Real Estate Analysis

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```
knitr::opts_chunk$set(echo=TRUE, tidy.opts = list(width.cutoff = 70), tidy = TRUE)

library("zoo")
```

```
## Warning: package 'zoo' was built under R version 4.2.2
```

```
##
## Attaching package: 'zoo'
```

```
## The following objects are masked from 'package:base':
##
##     as.Date, as.Date.numeric
```

```
library("tidyverse")
```

```
## Warning: package 'tidyverse' was built under R version 4.2.2
```

```
## -- Attaching packages --------------------------------------- tidyverse 1.3.2 --
```

```
## v ggplot2 3.4.4     v purrr   1.0.2
## v tibble  3.2.1     v dplyr   1.1.4
## v tidyr   1.3.0     v stringr 1.5.1
## v readr   2.1.2     v forcats 1.0.0
```

```
## Warning: package 'ggplot2' was built under R version 4.2.3
```

```
## Warning: package 'tibble' was built under R version 4.2.3
```

```
## Warning: package 'tidyr' was built under R version 4.2.3
```

```
## Warning: package 'purrr' was built under R version 4.2.3
```

```
## Warning: package 'dplyr' was built under R version 4.2.3
```

```
## Warning: package 'stringr' was built under R version 4.2.3
```

```
## Warning: package 'forcats' was built under R version 4.2.3
```

```
## -- Conflicts ------------------------------------------ tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()
```

```
library("semTools")
```

```
## Warning: package 'semTools' was built under R version 4.2.2
```

```
## Loading required package: lavaan
```

```
## Warning: package 'lavaan' was built under R version 4.2.2
```

```
## This is lavaan 0.6-13
## lavaan is FREE software! Please report any bugs.
##
## ###############################################################################
## This is semTools 0.5-6
## All users of R (or SEM) are invited to submit functions or ideas for functions.
## ###############################################################################
##
## Attaching package: 'semTools'
##
## The following object is masked from 'package:readr':
##
##     clipboard
```

- State level dataset used from https://www.realtor.com/research/data/: RDC_Inventory_Core_Metrics_State_History

Overall Goal

Examine variables, including potential subgroups based on location or date, and relationships between variables.

Data Preparation

Read in and prepare the data, ensuring the data is in the right shape and correct data type before you begin.

```
# import Realtor.com State data
RDC.State <- read.csv("RDC_Inventory_Core_Metrics_State_History.csv")

# examine data
summary(RDC.State)
```

```
##  month_date_yyyymm    state              state_id         median_listing_price
##  Min.   :201607    Length:3775        Length:3775        Min.   :134450
##  1st Qu.:201801    Class :character   Class :character   1st Qu.:230029
##  Median :201907    Mode  :character   Mode  :character   Median :290358
##  Mean   :201915                                          Mean   :325053
##  3rd Qu.:202102                                          3rd Qu.:375000
##  Max.   :202208                                          Max.   :879500
##
##  median_listing_price_mm median_listing_price_yy active_listing_count
##  Min.   :-0.0981         Min.   :-0.2142         Min.   :     1
```

```
##  1st Qu.:-0.0060         1st Qu.: 0.0372         1st Qu.:  5404
##  Median : 0.0009         Median : 0.0704         Median : 11895
##  Mean   : 0.0066         Mean   : 0.0795         Mean   : 20158
##  3rd Qu.: 0.0187         3rd Qu.: 0.1135         3rd Qu.: 24603
##  Max.   : 0.2090         Max.   : 0.3986         Max.   :163956
##  NA's   :613             NA's   :613
##  active_listing_count_mm active_listing_count_yy median_days_on_market
##  Min.   :-0.3977         Min.   :-0.7079         Min.   :  7.00
##  1st Qu.:-0.0624         1st Qu.:-0.2822         1st Qu.: 49.00
##  Median :-0.0100         Median :-0.1215         Median : 64.00
##  Mean   :-0.0060         Mean   :-0.1457         Mean   : 66.37
##  3rd Qu.: 0.0382         3rd Qu.:-0.0220         3rd Qu.: 81.00
##  Max.   : 0.6177         Max.   : 1.3855         Max.   :210.00
##  NA's   :613             NA's   :613
##  median_days_on_market_mm median_days_on_market_yy new_listing_count
##  Min.   :-0.7097          Min.   :-0.7064          Min.   :    0
##  1st Qu.:-0.0678          1st Qu.:-0.1679          1st Qu.: 2150
##  Median : 0.0270          Median :-0.0769          Median : 5500
##  Mean   : 0.0039          Mean   :-0.0960          Mean   : 8797
##  3rd Qu.: 0.0909          3rd Qu.:-0.0164          3rd Qu.:11206
##  Max.   : 0.8519          Max.   : 0.6923          Max.   :52876
##  NA's   :613              NA's   :613
##  new_listing_count_mm new_listing_count_yy price_increased_count
##  Min.   :-0.6874      Min.   :-0.7743      Min.   :    0.0
##  1st Qu.:-0.1011      1st Qu.:-0.0727      1st Qu.:  112.0
##  Median :-0.0103      Median :-0.0032      Median :  340.0
##  Mean   : 0.0150      Mean   : 0.0002      Mean   :  811.1
##  3rd Qu.: 0.1204      3rd Qu.: 0.0611      3rd Qu.:  848.0
##  Max.   : 2.3884      Max.   : 2.8965      Max.   :10460.0
##  NA's   :613          NA's   :613
##  price_increased_count_mm price_increased_count_yy price_reduced_count
##  Min.   :-0.9231          Min.   :-0.9540          Min.   :    0
##  1st Qu.:-0.1625          1st Qu.:-0.3125          1st Qu.: 1056
##  Median :-0.0117          Median :-0.0454          Median : 2892
##  Mean   : 0.0623          Mean   : 0.1377          Mean   : 5555
##  3rd Qu.: 0.1714          3rd Qu.: 0.3143          3rd Qu.: 6608
##  Max.   :19.5000          Max.   : 6.7090          Max.   :59600
##  NA's   :613              NA's   :613
##  price_reduced_count_mm price_reduced_count_yy pending_listing_count
##  Min.   :-0.7548        Min.   :-0.8341        Min.   :    0
##  1st Qu.:-0.1045        1st Qu.:-0.3331        1st Qu.: 1668
##  Median : 0.0133        Median :-0.0850        Median : 4838
##  Mean   : 0.0236        Mean   :-0.0709        Mean   : 9219
##  3rd Qu.: 0.1494        3rd Qu.: 0.0789        3rd Qu.:11526
##  Max.   : 2.8261        Max.   : 3.9203        Max.   :84759
##  NA's   :613            NA's   :613            NA's   :21
##  pending_listing_count_mm pending_listing_count_yy
##  Min.   :-1.0000          Min.   :-0.9858
##  1st Qu.:-0.0699          1st Qu.:-0.0861
##  Median :-0.0175          Median : 0.0459
##  Mean   : 0.0486          Mean   : 0.5859
##  3rd Qu.: 0.0861          3rd Qu.: 0.3232
##  Max.   :52.0903          Max.   :81.0000
##  NA's   :633              NA's   :643
```

```
##  median_listing_price_per_square_foot median_listing_price_per_square_foot_mm
##  Min.   : 78.0                        Min.   :-0.2090
##  1st Qu.:118.0                        1st Qu.:-0.0015
##  Median :146.0                        Median : 0.0049
##  Mean   :174.1                        Mean   : 0.0073
##  3rd Qu.:189.0                        3rd Qu.: 0.0147
##  Max.   :695.0                        Max.   : 0.2279
##                                       NA's   :613
##  median_listing_price_per_square_foot_yy median_square_feet
##  Min.   :-0.1432                         Min.   : 990
##  1st Qu.: 0.0432                         1st Qu.:1796
##  Median : 0.0726                         Median :1936
##  Mean   : 0.0894                         Mean   :1925
##  3rd Qu.: 0.1260                         3rd Qu.:2052
##  Max.   : 0.5369                         Max.   :2808
##  NA's   :613
##  median_square_feet_mm median_square_feet_yy average_listing_price
##  Min.   :-0.1124       Min.   :-0.3077       Min.   : 207337
##  1st Qu.:-0.0077       1st Qu.:-0.0245       1st Qu.: 312809
##  Median :-0.0013       Median :-0.0006       Median : 413261
##  Mean   :-0.0004       Mean   :-0.0063       Mean   : 517178
##  3rd Qu.: 0.0062       3rd Qu.: 0.0166       3rd Qu.: 620527
##  Max.   : 0.1921       Max.   : 0.2827       Max.   :1707319
##  NA's   :613           NA's   :613
##  average_listing_price_mm average_listing_price_yy total_listing_count
##  Min.   :-0.3395          Min.   :-0.3019          Min.   :     1
##  1st Qu.:-0.0070          1st Qu.: 0.0294          1st Qu.:  8253
##  Median : 0.0032          Median : 0.0652          Median : 18441
##  Mean   : 0.0062          Mean   : 0.0820          Mean   : 29331
##  3rd Qu.: 0.0181          3rd Qu.: 0.1164          3rd Qu.: 35516
##  Max.   : 0.5063          Max.   : 0.7601          Max.   :218268
##  NA's   :613              NA's   :613
##  total_listing_count_mm total_listing_count_yy pending_ratio
##  Min.   :-0.3557        Min.   :-0.4981        Min.   :0.0000
##  1st Qu.:-0.0437        1st Qu.:-0.1736        1st Qu.:0.1802
##  Median :-0.0002        Median :-0.0847        Median :0.3810
##  Mean   :-0.0028        Mean   :-0.0818        Mean   :0.5635
##  3rd Qu.: 0.0416        3rd Qu.:-0.0019        3rd Qu.:0.7967
##  Max.   : 0.7868        Max.   : 0.8937        Max.   :2.9593
##  NA's   :613            NA's   :613            NA's   :21
##  pending_ratio_mm  pending_ratio_yy   quality_flag
##  Min.   :-0.8885   Min.   :-1.3269   Min.   :0.0000
##  1st Qu.:-0.0247   1st Qu.:-0.0037   1st Qu.:0.0000
##  Median :-0.0005   Median : 0.0518   Median :0.0000
##  Mean   : 0.0064   Mean   : 0.1649   Mean   :0.0199
##  3rd Qu.: 0.0390   3rd Qu.: 0.2710   3rd Qu.:0.0000
##  Max.   : 1.2009   Max.   : 2.5016   Max.   :1.0000
##  NA's   :633       NA's   :640       NA's   :612
```

```
str(RDC.State)
```

```
## 'data.frame':    3775 obs. of  40 variables:
##  $ month_date_yyyymm                     : int  202208 202207 202206 202205 202204 202203 202202 20
##  $ state                                 : chr  "alaska" "alaska" "alaska" "alaska" ...
```

```
##  $ state_id                                : chr  "ak" "ak" "ak" "ak" ...
##  $ median_listing_price                    : int  399700 399000 409900 409500 405000 387450 368450 350
##  $ median_listing_price_mm                 : num  0.0018 -0.0266 0.001 0.0111 0.0453 0.0516 0.0527 0.0
##  $ median_listing_price_yy                 : num  0.176 0.184 0.216 0.204 0.224 ...
##  $ active_listing_count                    : int  1762 1808 1428 1106 874 733 718 833 1044 1246 ...
##  $ active_listing_count_mm                 : num  -0.0254 0.2661 0.2911 0.2654 0.1924 ...
##  $ active_listing_count_yy                 : num  -0.0387 0.0648 -0.0286 -0.142 -0.2765 ...
##  $ median_days_on_market                   : int  46 32 29 27 28 43 76 98 86 69 ...
##  $ median_days_on_market_mm                : num  0.4375 0.1034 0.0943 -0.0536 -0.3488 ...
##  $ median_days_on_market_yy                : num  0.2603 -0.0448 -0.0645 -0.2639 -0.3253 ...
##  $ new_listing_count                       : int  712 948 1048 888 804 628 448 320 280 352 ...
##  $ new_listing_count_mm                    : num  -0.2489 -0.0954 0.1802 0.1045 0.2803 ...
##  $ new_listing_count_yy                    : num  -0.2489 -0.1023 0.0195 -0.0976 0.0524 ...
##  $ price_increased_count                   : int  40 24 28 36 52 64 60 52 28 20 ...
##  $ price_increased_count_mm                : num  0.667 -0.143 -0.222 -0.308 -0.188 ...
##  $ price_increased_count_yy                : num  0 -0.25 0 -0.5 -0.235 ...
##  $ price_reduced_count                     : int  784 888 612 360 196 112 96 100 136 284 ...
##  $ price_reduced_count_mm                  : num  -0.117 0.451 0.7 0.837 0.75 ...
##  $ price_reduced_count_yy                  : num  0.037 0.47 0.354 0.268 -0.109 ...
##  $ pending_listing_count                   : int  100 88 88 109 104 87 68 62 77 94 ...
##  $ pending_listing_count_mm                : num  0.1364 0 -0.1927 0.0481 0.1954 ...
##  $ pending_listing_count_yy                : num  -0.2806 -0.2787 -0.296 -0.1417 -0.0877 ...
##  $ median_listing_price_per_square_foot    : int  216 218 222 225 224 217 215 212 203 197 ...
##  $ median_listing_price_per_square_foot_mm: num  -0.0061 -0.019 -0.0134 0.0039 0.0337 0.01 0.014 0.04
##  $ median_listing_price_per_square_foot_yy: num  0.112 0.114 0.135 0.152 0.16 ...
##  $ median_square_feet                      : int  1900 1884 1870 1857 1803 1783 1741 1730 1747 1759 .
##  $ median_square_feet_mm                   : num  0.0085 0.0075 0.007 0.03 0.0112 0.0244 0.0061 -0.009
##  $ median_square_feet_yy                   : num  0.087 0.0941 0.08 0.0521 0.0353 0.0464 0.051 0.039 0
##  $ average_listing_price                   : int  465011 466531 474554 489685 487352 475211 460437 448
##  $ average_listing_price_mm                : num  -0.0033 -0.0169 -0.0309 0.0048 0.0255 0.0321 0.0268
##  $ average_listing_price_yy                : num  0.162 0.185 0.183 0.18 0.162 ...
##  $ total_listing_count                     : int  1860 1896 1514 1216 978 817 786 893 1121 1341 ...
##  $ total_listing_count_mm                  : num  -0.019 0.252 0.245 0.243 0.197 ...
##  $ total_listing_count_yy                  : num  -0.0573 0.0418 -0.0532 -0.1412 -0.2602 ...
##  $ pending_ratio                           : num  0.0568 0.0487 0.0616 0.0986 0.119 ...
##  $ pending_ratio_mm                        : num  0.0081 -0.013 -0.0369 -0.0204 0.0003 0.024 0.0203 0
##  $ pending_ratio_yy                        : num  -0.0191 -0.0232 -0.0234 0 0.0246 0.0221 0.0214 0.010
##  $ quality_flag                            : int  0 0 0 0 0 0 0 0 0 0 ...
```

```
# re code variable data types, remove NAs
RDC.State.Cleaned <- RDC.State %>%
    na.omit(RDC.State) %>%
    mutate(pending_ratio_mm = as.numeric(pending_ratio_mm)) %>%
    mutate(pending_ratio_yy = as.numeric(pending_ratio_yy)) %>%
    mutate(month_date_yyyymm = as.Date(paste0(month_date_yyyymm, "01"),
        format = "%Y%m%d"))

# re-examine data for changes
str(RDC.State.Cleaned)
```

```
## 'data.frame':    3130 obs. of  40 variables:
##  $ month_date_yyyymm                       : Date, format: "2022-08-01" "2022-07-01" ...
##  $ state                                   : chr  "alaska" "alaska" "alaska" "alaska" ...
##  $ state_id                                : chr  "ak" "ak" "ak" "ak" ...
```

```
##  $ median_listing_price                  : int  399700 399000 409900 409500 405000 387450 368450 350
##  $ median_listing_price_mm               : num  0.0018 -0.0266 0.001 0.0111 0.0453 0.0516 0.0527 0.0
##  $ median_listing_price_yy               : num  0.176 0.184 0.216 0.204 0.224 ...
##  $ active_listing_count                  : int  1762 1808 1428 1106 874 733 718 833 1044 1246 ...
##  $ active_listing_count_mm               : num  -0.0254 0.2661 0.2911 0.2654 0.1924 ...
##  $ active_listing_count_yy               : num  -0.0387 0.0648 -0.0286 -0.142 -0.2765 ...
##  $ median_days_on_market                 : int  46 32 29 27 28 43 76 98 86 69 ...
##  $ median_days_on_market_mm              : num  0.4375 0.1034 0.0943 -0.0536 -0.3488 ...
##  $ median_days_on_market_yy              : num  0.2603 -0.0448 -0.0645 -0.2639 -0.3253 ...
##  $ new_listing_count                     : int  712 948 1048 888 804 628 448 320 280 352 ...
##  $ new_listing_count_mm                  : num  -0.2489 -0.0954 0.1802 0.1045 0.2803 ...
##  $ new_listing_count_yy                  : num  -0.2489 -0.1023 0.0195 -0.0976 0.0524 ...
##  $ price_increased_count                 : int  40 24 28 36 52 64 60 52 28 20 ...
##  $ price_increased_count_mm              : num  0.667 -0.143 -0.222 -0.308 -0.188 ...
##  $ price_increased_count_yy              : num  0 -0.25 0 -0.5 -0.235 ...
##  $ price_reduced_count                   : int  784 888 612 360 196 112 96 100 136 284 ...
##  $ price_reduced_count_mm                : num  -0.117 0.451 0.7 0.837 0.75 ...
##  $ price_reduced_count_yy                : num  0.037 0.47 0.354 0.268 -0.109 ...
##  $ pending_listing_count                 : int  100 88 88 109 104 87 68 62 77 94 ...
##  $ pending_listing_count_mm              : num  0.1364 0 -0.1927 0.0481 0.1954 ...
##  $ pending_listing_count_yy              : num  -0.2806 -0.2787 -0.296 -0.1417 -0.0877 ...
##  $ median_listing_price_per_square_foot  : int  216 218 222 225 224 217 215 212 203 197 ...
##  $ median_listing_price_per_square_foot_mm: num  -0.0061 -0.019 -0.0134 0.0039 0.0337 0.01 0.014 0.04
##  $ median_listing_price_per_square_foot_yy: num  0.112 0.114 0.135 0.152 0.16 ...
##  $ median_square_feet                    : int  1900 1884 1870 1857 1803 1783 1741 1730 1747 1759 .
##  $ median_square_feet_mm                 : num  0.0085 0.0075 0.007 0.03 0.0112 0.0244 0.0061 -0.009
##  $ median_square_feet_yy                 : num  0.087 0.0941 0.08 0.0521 0.0353 0.0464 0.051 0.039 0
##  $ average_listing_price                 : int  465011 466531 474554 489685 487352 475211 460437 448
##  $ average_listing_price_mm              : num  -0.0033 -0.0169 -0.0309 0.0048 0.0255 0.0321 0.0268
##  $ average_listing_price_yy              : num  0.162 0.185 0.183 0.18 0.162 ...
##  $ total_listing_count                   : int  1860 1896 1514 1216 978 817 786 893 1121 1341 ...
##  $ total_listing_count_mm                : num  -0.019 0.252 0.245 0.243 0.197 ...
##  $ total_listing_count_yy                : num  -0.0573 0.0418 -0.0532 -0.1412 -0.2602 ...
##  $ pending_ratio                         : num  0.0568 0.0487 0.0616 0.0986 0.119 ...
##  $ pending_ratio_mm                      : num  0.0081 -0.013 -0.0369 -0.0204 0.0003 0.024 0.0203 0
##  $ pending_ratio_yy                      : num  -0.0191 -0.0232 -0.0234 0 0.0246 0.0221 0.0214 0.010
##  $ quality_flag                          : int  0 0 0 0 0 0 0 0 0 0 ...
##  - attr(*, "na.action")= 'omit' Named int [1:645] 25 26 27 28 29 30 31 35 36 37 ...
##   ..- attr(*, "names")= chr [1:645] "25" "26" "27" "28" ...
```

Examine variables

Evaluate central tendency and spread for continuous variables, and frequency and relative frequency for categorical variables.

Variables that relate to price and listing count are showing a higher mean than median, suggesting that the distributions are right-skewed. This means that we should use the median for these variables throughout our analysis. Variables relating month to previous month and month to previous year changes have symmetrical distributions, meaning that is appropriate to use the mean. Listing prices are skewed because of low numbers of high-priced houses, meaning most house listing prices are concentrated on the lower end. Something else I observed is that median days on market compared to the previous month is centered below zero. This may suggest that houses continue to stay on the market for short periods of time as time goes on.

```r
# median_listing_price
mean(RDC.State.Cleaned$median_listing_price)
```

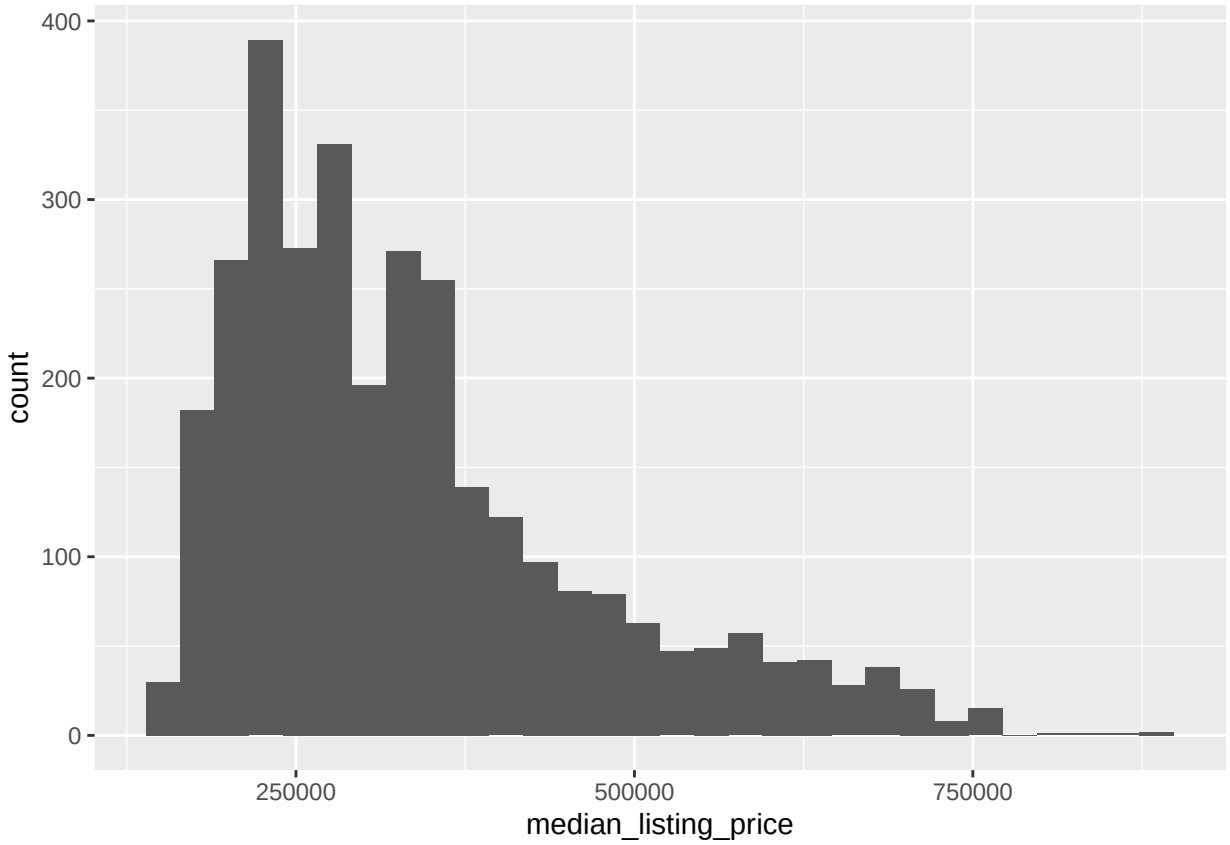
```
## [1] 335709.5
```

```r
# 335709.5
median(RDC.State.Cleaned$median_listing_price)
```

```
## [1] 299900
```

```r
# 299900

RDC.State.Cleaned %>%
    ggplot(aes(x = median_listing_price)) + geom_histogram()
```

```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```




```r
skew(RDC.State.Cleaned$median_listing_price)
```

```
##   skew (g1)          se           z           p
##  1.15238335  0.04378279 26.32046262  0.00000000
```

```r
kurtosis(RDC.State.Cleaned$median_listing_price)
```

```
## Excess Kur (g2)              se               z               p
##      0.89135528      0.08756558     10.17928773      0.00000000
```

```r
# The distribution is leptokurtic and right-skewed.
var(RDC.State.Cleaned$median_listing_price)
```

```
## [1] 17404378815
```

```r
# 17404378815
sd(RDC.State.Cleaned$median_listing_price)
```

```
## [1] 131925.7
```

```r
# 131925.7
range(RDC.State.Cleaned$median_listing_price)
```

```
## [1] 145450 879500
```

```r
# 145450 879500
IQR(RDC.State.Cleaned$median_listing_price)
```

```
## [1] 158428
```

```r
# 158428



# new_listing_count
mean(RDC.State.Cleaned$new_listing_count)
```

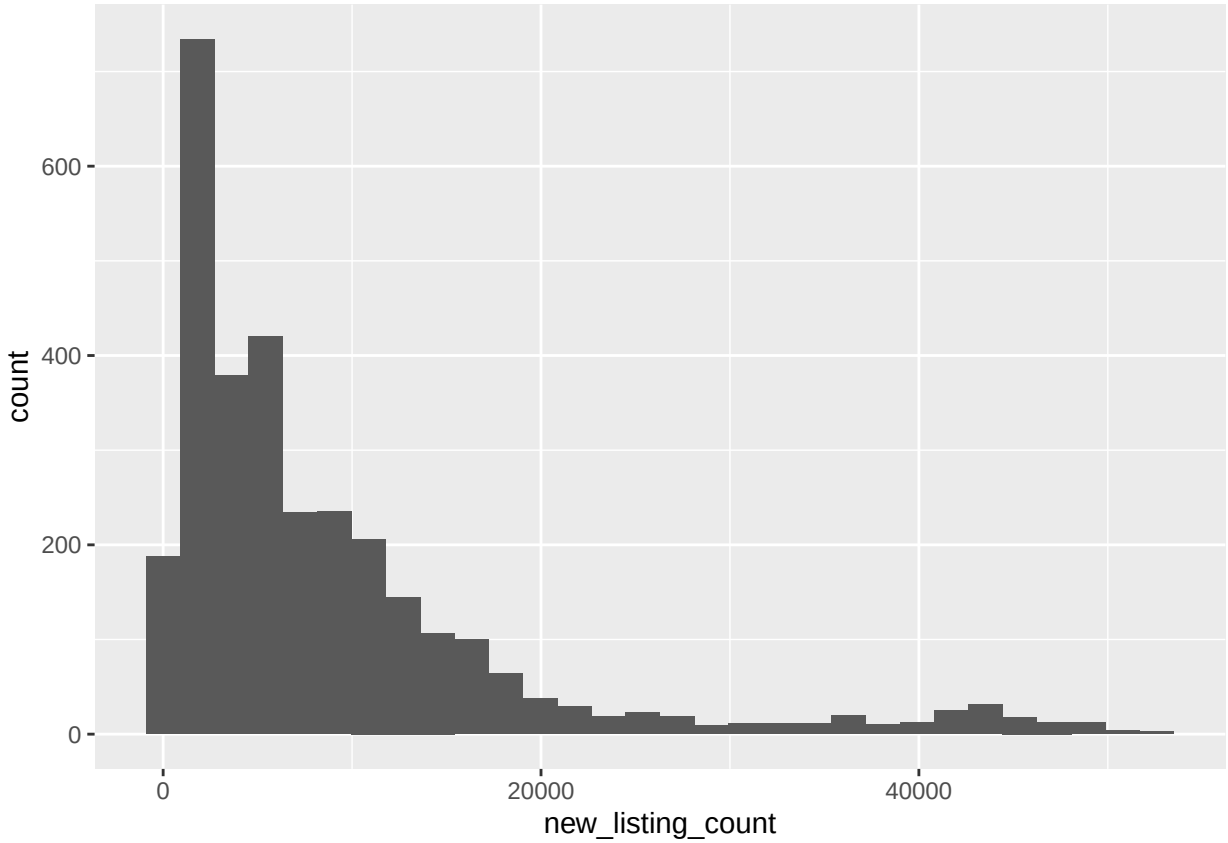
```
## [1] 8892.358
```

```r
# 8892.358
median(RDC.State.Cleaned$new_listing_count)
```

```
## [1] 5564
```

```r
# 5564

RDC.State.Cleaned %>%
    ggplot(aes(x = new_listing_count)) + geom_histogram()
```

```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```




```
skew(RDC.State.Cleaned$new_listing_count)
```

```
##   skew (g1)          se           z           p
##  2.19021277  0.04378279 50.02451083  0.00000000
```

```
kurtosis(RDC.State.Cleaned$new_listing_count)
```

```
## Excess Kur (g2)              se               z               p
##      4.93038282      0.08756558     56.30502934      0.00000000
```

```
# The distribution is right-skewed with a z-value of 56.305.

var(RDC.State.Cleaned$new_listing_count)
```

```
## [1] 98294305
```

```
# 98294305
sd(RDC.State.Cleaned$new_listing_count)
```

```
## [1] 9914.348
```

```r
# 9914.348
range(RDC.State.Cleaned$new_listing_count)
```

```
## [1]   280 52876
```

```r
# 280 52876
IQR(RDC.State.Cleaned$new_listing_count)
```

```
## [1] 9018
```

```r
# 9018



# active_listing_count
mean(RDC.State.Cleaned$active_listing_count)
```

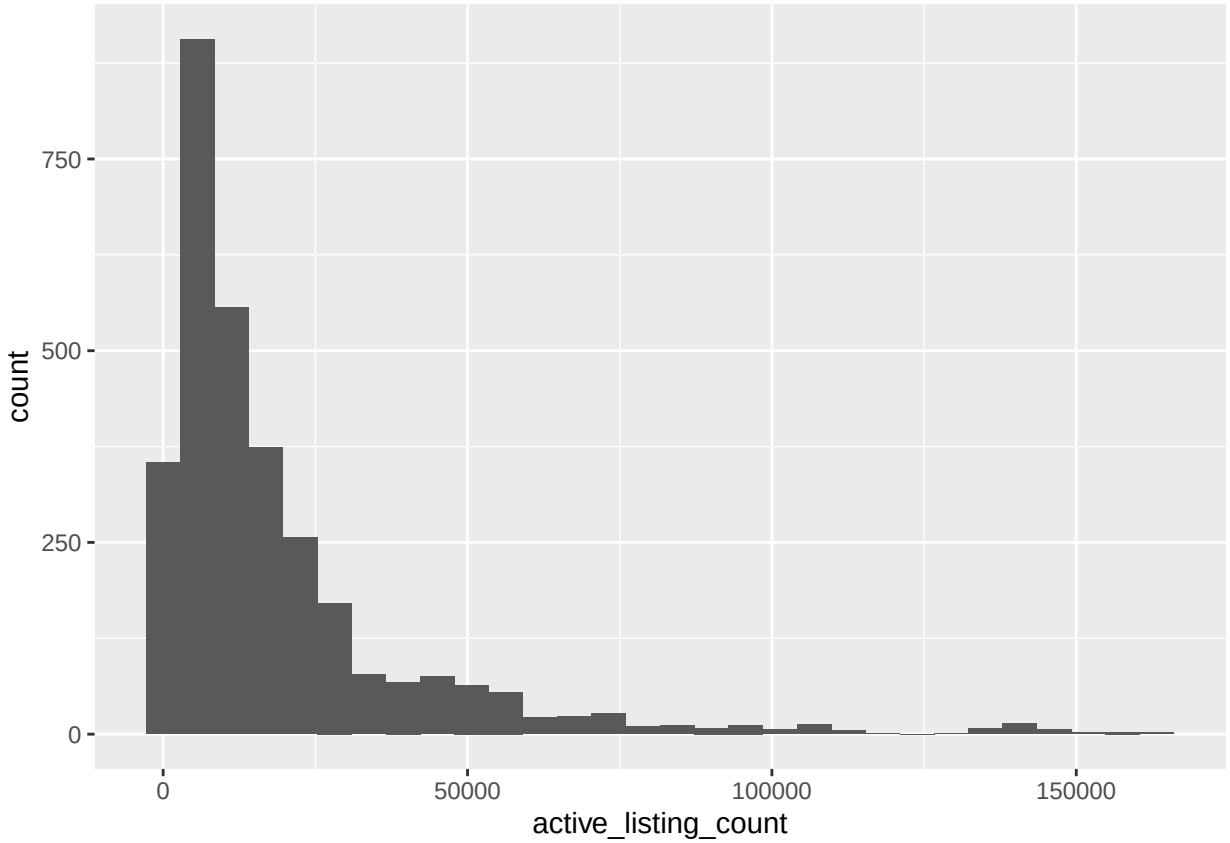
```
## [1] 19032.82
```

```r
# 19032.82
median(RDC.State.Cleaned$active_listing_count)
```

```
## [1] 11189.5
```

```r
# 11189.5

RDC.State.Cleaned %>%
    ggplot(aes(x = active_listing_count)) + geom_histogram()
```

```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```




```
skew(RDC.State.Cleaned$active_listing_count)
```

```
##   skew (g1)          se           z           p
##  2.85142589  0.04378279 65.12663392  0.00000000
```

```
kurtosis(RDC.State.Cleaned$active_listing_count)
```

```
## Excess Kur (g2)              se               z               p
##     10.21609957      0.08756558    116.66797641      0.00000000
```

```
# The distribution is right-skewed with a z-value of 65.12663392

var(RDC.State.Cleaned$active_listing_count)
```

```
## [1] 536829827
```

```
# 536829827
sd(RDC.State.Cleaned$active_listing_count)
```

```
## [1] 23169.59
```

```r
# 23169.59
range(RDC.State.Cleaned$active_listing_count)
```

```
## [1]    718 163956
```

```r
# 718 163956
IQR(RDC.State.Cleaned$active_listing_count)
```

```
## [1] 17574.25
```

```r
# 17574.25



# total_listing_count_mm
mean(RDC.State.Cleaned$total_listing_count_mm)
```

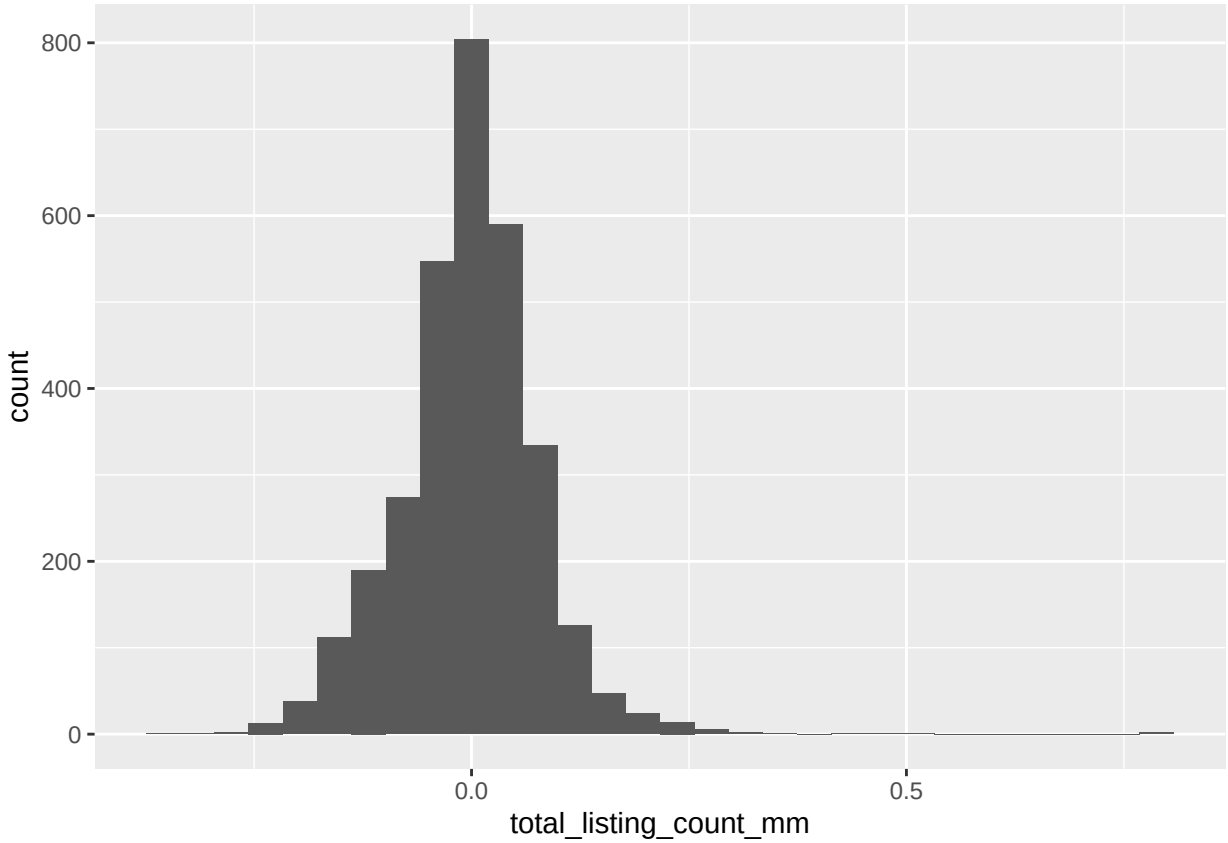
```
## [1] -0.002979329
```

```r
# 0.002979329
median(RDC.State.Cleaned$total_listing_count_mm)
```

```
## [1] -2e-04
```

```r
# -2e-04

RDC.State.Cleaned %>%
    ggplot(aes(x = total_listing_count_mm)) + geom_histogram()
```

```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```




```
skew(RDC.State.Cleaned$total_listing_count_mm)
```

```
##   skew (g1)          se           z           p
##  0.70249295  0.04378279 16.04495545  0.00000000
```

```
kurtosis(RDC.State.Cleaned$total_listing_count_mm)
```

```
## Excess Kur (g2)              se               z               p
##      7.33654797      0.08756558     83.78346346      0.00000000
```

```
# The distribution is leptokurtic with a z-value of 83.7834.
var(RDC.State.Cleaned$total_listing_count_mm)
```

```
## [1] 0.006501548
```

```
# 0.006501548
sd(RDC.State.Cleaned$total_listing_count_mm)
```

```
## [1] 0.08063218
```

```
# 0.08063218
range(RDC.State.Cleaned$total_listing_count_mm)
```

```
## [1] -0.3557  0.7868
```

```
# -0.3557 0.7868
IQR(RDC.State.Cleaned$total_listing_count_mm)
```

```
## [1] 0.08505
```

```
# 0.08505



# median_square_feet
mean(RDC.State.Cleaned$median_square_feet)
```

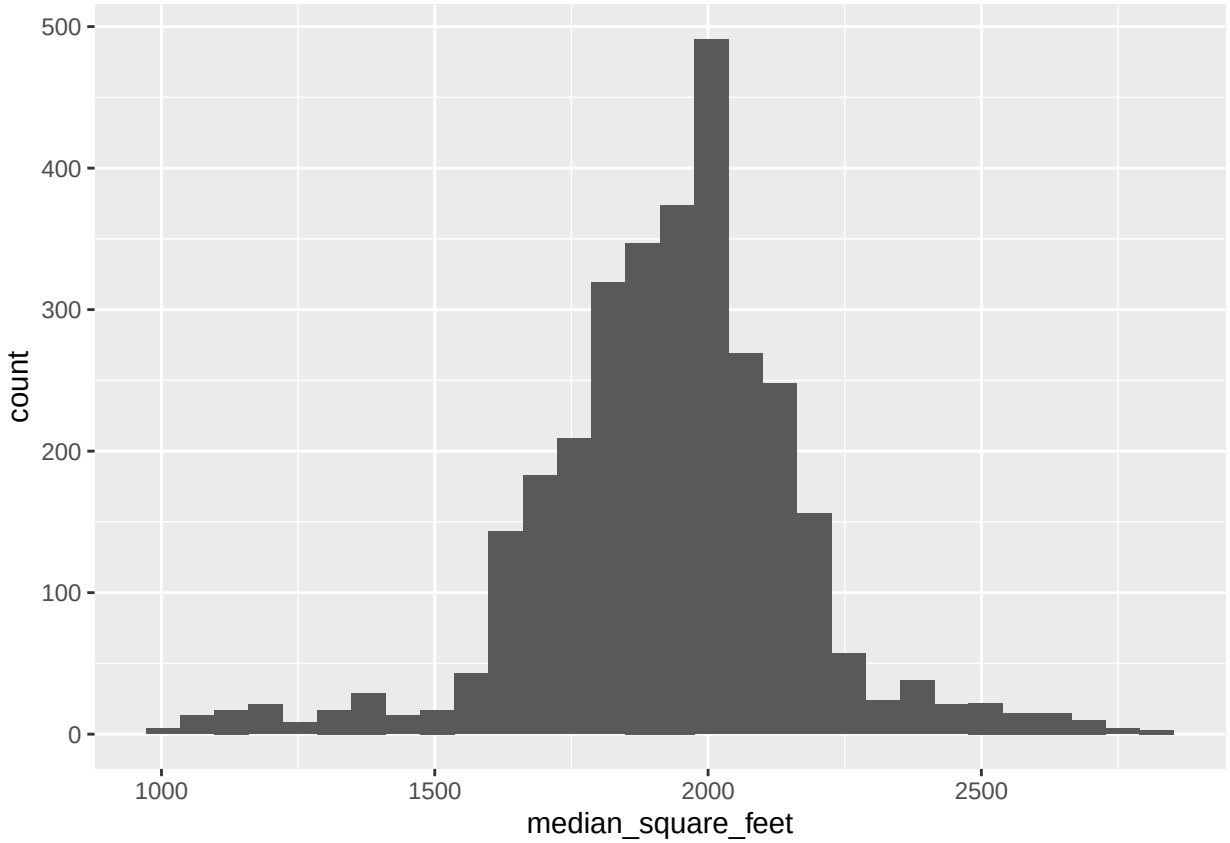
```
## [1] 1926.552
```

```
# 1926.552
median(RDC.State.Cleaned$median_square_feet)
```

```
## [1] 1941
```

```
# 1941

RDC.State.Cleaned %>%
    ggplot(aes(x = median_square_feet)) + geom_histogram()
```

```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```




```
skew(RDC.State.Cleaned$median_square_feet)
```

```
##     skew (g1)            se             z             p
## -3.061128e-01  4.378279e-02 -6.991624e+00  2.717160e-12
```

```
kurtosis(RDC.State.Cleaned$median_square_feet)
```

```
## Excess Kur (g2)             se              z              p
##      2.12391716      0.08756558     24.25515876      0.00000000
```

```
# The distribution is leptokurtic, but not skewed.
var(RDC.State.Cleaned$median_square_feet)
```

```
## [1] 58789.32
```

```
# 58789.32
sd(RDC.State.Cleaned$median_square_feet)
```

```
## [1] 242.4651
```

```
# 242.4651
range(RDC.State.Cleaned$median_square_feet)
```

```
## [1]  990 2808
```

```
# 990 2808
IQR(RDC.State.Cleaned$median_square_feet)
```

```
## [1] 258
```

```
# 258


# median_days_on_market
mean(RDC.State.Cleaned$median_days_on_market)
```

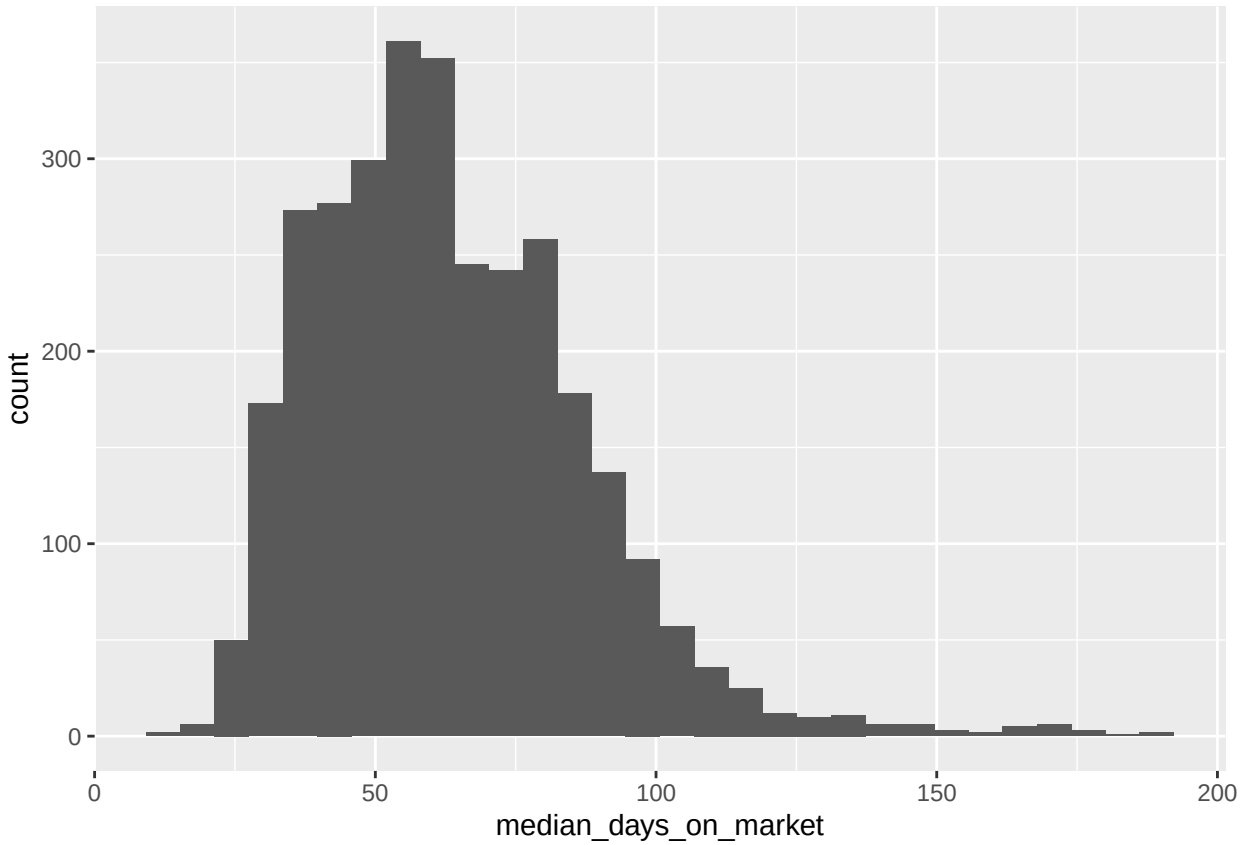
```
## [1] 63.30511
```

```
# 63.30511
median(RDC.State.Cleaned$median_days_on_market)
```

```
## [1] 60
```

```
# 60

RDC.State.Cleaned %>%
    ggplot(aes(x = median_days_on_market)) + geom_histogram()
```

```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```



```r
skew(RDC.State.Cleaned$median_days_on_market)
```

```
##   skew (g1)          se           z           p
##  1.04585493  0.04378279 23.88735110  0.00000000
```

```r
kurtosis(RDC.State.Cleaned$median_days_on_market)
```

```
## Excess Kur (g2)              se               z               p
##      2.24010501      0.08756558     25.58202532      0.00000000
```

```r
var(RDC.State.Cleaned$median_days_on_market)
```

```
## [1] 571.6432
```

```r
# 571.6432
sd(RDC.State.Cleaned$median_days_on_market)
```

```
## [1] 23.90906
```

```r
# 23.90906
range(RDC.State.Cleaned$median_days_on_market)
```

```
## [1]  14 191
```

```r
# 14 191
IQR(RDC.State.Cleaned$median_days_on_market)
```

```
## [1] 32
```

```r
# 32



# median_days_on_market_yy
mean(RDC.State.Cleaned$median_days_on_market_yy)
```

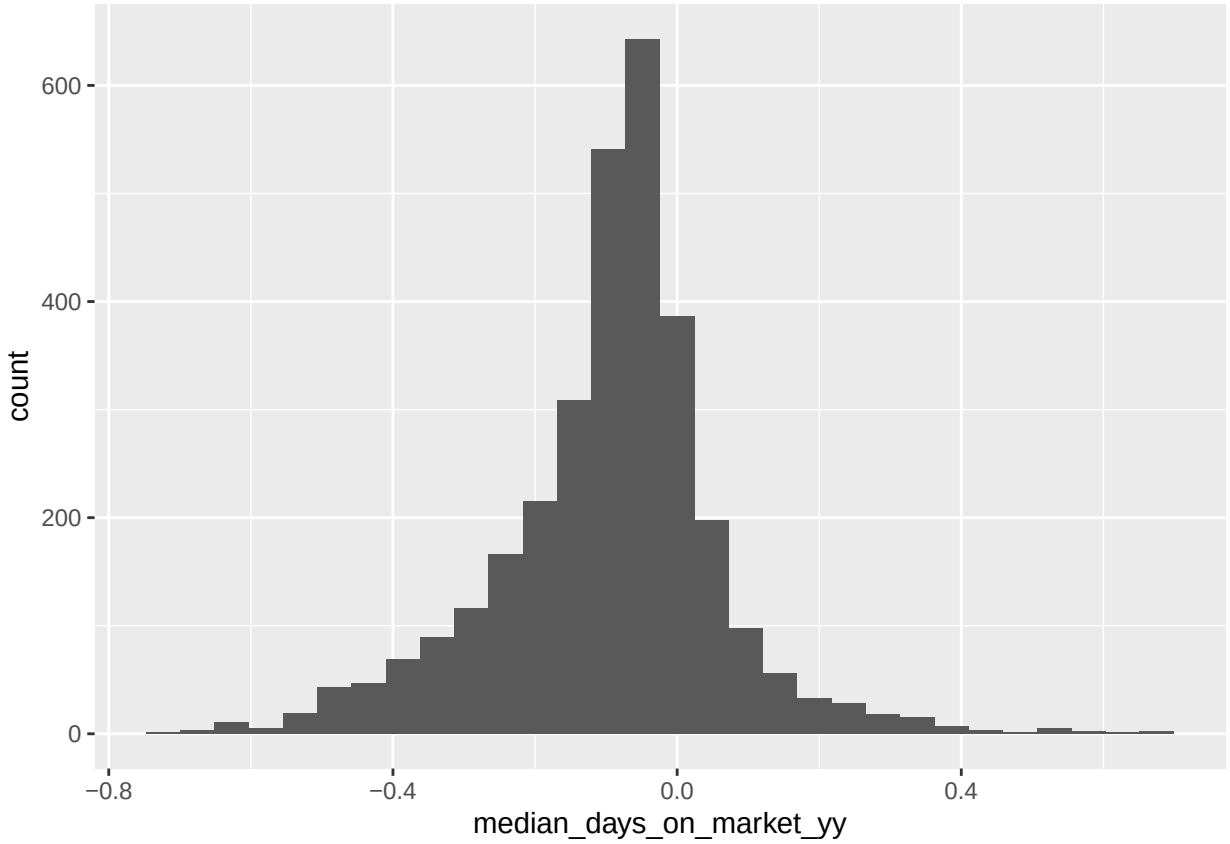
```
## [1] -0.09686895
```

```r
# -0.08939443
median(RDC.State.Cleaned$median_days_on_market_yy)
```

```
## [1] -0.0769
```

```r
# -0.087

RDC.State.Cleaned %>%
    ggplot(aes(x = median_days_on_market_yy)) + geom_histogram()
```

```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```




```
skew(RDC.State.Cleaned$median_days_on_market_yy)
```

```
##     skew (g1)            se             z             p
## -1.843381e-01  4.378279e-02 -4.210286e+00  2.550476e-05
```

```
kurtosis(RDC.State.Cleaned$median_days_on_market_yy)
```

```
## Excess Kur (g2)              se              z              p
##      2.14013856      0.08756558     24.44040738      0.00000000
```

```
var(RDC.State.Cleaned$median_days_on_market_yy)
```

```
## [1] 0.0246584
```

```
# 0.0246584
sd(RDC.State.Cleaned$median_days_on_market_yy)
```

```
## [1] 0.1570299
```

```r
# 0.1570299
range(RDC.State.Cleaned$median_days_on_market_yy)
```

```
## [1] -0.7064  0.6923
```

```r
# -0.7064 0.6923
IQR(RDC.State.Cleaned$median_days_on_market_yy)
```

```
## [1] 0.1518
```

```r
# 0.1518



# median_days_on_market_mm
mean(RDC.State.Cleaned$median_days_on_market_mm)
```

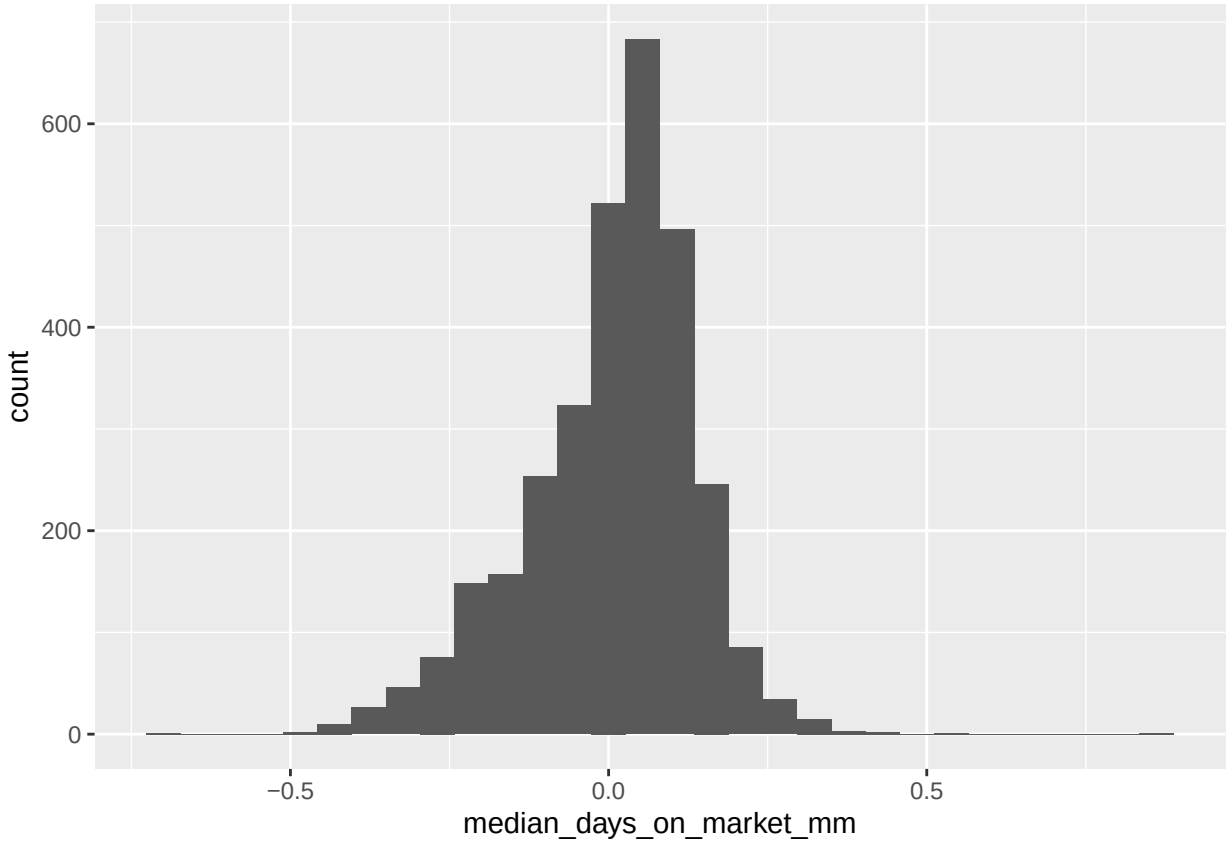
```
## [1] 0.003987764
```

```r
# 0.004394047
median(RDC.State.Cleaned$median_days_on_market_mm)
```

```
## [1] 0.027
```

```r
# 0.0208

RDC.State.Cleaned %>%
    ggplot(aes(x = median_days_on_market_mm)) + geom_histogram()
```

```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```




```
skew(RDC.State.Cleaned$median_days_on_market_mm)
```

```
##    skew (g1)           se            z           p
##  -0.57106147   0.04378279 -13.04305737   0.00000000
```

```
kurtosis(RDC.State.Cleaned$median_days_on_market_mm)
```

```
## Excess Kur (g2)             se              z              p
##      1.25392342      0.08756558     14.31982011      0.00000000
```

```
var(RDC.State.Cleaned$median_days_on_market_mm)
```

```
## [1] 0.01761392
```

```
# 0.01761392
sd(RDC.State.Cleaned$median_days_on_market_mm)
```

```
## [1] 0.1327174
```

```
# 0.1327174
range(RDC.State.Cleaned$median_days_on_market_mm)
```

```
## [1] -0.7097  0.8519
```

```r
# -0.7097 0.8519
IQR(RDC.State.Cleaned$median_days_on_market_mm)
```

```
## [1] 0.159225
```

```r
# 0.159225


# price_reduced_count
mean(RDC.State.Cleaned$price_reduced_count)
```

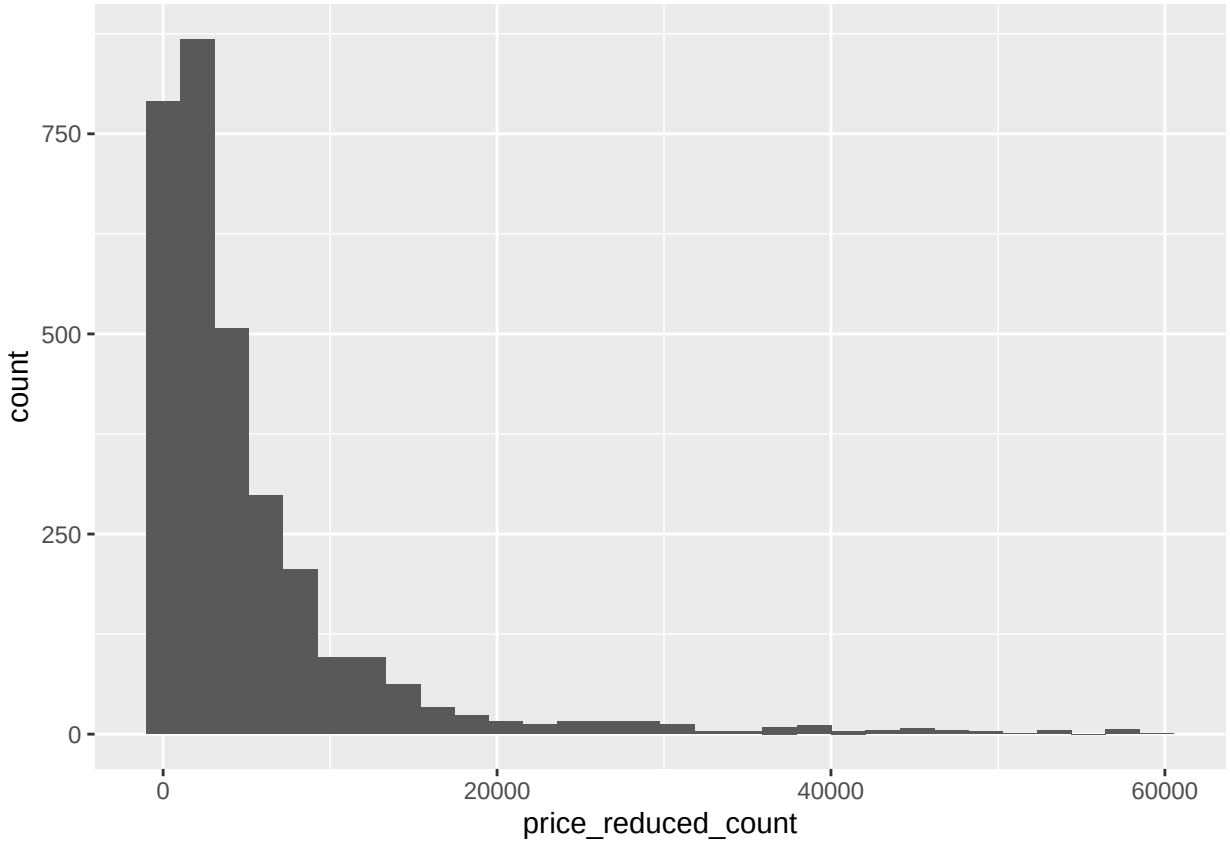
```
## [1] 5323.327
```

```r
# 5323.327
median(RDC.State.Cleaned$price_reduced_count)
```

```
## [1] 2748
```

```r
# 2748

RDC.State.Cleaned %>%
    ggplot(aes(x = price_reduced_count)) + geom_histogram()
```

```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```



```r
skew(RDC.State.Cleaned$price_reduced_count)
```

```
##   skew (g1)          se           z           p
##  3.41746976  0.04378279 78.05508921  0.00000000
```

```r
kurtosis(RDC.State.Cleaned$price_reduced_count)
```

```
## Excess Kur (g2)              se               z               p
##     14.46819602      0.08756558    165.22696746      0.00000000
```

```r
# The distribution is right-skewed with a z-value of 78.05508921.

var(RDC.State.Cleaned$price_reduced_count)
```

```
## [1] 59079858
```

```r
# 59079858
sd(RDC.State.Cleaned$price_reduced_count)
```

```
## [1] 7686.342
```

```r
# 7686.342
range(RDC.State.Cleaned$price_reduced_count)
```

```
## [1]    80 59600
```

```r
# 80 59600
IQR(RDC.State.Cleaned$price_reduced_count)
```

```
## [1] 5269
```

```r
# 5269


# price_reduced_count_mm
mean(RDC.State.Cleaned$price_reduced_count_mm)
```

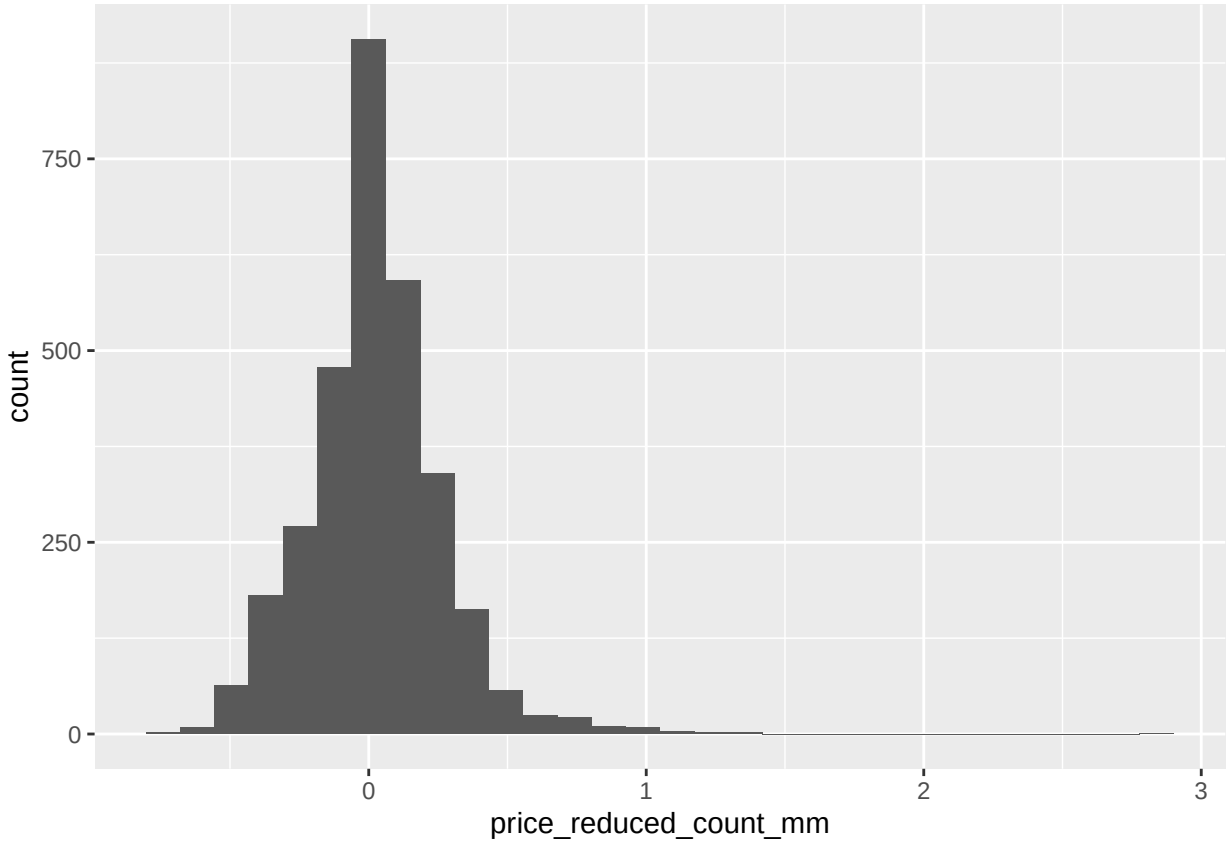
```
## [1] 0.02318013
```

```r
# 0.02318013
median(RDC.State.Cleaned$price_reduced_count_mm)
```

```
## [1] 0.01285
```

```r
# 0.01285

RDC.State.Cleaned %>%
    ggplot(aes(x = price_reduced_count_mm)) + geom_histogram()
```

```
## `stat_bin()` using `bins = 30`. Pick better value with `binwidth`.
```




```
skew(RDC.State.Cleaned$price_reduced_count_mm)
```

```
##   skew (g1)          se           z           p
##  1.07350279  0.04378279 24.51882873  0.00000000
```

```
kurtosis(RDC.State.Cleaned$price_reduced_count_mm)
```

```
## Excess Kur (g2)              se               z               p
##      7.70463765      0.08756558     87.98705195      0.00000000
```

```
# The distribution is symmetrical and leptokurtic.

var(RDC.State.Cleaned$price_reduced_count_mm)
```

```
## [1] 0.05873634
```

```
# 0.05873634
sd(RDC.State.Cleaned$price_reduced_count_mm)
```

```
## [1] 0.2423558
```

```
# 0.2423558
range(RDC.State.Cleaned$price_reduced_count_mm)
```

```
## [1] -0.7548  2.8261
```

```
# -0.7548 2.8261
IQR(RDC.State.Cleaned$price_reduced_count_mm)
```

```
## [1] 0.254425
```

```
# 0.254425
```

Group Variables

Group categorical variables further to see different patterns based on location and/or date

Median listing prices increase every year. Within each year, prices tend to be higher in the late-spring to summer months. Hawaii has the most expensive houses yet has one of the lowest square footage. Utah has by far the biggest houses. Square feet may not have as great of an effect on listing price as I previously thought. The state with the highest active listing count is Florida.

```
# evaluating the mean of the median price by state
median_price_groupby_state <- aggregate(RDC.State.Cleaned$median_listing_price,
    list(RDC.State.Cleaned$state), median)
colnames(median_price_groupby_state) <- c("state", "median_price")

# looking at the top 6 states median price
top_median_price_groupby_state <- median_price_groupby_state[order(-median_price_groupby_state$median_pr
    ]
head(top_median_price_groupby_state)
```

```
##                   state median_price
## 12               hawaii     685000.0
## 9  district of columbia     619925.0
## 5            california     580750.0
## 22        massachusetts     549000.0
## 33             new york     494749.5
## 6              colorado     493700.0
```

```
# looking at the bottom 6 states by median price
bottom_median_price_groupby_state <- median_price_groupby_state[order(median_price_groupby_state$median_
    ]
head(bottom_median_price_groupby_state)
```

```
##            state median_price
## 49 west virginia     169164.5
## 36          ohio     189350.0
## 4       arkansas     194600.0
## 17        kansas     195175.0
## 25   mississippi     204225.0
## 15       indiana     207259.0
```

```r
# evaluating median of active listing count by state
median_active_listing_groupby_state <- aggregate(RDC.State.Cleaned$active_listing_count,
    list(RDC.State.Cleaned$state), median)
colnames(median_active_listing_groupby_state) <- c("state", "median_active_listing_count")

# top 6 states by median active listing count
top_median_active_listing_groupby_state <- median_active_listing_groupby_state[order(-median_active_lis
    ]
head(top_median_active_listing_groupby_state)
```

```
##         state median_active_listing_count
## 10    florida                    136091.5
## 44      texas                     90580.5
## 5  california                     60434.5
## 11    georgia                     56783.5
## 33   new york                     55569.0
## 14   illinois                     43172.0
```

```r
# bottom 6 states by median active listing count
bottom_median_active_listing_groupby_state <- median_active_listing_groupby_state[order(median_active_li
    ]
head(bottom_median_active_listing_groupby_state)
```

```
##                   state median_active_listing_count
## 9  district of columbia                      1520.5
## 2                alaska                      1563.5
## 40         rhode island                      2495.0
## 51              wyoming                      2828.0
## 35         north dakota                      2983.0
## 42         south dakota                      3190.0
```

```r
# evaluating mean square feet by state
median_sqft_bystate <- aggregate(RDC.State.Cleaned$median_square_feet,
    list(RDC.State.Cleaned$state), median)
colnames(median_sqft_bystate) <- c("state", "median_sqft")

# top 6 states by mean square feet
top_median_sqft_bystate <- median_sqft_bystate[order(-median_sqft_bystate$median_sqft),
    ]
head(top_median_sqft_bystate)
```

```
##             state median_sqft
## 45           utah      2607.0
## 11        georgia      2357.0
## 6        colorado      2354.5
## 44          texas      2216.0
## 27        montana      2177.0
## 34 north carolina      2172.5
```

```r
# bottom 6 states by mean square feet
bottom_median_sqft_bystate <- median_sqft_bystate[order(median_sqft_bystate$median_sqft),
    ]
head(bottom_median_sqft_bystate)
```

```
##                   state median_sqft
## 9  district of columbia      1221.5
## 12               hawaii      1291.0
## 16                 iowa      1625.5
## 40         rhode island      1649.0
## 23             michigan      1654.5
## 20                maine      1700.0
```

```
# evaluating median price by date
median_price_bydate <- aggregate(RDC.State.Cleaned$median_listing_price,
    list(RDC.State.Cleaned$month_date_yyyymm), median)
colnames(median_price_bydate) <- c("date", "median_price")

# top 6 year-month by date
top_median_price_bydate <- median_price_bydate[order(-median_price_bydate$median_price),
    ]
head(top_median_price_bydate)
```

```
##          date median_price
## 60 2022-06-01       412500
## 61 2022-07-01       409600
## 62 2022-08-01       399950
## 59 2022-05-01       399500
## 58 2022-04-01       385000
## 57 2022-03-01       371000
```

```
# bottom 6 year-month by date
bottom_median_price_bydate <- median_price_bydate[order(median_price_bydate$median_price),
    ]
head(bottom_median_price_bydate)
```

```
##         date median_price
## 2 2017-08-01     259900.0
## 1 2017-07-01     261450.0
## 3 2017-09-01     262200.0
## 7 2018-01-01     262412.5
## 6 2017-12-01     263000.0
## 4 2017-10-01     265000.0
```

```
Yr2022.State <- RDC.State.Cleaned %>%
    filter(month_date_yyyymm > "2021-01-01")

Hawaii.2021 <- RDC.State.Cleaned %>%
    filter(state == "hawaii") %>%
    filter(month_date_yyyymm > "2021-01-01")

Hawaii <- RDC.State.Cleaned %>%
    filter(state == "hawaii")

Alaska <- RDC.State.Cleaned %>%
    filter(state == "alaska")
```

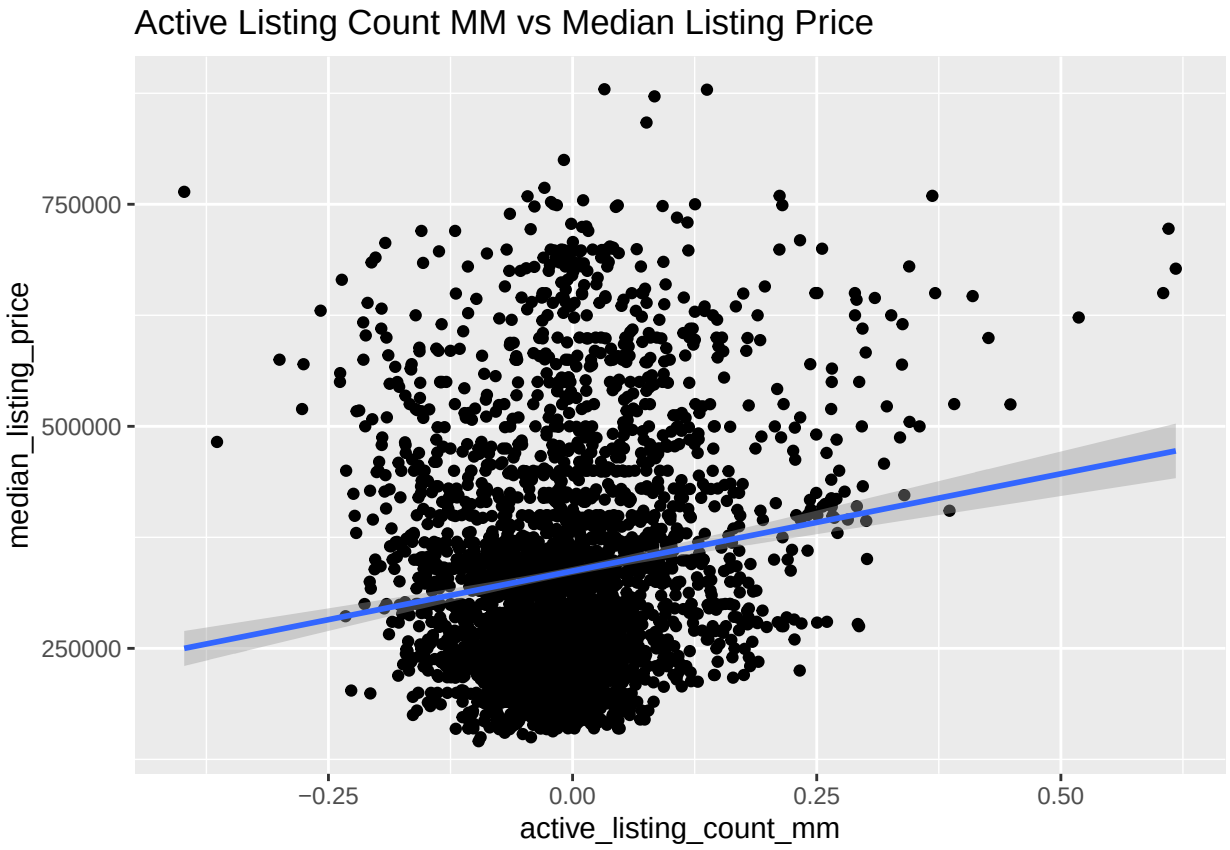
```
Virginia <- RDC.State.Cleaned %>%
    filter(state == "virginia")
```

Data Visualization

Create graphs depicting relationships between 2 variables

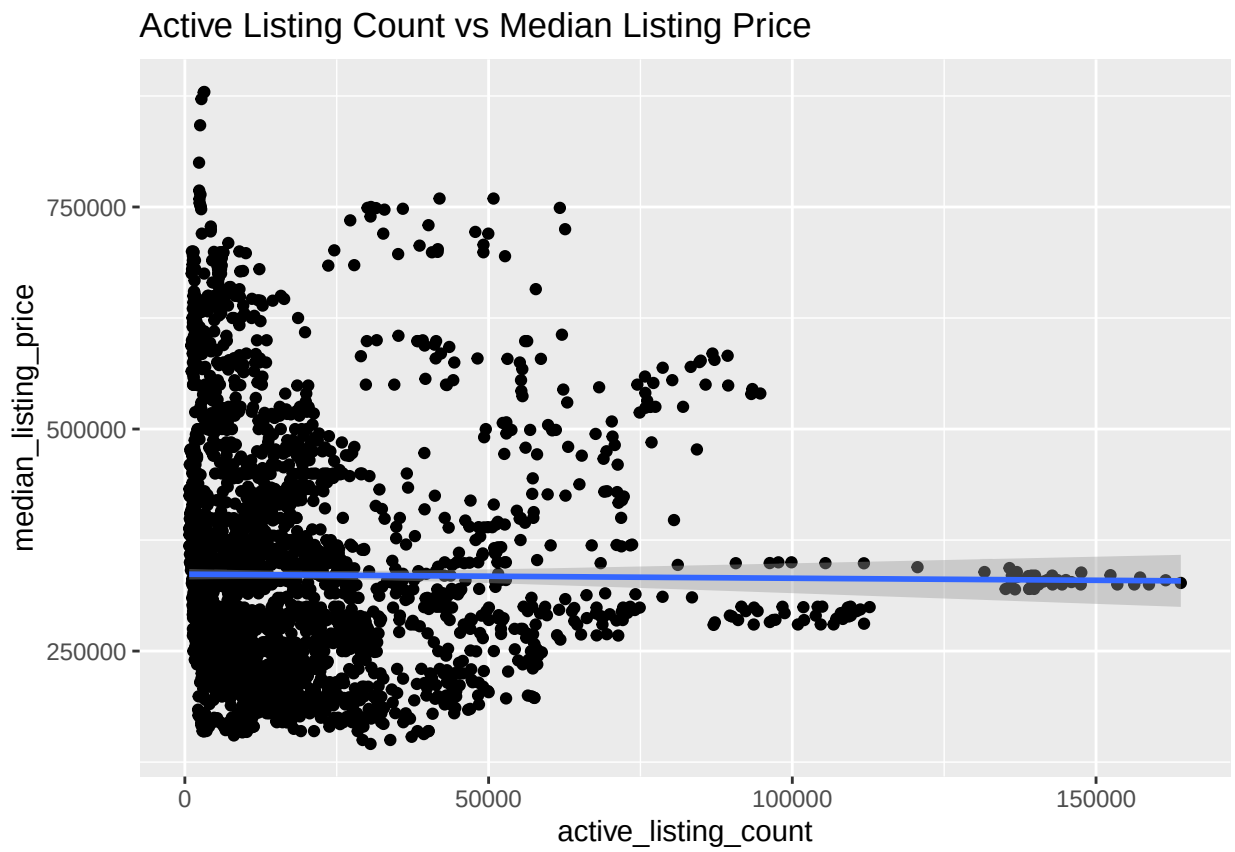
```
ActiveListCountmm.MedListPrice.Scatter <- RDC.State.Cleaned %>%
    ggplot(aes(x = active_listing_count_mm, y = median_listing_price)) +
    geom_point() + stat_smooth(method = "lm") + ggtitle("Active Listing Count MM vs Median Listing Price
ActiveListCountmm.MedListPrice.Scatter
```

```
## `geom_smooth()` using formula = 'y ~ x'
```



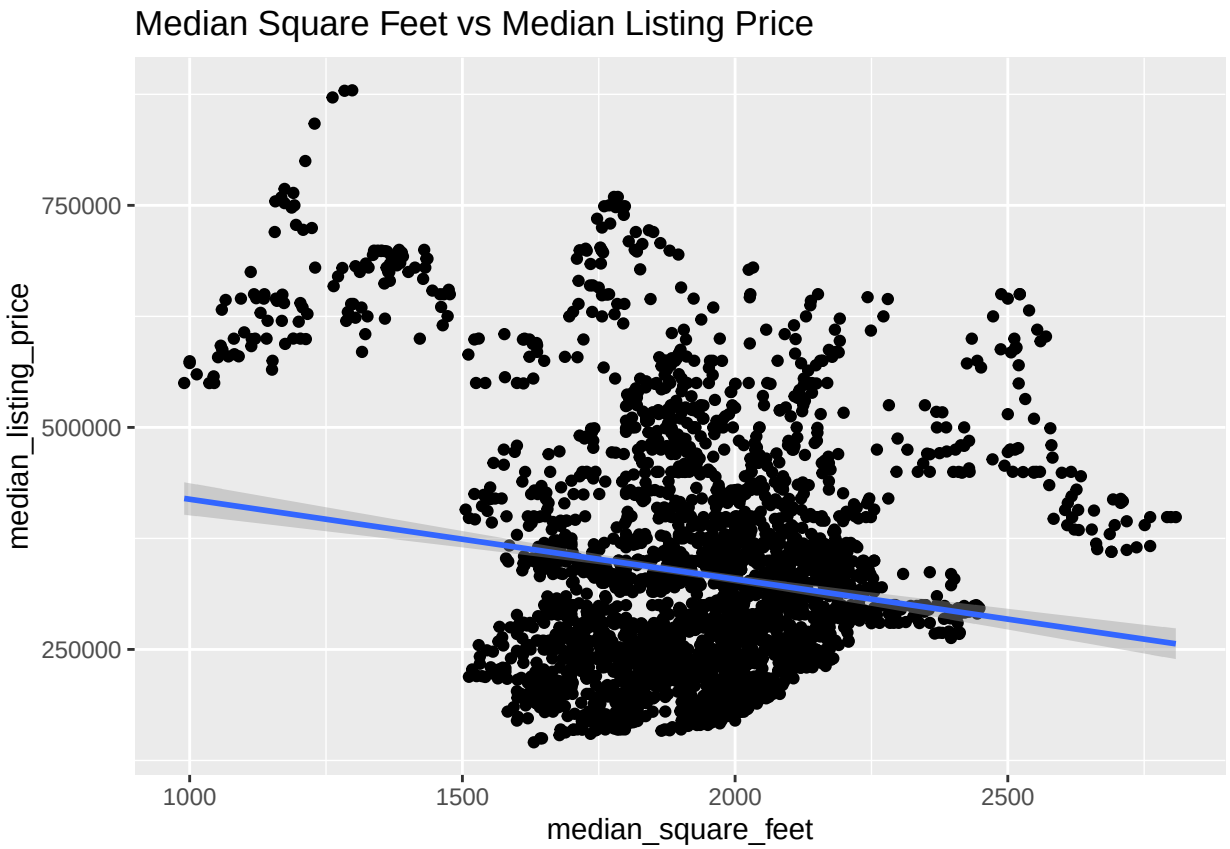

```
# This scatter plot with a regression line shows the relationship
# between change in active listing count from the previous month to
# the median listing price. While there doesn't seem to have a
# significant relationship looking at the plot, the trend line
# suggest a positive correlation.

ActiveListCount.MedListPrice.Scatter <- RDC.State.Cleaned %>%
    ggplot(aes(x = active_listing_count, y = median_listing_price)) + geom_point() +
    stat_smooth(method = "lm") + ggtitle("Active Listing Count vs Median Listing Price")
ActiveListCount.MedListPrice.Scatter
```

```
## `geom_smooth()` using formula = 'y ~ x'
```

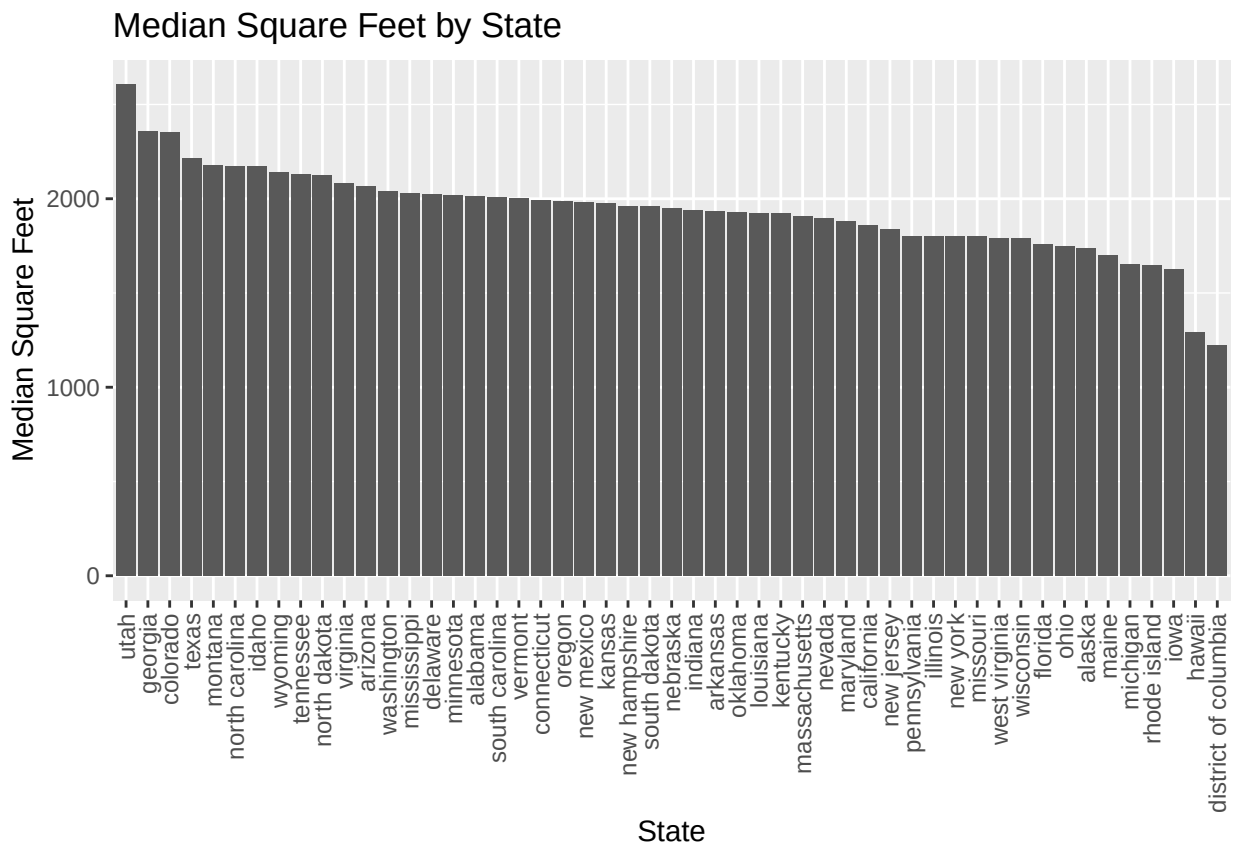



```
# This scatter plot with a regression line shows the relationship
# between active listing count and median listing price. This plot
# shows little to no correlation. The trend line appears to have
# little to no slope.

ListPrice.SqFt.Scatter <- RDC.State.Cleaned %>%
    ggplot(aes(x = median_square_feet, y = median_listing_price)) + geom_point() +
    stat_smooth(method = "lm") + ggtitle("Median Square Feet vs Median Listing Price")
ListPrice.SqFt.Scatter
```

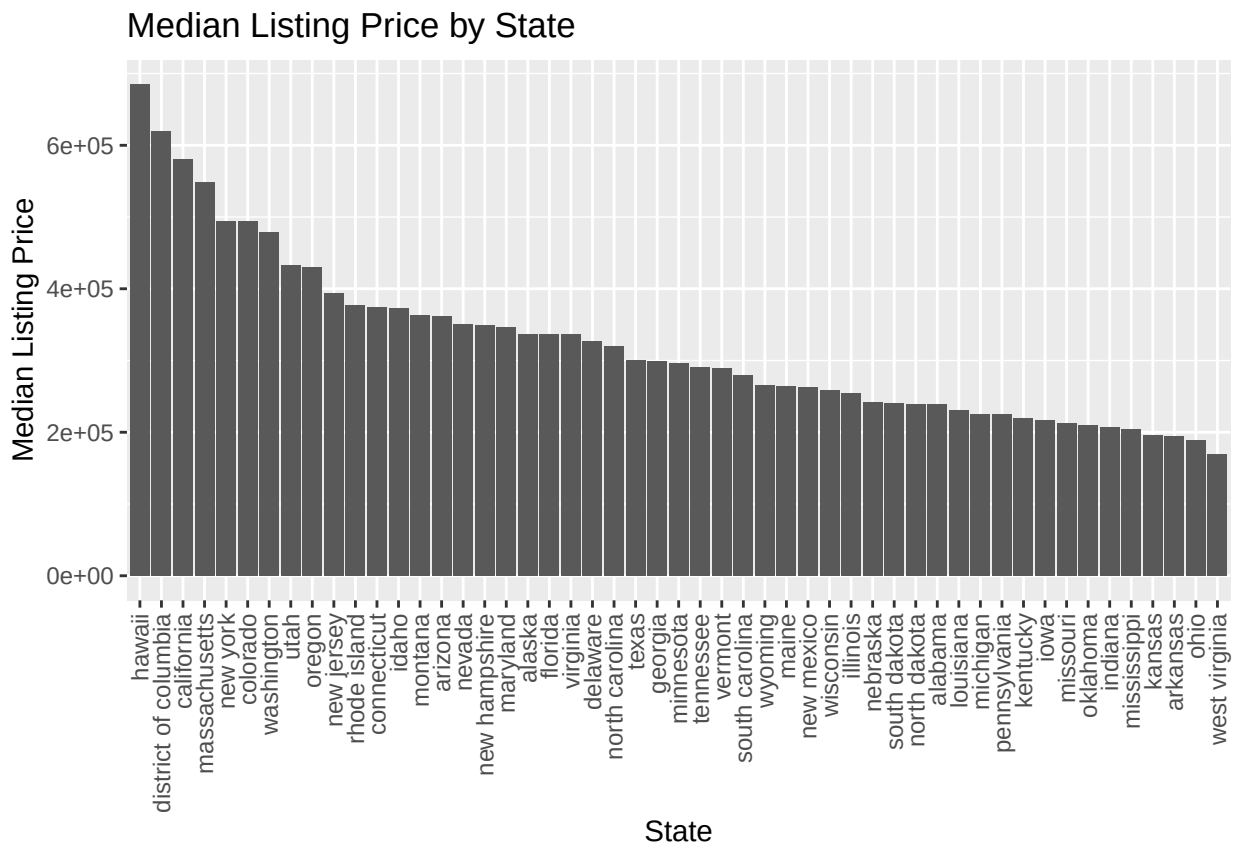
```
## `geom_smooth()` using formula = 'y ~ x'
```



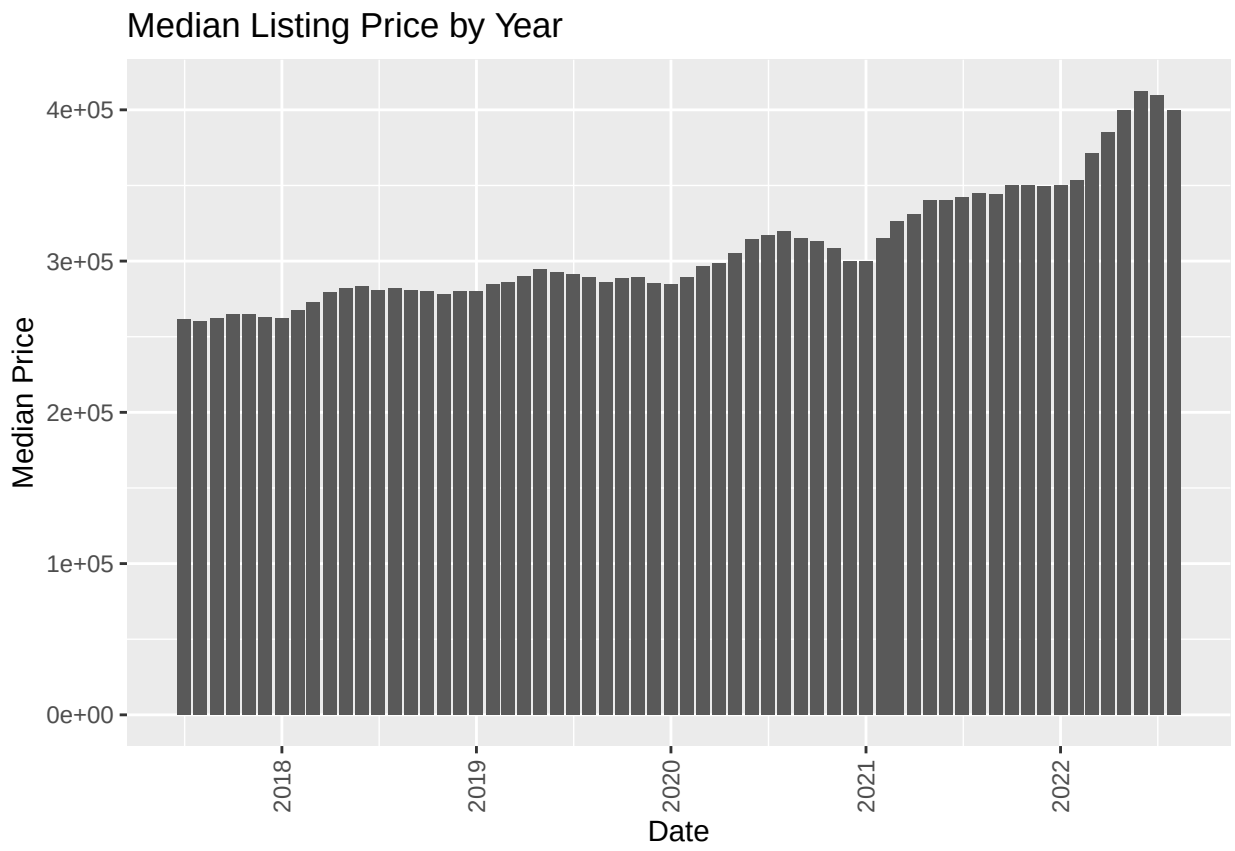

```
# This scatter plot with a regression line shows the relationship
# between median listing price and median square feet. There seems to
# be little to correlation, but the trend line slope shows a slightly
# negative relationship.

State.SqFt.Bar <- top_median_sqft_bystate %>%
    ggplot(aes(reorder(state, -median_sqft), median_sqft)) + geom_bar(stat = "identity",
    position = "dodge")
State.SqFt.Bar + theme(axis.text.x = element_text(angle = 90, vjust = 0.5,
    hjust = 1)) + ggtitle("Median Square Feet by State") + xlab("State") +
    ylab("Median Square Feet")
```




```
# This bar chart shows median square feet by state. Utah has the
# highest square feet.

State.MedPrice.Bar <- top_median_price_groupby_state %>%
    ggplot(aes(reorder(state, -median_price), median_price)) + geom_bar(stat = "identity",
    position = "dodge")
State.MedPrice.Bar + theme(axis.text.x = element_text(angle = 90, vjust = 0.5,
    hjust = 1)) + ggtitle("Median Listing Price by State") + xlab("State") +
    ylab("Median Listing Price")
```

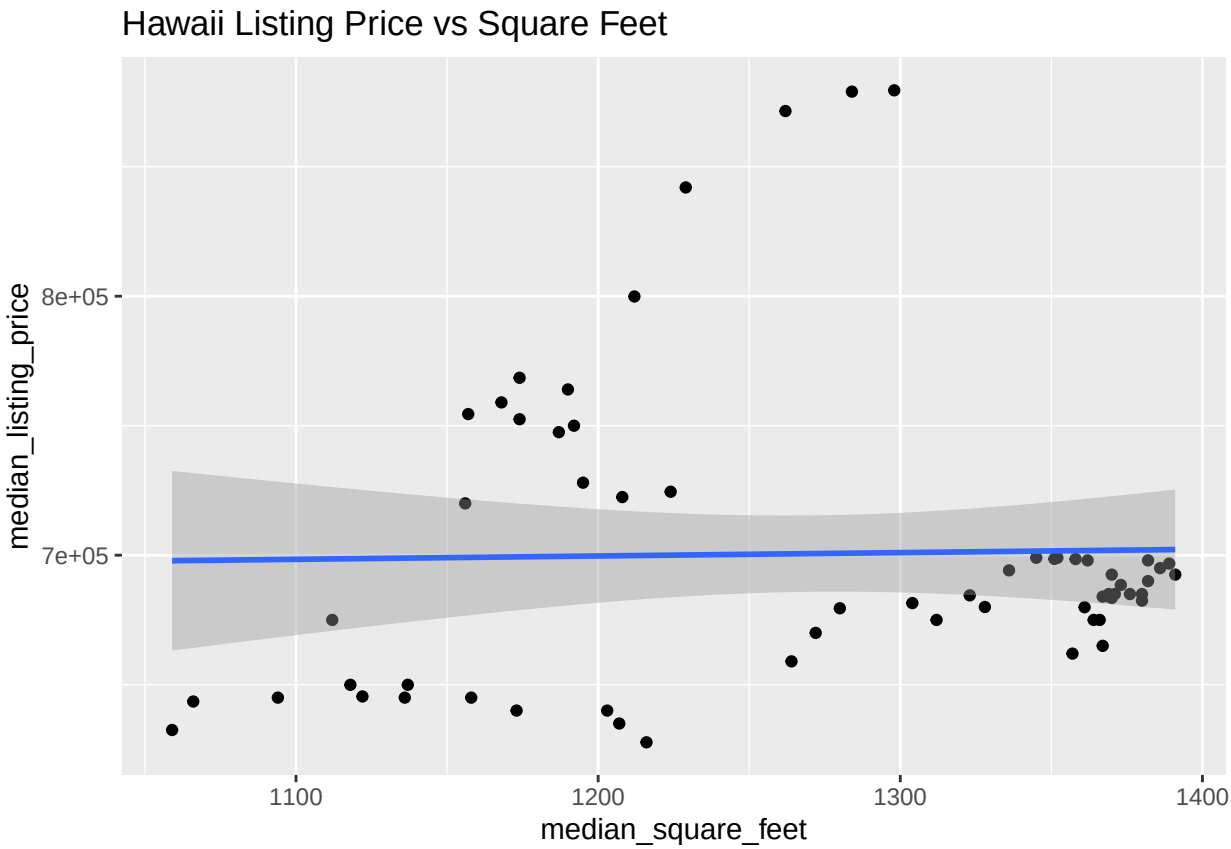



```
# This bar chart shows Median Listing Price by State in Descending
# order by listing price. Hawaii and DC have the highest listing
# prices.

Date.Price.Bar <- top_median_price_bydate %>%
    ggplot(aes(x = date, y = median_price)) + geom_bar(stat = "identity",
    position = "dodge")
Date.Price.Bar + theme(axis.text.x = element_text(angle = 90, vjust = 0.5,
    hjust = 1)) + ggtitle("Median Listing Price by Year") + xlab("Date") +
    ylab("Median Price")
```



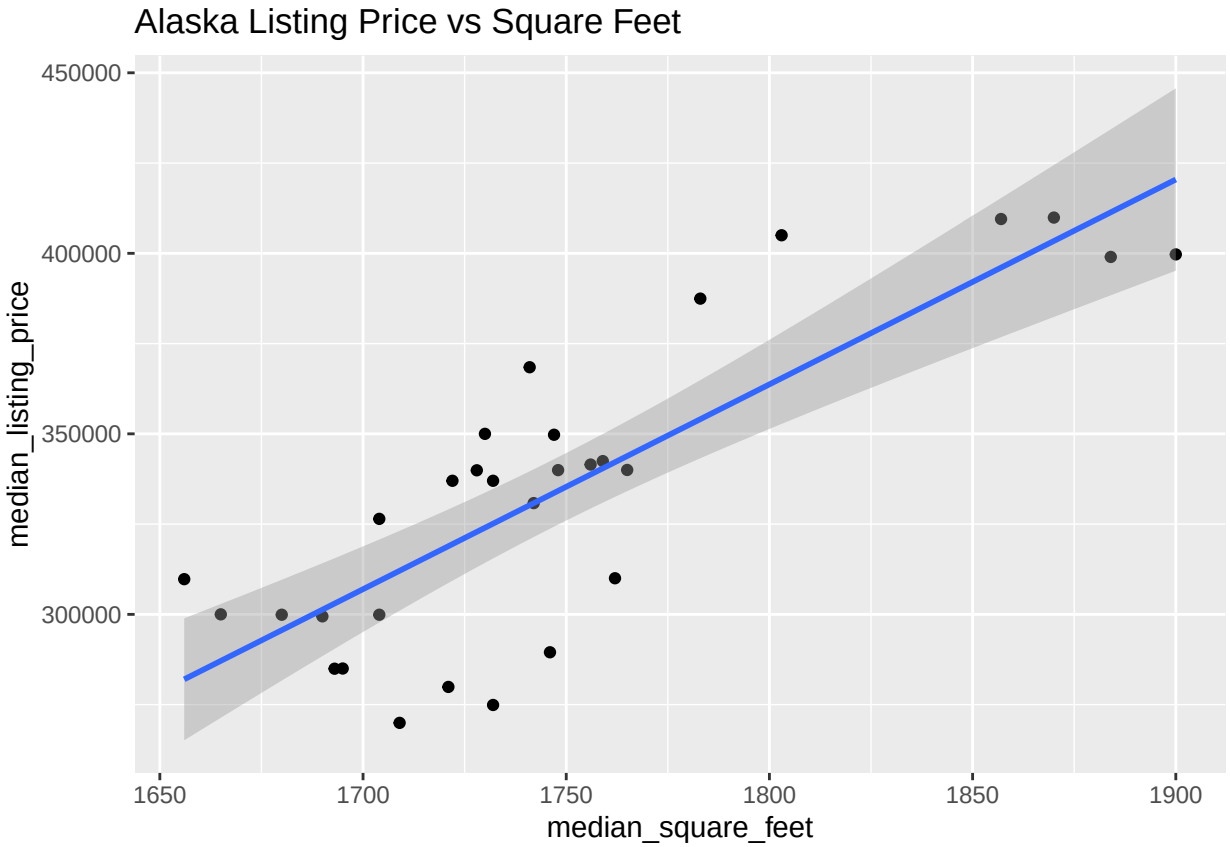

```
# This bar chart shows the relationship between Date-time by
# Year-Month and Median Price.

Hawaii.SqFt.Scatter <- Hawaii %>%
    ggplot(aes(x = median_square_feet, y = median_listing_price)) + geom_point() +
    stat_smooth(method = "lm") + ggtitle("Hawaii Listing Price vs Square Feet")
Hawaii.SqFt.Scatter
```

```
## `geom_smooth()` using formula = 'y ~ x'
```



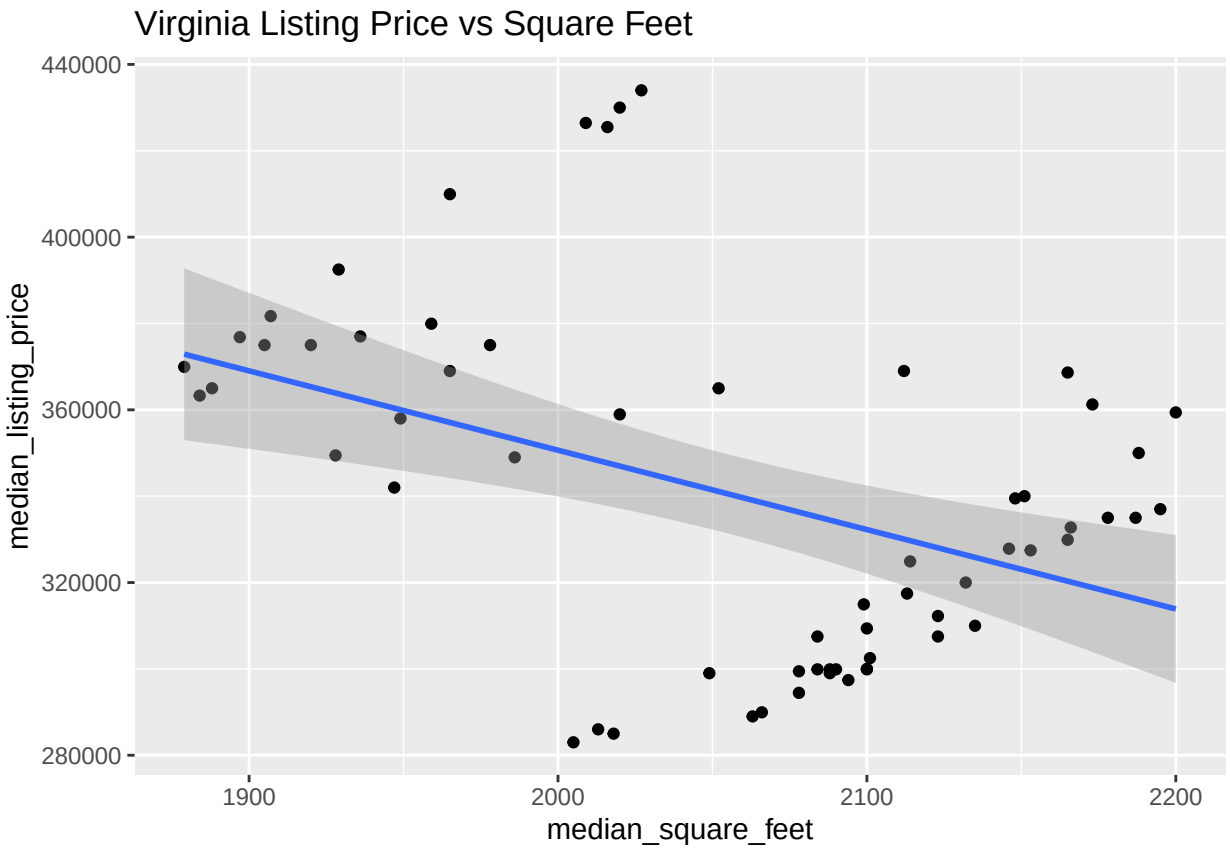

```
# This scatter plot shows the relationship between listing price and
# square feet in listing in Hawaii.

Alaska.SqFt.Scatter <- Alaska %>%
    ggplot(aes(x = median_square_feet, y = median_listing_price)) + geom_point() +
    stat_smooth(method = "lm") + ggtitle("Alaska Listing Price vs Square Feet")
Alaska.SqFt.Scatter
```

```
## `geom_smooth()` using formula = 'y ~ x'
```




```
# This scatter plot shows the relationship between listing price and
# square feet in listing in Alaska.

Virginia.SqFt.Scatter <- Virginia %>%
    ggplot(aes(x = median_square_feet, y = median_listing_price)) + geom_point() +
    stat_smooth(method = "lm") + ggtitle("Virginia Listing Price vs Square Feet")
Virginia.SqFt.Scatter
```

```
## `geom_smooth()` using formula = 'y ~ x'
```




```
# This scatter plot shows the relationship between listing price and
# square feet in listing in Virginia.
```

Make predictions

Make predictions about what you would find when you compare variables based on the graphs and statistics.

Based on what I have seen so far, I predict that listing price and square feet are positively correlated within each state. But when I break it down state by state, some have negative correlations and some have positive. Listing prices are not equal across states. I also predict that active listing count month to previous month is positively correlated with price, but active listing count total is negatively correlated.

Test relationships

Test relationships between price other variables.

One-Way ANOVA - Median Listing Price and State

```
# Step 1: H0: All population means of median listing price are equal
# among states.  HA: Not all population means of median listing price
# are equal among states.

# Steps 2 and 3:
oneway.test(median_listing_price ~ state, RDC.State.Cleaned, var.equal = TRUE)
```

```
##
##  One-way analysis of means
##
## data:  median_listing_price and state
## F = 380.9, num df = 50, denom df = 3079, p-value < 2.2e-16
```

```
# Steps 4 and 5: The F-test statistic is 380.9 with an associated
# p-value of < 2.2e-16, which is less than our alpha of .05. This
# p-value suggests that reject the null hypothesis in support of the
# alternative and conclude that median listing prices are not equal
# across states.

pairwise.t.test(RDC.State.Cleaned$median_listing_price, RDC.State.Cleaned$state,
    p.adj = "bonf")
```

```
##
##  Pairwise comparisons using t tests with pooled SD
##
## data:  RDC.State.Cleaned$median_listing_price and RDC.State.Cleaned$state
##
##                      alabama alaska  arizona arkansas california colorado
## alaska               1.5e-12 -       -       -        -          -
## arizona              < 2e-16 0.00610 -       -        -          -
## arkansas             0.00115 < 2e-16 < 2e-16 -        -          -
## california           < 2e-16 < 2e-16 < 2e-16 < 2e-16  -          -
## colorado             < 2e-16 < 2e-16 < 2e-16 < 2e-16  < 2e-16    -
## connecticut          < 2e-16 6.5e-05 1.00000 < 2e-16  < 2e-16    < 2e-16
## delaware             < 2e-16 1.00000 0.00727 < 2e-16  < 2e-16    < 2e-16
## district of columbia < 2e-16 < 2e-16 < 2e-16 < 2e-16  1.00000    < 2e-16
## florida              < 2e-16 1.00000 1.00000 < 2e-16  < 2e-16    < 2e-16
## georgia              4.7e-13 1.00000 1.6e-10 < 2e-16  < 2e-16    < 2e-16
## hawaii               < 2e-16 < 2e-16 < 2e-16 < 2e-16  7.1e-15    < 2e-16
## idaho                < 2e-16 1.3e-10 0.44632 < 2e-16  < 2e-16    < 2e-16
## illinois             1.00000 1.7e-08 < 2e-16 1.3e-07  < 2e-16    < 2e-16
## indiana              0.09581 < 2e-16 < 2e-16 1.00000  < 2e-16    < 2e-16
## iowa                 1.00000 < 2e-16 < 2e-16 1.00000  < 2e-16    < 2e-16
## kansas               0.00014 < 2e-16 < 2e-16 1.00000  < 2e-16    < 2e-16
## kentucky             1.00000 < 2e-16 < 2e-16 1.00000  < 2e-16    < 2e-16
## louisiana            1.00000 5.9e-13 < 2e-16 0.00235  < 2e-16    < 2e-16
## maine                0.01319 0.00975 < 2e-16 < 2e-16  < 2e-16    < 2e-16
## maryland             < 2e-16 1.00000 0.04019 < 2e-16  < 2e-16    < 2e-16
## massachusetts        < 2e-16 < 2e-16 < 2e-16 < 2e-16  4.5e-06    6.8e-08
## michigan             1.00000 < 2e-16 < 2e-16 1.00000  < 2e-16    < 2e-16
## minnesota            1.9e-07 1.00000 < 2e-16 < 2e-16  < 2e-16    < 2e-16
## mississippi          0.36652 < 2e-16 < 2e-16 1.00000  < 2e-16    < 2e-16
## missouri             1.00000 < 2e-16 < 2e-16 1.00000  < 2e-16    < 2e-16
## montana              < 2e-16 1.3e-09 1.00000 < 2e-16  < 2e-16    < 2e-16
## nebraska             1.00000 3.0e-11 < 2e-16 9.2e-05  < 2e-16    < 2e-16
## nevada               < 2e-16 0.10605 1.00000 < 2e-16  < 2e-16    < 2e-16
## new hampshire        < 2e-16 0.83937 1.00000 < 2e-16  < 2e-16    < 2e-16
## new jersey           < 2e-16 1.6e-06 1.00000 < 2e-16  < 2e-16    < 2e-16
## new mexico           1.00000 4.0e-05 < 2e-16 1.9e-12  < 2e-16    < 2e-16
## new york             < 2e-16 < 2e-16 < 2e-16 < 2e-16  < 2e-16    1.00000
## north carolina       2.3e-16 1.00000 8.2e-08 < 2e-16  < 2e-16    < 2e-16
```

```
## north dakota         1.00000 1.5e-12 < 2e-16 0.00113  < 2e-16    < 2e-16
## ohio                 1.2e-06 < 2e-16 < 2e-16 1.00000  < 2e-16    < 2e-16
## oklahoma             1.00000 < 2e-16 < 2e-16 1.00000  < 2e-16    < 2e-16
## oregon               < 2e-16 < 2e-16 1.5e-13 < 2e-16  < 2e-16    3.8e-06
## pennsylvania         1.00000 3.1e-15 < 2e-16 0.08039  < 2e-16    < 2e-16
## rhode island         < 2e-16 0.00072 1.00000 < 2e-16  < 2e-16    < 2e-16
## south carolina       0.00042 0.11604 < 2e-16 < 2e-16  < 2e-16    < 2e-16
## south dakota         1.00000 2.4e-09 < 2e-16 1.3e-06  < 2e-16    < 2e-16
## tennessee            1.2e-09 1.00000 4.5e-14 < 2e-16  < 2e-16    < 2e-16
## texas                1.1e-10 1.00000 6.6e-13 < 2e-16  < 2e-16    < 2e-16
## utah                 < 2e-16 < 2e-16 < 2e-16 < 2e-16  < 2e-16    0.16670
## vermont              1.8e-11 1.00000 4.5e-12 < 2e-16  < 2e-16    < 2e-16
## virginia             < 2e-16 1.00000 0.00107 < 2e-16  < 2e-16    < 2e-16
## washington           < 2e-16 < 2e-16 < 2e-16 < 2e-16  < 2e-16    1.00000
## west virginia        7.6e-13 < 2e-16 < 2e-16 1.00000  < 2e-16    < 2e-16
## wisconsin            1.00000 4.0e-07 < 2e-16 2.4e-09  < 2e-16    < 2e-16
## wyoming              0.00867 0.01366 < 2e-16 < 2e-16  < 2e-16    < 2e-16
##                      connecticut delaware district of columbia florida georgia
## alaska               -           -        -                     -       -
## arizona              -           -        -                     -       -
## arkansas             -           -        -                     -       -
## california           -           -        -                     -       -
## colorado             -           -        -                     -       -
## connecticut          -           -        -                     -       -
## delaware             2.4e-05     -        -                     -       -
## district of columbia < 2e-16     < 2e-16  -                     -       -
## florida              0.16476     1.00000  < 2e-16               -       -
## georgia              2.7e-14     1.00000  < 2e-16               0.00340 -
## hawaii               < 2e-16     < 2e-16  1.3e-15               < 2e-16 < 2e-16
## idaho                1.00000     8.2e-13  < 2e-16               3.7e-07 < 2e-16
## illinois             < 2e-16     < 2e-16  < 2e-16               < 2e-16 5.0e-08
## indiana              < 2e-16     < 2e-16  < 2e-16               < 2e-16 < 2e-16
## iowa                 < 2e-16     < 2e-16  < 2e-16               < 2e-16 < 2e-16
## kansas               < 2e-16     < 2e-16  < 2e-16               < 2e-16 < 2e-16
## kentucky             < 2e-16     < 2e-16  < 2e-16               < 2e-16 < 2e-16
## louisiana            < 2e-16     < 2e-16  < 2e-16               < 2e-16 1.5e-13
## maine                < 2e-16     3.6e-08  < 2e-16               4.4e-14 0.20624
## maryland             0.00020     1.00000  < 2e-16               1.00000 1.00000
## massachusetts        < 2e-16     < 2e-16  1.5e-05               < 2e-16 < 2e-16
## michigan             < 2e-16     < 2e-16  < 2e-16               < 2e-16 < 2e-16
## minnesota            < 2e-16     0.00397  < 2e-16               1.4e-07 1.00000
## mississippi          < 2e-16     < 2e-16  < 2e-16               < 2e-16 < 2e-16
## missouri             < 2e-16     < 2e-16  < 2e-16               < 2e-16 < 2e-16
## montana              1.00000     1.7e-11  < 2e-16               4.2e-06 < 2e-16
## nebraska             < 2e-16     < 2e-16  < 2e-16               < 2e-16 2.0e-11
## nevada               1.00000     0.22922  < 2e-16               1.00000 4.3e-08
## new hampshire        1.00000     1.00000  < 2e-16               1.00000 2.9e-06
## new jersey           1.00000     2.0e-07  < 2e-16               0.00521 < 2e-16
## new mexico           < 2e-16     2.3e-12  < 2e-16               < 2e-16 0.00047
## new york             < 2e-16     < 2e-16  < 2e-16               < 2e-16 < 2e-16
## north carolina       3.5e-11     1.00000  < 2e-16               0.17798 1.00000
## north dakota         < 2e-16     < 2e-16  < 2e-16               < 2e-16 4.8e-13
## ohio                 < 2e-16     < 2e-16  < 2e-16               < 2e-16 < 2e-16
## oklahoma             < 2e-16     < 2e-16  < 2e-16               < 2e-16 < 2e-16
```

```
## oregon               7.2e-10     < 2e-16  < 2e-16             < 2e-16 < 2e-16
## pennsylvania         < 2e-16     < 2e-16  < 2e-16             < 2e-16 < 2e-16
## rhode island         1.00000     0.00051  < 2e-16             1.00000 2.6e-12
## south carolina       < 2e-16     3.2e-06  < 2e-16             1.2e-11 1.00000
## south dakota         < 2e-16     < 2e-16  < 2e-16             < 2e-16 4.4e-09
## tennessee            < 2e-16     0.10976  < 2e-16             1.4e-05 1.00000
## texas                < 2e-16     0.40304  < 2e-16             8.8e-05 1.00000
## utah                 < 2e-16     < 2e-16  < 2e-16             < 2e-16 < 2e-16
## vermont              4.9e-16     0.98278  < 2e-16             0.00032 1.00000
## virginia             2.4e-06     1.00000  < 2e-16             1.00000 1.00000
## washington           < 2e-16     < 2e-16  < 2e-16             < 2e-16 < 2e-16
## west virginia        < 2e-16     < 2e-16  < 2e-16             < 2e-16 < 2e-16
## wisconsin            < 2e-16     7.9e-16  < 2e-16             < 2e-16 2.2e-06
## wyoming              < 2e-16     6.6e-08  < 2e-16             9.3e-14 0.29488
##                      hawaii  idaho   illinois indiana iowa    kansas  kentucky
## alaska               -       -       -        -       -       -       -
## arizona              -       -       -        -       -       -       -
## arkansas             -       -       -        -       -       -       -
## california           -       -       -        -       -       -       -
## colorado             -       -       -        -       -       -       -
## connecticut          -       -       -        -       -       -       -
## delaware             -       -       -        -       -       -       -
## district of columbia -       -       -        -       -       -       -
## florida              -       -       -        -       -       -       -
## georgia              -       -       -        -       -       -       -
## hawaii               -       -       -        -       -       -       -
## idaho                < 2e-16 -       -        -       -       -       -
## illinois             < 2e-16 < 2e-16 -        -       -       -       -
## indiana              < 2e-16 < 2e-16 4.5e-05  -       -       -       -
## iowa                 < 2e-16 < 2e-16 0.00424  1.00000 -       -       -
## kansas               < 2e-16 < 2e-16 9.0e-09  1.00000 1.00000 -       -
## kentucky             < 2e-16 < 2e-16 0.02482  1.00000 1.00000 1.00000 -
## louisiana            < 2e-16 < 2e-16 1.00000  0.17194 1.00000 0.00031 1.00000
## maine                < 2e-16 < 2e-16 1.00000  1.0e-13 9.7e-11 < 2e-16 1.6e-09
## maryland             < 2e-16 1.6e-11 < 2e-16  < 2e-16 < 2e-16 < 2e-16 < 2e-16
## massachusetts        < 2e-16 < 2e-16 < 2e-16  < 2e-16 < 2e-16 < 2e-16 < 2e-16
## michigan             < 2e-16 < 2e-16 0.14471  1.00000 1.00000 1.00000 1.00000
## minnesota            < 2e-16 < 2e-16 0.00157  < 2e-16 < 2e-16 < 2e-16 < 2e-16
## mississippi          < 2e-16 < 2e-16 0.00028  1.00000 1.00000 1.00000 1.00000
## missouri             < 2e-16 < 2e-16 0.00536  1.00000 1.00000 1.00000 1.00000
## montana              < 2e-16 1.00000 < 2e-16  < 2e-16 < 2e-16 < 2e-16 < 2e-16
## nebraska             < 2e-16 < 2e-16 1.00000  0.01177 0.46061 9.5e-06 1.00000
## nevada               < 2e-16 0.01608 < 2e-16  < 2e-16 < 2e-16 < 2e-16 < 2e-16
## new hampshire        < 2e-16 0.00066 < 2e-16  < 2e-16 < 2e-16 < 2e-16 < 2e-16
## new jersey           < 2e-16 1.00000 < 2e-16  < 2e-16 < 2e-16 < 2e-16 < 2e-16
## new mexico           < 2e-16 < 2e-16 1.00000  2.6e-09 8.6e-07 7.4e-14 8.7e-06
## new york             < 2e-16 < 2e-16 < 2e-16  < 2e-16 < 2e-16 < 2e-16 < 2e-16
## north carolina       < 2e-16 < 2e-16 9.1e-11  < 2e-16 < 2e-16 < 2e-16 < 2e-16
## north dakota         < 2e-16 < 2e-16 1.00000  0.09447 1.00000 0.00014 1.00000
## ohio                 < 2e-16 < 2e-16 2.2e-11  1.00000 1.00000 1.00000 0.78881
## oklahoma             < 2e-16 < 2e-16 0.00143  1.00000 1.00000 1.00000 1.00000
## oregon               < 2e-16 0.00271 < 2e-16  < 2e-16 < 2e-16 < 2e-16 < 2e-16
## pennsylvania         < 2e-16 < 2e-16 1.00000  1.00000 1.00000 0.01397 1.00000
## rhode island         < 2e-16 1.00000 < 2e-16  < 2e-16 < 2e-16 < 2e-16 < 2e-16
```

```
## south carolina       < 2e-16 < 2e-16 0.49598  2.4e-16 4.1e-13 < 2e-16 8.6e-12
## south dakota         < 2e-16 < 2e-16 1.00000  0.00031 0.02215 9.9e-08 0.11407
## tennessee            < 2e-16 < 2e-16 3.0e-05  < 2e-16 < 2e-16 < 2e-16 < 2e-16
## texas                < 2e-16 < 2e-16 4.4e-06  < 2e-16 < 2e-16 < 2e-16 < 2e-16
## utah                 < 2e-16 9.8e-09 < 2e-16  < 2e-16 < 2e-16 < 2e-16 < 2e-16
## vermont              < 2e-16 < 2e-16 1.0e-06  < 2e-16 < 2e-16 < 2e-16 < 2e-16
## virginia             < 2e-16 3.3e-14 < 2e-16  < 2e-16 < 2e-16 < 2e-16 < 2e-16
## washington           < 2e-16 5.8e-14 < 2e-16  < 2e-16 < 2e-16 < 2e-16 < 2e-16
## west virginia        < 2e-16 < 2e-16 < 2e-16  0.04009 0.00063 1.00000 8.2e-05
## wisconsin            < 2e-16 < 2e-16 1.00000  1.4e-06 0.00021 1.3e-10 0.00154
## wyoming              < 2e-16 < 2e-16 1.00000  4.7e-14 4.9e-11 < 2e-16 8.2e-10
##                      louisiana maine   maryland massachusetts michigan
## alaska               -         -       -        -             -
## arizona              -         -       -        -             -
## arkansas             -         -       -        -             -
## california           -         -       -        -             -
## colorado             -         -       -        -             -
## connecticut          -         -       -        -             -
## delaware             -         -       -        -             -
## district of columbia -         -       -        -             -
## florida              -         -       -        -             -
## georgia              -         -       -        -             -
## hawaii               -         -       -        -             -
## idaho                -         -       -        -             -
## illinois             -         -       -        -             -
## indiana              -         -       -        -             -
## iowa                 -         -       -        -             -
## kansas               -         -       -        -             -
## kentucky             -         -       -        -             -
## louisiana            -         -       -        -             -
## maine                0.00679   -       -        -             -
## maryland             < 2e-16   2.7e-09 -        -             -
## massachusetts        < 2e-16   < 2e-16 < 2e-16  -             -
## michigan             1.00000   2.8e-08 < 2e-16  < 2e-16       -
## minnesota            7.6e-08   1.00000 0.00060  < 2e-16       5.4e-15
## mississippi          0.62915   1.5e-12 < 2e-16  < 2e-16       1.00000
## missouri             1.00000   1.4e-10 < 2e-16  < 2e-16       1.00000
## montana              < 2e-16   < 2e-16 3.0e-10  < 2e-16       < 2e-16
## nebraska             1.00000   0.10616 < 2e-16  < 2e-16       1.00000
## nevada               < 2e-16   < 2e-16 0.95744  < 2e-16       < 2e-16
## new hampshire        < 2e-16   < 2e-16 1.00000  < 2e-16       < 2e-16
## new jersey           < 2e-16   < 2e-16 2.2e-06  < 2e-16       < 2e-16
## new mexico           1.00000   1.00000 1.1e-13  < 2e-16       9.2e-05
## new york             < 2e-16   < 2e-16 < 2e-16  8.2e-13       < 2e-16
## north carolina       < 2e-16   0.00406 1.00000  < 2e-16       < 2e-16
## north dakota         1.00000   0.01340 < 2e-16  < 2e-16       1.00000
## ohio                 2.8e-06   < 2e-16 < 2e-16  < 2e-16       0.16023
## oklahoma             1.00000   1.8e-11 < 2e-16  < 2e-16       1.00000
## oregon               < 2e-16   < 2e-16 < 2e-16  < 2e-16       < 2e-16
## pennsylvania         1.00000   0.00013 < 2e-16  < 2e-16       1.00000
## rhode island         < 2e-16   < 2e-16 0.00341  < 2e-16       < 2e-16
## south carolina       0.00020   1.00000 3.0e-07  < 2e-16       2.0e-10
## south dakota         1.00000   1.00000 < 2e-16  < 2e-16       0.57983
## tennessee            4.4e-10   1.00000 0.02158  < 2e-16       < 2e-16
```

```
## texas                3.9e-11   1.00000 0.08893  < 2e-16       < 2e-16
## utah                 < 2e-16   < 2e-16 < 2e-16  < 2e-16       < 2e-16
## vermont              6.1e-12   1.00000 0.23588  < 2e-16       < 2e-16
## virginia             < 2e-16   4.7e-07 1.00000  < 2e-16       < 2e-16
## washington           < 2e-16   < 2e-16 < 2e-16  2.0e-15       < 2e-16
## west virginia        2.4e-12   < 2e-16 < 2e-16  < 2e-16       7.7e-06
## wisconsin            1.00000   1.00000 < 2e-16  < 2e-16       0.01129
## wyoming              0.00441   1.00000 5.1e-09  < 2e-16       1.5e-08
##                      minnesota mississippi missouri montana nebraska nevada
## alaska               -         -           -       -       -        -
## arizona              -         -           -       -       -        -
## arkansas             -         -           -       -       -        -
## california           -         -           -       -       -        -
## colorado             -         -           -       -       -        -
## connecticut          -         -           -       -       -        -
## delaware             -         -           -       -       -        -
## district of columbia -         -           -       -       -        -
## florida              -         -           -       -       -        -
## georgia              -         -           -       -       -        -
## hawaii               -         -           -       -       -        -
## idaho                -         -           -       -       -        -
## illinois             -         -           -       -       -        -
## indiana              -         -           -       -       -        -
## iowa                 -         -           -       -       -        -
## kansas               -         -           -       -       -        -
## kentucky             -         -           -       -       -        -
## louisiana            -         -           -       -       -        -
## maine                -         -           -       -       -        -
## maryland             -         -           -       -       -        -
## massachusetts        -         -           -       -       -        -
## michigan             -         -           -       -       -        -
## minnesota            -         -           -       -       -        -
## mississippi          < 2e-16   -           -       -       -        -
## missouri             < 2e-16   1.00000     -       -       -        -
## montana              < 2e-16   < 2e-16     < 2e-16 -       -        -
## nebraska             3.9e-06   0.05231     0.55326 < 2e-16 -        -
## nevada               7.1e-14   < 2e-16     < 2e-16 0.08750 < 2e-16  -
## new hampshire        1.4e-11   < 2e-16     < 2e-16 0.00455 < 2e-16  1.00000
## new jersey           < 2e-16   < 2e-16     < 2e-16 1.00000 < 2e-16  1.00000
## new mexico           1.00000   2.6e-08     1.2e-06 < 2e-16 1.00000  < 2e-16
## new york             < 2e-16   < 2e-16     < 2e-16 < 2e-16 < 2e-16  < 2e-16
## north carolina       1.00000   < 2e-16     < 2e-16 < 2e-16 1.5e-14  1.2e-05
## north dakota         2.0e-07   0.36179     1.00000 < 2e-16 1.00000  < 2e-16
## ohio                 < 2e-16   1.00000     1.00000 < 2e-16 5.5e-08  < 2e-16
## oklahoma             < 2e-16   1.00000     1.00000 < 2e-16 0.19394  < 2e-16
## oregon               < 2e-16   < 2e-16     < 2e-16 0.00038 < 2e-16  < 2e-16
## pennsylvania         3.5e-10   1.00000     1.00000 < 2e-16 1.00000  < 2e-16
## rhode island         < 2e-16   < 2e-16     < 2e-16 1.00000 < 2e-16  1.00000
## south carolina       1.00000   4.6e-15     6.1e-13 < 2e-16 0.00466  < 2e-16
## south dakota         0.00025   0.00174     0.02750 < 2e-16 1.00000  < 2e-16
## tennessee            1.00000   < 2e-16     < 2e-16 < 2e-16 3.4e-08  2.7e-11
## texas                1.00000   < 2e-16     < 2e-16 < 2e-16 3.6e-09  3.1e-10
## utah                 < 2e-16   < 2e-16     < 2e-16 6.3e-10 < 2e-16  < 2e-16
## vermont              1.00000   < 2e-16     < 2e-16 < 2e-16 6.5e-10  1.7e-09
```

```
## virginia            0.02448   < 2e-16     < 2e-16  8.0e-13 < 2e-16  0.04520
## washington          < 2e-16   < 2e-16     < 2e-16  2.1e-15 < 2e-16  < 2e-16
## west virginia       < 2e-16   0.00885     0.00049  < 2e-16 1.5e-14  < 2e-16
## wisconsin           0.02516   1.0e-05     0.00028  < 2e-16 1.00000  < 2e-16
## wyoming             1.00000   7.3e-13     7.1e-11  < 2e-16 0.07267  < 2e-16
##                     new hampshire new jersey new mexico new york
## alaska              -             -          -          -
## arizona             -             -          -          -
## arkansas            -             -          -          -
## california          -             -          -          -
## colorado            -             -          -          -
## connecticut         -             -          -          -
## delaware            -             -          -          -
## district of columbia -            -          -          -
## florida             -             -          -          -
## georgia             -             -          -          -
## hawaii              -             -          -          -
## idaho               -             -          -          -
## illinois            -             -          -          -
## indiana             -             -          -          -
## iowa                -             -          -          -
## kansas              -             -          -          -
## kentucky            -             -          -          -
## louisiana           -             -          -          -
## maine               -             -          -          -
## maryland            -             -          -          -
## massachusetts       -             -          -          -
## michigan            -             -          -          -
## minnesota           -             -          -          -
## mississippi         -             -          -          -
## missouri            -             -          -          -
## montana             -             -          -          -
## nebraska            -             -          -          -
## nevada              -             -          -          -
## new hampshire       -             -          -          -
## new jersey          1.00000       -          -          -
## new mexico          < 2e-16       < 2e-16    -          -
## new york            < 2e-16       < 2e-16    < 2e-16    -
## north carolina      0.00045       6.7e-14    3.1e-06    < 2e-16
## north dakota        < 2e-16       < 2e-16    1.00000    < 2e-16
## ohio                < 2e-16       < 2e-16    < 2e-16    < 2e-16
## oklahoma            < 2e-16       < 2e-16    2.1e-07    < 2e-16
## oregon              < 2e-16       1.6e-07    < 2e-16    0.01352
## pennsylvania        < 2e-16       < 2e-16    0.07823    < 2e-16
## rhode island        1.00000       1.00000    < 2e-16    < 2e-16
## south carolina      2.5e-16       < 2e-16    1.00000    < 2e-16
## south dakota        < 2e-16       < 2e-16    1.00000    < 2e-16
## tennessee           3.3e-09       < 2e-16    0.06241    < 2e-16
## texas               3.2e-08       < 2e-16    0.01476    < 2e-16
## utah                < 2e-16       1.9e-14    < 2e-16    1.00000
## vermont             1.5e-07       < 2e-16    0.00481    < 2e-16
## virginia            0.63750       1.5e-08    4.7e-11    < 2e-16
## washington          < 2e-16       < 2e-16    < 2e-16    1.00000
## west virginia       < 2e-16       < 2e-16    < 2e-16    < 2e-16
```

```
## wisconsin           < 2e-16       < 2e-16    1.00000    < 2e-16
## wyoming             < 2e-16       < 2e-16    1.00000    < 2e-16
##                     north carolina north dakota ohio    oklahoma oregon
## alaska              -              -           -       -        -
## arizona             -              -           -       -        -
## arkansas            -              -           -       -        -
## california          -              -           -       -        -
## colorado            -              -           -       -        -
## connecticut         -              -           -       -        -
## delaware            -              -           -       -        -
## district of columbia -             -           -       -        -
## florida             -              -           -       -        -
## georgia             -              -           -       -        -
## hawaii              -              -           -       -        -
## idaho               -              -           -       -        -
## illinois            -              -           -       -        -
## indiana             -              -           -       -        -
## iowa                -              -           -       -        -
## kansas              -              -           -       -        -
## kentucky            -              -           -       -        -
## louisiana           -              -           -       -        -
## maine               -              -           -       -        -
## maryland            -              -           -       -        -
## massachusetts       -              -           -       -        -
## michigan            -              -           -       -        -
## minnesota           -              -           -       -        -
## mississippi         -              -           -       -        -
## missouri            -              -           -       -        -
## montana             -              -           -       -        -
## nebraska            -              -           -       -        -
## nevada              -              -           -       -        -
## new hampshire       -              -           -       -        -
## new jersey          -              -           -       -        -
## new mexico          -              -           -       -        -
## new york            -              -           -       -        -
## north carolina      -              -           -       -        -
## north dakota        2.4e-16        -           -       -        -
## ohio                < 2e-16        1.2e-06     -       -        -
## oklahoma            < 2e-16        1.00000     1.00000 -        -
## oregon              < 2e-16        < 2e-16     < 2e-16 < 2e-16  -
## pennsylvania        < 2e-16        1.00000     0.00024 1.00000  < 2e-16
## rhode island        2.1e-09        < 2e-16     < 2e-16 < 2e-16  1.1e-11
## south carolina      0.09416        0.00043     < 2e-16 6.6e-14  < 2e-16
## south dakota        6.0e-12        1.00000     3.2e-10 0.00801  < 2e-16
## tennessee           1.00000        1.3e-09     < 2e-16 < 2e-16  < 2e-16
## texas               1.00000        1.2e-10     < 2e-16 < 2e-16  < 2e-16
## utah                < 2e-16        < 2e-16     < 2e-16 < 2e-16  1.00000
## vermont             1.00000        1.9e-11     < 2e-16 < 2e-16  < 2e-16
## virginia            1.00000        < 2e-16     < 2e-16 < 2e-16  < 2e-16
## washington          < 2e-16        < 2e-16     < 2e-16 < 2e-16  0.28321
## west virginia       < 2e-16        7.4e-13     1.00000 0.00193  < 2e-16
## wisconsin           6.3e-09        1.00000     2.1e-13 6.4e-05  < 2e-16
## wyoming             0.00626        0.00881     < 2e-16 9.0e-12  < 2e-16
##                     pennsylvania rhode island south carolina south dakota
```

```
## alaska               -           -           -           -
## arizona              -           -           -           -
## arkansas             -           -           -           -
## california           -           -           -           -
## colorado             -           -           -           -
## connecticut          -           -           -           -
## delaware             -           -           -           -
## district of columbia -           -           -           -
## florida              -           -           -           -
## georgia              -           -           -           -
## hawaii               -           -           -           -
## idaho                -           -           -           -
## illinois             -           -           -           -
## indiana              -           -           -           -
## iowa                 -           -           -           -
## kansas               -           -           -           -
## kentucky             -           -           -           -
## louisiana            -           -           -           -
## maine                -           -           -           -
## maryland             -           -           -           -
## massachusetts        -           -           -           -
## michigan             -           -           -           -
## minnesota            -           -           -           -
## mississippi          -           -           -           -
## missouri             -           -           -           -
## montana              -           -           -           -
## nebraska             -           -           -           -
## nevada               -           -           -           -
## new hampshire        -           -           -           -
## new jersey           -           -           -           -
## new mexico           -           -           -           -
## new york             -           -           -           -
## north carolina       -           -           -           -
## north dakota         -           -           -           -
## ohio                 -           -           -           -
## oklahoma             -           -           -           -
## oregon               -           -           -           -
## pennsylvania         -           -           -           -
## rhode island         < 2e-16     -           -           -
## south carolina       2.3e-06     < 2e-16     -           -
## south dakota         1.00000     < 2e-16     0.12209     -
## tennessee            1.2e-12     4.4e-16     1.00000     3.7e-06
## texas                8.2e-14     7.7e-15     1.00000     4.9e-07
## utah                 < 2e-16     < 2e-16     < 2e-16     < 2e-16
## vermont              1.1e-14     5.8e-14     1.00000     1.0e-07
## virginia             < 2e-16     6.2e-05     3.1e-05     < 2e-16
## washington           < 2e-16     < 2e-16     < 2e-16     < 2e-16
## west virginia        8.4e-10     < 2e-16     < 2e-16     < 2e-16
## wisconsin            1.00000     < 2e-16     1.00000     1.00000
## wyoming              8.1e-05     < 2e-16     1.00000     1.00000
##                      tennessee texas   utah    vermont virginia washington
## alaska               -         -       -       -       -        -
## arizona              -         -       -       -       -        -
## arkansas             -         -       -       -       -        -
```

```
## california           -         -       -       -       -        -
## colorado             -         -       -       -       -        -
## connecticut          -         -       -       -       -        -
## delaware             -         -       -       -       -        -
## district of columbia -         -       -       -       -        -
## florida              -         -       -       -       -        -
## georgia              -         -       -       -       -        -
## hawaii               -         -       -       -       -        -
## idaho                -         -       -       -       -        -
## illinois             -         -       -       -       -        -
## indiana              -         -       -       -       -        -
## iowa                 -         -       -       -       -        -
## kansas               -         -       -       -       -        -
## kentucky             -         -       -       -       -        -
## louisiana            -         -       -       -       -        -
## maine                -         -       -       -       -        -
## maryland             -         -       -       -       -        -
## massachusetts        -         -       -       -       -        -
## michigan             -         -       -       -       -        -
## minnesota            -         -       -       -       -        -
## mississippi          -         -       -       -       -        -
## missouri             -         -       -       -       -        -
## montana              -         -       -       -       -        -
## nebraska             -         -       -       -       -        -
## nevada               -         -       -       -       -        -
## new hampshire        -         -       -       -       -        -
## new jersey           -         -       -       -       -        -
## new mexico           -         -       -       -       -        -
## new york             -         -       -       -       -        -
## north carolina       -         -       -       -       -        -
## north dakota         -         -       -       -       -        -
## ohio                 -         -       -       -       -        -
## oklahoma             -         -       -       -       -        -
## oregon               -         -       -       -       -        -
## pennsylvania         -         -       -       -       -        -
## rhode island         -         -       -       -       -        -
## south carolina       -         -       -       -       -        -
## south dakota         -         -       -       -       -        -
## tennessee            -         -       -       -       -        -
## texas                1.00000   -       -       -       -        -
## utah                 < 2e-16   < 2e-16 -       -       -        -
## vermont              1.00000   1.00000 < 2e-16 -       -        -
## virginia             0.51554   1.00000 < 2e-16 1.00000 -        -
## washington           < 2e-16   < 2e-16 1.00000 < 2e-16 < 2e-16  -
## west virginia        < 2e-16   < 2e-16 < 2e-16 < 2e-16 < 2e-16  < 2e-16
## wisconsin            0.00072   0.00013 < 2e-16 3.3e-05 2.3e-14  < 2e-16
## wyoming              1.00000   1.00000 < 2e-16 1.00000 8.3e-07  < 2e-16
##                      west virginia wisconsin
## alaska               -             -
## arizona              -             -
## arkansas             -             -
## california           -             -
## colorado             -             -
## connecticut          -             -
```

```
## delaware             -            -
## district of columbia -            -
## florida              -            -
## georgia              -            -
## hawaii               -            -
## idaho                -            -
## illinois             -            -
## indiana              -            -
## iowa                 -            -
## kansas               -            -
## kentucky             -            -
## louisiana            -            -
## maine                -            -
## maryland             -            -
## massachusetts        -            -
## michigan             -            -
## minnesota            -            -
## mississippi          -            -
## missouri             -            -
## montana              -            -
## nebraska             -            -
## nevada               -            -
## new hampshire        -            -
## new jersey           -            -
## new mexico           -            -
## new york             -            -
## north carolina       -            -
## north dakota         -            -
## ohio                 -            -
## oklahoma             -            -
## oregon               -            -
## pennsylvania         -            -
## rhode island         -            -
## south carolina       -            -
## south dakota         -            -
## tennessee            -            -
## texas                -            -
## utah                 -            -
## vermont              -            -
## virginia             -            -
## washington           -            -
## west virginia        -            -
## wisconsin            < 2e-16      -
## wyoming              < 2e-16      1.00000
##
## P value adjustment method: bonferroni
```

```
# A vast majority of the state comparisons at a p-value < 2e-16,
# meaning that there are differences in median listing price.
# Although Alaska-Delaware, DC-California, Florida-Arizona, and
# others suggest that there are no differences in median listing
# price.
```

One-Way ANOVA - Median Listing Price and Year-Month

```r
# Step 1: H0: All population means of median listing price are equal
# HA: Not all population means of median listing price are equal

# Steps 2 and 3:
oneway.test(median_listing_price ~ month_date_yyyymm, RDC.State.Cleaned,
    var.equal = TRUE)
```

```
##
##  One-way analysis of means
##
## data:  median_listing_price and month_date_yyyymm
## F = 5.3877, num df = 61, denom df = 3068, p-value < 2.2e-16
```

```r
# Steps 4 and 5: The F-test statistic is 5.3877 with an associated
# p-value of < 2.2e-16, which is less than our alpha of .05. This
# p-value suggests that reject the null hypothesis in support of the
# alternative.

# Step 6:
pairwise.t.test(RDC.State.Cleaned$median_listing_price, RDC.State.Cleaned$month_date_yyyymm,
    p.adj = "bonf")
```

```
##
##  Pairwise comparisons using t tests with pooled SD
##
## data:  RDC.State.Cleaned$median_listing_price and RDC.State.Cleaned$month_date_yyyymm
##
##            2017-07-01 2017-08-01 2017-09-01 2017-10-01 2017-11-01 2017-12-01
## 2017-08-01 1.00000    -          -          -          -          -
## 2017-09-01 1.00000    1.00000    -          -          -          -
## 2017-10-01 1.00000    1.00000    1.00000    -          -          -
## 2017-11-01 1.00000    1.00000    1.00000    1.00000    -          -
## 2017-12-01 1.00000    1.00000    1.00000    1.00000    1.00000    -
## 2018-01-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2018-02-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2018-03-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2018-04-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2018-05-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2018-06-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2018-07-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2018-08-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2018-09-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2018-10-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2018-11-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2018-12-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2019-01-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2019-02-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2019-03-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2019-04-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2019-05-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2019-06-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2019-07-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2019-08-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
```

```
## 2019-09-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2019-10-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2019-11-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2019-12-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2020-01-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2020-02-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2020-03-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2020-04-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2020-05-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2020-06-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2020-07-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2020-08-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2020-09-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2020-10-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2020-11-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2020-12-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2021-01-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2021-02-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2021-03-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2021-04-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2021-05-01 1.00000    1.00000    1.00000    1.00000    0.76769    0.60415
## 2021-06-01 0.84300    0.53739    0.54562    0.42790    0.29489    0.22987
## 2021-07-01 0.75447    0.47940    0.48679    0.38088    0.26180    0.20385
## 2021-08-01 1.00000    0.88667    0.89981    0.71289    0.49704    0.38941
## 2021-09-01 1.00000    0.91745    0.93102    0.73813    0.51505    0.40367
## 2021-10-01 1.00000    0.94596    0.95992    0.76152    0.53175    0.41689
## 2021-11-01 1.00000    0.92793    0.94164    0.74673    0.52118    0.40853
## 2021-12-01 1.00000    1.00000    1.00000    0.94478    0.66305    0.52100
## 2022-01-01 0.96564    0.61805    0.62743    0.49345    0.34116    0.26631
## 2022-02-01 0.14689    0.08918    0.09069    0.06865    0.04549    0.03491
## 2022-03-01 0.02415    0.01400    0.01426    0.01042    0.00666    0.00504
## 2022-04-01 0.00160    0.00087    0.00089    0.00062    0.00038    0.00028
## 2022-05-01 0.00011    5.6e-05    5.7e-05    3.8e-05    2.2e-05    1.6e-05
## 2022-06-01 2.4e-05    1.2e-05    1.2e-05    8.1e-06    4.6e-06    3.4e-06
## 2022-07-01 4.1e-05    2.0e-05    2.1e-05    1.4e-05    7.8e-06    5.7e-06
## 2022-08-01 0.00013    6.5e-05    6.7e-05    4.4e-05    2.6e-05    1.9e-05
##            2018-01-01 2018-02-01 2018-03-01 2018-04-01 2018-05-01 2018-06-01
## 2017-08-01 -          -          -          -          -          -
## 2017-09-01 -          -          -          -          -          -
## 2017-10-01 -          -          -          -          -          -
## 2017-11-01 -          -          -          -          -          -
## 2017-12-01 -          -          -          -          -          -
## 2018-01-01 -          -          -          -          -          -
## 2018-02-01 1.00000    -          -          -          -          -
## 2018-03-01 1.00000    1.00000    -          -          -          -
## 2018-04-01 1.00000    1.00000    1.00000    -          -          -
## 2018-05-01 1.00000    1.00000    1.00000    1.00000    -          -
## 2018-06-01 1.00000    1.00000    1.00000    1.00000    1.00000    -
## 2018-07-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2018-08-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2018-09-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2018-10-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2018-11-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2018-12-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
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## 2019-01-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2019-02-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2019-03-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2019-04-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2019-05-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2019-06-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2019-07-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2019-08-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2019-09-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2019-10-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2019-11-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2019-12-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2020-01-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2020-02-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2020-03-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2020-04-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2020-05-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2020-06-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2020-07-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2020-08-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2020-09-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2020-10-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2020-11-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2020-12-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2021-01-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2021-02-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2021-03-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2021-04-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2021-05-01 0.65453    1.00000    1.00000    1.00000    1.00000    1.00000
## 2021-06-01 0.25024    0.53040    1.00000    1.00000    1.00000    1.00000
## 2021-07-01 0.22204    0.47311    1.00000    1.00000    1.00000    1.00000
## 2021-08-01 0.42282    0.87550    1.00000    1.00000    1.00000    1.00000
## 2021-09-01 0.43822    0.90592    1.00000    1.00000    1.00000    1.00000
## 2021-10-01 0.45251    0.93409    1.00000    1.00000    1.00000    1.00000
## 2021-11-01 0.44347    0.91627    1.00000    1.00000    1.00000    1.00000
## 2021-12-01 0.56488    1.00000    1.00000    1.00000    1.00000    1.00000
## 2022-01-01 0.28969    0.61008    1.00000    1.00000    1.00000    1.00000
## 2022-02-01 0.03833    0.08789    0.34782    1.00000    1.00000    1.00000
## 2022-03-01 0.00558    0.01378    0.06210    0.23201    0.48058    0.55660
## 2022-04-01 0.00031    0.00086    0.00462    0.02035    0.04644    0.05487
## 2022-05-01 1.8e-05    5.5e-05    0.00034    0.00176    0.00439    0.00528
## 2022-06-01 3.8e-06    1.2e-05    8.2e-05    0.00045    0.00118    0.00143
## 2022-07-01 6.5e-06    2.0e-05    0.00013    0.00072    0.00185    0.00224
## 2022-08-01 2.1e-05    6.4e-05    0.00040    0.00203    0.00503    0.00605
##            2018-07-01 2018-08-01 2018-09-01 2018-10-01 2018-11-01 2018-12-01
## 2017-08-01 -          -          -          -          -          -
## 2017-09-01 -          -          -          -          -          -
## 2017-10-01 -          -          -          -          -          -
## 2017-11-01 -          -          -          -          -          -
## 2017-12-01 -          -          -          -          -          -
## 2018-01-01 -          -          -          -          -          -
## 2018-02-01 -          -          -          -          -          -
## 2018-03-01 -          -          -          -          -          -
## 2018-04-01 -          -          -          -          -          -
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## 2018-05-01 -          -          -          -          -          -
## 2018-06-01 -          -          -          -          -          -
## 2018-07-01 -          -          -          -          -          -
## 2018-08-01 1.00000    -          -          -          -          -
## 2018-09-01 1.00000    1.00000    -          -          -          -
## 2018-10-01 1.00000    1.00000    1.00000    -          -          -
## 2018-11-01 1.00000    1.00000    1.00000    1.00000    -          -
## 2018-12-01 1.00000    1.00000    1.00000    1.00000    1.00000    -
## 2019-01-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2019-02-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2019-03-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2019-04-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2019-05-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
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## 2019-07-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2019-08-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2019-09-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2019-10-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2019-11-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
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## 2020-01-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2020-02-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2020-03-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2020-04-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2020-05-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2020-06-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2020-07-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2020-08-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2020-09-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2020-10-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2020-11-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2020-12-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2021-01-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2021-02-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2021-03-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2021-04-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2021-05-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2021-06-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2021-07-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2021-08-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2021-09-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2021-10-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2021-11-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2021-12-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2022-01-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2022-02-01 1.00000    1.00000    1.00000    0.85633    0.67490    0.39713
## 2022-03-01 0.44324    0.28201    0.20806    0.16738    0.12874    0.07119
## 2022-04-01 0.04237    0.02538    0.01800    0.01408    0.01047    0.00531
## 2022-05-01 0.00396    0.00225    0.00154    0.00117    0.00085    0.00040
## 2022-06-01 0.00106    0.00059    0.00039    0.00030    0.00021    9.4e-05
## 2022-07-01 0.00166    0.00093    0.00063    0.00047    0.00034    0.00015
## 2022-08-01 0.00455    0.00259    0.00177    0.00135    0.00098    0.00046
##            2019-01-01 2019-02-01 2019-03-01 2019-04-01 2019-05-01 2019-06-01
## 2017-08-01 -          -          -          -          -          -
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## 2017-09-01 -          -          -          -          -          -
## 2017-10-01 -          -          -          -          -          -
## 2017-11-01 -          -          -          -          -          -
## 2017-12-01 -          -          -          -          -          -
## 2018-01-01 -          -          -          -          -          -
## 2018-02-01 -          -          -          -          -          -
## 2018-03-01 -          -          -          -          -          -
## 2018-04-01 -          -          -          -          -          -
## 2018-05-01 -          -          -          -          -          -
## 2018-06-01 -          -          -          -          -          -
## 2018-07-01 -          -          -          -          -          -
## 2018-08-01 -          -          -          -          -          -
## 2018-09-01 -          -          -          -          -          -
## 2018-10-01 -          -          -          -          -          -
## 2018-11-01 -          -          -          -          -          -
## 2018-12-01 -          -          -          -          -          -
## 2019-01-01 -          -          -          -          -          -
## 2019-02-01 1.00000    -          -          -          -          -
## 2019-03-01 1.00000    1.00000    -          -          -          -
## 2019-04-01 1.00000    1.00000    1.00000    -          -          -
## 2019-05-01 1.00000    1.00000    1.00000    1.00000    -          -
## 2019-06-01 1.00000    1.00000    1.00000    1.00000    1.00000    -
## 2019-07-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2019-08-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2019-09-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2019-10-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2019-11-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2019-12-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2020-01-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2020-02-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2020-03-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2020-04-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2020-05-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2020-06-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2020-07-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2020-08-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2020-09-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2020-10-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2020-11-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2020-12-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
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## 2021-02-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2021-03-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2021-04-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2021-05-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2021-06-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2021-07-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2021-08-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2021-09-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2021-10-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2021-11-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2021-12-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2022-01-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2022-02-01 0.43974    0.92236    1.00000    1.00000    1.00000    1.00000
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## 2022-03-01 0.08035    0.18168    0.68562    1.00000    1.00000    1.00000
## 2022-04-01 0.00616    0.01544    0.06956    0.25256    0.52942    0.65775
## 2022-05-01 0.00047    0.00130    0.00687    0.02887    0.06616    0.08443
## 2022-06-01 0.00011    0.00033    0.00189    0.00858    0.02059    0.02665
## 2022-07-01 0.00019    0.00053    0.00294    0.01299    0.03068    0.03952
## 2022-08-01 0.00055    0.00150    0.00786    0.03277    0.07471    0.09520
##            2019-07-01 2019-08-01 2019-09-01 2019-10-01 2019-11-01 2019-12-01
## 2017-08-01 -          -          -          -          -          -
## 2017-09-01 -          -          -          -          -          -
## 2017-10-01 -          -          -          -          -          -
## 2017-11-01 -          -          -          -          -          -
## 2017-12-01 -          -          -          -          -          -
## 2018-01-01 -          -          -          -          -          -
## 2018-02-01 -          -          -          -          -          -
## 2018-03-01 -          -          -          -          -          -
## 2018-04-01 -          -          -          -          -          -
## 2018-05-01 -          -          -          -          -          -
## 2018-06-01 -          -          -          -          -          -
## 2018-07-01 -          -          -          -          -          -
## 2018-08-01 -          -          -          -          -          -
## 2018-09-01 -          -          -          -          -          -
## 2018-10-01 -          -          -          -          -          -
## 2018-11-01 -          -          -          -          -          -
## 2018-12-01 -          -          -          -          -          -
## 2019-01-01 -          -          -          -          -          -
## 2019-02-01 -          -          -          -          -          -
## 2019-03-01 -          -          -          -          -          -
## 2019-04-01 -          -          -          -          -          -
## 2019-05-01 -          -          -          -          -          -
## 2019-06-01 -          -          -          -          -          -
## 2019-07-01 -          -          -          -          -          -
## 2019-08-01 1.00000    -          -          -          -          -
## 2019-09-01 1.00000    1.00000    -          -          -          -
## 2019-10-01 1.00000    1.00000    1.00000    -          -          -
## 2019-11-01 1.00000    1.00000    1.00000    1.00000    -          -
## 2019-12-01 1.00000    1.00000    1.00000    1.00000    1.00000    -
## 2020-01-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2020-02-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2020-03-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2020-04-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2020-05-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2020-06-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2020-07-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2020-08-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2020-09-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2020-10-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2020-11-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2020-12-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2021-01-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2021-02-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2021-03-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2021-04-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2021-05-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2021-06-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
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## 2021-07-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2021-08-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2021-09-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2021-10-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2021-11-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2021-12-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2022-01-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2022-02-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2022-03-01 1.00000    1.00000    1.00000    1.00000    1.00000    0.75364
## 2022-04-01 0.51918    0.31635    0.20945    0.22103    0.13315    0.07654
## 2022-05-01 0.06473    0.03715    0.02343    0.02488    0.01397    0.00754
## 2022-06-01 0.02012    0.01119    0.00688    0.00733    0.00397    0.00207
## 2022-07-01 0.02999    0.01686    0.01046    0.01113    0.00610    0.00322
## 2022-08-01 0.07310    0.04209    0.02662    0.02825    0.01593    0.00863
##            2020-01-01 2020-02-01 2020-03-01 2020-04-01 2020-05-01 2020-06-01
## 2017-08-01 -          -          -          -          -          -
## 2017-09-01 -          -          -          -          -          -
## 2017-10-01 -          -          -          -          -          -
## 2017-11-01 -          -          -          -          -          -
## 2017-12-01 -          -          -          -          -          -
## 2018-01-01 -          -          -          -          -          -
## 2018-02-01 -          -          -          -          -          -
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## 2018-04-01 -          -          -          -          -          -
## 2018-05-01 -          -          -          -          -          -
## 2018-06-01 -          -          -          -          -          -
## 2018-07-01 -          -          -          -          -          -
## 2018-08-01 -          -          -          -          -          -
## 2018-09-01 -          -          -          -          -          -
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## 2018-12-01 -          -          -          -          -          -
## 2019-01-01 -          -          -          -          -          -
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## 2019-04-01 -          -          -          -          -          -
## 2019-05-01 -          -          -          -          -          -
## 2019-06-01 -          -          -          -          -          -
## 2019-07-01 -          -          -          -          -          -
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## 2019-09-01 -          -          -          -          -          -
## 2019-10-01 -          -          -          -          -          -
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## 2019-12-01 -          -          -          -          -          -
## 2020-01-01 -          -          -          -          -          -
## 2020-02-01 1.00000    -          -          -          -          -
## 2020-03-01 1.00000    1.00000    -          -          -          -
## 2020-04-01 1.00000    1.00000    1.00000    -          -          -
## 2020-05-01 1.00000    1.00000    1.00000    1.00000    -          -
## 2020-06-01 1.00000    1.00000    1.00000    1.00000    1.00000    -
## 2020-07-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2020-08-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
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## 2020-11-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
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## 2021-09-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
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## 2022-02-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2022-03-01 0.70659    1.00000    1.00000    1.00000    1.00000    1.00000
## 2022-04-01 0.07112    0.25233    1.00000    1.00000    1.00000    1.00000
## 2022-05-01 0.00695    0.02884    0.14601    0.14345    0.56868    1.00000
## 2022-06-01 0.00190    0.00857    0.04757    0.04668    0.20133    0.98917
## 2022-07-01 0.00296    0.01297    0.06980    0.06853    0.28732    1.00000
## 2022-08-01 0.00796    0.03273    0.16406    0.16120    0.63332    1.00000
##            2020-07-01 2020-08-01 2020-09-01 2020-10-01 2020-11-01 2020-12-01
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## 2020-03-01 -          -          -          -          -          -
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## 2020-07-01 -          -          -          -          -          -
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## 2020-10-01 1.00000    1.00000    1.00000    -          -          -
## 2020-11-01 1.00000    1.00000    1.00000    1.00000    -          -
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## 2022-05-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2022-06-01 1.00000    1.00000    1.00000    1.00000    0.80956    0.49528
## 2022-07-01 1.00000    1.00000    1.00000    1.00000    1.00000    0.69498
## 2022-08-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
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## 2019-07-01 -          -          -          -          -          -
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## 2022-05-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2022-06-01 0.53788    1.00000    1.00000    1.00000    1.00000    1.00000
## 2022-07-01 0.75344    1.00000    1.00000    1.00000    1.00000    1.00000
## 2022-08-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
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## 2017-11-01 -          -          -          -          -          -
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## 2018-01-01 -          -          -          -          -          -
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## 2018-04-01 -          -          -          -          -          -
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## 2018-06-01 -          -          -          -          -          -
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## 2018-11-01 -          -          -          -          -          -
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## 2021-08-01 1.00000    -          -          -          -          -
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## 2022-05-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
## 2022-06-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
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## 2017-11-01 -          -          -          -          -          -
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## 2018-03-01 -          -          -          -          -          -
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## 2021-11-01 -          -          -          -          -          -
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## 2022-05-01 1.00000    1.00000    1.00000    1.00000    -          -
## 2022-06-01 1.00000    1.00000    1.00000    1.00000    1.00000    -
## 2022-07-01 1.00000    1.00000    1.00000    1.00000    1.00000    1.00000
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## 2022-06-01 -
## 2022-07-01 -
## 2022-08-01 1.00000
##
## P value adjustment method: bonferroni
```

```
# Evaluating the results of the Bonferroni test shows only 1s, which
# means there is no evidence to reject the null hypothesis. Therefore
# we should retain the null hypothesis.
```

Regression Test - Median Listing Price and Active Listing Count

```
# Define null and alternative hypothesis H0: The slope of the line is
# equal to zero.  HA: The slope of the line is not equal to zero.

# Fit linear model
MedListPrice.ActiveListCt.lmtest <- lm(median_listing_price ~ active_listing_count,
    data = RDC.State.Cleaned)
summary(MedListPrice.ActiveListCt.lmtest)
```

```
##
## Call:
## lm(formula = median_listing_price ~ active_listing_count, data = RDC.State.Cleaned)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -189730  -99039  -35718   58822  543064
##
## Coefficients:
##                         Estimate Std. Error t value Pr(>|t|)
## (Intercept)           3.366e+05  3.052e+03 110.274   <2e-16 ***
## active_listing_count -4.589e-02  1.018e-01  -0.451    0.652
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 131900 on 3128 degrees of freedom
## Multiple R-squared:  6.495e-05,  Adjusted R-squared:  -0.0002547
## F-statistic: 0.2032 on 1 and 3128 DF,  p-value: 0.6522
```

Looking at Goodness of Fit, the R-squared at 6.495e-05 is very small and the adjusted R-squared is -0.0002547 which is negative. This suggests the regression line does not explain the data well. The F-test statistic is 0.2032 which means the model leaves more unexplained that it explains. The p-value is 0.652 which is not significant at the .05 level. This suggests that we should retain the null hypothesis that the slope of the line is equal to 0.

Regression Test - Median Listing Price and Median Days On Market

```r
# Define null and alternative hypothesis H0: The slope of the line is
# equal to zero.  HA: The slope of the line is not equal to zero.

# Fit linear model
MedListPrice.DaysOnMarket.lmtest <- lm(median_listing_price ~ median_days_on_market,
    data = RDC.State.Cleaned)
summary(MedListPrice.DaysOnMarket.lmtest)
```

```
##
## Call:
## lm(formula = median_listing_price ~ median_days_on_market, data = RDC.State.Cleaned)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -187494  -91086  -25610   56537  522609
##
## Coefficients:
##                          Estimate Std. Error t value Pr(>|t|)
## (Intercept)            465826.25    6195.57   75.19   <2e-16 ***
## median_days_on_market  -2055.39      91.56  -22.45   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 122500 on 3128 degrees of freedom
## Multiple R-squared:  0.1388, Adjusted R-squared:  0.1385
## F-statistic:   504 on 1 and 3128 DF,  p-value: < 2.2e-16
```

```r
# Correlation test
cor.test(RDC.State.Cleaned$median_listing_price, RDC.State.Cleaned$median_days_on_market)
```

```
##
##  Pearson's product-moment correlation
##
## data:  RDC.State.Cleaned$median_listing_price and RDC.State.Cleaned$median_days_on_market
## t = -22.449, df = 3128, p-value < 2.2e-16
## alternative hypothesis: true correlation is not equal to 0
## 95 percent confidence interval:
##  -0.4022863 -0.3419282
## sample estimates:
##        cor
## -0.3725011
```

```r
# A correlation of -0.3725 shows that there is a weak negative
# correlation. There is a relationship between the two variables.
```

Evaluating Goodness of Fit, the R-squared at 0.1388 is very close to the adjusted R-squared of 0.1385. This means that days on market explains 13.85% of the variance in listing price. We see an F-test Statistic of 504 with an associated p-value of $<$ 2.2e-16 in our output, which means our model explains more than it leaves unexplained. Our p-value suggests that our model is significant. This means that our predictor variable of days on market does influence listing price. We can reject the null and support the alternative hypothesis that the slope of the line is not equal top zero.

Regression Test - Median Listing Price and Median Square Feet

```r
# Define null and alternative hypothesis H0: The slope of the line is
# equal to zero.  HA: The slope of the line is not equal to zero.

# Fit linear model
MedListPrice.MedSqFt.lmtest <- lm(median_listing_price ~ median_square_feet,
    data = RDC.State.Cleaned)
summary(MedListPrice.MedSqFt.lmtest)
```

```
##
## Call:
## lm(formula = median_listing_price ~ median_square_feet, data = RDC.State.Cleaned)
##
## Residuals:
##     Min      1Q  Median      3Q     Max
## -216860 -100861  -22229   60816  487219
##
## Coefficients:
##                       Estimate Std. Error t value Pr(>|t|)
## (Intercept)         509104.881  18630.063  27.327   <2e-16 ***
## median_square_feet     -90.003      9.594  -9.381   <2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 130100 on 3128 degrees of freedom
## Multiple R-squared:  0.02736,    Adjusted R-squared:  0.02705
## F-statistic:    88 on 1 and 3128 DF,  p-value: < 2.2e-16
```

Evaluating Goodness of Fit, the R-squared at 0.02736 is very close to the adjusted R-squared of 0.02705. This means that median square feet only explains 2.7% of the variance in median listing price. We see an F-test Statistic of 88 with an associated p-value of $<$ 2.2e-16 in our output. Our p-value suggests that our model is significant. This means that our predictor variable of median square, while explaining a low amount of variance, does influence listing price. We can reject the null and support the alternative hypothesis that the slope of the line is not equal top zero.

Conclusion

Describe the variables you found to be the strongest predictors of price. (limitations, biases, confounding variables)

After running the One-Way ANOVA test, I conclude the state variable is one the strongest predictors of price. Evaluating the date variable through the One-Way ANOVA test, I would have to conclude that data isn't a strong predictor in price. But, the bar chart showing listing price over time showed a steady increase. This problem may be due to the date variable not being calculated correctly through the Bonferroni test. Now looking at days on market, I can conclude that it is a strong predictor of price. The correlation was negative and the regression test model showed significance. Additionally, square feet is a predictor of price, though with a negative correlation, which goes against my previous prediction. I think there are other factors that affect price that may not be measured in this data set. For example, I think local economies and metropolitan areas may also affect listing price. Metropolitan areas can also stretch over multiple states, making state a less reliable predicting variable. I think it may prove useful to measure more variables that could potentially affect price.