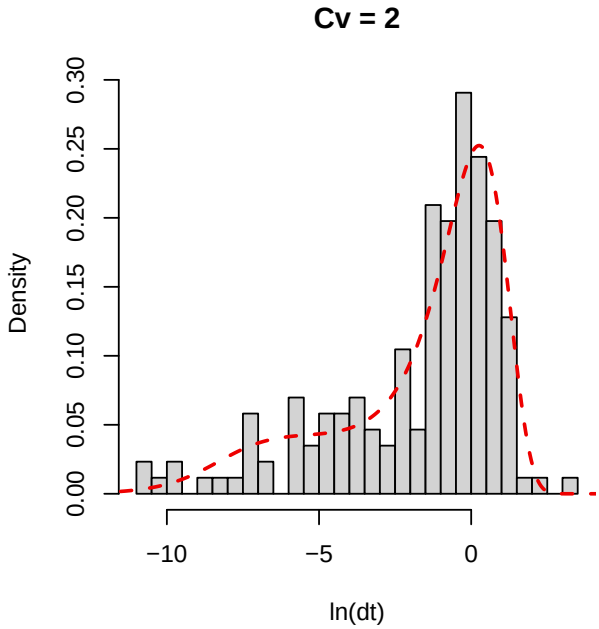

p =1.03 [1.01,1.08] ; loglambdac =−3.7; n =0.33 [0.12,0.737]

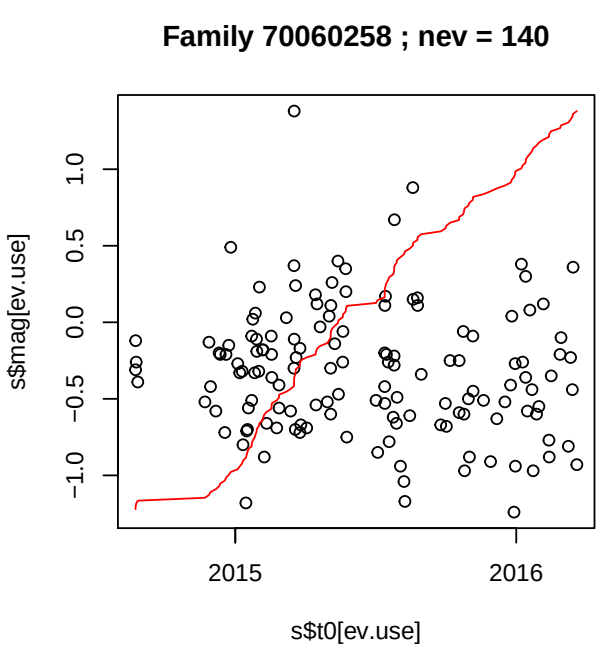

Cv = 1.6
Density
ln(dt)
−10
−8
−6
−4
−2
0
2
0.00
0.10
0.20
0.30

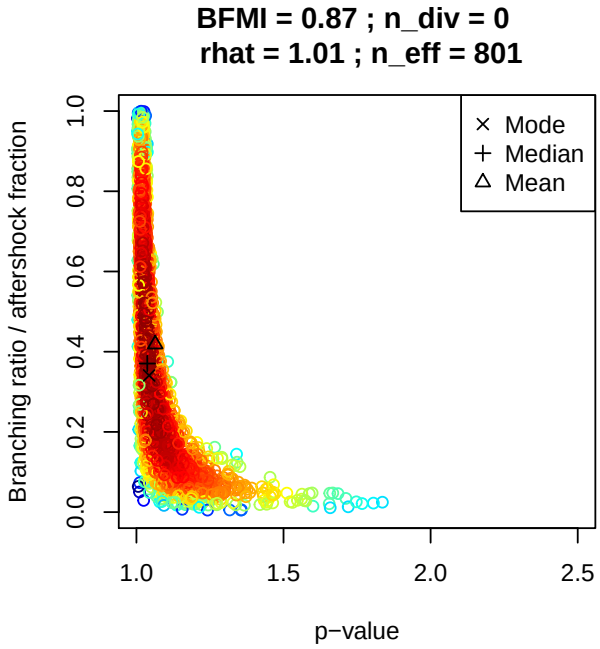

Family 70060173 ; nev = 173
s$mag[ev.use]
−0.5
0.0
0.5
1.0
1.5
2015
2016
s$t0[ev.use]

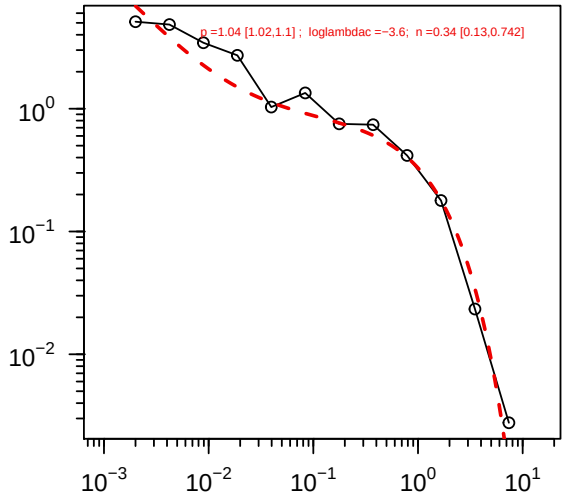

BFMI = 0.84 ; n_div = 0
rhat = 1.01 ; n_eff = 737
Mode
Median
Mean
Branching ratio / aftershock fraction
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5
p−value

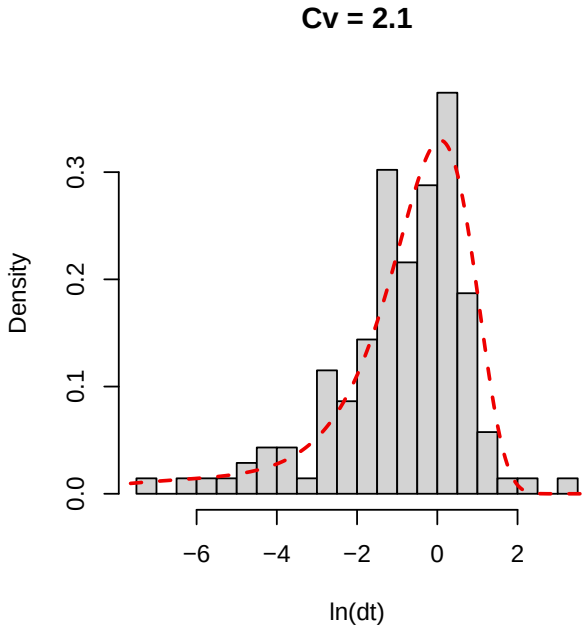

p =1.1 [1.06,1.15] ; loglambdac =−3.5; n =0.55 [0.4,0.863]
$10^{3}$
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-3}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

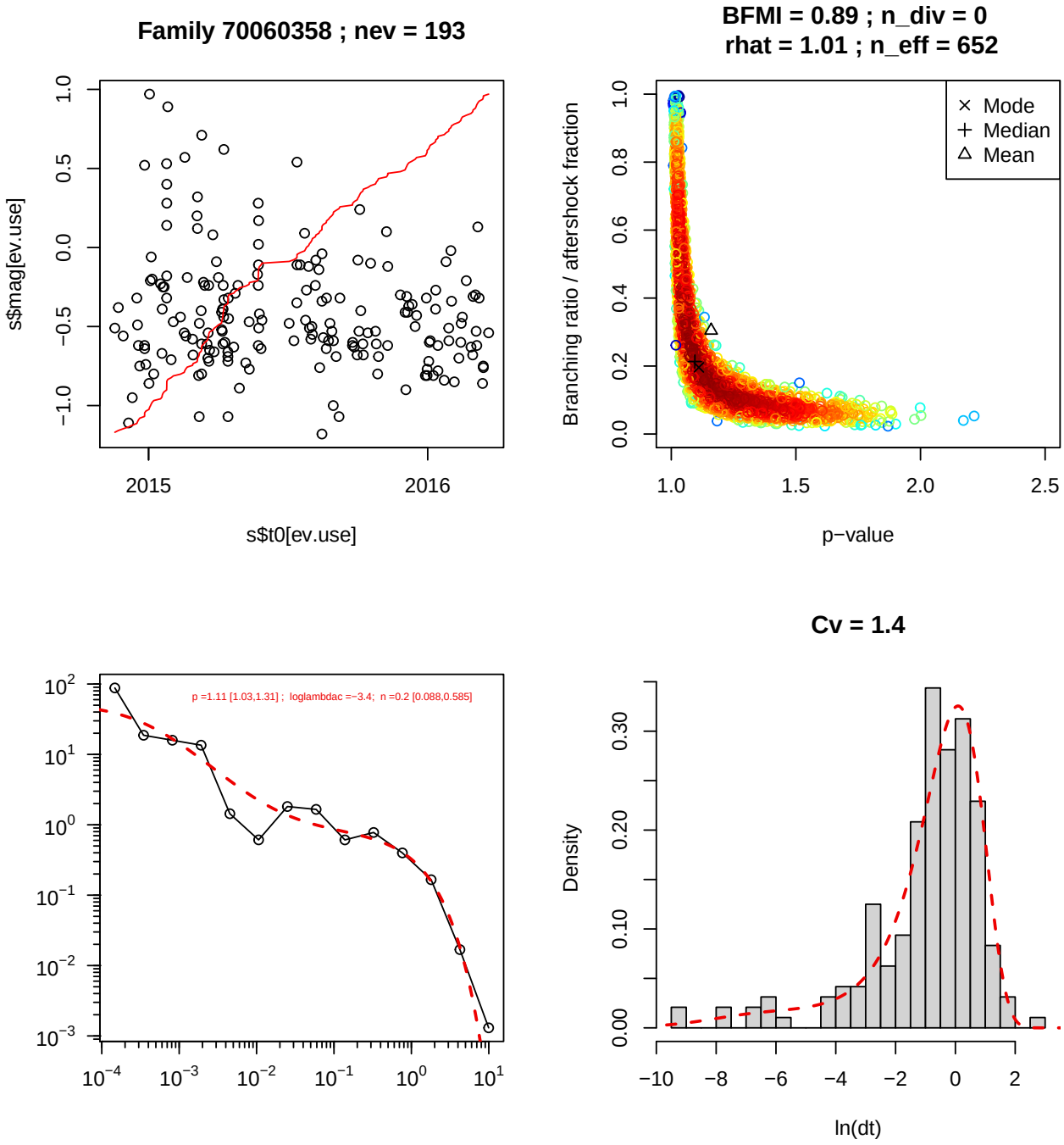

Cv = 2
Density
0.00
0.05
0.10
0.15
0.20
0.25
0.30
−10
−5
0
ln(dt)

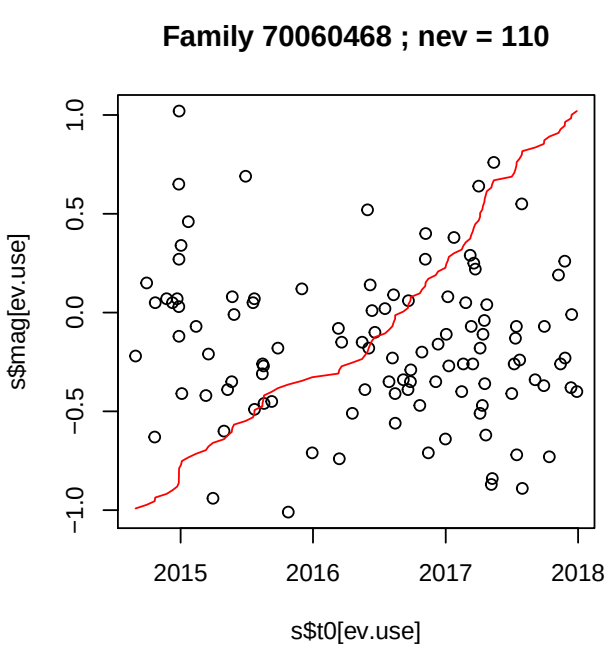

Family 70060258 ; nev = 140
s$mag[ev.use]
1.0
0.5
0.0
−0.5
−1.0
2015
2016
s$t0[ev.use]

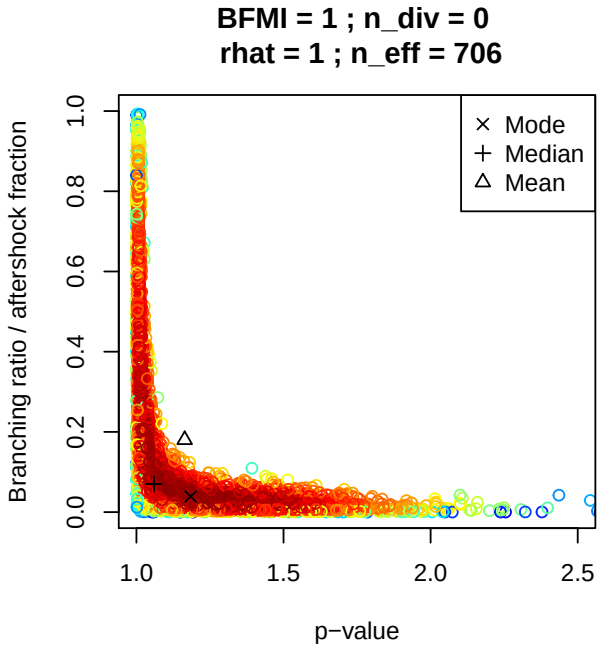

BFMI = 0.87 ; n_div = 0
rhat = 1.01 ; n_eff = 801
Mode
Median
Mean
Branching ratio / aftershock fraction
1.0
0.8
0.6
0.4
0.2
0.0
1.0
1.5
2.0
2.5
p−value

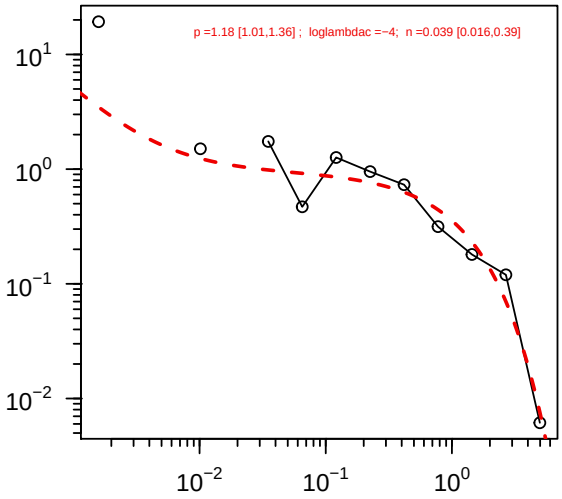

p =1.04 [1.02,1.1] ; loglambdac =−3.6; n =0.34 [0.13,0.742]
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

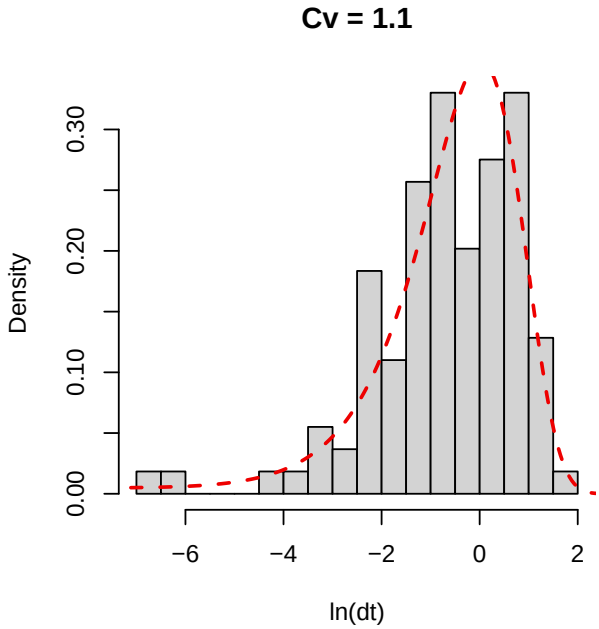

Cv = 2.1
Density
0.3
0.2
0.1
0.0
−6
−4
−2
0
2
ln(dt)

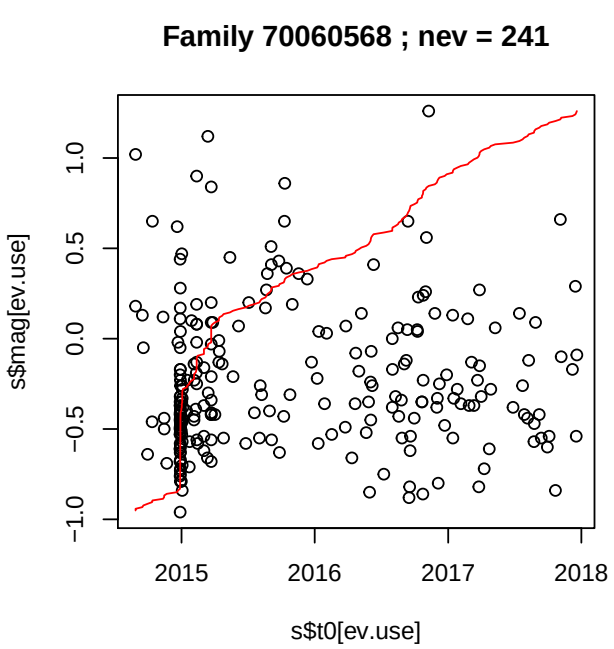

Family 70060358 ; nev = 193
s$mag[ev.use]
s$t0[ev.use]
2015
2016
BFMI = 0.89 ; n_div = 0
rhat = 1.01 ; n_eff = 652
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
p =1.11 [1.03,1.31] ; loglambdac =−3.4; n =0.2 [0.088,0.585]
Cv = 1.4
Density
ln(dt)

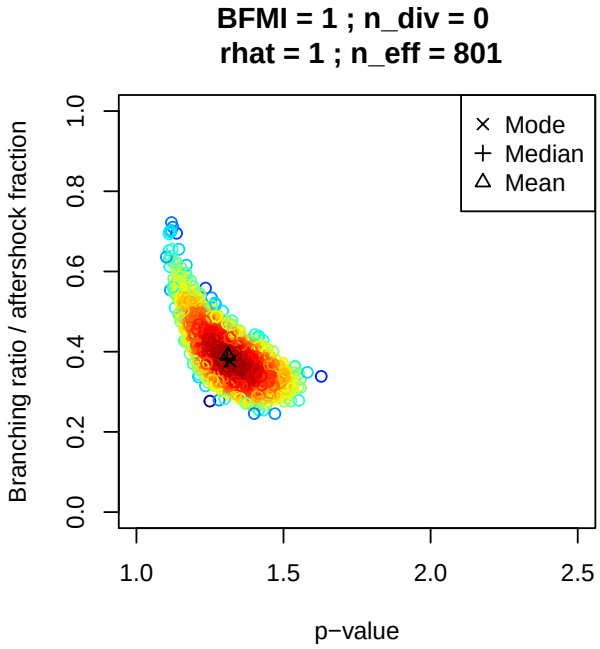

Family 70060468 ; nev = 110
s$mag[ev.use]
s$t0[ev.use]
1.0
0.5
0.0
−0.5
−1.0
2015
2016
2017
2018

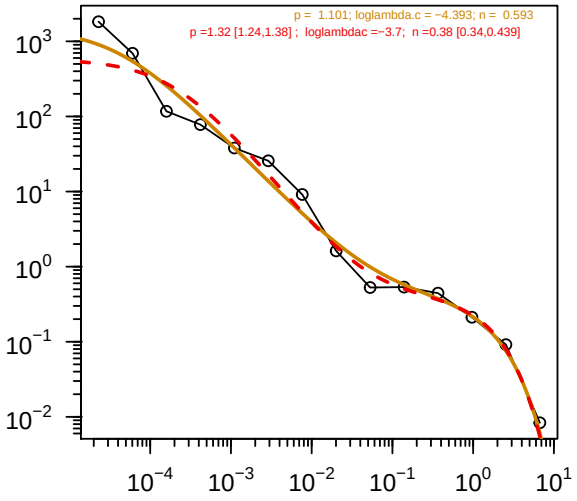

BFMI = 1 ; n_div = 0
rhat = 1 ; n_eff = 706
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5

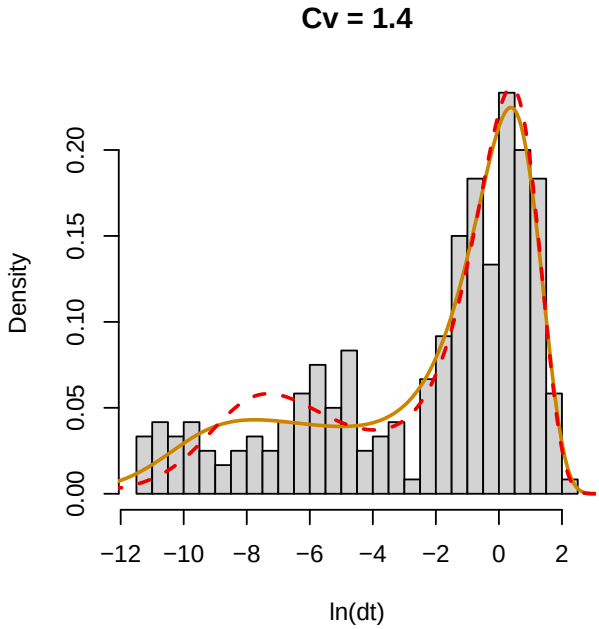

p =1.18 [1.01,1.36] ; loglambdac =−4; n =0.039 [0.016,0.39]
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-2}$
$10^{-1}$
$10^{0}$

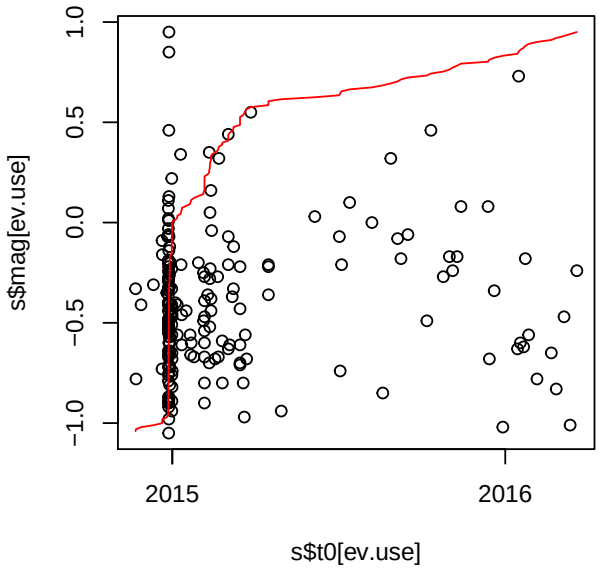

Cv = 1.1
Density
ln(dt)
0.00
0.10
0.20
0.30
−6
−4
−2
0
2

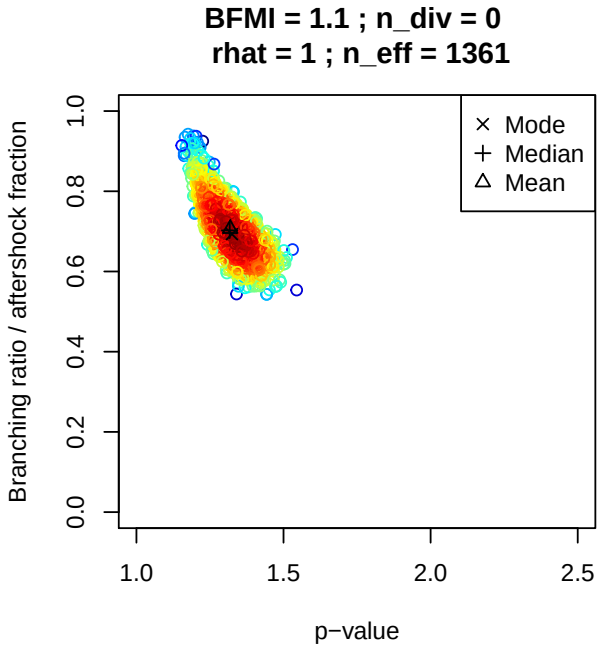

Family 70060568 ; nev = 241
s$mag[ev.use]
s$t0[ev.use]
2015
2016
2017
2018
−1.0
−0.5
0.0
0.5
1.0

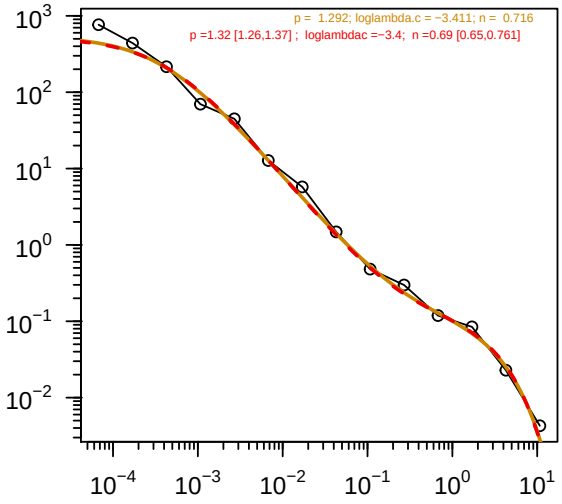

BFMI = 1 ; n_div = 0
rhat = 1 ; n_eff = 801
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5

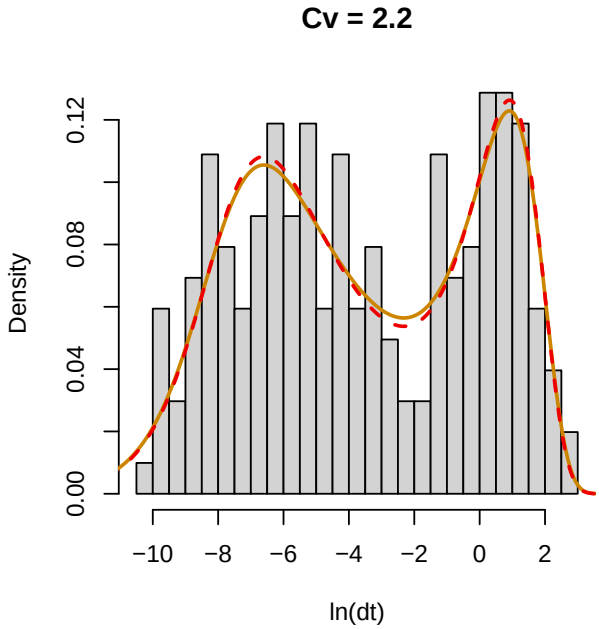

p = 1.101; loglambda.c = −4.393; n = 0.593
p =1.32 [1.24,1.38] ; loglambdac =−3.7; n =0.38 [0.34,0.439]
$10^{3}$
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

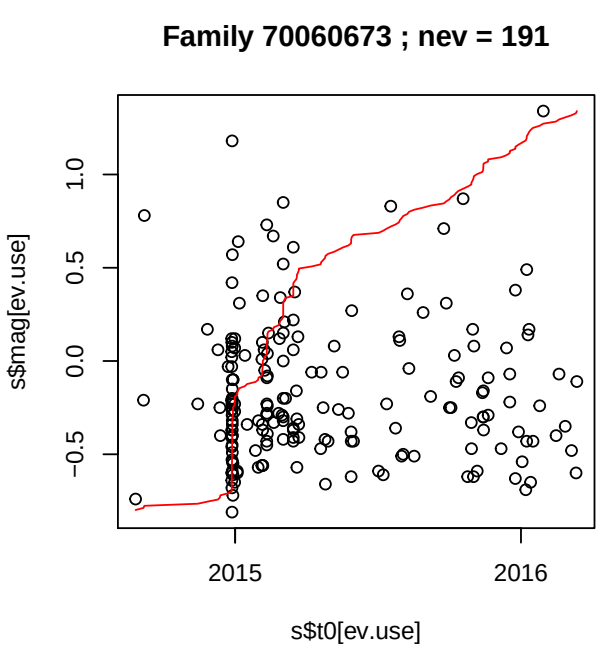

Cv = 1.4
Density
ln(dt)
0.00
0.05
0.10
0.15
0.20
−12
−10
−8
−6
−4
−2
0
2

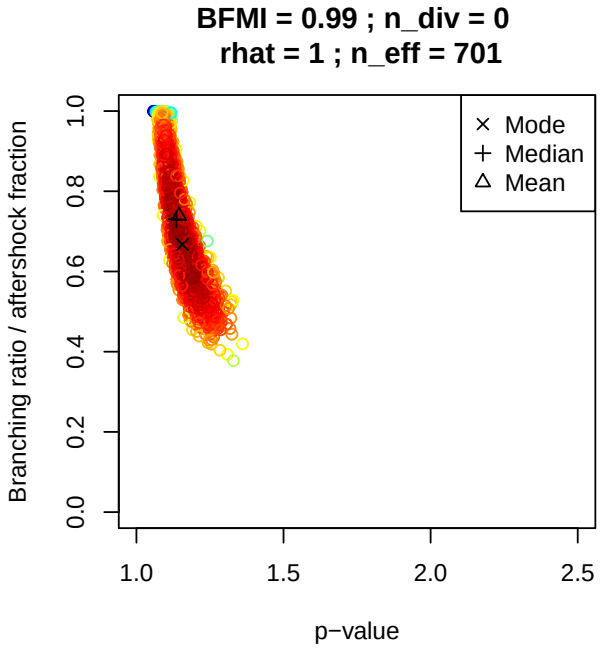

Family 70060593 ; nev = 203
s$mag[ev.use]
1.0
0.5
0.0
−0.5
−1.0
2015
2016
s$t0[ev.use]

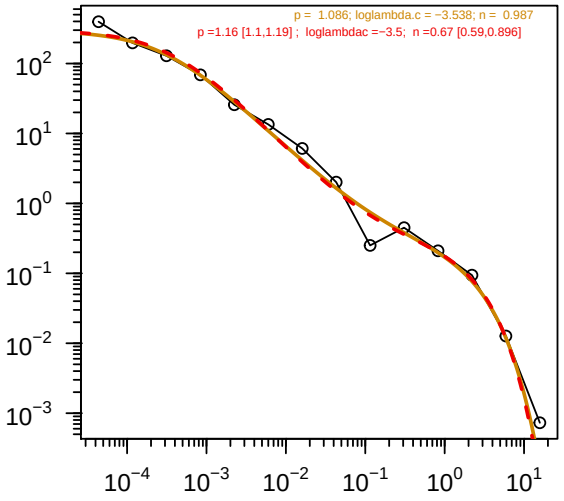

BFMI = 1.1 ; n_div = 0
rhat = 1 ; n_eff = 1361
Mode
Median
Mean
Branching ratio / aftershock fraction
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5
p−value

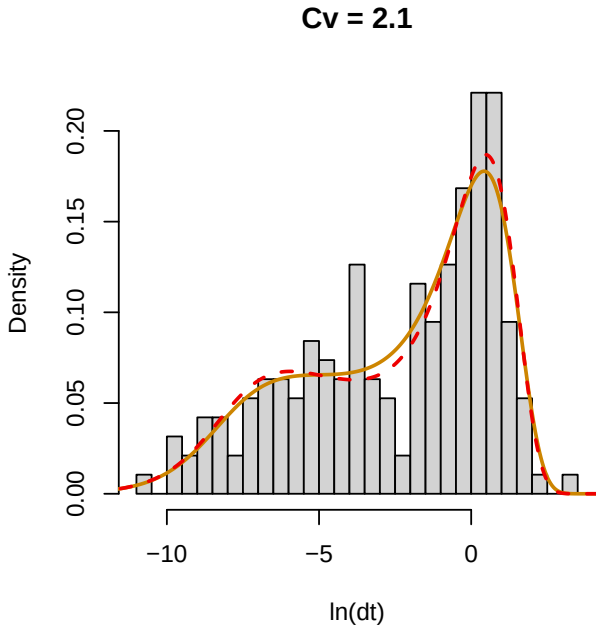

p = 1.292; loglambda.c = −3.411; n = 0.716
p =1.32 [1.26,1.37] ; loglambdac =−3.4; n =0.69 [0.65,0.761]
$10^{3}$
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

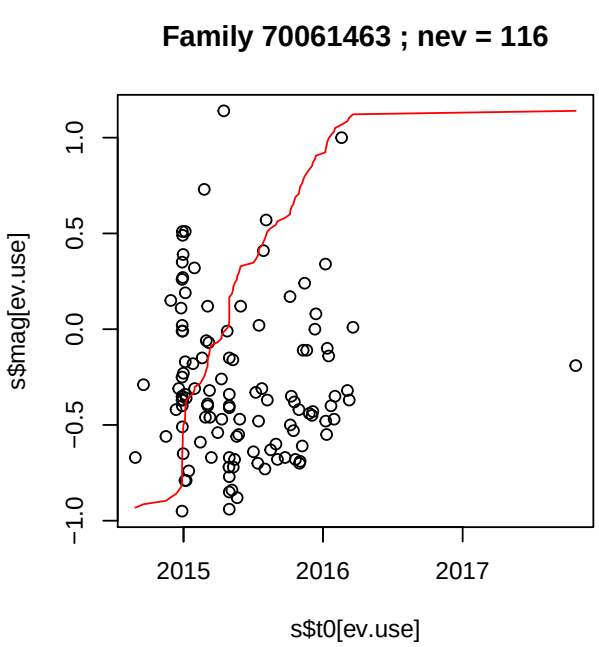

Cv = 2.2
Density
0.00
0.04
0.08
0.12
−10
−8
−6
−4
−2
0
2
ln(dt)

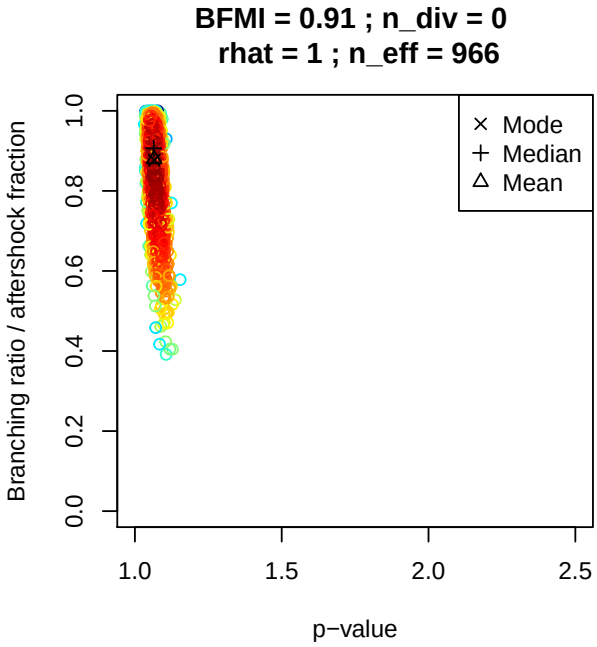

Family 70060673 ; nev = 191
s$mag[ev.use]
1.0
0.5
0.0
−0.5
2015
2016
s$t0[ev.use]

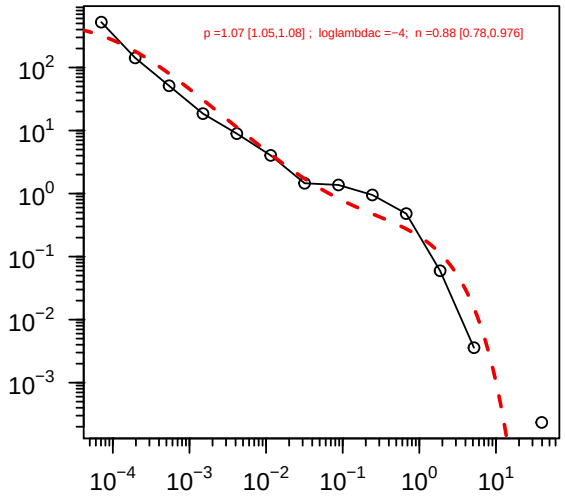

BFMI = 0.99 ; n_div = 0
rhat = 1 ; n_eff = 701
Mode
Median
Mean
Branching ratio / aftershock fraction
1.0
0.8
0.6
0.4
0.2
0.0
1.0
1.5
2.0
2.5
p−value

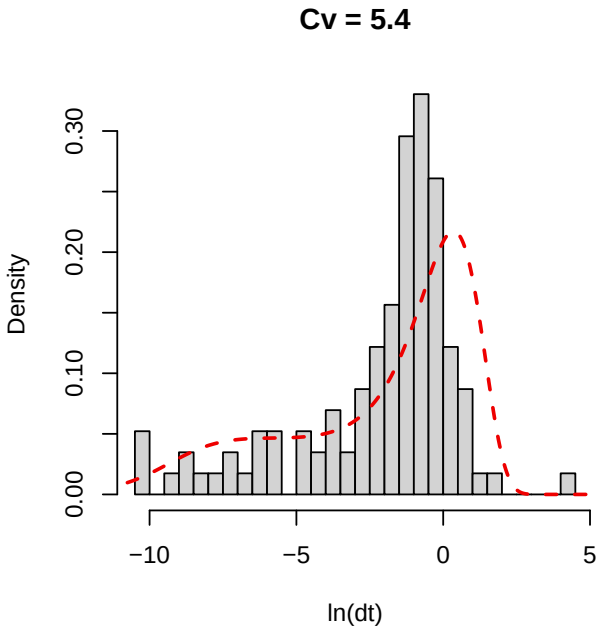

p = 1.086; loglambda.c = −3.538; n = 0.987
p =1.16 [1.1,1.19] ; loglambdac =−3.5; n =0.67 [0.59,0.896]
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-3}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

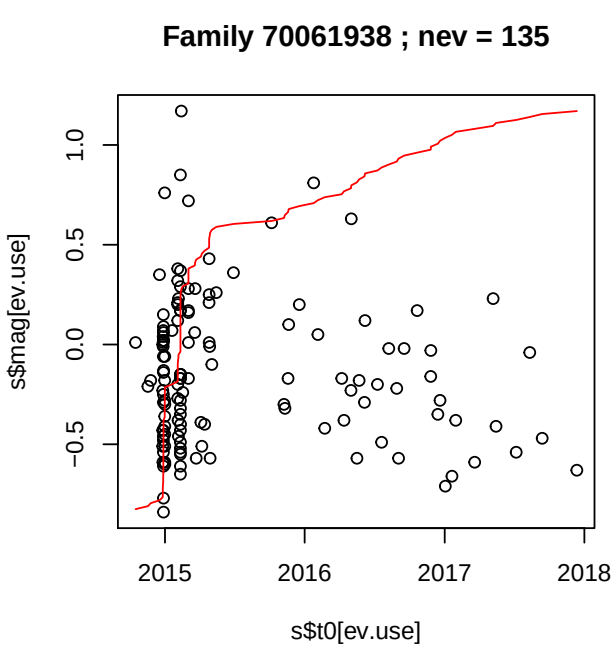

Cv = 2.1
Density
0.00
0.05
0.10
0.15
0.20
−10
−5
0
ln(dt)

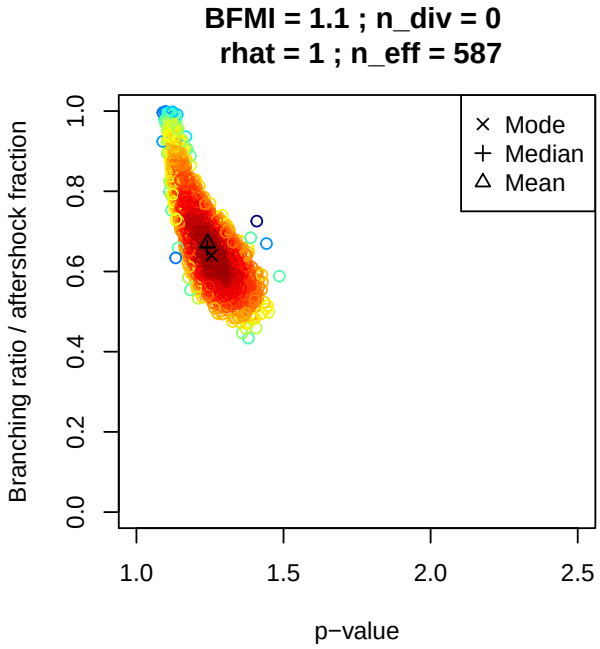

Family 70061463 ; nev = 116
s$mag[ev.use]
s$t0[ev.use]
1.0
0.5
0.0
−0.5
−1.0
2015
2016
2017

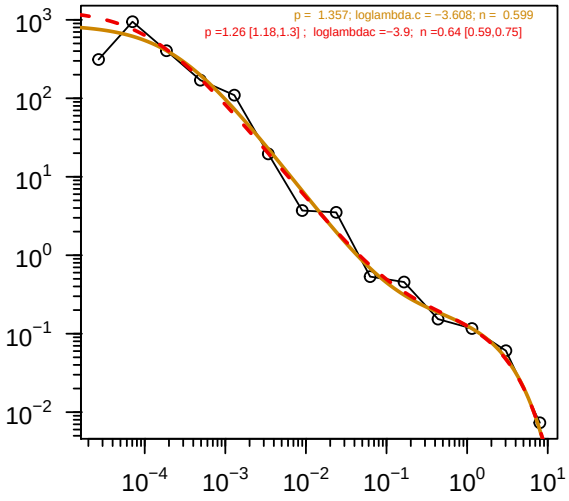

BFMI = 0.91 ; n_div = 0
rhat = 1 ; n_eff = 966
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5

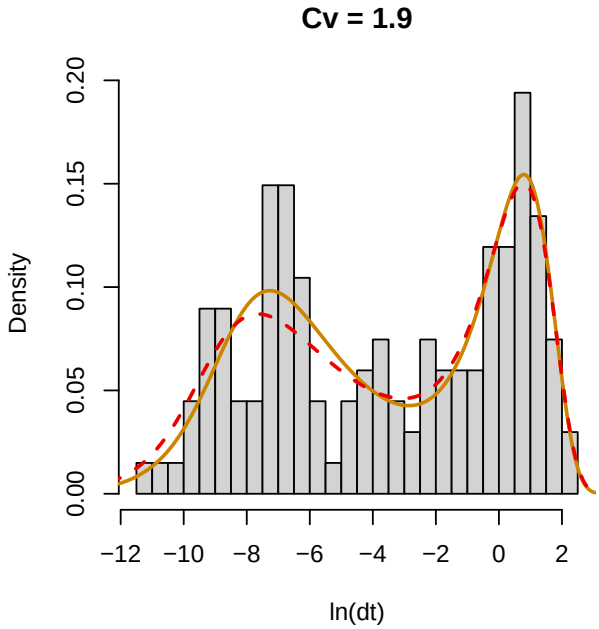

p =1.07 [1.05,1.08] ; loglambdac =−4; n =0.88 [0.78,0.976]
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-3}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

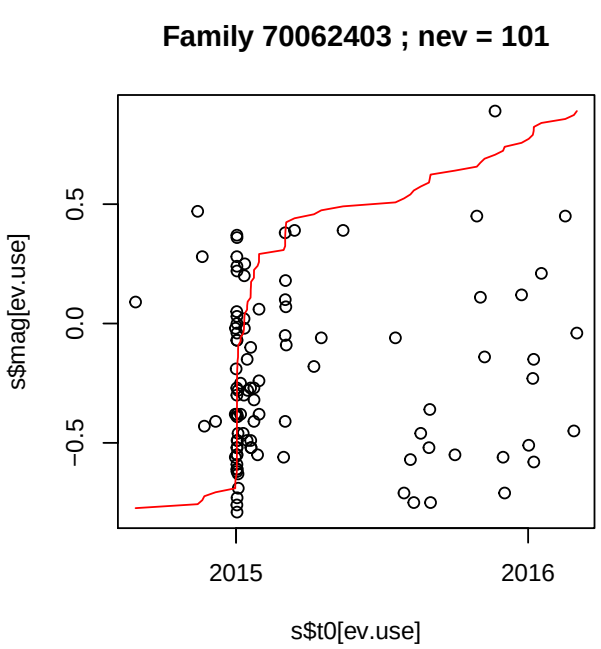

Cv = 5.4
Density
ln(dt)
0.00
0.10
0.20
0.30
−10
−5
0
5

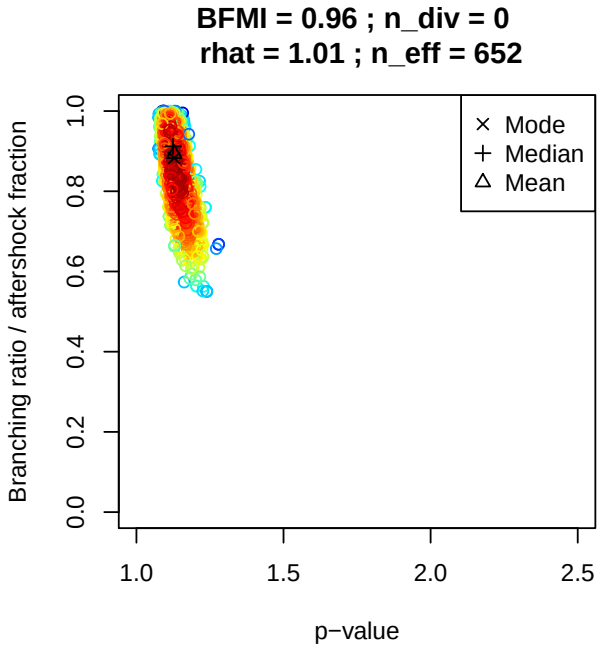

Family 70061938 ; nev = 135
s$mag[ev.use]
s$t0[ev.use]
2015
2016
2017
2018
−0.5
0.0
0.5
1.0

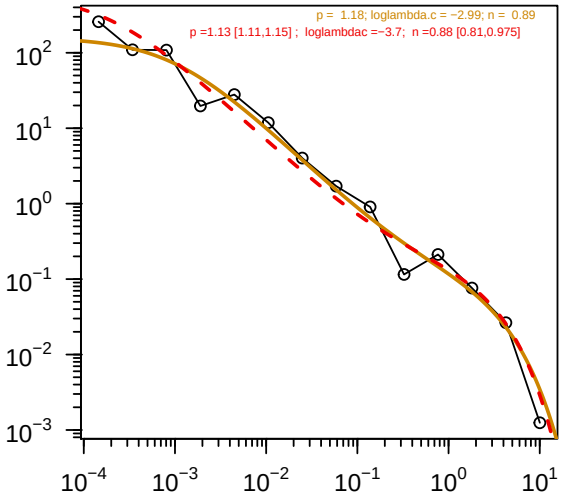

BFMI = 1.1 ; n_div = 0
rhat = 1 ; n_eff = 587
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5

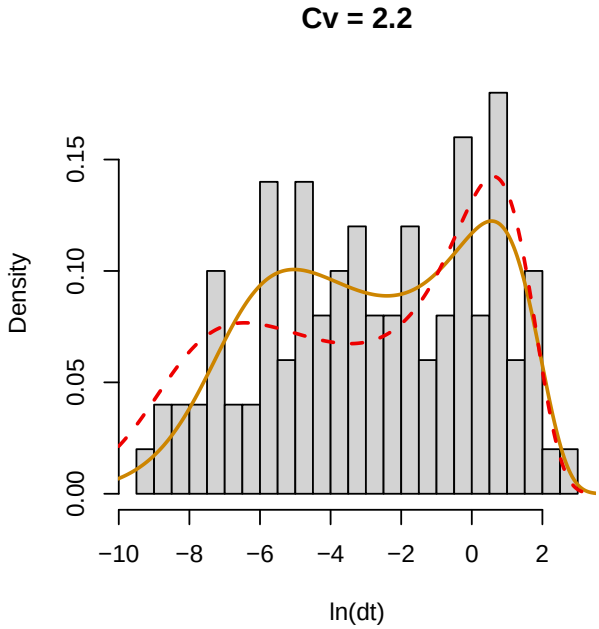

p = 1.357; loglambda.c = −3.608; n = 0.599
p =1.26 [1.18,1.3] ; loglambdac =−3.9; n =0.64 [0.59,0.75]

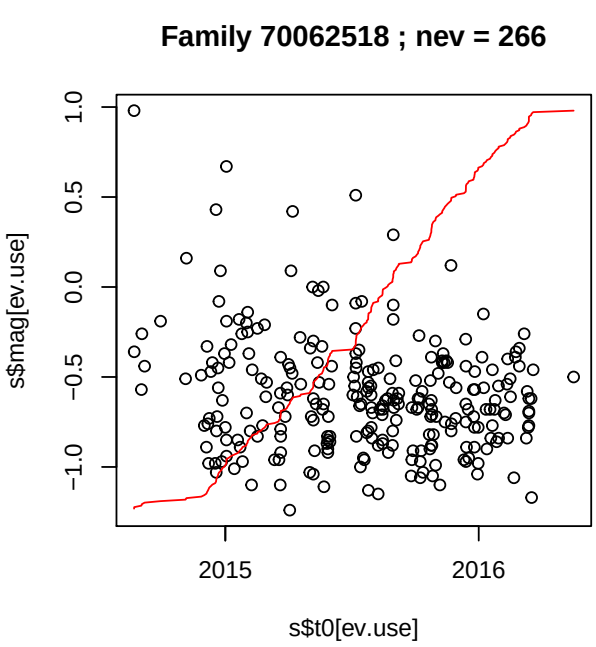

Cv = 1.9
Density
ln(dt)
0.00
0.05
0.10
0.15
0.20
−12
−10
−8
−6
−4
−2
0
2

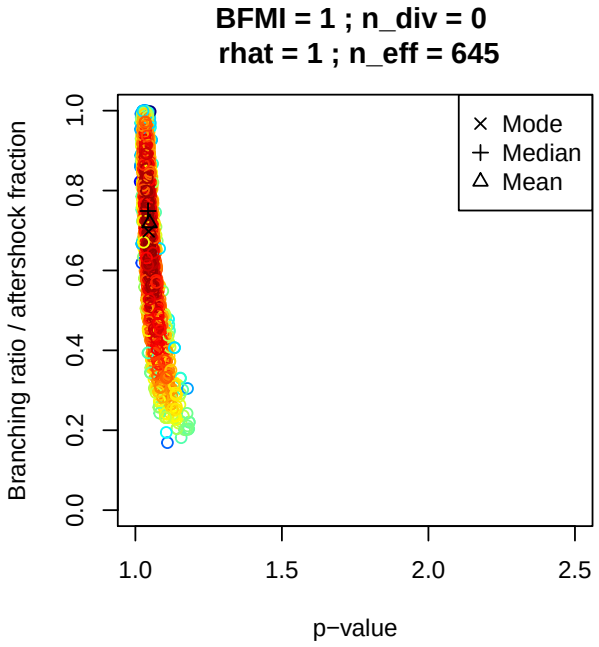

Family 70062403 ; nev = 101
s$mag[ev.use]
0.5
0.0
−0.5
2015
2016
s$t0[ev.use]

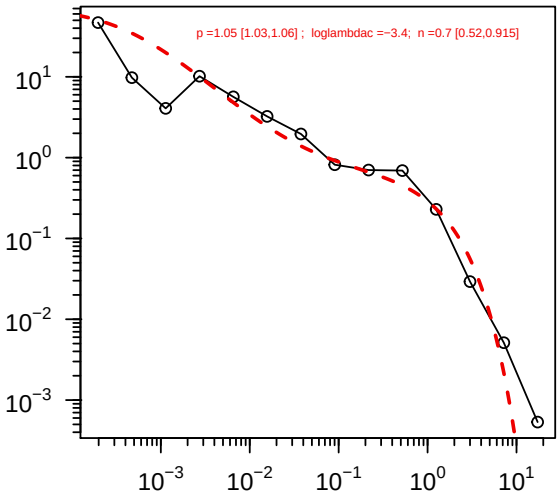

BFMI = 0.96 ; n_div = 0
rhat = 1.01 ; n_eff = 652
Mode
Median
Mean
Branching ratio / aftershock fraction
1.0
0.8
0.6
0.4
0.2
0.0
1.0
1.5
2.0
2.5
p−value

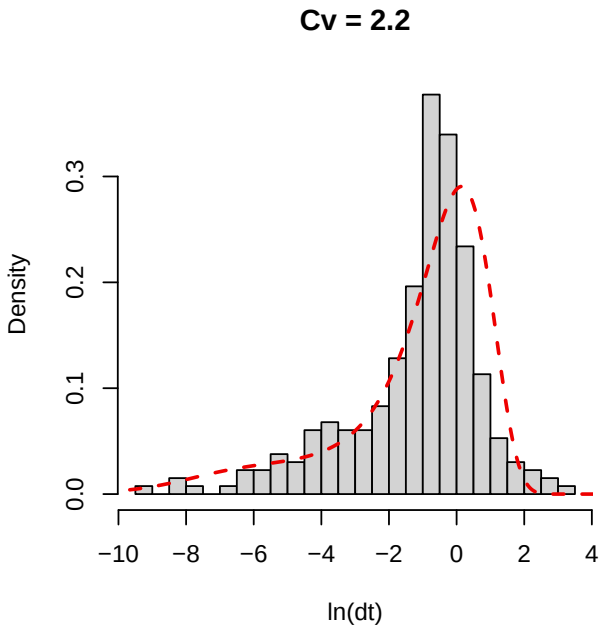

p = 1.18; loglambda.c = −2.99; n = 0.89
p =1.13 [1.11,1.15] ; loglambdac =−3.7; n =0.88 [0.81,0.975]
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-3}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

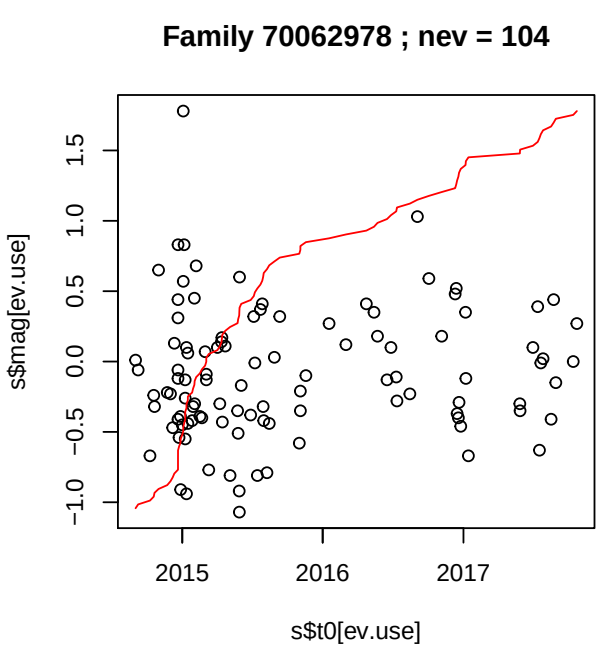

Cv = 2.2
Density
0.15
0.10
0.05
0.00
−10
−8
−6
−4
−2
0
2
ln(dt)

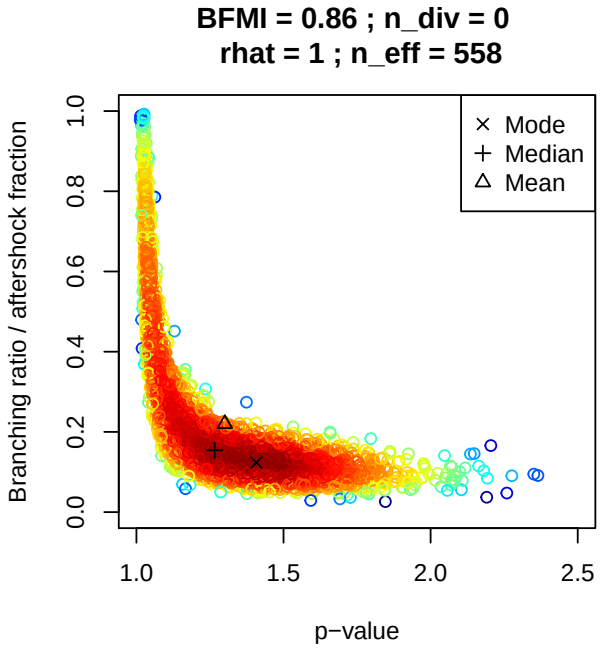

Family 70062518 ; nev = 266
s$mag[ev.use]
1.0
0.5
0.0
−0.5
−1.0
2015
2016
s$t0[ev.use]

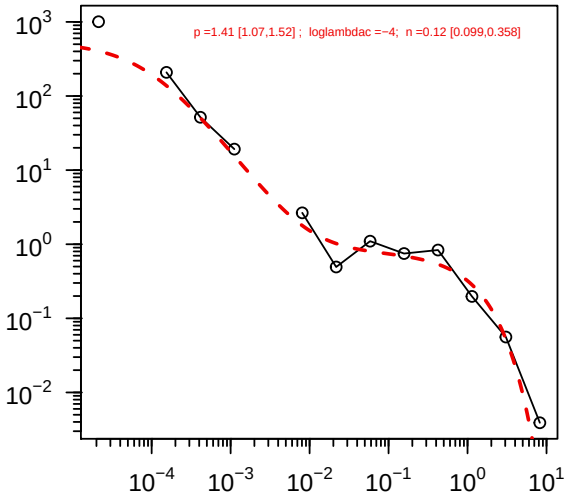

BFMI = 1 ; n_div = 0
rhat = 1 ; n_eff = 645
Mode
Median
Mean
Branching ratio / aftershock fraction
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5
p−value

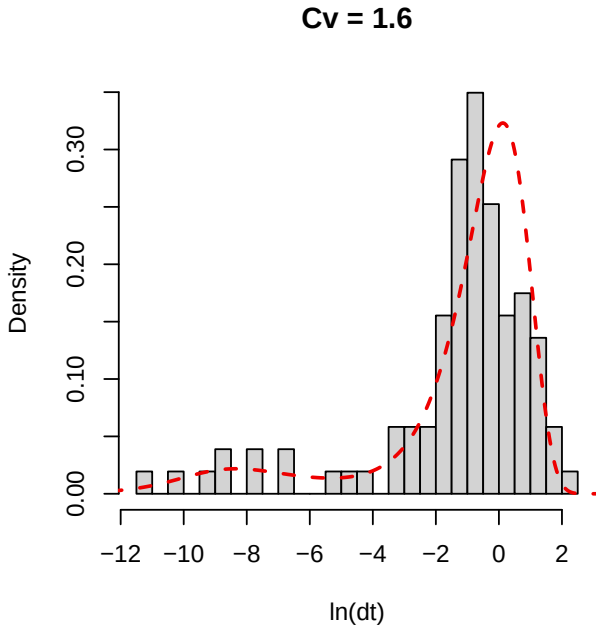

p =1.05 [1.03,1.06] ; loglambdac =−3.4; n =0.7 [0.52,0.915]
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-3}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

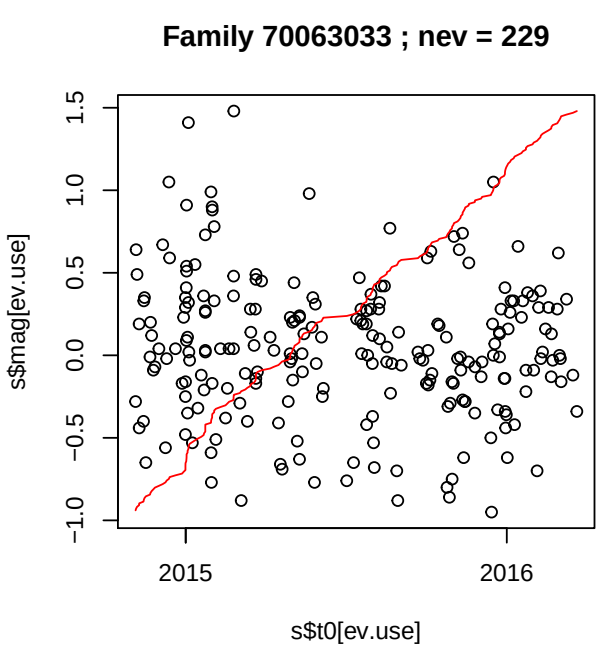

Cv = 2.2
Density
0.0
0.1
0.2
0.3
−10
−8
−6
−4
−2
0
2
4
ln(dt)

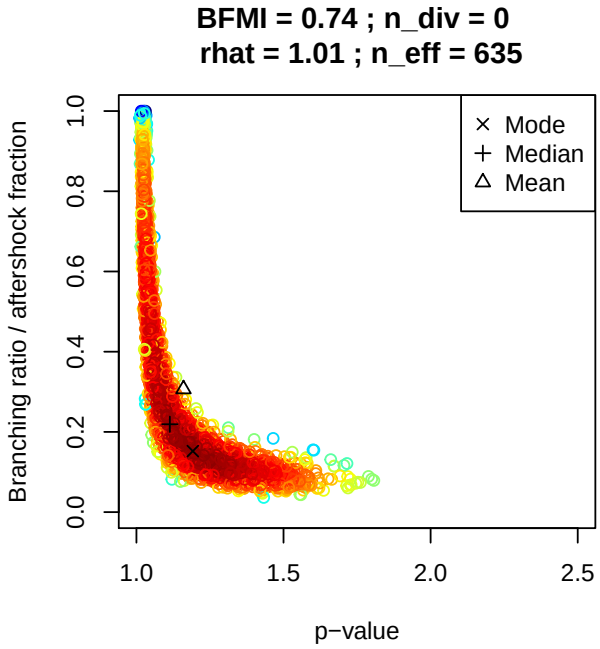

Family 70062978 ; nev = 104
s$mag[ev.use]
s$t0[ev.use]
2015
2016
2017
−1.0
−0.5
0.0
0.5
1.0
1.5

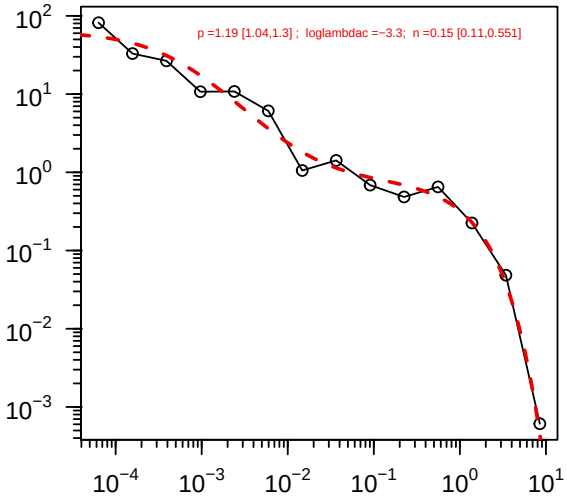

BFMI = 0.86 ; n_div = 0
rhat = 1 ; n_eff = 558
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
1.0
1.5
2.0
2.5
0.0
0.2
0.4
0.6
0.8
1.0

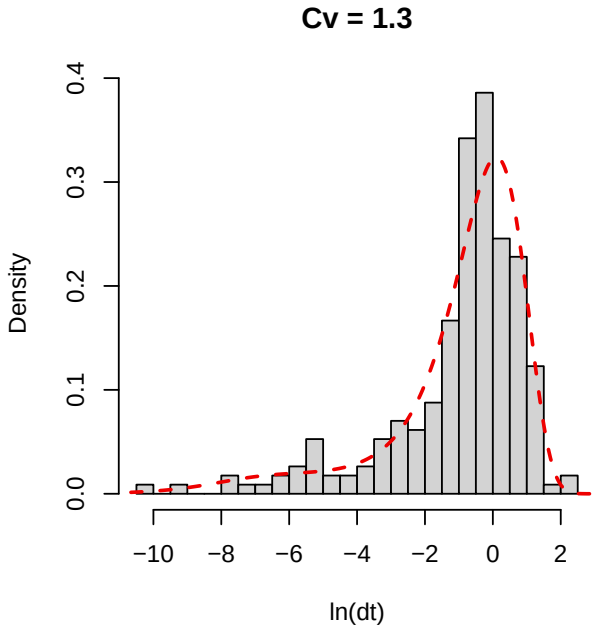

p =1.41 [1.07,1.52] ; loglambdac =−4; n =0.12 [0.099,0.358]

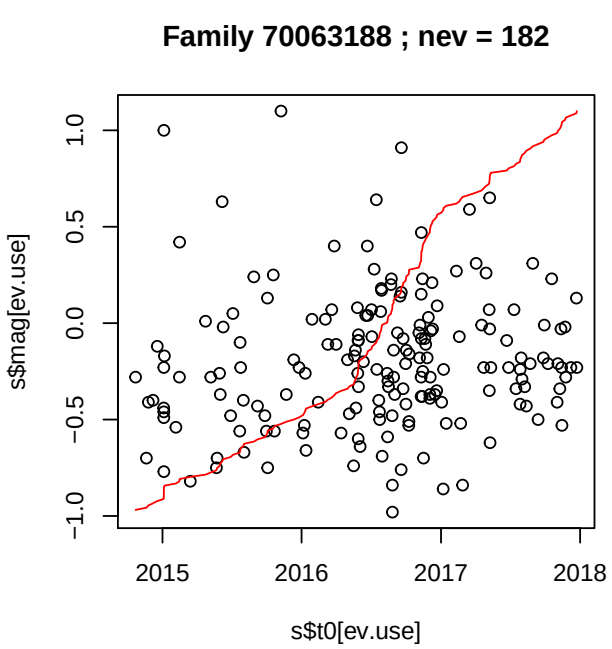

Cv = 1.6
Density
ln(dt)
−12
−10
−8
−6
−4
−2
0
2
0.00
0.10
0.20
0.30

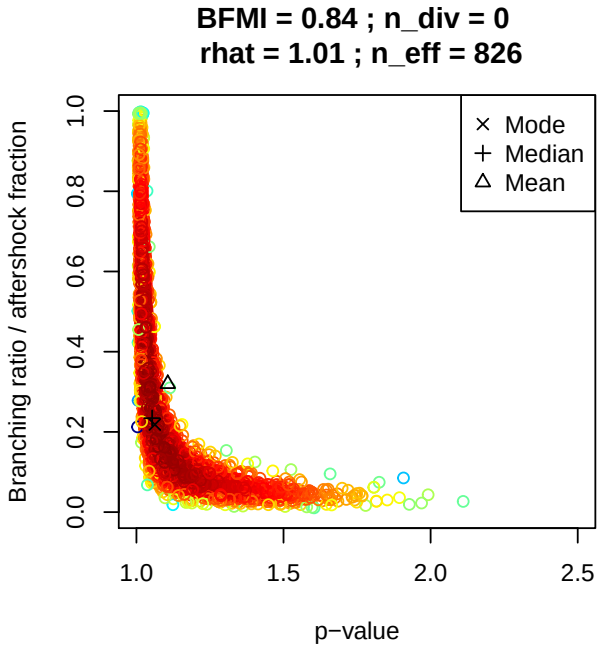

Family 70063033 ; nev = 229
s$mag[ev.use]
s$t0[ev.use]
2015
2016

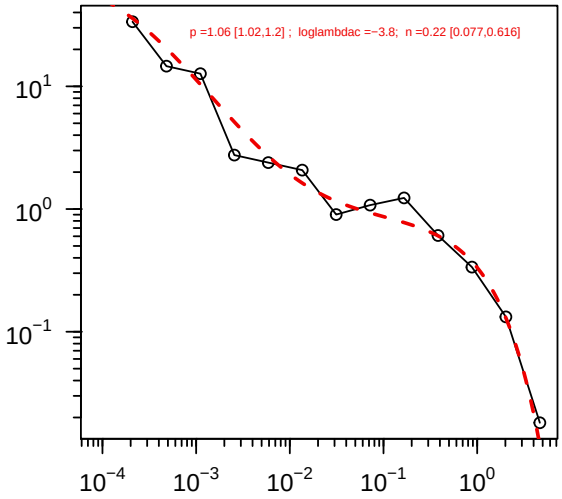

BFMI = 0.74 ; n_div = 0
rhat = 1.01 ; n_eff = 635
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value

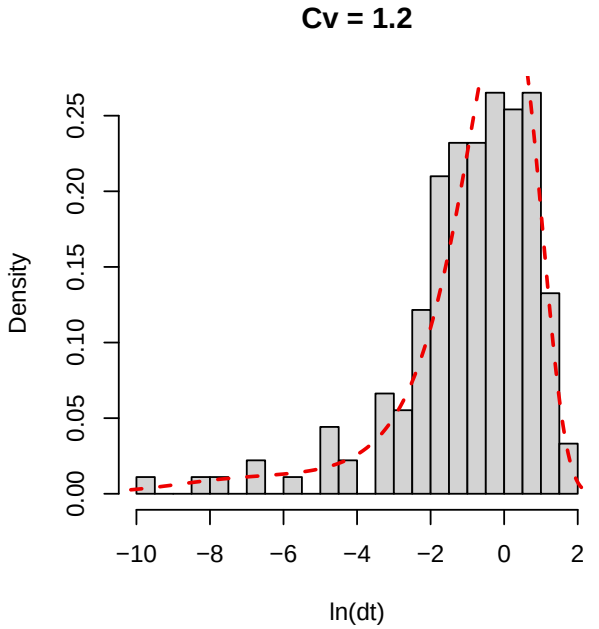

p =1.19 [1.04,1.3] ; loglambdac =−3.3; n =0.15 [0.11,0.551]

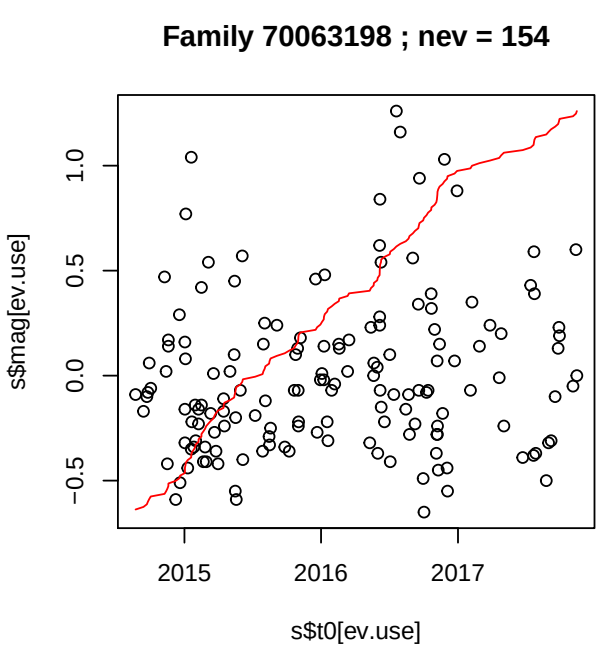

Cv = 1.3
Density
ln(dt)

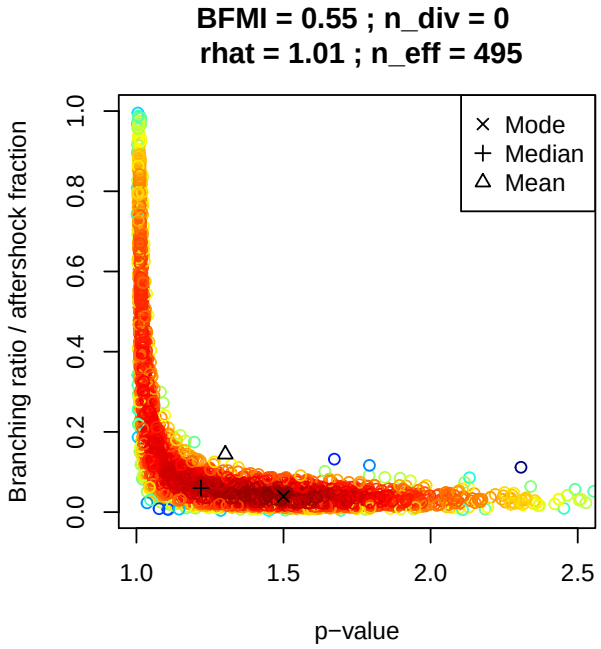

Family 70063188 ; nev = 182
s$mag[ev.use]
s$t0[ev.use]
1.0
0.5
0.0
−0.5
−1.0
2015
2016
2017
2018

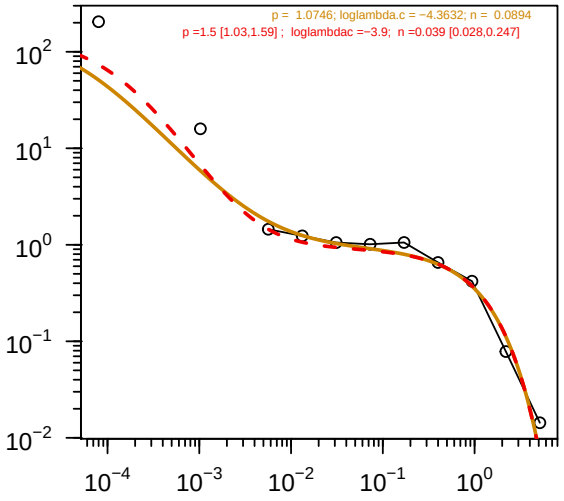

BFMI = 0.84 ; n_div = 0
rhat = 1.01 ; n_eff = 826
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
1.0
0.8
0.6
0.4
0.2
0.0
1.0
1.5
2.0
2.5

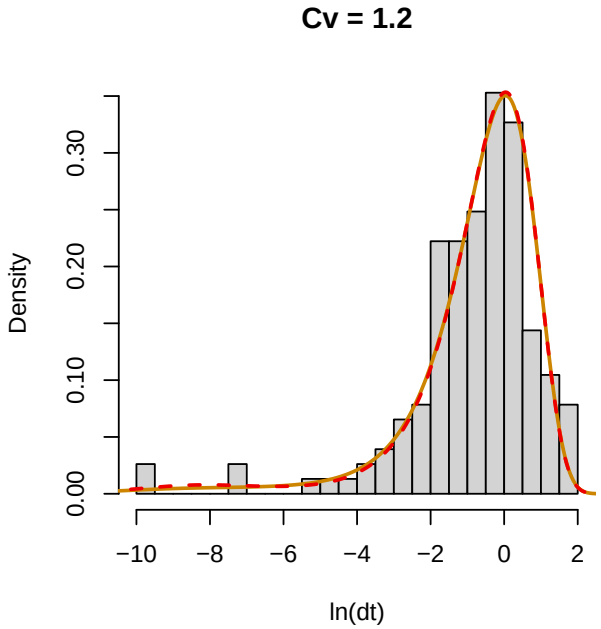

p =1.06 [1.02,1.2] ; loglambdac =−3.8; n =0.22 [0.077,0.616]
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$

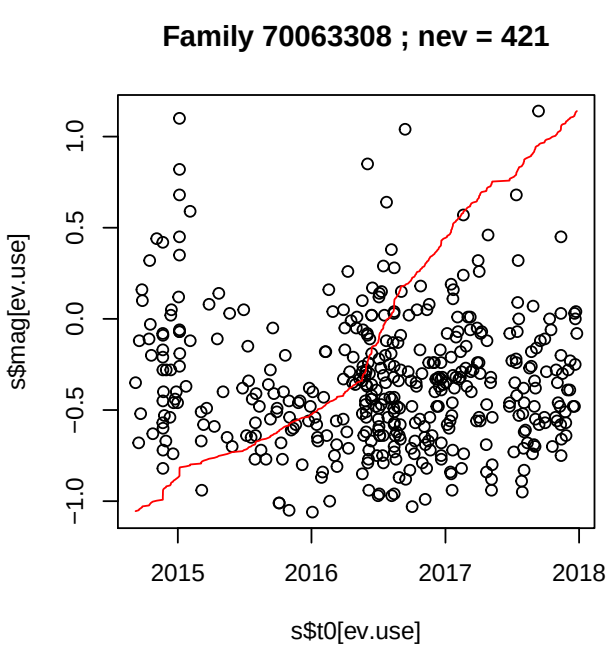

Cv = 1.2
Density
ln(dt)
0.25
0.20
0.15
0.10
0.05
0.00
−10
−8
−6
−4
−2
0
2

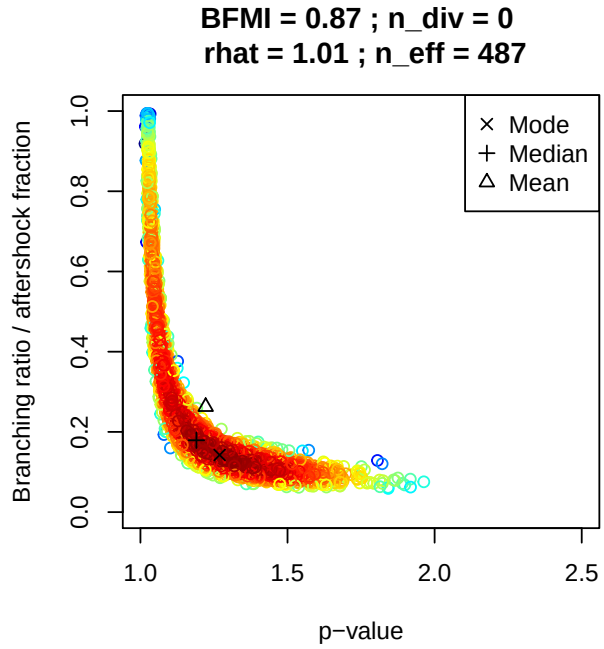

Family 70063198 ; nev = 154
s$mag[ev.use]
s$t0[ev.use]
2015
2016
2017
−0.5
0.0
0.5
1.0

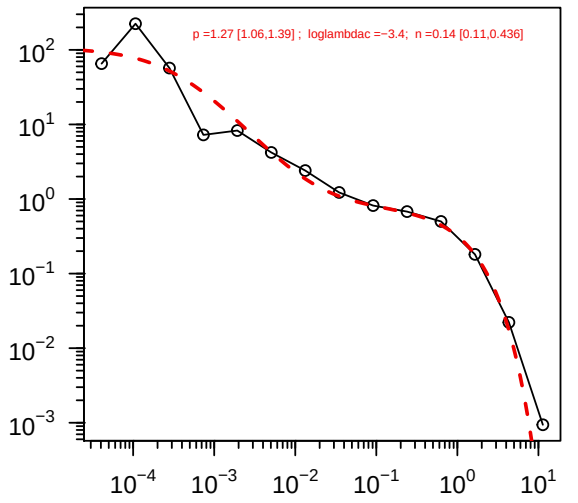

BFMI = 0.55 ; n_div = 0
rhat = 1.01 ; n_eff = 495
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5

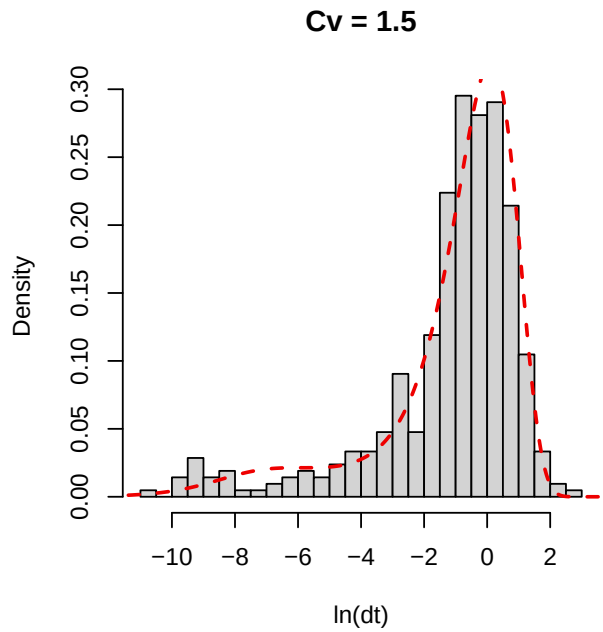

p = 1.0746; loglambda.c = −4.3632; n = 0.0894
p =1.5 [1.03,1.59] ; loglambdac =−3.9; n =0.039 [0.028,0.247]
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$

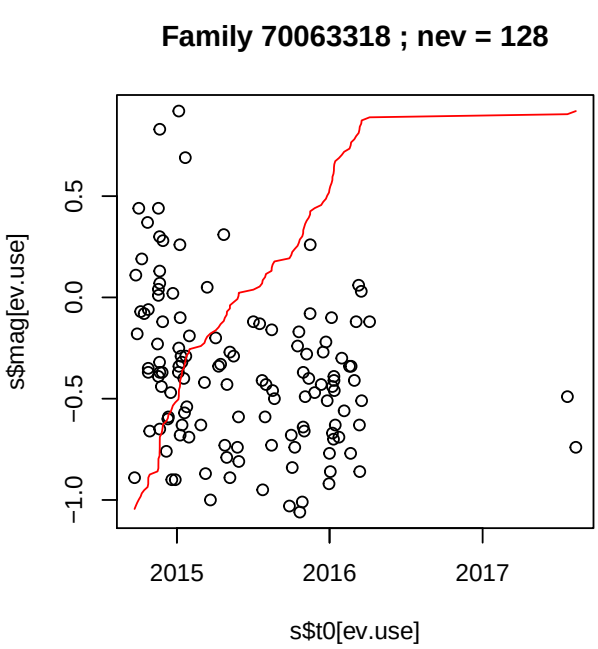

Cv = 1.2
Density
ln(dt)
0.00
0.10
0.20
0.30
−10
−8
−6
−4
−2
0
2

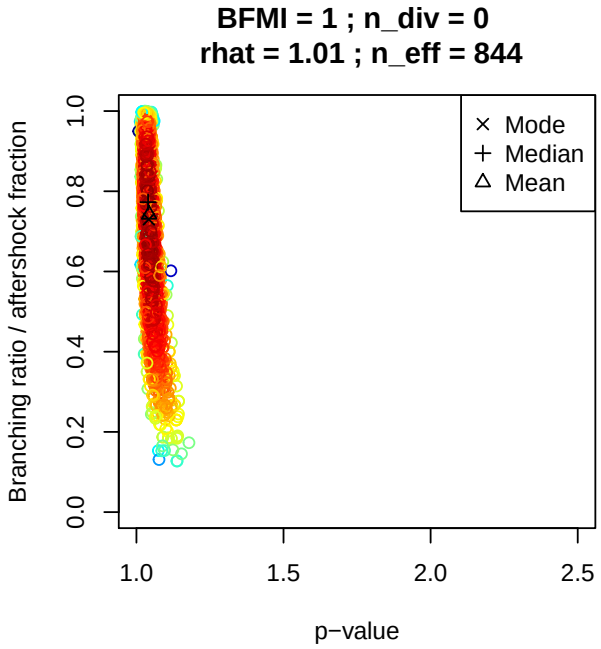

Family 70063308 ; nev = 421
s$mag[ev.use]
s$t0[ev.use]
2015
2016
2017
2018
−1.0
−0.5
0.0
0.5
1.0

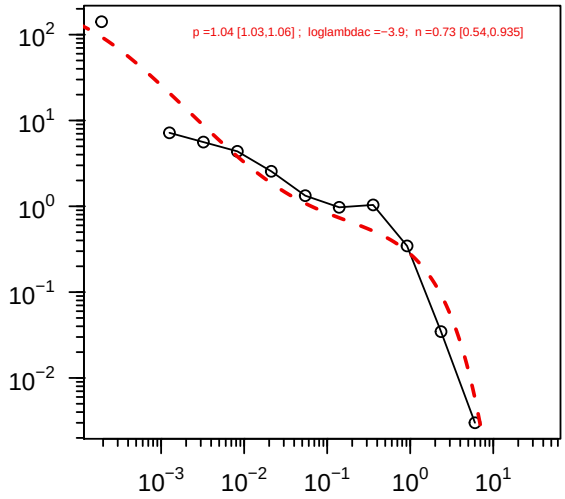

BFMI = 0.87 ; n_div = 0
rhat = 1.01 ; n_eff = 487
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5

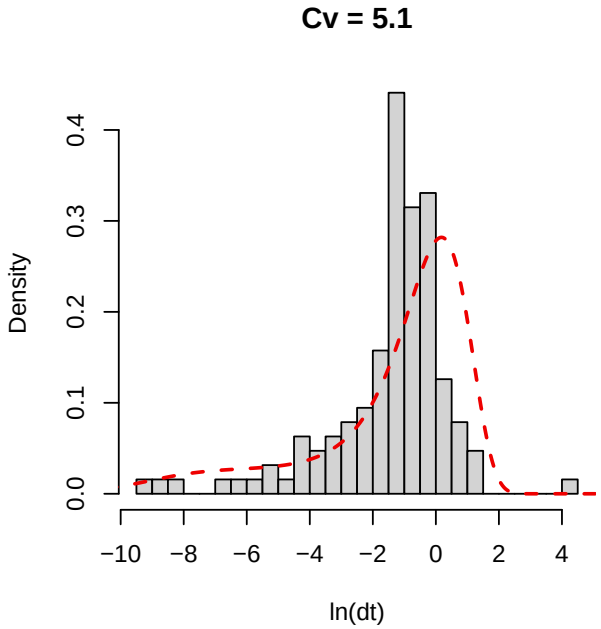

p =1.27 [1.06,1.39] ; loglambdac =−3.4; n =0.14 [0.11,0.436]
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-3}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

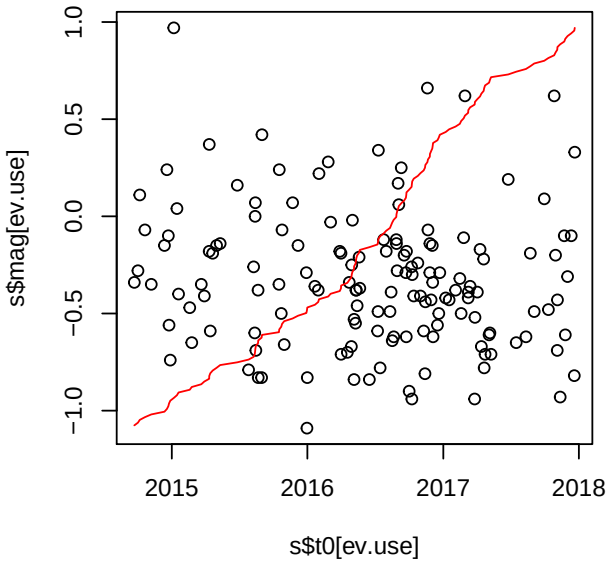

Cv = 1.5
Density
ln(dt)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
−10
−8
−6
−4
−2
0
2

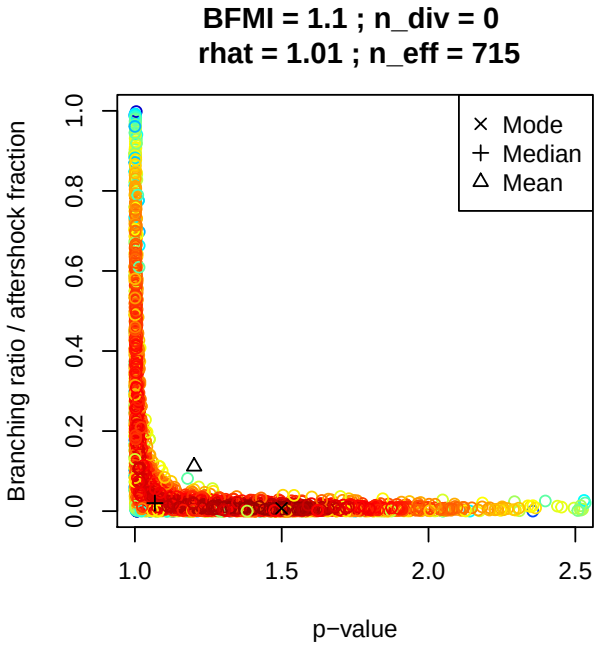

Family 70063318 ; nev = 128
s$mag[ev.use]
s$t0[ev.use]
2015
2016
2017
−1.0
−0.5
0.0
0.5

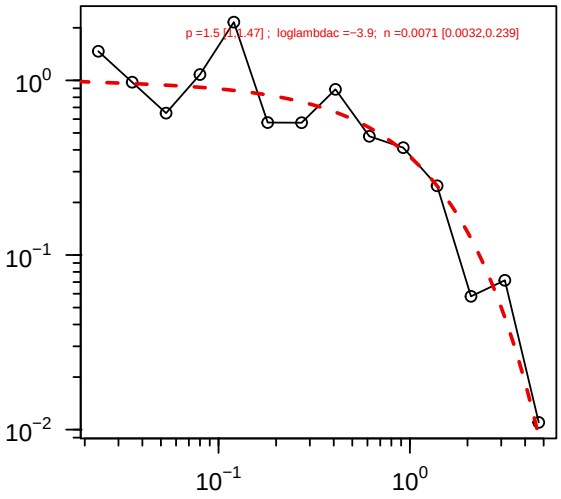

BFMI = 1 ; n_div = 0
rhat = 1.01 ; n_eff = 844
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5

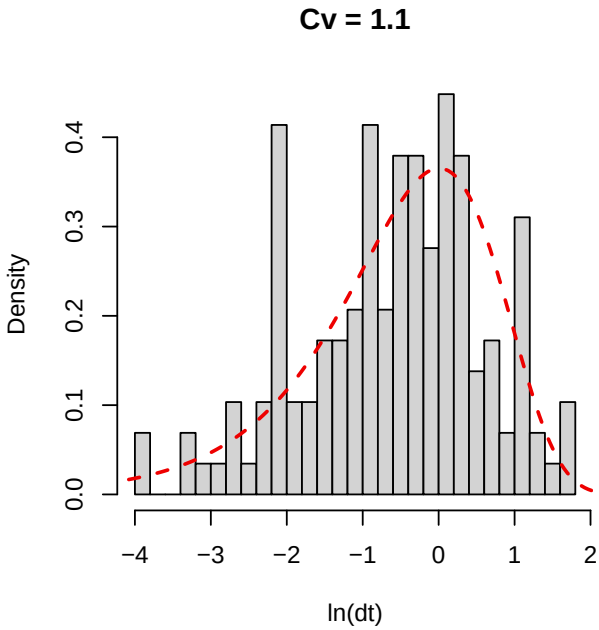

p =1.04 [1.03,1.06] ; loglambdac =−3.9; n =0.73 [0.54,0.935]
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

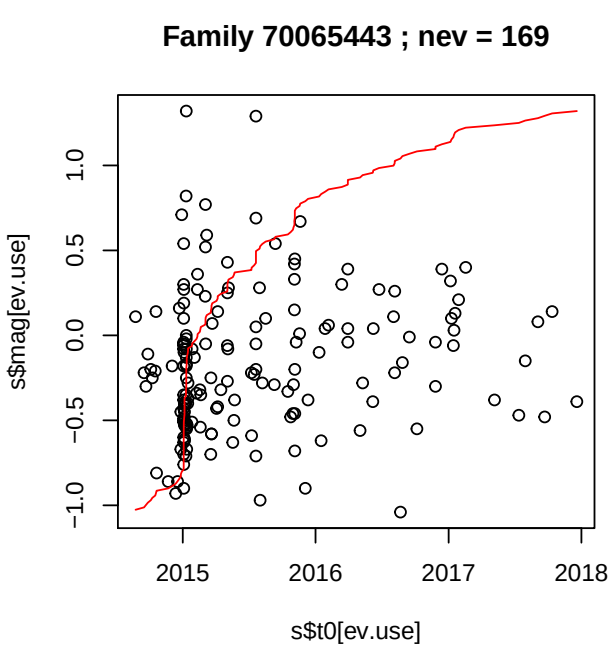

Cv = 5.1
Density
ln(dt)
0.0
0.1
0.2
0.3
0.4
−10
−8
−6
−4
−2
0
2
4

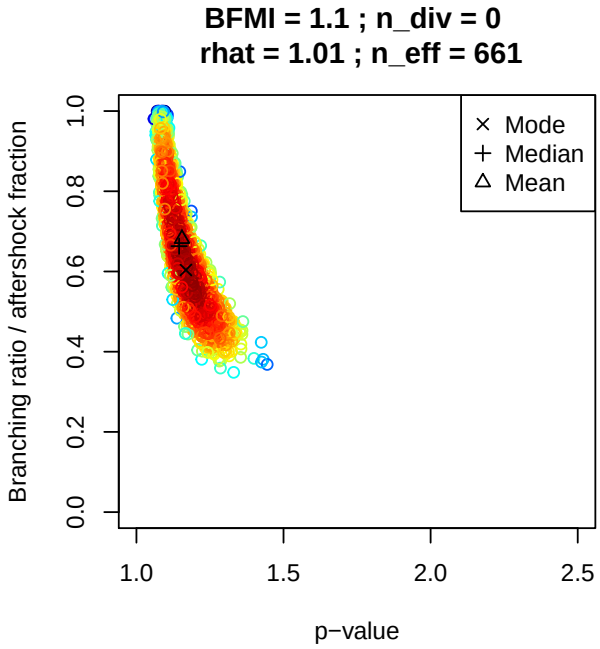

Family 70063728 ; nev = 146
s$mag[ev.use]
s$t0[ev.use]
2015
2016
2017
2018
1.0
0.5
0.0
−0.5
−1.0

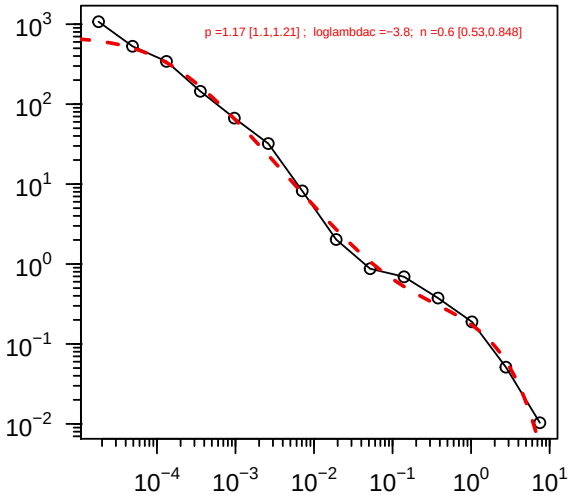

BFMI = 1.1 ; n_div = 0
rhat = 1.01 ; n_eff = 715
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
1.0
1.5
2.0
2.5
0.0
0.2
0.4
0.6
0.8
1.0

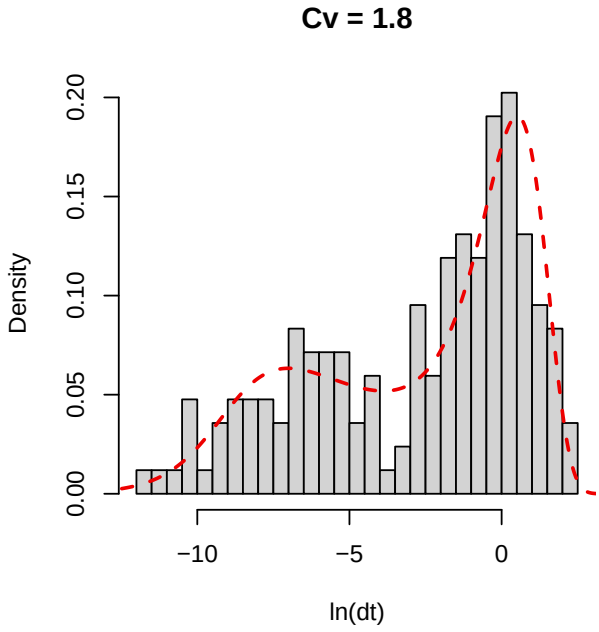

p =1.5 [1.1,1.47] ; loglambdac =−3.9; n =0.0071 [0.0032,0.239]
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-1}$
$10^{0}$

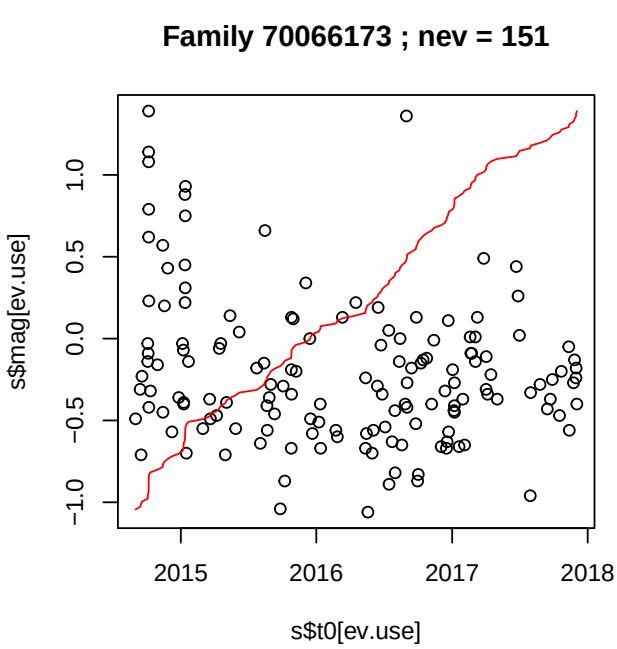

Cv = 1.1
Density
ln(dt)
0.0
0.1
0.2
0.3
0.4
−4
−3
−2
−1
0
1
2

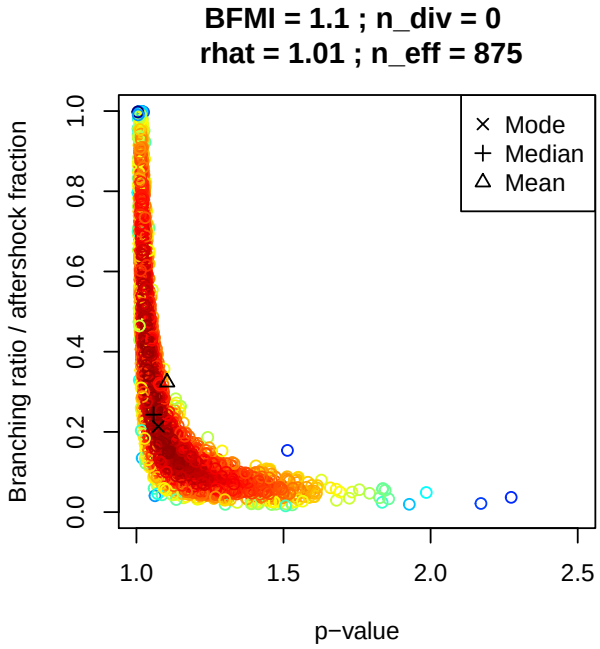

Family 70065443 ; nev = 169
s$mag[ev.use]
s$t0[ev.use]
2015
2016
2017
2018
−1.0
−0.5
0.0
0.5
1.0

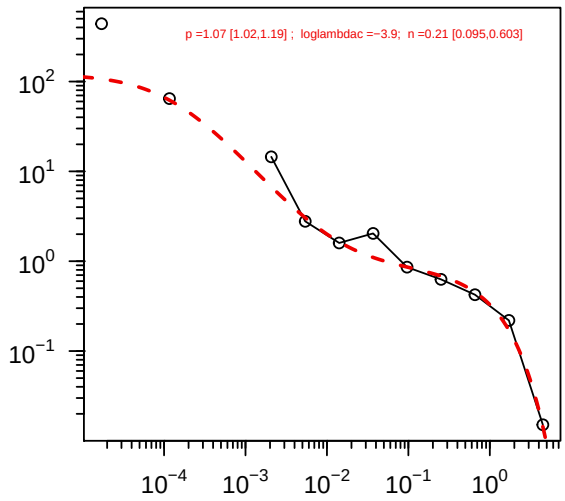

BFMI = 1.1 ; n_div = 0
rhat = 1.01 ; n_eff = 661
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5

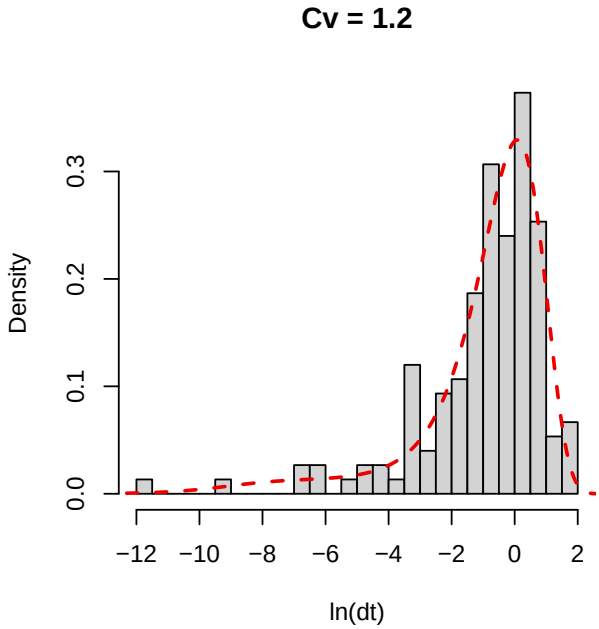

p =1.17 [1.1,1.21] ; loglambdac =−3.8; n =0.6 [0.53,0.848]
$10^{3}$
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

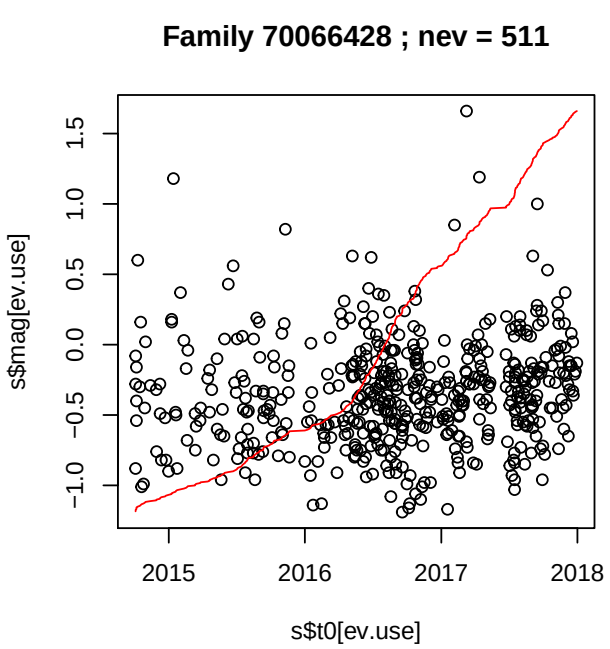

Cv = 1.8
Density
ln(dt)
0.00
0.05
0.10
0.15
0.20
−10
−5
0

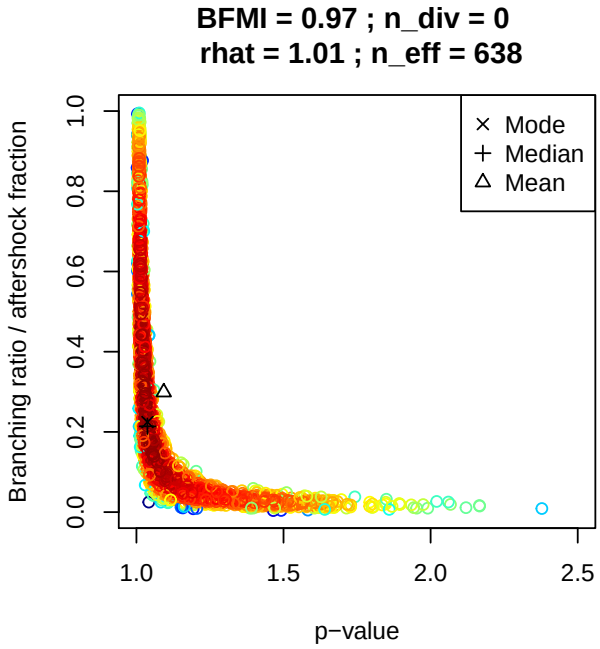

Family 70066173 ; nev = 151
s$mag[ev.use]
s$t0[ev.use]
2015
2016
2017
2018
−1.0
−0.5
0.0
0.5
1.0

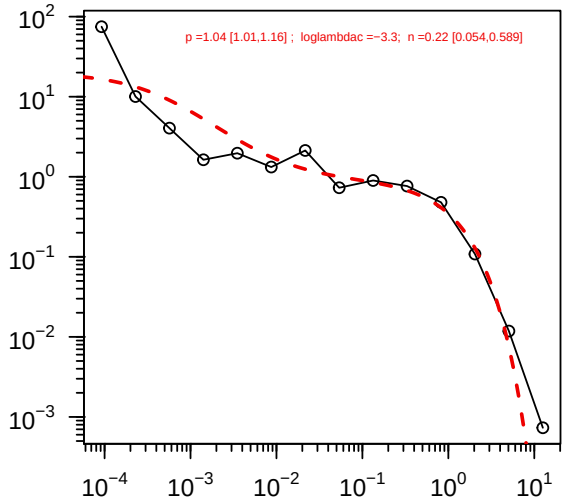

BFMI = 1.1 ; n_div = 0
rhat = 1.01 ; n_eff = 875
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5

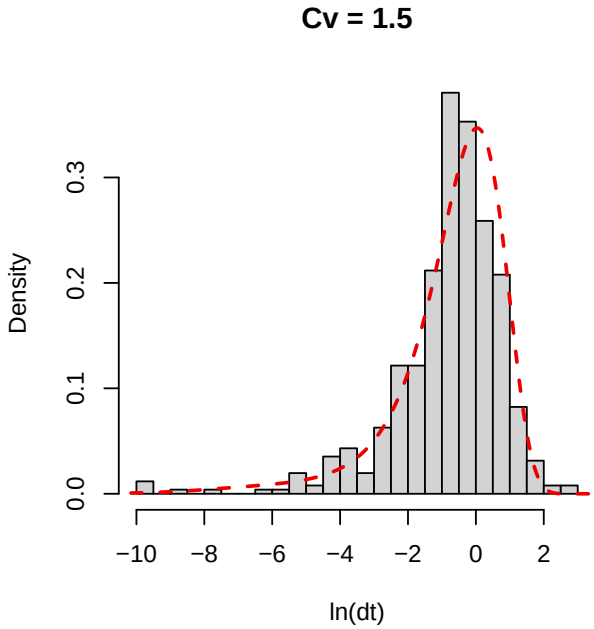

p =1.07 [1.02,1.19] ; loglambdac =−3.9; n =0.21 [0.095,0.603]
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$

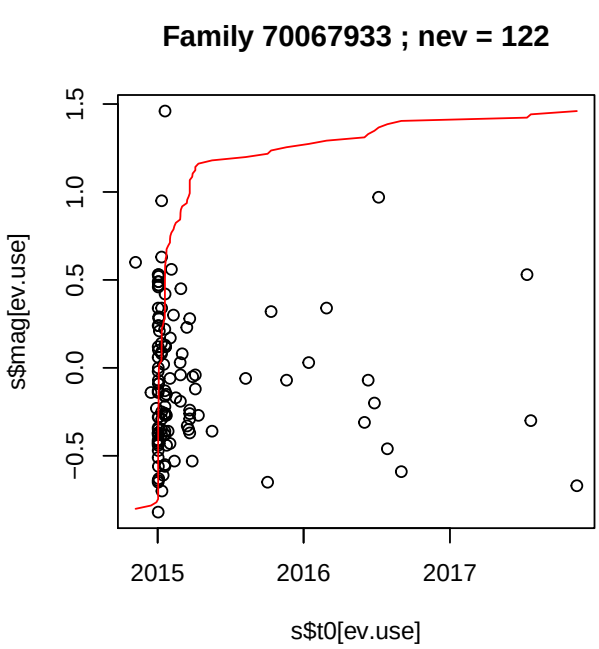

Cv = 1.2
Density
ln(dt)
0.0
0.1
0.2
0.3
−12
−10
−8
−6
−4
−2
0
2

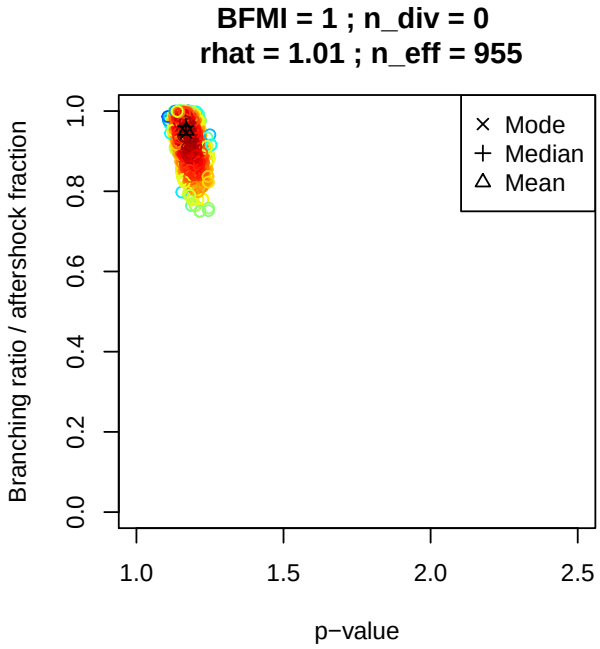

Family 70066428 ; nev = 511
s$mag[ev.use]
s$t0[ev.use]
2015
2016
2017
2018
−1.0
−0.5
0.0
0.5
1.0
1.5

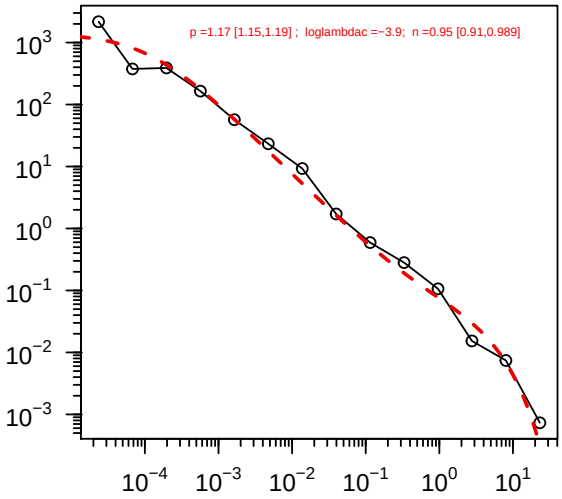

BFMI = 0.97 ; n_div = 0
rhat = 1.01 ; n_eff = 638
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5

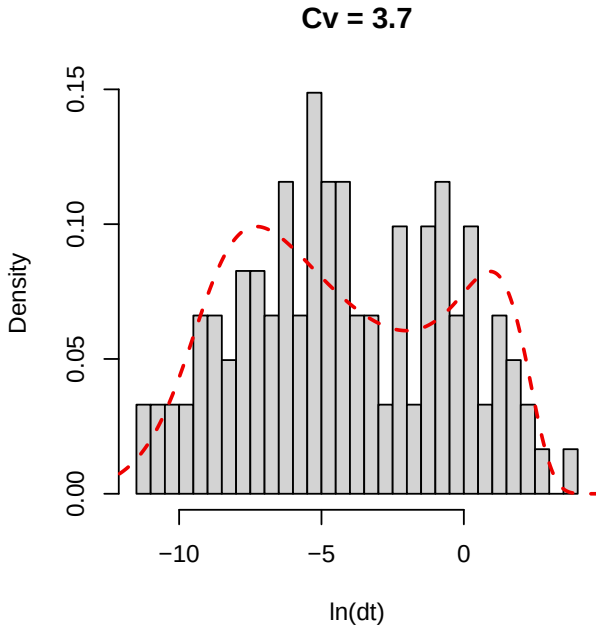

p =1.04 [1.01,1.16] ; loglambdac =−3.3; n =0.22 [0.054,0.589]
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-3}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

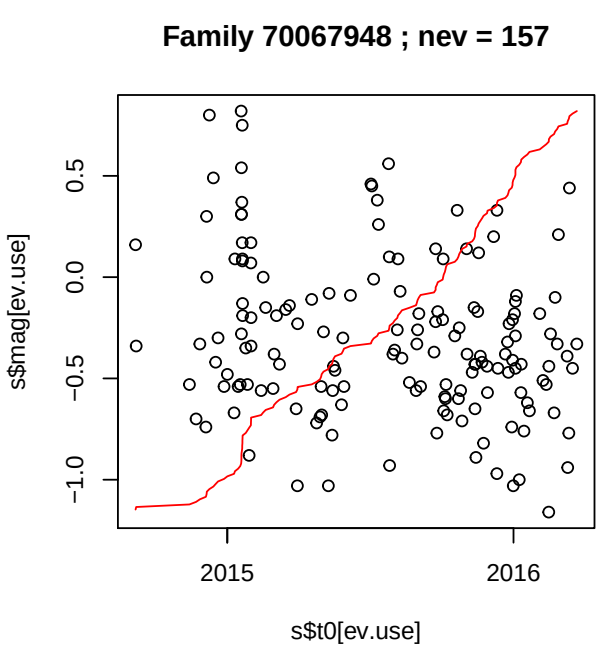

Cv = 1.5
Density
ln(dt)
0.0
0.1
0.2
0.3
−10
−8
−6
−4
−2
0
2

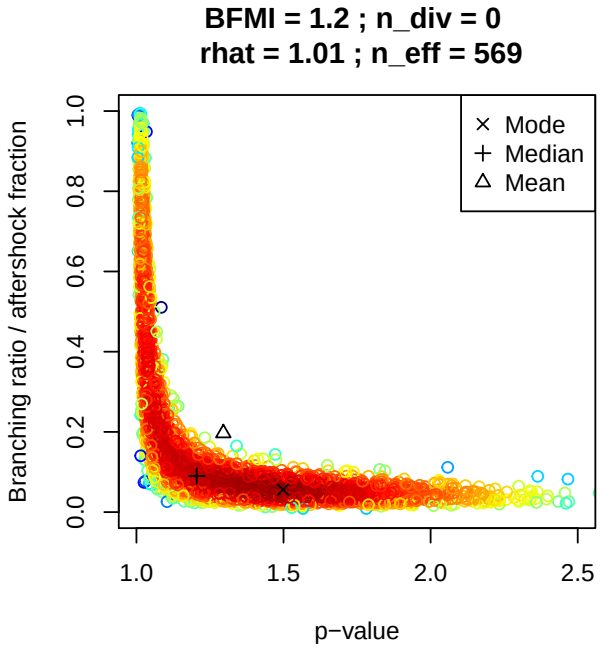

Family 70067933 ; nev = 122
s$mag[ev.use]
s$t0[ev.use]
2015
2016
2017
−0.5
0.0
0.5
1.0
1.5

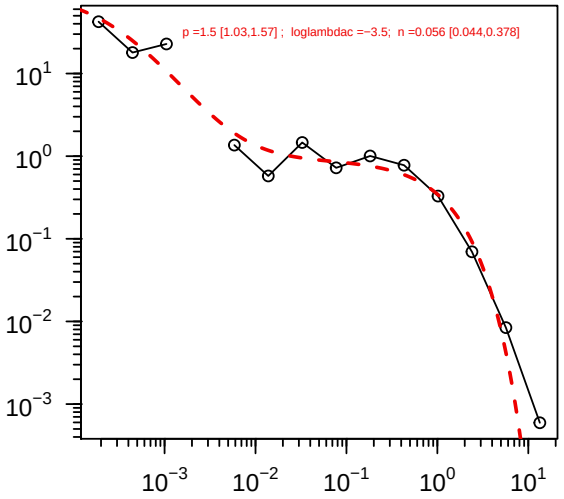

BFMI = 1 ; n_div = 0
rhat = 1.01 ; n_eff = 955
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5

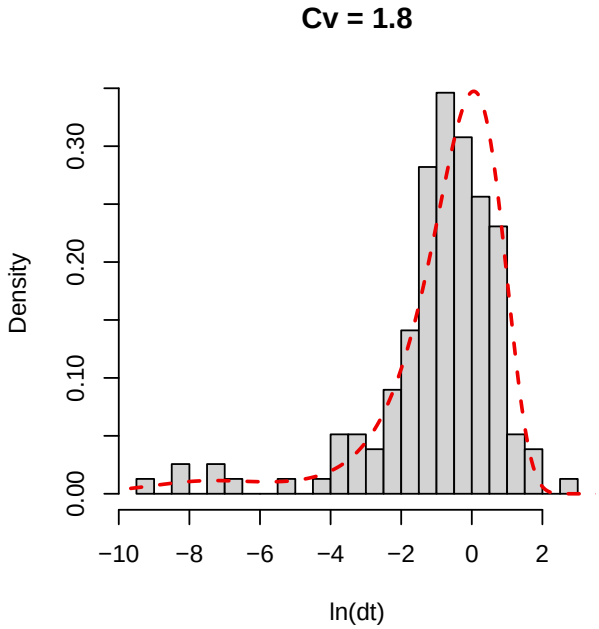

p =1.17 [1.15,1.19] ; loglambdac =−3.9; n =0.95 [0.91,0.989]

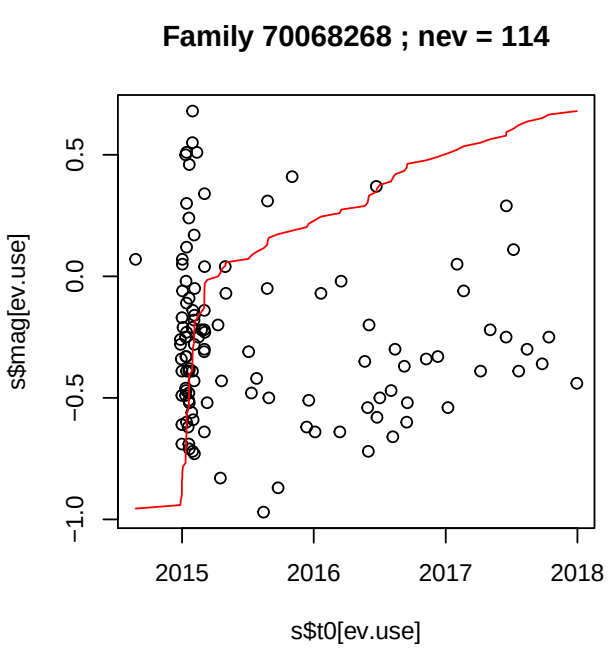

Cv = 3.7
Density
ln(dt)
0.00
0.05
0.10
0.15
−10
−5
0

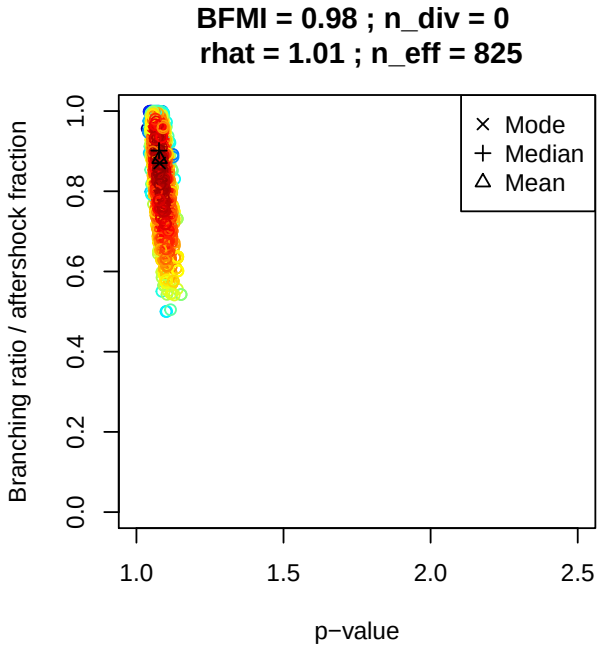

Family 70067948 ; nev = 157
s$mag[ev.use]
s$t0[ev.use]
2015
2016
0.5
0.0
−0.5
−1.0

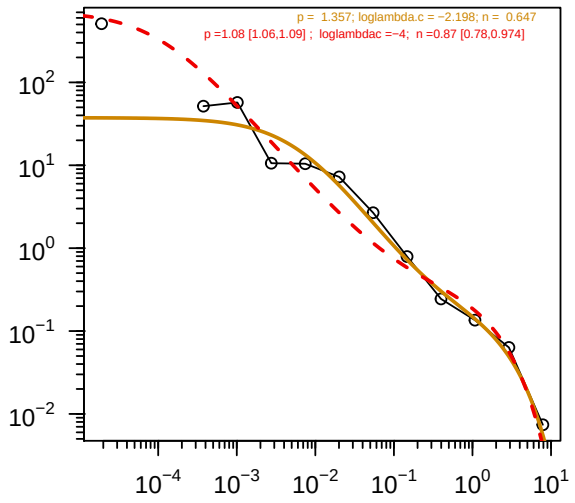

BFMI = 1.2 ; n_div = 0
rhat = 1.01 ; n_eff = 569
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
0.0
0.2
0.4
0.6
0.8
1.0
1.5
2.0
2.5

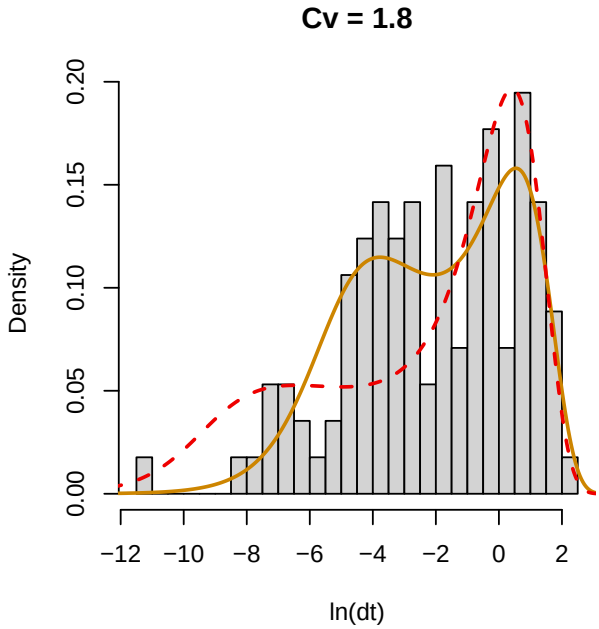

p =1.5 [1.03,1.57] ; loglambdac =−3.5; n =0.056 [0.044,0.378]
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-3}$

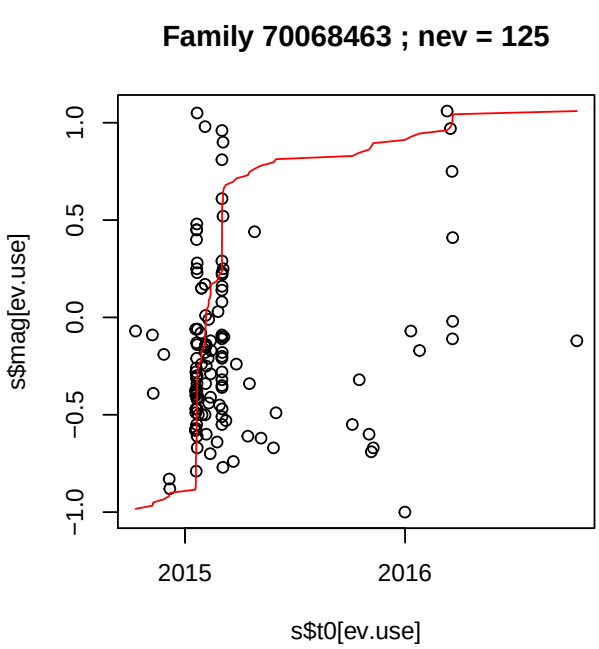

Cv = 1.8
Density
ln(dt)
0.00
0.10
0.20
0.30
−10
−8
−6
−4
−2
0
2

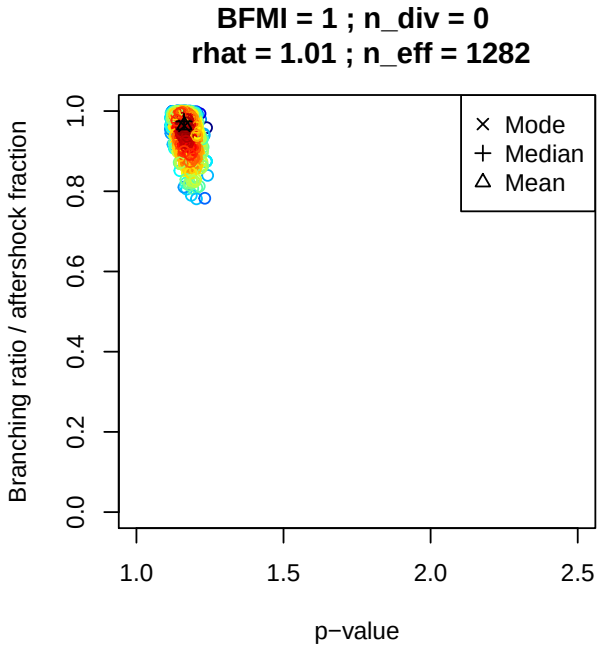

Family 70068268 ; nev = 114
s$mag[ev.use]
s$t0[ev.use]
−1.0
−0.5
0.0
0.5
2015
2016
2017
2018

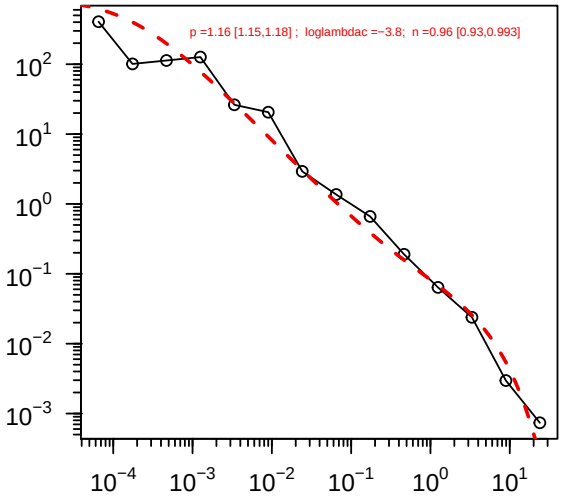

BFMI = 0.98 ; n_div = 0
rhat = 1.01 ; n_eff = 825
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5

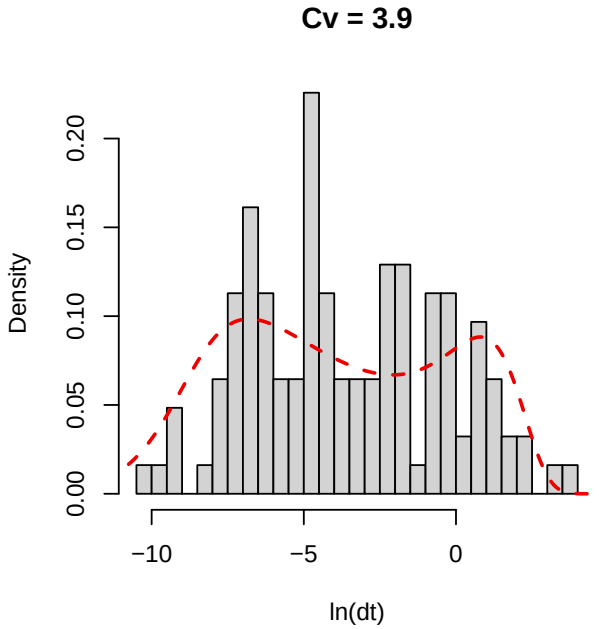

p = 1.357; loglambda.c = −2.198; n = 0.647
p =1.08 [1.06,1.09] ; loglambdac =−4; n =0.87 [0.78,0.974]
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

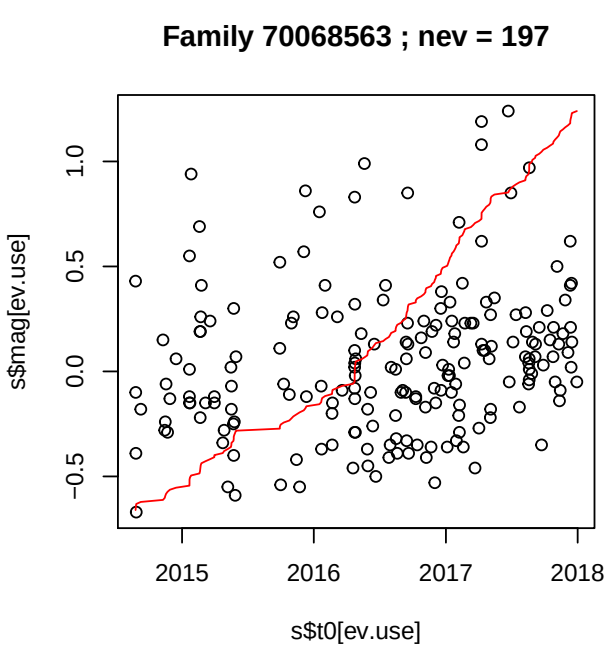

Cv = 1.8
Density
ln(dt)
0.00
0.05
0.10
0.15
0.20
−12
−10
−8
−6
−4
−2
0
2

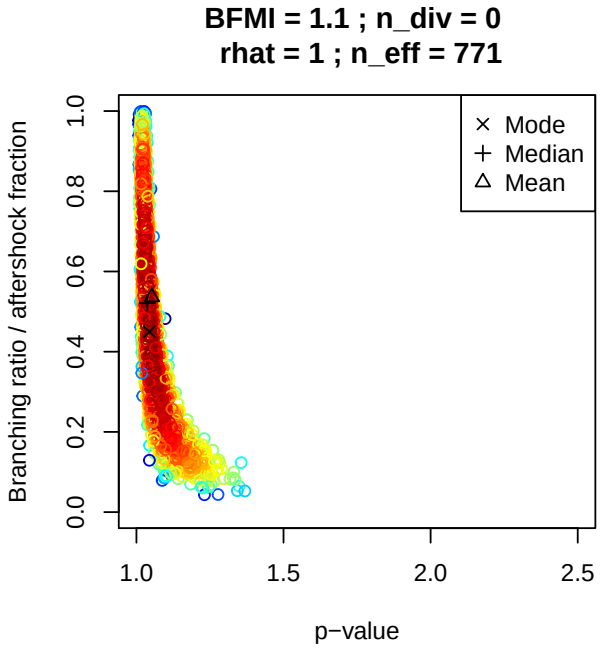

Family 70068463 ; nev = 125
s$mag[ev.use]
1.0
0.5
0.0
−0.5
−1.0
2015
2016
s$t0[ev.use]

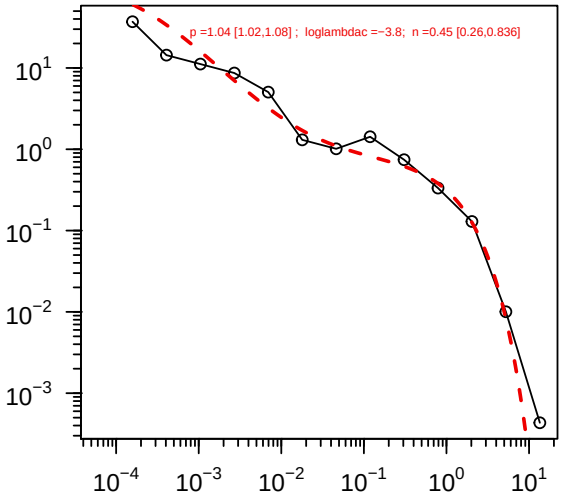

BFMI = 1 ; n_div = 0
rhat = 1.01 ; n_eff = 1282
Mode
Median
Mean
Branching ratio / aftershock fraction
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5
p−value

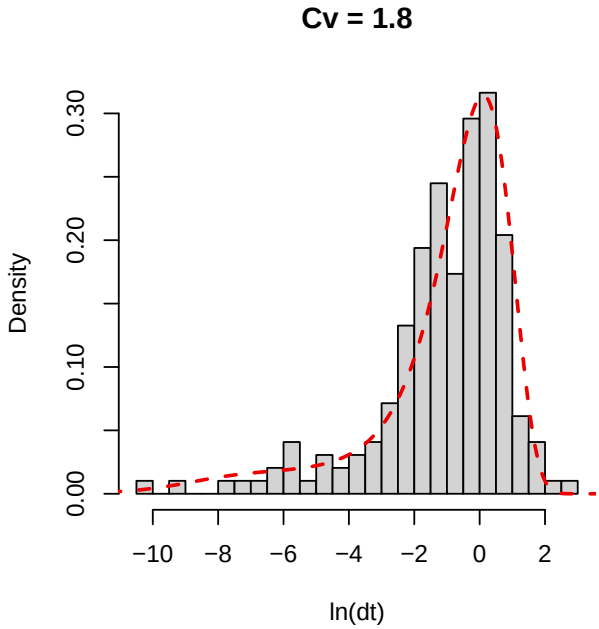

p =1.16 [1.15,1.18] ; loglambdac =−3.8; n =0.96 [0.93,0.993]
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-3}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

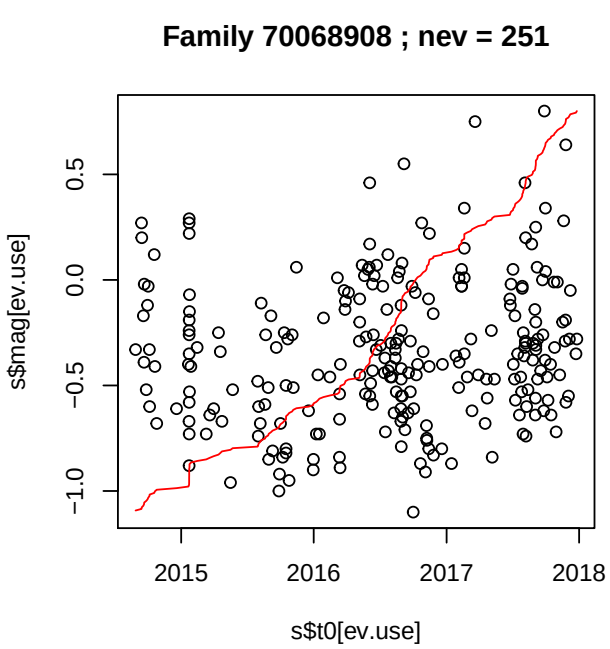

Cv = 3.9
Density
0.00
0.05
0.10
0.15
0.20
−10
−5
0
ln(dt)

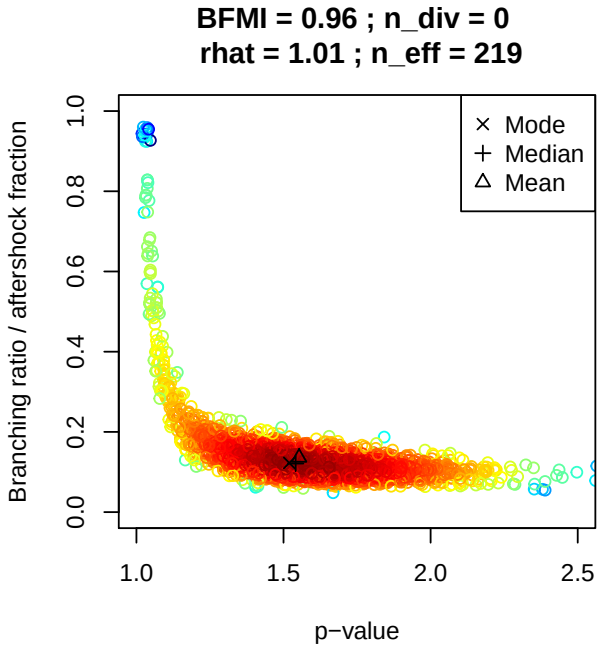

Family 70068563 ; nev = 197
s$mag[ev.use]
s$t0[ev.use]
2015
2016
2017
2018
−0.5
0.0
0.5
1.0

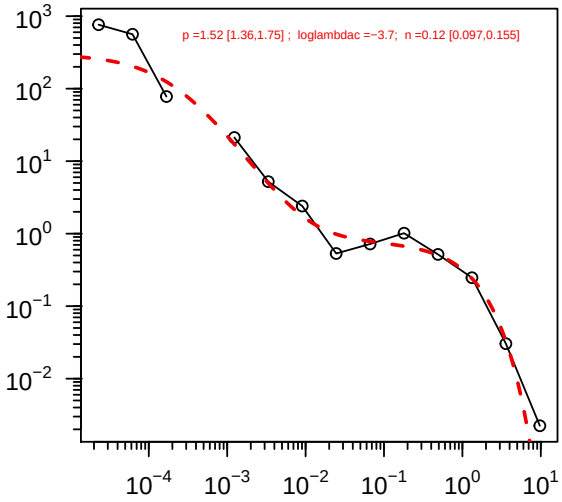

BFMI = 1.1 ; n_div = 0
rhat = 1 ; n_eff = 771
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
1.0
1.5
2.0
2.5
0.0
0.2
0.4
0.6
0.8
1.0

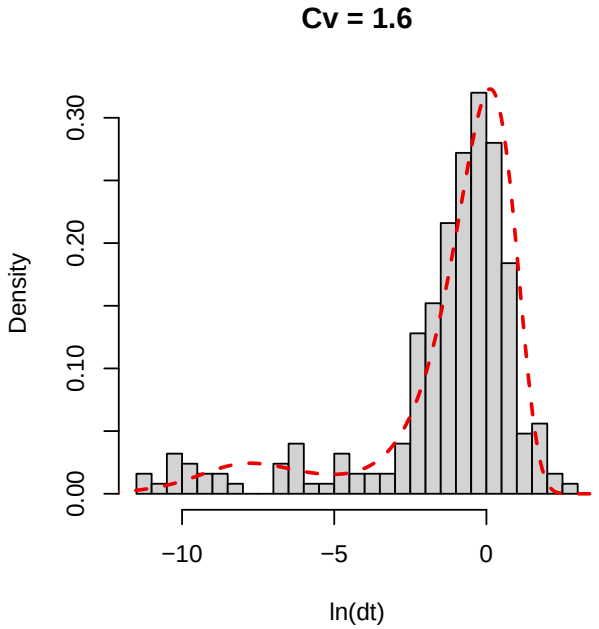

p =1.04 [1.02,1.08] ; loglambdac =−3.8; n =0.45 [0.26,0.836]
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-3}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

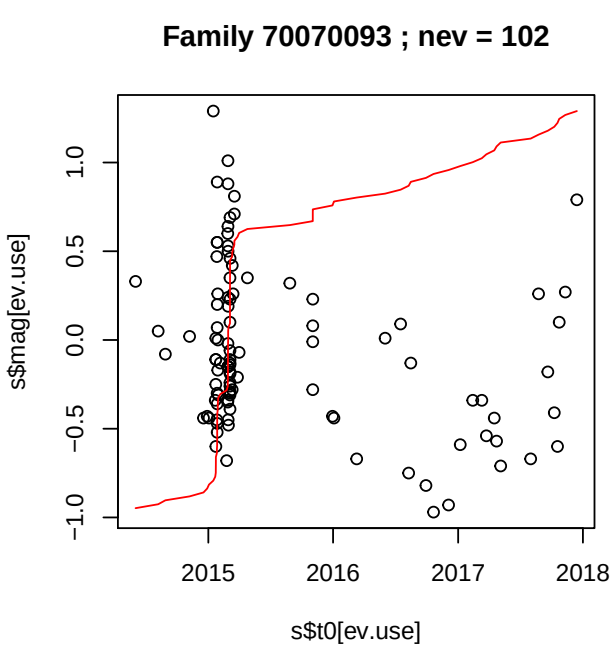

Cv = 1.8
Density
ln(dt)
0.00
0.10
0.20
0.30
−10
−8
−6
−4
−2
0
2

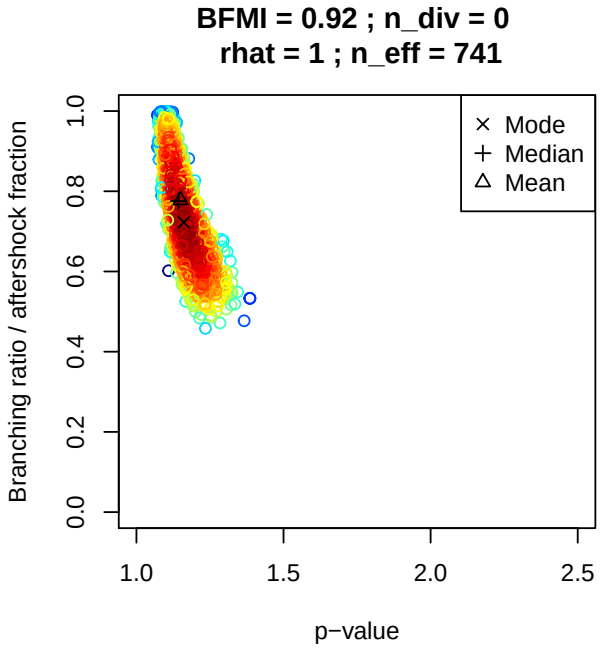

Family 70068908 ; nev = 251
s$mag[ev.use]
s$t0[ev.use]
2015
2016
2017
2018
0.5
0.0
−0.5
−1.0

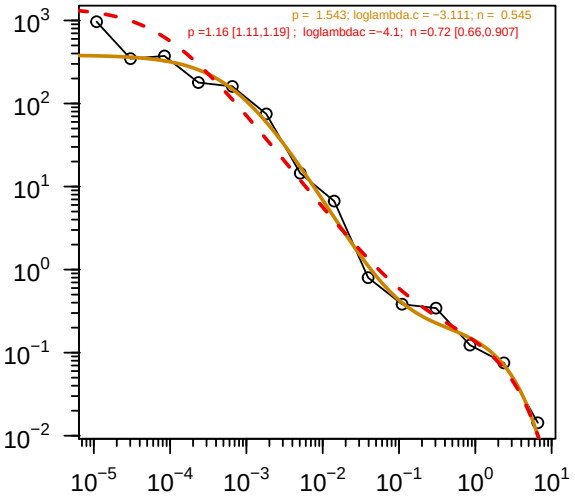

BFMI = 0.96 ; n_div = 0
rhat = 1.01 ; n_eff = 219
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
1.0
1.5
2.0
2.5
0.0
0.2
0.4
0.6
0.8
1.0

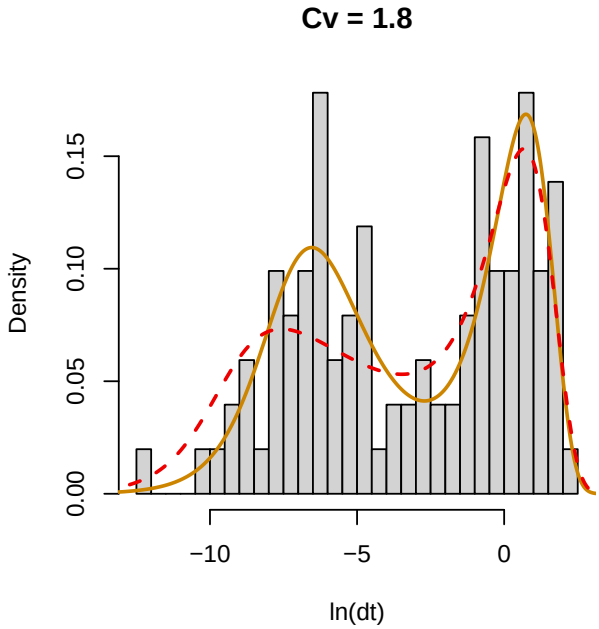

p =1.52 [1.36,1.75] ; loglambdac =−3.7; n =0.12 [0.097,0.155]
$10^{3}$
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

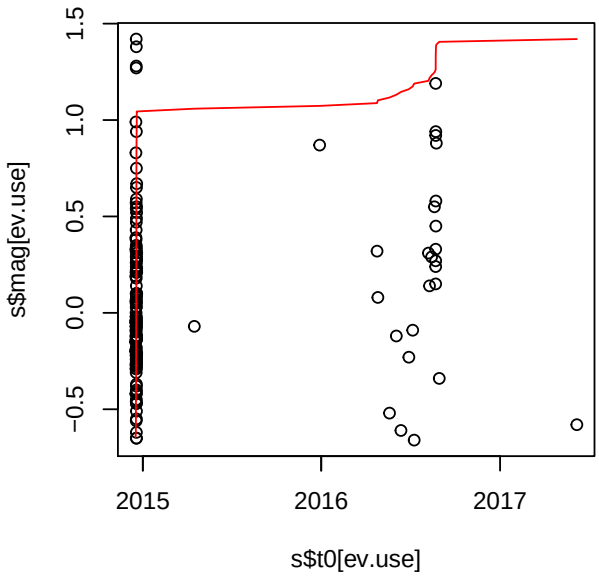

Cv = 1.6
Density
ln(dt)
0.00
0.10
0.20
0.30
−10
−5
0

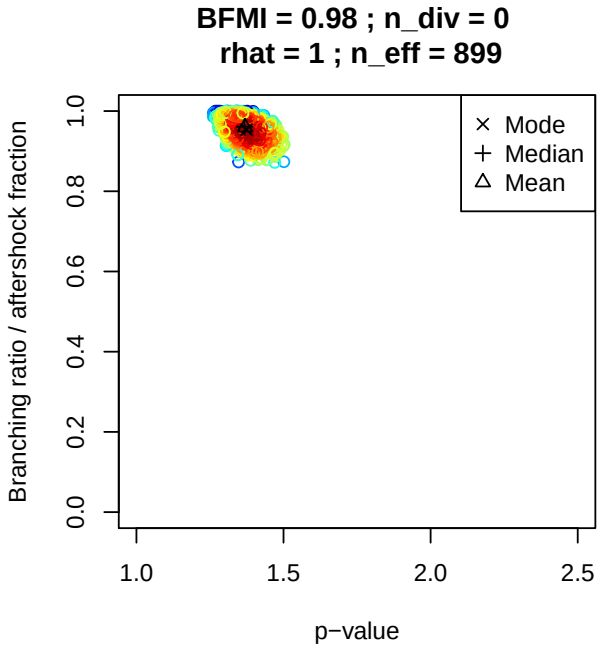

Family 70070093 ; nev = 102
s$mag[ev.use]
s$t0[ev.use]
2015
2016
2017
2018
−1.0
−0.5
0.0
0.5
1.0

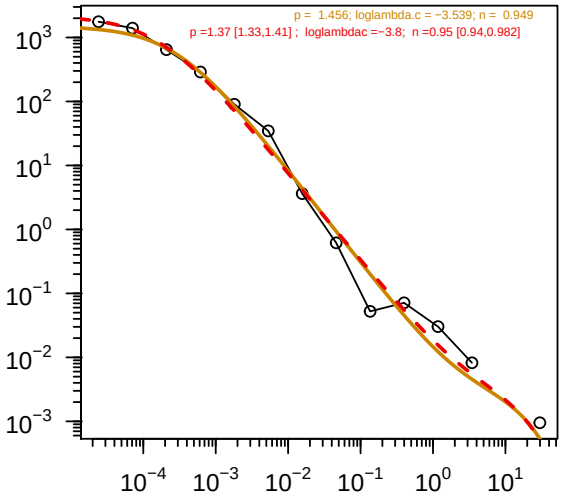

BFMI = 0.92 ; n_div = 0
rhat = 1 ; n_eff = 741
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5

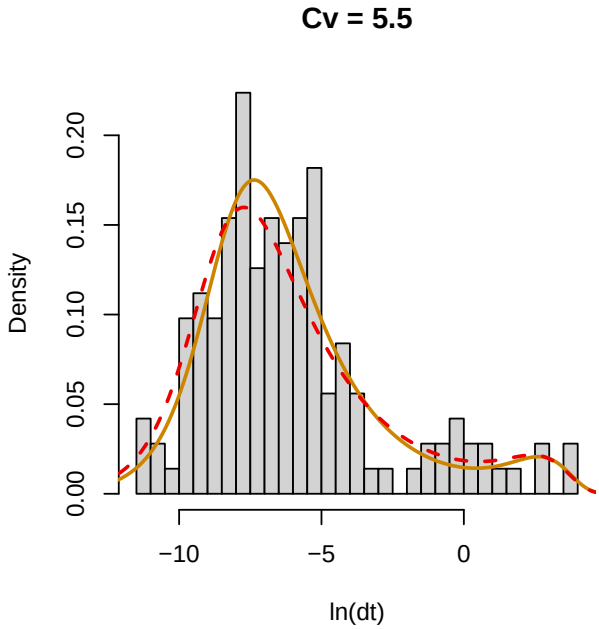

p = 1.543; loglambda.c = −3.111; n = 0.545
p =1.16 [1.11,1.19] ; loglambdac =−4.1; n =0.72 [0.66,0.907]
$10^{3}$
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-5}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

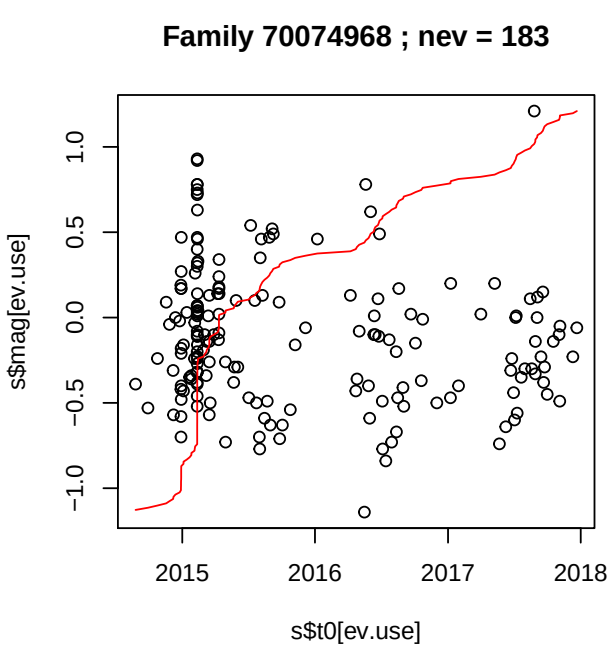

Cv = 1.8
Density
ln(dt)
0.00
0.05
0.10
0.15
−10
−5
0

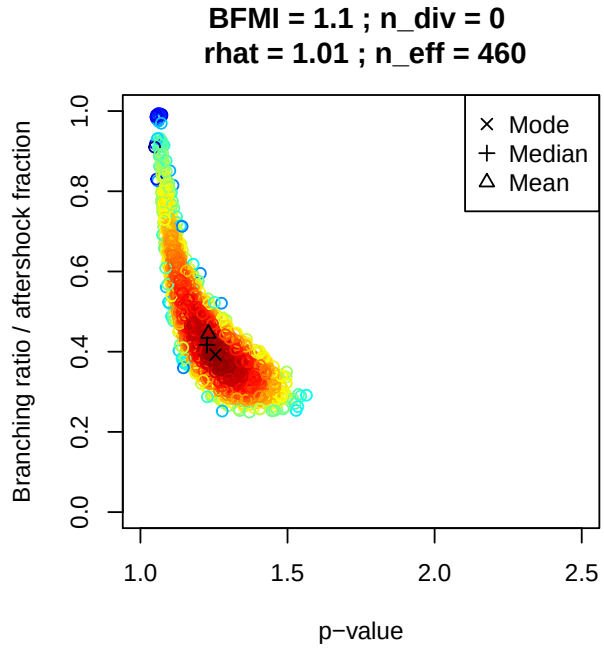

Family 70072358 ; nev = 144
s$mag[ev.use]
s$t0[ev.use]
2015
2016
2017
−0.5
0.0
0.5
1.0
1.5

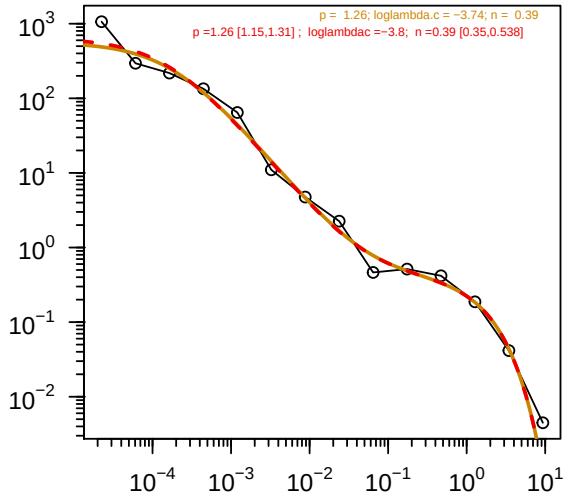

BFMI = 0.98 ; n_div = 0
rhat = 1 ; n_eff = 899
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5

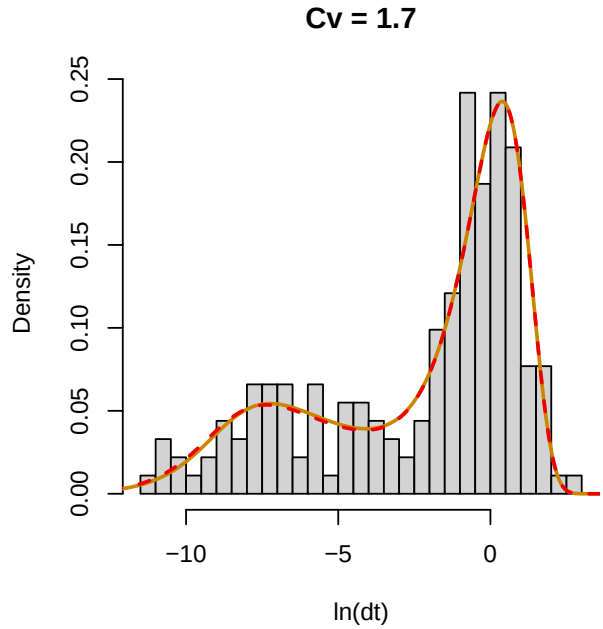

p = 1.456; loglambda.c = −3.539; n = 0.949
p =1.37 [1.33,1.41] ; loglambdac =−3.8; n =0.95 [0.94,0.982]

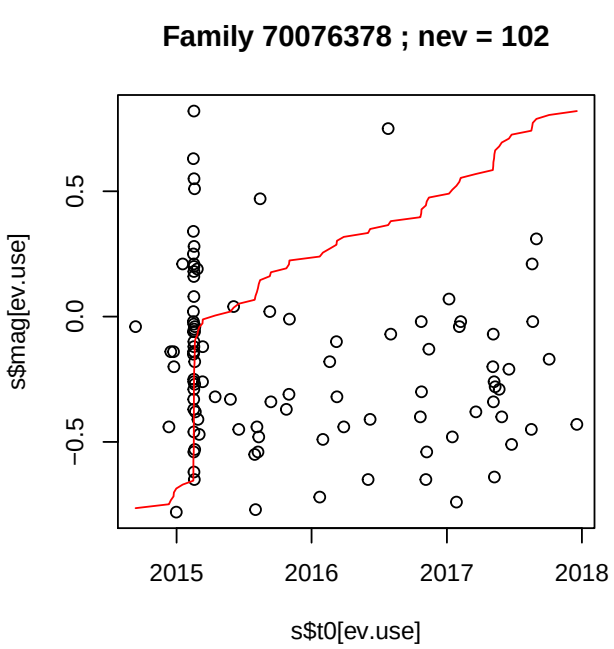

Cv = 5.5
Density
ln(dt)
0.00
0.05
0.10
0.15
0.20
−10
−5
0

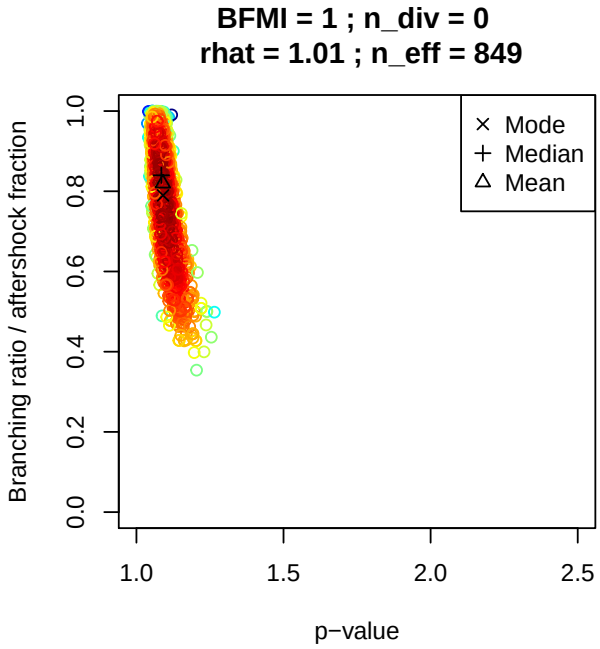

Family 70074968 ; nev = 183
s$mag[ev.use]
s$t0[ev.use]
2015
2016
2017
2018
−1.0
−0.5
0.0
0.5
1.0

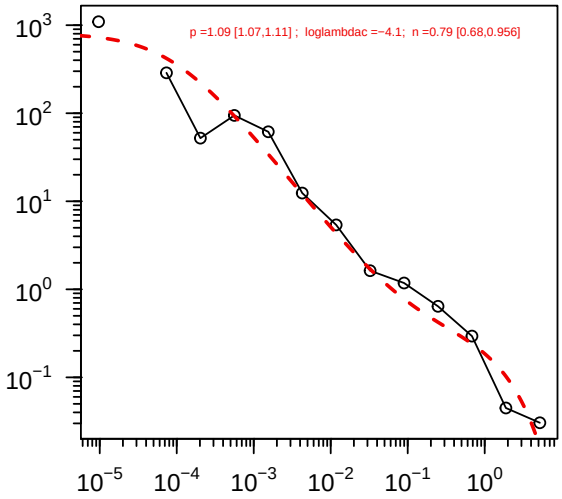

BFMI = 1.1 ; n_div = 0
rhat = 1.01 ; n_eff = 460
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5

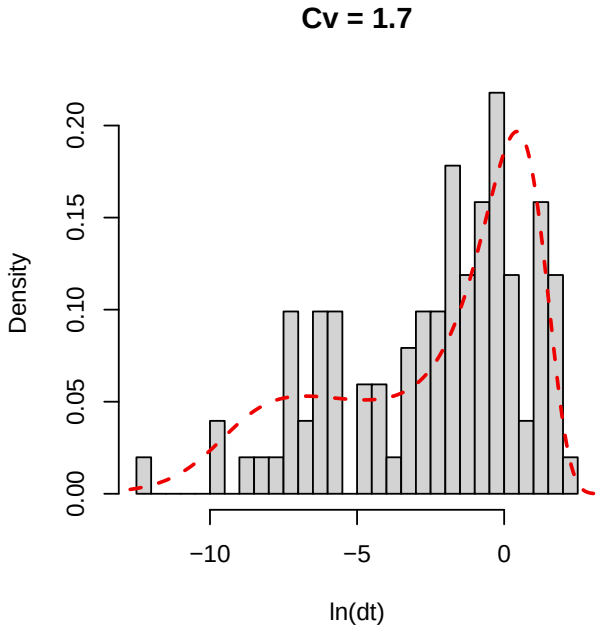

p = 1.26; loglambda.c = −3.74; n = 0.39
p =1.26 [1.15,1.31] ; loglambdac =−3.8; n =0.39 [0.35,0.538]
$10^{3}$
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

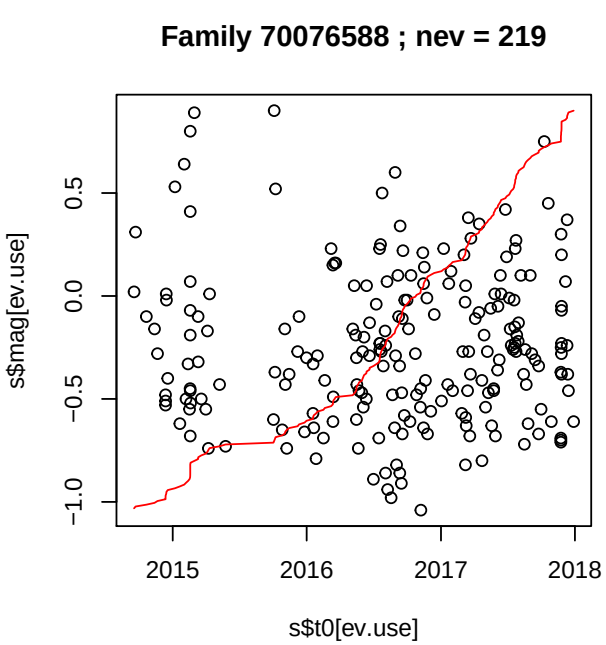

Cv = 1.7
Density
ln(dt)
0.00
0.05
0.10
0.15
0.20
0.25
−10
−5
0

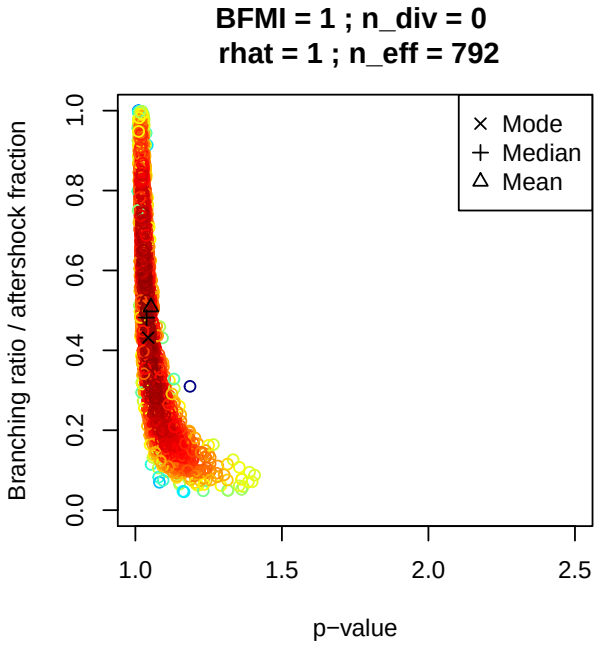

Family 70076378 ; nev = 102
s$mag[ev.use]
0.5
0.0
−0.5
2015
2016
2017
2018
s$t0[ev.use]

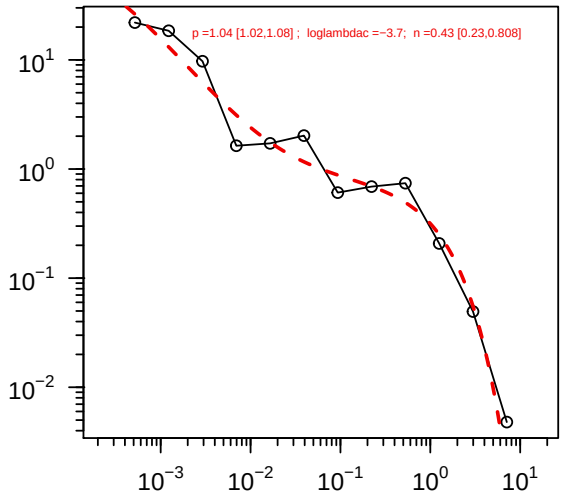

BFMI = 1 ; n_div = 0
rhat = 1.01 ; n_eff = 849
Mode
Median
Mean
Branching ratio / aftershock fraction
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5
p−value

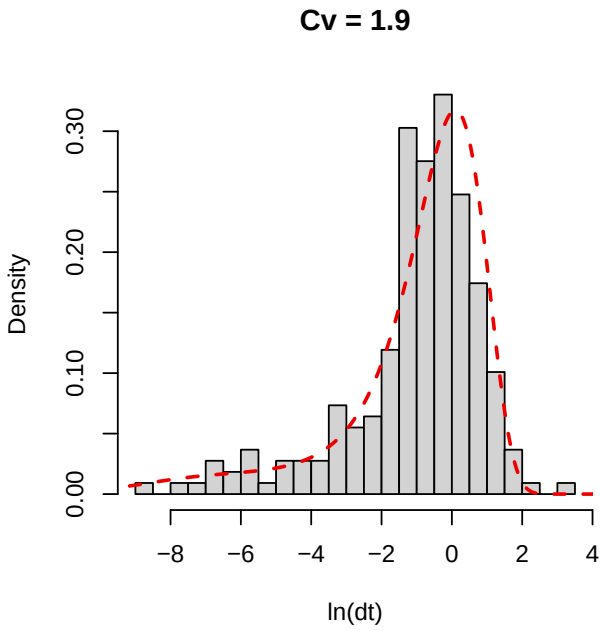

p =1.09 [1.07,1.11] ; loglambdac =−4.1; n =0.79 [0.68,0.956]
$10^3$
$10^2$
$10^1$
$10^0$
$10^{-1}$
$10^{-5}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^0$

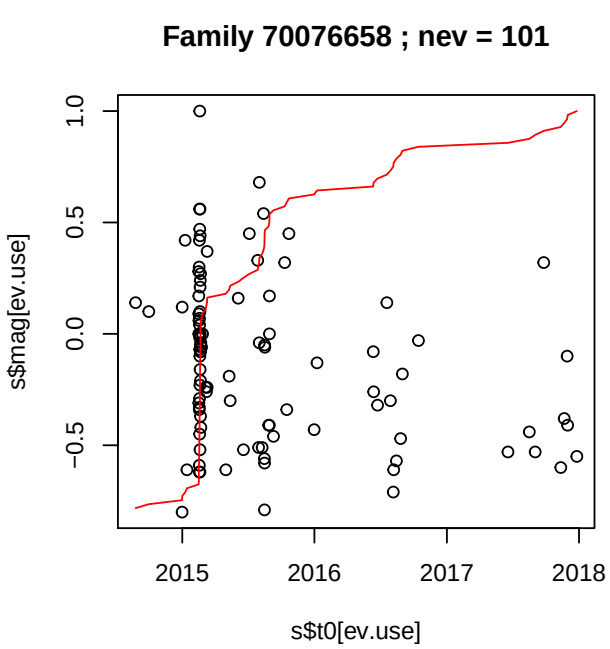

Cv = 1.7
Density
0.00
0.05
0.10
0.15
0.20
−10
−5
0
ln(dt)

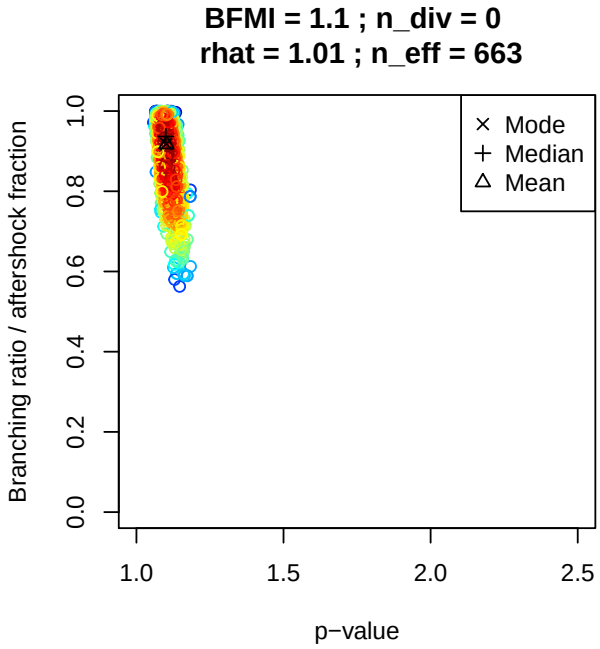

Family 70076588 ; nev = 219
s$mag[ev.use]
s$t0[ev.use]
2015
2016
2017
2018
−1.0
−0.5
0.0
0.5

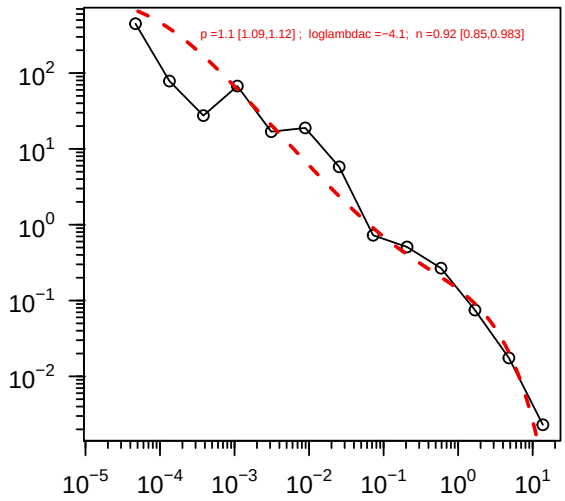

BFMI = 1 ; n_div = 0
rhat = 1 ; n_eff = 792
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
1.0
1.5
2.0
2.5
0.0
0.2
0.4
0.6
0.8
1.0

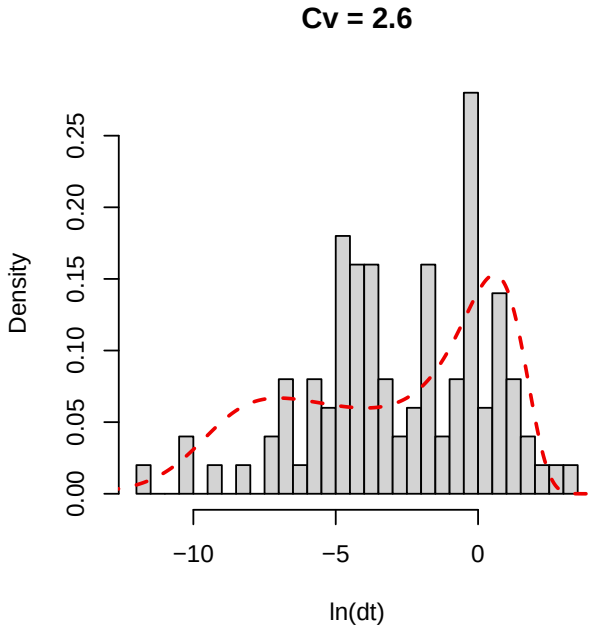

p =1.04 [1.02,1.08] ; loglambdac =−3.7; n =0.43 [0.23,0.808]
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

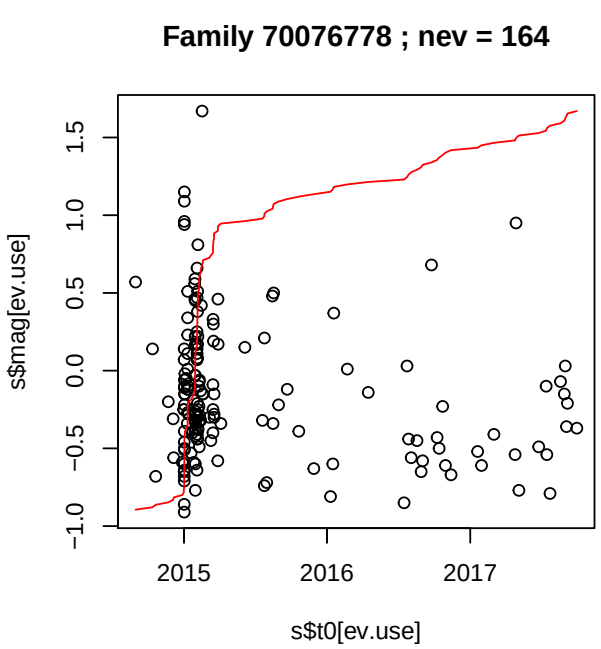

Cv = 1.9
Density
ln(dt)
0.00
0.10
0.20
0.30
−8
−6
−4
−2
0
2
4

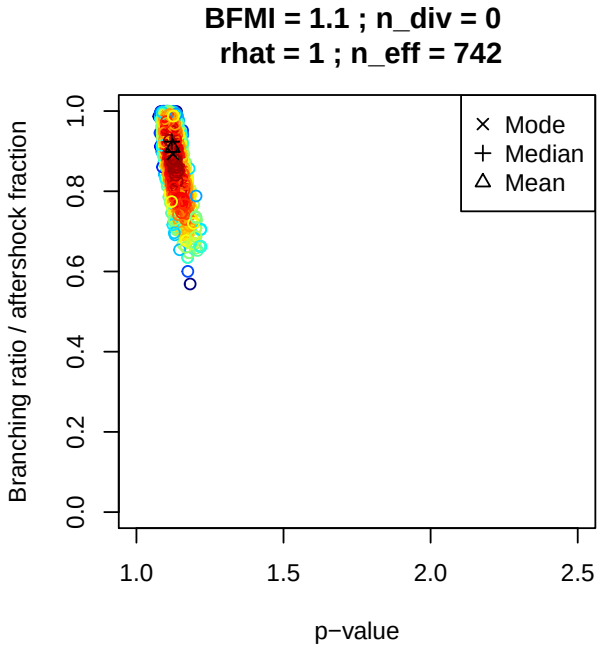

Family 70076658 ; nev = 101
s$mag[ev.use]
s$t0[ev.use]
1.0
0.5
0.0
−0.5
2015
2016
2017
2018

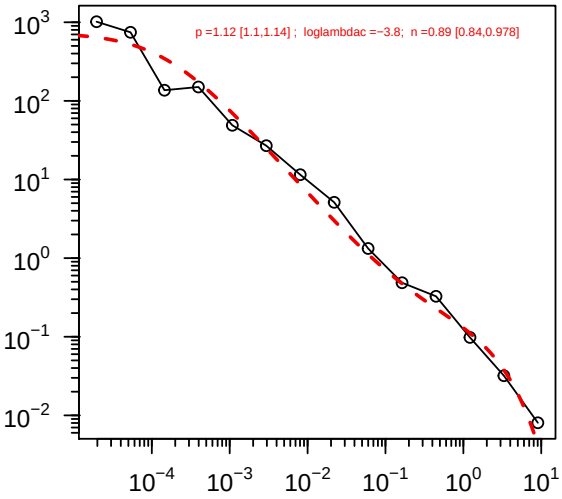

BFMI = 1.1 ; n_div = 0
rhat = 1.01 ; n_eff = 663
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5

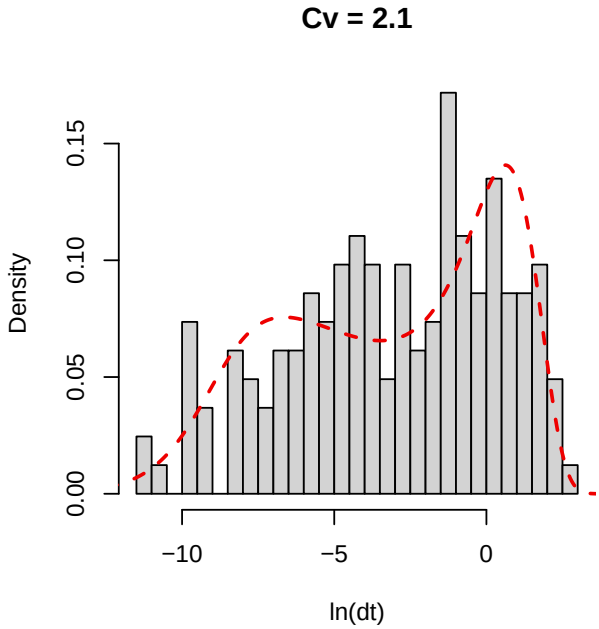

p =1.1 [1.09,1.12] ; loglambdac =−4.1; n =0.92 [0.85,0.983]
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-5}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

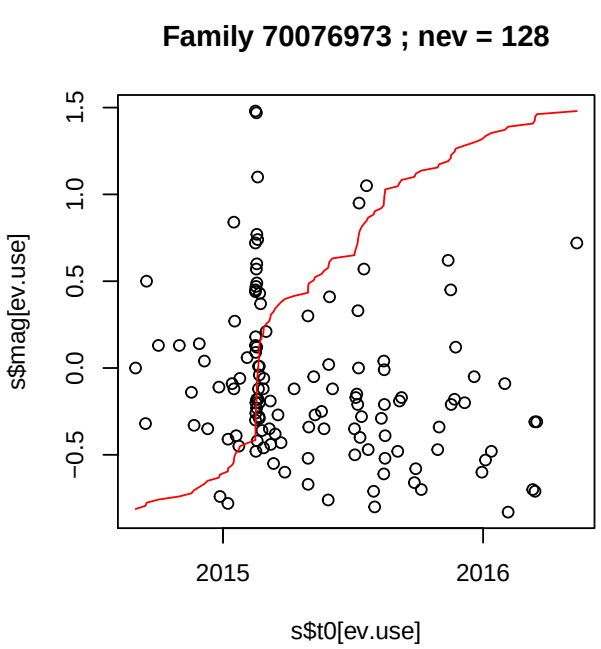

Cv = 2.6
Density
ln(dt)
0.00
0.05
0.10
0.15
0.20
0.25
−10
−5
0

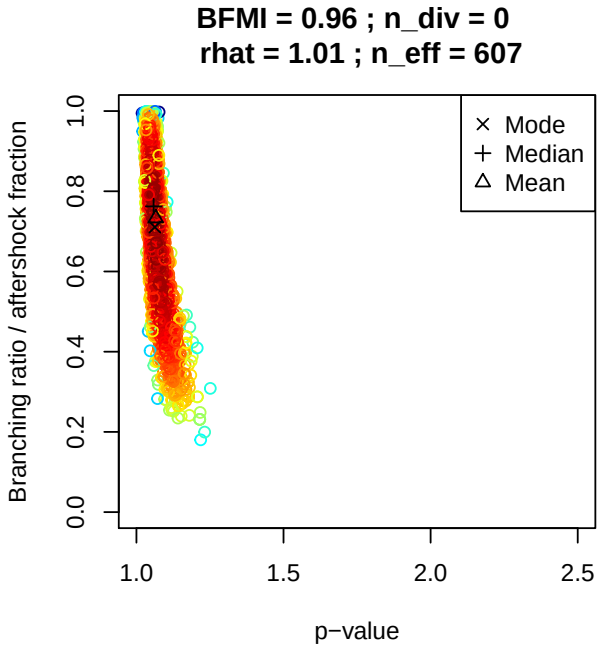

Family 70076778 ; nev = 164
s$mag[ev.use]
s$t0[ev.use]
2015
2016
2017

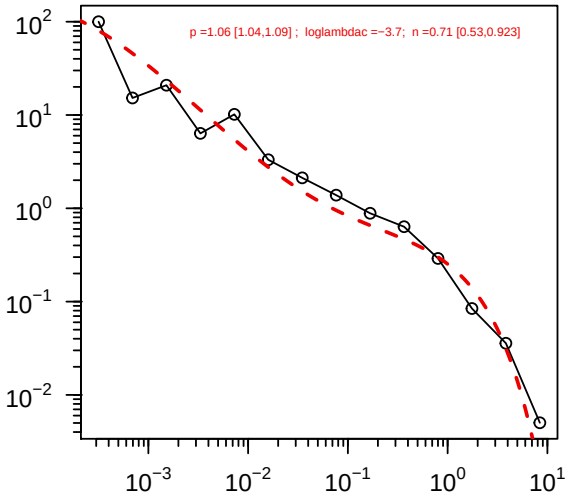

BFMI = 1.1 ; n_div = 0
rhat = 1 ; n_eff = 742
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value

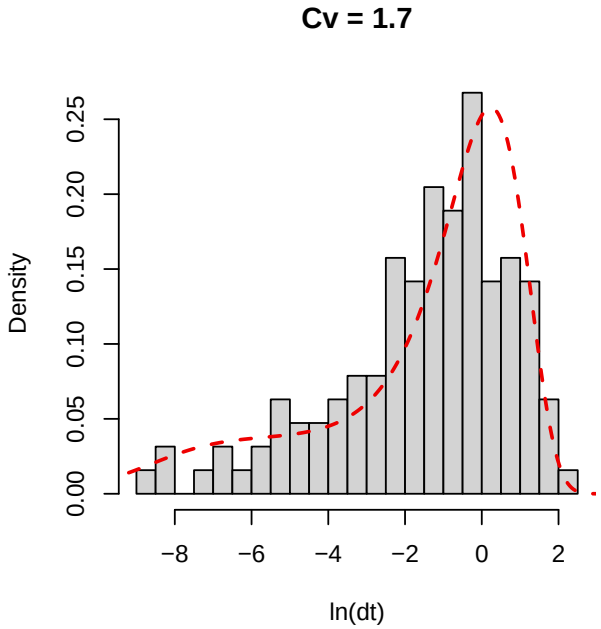

p =1.12 [1.1,1.14] ; loglambdac =−3.8; n =0.89 [0.84,0.978]

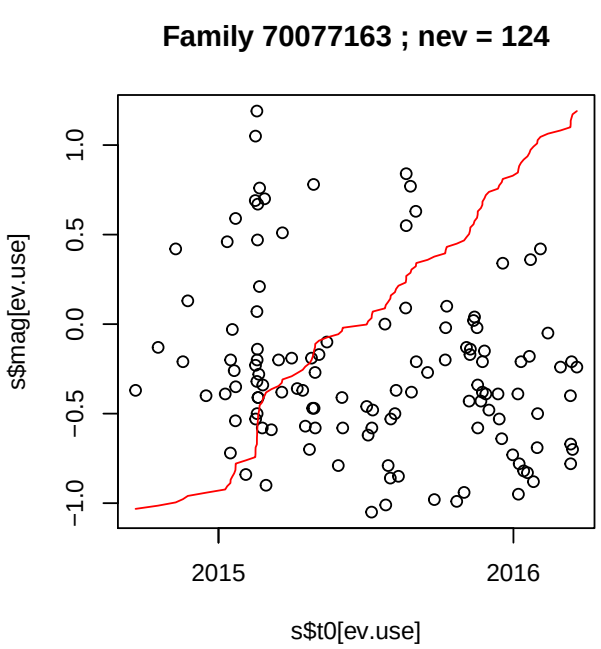

Cv = 2.1
Density
ln(dt)

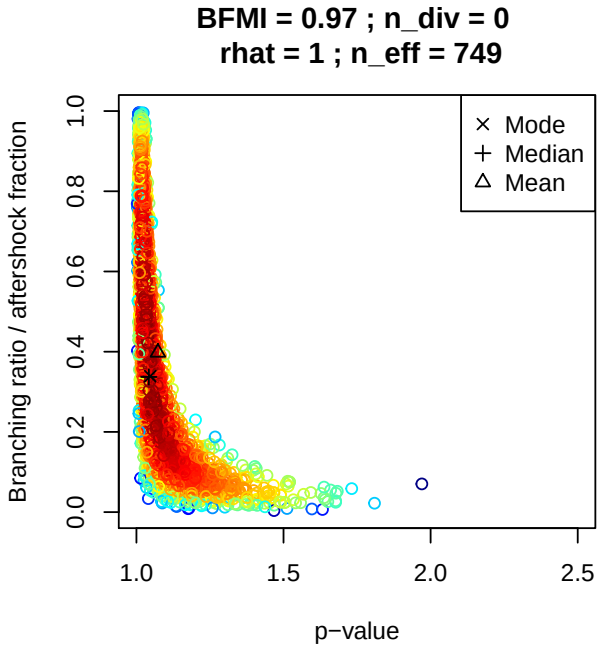

Family 70076973 ; nev = 128
s$mag[ev.use]
s$t0[ev.use]
2015
2016

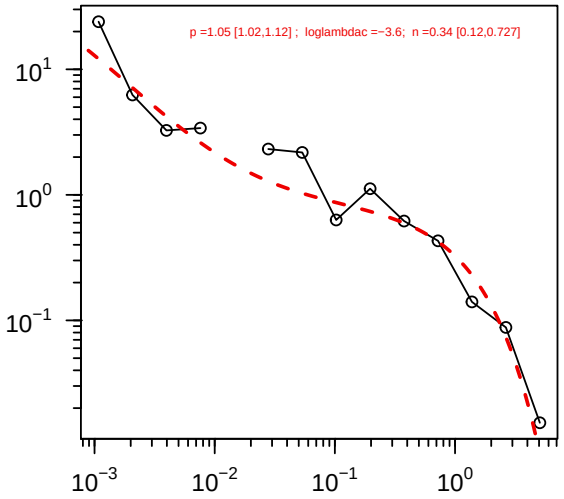

BFMI = 0.96 ; n_div = 0
rhat = 1.01 ; n_eff = 607
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value

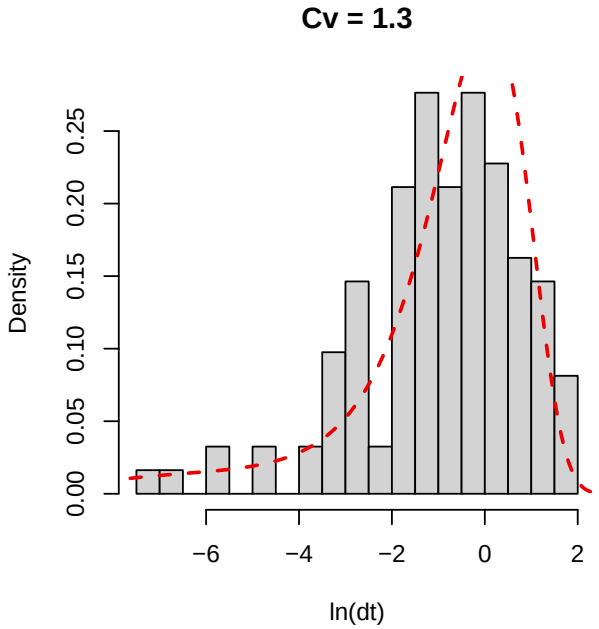

p =1.06 [1.04,1.09] ; loglambdac =−3.7; n =0.71 [0.53,0.923]

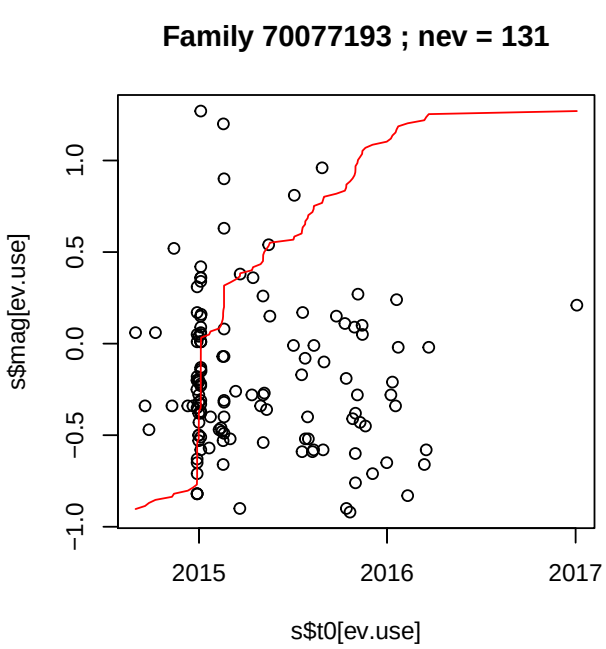

Cv = 1.7
Density
ln(dt)

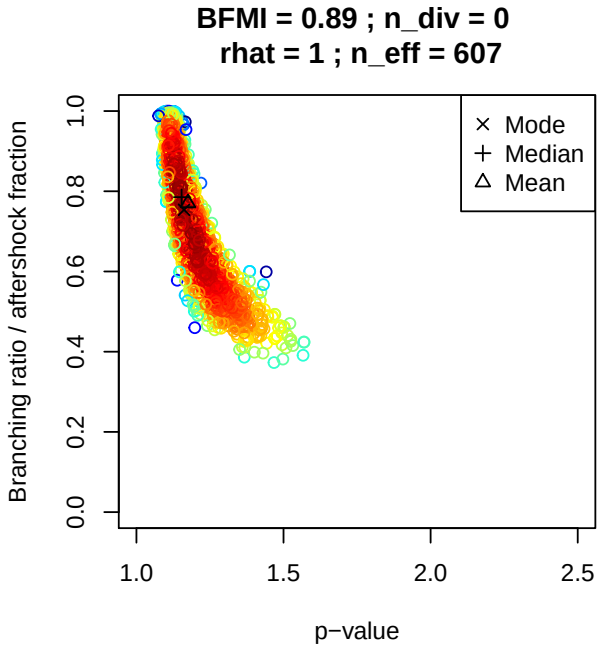

Family 70077163 ; nev = 124
s$mag[ev.use]
1.0
0.5
0.0
−0.5
−1.0
2015
2016
s$t0[ev.use]

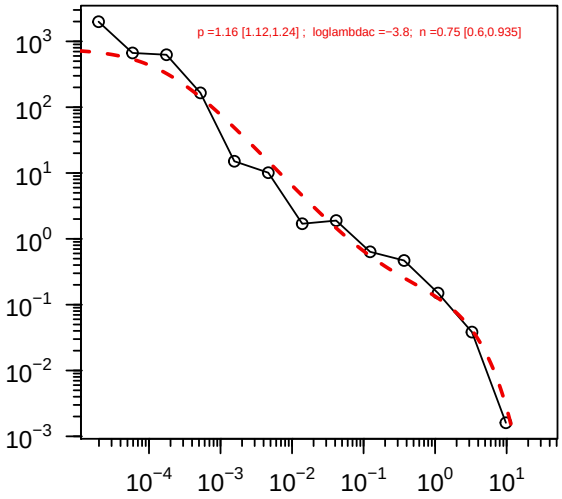

BFMI = 0.97 ; n_div = 0
rhat = 1 ; n_eff = 749
Mode
Median
Mean
Branching ratio / aftershock fraction
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5
p−value

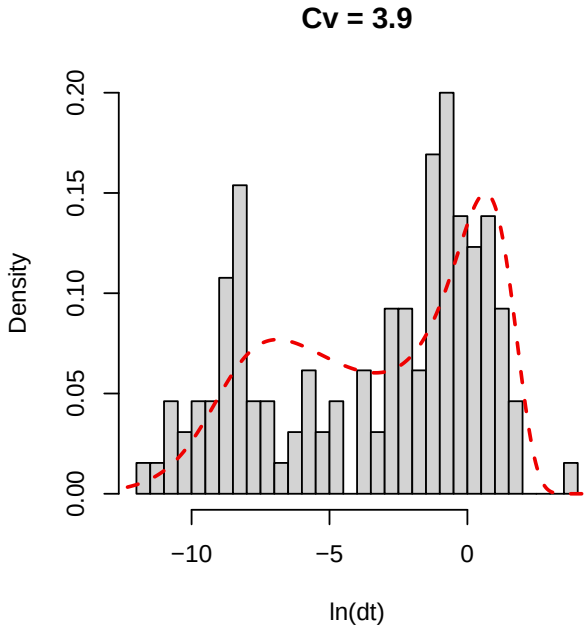

p =1.05 [1.02,1.12] ; loglambdac =−3.6; n =0.34 [0.12,0.727]
$10^1$
$10^0$
$10^{-1}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^0$

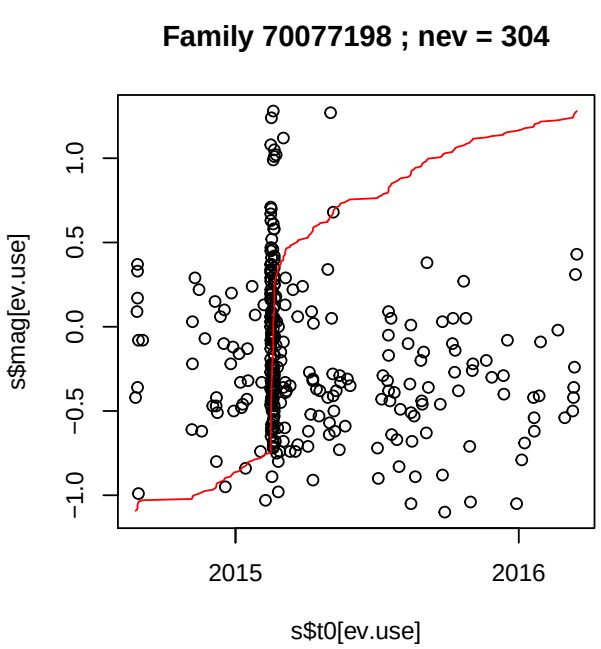

Cv = 1.3
Density
0.00
0.05
0.10
0.15
0.20
0.25
−6
−4
−2
0
2
ln(dt)

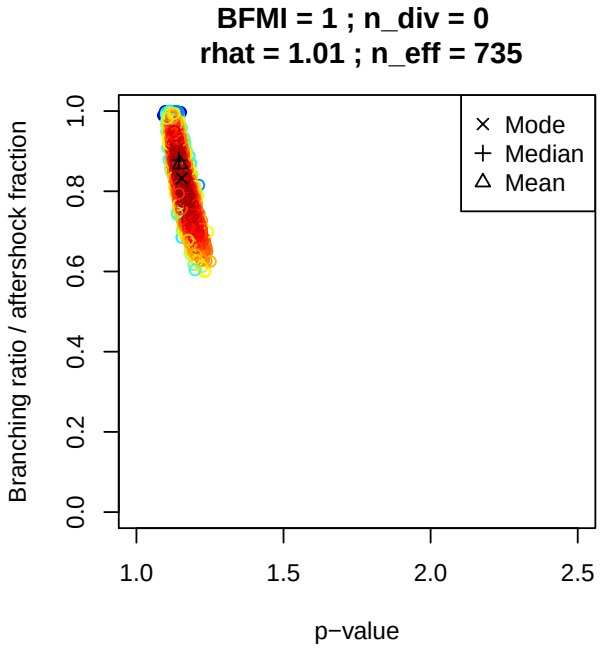

Family 70077193 ; nev = 131
s$mag[ev.use]
s$t0[ev.use]
2015
2016
2017
−1.0
−0.5
0.0
0.5
1.0

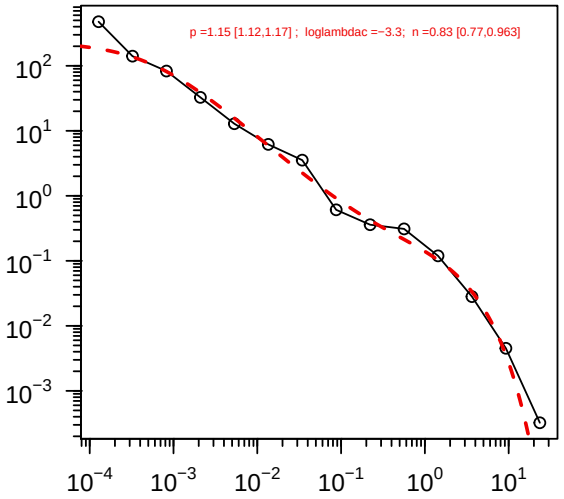

BFMI = 0.89 ; n_div = 0
rhat = 1 ; n_eff = 607
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
1.0
1.5
2.0
2.5
0.0
0.2
0.4
0.6
0.8
1.0

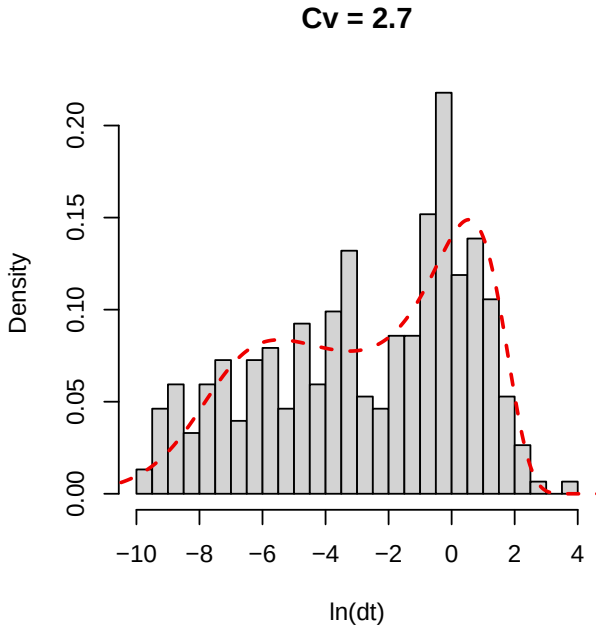

p =1.16 [1.12,1.24] ; loglambdac =−3.8; n =0.75 [0.6,0.935]

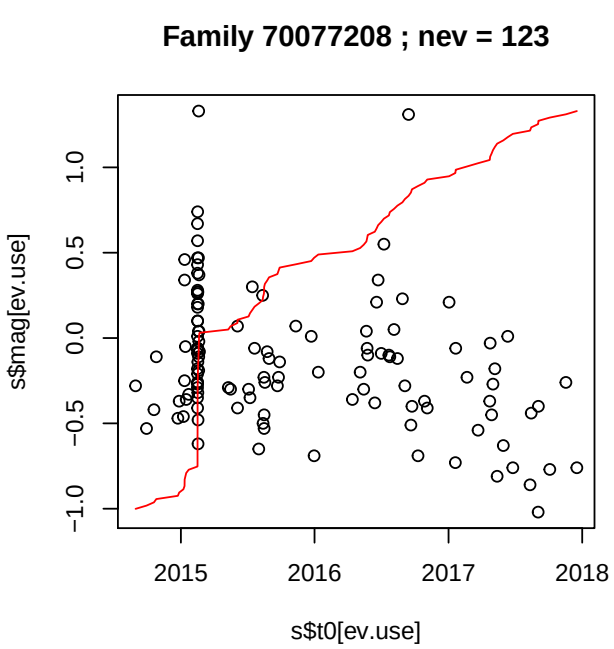

Cv = 3.9
Density
ln(dt)
−10
−5
0
0.00
0.05
0.10
0.15
0.20

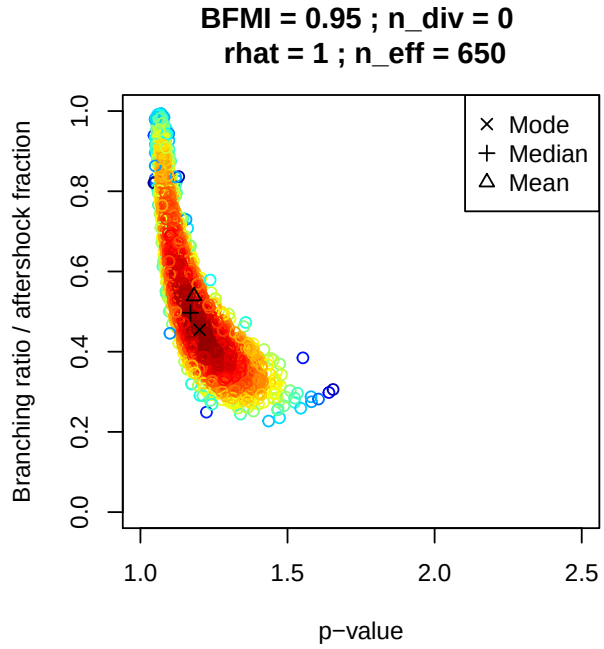

Family 70077198 ; nev = 304
s$mag[ev.use]
−1.0
−0.5
0.0
0.5
1.0
2015
2016
s$t0[ev.use]

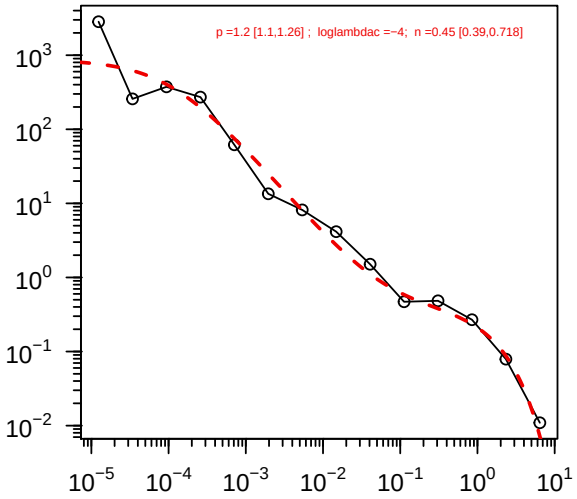

BFMI = 1 ; n_div = 0
rhat = 1.01 ; n_eff = 735
Mode
Median
Mean
Branching ratio / aftershock fraction
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5
p−value

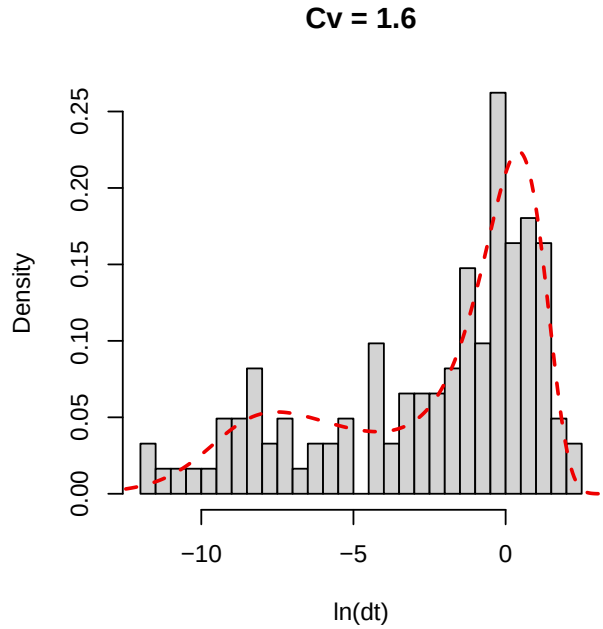

p =1.15 [1.12,1.17] ; loglambdac =−3.3; n =0.83 [0.77,0.963]
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-3}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

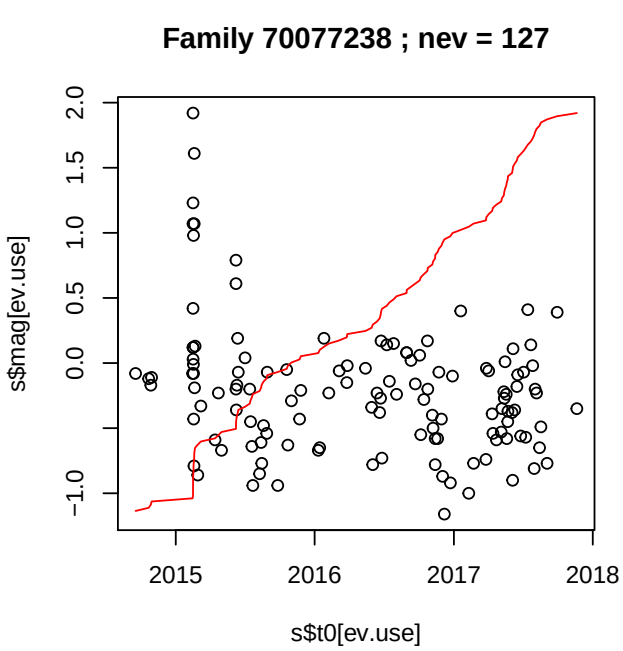

Cv = 2.7
Density
0.00
0.05
0.10
0.15
0.20
−10
−8
−6
−4
−2
0
2
4
ln(dt)

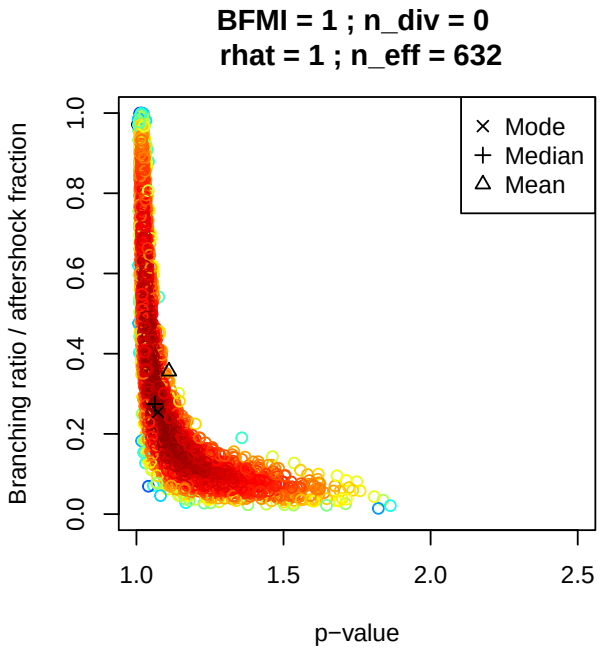

Family 70077208 ; nev = 123
s$mag[ev.use]
s$t0[ev.use]
2015
2016
2017
2018
−1.0
−0.5
0.0
0.5
1.0

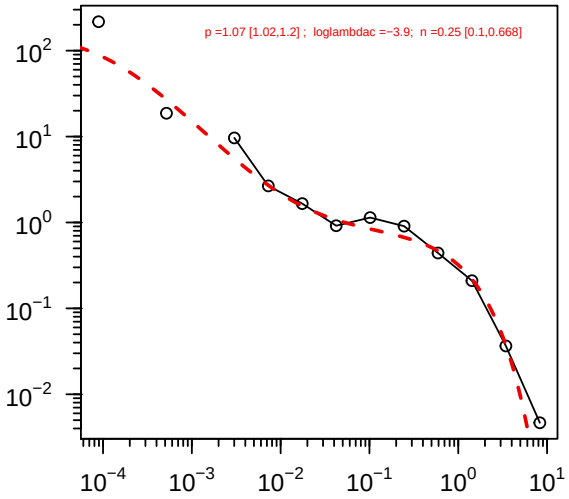

BFMI = 0.95 ; n_div = 0
rhat = 1 ; n_eff = 650
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5

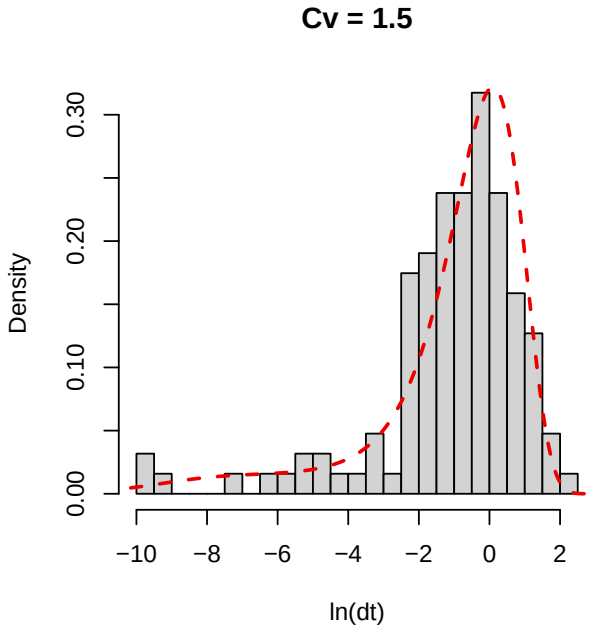

p =1.2 [1.1,1.26] ; loglambdac =−4; n =0.45 [0.39,0.718]
$10^{3}$
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-5}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

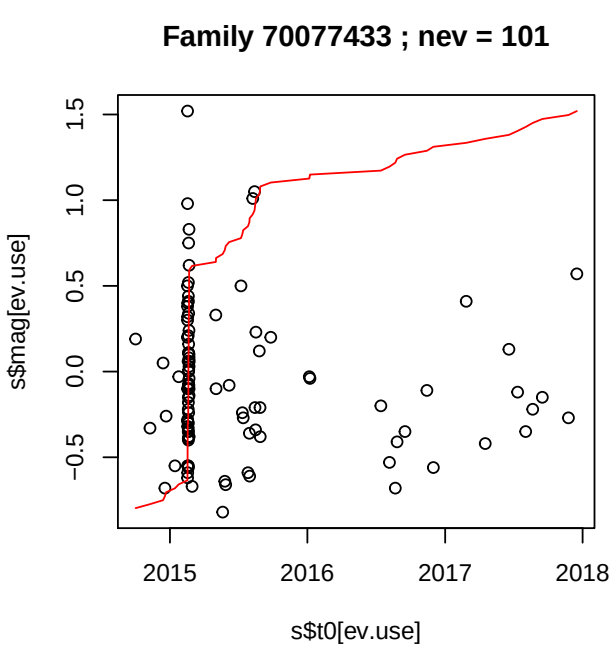

Cv = 1.6
Density
ln(dt)
0.00
0.05
0.10
0.15
0.20
0.25
−10
−5
0

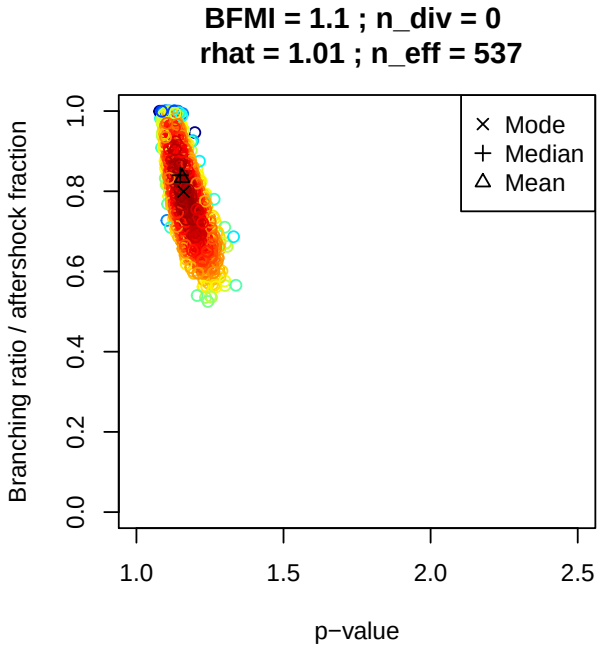

Family 70077238 ; nev = 127
s$mag[ev.use]
s$t0[ev.use]
2015
2016
2017
2018
−1.0
0.0
0.5
1.0
1.5
2.0

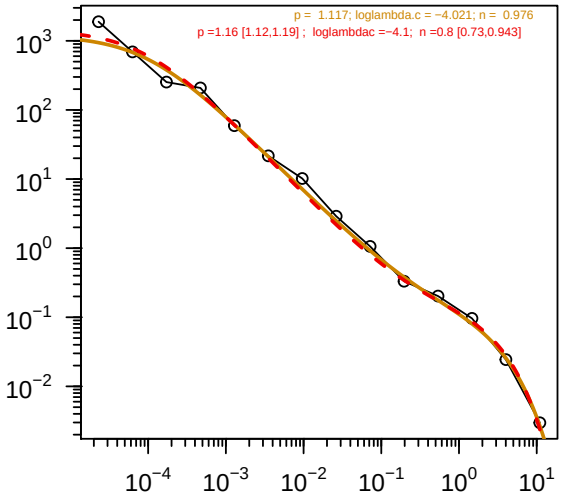

BFMI = 1 ; n_div = 0
rhat = 1 ; n_eff = 632
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5

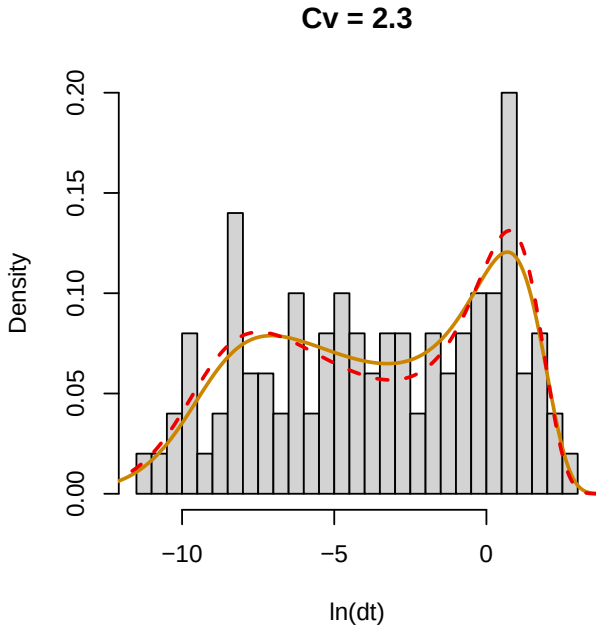

p =1.07 [1.02,1.2] ; loglambdac =−3.9; n =0.25 [0.1,0.668]
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

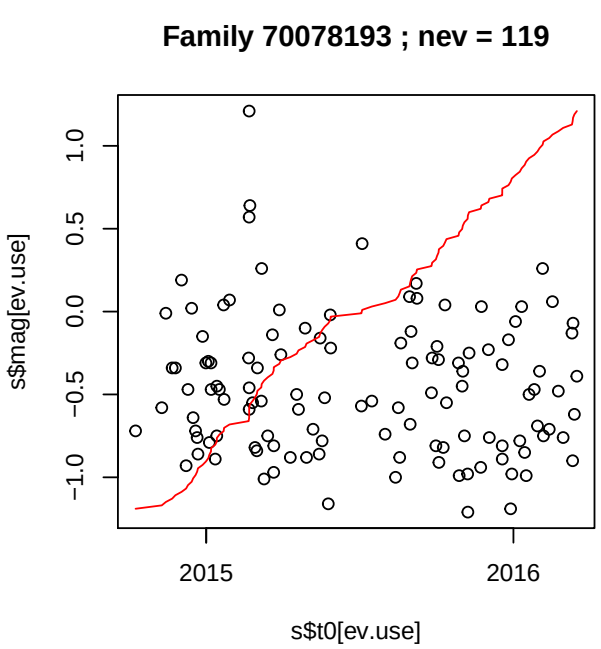

Cv = 1.5
Density
ln(dt)
0.00
0.10
0.20
0.30
−10
−8
−6
−4
−2
0
2

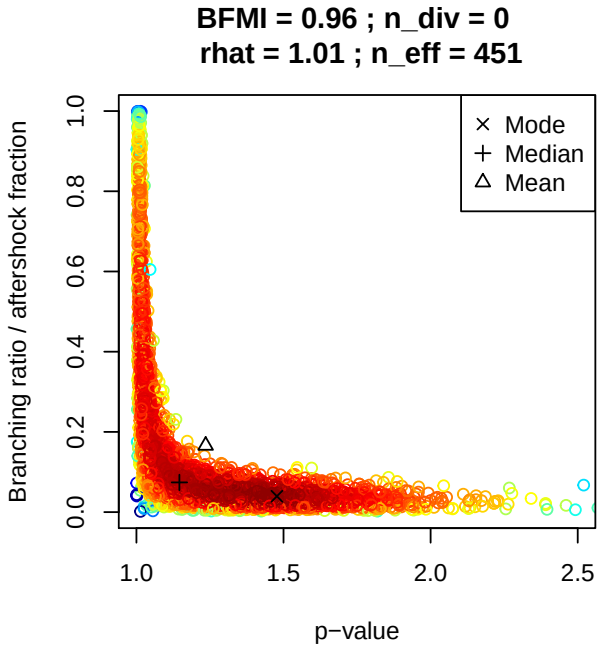

Family 70077433 ; nev = 101
s$mag[ev.use]
s$t0[ev.use]
2015
2016
2017
2018
−0.5
0.0
0.5
1.0
1.5

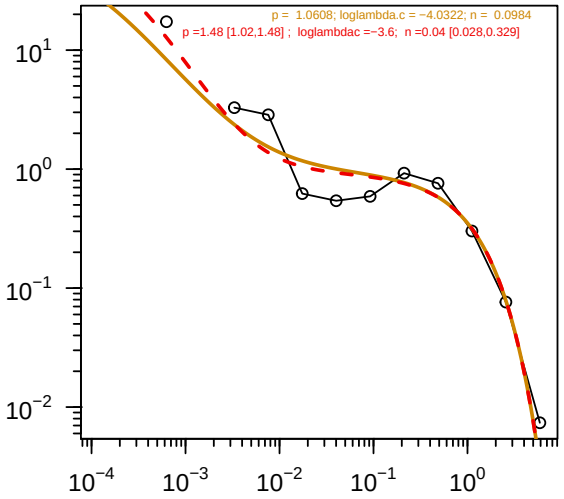

BFMI = 1.1 ; n_div = 0
rhat = 1.01 ; n_eff = 537
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5

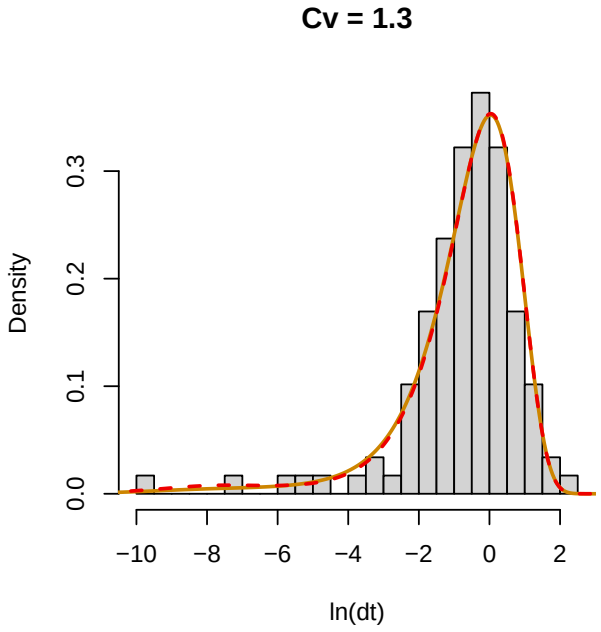

p = 1.117; loglambda.c = −4.021; n = 0.976
p =1.16 [1.12,1.19] ; loglambdac =−4.1; n =0.8 [0.73,0.943]
$10^{3}$
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

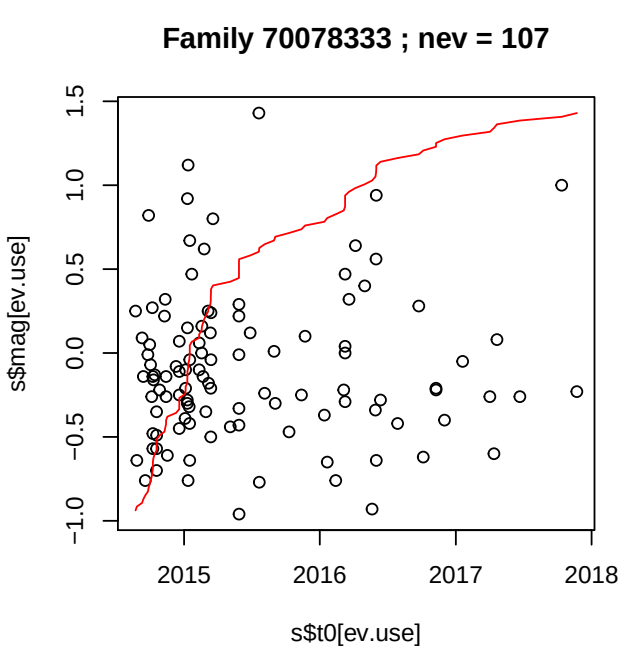

Cv = 2.3
Density
ln(dt)
0.00
0.05
0.10
0.15
0.20
−10
−5
0

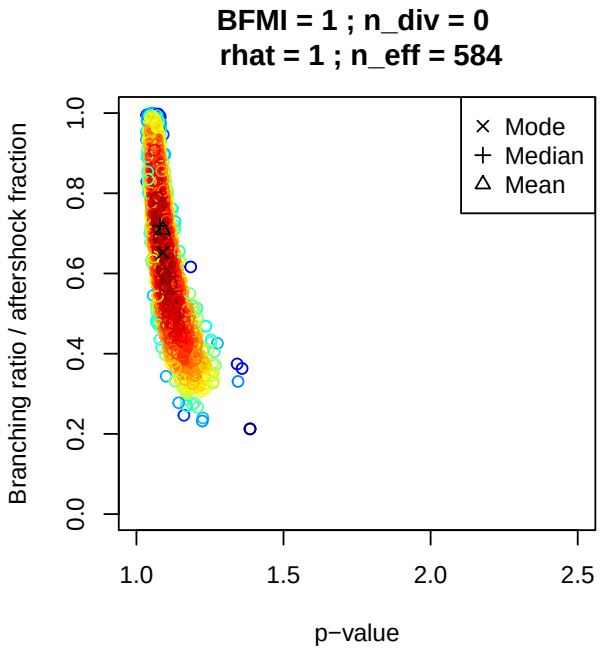

Family 70078193 ; nev = 119
s$mag[ev.use]
1.0
0.5
0.0
−0.5
−1.0
2015
2016
s$t0[ev.use]

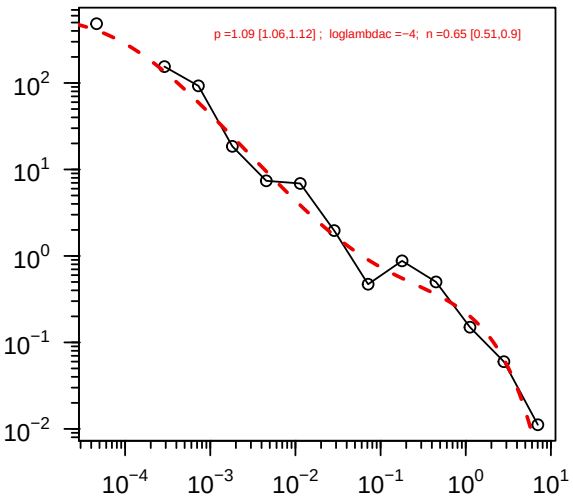

BFMI = 0.96 ; n_div = 0
rhat = 1.01 ; n_eff = 451
Mode
Median
Mean
Branching ratio / aftershock fraction
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5
p−value

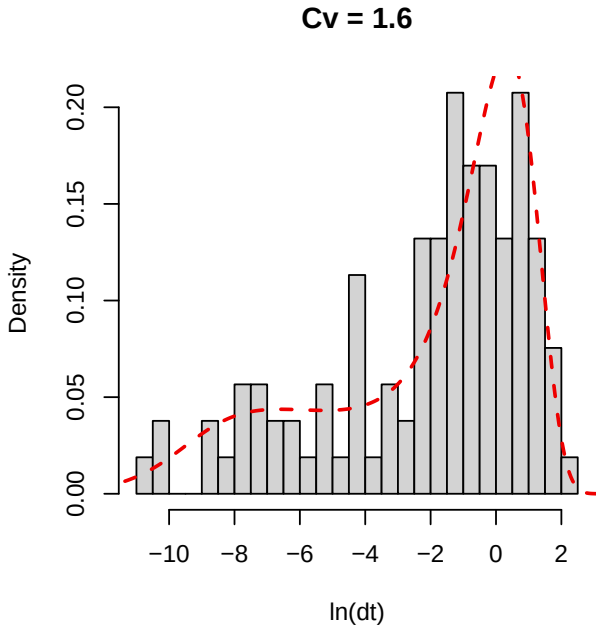

p = 1.0608; loglambda.c = −4.0322; n = 0.0984
p =1.48 [1.02,1.48] ; loglambdac =−3.6; n =0.04 [0.028,0.329]
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$

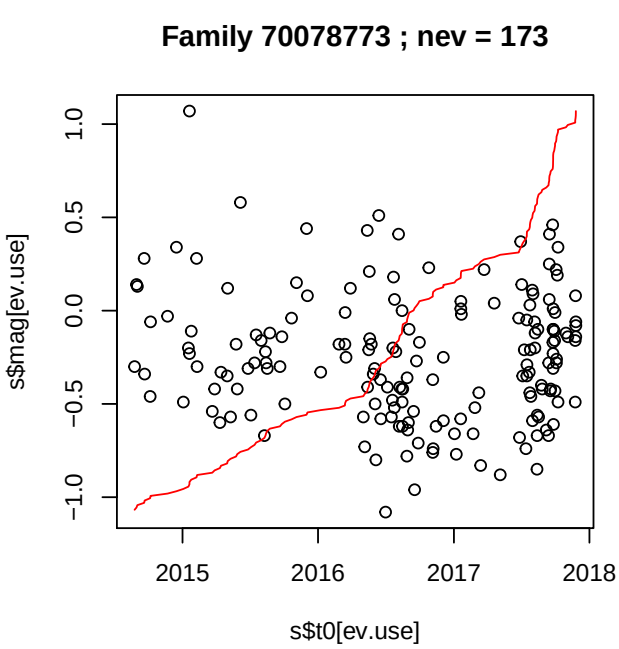

Cv = 1.3
Density
0.0
0.1
0.2
0.3
−10
−8
−6
−4
−2
0
2
ln(dt)

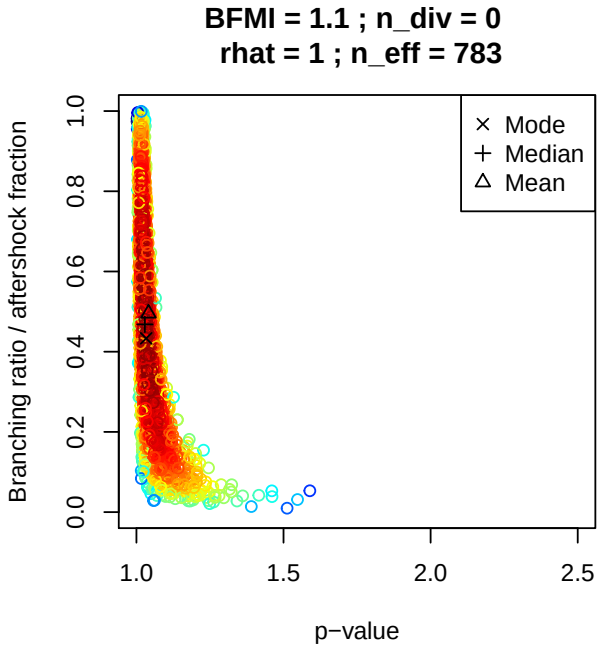

Family 70078333 ; nev = 107
s$mag[ev.use]
s$t0[ev.use]
2015
2016
2017
2018

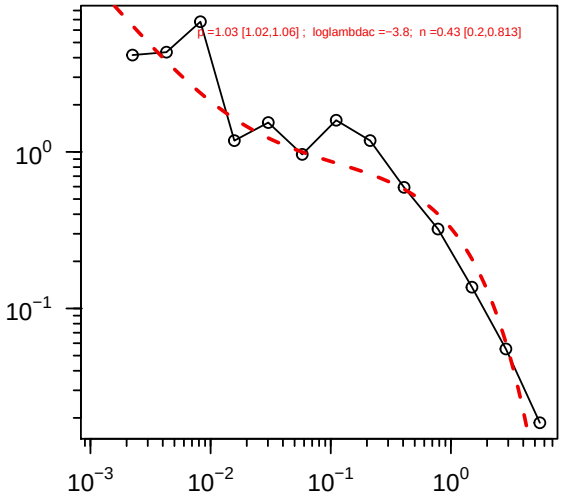

BFMI = 1 ; n_div = 0
rhat = 1 ; n_eff = 584
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value

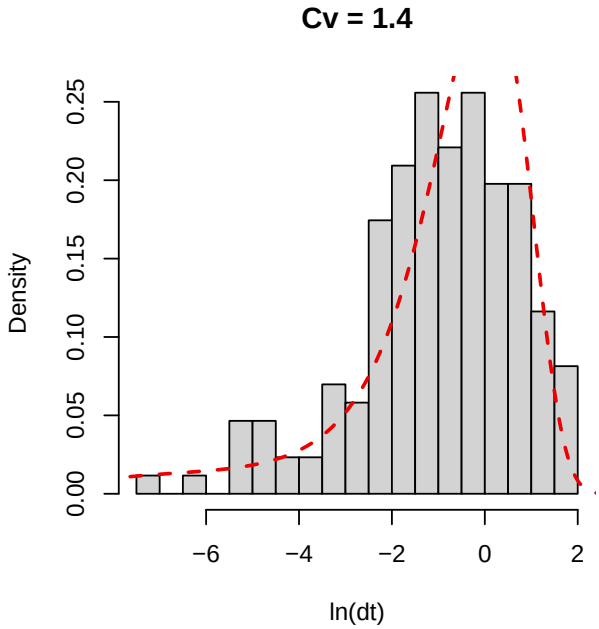

p =1.09 [1.06,1.12] ; loglambdac =−4; n =0.65 [0.51,0.9]

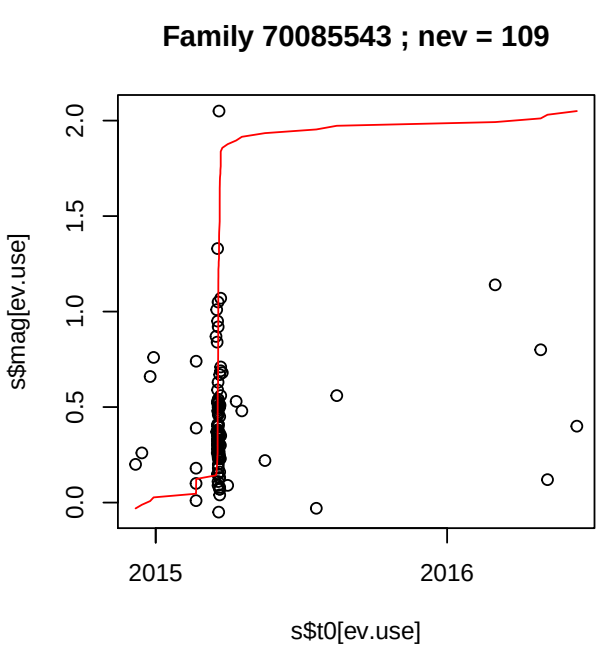

Cv = 1.6
Density
ln(dt)

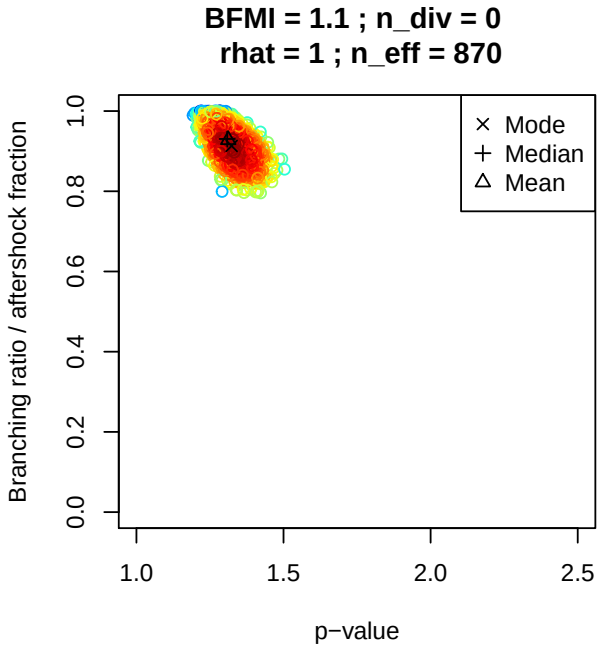

Family 70078773 ; nev = 173
s$mag[ev.use]
s$t0[ev.use]
1.0
0.5
0.0
−0.5
−1.0
2015
2016
2017
2018

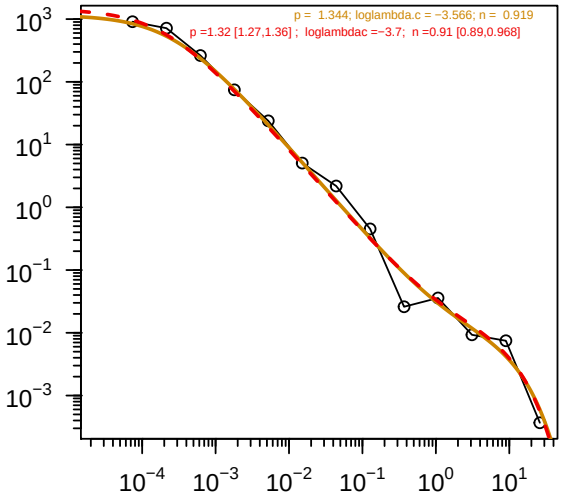

BFMI = 1.1 ; n_div = 0
rhat = 1 ; n_eff = 783
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5

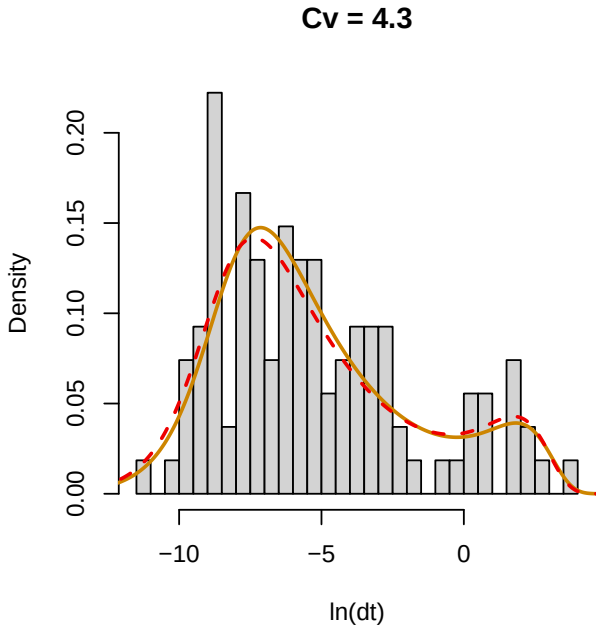

p =1.03 [1.02,1.06] ; loglambdac =−3.8; n =0.43 [0.2,0.813]
$10^0$
$10^{-1}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^0$

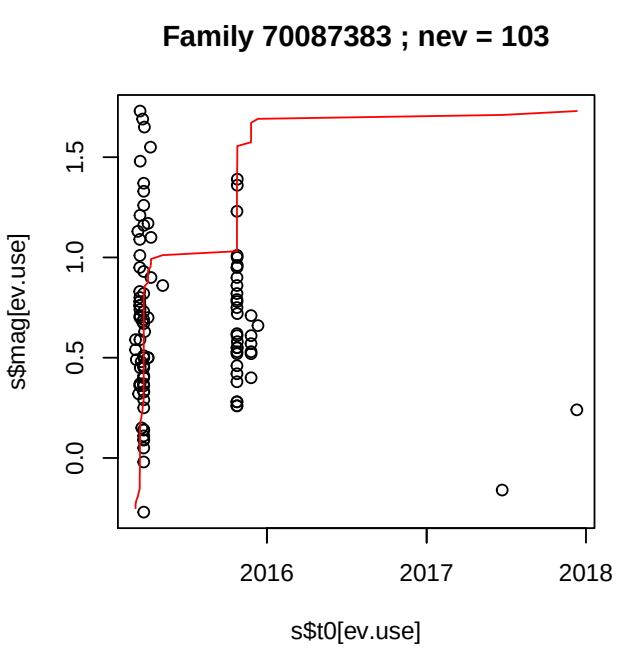

Cv = 1.4
Density
ln(dt)
0.00
0.05
0.10
0.15
0.20
0.25
−6
−4
−2
0
2

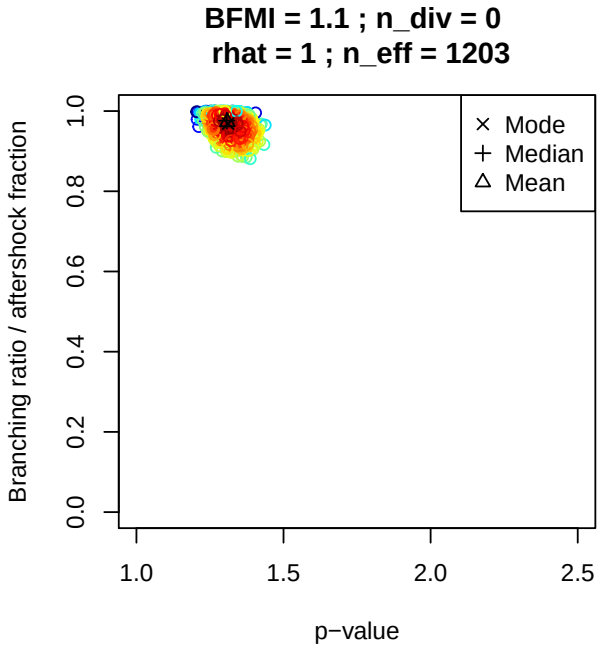

Family 70085543 ; nev = 109
s$mag[ev.use]
0.0
0.5
1.0
1.5
2.0
2015
2016
s$t0[ev.use]

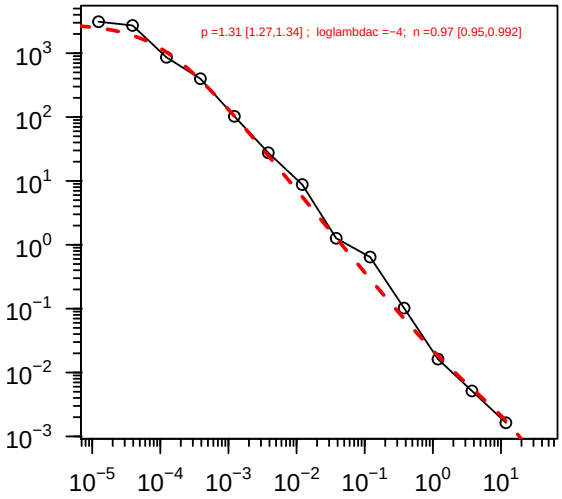

BFMI = 1.1 ; n_div = 0
rhat = 1 ; n_eff = 870
Mode
Median
Mean
Branching ratio / aftershock fraction
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5
p−value

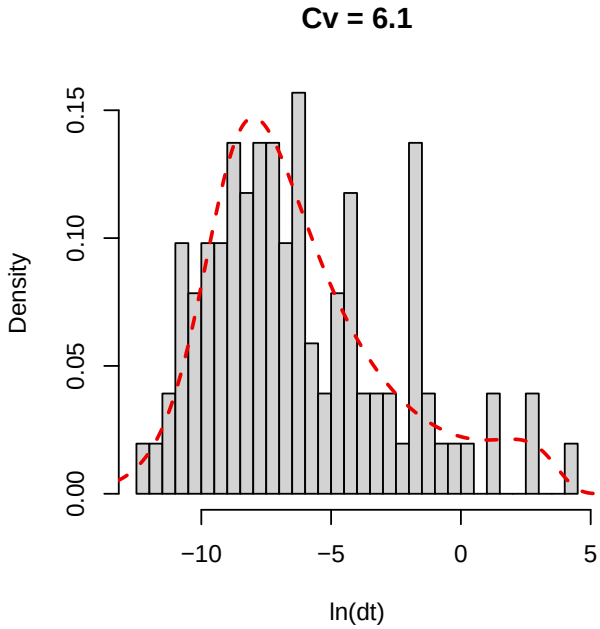

p = 1.344; loglambda.c = −3.566; n = 0.919
p =1.32 [1.27,1.36] ; loglambdac =−3.7; n =0.91 [0.89,0.968]
$10^{3}$
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-3}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

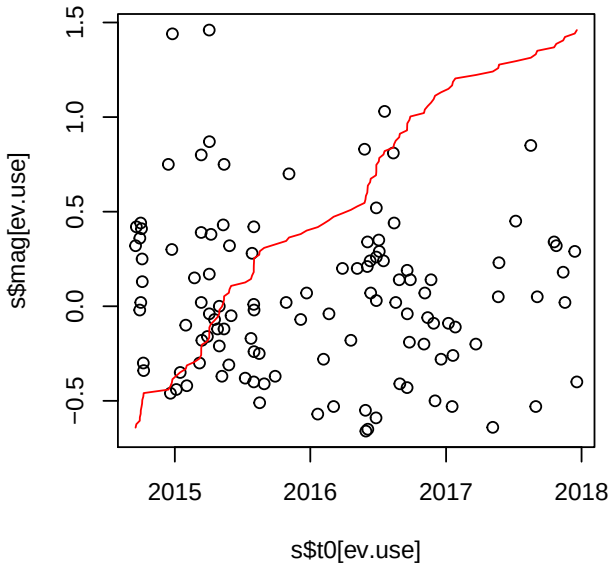

Cv = 4.3
Density
0.00
0.05
0.10
0.15
0.20
−10
−5
0
ln(dt)

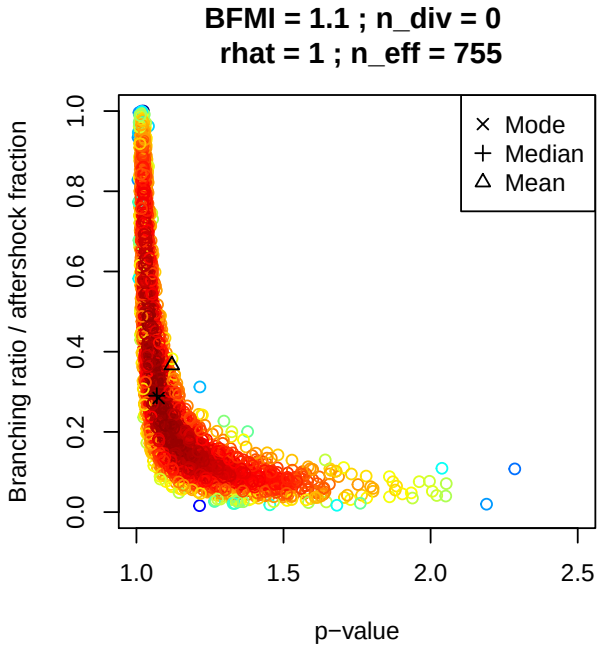

Family 70087383 ; nev = 103
s$mag[ev.use]
0.0
0.5
1.0
1.5
2016
2017
2018
s$t0[ev.use]

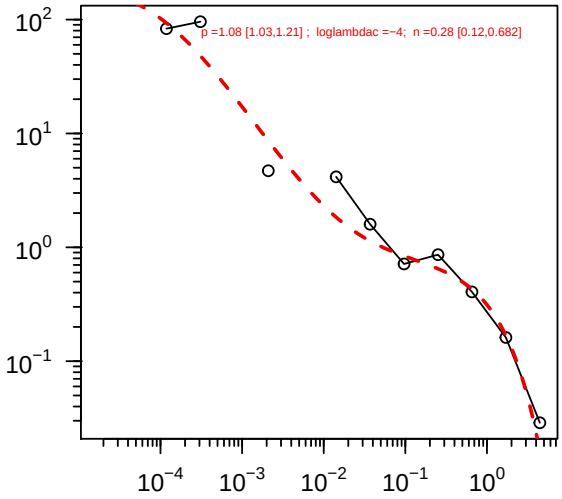

BFMI = 1.1 ; n_div = 0
rhat = 1 ; n_eff = 1203
Mode
Median
Mean
Branching ratio / aftershock fraction
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5
p−value

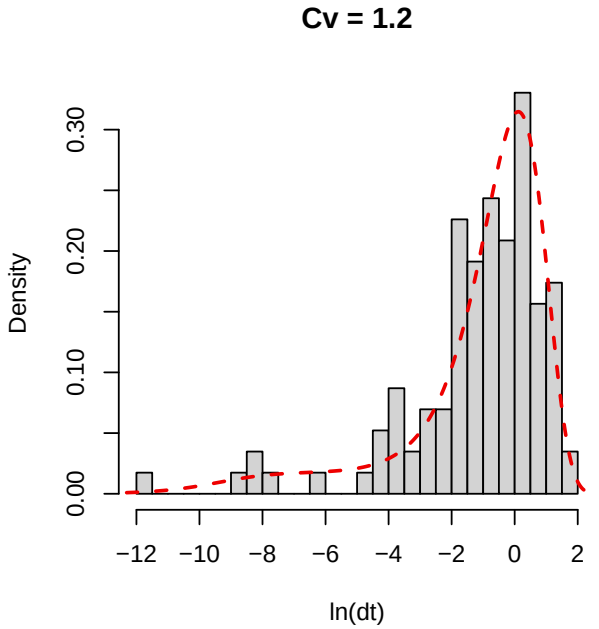

p =1.31 [1.27,1.34] ; loglambdac =−4; n =0.97 [0.95,0.992]
$10^{3}$
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-3}$
$10^{-5}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

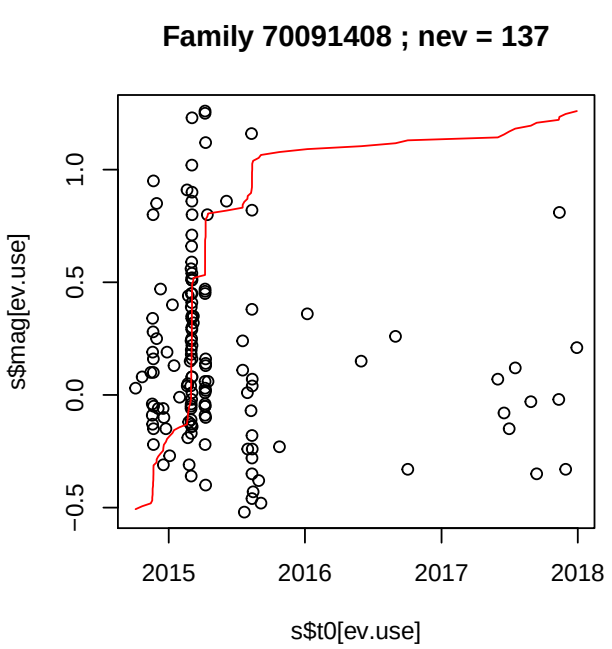

Cv = 6.1
Density
0.00
0.05
0.10
0.15
−10
−5
0
5
ln(dt)

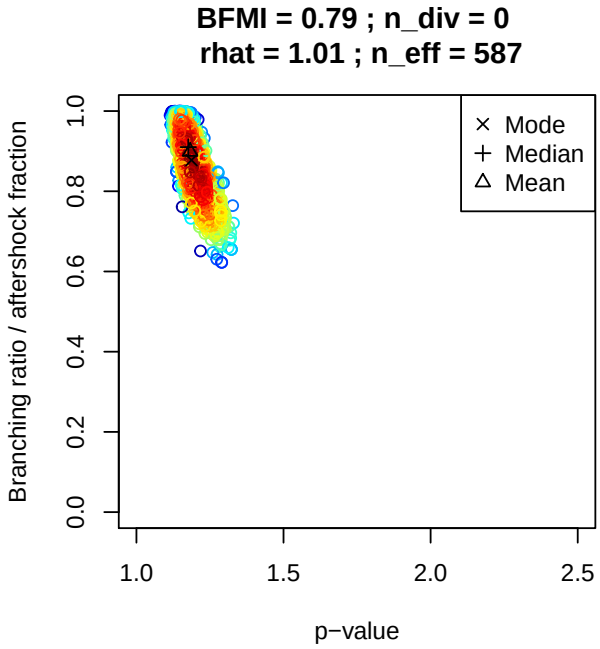

Family 70089778 ; nev = 116
s$mag[ev.use]
s$t0[ev.use]
2015
2016
2017
2018
−0.5
0.0
0.5
1.0
1.5

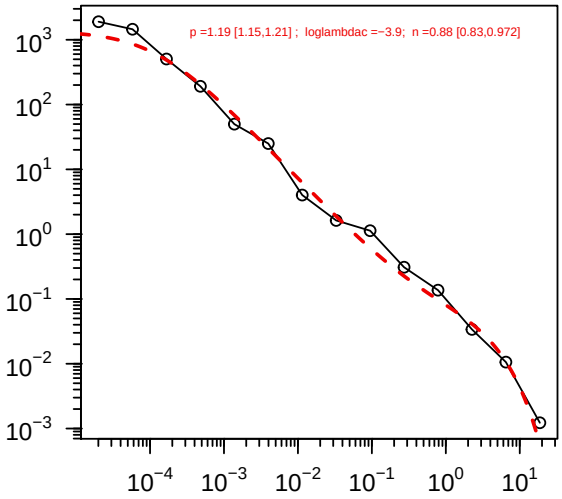

BFMI = 1.1 ; n_div = 0
rhat = 1 ; n_eff = 755
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5

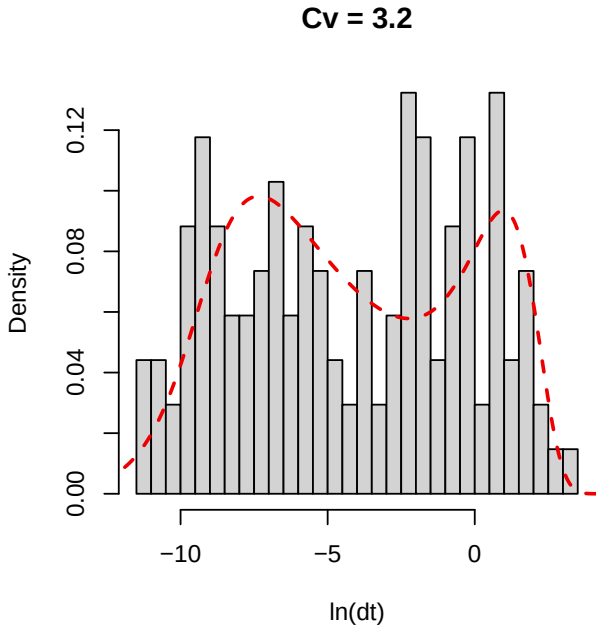

p =1.08 [1.03,1.21] ; loglambdac =−4; n =0.28 [0.12,0.682]
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$

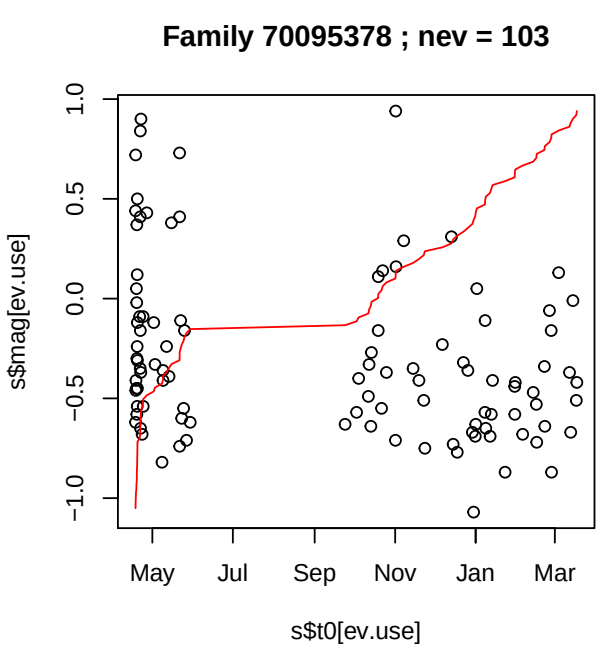

Cv = 1.2
Density
ln(dt)
0.00
0.10
0.20
0.30
−12
−10
−8
−6
−4
−2
0
2

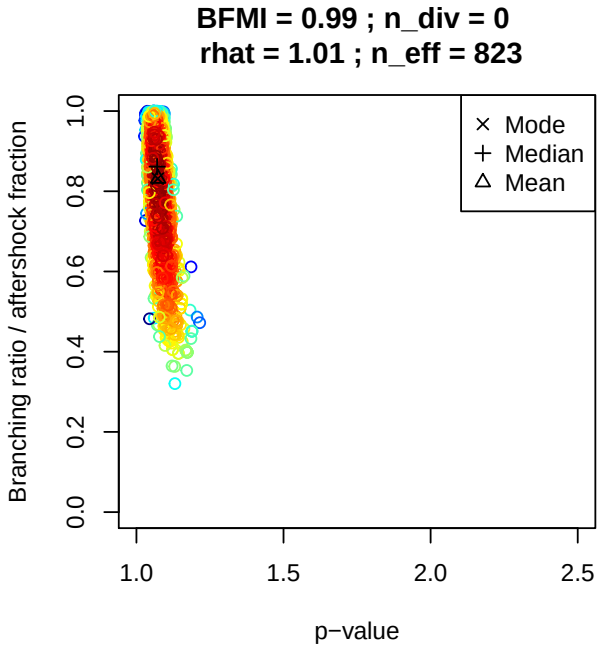

Family 70091408 ; nev = 137
s$mag[ev.use]
s$t0[ev.use]
2015
2016
2017
2018
−0.5
0.0
0.5
1.0

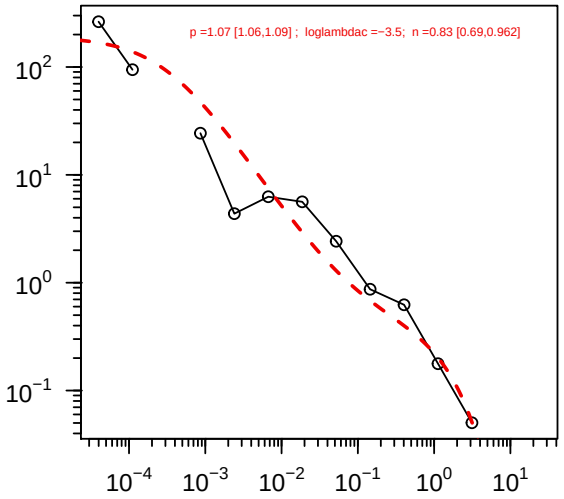

BFMI = 0.79 ; n_div = 0
rhat = 1.01 ; n_eff = 587
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
1.0
1.5
2.0
2.5
0.0
0.2
0.4
0.6
0.8
1.0

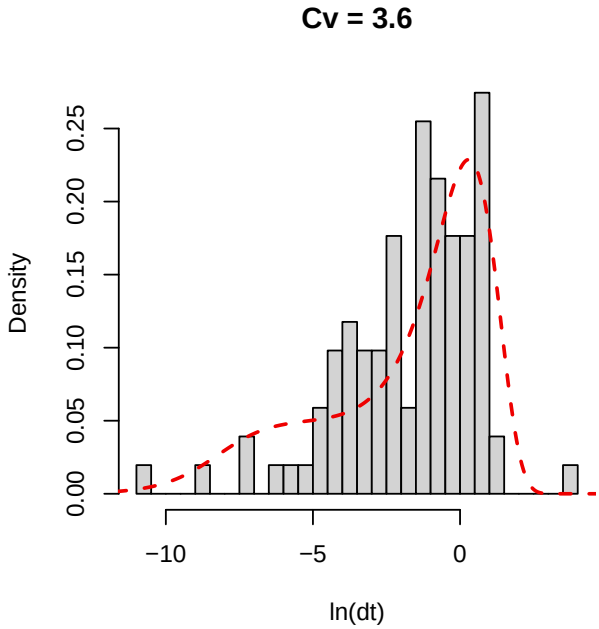

p =1.19 [1.15,1.21] ; loglambdac =−3.9; n =0.88 [0.83,0.972]

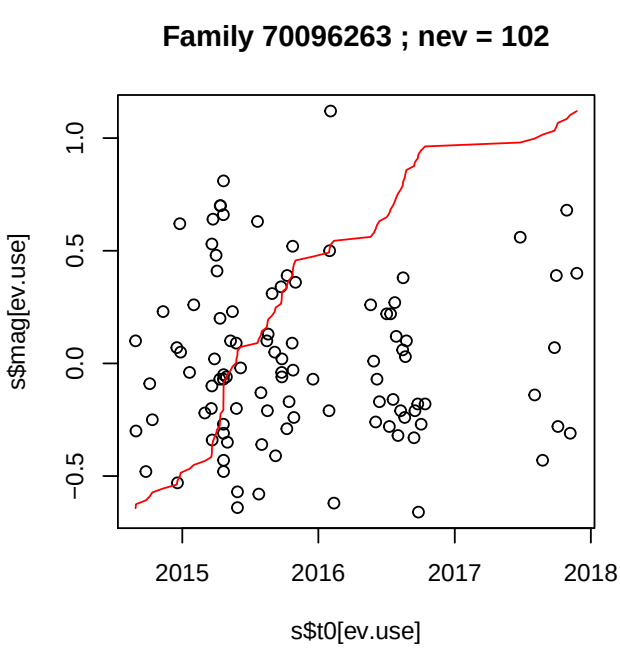

Cv = 3.2
Density
ln(dt)
−10
−5
0
0.00
0.04
0.08
0.12

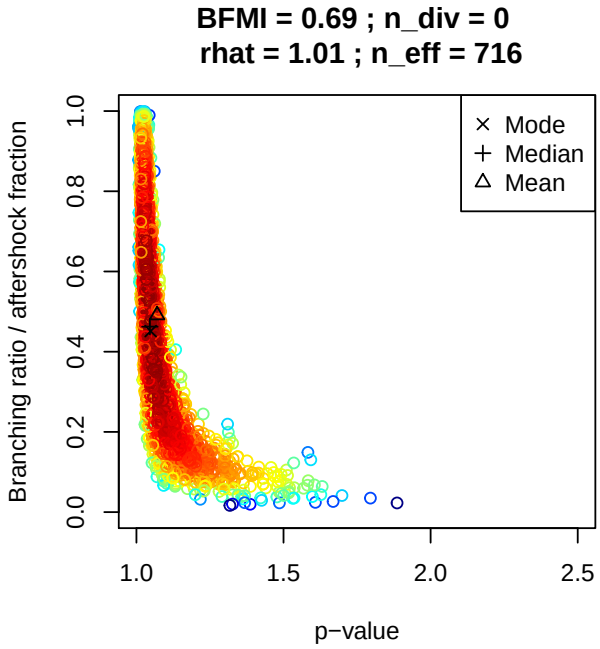

Family 70095378 ; nev = 103
s$mag[ev.use]
1.0
0.5
0.0
−0.5
−1.0
May
Jul
Sep
Nov
Jan
Mar
s$t0[ev.use]

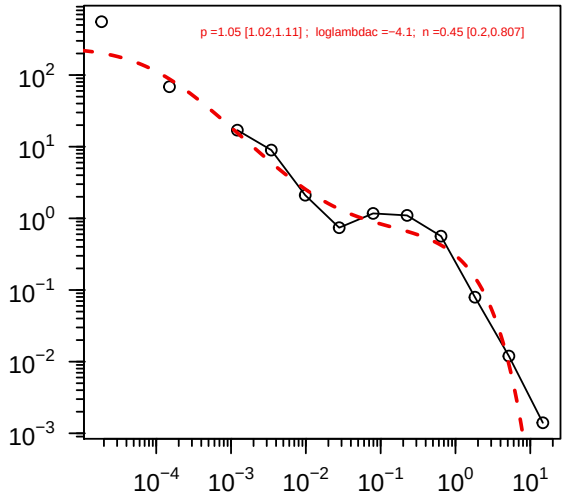

BFMI = 0.99 ; n_div = 0
rhat = 1.01 ; n_eff = 823
Branching ratio / aftershock fraction
1.0
0.8
0.6
0.4
0.2
0.0
Mode
Median
Mean
1.0
1.5
2.0
2.5
p−value

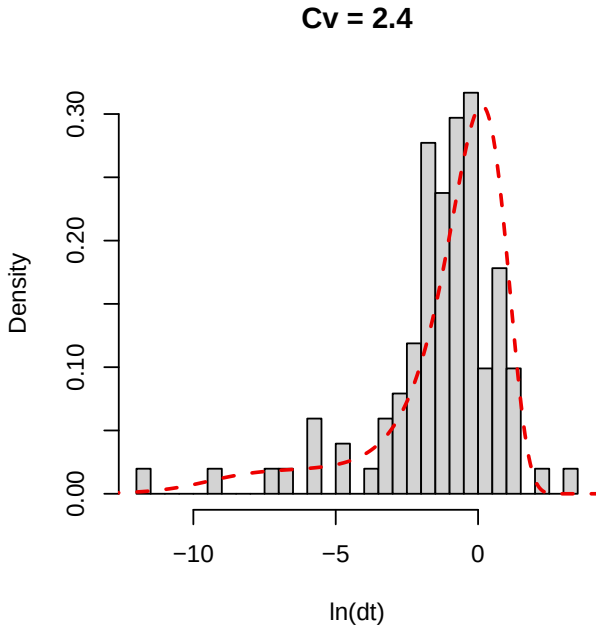

p =1.07 [1.06,1.09] ; loglambdac =−3.5; n =0.83 [0.69,0.962]
$10^2$
$10^1$
$10^0$
$10^{-1}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^0$
$10^1$

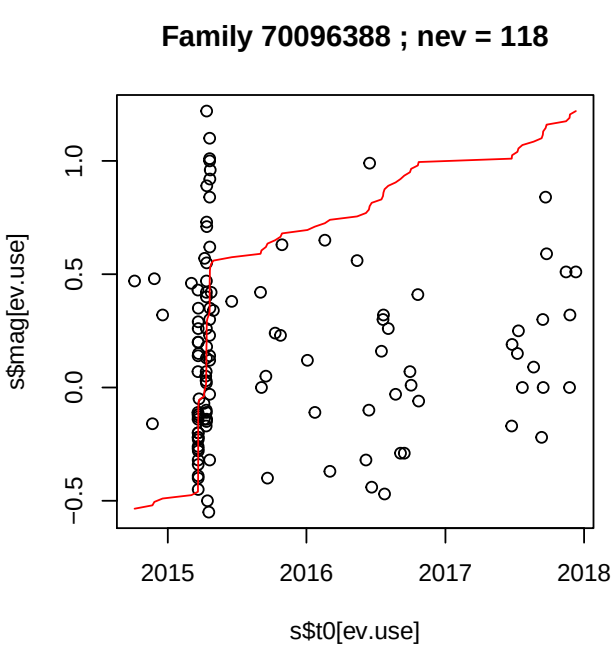

Cv = 3.6
Density
0.25
0.20
0.15
0.10
0.05
0.00
−10
−5
0
ln(dt)

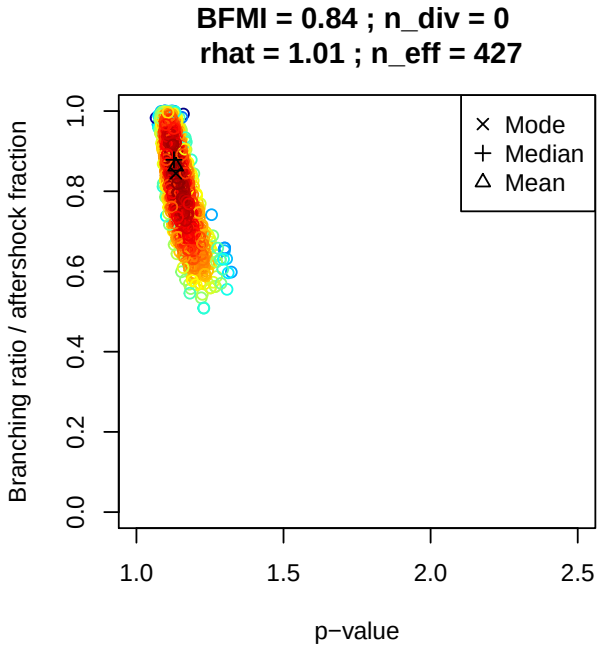

Family 70096263 ; nev = 102
s$mag[ev.use]
s$t0[ev.use]
2015
2016
2017
2018
1.0
0.5
0.0
−0.5

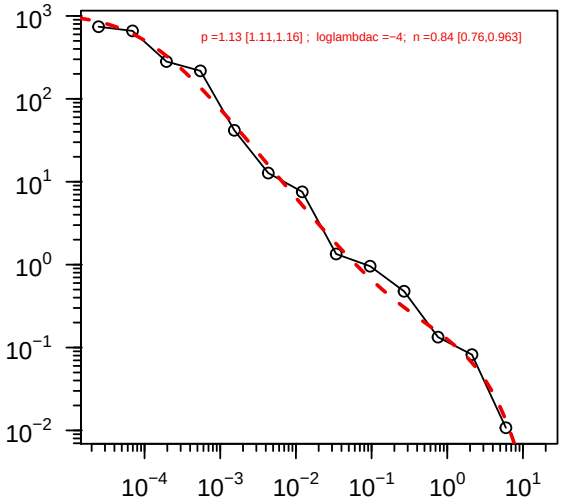

BFMI = 0.69 ; n_div = 0
rhat = 1.01 ; n_eff = 716
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
1.0
1.5
2.0
2.5
0.0
0.2
0.4
0.6
0.8
1.0

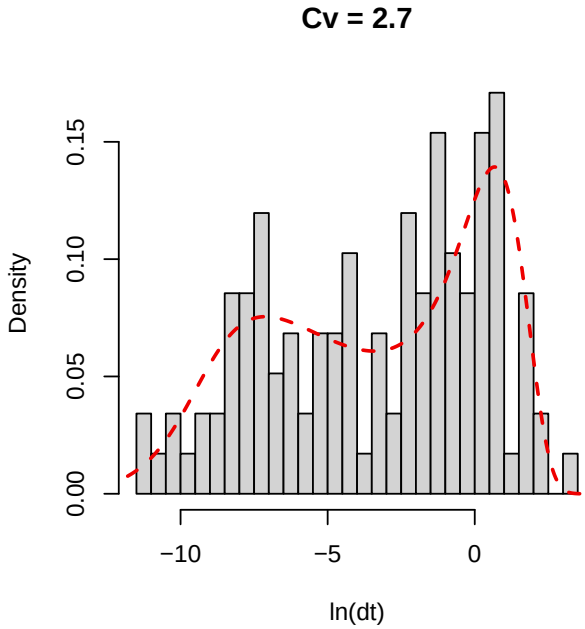

p =1.05 [1.02,1.11] ; loglambdac =−4.1; n =0.45 [0.2,0.807]
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-3}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

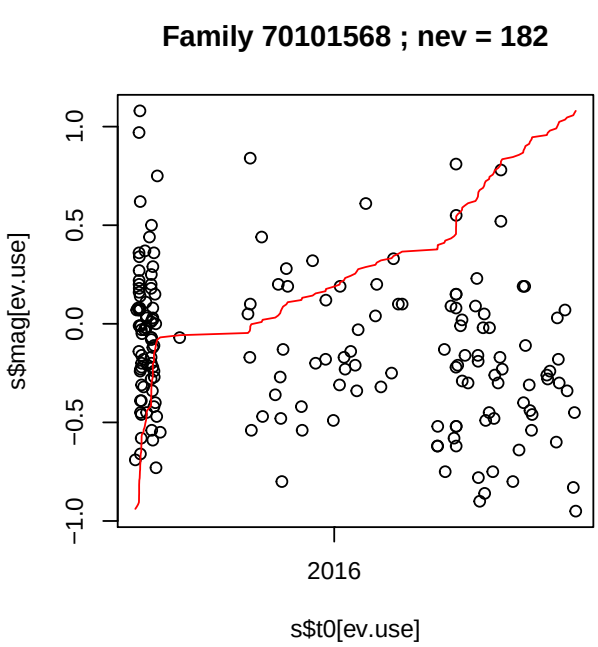

Cv = 2.4
Density
ln(dt)
0.00
0.10
0.20
0.30
−10
−5
0

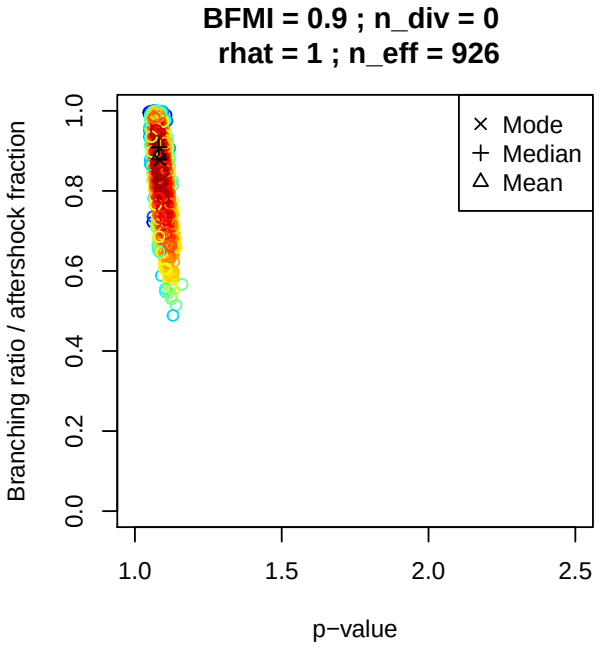

Family 70096388 ; nev = 118
s$mag[ev.use]
s$t0[ev.use]
−0.5
0.0
0.5
1.0
2015
2016
2017
2018

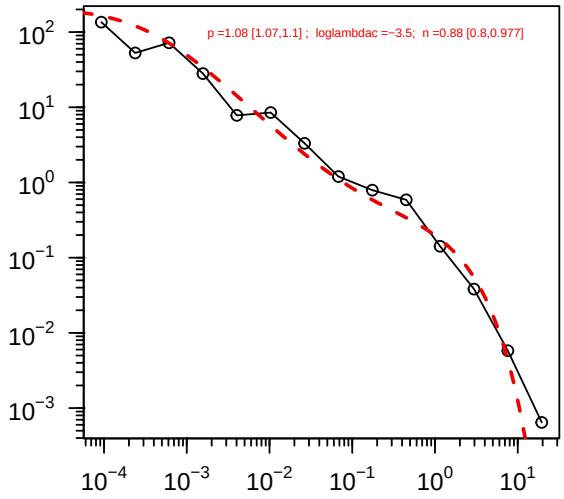

BFMI = 0.84 ; n_div = 0
rhat = 1.01 ; n_eff = 427
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5

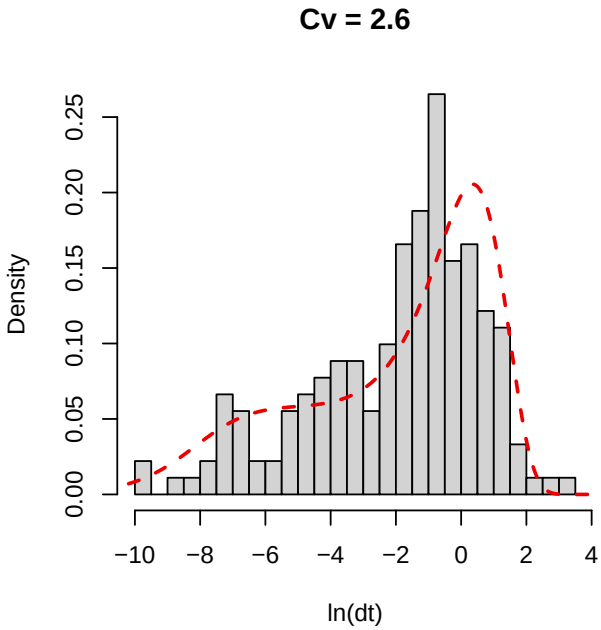

p =1.13 [1.11,1.16] ; loglambdac =−4; n =0.84 [0.76,0.963]
$10^{3}$
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

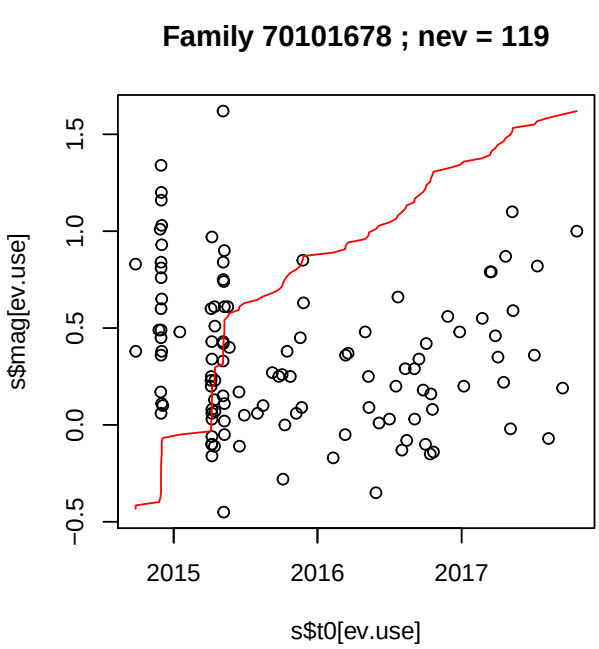

Cv = 2.7
Density
ln(dt)
0.00
0.05
0.10
0.15
−10
−5
0

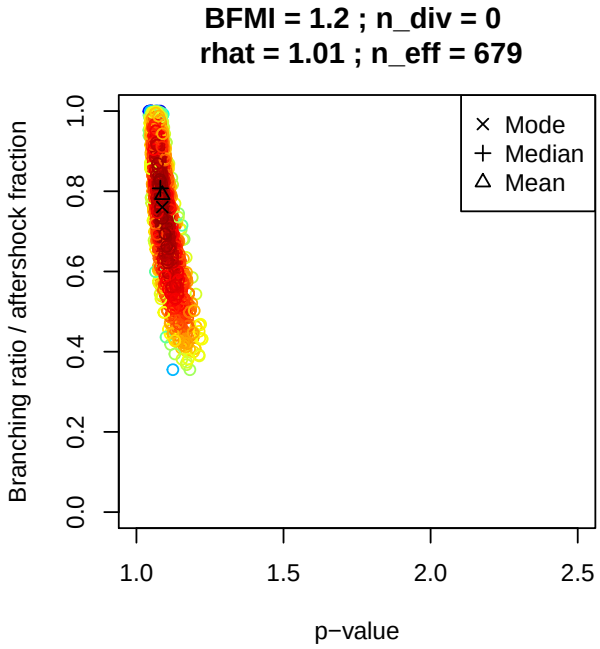

Family 70101568 ; nev = 182
s$mag[ev.use]
1.0
0.5
0.0
−0.5
−1.0
2016
s$t0[ev.use]

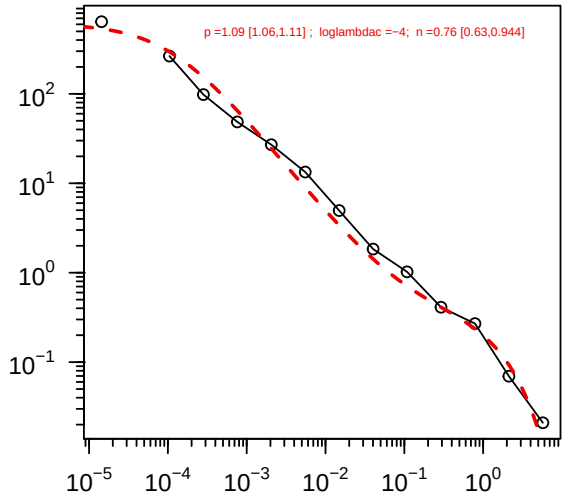

BFMI = 0.9 ; n_div = 0
rhat = 1 ; n_eff = 926
Mode
Median
Mean
Branching ratio / aftershock fraction
1.0
0.8
0.6
0.4
0.2
0.0
1.0
1.5
2.0
2.5
p−value

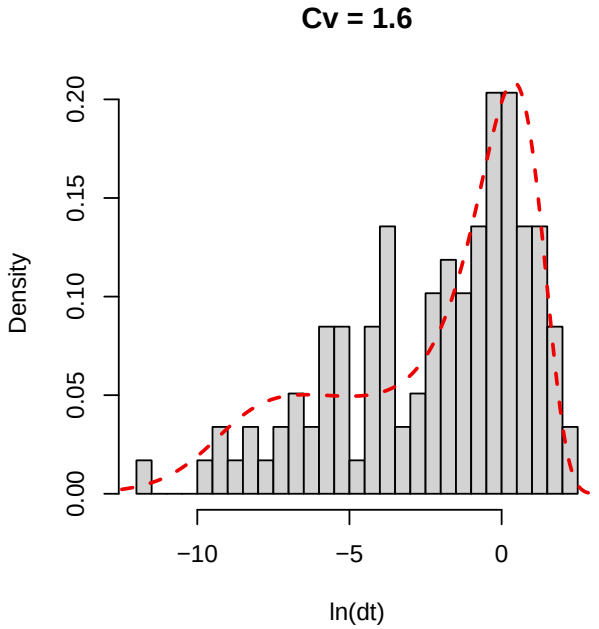

p =1.08 [1.07,1.1] ; loglambdac =−3.5; n =0.88 [0.8,0.977]
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-3}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

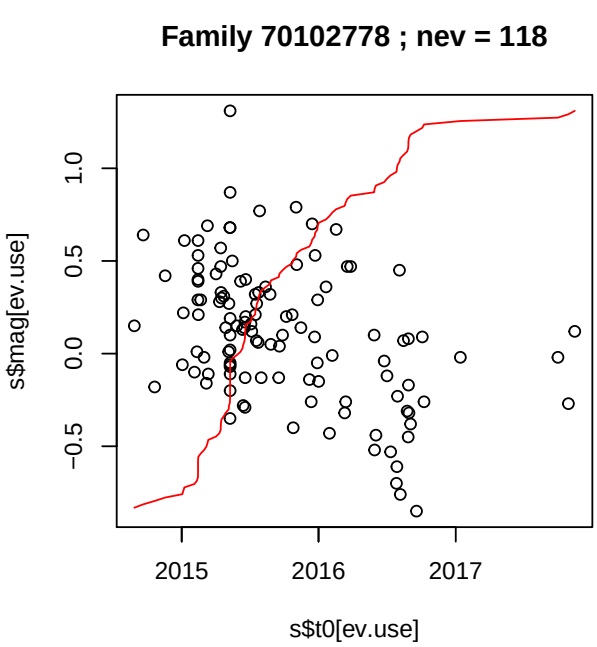

Cv = 2.6
Density
0.25
0.20
0.15
0.10
0.05
0.00
−10
−8
−6
−4
−2
0
2
4
ln(dt)

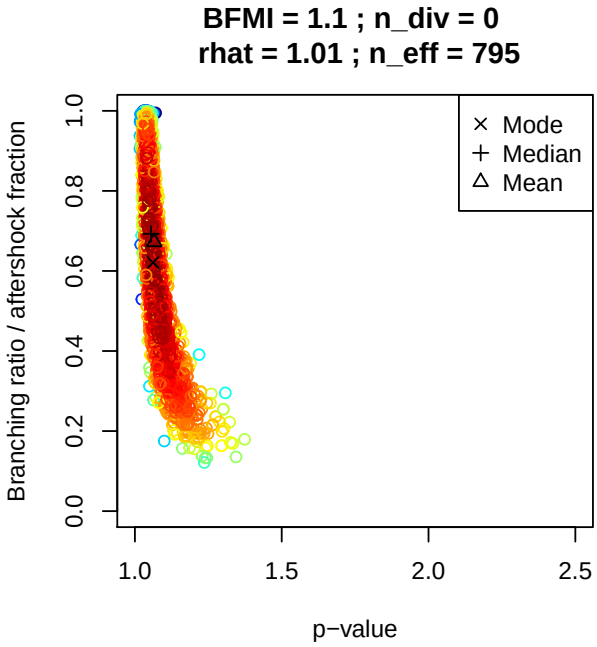

Family 70101678 ; nev = 119
s$mag[ev.use]
s$t0[ev.use]
−0.5
0.0
0.5
1.0
1.5
2015
2016
2017

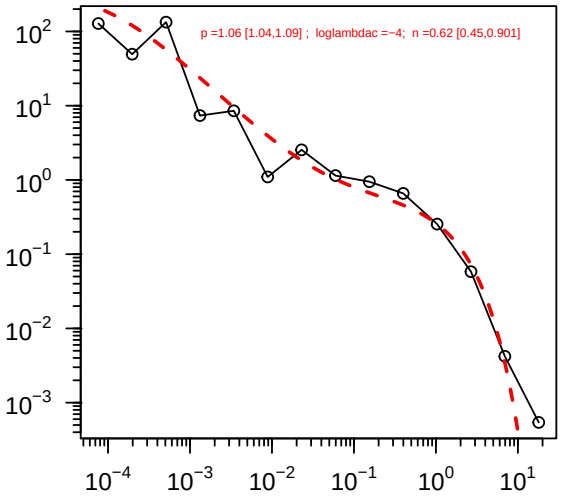

BFMI = 1.2 ; n_div = 0
rhat = 1.01 ; n_eff = 679
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5

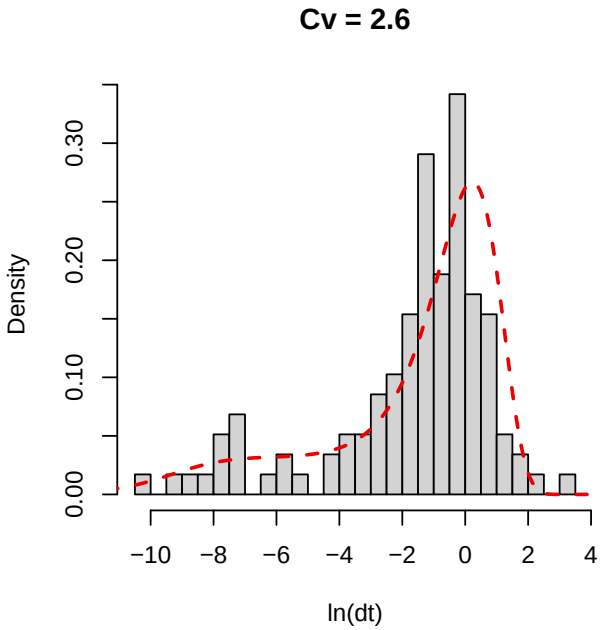

p =1.09 [1.06,1.11] ; loglambdac =−4; n =0.76 [0.63,0.944]
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-5}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$

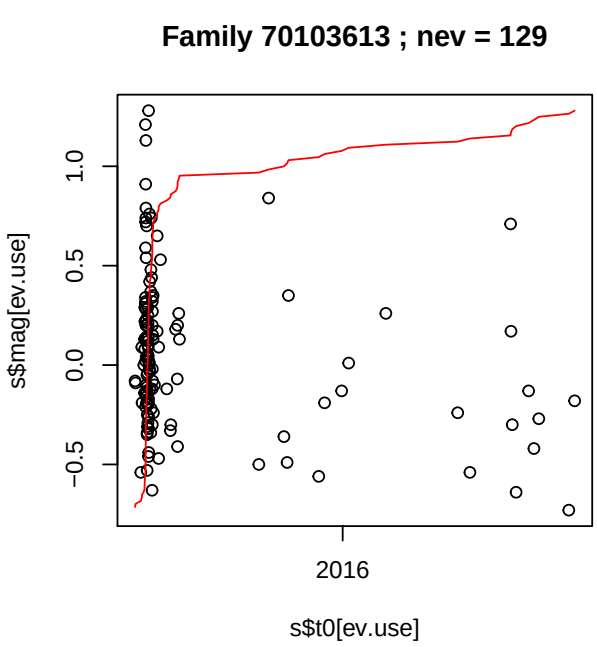

Cv = 1.6
Density
ln(dt)
0.00
0.05
0.10
0.15
0.20
−10
−5
0

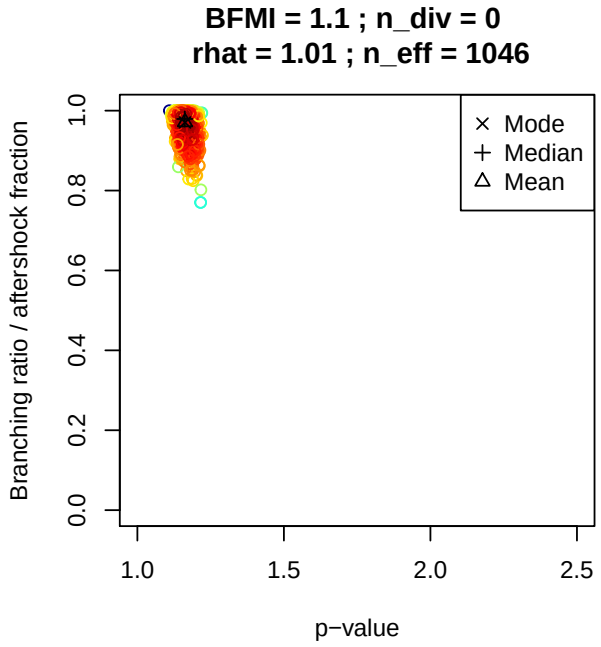

Family 70102778 ; nev = 118
s$mag[ev.use]
s$t0[ev.use]
2015
2016
2017
−0.5
0.0
0.5
1.0

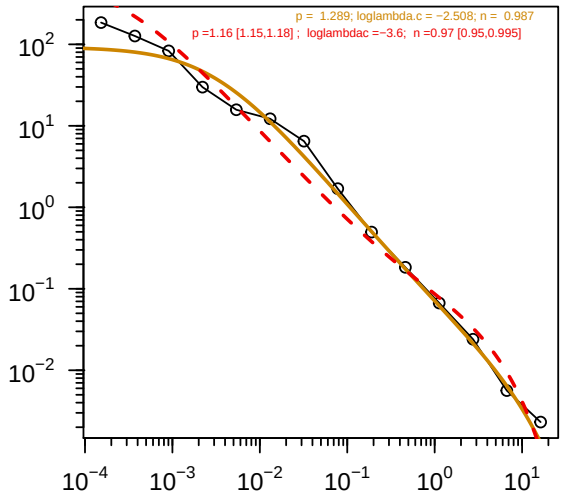

BFMI = 1.1 ; n_div = 0
rhat = 1.01 ; n_eff = 795
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5

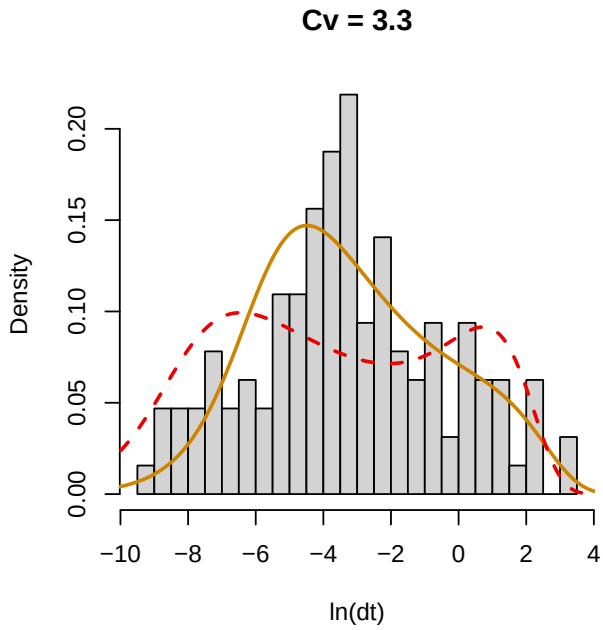

p =1.06 [1.04,1.09] ; loglambdac =−4; n =0.62 [0.45,0.901]
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-3}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

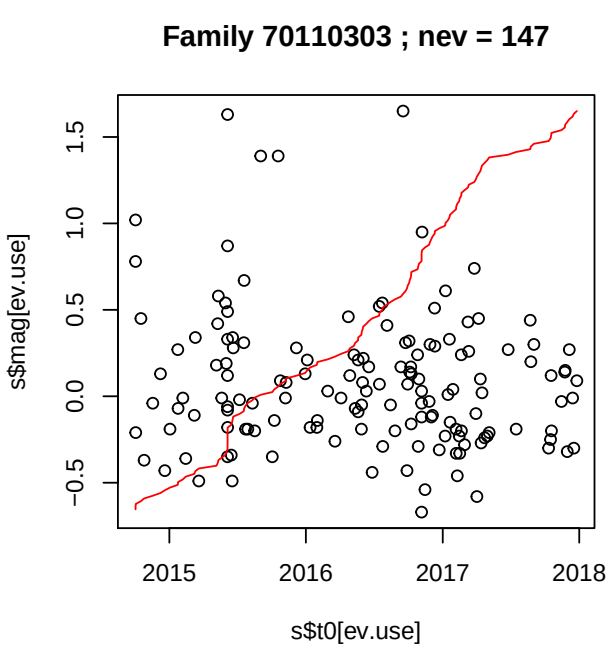

Cv = 2.6
Density
ln(dt)
0.00
0.10
0.20
0.30
−10
−8
−6
−4
−2
0
2
4

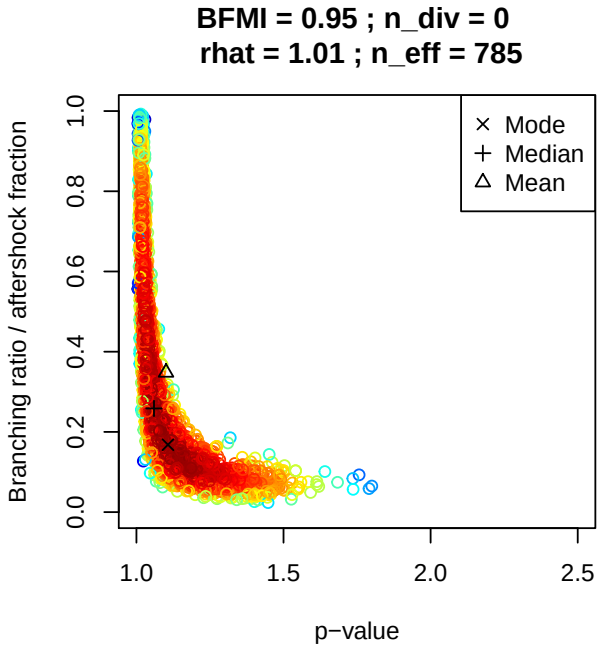

Family 70103613 ; nev = 129
s$mag[ev.use]
−0.5
0.0
0.5
1.0
2016
s$t0[ev.use]

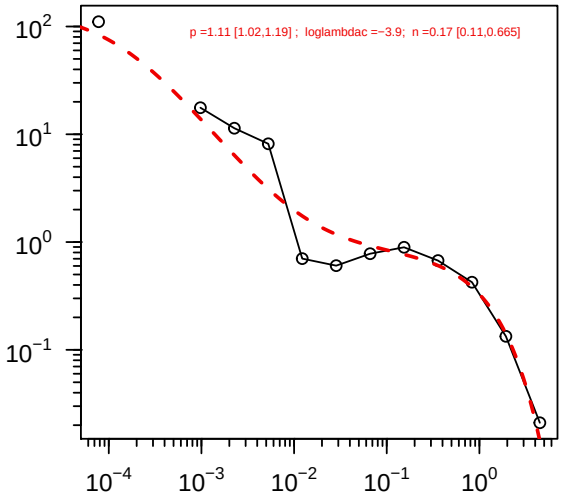

BFMI = 1.1 ; n_div = 0
rhat = 1.01 ; n_eff = 1046
Mode
Median
Mean
Branching ratio / aftershock fraction
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5
p−value

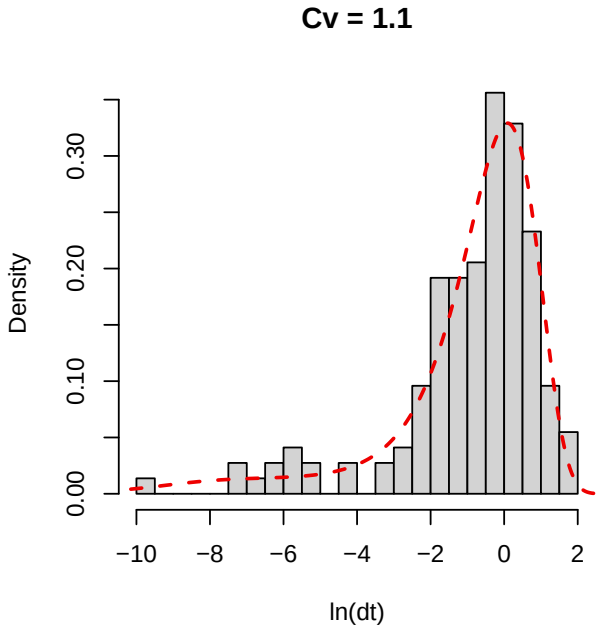

p = 1.289; loglambda.c = −2.508; n = 0.987
p =1.16 [1.15,1.18] ; loglambdac =−3.6; n =0.97 [0.95,0.995]
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

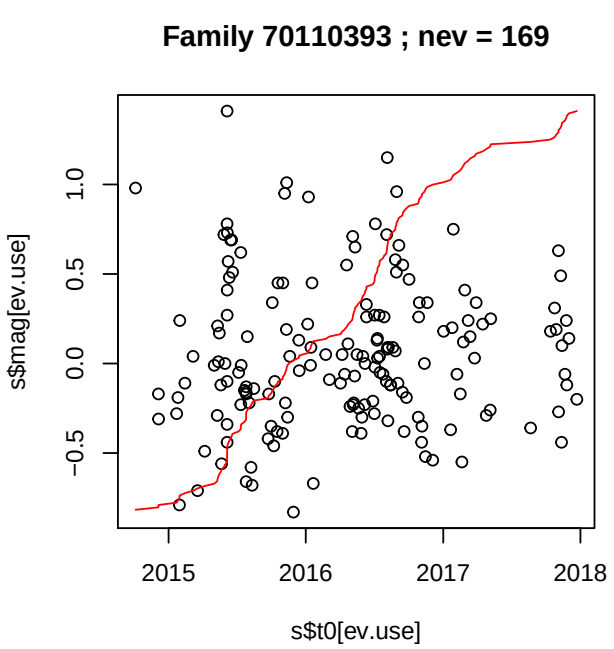

Cv = 3.3
Density
0.00
0.05
0.10
0.15
0.20
−10
−8
−6
−4
−2
0
2
4
ln(dt)

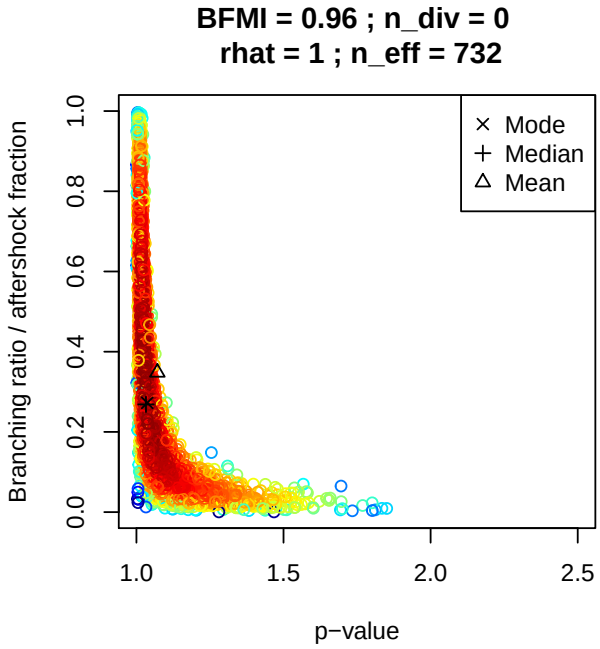

Family 70110303 ; nev = 147
s$mag[ev.use]
s$t0[ev.use]
2015
2016
2017
2018
−0.5
0.0
0.5
1.0
1.5

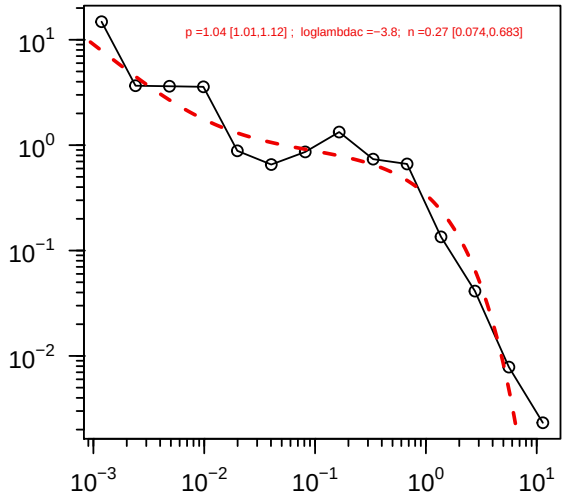

BFMI = 0.95 ; n_div = 0
rhat = 1.01 ; n_eff = 785
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5

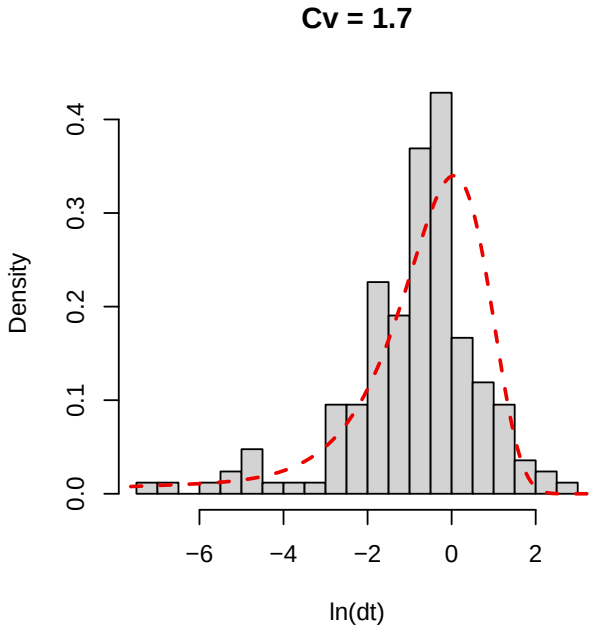

p =1.11 [1.02,1.19] ; loglambdac =−3.9; n =0.17 [0.11,0.665]
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$

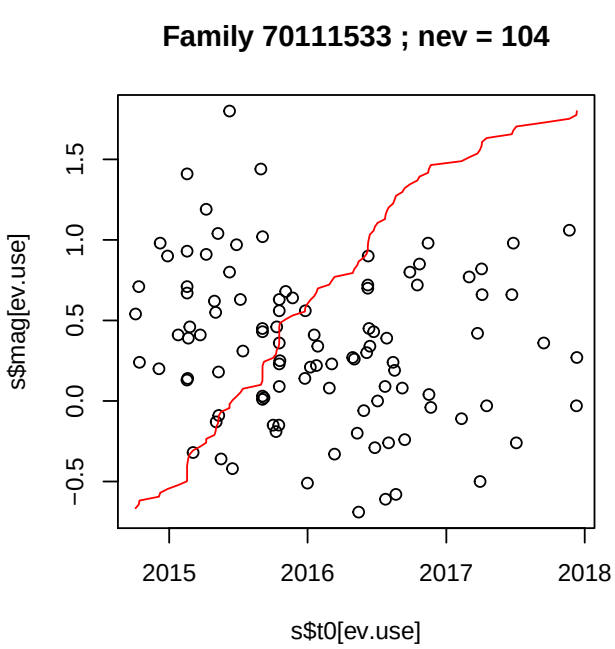

Cv = 1.1
Density
ln(dt)
0.00
0.10
0.20
0.30
−10
−8
−6
−4
−2
0
2

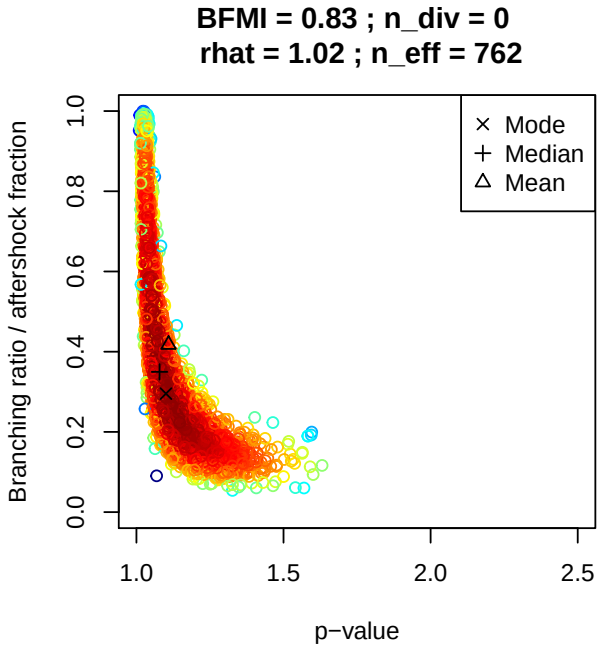

Family 70110393 ; nev = 169
s$mag[ev.use]
s$t0[ev.use]
2015
2016
2017
2018
−0.5
0.0
0.5
1.0

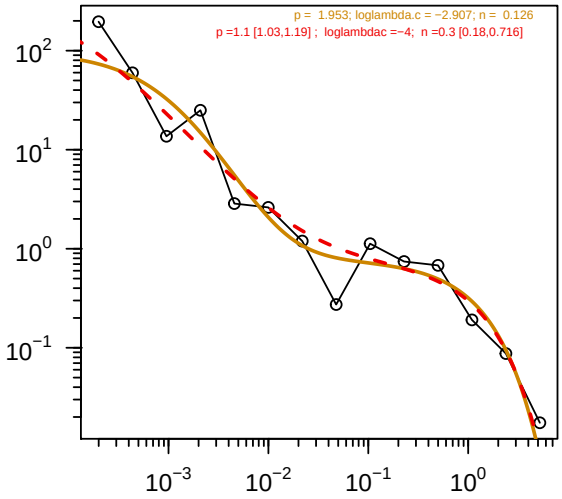

BFMI = 0.96 ; n_div = 0
rhat = 1 ; n_eff = 732
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5

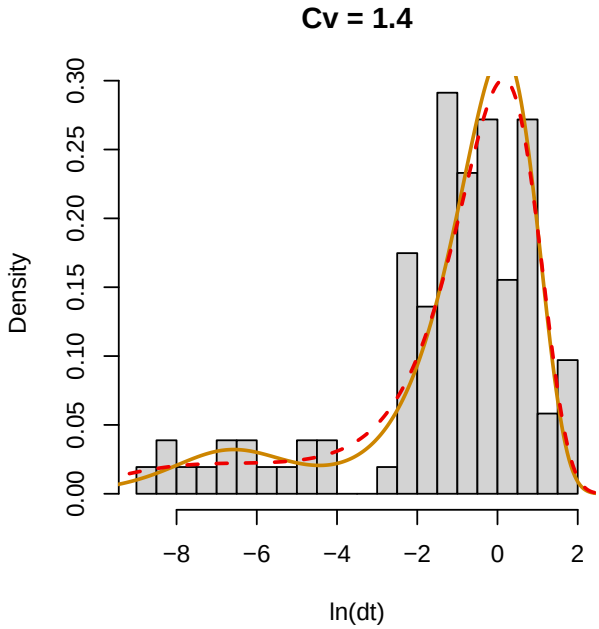

p =1.04 [1.01,1.12] ; loglambdac =−3.8; n =0.27 [0.074,0.683]
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

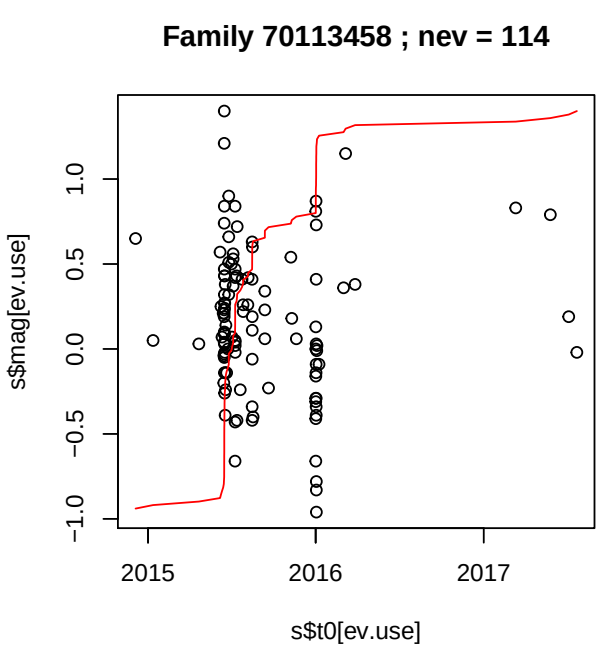

Cv = 1.7
Density
ln(dt)
0.0
0.1
0.2
0.3
0.4
−6
−4
−2
0
2

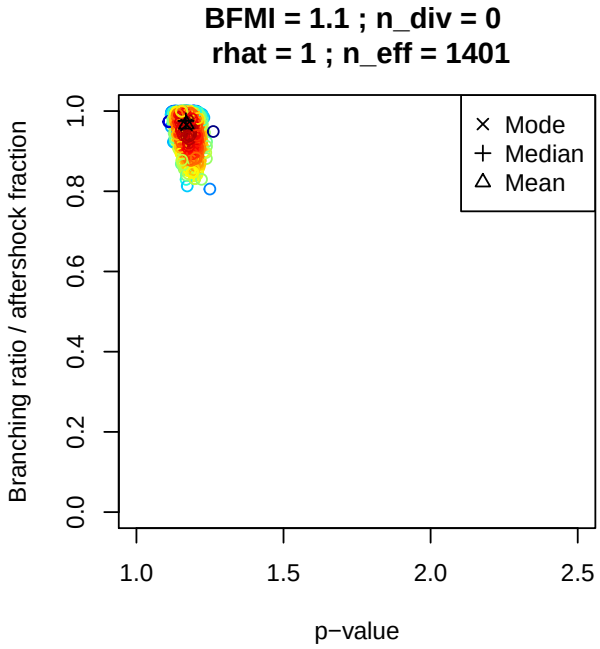

Family 70111533 ; nev = 104
s$mag[ev.use]
s$t0[ev.use]
2015
2016
2017
2018
−0.5
0.0
0.5
1.0
1.5

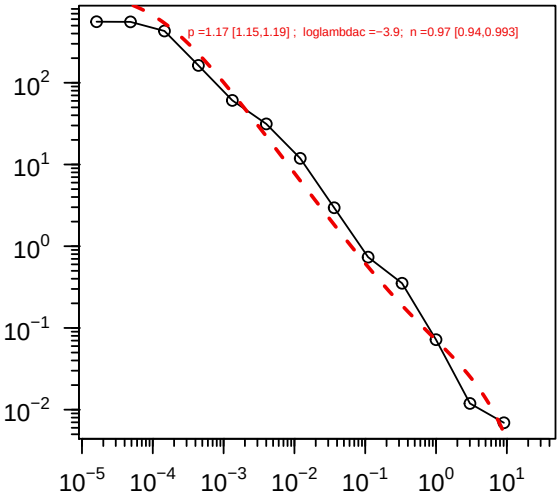

BFMI = 0.83 ; n_div = 0
rhat = 1.02 ; n_eff = 762
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
1.0
1.5
2.0
2.5
0.0
0.2
0.4
0.6
0.8
1.0

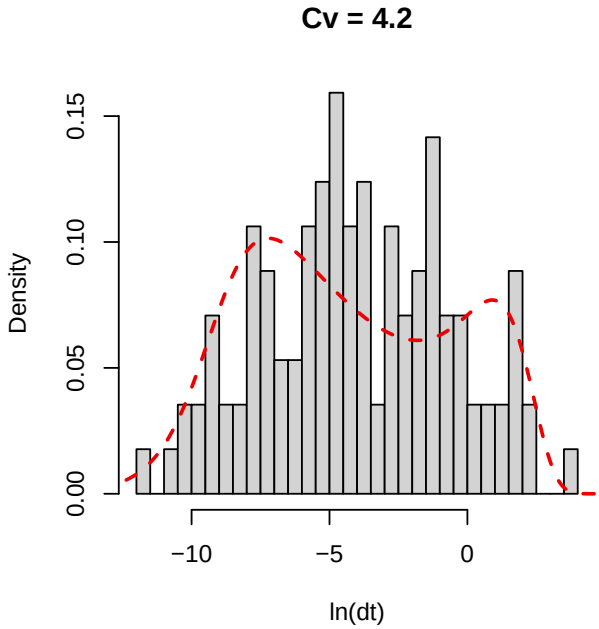

p = 1.953; loglambda.c = −2.907; n = 0.126
p =1.1 [1.03,1.19] ; loglambdac =−4; n =0.3 [0.18,0.716]
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$

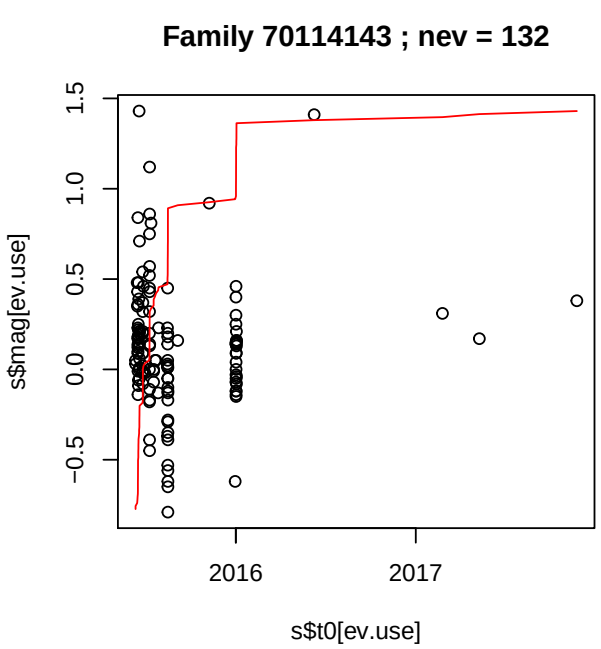

Cv = 1.4
Density
ln(dt)
0.00
0.05
0.10
0.15
0.20
0.25
0.30
−8
−6
−4
−2
0
2

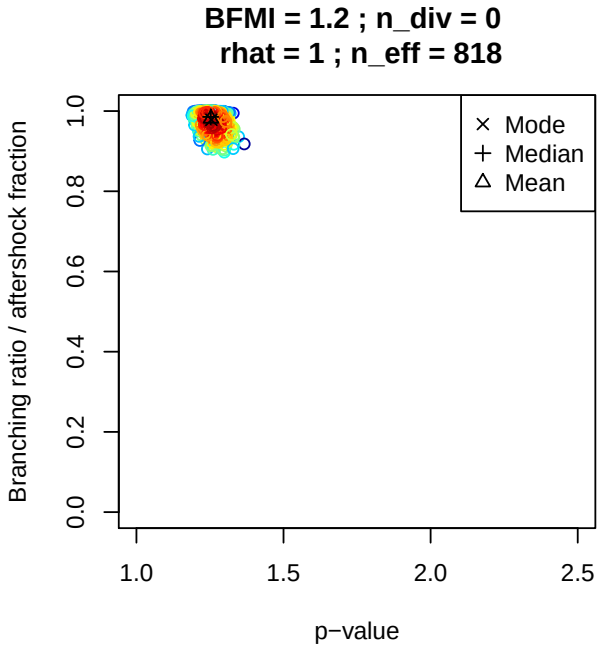

Family 70113458 ; nev = 114
s$mag[ev.use]
s$t0[ev.use]
2015
2016
2017
−1.0
−0.5
0.0
0.5
1.0

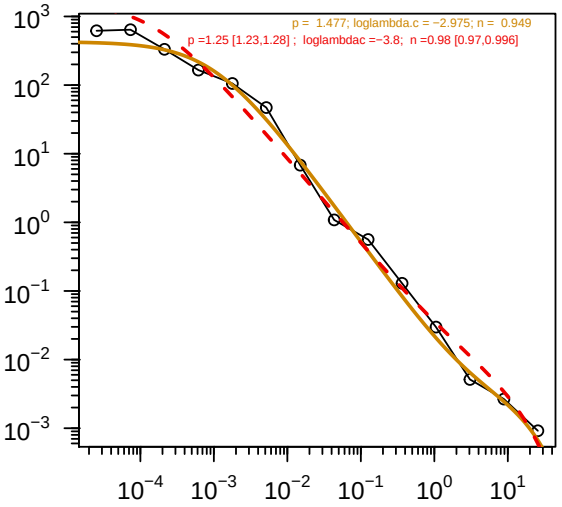

BFMI = 1.1 ; n_div = 0
rhat = 1 ; n_eff = 1401
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5

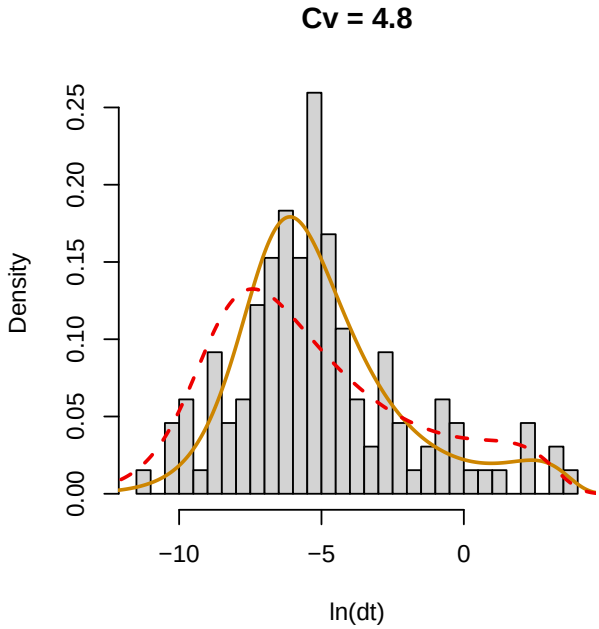

p =1.17 [1.15,1.19] ; loglambdac =−3.9; n =0.97 [0.94,0.993]
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-5}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

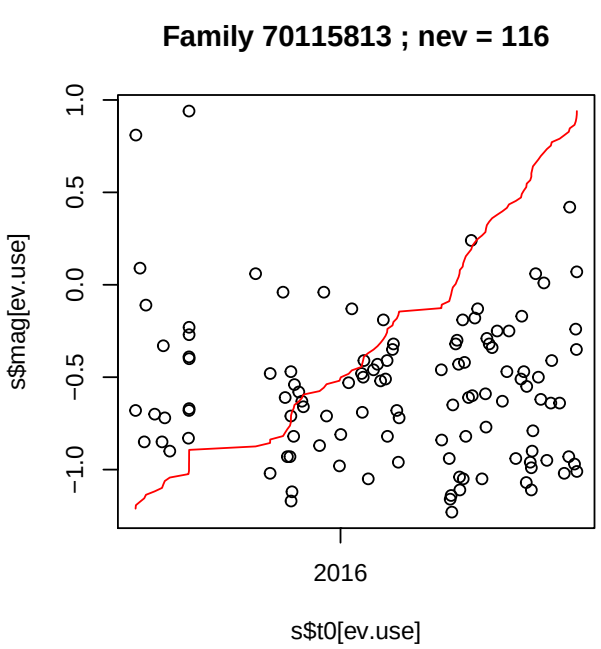

Cv = 4.2
Density
ln(dt)
0.00
0.05
0.10
0.15
−10
−5
0

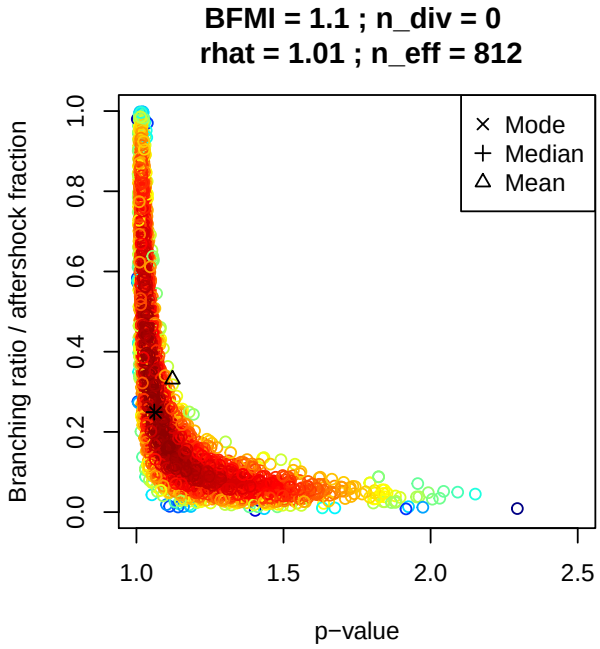

Family 70114143 ; nev = 132
s$mag[ev.use]
s$t0[ev.use]
2016
2017

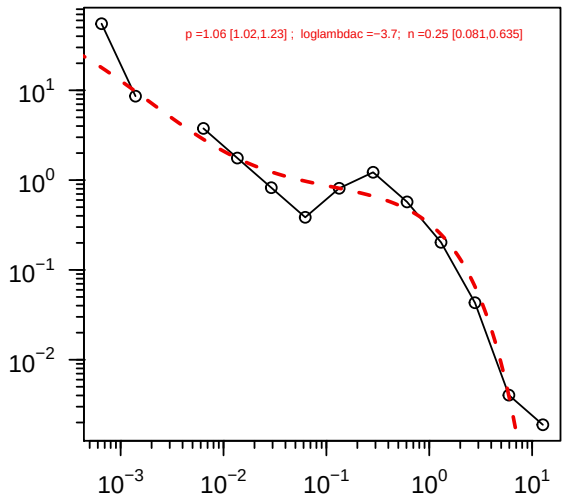

BFMI = 1.2 ; n_div = 0
rhat = 1 ; n_eff = 818
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value

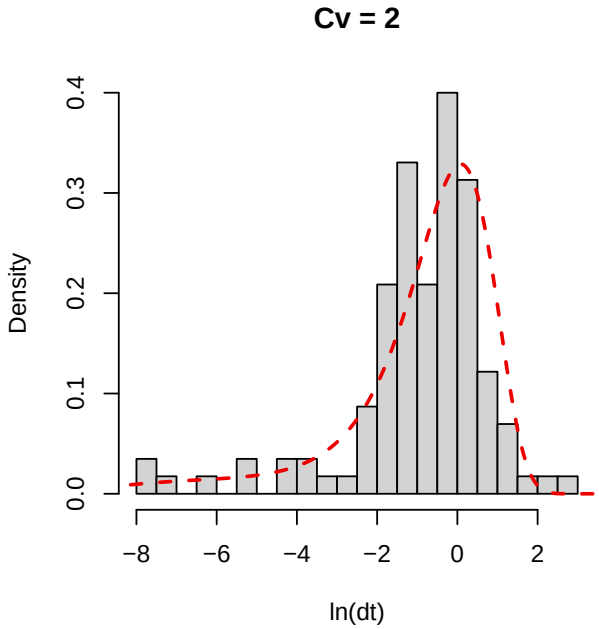

p = 1.477; loglambda.c = −2.975; n = 0.949
p =1.25 [1.23,1.28] ; loglambdac =−3.8; n =0.98 [0.97,0.996]

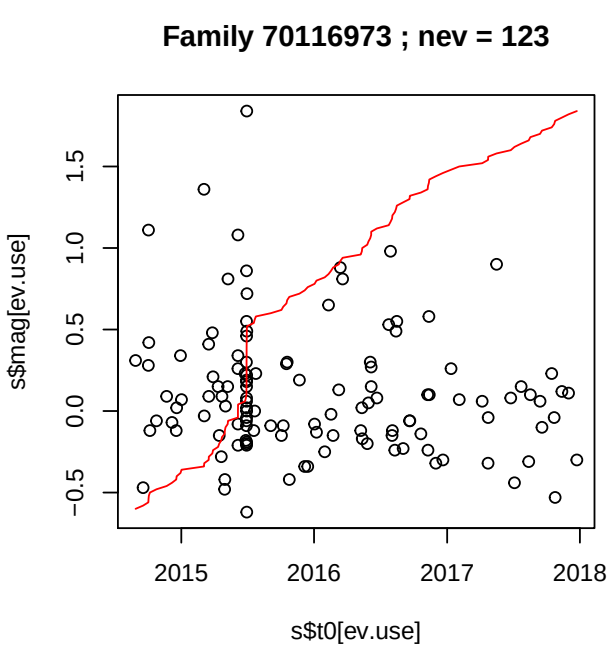

Cv = 4.8
Density
ln(dt)

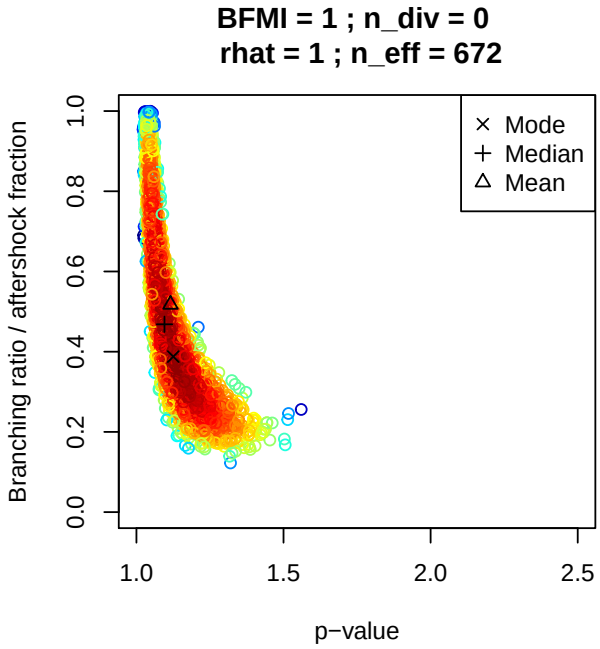

Family 70115813 ; nev = 116
s$mag[ev.use]
1.0
0.5
0.0
−0.5
−1.0
2016
s$t0[ev.use]

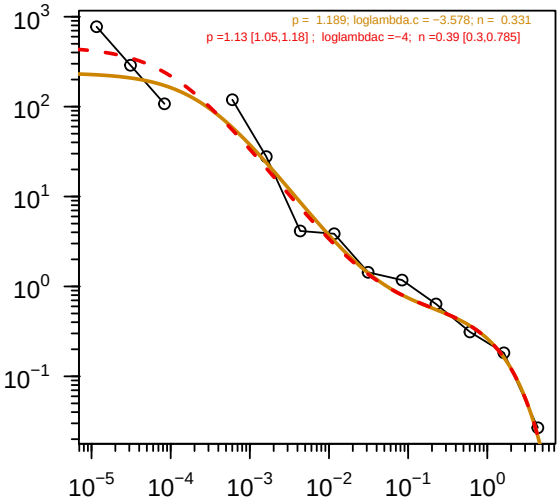

BFMI = 1.1 ; n_div = 0
rhat = 1.01 ; n_eff = 812
Mode
Median
Mean
Branching ratio / aftershock fraction
1.0
0.8
0.6
0.4
0.2
0.0
1.0
1.5
2.0
2.5
p−value

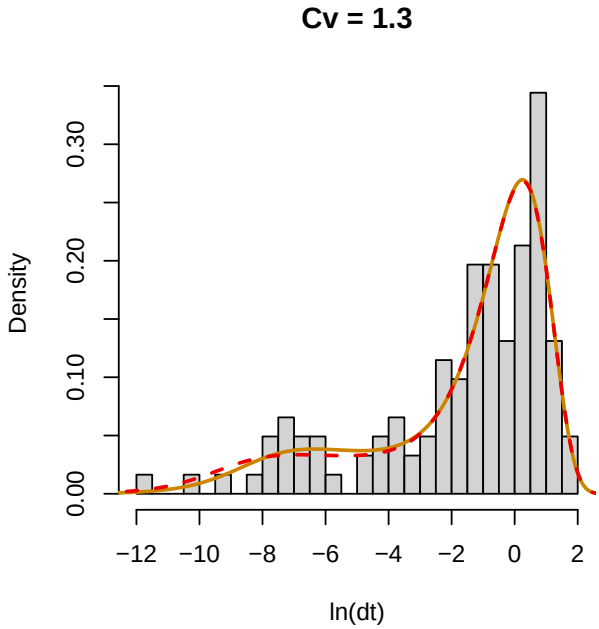

p =1.06 [1.02,1.23] ; loglambdac =−3.7; n =0.25 [0.081,0.635]
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

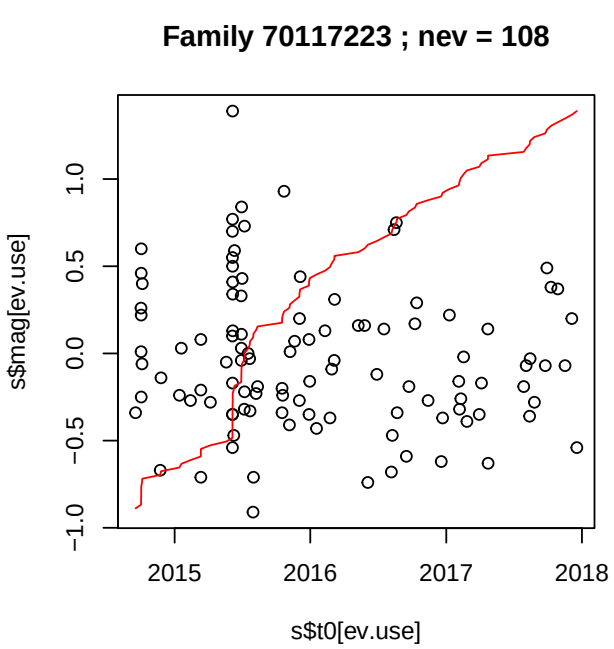

Cv = 2
Density
0.4
0.3
0.2
0.1
0.0
−8
−6
−4
−2
0
2
ln(dt)

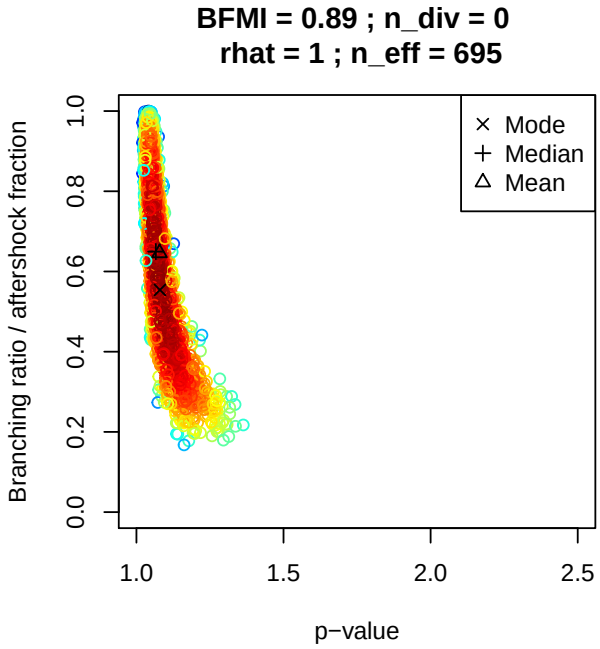

Family 70116973 ; nev = 123
s$mag[ev.use]
s$t0[ev.use]
2015
2016
2017
2018
−0.5
0.0
0.5
1.0
1.5

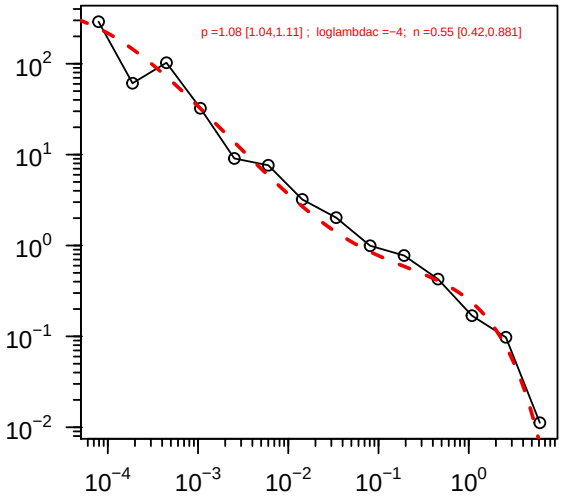

BFMI = 1 ; n_div = 0
rhat = 1 ; n_eff = 672
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5

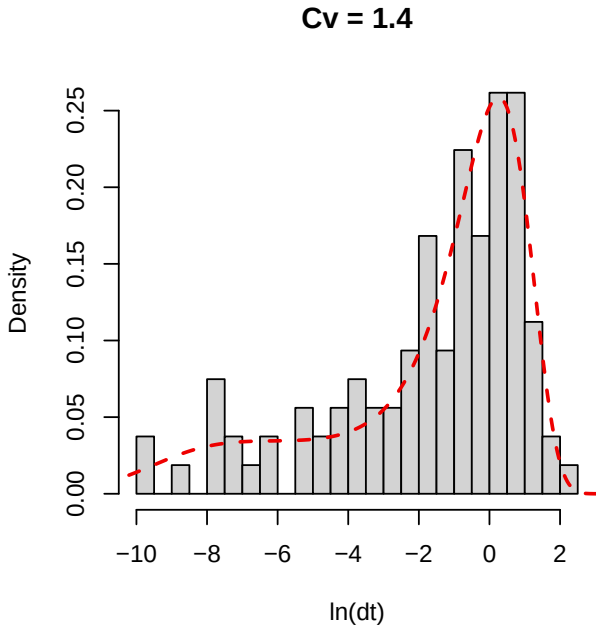

p = 1.189; loglambda.c = −3.578; n = 0.331
p =1.13 [1.05,1.18] ; loglambdac =−4; n =0.39 [0.3,0.785]
$10^3$
$10^2$
$10^1$
$10^0$
$10^{-1}$
$10^{-5}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^0$

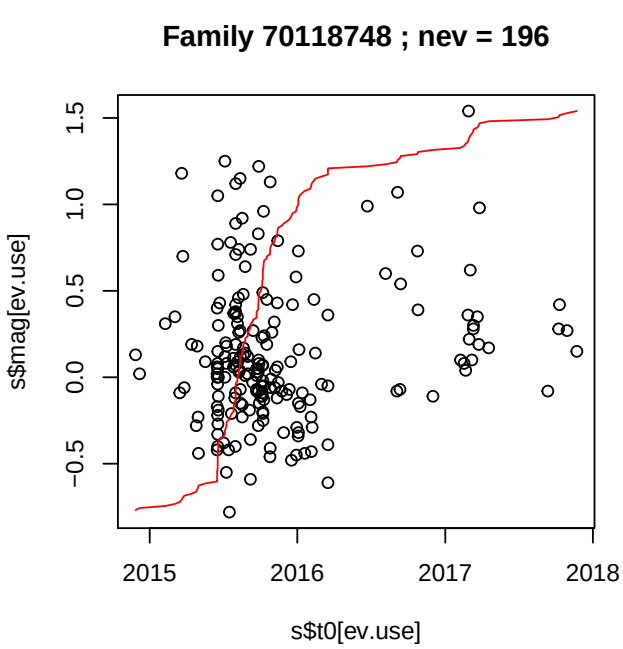

Cv = 1.3
Density
ln(dt)
0.00
0.10
0.20
0.30
−12
−10
−8
−6
−4
−2
0
2

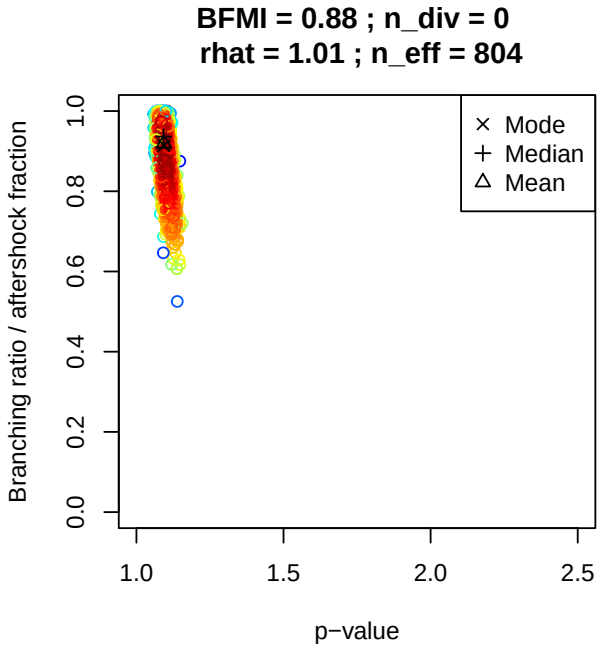

Family 70117223 ; nev = 108
s$mag[ev.use]
s$t0[ev.use]
−1.0
−0.5
0.0
0.5
1.0
2015
2016
2017
2018

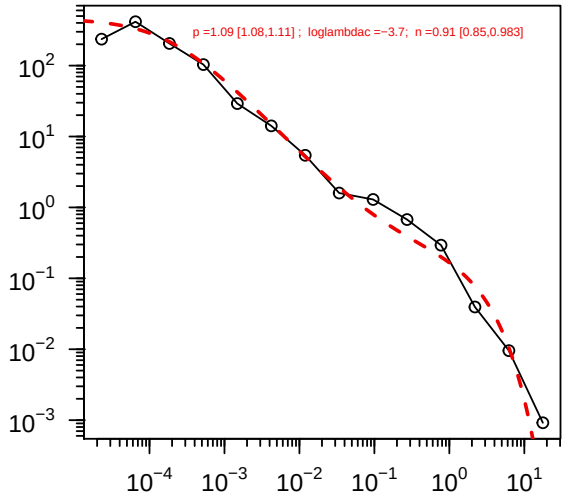

BFMI = 0.89 ; n_div = 0
rhat = 1 ; n_eff = 695
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5

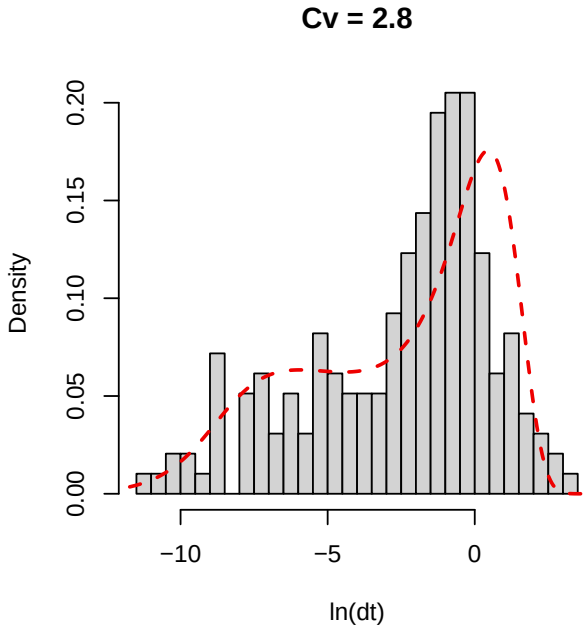

p =1.08 [1.04,1.11] ; loglambdac =−4; n =0.55 [0.42,0.881]
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$

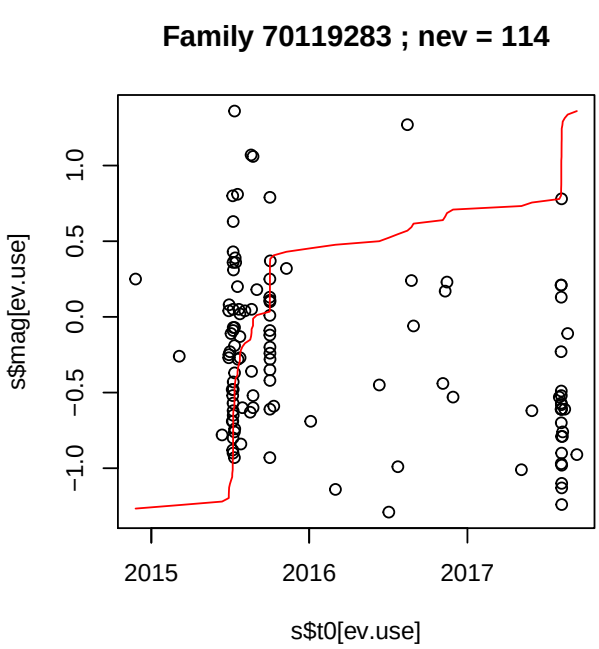

Cv = 1.4
Density
ln(dt)
0.00
0.05
0.10
0.15
0.20
0.25
−10
−8
−6
−4
−2
0
2

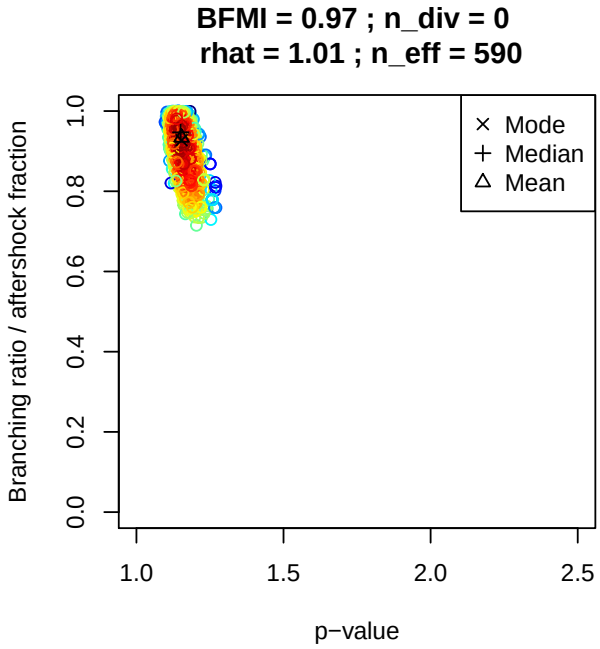

Family 70118748 ; nev = 196
s$mag[ev.use]
s$t0[ev.use]
2015
2016
2017
2018
−0.5
0.0
0.5
1.0
1.5

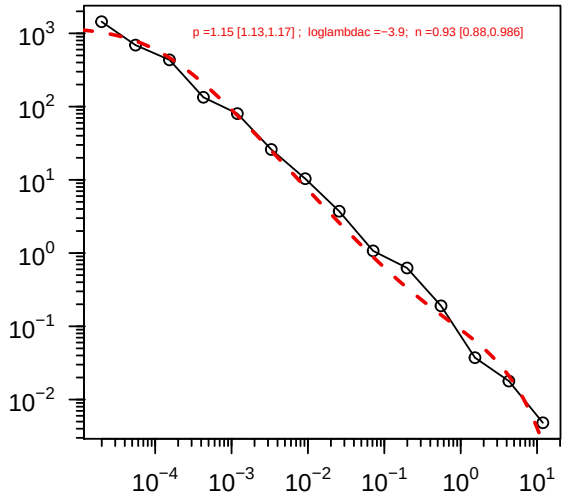

BFMI = 0.88 ; n_div = 0
rhat = 1.01 ; n_eff = 804
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5

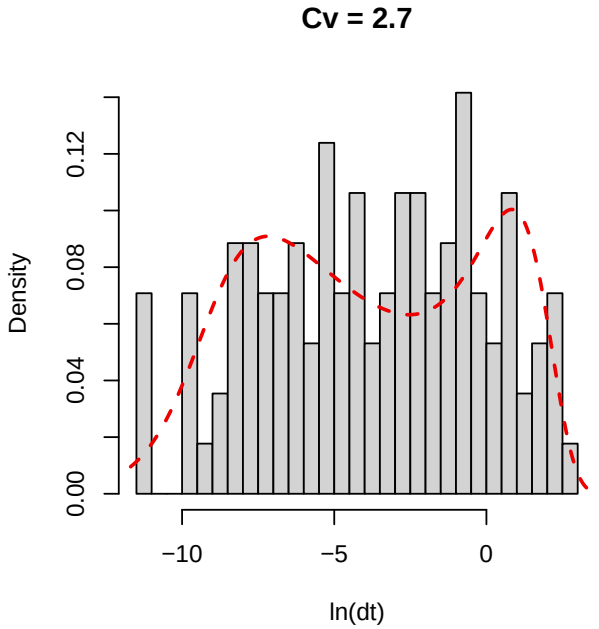

p =1.09 [1.08,1.11] ; loglambdac =−3.7; n =0.91 [0.85,0.983]
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-3}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

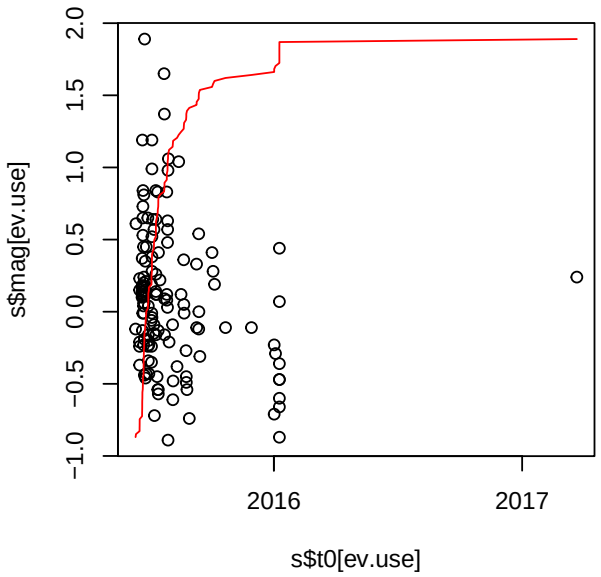

Cv = 2.8
Density
ln(dt)
0.00
0.05
0.10
0.15
0.20
−10
−5
0

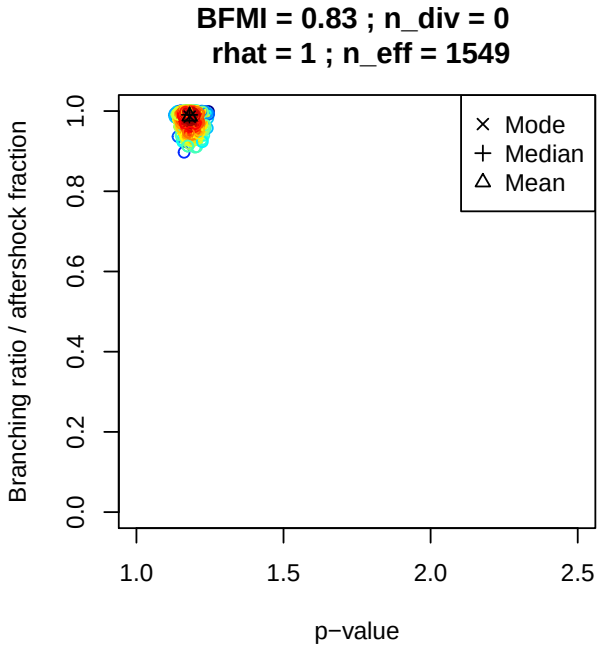

Family 70119283 ; nev = 114
s$mag[ev.use]
s$t0[ev.use]
2015
2016
2017
−1.0
−0.5
0.0
0.5
1.0

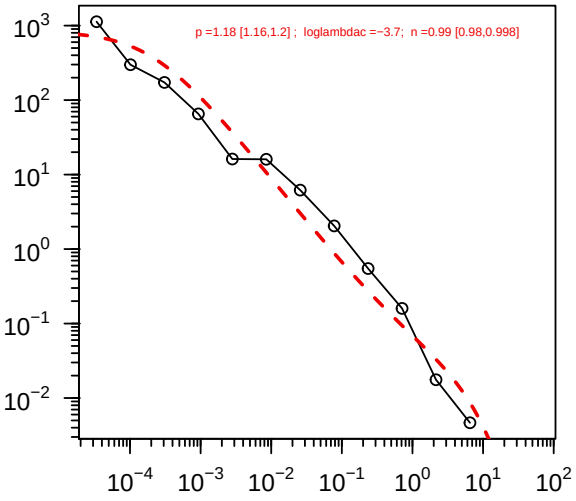

BFMI = 0.97 ; n_div = 0
rhat = 1.01 ; n_eff = 590
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5

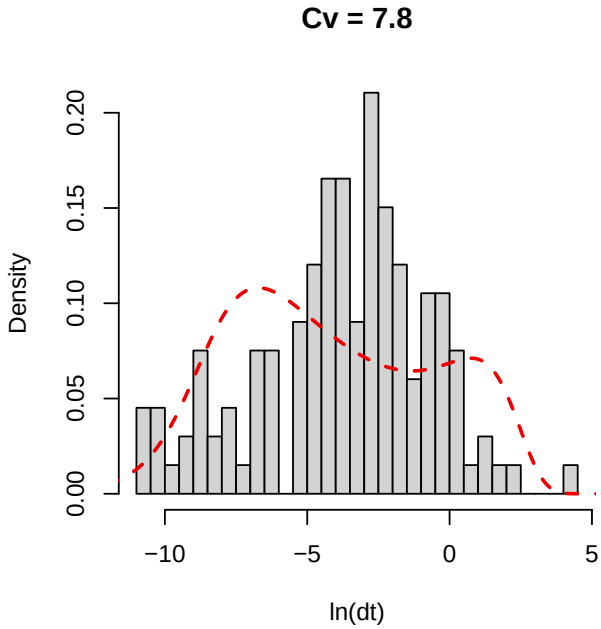

p =1.15 [1.13,1.17] ; loglambdac =−3.9; n =0.93 [0.88,0.986]
$10^{3}$
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

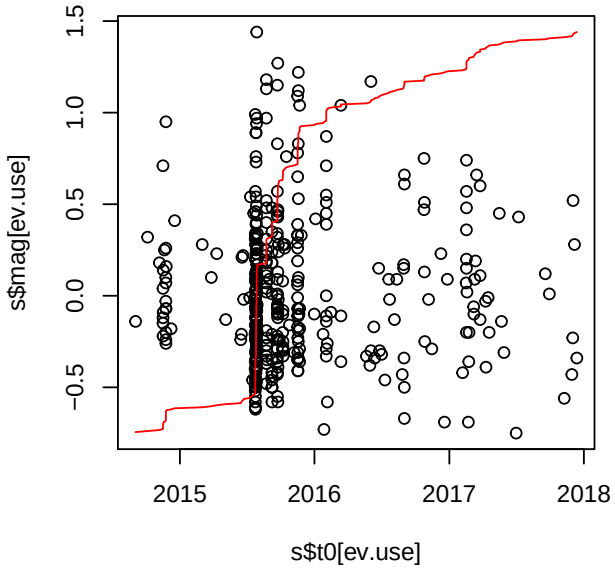

Cv = 2.7
Density
ln(dt)
0.00
0.04
0.08
0.12
−10
−5
0

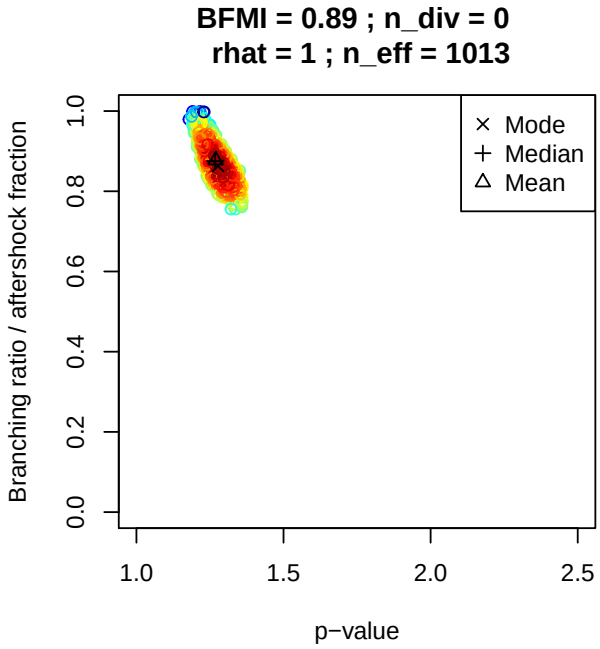

Family 70123208 ; nev = 134
s$mag[ev.use]
s$t0[ev.use]
2016
2017

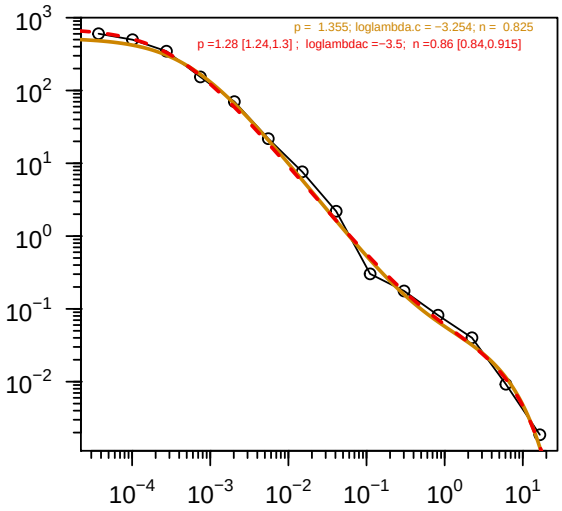

BFMI = 0.83 ; n_div = 0
rhat = 1 ; n_eff = 1549
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value

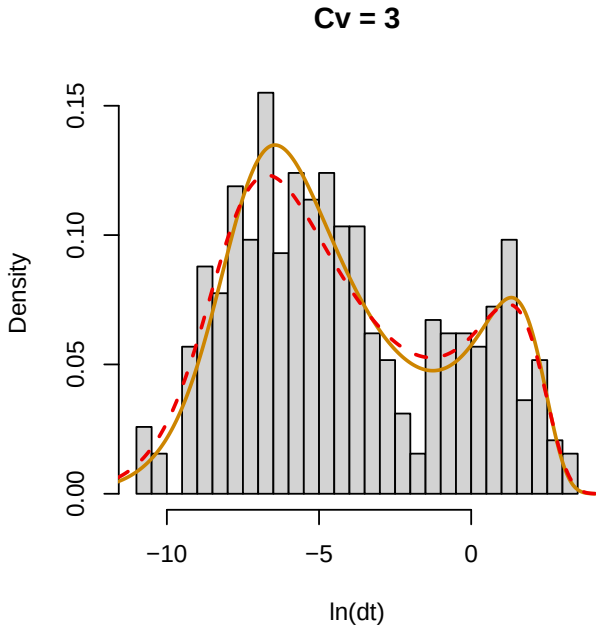

p =1.18 [1.16,1.2] ; loglambdac =−3.7; n =0.99 [0.98,0.998]

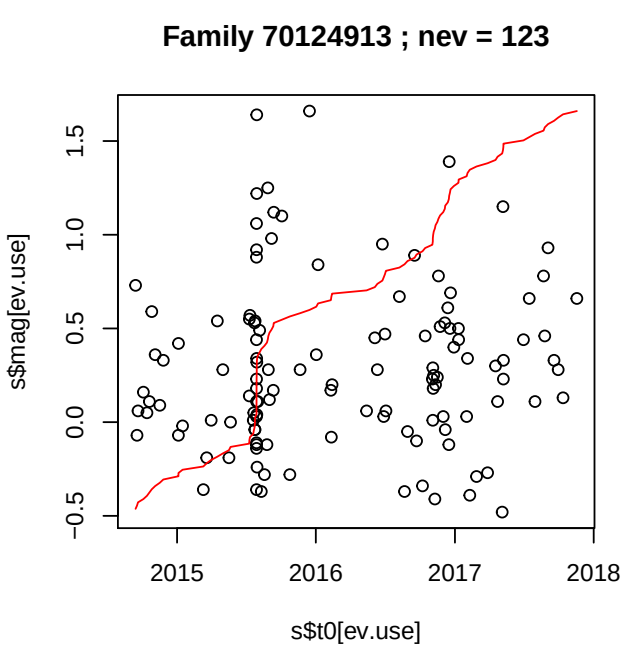

Cv = 7.8
Density
ln(dt)

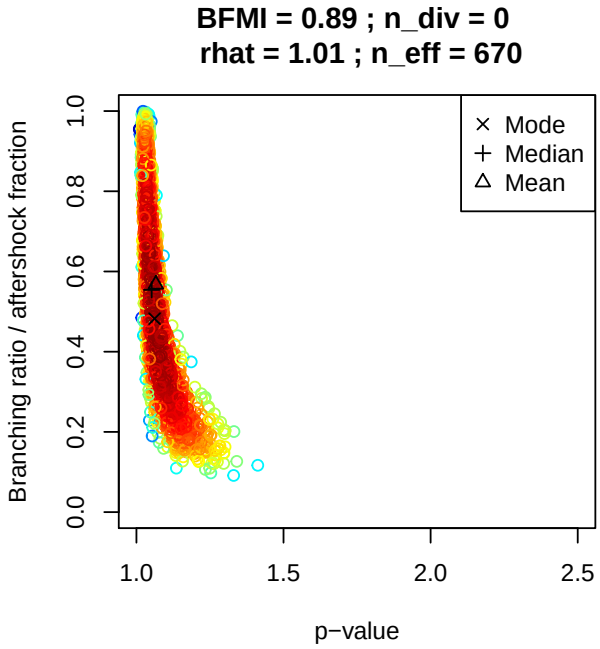

Family 70124853 ; nev = 388
s$mag[ev.use]
s$t0[ev.use]
2015
2016
2017
2018

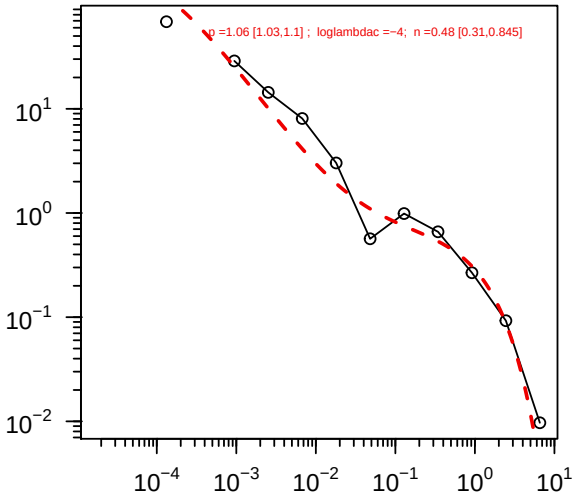

BFMI = 0.89 ; n_div = 0
rhat = 1 ; n_eff = 1013
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value

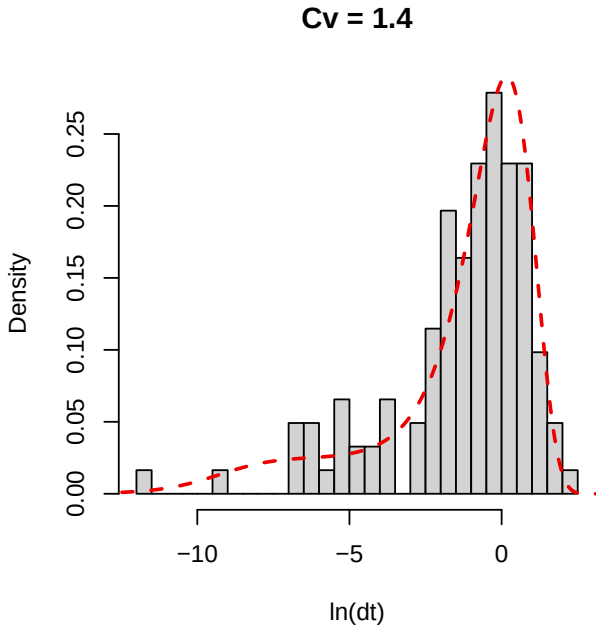

p = 1.355; loglambda.c = −3.254; n = 0.825
p =1.28 [1.24,1.3] ; loglambdac =−3.5; n =0.86 [0.84,0.915]

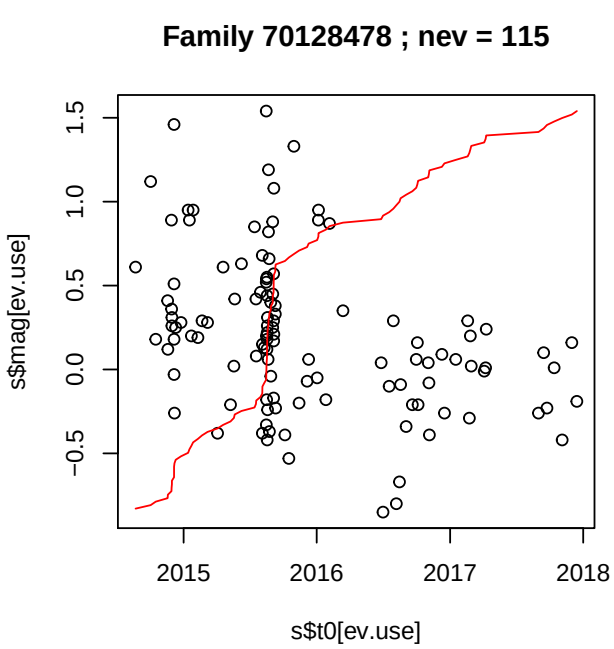

Cv = 3
Density
ln(dt)

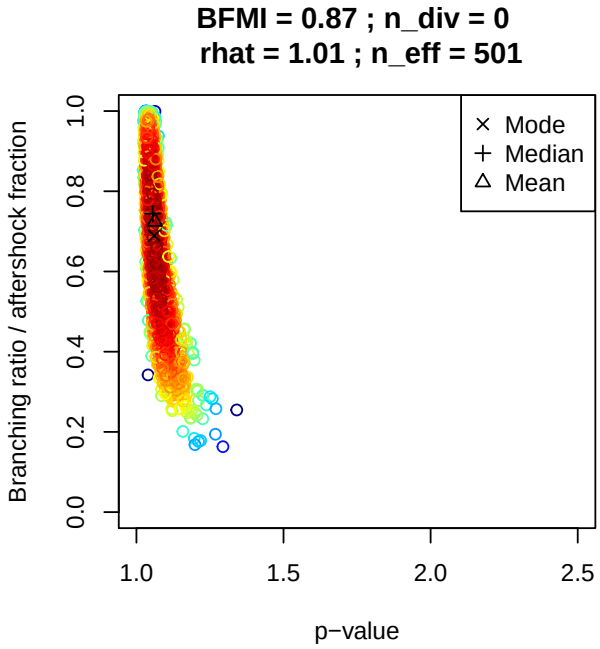

Family 70124913 ; nev = 123
s$mag[ev.use]
s$t0[ev.use]
2015
2016
2017
2018
−0.5
0.0
0.5
1.0
1.5

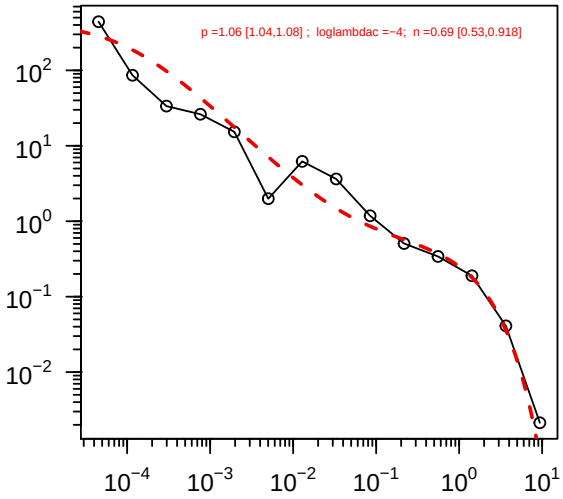

BFMI = 0.89 ; n_div = 0
rhat = 1.01 ; n_eff = 670
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
1.0
1.5
2.0
2.5
0.0
0.2
0.4
0.6
0.8
1.0

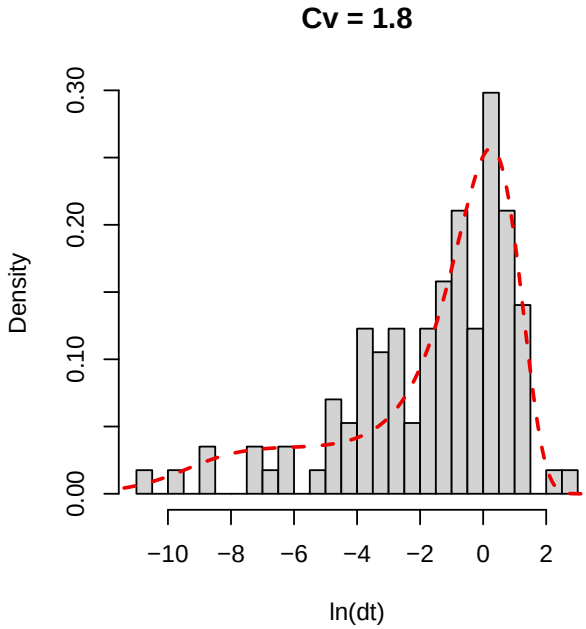

p =1.06 [1.03,1.1] ; loglambdac =−4; n =0.48 [0.31,0.845]
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

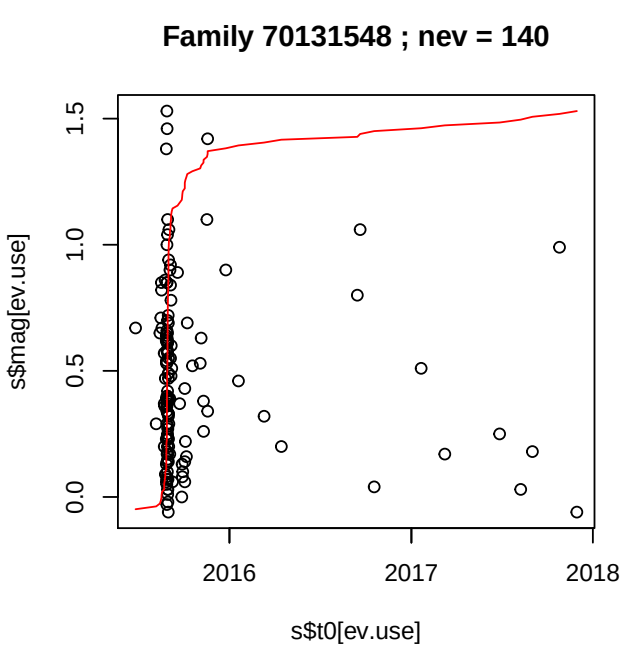

Cv = 1.4
Density
ln(dt)
−10
−5
0
0.00
0.05
0.10
0.15
0.20
0.25

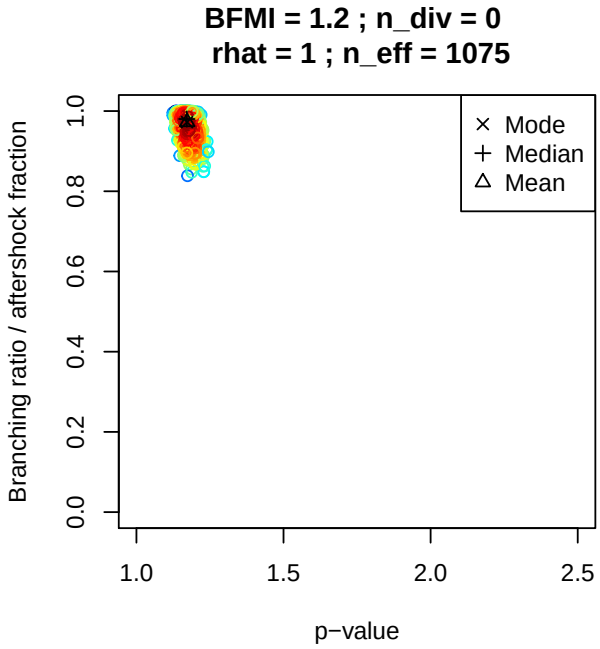

Family 70128478 ; nev = 115
s$mag[ev.use]
s$t0[ev.use]
2015
2016
2017
2018
−0.5
0.0
0.5
1.0
1.5

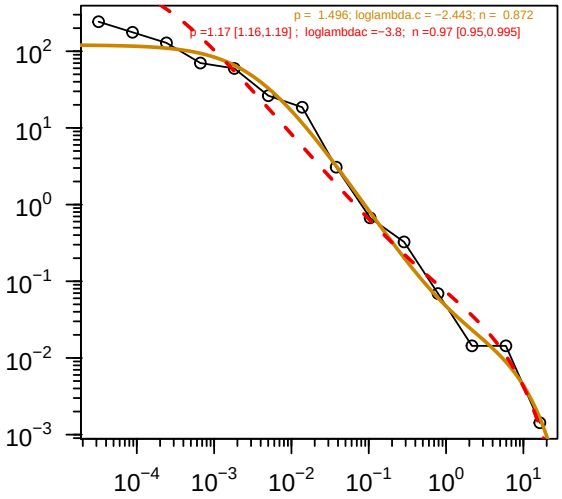

BFMI = 0.87 ; n_div = 0
rhat = 1.01 ; n_eff = 501
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
1.0
1.5
2.0
2.5
0.0
0.2
0.4
0.6
0.8
1.0

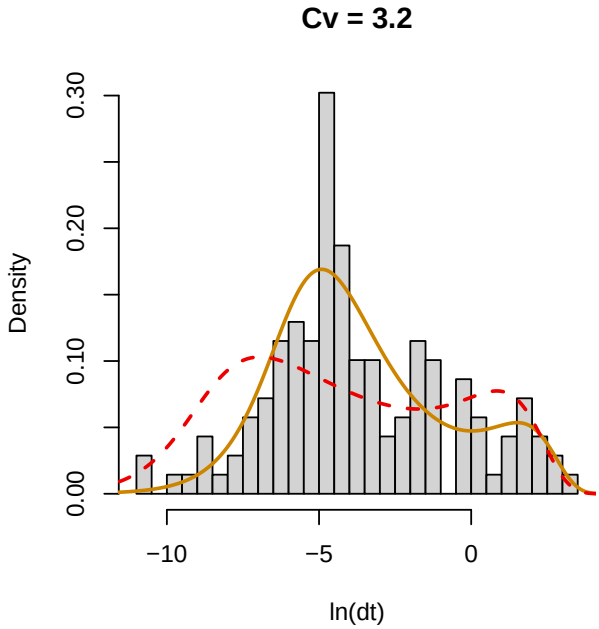

p =1.06 [1.04,1.08] ; loglambdac =−4; n =0.69 [0.53,0.918]
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

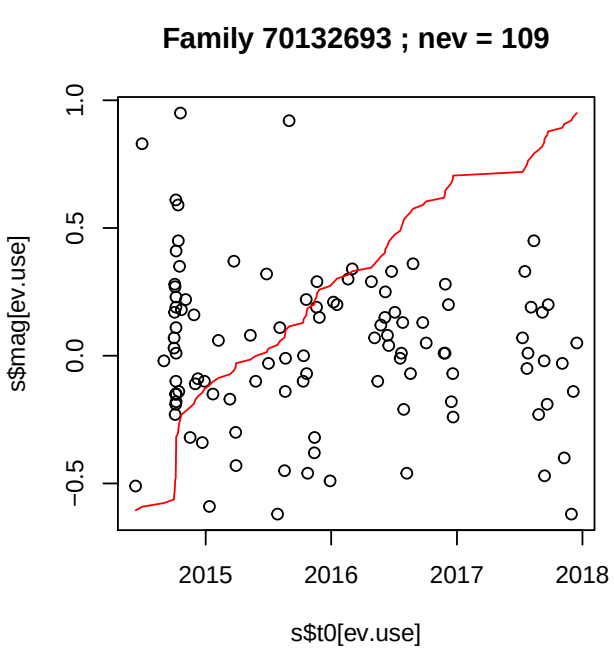

Cv = 1.8
Density
ln(dt)
0.00
0.10
0.20
0.30
−10
−8
−6
−4
−2
0
2

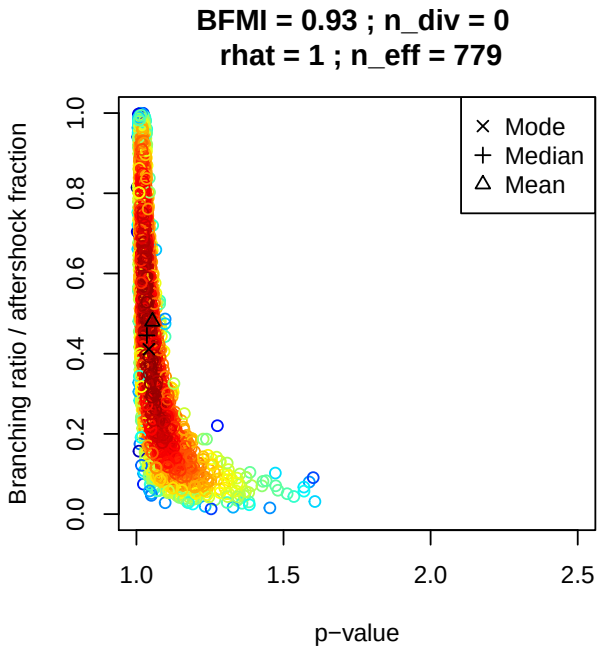

Family 70131548 ; nev = 140
s$mag[ev.use]
s$t0[ev.use]
0.0
0.5
1.0
1.5
2016
2017
2018

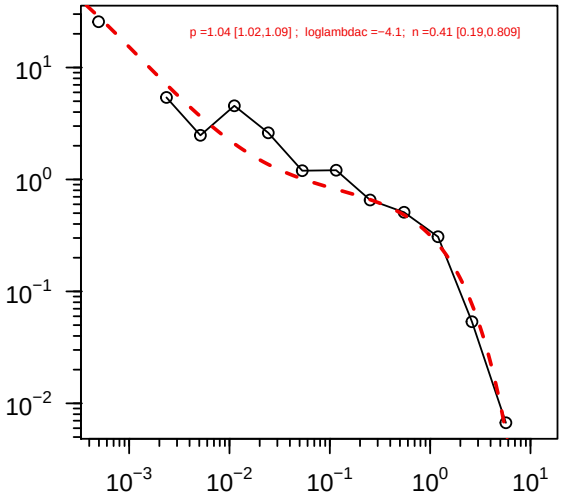

BFMI = 1.2 ; n_div = 0
rhat = 1 ; n_eff = 1075
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5

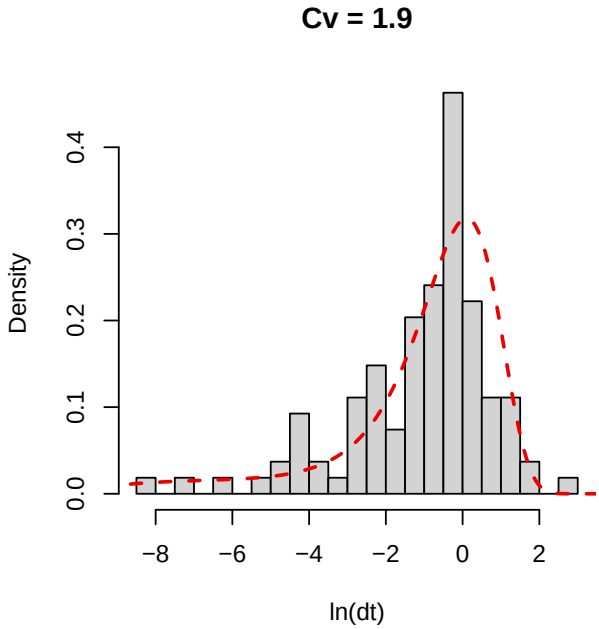

p = 1.496; loglambda.c = −2.443; n = 0.872
p =1.17 [1.16,1.19] ; loglambdac =−3.8; n =0.97 [0.95,0.995]

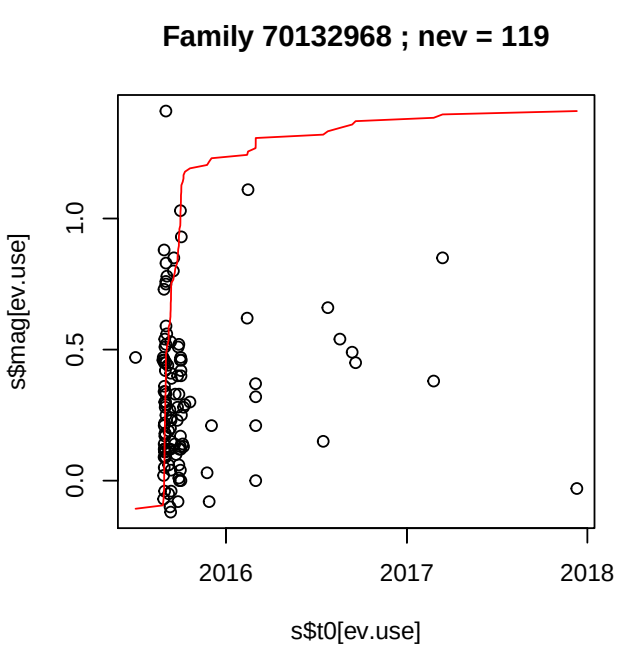

Cv = 3.2
Density
ln(dt)
0.00
0.10
0.20
0.30
−10
−5
0

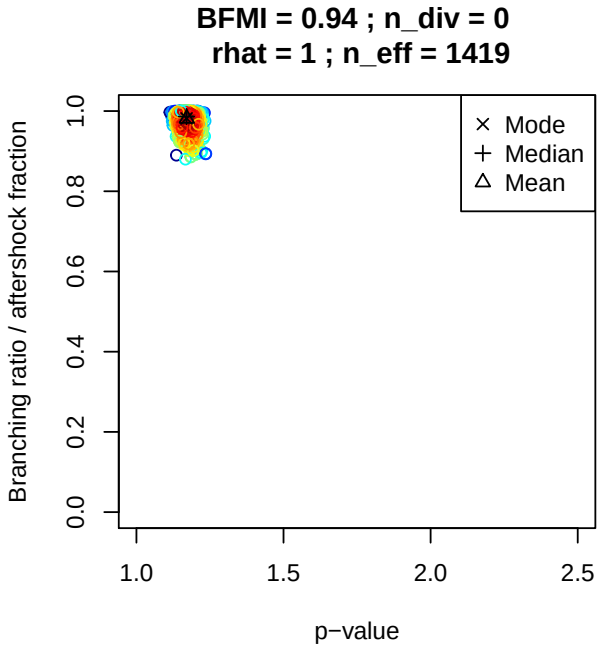

Family 70132693 ; nev = 109
s$mag[ev.use]
s$t0[ev.use]
1.0
0.5
0.0
−0.5
2015
2016
2017
2018

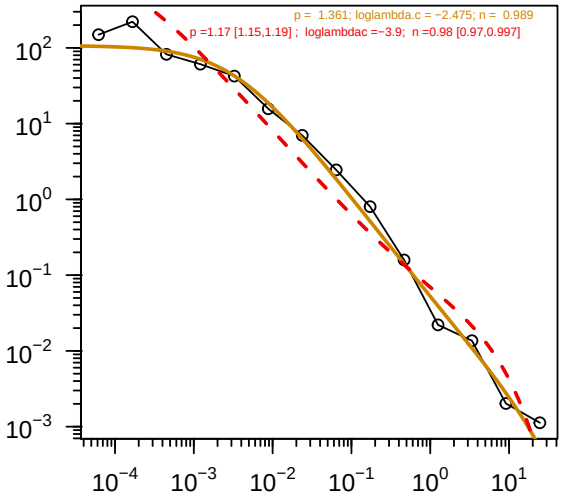

BFMI = 0.93 ; n_div = 0
rhat = 1 ; n_eff = 779
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5

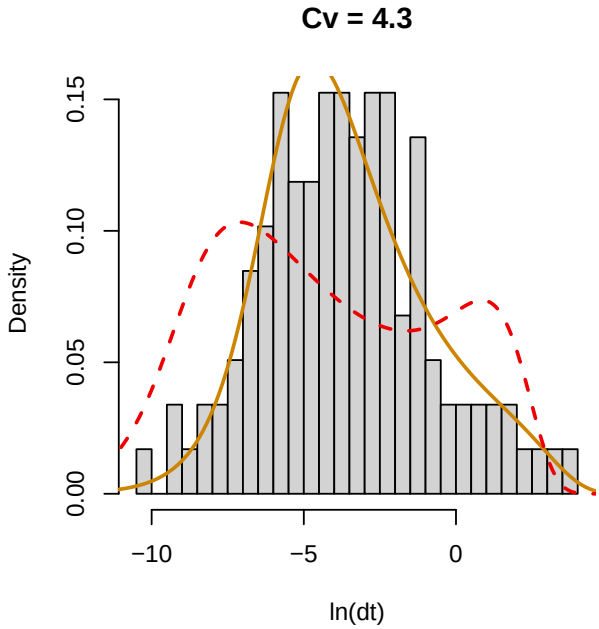

p =1.04 [1.02,1.09] ; loglambdac =−4.1; n =0.41 [0.19,0.809]
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

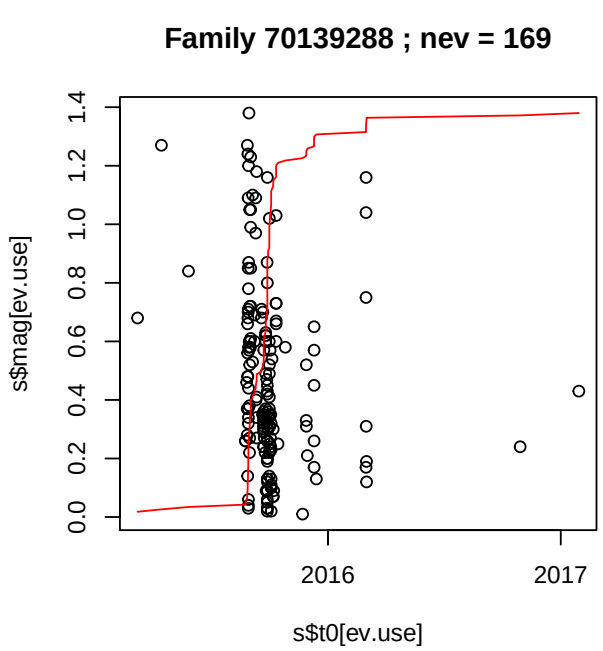

Cv = 1.9
Density
ln(dt)
0.0
0.1
0.2
0.3
0.4
−8
−6
−4
−2
0
2

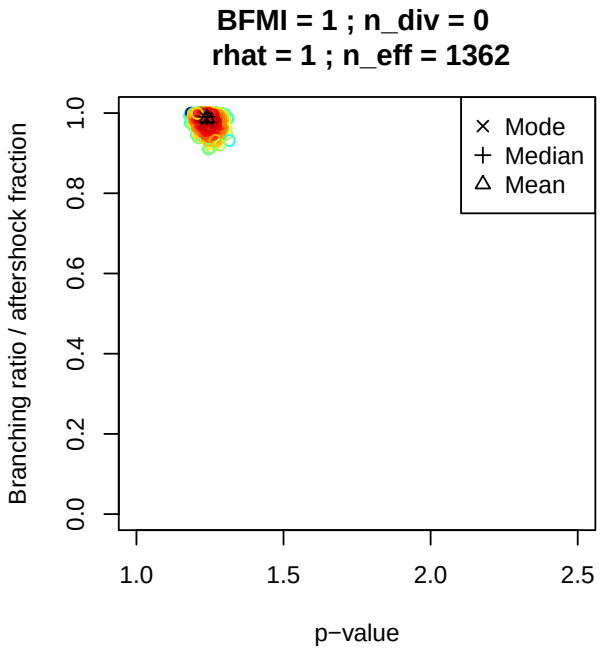

Family 70132968 ; nev = 119
s$mag[ev.use]
0.0
0.5
1.0
2016
2017
2018
s$t0[ev.use]

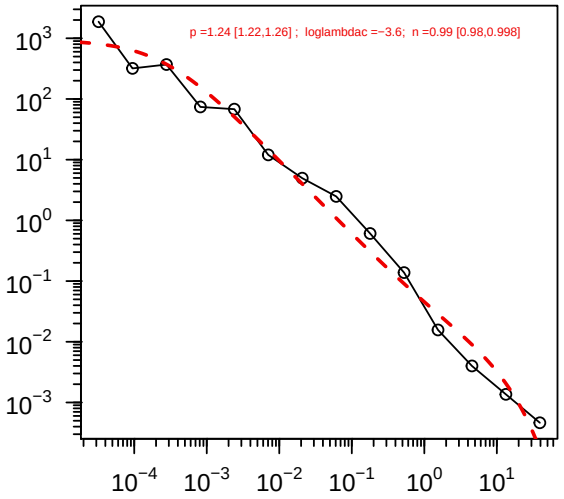

BFMI = 0.94 ; n_div = 0
rhat = 1 ; n_eff = 1419
Mode
Median
Mean
Branching ratio / aftershock fraction
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5
p−value

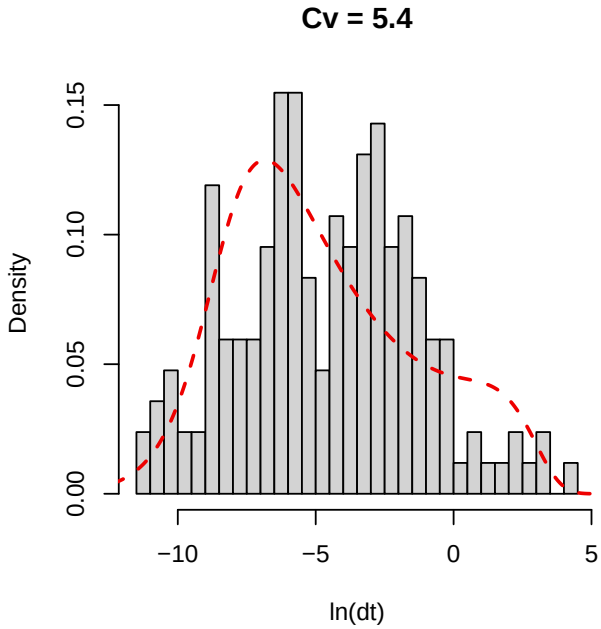

p = 1.361; loglambda.c = −2.475; n = 0.989
p =1.17 [1.15,1.19] ; loglambdac =−3.9; n =0.98 [0.97,0.997]
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-3}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

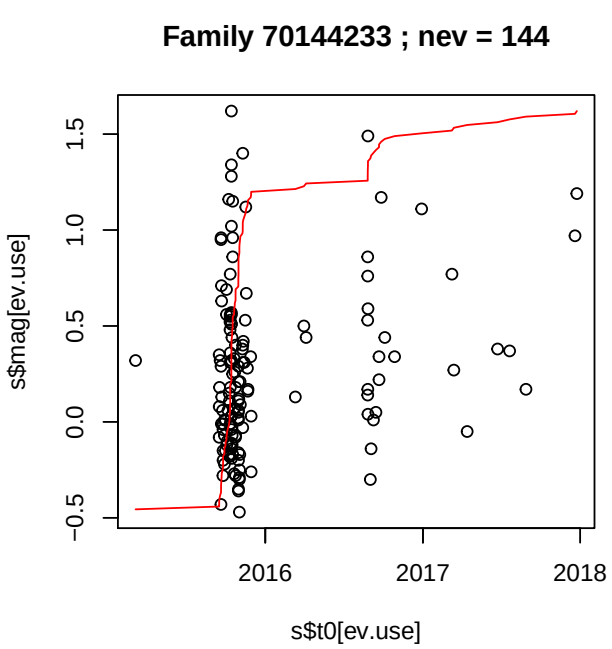

Cv = 4.3
Density
0.00
0.05
0.10
0.15
−10
−5
0
ln(dt)

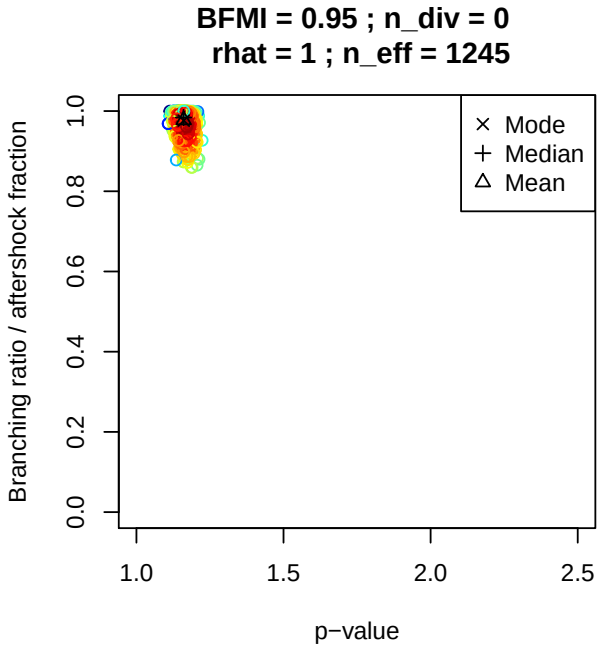

Family 70139288 ; nev = 169
s$mag[ev.use]
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
2016
2017
s$t0[ev.use]

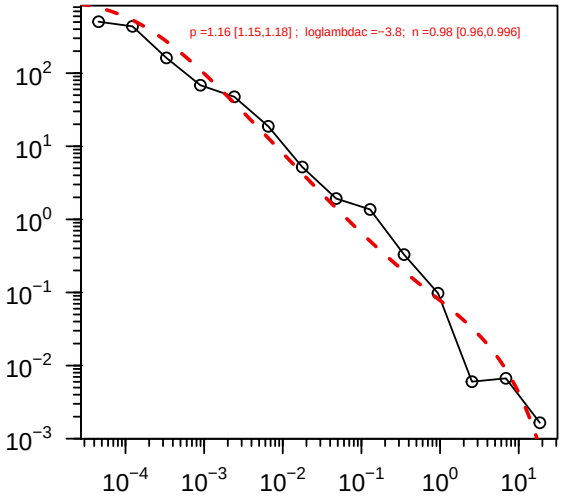

BFMI = 1 ; n_div = 0
rhat = 1 ; n_eff = 1362
Branching ratio / aftershock fraction
0.0
0.2
0.4
0.6
0.8
1.0
× Mode
+ Median
△ Mean
1.0
1.5
2.0
2.5
p−value

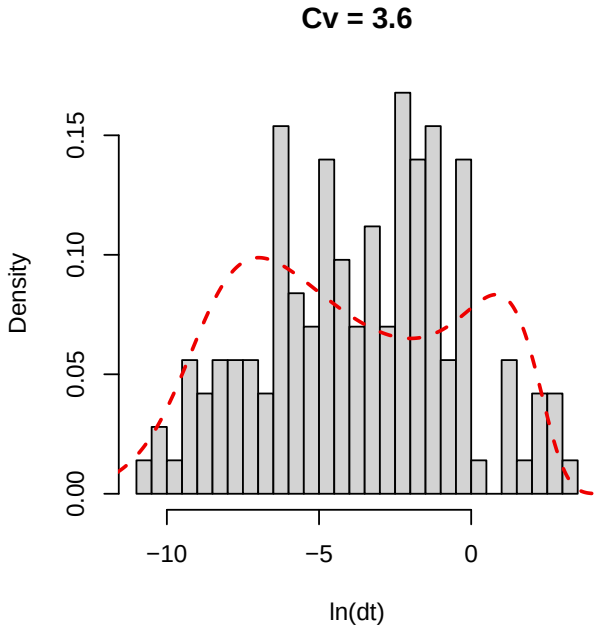

p =1.24 [1.22,1.26] ; loglambdac =−3.6; n =0.99 [0.98,0.998]
$10^{3}$
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-3}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

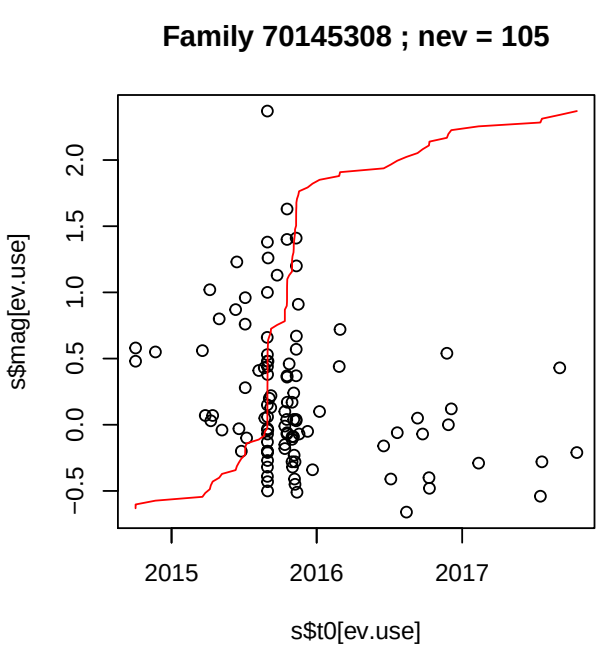

Cv = 5.4
Density
0.00
0.05
0.10
0.15
−10
−5
0
5
ln(dt)

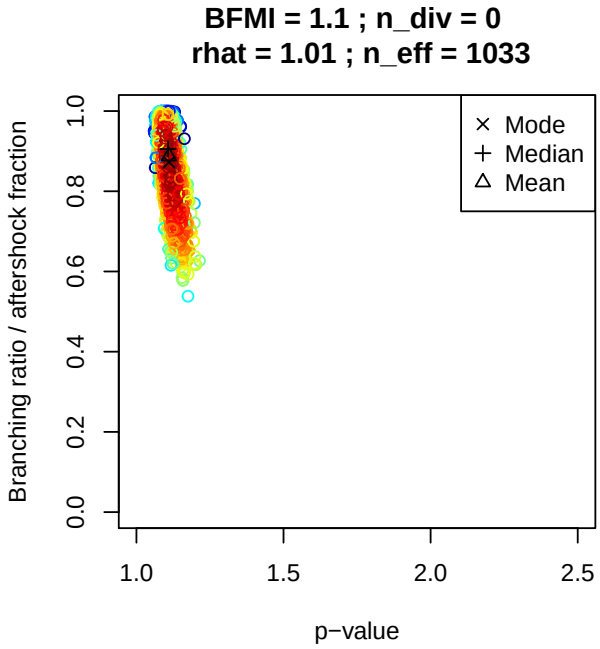

Family 70144233 ; nev = 144
s$mag[ev.use]
s$t0[ev.use]
−0.5
0.0
0.5
1.0
1.5
2016
2017
2018

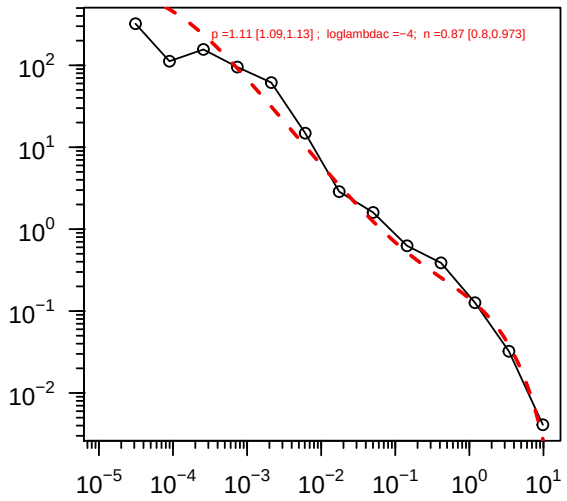

BFMI = 0.95 ; n_div = 0
rhat = 1 ; n_eff = 1245
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5

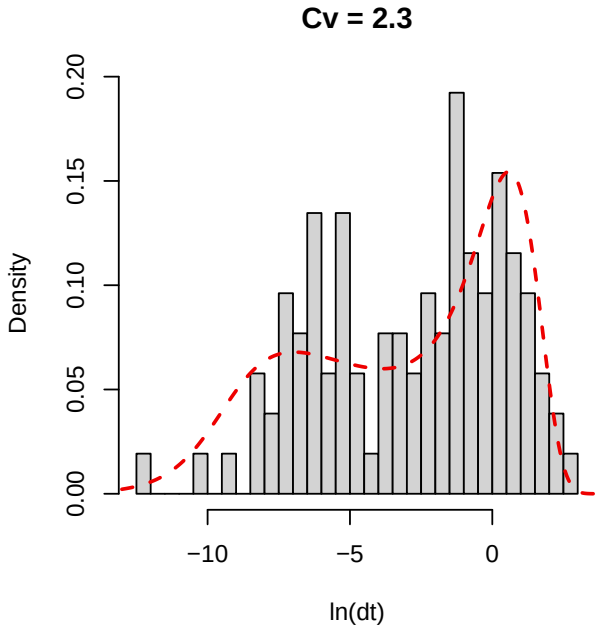

p =1.16 [1.15,1.18] ; loglambdac =−3.8; n =0.98 [0.96,0.996]
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-3}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

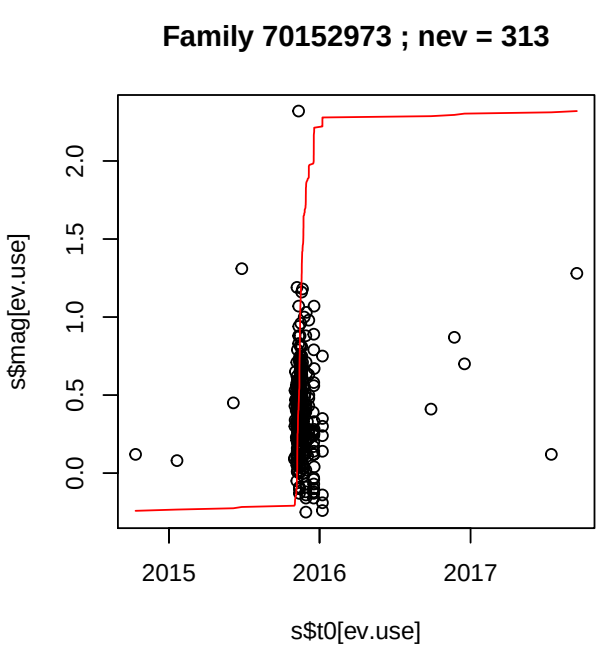

Cv = 3.6
Density
ln(dt)
0.00
0.05
0.10
0.15
−10
−5
0

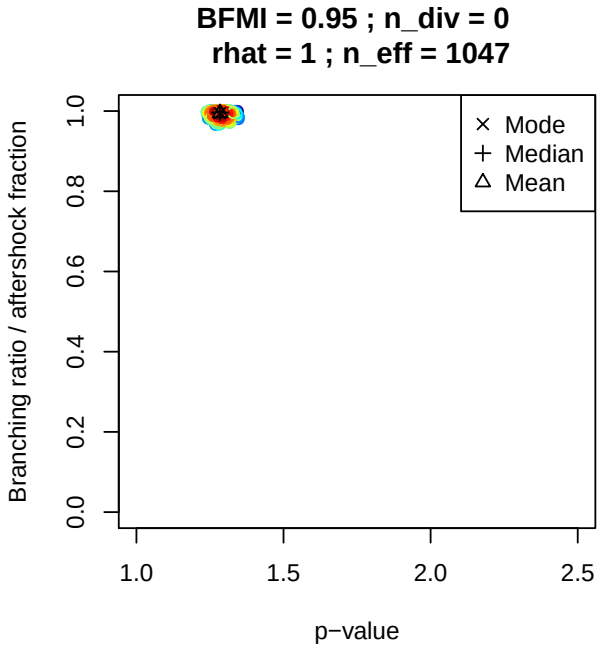

Family 70145308 ; nev = 105
s$mag[ev.use]
s$t0[ev.use]
2015
2016
2017
−0.5
0.0
0.5
1.0
1.5
2.0

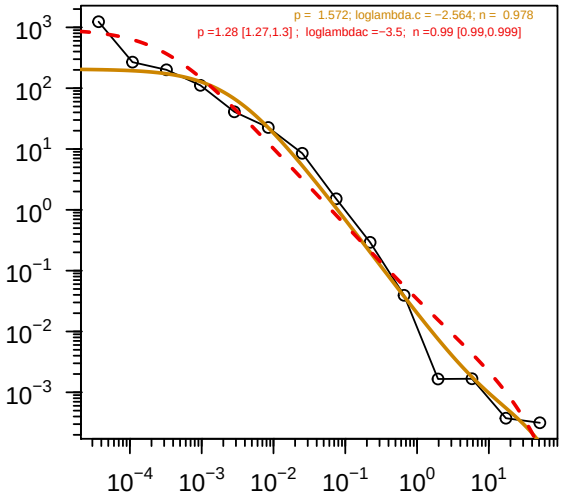

BFMI = 1.1 ; n_div = 0
rhat = 1.01 ; n_eff = 1033
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5

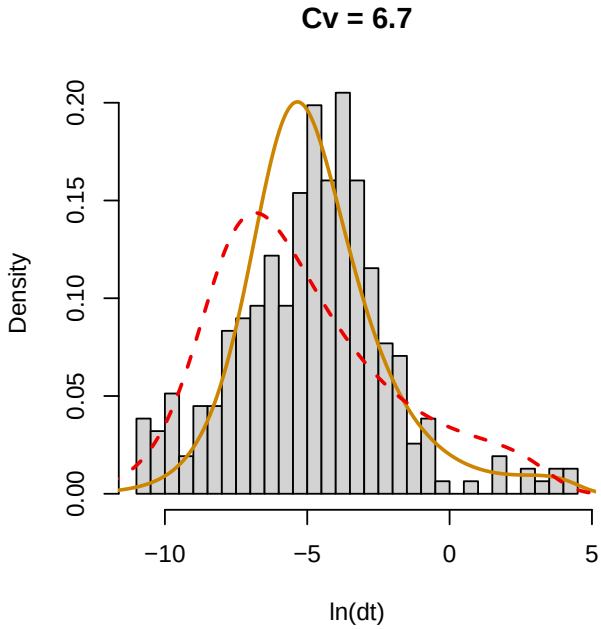

p =1.11 [1.09,1.13] ; loglambdac =−4; n =0.87 [0.8,0.973]
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-5}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

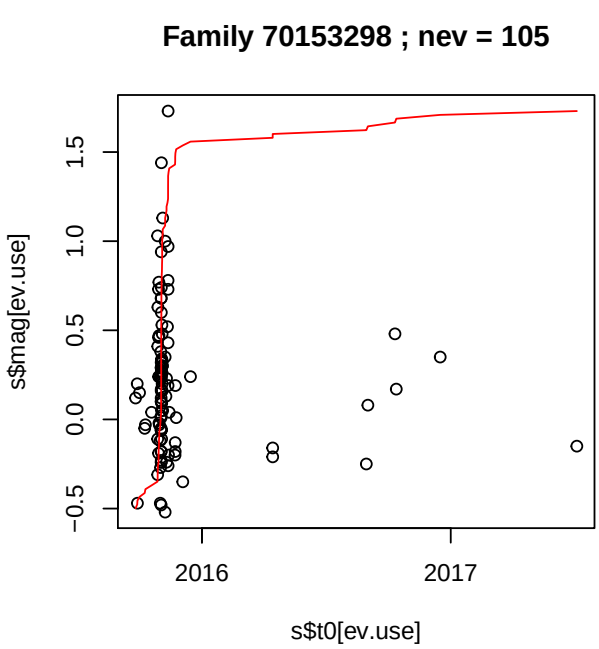

Cv = 2.3
Density
ln(dt)
0.00
0.05
0.10
0.15
0.20
−10
−5
0

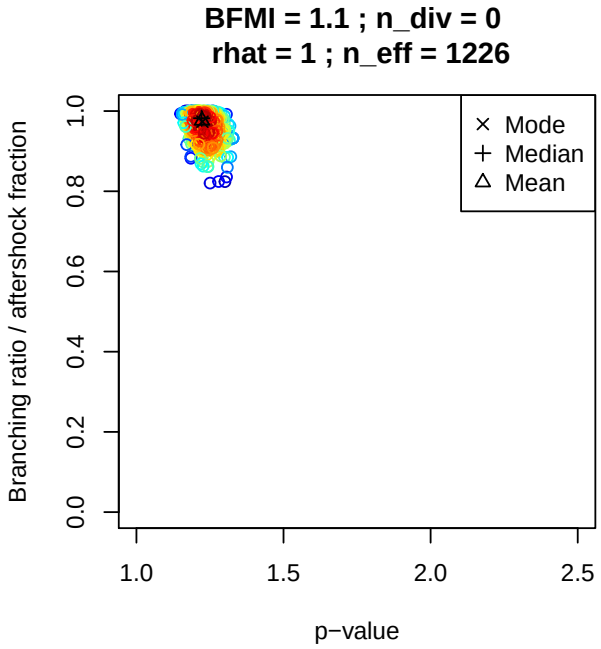

Family 70152973 ; nev = 313
s$mag[ev.use]
0.0
0.5
1.0
1.5
2.0
2015
2016
2017
s$t0[ev.use]

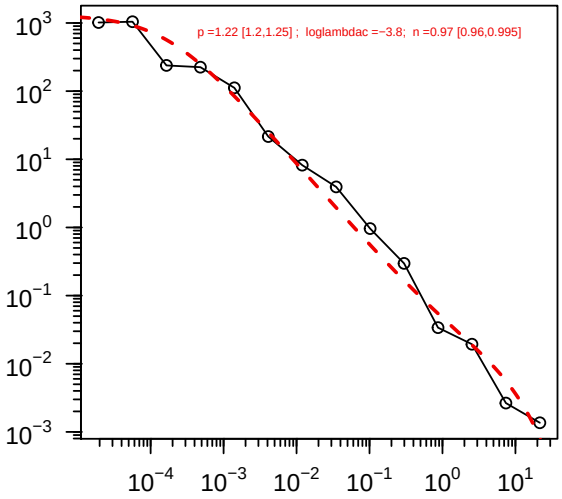

BFMI = 0.95 ; n_div = 0
rhat = 1 ; n_eff = 1047
Mode
Median
Mean
Branching ratio / aftershock fraction
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5
p−value

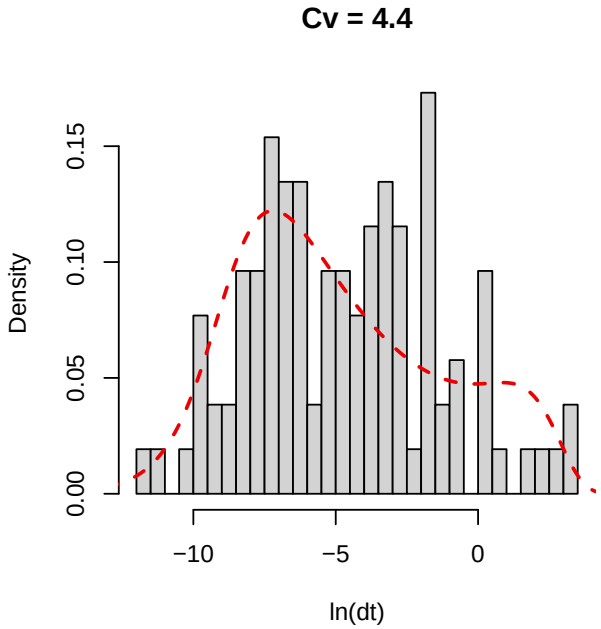

p = 1.572; loglambda.c = −2.564; n = 0.978
p =1.28 [1.27,1.3] ; loglambdac =−3.5; n =0.99 [0.99,0.999]
$10^{3}$
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-3}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

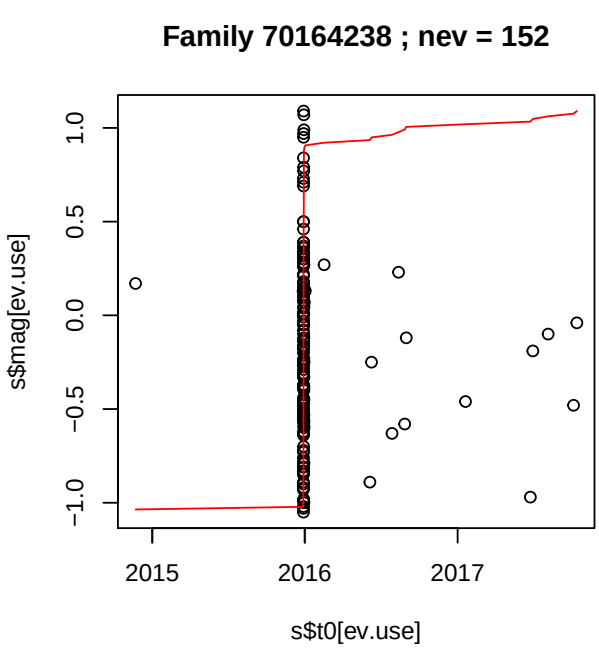

Cv = 6.7
Density
0.00
0.05
0.10
0.15
0.20
−10
−5
0
5
ln(dt)

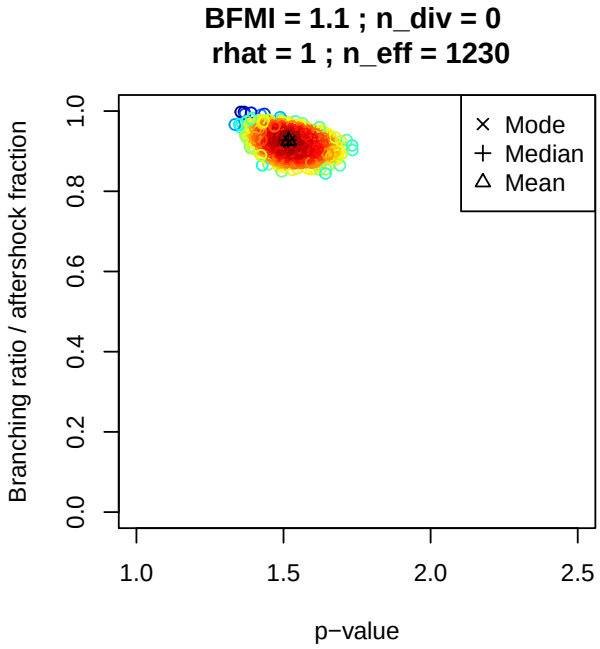

Family 70153298 ; nev = 105
s$mag[ev.use]
s$t0[ev.use]
2016
2017

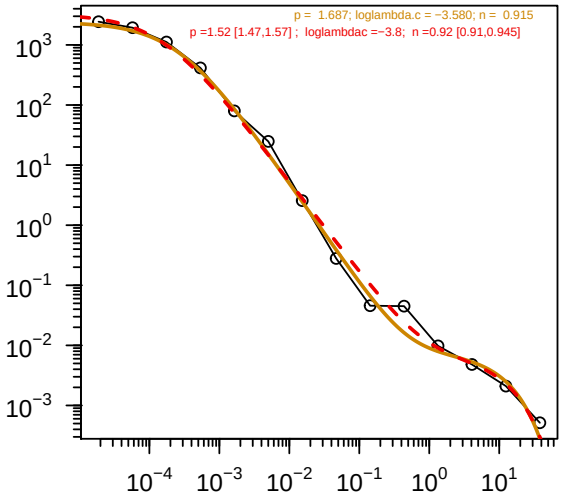

BFMI = 1.1 ; n_div = 0
rhat = 1 ; n_eff = 1226
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value

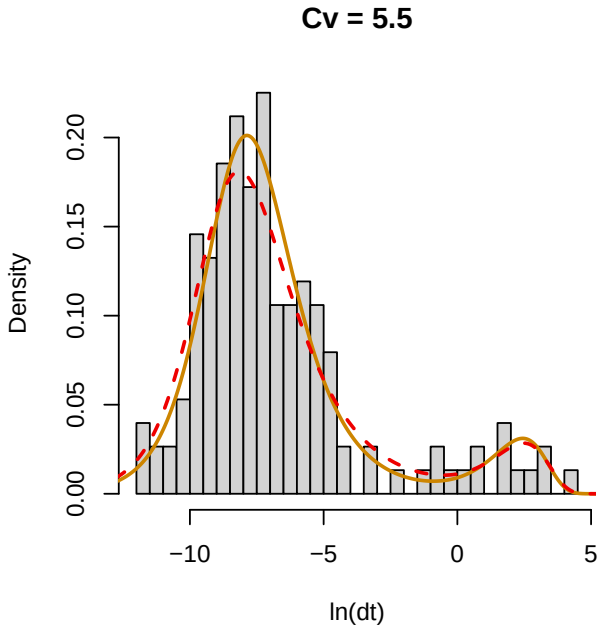

p =1.22 [1.2,1.25] ; loglambdac =−3.8; n =0.97 [0.96,0.995]

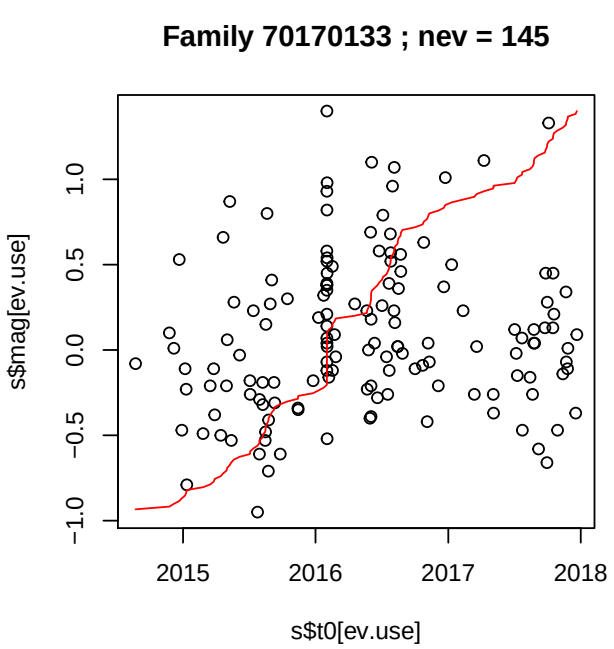

Cv = 4.4
Density
ln(dt)

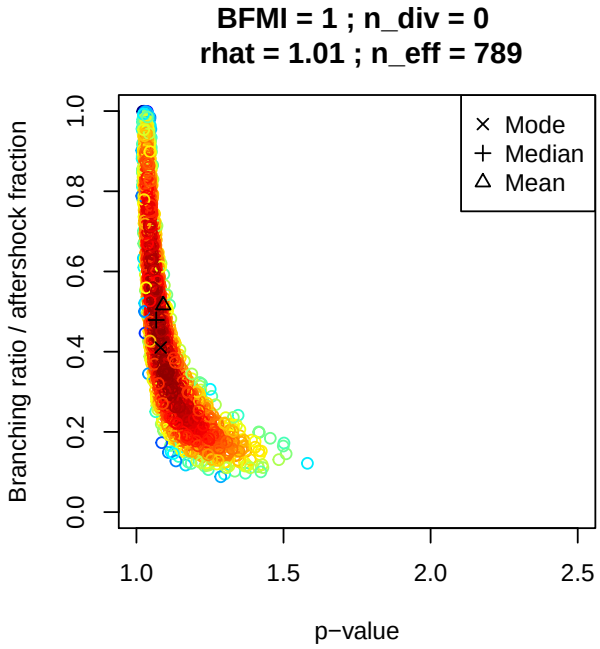

Family 70164238 ; nev = 152
s$mag[ev.use]
s$t0[ev.use]
2015
2016
2017
−1.0
−0.5
0.0
0.5
1.0

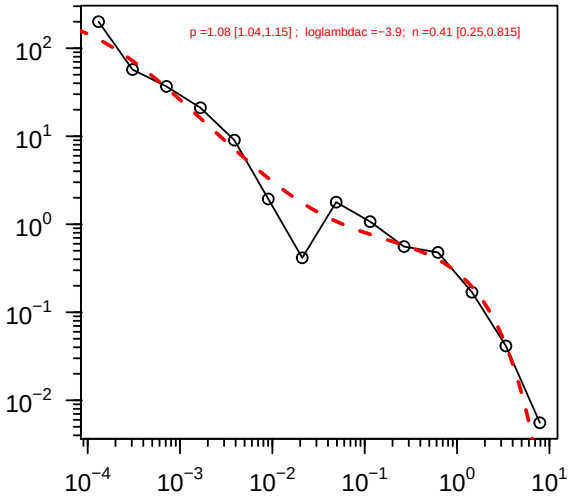

BFMI = 1.1 ; n_div = 0
rhat = 1 ; n_eff = 1230
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5

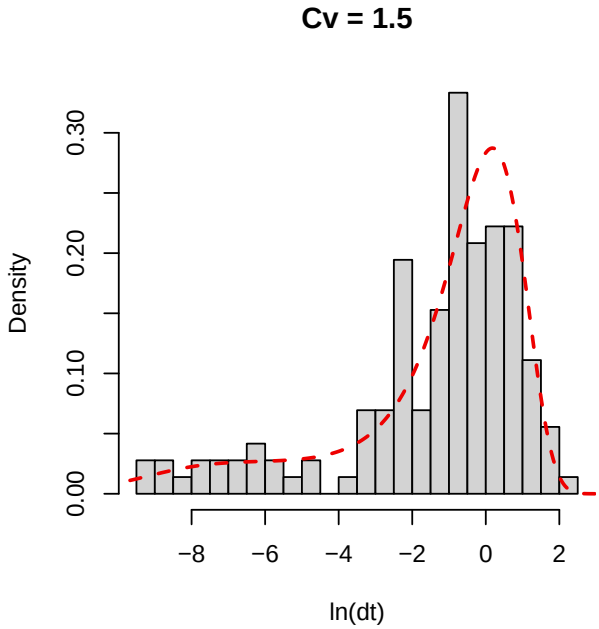

p = 1.687; loglambda.c = −3.580; n = 0.915
p =1.52 [1.47,1.57] ; loglambdac =−3.8; n =0.92 [0.91,0.945]

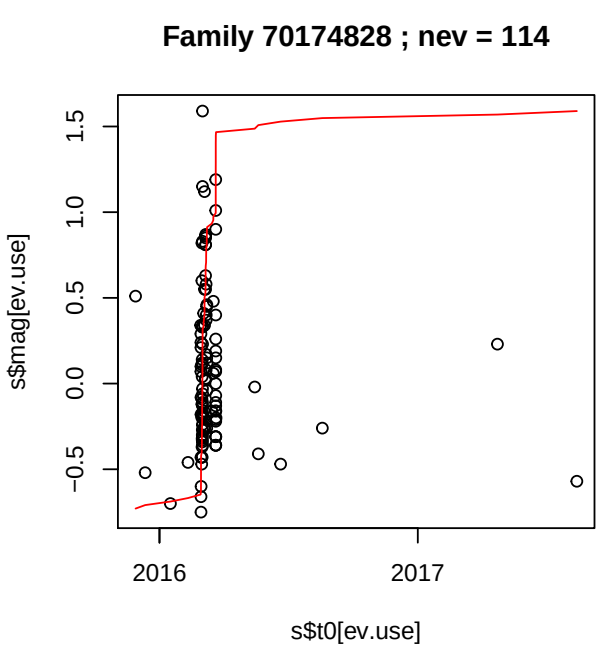

Cv = 5.5
Density
ln(dt)
0.00
0.05
0.10
0.15
0.20
−10
−5
0
5

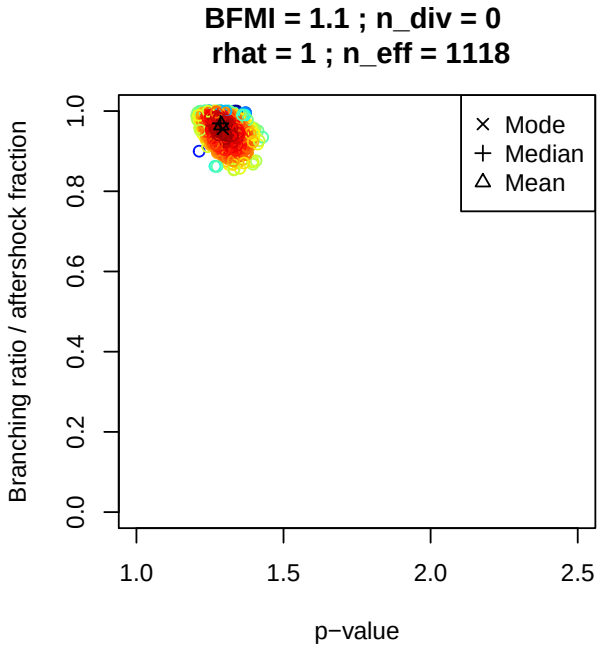

Family 70170133 ; nev = 145
s$mag[ev.use]
s$t0[ev.use]
−1.0
−0.5
0.0
0.5
1.0
2015
2016
2017
2018

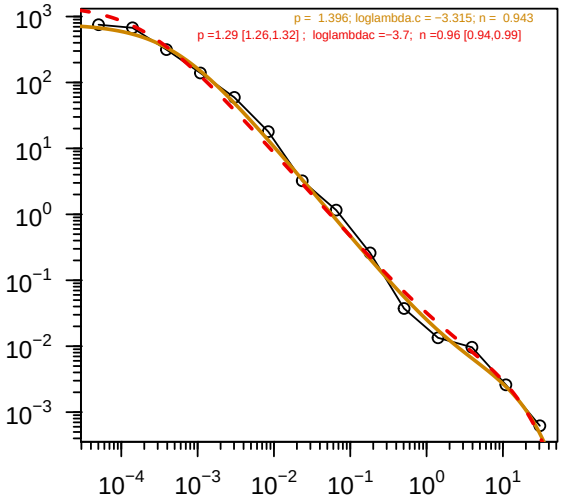

BFMI = 1 ; n_div = 0
rhat = 1.01 ; n_eff = 789
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5

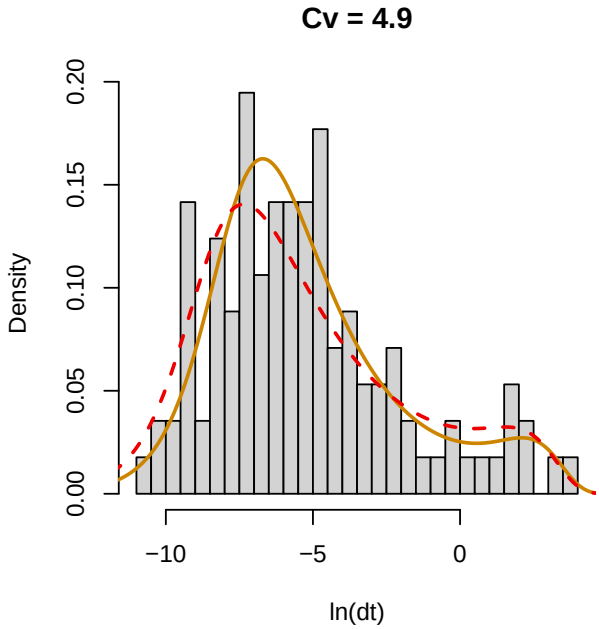

p =1.08 [1.04,1.15] ; loglambdac =−3.9; n =0.41 [0.25,0.815]
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

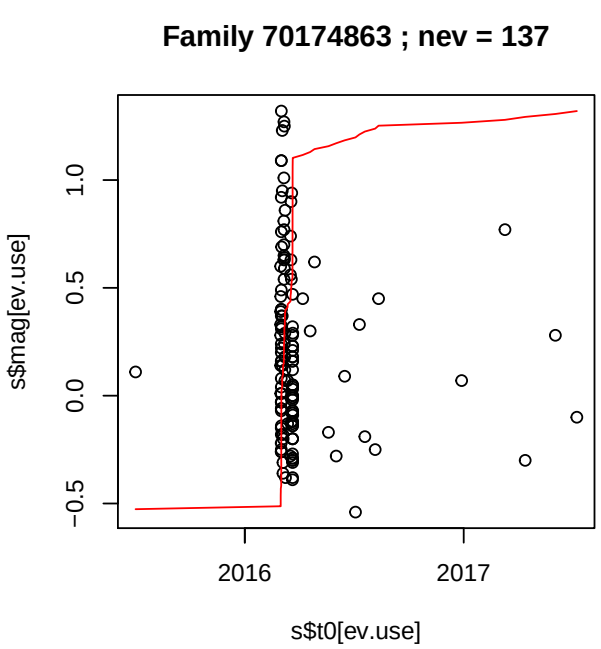

Cv = 1.5
Density
ln(dt)
0.00
0.10
0.20
0.30
−8
−6
−4
−2
0
2

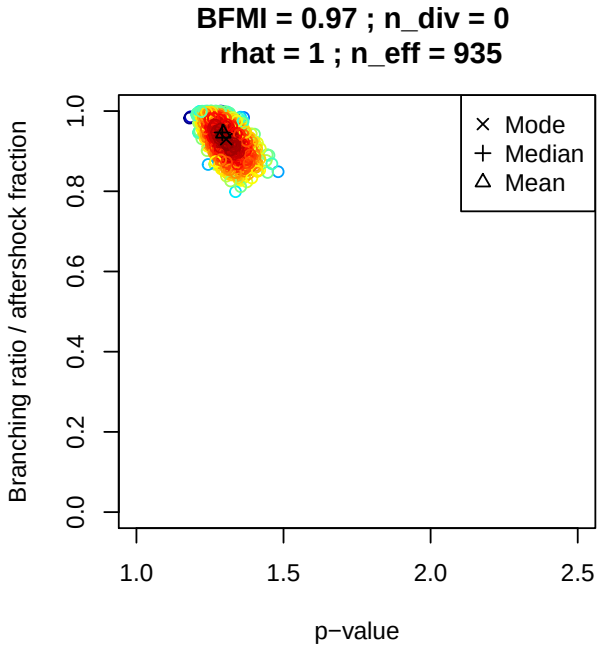

Family 70174828 ; nev = 114
s$mag[ev.use]
s$t0[ev.use]
2016
2017
−0.5
0.0
0.5
1.0
1.5

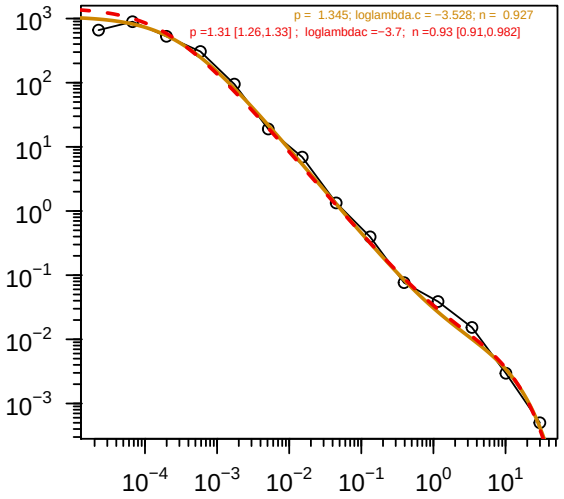

BFMI = 1.1 ; n_div = 0
rhat = 1 ; n_eff = 1118
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5

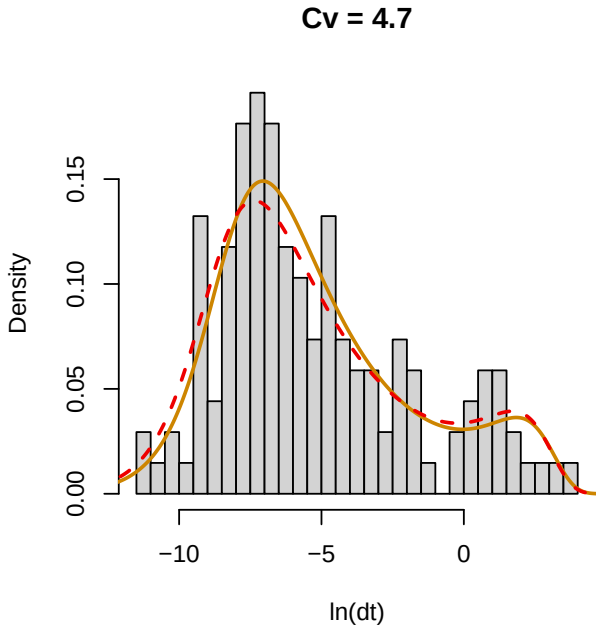

p = 1.396; loglambda.c = −3.315; n = 0.943
p =1.29 [1.26,1.32] ; loglambdac =−3.7; n =0.96 [0.94,0.99]

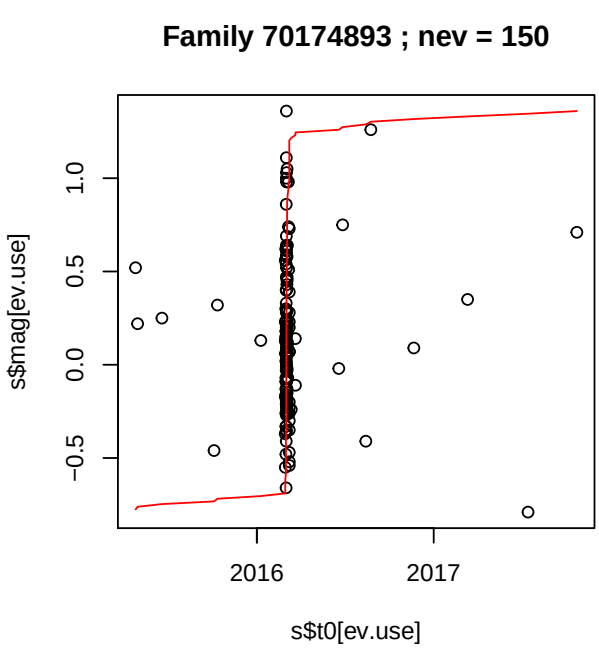

Cv = 4.9
Density
ln(dt)
0.00
0.05
0.10
0.15
0.20
−10
−5
0

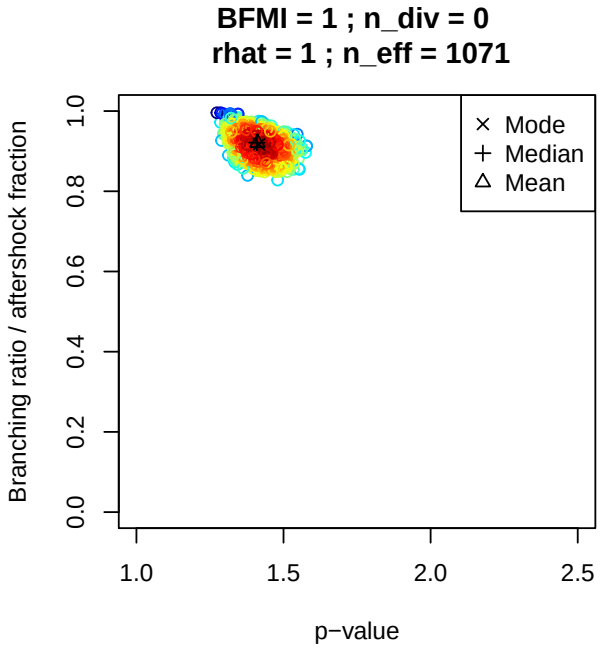

Family 70174863 ; nev = 137
s$mag[ev.use]
1.0
0.5
0.0
−0.5
2016
2017
s$t0[ev.use]

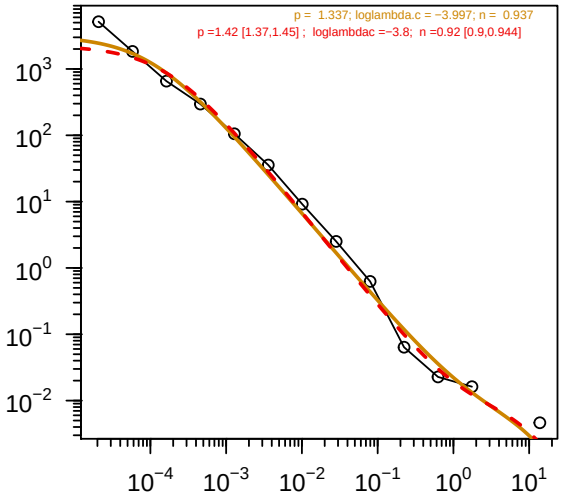

BFMI = 0.97 ; n_div = 0
rhat = 1 ; n_eff = 935
Mode
Median
Mean
Branching ratio / aftershock fraction
1.0
0.8
0.6
0.4
0.2
0.0
1.0
1.5
2.0
2.5
p−value

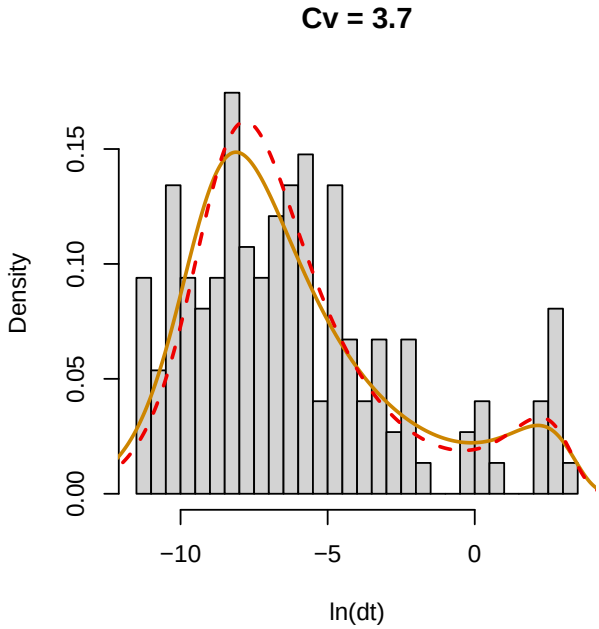

p = 1.345; loglambda.c = −3.528; n = 0.927
p =1.31 [1.26,1.33] ; loglambdac =−3.7; n =0.93 [0.91,0.982]
10^3
10^2
10^1
10^0
10^−1
10^−2
10^−3
10^−4
10^−3
10^−2
10^−1
10^0
10^1

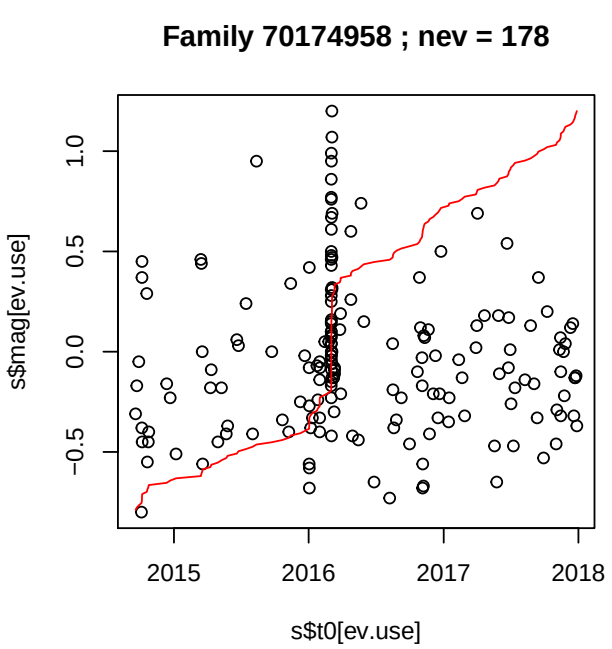

Cv = 4.7
Density
0.15
0.10
0.05
0.00
−10
−5
0
ln(dt)

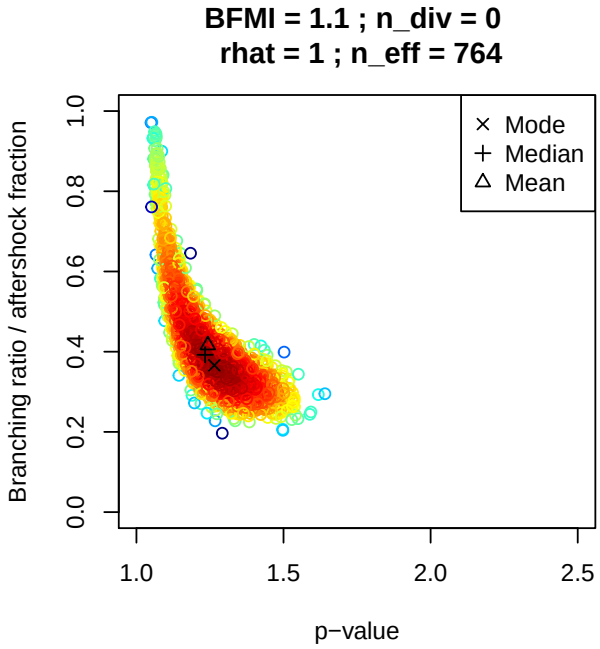

Family 70174893 ; nev = 150
s$mag[ev.use]
s$t0[ev.use]
2016
2017
−0.5
0.0
0.5
1.0

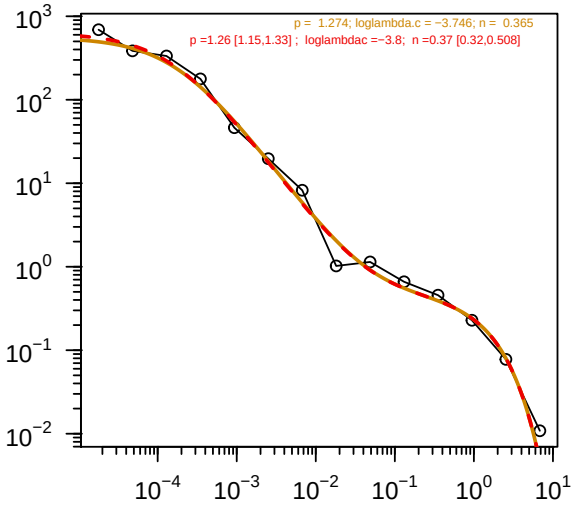

BFMI = 1 ; n_div = 0
rhat = 1 ; n_eff = 1071
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5

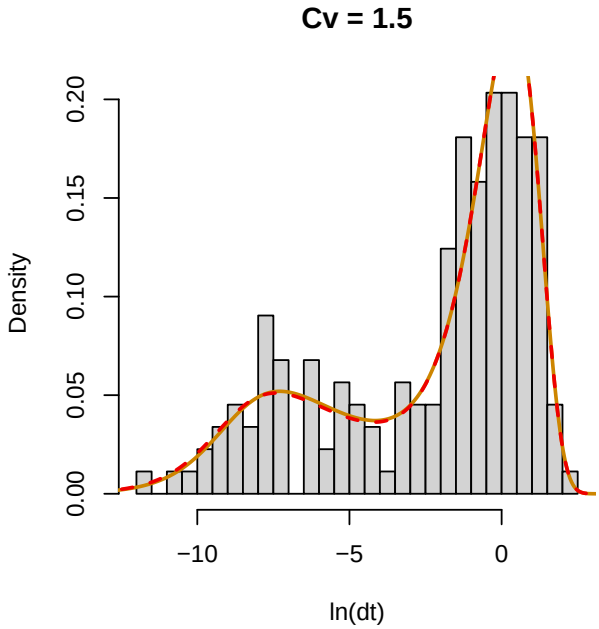

p = 1.337; loglambda.c = −3.997; n = 0.937
p =1.42 [1.37,1.45] ; loglambdac =−3.8; n =0.92 [0.9,0.944]
$10^{3}$
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

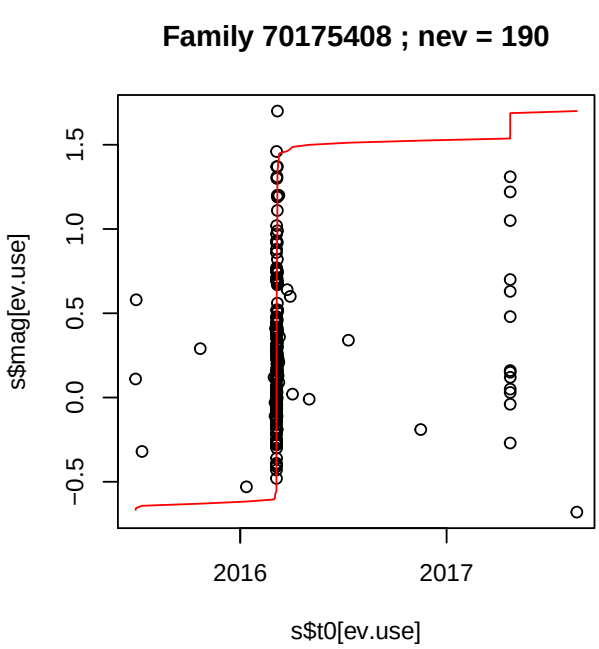

Cv = 3.7
Density
ln(dt)
0.00
0.05
0.10
0.15
−10
−5
0

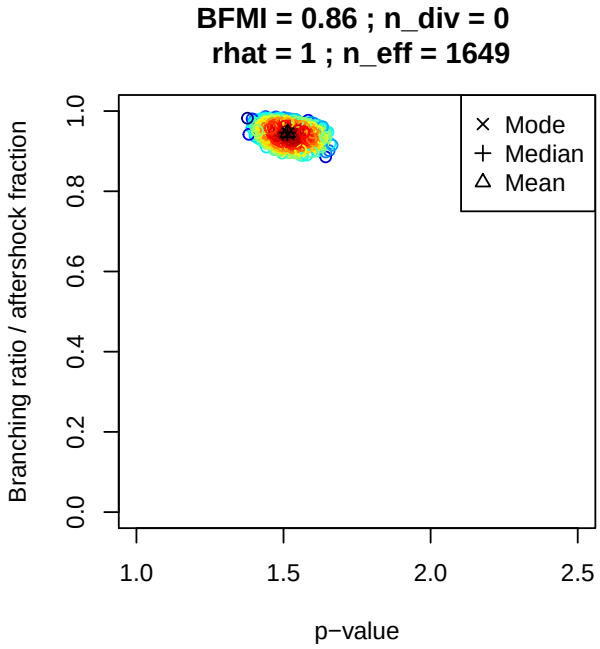

Family 70174958 ; nev = 178
s$mag[ev.use]
s$t0[ev.use]
2015
2016
2017
2018
−0.5
0.0
0.5
1.0

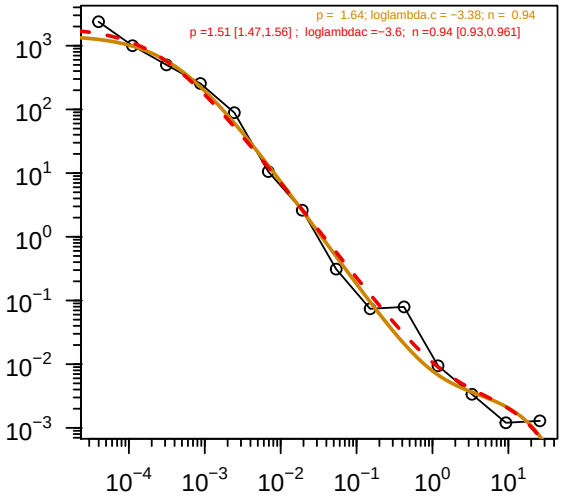

BFMI = 1.1 ; n_div = 0
rhat = 1 ; n_eff = 764
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5

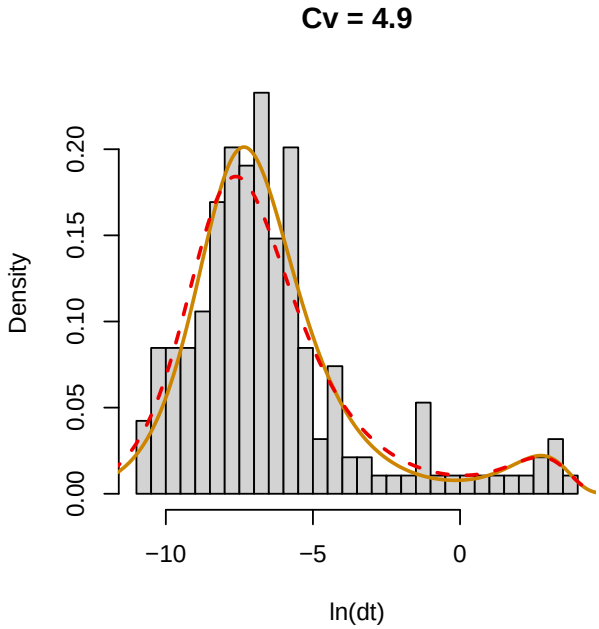

p = 1.274; loglambda.c = −3.746; n = 0.365
p =1.26 [1.15,1.33] ; loglambdac =−3.8; n =0.37 [0.32,0.508]
$10^{3}$
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

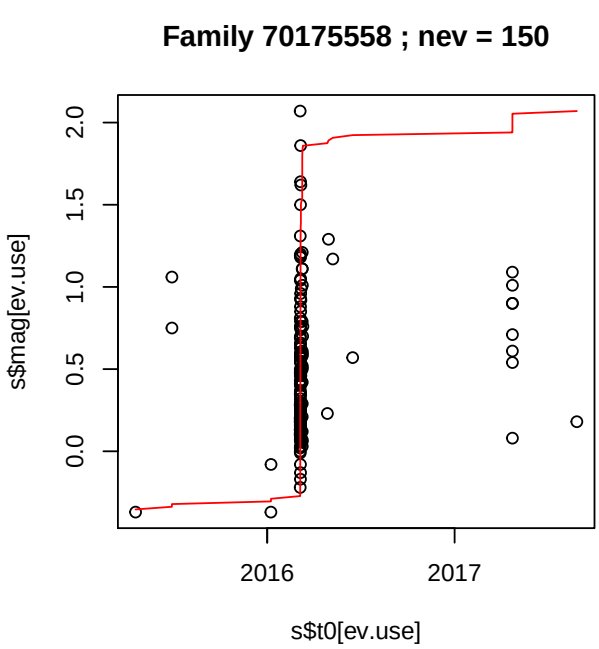

Cv = 1.5
Density
ln(dt)
0.00
0.05
0.10
0.15
0.20
−10
−5
0

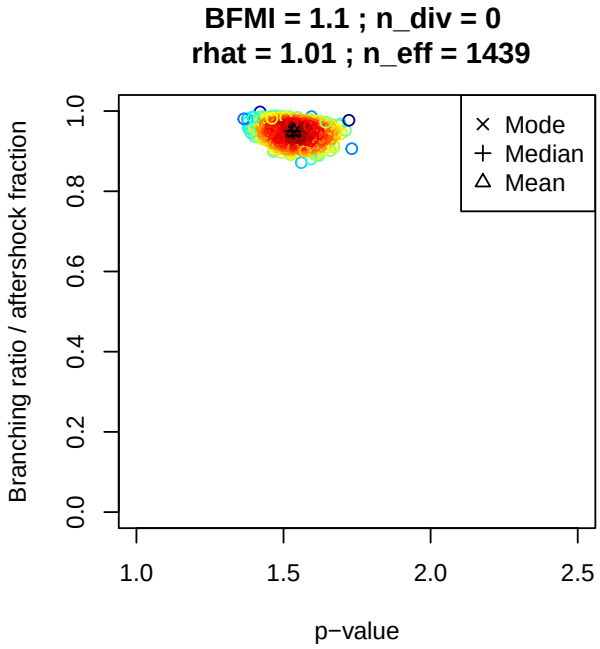

Family 70175408 ; nev = 190
s$mag[ev.use]
s$t0[ev.use]
2016
2017
−0.5
0.0
0.5
1.0
1.5

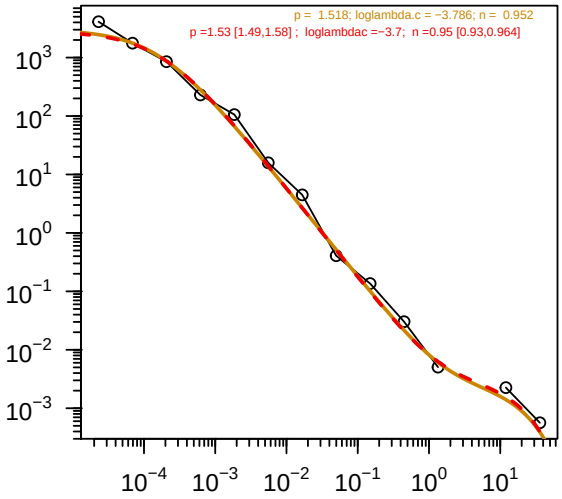

BFMI = 0.86 ; n_div = 0
rhat = 1 ; n_eff = 1649
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5

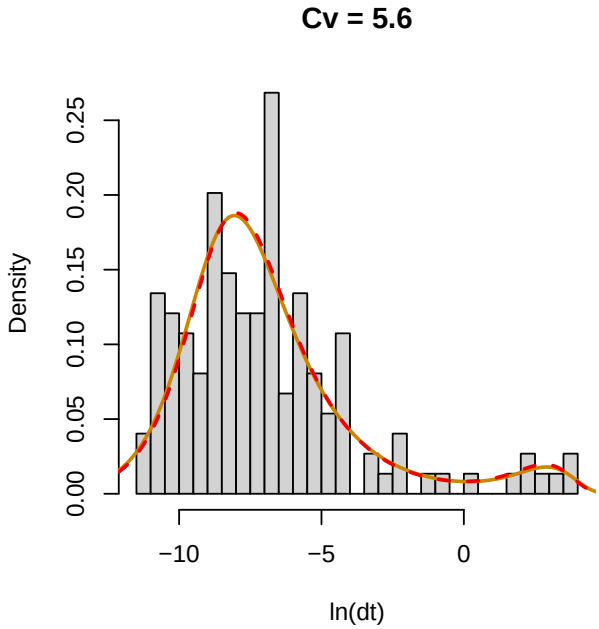

p = 1.64; loglambda.c = −3.38; n = 0.94
p =1.51 [1.47,1.56] ; loglambdac =−3.6; n =0.94 [0.93,0.961]

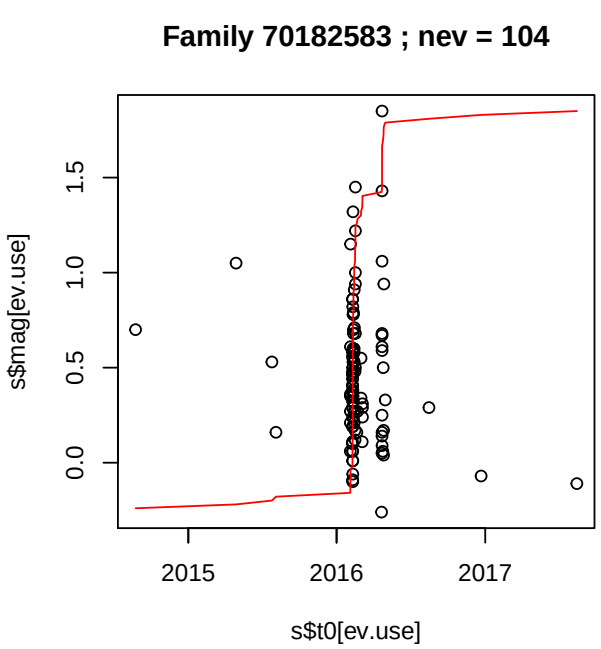

Cv = 4.9
Density
ln(dt)
0.00
0.05
0.10
0.15
0.20
−10
−5
0

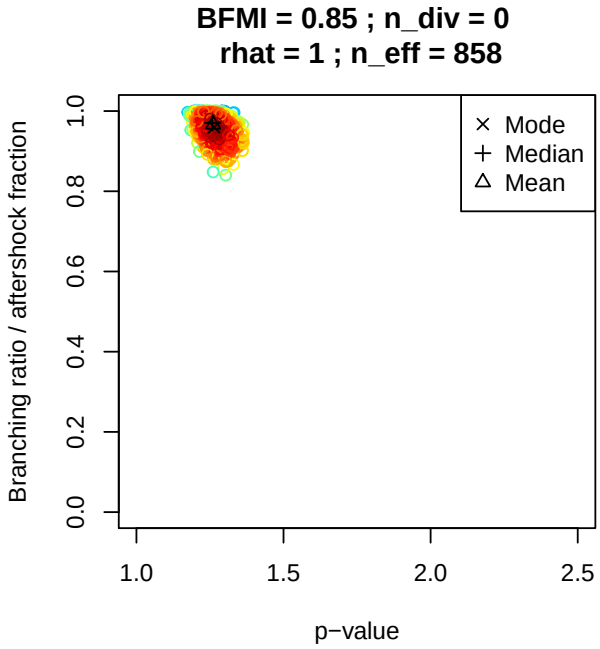

Family 70175558 ; nev = 150
s$mag[ev.use]
0.0
0.5
1.0
1.5
2.0
2016
2017
s$t0[ev.use]

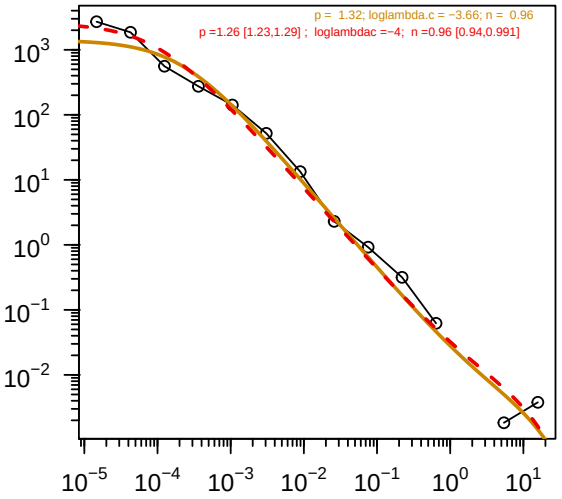

BFMI = 1.1 ; n_div = 0
rhat = 1.01 ; n_eff = 1439
Mode
Median
Mean
Branching ratio / aftershock fraction
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5
p−value

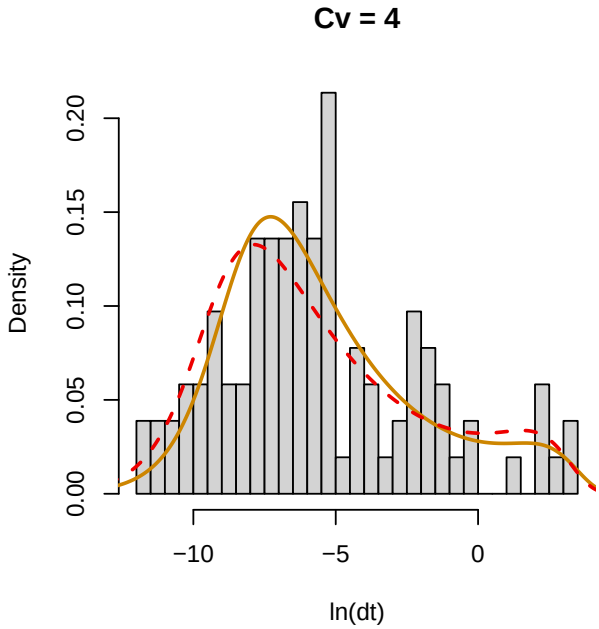

p = 1.518; loglambda.c = −3.786; n = 0.952
p =1.53 [1.49,1.58] ; loglambdac =−3.7; n =0.95 [0.93,0.964]
$10^{3}$
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-3}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

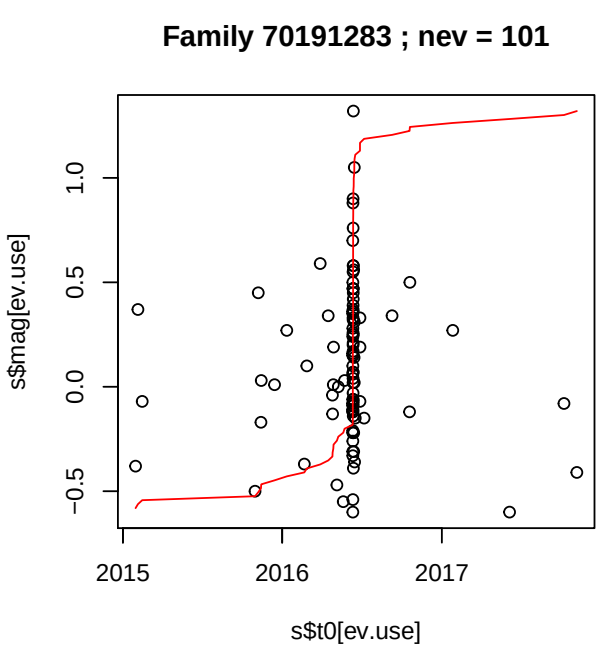

Cv = 5.6
Density
0.00
0.05
0.10
0.15
0.20
0.25
−10
−5
0
ln(dt)

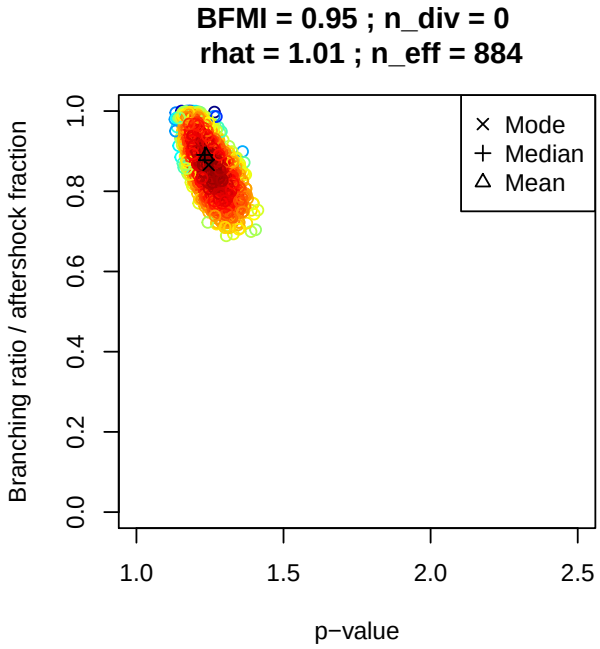

Family 70182583 ; nev = 104
s$mag[ev.use]
0.0
0.5
1.0
1.5
2015
2016
2017
s$t0[ev.use]

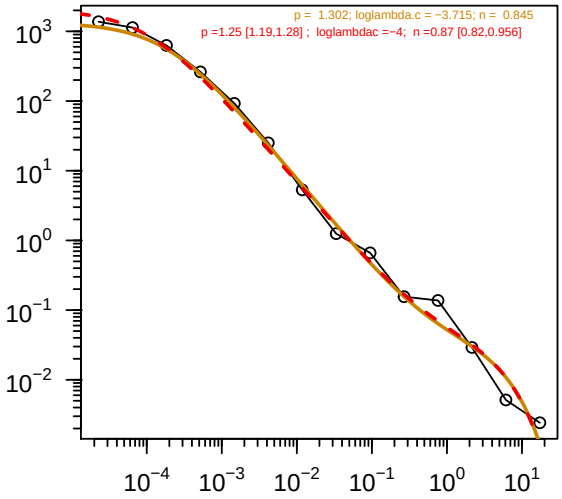

BFMI = 0.85 ; n_div = 0
rhat = 1 ; n_eff = 858
Mode
Median
Mean
Branching ratio / aftershock fraction
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5
p−value

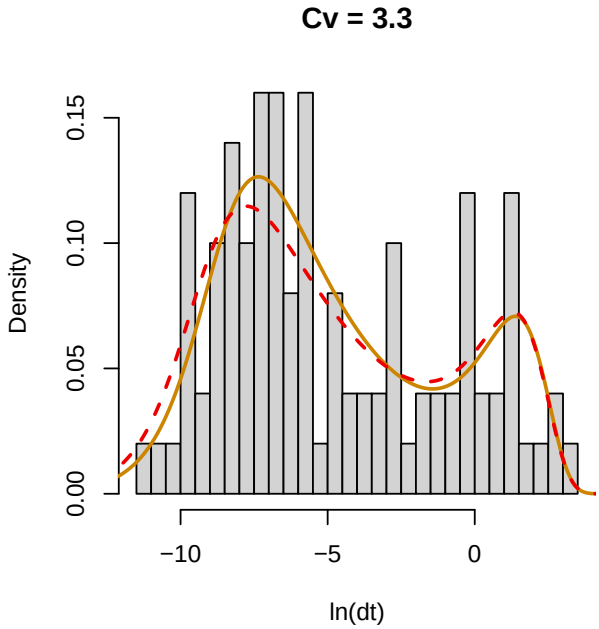

p = 1.32; loglambda.c = −3.66; n = 0.96
p =1.26 [1.23,1.29] ; loglambdac =−4; n =0.96 [0.94,0.991]
$10^{3}$
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-5}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

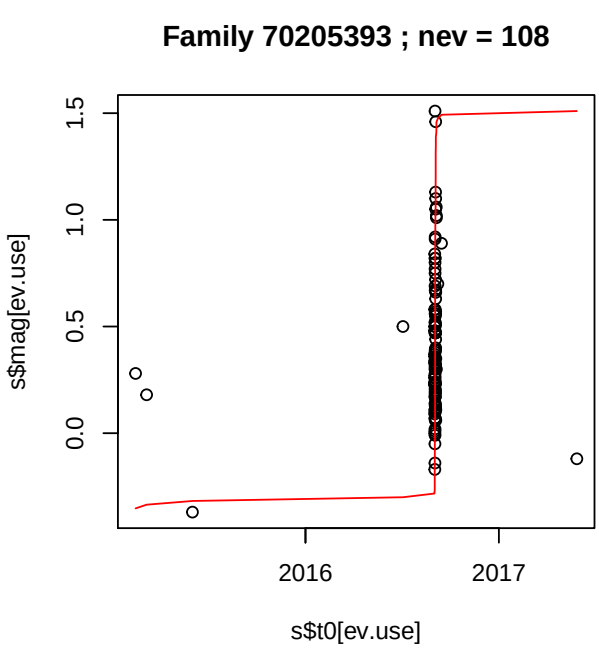

Cv = 4
Density
0.00
0.05
0.10
0.15
0.20
−10
−5
0
ln(dt)

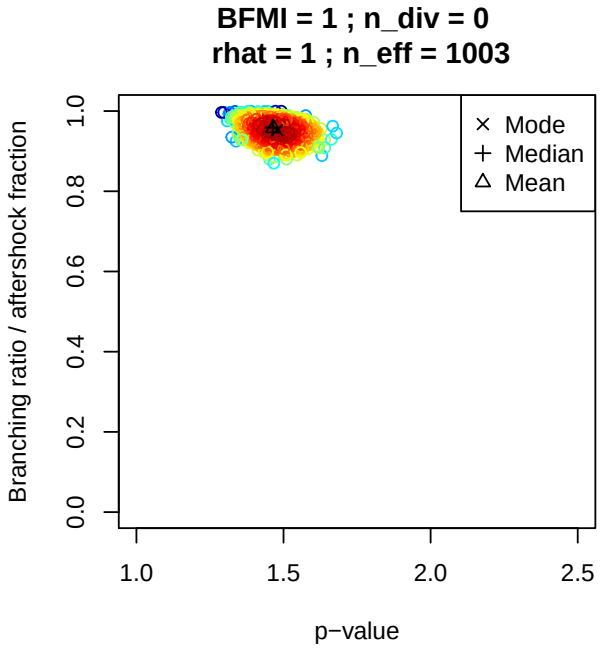

Family 70191283 ; nev = 101
s$mag[ev.use]
s$t0[ev.use]
2015
2016
2017
−0.5
0.0
0.5
1.0

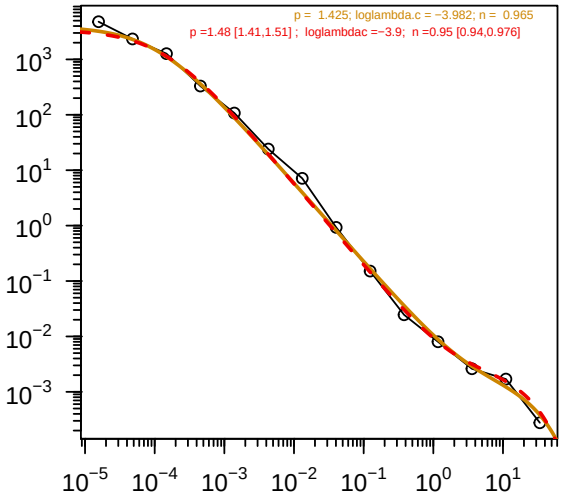

BFMI = 0.95 ; n_div = 0
rhat = 1.01 ; n_eff = 884
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5

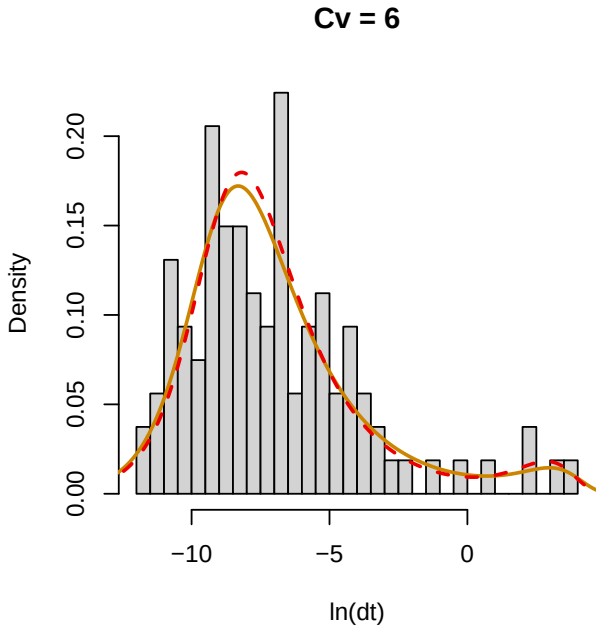

p = 1.302; loglambda.c = −3.715; n = 0.845
p =1.25 [1.19,1.28] ; loglambdac =−4; n =0.87 [0.82,0.956]
$10^{3}$
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

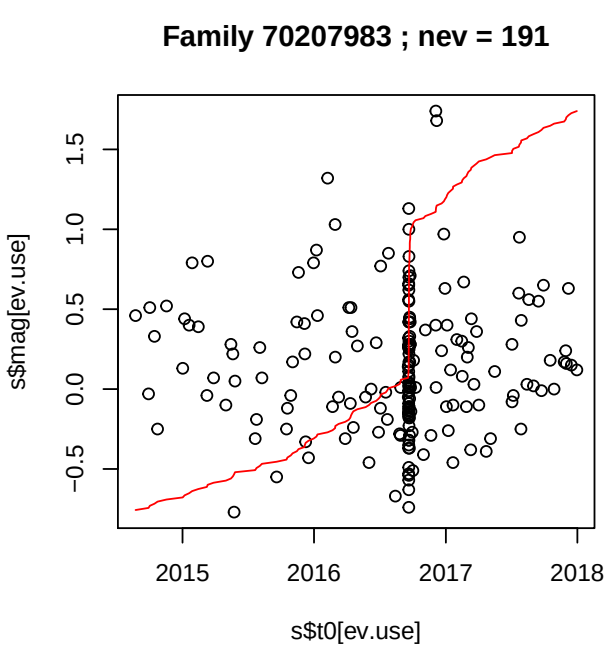

Cv = 3.3
Density
ln(dt)
0.00
0.05
0.10
0.15
−10
−5
0

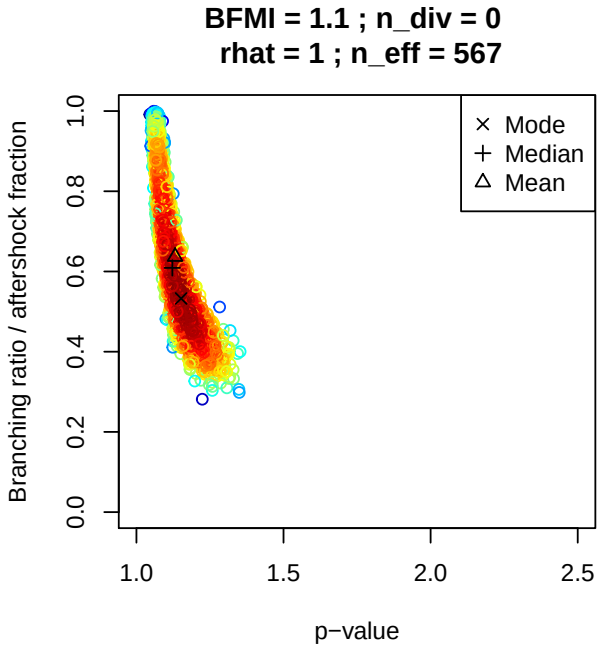

Family 70205393 ; nev = 108
s$mag[ev.use]
0.0
0.5
1.0
1.5
2016
2017
s$t0[ev.use]

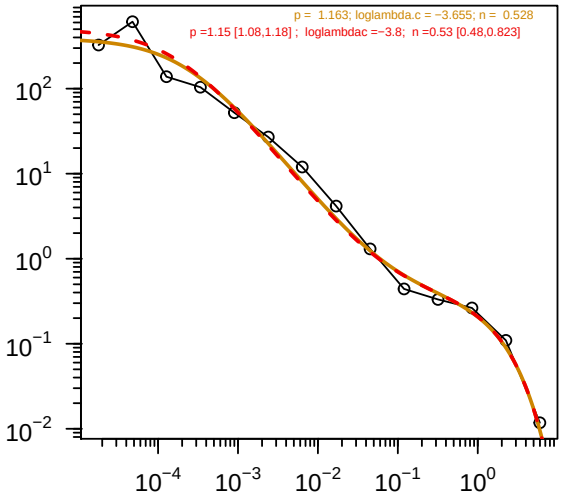

BFMI = 1 ; n_div = 0
rhat = 1 ; n_eff = 1003
Mode
Median
Mean
Branching ratio / aftershock fraction
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5
p−value

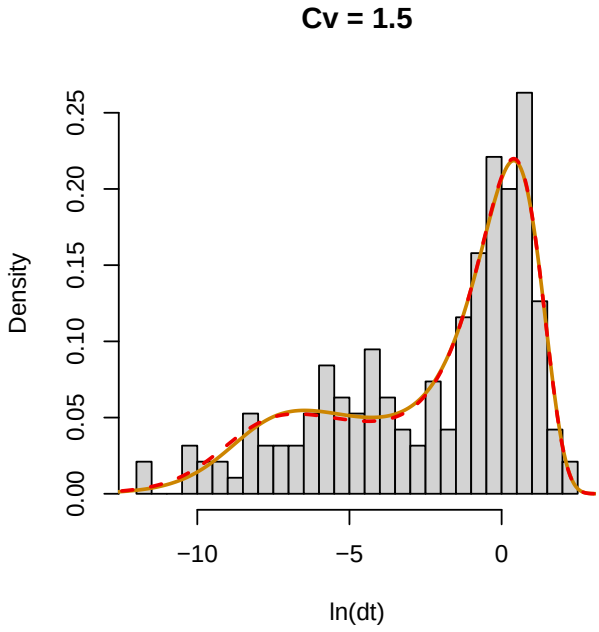

p = 1.425; loglambda.c = −3.982; n = 0.965
p =1.48 [1.41,1.51] ; loglambdac =−3.9; n =0.95 [0.94,0.976]
$10^{3}$
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-3}$
$10^{-5}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

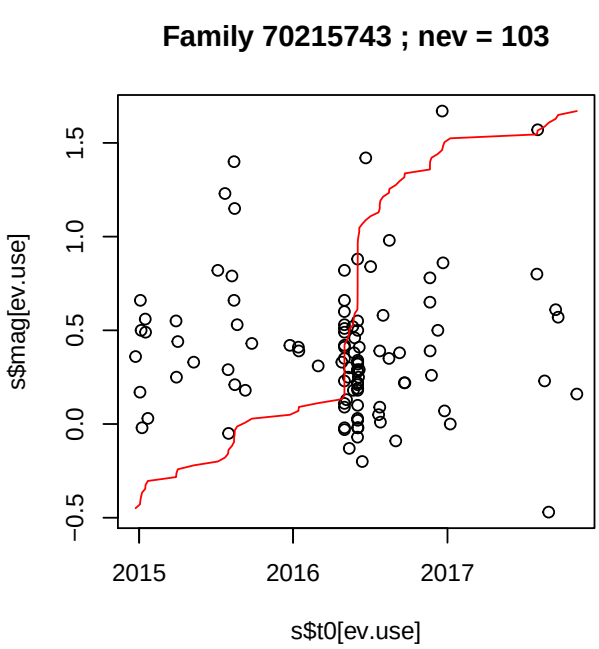

Cv = 6
Density
0.00
0.05
0.10
0.15
0.20
−10
−5
0
ln(dt)

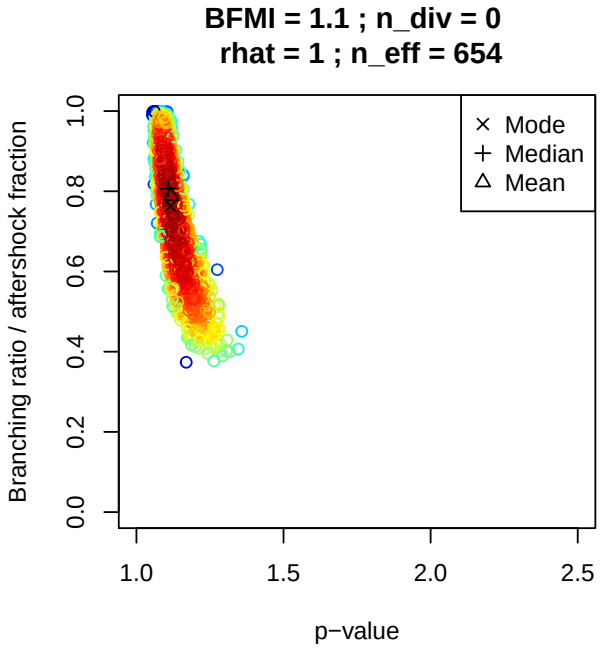

Family 70207983 ; nev = 191
s$mag[ev.use]
s$t0[ev.use]
2015
2016
2017
2018
−0.5
0.0
0.5
1.0
1.5

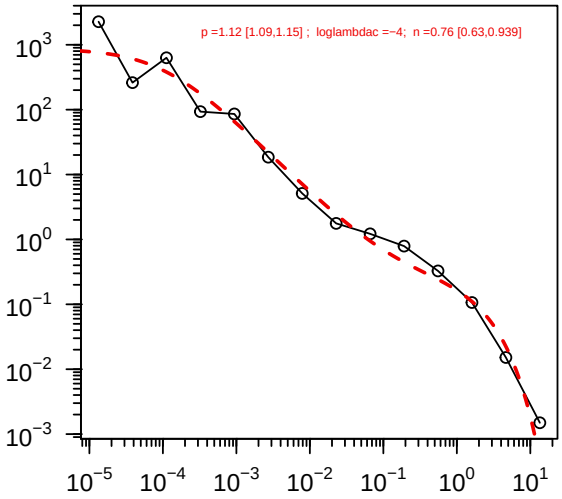

BFMI = 1.1 ; n_div = 0
rhat = 1 ; n_eff = 567
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5

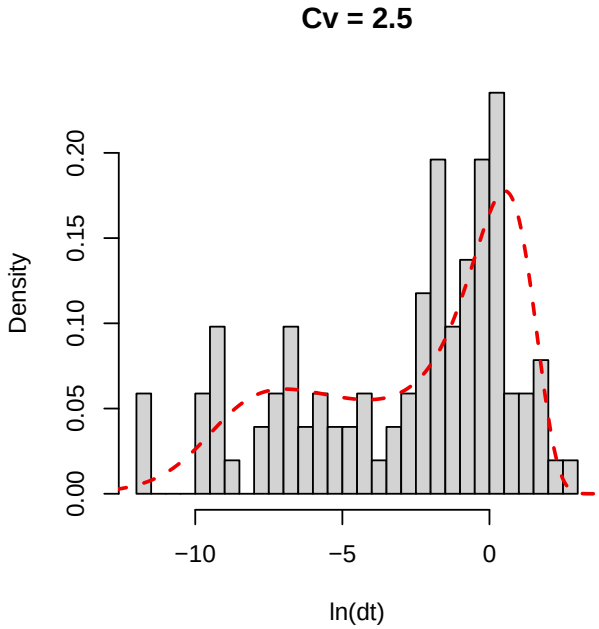

p = 1.163; loglambda.c = −3.655; n = 0.528
p =1.15 [1.08,1.18] ; loglambdac =−3.8; n =0.53 [0.48,0.823]
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$

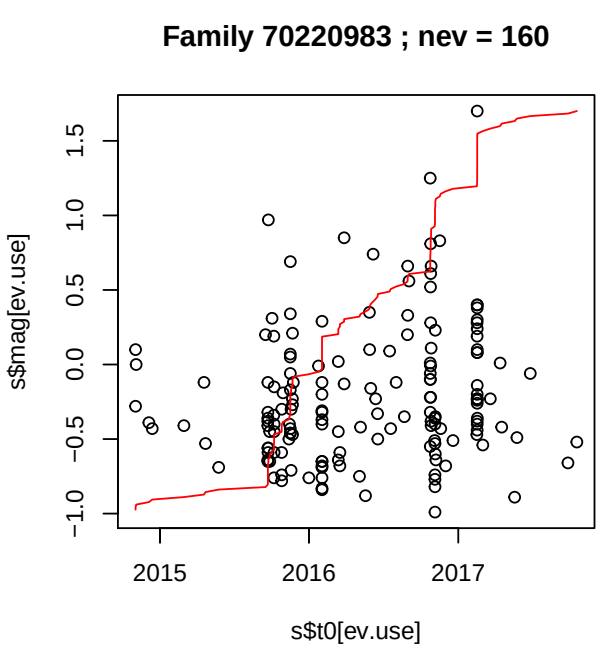

Cv = 1.5
Density
ln(dt)
0.00
0.05
0.10
0.15
0.20
0.25
−10
−5
0

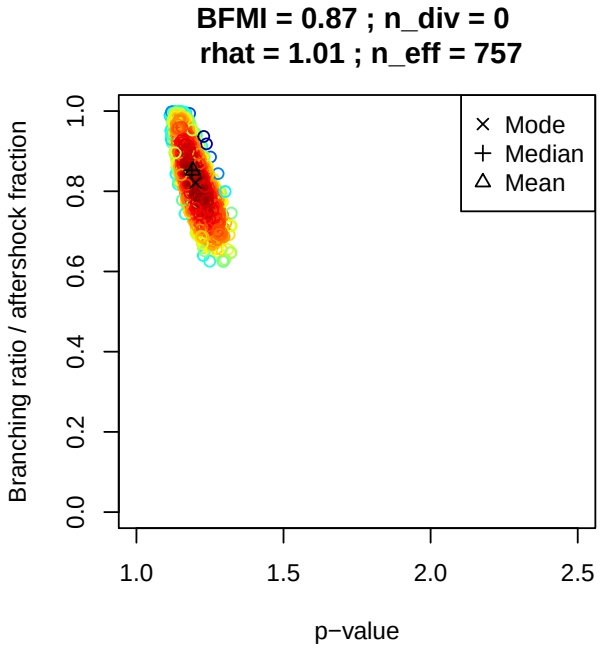

Family 70215743 ; nev = 103
s$mag[ev.use]
s$t0[ev.use]
−0.5
0.0
0.5
1.0
1.5
2015
2016
2017

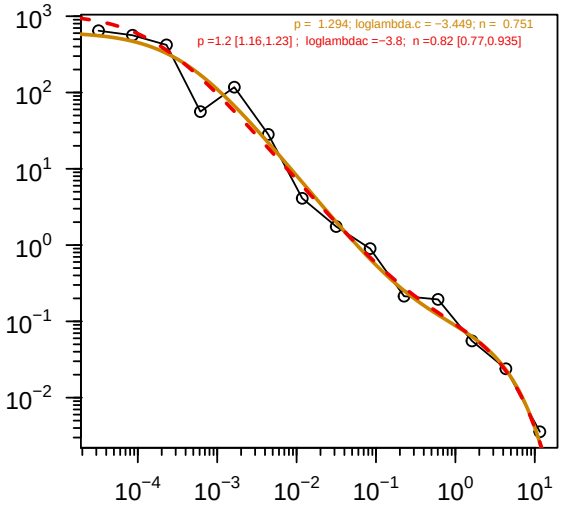

BFMI = 1.1 ; n_div = 0
rhat = 1 ; n_eff = 654
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5

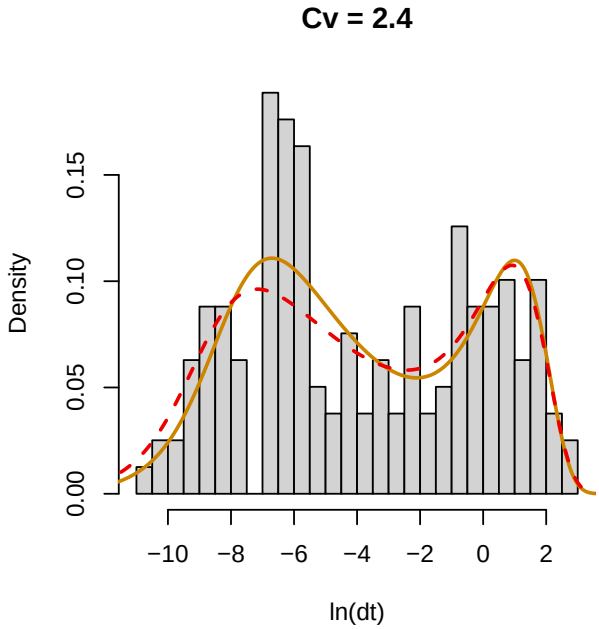

p =1.12 [1.09,1.15] ; loglambdac =−4; n =0.76 [0.63,0.939]
$10^{3}$
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-3}$
$10^{-5}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

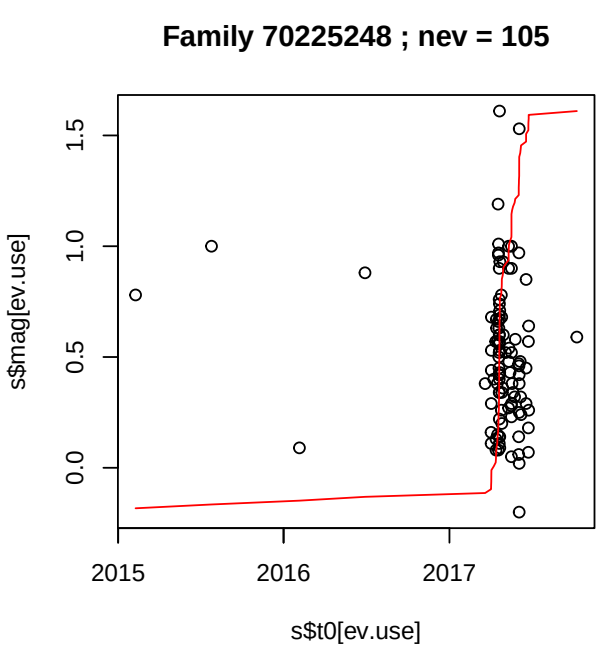

Cv = 2.5
Density
ln(dt)
0.00
0.05
0.10
0.15
0.20
−10
−5
0

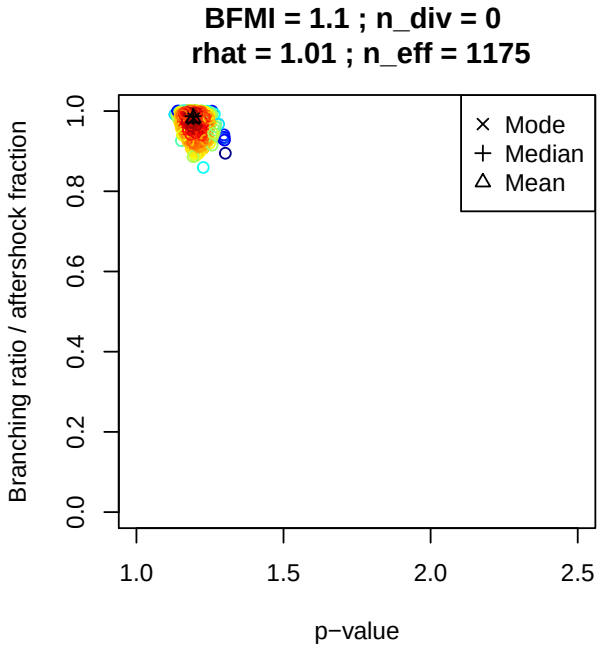

Family 70220983 ; nev = 160
s$mag[ev.use]
s$t0[ev.use]
2015
2016
2017
−1.0
−0.5
0.0
0.5
1.0
1.5

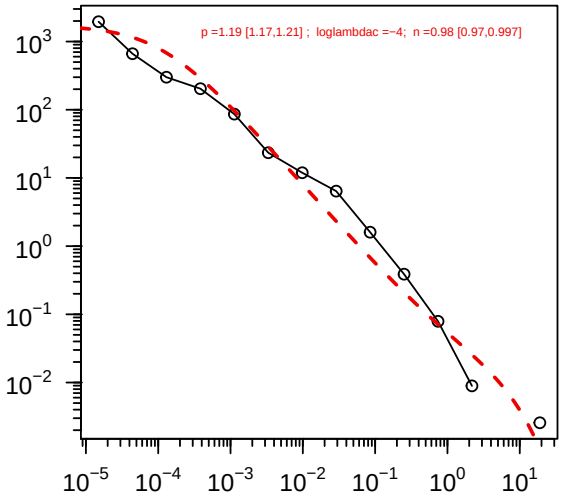

BFMI = 0.87 ; n_div = 0
rhat = 1.01 ; n_eff = 757
Mode
Median
Mean
Branching ratio / aftershock fraction
p−value
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5

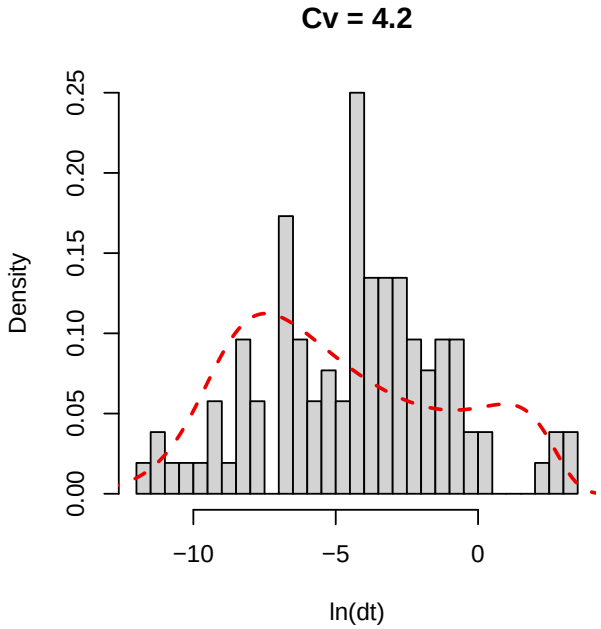

p = 1.294; loglambda.c = −3.449; n = 0.751
p =1.2 [1.16,1.23] ; loglambdac =−3.8; n =0.82 [0.77,0.935]
$10^{3}$
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$

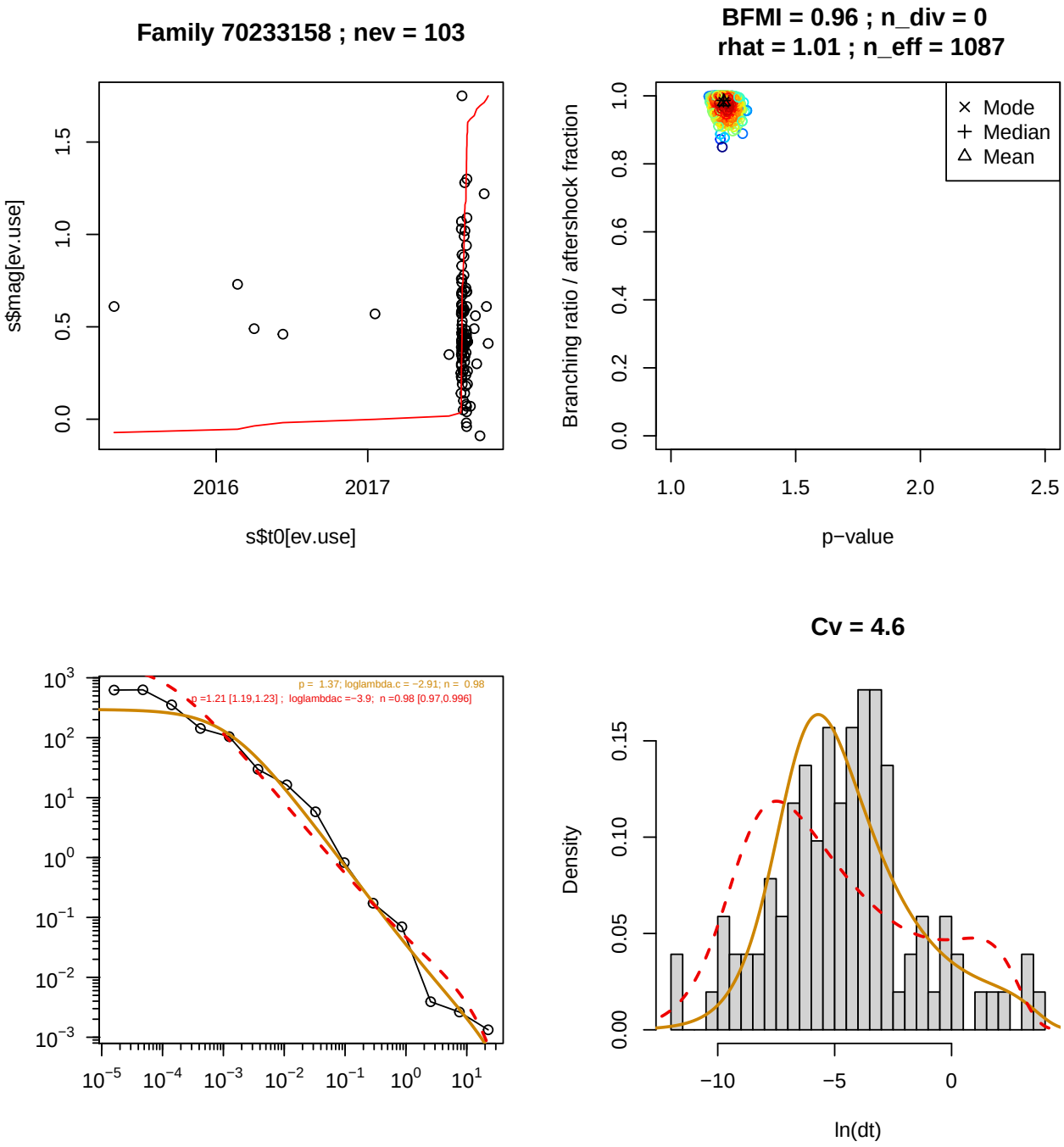

Cv = 2.4
Density
ln(dt)
0.00
0.05
0.10
0.15
−10
−8
−6
−4
−2
0
2


Family 70225248 ; nev = 105
s$mag[ev.use]
0.0
0.5
1.0
1.5
2015
2016
2017
s$t0[ev.use]


BFMI = 1.1 ; n_div = 0
rhat = 1.01 ; n_eff = 1175
Mode
Median
Mean
Branching ratio / aftershock fraction
0.0
0.2
0.4
0.6
0.8
1.0
1.0
1.5
2.0
2.5
p−value


p =1.19 [1.17,1.21] ; loglambdac =−4; n =0.98 [0.97,0.997]
$10^{3}$
$10^{2}$
$10^{1}$
$10^{0}$
$10^{-1}$
$10^{-2}$
$10^{-5}$
$10^{-4}$
$10^{-3}$
$10^{-2}$
$10^{-1}$
$10^{0}$
$10^{1}$


Cv = 4.2
Density
0.00
0.05
0.10
0.15
0.20
0.25
−10
−5
0
ln(dt)



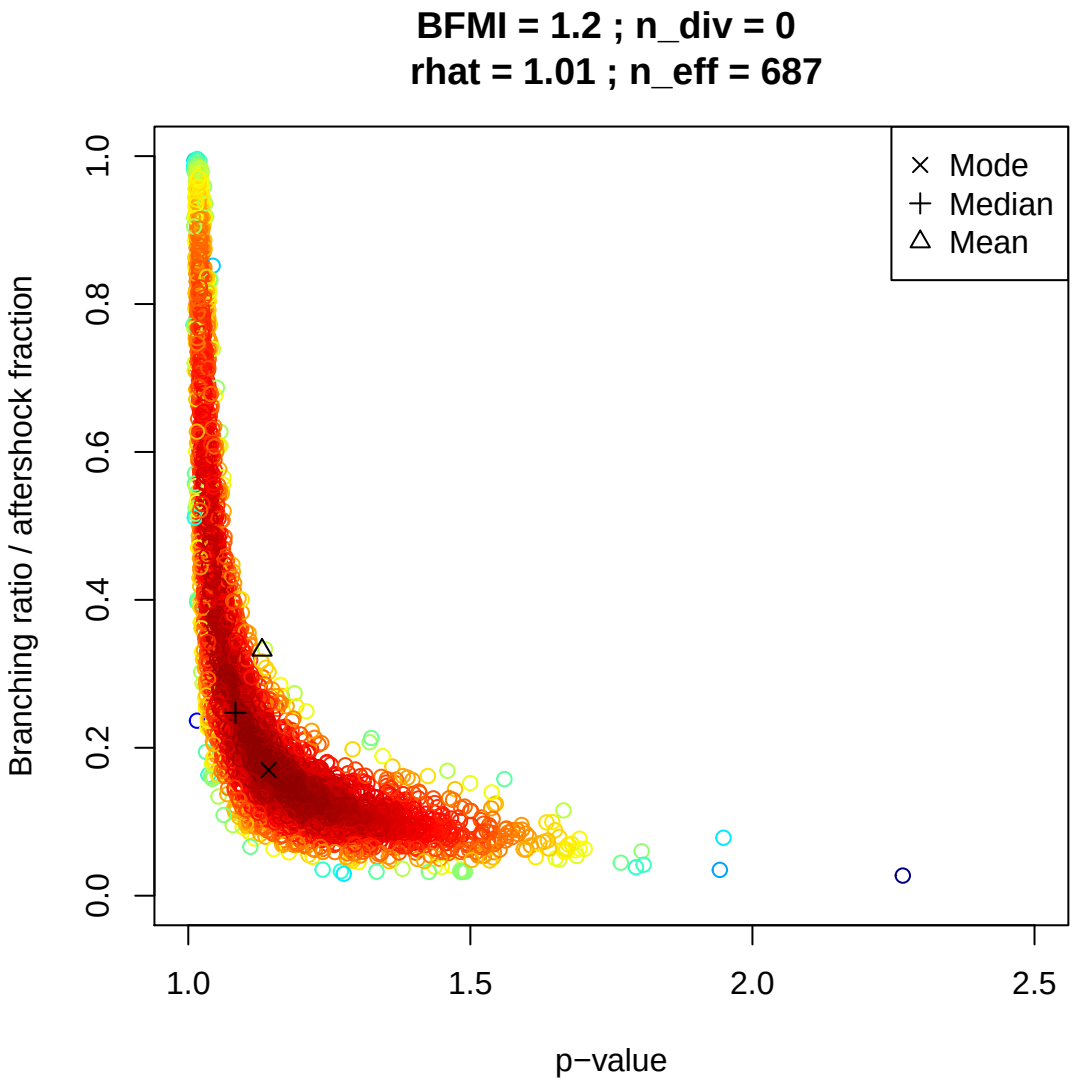

## Some puzzling examples

### Mode outside 68% CIs

I was originally using the mode (more precisely, the point in parameter space in the MCMC sample that had the highest value of the posterior pdf) as the central estimates of the parameters. There are cases where this mode falls outside the confidence intervals. That is, even though this is only a 3-dimensional parameter space, we can still have cases where the volume around the mode is small and far from central part of the "typical set" where most of the total probability lies.

Below is a plot of the MCMC samples to show what is going on. Note that the samples are colored by the value of the likelihood at those values (with "hotter" color indicating higher likelihoods).

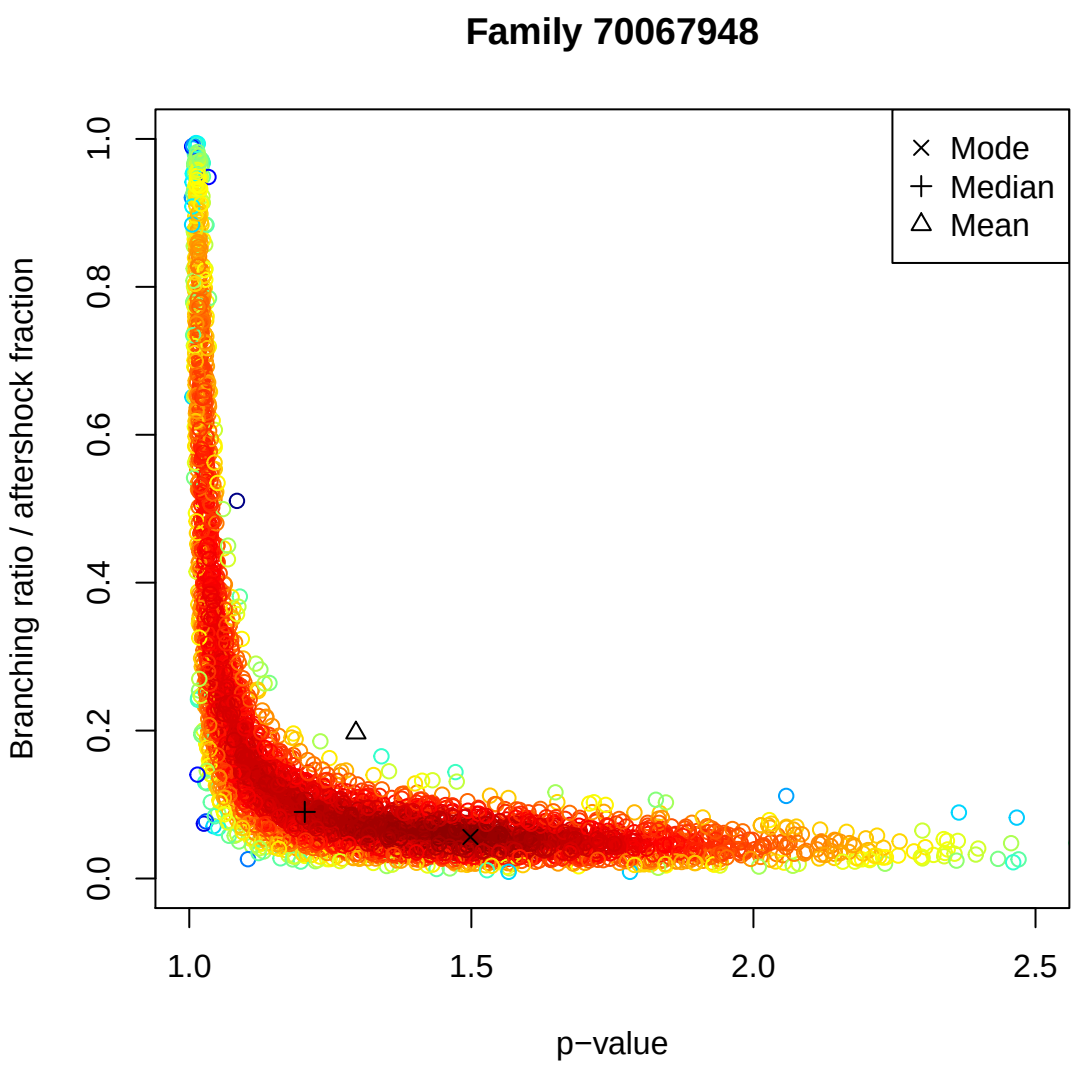
```
fam = 70054108
f = match(fam, fids)
i.f = match(f, fuse)

mkMCMCParamSpacePlot(f.stan[[i.f]], bfmi[i.f], n_div[i.f], rhat[i.f], n_eff[i.f])
```




From this example, it might seem like using, *e.g.* the medians of the marginal pdfs of the MCMC sampled parameters as the central values, but depending on the shape of the typical set, the means/medians are sometimes not in the typical set at all:

```
fam = 70067948
f = match(fam, fids)
i.f = match(f, fuse)

dt_sim = extract(f.stan[[i.f]], permute=TRUE)
palette(jet(100))
col = 1 + 99*(dt_sim$lp__ - min(dt_sim$lp__))/diff(range(dt_sim$lp__))
plot(dt_sim$p, dt_sim$n, col=col, xlim=c(1, 2.5), ylim=c(0,1), xlab="p-value",
```

```
     ylab="Branching ratio / aftershock fraction",
     main=paste("Family", fam))
points(p.stan.mode[i.f], n.stan.mode[i.f], pch=4)
points(p.stan.median[i.f], n.stan.median[i.f], pch=3)
points(p.stan.mean[i.f], n.stan.mean[i.f], pch=2)
legend("topright", c("Mode", "Median", "Mean"), pch=c(4,3,2))
```

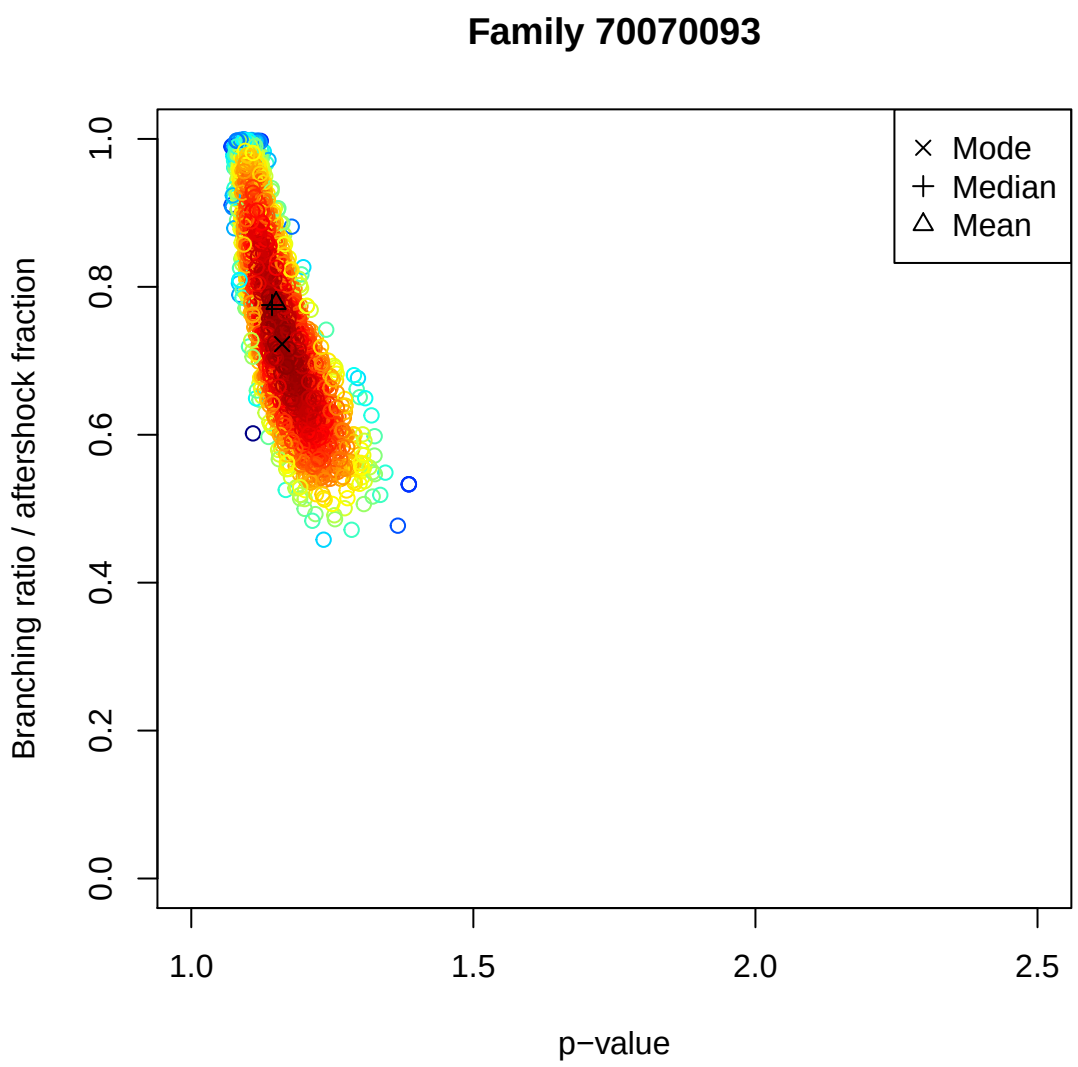



In this case, using the median/mean parameters won't even generate a reasonable fit to the distribution. So I will stick with using the mode for the central value, but still quoting the CIs of the marginal distributions.

This (mode/max-likelihood being far away from the median/mean) does not always happen; here is an example where all three are close together.

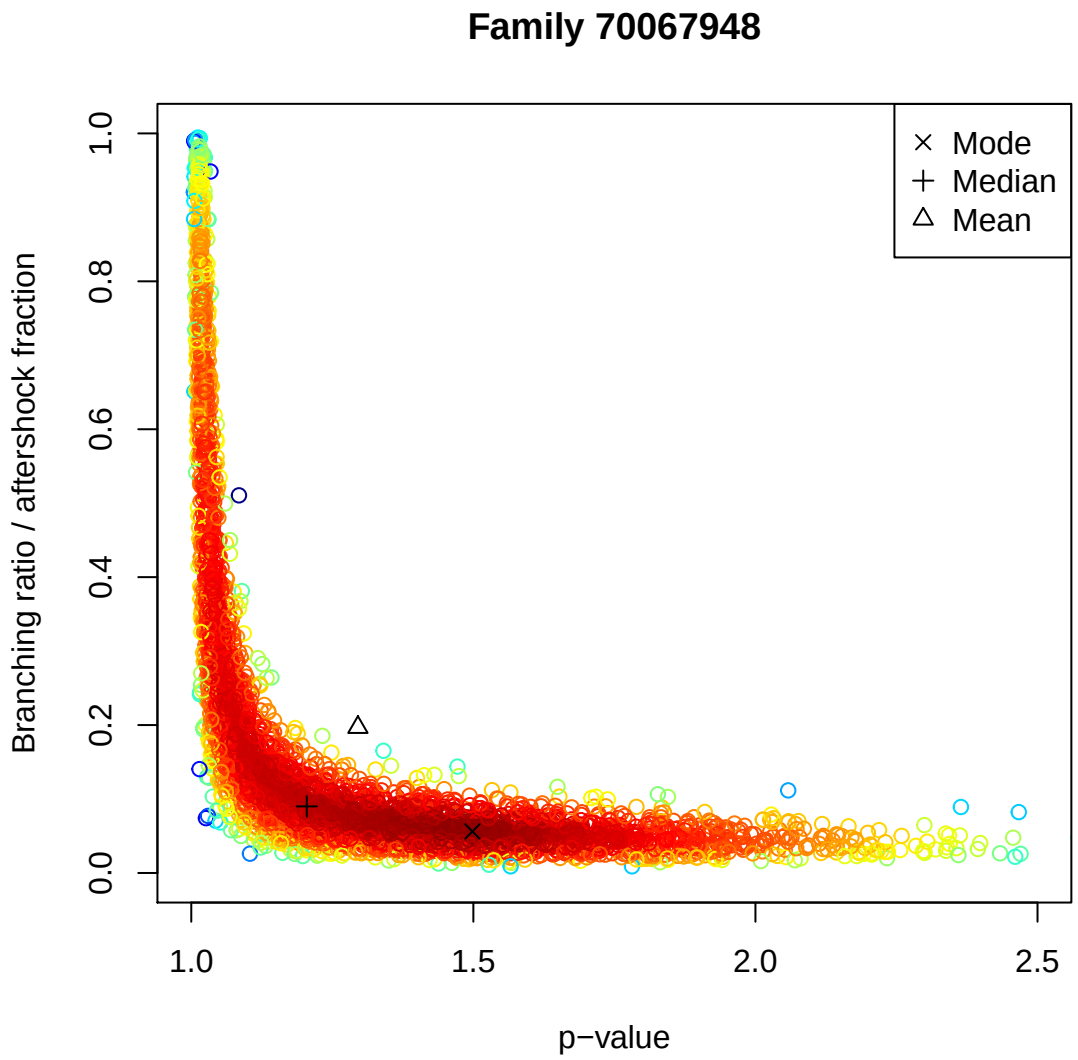
```
fam = 70070093
f = match(fam, fids)
i.f = match(f, fuse)

dt_sim = extract(f.stan[[i.f]], permute=TRUE)
palette(jet(100))
col = 1 + 99*(dt_sim$lp__ - min(dt_sim$lp__))/diff(range(dt_sim$lp__))
plot(dt_sim$p, dt_sim$n, col=col, xlim=c(1, 2.5), ylim=c(0,1), xlab="p-value",
```

```
     ylab="Branching ratio / aftershock fraction",
     main=paste("Family", fam))
points(p.stan.mode[i.f], n.stan.mode[i.f], pch=4)
points(p.stan.median[i.f], n.stan.median[i.f], pch=3)
points(p.stan.mean[i.f], n.stan.mean[i.f], pch=2)
legend("topright", c("Mode", "Median", "Mean"), pch=c(4,3,2))
```




```
#fam = 70139288
fam = 70067948
f = match(fam, fids)
i.f = match(f, fuse)

dt_sim = extract(f.stan[[i.f]], permute=TRUE)
palette(jet(100))
col = 1 + 99*(dt_sim$lp__ - min(dt_sim$lp__))/diff(range(dt_sim$lp__))
plot(dt_sim$p, dt_sim$n, col=col, xlim=c(1, 2.5), ylim=c(0,1), xlab="p-value",
     ylab="Branching ratio / aftershock fraction",
     main=paste("Family", fam))
points(p.stan.mode[i.f], n.stan.mode[i.f], pch=4)
points(p.stan.median[i.f], n.stan.median[i.f], pch=3)
```

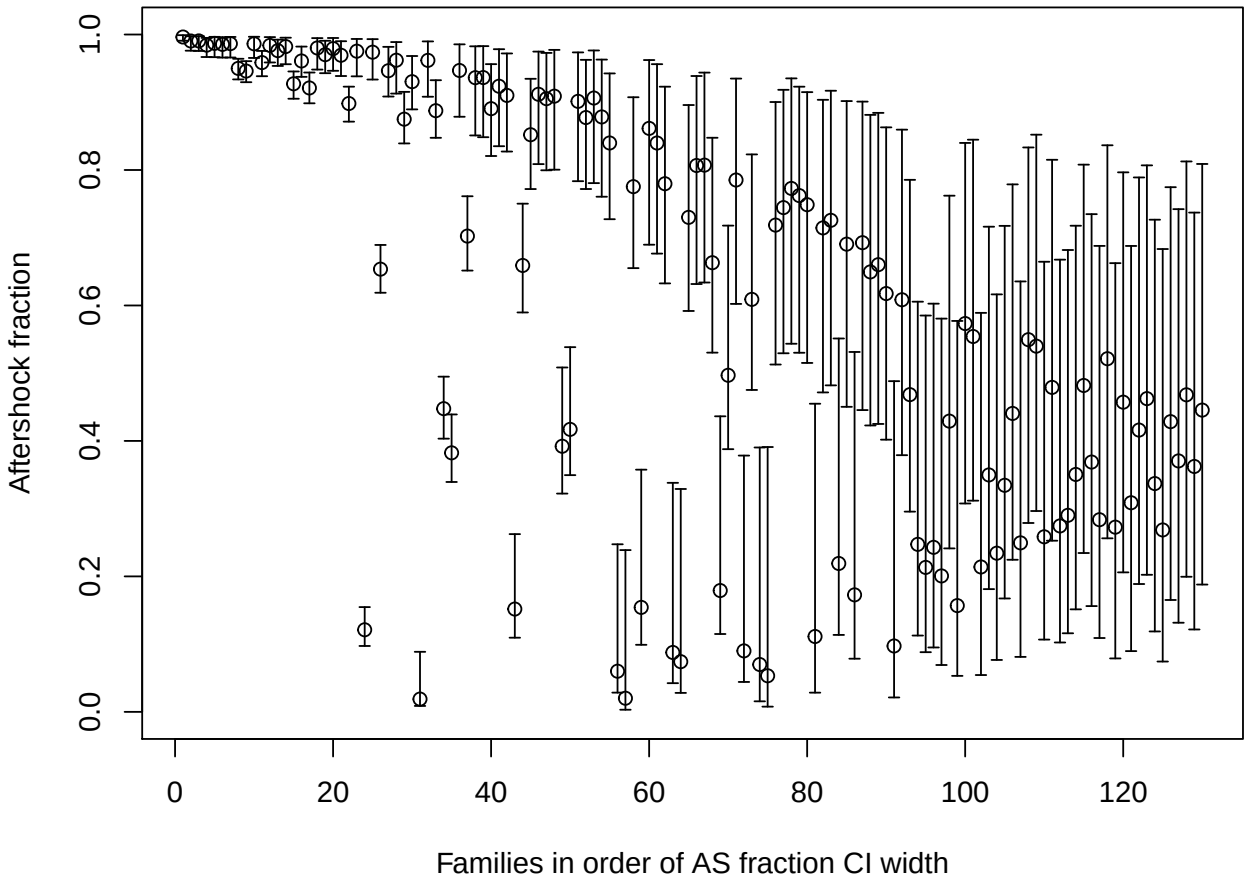
```
points(p.stan.mean[i.f], n.stan.mean[i.f], pch=2)
legend("topright", c("Mode", "Median", "Mean"), pch=c(4,3,2))
```




```
for (f in fuse) {
  i.f = match(f, fuse)

  dt_sim = extract(f.stan[[i.f]], permute=TRUE)
  palette(jet(100))
  col = 1 + 99*(dt_sim$lp__ - min(dt_sim$lp__))/diff(range(dt_sim$lp__))
  plot(dt_sim$p, dt_sim$n, col=col, xlim=c(1, 2.5), ylim=c(0,1), xlab="p-value",
       ylab="Branching ratio / aftershock fraction",
       main=paste("Family", fam))
  points(p.stan.mode[i.f], n.stan.mode[i.f], pch=4)
  points(p.stan.median[i.f], n.stan.median[i.f], pch=3)
  points(p.stan.mean[i.f], n.stan.mean[i.f], pch=2)
  legend("topright", c("Mode", "Median", "Mean"), pch=c(4,3,2))

  cat("\r\n\r\n")
}
```

### Widths of aftershock fraction CIs

```
dn = nCI.stan[,2] - nCI.stan[,1]
ord = order(dn)
plot(1:length(fuse), n.stan.median[ord], ylim=c(0,1),
     xlab="Families in order of AS fraction CI width",
     ylab="Aftershock fraction")
arrows(1:length(fuse), nCI.stan[ord,1], 1:length(fuse), nCI.stan[ord,2], angle=90, ylim=c(0,1), length=0
```

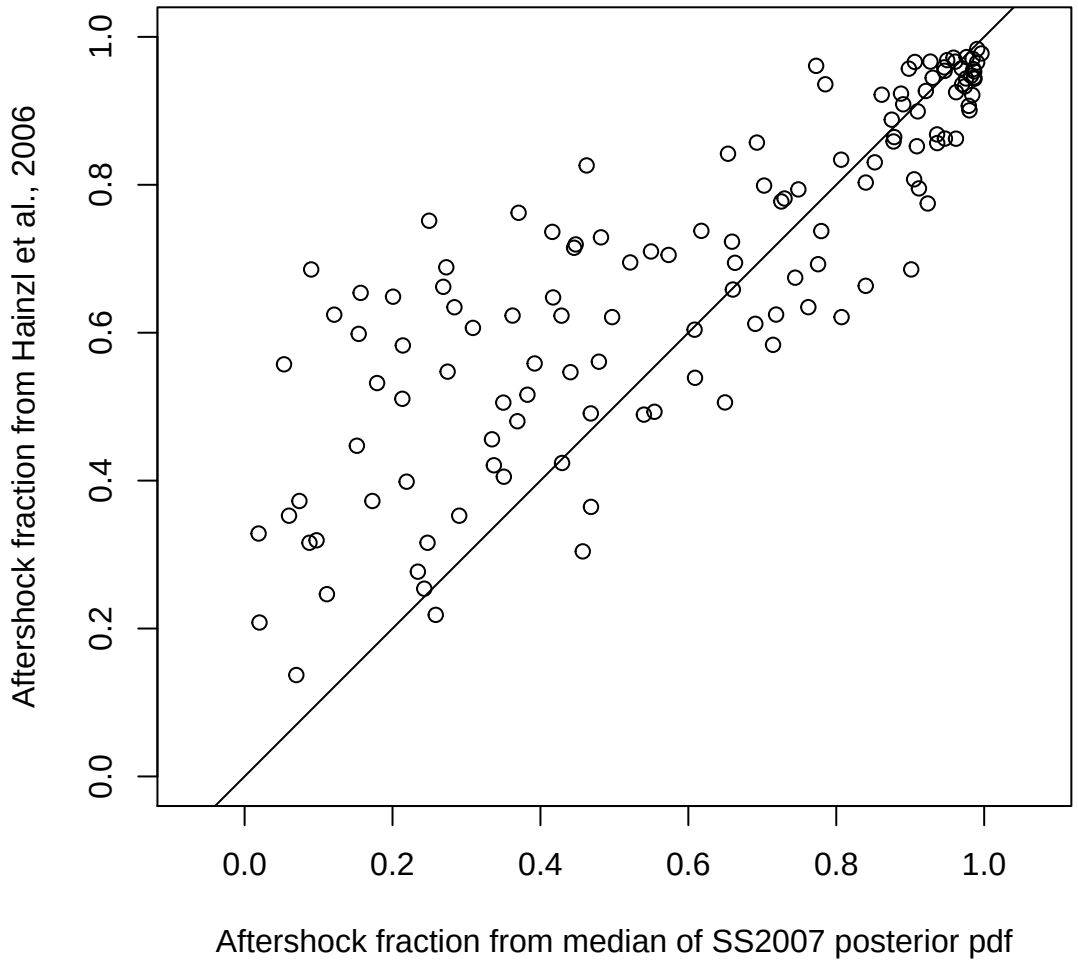



### Comparison with *Hainzl et al.* [2006]

Note that I haven't applied their bias correction here, this is just their basic procedure of taking the reciprocal of the variance of the (normalized) interevent times as the background fraction (and so the aftershock fraction is that subtracted from 1).

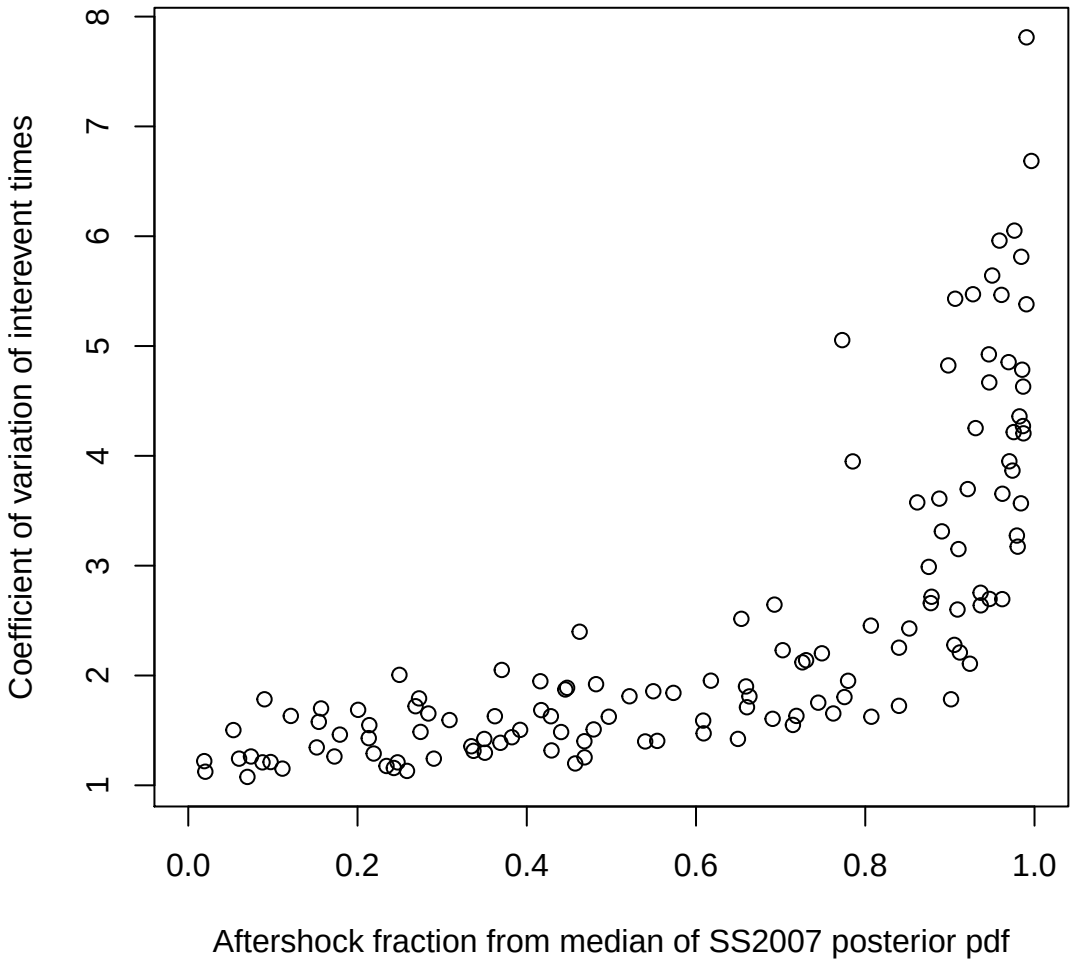
```
n.hainzl = rep(NA, length(fuse))
for (f in fuse) {
  i.f = match(f, fuse)
  ev.use = which(s$parent == fids[f])
  dt = diff(s$t0numeric[ev.use])
  dt = dt/mean(dt)
  n.hainzl[i.f] = 1 - 1/var(dt)
}

plot(n.stan.median, n.hainzl, asp=1, xlim=c(0,1), ylim=c(0,1),
```

```
     xlab="Aftershock fraction from median of SS2007 posterior pdf",
     ylab="Aftershock fraction from Hainzl et al., 2006")
abline(0,1)
```

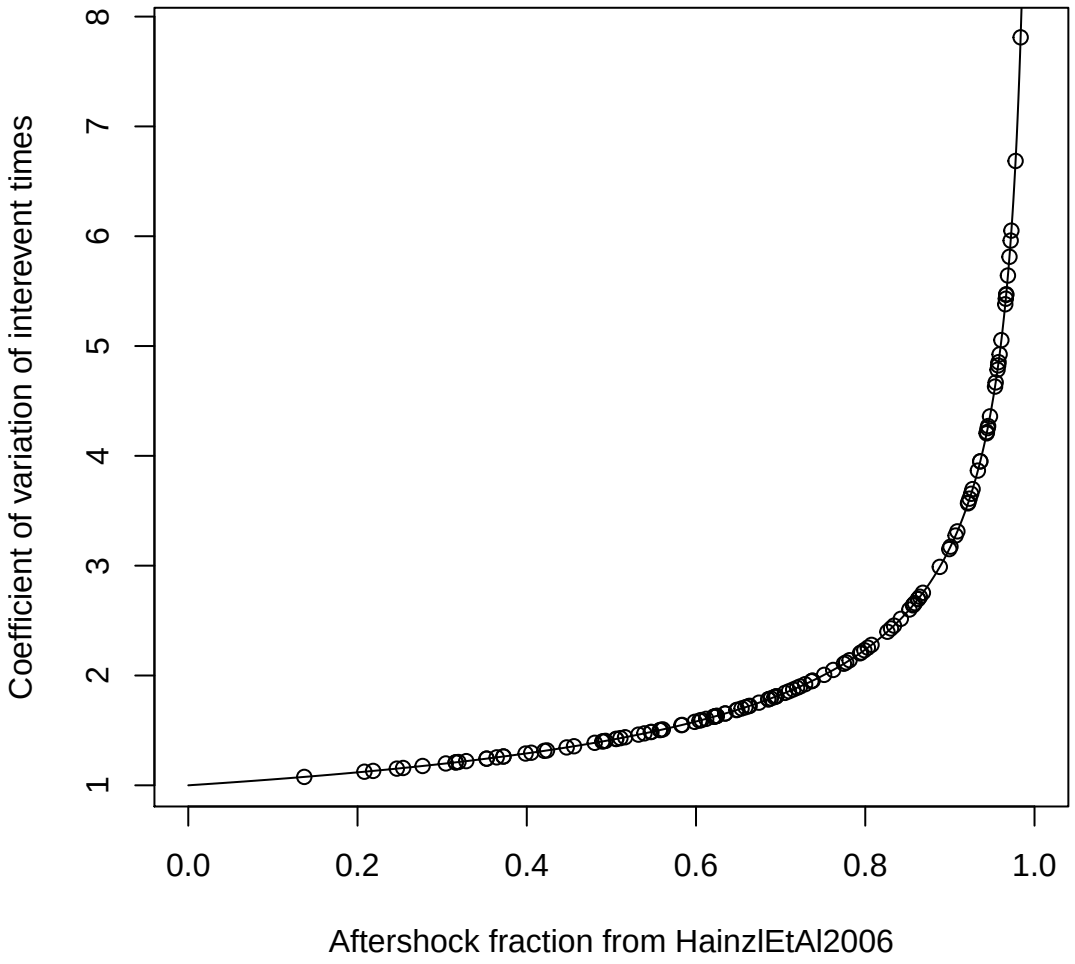



### Comparison to standard deviation of dt ala *Cochran et al.* [2018]

```
sd.cochran = rep(NA, length(fuse))
for (f in fuse) {
  i.f = match(f, fuse)
  ev.use = which(s$parent == fids[f])
  dt = diff(s$t0numeric[ev.use])
  dt = dt/mean(dt)
  sd.cochran[i.f] = sd(dt)
}

plot(n.stan.median, sd.cochran, xlim=c(0,1),
     xlab="Aftershock fraction from median of SS2007 posterior pdf",
     ylab="Coefficient of variation of interevent times")
```




```
plot(n.hainzl, sd.cochran, xlim=c(0,1),
     xlab="Aftershock fraction from HainzlEtAl2006",
     ylab="Coefficient of variation of interevent times")
n.plot = seq(0, 1, length=1000)
lines(n.plot, (1-n.plot)^(-1/2))
```




*Cochran et al.* [2018]'s use of the coefficient of variation of the interevent times as a measure of the relative fractions of background vs. aftershock events is essentially the same as that of *Hainzl et al.* [2006]. The curve on the above plot is given by $C_v = (1 - f_a)^{-1/2}$. From the paragraph at the beginning of pg. 315 of *Hainzl et al.* [2006], their esitmate of the background fraction, $f_b$, is just $1/\beta$ where $\beta$ is a parameter of the gamma distribution (their eqn. (1)), and equal to the variance of the normalized interevent time distribution, $\beta = \sigma_\tau^2$. The coefficient of variation of *Cochran et al.* [2018] ($C_v = \sigma_T/\bar{T}$, where $T$ are the unnormalized interevent times) is just equal to *Hainzl et al.* [2006]'s $\sigma_\tau$: since $\tau = T/\bar{T}$, $\sigma_\tau = \sigma_T/\bar{T}$, and thus $C_v = \sigma_\tau$. So $f_b = 1/C_v^2$, and since $f_a = 1 - f_b$, $f_a = 1 - 1/C_v^2$ or $C_v = (1 - f_a)^{-1/2}$.

## Aftershock fraction estimation a la *Zaliapin and Ben-Zion* [2016]

Still in progress: so far results don't look right - nearly always less than that from SS2007 - need to look more carefully at some individual cases. I think problem may be that many events have exactly the same location?

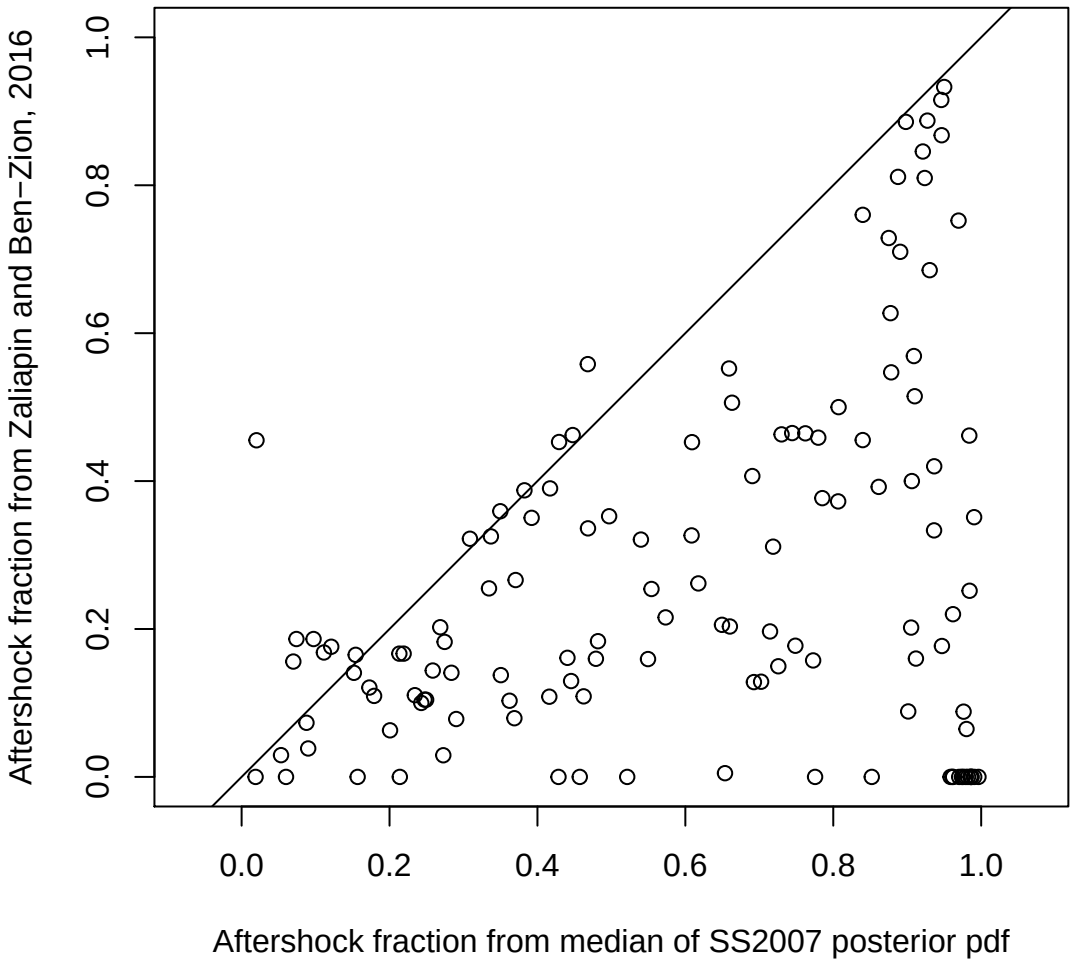
```
n.zaliapin = rep(NA, length(fuse))
for (f in fuse) {
  i.f = match(f, fuse)
  ev.use = which(s$parent == fids[f])
  z = zaliapin(list(t0yr = s$t0numeric[ev.use]/(365.25*86400), M=s$mag[ev.use],
                    x=s$utmx[ev.use], y=s$utmy[ev.use], t0=s$t0numeric[ev.use]),
               sderrh=100)
  n.zaliapin[i.f] = sum(log10(z$eta) < z$log10eta.c, na.rm=TRUE)/sum(is.finite(z$eta))
}
```

```
## [1]  0.8669339  0.1330661 -3.1880364 -4.3468965  0.5838018  1.6700145
## [1]  0.90738383  0.09261617 -3.92224832 -5.92038131  0.64912581  1.43207187
## [1]  0.8470818  0.1529182 -3.8807582 -5.3758216  0.5582242  1.1446130
## [1]  0.7854556  0.2145444 -3.9467592 -5.4289747  0.5191455  1.1774859
## [1]  0.08800939  0.91199061 -5.28861078 -4.04067613  1.09406440  0.62269270
## [1]  0.1301972  0.8698028 -3.9171842 -3.1317312  1.6107708  0.5203818
## [1]  0.5155931  0.4844069 -3.3674581 -6.1913543  0.4907685  1.1750499
## [1]  1.000000e+00  8.247095e-11 -5.600448e+00 -9.128839e+00  1.875316e+00
## [6]  0.000000e+00
## [1]  0.7570960  0.2429040 -3.9893610 -5.4729297  0.5874894  1.3341868
## [1]  0.5812441  0.4187559 -3.1796502 -4.2632315  0.4711669  0.7645282
## [1]  0.8773689  0.1226311 -3.4521243 -5.0180808  0.6131161  1.1341270
## [1]  0.7911020  0.2088980 -3.7914767 -5.9190238  0.5168468  1.6281961
## [1]  0.97667086  0.02332914 -3.72696412 -5.31491845  0.58164500  2.73719081
## [1]  0.6762177  0.3237823 -3.5119714 -4.9618546  0.4826929  1.0683933
## [1]  0.7776966  0.2223034 -3.8948604 -6.1833525  0.6164390  0.7834945
## [1]  0.8335614  0.1664386 -6.4524786 -7.3326189  1.0524636  0.2766537
## [1]  0.6159662  0.3840338 -3.2539772 -4.9219478  0.4501739  1.2232803
## [1]  0.7289613  0.2710387 -3.6818069 -4.9596289  0.5149176  1.0321262
## [1]  0.7300121  0.2699879 -3.3297038 -4.2890240  0.5081062  0.9504798
## [1]  0.3745489  0.6254511 -3.8246341 -4.6187746  0.2864871  1.1769464
## [1]  0.532044  0.467956 -3.672249 -6.594998  0.490704  1.054996
## [1]  0.8486442  0.1513558 -3.8773755 -6.4622714  0.6294963  0.9001226
## [1]  0.5590940  0.4409060 -3.7590609 -4.8735625  0.4360487  1.0834405
## [1]  0.7539702  0.2460298 -3.7343243 -5.1991799  0.5457887  1.1983753
## [1]  0.8304969  0.1695031 -3.4515612 -4.9942686  0.4946922  1.3198164
## [1]  0.7292154  0.2707846 -3.1328080 -4.0203646  0.4233849  0.8291517
## [1]  0.97160096  0.02839904 -3.47874081 -5.34972029  0.59644326  0.04395247
## [1]  0.8952594  0.1047406 -4.8767840 -6.0678290  1.2650039  0.2012075
## [1]  0.7062441  0.2937559 -3.3318746 -4.8593257  0.5215481  1.3964765
## [1]  0.8589125  0.1410875 -3.7539745 -6.0283272  0.6048435  1.0613089
## [1]  0.1837753  0.8162247 -3.5281410 -6.4577300  0.6121423  1.0348472
## [1]  0.1143787  0.8856213 -3.5001689 -6.7355149  0.6501575  0.7812125
## [1]  0.4758589  0.5241411 -3.2553867 -4.7834670  0.3535793  1.3342235
## [1]  0.9618785  0.0381215 -3.4169824 -5.5760892  0.6158647  0.8224735
## [1]  0.8236527  0.1763473 -3.4665077 -5.2807841  0.5407003  1.0898973
## [1]  0.92040094  0.07959906 -3.89505657 -7.22820876  0.70479416  0.86455312
## [1]  0.8409488  0.1590512 -3.9976041 -5.2825268  0.6057111  1.0761867
## [1]  0.6658167  0.3341833 -4.0170774 -5.8539270  0.4755648  1.2542683
## [1]  0.6281086  0.3718914 -3.5645440 -4.3615365  0.3776269  0.9173761
## [1]  0.7363962  0.2636038 -3.6693787 -4.8402379  0.4959088  1.2167330
## [1]  0.7441931  0.2558069 -3.2065723 -4.1763869  0.5169905  0.8961020
## [1]  0.5584895  0.4415105 -3.5558443 -5.6907716  0.4708024  1.2459487
## [1]  0.90073467  0.09926533 -5.00617243 -7.05662650  1.34531678  0.38487321
## [1]  0.4577316  0.5422684 -3.8974073 -5.6416577  0.5394354  1.2643920
## [1]  0.4449790  0.5550210 -3.4468942 -4.4794601  0.4083087  1.3158606
## [1]  0.4472632  0.5527368 -3.3691828 -6.1431643  0.6680665  0.9823959
## [1]  0.8548916  0.1451084 -4.1604557 -6.4762848  1.0343566  0.3068899
## [1]  0.7770586  0.2229414 -3.5539075 -5.0141367  0.5254482  0.8279790
## [1]  0.8192701  0.1807299 -3.5503533 -5.8423975  0.5654645  1.1691548
## [1]  0.7783143  0.2216857 -4.2002712 -5.5455911  0.4686974  1.1579232
## [1]  0.8493928  0.1506072 -3.5080283 -4.9377894  0.5169356  0.9673475
## [1]  0.8566080  0.1433920 -3.7051815 -4.6298573  0.5012318  1.4256912
## [1]  0.8574051  0.1425949 -3.7712527 -5.8949213  0.5932176  1.1229378
```

```
## [1]  0.7709859  0.2290141 -3.4858730 -4.7529671  0.5470107  1.0450658
## [1]  0.5035984  0.4964016 -2.9828977 -3.7551286  0.3345131  0.4640188
## [1]  0.4530050  0.5469950 -3.4097610 -5.5867970  0.5560161  1.3440058
## [1]  0.8422907  0.1577093 -3.4201795 -5.2471019  0.6097236  1.7292839
## [1]  0.6890375  0.3109625 -3.7728348 -4.5719945  0.4798221  0.8716528
## [1]  0.8831593  0.1168407 -4.9058909 -6.9911856  1.2305199  0.8290902
## [1]  0.96186997  0.03813003 -3.81604360 -6.86355295  0.61962406  0.38053249
## [1]  0.95353712  0.04646288 -3.95821779 -5.75614864  1.03671886  0.06132440
## [1]  0.91141262  0.08858738 -4.92400256 -6.14906240  1.29273201  1.01337842
## [1]  0.8214997  0.1785003 -3.8755497 -4.8699268  0.5717315  1.2456111
## [1]  0.7515274  0.2484726 -3.4728571 -5.2131510  0.4933993  1.6347454
## [1]  0.992586346  0.007413654 -6.346797975 -8.347014991  1.282812481
## [6]  0.165176892
## [1]  0.5721366  0.4278634 -3.4190700 -5.8766706  0.5035860  1.3356827
## [1]  0.4901732  0.5098268 -3.1013185 -5.2638157  0.5104665  1.0974319
## [1]  0.7292603  0.2707397 -3.5437952 -4.5689140  0.5005775  1.0593389
## [1]  0.9115018  0.0884982 -4.3005019 -4.7399132  1.3775392  0.0900997
## [1]  0.1491564  0.8508436 -2.9444717 -5.1696507  0.3021409  1.3532918
## [1]  0.4111939  0.5888061 -3.6895413 -4.9496843  0.4510306  1.1327186
## [1]  0.5115371  0.4884629 -3.5711608 -4.4179869  0.5526076  1.0651707
## [1]  0.6234423  0.3765577 -3.6230196 -6.7734700  0.6681391  0.8703395
## [1]  0.3233445  0.6766555 -3.7527611 -5.8782949  0.4723273  1.2095541
## [1]  0.6559624  0.3440376 -3.3091376 -6.2913767  0.6151772  0.9715708
## [1]  0.7755121  0.2244879 -3.5296709 -5.4826587  0.5797890  1.4378640
## [1]  0.2276729  0.7723271 -2.6015854 -5.3629454  0.4177085  1.4258060
## [1]  0.7368220  0.2631780 -3.3503989 -4.6050194  0.4146172  1.5307197
## [1]  0.6172384  0.3827616 -3.5293589 -5.1571900  0.5114209  1.2899537
## [1]  0.2511801  0.7488199 -3.2160523 -3.8544214  0.1555464  0.8600999
## [1]  0.4778982  0.5221018 -5.6302704 -7.1068107  1.5458935  0.5877080
## [1]  0.96833081  0.03166919 -6.53872085 -8.34532752  1.32850719  0.07630969
## [1]  0.91792855  0.08207145 -3.79109669 -6.59394765  0.60140520  0.95157469
## [1]  0.4616931  0.5383069 -3.8732760 -6.5060142  0.7715390  1.0894063
## [1]  0.5629601  0.4370399 -3.6006120 -4.9946575  0.4716617  0.9541453
## [1]  0.8622699  0.1377301 -3.6319330 -5.4257347  0.6083754  1.3846622
## [1]  0.4123862  0.5876138 -3.4970085 -5.7912781  0.5480840  1.2811189
## [1]  0.3844025  0.6155975 -3.7273240 -5.1308354  0.5035295  0.9862059
## [1]  0.3777856  0.6222144 -3.6302114 -5.3523761  0.4386957  1.4682487
## [1]  0.8732830  0.1267170 -3.8630479 -6.9196236  0.7491357  0.6790985
## [1]  0.8008887  0.1991113 -5.0998322 -6.1712368  1.2613857  0.6478935
## [1]  0.8147039  0.1852961 -3.8060599 -5.4558723  0.4905956  1.1942229
## [1]  0.7080166  0.2919834 -3.7394745 -4.7340156  0.4864577  0.8528665
## [1]  0.5672970  0.4327030 -3.6914179 -4.9668105  0.5359772  1.0101194
## [1]  0.8301526  0.1698474 -5.1455664 -6.8175454  1.2117696  1.0346007
## [1]  0.7244460  0.2755540 -5.7153847 -5.8464358  1.2842678  0.2389391
## [1]  0.8730703  0.1269297 -3.2752193 -5.1368644  0.4493648  1.1609440
## [1]  0.6060701  0.3939299 -3.5304723 -5.4588231  0.4526075  1.2623908
## [1]  0.7886315  0.2113685 -3.5585458 -5.9578418  0.6778481  0.6635083
## [1]  0.5794132  0.4205868 -4.2438051 -5.7692681  0.7725604  1.2968943
## [1]  0.8283209  0.1716791 -4.4968842 -6.9507515  1.1524893  0.5157259
## [1]  0.4639311  0.5360689 -5.2293967 -5.7400531  0.5323676  1.3362272
## [1]  0.2664684  0.7335316 -3.9277530 -6.4554493  0.6900809  0.9324080
## [1]  0.6800498  0.3199502 -3.8196225 -5.3987293  0.5245639  1.2178198
## [1]  0.4446453  0.5553547 -3.5135816 -4.9270874  0.3656760  1.1116447
## [1]  0.97351692  0.02648308 -5.51715232 -7.18736203  1.14083049  0.08857108
```

```
## [1]  0.8042979  0.1957021 -3.4846245 -4.8793107  0.6139817  1.0913067
## [1]  0.3151007  0.6848993 -5.2159706 -5.2907376  0.3739572  1.3396138
## [1]  0.5760082  0.4239918 -5.5801865 -6.7601902  1.1019933  1.1495721
## [1]  0.5190139  0.4809861 -4.4621053 -6.0026322  0.9555924  1.0345516
## [1]  0.8083298  0.1916702 -4.7868527 -7.2369153  0.9685981  0.5576418
## [1]  0.6304448  0.3695552 -6.0318014 -6.2912606  0.6467685  1.6089324
## [1]  0.7456042  0.2543958 -5.3541616 -6.4802106  1.1841868  1.1056256
## [1]  0.1221290  0.8778710 -3.4979652 -6.7836722  0.9439829  0.7464738
## [1]  0.8271523  0.1728477 -3.7423808 -6.5247251  0.6007023  1.1501753
## [1]  0.3454889  0.6545111 -4.9689665 -6.4688806  1.2633449  0.8361493
## [1]  0.1294972  0.8705028 -3.8175607 -6.5111799  0.6641770  0.9006096
## [1]  0.1864524  0.8135476 -4.2753149 -6.8988905  1.2547515  0.9123740
## [1]  0.6445054  0.3554946 -3.4762150 -6.1980454  0.5564428  1.0184043
## [1]  0.08510732  0.91489268 -3.67829916 -7.06466302  0.99797990  0.79561673
## [1]  0.06946016  0.93053984 -3.89285940 -7.41088251  0.98579495  0.73175528
## [1]  0.5818033  0.4181967 -5.9583393 -6.2910945  1.7906300  0.7850538
## [1]  0.2892697  0.7107303 -3.2752241 -6.3260259  0.6768774  0.8460248
## [1]  0.1718024  0.8281976 -5.5547436 -7.0122196  2.4146118  0.7633404
## [1]  0.4805150  0.5194850 -3.7976999 -5.7464364  0.5852767  1.3128840
## [1]  0.5523409  0.4476591 -3.9575219 -5.9581623  0.5728639  1.3189322
## [1]  0.91453531  0.08546469 -4.78310851 -7.28236928  1.35745725  1.19101085
## [1]  0.8032118  0.1967882 -5.2455250 -6.9111087  1.0322594  1.0983560
## [1]  0.4815551  0.5184449 -5.5781386 -5.9785101  1.7121300  0.7586046
```

```
plot(n.stan.median, n.zaliapin, asp=1, xlim=c(0,1), ylim=c(0,1),
     xlab="Aftershock fraction from median of SS2007 posterior pdf",
     ylab="Aftershock fraction from Zaliapin and Ben-Zion, 2016")
abline(0,1)
```




## Todo

- ~~wrap making plots into a function~~
- ~~check converge, etc. of Stan fits~~
- fit full ETAS model?
- ~~add comparisons to *Hainzl et al.* [2006]~~
- ~~plots~~/discussions of widths of estimates
  - plot(n.stan.median, ylim=c(0,1))
  - arrows(1:130, nCI.stan[,1], 1:130, nCI.stan[,2], angle=90, ylim=c(0,1), length=0.05, code=3)

## References

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Hainzl, S., F. Scherbaum, and C. Beauval (2006), Estimating background activity based on interevent-time distribution, *Bulletin of the Seismological Society of America*, *96*(1), 313–320.

Saichev, A., and D. Sornette (2007), Theory of earthquake recurrence times, *Journal of Geophysical Research: Solid Earth*, *112*(B4).

Zaliapin, I., and Y. Ben-Zion (2016), Discriminating characteristics of tectonic and human-induced seismicity, *Bulletin of the Seismological Society of America*, *106*(3), 846–859.