SMR over time (year and day/night)

Amber Lee

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Set up (from 1 Set up SMR)

```
library(RMySQL)

library(tidyverse)
library(tidyr)
library(broom)
library(lubridate)
library(stringr)
library(kableExtra)
library(data.table) # for transposing coordinates

library(XML)
library(RCurl)
library(lutz)
library(suncalc)
```

```
dataset_names <- dbGetQuery(con, "SHOW TABLES")[[1]]

# remove datasets with "_" in the name
dataset_names <- dataset_names[str_detect(dataset_names, "_", negate = TRUE)]

query_sample <- function(dataset_str, percent){
  # input is dataset_str (str) with dataset name, and percent (dbl) for the random sample %
  # output is the dataframe with a column added for the name of dataset and character NA's
  # replaced with NA's
  # global variable con is the SQL connection

  command <- paste("SELECT * FROM", dataset_str, "WHERE rand() <=", percent,
                   # in SQL, filter for vehicular stops
                   " AND type = 'vehicular'",
                   sep = " ")

  df <- dbGetQuery(con, command) %>% mutate(dataset_name = dataset_str)

  # do not consider empty datasets
  if (dim(df)[1] == 0){
    return(NULL)
  }

  # replace character NA's with NA
```

```
  if (sum(is.na(df) == 0)){

    df[df == "NA"] = NA

  }

  return(df %>% dplyr::select(-type))

}

dataset_lst <- lapply(dataset_names, query_sample, 0.15)

# remove empty datasets through logical indexing
dataset_lst <- dataset_lst[sapply(dataset_lst, function(x) isTRUE(nrow(x) > 0))]
```

```
check_nonempty <- function(var, dataset, n_obsv){
  # helper function for removing empty columns

  # the function environment has the parameter dataset
  col_str <- paste("dataset$", var, sep = "")
  col <- eval(parse(text = col_str))
  isCollected <- sum(is.na(col)) < n_obsv

  return(isCollected)

}

remove_empty_col <- function(dataset){
  # a variable is 'collected' if there is a column for it in the dataset
  # but being collected doesn't imply nonempty

  collected_var <- names(dataset)
  n_obsv <- dim(dataset)[1]

  nonempty_bools <- unlist(lapply(collected_var, check_nonempty, dataset, n_obsv))

  # use logial indexing!
  nonempty_var <- collected_var[nonempty_bools]

  ## in case i need this information
  # empty_var <- collected_var[!nonempty_bools]

  return(dataset %>% dplyr::select({{ nonempty_var }}))

}

dataset_lst <- lapply(dataset_lst, remove_empty_col)
```

```
myfilter_for <- function(dataset, var_vect, need_containment){
  # if need_containment is true, then function only returns
  # datasets containing ALL variables specified in var_vect

  # need_containment = TRUE results in more restrictive filtering
```

```
  dataset_var <- names(dataset)
  intersection <- var_vect[var_vect %in% dataset_var]

  if (need_containment){

    if (length(intersection) == length(var_vect)) {
      # embrace syntax from dplyr programming
      return(dataset %>% dplyr::select({{ var_vect }}))
    } else {
      return(NULL)
    }

  } else if (!need_containment){

    if (length(intersection > 0)) {
      # embrace syntax from dplyr programming
      return(dataset %>% dplyr::select({{ intersection }}))
    } else{
      return(NULL)
    }

  }

}
```

```
dataset_containing <- function(dataset, var_vect){
  # var_vect is str with the variables we WANT
  # returns the whole dataset

  if(var_vect %in% names(dataset)){
    return(dataset)

  } else {
    return(NULL)

  }

}
```

```
find_dataset <- function(dataset, name_str){

  if(dim(dataset)[1] <= 1){
    return(NULL)
  }

  if(dataset$dataset_name[1] == name_str){
    return(dataset)
  }

}

mysearch_dataset <- function(dataset_list, name_str){

  df <- lapply(dataset_list, find_dataset, name_str)
```

```
  df <- df[sapply(df, function(x) isTRUE(nrow(x) > 0))]

  return(df[[1]])

}
```

```
check_missing <- function(n_threshold, df){

  col <- df %>%
    mutate("isMissing_{{ n_threshold }}" := case_when(missing >= n_threshold ~ TRUE,
                                                      TRUE ~ FALSE)) %>%
    select(starts_with("isMissing"))

  return(col)

}

countMissing <- function(dataset, n_threshold, exclude_bool, exclude_var){
  # <n_threshold> is used to classify the observations with
  # at least n_threshold missing values as completely missing

  # <exclude_var> is str specifying which variables we don't count for NA's

  n_var <- dim(dataset)[2]

  if (exclude_bool){
    missing <- list(missing = rowSums(is.na(dataset %>% select(-all_of(exclude_var)))))

  } else {
    missing <- list(missing = rowSums(is.na(dataset)))

  }

  dataset <- dataset %>%
    bind_cols(list(missing), .id = NULL) %>%
    mutate(stop_missing_rate = missing/n_var)

  dataset <- dataset %>%
    # check_missing operates on dataset with missingness already counted
    bind_cols(lapply(1:n_threshold, check_missing, dataset))

  return(as.data.frame(dataset))

}

missing_lst <- lapply(dataset_lst, countMissing, 1, FALSE)
```

```
# 15 most frequently recorded variables
freq_var <- data.frame("var" = unlist(lapply(dataset_lst, function(dataset) names(dataset)))) %>%
  group_by(var) %>%
  summarize(count = n(), .groups = "drop") %>%
  # drop type (either pedestrian or vehicular)
  filter(var != "type" & str_detect(var, "row", negate = TRUE)) %>%
  # could make this function that returns top n var
```

```
  slice_max(count, n = 16) %>%
  pull(var)
```

SMR by week (throughout years)

We do *not* require containment when we use `myfilter_for`.

```
date_lst <- lapply(dataset_lst, myfilter_for, freq_var, FALSE)

# filtering OUT datasets that don't record date
date_lst <- lapply(date_lst, dataset_containing, "date")
date_lst <- date_lst[sapply(date_lst, function(x) isTRUE(nrow(x) > 0))]
```

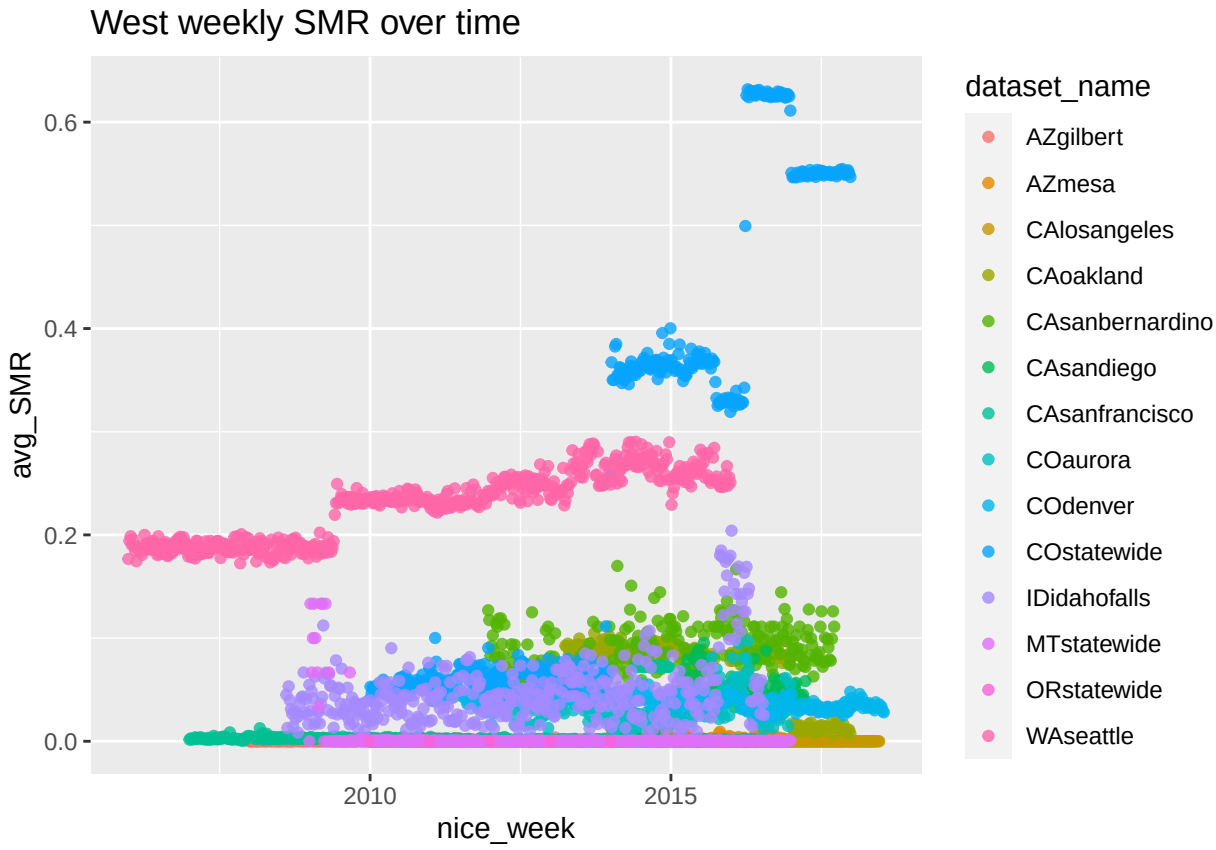
```
# helper function
summarizeMissingTemporally <- function(dataset){

  dataset <- dataset %>%
    mutate(nice_date = ymd(date),
           nice_week = ymd(cut(nice_date, "week"))) %>%
    select(dataset_name, nice_week, stop_missing_rate) %>%
    ungroup() %>%
    group_by(nice_week, dataset_name) %>%
    summarize(avg_SMR = mean(stop_missing_rate), stop_count = n(), .groups = "drop")

  return(dataset)

}

makeDF.SMRByDate <- function(date_list){

  # count NA
  date_list <- lapply(date_list, countMissing, 1, TRUE, "date")

  # summarize
  date_list <- lapply(date_list, summarizeMissingTemporally)

  state_df <- data.frame(state = state.abb, region = state.region)

  southern_str <- state_df$state[state_df$region == "South"]
  west_str <- state_df$state[state_df$region == "West"]
  northeast_str <- state_df$state[state_df$region == "Northeast"]
  northcent_str <- state_df$state[state_df$region == "North Central"]

  nvar_per_dataset <- data.frame(dataset_name = sapply(dataset_lst,
                                                       function(dataset) dataset$dataset_name[1]),
                         n_var = sapply(dataset_lst,
                                        function(dataset) length(names(dataset))))

  # make df just include date and SMR
  date_df <- bind_rows(date_list) %>%
    mutate(state_abb = substr(dataset_name, 1, 2),
           region = case_when(state_abb %in% southern_str ~ "South",
```

```
                              state_abb %in% west_str ~ "West",
                              state_abb %in% northeast_str ~ "Northeast",
                              state_abb %in% northcent_str ~ "North Central",
                              TRUE ~ "No regioned (error!)")) %>%
    #something off about this left join
    left_join(nvar_per_dataset, by = "dataset_name")

  return(date_df)

}

date_df <- makeDF.SMRByDate(date_lst)
```

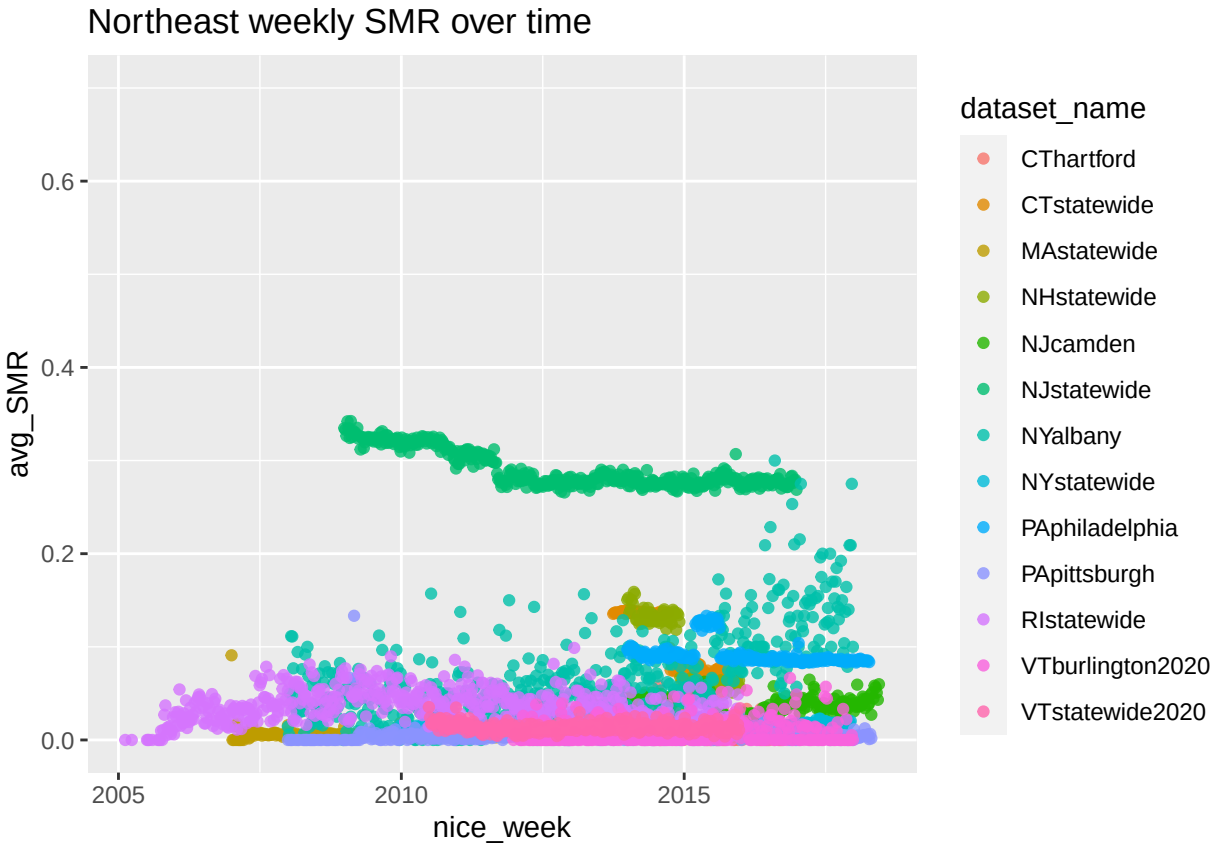
```
ggplot_date <- function(date_dataset, region_or_dataset){

  plot_region <- function(name){

    p <- date_dataset %>%
      filter(region == name) %>%
      ggplot() +
      geom_point(aes(x = nice_week, y = avg_SMR,
                     color = dataset_name), alpha = .8) +
      ggtitle(paste(name, "weekly SMR over time"))

    ggsave(paste(name, "weekly SMR.png"), p)
    return(p)

  }

  plot_dataset <- function(name){

    p <- date_dataset %>%
      filter(dataset_name == name) %>%
      ggplot() +
      geom_point(aes(x = nice_week, y = avg_SMR), alpha = .8) +
      ggtitle(paste(name, "weekly SMR over time"))

    ggsave(paste(name, "weekly SMR.png"), p)
    return(p)

  }

  if (region_or_dataset == "region"){
    region_names <- date_dataset %>% distinct(region) %>% pull (region)
    plots <- lapply(region_names, plot_region)

  } else if (region_or_dataset == "dataset"){
    dataset_names <- date_dataset %>% distinct(dataset_name) %>% pull(dataset_name)
    plots <- lapply(dataset_names, plot_dataset)

  } else {return(stop("typo in region_or_dataset"))}

  return(plots)
```

```
}

ggplot_date(date_df, "region")
```

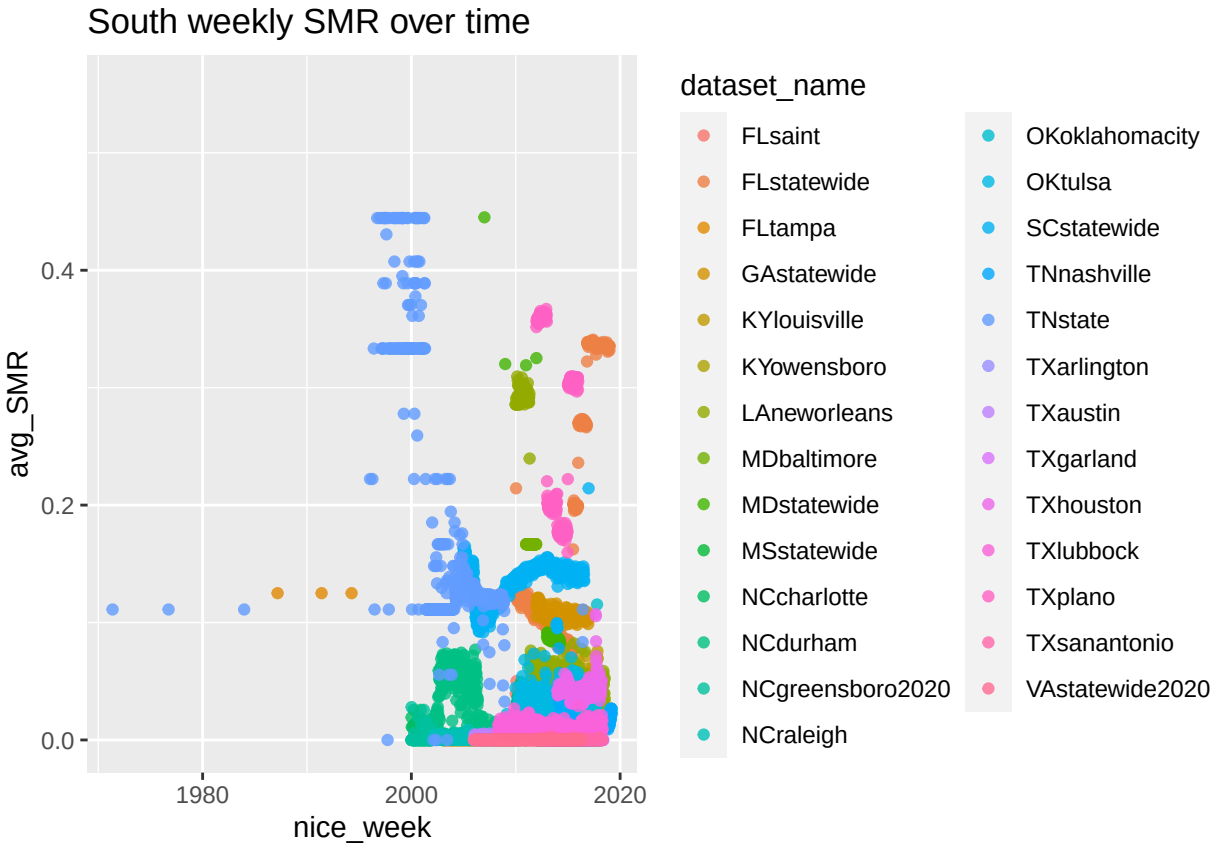
```
## [[1]]
```



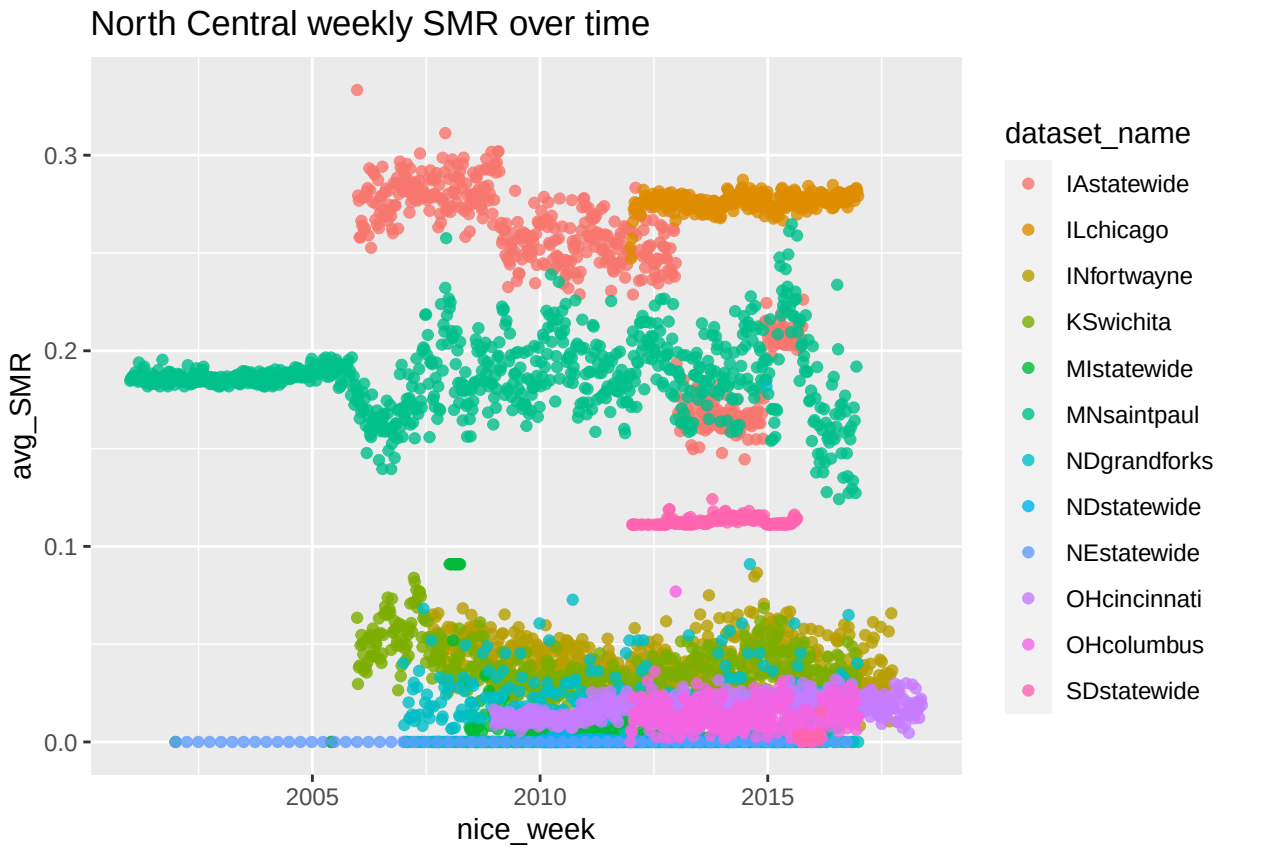

```
##
## [[2]]
```


Northeast weekly SMR over time
avg_SMR
0.0
0.2
0.4
0.6
2005
2010
2015
nice_week
dataset_name
CThartford
CTstatewide
MAstatewide
NHstatewide
NJcamden
NJstatewide
NYalbany
NYstatewide
PAphiladelphia
PApittsburgh
RIstatewide
VTburlington2020
VTstatewide2020

```
##
## [[3]]
```

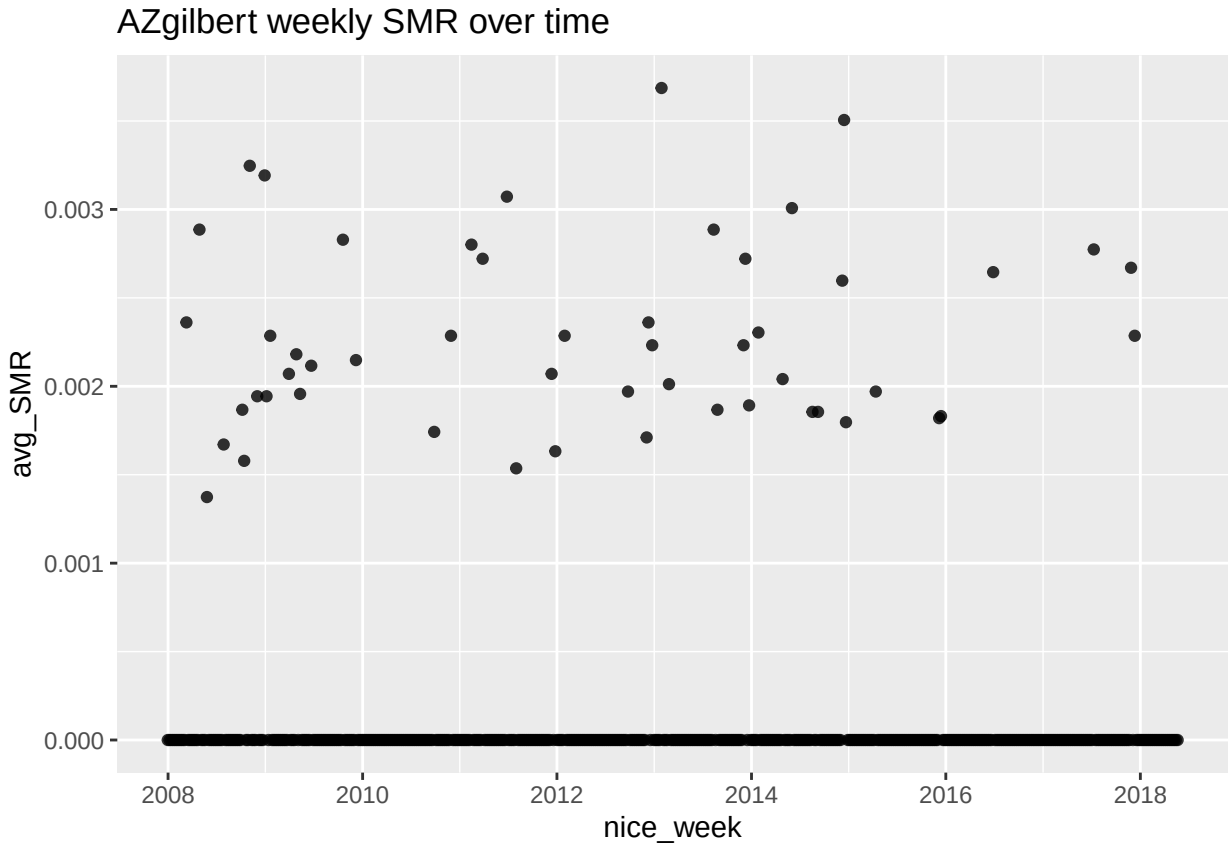

South weekly SMR over time
avg_SMR
0.0
0.2
0.4
1980
2000
2020
nice_week
dataset_name
FLsaint
FLstatewide
FLtampa
GAstatewide
KYlouisville
KYowensboro
LAneworleans
MDbaltimore
MDstatewide
MSstatewide
NCcharlotte
NCdurham
NCgreensboro2020
NCraleigh
OKoklahomacity
OKtulsa
SCstatewide
TNnashville
TNstate
TXarlington
TXaustin
TXgarland
TXhouston
TXlubbock
TXplano
TXsanantonio
VAstatewide2020

```
##
## [[4]]
```

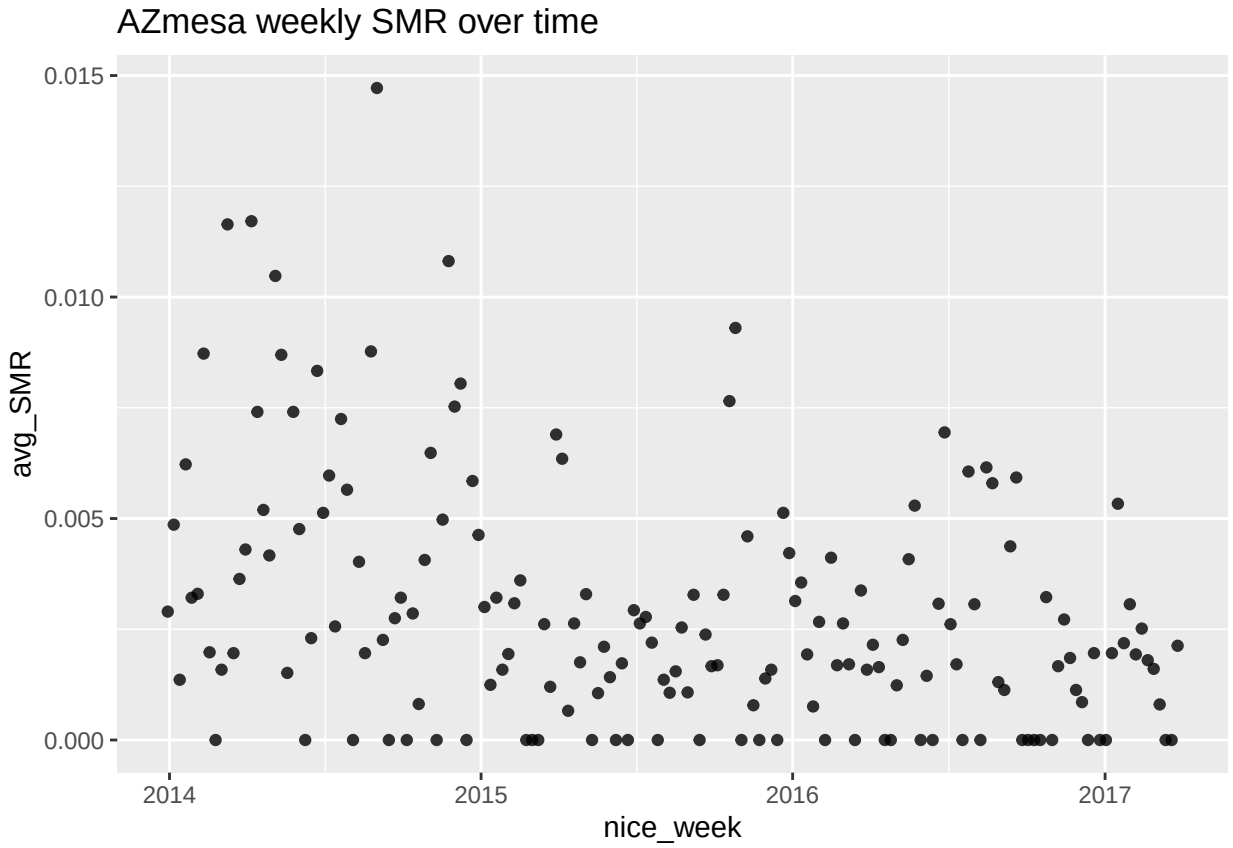



```
ggplot_date(date_df, "dataset")
```

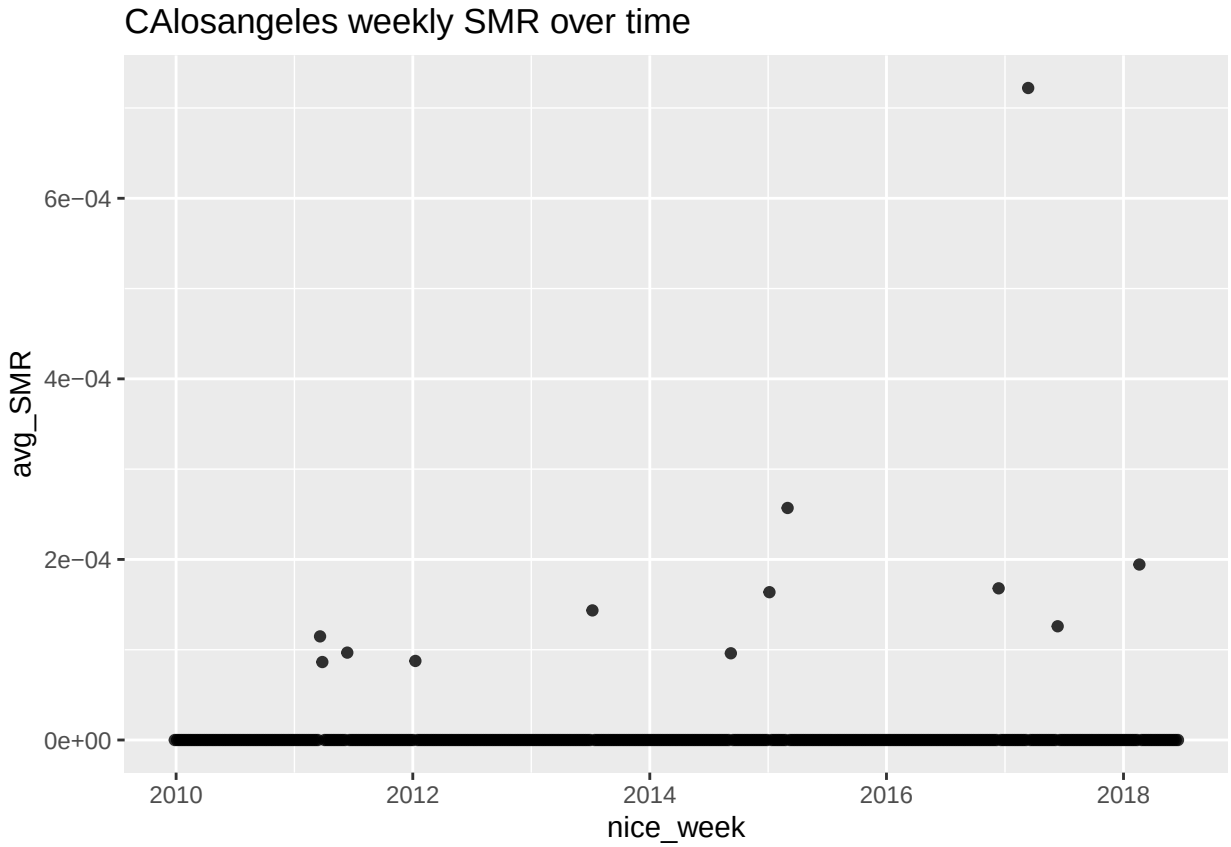
```
## [[1]]
```


AZgilbert weekly SMR over time
avg_SMR
0.003
0.002
0.001
0.000
2008
2010
2012
2014
2016
2018
nice_week

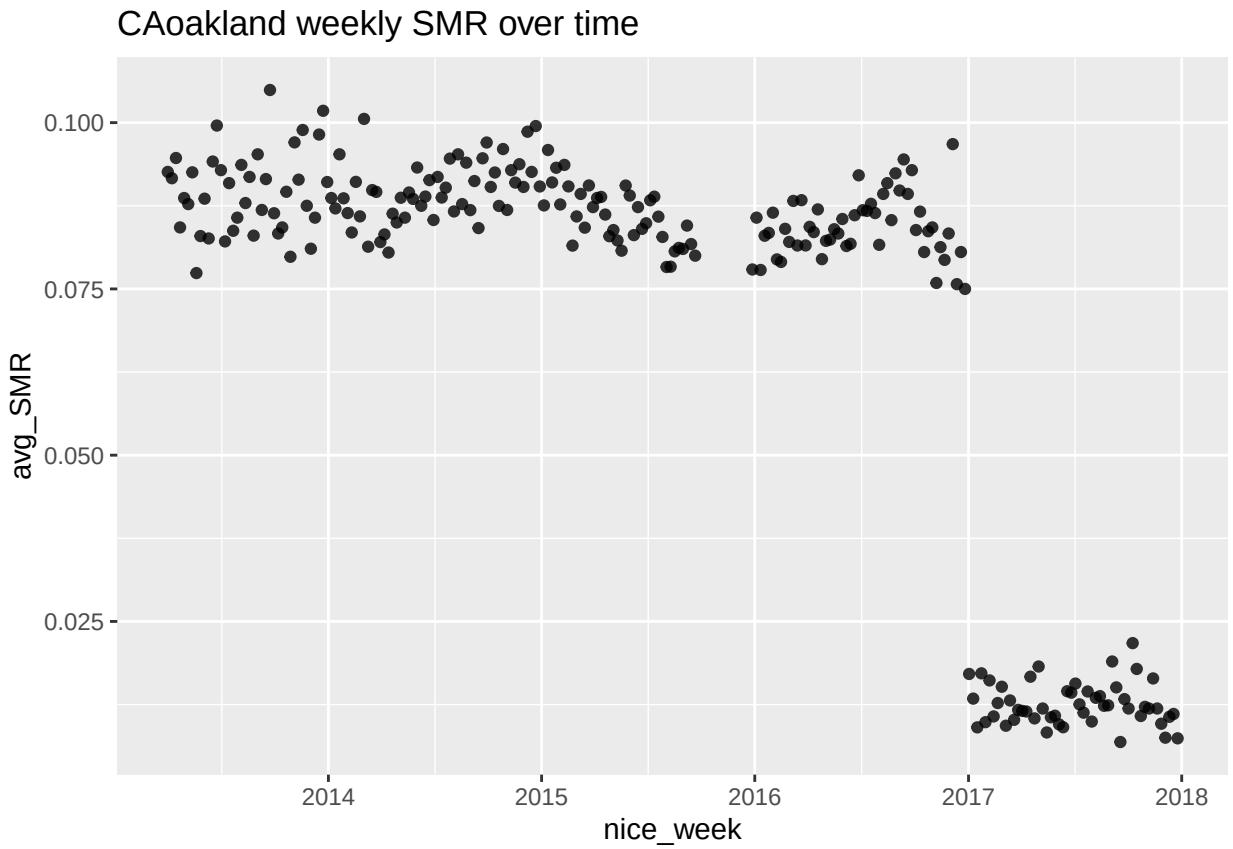
```
##
## [[2]]
```


AZmesa weekly SMR over time
0.015
0.010
0.005
0.000
avg_SMR
2014
2015
2016
2017
nice_week

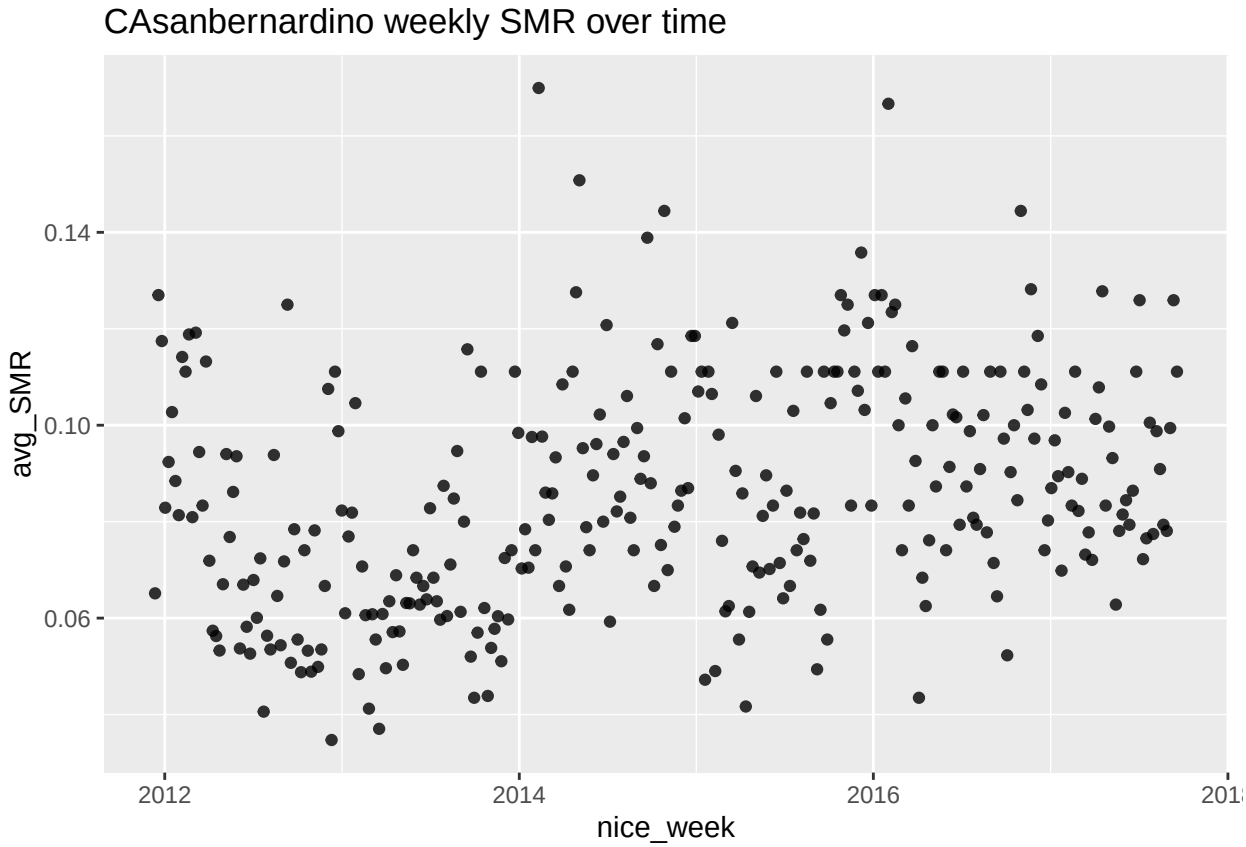
```
##
## [[3]]
```


CAlosangeles weekly SMR over time
avg_SMR
6e−04
4e−04
2e−04
0e+00
2010
2012
2014
2016
2018
nice_week

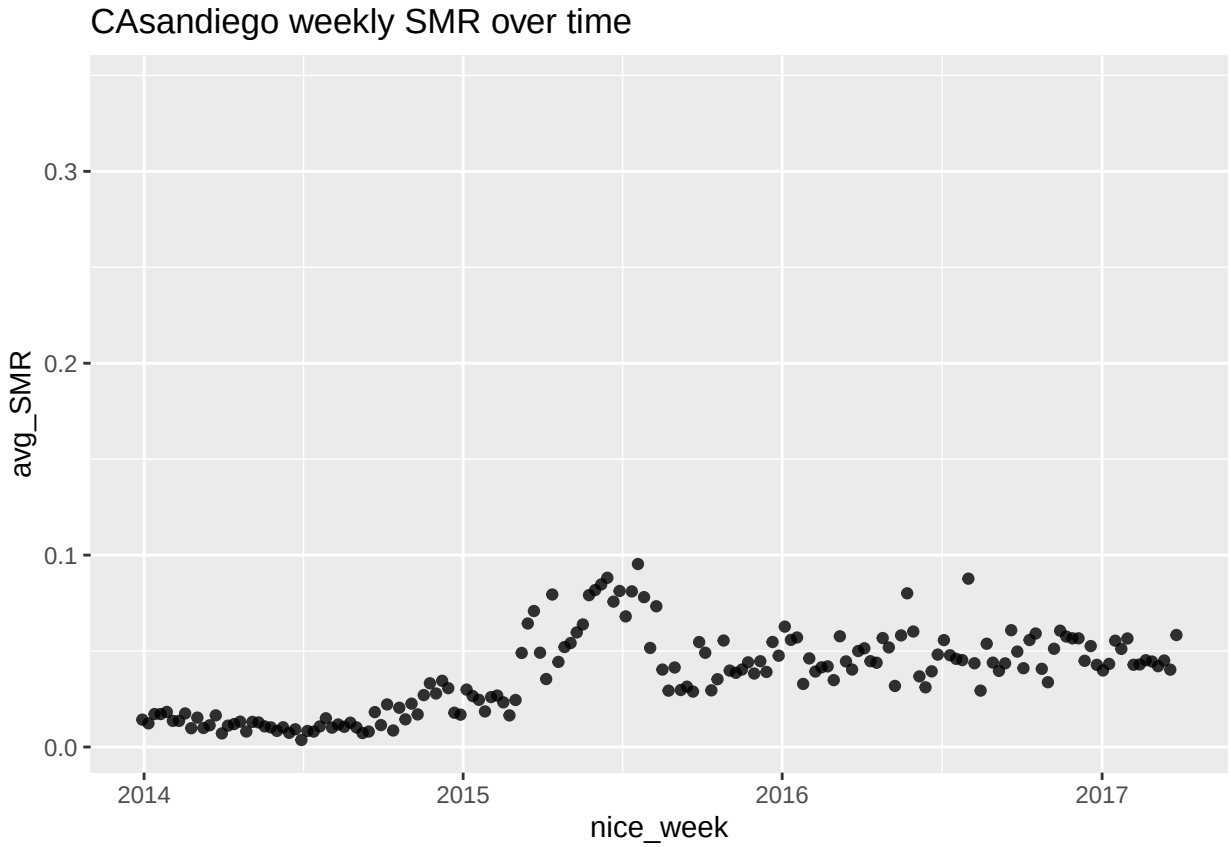
```
##
## [[4]]
```


CAoakland weekly SMR over time
avg_SMR
0.100
0.075
0.050
0.025
2014
2015
2016
2017
2018
nice_week

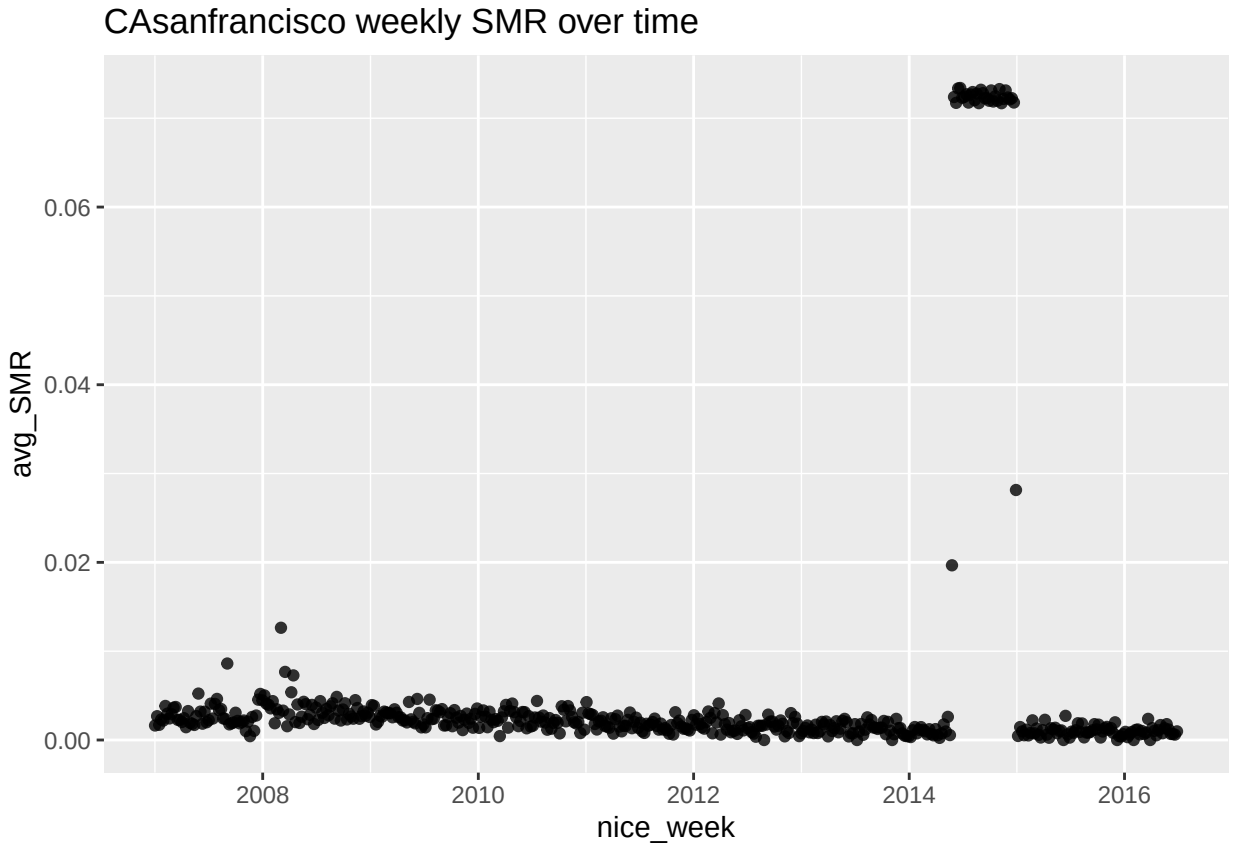
```
##
## [[5]]
```


CAsanbernardino weekly SMR over time
avg_SMR
0.14
0.10
0.06
2012
2014
2016
nice_week

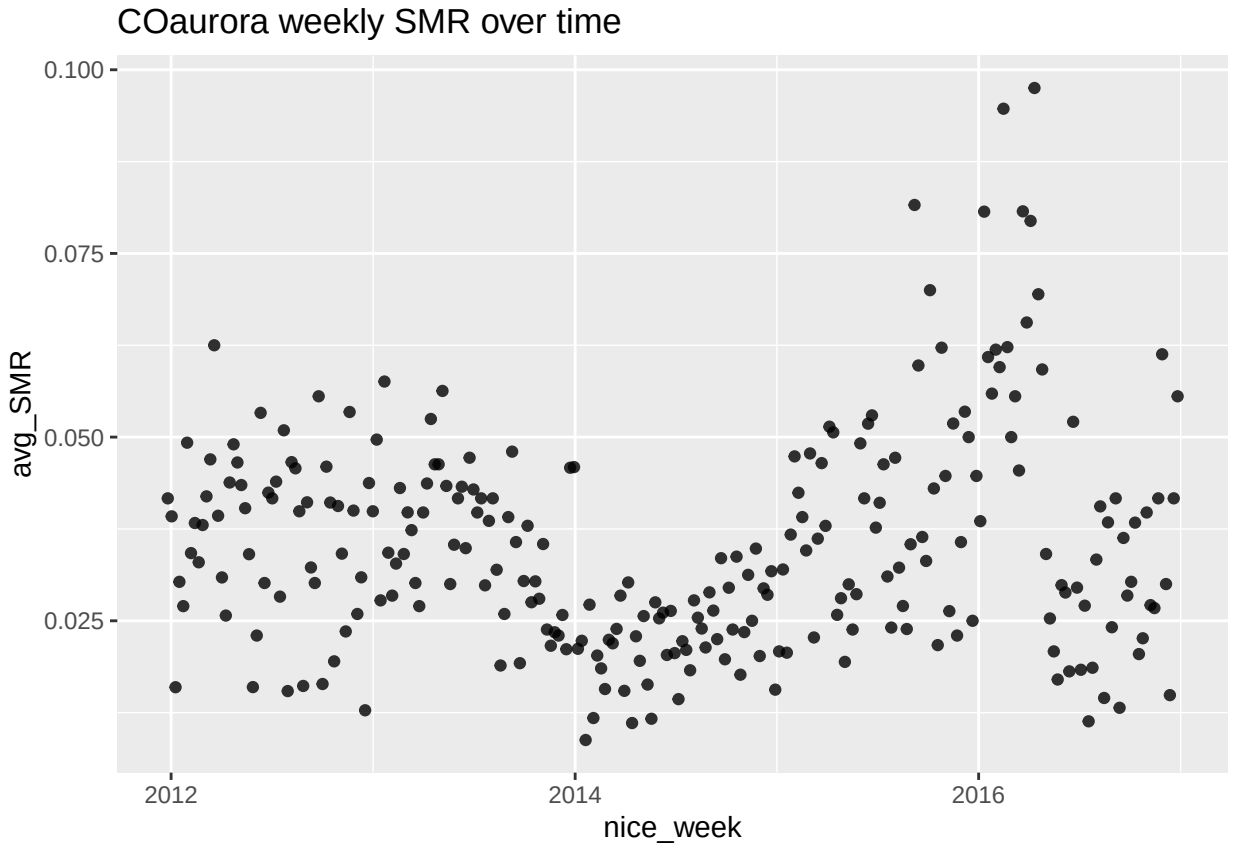
```
##
## [[6]]
```


CAsandiego weekly SMR over time
avg_SMR
0.0
0.1
0.2
0.3
2014
2015
2016
2017
nice_week

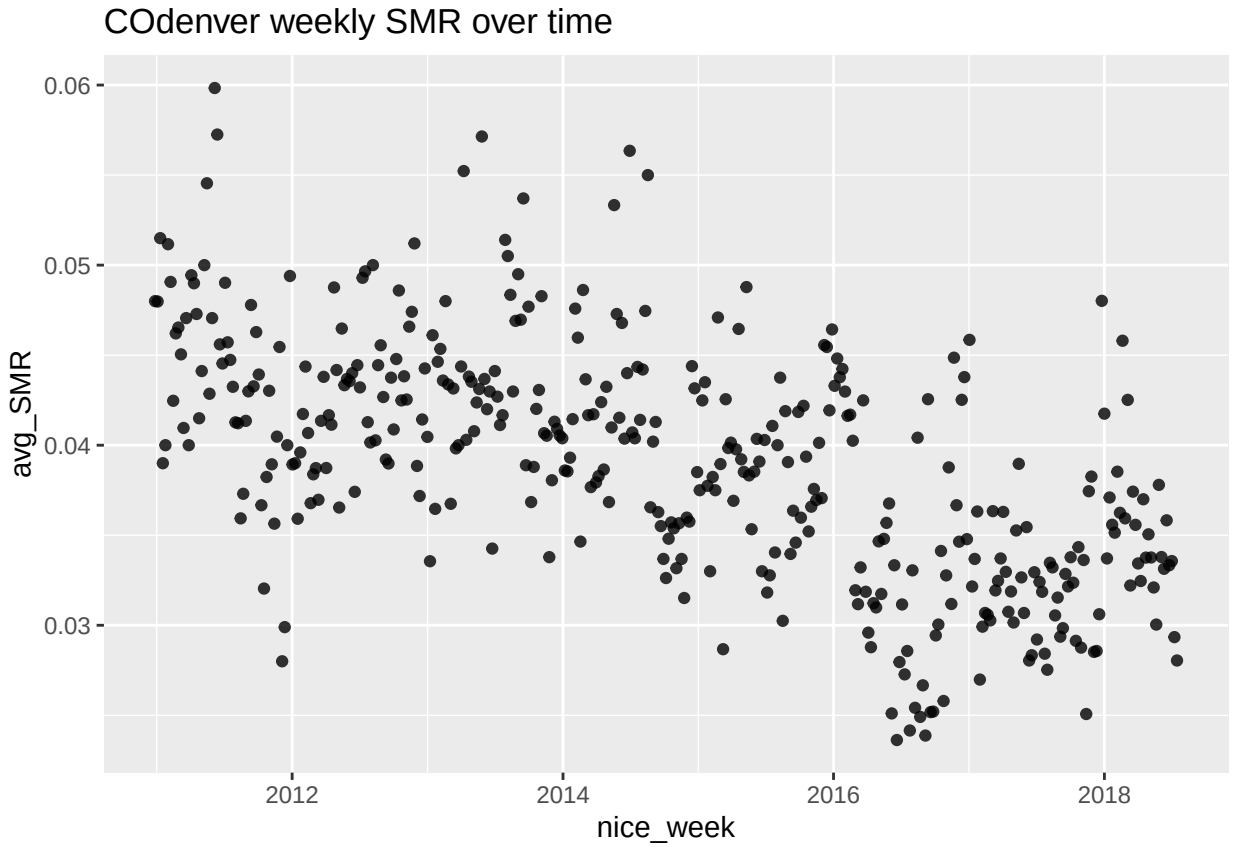
```
##
## [[7]]
```


CAsanfrancisco weekly SMR over time
avg_SMR
0.06
0.04
0.02
0.00
2008
2010
2012
2014
2016
nice_week

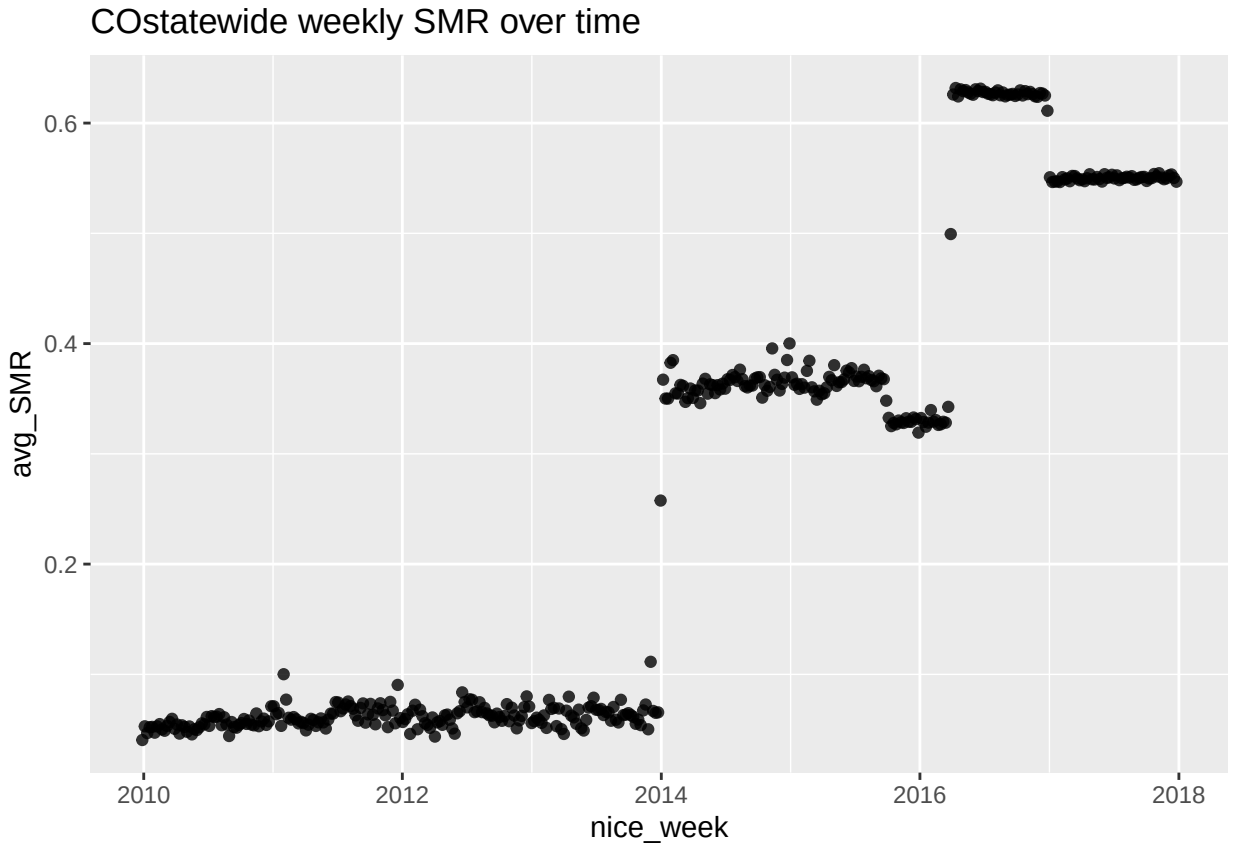
```
##
## [[8]]
```


COaurora weekly SMR over time
0.100
0.075
0.050
0.025
avg_SMR
2012
2014
2016
nice_week

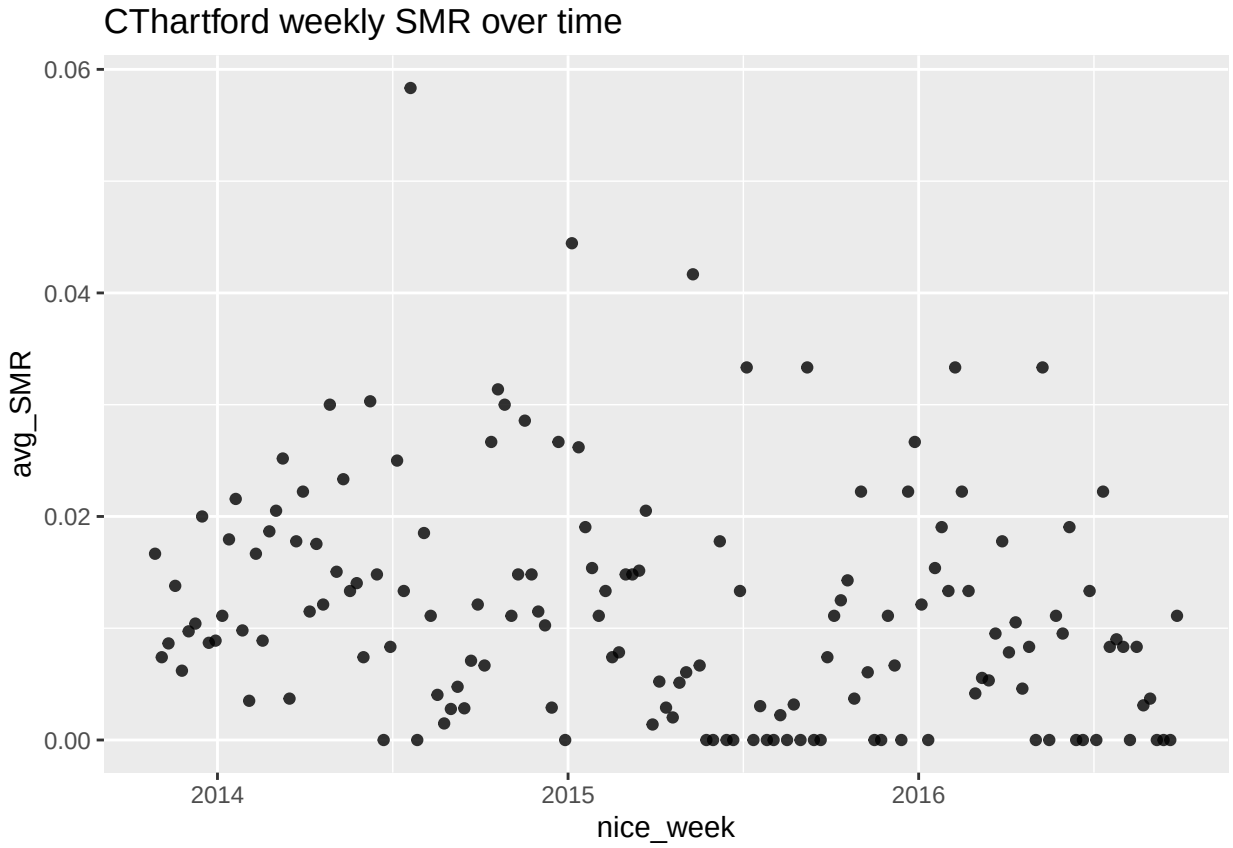
```
##
## [[9]]
```


COdenver weekly SMR over time
0.06
0.05
0.04
0.03
avg_SMR
2012
2014
2016
2018
nice_week

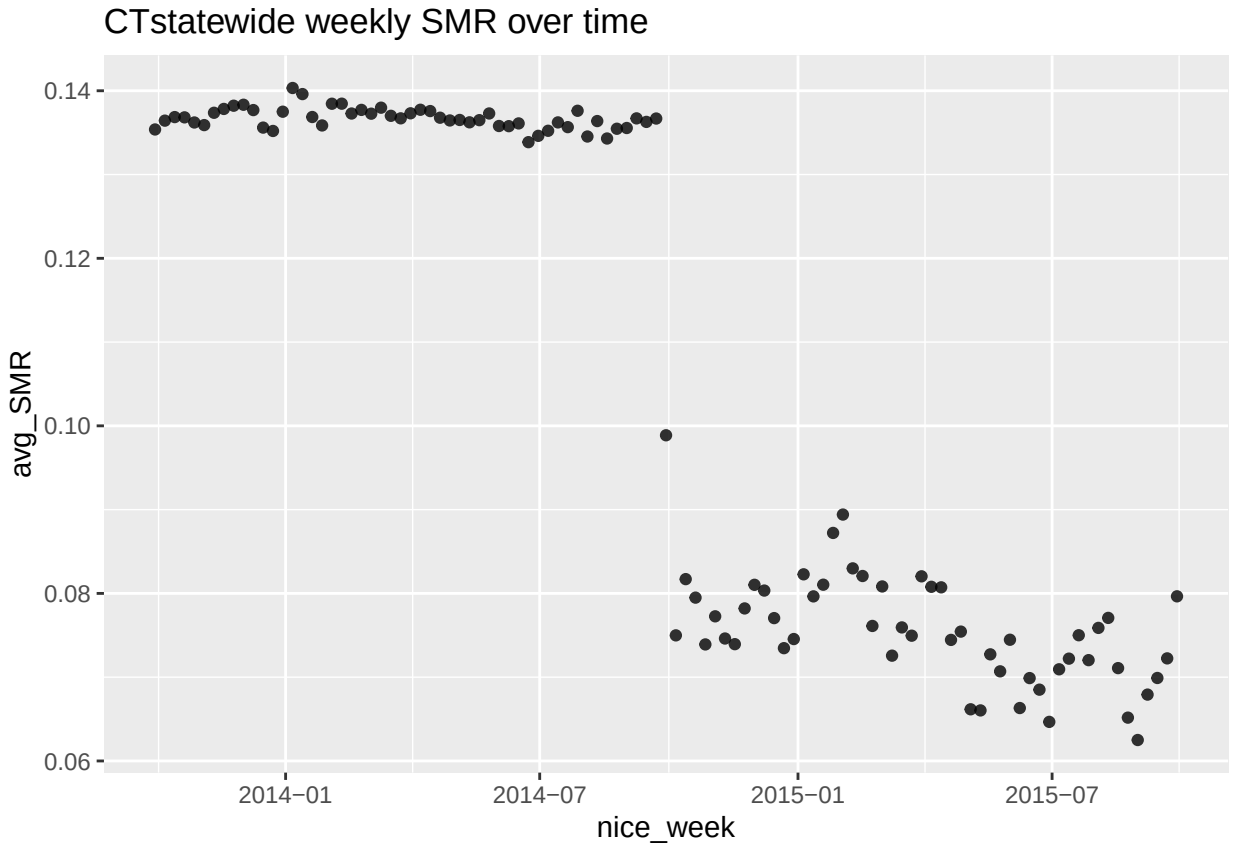
```
##
## [[10]]
```


COstatewide weekly SMR over time
avg_SMR
0.6
0.4
0.2
2010
2012
2014
2016
2018
nice_week

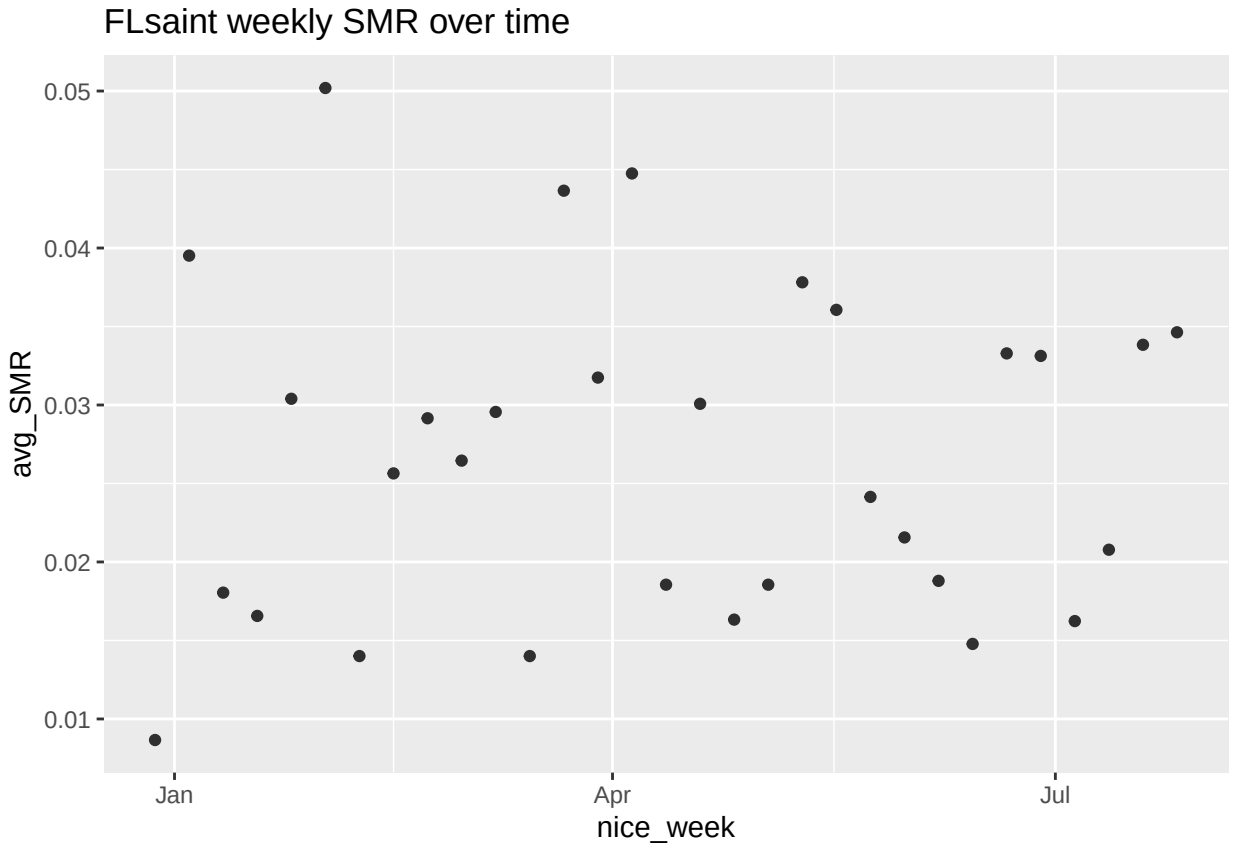
```
##
## [[11]]
```


CThartford weekly SMR over time
0.06
0.04
0.02
0.00
avg_SMR
2014
2015
2016
nice_week

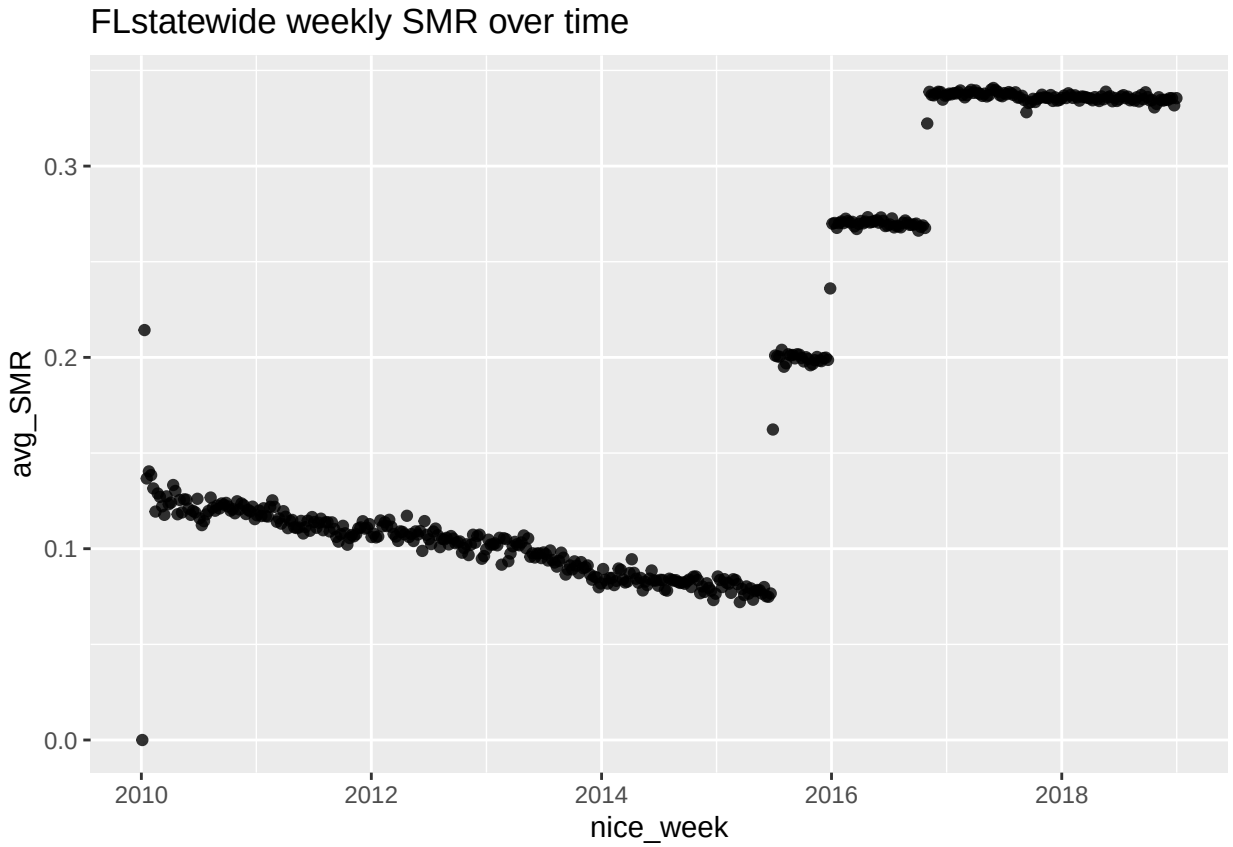
```
##
## [[12]]
```


CTstatewide weekly SMR over time
0.14
0.12
0.10
0.08
0.06
avg_SMR
2014−01
2014−07
2015−01
2015−07
nice_week

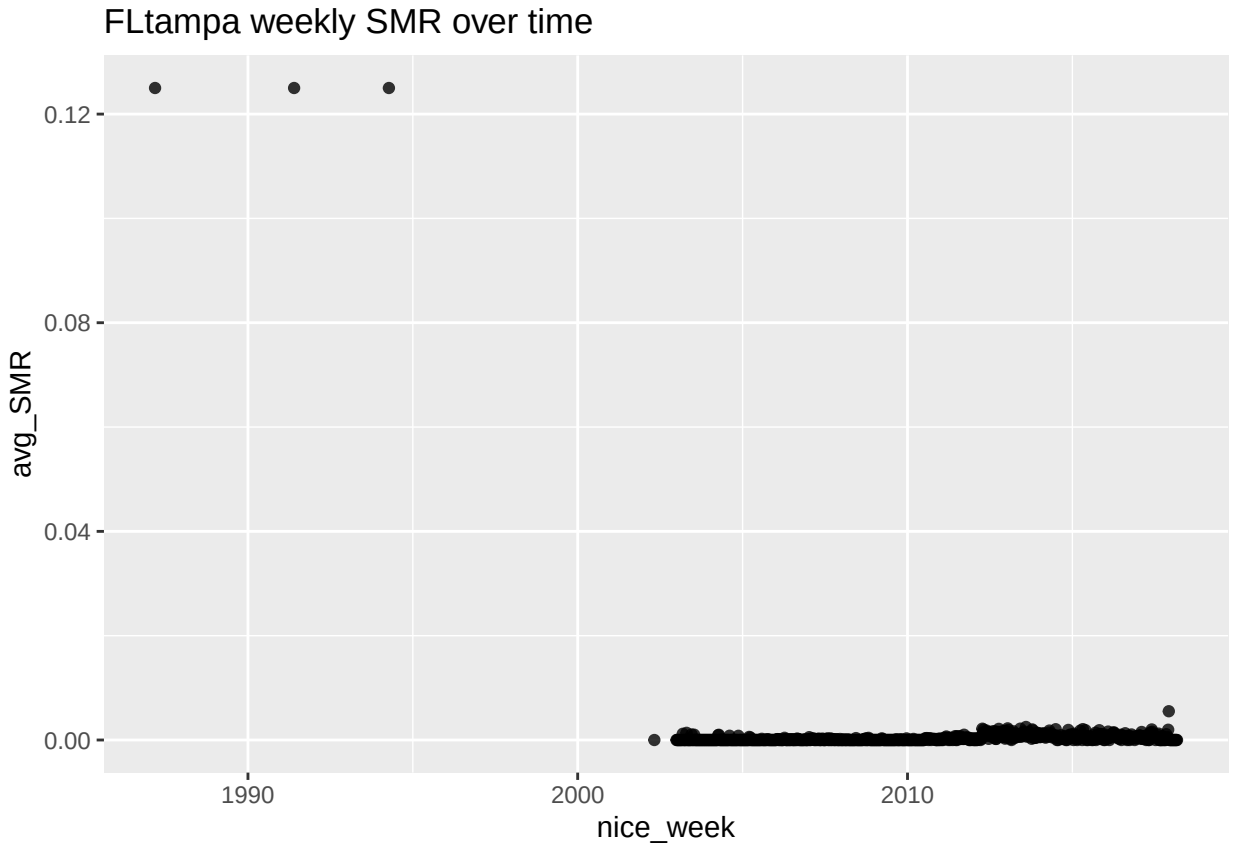
```
##
## [[13]]
```


FLsaint weekly SMR over time
avg_SMR
0.05
0.04
0.03
0.02
0.01
Jan
Apr
Jul
nice_week

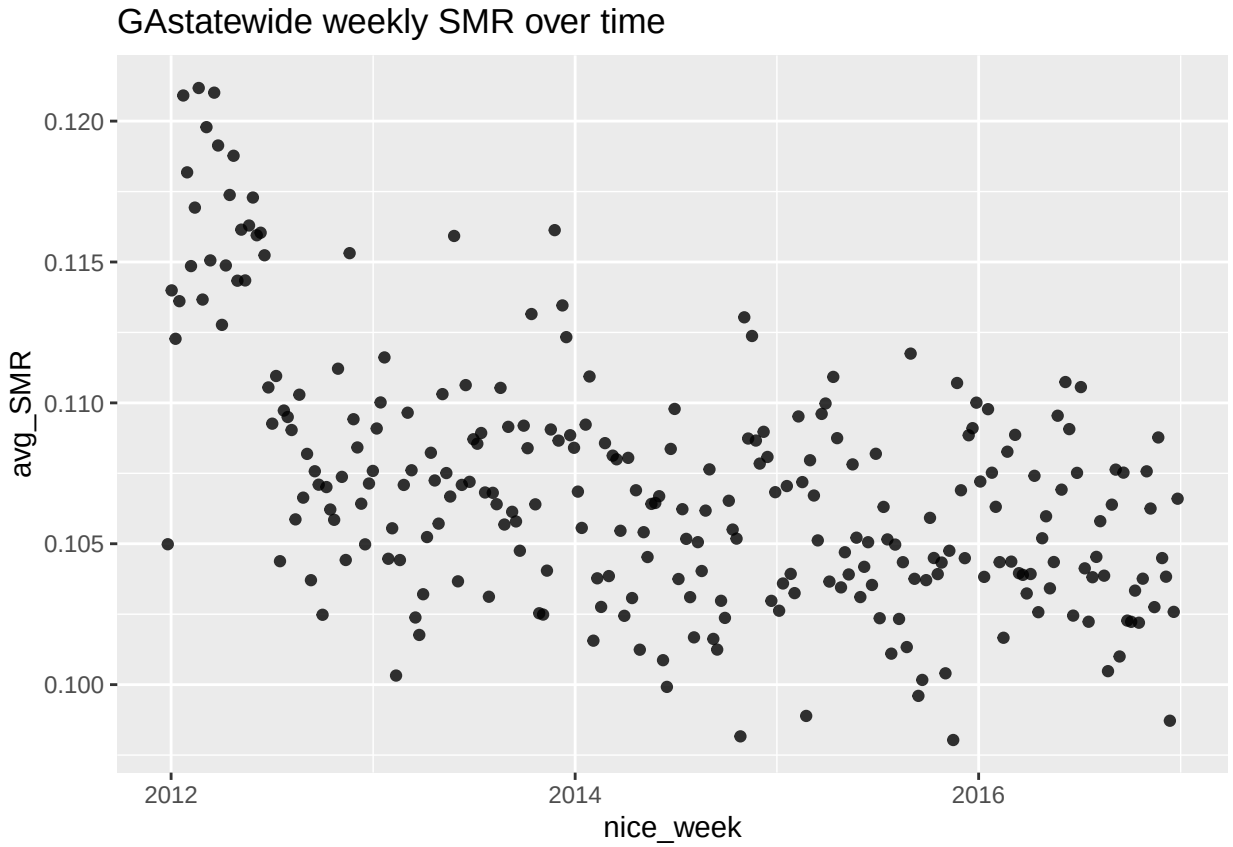
```
##
## [[14]]
```


FLstatewide weekly SMR over time
avg_SMR
0.0
0.1
0.2
0.3
2010
2012
2014
2016
2018
nice_week

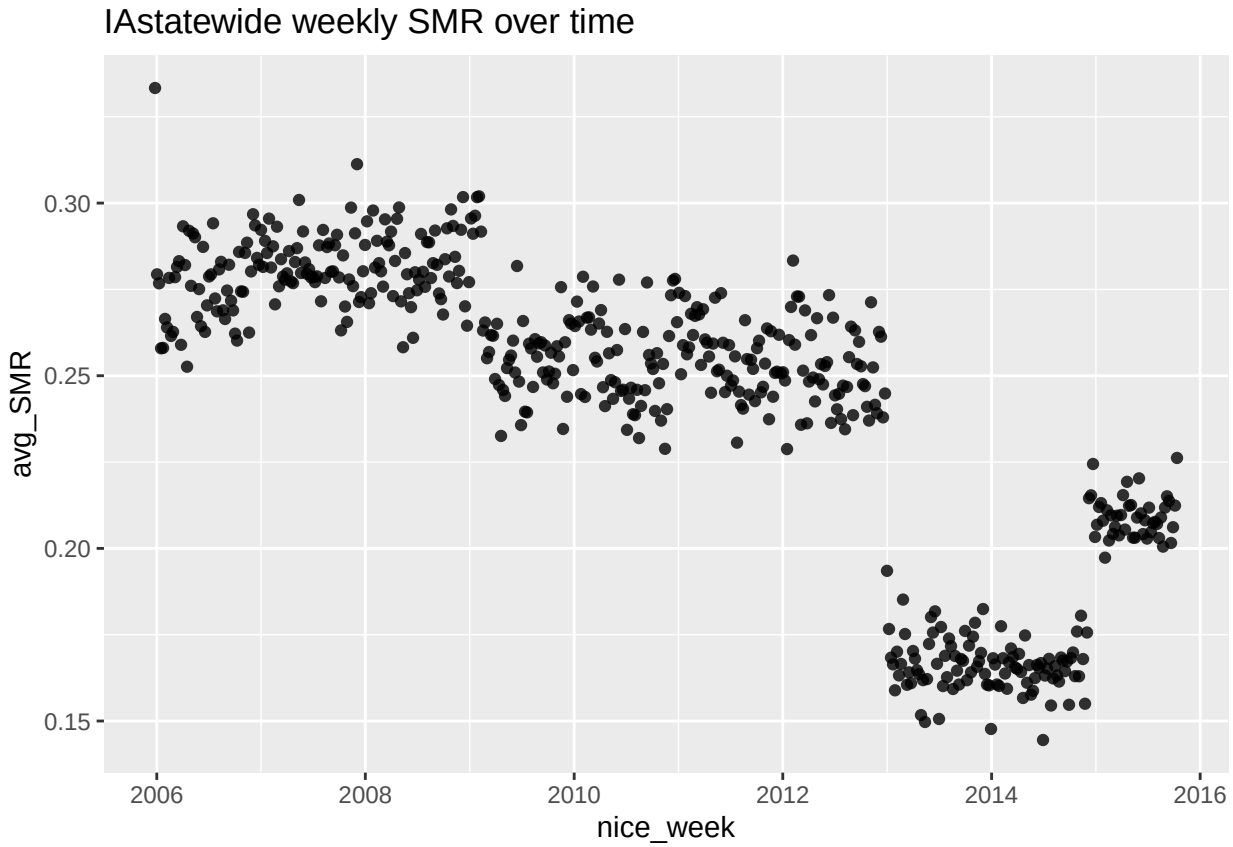
```
##
## [[15]]
```


FLtampa weekly SMR over time
0.12
0.08
0.04
0.00
avg_SMR
1990
2000
2010
nice_week

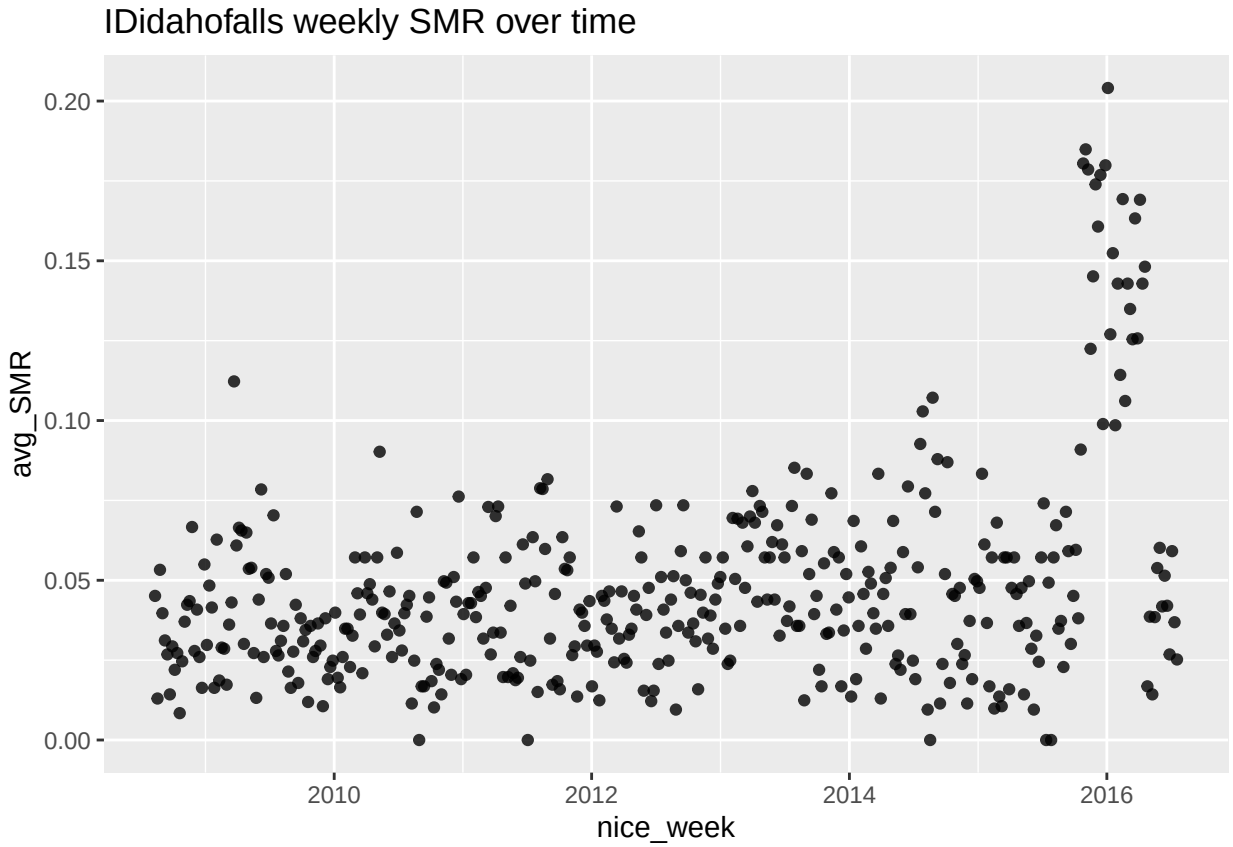
```
##
## [[16]]
```


GAstatewide weekly SMR over time
avg_SMR
0.120
0.115
0.110
0.105
0.100
2012
2014
2016
nice_week

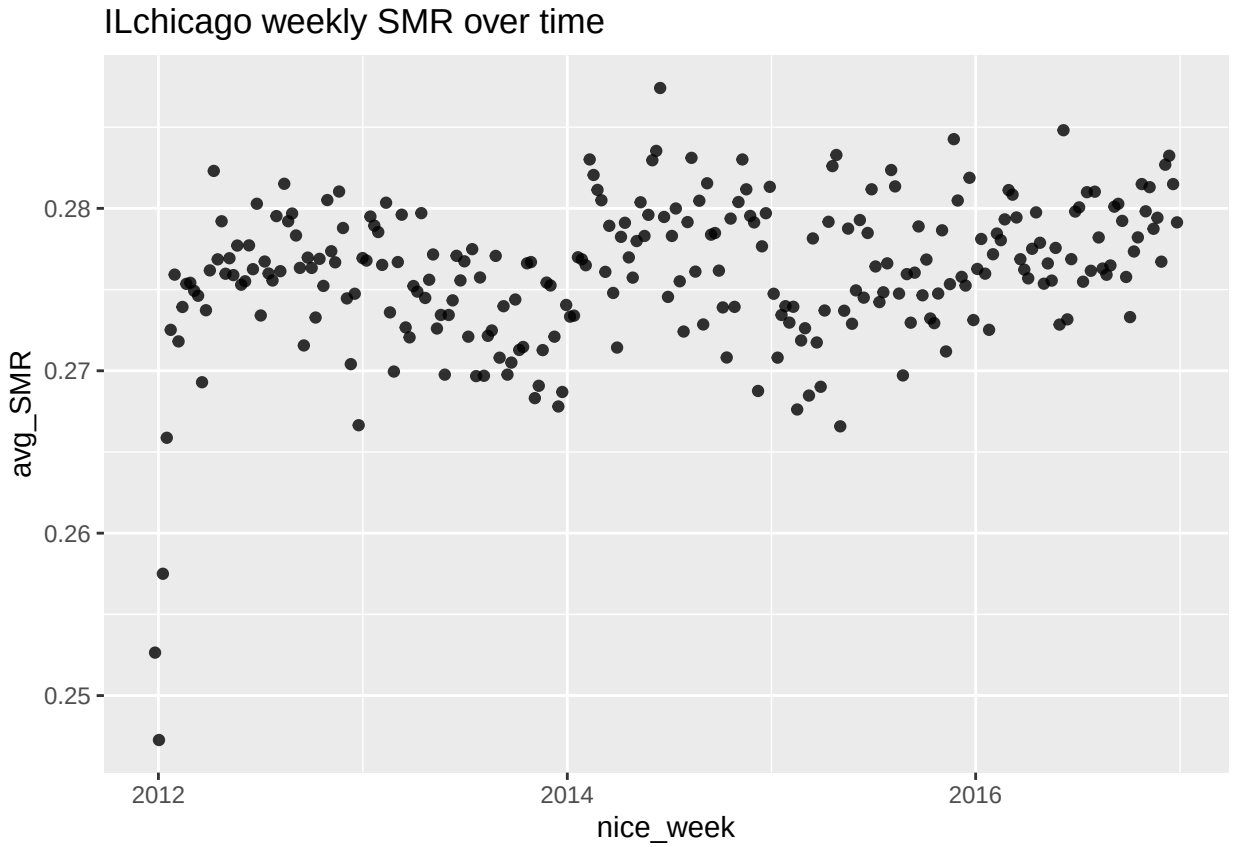
```
##
## [[17]]
```


IAstatewide weekly SMR over time
avg_SMR
0.30
0.25
0.20
0.15
2006
2008
2010
2012
2014
2016
nice_week

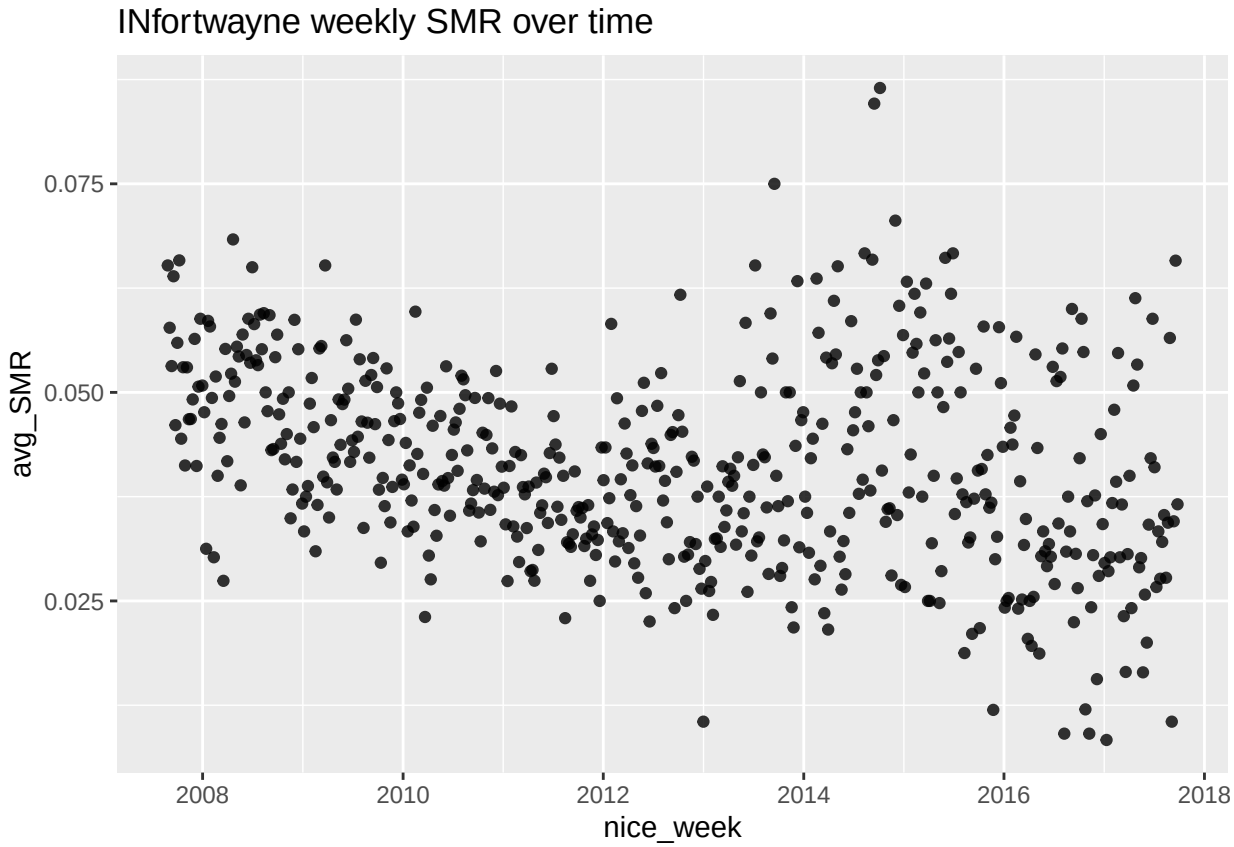
```
##
## [[18]]
```


IDidahofalls weekly SMR over time
avg_SMR
0.20
0.15
0.10
0.05
0.00
2010
2012
2014
2016
nice_week

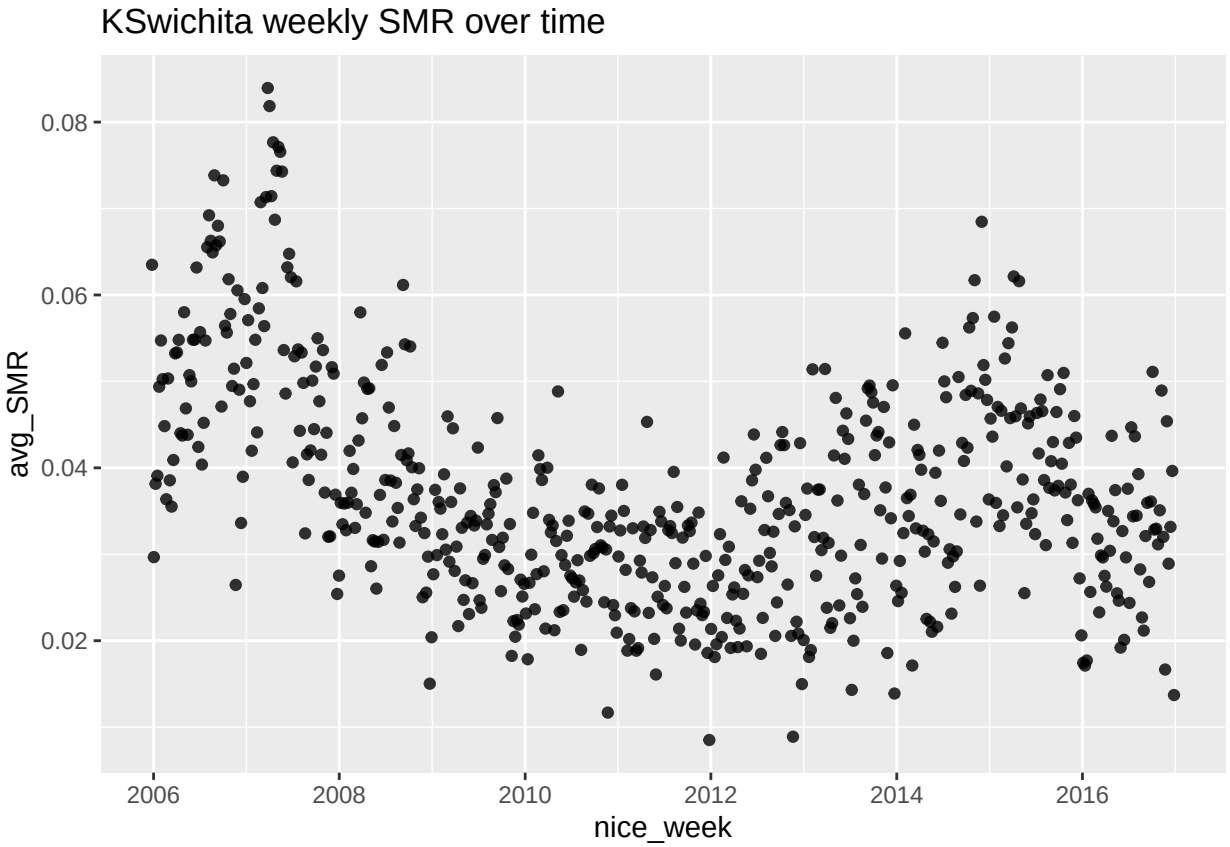
```
##
## [[19]]
```


ILchicago weekly SMR over time
avg_SMR
0.28
0.27
0.26
0.25
2012
2014
2016
nice_week

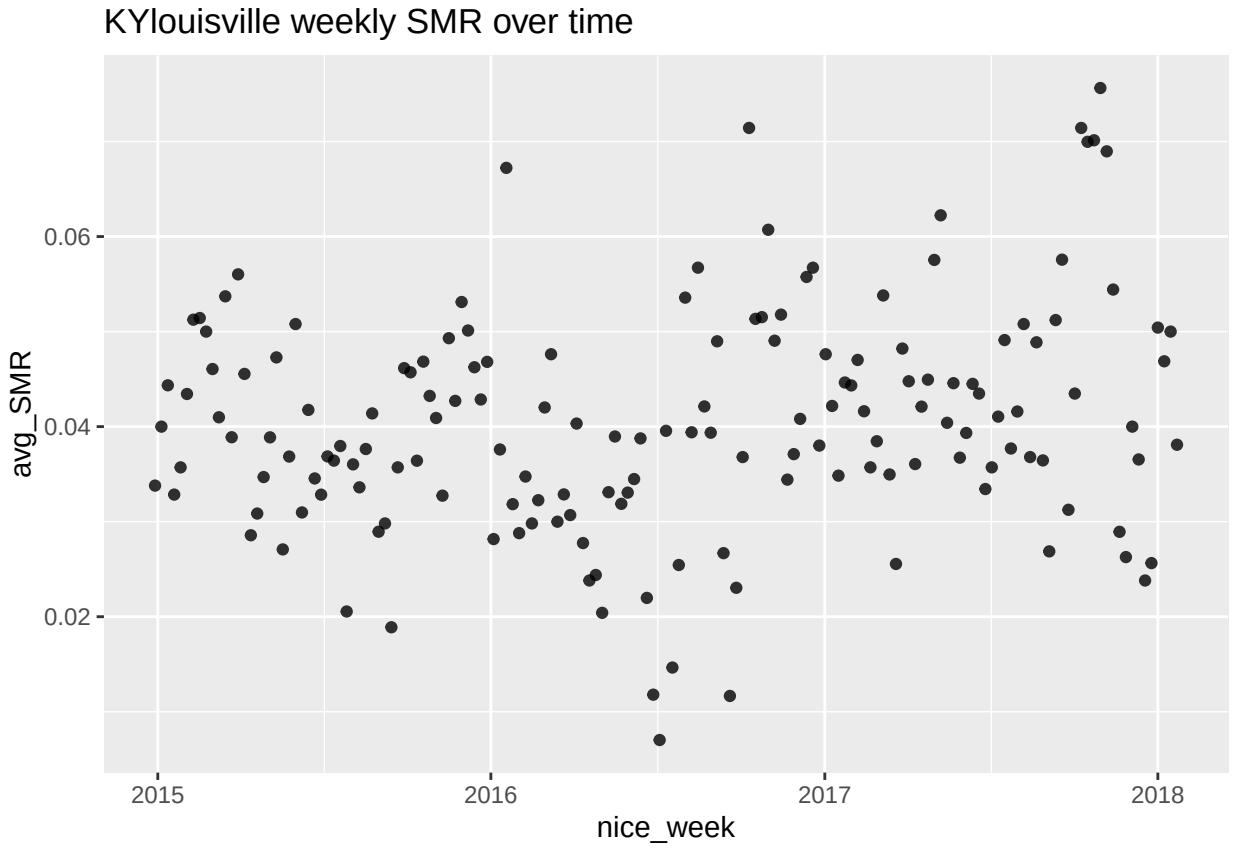
```
##
## [[20]]
```


INfortwayne weekly SMR over time
avg_SMR
0.075
0.050
0.025
2008
2010
2012
2014
2016
2018
nice_week

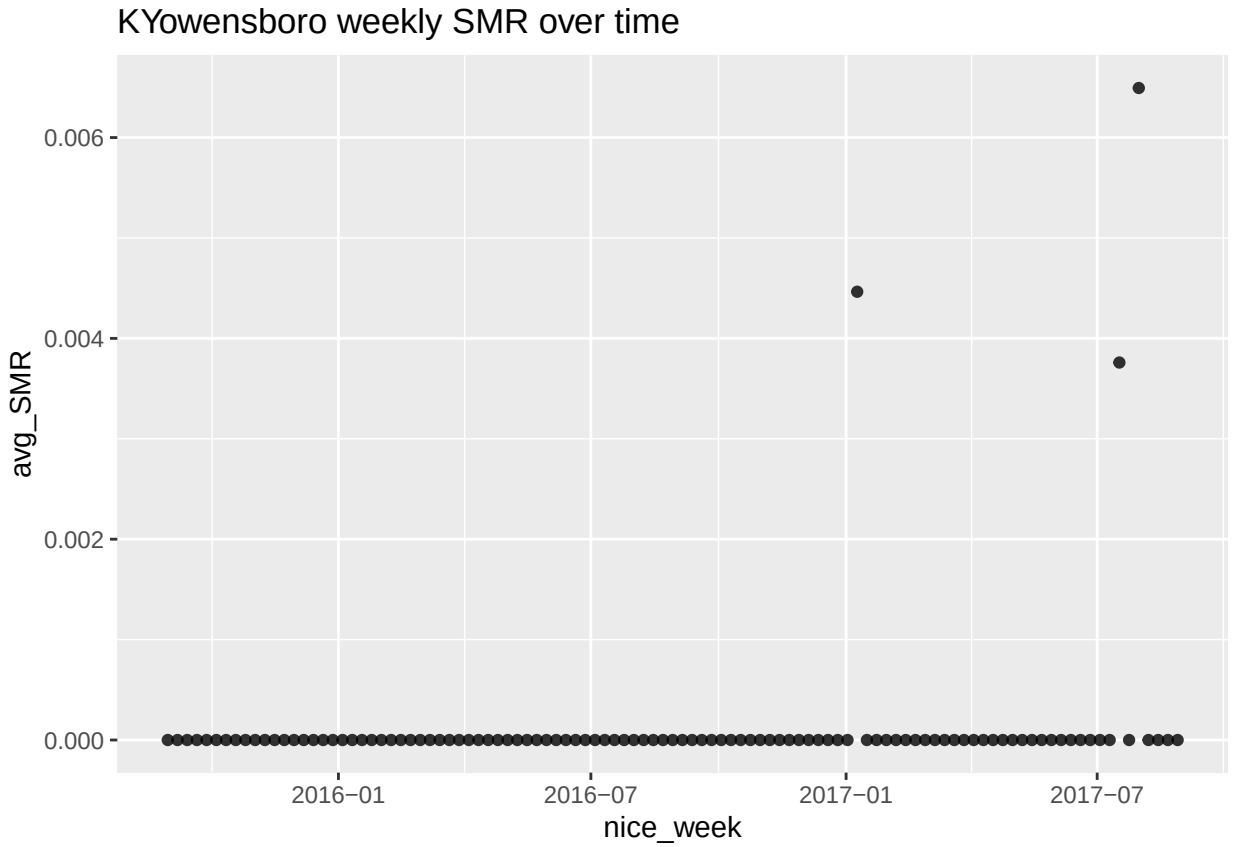
```
##
## [[21]]
```


KSwichita weekly SMR over time
avg_SMR
0.08
0.06
0.04
0.02
2006
2008
2010
2012
2014
2016
nice_week

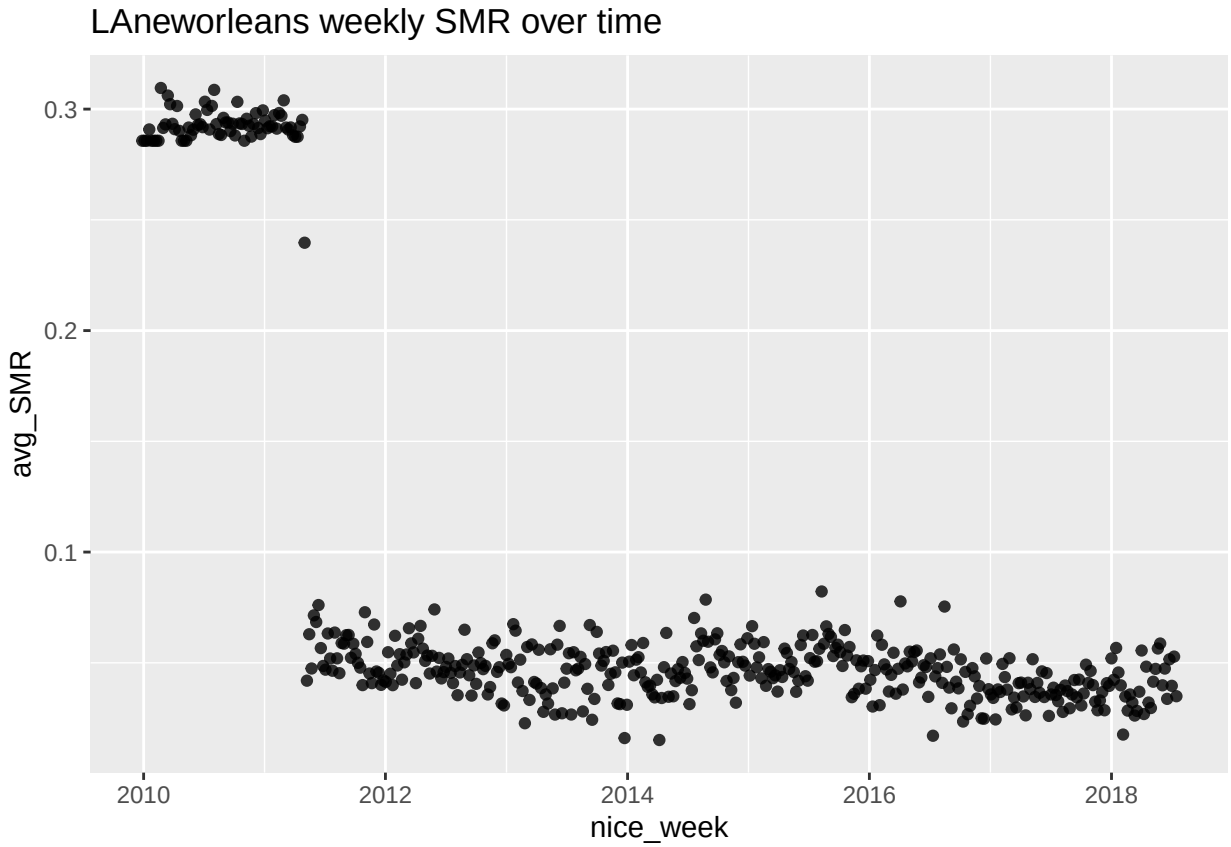
```
##
## [[22]]
```


KYlouisville weekly SMR over time
avg_SMR
0.06
0.04
0.02
2015
2016
2017
2018
nice_week

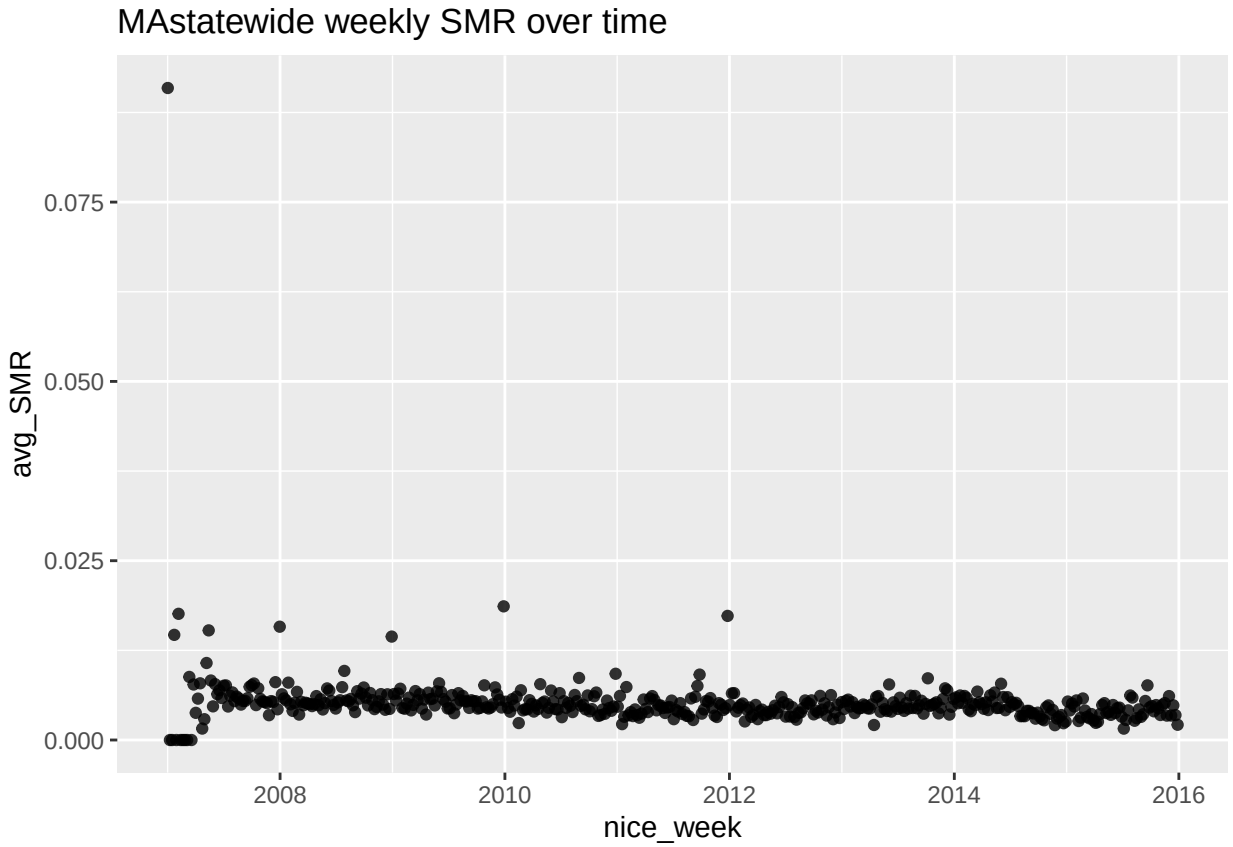
```
##
## [[23]]
```


KYowensboro weekly SMR over time
avg_SMR
0.006
0.004
0.002
0.000
2016−01
2016−07
2017−01
2017−07
nice_week

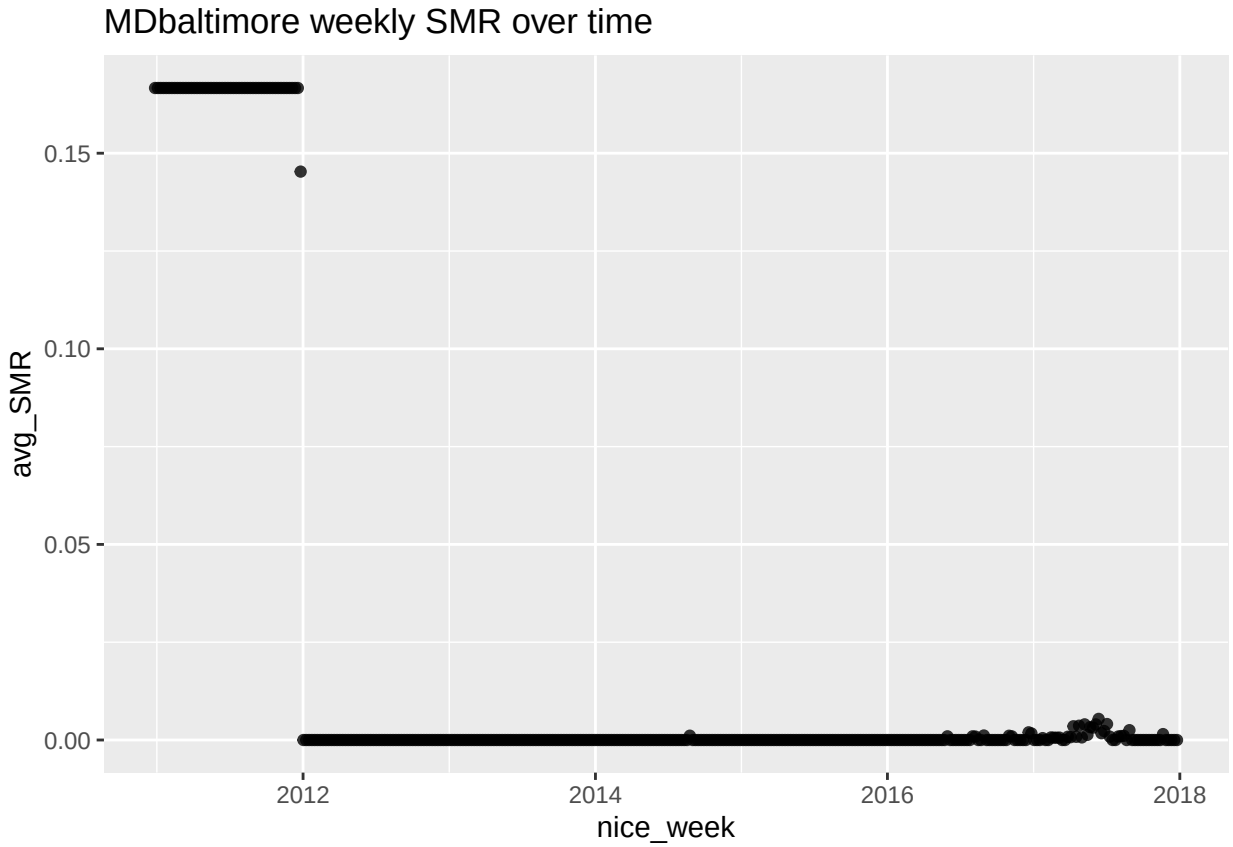
```
##
## [[24]]
```


LAneworleans weekly SMR over time
0.3
0.2
0.1
avg_SMR
2010
2012
2014
2016
2018
nice_week

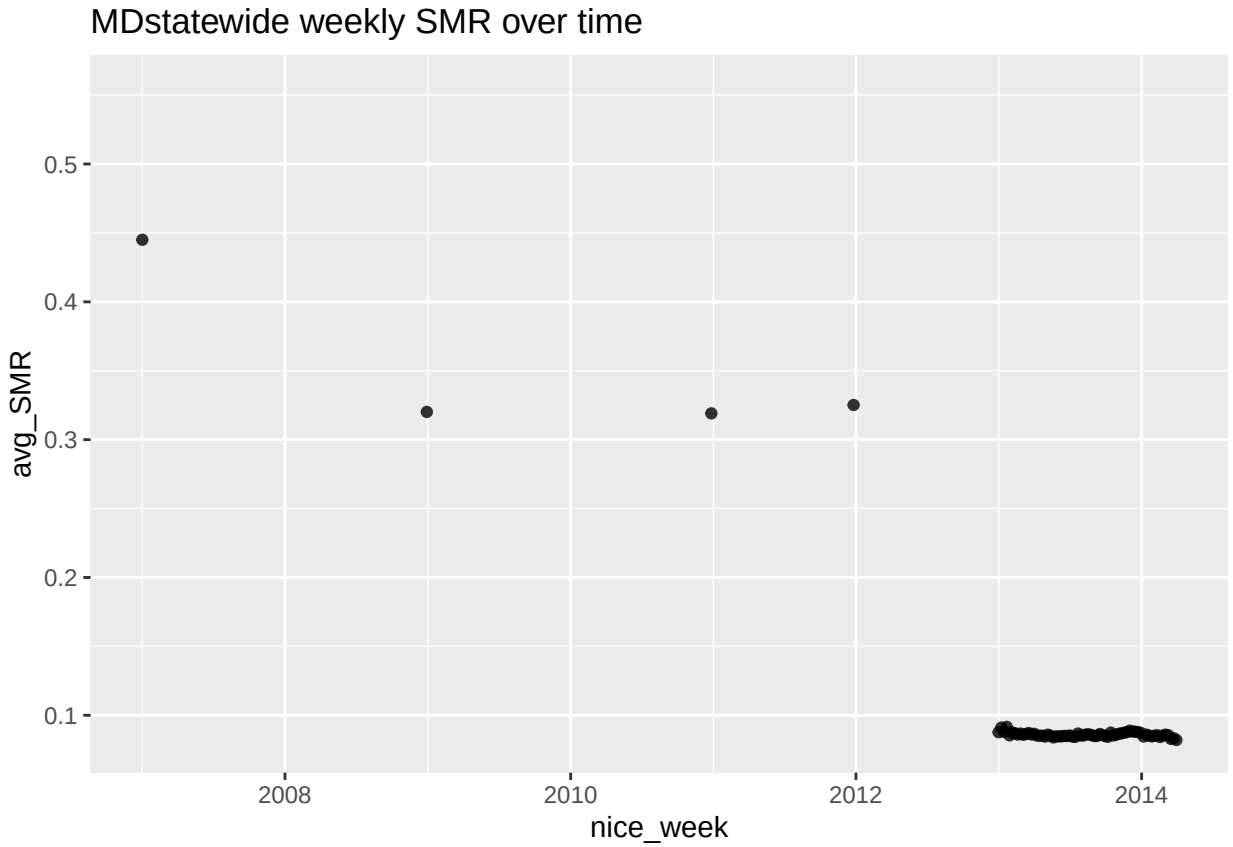
```
##
## [[25]]
```


MAstatewide weekly SMR over time
avg_SMR
0.075
0.050
0.025
0.000
2008
2010
2012
2014
2016
nice_week

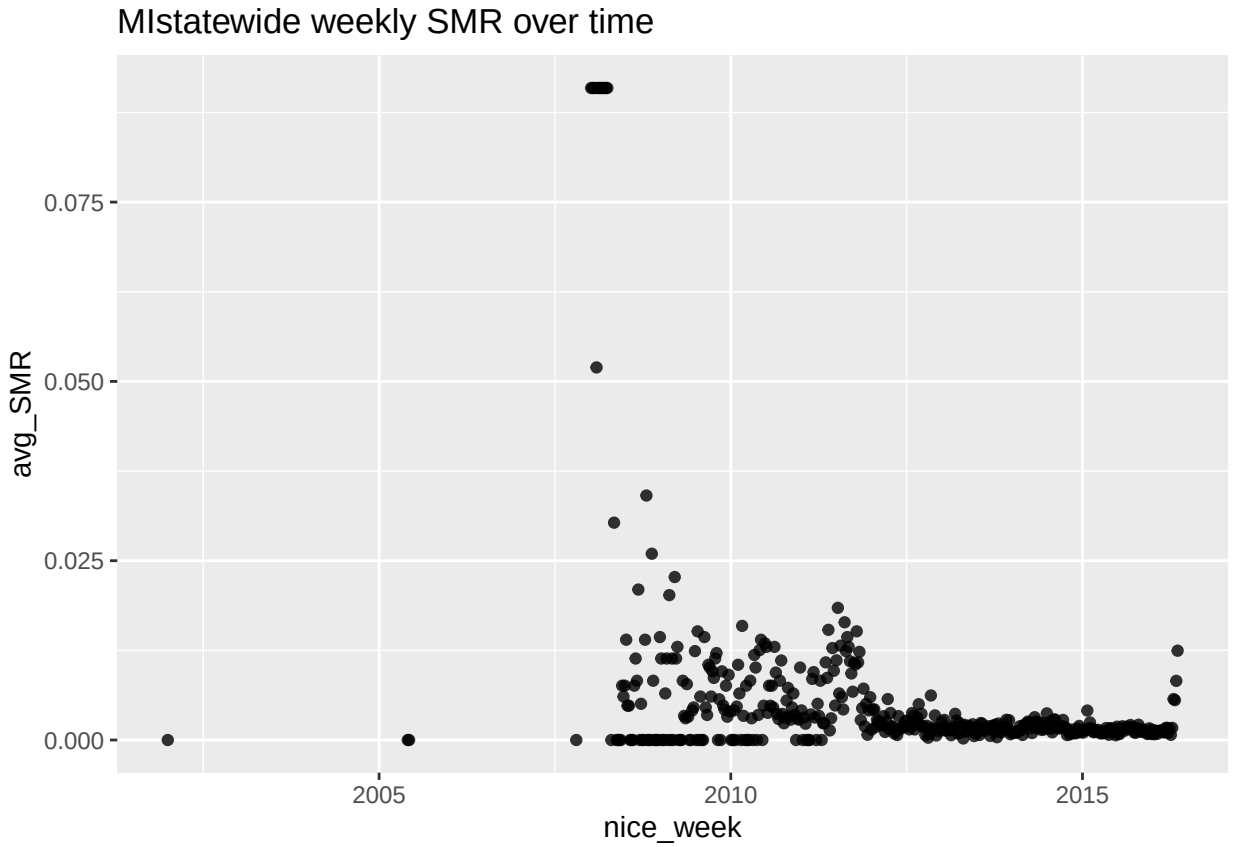
```
##
## [[26]]
```


MDbaltimore weekly SMR over time
avg_SMR
0.15
0.10
0.05
0.00
2012
2014
2016
2018
nice_week

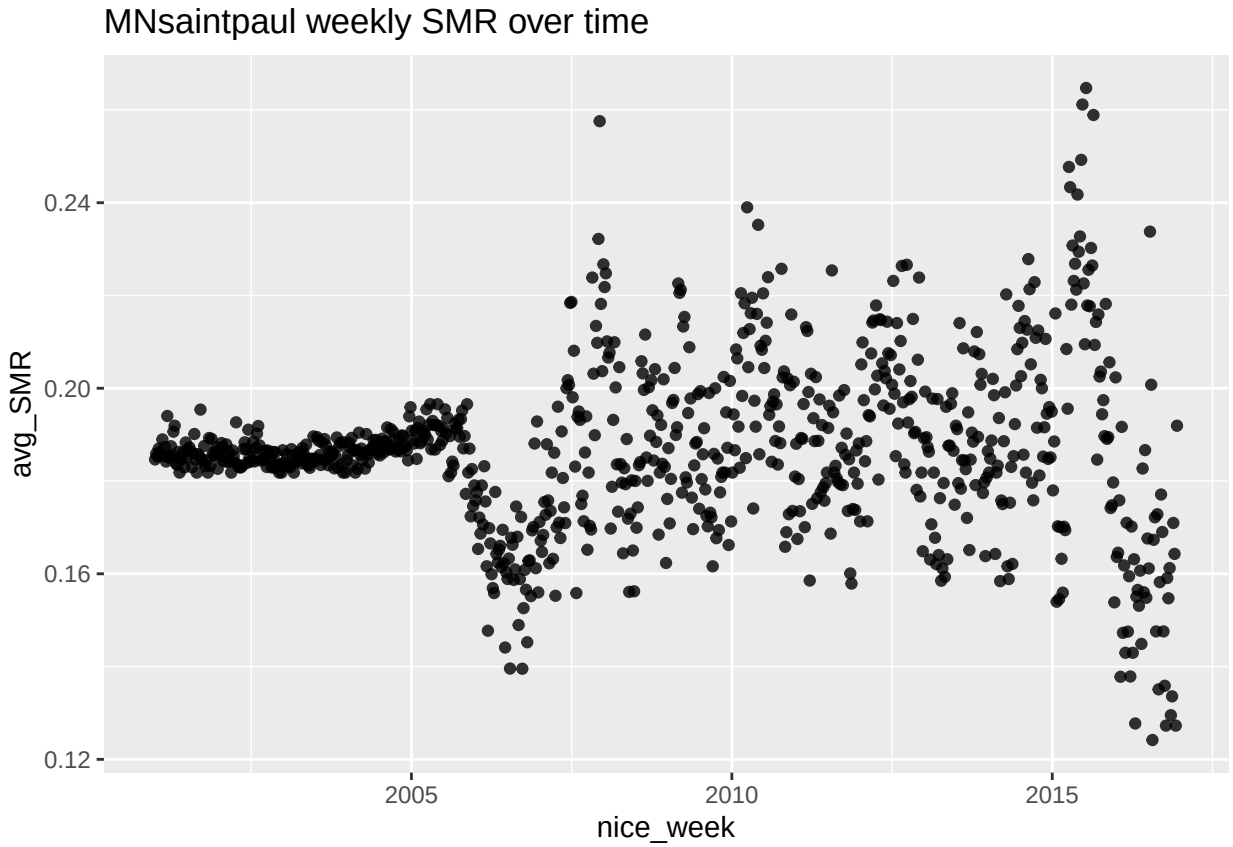
```
##
## [[27]]
```


MDstatewide weekly SMR over time
avg_SMR
0.5
0.4
0.3
0.2
0.1
2008
2010
2012
2014
nice_week

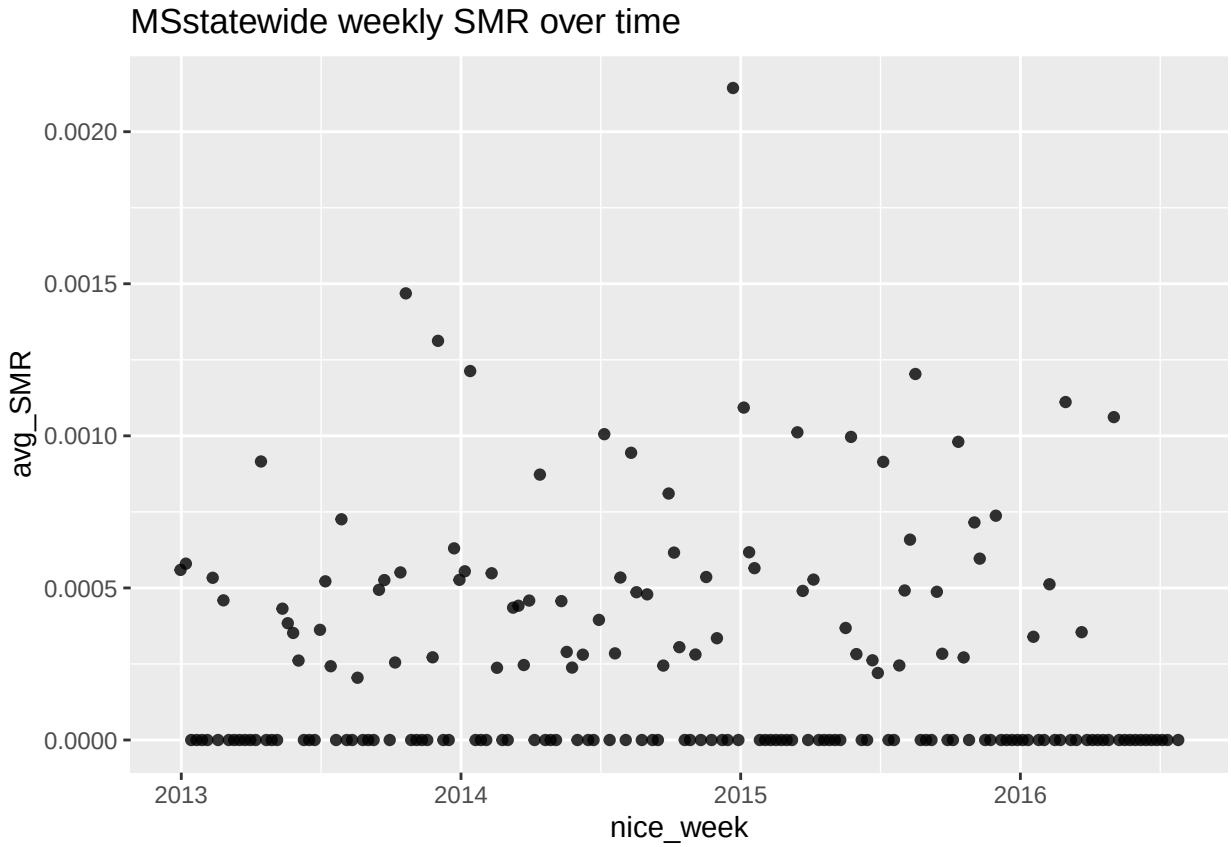
```
##
## [[28]]
```


MIstatewide weekly SMR over time
avg_SMR
0.075
0.050
0.025
0.000
2005
2010
2015
nice_week

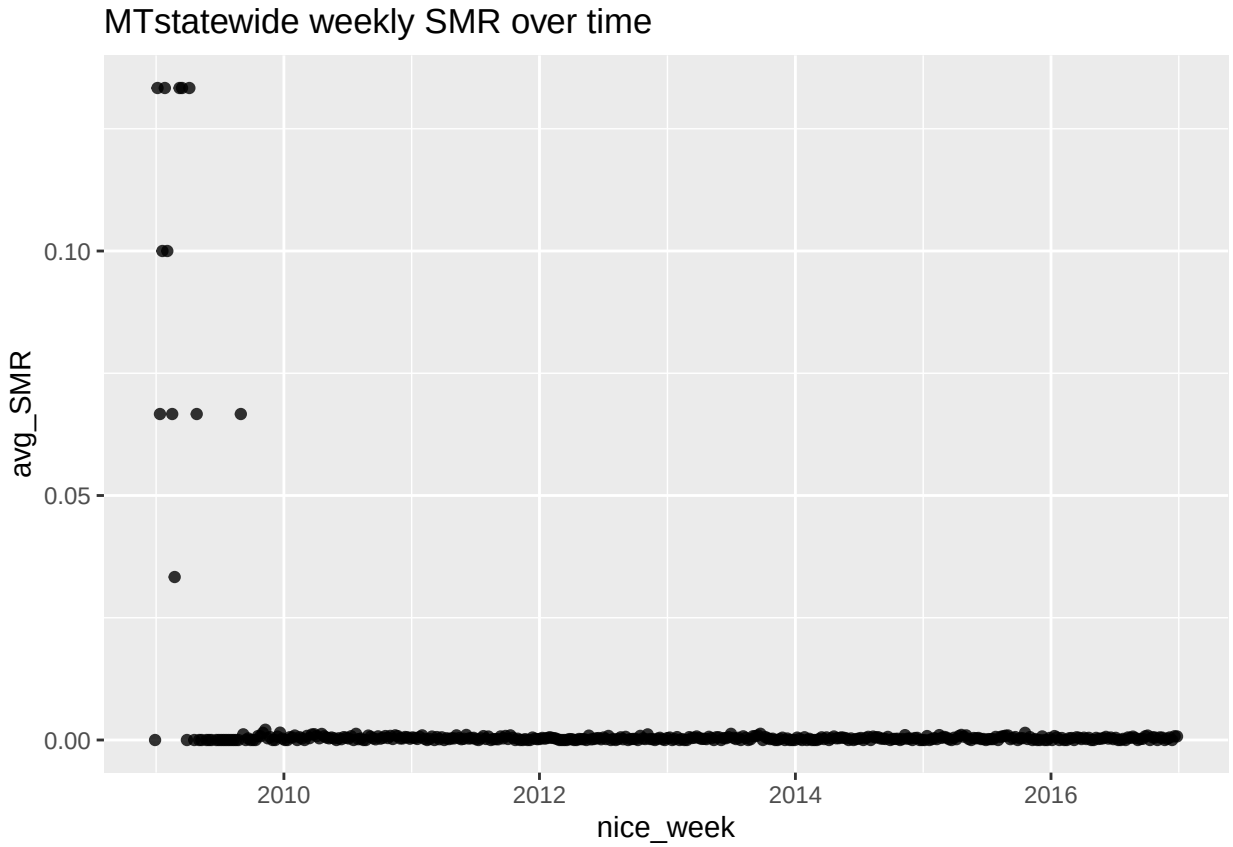
```
##
## [[29]]
```


MNsaintpaul weekly SMR over time
avg_SMR
0.24
0.20
0.16
0.12
2005
2010
2015
nice_week

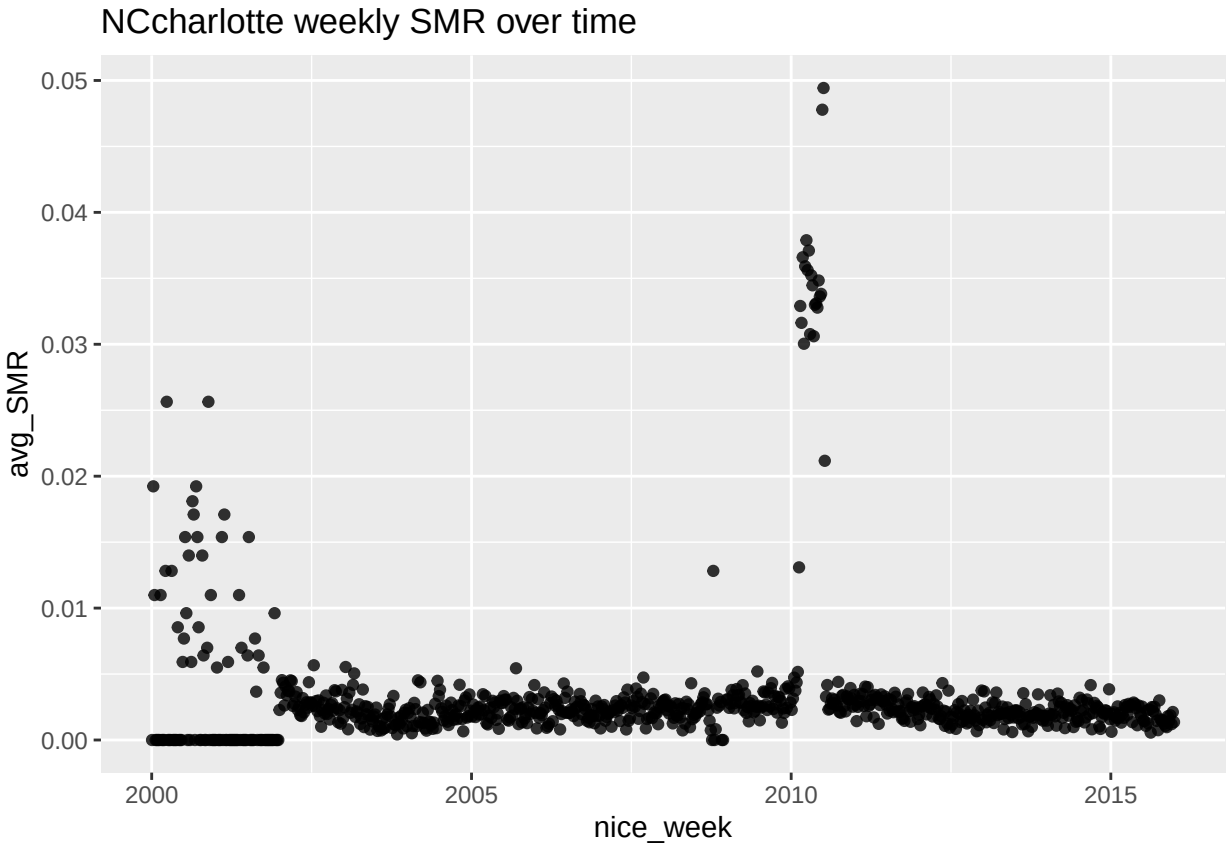
```
##
## [[30]]
```


MSstatewide weekly SMR over time
avg_SMR
0.0020
0.0015
0.0010
0.0005
0.0000
2013
2014
2015
2016
nice_week

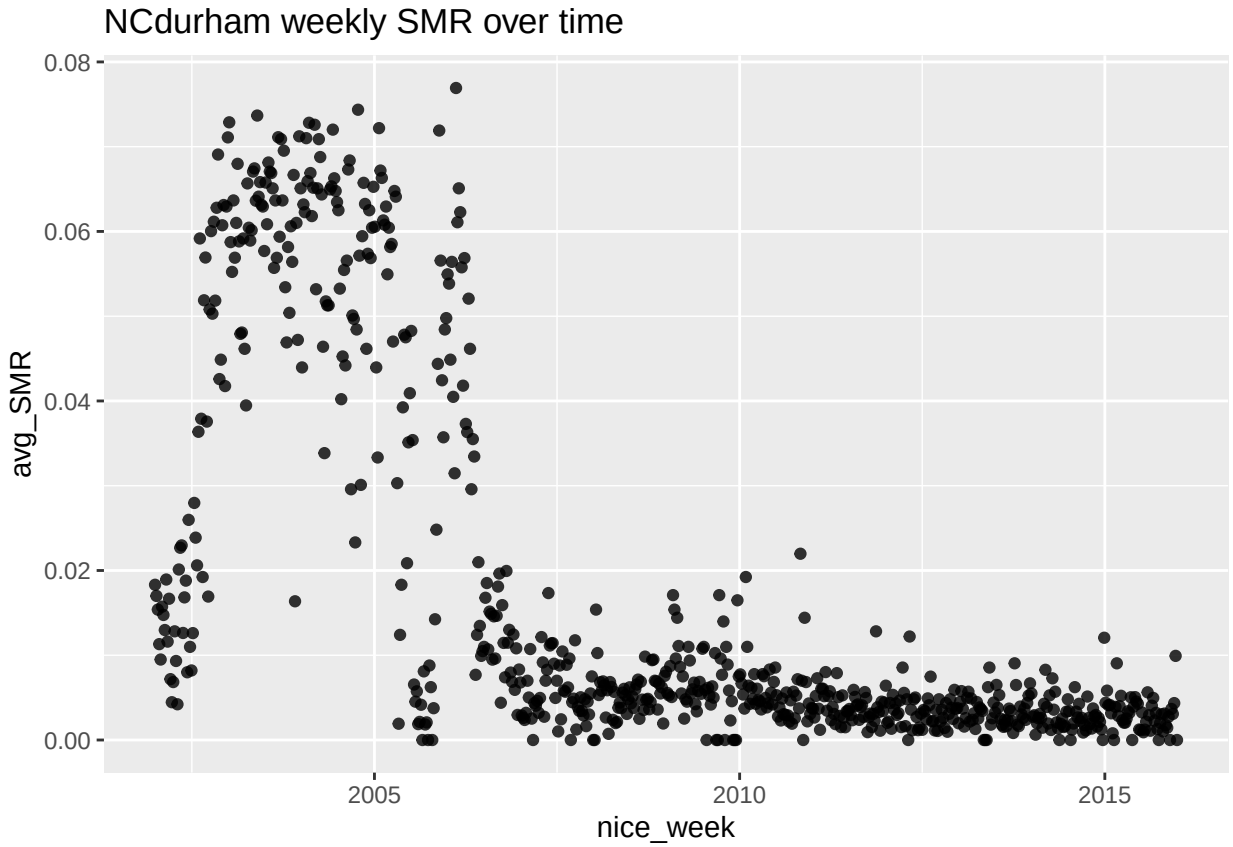
```
##
## [[31]]
```


MTstatewide weekly SMR over time
avg_SMR
0.10
0.05
0.00
2010
2012
2014
2016
nice_week

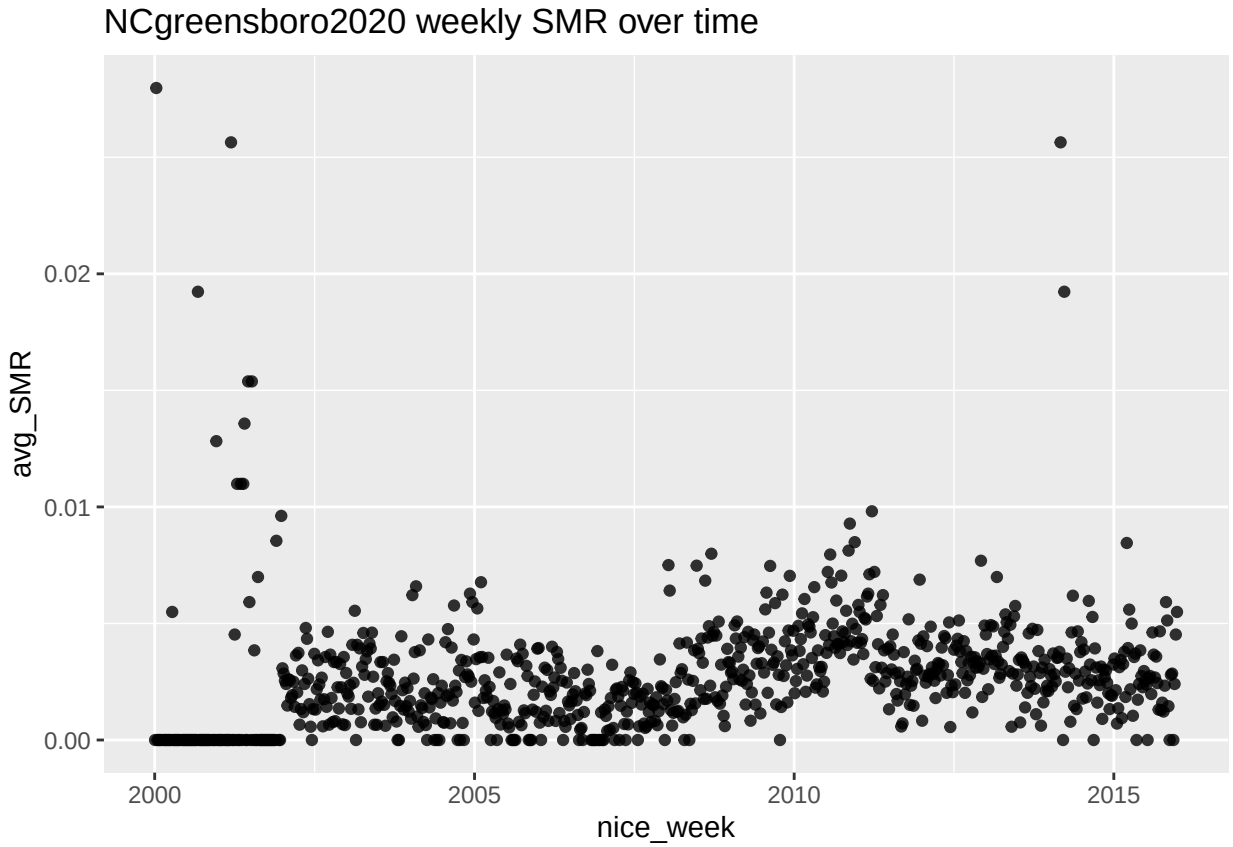
```
##
## [[32]]
```


NCcharlotte weekly SMR over time
avg_SMR
0.05
0.04
0.03
0.02
0.01
0.00
2000
2005
2010
2015
nice_week

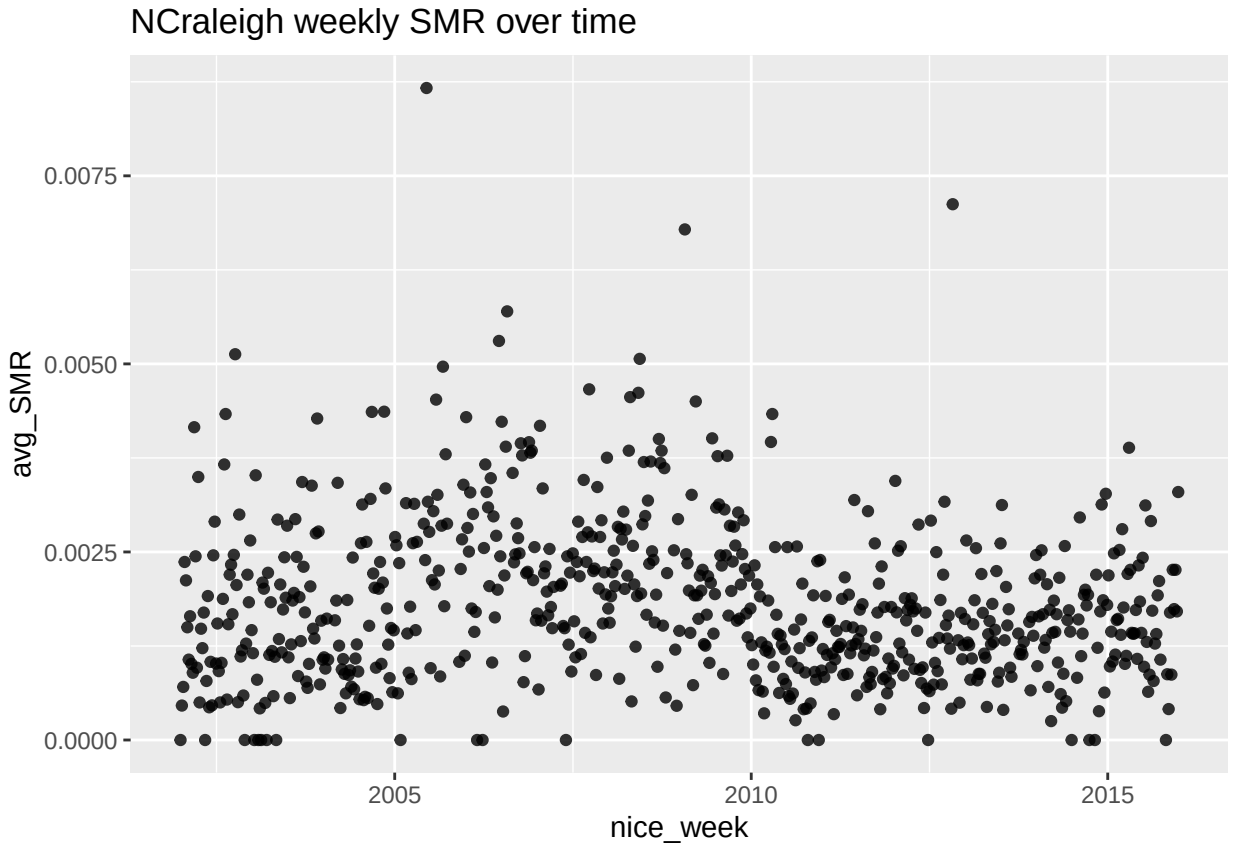
```
##
## [[33]]
```


NCdurham weekly SMR over time
avg_SMR
0.08
0.06
0.04
0.02
0.00
2005
2010
2015
nice_week

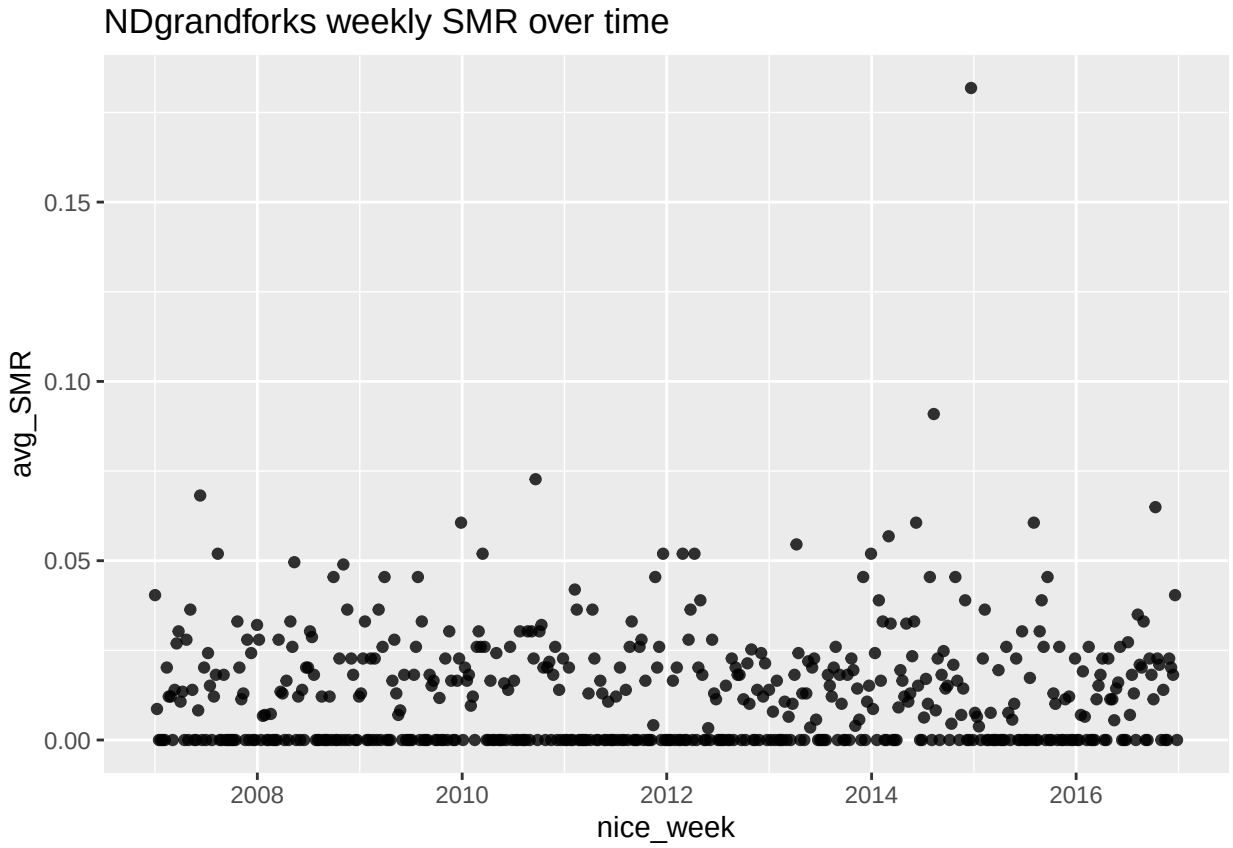
```
##
## [[34]]
```


NCgreensboro2020 weekly SMR over time
avg_SMR
0.02
0.01
0.00
2000
2005
2010
2015
nice_week

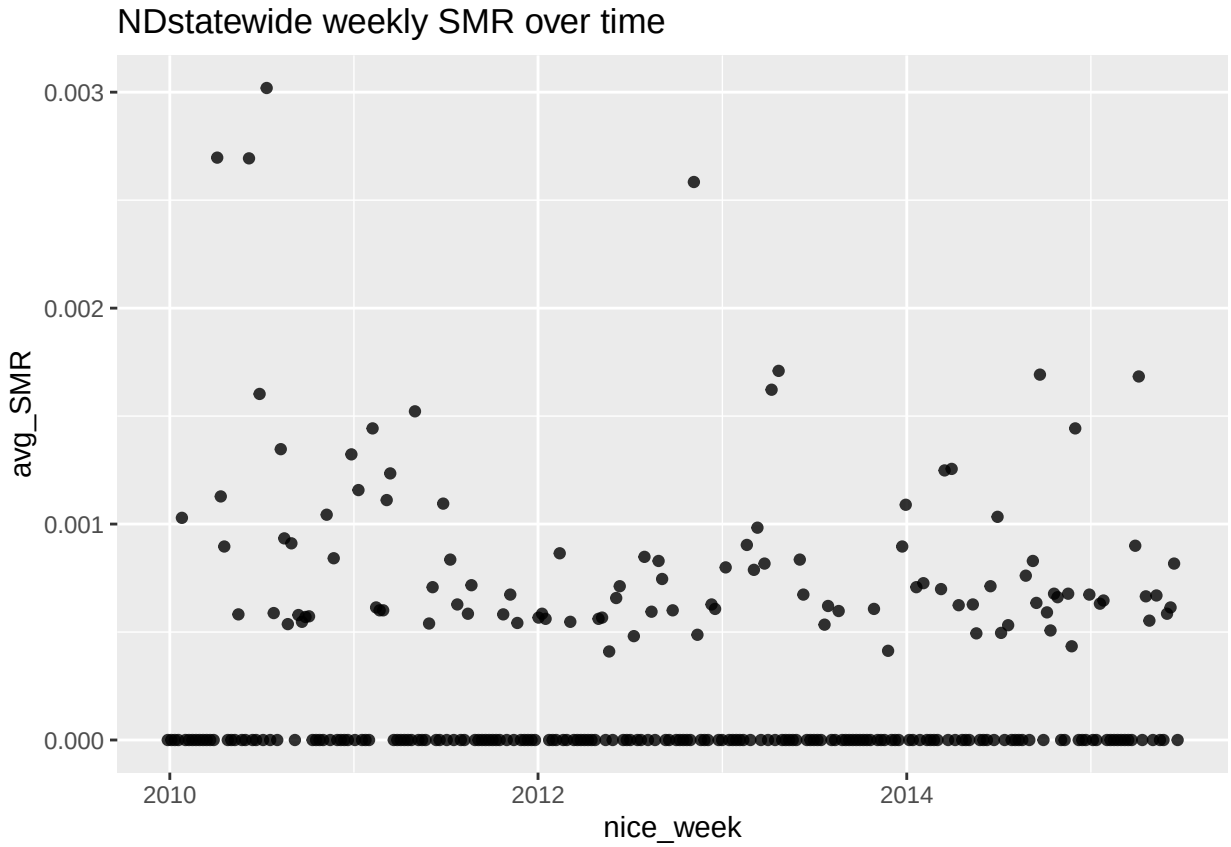
```
##
## [[35]]
```


NCraleigh weekly SMR over time
avg_SMR
0.0075
0.0050
0.0025
0.0000
2005
2010
2015
nice_week

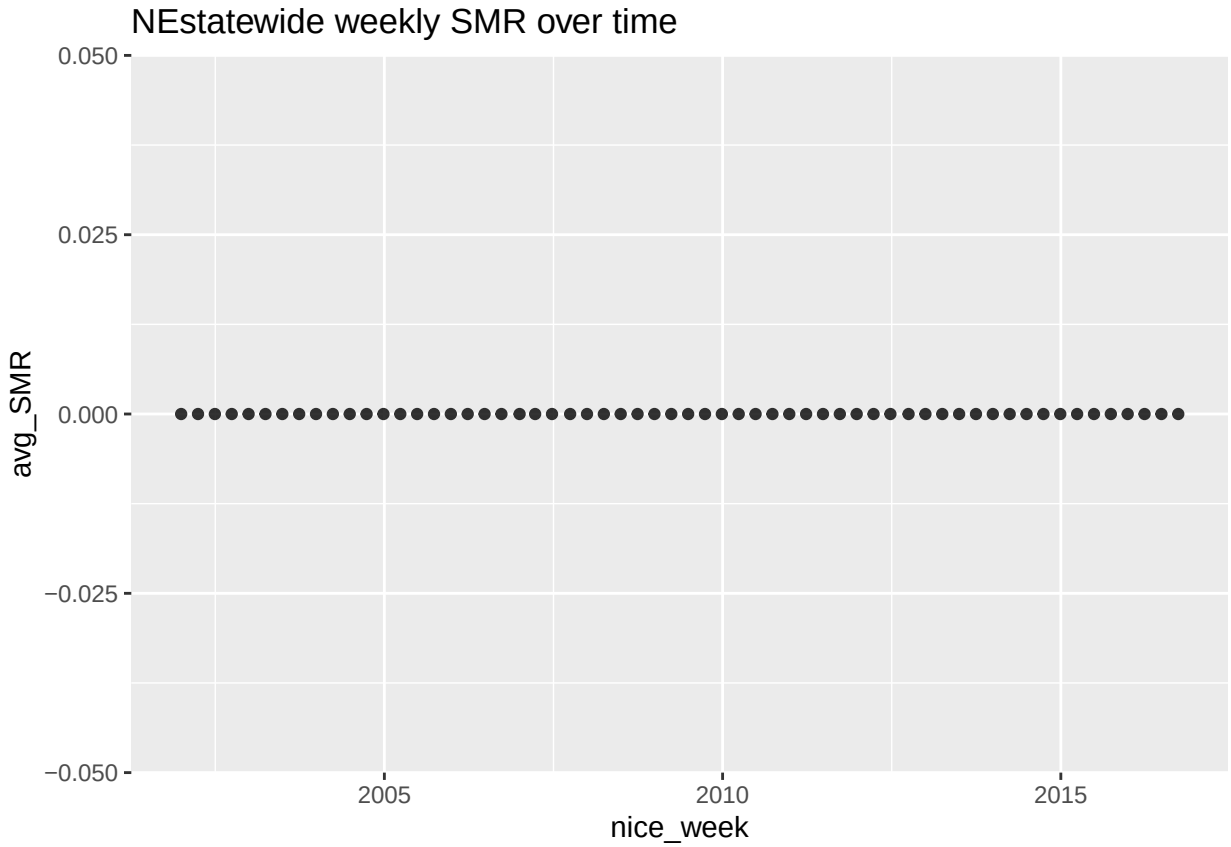
```
##
## [[36]]
```


NDgrandforks weekly SMR over time
avg_SMR
0.15
0.10
0.05
0.00
2008
2010
2012
2014
2016
nice_week

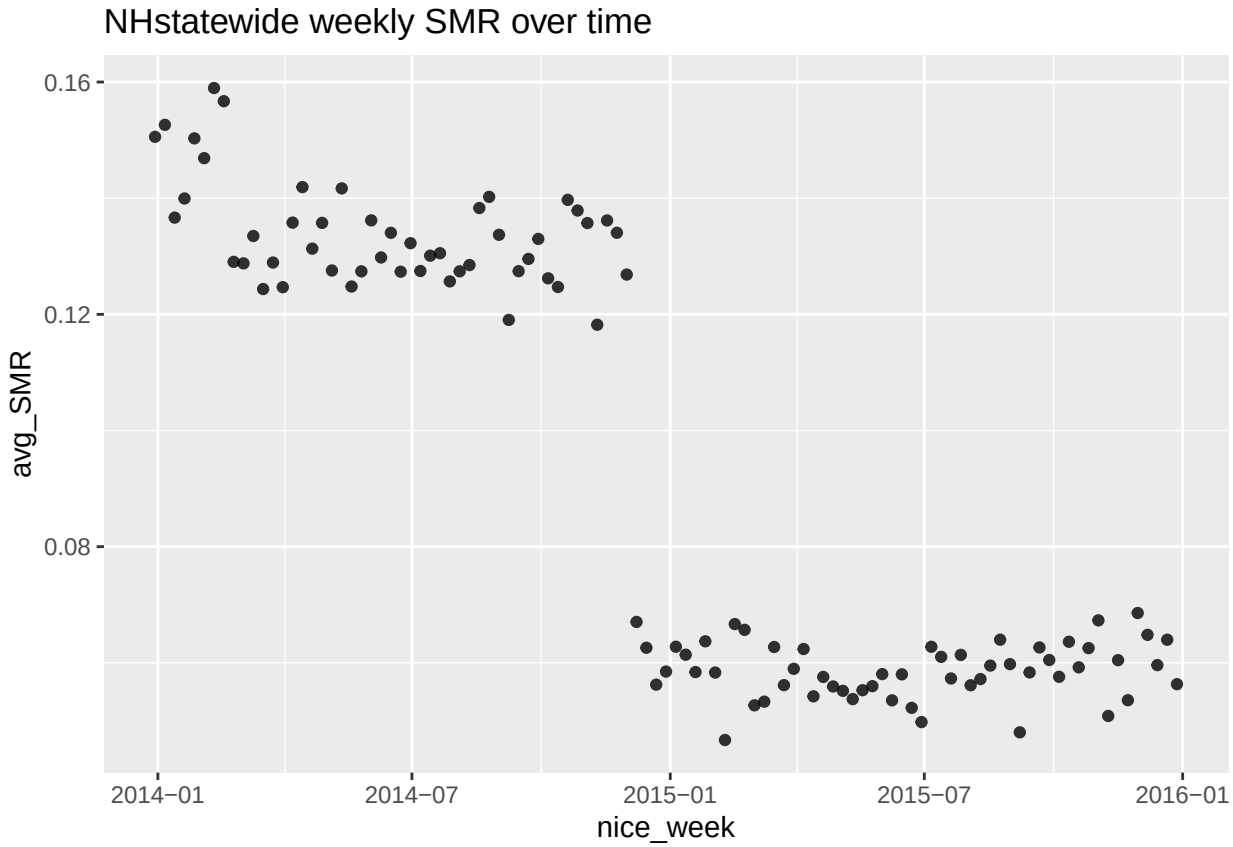
```
##
## [[37]]
```


NDstatewide weekly SMR over time
0.003
0.002
0.001
0.000
avg_SMR
2010
2012
2014
nice_week

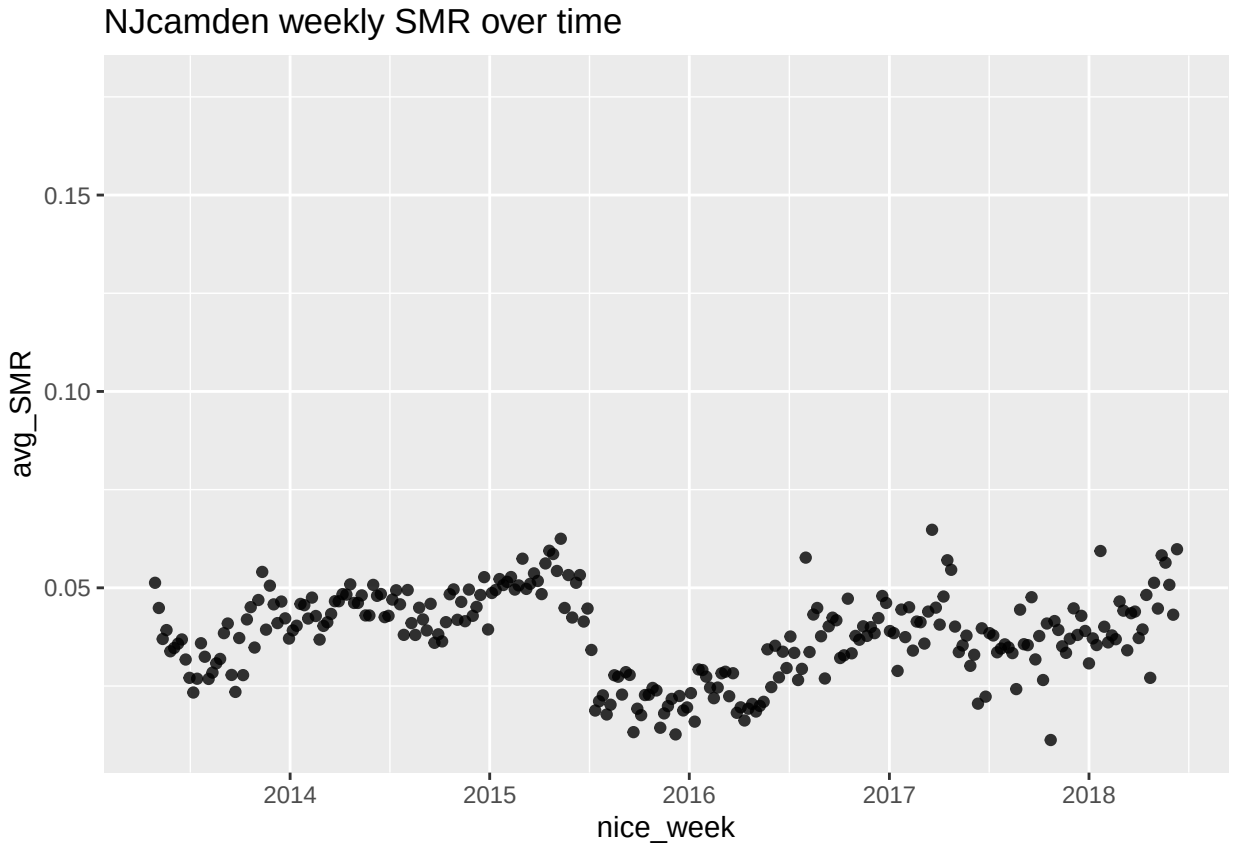
```
##
## [[38]]
```


NEstatewide weekly SMR over time
0.050
0.025
0.000
−0.025
−0.050
avg_SMR
2005
2010
2015
nice_week

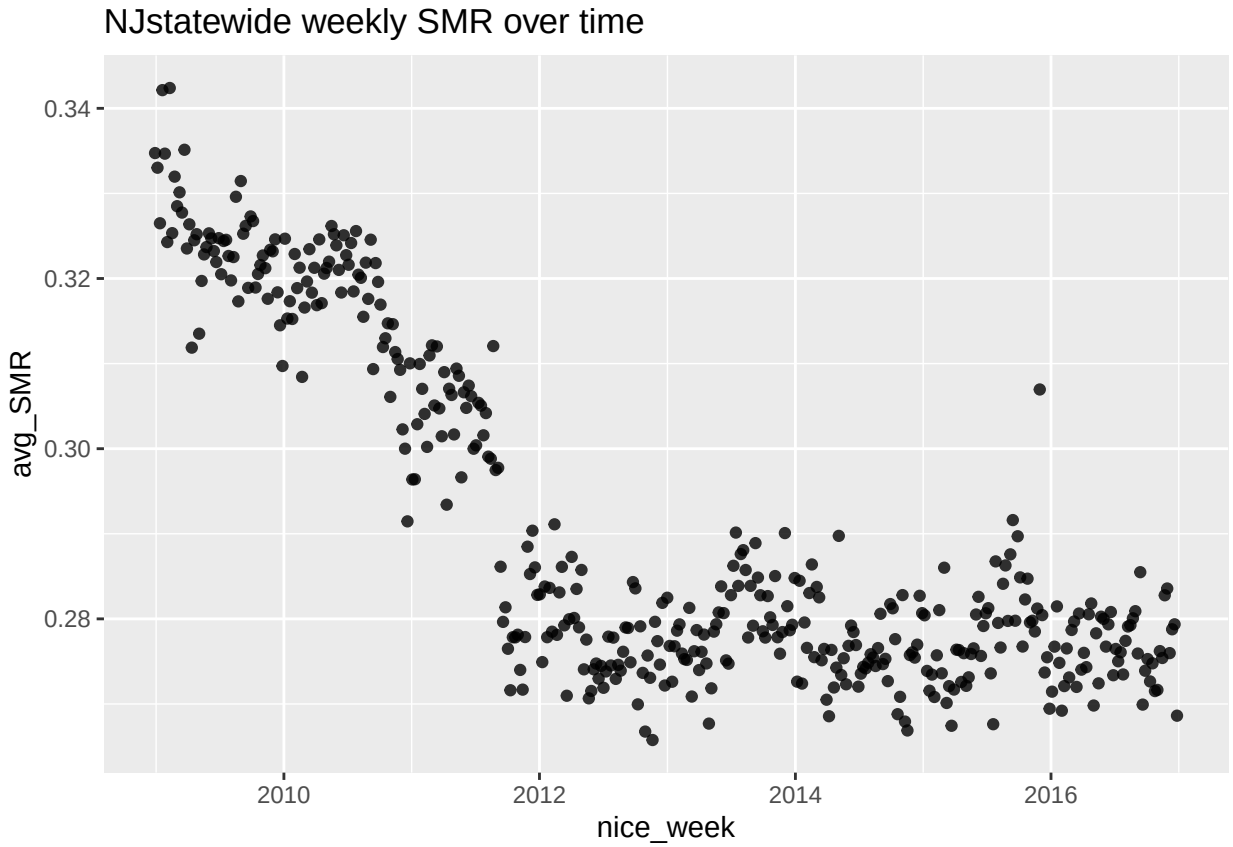
```
##
## [[39]]
```


NHstatewide weekly SMR over time
0.16
0.12
0.08
avg_SMR
2014−01
2014−07
2015−01
2015−07
2016−01
nice_week

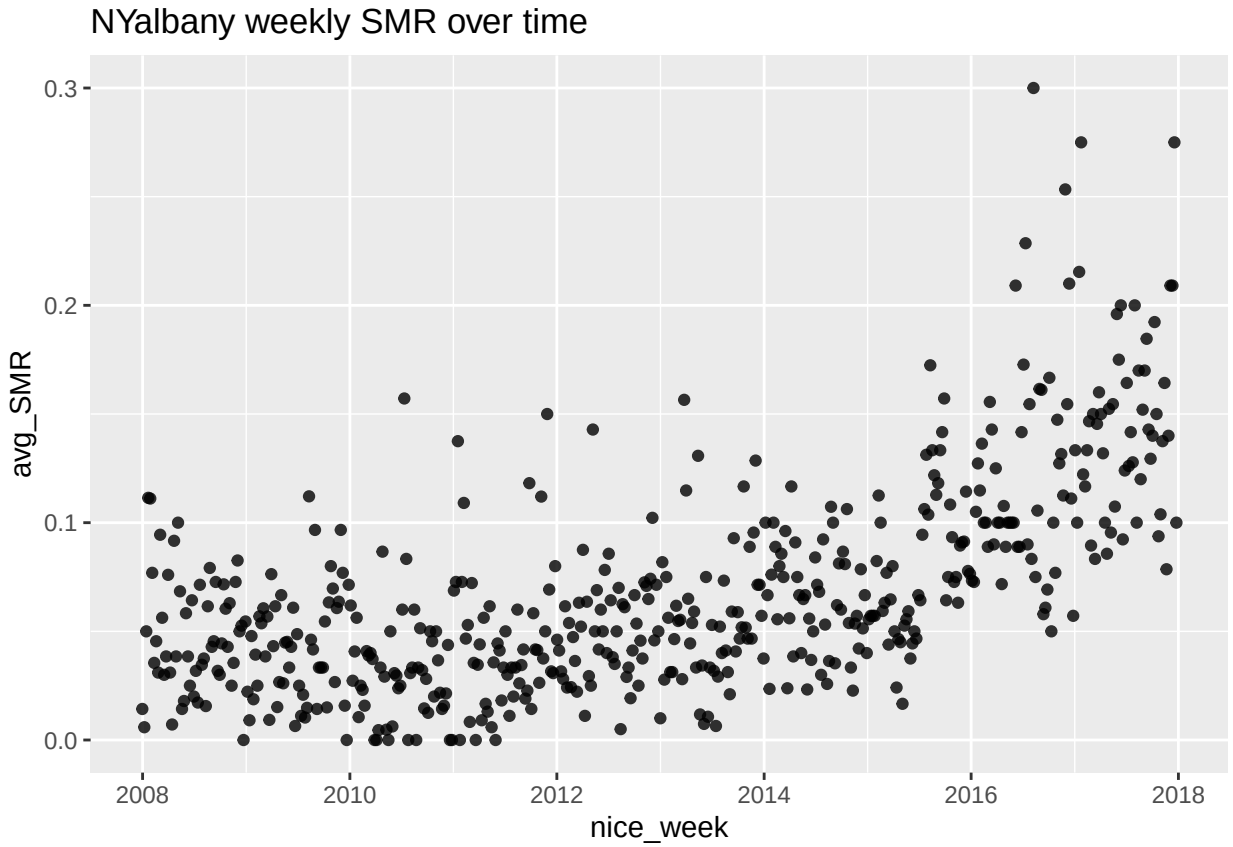
```
##
## [[40]]
```


NJcamden weekly SMR over time
avg_SMR
0.15
0.10
0.05
2014
2015
2016
2017
2018
nice_week

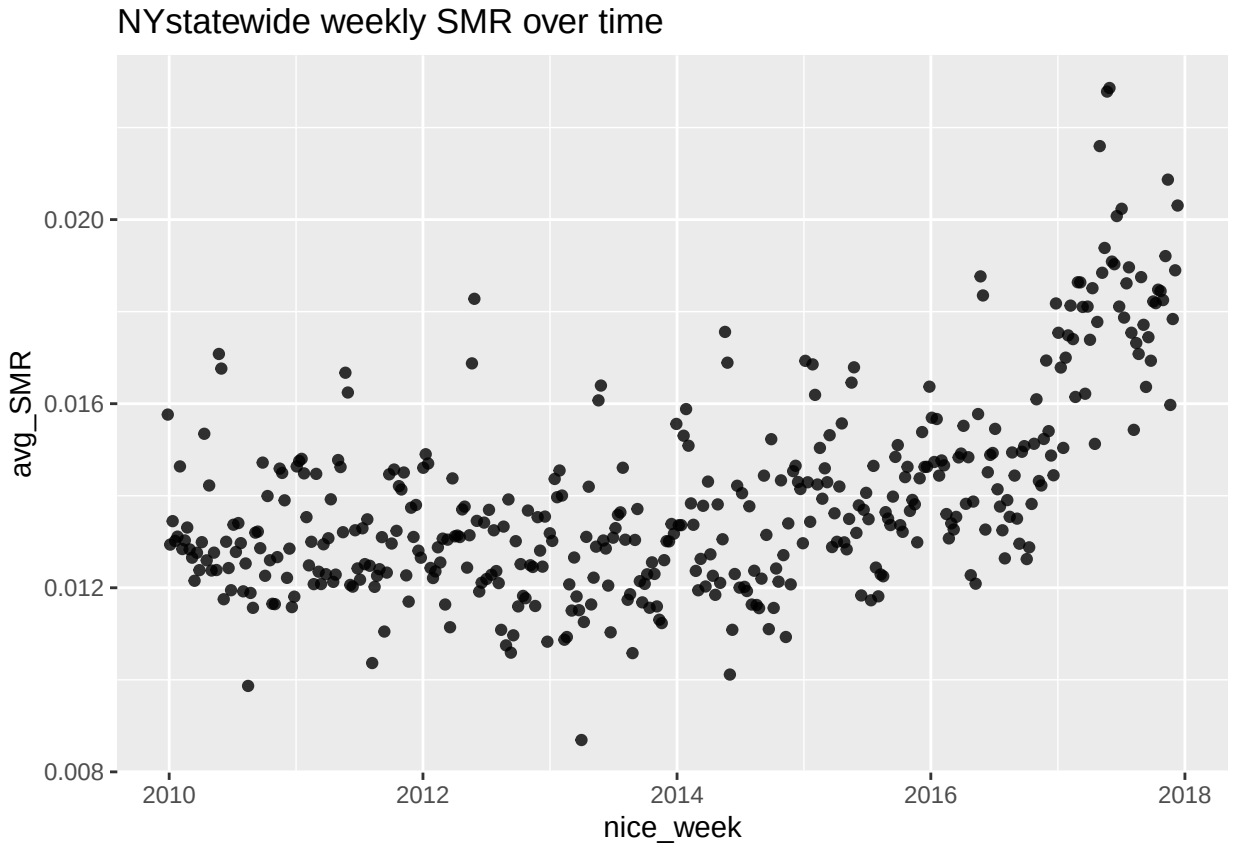
```
##
## [[41]]
```


NJstatewide weekly SMR over time
avg_SMR
0.34
0.32
0.30
0.28
2010
2012
2014
2016
nice_week

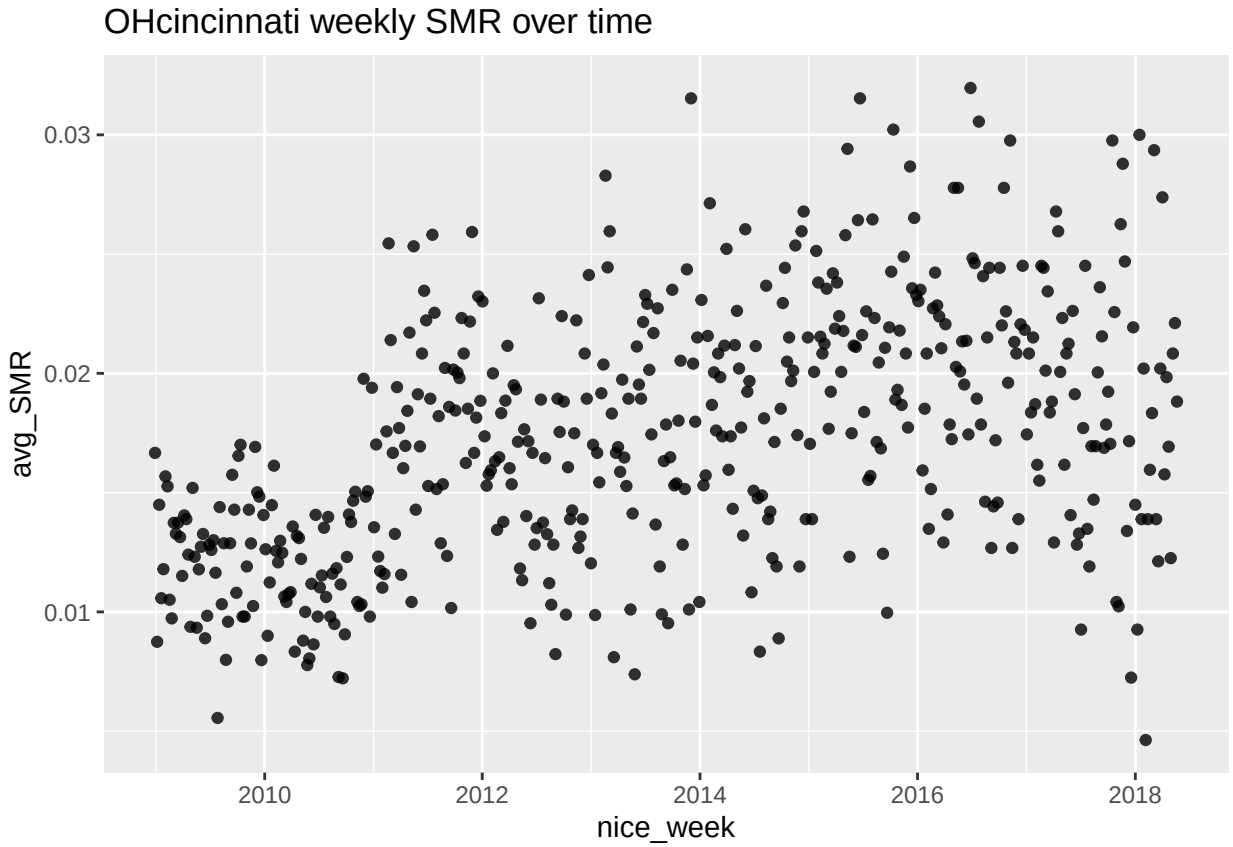
```
##
## [[42]]
```


NYalbany weekly SMR over time
avg_SMR
0.3
0.2
0.1
0.0
2008
2010
2012
2014
2016
2018
nice_week

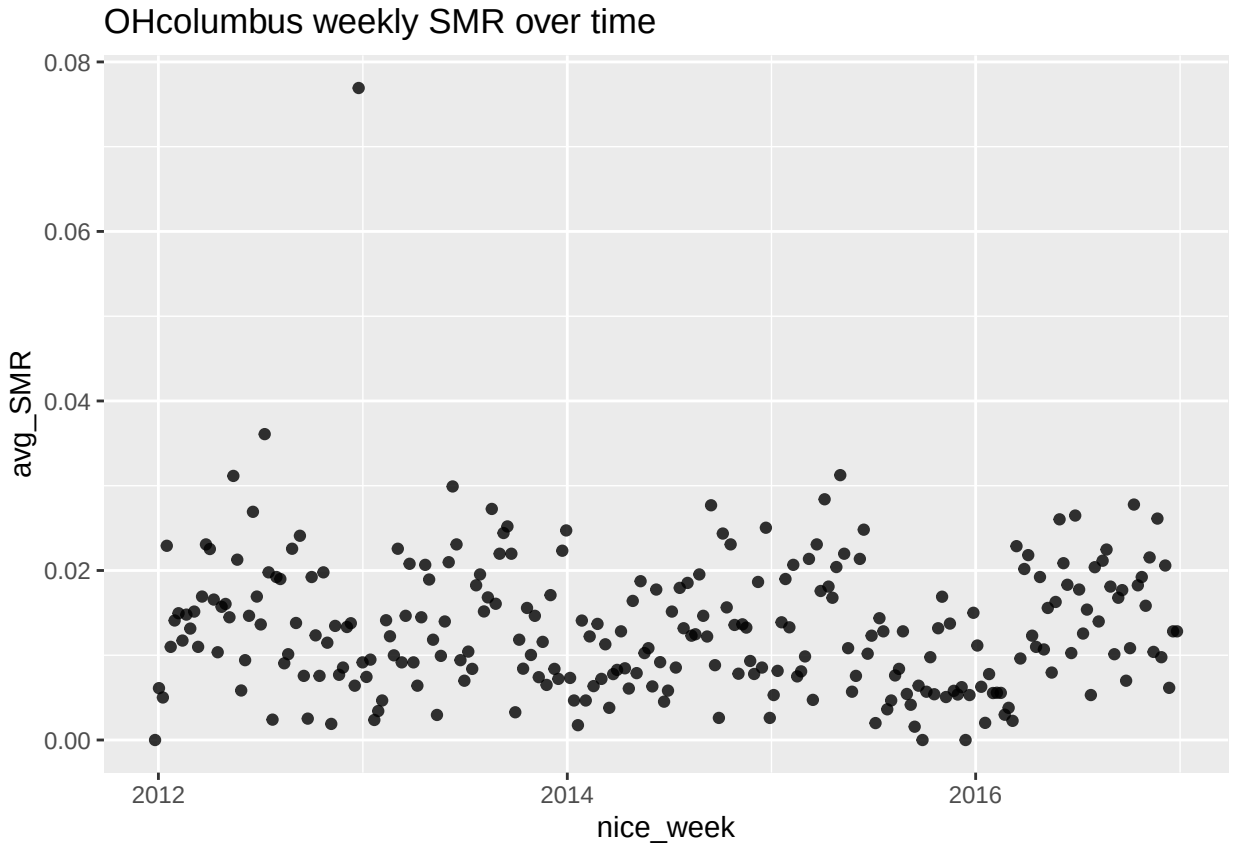
```
##
## [[43]]
```


NYstatewide weekly SMR over time
avg_SMR
0.020
0.016
0.012
0.008
2010
2012
2014
2016
2018
nice_week

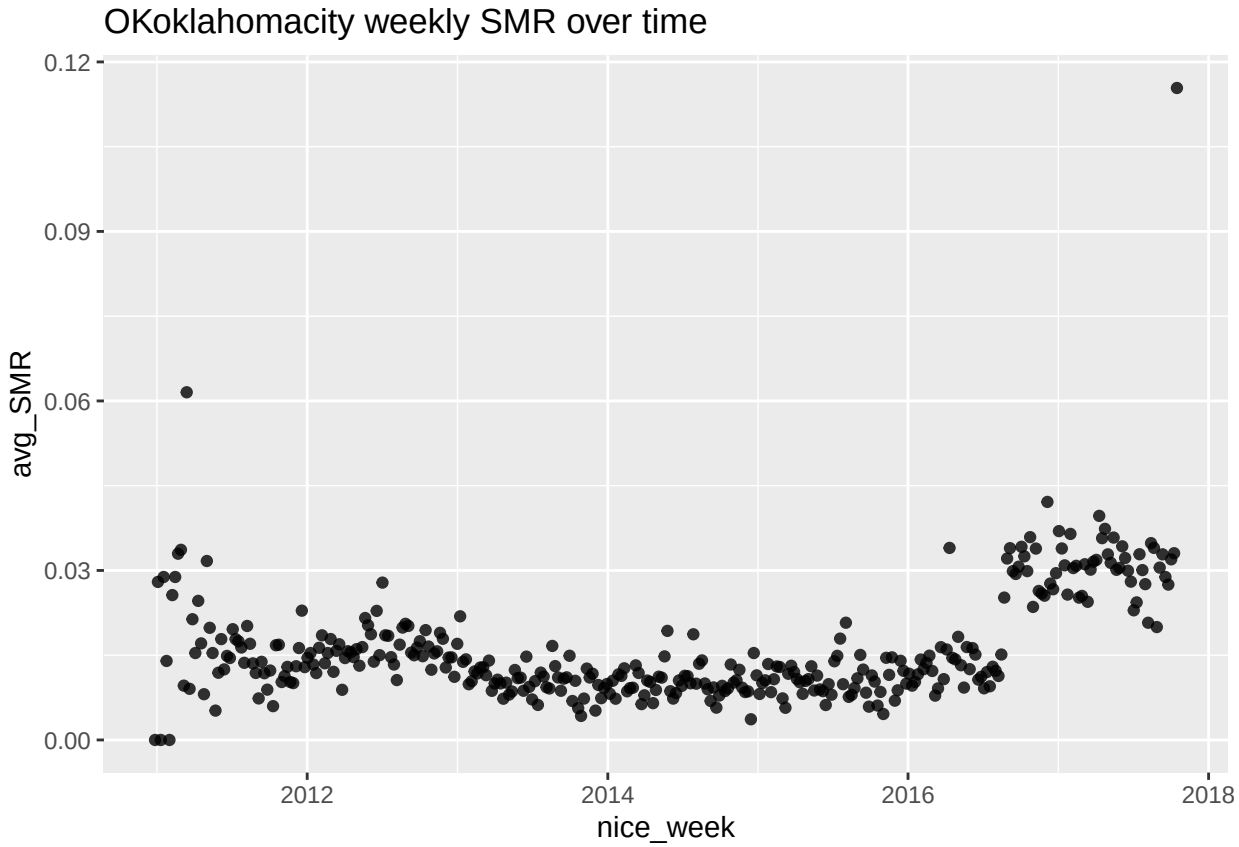
```
##
## [[44]]
```


OHcincinnati weekly SMR over time
avg_SMR
0.03
0.02
0.01
2010
2012
2014
2016
2018
nice_week

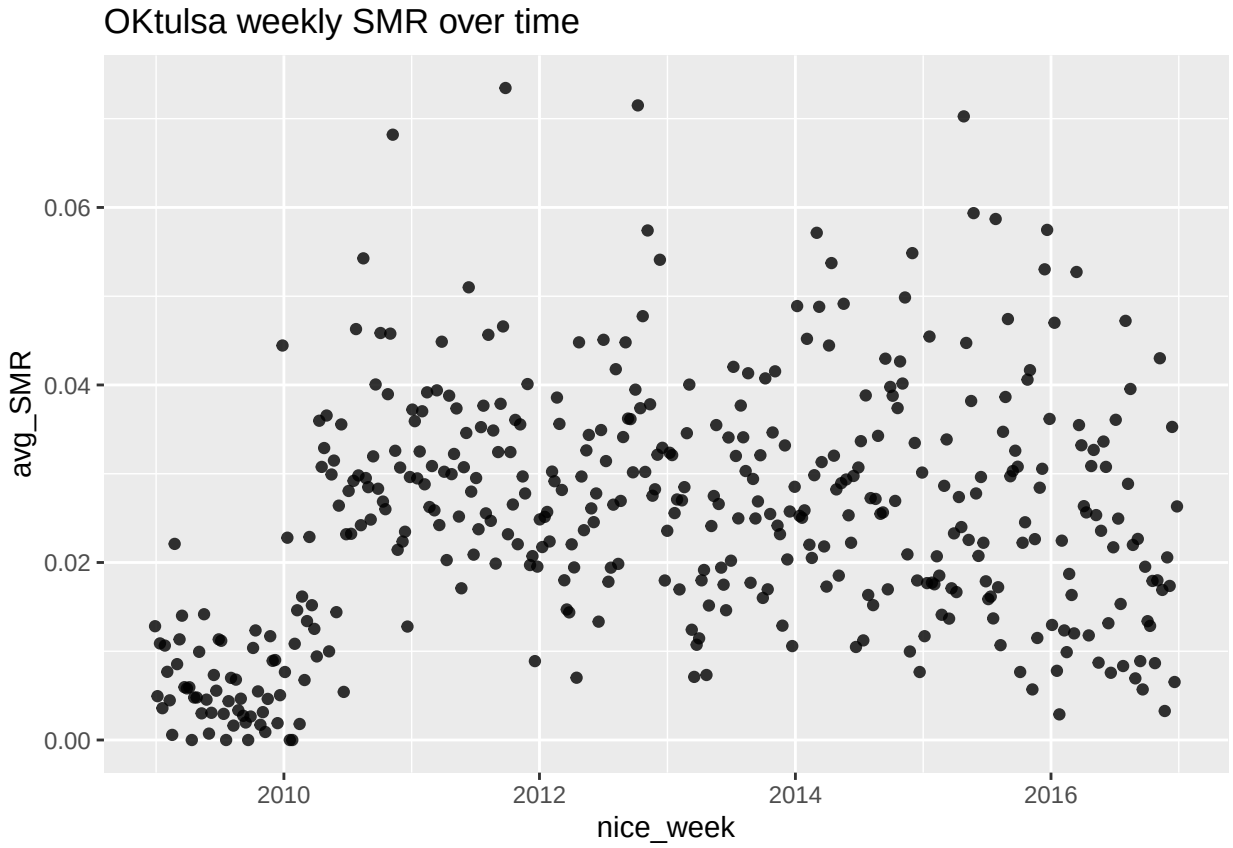
```
##
## [[45]]
```


OHcolumbus weekly SMR over time
avg_SMR
0.08
0.06
0.04
0.02
0.00
2012
2014
2016
nice_week

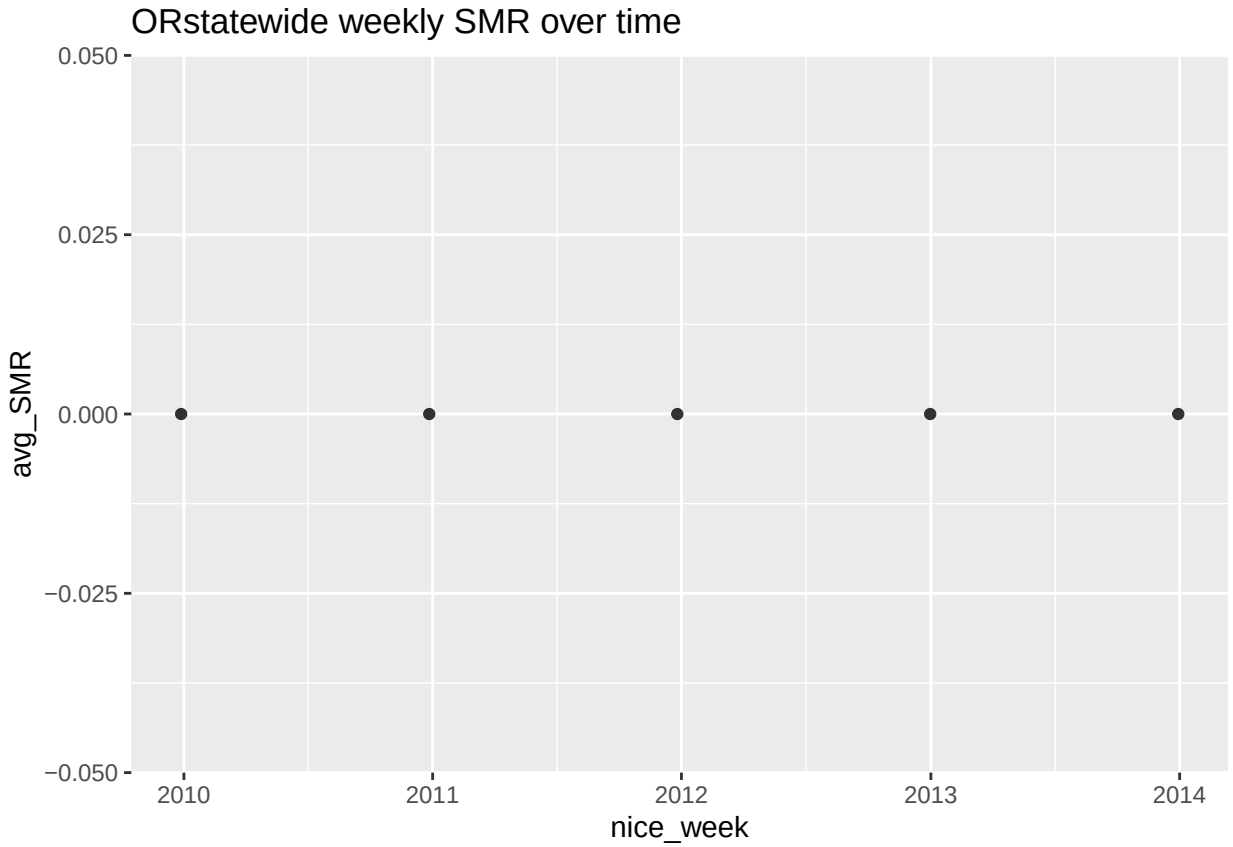
```
##
## [[46]]
```


OKoklahomacity weekly SMR over time
0.12
0.09
0.06
0.03
0.00
avg_SMR
2012
2014
2016
2018
nice_week

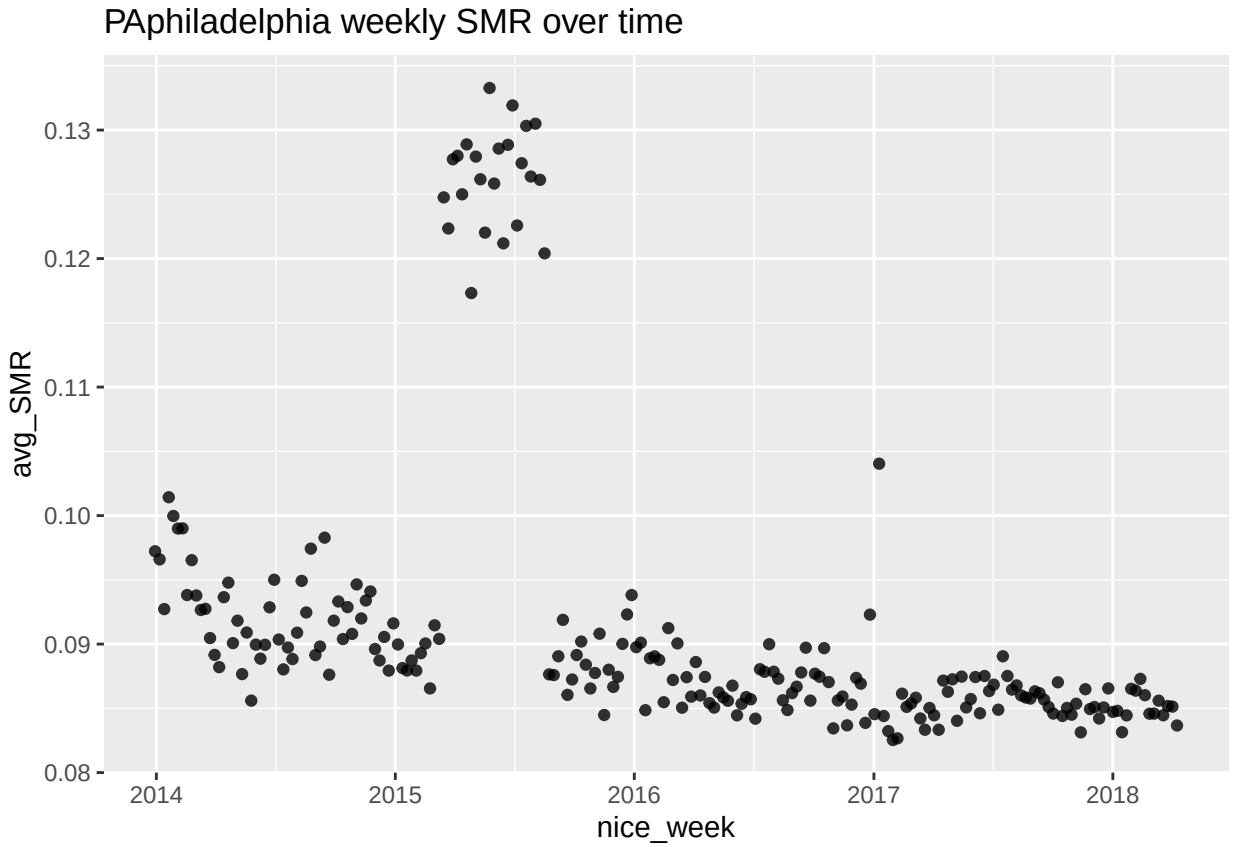
```
##
## [[47]]
```


OKtulsa weekly SMR over time
avg_SMR
0.06
0.04
0.02
0.00
2010
2012
2014
2016
nice_week

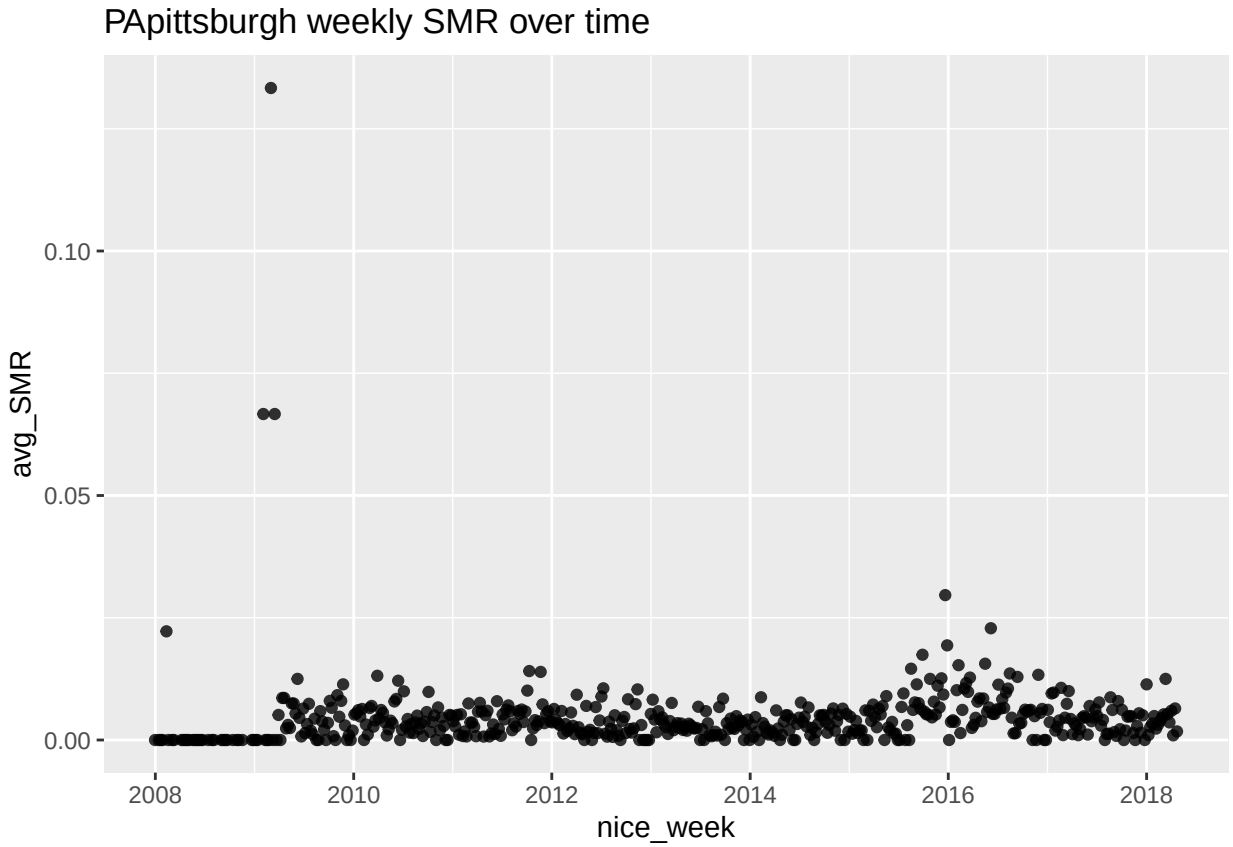
```
##
## [[48]]
```


ORstatewide weekly SMR over time
0.050
0.025
0.000
−0.025
−0.050
avg_SMR
2010
2011
2012
2013
2014
nice_week

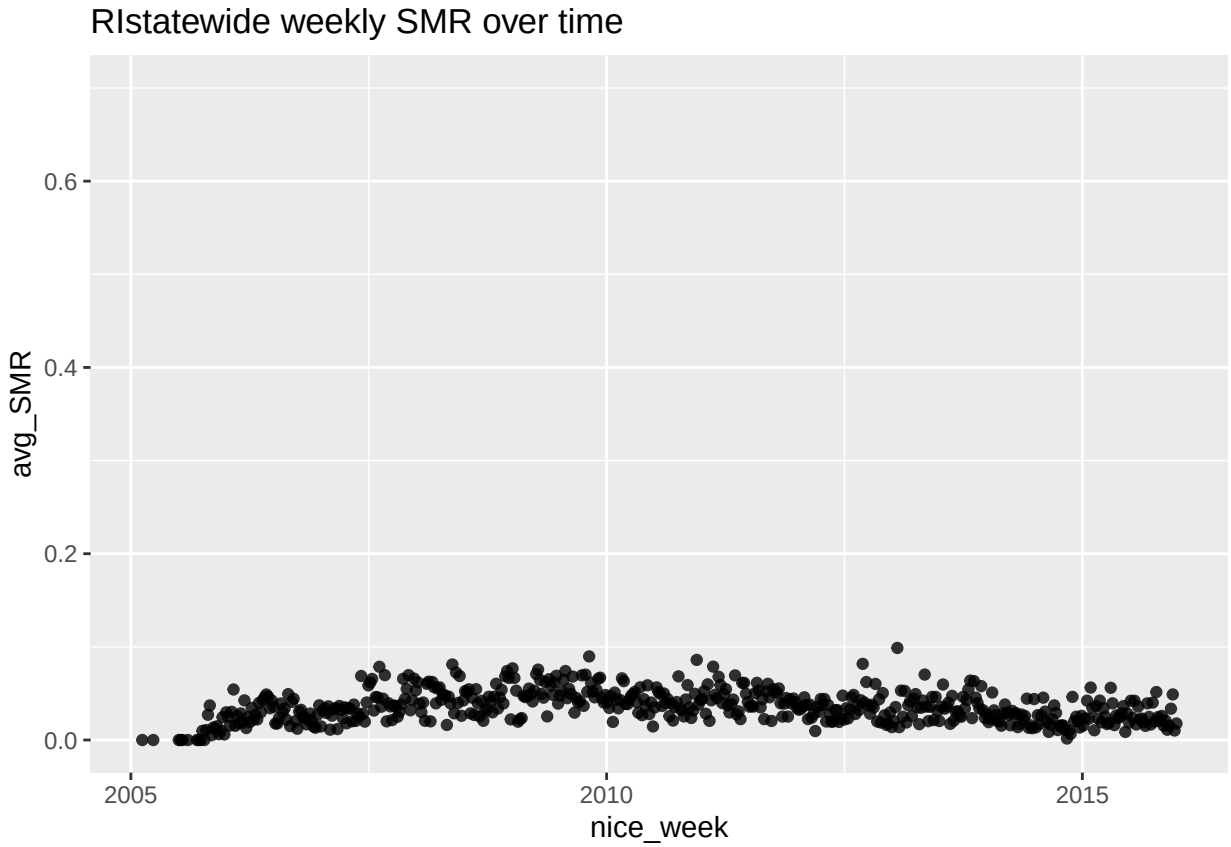
```
##
## [[49]]
```


PAphiladelphia weekly SMR over time
avg_SMR
0.13
0.12
0.11
0.10
0.09
0.08
2014
2015
2016
2017
2018
nice_week

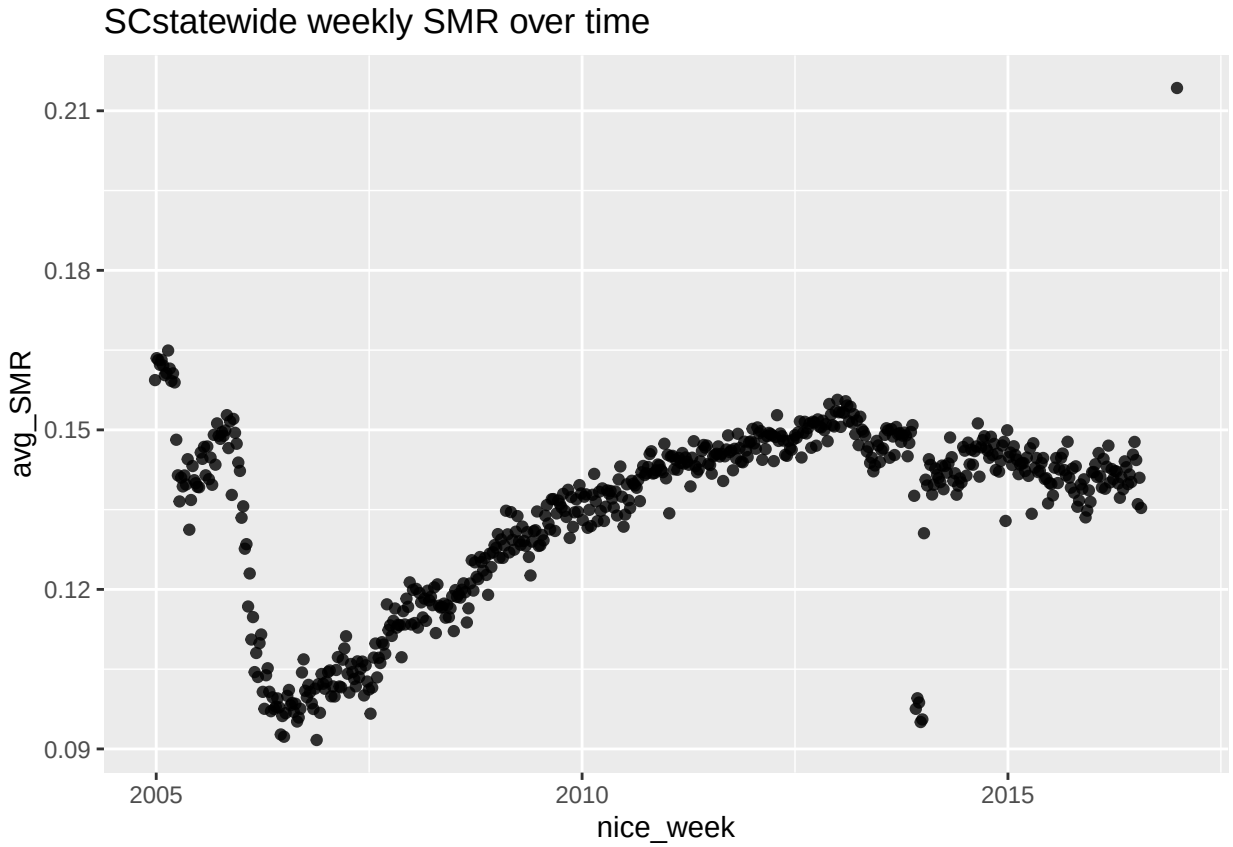
```
##
## [[50]]
```


PApittsburgh weekly SMR over time
avg_SMR
0.10
0.05
0.00
2008
2010
2012
2014
2016
2018
nice_week

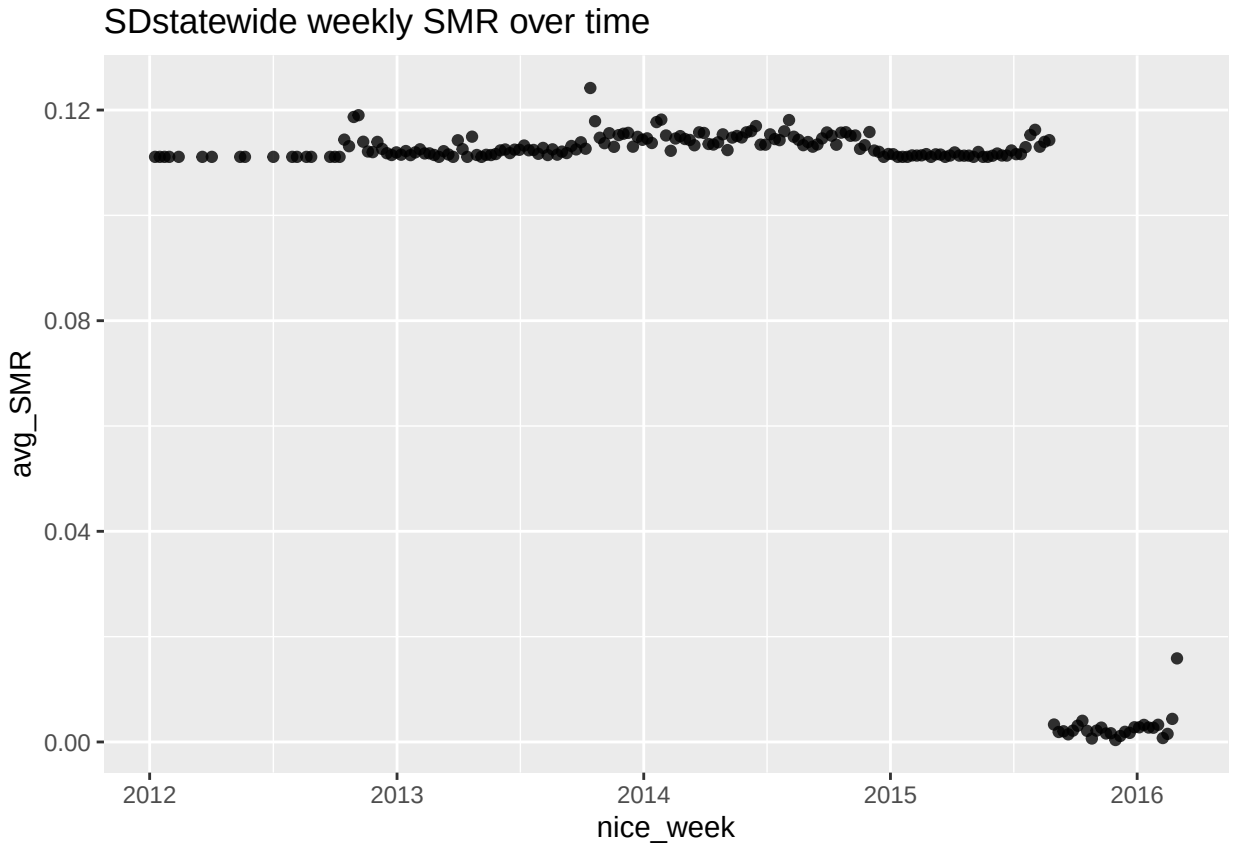
```
##
## [[51]]
```


RIstatewide weekly SMR over time
avg_SMR
0.6
0.4
0.2
0.0
2005
2010
2015
nice_week

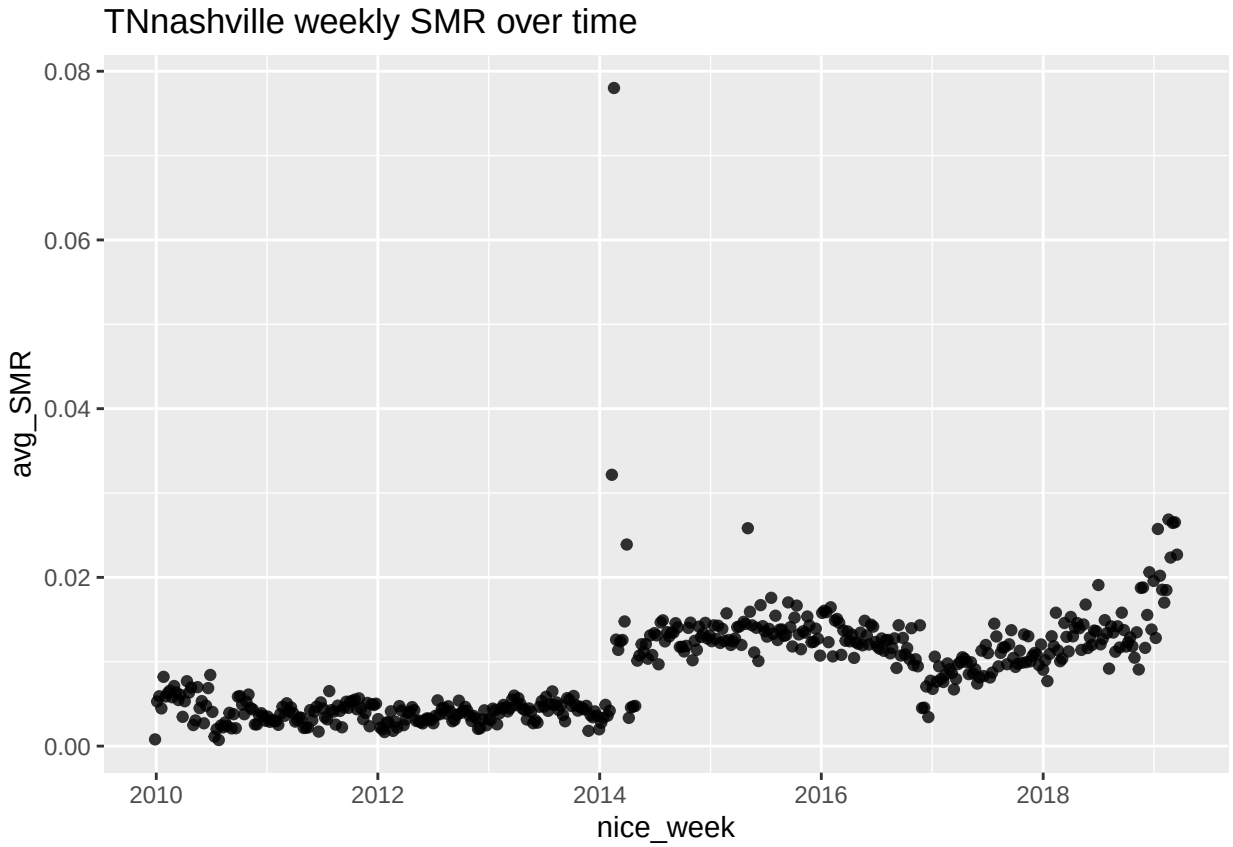
```
##
## [[52]]
```


SCstatewide weekly SMR over time
avg_SMR
0.21
0.18
0.15
0.12
0.09
2005
2010
2015
nice_week

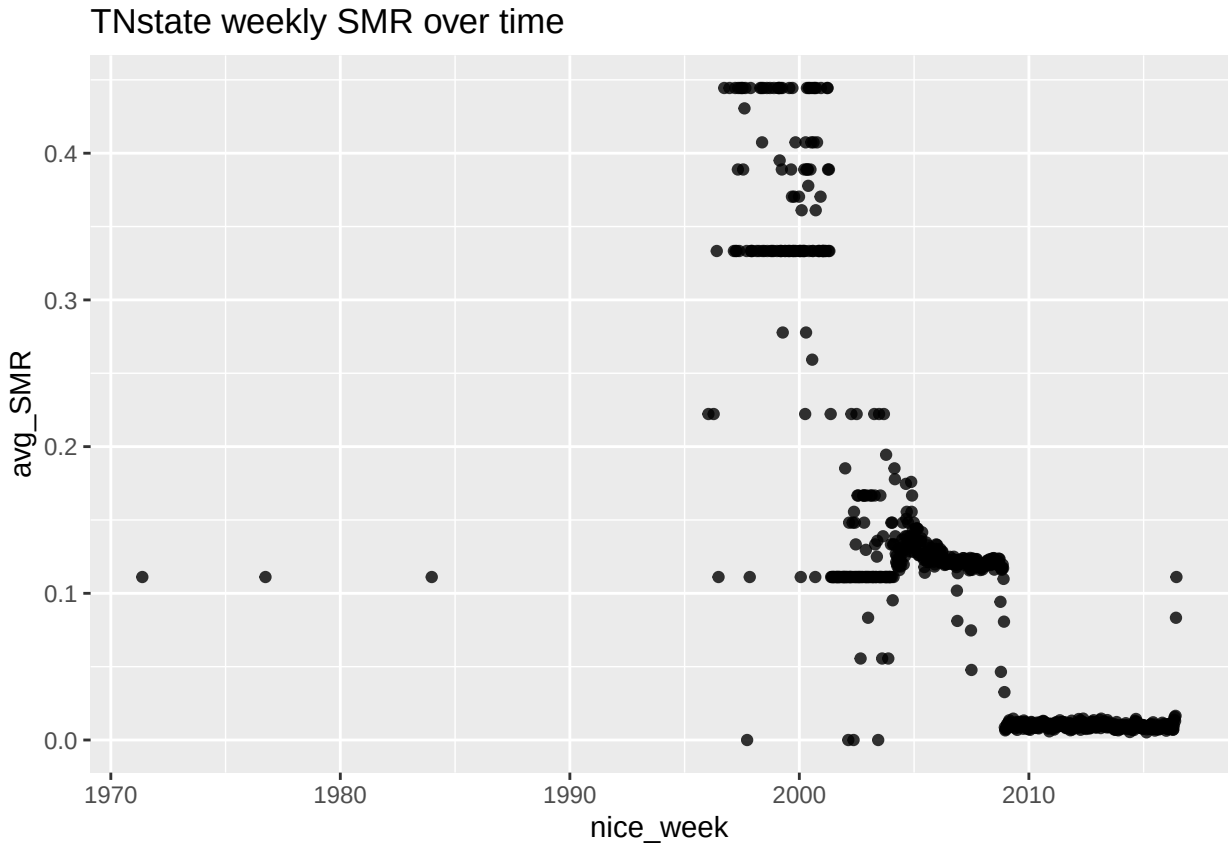
```
##
## [[53]]
```


SDstatewide weekly SMR over time
0.12
0.08
0.04
0.00
avg_SMR
2012
2013
2014
2015
2016
nice_week

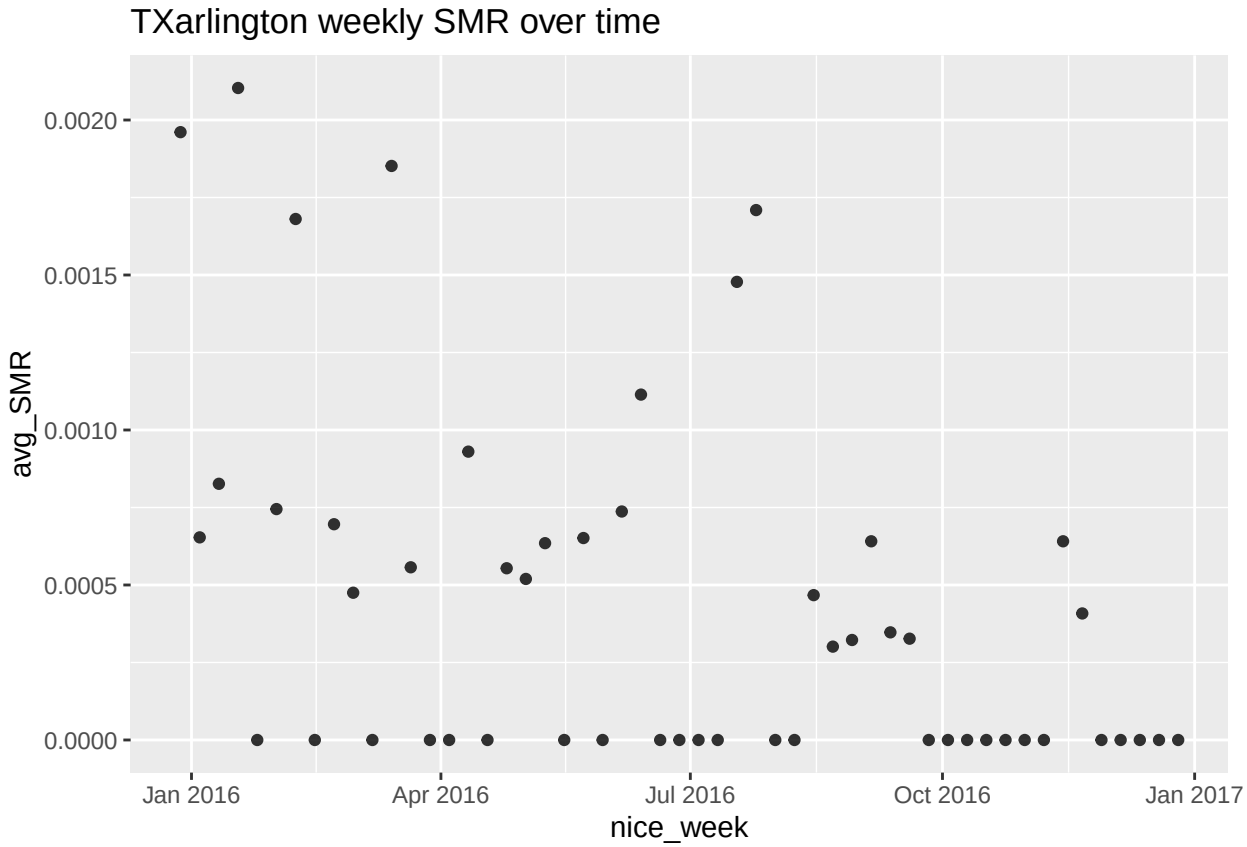
```
##
## [[54]]
```


TNnashville weekly SMR over time
avg_SMR
0.08
0.06
0.04
0.02
0.00
2010
2012
2014
2016
2018
nice_week

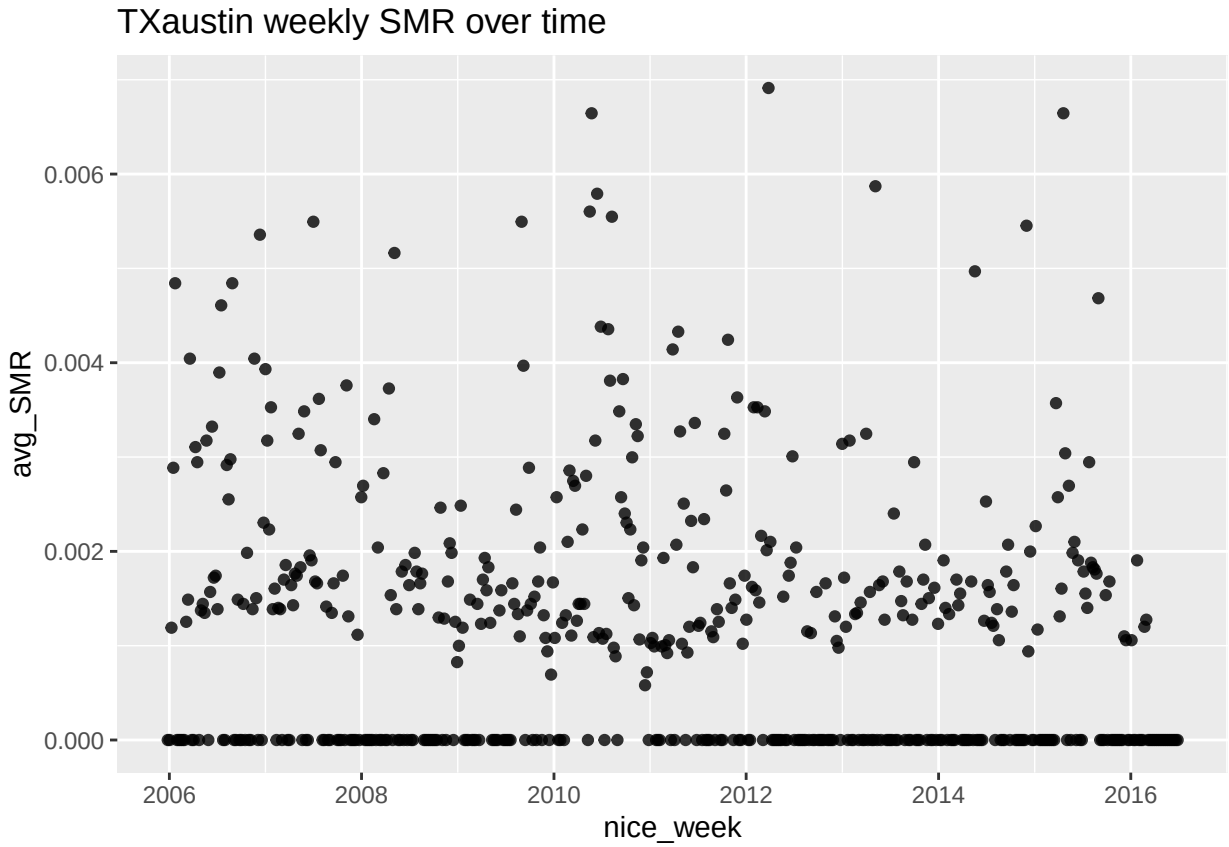
```
##
## [[55]]
```


TNstate weekly SMR over time
avg_SMR
0.0
0.1
0.2
0.3
0.4
1970
1980
1990
2000
2010
nice_week

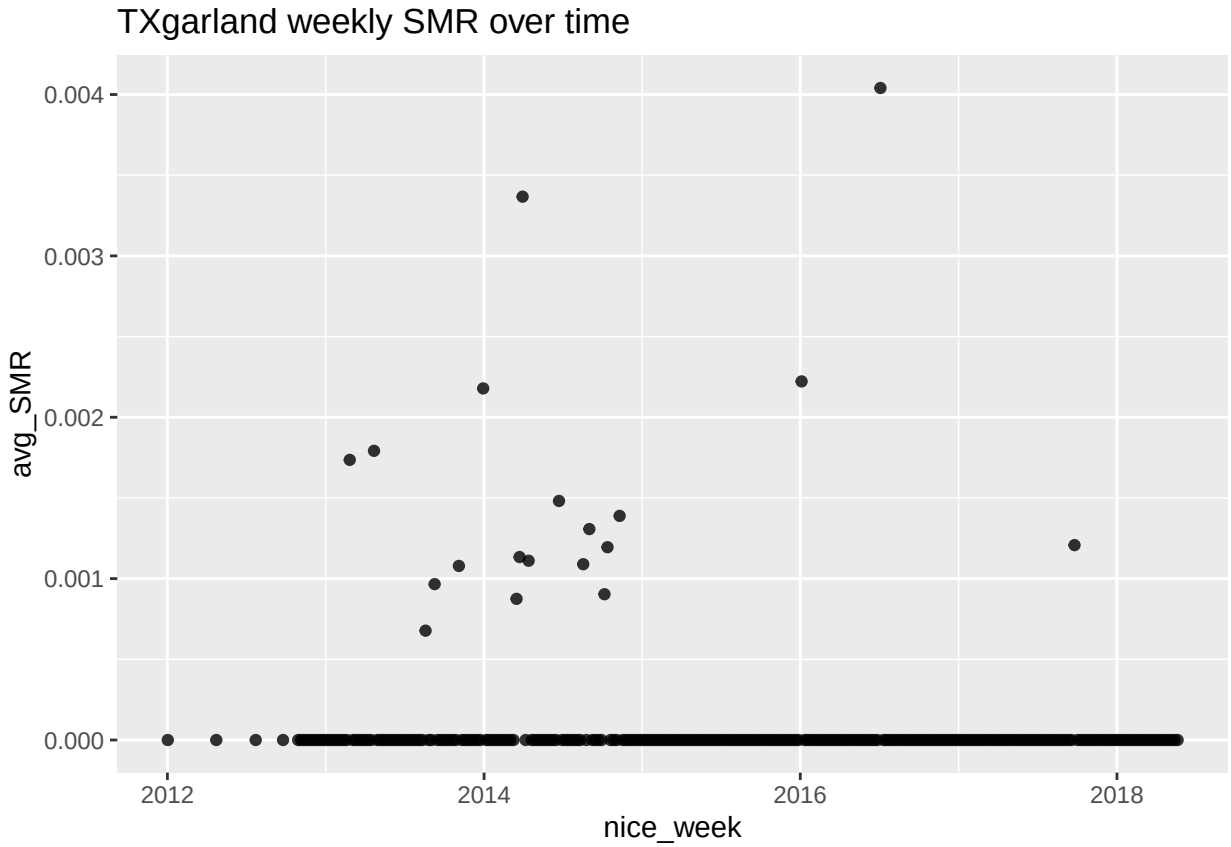
```
##
## [[56]]
```


TXarlington weekly SMR over time
avg_SMR
0.0020
0.0015
0.0010
0.0005
0.0000
Jan 2016
Apr 2016
Jul 2016
Oct 2016
Jan 2017
nice_week

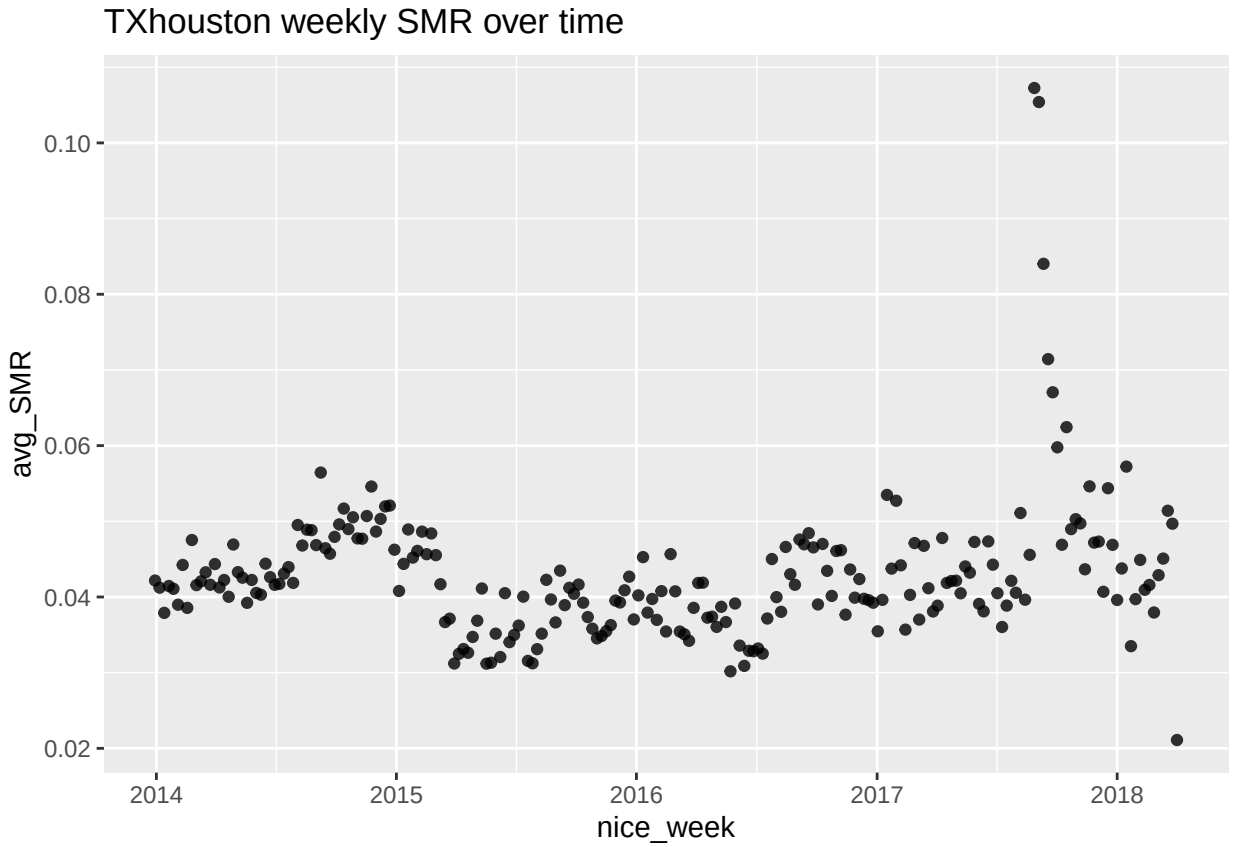
```
##
## [[57]]
```


TXaustin weekly SMR over time
avg_SMR
0.006
0.004
0.002
0.000
2006
2008
2010
2012
2014
2016
nice_week

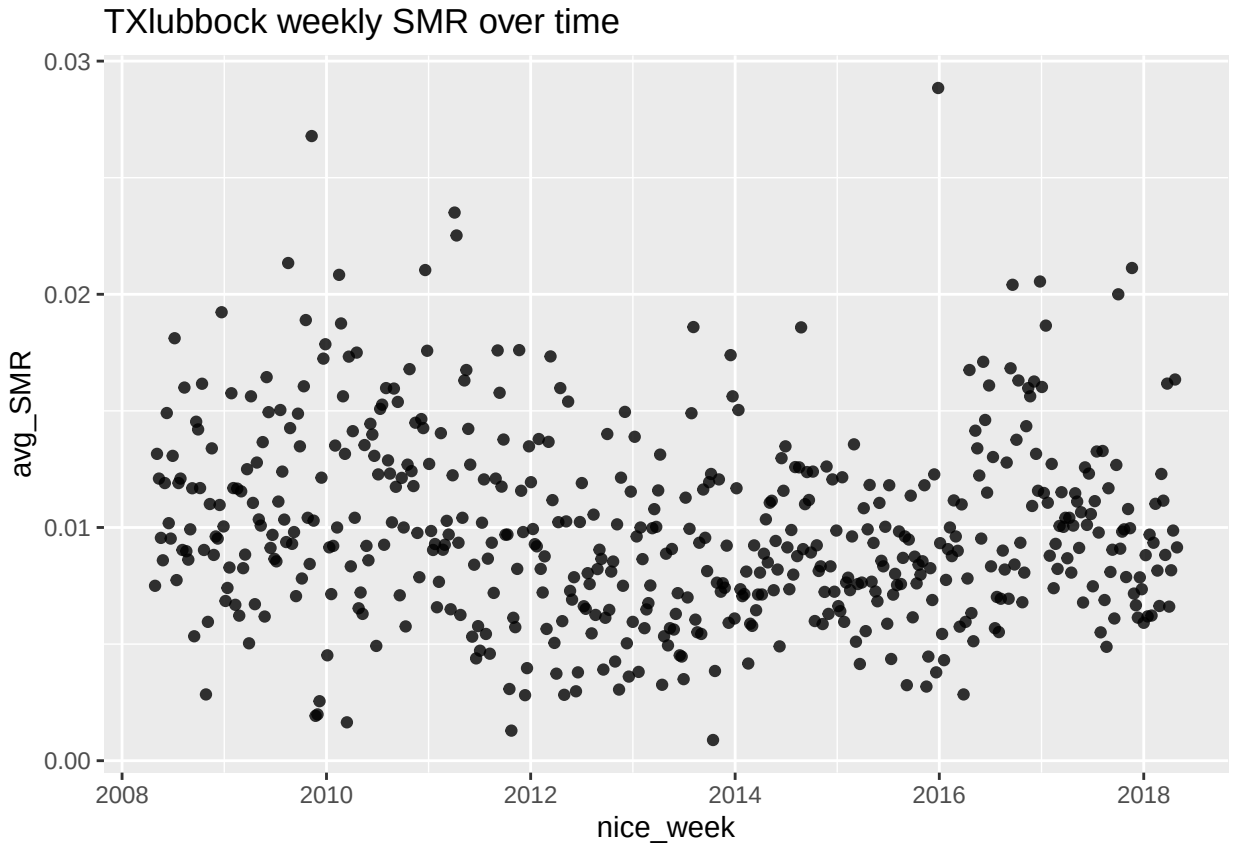
```
##
## [[58]]
```


TXgarland weekly SMR over time
avg_SMR
0.004
0.003
0.002
0.001
0.000
2012
2014
2016
2018
nice_week

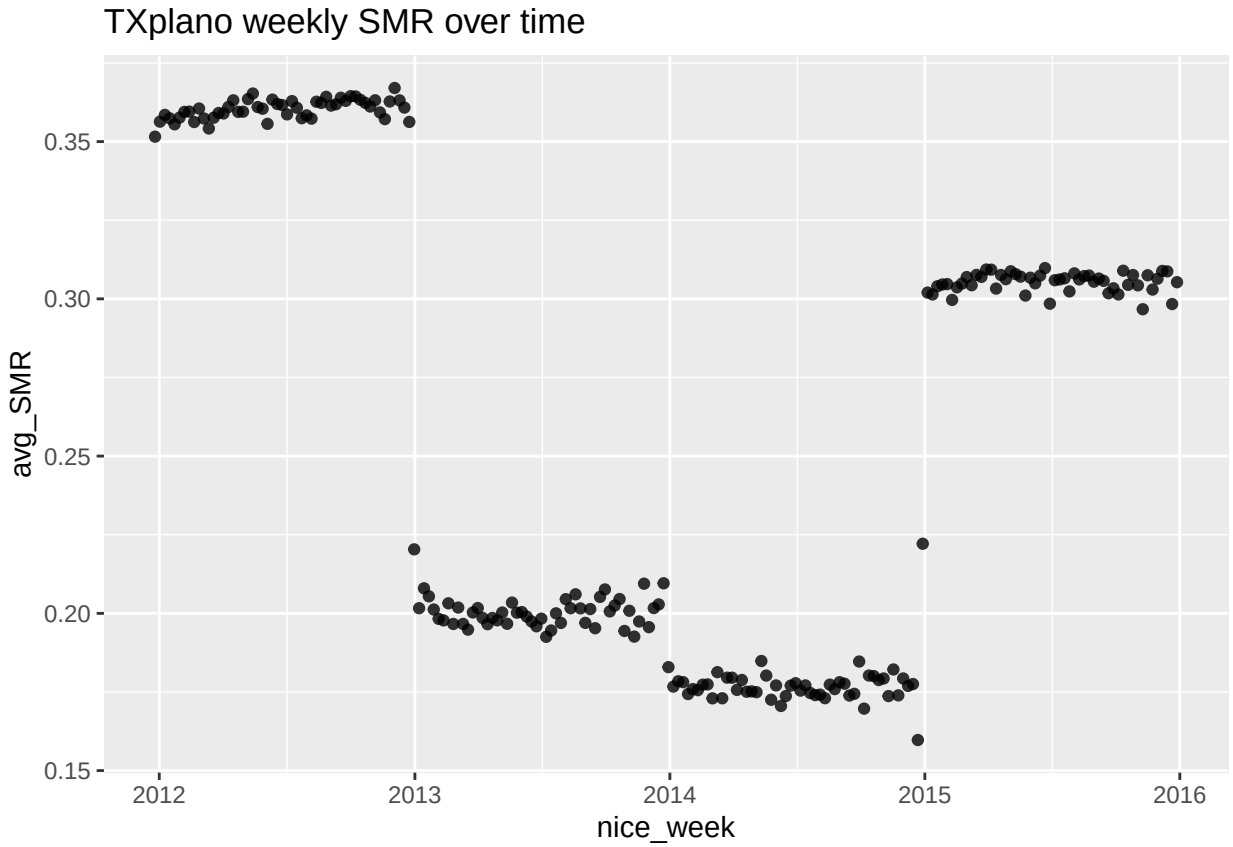
```
##
## [[59]]
```


TXhouston weekly SMR over time
avg_SMR
0.10
0.08
0.06
0.04
0.02
2014
2015
2016
2017
2018
nice_week

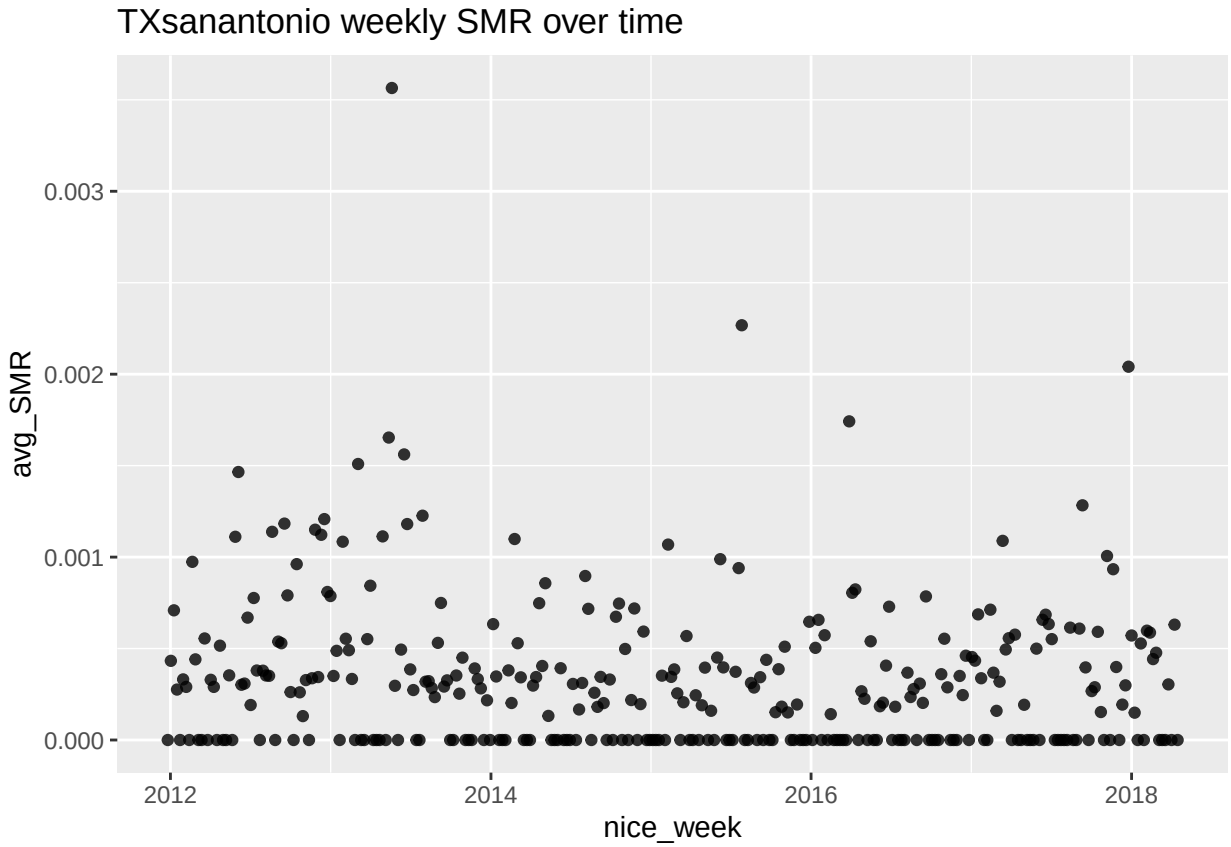
```
##
## [[60]]
```


TXlubbock weekly SMR over time
avg_SMR
0.03
0.02
0.01
0.00
2008
2010
2012
2014
2016
2018
nice_week

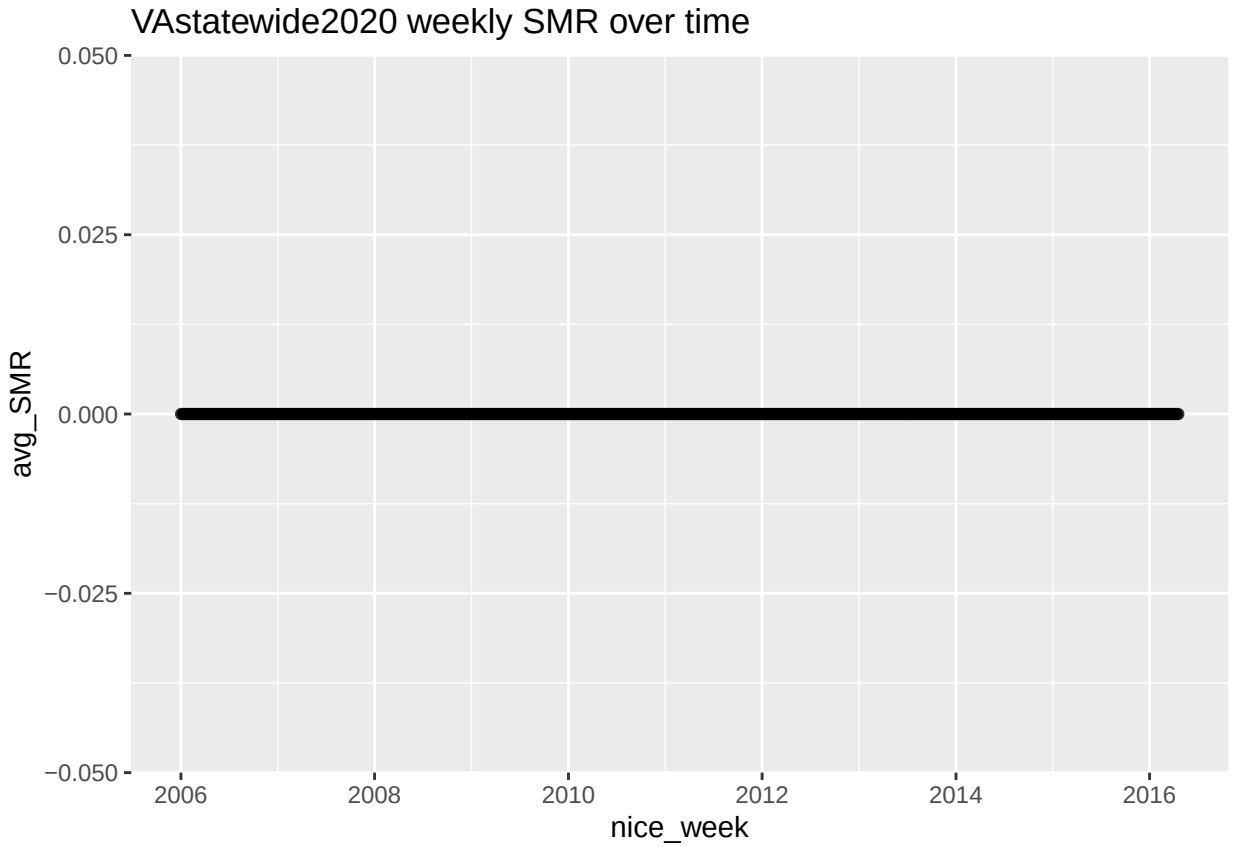
```
##
## [[61]]
```


TXplano weekly SMR over time
avg_SMR
0.35
0.30
0.25
0.20
0.15
2012
2013
2014
2015
2016
nice_week

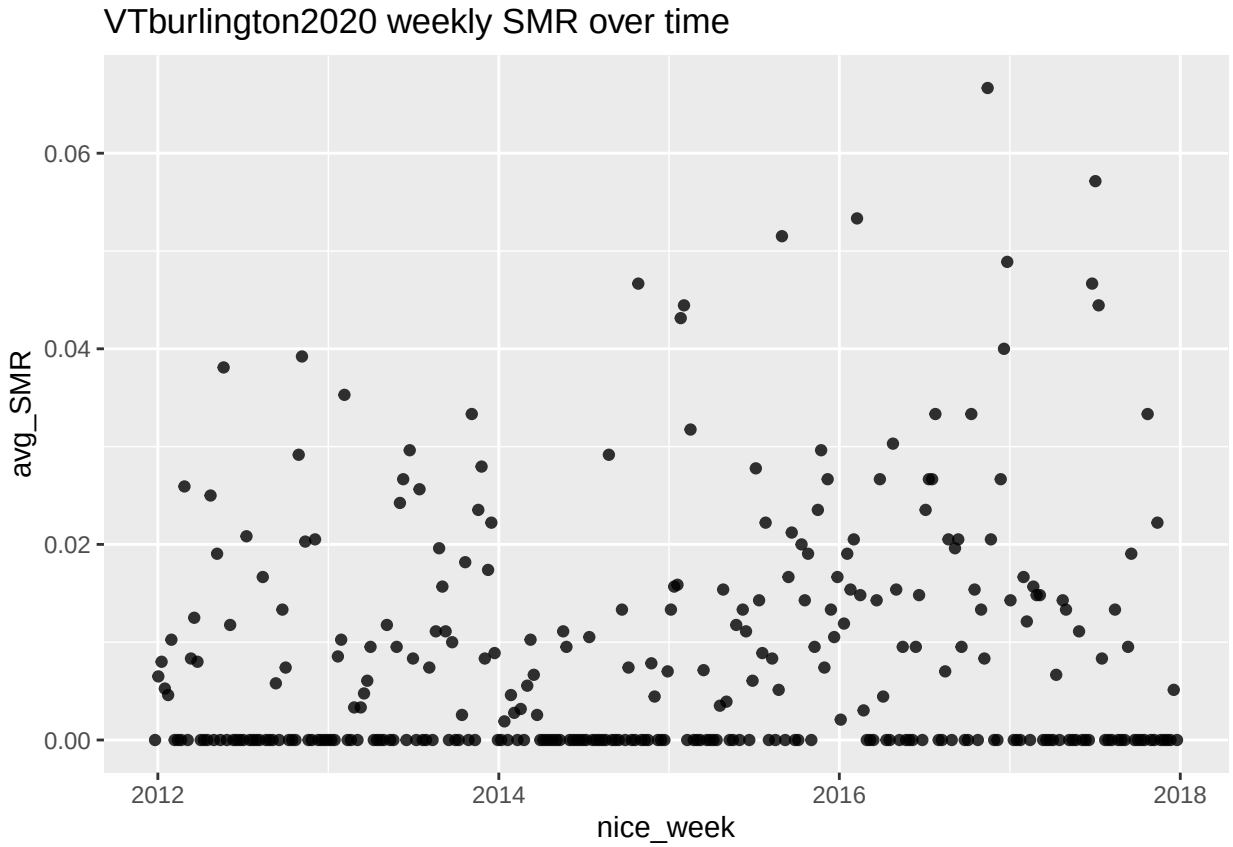
```
##
## [[62]]
```


TXsanantonio weekly SMR over time
avg_SMR
0.003
0.002
0.001
0.000
2012
2014
2016
2018
nice_week

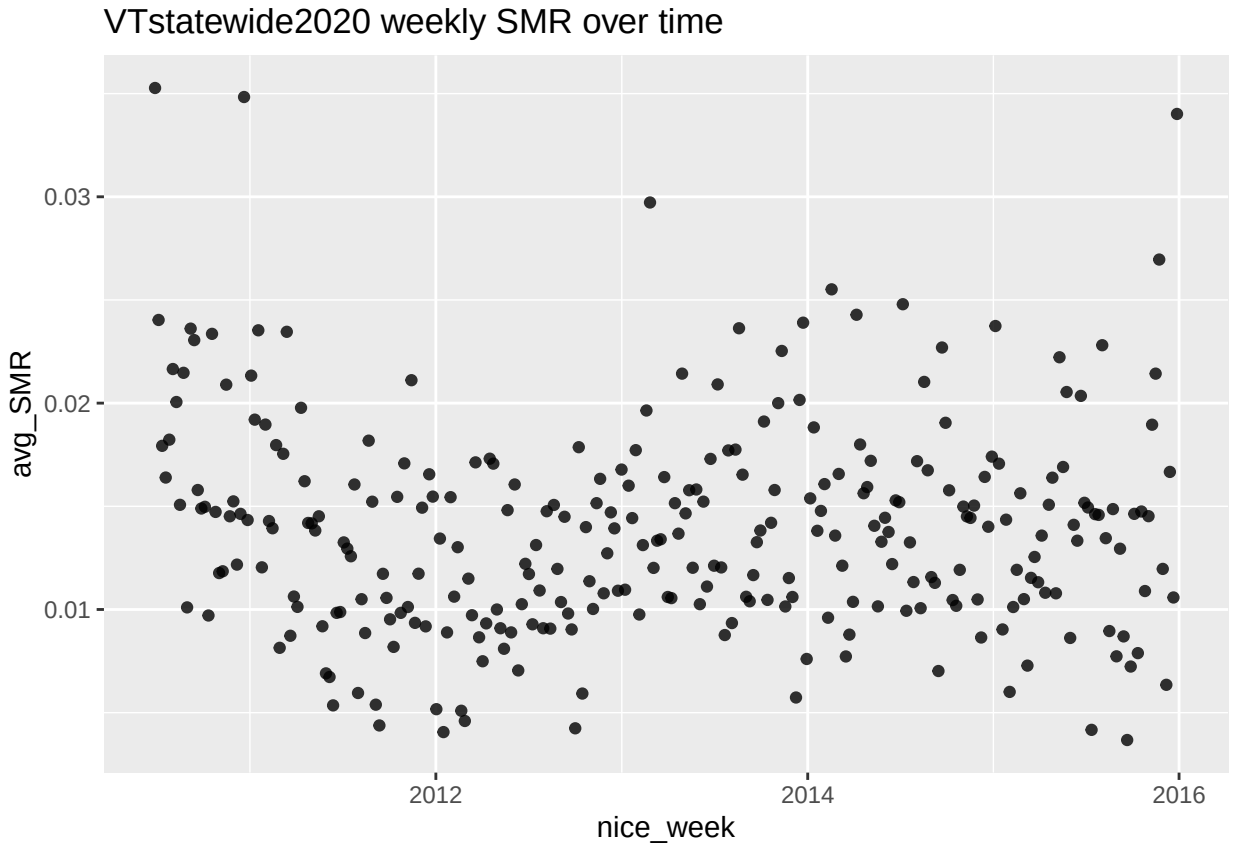
```
##
## [[63]]
```


VAstatewide2020 weekly SMR over time
0.050
0.025
0.000
−0.025
−0.050
avg_SMR
2006
2008
2010
2012
2014
2016
nice_week

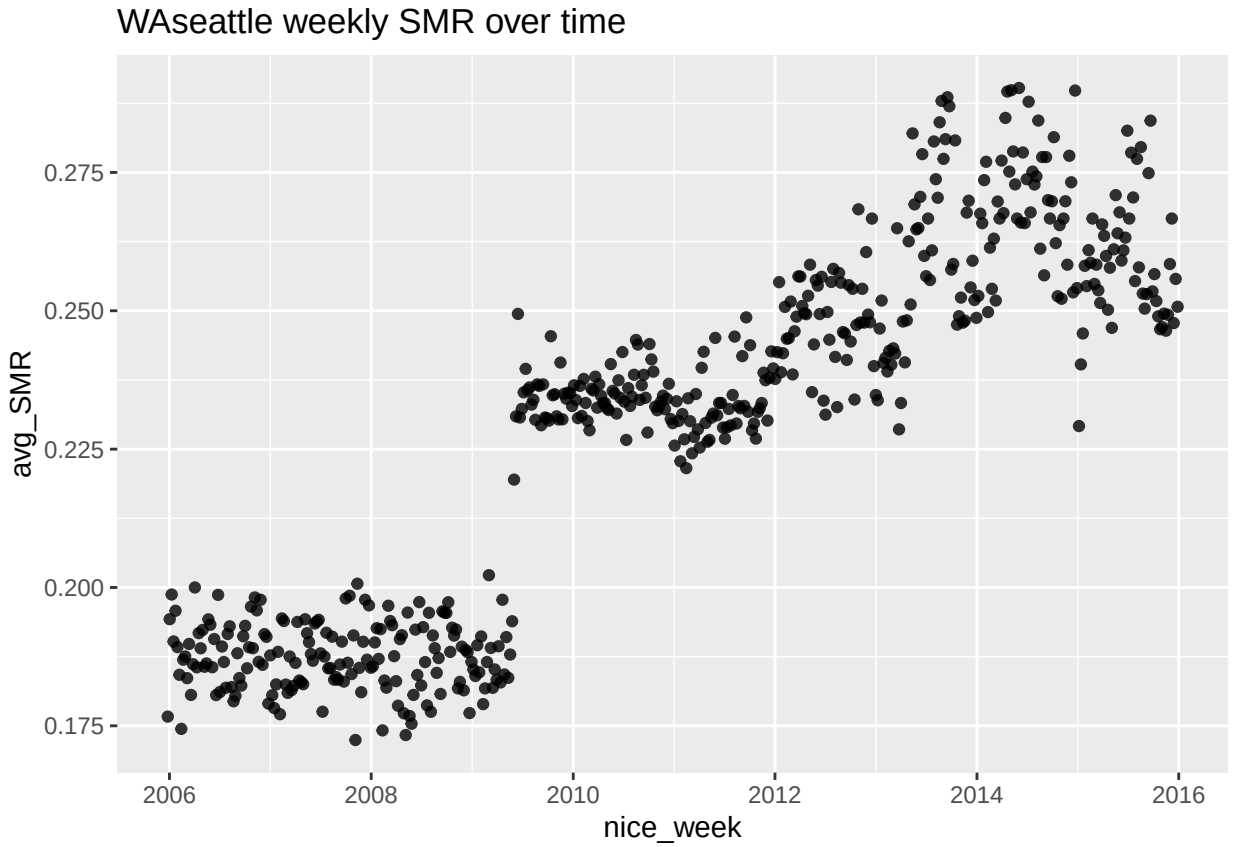
```
##
## [[64]]
```


VTburlington2020 weekly SMR over time
avg_SMR
0.06
0.04
0.02
0.00
2012
2014
2016
2018
nice_week

```
##
## [[65]]
```


VTstatewide2020 weekly SMR over time
avg_SMR
0.03
0.02
0.01
2012
2014
2016
nice_week

```
##
## [[66]]
```



- SMR and its spread is different throughout the years
- the roughly-discernible average SMR can have level changes (Iowa statewide) or have gradual sloping changes
- a low missingness rate isn't indicative of a *good* data set. example is CA los angeles – the dataset records very few variable with a consistenly near-0 SMR. but no discrimination analysis tests can be done on it because it doesn't record subject_race!
- some datasets put in all their data by the month, so the dates are actually all inaccurate because the date of the traffic stop is actually when the data are entered, not when the stop takes place!

What is wrong with ORstatewide?

Oregon records its stops by the year. So there are only 5 data points for the 5 years 2010 to 2014.

```
mysearch_dataset(dataset_lst, "ORstatewide") %>% distinct(date)
```

SMR by night/day, throughout years

Set up

To add the variable `day_night`, we find the sunset, sunrise, and intertwilight times and categorize each traffic stop as having occurred in the darkness, in the sunlight, or during an ambiguous twilight time.

Filter datasets For *time of day* analysis, we need variables `date` *and* `time`. We build on the filtering from the previous section.

```r
# filtering OUT datasets that don't record time
time_lst <- lapply(dataset_lst, dataset_containing, c("time", "date"))
time_lst <- time_lst[sapply(time_lst, function(x) isTRUE(nrow(x) > 0))]
```

```r
makeDF.Coordinates <- function(dataset_lst){

  pull_location_str <- function(dataset, for_URL){
    # for_URL is a boolean indicating if pulling the location_str
    # for a URL or not

    name <- dataset$dataset_name[1]

    if(for_URL){

      # extract lowecase letters of name
      check <- str_extract(name, "[a-z]+")
      state <- state.name[grep(str_sub(name, 1,2), state.abb)]

      if(check == "statewide" | check == "state"){

        url_name <- gsub(" ", "+", state.name[grep(str_sub(name, 1,2), state.abb)])
        # return full name of the state

        return(url_name)

      } else {

        url_name <- gsub(" ", "+", paste(check, state))
        return(url_name)

      }

    }

  # otherwise just turn dataset_name, as it is formatted in the dataset
  return(name)

}

  location_str_URL <- lapply(time_lst, pull_location_str, TRUE)

  # scraper function to fetch coordinates from city string
  get_coordinates <- function(city){

    # city is a string

    url_str <- paste("http://www.google.com/search?q=latitude+and+longitude+of+",
                city, sep = "")

    doc <- htmlParse(getURL(url_str))

    # class = BNeawe iBp4i AP7Wnd retrieves the coordinates
```

```
    coordinates <- xpathSApply(doc, "//div[@class='BNeawe iBp4i AP7Wnd']", xmlValue)[1]

    clean_coordinates <- str_split(coordinates, ", ")[[1]]

    # use regular expressions to extract lat and lng
    lat <- as.numeric(str_extract(clean_coordinates[1], "\\d+\\.*\\d*"))
    # multiple long by -1 b/c...?
    long <- -1*as.numeric(str_extract(clean_coordinates[2], "\\d+\\.*\\d*"))

    final_coordinates <- c(lat, long)
    return(final_coordinates)

  }

  # find lat/long information using get_coordinates function and relevant_dataset_names df
  coordinates_lst <- lapply(location_str_URL, get_coordinates)

  # bind lat/long information with relevant_dataset_names
  coordinates_df <- data.table::transpose(data.frame(coordinates_lst)) %>%
    # join with dataset_names
    bind_cols(data.table::transpose(data.frame(lapply(time_lst, pull_location_str, FALSE)))) %>%
    rename(lat = V1...1, lng = V2, dataset_name = V1...3)

  return(coordinates_df)

}


coordinates_df <- makeDF.Coordinates(time_lst)
```

Find the lat/lng for each dataset (city and/or state) (can we use lat/lng from other packages like tigris... other geolocators probably exist)

```
# helper function for add_day_night, returns minute of the day
time_to_minute <- function(time){
  # time can be str
  lubridate::hour(hms(time)) * 60 + lubridate::minute(hms(time))
}

# calculate sunset, sunrise, dusk, and dawn times
oursunriseset <- function(latitude, longitude, date, timezone, direction) {

  date.lat.long <- data.frame(date = date, lat = latitude, lon = longitude)

  if(direction == "sunset"){
    # call getSunlightTimes from the lutz package
    getSunlightTimes(data = date.lat.long, keep=direction, tz=timezone)$sunset

  } else if(direction == "sunrise"){
    getSunlightTimes(data = date.lat.long, keep=direction, tz=timezone)$sunri

  } else if (direction == "dusk"){
```

```
    getSunlightTimes(data = date.lat.long, keep=direction, tz=timezone)$dusk

  } else if (direction == "dawn"){
    getSunlightTimes(data = date.lat.long, keep=direction, tz=timezone)$dawn
  }
}

add_day_night <- function(dataset, coord_df){

  dataset_name_str <- dataset$dataset_name[1]

  # filter for lat/long information of dataset
  coord_df <- coord_df %>% filter(dataset_name == dataset_name_str)

  # intialize lat, long, tz information
  lat <- coord_df$lat[1]
  lng <- coord_df$lng[1]
  time_zone <- lutz::tz_lookup_coords(lat, lng, warn = F)

  # use lubridate to clean date type in dataset
  dataset <- dataset %>%
    filter(!is.na(time) & !is.na(date)) %>%
    mutate(date = as.Date(ymd(date, tz = time_zone)),
           stop_minute = time_to_minute(time))

  # df for dawn, sunrise, sunset, and dusk times for distinct dates
  sunriseset_times <- dataset %>%
    filter(!is.na(date)) %>%
    distinct(date) %>%
    mutate(dawn_hms = format(oursunriseset(lat, lng, date,
                                           time_zone, direction = "dawn"),
                             "%H:%M:%S"),
           sunrise_hms = format(oursunriseset(lat, lng, date,
                                              time_zone, direction = "sunrise"),
                                "%H:%M:%S"),
           sunset_hms = format(oursunriseset(lat, lng, date,
                                             time_zone, direction = "sunset"),
                               "%H:%M:%S"),
           dusk_hms = format(oursunriseset(lat, lng, date,
                                           time_zone, direction = "dusk"),
                             "%H:%M:%S"),
           dawn = time_to_minute(dawn_hms),
           sunrise = time_to_minute(sunrise_hms),
           sunset = time_to_minute(sunset_hms),
           dusk = time_to_minute(dusk_hms))

  # filter dataset for stops occurring during window_of_stop
  dataset <- dataset %>%
    left_join(sunriseset_times, by = "date") %>%
    mutate(day_night = case_when(stop_minute >= dawn &
                                   stop_minute < sunrise ~ "twilight morning",
                                 stop_minute >= sunrise &
                                   stop_minute < sunset ~ "day",
```

```
                                    stop_minute >= sunset &
                                      stop_minute < dusk ~ "twilight evening",
                                    stop_minute >= dusk |
                                      stop_minute < dawn ~ "night",
                                    TRUE ~ "missing"))

}

sunriseset_lst <- lapply(time_lst, add_day_night, coordinates_df)
```

Add day/night/twilight variable We can visualize the newly added day and night variables by plotting the stop minute over the date and color code by the labels day, night, and twilight. The following plot is for San Bernadino.

```
ggplot(data = sunriseset_lst[[1]]) +
  geom_point(aes(x = date, y = stop_minute, color = day_night), alpha = .1)
```

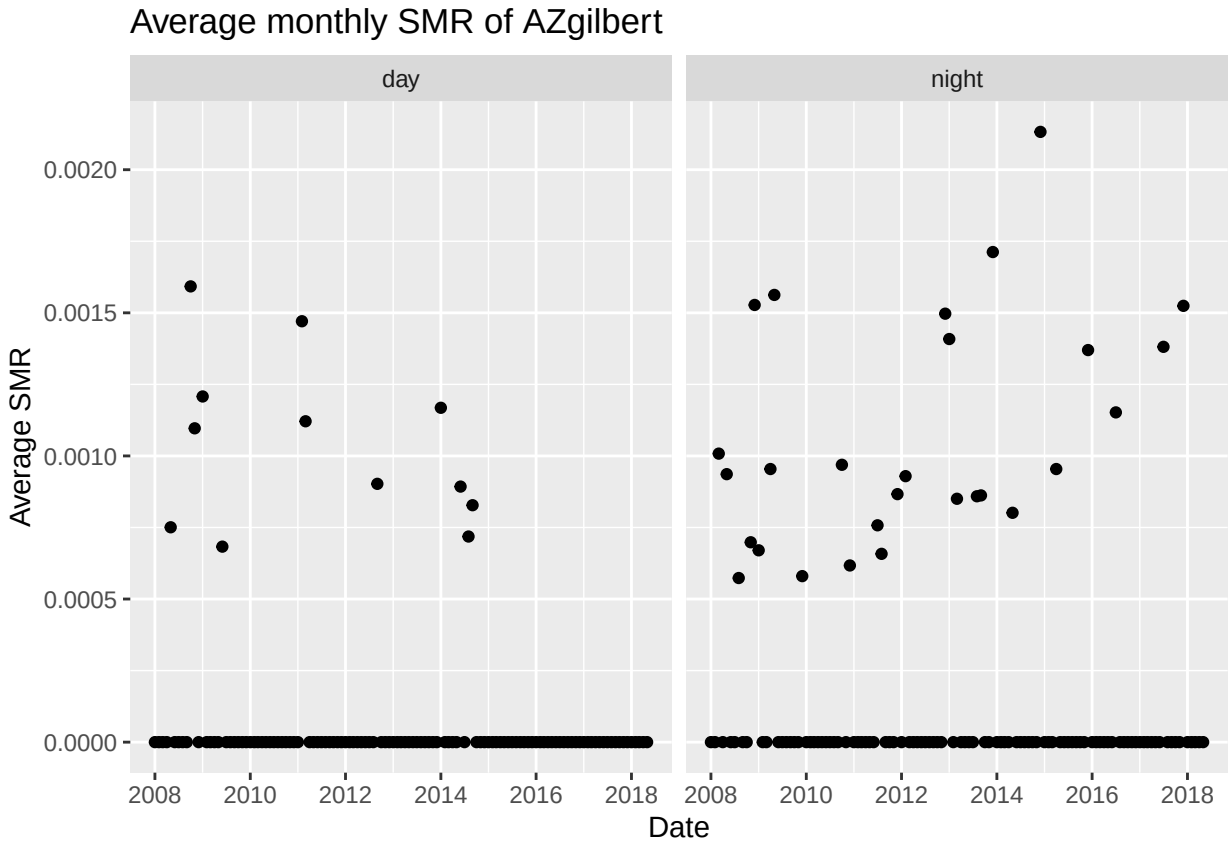
Time analysis

```
summarizeSMRDayNight <- function(dataset){
    # calculate average SMR per month for day and night
    # find_diff_bool indicates if we want to SPREAD the dataset

    dataset <- dataset %>%
      mutate(nice_month = ymd(cut(ymd(date), "month"))) %>%
      group_by(dataset_name, nice_month, day_night) %>%
      # filter out stops occurring during twilight
      filter(str_detect(day_night, "twilight", negate = TRUE)) %>%
      summarize(avg_SMR = mean(stop_missing_rate), .groups = "drop")

    return(dataset)

  }

makeDF.SMRTime <- function(sunriseset_list, find_diff_bool){

  # filter away the helper columns like stop_minute and dusk_hms
  sunriseset_list <- lapply(sunriseset_list, myfilter_for, c(freq_var, "day_night"), FALSE)

  # count NA
  sunriseset_list <- lapply(sunriseset_list, countMissing, 1, TRUE,
                            c("time", "day_night", "date"))

  # summarize SMR per month by day and night
  sunriseset_list <- lapply(sunriseset_list, summarizeSMRDayNight)

  sunriseset_df <- bind_rows(sunriseset_list)

  if (find_diff_bool){

    sunriseset_df <- sunriseset_df %>%
      spread(key = day_night, value = avg_SMR) %>%
      mutate(diff_SMR = day - night)
```

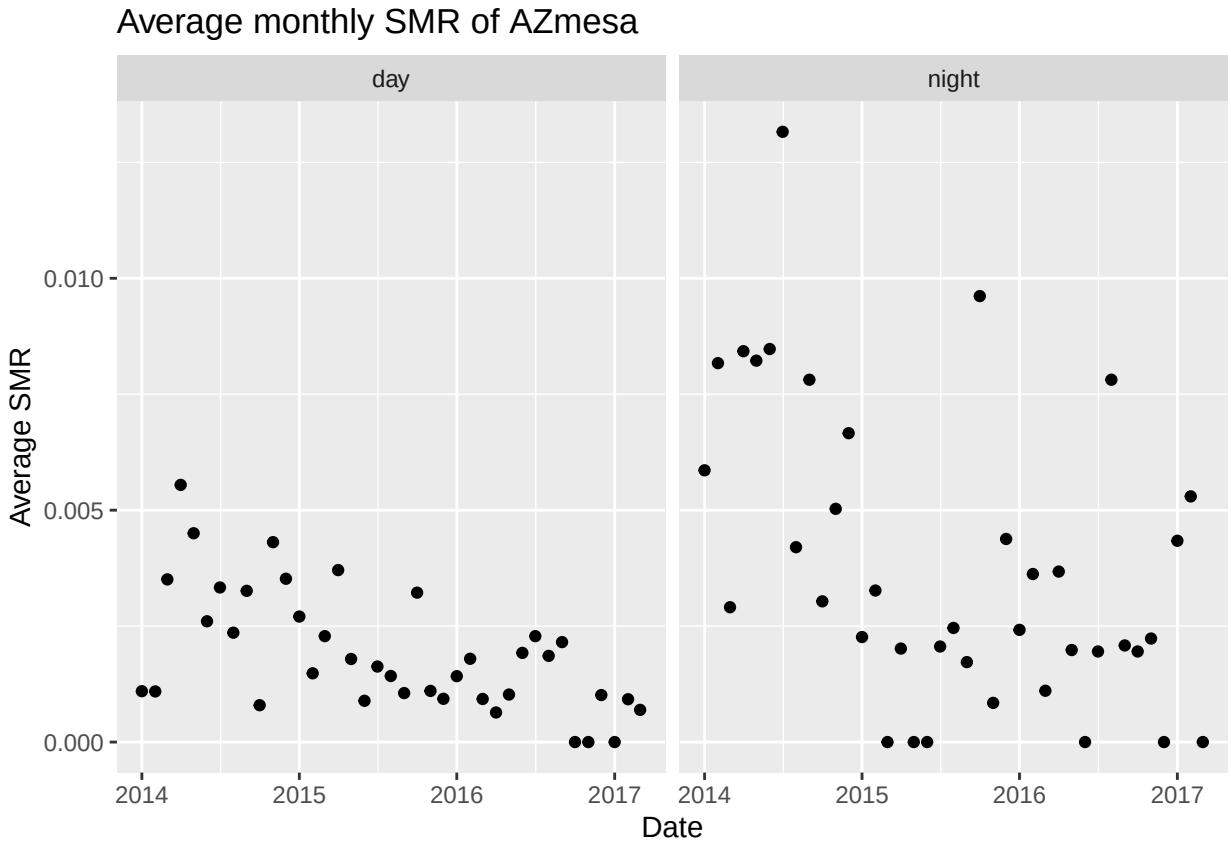
```
  }

  return(sunriseset_df)

}

sunriseset_df <- makeDF.SMRTime(sunriseset_lst, FALSE)
sunrisesetdiff_df <- makeDF.SMRTime(sunriseset_lst, TRUE)

ggplot_sunriseset <- function(sunriseset_dataset, variable_str){

  plot_avg <- function(name){

    p <- sunriseset_dataset %>%
      filter(dataset_name == name) %>%
      ggplot(aes(x = nice_month, y = avg_SMR)) +
      geom_point() +
      facet_wrap(~ day_night) +
      ggtitle(paste("Average monthly SMR of", name)) +
      labs(x = "Date", y = "Average SMR")

    ggsave(paste(name, "SMR by day and night.png"), p)

    return(p)

  }

  plot_diff <- function(name){

    p <- sunriseset_dataset %>%
      filter(dataset_name == name) %>%
      ggplot(aes(x = nice_month, y = diff_SMR)) +
      geom_point() +
      ggtitle(paste("Difference in SMR of", name,
                    "Between Day and Night per month")) +
      labs(x = "Date", y = "Difference in SMR")

    ggsave(paste(name, "SMR day and night.png"), p)

    return(p)

  }

  dataset_name <- sunriseset_dataset %>% distinct(dataset_name) %>% pull(dataset_name)

  if (variable_str == "avg_SMR"){
    plots <- lapply(dataset_name, plot_avg)

  } else if (variable_str == "diff_SMR") {
    plots <- lapply(dataset_name, plot_diff)

  } else {stop("typo in variable_str!")}
```

```
  return(plots)

}

ggplot_sunriseset(sunriseset_df, "avg_SMR")
```

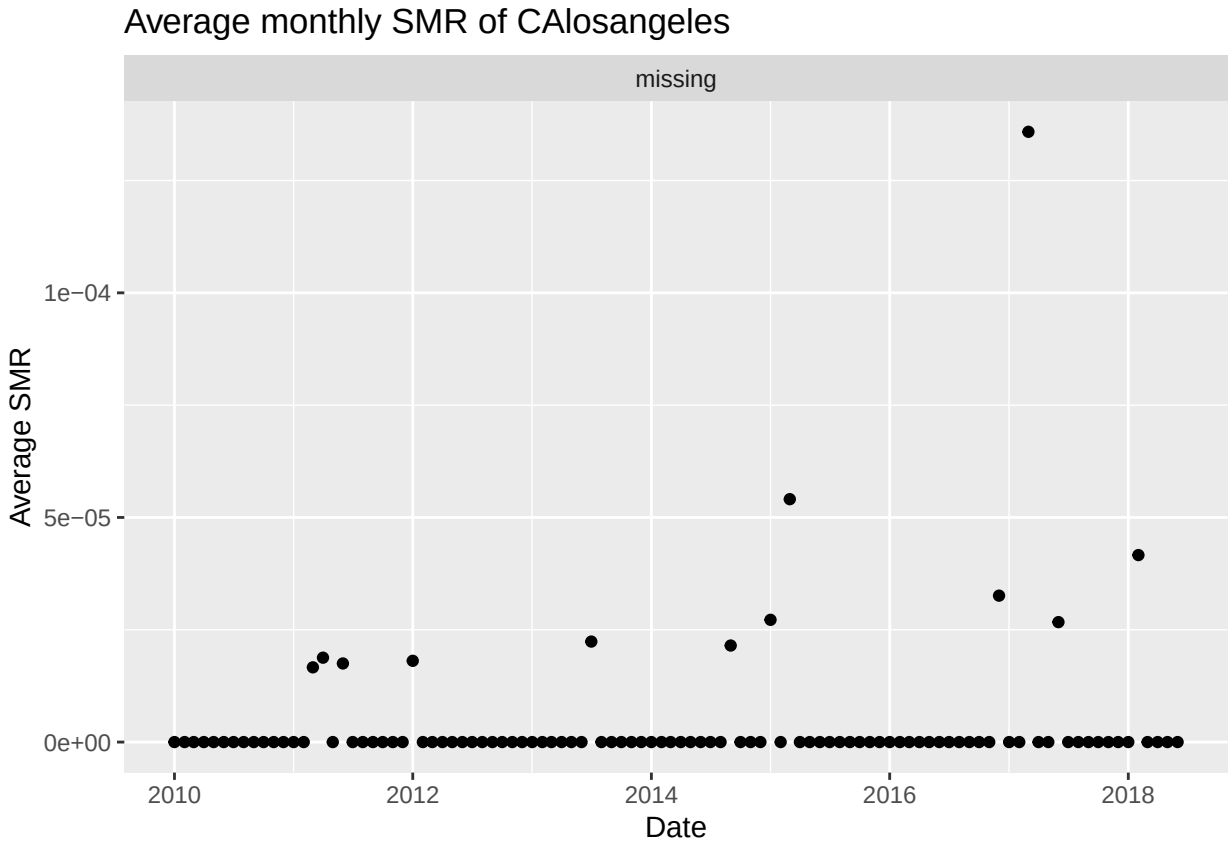
```
## [[1]]
```



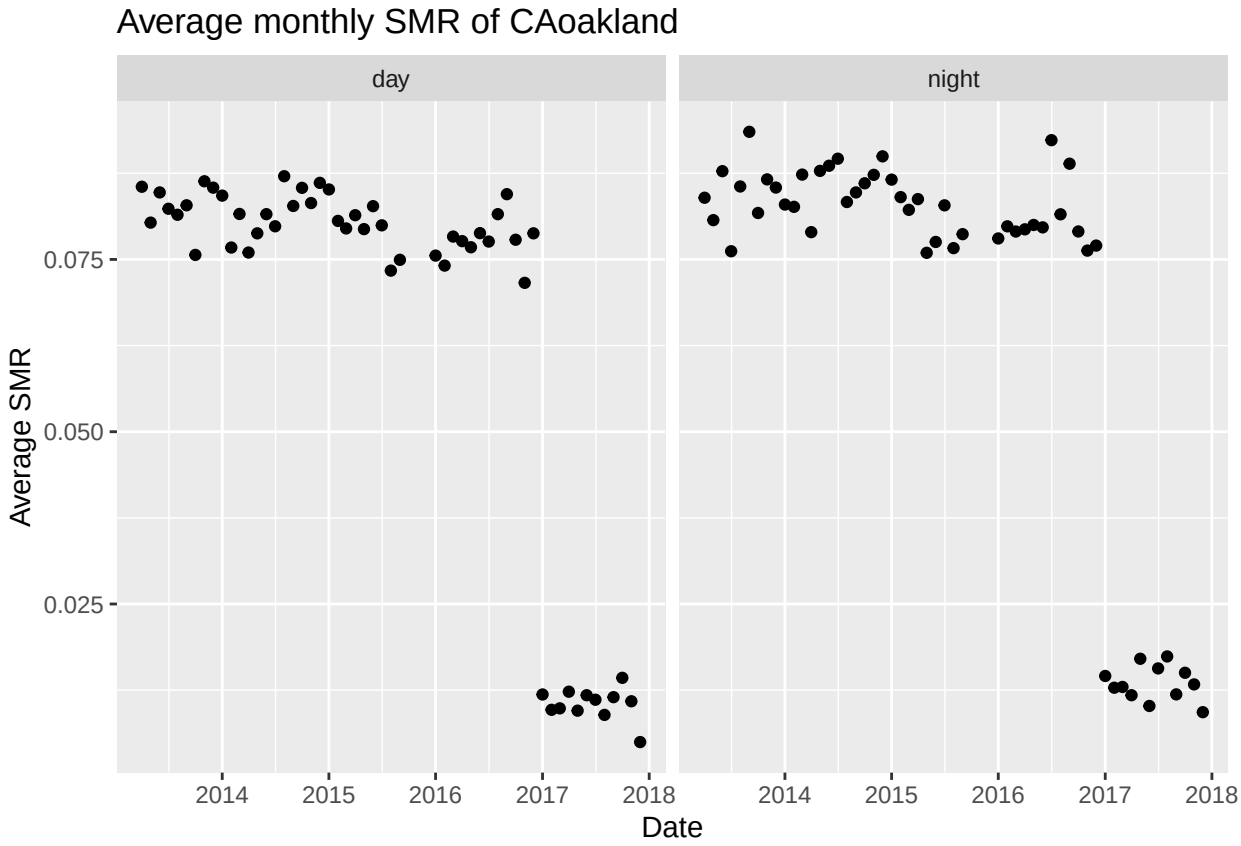

```
##
## [[2]]
```


Average monthly SMR of AZmesa
day
night
0.010
0.005
0.000
Average SMR
2014
2015
2016
2017
Date

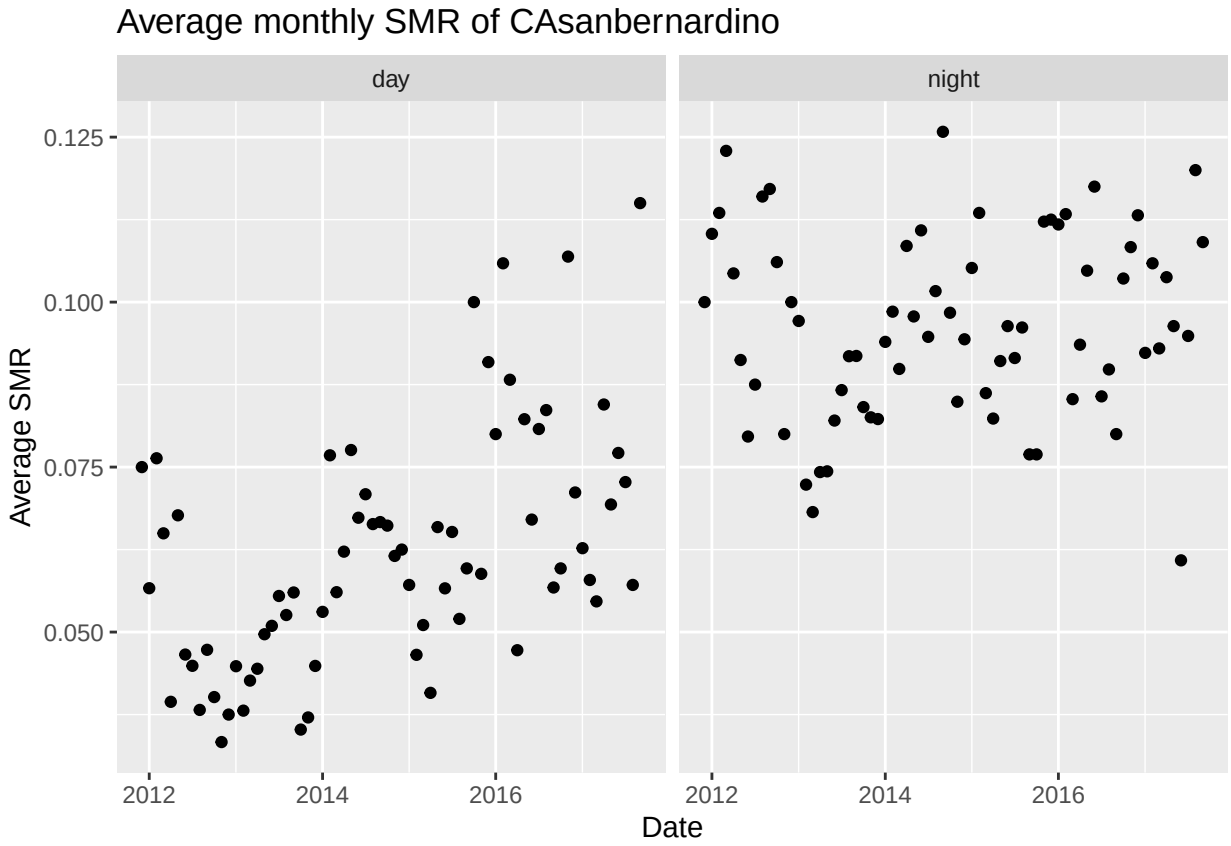
```
##
## [[3]]
```


Average monthly SMR of CAlosangeles
missing
1e−04
5e−05
0e+00
Average SMR
2010
2012
2014
2016
2018
Date

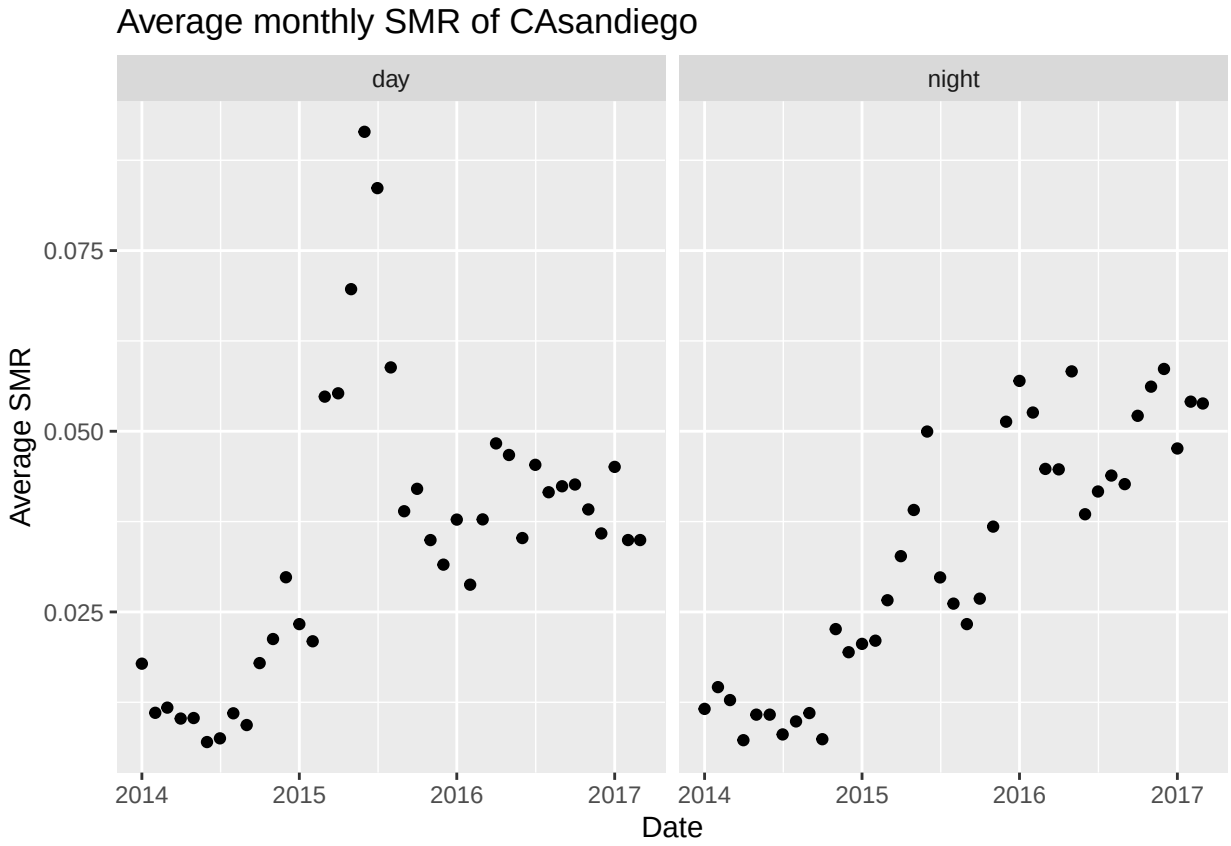
```
##
## [[4]]
```


Average monthly SMR of CAoakland
day
night
0.075
0.050
0.025
Average SMR
2014
2015
2016
2017
2018
Date

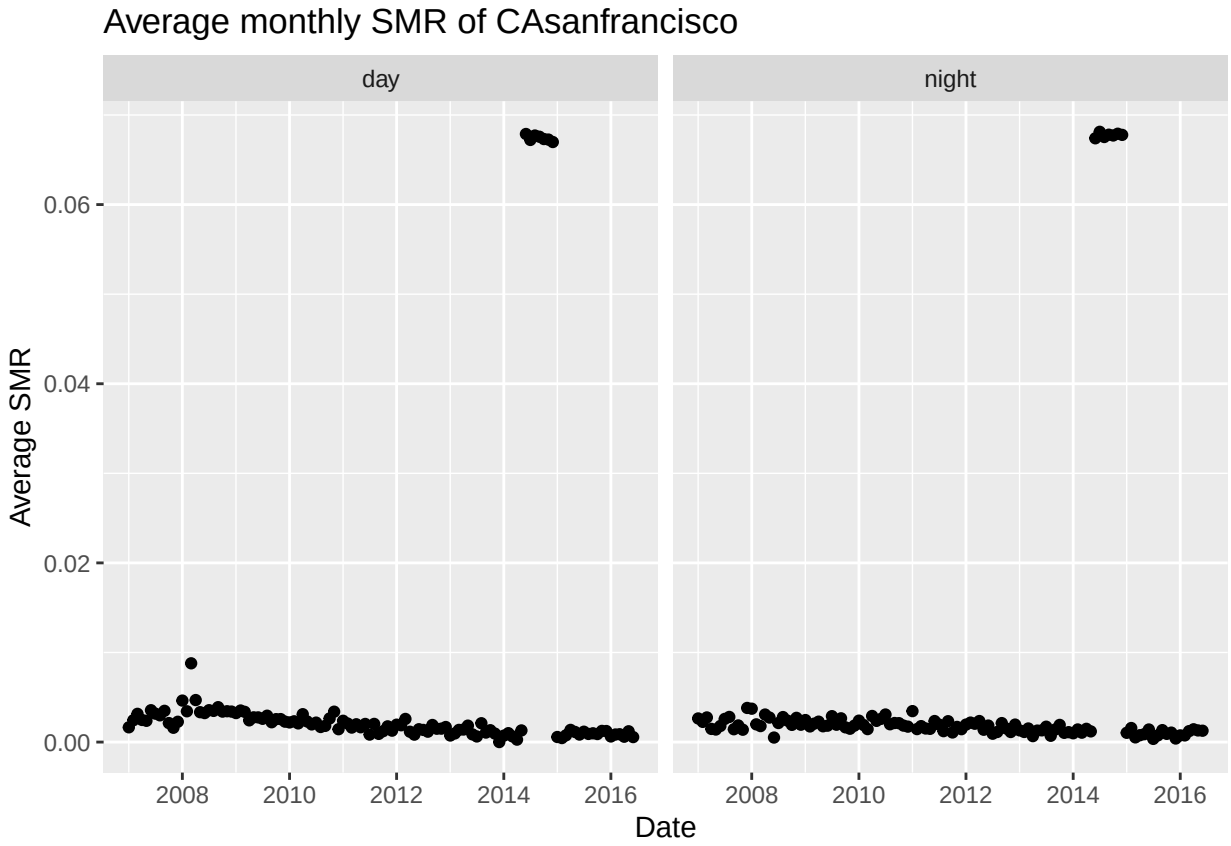
```
##
## [[5]]
```


Average monthly SMR of CAsanbernardino
day
night
0.125
0.100
0.075
0.050
Average SMR
2012
2014
2016
Date

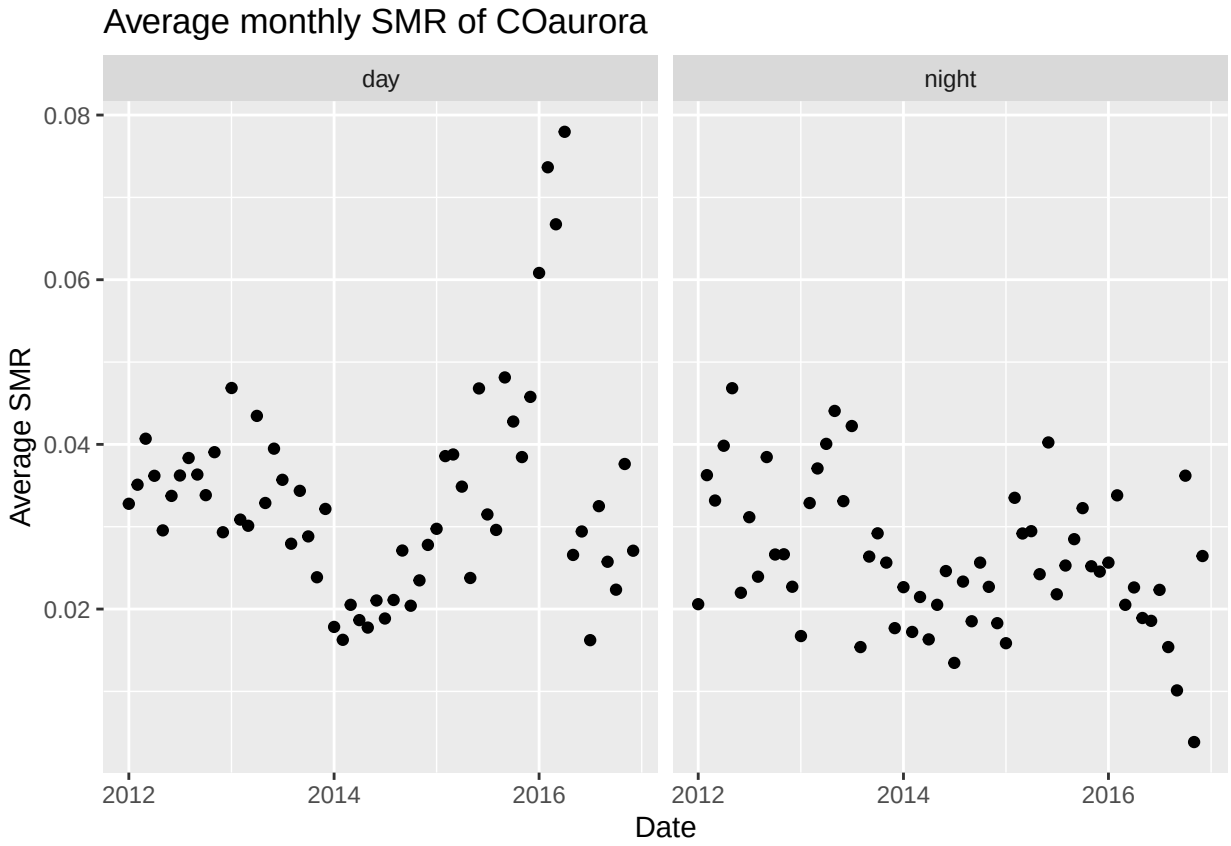
```
##
## [[6]]
```


Average monthly SMR of CAsandiego
day
night
0.075
0.050
0.025
Average SMR
2014
2015
2016
2017
Date

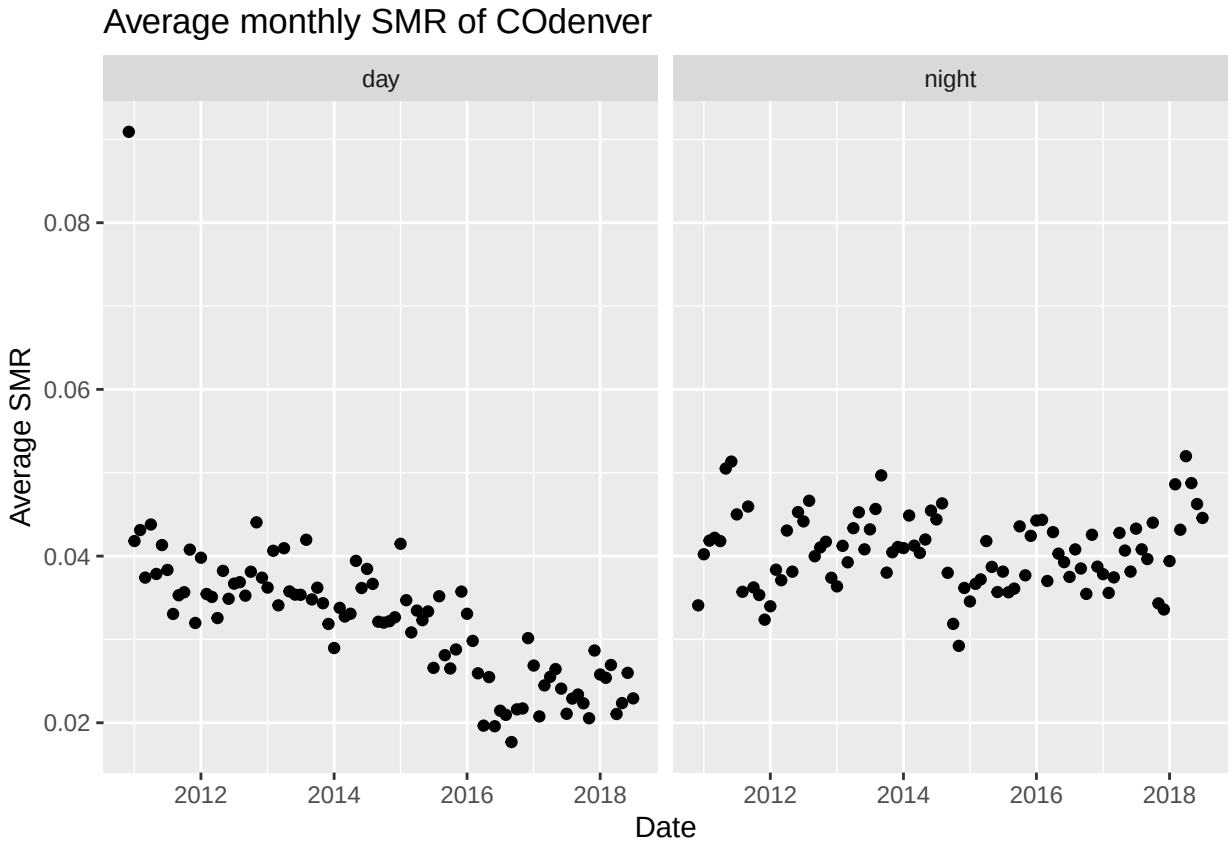
```
##
## [[7]]
```


Average monthly SMR of CAsanfrancisco
day
night
Average SMR
0.06
0.04
0.02
0.00
2008
2010
2012
2014
2016
Date

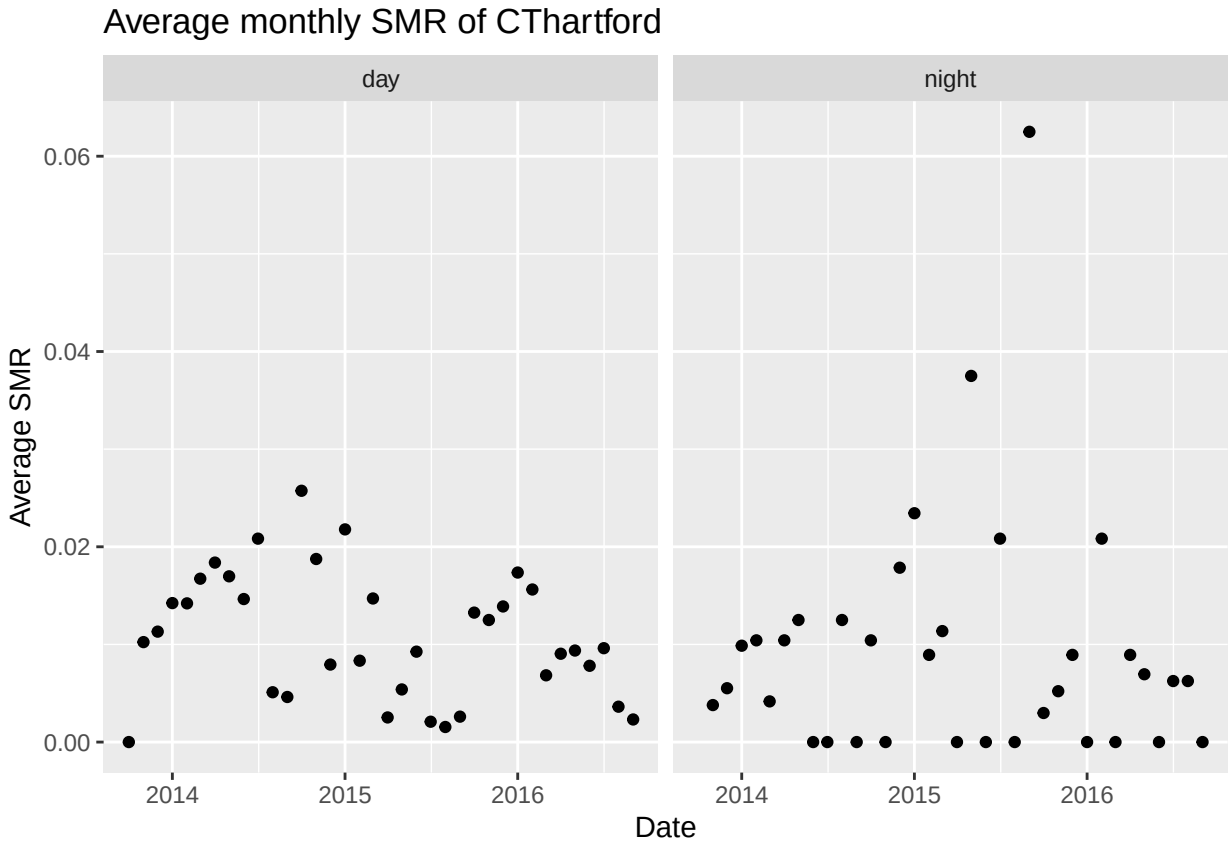
```
##
## [[8]]
```


Average monthly SMR of COaurora
day
night
0.08
0.06
0.04
0.02
Average SMR
2012
2014
2016
Date

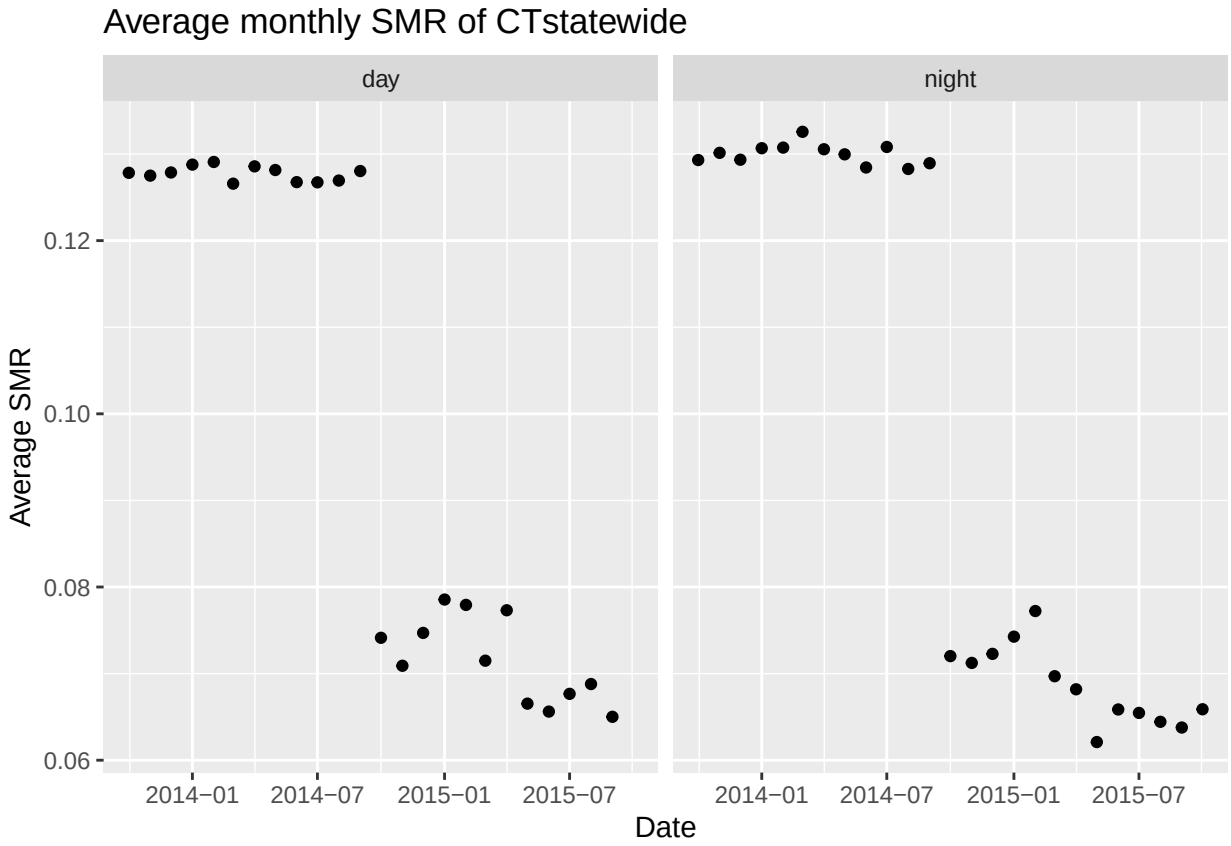
```
##
## [[9]]
```


Average monthly SMR of COdenver
day
night
0.08
0.06
0.04
0.02
Average SMR
2012
2014
2016
2018
Date

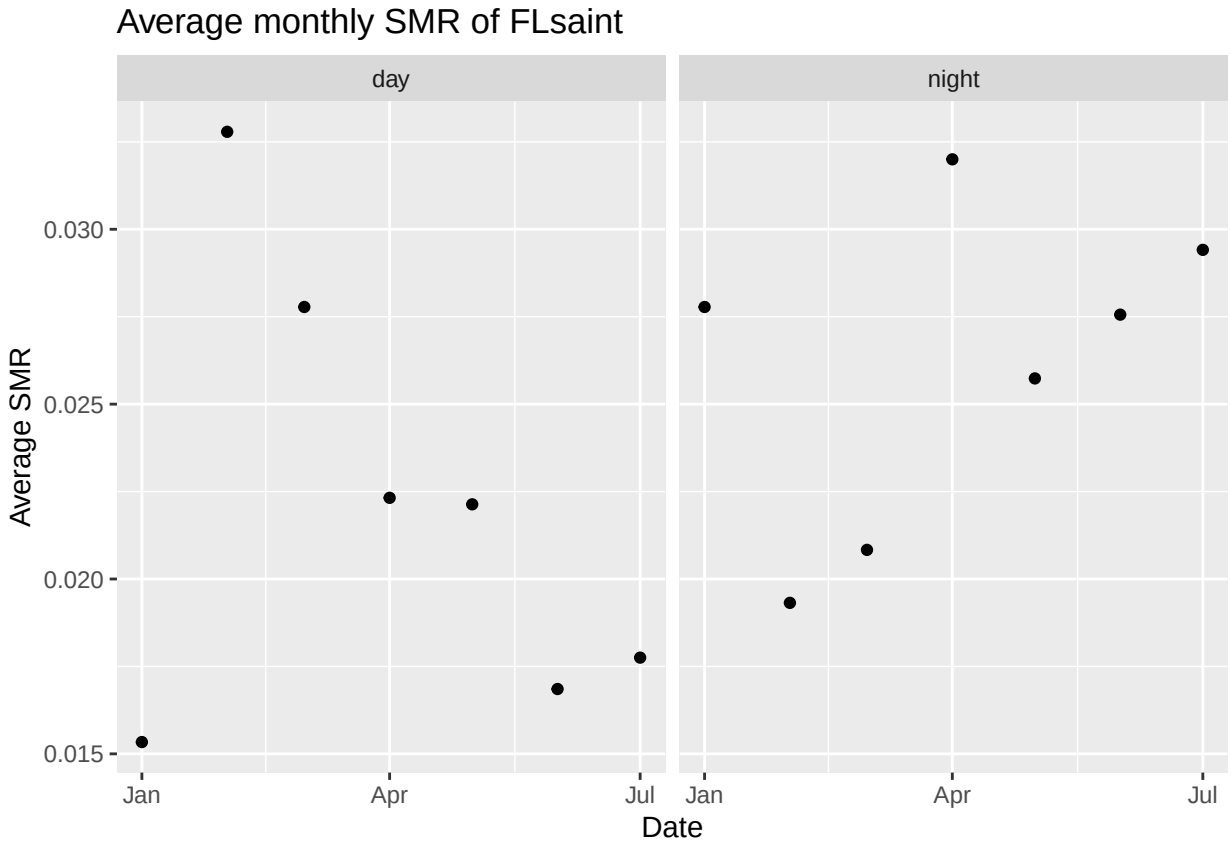
```
##
## [[10]]
```


Average monthly SMR of CThartford
day
night
0.06
0.04
0.02
0.00
Average SMR
2014
2015
2016
Date

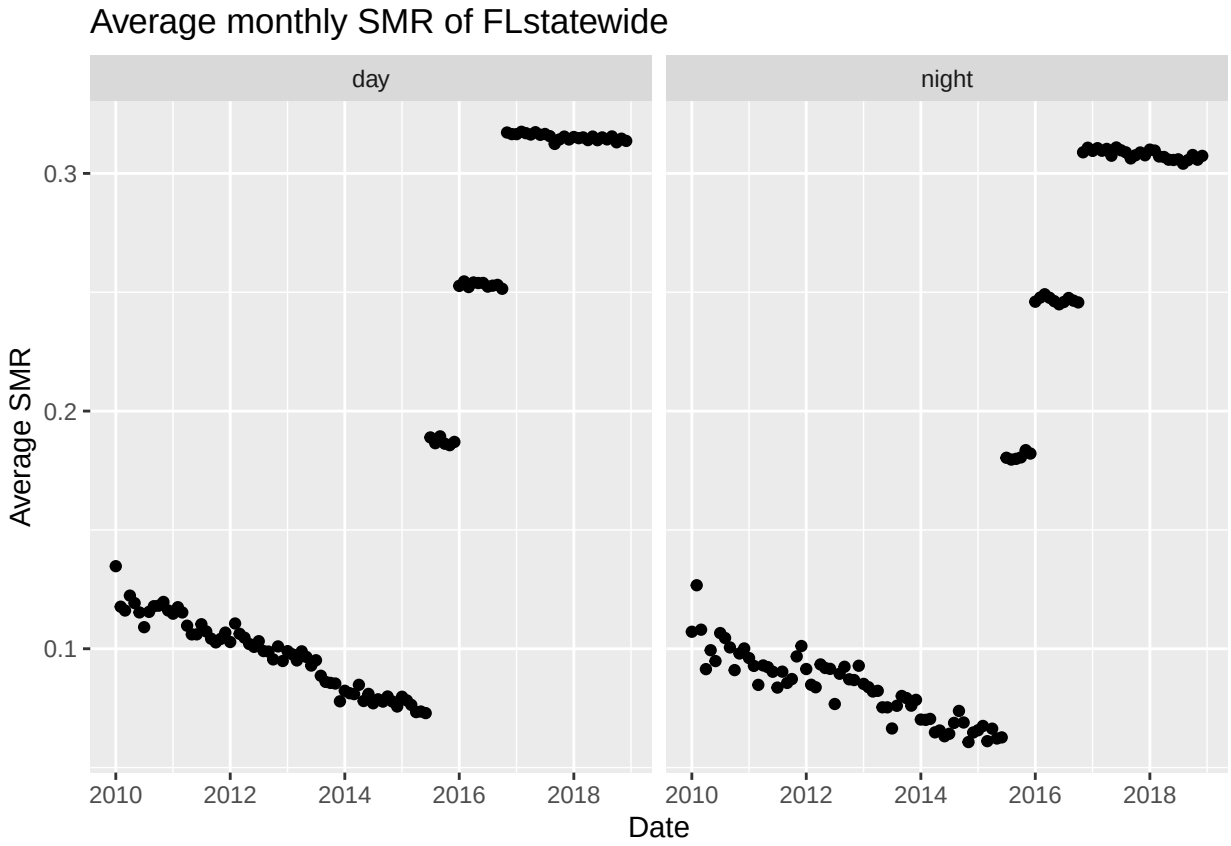
```
##
## [[11]]
```


Average monthly SMR of CTstatewide
day
night
0.12
0.10
0.08
0.06
Average SMR
2014−01
2014−07
2015−01
2015−07
Date

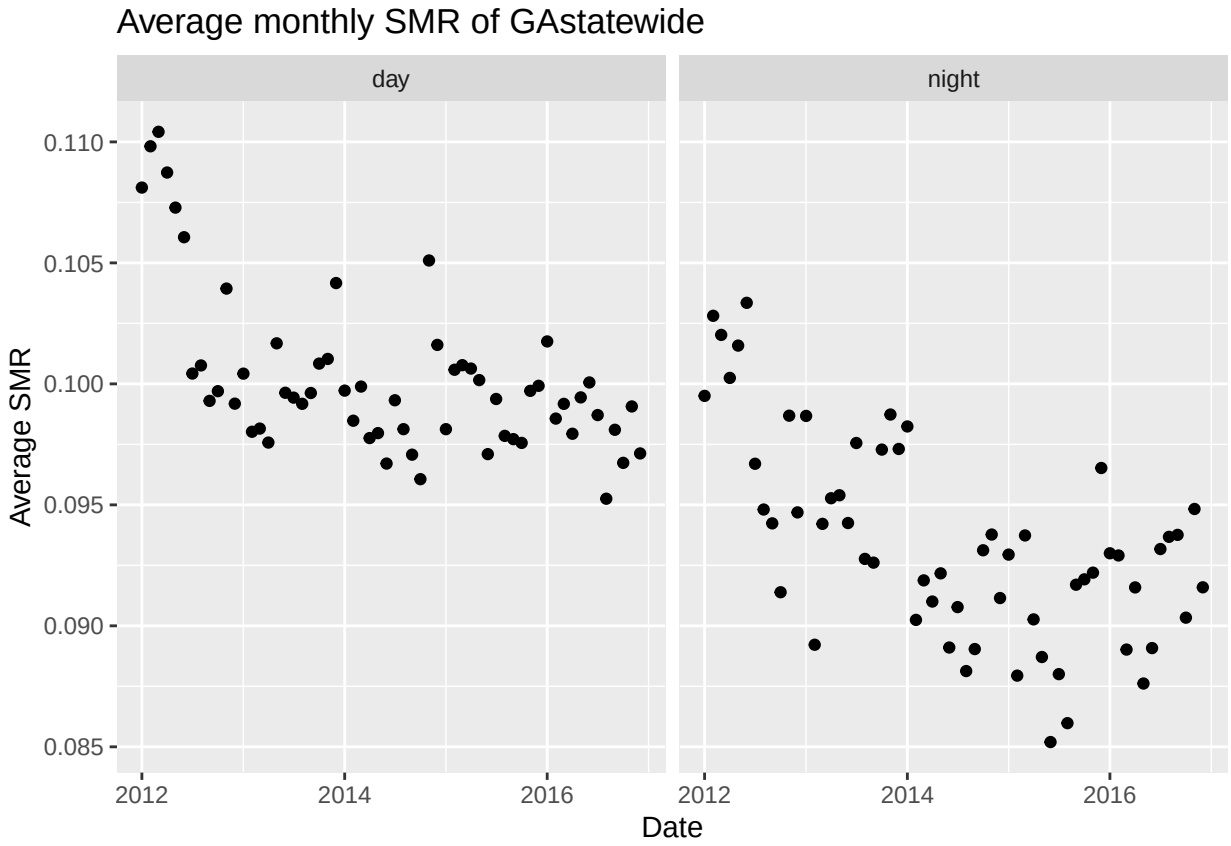
```
##
## [[12]]
```


Average monthly SMR of FLsaint
day
night
0.030
0.025
0.020
0.015
Average SMR
Jan
Apr
Jul
Jan
Apr
Jul
Date

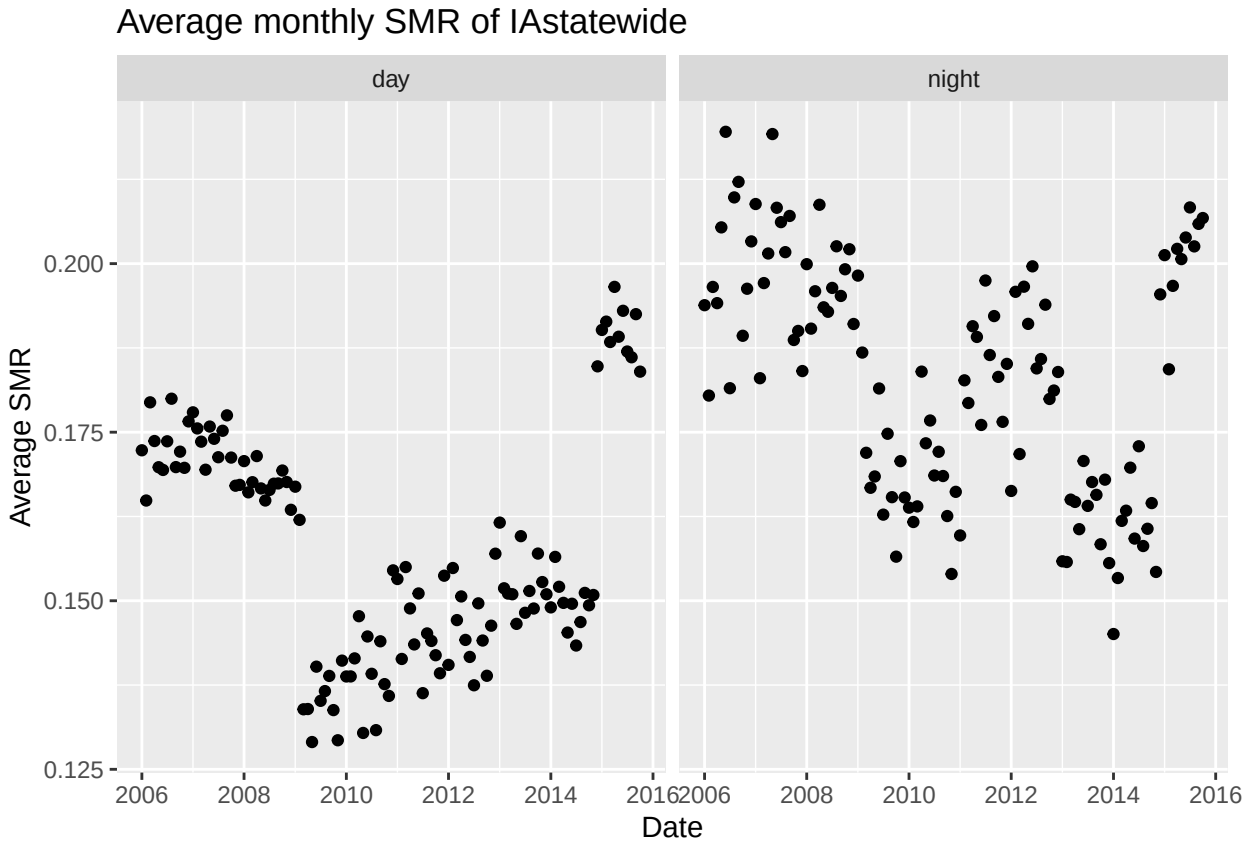
```
##
## [[13]]
```


Average monthly SMR of FLstatewide
day
night
Average SMR
0.3
0.2
0.1
2010
2012
2014
2016
2018
Date

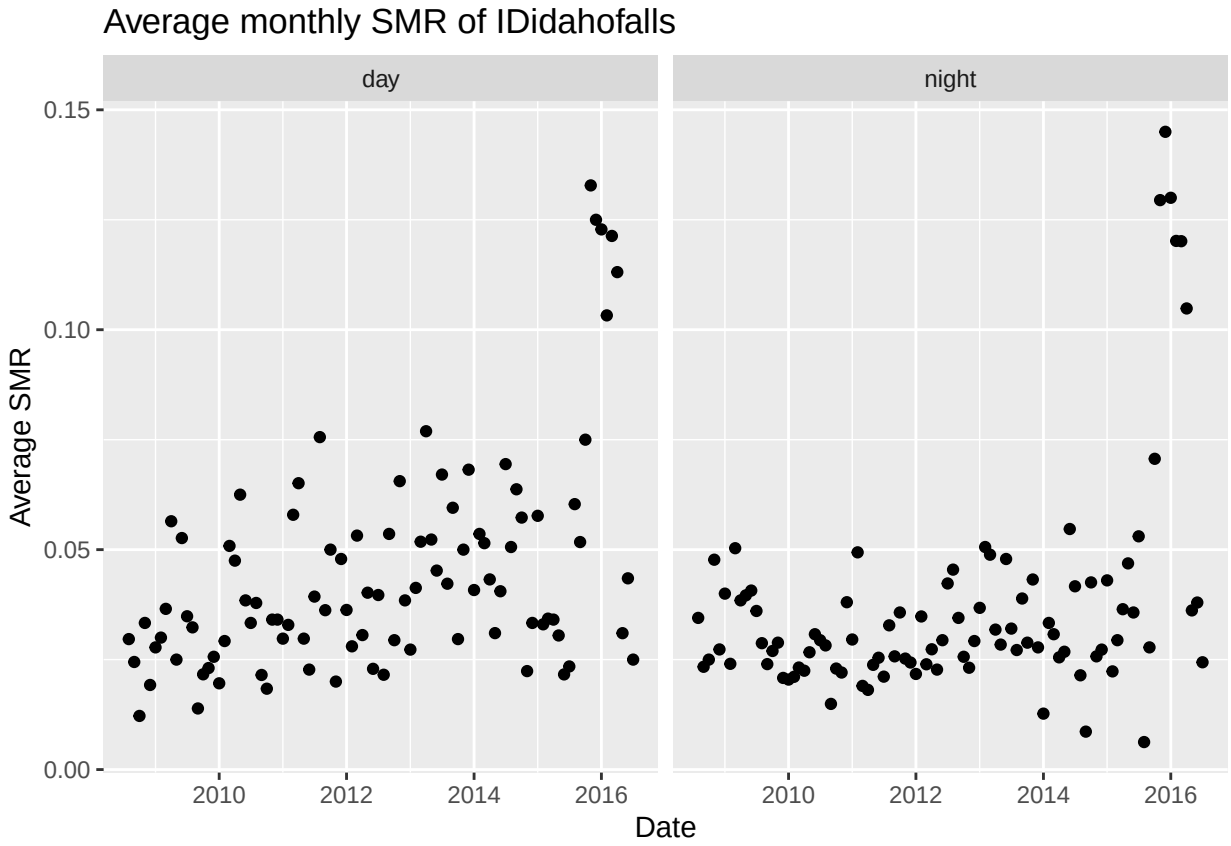
```
##
## [[14]]
```


Average monthly SMR of GAstatewide
day
night
Average SMR
0.110
0.105
0.100
0.095
0.090
0.085
2012
2014
2016
Date

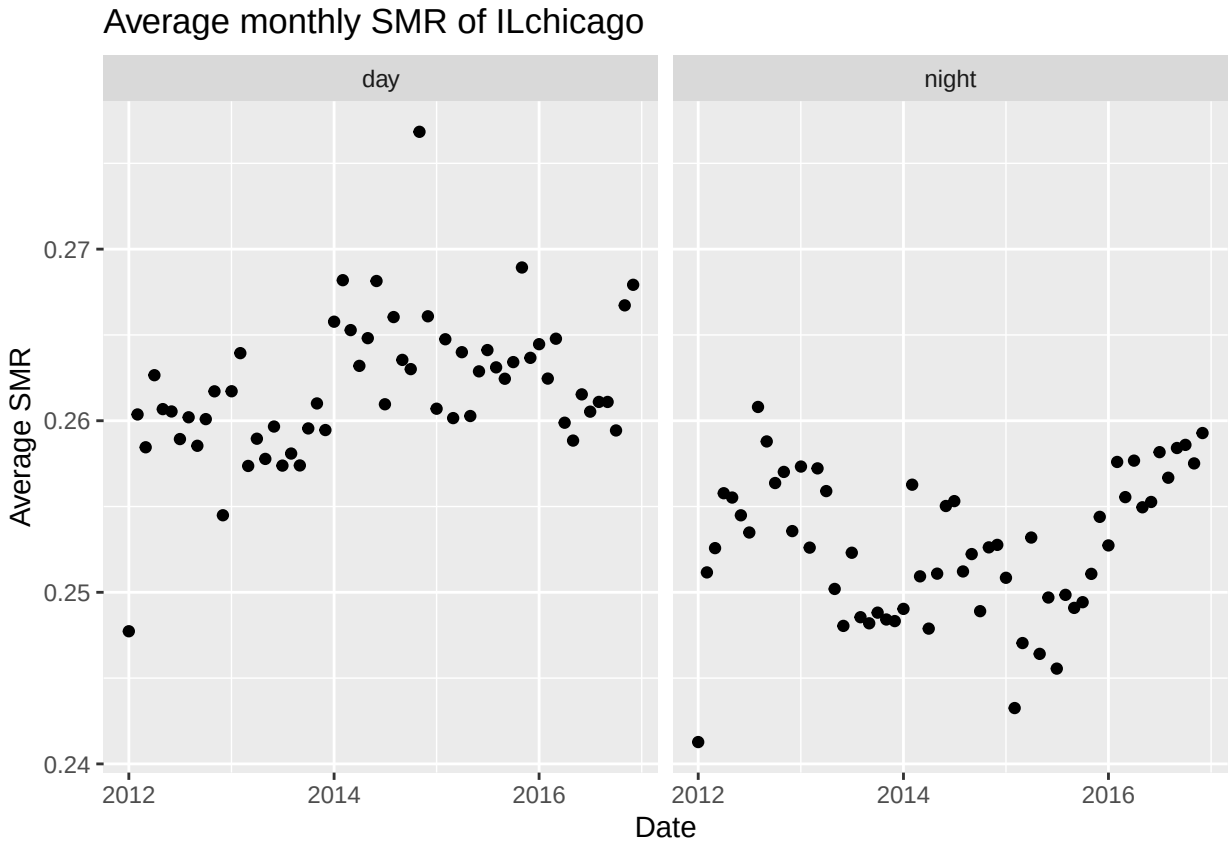
```
##
## [[15]]
```


Average monthly SMR of IAstatewide
day
night
Average SMR
0.200
0.175
0.150
0.125
2006
2008
2010
2012
2014
2016
Date

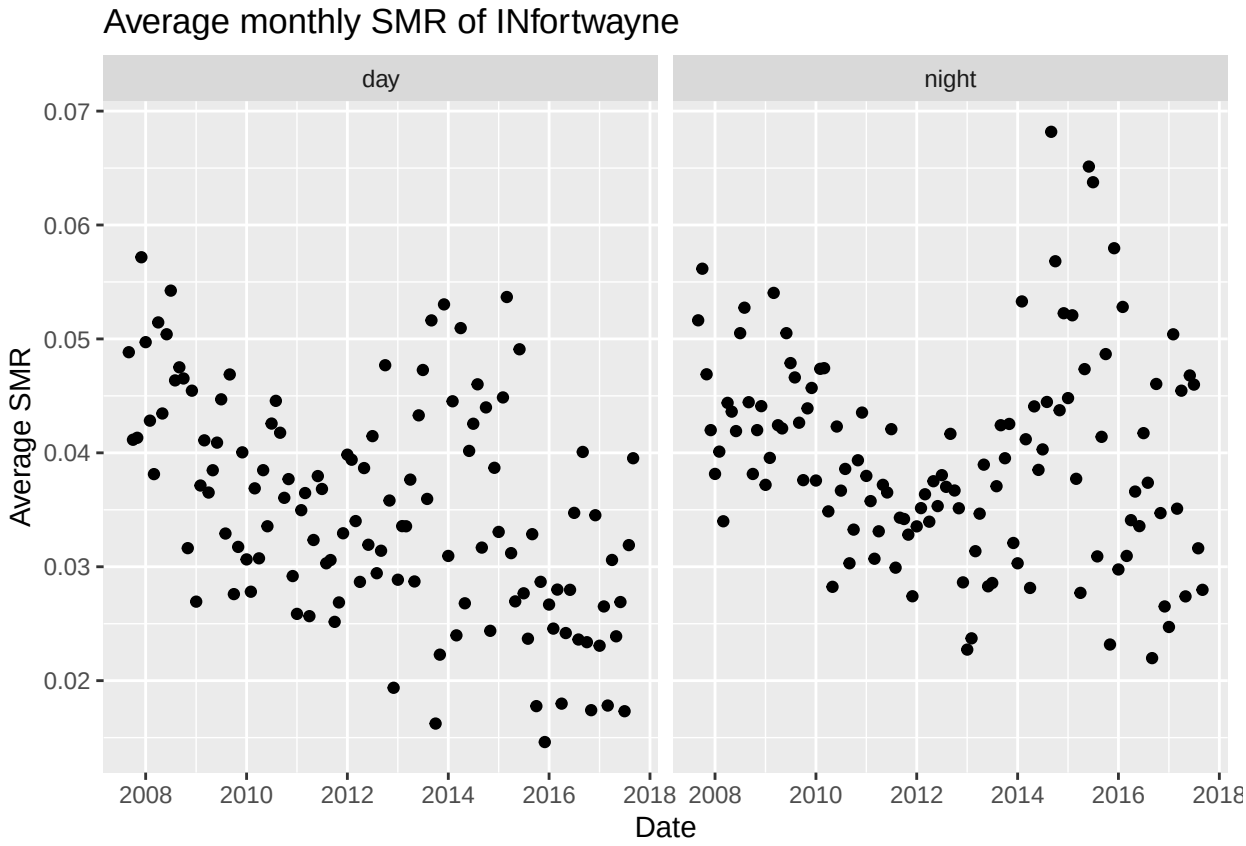
```
##
## [[16]]
```


Average monthly SMR of IDidahofalls
day
night
0.15
0.10
0.05
0.00
Average SMR
2010
2012
2014
2016
Date

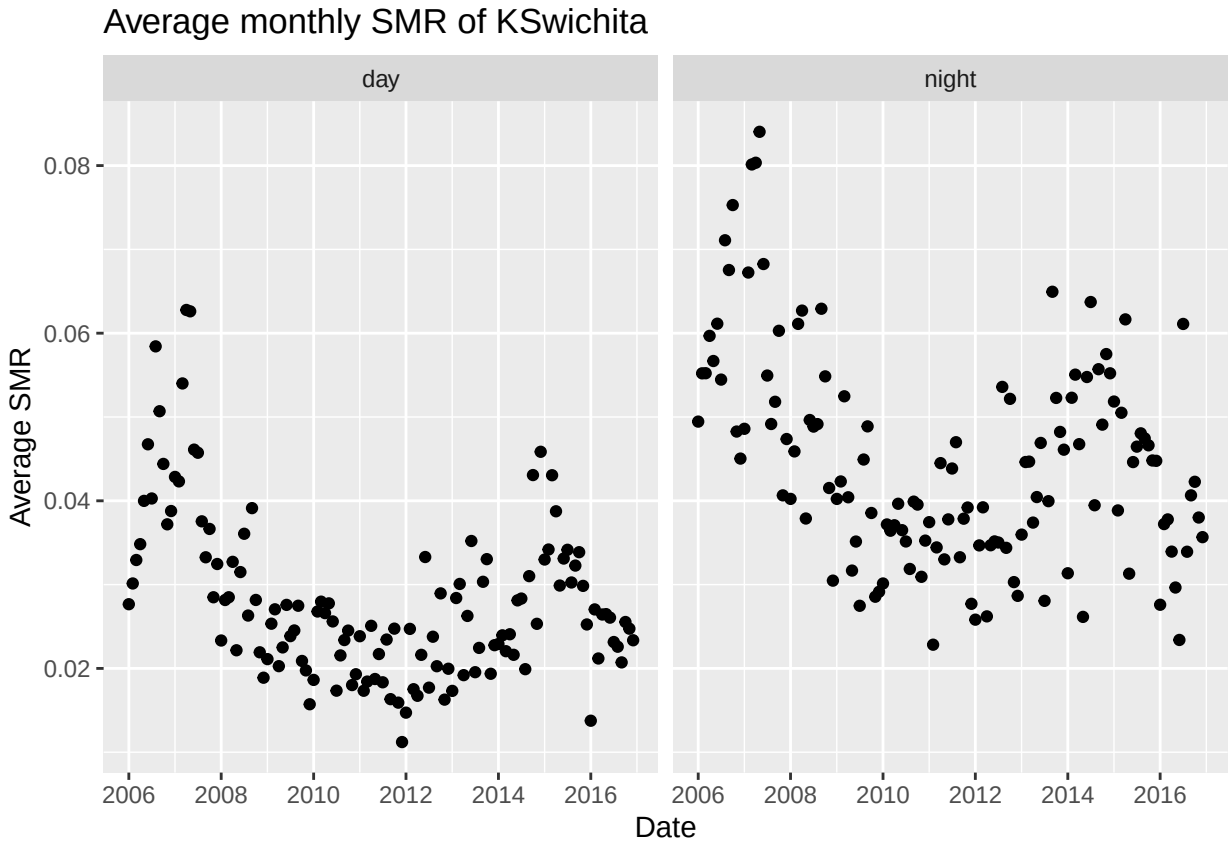
```
##
## [[17]]
```


Average monthly SMR of ILchicago
day
night
Average SMR
0.27
0.26
0.25
0.24
2012
2014
2016
Date

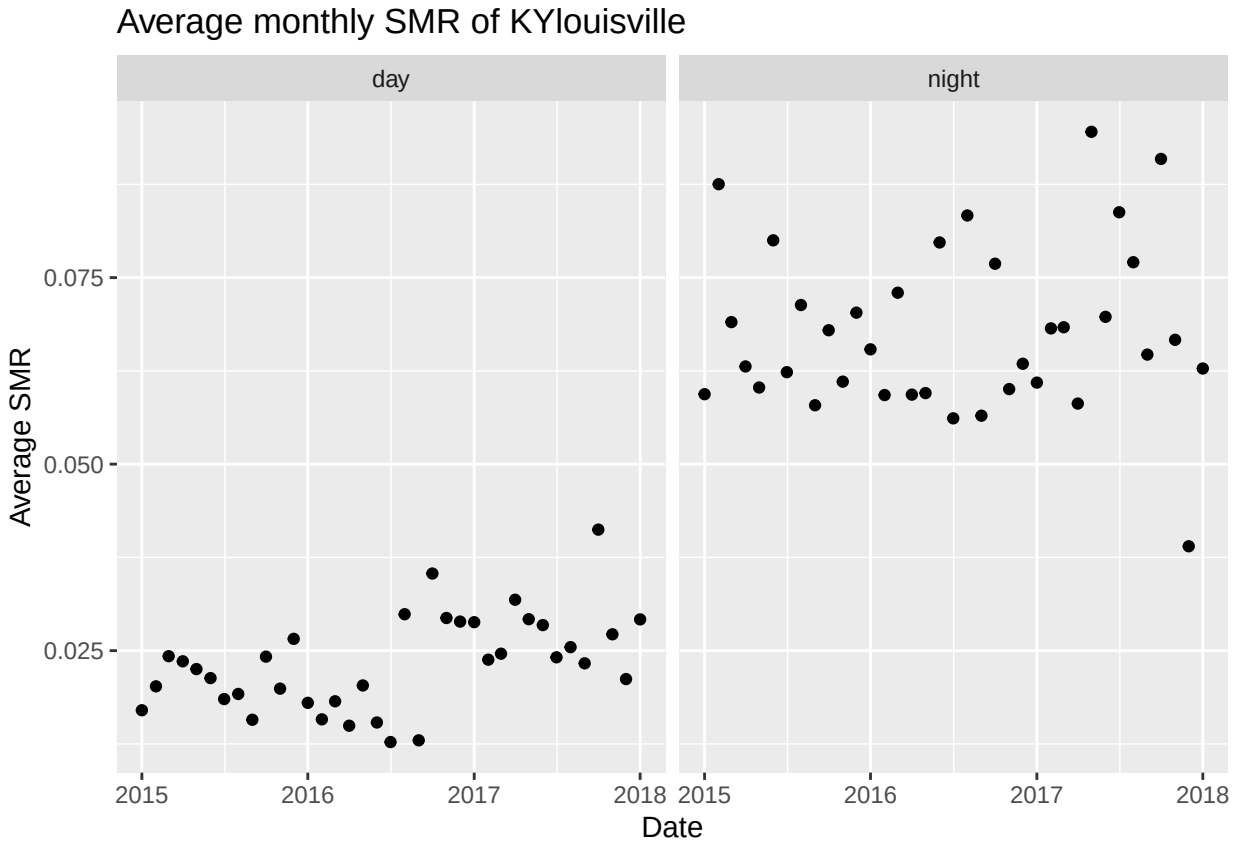
```
##
## [[18]]
```


Average monthly SMR of INfortwayne
day
night
Average SMR
0.07
0.06
0.05
0.04
0.03
0.02
2008
2010
2012
2014
2016
2018
Date

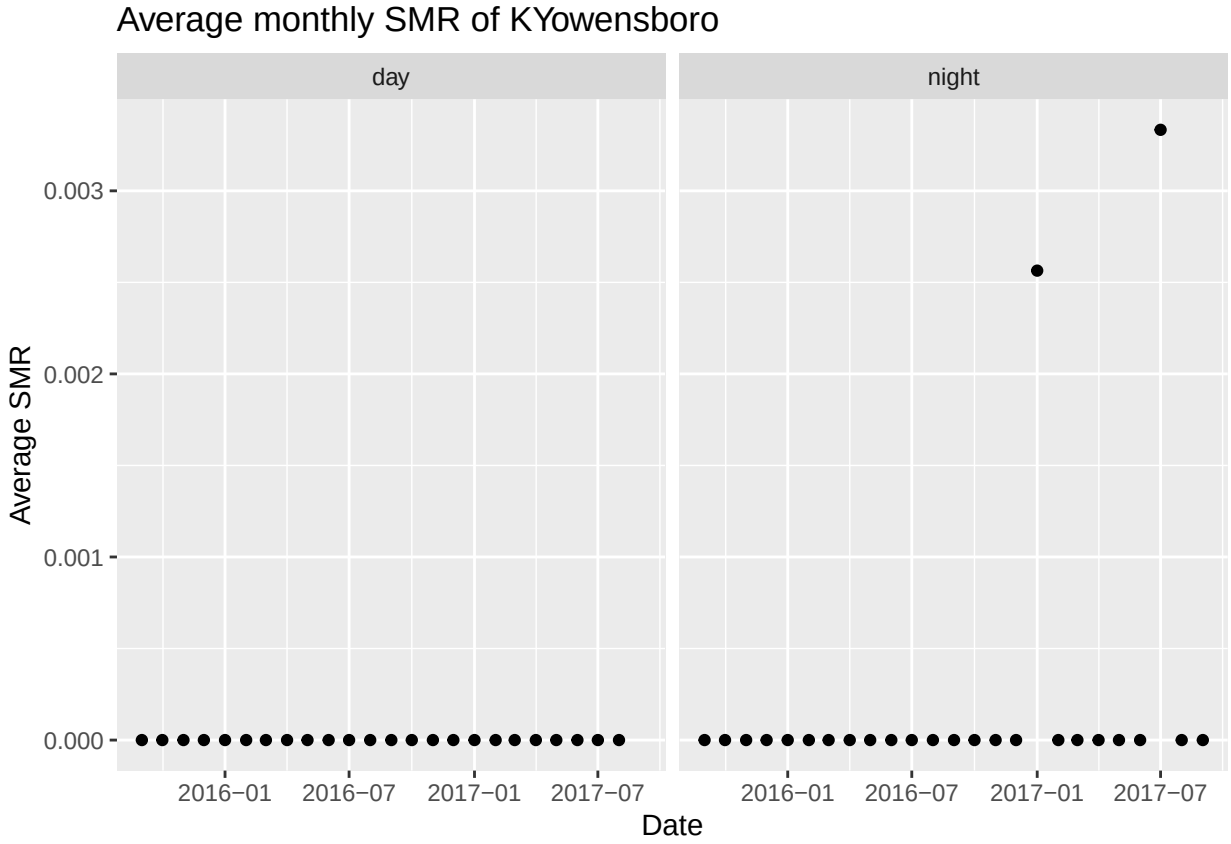
```
##
## [[19]]
```


Average monthly SMR of KSwichita
day
night
0.08
0.06
0.04
0.02
Average SMR
2006
2008
2010
2012
2014
2016
Date

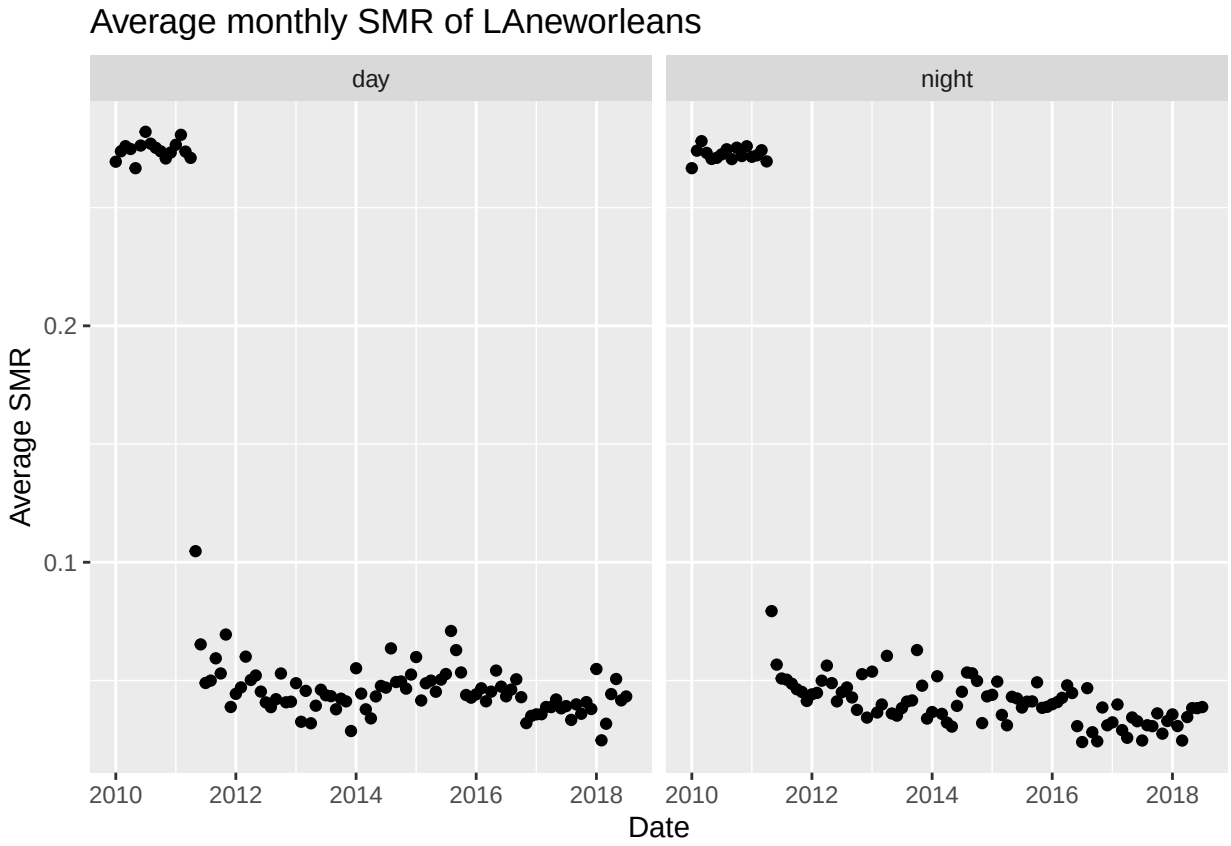
```
##
## [[20]]
```


Average monthly SMR of KYlouisville
day
night
0.075
0.050
0.025
Average SMR
2015
2016
2017
2018
Date

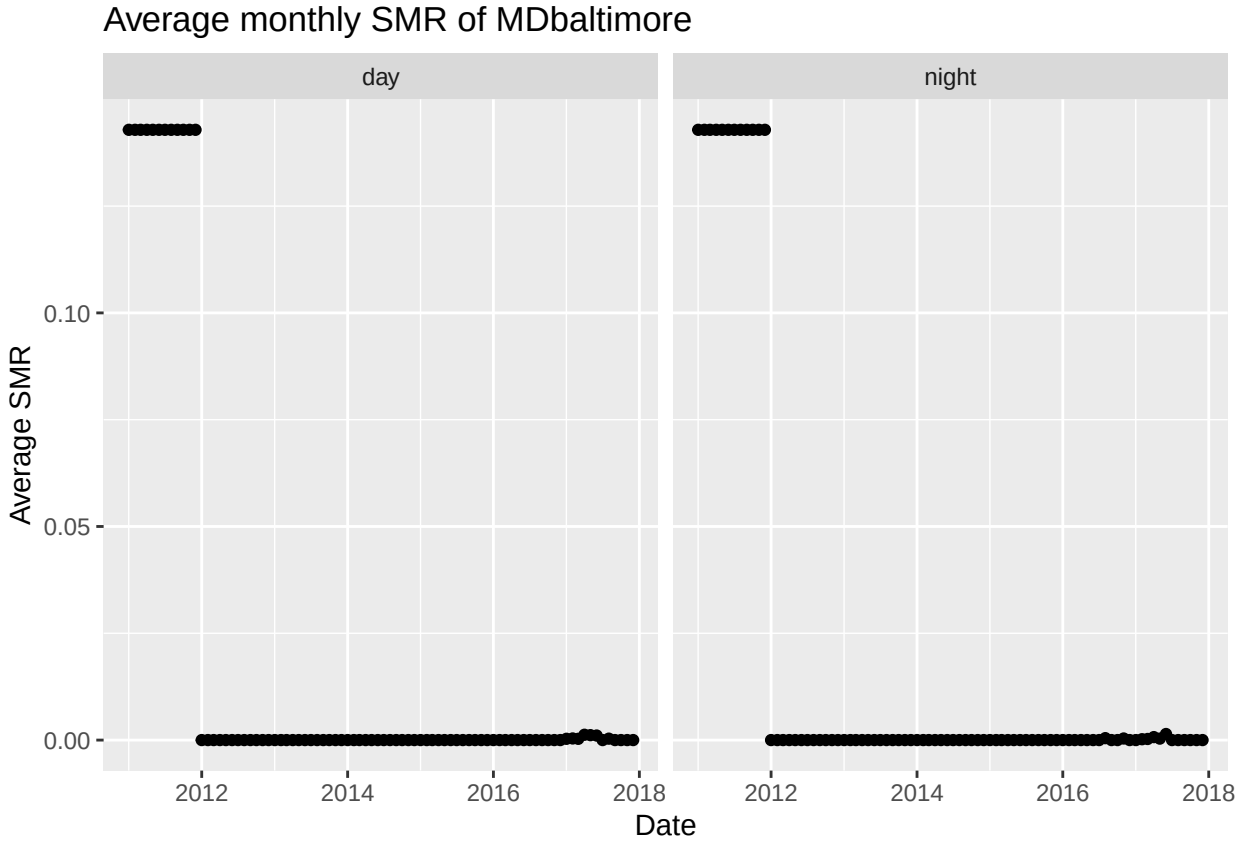
```
##
## [[21]]
```


Average monthly SMR of KYowensboro
day
night
0.003
0.002
0.001
0.000
Average SMR
2016−01
2016−07
2017−01
2017−07
Date

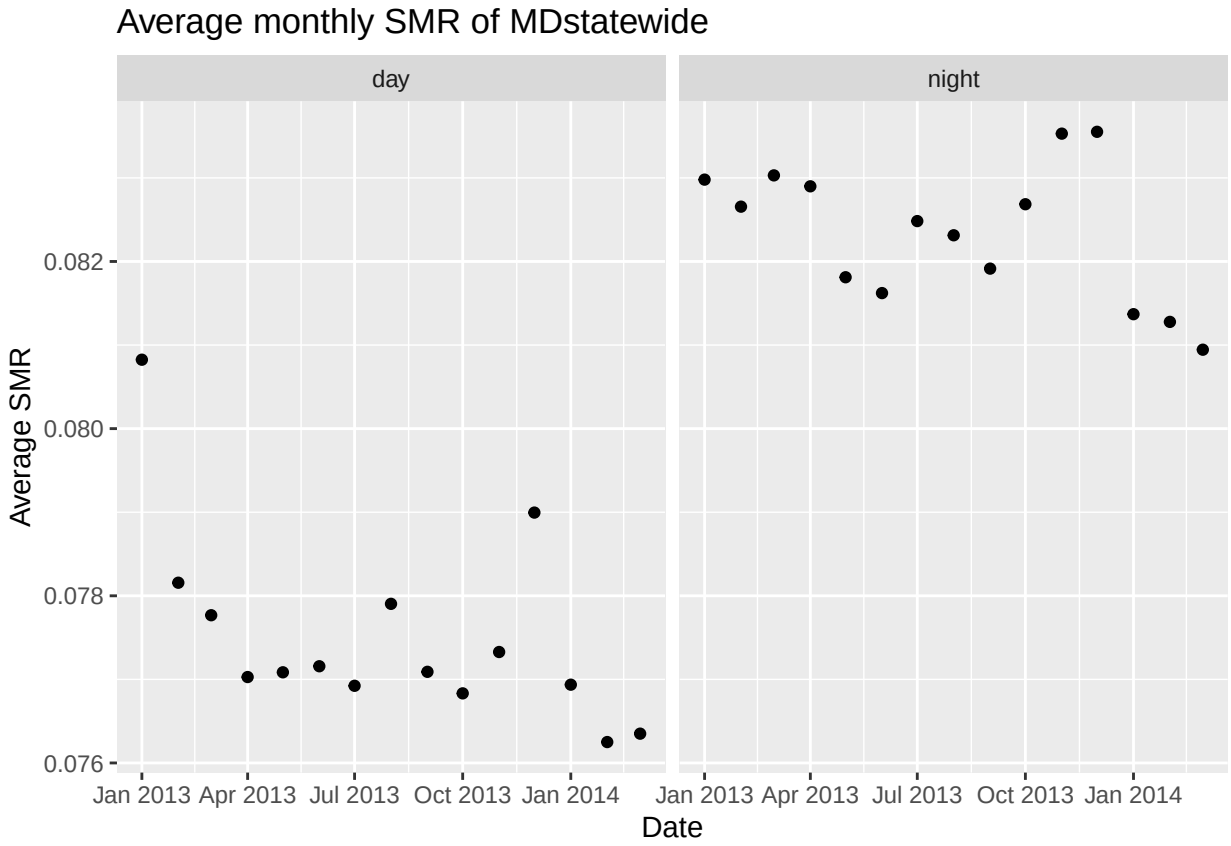
```
##
## [[22]]
```


Average monthly SMR of LAneworleans
day
night
0.2
0.1
Average SMR
2010
2012
2014
2016
2018
Date

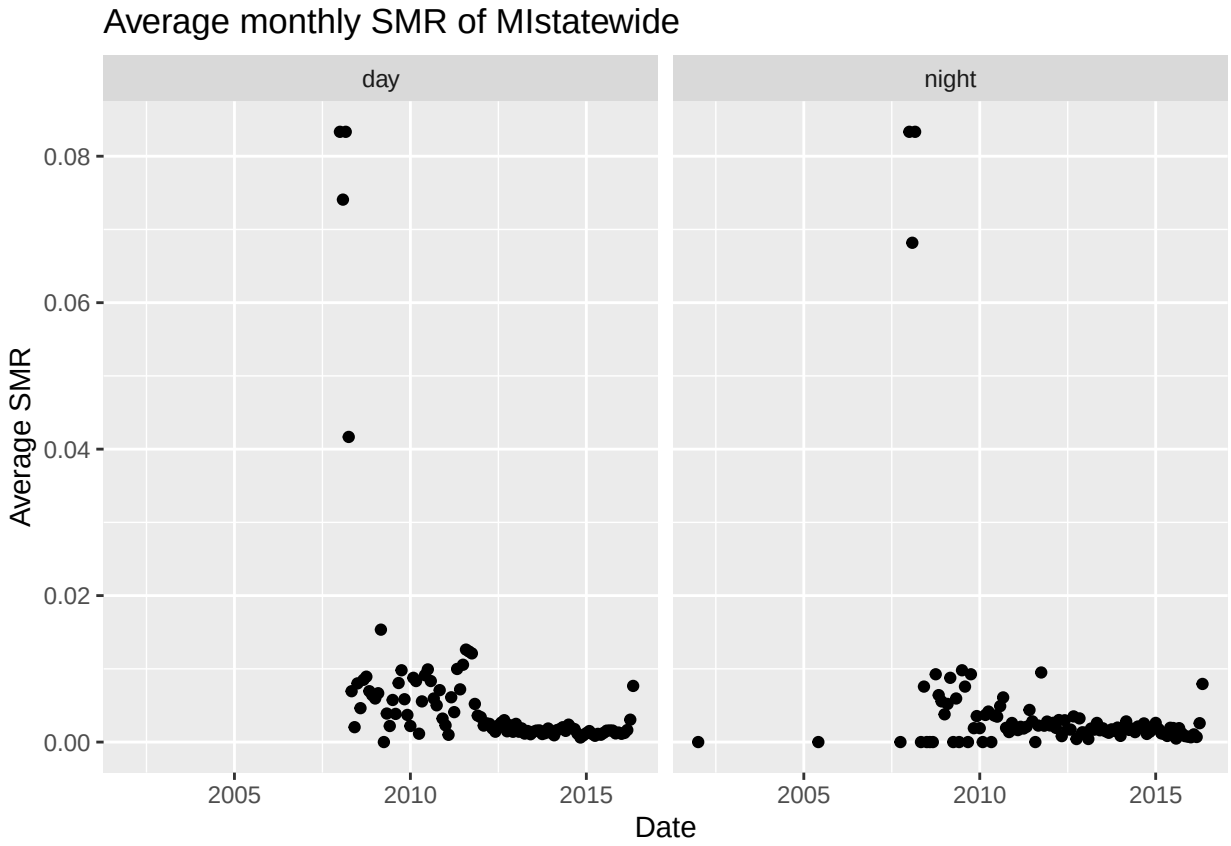
```
##
## [[23]]
```


Average monthly SMR of MDbaltimore
day
night
0.10
0.05
0.00
Average SMR
2012
2014
2016
2018
Date

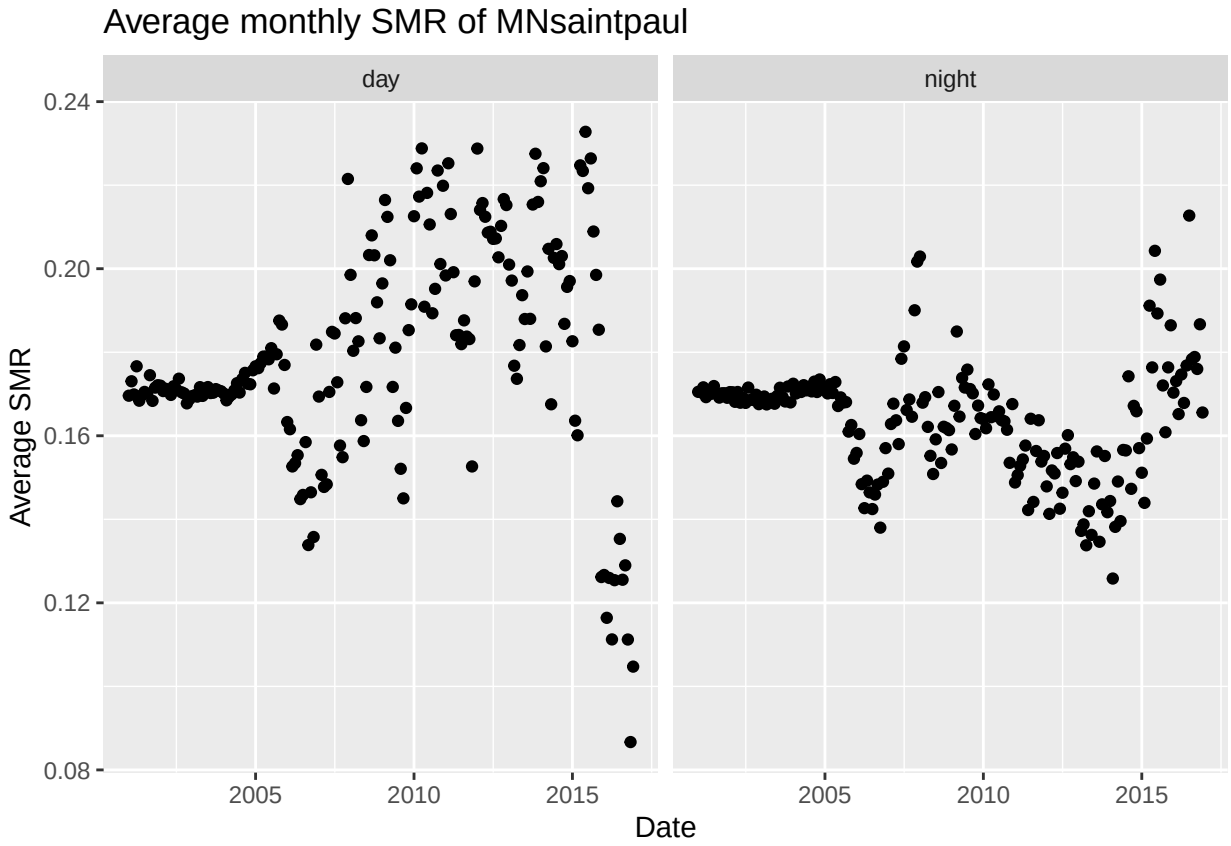
```
##
## [[24]]
```


Average monthly SMR of MDstatewide
day
night
0.082
0.080
0.078
0.076
Average SMR
Jan 2013
Apr 2013
Jul 2013
Oct 2013
Jan 2014
Date

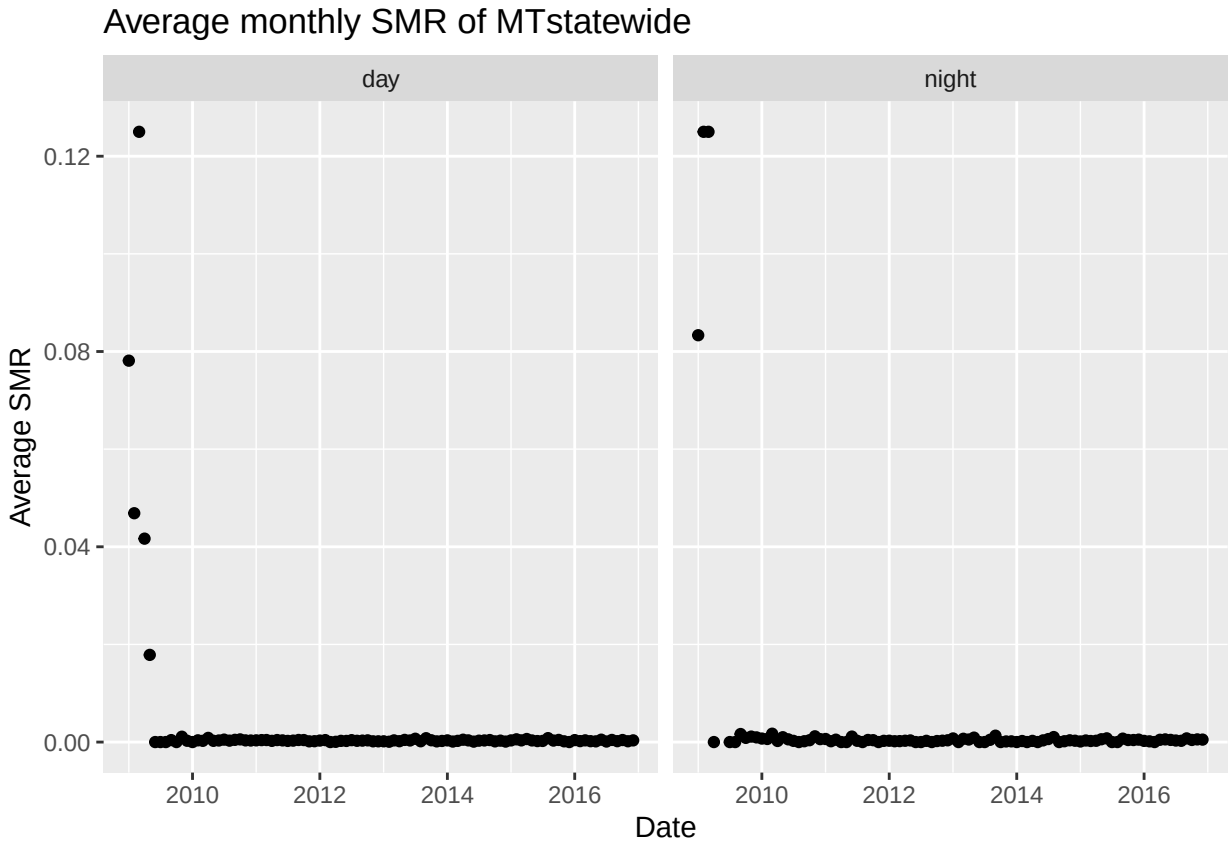
```
##
## [[25]]
```


Average monthly SMR of MIstatewide
day
night
0.08
0.06
0.04
0.02
0.00
Average SMR
2005
2010
2015
Date

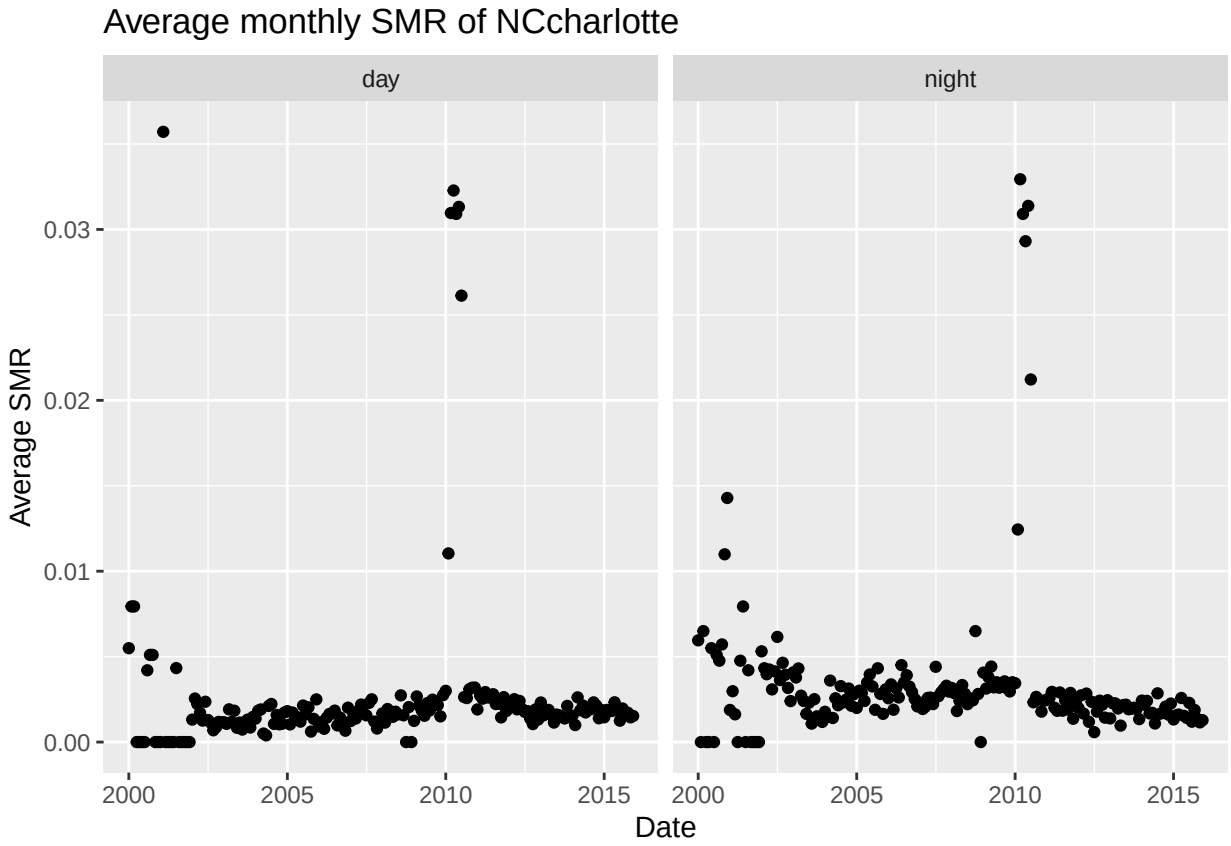
```
##
## [[26]]
```


Average monthly SMR of MNsaintpaul
day
night
0.24
0.20
0.16
0.12
0.08
Average SMR
2005
2010
2015
Date

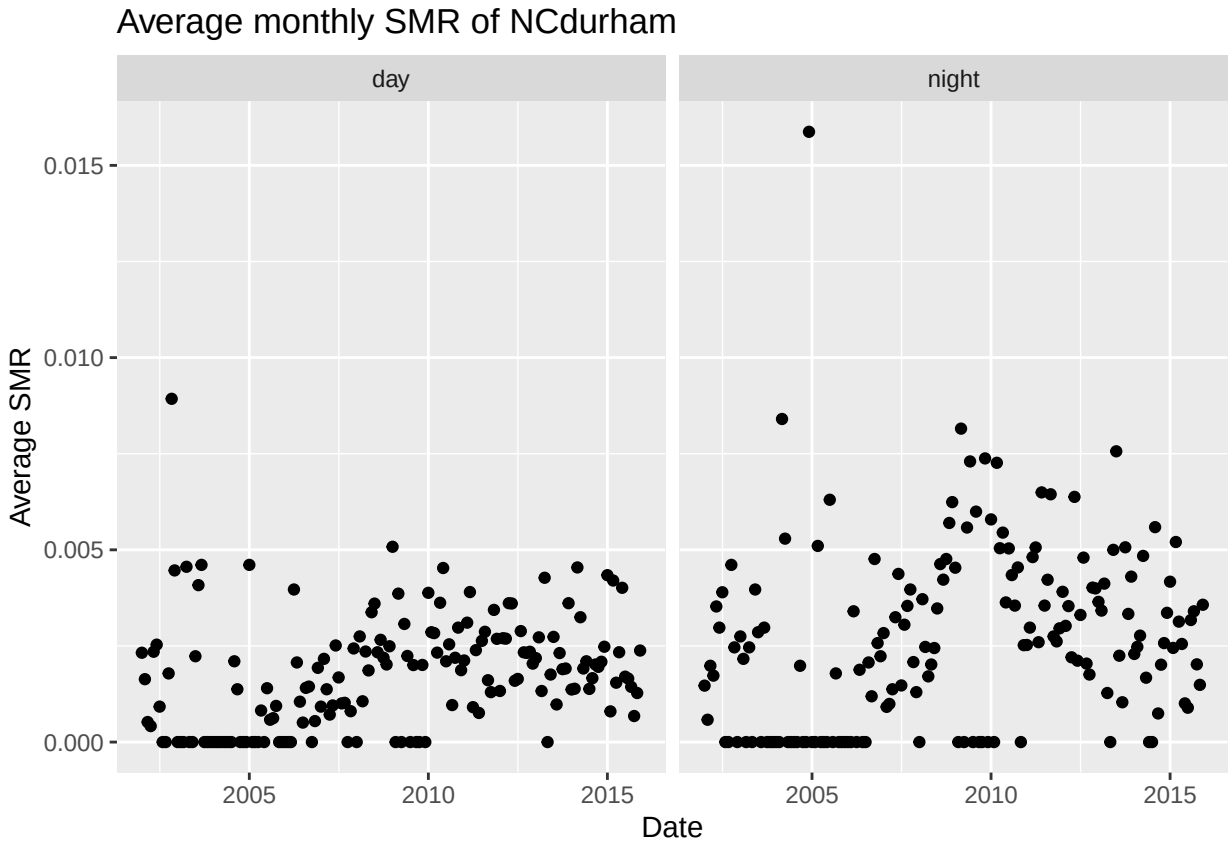
```
##
## [[27]]
```


Average monthly SMR of MTstatewide
day
night
0.12
0.08
0.04
0.00
Average SMR
2010
2012
2014
2016
Date

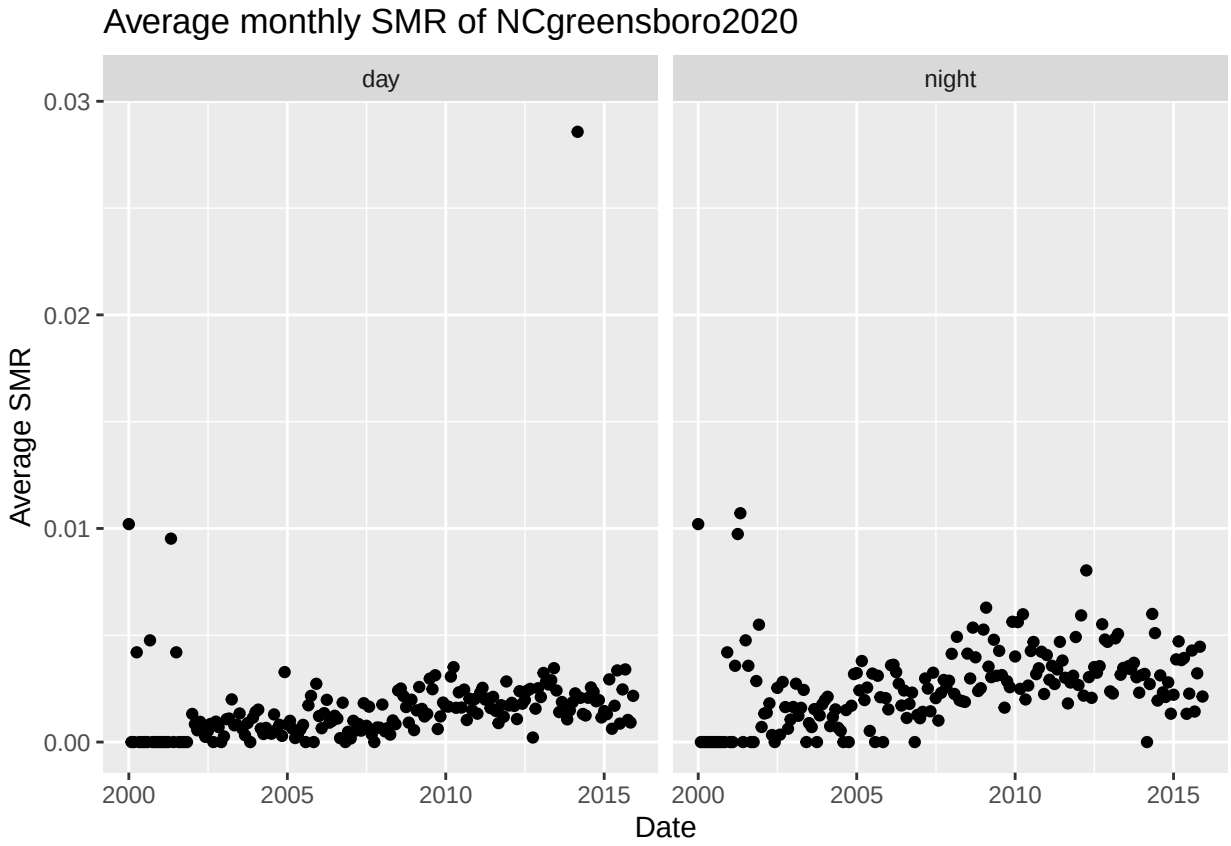
```
##
## [[28]]
```


Average monthly SMR of NCcharlotte
day
night
Average SMR
0.03
0.02
0.01
0.00
2000
2005
2010
2015
Date

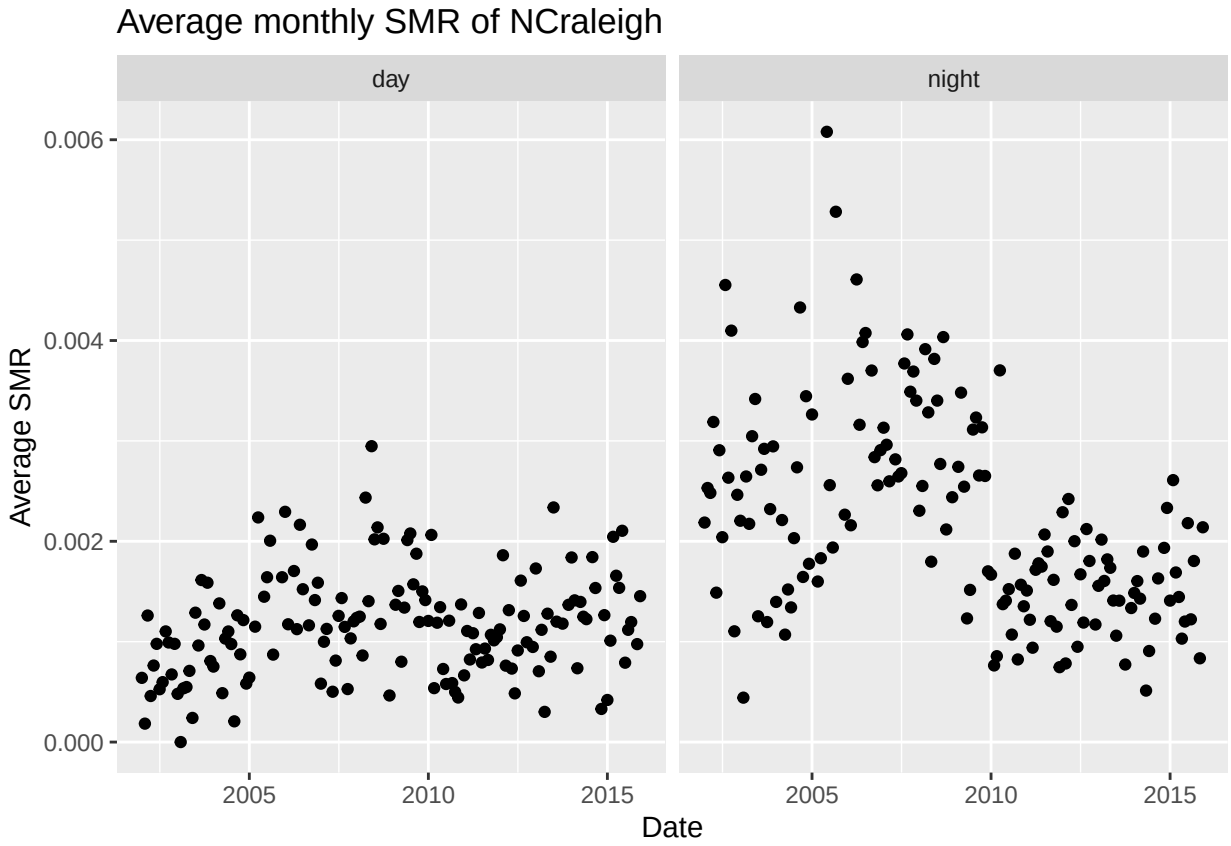
```
##
## [[29]]
```


Average monthly SMR of NCdurham
day
night
0.015
0.010
0.005
0.000
Average SMR
2005
2010
2015
Date

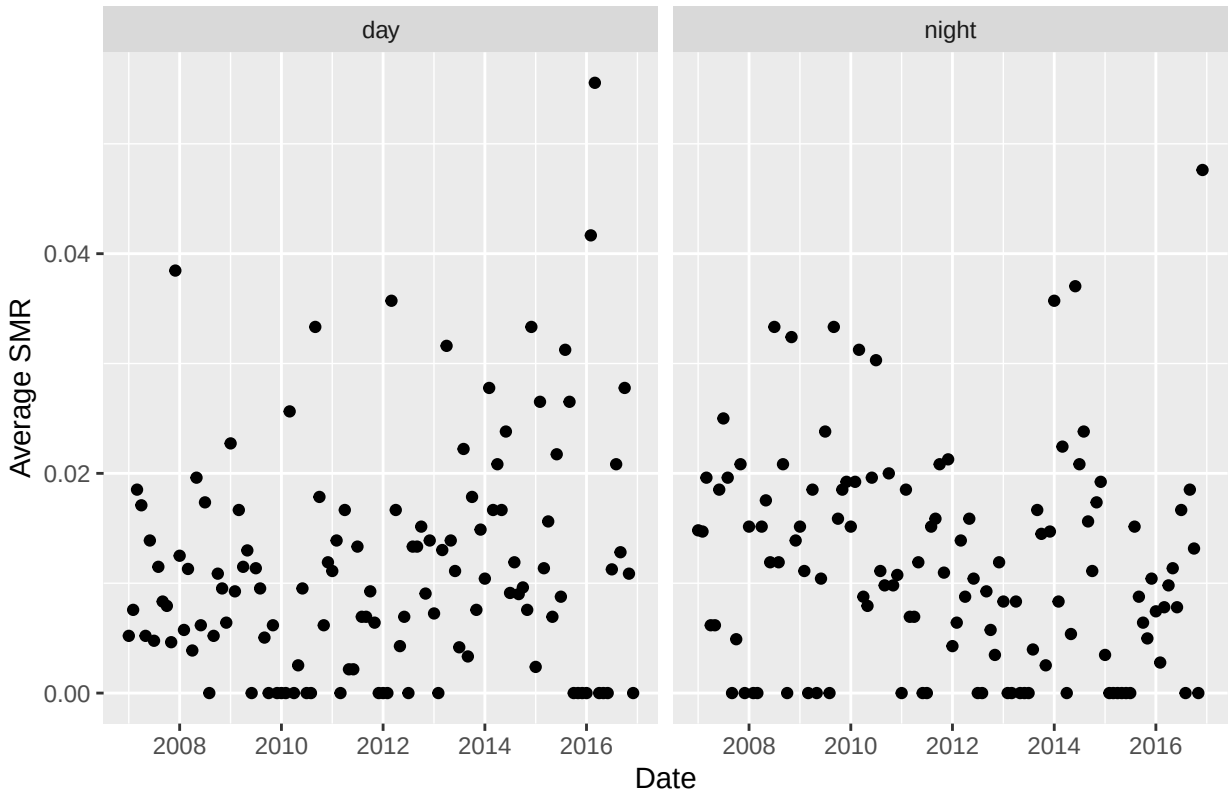
```
##
## [[30]]
```


Average monthly SMR of NCgreensboro2020
day
night
0.03
0.02
0.01
0.00
Average SMR
2000
2005
2010
2015
Date

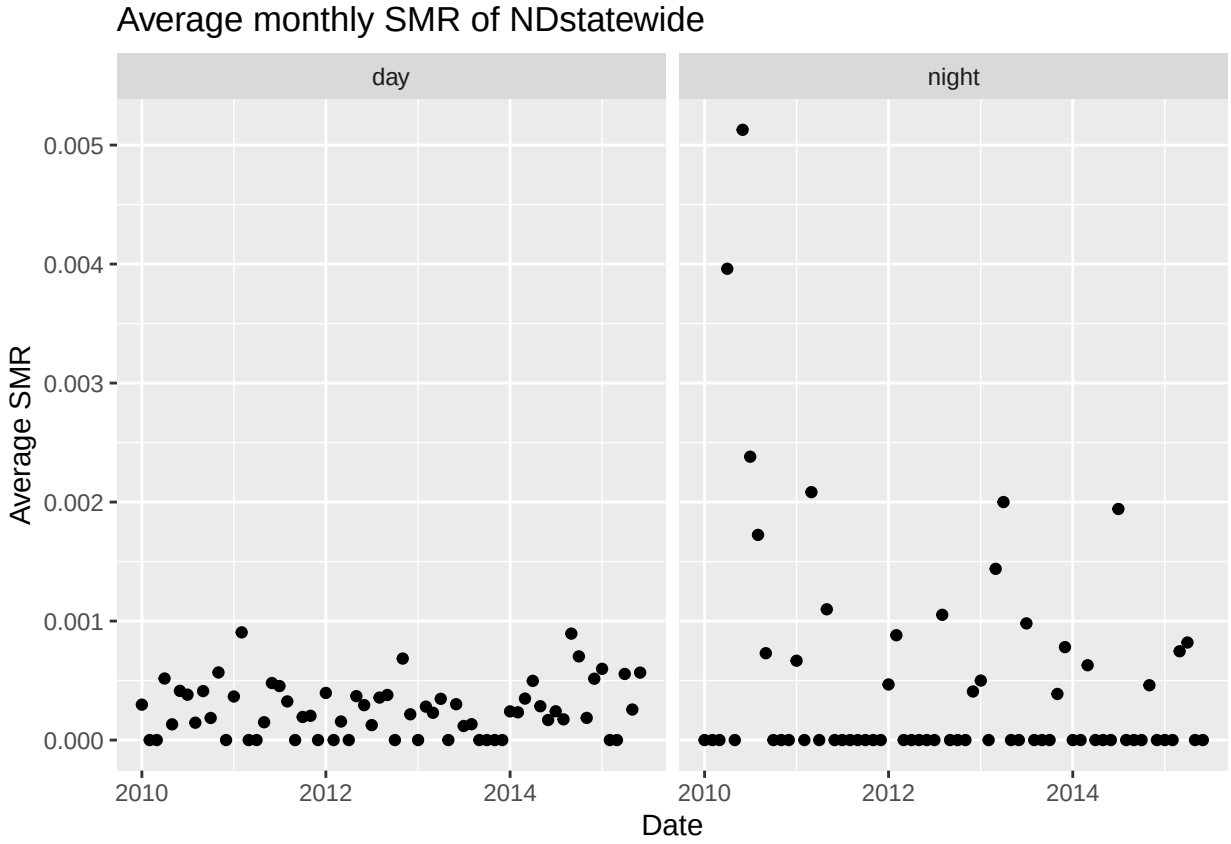
```
##
## [[31]]
```


Average monthly SMR of NCraleigh
day
night
0.006
0.004
0.002
0.000
Average SMR
2005
2010
2015
Date

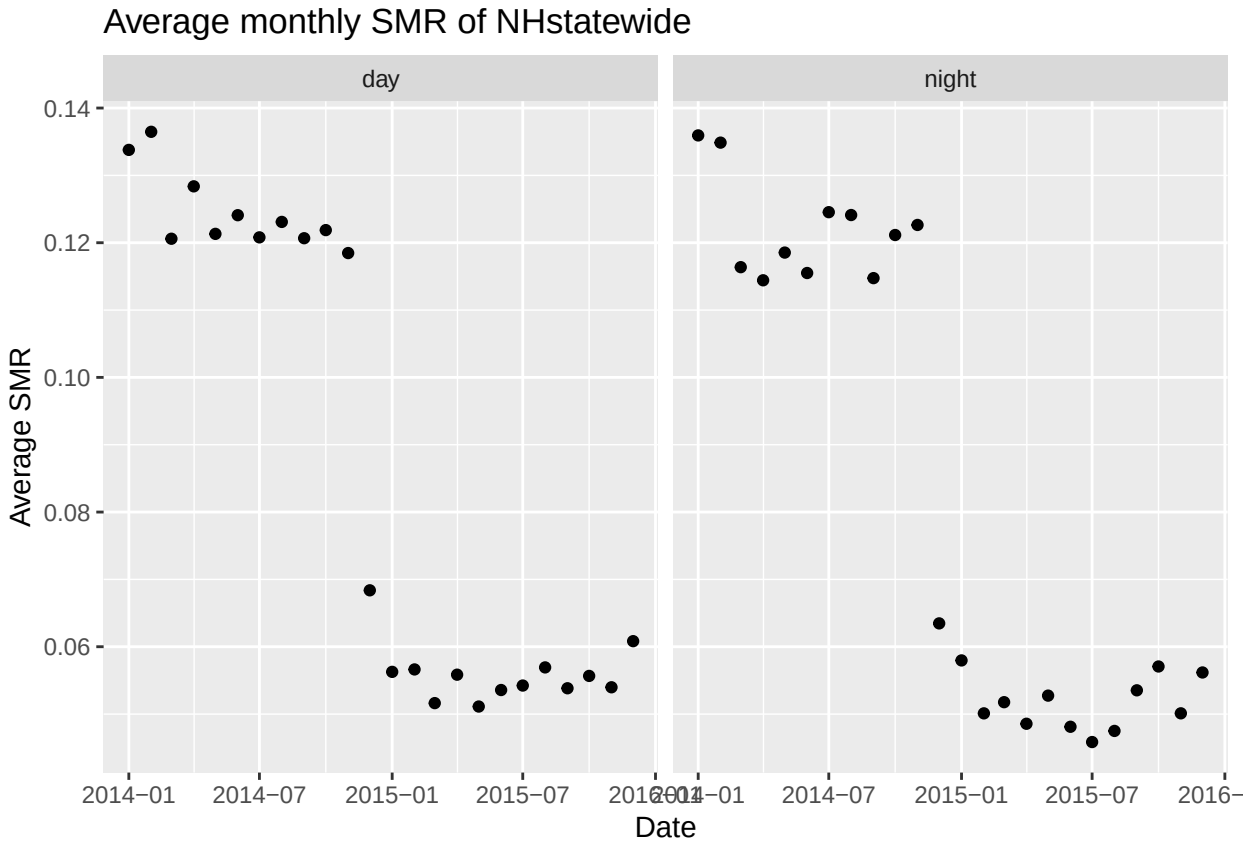
```
##
## [[32]]
```


Average monthly SMR of NDgrandforks
day
night
Average SMR
0.04
0.02
0.00
2008
2010
2012
2014
2016
Date

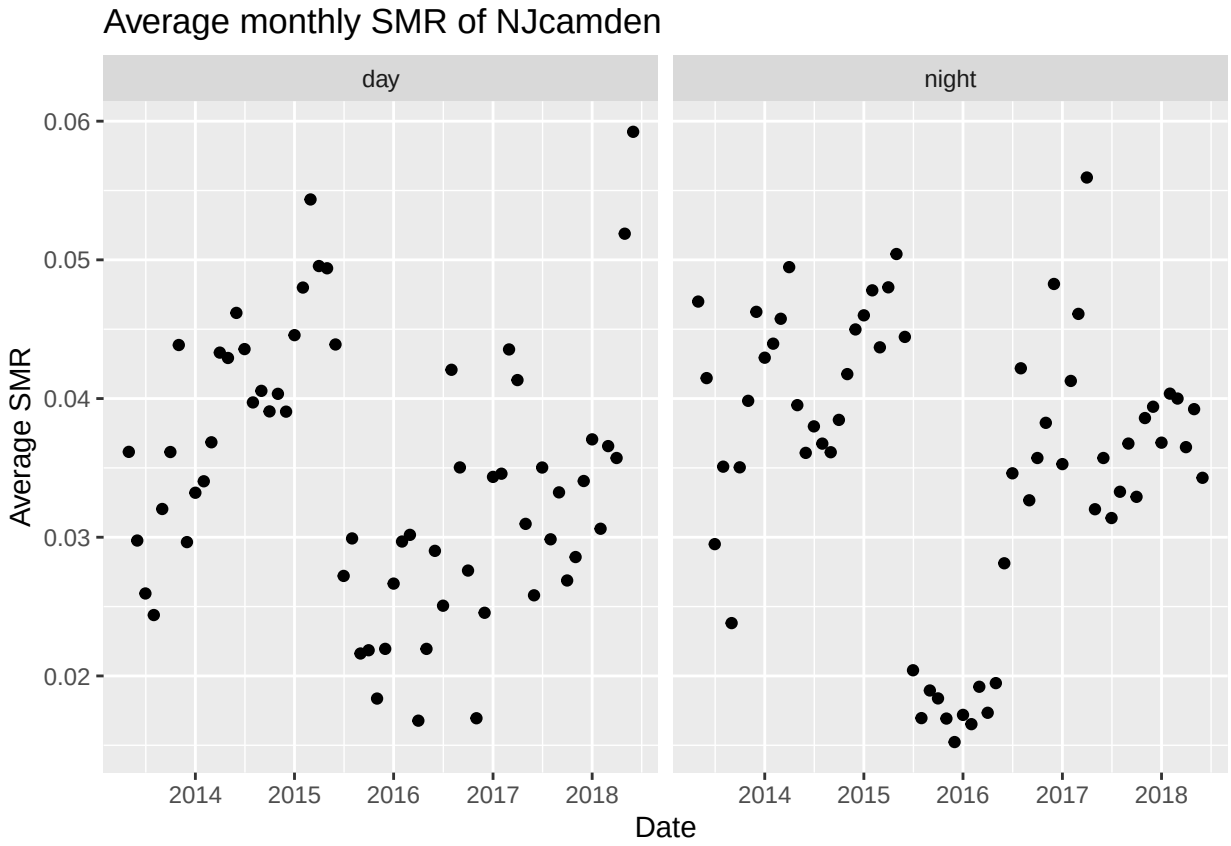
```
##
## [[33]]
```


Average monthly SMR of NDstatewide
day
night
0.005
0.004
0.003
0.002
0.001
0.000
Average SMR
2010
2012
2014
Date

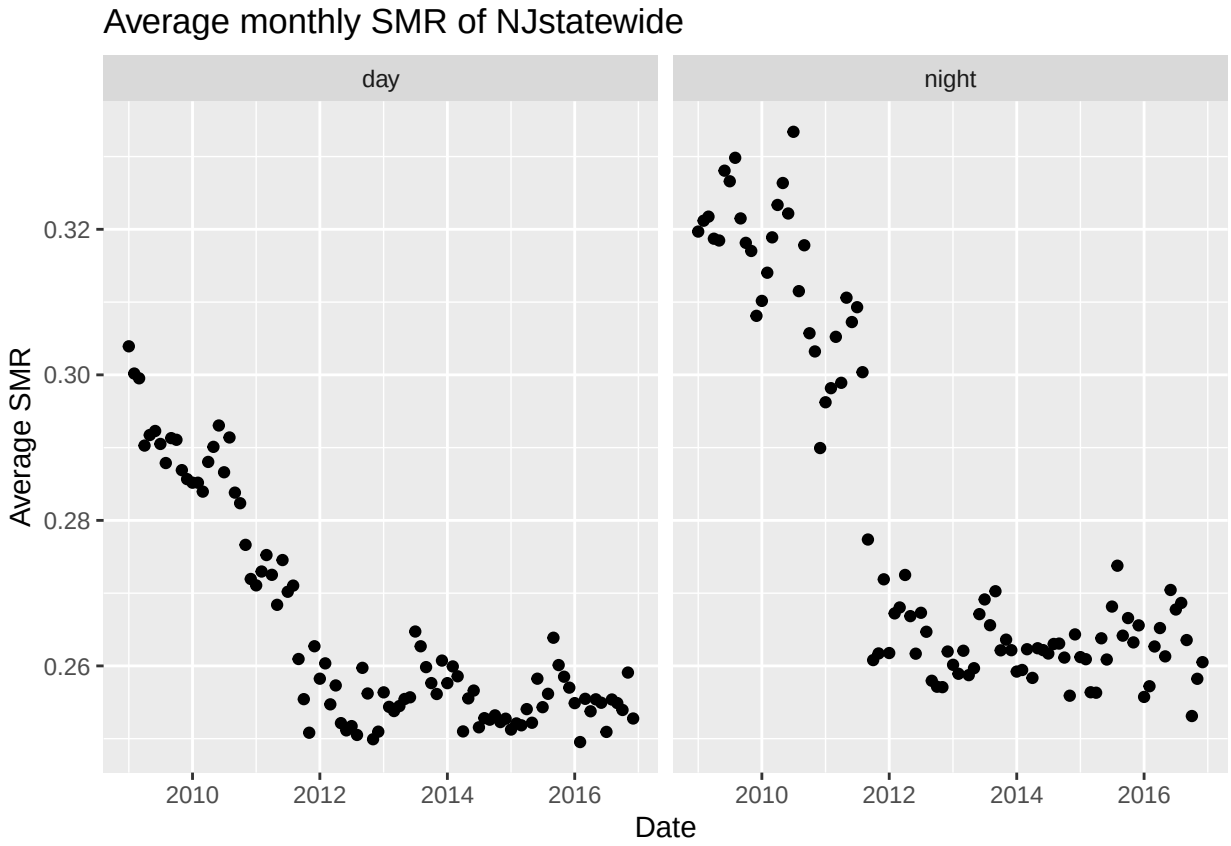
```
##
## [[34]]
```


Average monthly SMR of NHstatewide
day
night
0.14
0.12
0.10
0.08
0.06
Average SMR
2014−01
2014−07
2015−01
2015−07
2016−
Date

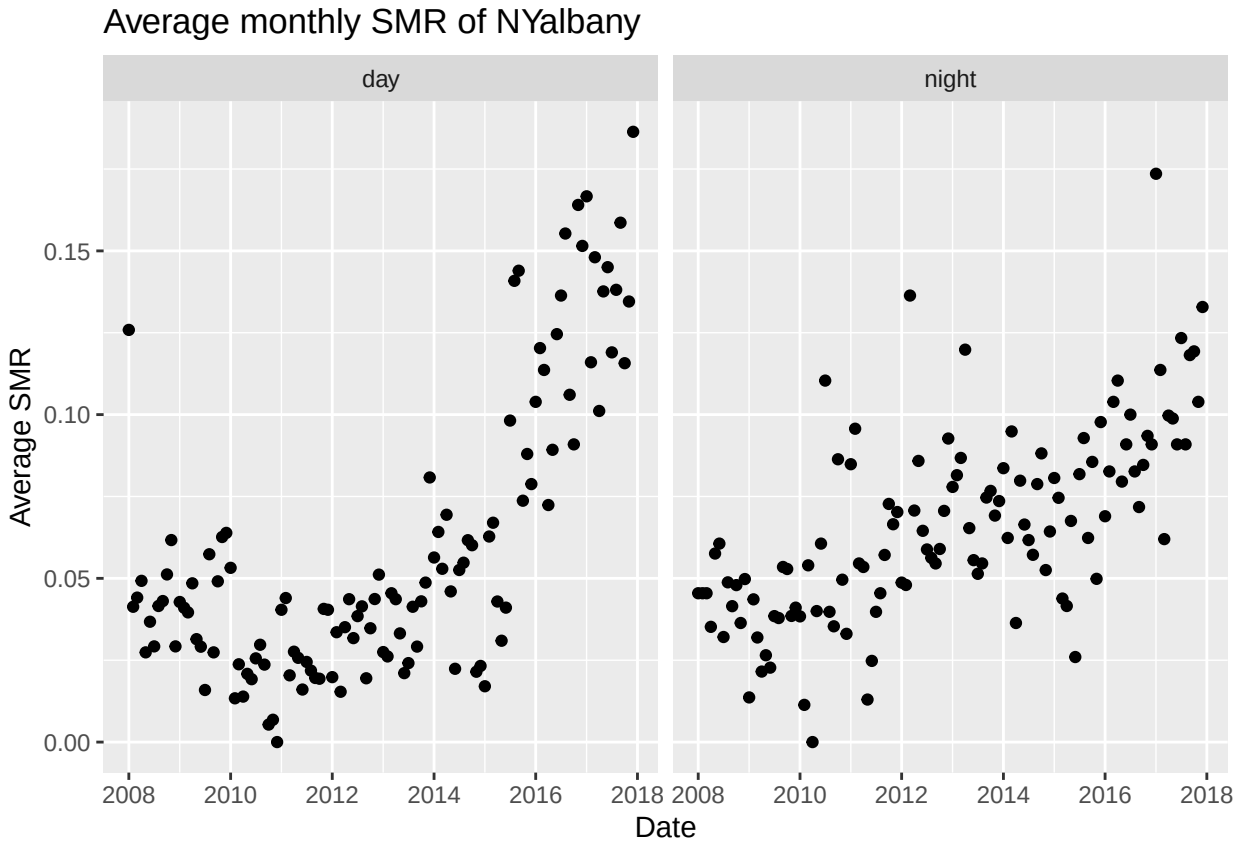
```
##
## [[35]]
```


Average monthly SMR of NJcamden
day
night
Average SMR
0.06
0.05
0.04
0.03
0.02
2014
2015
2016
2017
2018
Date

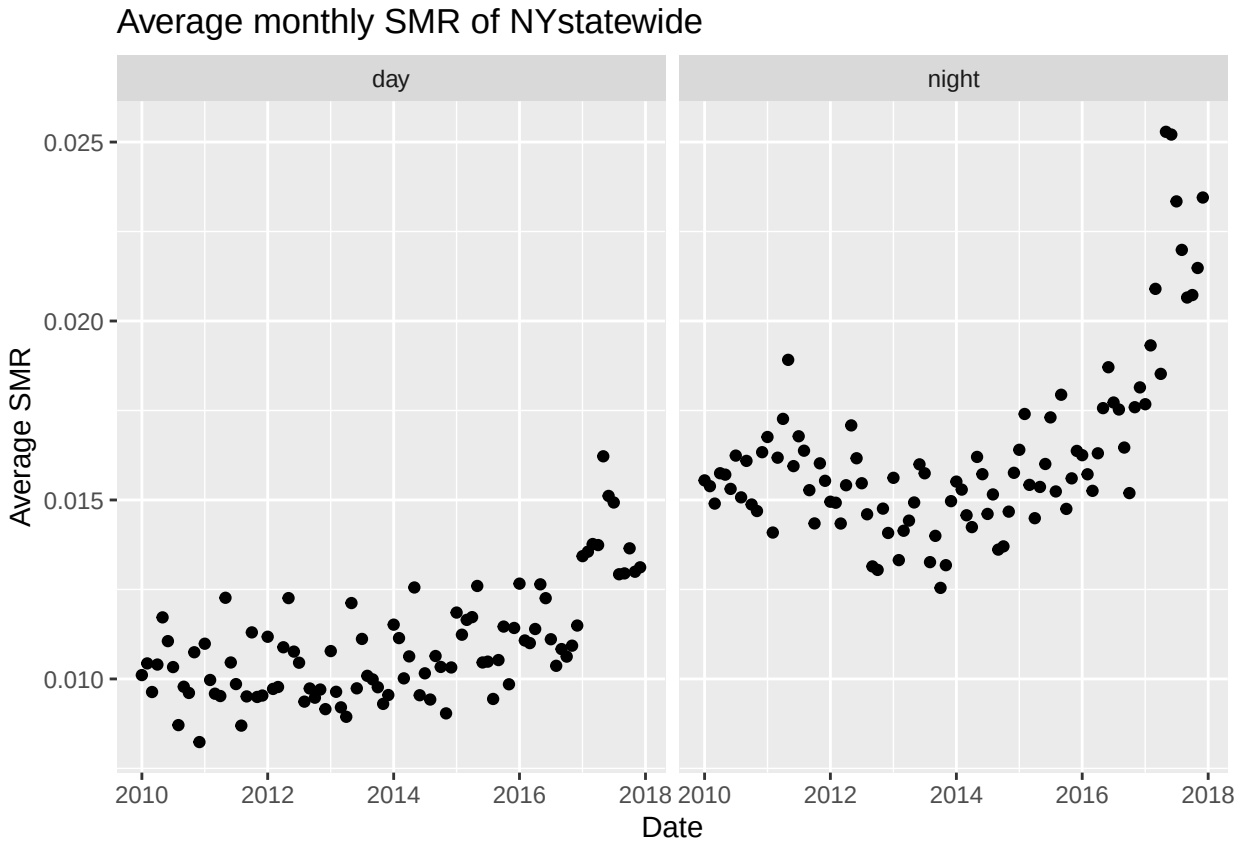
```
##
## [[36]]
```


Average monthly SMR of NJstatewide
day
night
Average SMR
0.32
0.30
0.28
0.26
2010
2012
2014
2016
Date

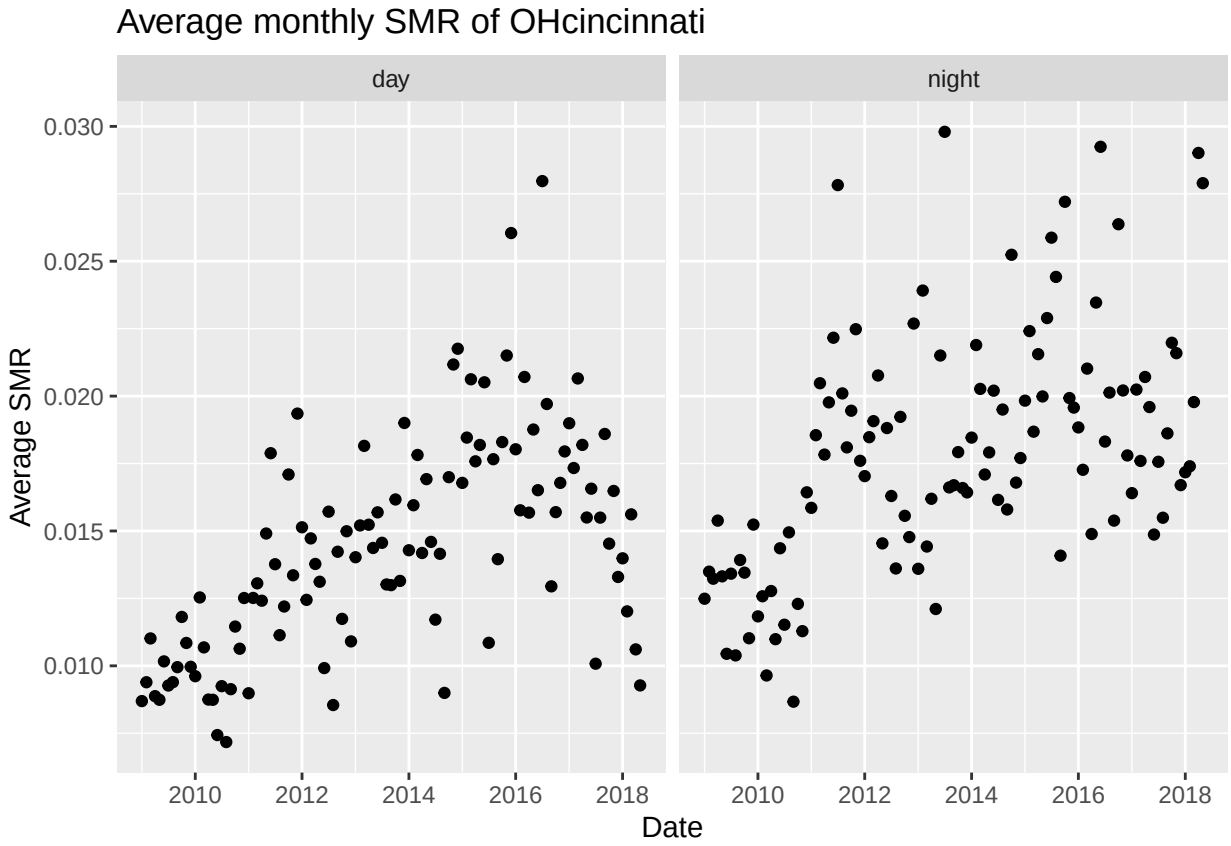
```
##
## [[37]]
```


Average monthly SMR of NYalbany
day
night
Average SMR
0.15
0.10
0.05
0.00
2008
2010
2012
2014
2016
2018
Date

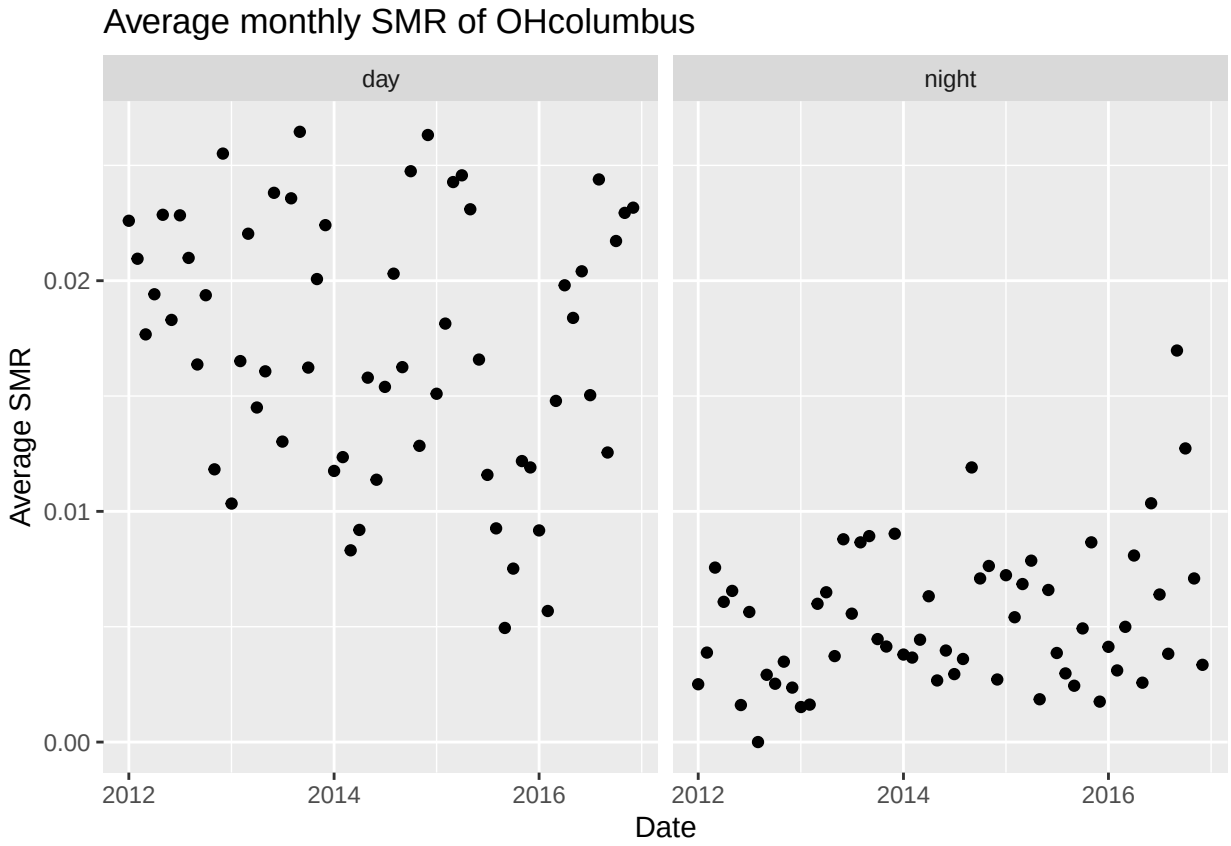
```
##
## [[38]]
```


Average monthly SMR of NYstatewide
day
night
0.025
0.020
0.015
0.010
Average SMR
2010
2012
2014
2016
2018
Date

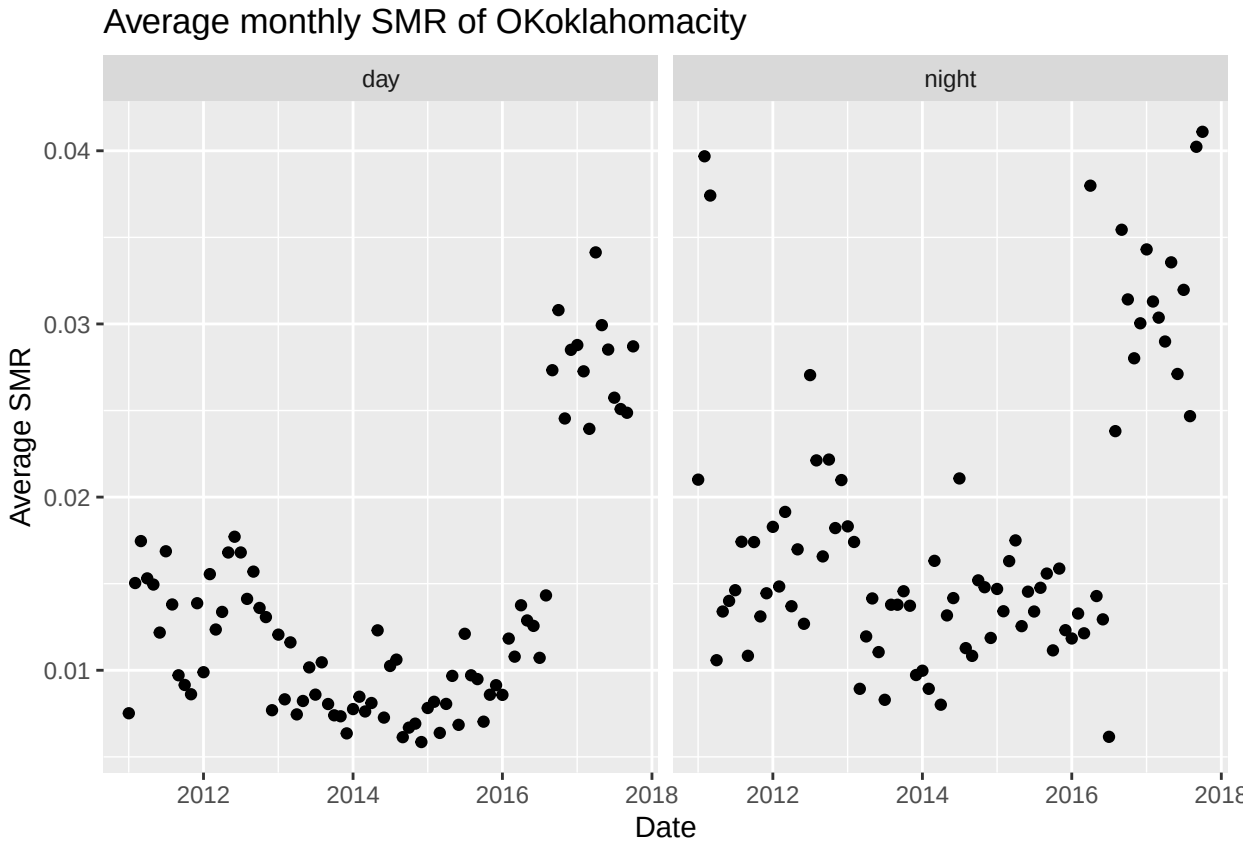
```
##
## [[39]]
```


Average monthly SMR of OHcincinnati
day
night
0.030
0.025
0.020
0.015
0.010
Average SMR
2010
2012
2014
2016
2018
Date

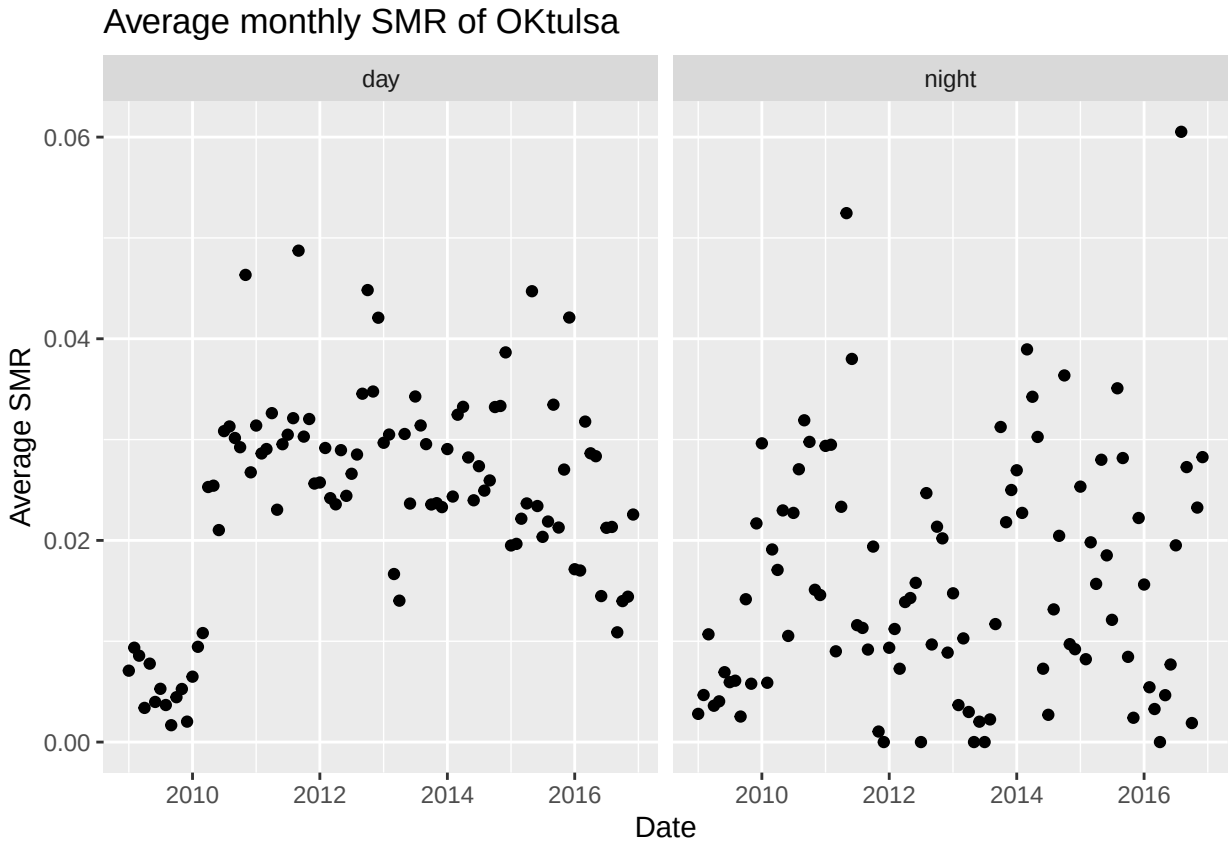
```
##
## [[40]]
```


Average monthly SMR of OHcolumbus
day
night
0.02
0.01
0.00
Average SMR
2012
2014
2016
Date

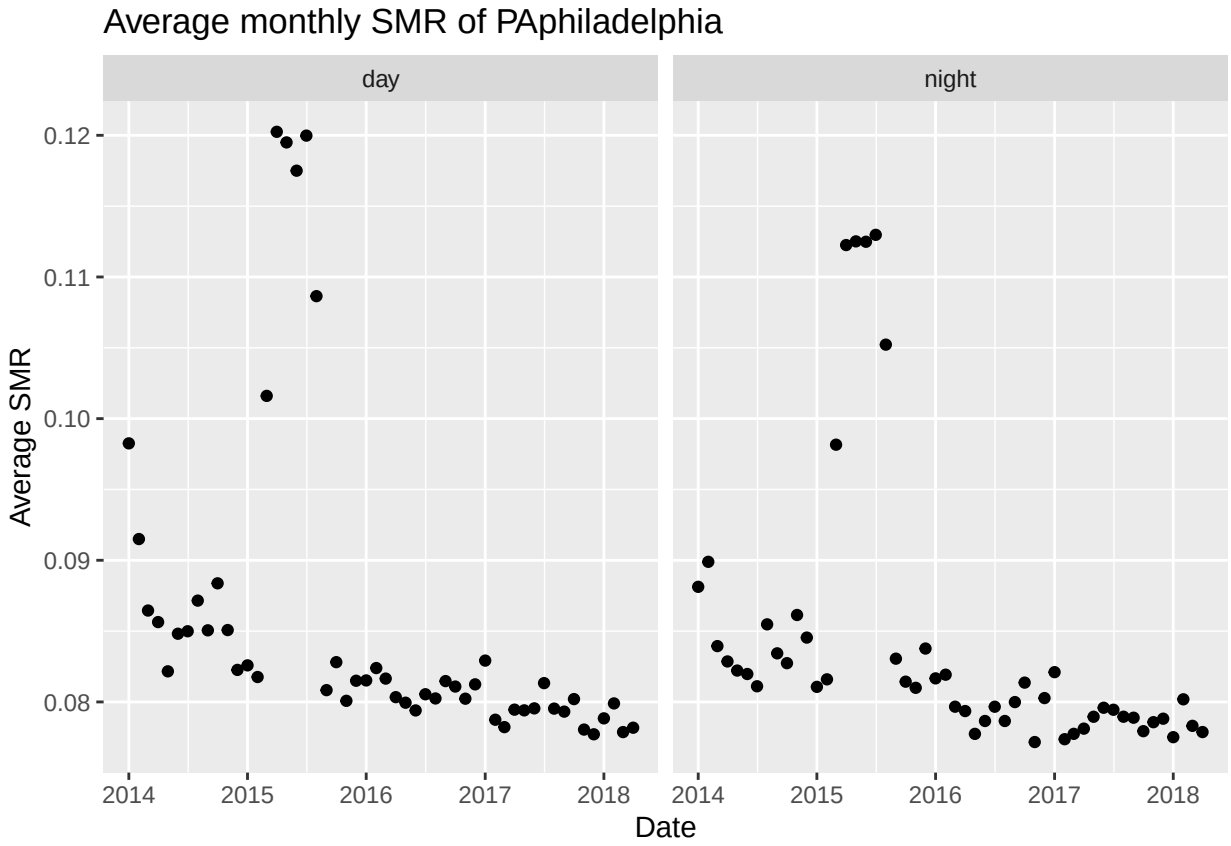
```
##
## [[41]]
```


Average monthly SMR of OKoklahomacity
day
night
0.04
0.03
0.02
0.01
Average SMR
2012
2014
2016
2018
Date

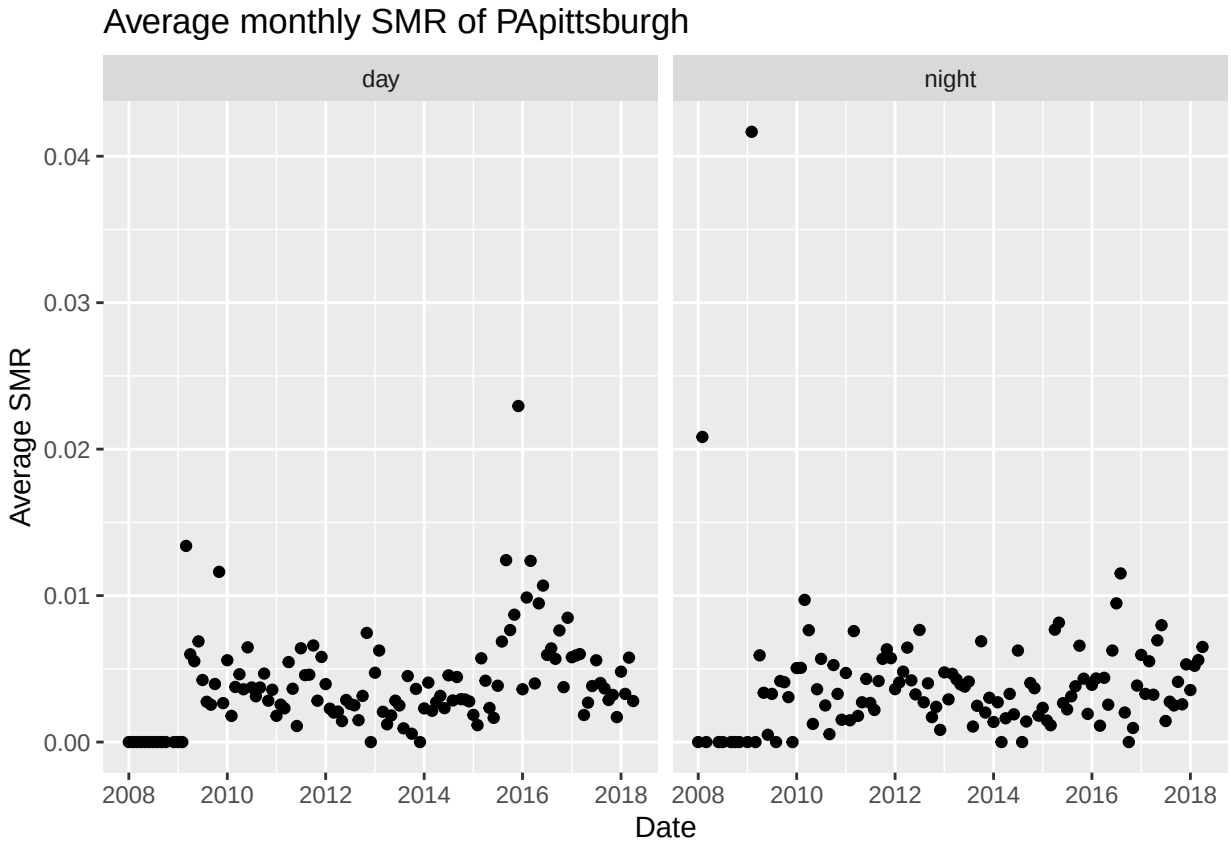
```
##
## [[42]]
```


Average monthly SMR of OKtulsa
day
night
0.06
0.04
0.02
0.00
Average SMR
2010
2012
2014
2016
Date

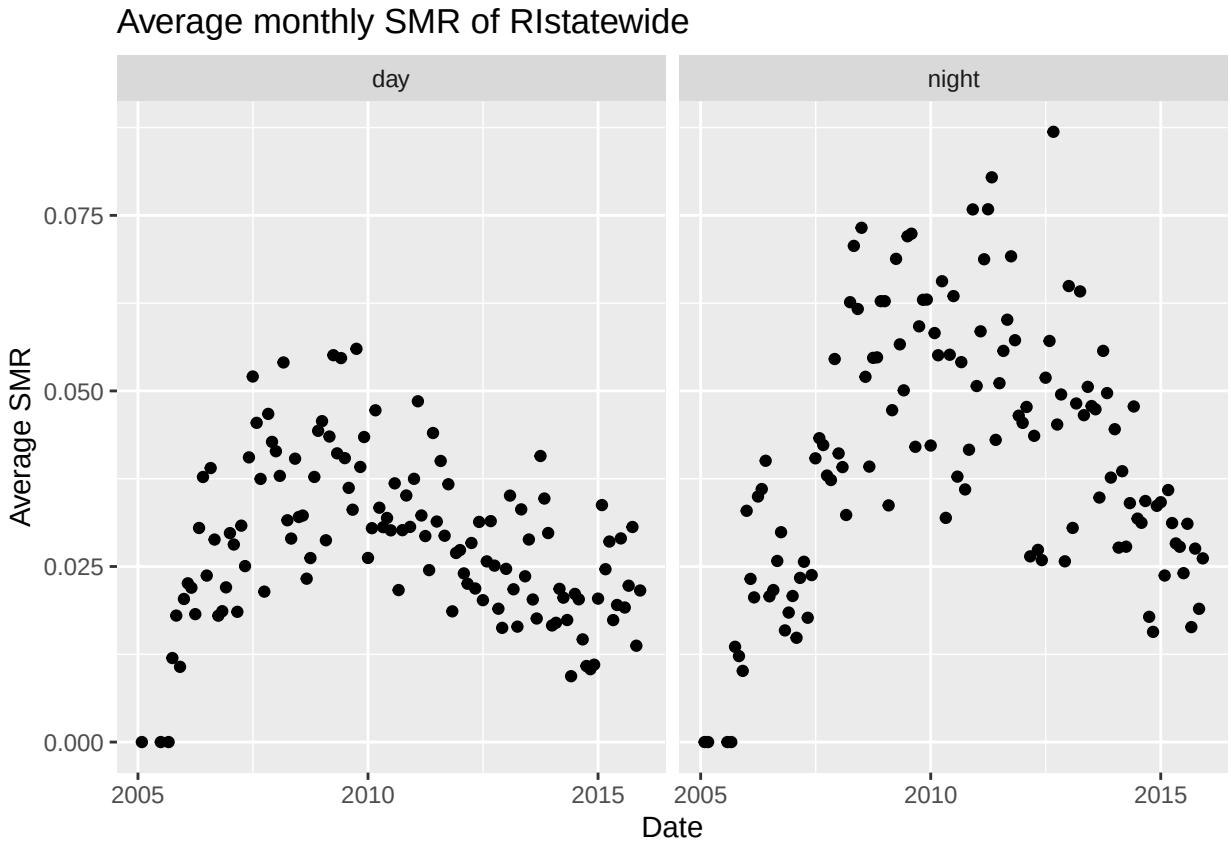
```
##
## [[43]]
```


Average monthly SMR of PAphiladelphia
day
night
Average SMR
0.12
0.11
0.10
0.09
0.08
2014
2015
2016
2017
2018
Date

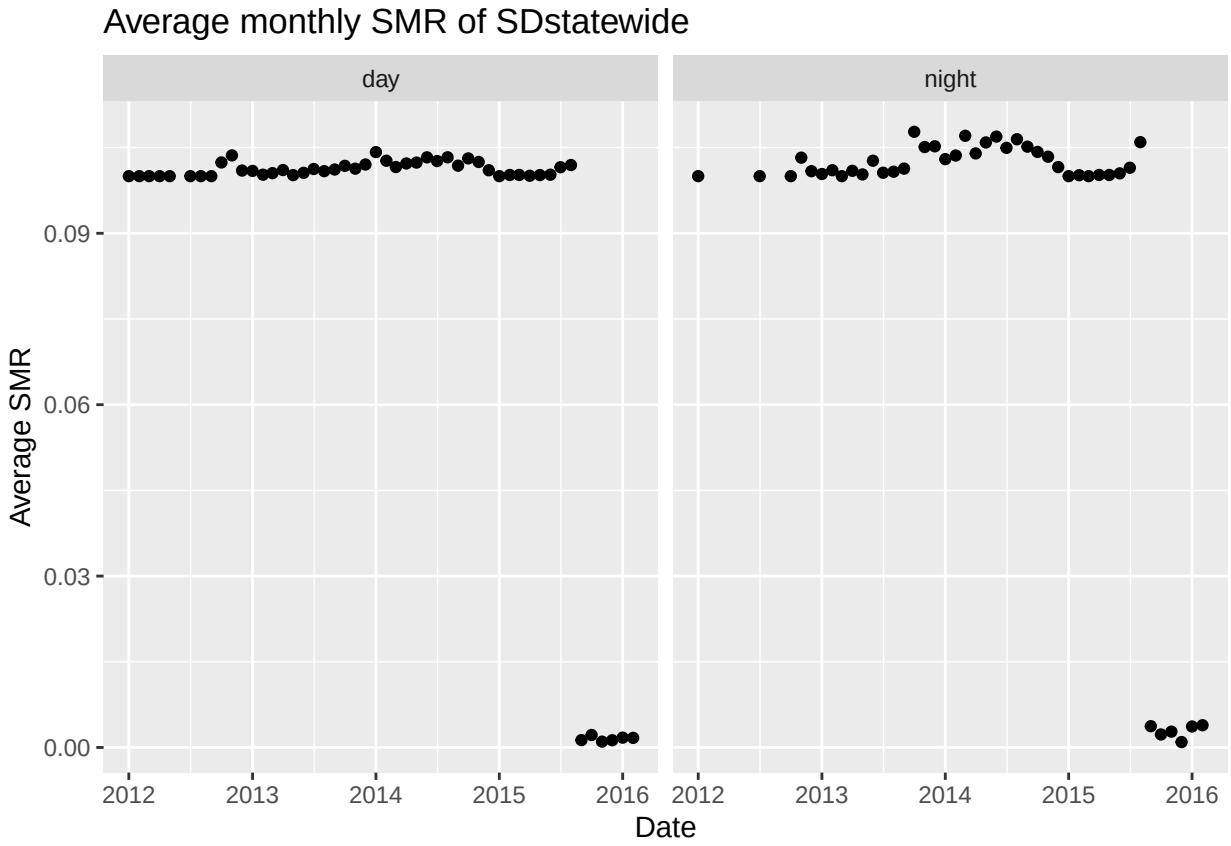
```
##
## [[44]]
```


Average monthly SMR of PApittsburgh
day
night
Average SMR
0.04
0.03
0.02
0.01
0.00
2008
2010
2012
2014
2016
2018
Date

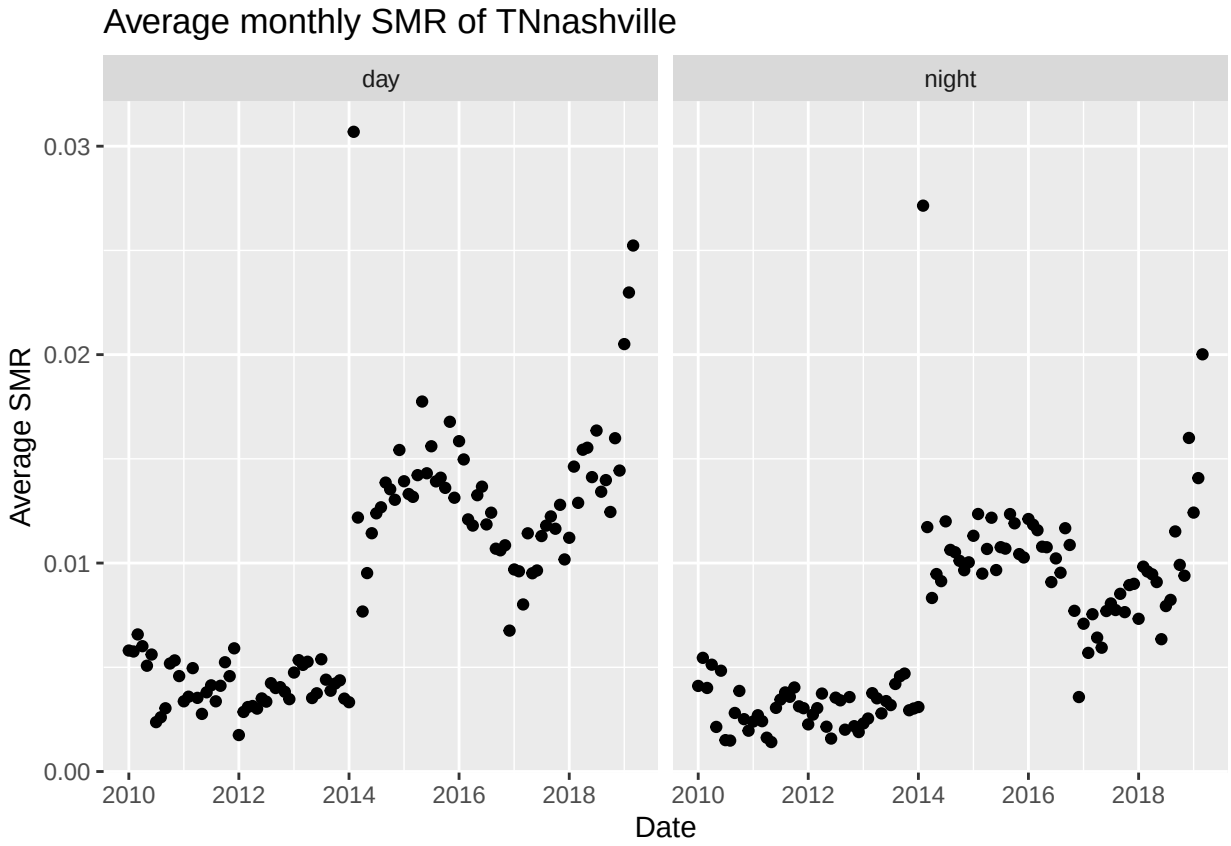
```
##
## [[45]]
```


Average monthly SMR of RIstatewide
day
night
0.075
0.050
0.025
0.000
Average SMR
2005
2010
2015
Date

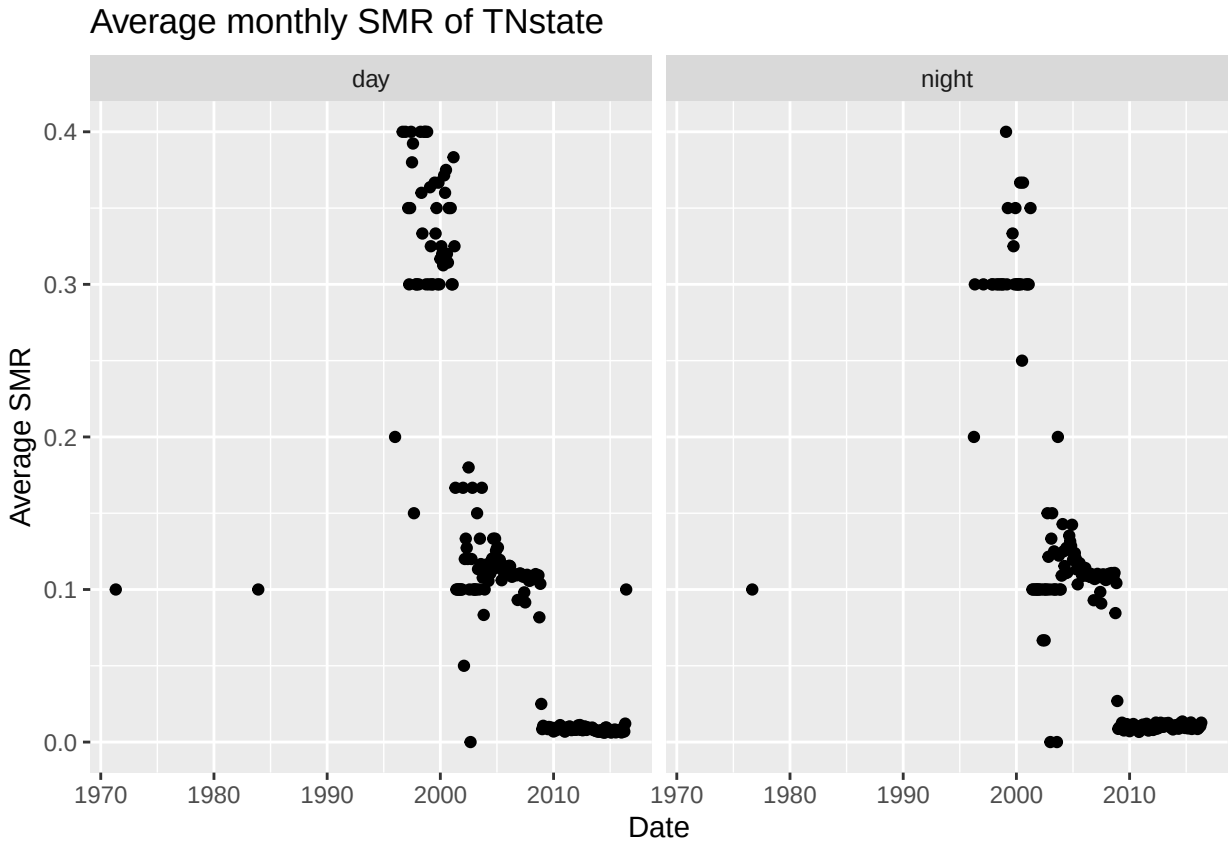
```
##
## [[46]]
```


Average monthly SMR of SDstatewide
day
night
Average SMR
0.09
0.06
0.03
0.00
2012
2013
2014
2015
2016
Date

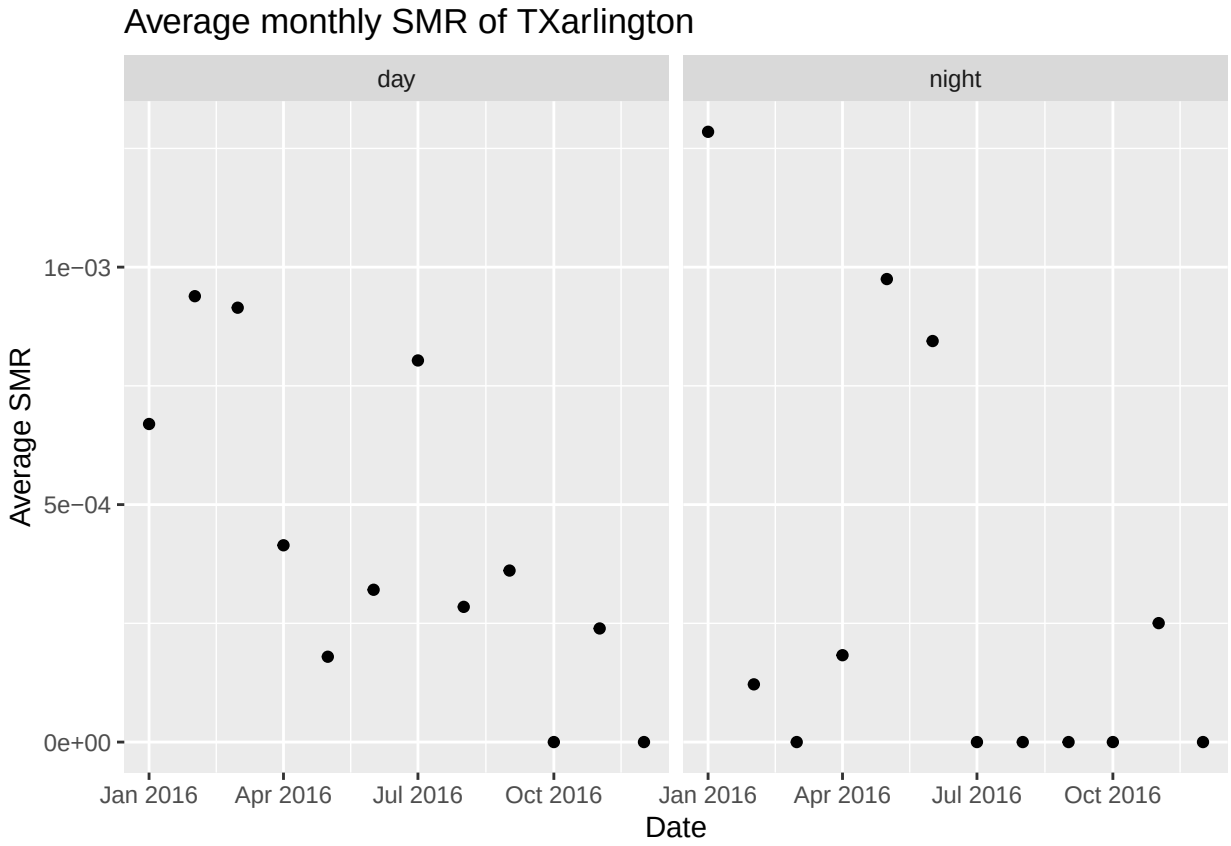
```
##
## [[47]]
```


Average monthly SMR of TNnashville
day
night
Average SMR
0.03
0.02
0.01
0.00
2010
2012
2014
2016
2018
Date

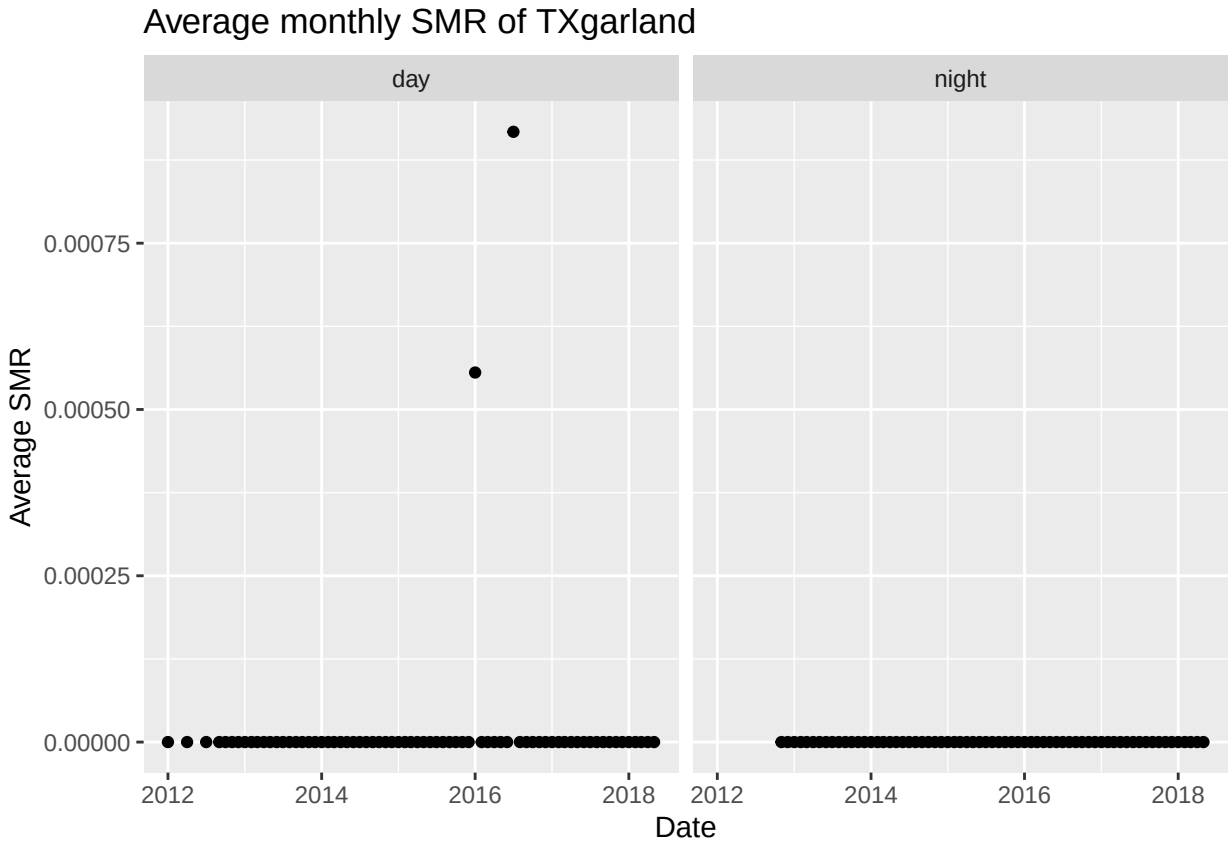
```
##
## [[48]]
```


Average monthly SMR of TNstate
day
night
Average SMR
0.4
0.3
0.2
0.1
0.0
1970
1980
1990
2000
2010
Date

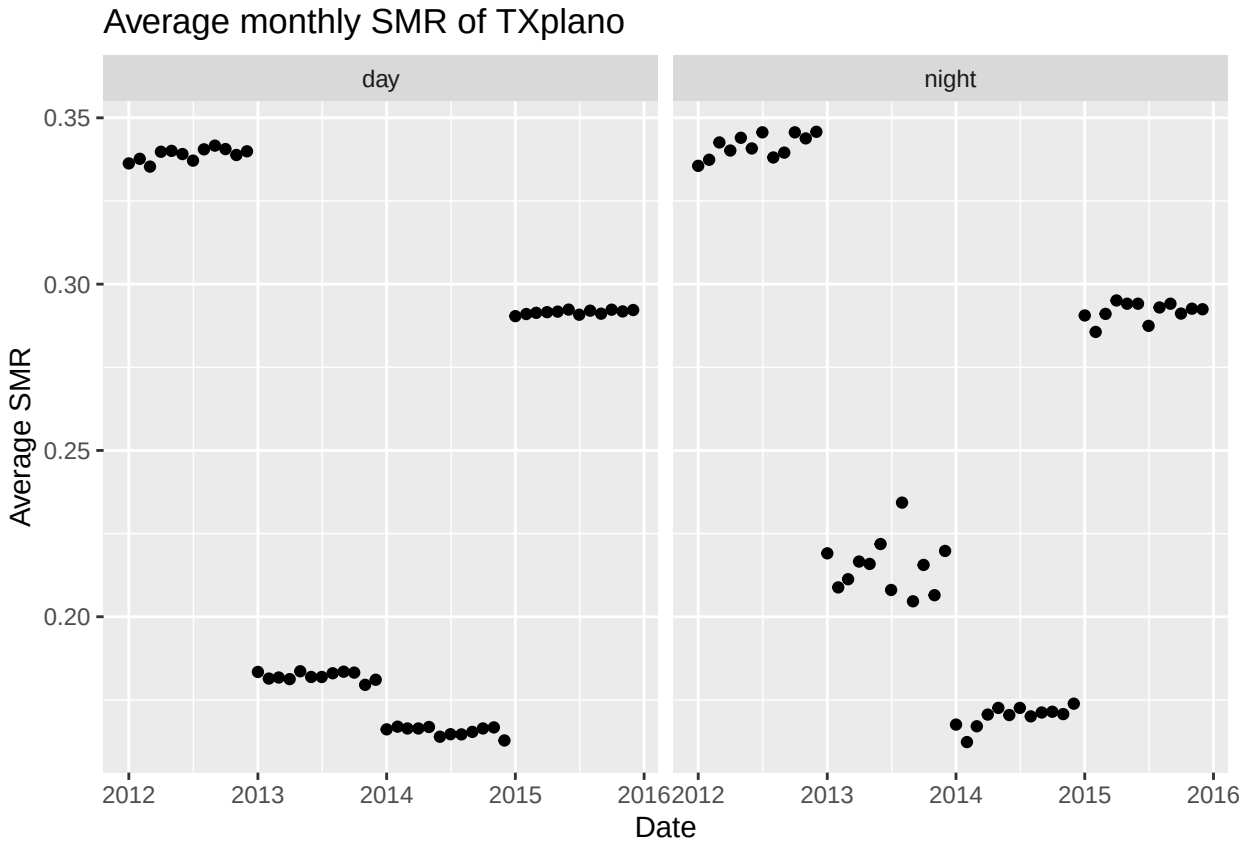
```
##
## [[49]]
```


Average monthly SMR of TXarlington
day
night
1e−03
5e−04
0e+00
Average SMR
Jan 2016
Apr 2016
Jul 2016
Oct 2016
Jan 2016
Apr 2016
Jul 2016
Oct 2016
Date

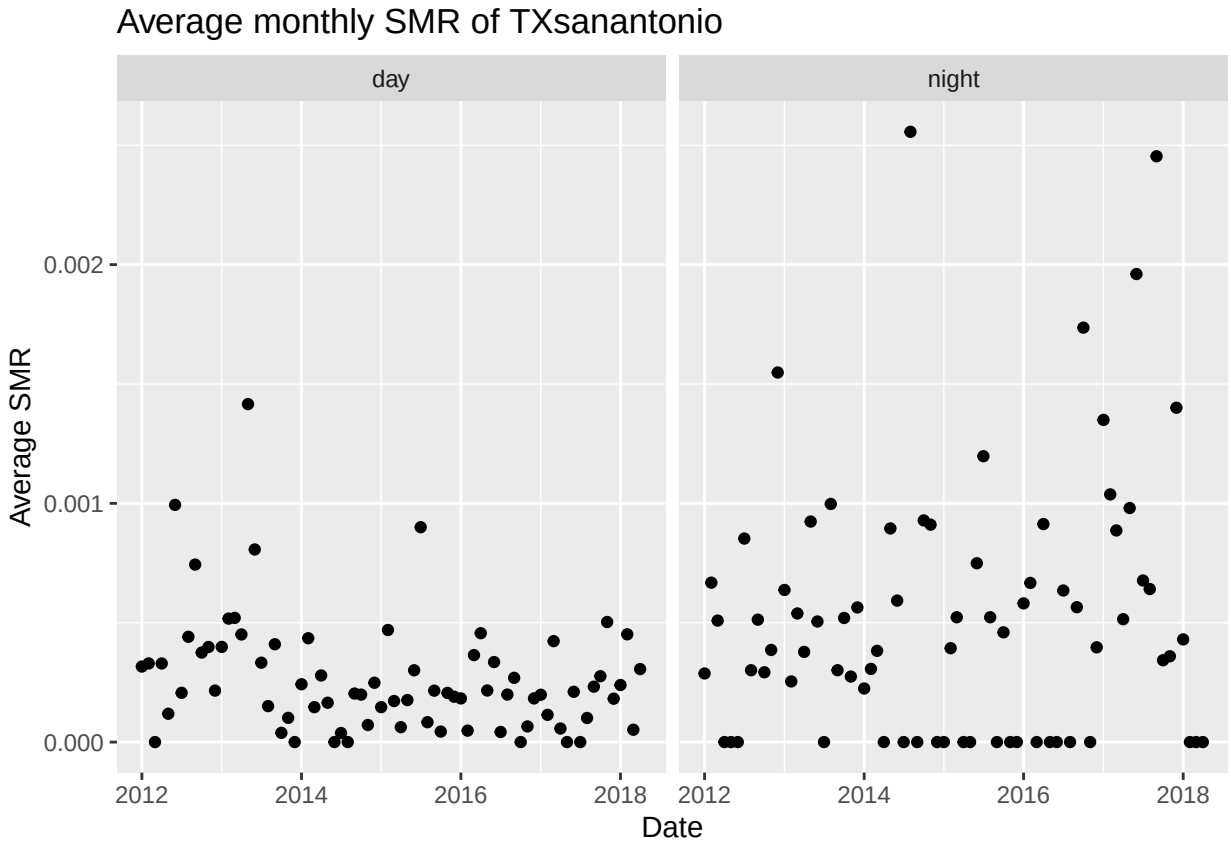
```
##
## [[50]]
```


Average monthly SMR of TXgarland
day
night
0.00075
0.00050
0.00025
0.00000
Average SMR
2012
2014
2016
2018
Date

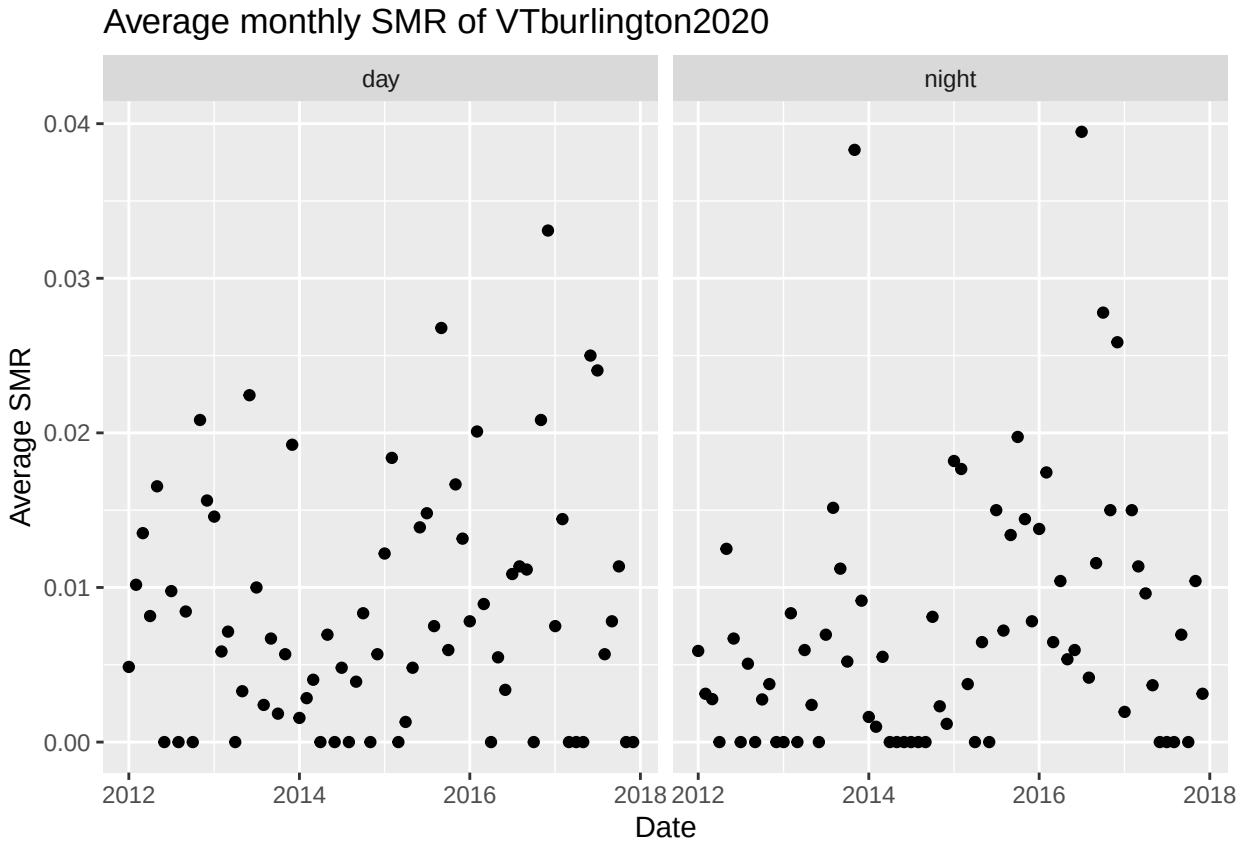
```
##
## [[51]]
```


Average monthly SMR of TXplano
day
night
0.35
0.30
0.25
0.20
Average SMR
2012
2013
2014
2015
2016
Date

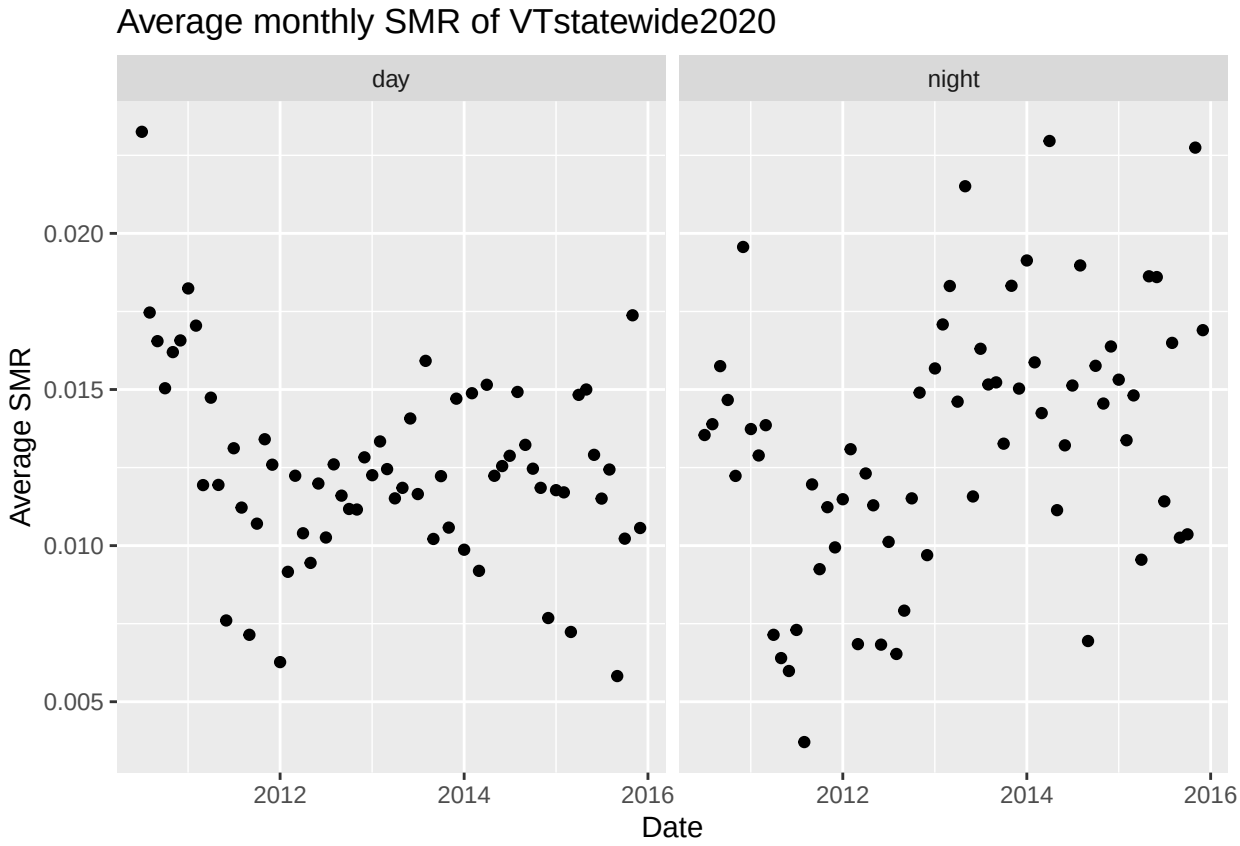
```
##
## [[52]]
```


Average monthly SMR of TXsanantonio
day
night
0.002
0.001
0.000
Average SMR
2012
2014
2016
2018
Date

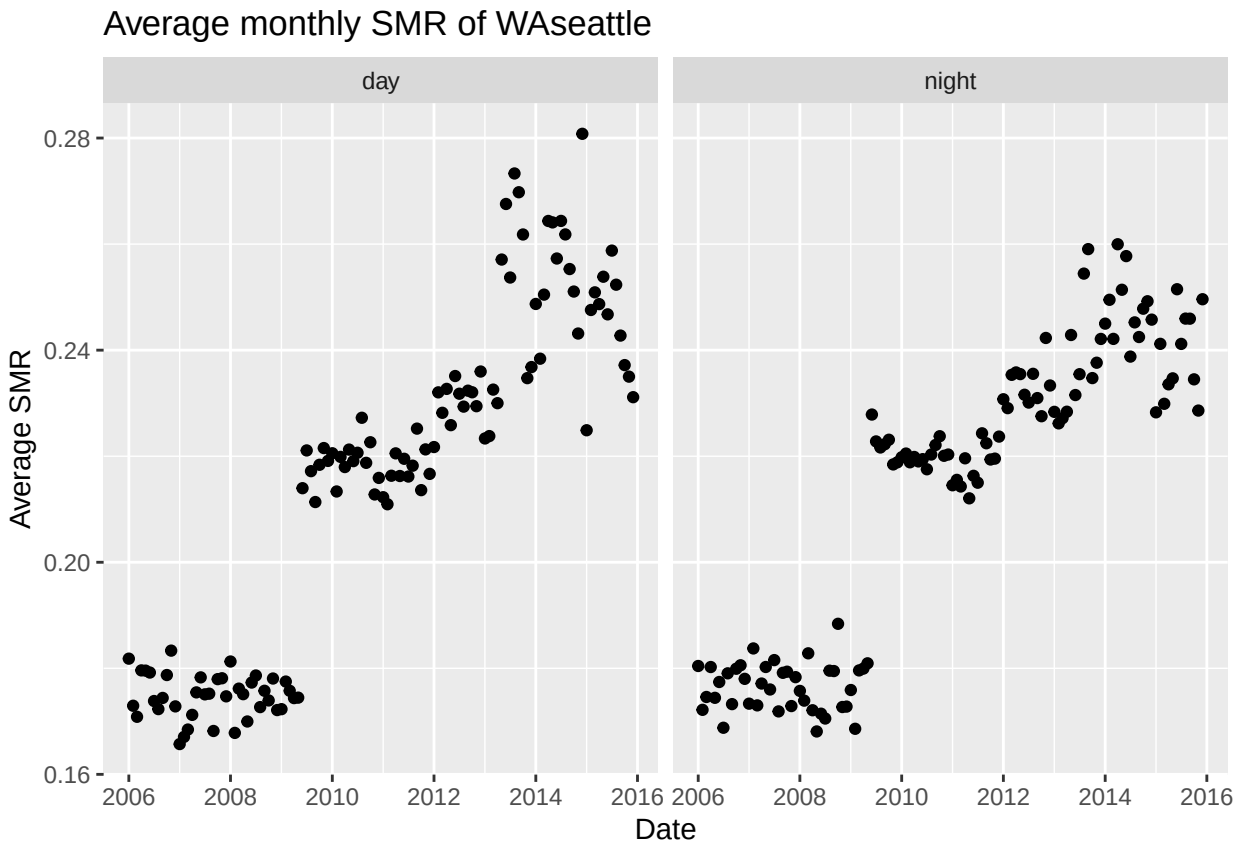
```
##
## [[53]]
```


Average monthly SMR of VTburlington2020
day
night
0.04
0.03
0.02
0.01
0.00
Average SMR
2012
2014
2016
2018
Date

```
##
## [[54]]
```

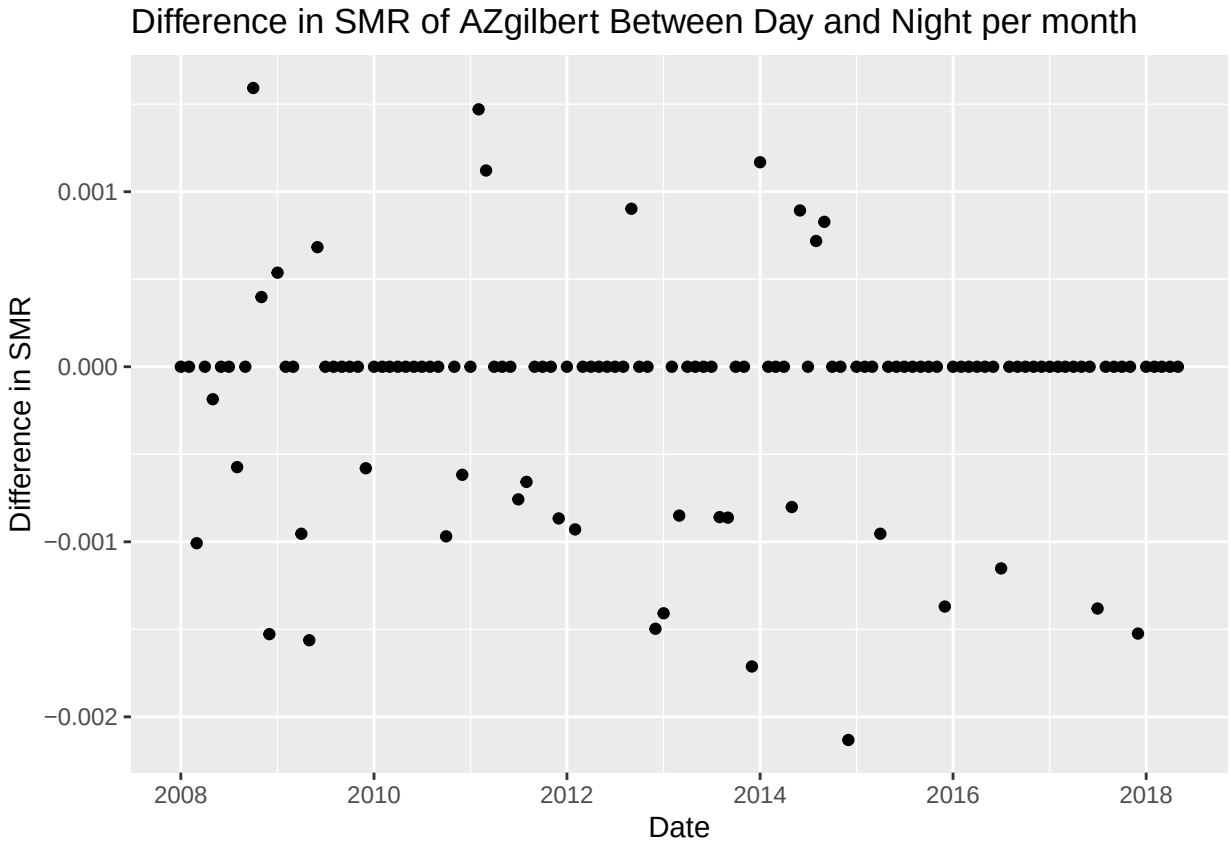

Average monthly SMR of VTstatewide2020
day
night
0.020
0.015
0.010
0.005
Average SMR
2012
2014
2016
Date

```
##
## [[55]]
```

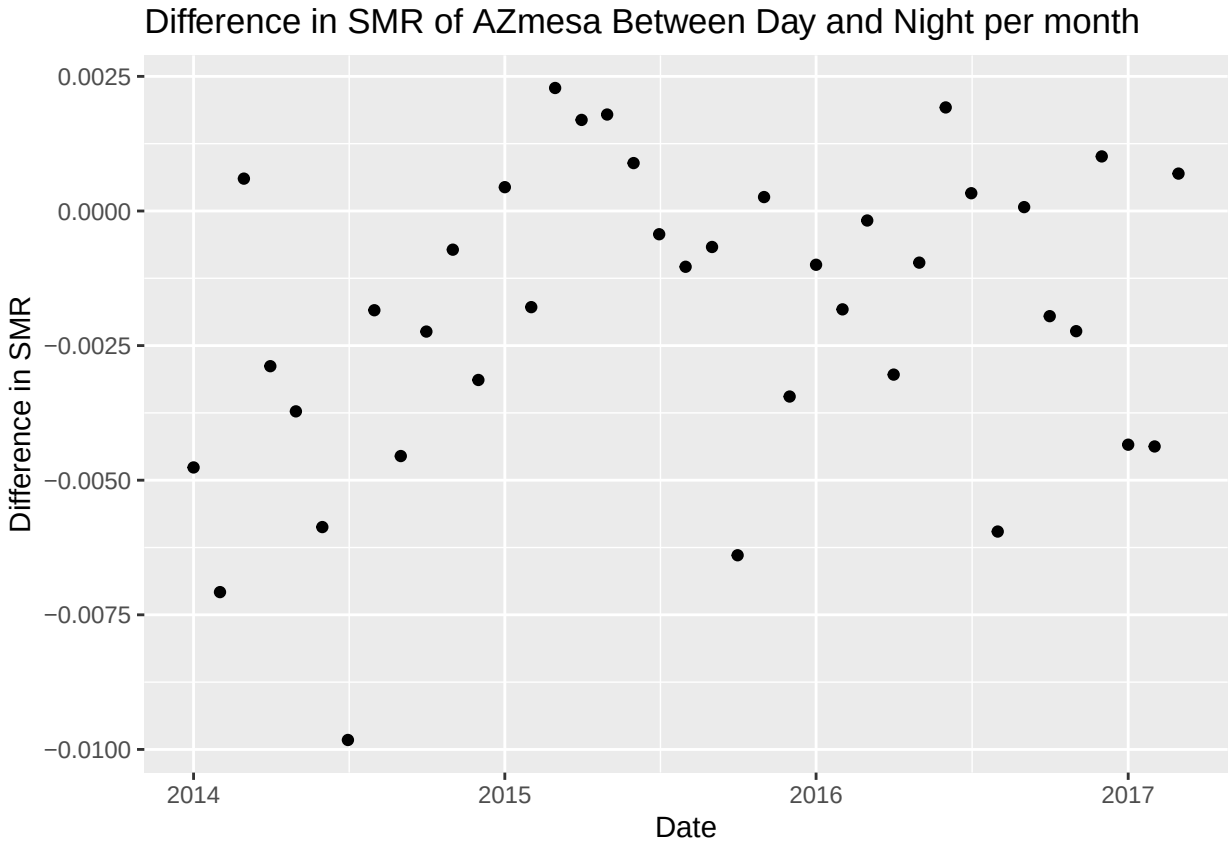



```
ggplot_sunriseset(sunrisesetdiff_df, "diff_SMR")
```

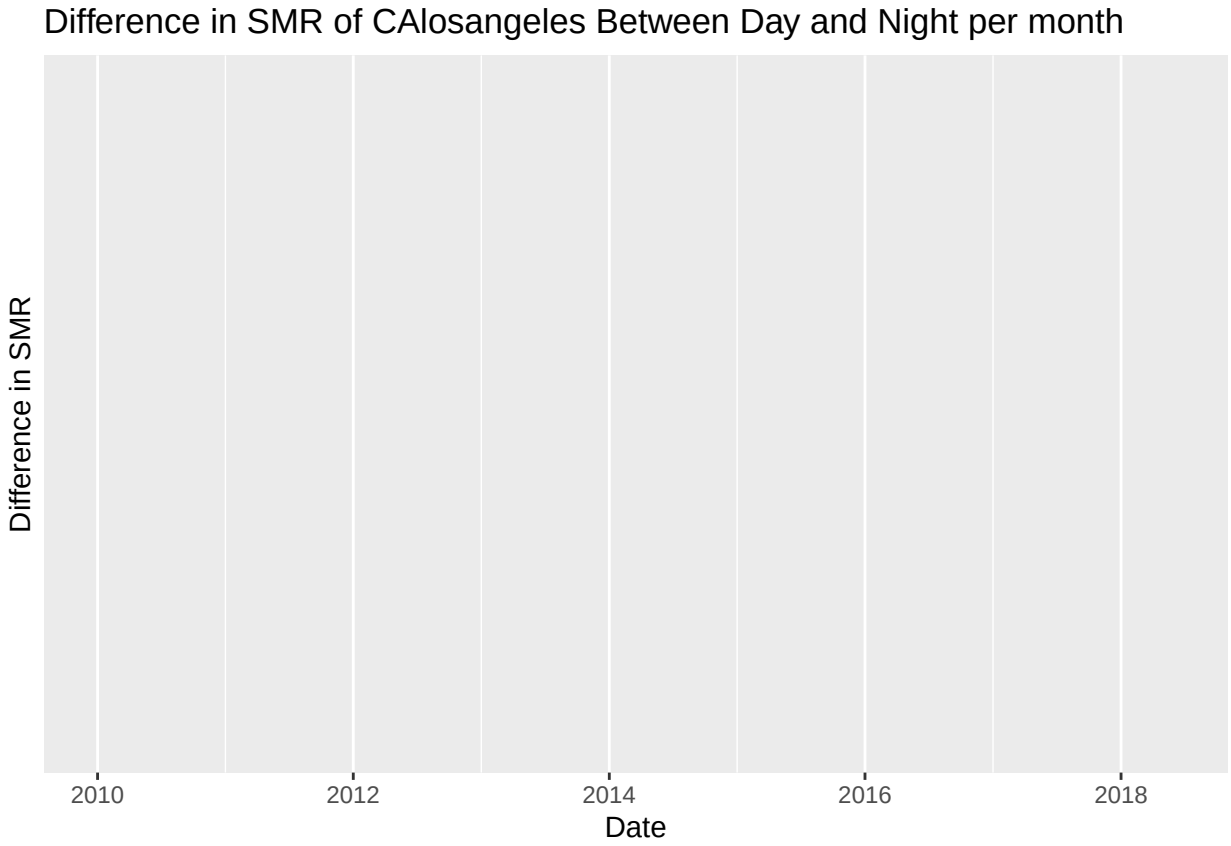
```
## [[1]]
```


Difference in SMR of AZgilbert Between Day and Night per month
Difference in SMR
0.001
0.000
−0.001
−0.002
2008
2010
2012
2014
2016
2018
Date

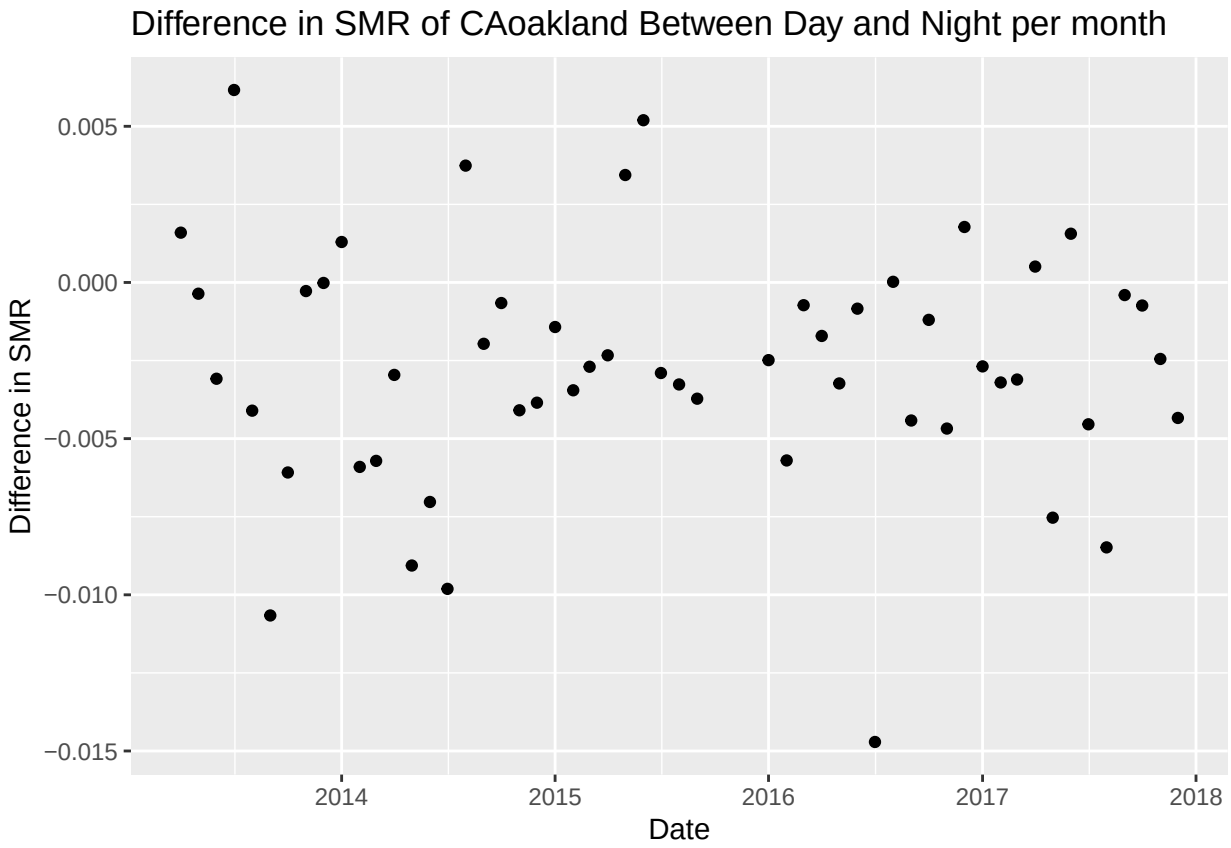
```
##
## [[2]]
```


Difference in SMR of AZmesa Between Day and Night per month
Difference in SMR
0.0025
0.0000
−0.0025
−0.0050
−0.0075
−0.0100
2014
2015
2016
2017
Date

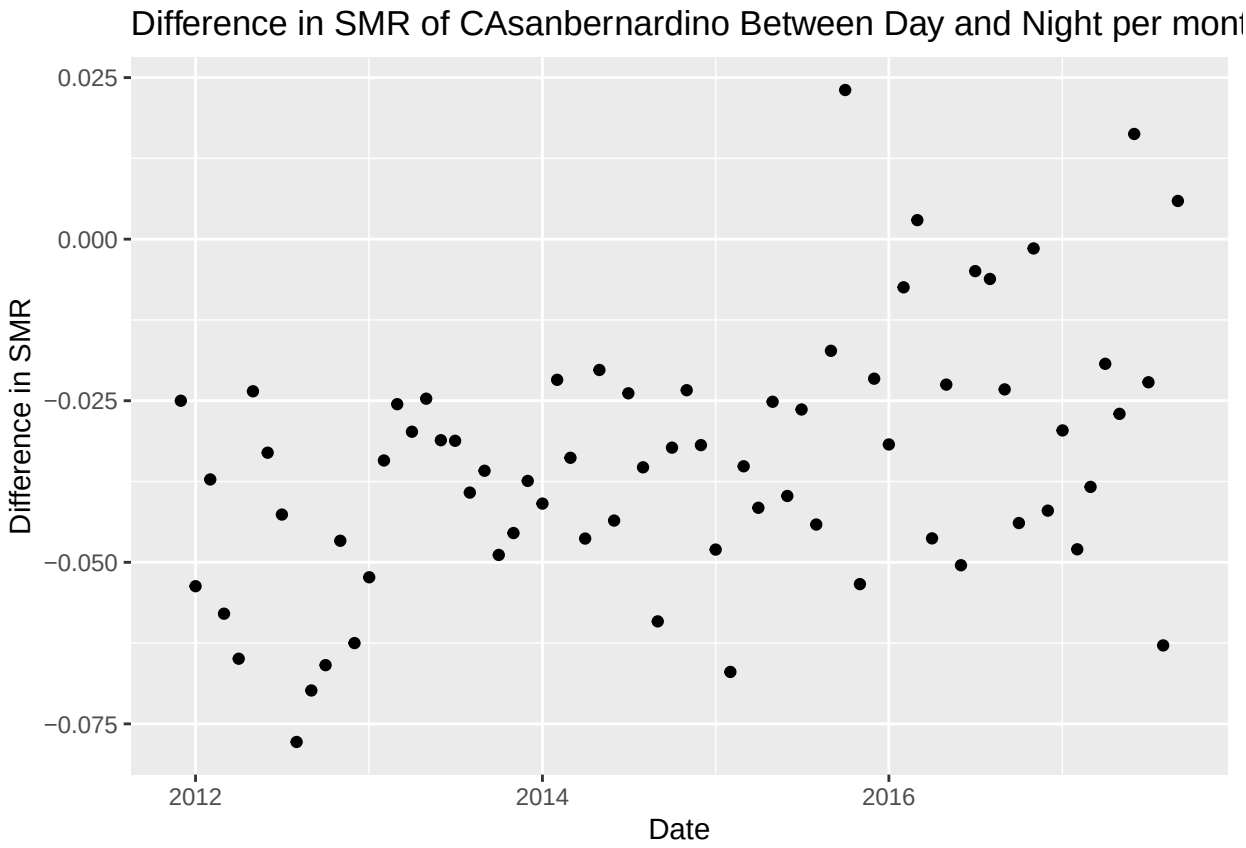
```
##
## [[3]]
```


Difference in SMR of CAlosangeles Between Day and Night per month
Difference in SMR
2010
2012
2014
2016
2018
Date

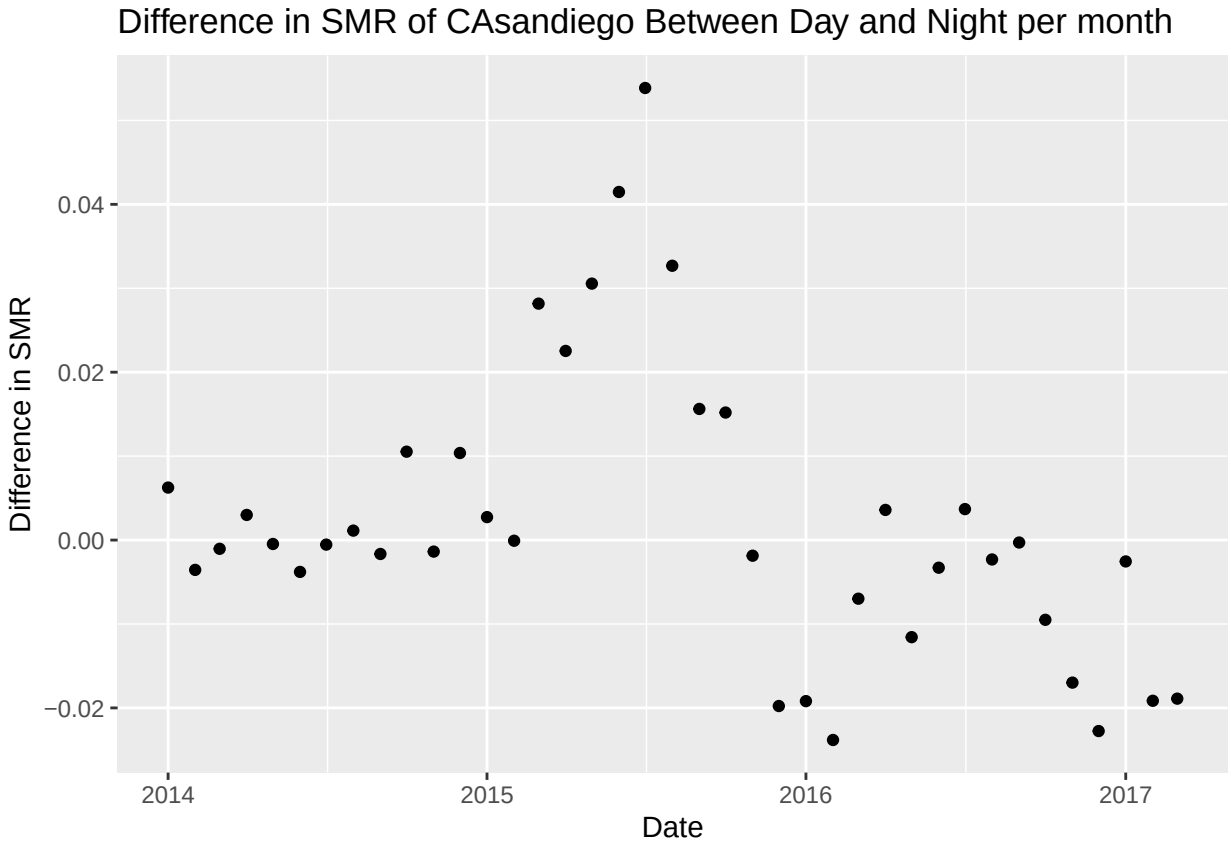
```
##
## [[4]]
```


Difference in SMR of CAoakland Between Day and Night per month
Difference in SMR
0.005
0.000
−0.005
−0.010
−0.015
2014
2015
2016
2017
2018
Date

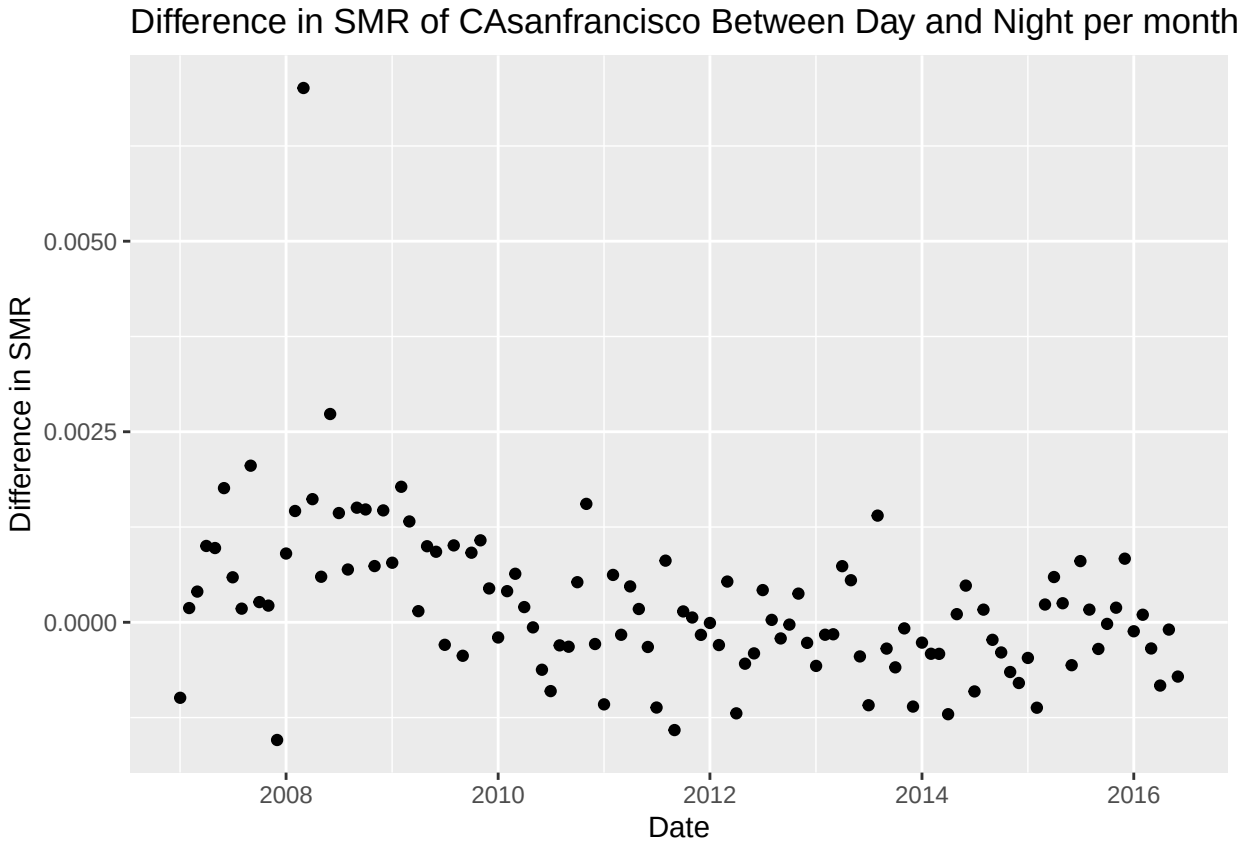
```
##
## [[5]]
```


Difference in SMR of CAsanbernardino Between Day and Night per mont
0.025
0.000
−0.025
−0.050
−0.075
Difference in SMR
2012
2014
2016
Date

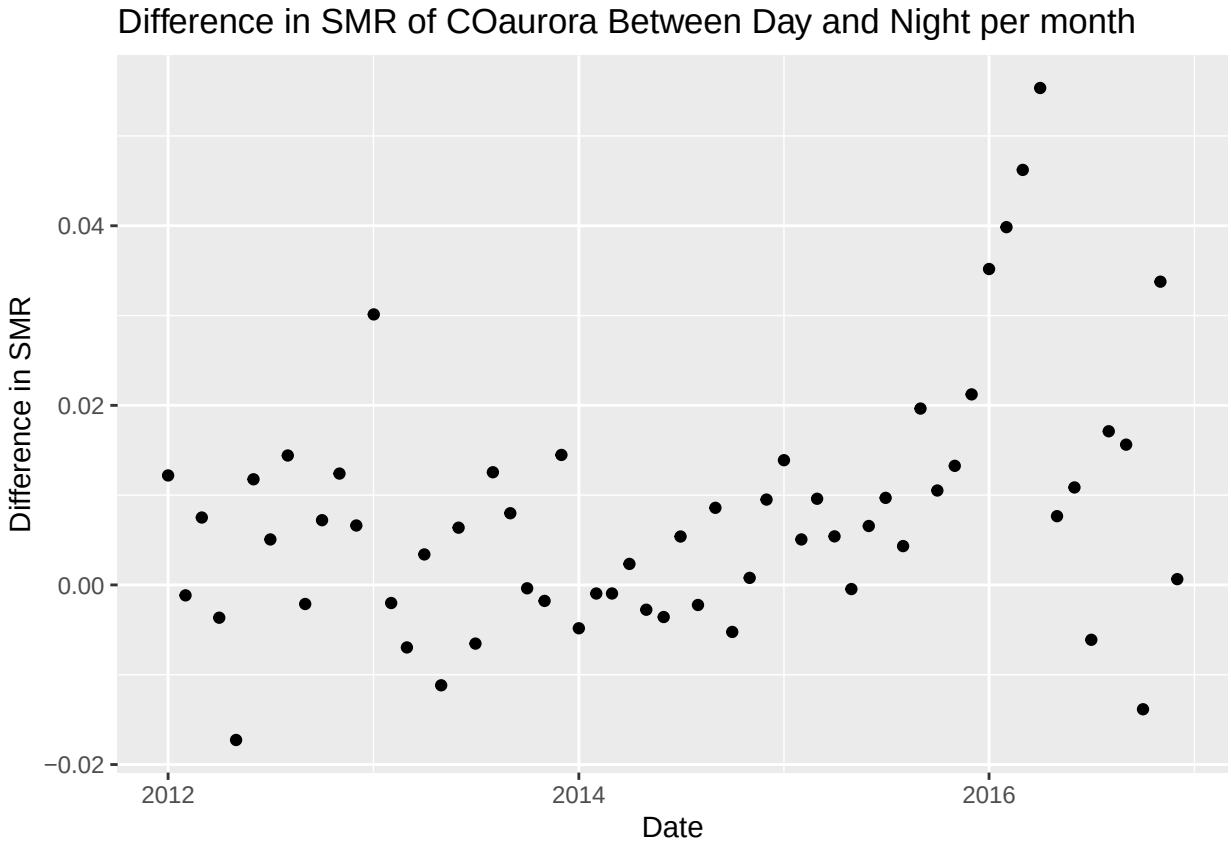
```
##
## [[6]]
```


Difference in SMR of CAsandiego Between Day and Night per month
Difference in SMR
0.04
0.02
0.00
−0.02
2014
2015
2016
2017
Date

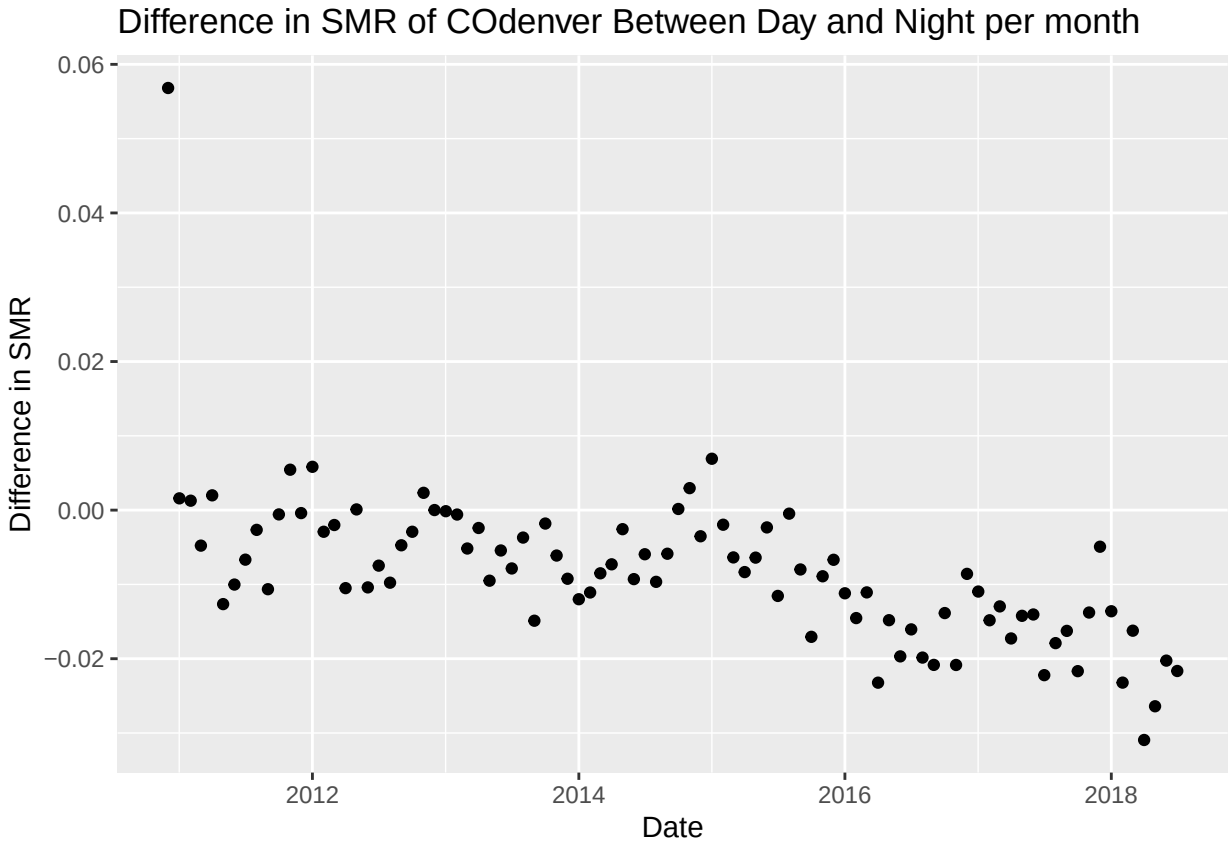
```
##
## [[7]]
```


Difference in SMR of CAsanfrancisco Between Day and Night per month
Difference in SMR
0.0050
0.0025
0.0000
2008
2010
2012
2014
2016
Date

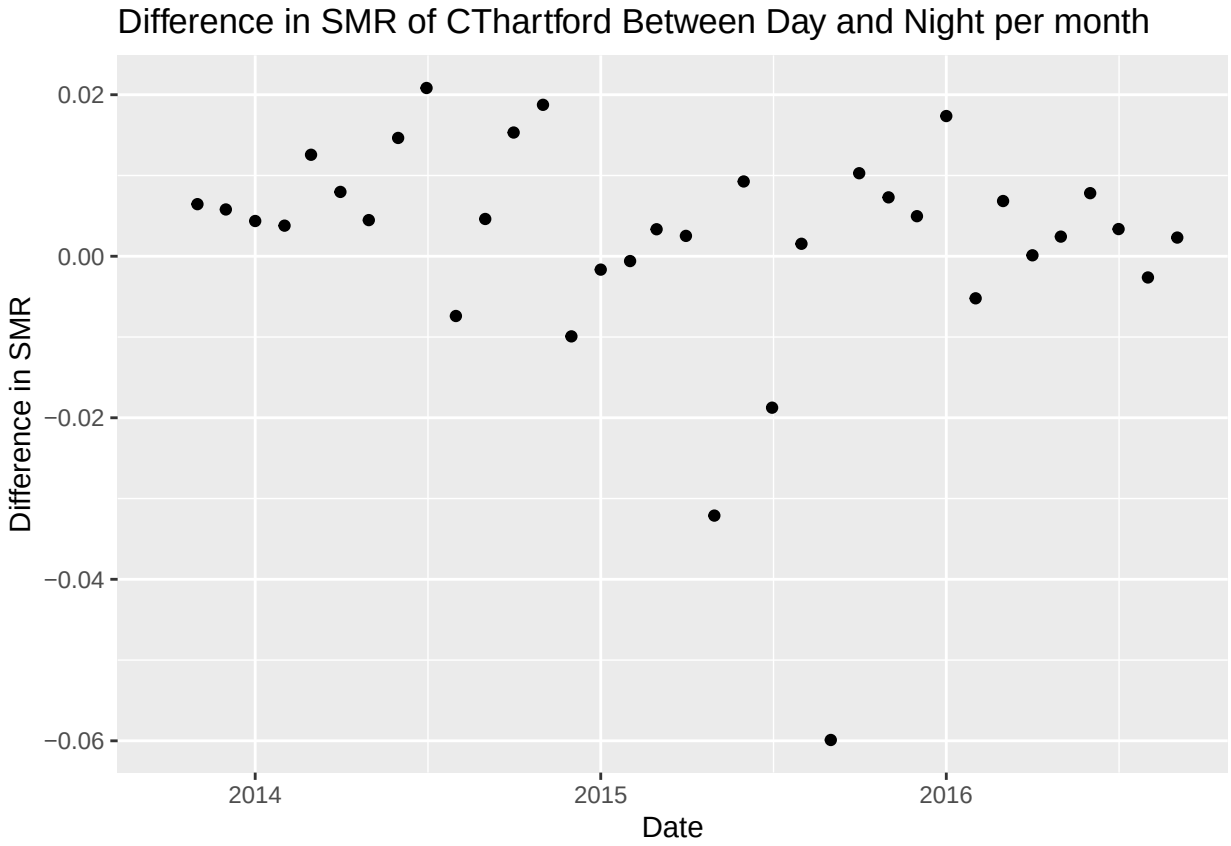
```
##
## [[8]]
```


Difference in SMR of COaurora Between Day and Night per month
Difference in SMR
0.04
0.02
0.00
−0.02
2012
2014
2016
Date

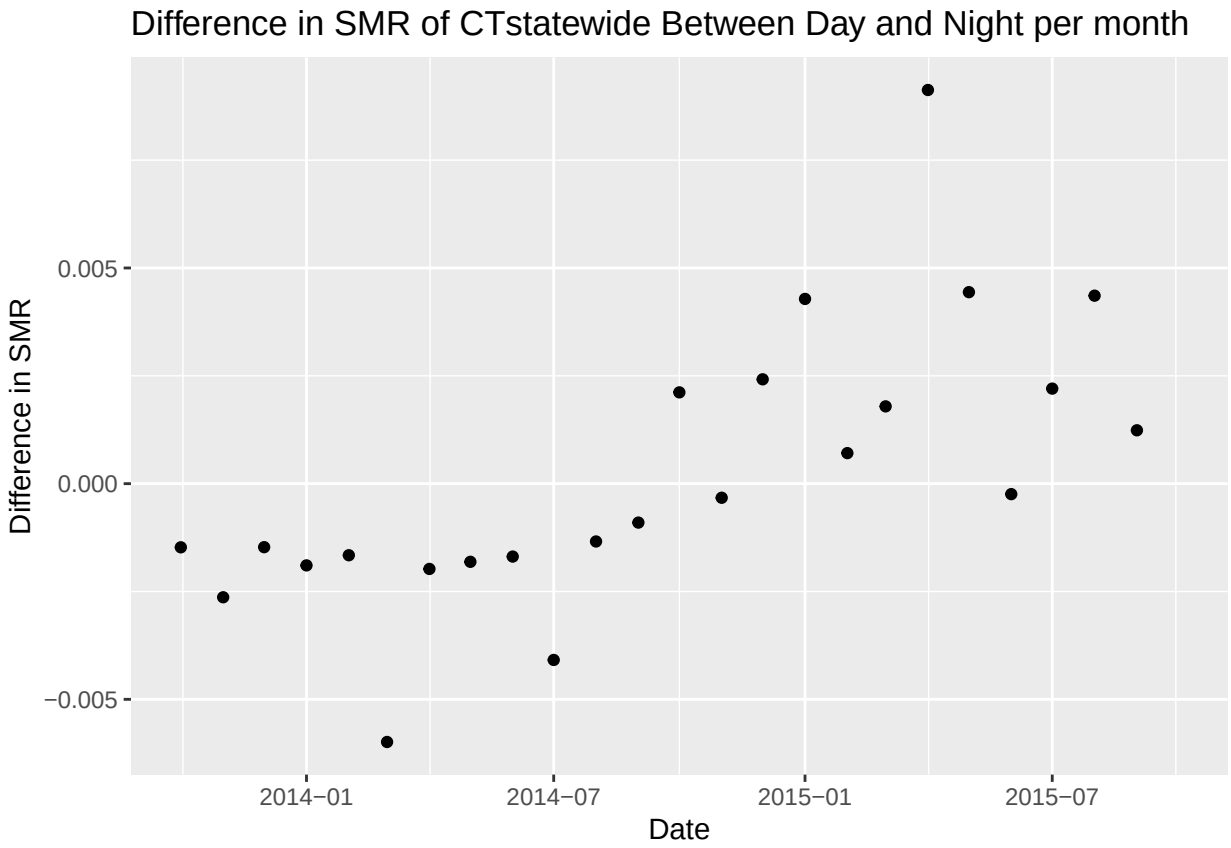
```
##
## [[9]]
```


Difference in SMR of COdenver Between Day and Night per month
Difference in SMR
0.06
0.04
0.02
0.00
−0.02
2012
2014
2016
2018
Date

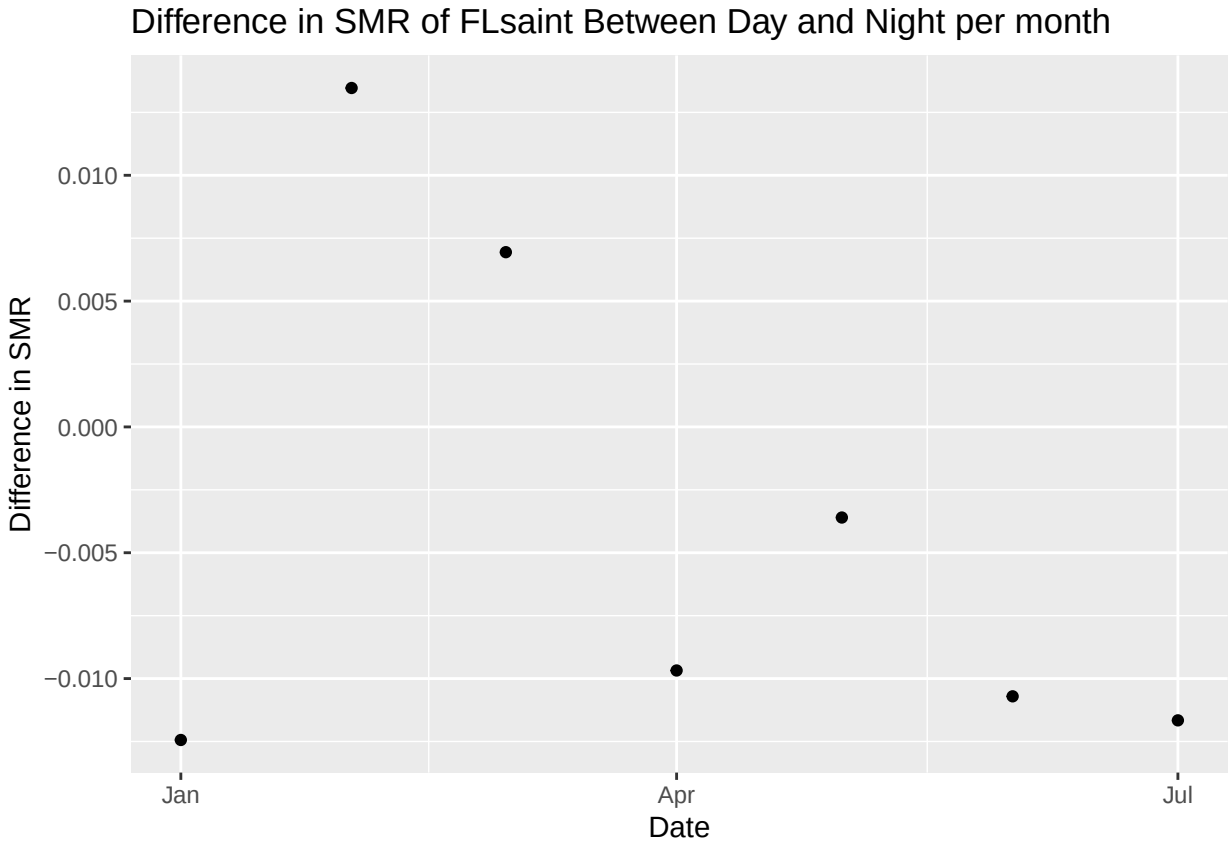
```
##
## [[10]]
```


Difference in SMR of CThartford Between Day and Night per month
0.02
0.00
−0.02
−0.04
−0.06
Difference in SMR
2014
2015
2016
Date

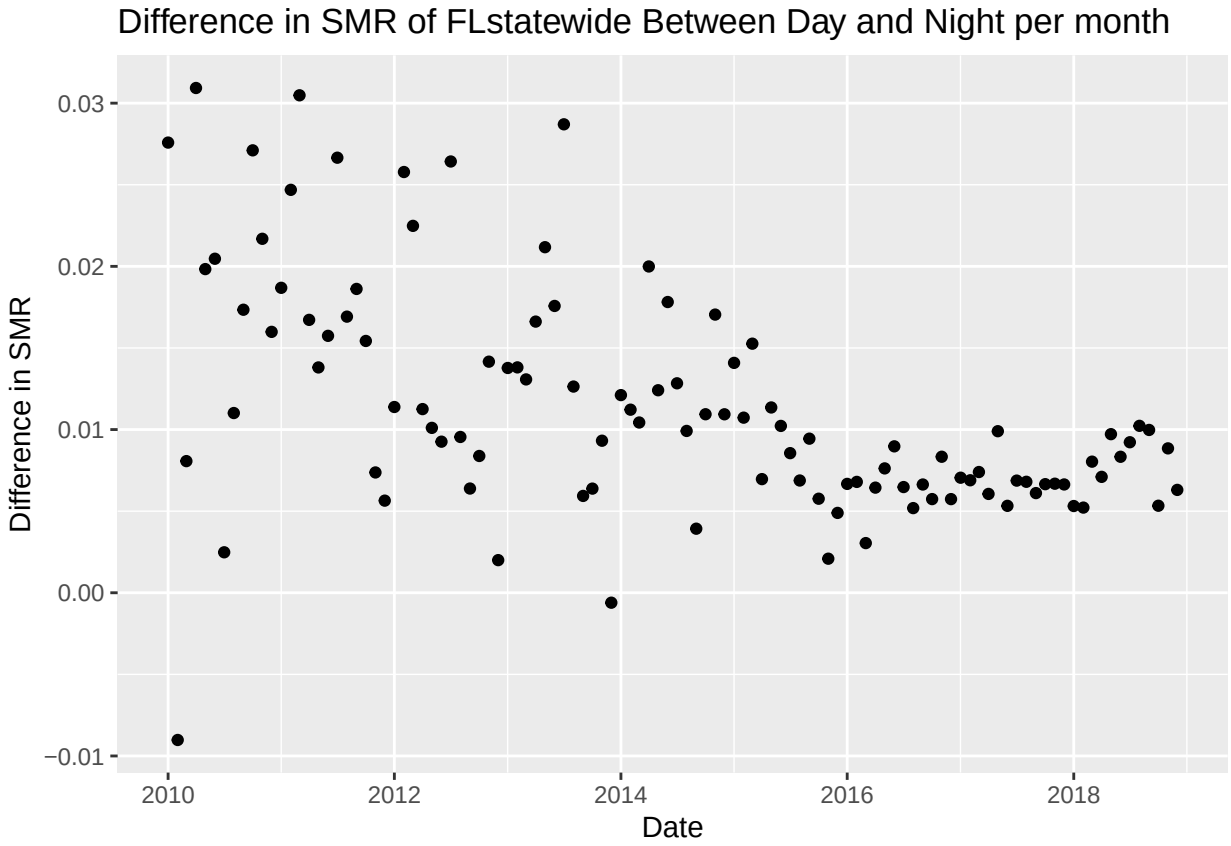
```
##
## [[11]]
```


Difference in SMR of CTstatewide Between Day and Night per month
Difference in SMR
0.005
0.000
−0.005
2014−01
2014−07
2015−01
2015−07
Date

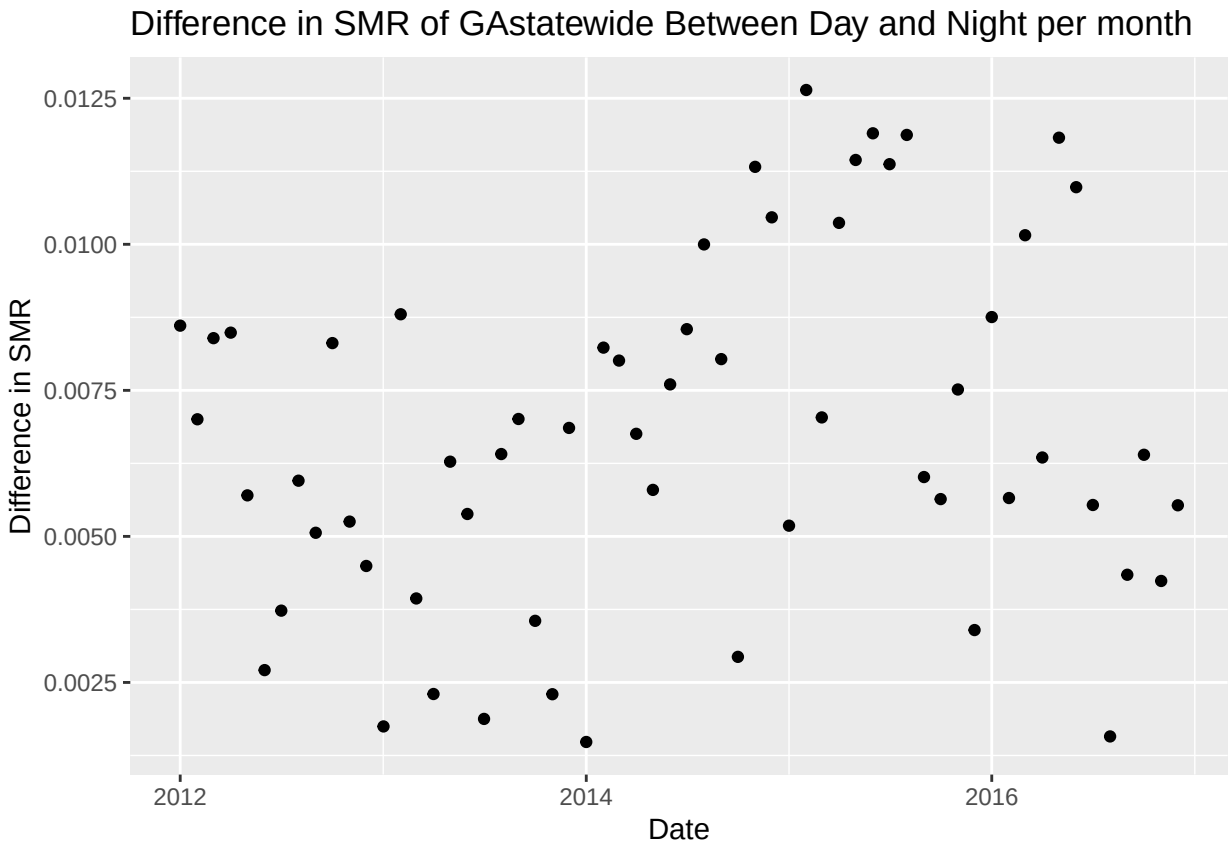
```
##
## [[12]]
```


Difference in SMR of FLsaint Between Day and Night per month
Difference in SMR
0.010
0.005
0.000
−0.005
−0.010
Jan
Apr
Jul
Date

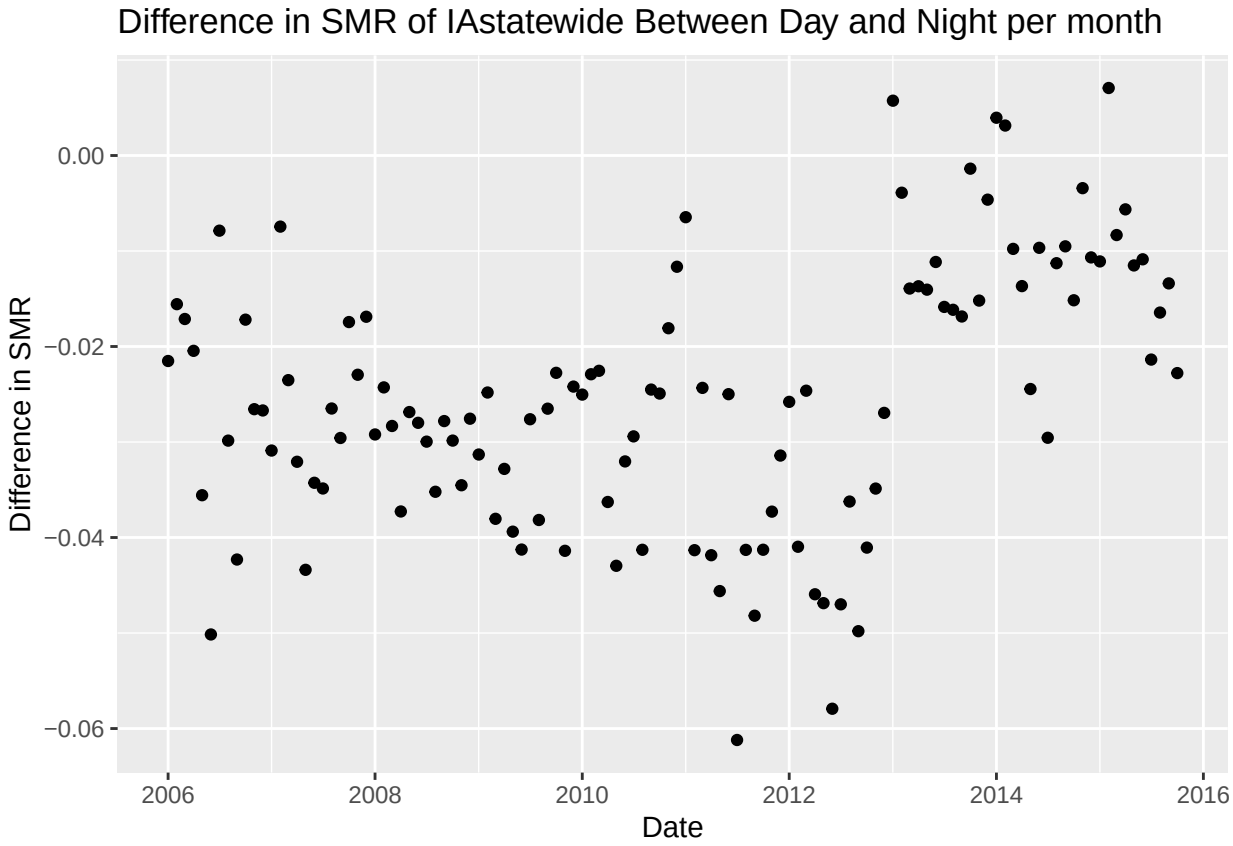
```
##
## [[13]]
```


Difference in SMR of FLstatewide Between Day and Night per month
Difference in SMR
0.03
0.02
0.01
0.00
−0.01
2010
2012
2014
2016
2018
Date

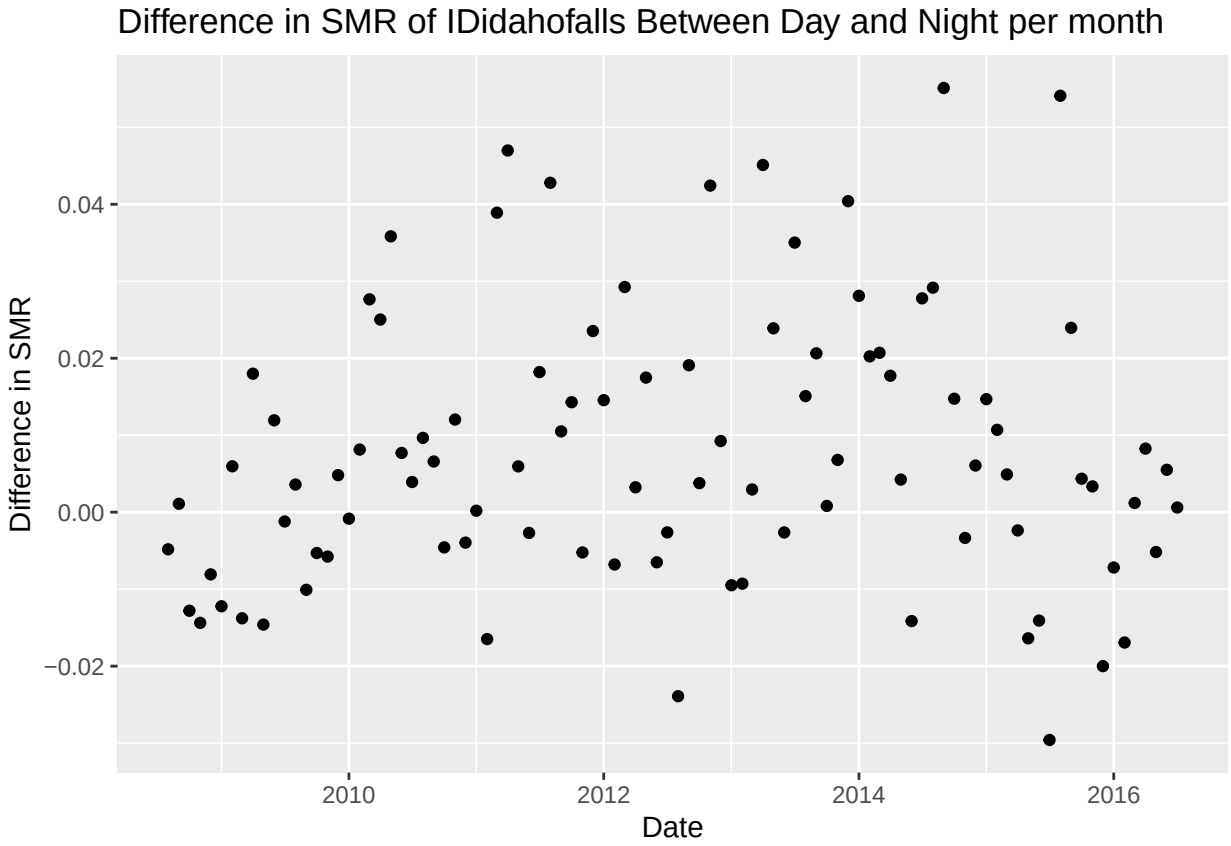
```
##
## [[14]]
```


Difference in SMR of GAstatewide Between Day and Night per month
Difference in SMR
0.0125
0.0100
0.0075
0.0050
0.0025
2012
2014
2016
Date

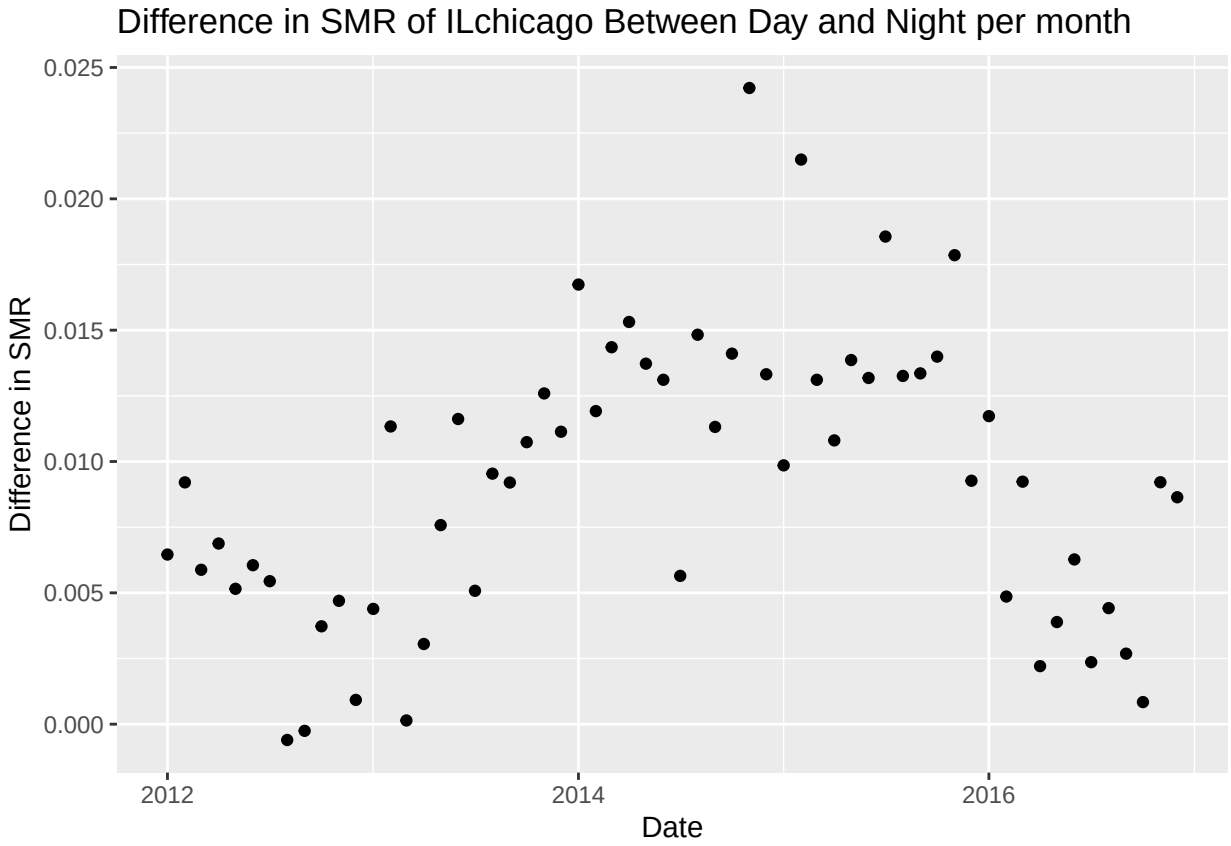
```
##
## [[15]]
```


Difference in SMR of IAstatewide Between Day and Night per month
Difference in SMR
0.00
−0.02
−0.04
−0.06
2006
2008
2010
2012
2014
2016
Date

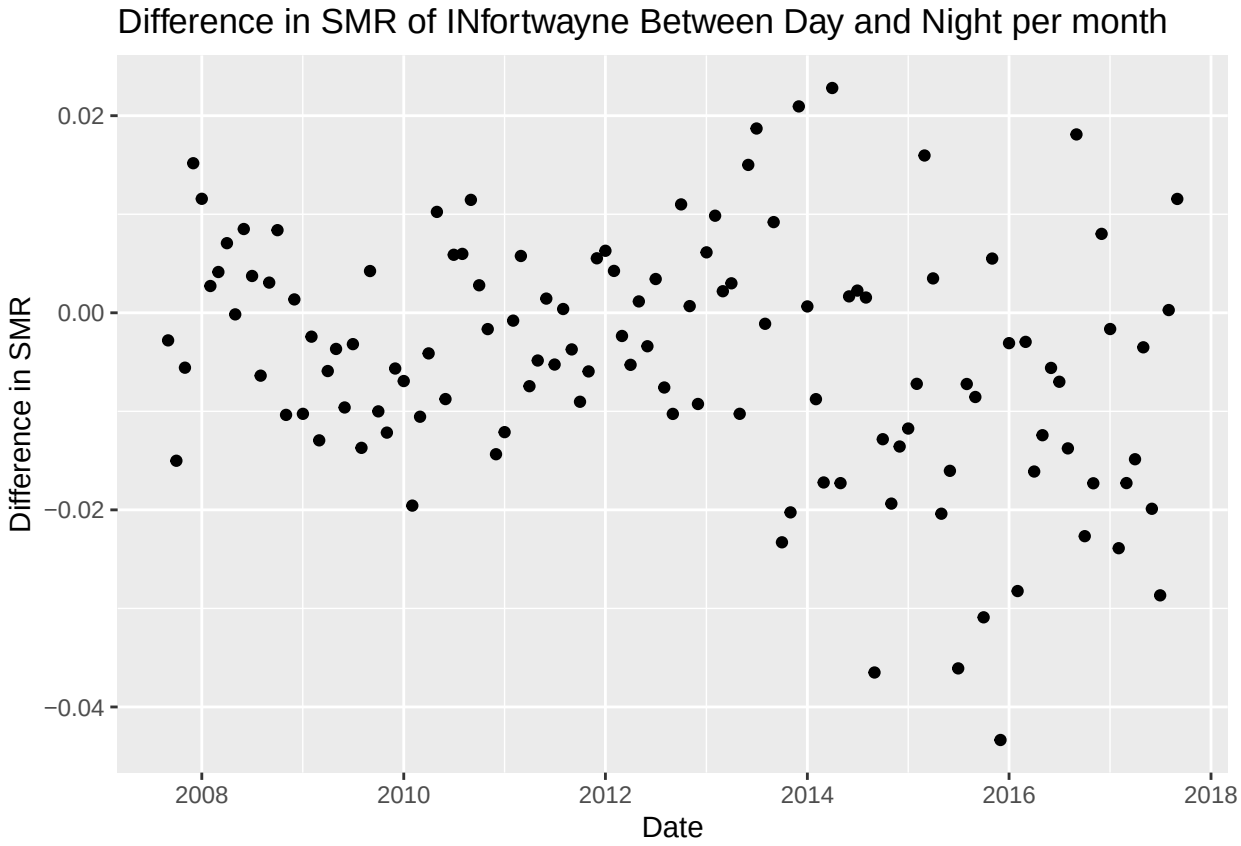
```
##
## [[16]]
```


Difference in SMR of IDidahofalls Between Day and Night per month
Difference in SMR
0.04
0.02
0.00
−0.02
2010
2012
2014
2016
Date

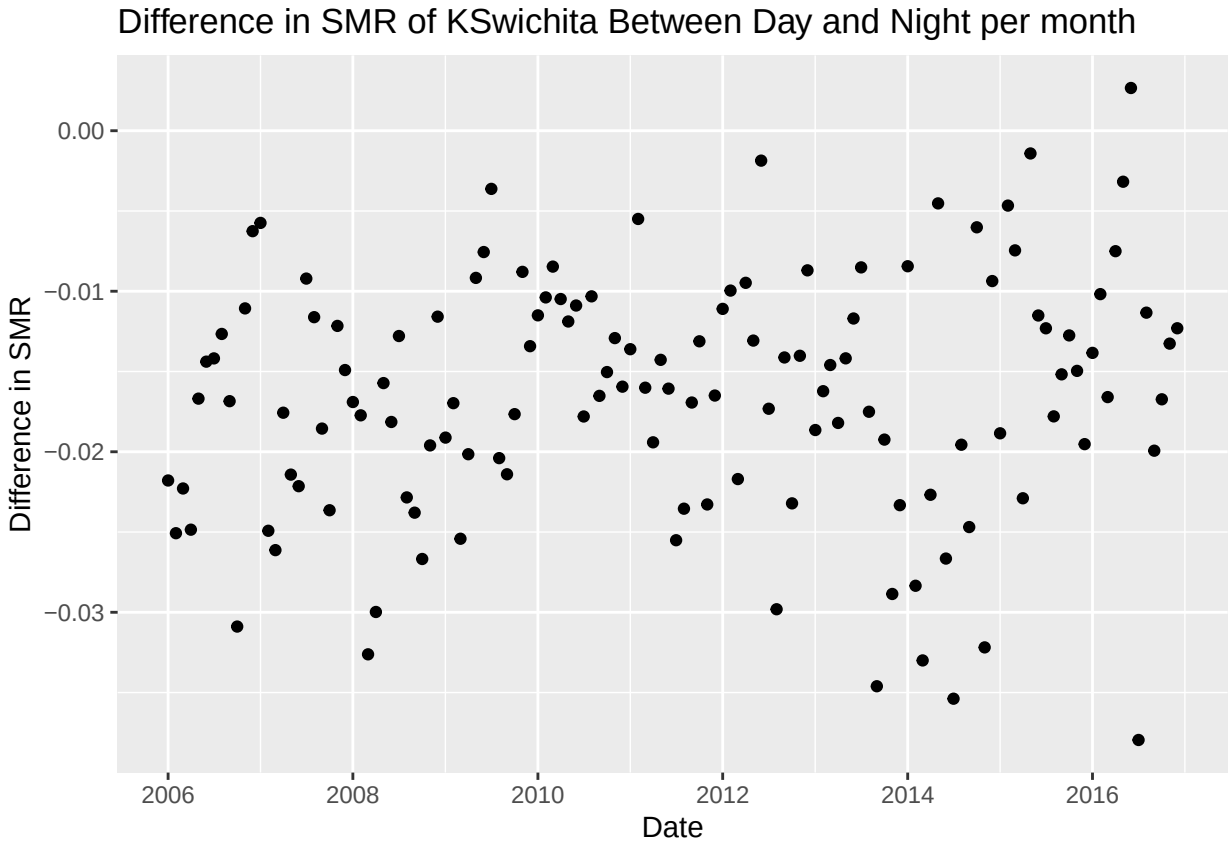
```
##
## [[17]]
```


Difference in SMR of ILchicago Between Day and Night per month
Difference in SMR
0.025
0.020
0.015
0.010
0.005
0.000
2012
2014
2016
Date

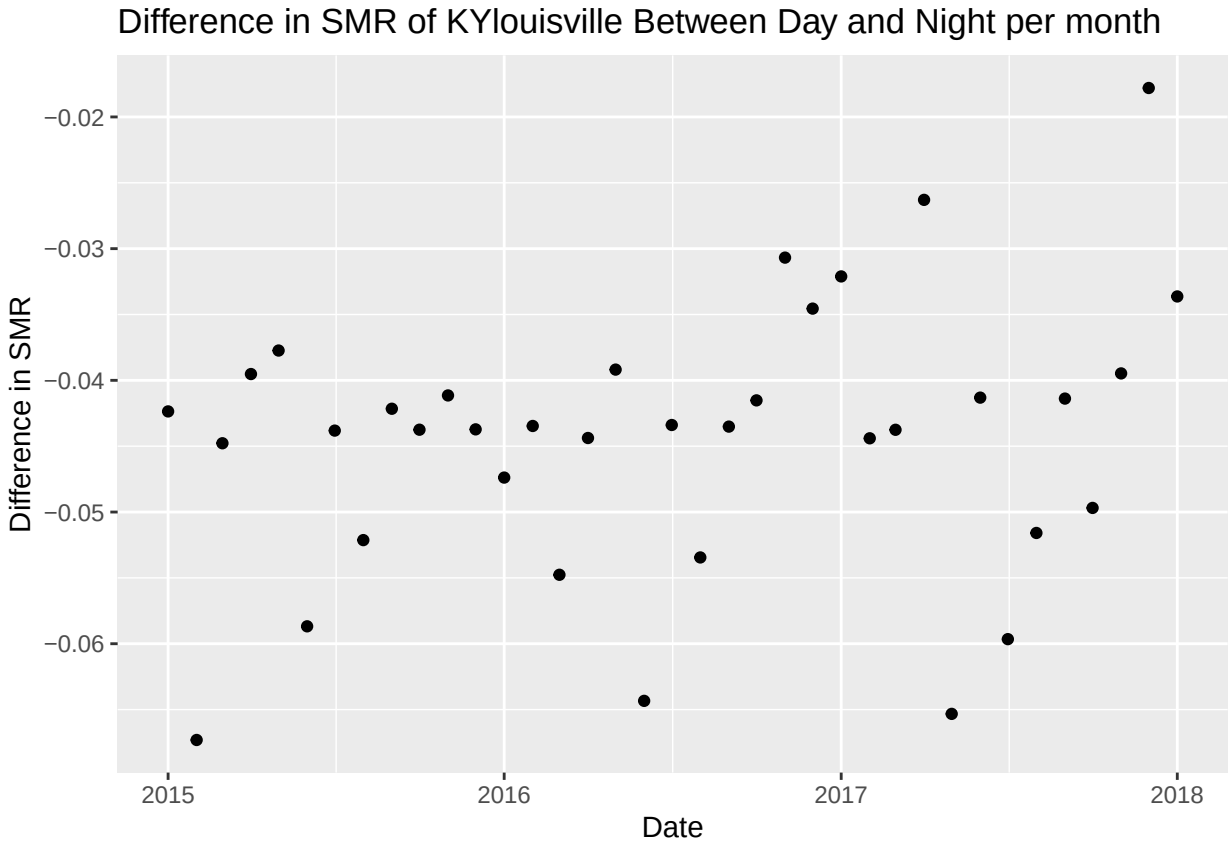
```
##
## [[18]]
```


Difference in SMR of INfortwayne Between Day and Night per month
Difference in SMR
0.02
0.00
−0.02
−0.04
2008
2010
2012
2014
2016
2018
Date

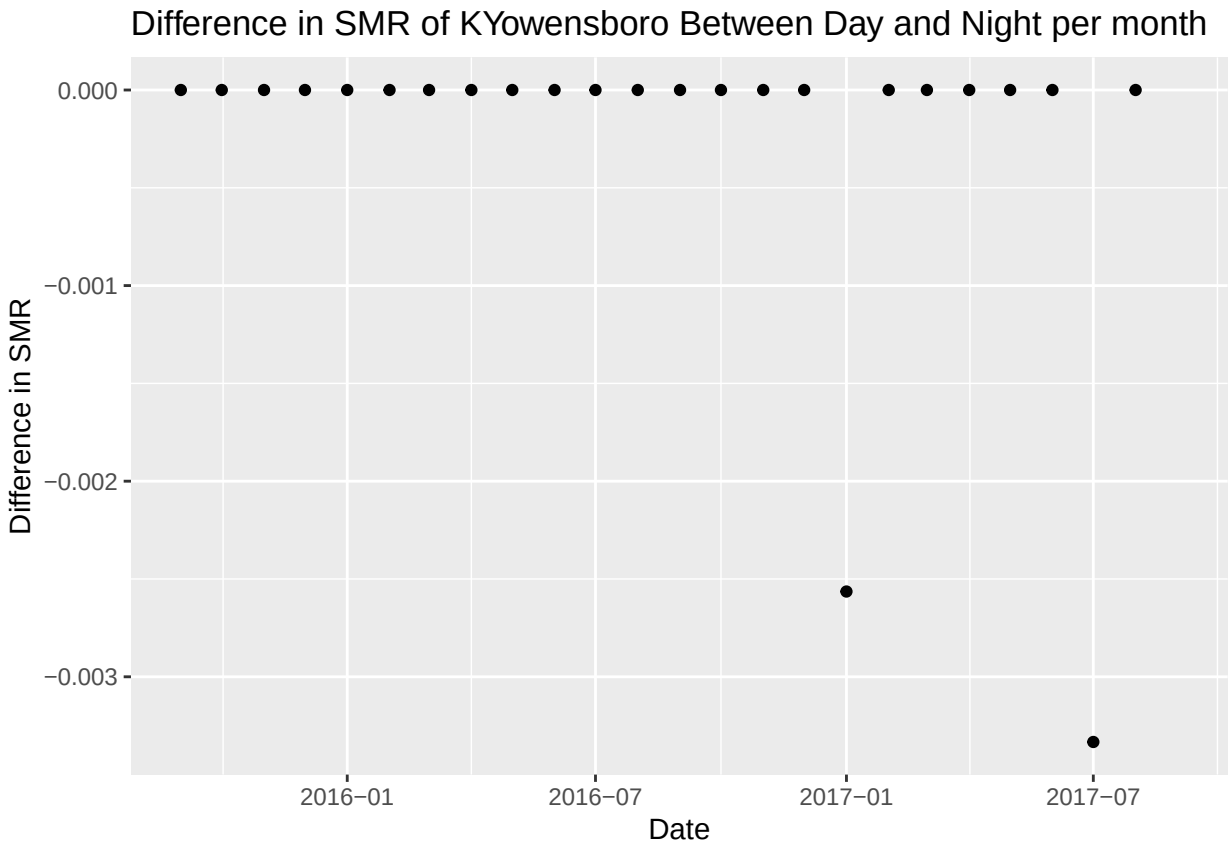
```
##
## [[19]]
```


Difference in SMR of KSwichita Between Day and Night per month
0.00
−0.01
−0.02
−0.03
Difference in SMR
2006
2008
2010
2012
2014
2016
Date

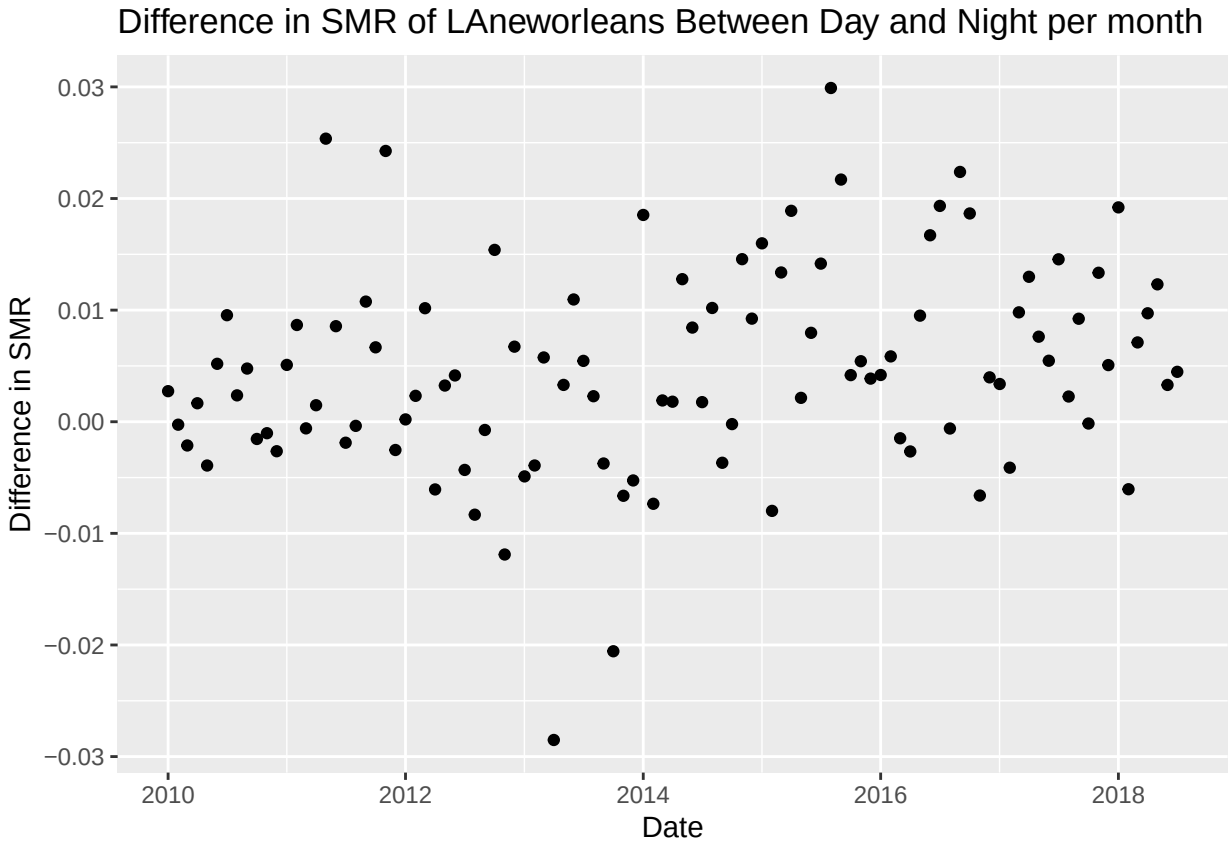
```
##
## [[20]]
```


Difference in SMR of KYlouisville Between Day and Night per month
Difference in SMR
−0.02
−0.03
−0.04
−0.05
−0.06
2015
2016
2017
2018
Date

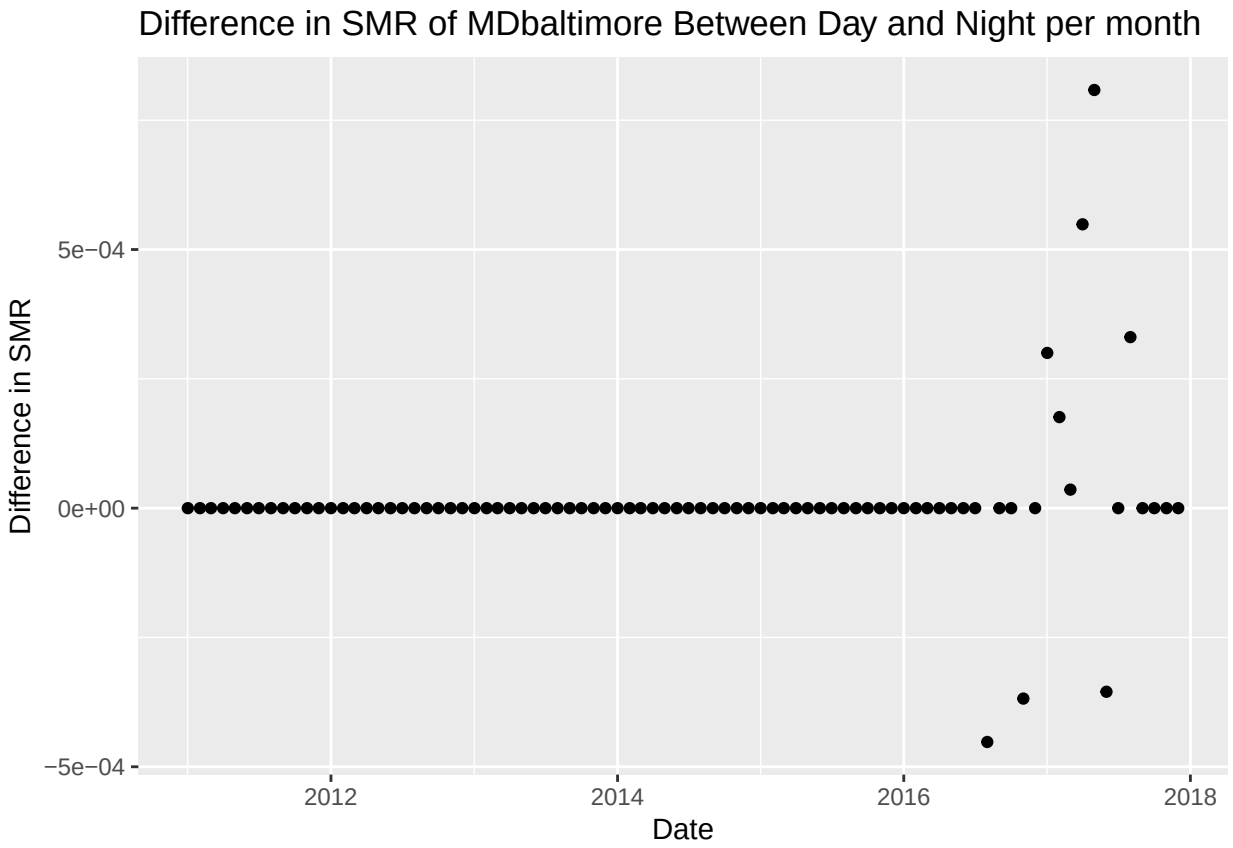
```
##
## [[21]]
```


Difference in SMR of KYowensboro Between Day and Night per month
0.000
−0.001
−0.002
−0.003
Difference in SMR
2016−01
2016−07
2017−01
2017−07
Date

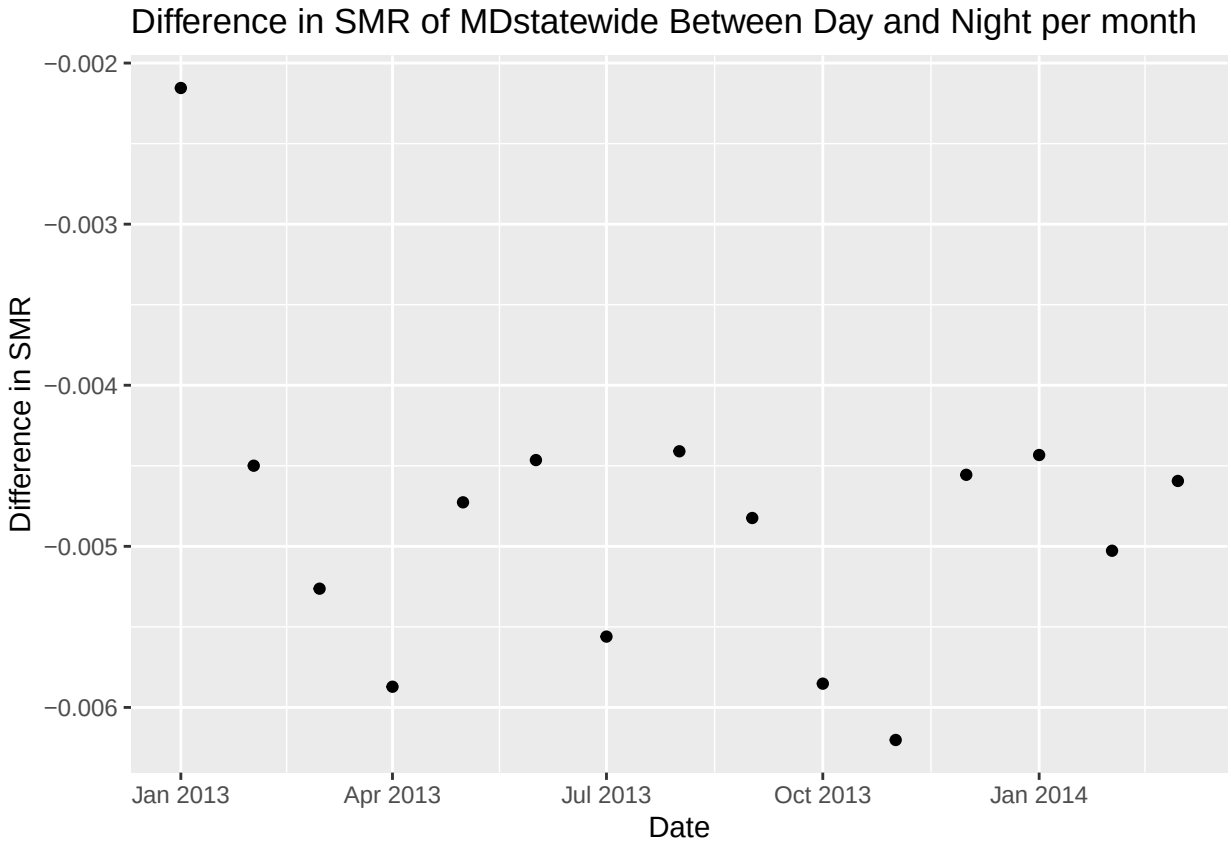
```
##
## [[22]]
```


Difference in SMR of LAneworleans Between Day and Night per month
Difference in SMR
0.03
0.02
0.01
0.00
−0.01
−0.02
−0.03
2010
2012
2014
2016
2018
Date

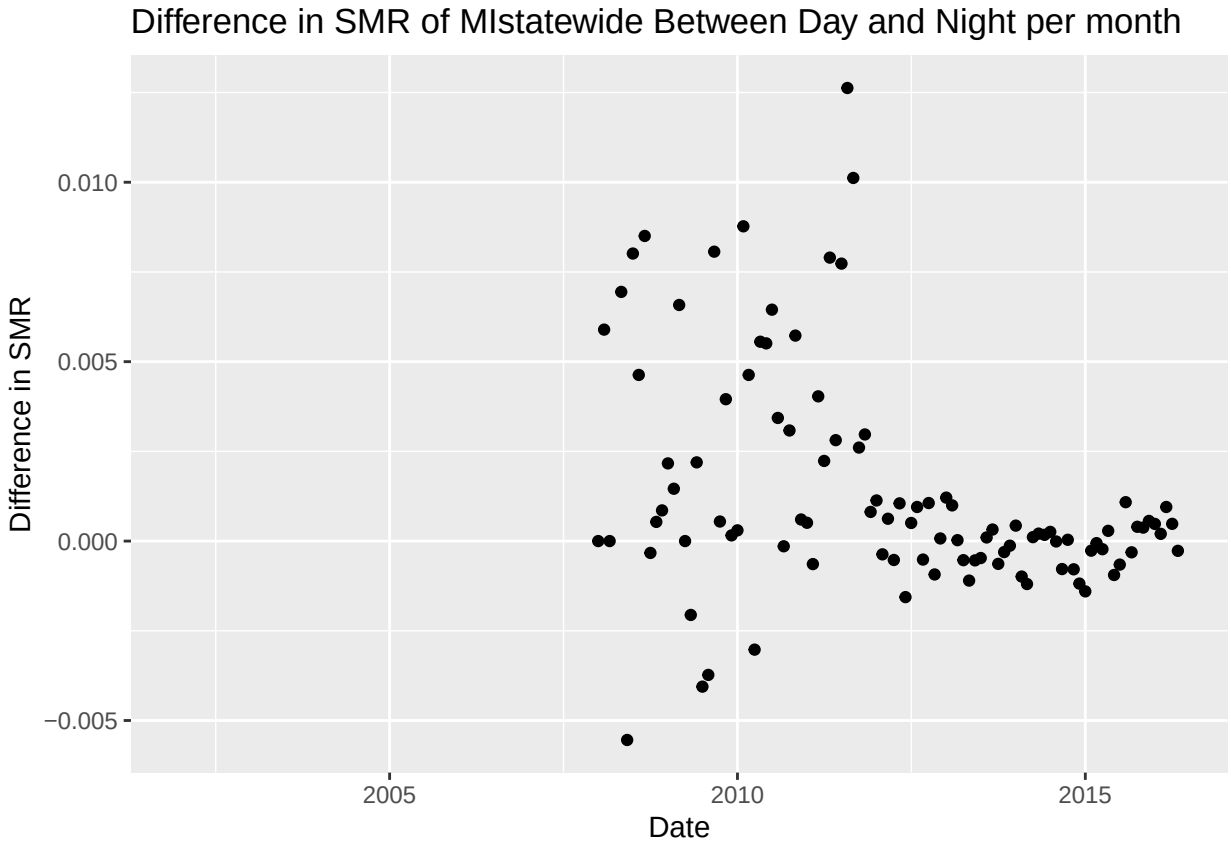
```
##
## [[23]]
```


Difference in SMR of MDbaltimore Between Day and Night per month
Difference in SMR
5e−04
0e+00
−5e−04
2012
2014
2016
2018
Date

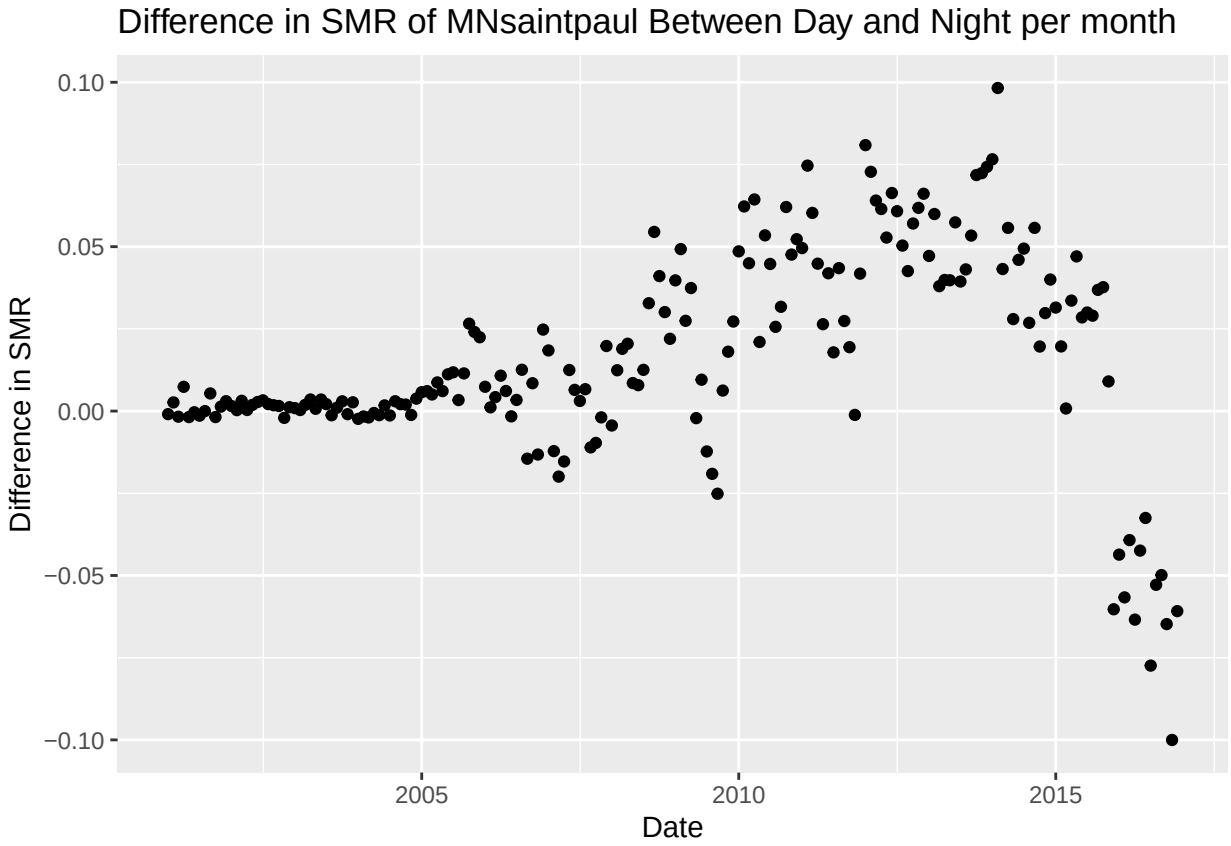
```
##
## [[24]]
```


Difference in SMR of MDstatewide Between Day and Night per month
−0.002
−0.003
−0.004
−0.005
−0.006
Difference in SMR
Jan 2013
Apr 2013
Jul 2013
Oct 2013
Jan 2014
Date

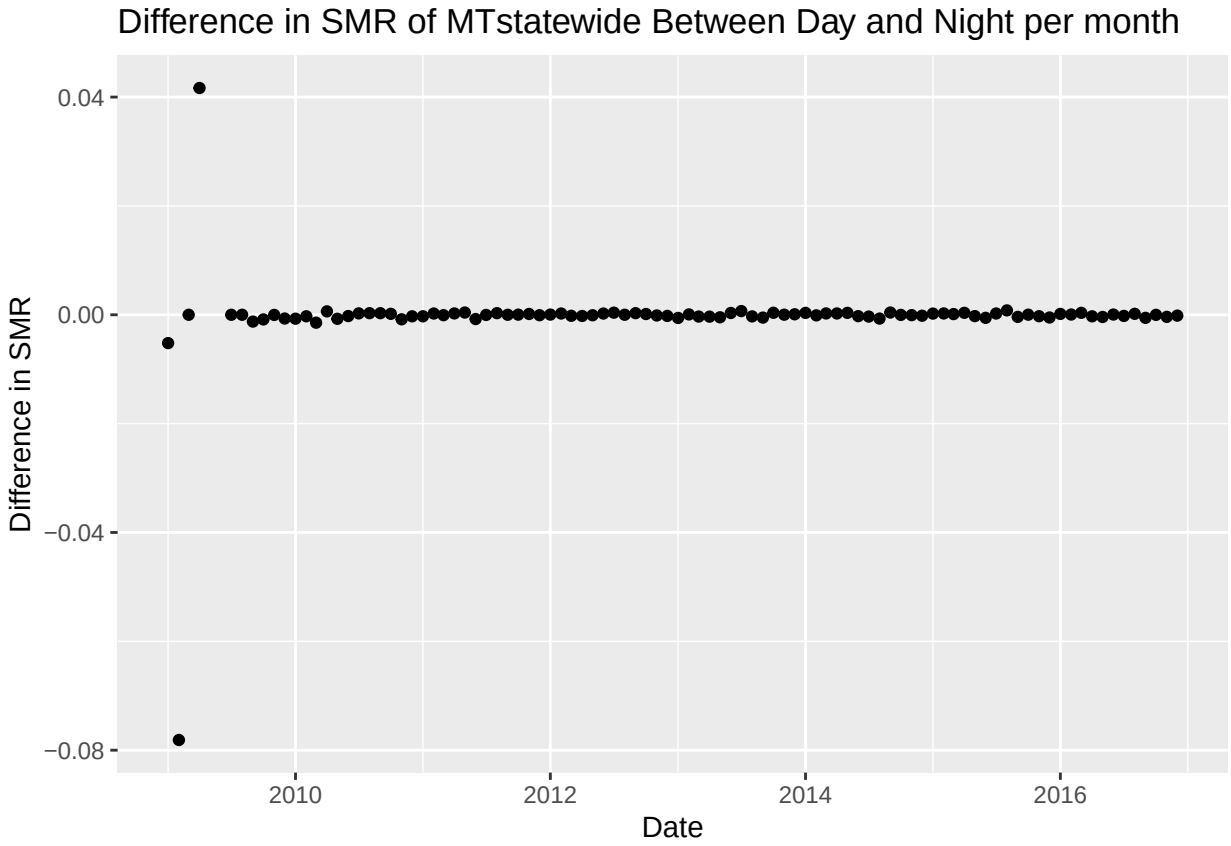
```
##
## [[25]]
```


Difference in SMR of MIstatewide Between Day and Night per month
Difference in SMR
0.010
0.005
0.000
−0.005
2005
2010
2015
Date

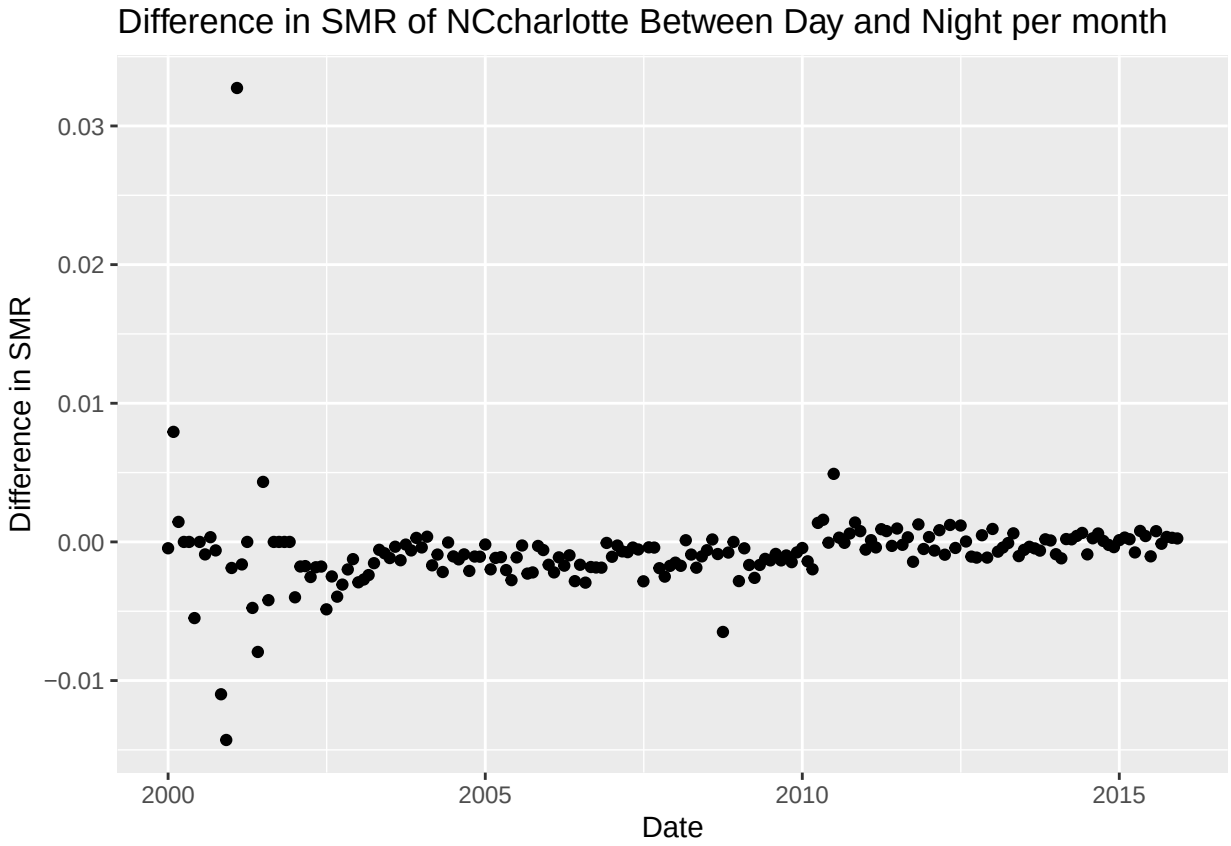
```
##
## [[26]]
```


Difference in SMR of MNsaintpaul Between Day and Night per month
0.10
0.05
0.00
−0.05
−0.10
Difference in SMR
2005
2010
2015
Date

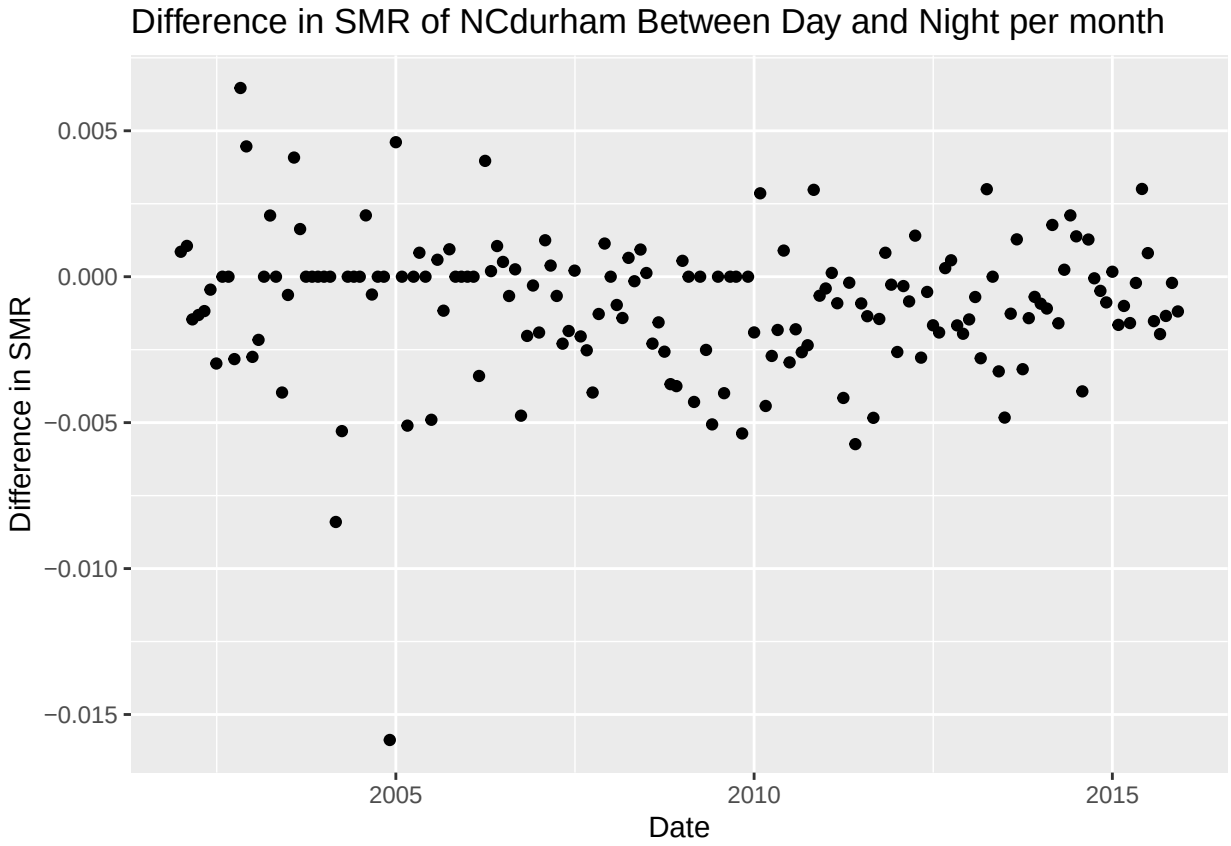
```
##
## [[27]]
```


Difference in SMR of MTstatewide Between Day and Night per month
0.04
0.00
−0.04
−0.08
Difference in SMR
2010
2012
2014
2016
Date

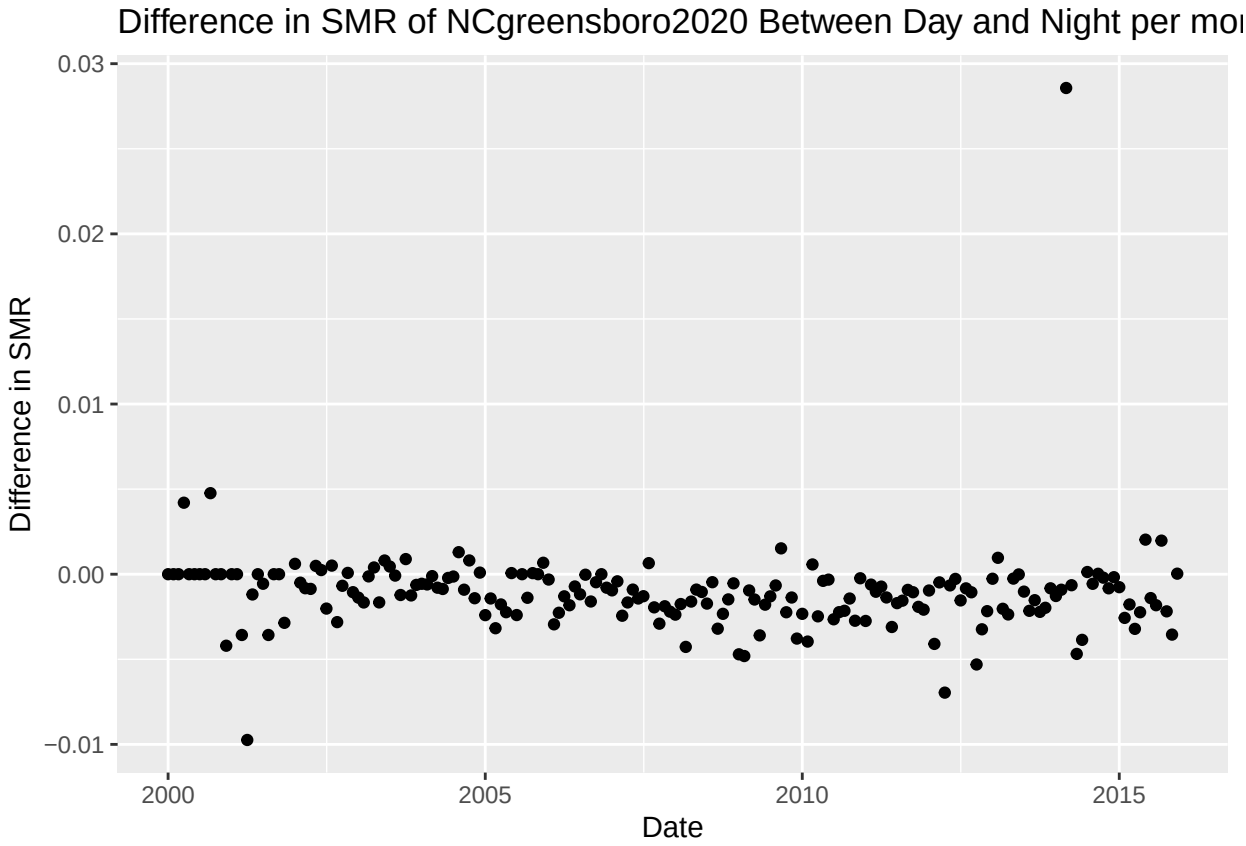
```
##
## [[28]]
```


Difference in SMR of NCcharlotte Between Day and Night per month
Difference in SMR
0.03
0.02
0.01
0.00
−0.01
2000
2005
2010
2015
Date

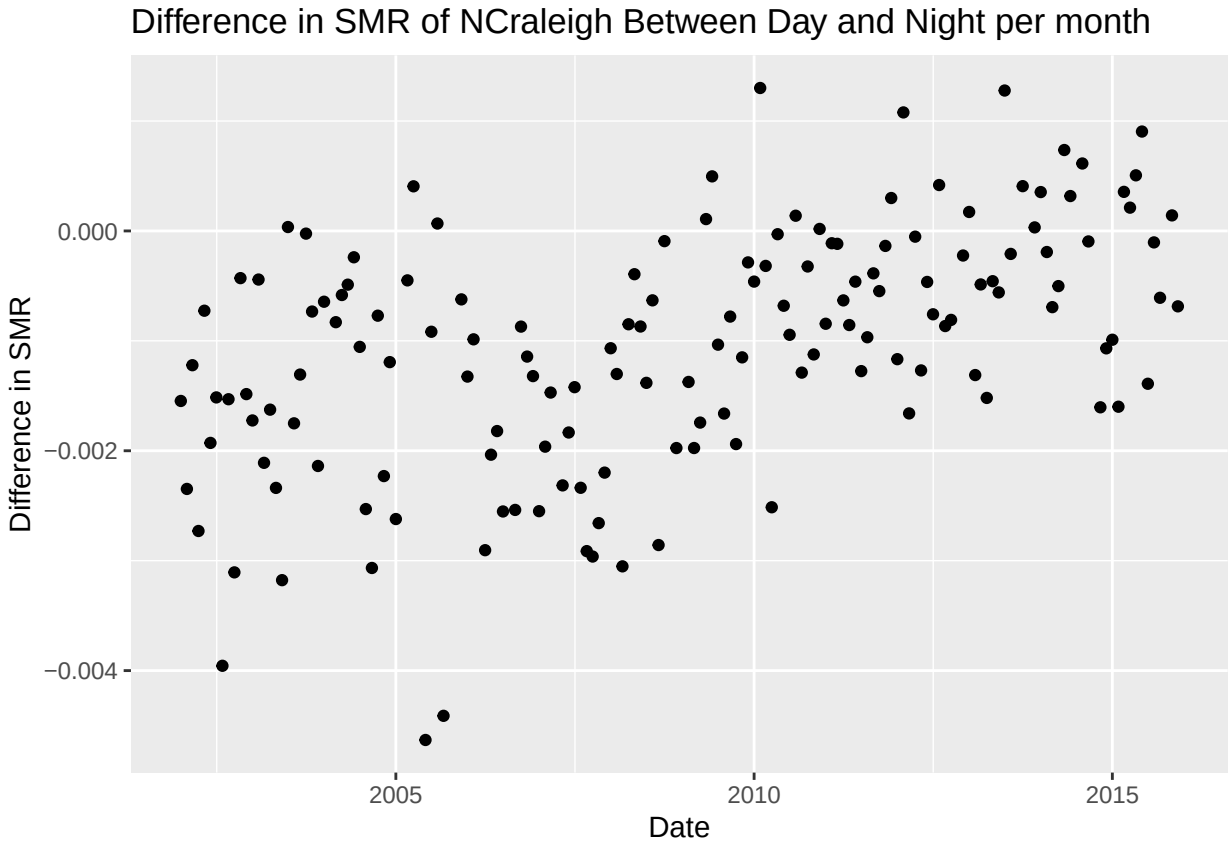
```
##
## [[29]]
```


Difference in SMR of NCdurham Between Day and Night per month
Difference in SMR
0.005
0.000
−0.005
−0.010
−0.015
2005
2010
2015
Date

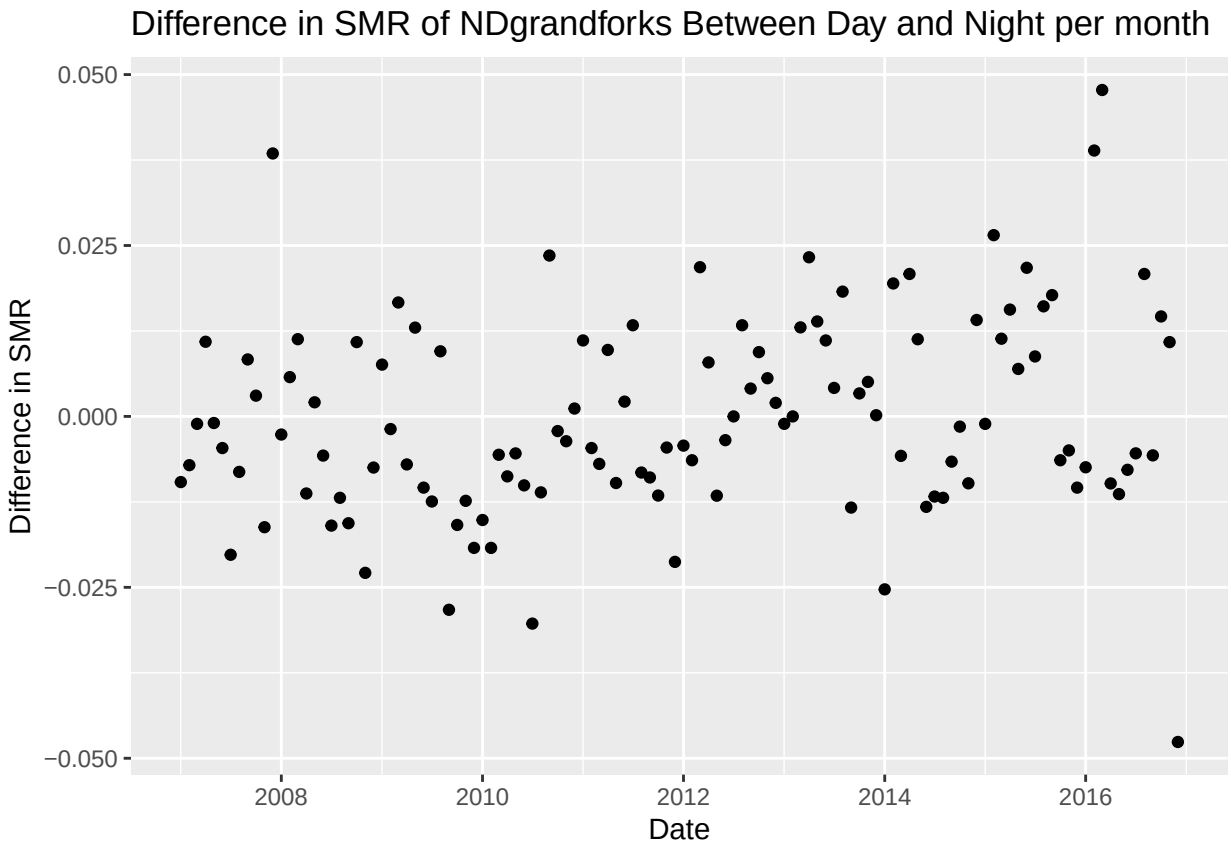
```
##
## [[30]]
```


Difference in SMR of NCgreensboro2020 Between Day and Night per mo
0.03
0.02
0.01
0.00
−0.01
Difference in SMR
2000
2005
2010
2015
Date

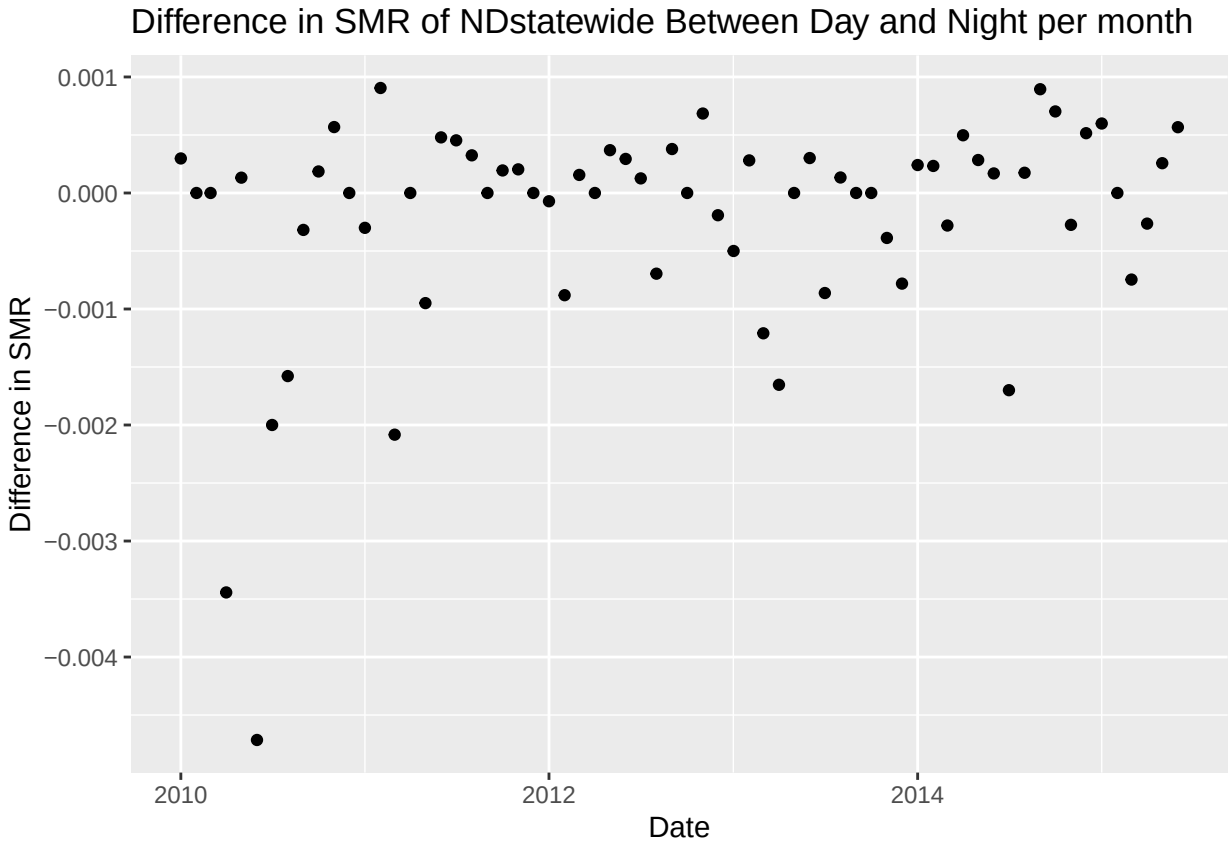
```
##
## [[31]]
```


Difference in SMR of NCraleigh Between Day and Night per month
Difference in SMR
0.000
−0.002
−0.004
2005
2010
2015
Date

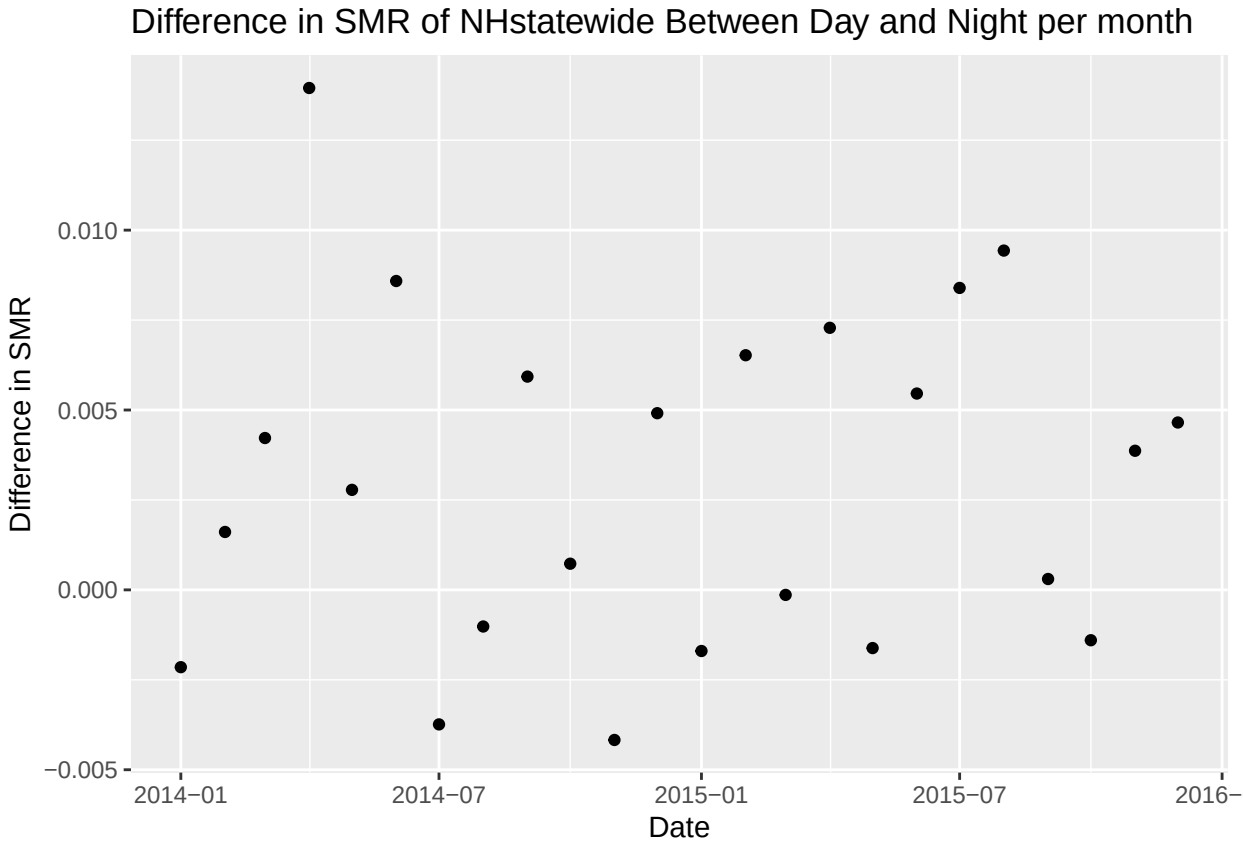
```
##
## [[32]]
```


Difference in SMR of NDgrandforks Between Day and Night per month
0.050
0.025
0.000
−0.025
−0.050
Difference in SMR
2008
2010
2012
2014
2016
Date

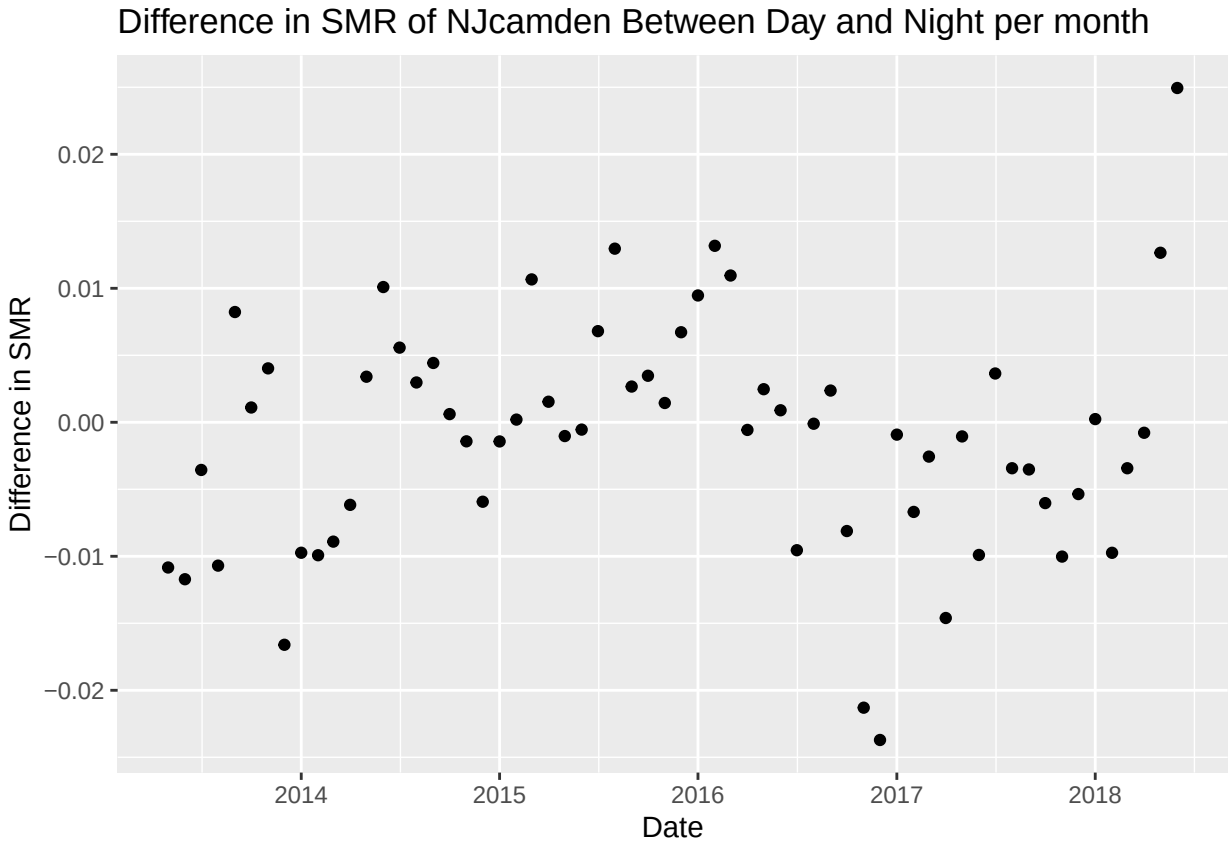
```
##
## [[33]]
```


Difference in SMR of NDstatewide Between Day and Night per month
0.001
0.000
−0.001
−0.002
−0.003
−0.004
Difference in SMR
2010
2012
2014
Date

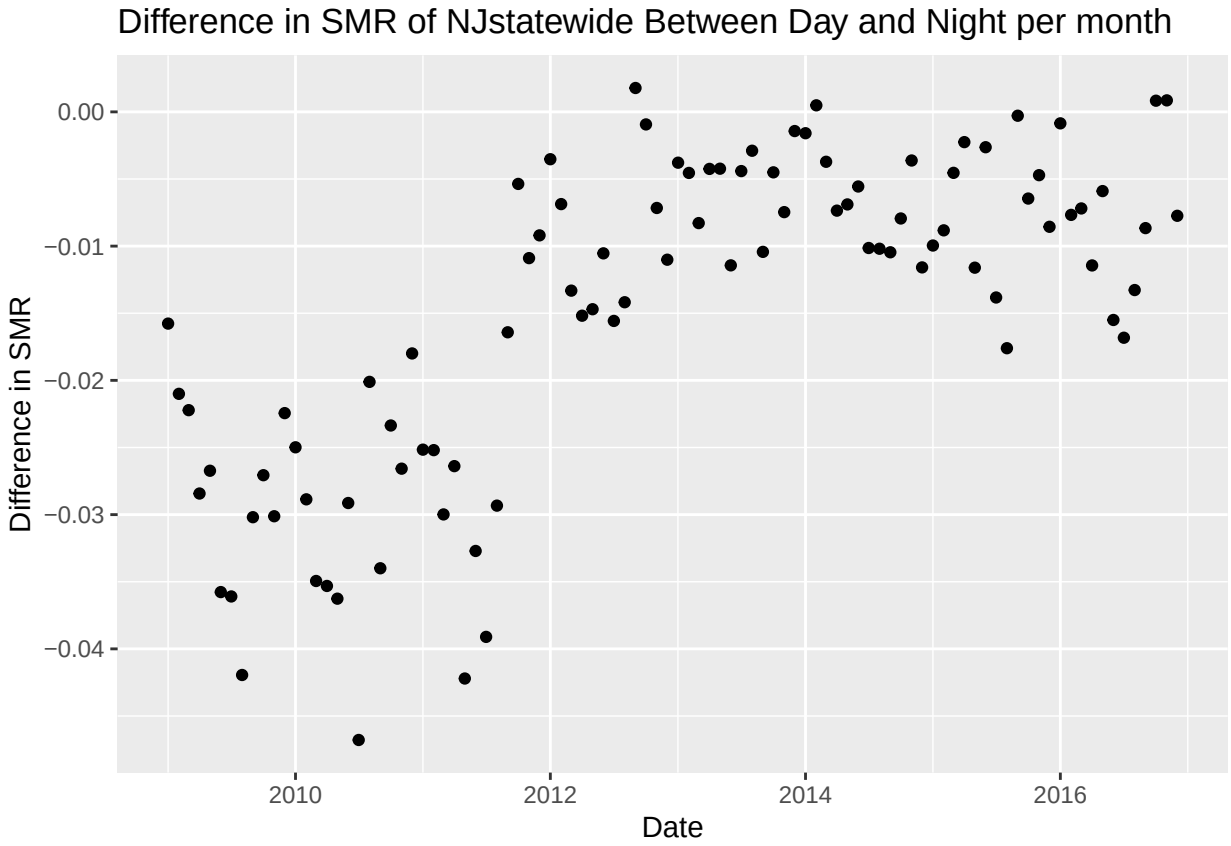
```
##
## [[34]]
```


Difference in SMR of NHstatewide Between Day and Night per month
Difference in SMR
0.010
0.005
0.000
−0.005
2014−01
2014−07
2015−01
2015−07
2016−
Date

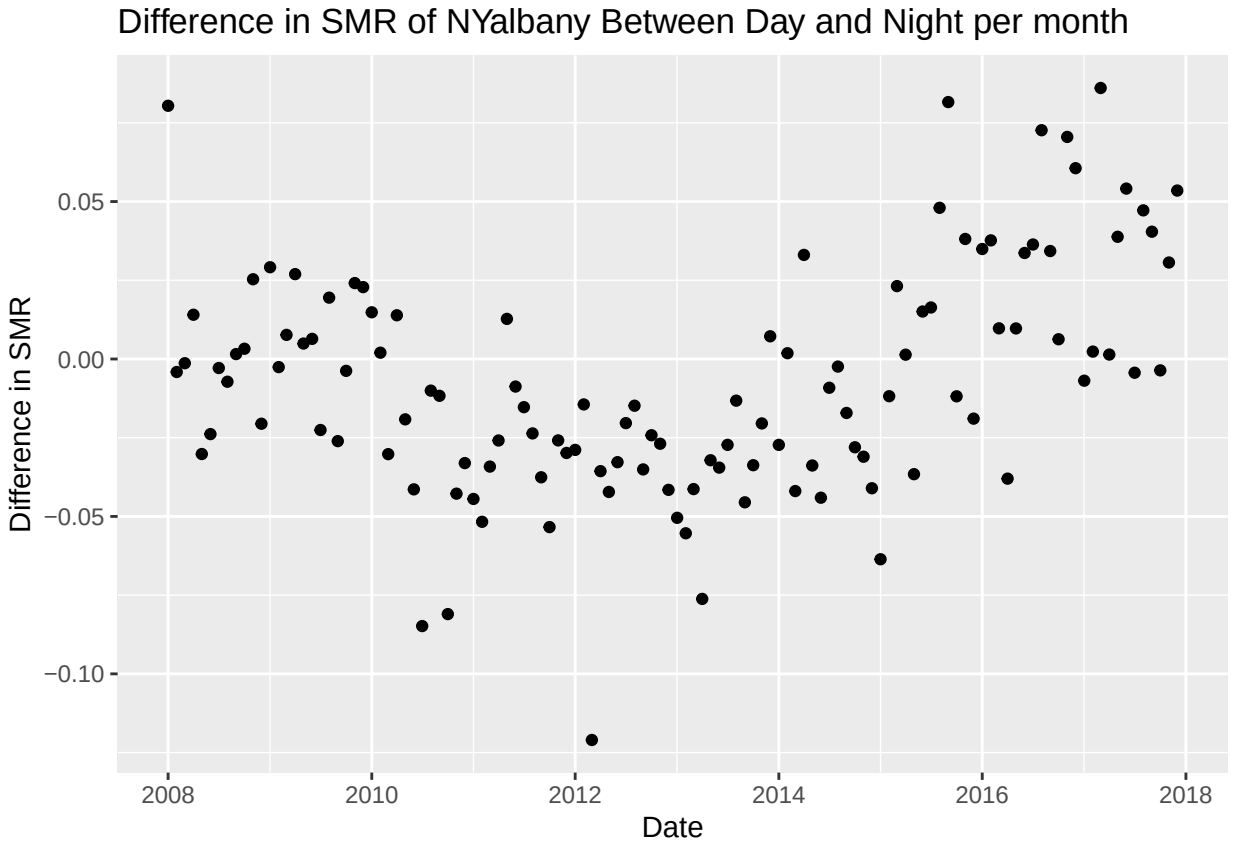
```
##
## [[35]]
```


Difference in SMR of NJcamden Between Day and Night per month
Difference in SMR
0.02
0.01
0.00
−0.01
−0.02
2014
2015
2016
2017
2018
Date

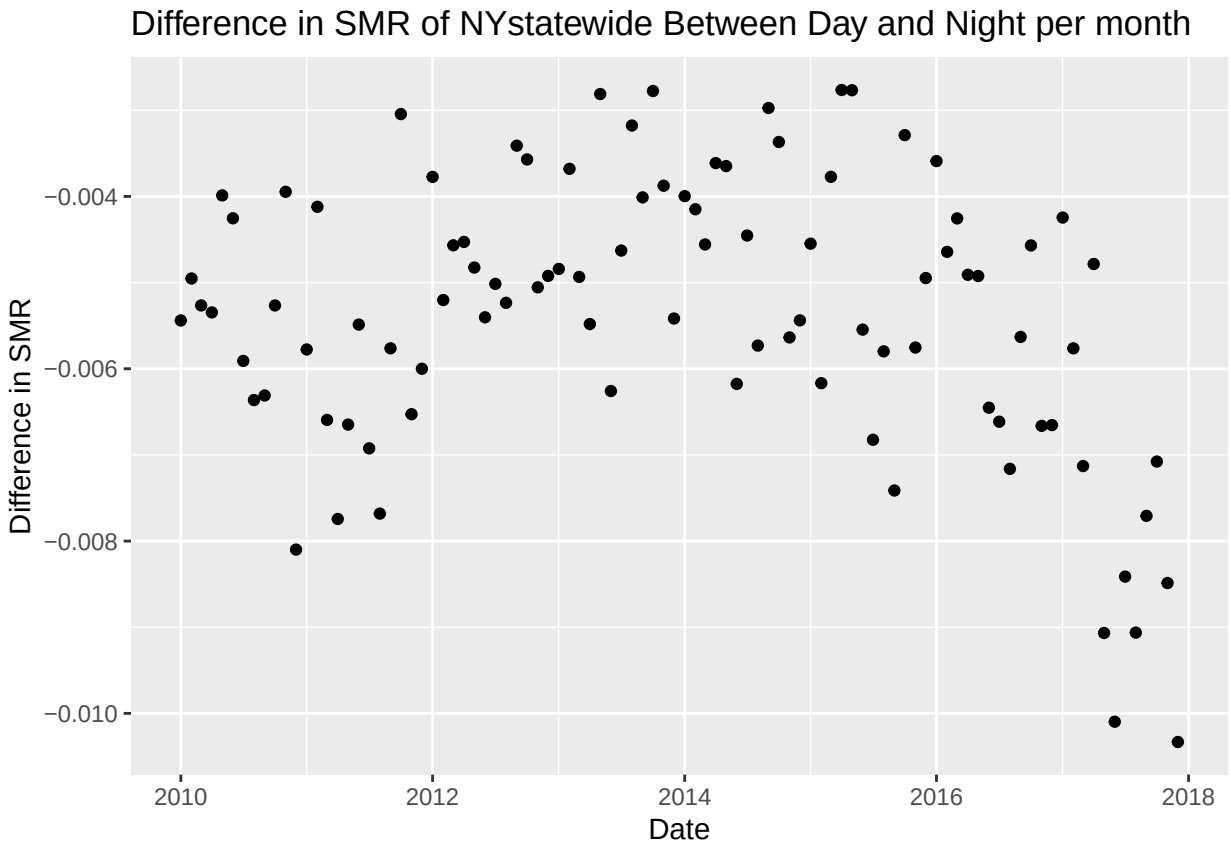
```
##
## [[36]]
```


Difference in SMR of NJstatewide Between Day and Night per month
0.00
−0.01
−0.02
−0.03
−0.04
Difference in SMR
2010
2012
2014
2016
Date

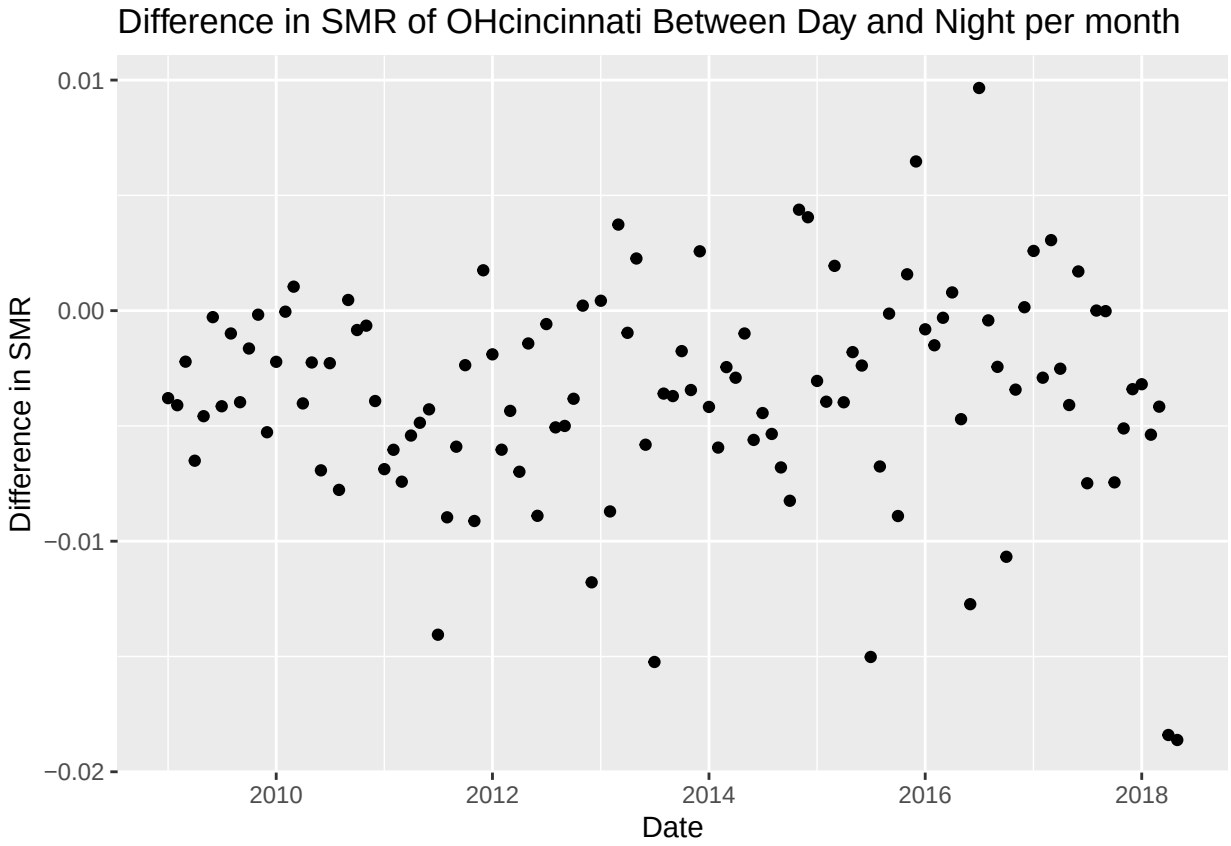
```
##
## [[37]]
```


Difference in SMR of NYalbany Between Day and Night per month
Difference in SMR
0.05
0.00
−0.05
−0.10
2008
2010
2012
2014
2016
2018
Date

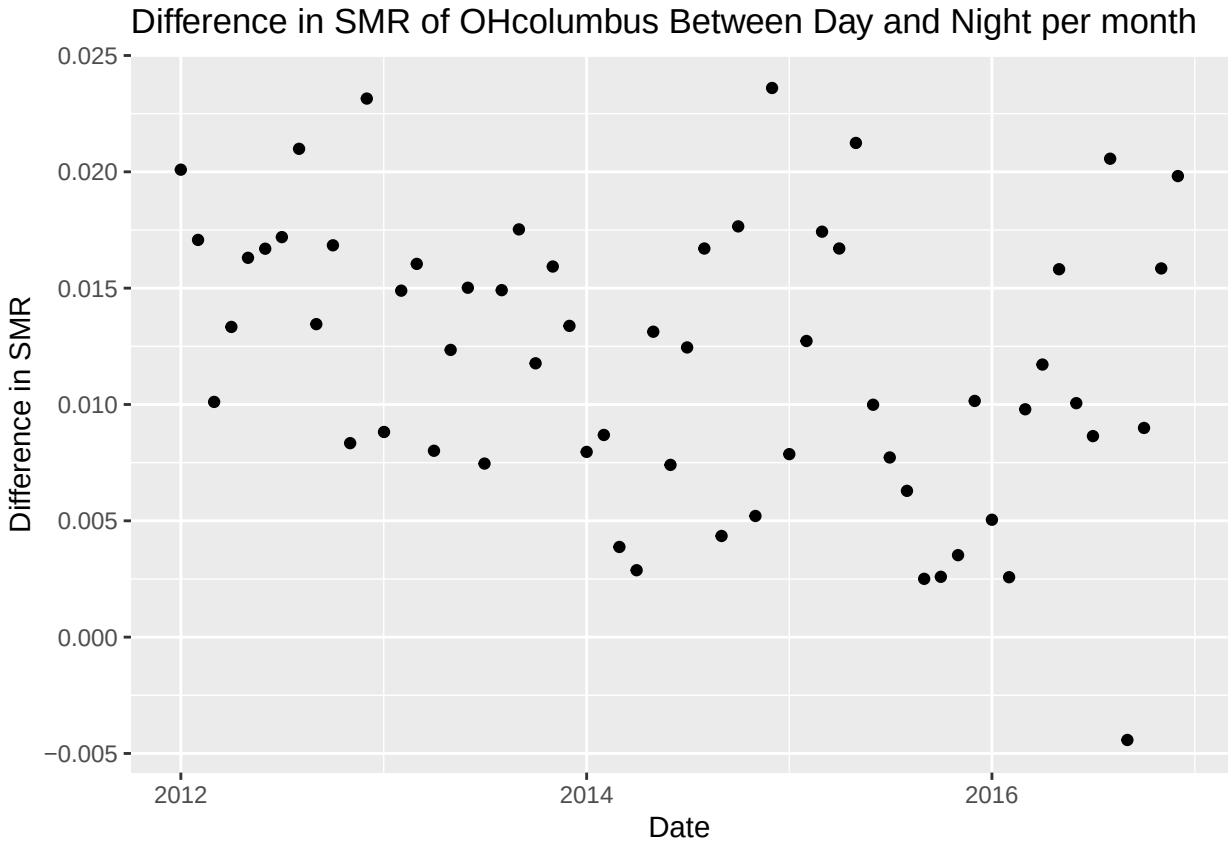
```
##
## [[38]]
```


Difference in SMR of NYstatewide Between Day and Night per month
Difference in SMR
−0.004
−0.006
−0.008
−0.010
2010
2012
2014
2016
2018
Date

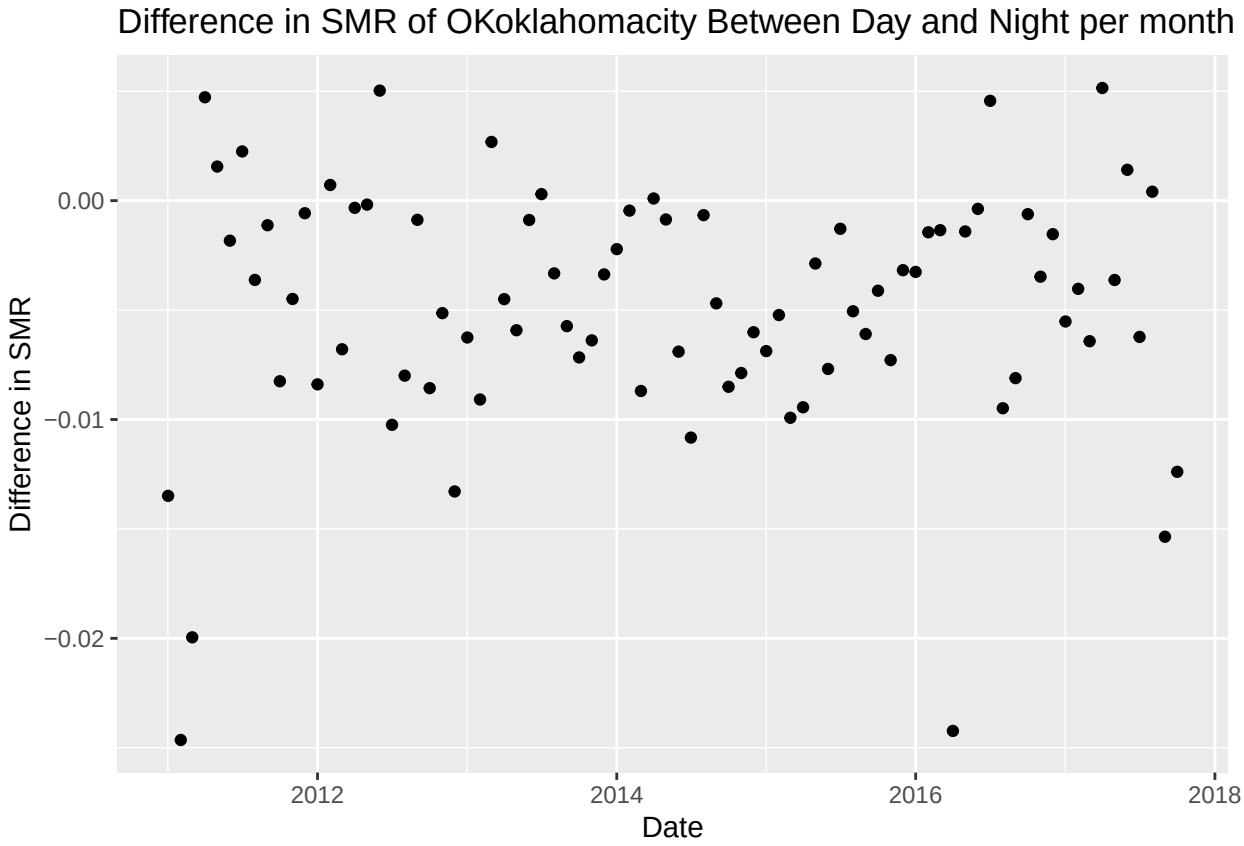
```
##
## [[39]]
```


Difference in SMR of OHcincinnati Between Day and Night per month
Difference in SMR
0.01
0.00
−0.01
−0.02
2010
2012
2014
2016
2018
Date

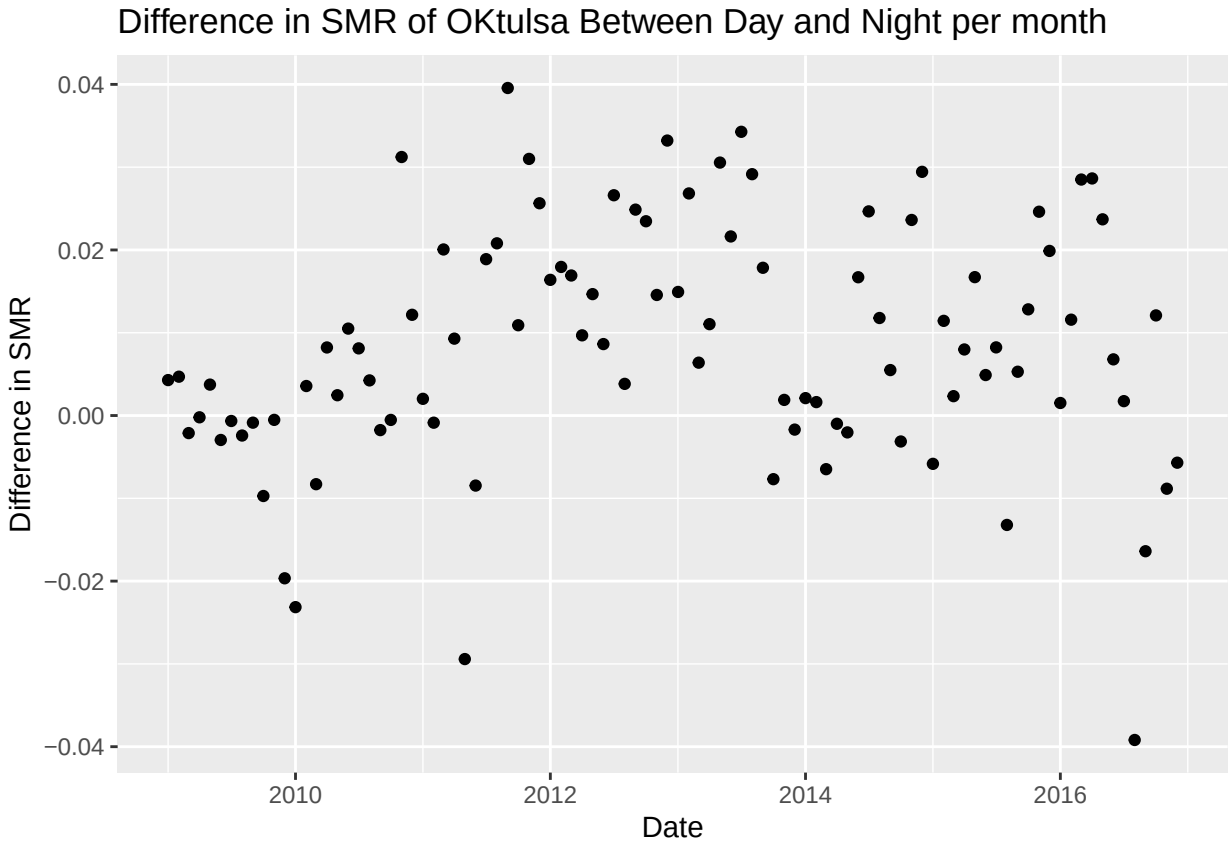
```
##
## [[40]]
```


Difference in SMR of OHcolumbus Between Day and Night per month
Difference in SMR
0.025
0.020
0.015
0.010
0.005
0.000
−0.005
2012
2014
2016
Date

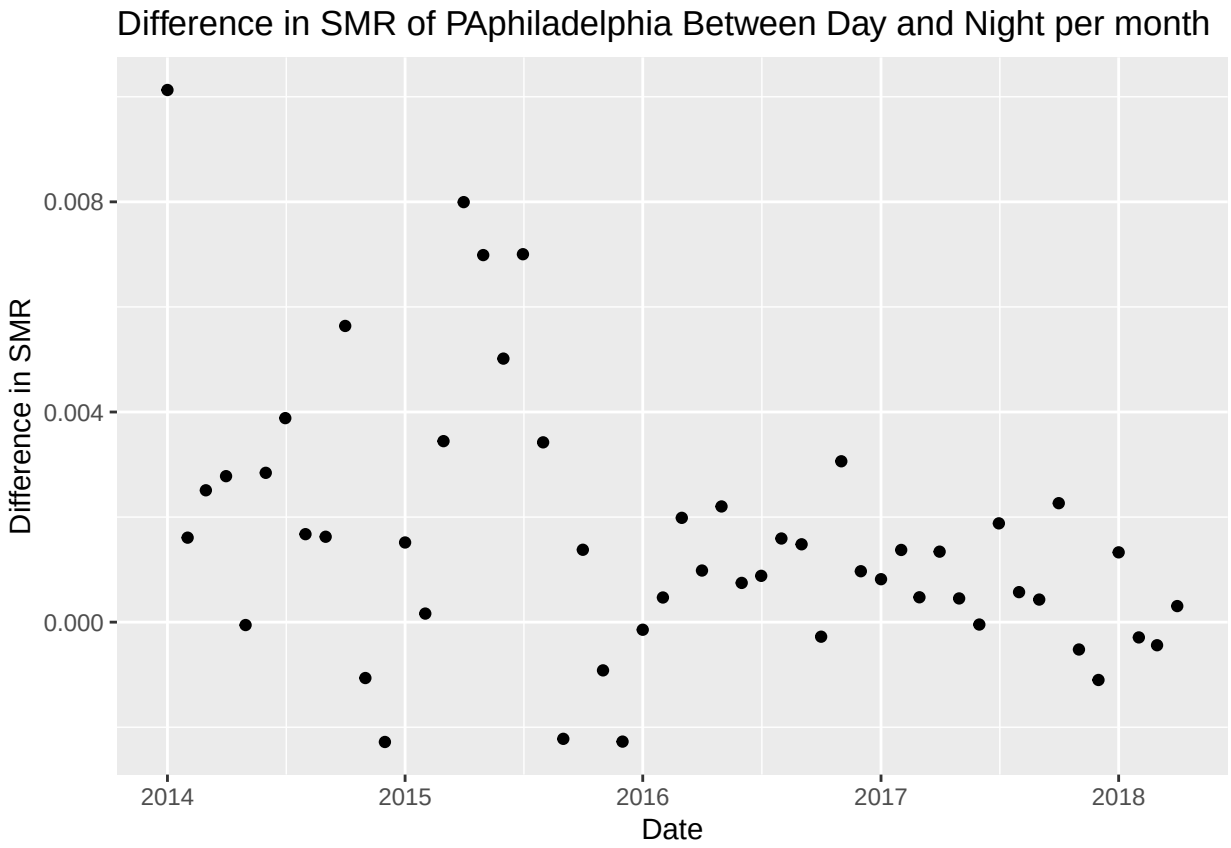
```
##
## [[41]]
```


Difference in SMR of OKoklahomacity Between Day and Night per month
Difference in SMR
0.00
−0.01
−0.02
2012
2014
2016
2018
Date

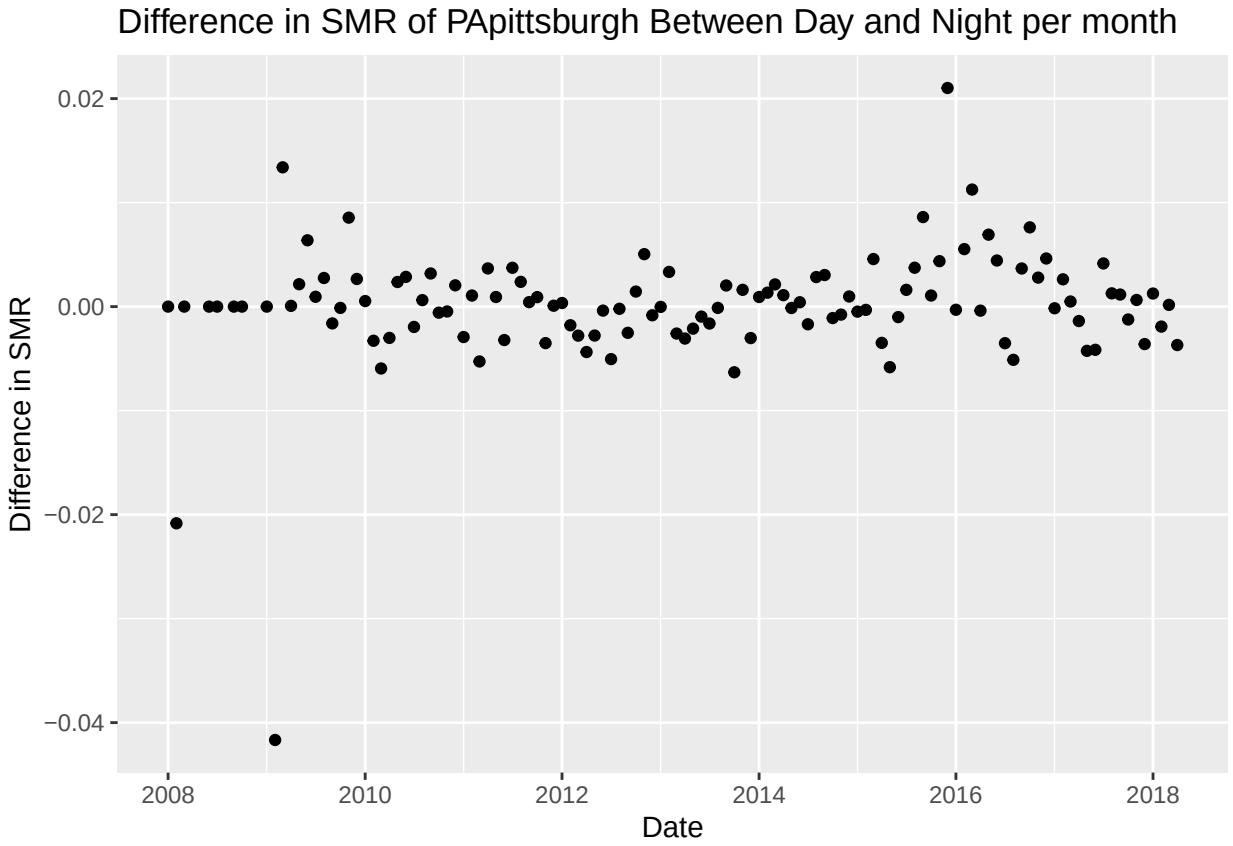
```
##
## [[42]]
```


Difference in SMR of OKtulsa Between Day and Night per month
Difference in SMR
0.04
0.02
0.00
−0.02
−0.04
2010
2012
2014
2016
Date

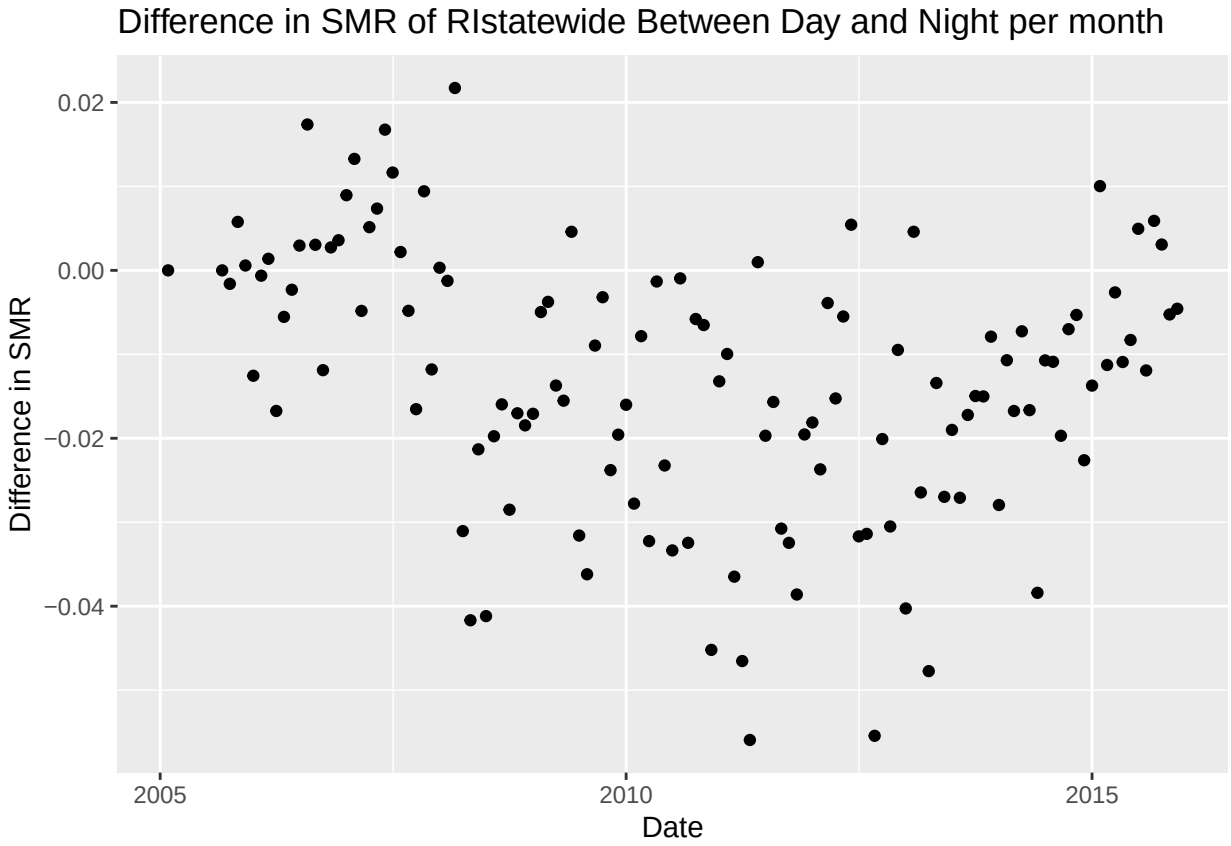
```
##
## [[43]]
```


Difference in SMR of PAphiladelphia Between Day and Night per month
Difference in SMR
0.008
0.004
0.000
2014
2015
2016
2017
2018
Date

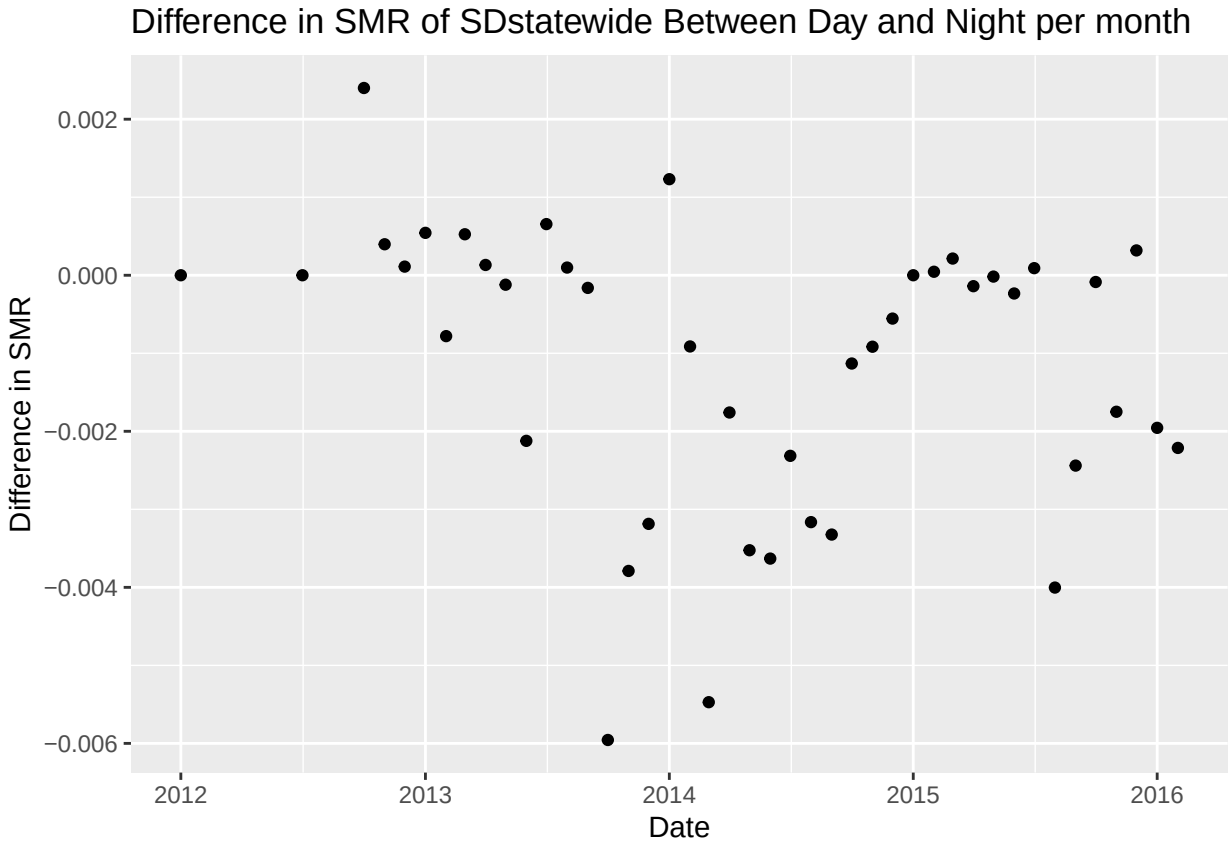
```
##
## [[44]]
```


Difference in SMR of PApittsburgh Between Day and Night per month
Difference in SMR
0.02
0.00
−0.02
−0.04
2008
2010
2012
2014
2016
2018
Date

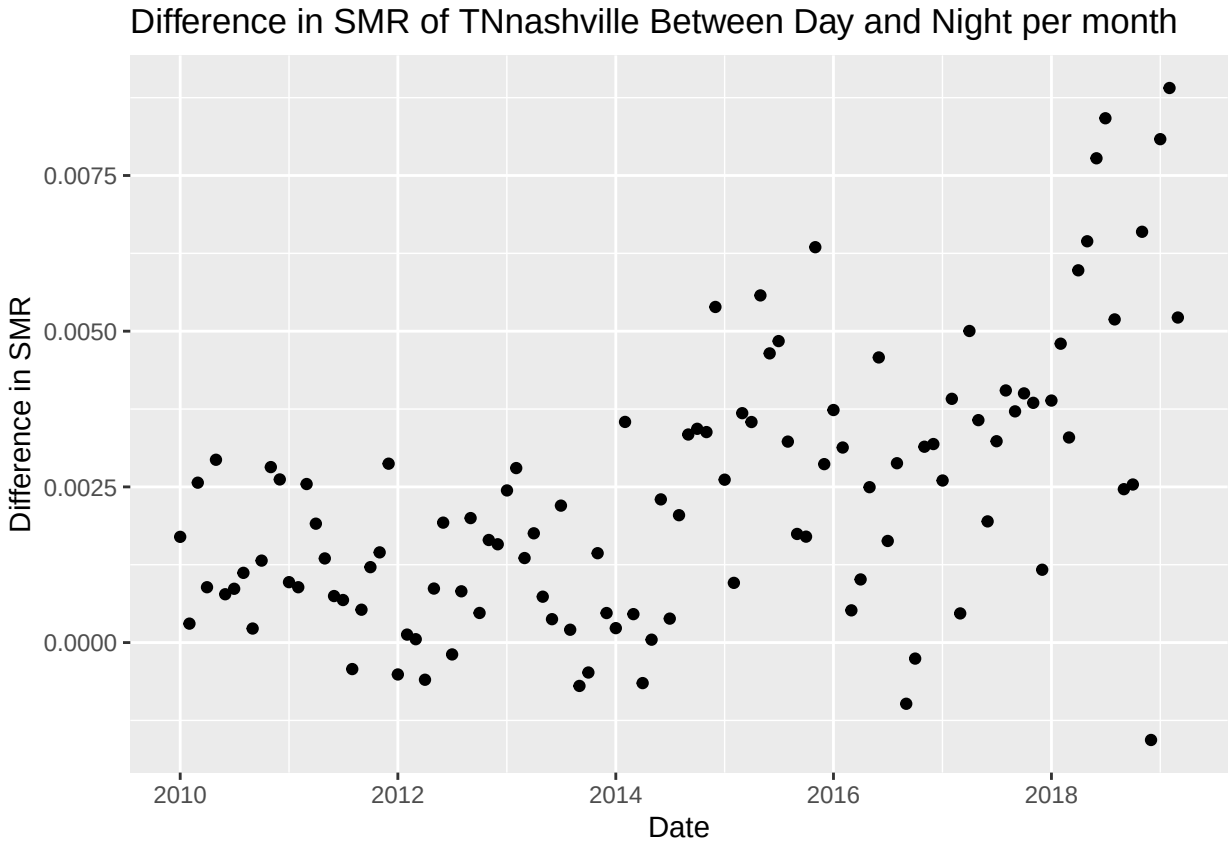
```
##
## [[45]]
```


Difference in SMR of RIstatewide Between Day and Night per month
0.02
0.00
−0.02
−0.04
Difference in SMR
2005
2010
2015
Date

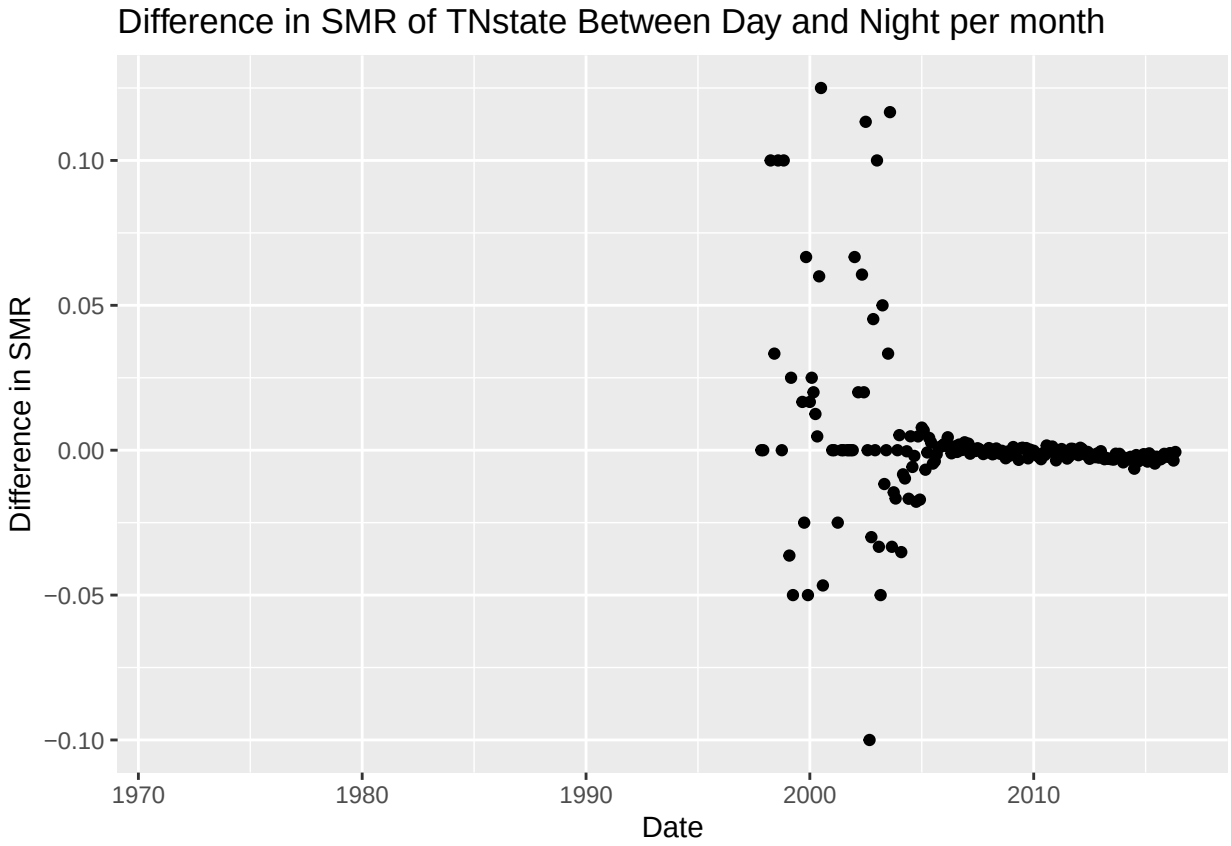
```
##
## [[46]]
```


Difference in SMR of SDstatewide Between Day and Night per month
0.002
0.000
−0.002
−0.004
−0.006
Difference in SMR
2012
2013
2014
2015
2016
Date

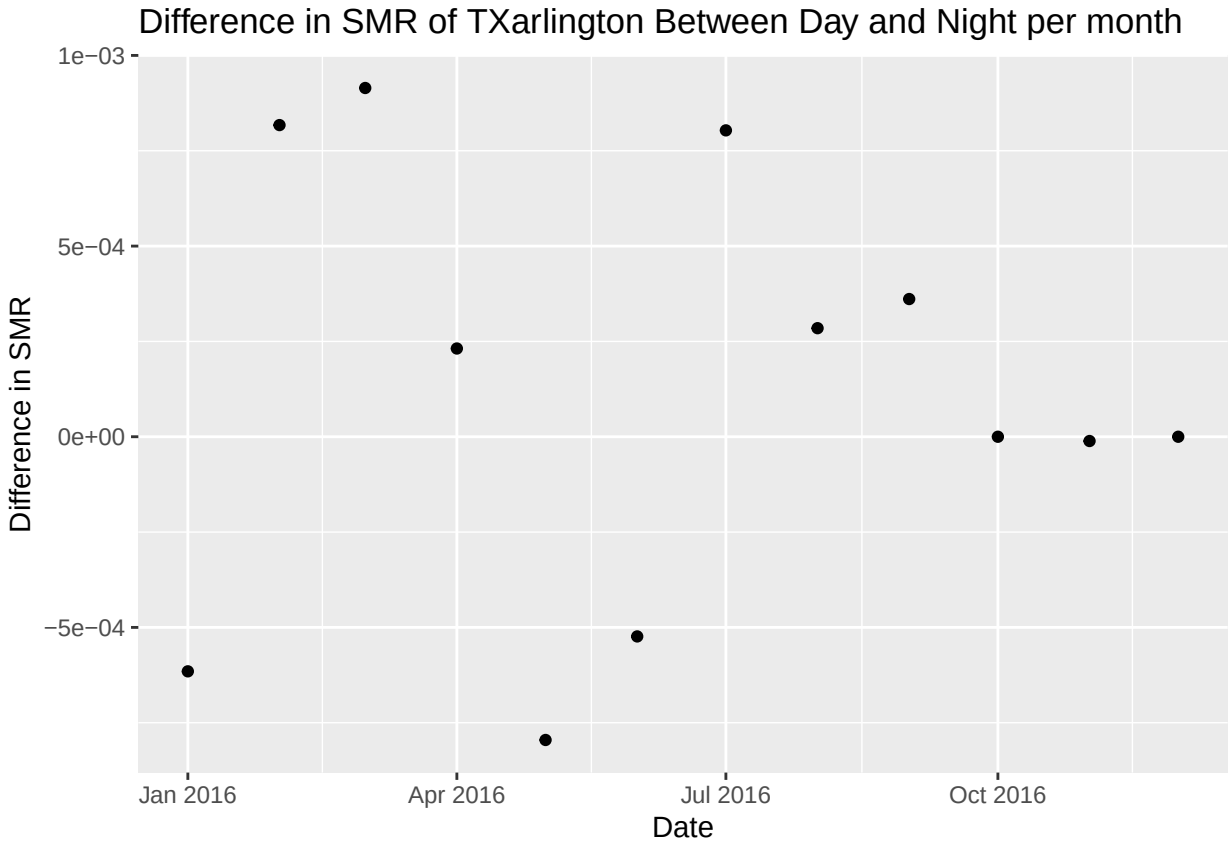
```
##
## [[47]]
```


Difference in SMR of TNnashville Between Day and Night per month
Difference in SMR
0.0075
0.0050
0.0025
0.0000
2010
2012
2014
2016
2018
Date

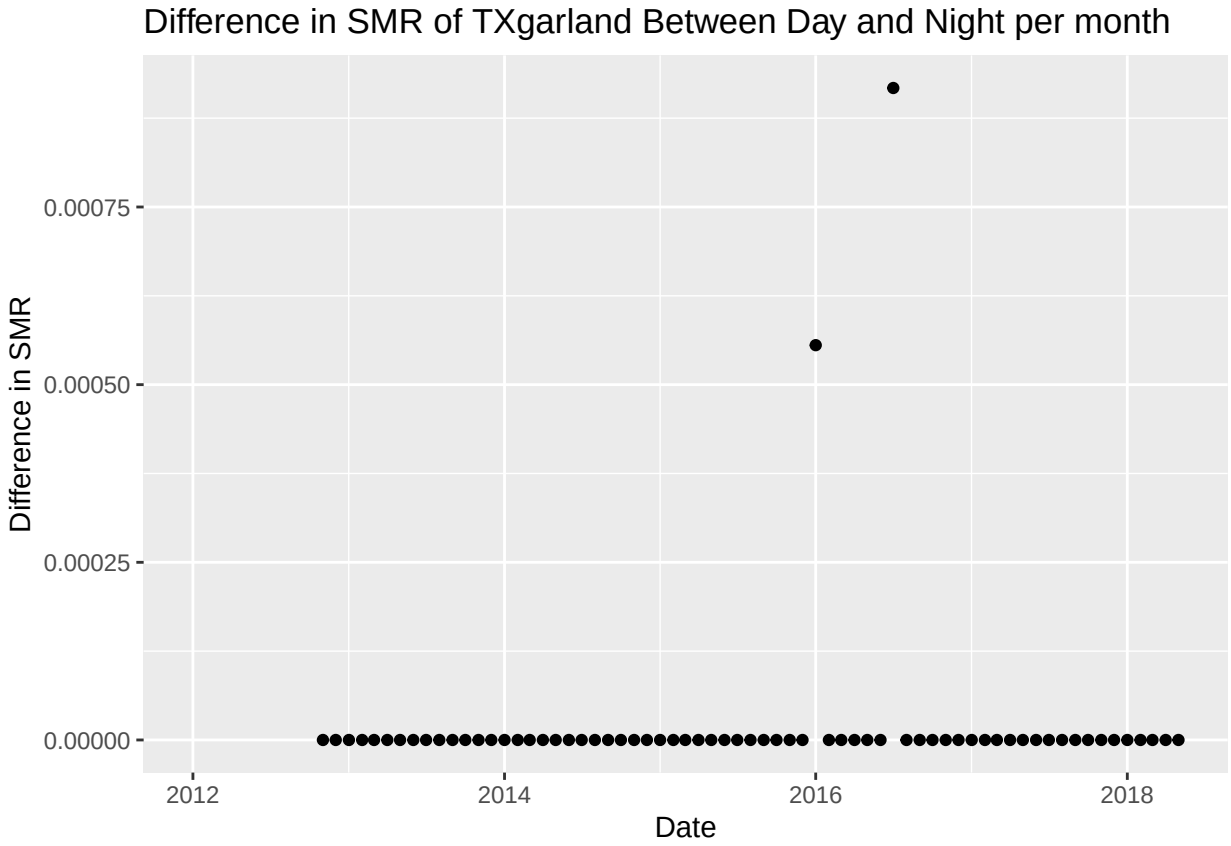
```
##
## [[48]]
```


Difference in SMR of TNstate Between Day and Night per month
Difference in SMR
0.10
0.05
0.00
−0.05
−0.10
1970
1980
1990
2000
2010
Date

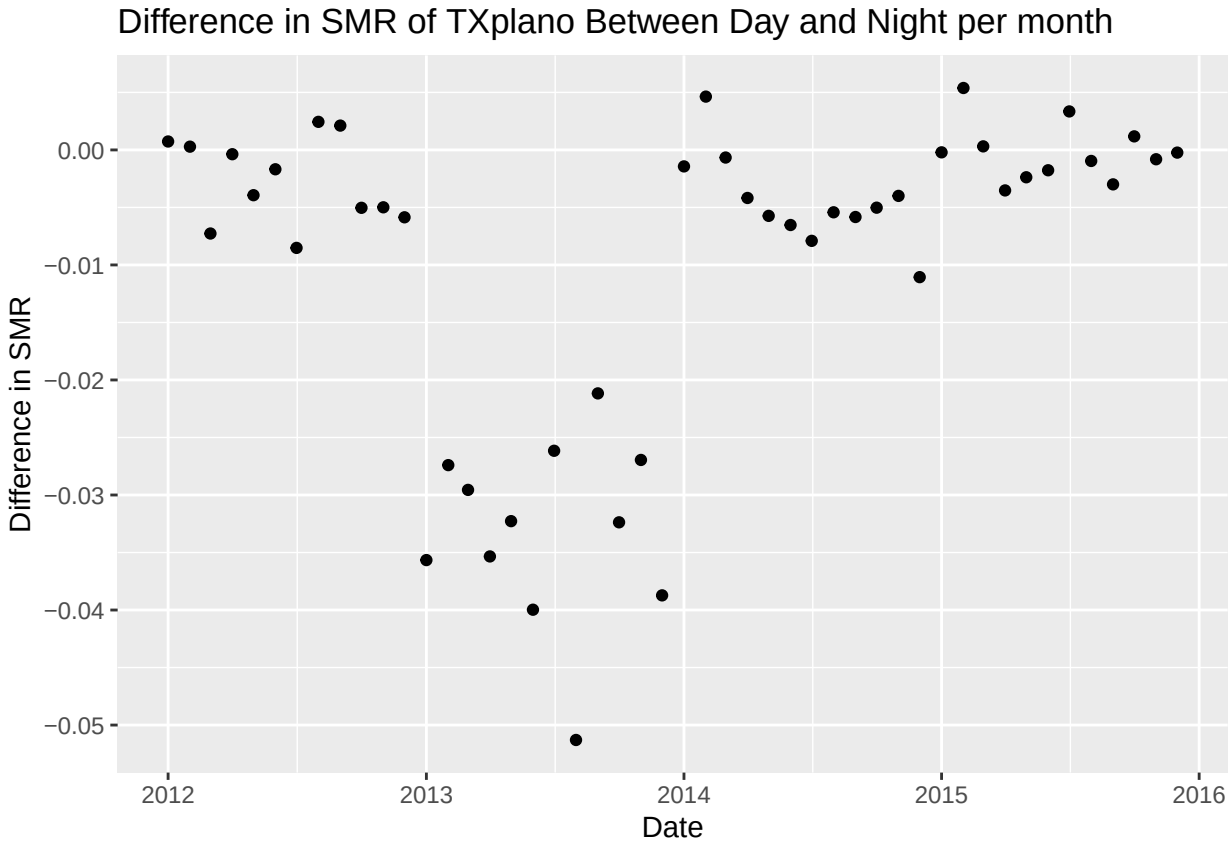
```
##
## [[49]]
```


Difference in SMR of TXarlington Between Day and Night per month
1e−03
5e−04
0e+00
−5e−04
Difference in SMR
Jan 2016
Apr 2016
Jul 2016
Oct 2016
Date

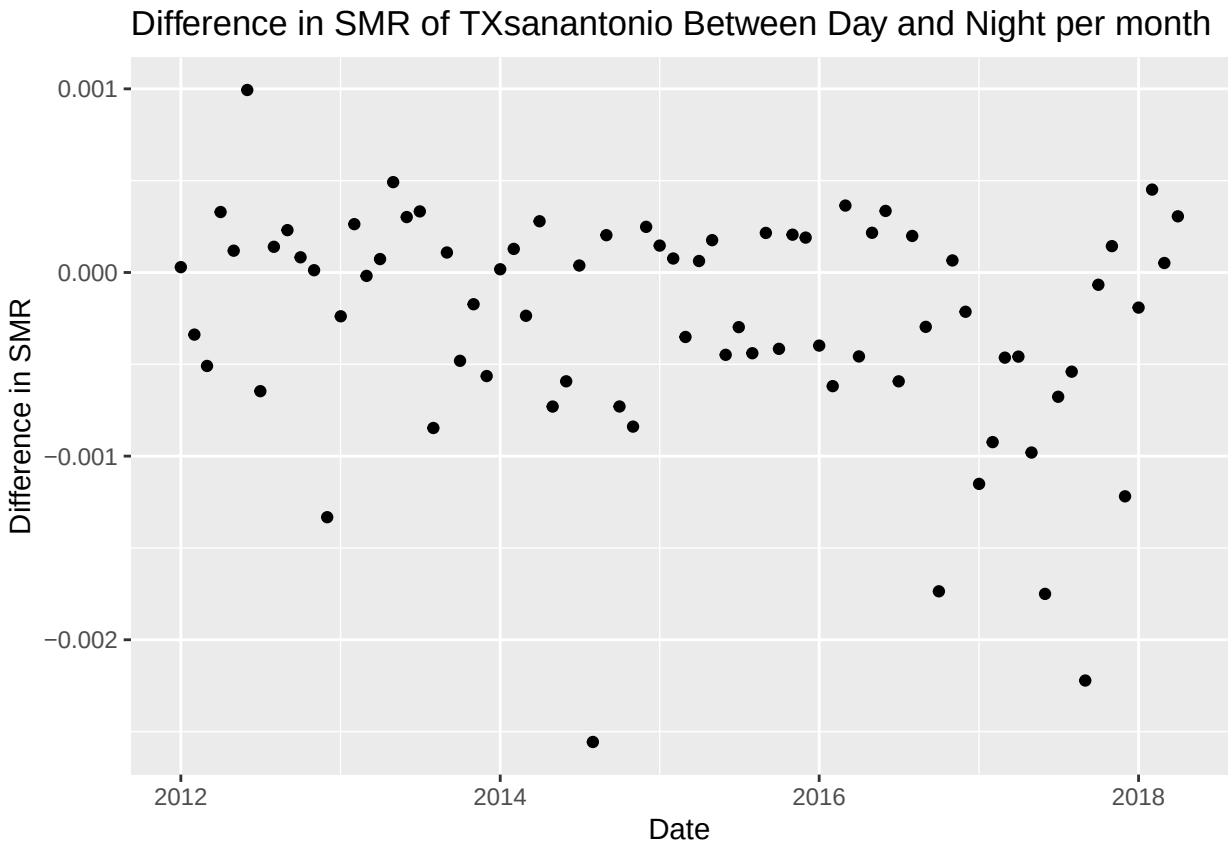
```
##
## [[50]]
```


Difference in SMR of TXgarland Between Day and Night per month
Difference in SMR
0.00075
0.00050
0.00025
0.00000
2012
2014
2016
2018
Date

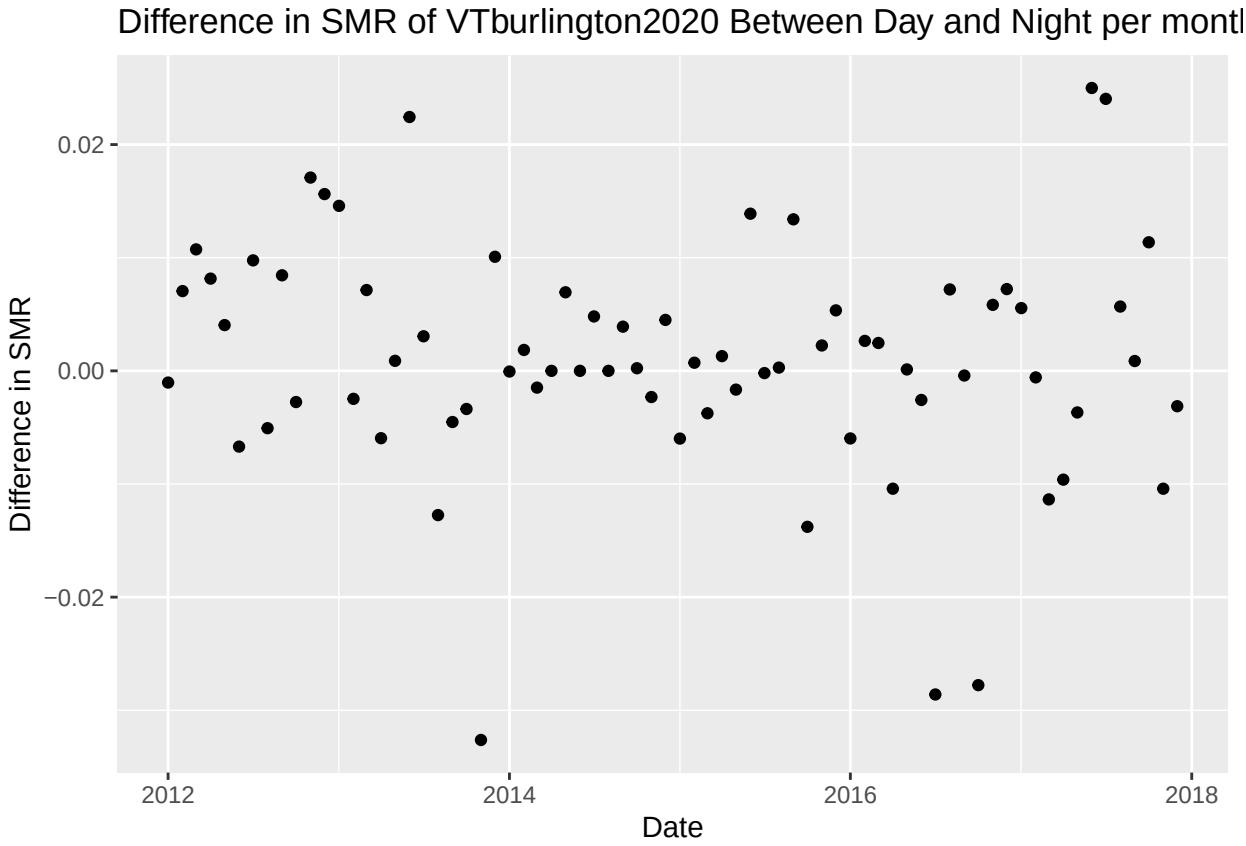
```
##
## [[51]]
```


Difference in SMR of TXplano Between Day and Night per month
Difference in SMR
0.00
−0.01
−0.02
−0.03
−0.04
−0.05
2012
2013
2014
2015
2016
Date

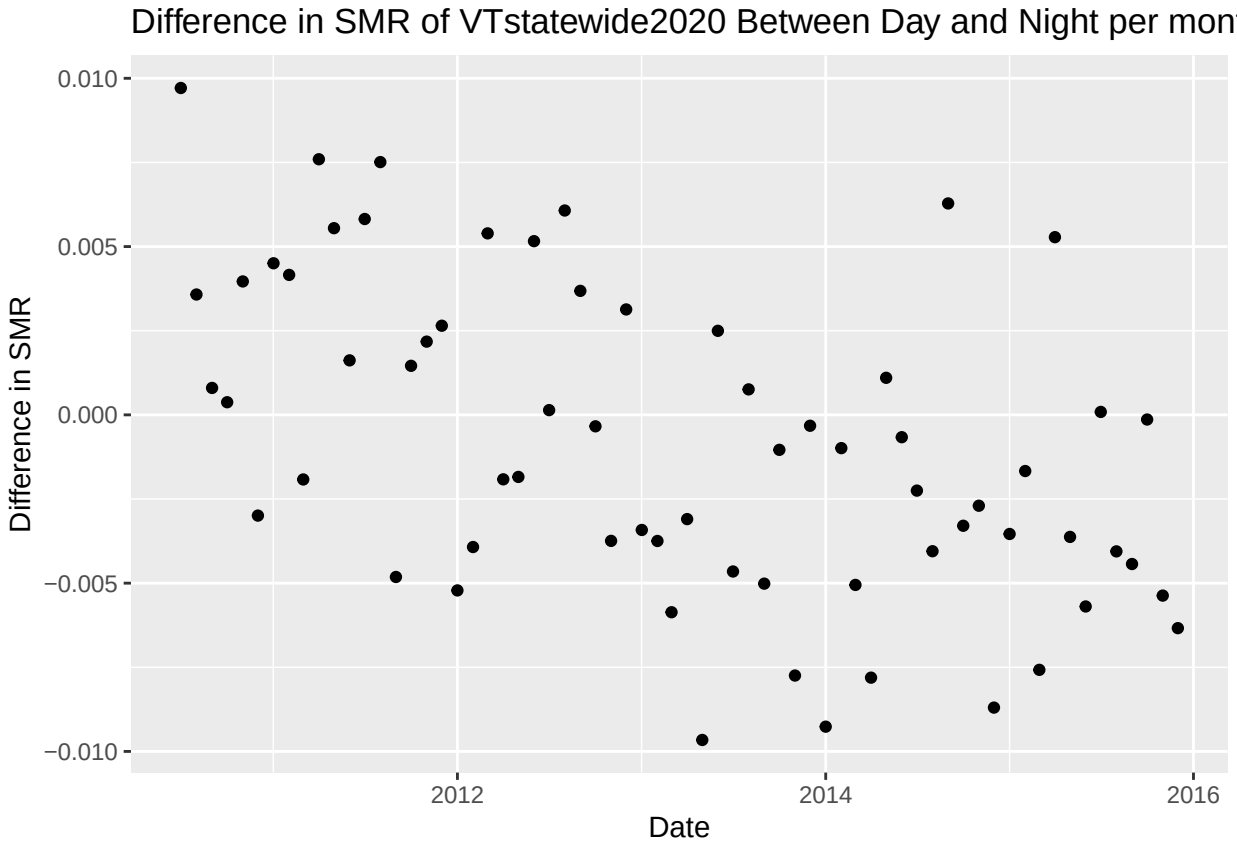
```
##
## [[52]]
```


Difference in SMR of TXsanantonio Between Day and Night per month
0.001
0.000
−0.001
−0.002
Difference in SMR
2012
2014
2016
2018
Date

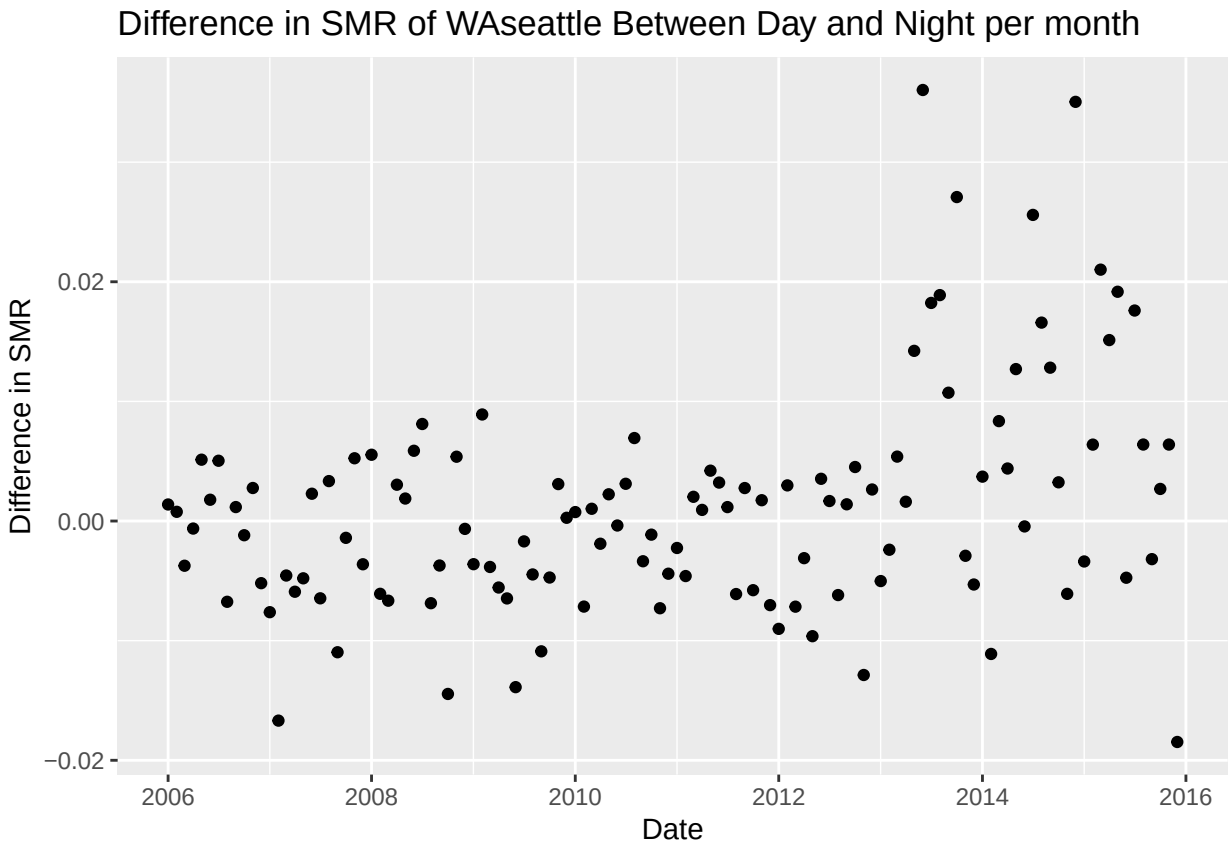
```
##
## [[53]]
```


Difference in SMR of VTburlington2020 Between Day and Night per montl
0.02
0.00
−0.02
Difference in SMR
2012
2014
2016
2018
Date

```
##
## [[54]]
```


Difference in SMR of VTstatewide2020 Between Day and Night per mont
0.010
0.005
0.000
−0.005
−0.010
Difference in SMR
2012
2014
2016
Date

```
##
## [[55]]
```



Toy log reg

outcome = race*age + gender + 4-hour period of the day + day of the week + year ???

```
sc_lst <- lapply(sunriseset_lst, myfilter_for, c("subject_race", "dataset_name", "time", "date", "searc

sc_lst <- sc_lst[sapply(sc_lst, function(x) isTRUE(nrow(x) > 0))]

sc_lst <- lapply(sc_lst, outcome_clean, "search_conducted")

sapply(sc_lst, function(x) x$dataset_name[1])
```

```
am_lst <- lapply(sunriseset_lst, myfilter_for, c("subject_race", "dataset_name", "time", "date", "arres

am_lst <- am_lst[sapply(am_lst, function(x) isTRUE(nrow(x) > 0))]

am_lst <- lapply(am_lst, outcome_clean, "arrest_made")

sapply(am_lst, function(x) x$dataset_name[1])
```

```
# pre 2014-02-10 0% to 1%
# lat/lng

TNnash <- mysearch_dataset(sunriseset_lst, "TNnashville") %>%
  mutate(day_week = as.factor(wday(ymd(date))),
         hour = lubridate::hour(hms(time)),
```

```
         hour = case_when(hour <= 4 ~ 1,
                          hour <= 8 & hour > 4 ~ 2,
                          hour <= 12 & hour > 8 ~ 3,
                          hour <= 16 & hour > 12 ~ 4,
                          hour <= 20 & hour > 16 ~ 5,
                          hour > 20 ~ 6),
         hour = as.factor(hour),
         subject_age = as.numeric(subject_age),
         subject_race = as.factor(subject_race))

TNnash <- outcome_clean(TNnash, "arrest_made")

TNpre <- TNnash %>%
  filter(date < ymd("2014-02-10"))

TNpost <- TNnash %>%
  filter(date > ymd("2014-02-10"))
```

```r
fit_TNpre <- glm(arrest_made ~ subject_race + subject_age + subject_sex + day_week + hour, data = TNpre
tidy(fit_TNpre) %>%
  kbl(booktabs = T) %>%
  kableExtra::landscape()
```

```r
fit_TNpost <- glm(arrest_made ~ subject_race +subject_age + subject_sex + day_week + hour, data = TNpos
tidy(fit_TNpost) %>%
  kbl(booktabs = T) %>%
  kableExtra::landscape()
```

```
fit_TN <- glm(arrest_made ~ subject_race +subject_age + subject_sex + day_week + hour, data = TNnash, fa
tidy(fit_TN) %>%
  kbl(booktabs = T) %>%
  kableExtra::landscape()
```

```
NCraleigh <- mysearch_dataset(sunriseset_lst, "NCraleigh") %>%
  mutate(day_week = as.factor(wday(ymd(date))),
         hour = lubridate::hour(hms(time)),
         hour = case_when(hour <= 4 ~ 1,
                          hour <= 8 & hour > 4 ~ 2,
                          hour <= 12 & hour > 8 ~ 3,
                          hour <= 16 & hour > 12 ~ 4,
                          hour <= 20 & hour > 16 ~ 5,
                          hour > 20 ~ 6),
         hour = as.factor(hour),
         subject_age = as.numeric(subject_age),
         subject_race = as.factor(subject_race))

NCraleigh <- outcome_clean(NCraleigh, "arrest_made")
NCraleigh <- outcome_clean(NCraleigh, "search_conducted")

NCday <- NCraleigh %>% filter(day_night == "day")

NCnight <- NCraleigh %>% filter(day_night == "night")
```

```r
fit_NCday <- glm(arrest_made ~ subject_race +subject_age + subject_sex + day_week, data = NCday, family
tidy(fit_NCday) %>%
  kbl(booktabs = T) %>%
  kableExtra::landscape()
```

```r
fit_NCnight <- glm(arrest_made ~ subject_race + subject_age + subject_sex + day_week, data = NCnight, fa
tidy(fit_NCnight) %>%
  kbl(booktabs = T) %>%
  kableExtra::landscape()
```

```
fit_NC <- glm(arrest_made ~ subject_race + subject_age + subject_sex + day_week, data = NCraleigh, famil
tidy(fit_NC) %>%
  kbl(booktabs = T) %>%
  kableExtra::landscape()
```

now for search_conducted

```
fit_NCday <- glm(search_conducted ~ subject_race + subject_age + subject_sex + day_week, data = NCday, f
tidy(fit_NCday) %>%
  kbl(booktabs = T) %>%
  kableExtra::landscape()
```

```r
fit_NCnight <- glm(search_conducted ~ subject_race + subject_age + subject_sex + day_week, data = NCnigh
tidy(fit_NCnight) %>%
  kbl(booktabs = T) %>%
  kableExtra::landscape()
```

```r
fit_NC <- glm(search_conducted ~ subject_race + subject_age + subject_sex + day_week, data = NCraleigh,
tidy(fit_NC) %>%
  kbl(booktabs = T) %>%
  kableExtra::landscape()
```

```r
WAseattle <- mysearch_dataset(sunriseset_lst, "WAseattle")  %>%
  mutate(day_week = as.factor(wday(ymd(date))),
         hour = lubridate::hour(hms(time)),
         hour = case_when(hour <= 4 ~ 1,
                          hour <= 8 & hour > 4 ~ 2,
                          hour <= 12 & hour > 8 ~ 3,
                          hour <= 16 & hour > 12 ~ 4,
                          hour <= 20 & hour > 16 ~ 5,
                          hour > 20 ~ 6),
         hour = as.factor(hour),
         subject_age = as.numeric(subject_age),
         subject_race = as.factor(subject_race))

WAseattle %>% group_by(arrest_made, subject_race) %>% summarize(count = n())
```

scraps

```r
#year
SDstatewide <- mysearch_dataset(date_lst, "SDstatewide") # 2015-08-31 14% to ~ 0%
  # location is different
NHstatewide <- mysearch_dataset(date_lst, "NHstatewide") # 2014-12-08 15% to 7%
  # subject_age
LAneworleans <- mysearch_dataset(date_lst, "LAneworleans") # 2011-05-09 30% to ~10%
  # location, lat, lng, outcome
FLstatewide <- mysearch_dataset(date_lst, "FLstatewide") # pre 2015-06-15, post 2016-10-31, 10% to 40%
  # location, subject_sex, subject_age
CAoakland <- mysearch_dataset(date_lst, "CAoakland") # pre 2016-12-26    10% to 1%
  # subject_age

#daynight
OHcolumbus <- mysearch_dataset(sunriseset_lst, "OHcolumbus")
KYlouisville <- mysearch_dataset(sunriseset_lst, "KYlouisville")

# finding the differences here:
CAoakland %>% filter(str_detect(date, "2017"))


date_df %>% filter(dataset_name == "CAoakland")
```

```r
 # 2014-12-08 15% to 7%

NHpre2014 <- NHstatewide %>%
  mutate(date = lubridate::ymd(date)) %>%
  filter(date < ymd("2014-12-08"))

NHpost2014 <- NHstatewide %>%
  mutate(date = lubridate::ymd(date)) %>%
```

```
  filter(date > ymd("2014-12-08"))

fit_NHpre2014 <- glm(citation_issued ~ as.numeric(subject_age)*as.factor(subject_race) + subject_sex, da
summary(fit_NHpre2014)

fit_NHpost2014 <- glm(citation_issued ~ as.numeric(subject_age)*as.factor(subject_race) + subject_sex, 
summary(fit_NHpost2014)

fit_NH <- glm(citation_issued ~ as.numeric(subject_age)*as.factor(subject_race) + subject_sex, data = NH
summary(fit_NH)
```

```
LAneworleans <- DBI::dbGetQuery(con, "SELECT * FROM LAneworleans WHERE type = 'vehicular'")


# 2011-05-09 30% to ~10%
# location, lat, lng, outcome

LApre <- LAneworleans %>%
  mutate(date = lubridate::ymd(date)) %>%
  filter(date < ymd("2011-05-09")) %>%
  select(subject_age, subject_race, subject_sex, search_conducted, officer_assignment, district, zone)

LApost <- LAneworleans %>%
  mutate(date = lubridate::ymd(date)) %>%
  filter(date > ymd("2011-05-09")) %>%
  select(subject_age, subject_race, subject_sex, search_conducted, officer_assignment, district, zone)

fit_LApre2011 <- glm(search_conducted ~ as.numeric(subject_age)*as.factor(subject_race) + subject_sex +
summary(fit_LApre2011)

fit_LApost2011 <- glm(search_conducted ~ as.numeric(subject_age)*as.factor(subject_race) + subject_sex 
summary(fit_LApost2011)

fit_LA <- glm(search_conducted ~ as.numeric(subject_age)*as.factor(subject_race) + subject_sex + office
summary(fit_LA)
```

```
# pre 2015-06-15, post 2016-10-31, 10% to 40%
# location, subject_sex, subject_age

FLpre <- FLstatewide %>%
  mutate(date = lubridate::ymd(date)) %>%
  filter(date < ymd("2015-06-15"))

FLpost <- FLstatewide %>%
  mutate(date = lubridate::ymd(date)) %>%
  filter(date > ymd("2016-10-31"))
# post doesn't collect sex, age, ...
# so the pre and the aggregate models all have the same ... results?

fit_FLpre <- glm(search_conducted ~ as.numeric(subject_age)*as.factor(subject_race) + subject_sex, data
summary(fit_FLpre)

fit_FLpost <- glm(search_conducted ~ as.numeric(subject_age)*as.factor(subject_race), data = FLpost, fa
summary(fit_FLpost)
```

```
fit_FL <- glm(search_conducted ~ as.numeric(subject_age)*as.factor(subject_race) + subject_sex, data = F
summary(fit_FL)
```

```
# pre 2016-12-26     10% to 1%
# subject_age

CApre <- CAoakland %>%
  mutate(date = lubridate::ymd(date)) %>%
  filter(date < ymd("2016-12-26"))

CApost <- CAoakland %>%
  mutate(date = lubridate::ymd(date)) %>%
  filter(date > ymd("2016-12-26"))


fit_CApre <- glm(search_conducted ~ as.factor(subject_race) + subject_sex, data = CApre, family = "binor
summary(fit_CApre)

fit_CApost <- glm(search_conducted ~ as.numeric(subject_age) + as.factor(subject_race) + subject_sex, da
summary(fit_CApost)

fit_LA <- glm(search_conducted ~ as.numeric(subject_age) + as.factor(subject_race) + subject_sex, data =
summary(fit_LA)
```

```
OHday <- OHcolumbus %>% filter(day_night == "day")
OHnight <- OHcolumbus %>% filter(day_night == "night")

fit_OHday <- glm(search_conducted ~ as.factor(subject_race) + subject_sex, data = OHday, family = "binor
fit_OHnight <- glm(search_conducted ~ as.factor(subject_race) + subject_sex, data = OHnight, family = "
fit_OH <- glm(search_conducted ~ as.factor(subject_race) + subject_sex, data = OHcolumbus, family = "bi

summary(fit_OHday)
summary(fit_OHnight)
summary(fit_OH)

KYday <- KYlouisville %>% filter(day_night == "day")
KYnight <- KYlouisville %>% filter(day_night == "night")

fit_KYday <- glm(search_conducted ~ as.numeric(subject_age)*as.factor(subject_race) + subject_sex, data
summary(fit_KYday)

fit_KYnight <- glm(search_conducted ~ as.numeric(subject_age)*as.factor(subject_race) + subject_sex, da
summary(fit_KYnight)

fit_KY <- glm(search_conducted ~ as.numeric(subject_age)*as.factor(subject_race) + subject_sex, data = F
summary(fit_KY)
```