SNOTEL Bayesian Regression

Thea Sukianto

January 18, 2021

```
library(dplyr)
library(brms)
library(ggplot2)
library(tidybayes)
```

Data Preparation

```
snotel_df <- read.csv("../data/Idaho_SNOTEL_locations.csv") %>% # read SNOTEL data and abbreviate perti
  dplyr::rename(snow = Max.Snow.Depth,
                precip = Max.Accumulated.Precipitation)
```

Fit Bayesian Regression Model

(Code adapted from section 2.3 of "Doing Bayesian Data Analysis in brms and the tidyverse" by A. Solomon Kurz)

```
fit_snotel <-
  brm(data = snotel_df,
      family = gaussian, # specify Gaussian response variable (do linear regression)
      snow ~ 1 + precip, # model formula: snow = intercept + precip
      prior = c(prior(normal(0, 100), class = Intercept), # N(0, 100) prior for intercept
                prior(normal(0, 100), class = b), # N(0, 100) prior for slope
                prior(cauchy(0, 10),  class = sigma)), # Cauchy(0, 10) prior for noise standard deviati
      chains = 4, # Markov chains
      cores = 4, # Processor cores
      iter = 2000,
      warmup = 1000,
      seed = 2)
```

```
## Warning: Rows containing NAs were excluded from the model.
```

```
## Compiling Stan program...
```

```
## Trying to compile a simple C file
```

```
## Running /Library/Frameworks/R.framework/Resources/bin/R CMD SHLIB foo.c
## clang -mmacosx-version-min=10.13 -I"/Library/Frameworks/R.framework/Resources/include" -DNDEBUG   -I
## In file included from <built-in>:1:
## In file included from /Library/Frameworks/R.framework/Versions/4.0/Resources/library/StanHeaders/incl
## In file included from /Library/Frameworks/R.framework/Versions/4.0/Resources/library/RcppEigen/inclu
## In file included from /Library/Frameworks/R.framework/Versions/4.0/Resources/library/RcppEigen/inclu
## /Library/Frameworks/R.framework/Versions/4.0/Resources/library/RcppEigen/include/Eigen/src/Core/util/
## namespace Eigen {
## ^
```

```
## /Library/Frameworks/R.framework/Versions/4.0/Resources/library/RcppEigen/include/Eigen/src/Core/util
## namespace Eigen {
##                 ^
##                 ;
## In file included from <built-in>:1:
## In file included from /Library/Frameworks/R.framework/Versions/4.0/Resources/library/StanHeaders/inc
## In file included from /Library/Frameworks/R.framework/Versions/4.0/Resources/library/RcppEigen/inclu
## /Library/Frameworks/R.framework/Versions/4.0/Resources/library/RcppEigen/include/Eigen/Core:96:10: fa
## #include <complex>
##          ^~~~~~~~
## 3 errors generated.
## make: *** [foo.o] Error 1
```

```
## Start sampling
```

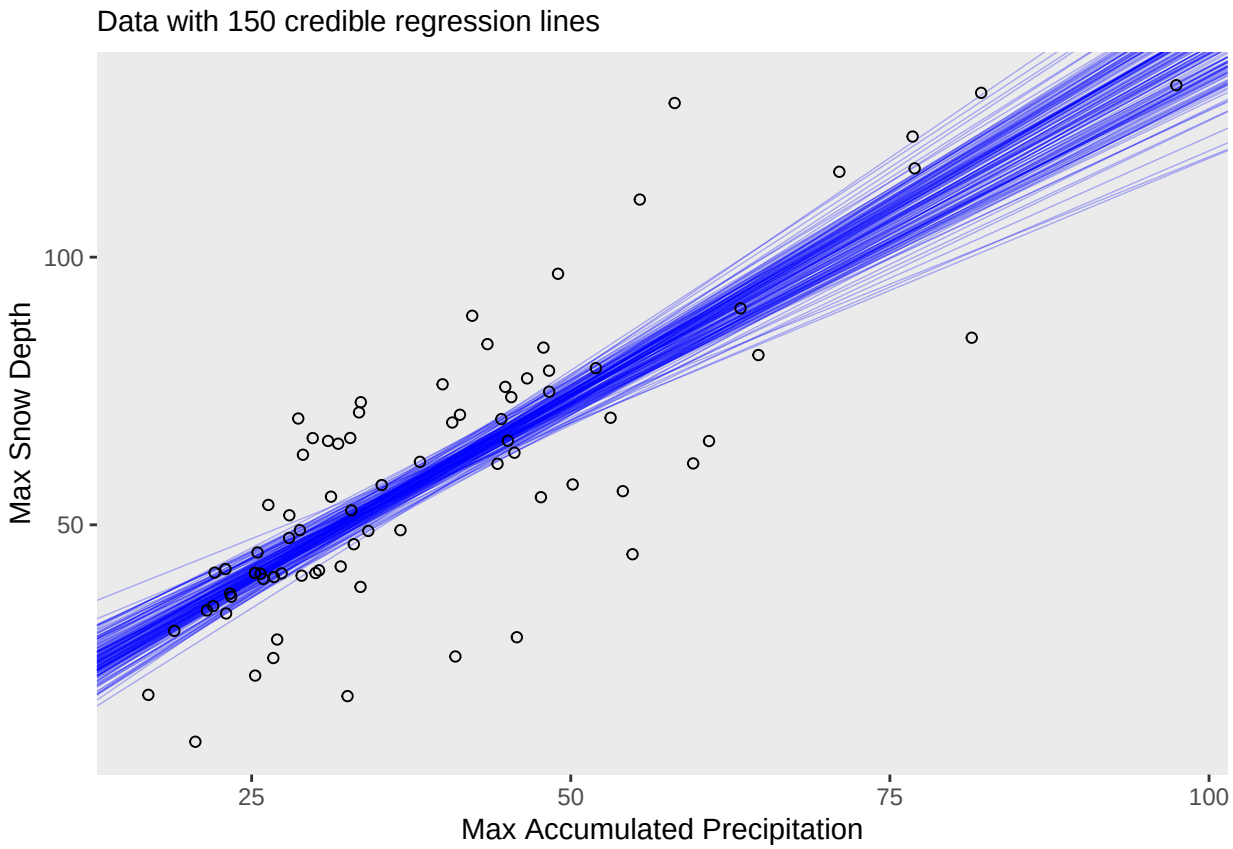
Plot credible regression lines

```
# extract the posterior draws
post <- posterior_samples(fit_snotel)

# this will streamline some of the code, below
n_lines <- 150

# plot!
snotel_df %>%
  ggplot(aes(x = precip, y = snow)) +
  geom_abline(intercept = post[1:n_lines, 1],
              slope     = post[1:n_lines, 2],
              color = "blue",
              size = 1/4, alpha = .3) +
  geom_point(shape = 1) +
  # the `eval(substitute(paste()))` trick came from: https://www.r-bloggers.com/value-of-an-r-object-in
  labs(subtitle = eval(substitute(paste("Data with", n_lines, "credible regression lines"))),
       x = "Max Accumulated Precipitation",
       y = "Max Snow Depth") +
  coord_cartesian(xlim = c(min(snotel_df$precip), max(snotel_df$precip)),
                  ylim = c(min(snotel_df$snow), max(snotel_df$snow))) +
  theme(panel.grid = element_blank())
```

```
## Warning: Removed 2 rows containing missing values (geom_point).
```



Plot posterior distribution

```
post %>%
  ggplot(aes(x = b_precip, y = 0)) +
  stat_histinterval(point_interval = mode_hdi, .width = .95,
                    fill = "grey67", slab_color = "grey92",
                    breaks = 40, slab_size = .2, outline_bars = T) +
  scale_y_continuous(NULL, breaks = NULL) +
  coord_cartesian(xlim = c(0.5, 2)) +
  labs(title = "The posterior distribution",
       subtitle = "The mode and 95% HPD intervals are\nthe dot and horizontal line at the bottom.",
       x = expression(paste(beta[1], " (slope)"))) +
  theme(panel.grid = element_blank())
```

The posterior distribution

The mode and 95% HPD intervals are
the dot and horizontal line at the bottom.