```
library(ggplot2)

pgm_name="precip_gamma"

read_site<-function(sname="amherst"){
  tempdf<-read.csv(paste(sname,"PRECIP.csv",sep=''))
  tempdf$site<-as.factor(rep(sname,nrow(tempdf)))
  names(tempdf)<-c("n","year","month","day","rain_mm","X01","site")
  return(tempdf)
}
rainfall=read.csv("amherstPRECIP.csv")
rainfall$site<-as.factor(rep("amherst",nrow(rainfall)))
names(rainfall)<-c("n","year","month","day","rain_mm","X01","site")

rainfall<-rbind(rainfall,read_site(sname="bedford"))
rainfall<-rbind(rainfall,read_site(sname="bluehill"))
rainfall<-rbind(rainfall,read_site(sname="gb"))
rainfall<-rbind(rainfall,read_site(sname="lawrence"))
rainfall<-rbind(rainfall,read_site(sname="nb"))
rainfall<-rbind(rainfall,read_site(sname="pk"))
rainfall<-rbind(rainfall,read_site(sname="ptown"))
rainfall<-rbind(rainfall,read_site(sname="reading"))
rainfall<-rbind(rainfall,read_site(sname="taunton"))
rainfall<-rbind(rainfall,read_site(sname="walpole"))
rainfall<-rbind(rainfall,read_site(sname="wm"))

str(rainfall)

## 'data.frame': 349544 obs. of  7 variables:
##  $ n      : int  2 3 4 5 6 7 8 9 10 11 ...
##  $ year   : int  1893 1893 1893 1893 1893 1893 1893 1893 1893 1893 ...
##  $ month  : int  1 1 1 1 1 1 1 1 1 1 ...
##  $ day    : int  2 3 4 5 6 7 8 9 10 11 ...
##  $ rain_mm: num  215 0 0 0 4 0 0 NaN 6 NaN ...
##  $ X01    : int  0 0 0 0 0 0 0 0 0 0 ...
##  $ site   : Factor w/ 12 levels "amherst","bedford",..: 1 1 1 1 1 1 1 1 1 1 ...
```

Select the desired subset and build the data STAN will read

```
rainfall2<-subset(rainfall,!is.na(rain_mm) & year>=1990 & year <= 1999 & rain_mm>0)

table(rainfall2$rain_mm)

##
##    1    2    3    4    5    6    7    8    9   10   11   12   13   14   15
##  925  936  728  479  588  378  290  341  246  398  241  275  227  212  226
```

```
##   16   17   18   19   20   21   22   23   24   25   26   27   28   29   30
##  167  178  210  147  168  125  145  132  142  183  106  108  154  101  148
##   31   32   33   34   35   36   37   38   39   40   41   42   43   44   45
##   92  121  118   98  122   95   74   89   70  112   59  107   79   63   94
##   46   47   48   49   50   51   52   53   54   55   56   57   58   59   60
##   84   55   71   48   84   54   64   66   56   74   53   66   67   41   60
##   61   62   63   64   65   66   67   68   69   70   71   72   73   74   75
##   49   54   49   47   60   37   35   60   30   60   40   42   47   33   70
##   76   77   78   79   80   81   82   83   84   85   86   87   88   89   90
##   31   39   45   26   48   30   35   40   27   37   32   30   25   23   29
##   91   92   93   94   95   96   97   98  100  101  102  103  104  105  106
##   30   31   21   21   24   26   16   27   54   19   25   29   23   21   18
##  107  108  109  110  111  112  113  114  115  116  117  118  119  120  121
##   22   24   16   36   10   29   22   17   25   13   13   19   17   22   12
##  122  123  124  125  126  127  128  129  130  131  132  133  134  135  136
##   11   21   11   18    9   12   11    8   17   11   12   13   12   18   13
##  137  138  139  140  141  142  143  144  145  146  147  148  149  150  151
##    5   10    9   23   12   17   16    7    9    9    8   13    6   13   11
##  152  153  154  155  156  157  158  159  160  161  162  163  164  165  166
##    4    7    9    9   13    8    9    8    9    7    5    6    8    8    2
##  167  168  169  170  171  172  173  174  175  176  177  178  179  180  181
##    2   11    3    6    3    3    9    5    9    3    8    4    4    8    1
##  182  183  184  185  186  187  188  189  190  191  192  193  194  195  196
##    1    2    9   10    1    1    4    3    4    2    3    3    5    8    6
##  197  198  199  200  201  202  203  204  205  206  207  208  209  210  211
##    4    3    2   11    2    4    3    6    6    3    2    2    1    5    3
##  212  213  215  216  217  218  219  220  221  222  223  224  225  226  227
##    7    1    3    2    2    3    2    1    1    1    4    1    4    1    3
##  228  229  230  231  232  233  234  235  236  238  239  240  241  242  243
##    4    3    5    5    2    3    3    3    2    2    2    1    1    2    3
##  244  245  246  247  249  250  251  252  253  254  255  257  258  260  264
##    2    1    2    3    1    3    2    1    3    3    3    3    1    4    1
##  265  266  267  269  270  271  272  274  275  279  280  281  282  284  285
##    2    1    3    2    2    1    1    1    2    1    1    1    2    1    1
##  286  287  288  289  294  299  300  304  305  308  310  311  312  313  314
##    1    1    1    1    1    1    1    1    2    2    1    1    3    1    2
##  315  318  319  320  325  329  330  331  332  334  335  336  338  340  343
##    1    2    2    1    1    1    1    1    2    1    1    2    1    3    1
##  349  352  353  354  358  365  367  371  372  373  374  377  380  383  387
##    1    1    1    1    1    1    1    1    1    1    1    1    1    1    2
##  393  394  396  400  401  406  413  425  445  451  455  456  467  472  477
##    1    1    1    1    1    1    1    1    1    1    1    1    1    1    1
##  478  500  509  541  547  559  562  581  583  584  605  607  639  672  700
##    1    1    1    1    2    1    1    1    1    1    1    1    1    1    1
##  710  728  767  783 1000 1020
```

```
##    1    1    1    1    1    1

Nobs<-length(table(rainfall2$rain_mm))

log_rain_mm<-1+log(rainfall2$rain_mm)   #rainfall mm

Nobs<-length(log_rain_mm)              #number of obs

Nobs

## [1] 13833
```

Run STAN

```
library(rstan)

## rstan (Version 2.8.2, packaged:  2015-11-26 15:27:02 UTC, GitRev:
05c3d0058b6a)
## For execution on a local, multicore CPU with excess RAM we recommend
calling
## rstan_options(auto_write = TRUE)
## options(mc.cores = parallel::detectCores())

rstan_options(auto_write = TRUE)
options(mc.cores = parallel::detectCores())

#library(ShinyStan)  #not available on cran for R3.2.2
library(shinystan)   #downloaded from cran

## Loading required package:  shiny
##
## This is shinystan version 2.0.1

stanfit<-stan("precip_gamma.stan",iter=6000)

fname=paste("Rdata/",pgm_name,"_rainfall_gamma_",format(Sys.time(),'%m%d%Y%H%M%S'),".Rdata",
save(stanfit,file=fname)

launch_shinystan(stanfit)

##
## Loading...
## Note:  for large models ShinyStan may take a few moments to launch.
##
## Listening on http://127.0.0.1:6739
```

Compare the data and posterior predictive draw

```r
library(ggplot2)
quantile(log_rain_mm,c(.025,.25,.50,.75,.975,.999))
```

```
##     2.5%      25%      50%      75%    97.5%    99.9%
## 1.000000 2.609438 3.890372 4.912023 6.194065 7.337088
```

```r
print(stanfit)
```

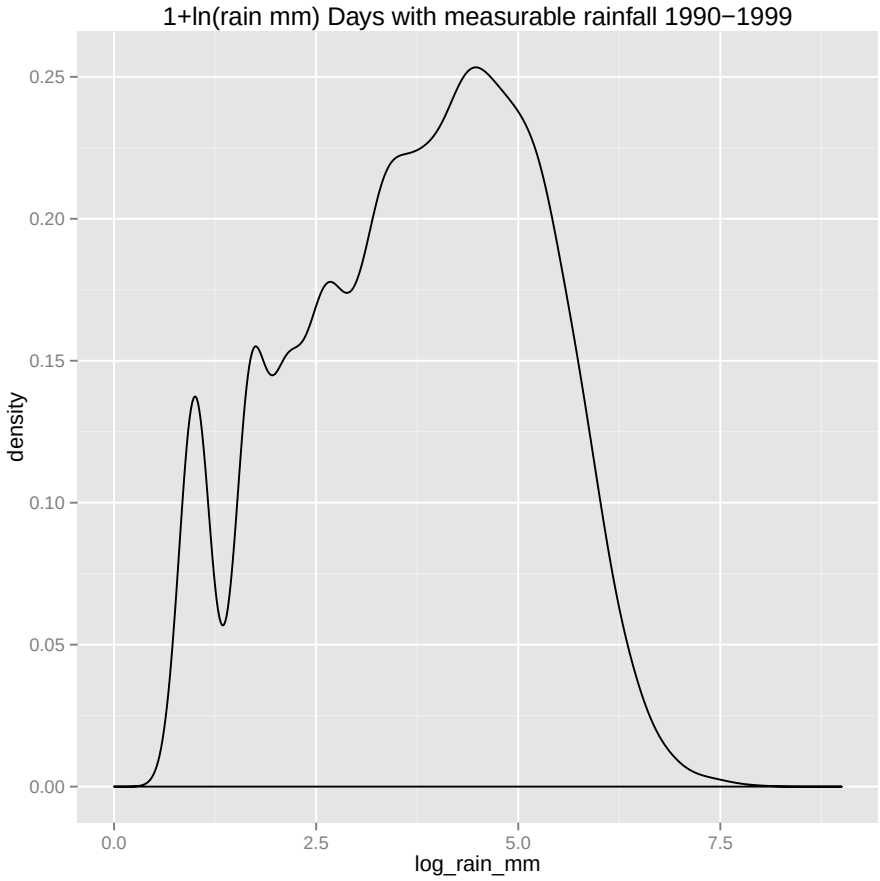
```
## Inference for Stan model: precip_gamma.
## 4 chains, each with iter=6000; warmup=3000; thin=1;
## post-warmup draws per chain=3000, total post-warmup draws=12000.
##
##                      mean se_mean   sd      2.5%       25%       50%
## alpha                5.25    0.00 0.06      5.13      5.20      5.25
## beta                 1.40    0.00 0.02      1.36      1.38      1.40
## log_rain_mm_rep      3.75    0.02 1.63      1.28      2.54      3.50
## lp__            -25559.06    0.02 0.99 -25561.73 -25559.43 -25558.75
##                      75%     97.5% n_eff Rhat
## alpha                5.29      5.37  2163    1
## beta                 1.41      1.43  2183    1
## log_rain_mm_rep      4.70      7.59 11680    1
## lp__            -25558.36 -25558.09  2718    1
##
## Samples were drawn using NUTS(diag_e) at Mon Dec 28 10:14:29 2015.
## For each parameter, n_eff is a crude measure of effective sample size,
## and Rhat is the potential scale reduction factor on split chains (at
## convergence, Rhat=1).
```

```r
mean(log_rain_mm)
```

```
## [1] 3.758728
```

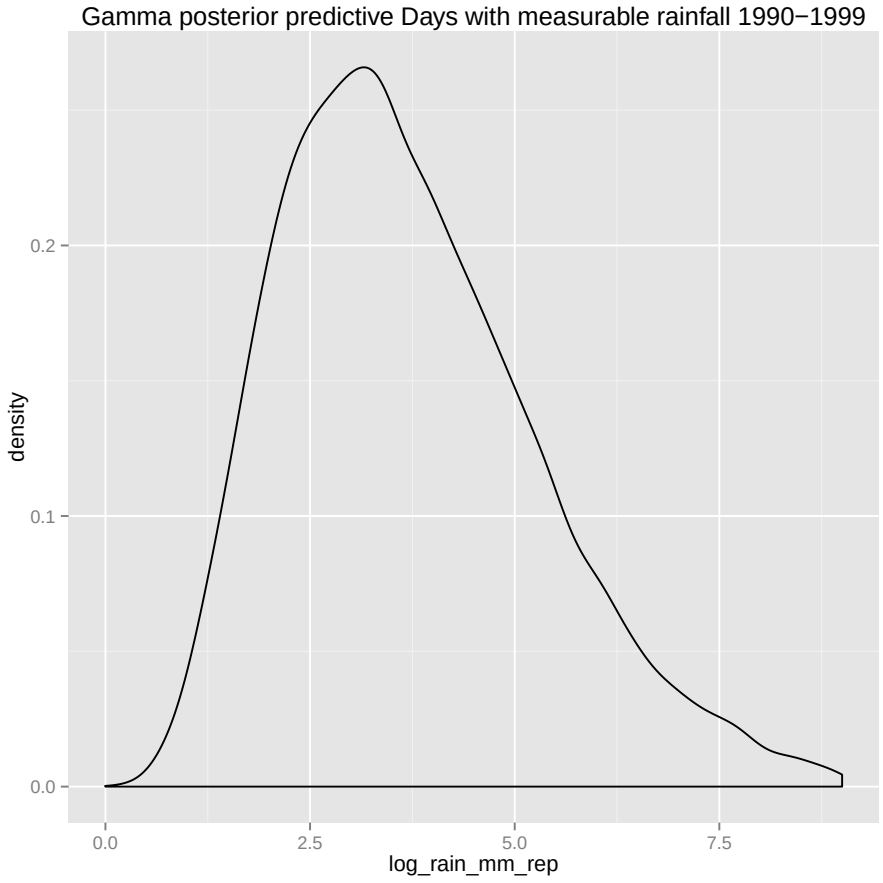
```r
rain_mm<-rainfall2$rain_mm
sfx<-extract(stanfit,c("log_rain_mm_rep"))
log_rain_mm_rep<-sfx$log_rain_mm_rep
pdf1<-data.frame(log_rain_mm)
pdf2<-data.frame(log_rain_mm_rep)

qplot(log_rain_mm,data=pdf1,geom="density",main="1+ln(rain mm) Days with measurable rainfall
```




```
qplot(log_rain_mm_rep,data=pdf2,geom="density",main="Gamma posterior predictive Days with me

## Warning:  Removed 74 rows containing non-finite values (stat_density).
```


Gamma posterior predictive Days with measurable rainfall 1990−1999
density
0.2
0.1
0.0
0.0
2.5
5.0
7.5
log_rain_mm_rep