

# Homework 2.5

2025-10-04

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I am first adding a model with per-capita variables to consider before starting homework 3. Homework 2's models are also included below.

Continuous target variable: Population, low access to store (% change), 2015-19 [PCH\_LACCESS\_POP\_15\_19] [ACCESS]

Continuous predictor variables: nine variables with per capita alternatives

1. Grocery stores (% change), 2016-20 [PCH\_GROC\_16\_20] [STORES] Grocery stores/1,000 pop (% change), 2016-20 [PCH\_GROCPTH\_16\_20]
2. Supercenters & club stores (% change), 2016-20 [PCH\_SUPERC\_16\_20] Supercenters & club stores/1,000 pop (% change), 2016-20 [PCH\_SUPERCPTH\_16\_20]
3. Convenience stores (% change), 2016-20 [PCH\_CONVS\_16\_20] Convenience stores/1,000 pop (% change), 2016-20 [PCH\_CONVSPTH\_16\_20]
4. Specialized food stores (% change), 2016-20 [PCH\_SPECS\_16\_20] Specialized food stores/1,000 pop (% change), 2016-20 [PCH\_SPECSPTH\_16\_20]
5. SNAP-authorized stores (% change), 2017-23 [PCH\_SNAPS\_17\_23] SNAP-authorized stores/1,000 pop (% change), 2017-23 [PCH\_SNAPSPTH\_17\_23]
6. WIC-authorized stores (% change), 2016-22 [PCH\_WICS\_16\_22] WIC-authorized stores/1,000 pop (% change), 2016-22 [PCH\_WICSPTH\_16\_22]
7. Fast-food restaurants (% change), 2016-20 [PCH\_FFR\_16\_20] Fast-food restaurants/1,000 pop (% change), 2016-20 [PCH\_FFRPTH\_16\_20]
8. Full-service restaurants (% change), 2016-20 [PCH\_FSR\_16\_20] Full-service restaurants/1,000 pop (% change), 2016-20 [PCH\_FSRPTH\_16\_20]
9. Direct farm sales (% change), 2012 - 17 [PCH\_DIRSALES\_12\_17] [LOCAL] Direct farm sales per capita (% change), 2012 - 17 [PCH\_PC\_DIRSALES\_12\_17]

Binary variable to add later on: Persistent-poverty counties, 2017-21 [PERPOV17\_21] [SOCIOECONOMIC]

```
install.packages("ggfortify", repos="http://cran.us.r-project.org")
```

```
## Installing package into 'C:/Users/harip/AppData/Local/R/win-library/4.5'  
## (as 'lib' is unspecified)
```

```
## package 'ggfortify' successfully unpacked and MD5 sums checked  
##
```

```
## The downloaded binary packages are in  
##   C:\Users\harip\AppData\Local\Temp\Rtmpmkx5ik\downloaded_packages
```

```
install.packages("mvnormtest", repos="http://cran.us.r-project.org")
```

```
## Installing package into 'C:/Users/harip/AppData/Local/R/win-library/4.5'  
## (as 'lib' is unspecified)
```

```
## package 'mvnormtest' successfully unpacked and MD5 sums checked  
##
```

```
## The downloaded binary packages are in  
##   C:\Users\harip\AppData\Local\Temp\Rtmpmkx5ik\downloaded_packages
```

```
install.packages("dataarium", repos="http://cran.us.r-project.org")
```

```
## Installing package into 'C:/Users/harip/AppData/Local/R/win-library/4.5'  
## (as 'lib' is unspecified)
```

```

## package 'datarium' successfully unpacked and MD5 sums checked
##
## The downloaded binary packages are in
##   C:\Users\harip\AppData\Local\Temp\Rtmpmkx5ik\downloaded_packages
install.packages("ggplot2", repos="http://cran.us.r-project.org")

## Installing package into 'C:/Users/harip/AppData/Local/R/win-library/4.5'
## (as 'lib' is unspecified)

## package 'ggplot2' successfully unpacked and MD5 sums checked
##
## The downloaded binary packages are in
##   C:\Users\harip\AppData\Local\Temp\Rtmpmkx5ik\downloaded_packages
install.packages("car", repos="http://cran.us.r-project.org")

## Installing package into 'C:/Users/harip/AppData/Local/R/win-library/4.5'
## (as 'lib' is unspecified)

## package 'car' successfully unpacked and MD5 sums checked
##
## The downloaded binary packages are in
##   C:\Users\harip\AppData\Local\Temp\Rtmpmkx5ik\downloaded_packages
library(MASS)
library(car)

## Loading required package: carData
library(datarium)
library(ggplot2)
library(broom)
library(ggfortify)
library(tidyverse)

## -- Attaching core tidyverse packages ----- tidyverse 2.0.0 --
## v dplyr     1.1.4    v readr     2.1.5
## vforcats   1.0.0    v stringr   1.5.1
## v lubridate 1.9.4    v tibble    3.3.0
## v purrr     1.1.0    v tidyrr    1.3.1

## -- Conflicts ----- tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()   masks stats::lag()
## x dplyr::recode() masks car::recode()
## x dplyr::select() masks MASS::select()
## x purrr::some()  masks car::some()
## i Use the conflicted package (<http://conflicted.r-lib.org/>) to force all conflicts to become errors

library(mvnormtest)

library(readxl)
X2025_food_environment_atlas_data <- read_excel("2025-food-environment-atlas-data.xlsx",
  sheet = "ACCESS", skip = 1)
access <- read_excel("2025-food-environment-atlas-data.xlsx",
  sheet = "ACCESS", skip = 1)
access

```

```

## # A tibble: 3,144 x 68
##   FIPS State County  LACCESS_POP15 LACCESS_POP19 PCH_LACCESS_POP_15_19
##   <chr> <chr> <chr>      <dbl>      <dbl>          <dbl>
## 1 01001 AL Autauga     18093.    18503.         2.27
## 2 01003 AL Baldwin     46400.    45789.        -1.32
## 3 01005 AL Barbour     6684.     5634.        -15.7
## 4 01007 AL Bibb        296.      365.         23.5
## 5 01009 AL Blount     5856.     3902.        -33.4
## 6 01011 AL Bullock    6100.     7480.         22.6
## 7 01013 AL Butler     2478.     2508.         1.23
## 8 01015 AL Calhoun    34221.    42575.        24.4
## 9 01017 AL Chambers    6794.     6745.        -0.720
## 10 01019 AL Cherokee   3519.     3506.        -0.358
## # i 3,134 more rows
## # i 62 more variables: PCT_LACCESS_POP15 <dbl>, PCT_LACCESS_POP19 <dbl>,
## #   LACCESS_LOWI15 <dbl>, LACCESS_LOWI19 <dbl>, PCH_LACCESS_LOWI_15_19 <dbl>,
## #   PCT_LACCESS_LOWI15 <dbl>, PCT_LACCESS_LOWI19 <dbl>, LACCESS_HHNV15 <dbl>,
## #   LACCESS_HHNV19 <dbl>, PCH_LACCESS_HHNV_15_19 <dbl>,
## #   PCT_LACCESS_HHNV15 <dbl>, PCT_LACCESS_HHNV19 <dbl>, LACCESS_SNAP15 <dbl>,
## #   LACCESS_SNAP19 <dbl>, PCH_LACCESS_SNAP_15_19 <dbl>, ...
library(readxl)
X2025_food_environment_atlas_data <- read_excel("2025-food-environment-atlas-data.xlsx",
                                               sheet = "STORES", skip = 1)
stores <- read_excel("2025-food-environment-atlas-data.xlsx",
                     sheet = "STORES", skip = 1)
stores

## # A tibble: 3,144 x 41
##   FIPS State County  GROC16 GROC20 PCH_GROC_16_20 GROCPTH16 GROCPTH20
##   <chr> <chr> <chr>   <dbl>  <dbl>       <dbl>      <dbl>          <dbl>
## 1 01001 AL Autauga     3      4       33.3     0.0542        0.0712
## 2 01003 AL Baldwin     29     29        0       0.140        0.126
## 3 01005 AL Barbour     4      5       25       0.155        0.203
## 4 01007 AL Bibb        5      4      -20       0.221        0.181
## 5 01009 AL Blount     5      4      -20       0.0870       0.0691
## 6 01011 AL Bullock    3    -9999      -9999     0.289      -9999
## 7 01013 AL Butler     3      3        0       0.150        0.154
## 8 01015 AL Calhoun    27     21      -22.2     0.235        0.185
## 9 01017 AL Chambers    7      5      -28.6     0.207        0.152
## 10 01019 AL Cherokee   5    -9999      -9999     0.194      -9999
## # i 3,134 more rows
## # i 33 more variables: PCH_GROCPTH_16_20 <dbl>, SUPERC16 <dbl>, SUPERC20 <dbl>,
## #   PCH_SUPERC_16_20 <dbl>, SUPERCPTH16 <dbl>, SUPERCPTH20 <dbl>,
## #   PCH_SUPERCPTH_16_20 <dbl>, CONVS16 <dbl>, CONVS20 <dbl>,
## #   PCH_CONVS_16_20 <dbl>, CONVSPTH16 <dbl>, CONVSPTH20 <dbl>,
## #   PCH_CONVSPTH_16_20 <dbl>, SPECS16 <dbl>, SPECS20 <dbl>,
## #   PCH_SPECS_16_20 <dbl>, SPECSPTH16 <dbl>, SPECSPTH20 <dbl>,...
library(readxl)
X2025_food_environment_atlas_data <- read_excel("2025-food-environment-atlas-data.xlsx",
                                               sheet = "RESTAURANTS", skip = 1)
restaurants <- read_excel("2025-food-environment-atlas-data.xlsx",
                           sheet = "RESTAURANTS", skip = 1)
restaurants

```

```

## # A tibble: 3,144 x 15
##   FIPS State County   FFR16 FFR20 PCH_FFR_16_20 FFRPTH16 FFRPTH20
##   <chr> <chr> <chr>   <dbl> <dbl>      <dbl>    <dbl>    <dbl>
## 1 01001 AL Autauga     44     45      2.27    0.796    0.801
## 2 01003 AL Baldwin    156    172     10.3    0.751    0.750
## 3 01005 AL Barbour    23     24      4.35    0.891    0.976
## 4 01007 AL Bibb        7      7       0       0.310    0.316
## 5 01009 AL Blount     23     24      4.35    0.400    0.415
## 6 01011 AL Bullock     3      3       0       0.289    0.301
## 7 01013 AL Butler     18     21     16.7    0.898    1.08
## 8 01015 AL Calhoun    95    104     9.47    0.826    0.917
## 9 01017 AL Chambers    29     32     10.3    0.859    0.974
## 10 01019 AL Cherokee    15     18      20      0.582    0.685
## # i 3,134 more rows
## # i 7 more variables: PCH_FFRPTH_16_20 <dbl>, FSR16 <dbl>, FSR20 <dbl>,
## #   PCH_FSR_16_20 <dbl>, FSRPTH16 <dbl>, FSRPTH20 <dbl>, PCH_FSRPTH_16_20 <dbl>

library(readxl)
X2025_food_environment_atlas_data <- read_excel("2025-food-environment-atlas-data.xlsx",
sheet = "LOCAL", skip = 1)
local <- read_excel("2025-food-environment-atlas-data.xlsx",
sheet = "LOCAL", skip = 1)
local

## # A tibble: 3,161 x 98
##   FIPS State County   DIRSALES_FARMS12 DIRSALES_FARMS17 PCH_DIRSALES_FARMS_1~1
##   <chr> <chr> <chr>      <dbl>          <dbl>          <dbl>
## 1 01001 AL Autauga      51            16           -68.6
## 2 01003 AL Baldwin     103            78           -24.3
## 3 01005 AL Barbour     13             9           -30.8
## 4 01007 AL Bibb         13            11           -15.4
## 5 01009 AL Blount      88            40           -54.5
## 6 01011 AL Bullock     12             2           -83.3
## 7 01013 AL Butler      31            20           -35.5
## 8 01015 AL Calhoun     50            52              4
## 9 01017 AL Chambers     22            13           -40.9
## 10 01019 AL Cherokee     14            14              0
## # i 3,151 more rows
## # i abbreviated name: 1: PCH_DIRSALES_FARMS_12_17
## # i 92 more variables: PCT_LOCLFARM12 <dbl>, PCT_LOCLFARM17 <dbl>,
## #   PCT_LOCLSALE12 <dbl>, PCT_LOCLSALE17 <dbl>, DIRSALES12 <dbl>,
## #   DIRSALES17 <dbl>, PCH_DIRSALES_12_17 <dbl>, PC_DIRSALES12 <dbl>,
## #   PC_DIRSALES17 <dbl>, PCH_PC_DIRSALES_12_17 <dbl>, FMRKT13 <dbl>,
## #   FMRKT18 <dbl>, PCH_FMRKT_13_18 <dbl>, FMRKTPTH13 <dbl>, ...
atlasog = merge(access, stores, by.x = "FIPS", by.y = "FIPS")
atlasog = merge(atlasog, restaurants, by.x = "FIPS", by.y = "FIPS")
atlasog = merge(atlasog, local, by.x = "FIPS", by.y = "FIPS")

## Warning in merge.data.frame(atlasog, local, by.x = "FIPS", by.y = "FIPS"):
## column names 'State.x', 'County.x', 'State.y', 'County.y' are duplicated in the
## result
```

Scatter plots and regression:

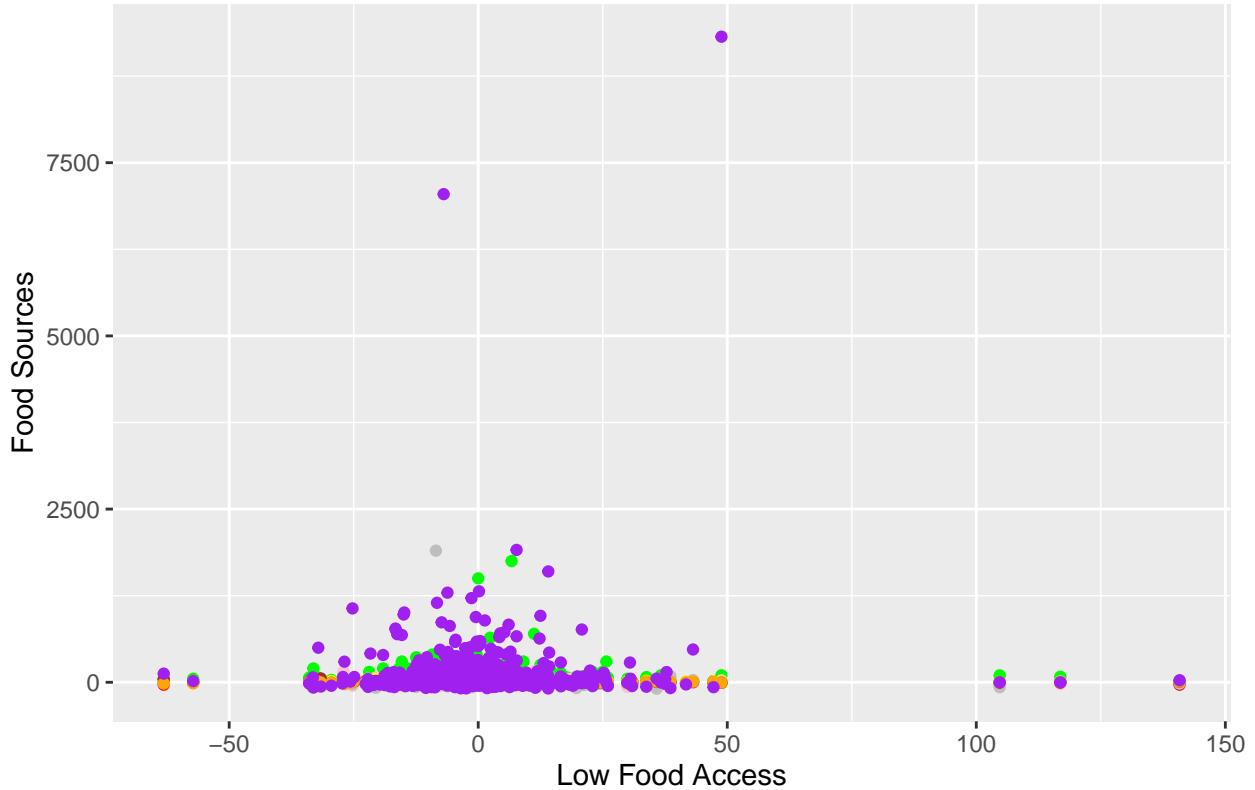
```

atlas = select(atlasog, PCH_LACCESS_POP_15_19, PCH_GROC_16_20, PCH_SUPERC_16_20, PCH_CONVS_16_20, PCH_S
atlas = filter(atlas, PCH_LACCESS_POP_15_19 != -9999, PCH_GROC_16_20 != -9999, PCH_SUPERC_16_20 != -9999
atlas = filter(atlas, PCH_LACCESS_POP_15_19 != -8888, PCH_GROC_16_20 != -8888, PCH_SUPERC_16_20 != -8888

# adjust Jupyter plot size
options(repr.plot.width=4, repr.plot.height=4)
ggplot(atlas) +
  geom_point(aes(y = PCH_GROC_16_20, x = PCH_LACCESS_POP_15_19), color="red")+
  geom_point(aes(y = PCH_SUPERC_16_20, x = PCH_LACCESS_POP_15_19), color="green")+
  geom_point(aes(y = PCH_CONVS_16_20, x = PCH_LACCESS_POP_15_19), color="blue")+
  geom_point(aes(y = PCH_SPECS_16_20, x = PCH_LACCESS_POP_15_19), color="pink")+
  geom_point(aes(y = PCH_SNAPS_17_23, x = PCH_LACCESS_POP_15_19), color="yellow")+
  geom_point(aes(y = PCH_WICS_16_22, x = PCH_LACCESS_POP_15_19), color="gray")+
  geom_point(aes(y = PCH_FFR_16_20, x = PCH_LACCESS_POP_15_19), color="brown")+
  geom_point(aes(y = PCH_FSR_16_20, x = PCH_LACCESS_POP_15_19), color="orange")+
  geom_point(aes(y = PCH_DIRSALES_12_17, x = PCH_LACCESS_POP_15_19), color="purple")+
  labs(title = "Low Food Access vs. Food Sources",
       x = "Low Food Access",
       y = "Food Sources")

```

## Low Food Access vs. Food Sources



```

#There are two points that are clearly outliers at thousands of percents higher than the others, so I a
atlas2 = filter(atlas, PCH_LACCESS_POP_15_19 < 5000, PCH_GROC_16_20 < 5000, PCH_SUPERC_16_20 < 5000, PCH_C
#normalize predictors
colMeans(atlas2)

```

```

## PCH_LACCESS_POP_15_19      PCH_GROC_16_20      PCH_SUPERC_16_20
##          0.2320956        -0.7079341       68.9385445
## PCH_CONVS_16_20            PCH_SPECS_16_20     PCH_SNAPS_17_23
##          2.6007777        -0.6579917       11.6952787
## PCH_WICS_16_22             PCH_FFR_16_20      PCH_FSR_16_20
##          -5.6402305        6.6306411       1.8834212
## PCH_DIRSALES_12_17
##          106.6679969

mutate(atlas2, PCH_GROC_16_20 = PCH_GROC_16_20 + 0.7079341) |>
select(PCH_GROC_16_20)

##      PCH_GROC_16_20
## 1    0.70793410
## 2    0.70793410
## 3    6.31541074
## 4    0.70793410
## 5   -1.46597894
## 6    5.25338865
## 7    7.85079124
## 8   -8.11559531
## 9   -27.06984368
## 10   31.47716487
## 11   20.70793410
## 12  -18.04206590
## 13  -9.29206590
## 14   0.49380134
## 15  12.47263998
## 16  -6.43492304
## 17   3.16695049
## 18  -21.87271106
## 19  -6.18861762
## 20  -8.96948525
## 21  33.14036653
## 22  -14.67668128
## 23  -18.04206590
## 24   9.47986392
## 25  17.37460077
## 26   8.40024179
## 27  -1.17378633
## 28  -10.40317701
## 29   12.70793410
## 30  -0.84848613
## 31  -15.95873257
## 32  -27.86349447
## 33   2.84697153
## 34  39.99364839
## 35  -2.92842954
## 36   7.85079124
## 37  -18.40971296
## 38   8.74364839
## 39   3.32890184
## 40   2.27043410
## 41   1.85406591
## 42   7.61702501

```

```

## 43      0.38430950
## 44      0.36251096
## 45      15.70793410
## 46     -12.33554416
## 47      0.15848355
## 48      4.04126743
## 49     -3.31505441
## 50     -7.74277013
## 51      17.85079124
## 52      2.09682299
## 53      1.42221981
## 54     -4.63557735
## 55      5.46983886
## 56     -5.17441884
## 57      5.49835326
## 58     -6.11024772
## 59      0.70793410
## 60     -0.34469748
## 61     -0.93141016
## 62      16.70793410
## 63      2.34727836
## 64     -19.29206590
## 65     -2.57075442
## 66      6.26348966
## 67     -18.33968495
## 68     -28.70383061
## 69     -8.66706590
## 70      2.15024179
## 71     -8.59439148
## 72     -10.65570226
## 73     -6.05535092
## 74      5.83613923
## 75     -32.62539923
## 76     -6.43492304
## 77      6.89350111
## 78     -12.05802335
## 79     -5.20604439
## 80     -1.61764730
## 81      4.15620996
## 82      5.70793410
## 83     -0.37023302
## 84      5.46983886
## 85      6.26348966
## 86      10.23174362
## 87      7.26531115
## 88      3.58149732
## 89      2.88184714
## 90      23.43520683
## 91      3.20793410
## 92      11.81904521
## 93      9.04126743
## 94      19.22645262
## 95     -8.22063733
## 96      3.64911057

```

```

## 97      -0.22374292
## 98       0.70793410
## 99      13.20793410
## 100      7.52611592
## 101      6.16247955
## 102      6.38975228
## 103     10.23174362
## 104      2.21547179
## 105      8.75391111
## 106      7.52611592
## 107     14.99364839
## 108    -11.65161646
## 109      16.33293410
## 110      13.94322822
## 111    -22.36898898
## 112      14.16947256
## 113      6.59028704
## 114      5.05576019
## 115      4.62950273
## 116      5.33756373
## 117     10.23174362
## 118     -0.60785537
## 119      0.70793410
## 120    -28.70383061
## 121     -2.06984368
## 122     -9.49614753
## 123     11.23424989
## 124     10.36310651
## 125      6.42221981
## 126     -6.69947331
## 127     14.99364839
## 128    -16.36523663
## 129      0.70793410
## 130    -21.51428812
## 131      0.70793410
## 132     -1.61764730
## 133     -9.56233617
## 134      2.83559367
## 135      9.21857240
## 136     -8.38297499
## 137     20.70793410
## 138     -7.29206590
## 139     -4.29206590
## 140      0.70793410
## 141     -1.92364485
## 142    -12.05657102
## 143     -4.81353829
## 144     -1.99476860
## 145     -4.29206590
## 146     22.93015632
## 147      8.40024179
## 148    -12.92842954
## 149     -1.46597894
## 150      4.27936267

```

```
## 151 -27.86349447
## 152 -9.70873257
## 153 -27.59395269
## 154 4.55408795
## 155 -8.18095479
## 156 13.61115991
## 157 0.70793410
## 158 -0.39096700
## 159 -4.46447969
## 160 -13.57778019
## 161 -7.62539923
## 162 -42.14920876
## 163 -6.98437359
## 164 8.81604221
## 165 -29.29206590
## 166 -12.80557941
## 167 -7.62539923
## 168 0.70793410
## 169 -26.56479317
## 170 -3.13821975
## 171 -29.29206590
## 172 0.70793410
## 173 0.70793410
## 174 0.70793410
## 175 15.34208044
## 176 -7.29206590
## 177 -14.29206590
## 178 13.20793410
## 179 0.70793410
## 180 40.70793410
## 181 -9.63689349
## 182 20.96109866
## 183 -8.38297499
## 184 -7.29206590
## 185 17.37460077
## 186 -10.40317701
## 187 5.97109199
## 188 0.70793410
## 189 5.52721121
## 190 -15.95873257
## 191 6.11333951
## 192 -13.57778019
## 193 8.40024179
## 194 20.70793410
## 195 -22.82147766
## 196 -0.83052744
## 197 7.85079124
## 198 -3.16303364
## 199 -8.38297499
## 200 -9.81838169
## 201 14.34429774
## 202 -16.93912472
## 203 0.70793410
## 204 7.15954700
```

```
## 205 -0.13240203
## 206 2.59472655
## 207 -7.62539923
## 208 -11.79206590
## 209 -2.94170094
## 210 10.23174362
## 211 7.85079124
## 212 -4.55522379
## 213 -4.29206590
## 214 0.70793410
## 215 2.04126743
## 216 -6.69947331
## 217 7.37460077
## 218 -6.26881009
## 219 9.21857240
## 220 8.87119941
## 221 13.20793410
## 222 -11.79206590
## 223 43.56507696
## 224 9.27936267
## 225 30.70793410
## 226 8.02500727
## 227 1.70295898
## 228 6.95793410
## 229 -11.05677178
## 230 -14.67668128
## 231 19.93870333
## 232 10.70793410
## 233 -17.65272164
## 234 -12.44996064
## 235 -25.00635161
## 236 5.05576019
## 237 -5.77855239
## 238 -6.02283513
## 239 6.59028704
## 240 2.18941558
## 241 -5.12539923
## 242 -6.26881009
## 243 -2.99576960
## 244 -6.16229491
## 245 36.00205175
## 246 -17.47388408
## 247 0.70793410
## 248 -39.29206590
## 249 0.70793410
## 250 -14.10688071
## 251 5.46983886
## 252 0.70793410
## 253 -9.29206590
## 254 0.70793410
## 255 0.70793410
## 256 27.98066137
## 257 1.77176389
## 258 -4.84762146
```

```
## 259 -13.69206590
## 260 -20.72063733
## 261 -22.01933863
## 262 0.27503367
## 263 13.61115991
## 264 -17.24078385
## 265 -11.79206590
## 266 9.79884319
## 267 -34.29206590
## 268 -2.46666907
## 269 -10.15626343
## 270 11.81904521
## 271 -13.57778019
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## 273 0.70793410
## 274 14.70793410
## 275 1.57000307
## 276 -17.47388408
## 277 -6.98437359
## 278 20.31577724
## 279 6.95793410
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## 282 19.93870333
## 283 9.04126743
## 284 -9.29206590
## 285 3.83293410
## 286 70.70793410
## 287 10.70793410
## 288 0.70793410
## 289 -8.96948525
## 290 -4.29206590
## 291 8.02500727
## 292 -1.16122478
## 293 18.88975228
## 294 -7.98771807
## 295 -3.83752045
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## 298 28.48571188
## 299 17.37460077
## 300 23.78485718
## 301 -9.29206590
## 302 -4.84762146
## 303 0.70793410
## 304 14.04126743
## 305 0.70793410
## 306 -15.95873257
## 307 11.42221981
## 308 20.70793410
## 309 -6.98437359
## 310 7.60448582
## 311 -0.76265414
## 312 14.99364839
```

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## 322 -1.83443878
## 323 2.59472655
## 324 -10.00635161
## 325 -0.31247406
## 326 -2.01933863
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## 333 34.04126743
## 334 -20.72063733
## 335 -14.14355105
## 336 -15.10996713
## 337 -6.43492304
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## 339 -34.29206590
## 340 -18.48398509
## 341 -10.54608519
## 342 -17.47388408
## 343 -16.93912472
## 344 -18.37022221
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## 346 -21.80912428
## 347 6.59028704
## 348 -26.05262928
## 349 -12.51520640
## 350 -20.34469748
## 351 -6.69947331
## 352 -4.05397066
## 353 -7.18680274
## 354 -18.71355350
## 355 -9.20197581
## 356 -39.29206590
## 357 -2.86349447
## 358 2.88184714
## 359 -10.29002924
## 360 -4.05397066
## 361 -3.54738505
## 362 -21.51428812
## 363 -12.28175662
## 364 -9.63689349
## 365 14.99364839
## 366 20.06277281
```

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## 367 -16.43492304
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## 369 -1.21514282
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## 374 0.70793410
## 375 0.70793410
## 376 15.70793410
## 377 -6.69947331
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## 379 13.59453204
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## 381 0.70793410
## 382 6.95793410
## 383 0.70793410
## 384 -11.79206590
## 385 36.42221981
## 386 -21.51428812
## 387 13.75141236
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## 396 -6.89440508
## 397 -8.38297499
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## 399 -12.92842954
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## 401 -1.95873257
## 402 0.70793410
## 403 0.70793410
## 404 -8.38297499
## 405 -2.82147766
## 406 -6.43492304
## 407 -4.29206590
## 408 -12.92842954
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## 410 10.23174362
## 411 -10.40317701
## 412 4.15620996
## 413 6.95793410
## 414 -35.83052744
## 415 17.37460077
## 416 -43.24810986
## 417 -2.48355526
## 418 8.40024179
## 419 -9.63689349
## 420 -11.79206590

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```
## 421 -24.29206590
## 422 13.20793410
## 423 -15.08153958
## 424 4.41163780
## 425 12.13650553
## 426 6.95793410
## 427 6.95793410
## 428 7.26531115
## 429 12.47263998
## 430 -4.55522379
## 431 -6.11024772
## 432 -3.23943432
## 433 7.85079124
## 434 -8.93062012
## 435 14.99364839
## 436 -12.99069604
## 437 -15.29206590
## 438 4.76198815
## 439 11.23424989
## 440 -4.78657139
## 441 -12.19529171
## 442 6.59028704
## 443 8.40024179
## 444 -11.05677178
## 445 -4.55522379
## 446 9.63650553
## 447 0.70793410
## 448 14.59682299
## 449 -17.14920876
## 450 -8.96948525
## 451 22.93015632
## 452 -10.91997288
## 453 16.44867484
## 454 3.73823713
## 455 -20.34469748
## 456 22.37460077
## 457 0.70793410
## 458 -6.43492304
## 459 18.35499292
## 460 3.44766013
## 461 0.70793410
## 462 3.65344220
## 463 0.70793410
## 464 -5.17441884
## 465 -8.66706590
## 466 -10.40317701
## 467 -14.44358105
## 468 4.15620996
## 469 13.20793410
## 470 9.69669814
## 471 -18.64690461
## 472 14.34429774
## 473 10.70793410
## 474 21.63816666
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## 475      0.70793410
## 476     -14.29206590
## 477     -1.51428812
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## 480      3.93374055
## 481     -36.79206590
## 482     -12.62539923
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## 484     -6.55013042
## 485      9.32862376
## 486     -9.15122083
## 487     -25.95873257
## 488     -25.95873257
## 489      0.70793410
## 490     -16.93912472
## 491     -5.35267196
## 492     -7.88102296
## 493     -15.08153958
## 494     -14.29206590
## 495     -13.57778019
## 496     -15.95873257
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## 498     -2.51787235
## 499     -2.78043799
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## 503      8.70793410
## 504     13.20793410
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## 506     10.85286164
## 507      0.70793410
## 508     36.42221981
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## 510     26.74960077
## 511     -10.83052744
## 512     25.70793410
## 513      2.14396543
## 514     50.70793410
## 515     15.63330723
## 516     -11.19682780
## 517      0.70793410
## 518     18.88975228
## 519     32.52611592
## 520      0.70793410
## 521     17.37460077
## 522      0.70793410
## 523     -8.38297499
## 524      0.70793410
## 525     -10.40317701
## 526      0.70793410
## 527      0.70793410
## 528    100.70793410

```

```
## 529 -21.51428812
## 530 39.83836888
## 531 3.62460077
## 532 9.04126743
## 533 -15.95873257
## 534 4.68144403
## 535 0.70793410
## 536 -20.72063733
## 537 -13.57778019
## 538 8.02500727
## 539 0.70793410
## 540 -19.29206590
## 541 5.22406313
## 542 -1.41972547
## 543 -4.55522379
## 544 -2.74034176
## 545 16.98700387
## 546 13.20793410
## 547 0.70793410
## 548 -9.15122083
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## 552 27.98066137
## 553 14.99364839
## 554 6.95793410
## 555 39.59682299
## 556 0.70793410
## 557 -32.62539923
## 558 7.15954700
## 559 5.70793410
## 560 -6.43492304
## 561 13.69494709
## 562 -19.98172107
## 563 -4.05397066
## 564 16.09254948
## 565 5.70793410
## 566 0.70793410
## 567 -17.47388408
## 568 -3.53917015
## 569 -5.81380503
## 570 -4.05397066
## 571 -21.16706590
## 572 0.05433933
## 573 -0.52663380
## 574 -4.95244326
## 575 25.70793410
## 576 -6.60913907
## 577 3.56507696
## 578 -8.96948525
## 579 -24.29206590
## 580 8.40024179
## 581 -8.38297499
## 582 -5.17441884
```

```

## 583      1.95793410
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## 588     -3.22219690
## 589      4.87460077
## 590     17.37460077
## 591     -7.18680274
## 592      5.05576019
## 593     -9.29206590
## 594    -10.40317701
## 595    -20.34469748
## 596      0.70793410
## 597     -8.06399572
## 598      31.95793410
## 599     -32.62539923
## 600      0.70793410

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select(PCH_SUPERC_16_20)

##      PCH_SUPERC_16_20
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## 2     -35.6052112
## 3     -74.2017024
## 4     -35.6052112
## 5     -68.9385445
## 6     -68.9385445
## 7     -68.9385445
## 8     -52.2718778
## 9     -18.9385445
## 10    -28.9385445
## 11    -68.9385445
## 12    -35.6052112
## 13    -2.2718778
## 14    -35.9488538
## 15    31.0614555
## 16    -68.9385445
## 17    -27.7620739
## 18    -68.9385445
## 19    -68.9385445
## 20    -52.2718778
## 21    573.9185984
## 22    31.0614555
## 23    -68.9385445
## 24    -38.9385445
## 25    -48.9385445
## 26    -52.2718778
## 27    281.0614555
## 28    231.0614555
## 29    151.0614555
## 30    31.0614555
## 31    31.0614555
## 32    -43.9385445

```

```

## 33      31.0614555
## 34     -18.9385445
## 35      116.7757412
## 36      231.0614555
## 37       64.3947888
## 38      -8.9385445
## 39      108.8392333
## 40      81.0614555
## 41       1.4318259
## 42     -14.3930900
## 43      53.2836777
## 44      71.8021962
## 45      -18.9385445
## 46      331.0614555
## 47     1681.0614555
## 48     181.0614555
## 49     149.2432737
## 50     231.0614555
## 51     -35.6052112
## 52     -31.4385445
## 53     231.0614555
## 54     131.0614555
## 55     -18.9385445
## 56     81.0614555
## 57      97.7281222
## 58     131.0614555
## 59     -59.8476354
## 60     -48.9385445
## 61     -28.9385445
## 62     -35.6052112
## 63     -55.6052112
## 64     131.0614555
## 65     -33.2242588
## 66     -46.7163223
## 67     -35.6052112
## 68     -43.9385445
## 69     -68.9385445
## 70     111.0614555
## 71     145.3471698
## 72     231.0614555
## 73      41.0614555
## 74      97.7281222
## 75     -2.2718778
## 76     -35.6052112
## 77      71.0614555
## 78     -18.9385445
## 79      11.0614555
## 80     131.0614555
## 81     -35.6052112
## 82     -27.2718778
## 83     -22.0635445
## 84     -68.9385445
## 85     -68.9385445
## 86     -43.9385445

```

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## 87      -26.0814016
## 88      -40.3671159
## 89      -2.2718778
## 90      -48.9385445
## 91      -45.8616214
## 92      -35.6052112
## 93      -57.8274334
## 94      -31.4385445
## 95      -54.6528302
## 96      -18.9385445
## 97      -7.4000830
## 98      131.0614555
## 99      -28.9385445
## 100     -25.4602836
## 101     -57.8274334
## 102     -37.1203627
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## 104     7.9845324
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## 106     -52.2718778
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## 108     -26.0814016
## 109     -18.9385445
## 110     -48.9385445
## 111     -68.9385445
## 112     -40.3671159
## 113     -68.9385445
## 114     -18.9385445
## 115     -68.9385445
## 116     -10.6052112
## 117     -2.2718778
## 118     -61.7956874
## 119     31.0614555
## 120     -68.9385445
## 121     -54.6528302
## 122     -8.9385445
## 123     -18.9385445
## 124     -43.9385445
## 125     -68.9385445
## 126     -68.9385445
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## 128     -18.9385445
## 129     -68.9385445
## 130     -18.9385445
## 131     -18.9385445
## 132     331.0614555
## 133     3.7887282
## 134     131.0614555
## 135     -45.8616214
## 136     -68.9385445
## 137     -43.9385445
## 138     -28.9385445
## 139     -28.9385445
## 140     -35.6052112

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## 141      -40.3671159
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## 143      -11.7956874
## 144      -28.9385445
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## 146      -28.9385445
## 147      -15.0923907
## 148      -35.6052112
## 149      -50.7567263
## 150      -43.9385445
## 151      -35.6052112
## 152      -18.9385445
## 153       31.0614555
## 154      -68.9385445
## 155       64.3947888
## 156      -48.9385445
## 157      -48.9385445
## 158      -37.6885445
## 159      -26.0814016
## 160      -50.7567263
## 161      -35.6052112
## 162      -2.2718778
## 163      -35.6052112
## 164      -48.9385445
## 165      -18.9385445
## 166      -54.6528302
## 167      -46.7163223
## 168      -35.6052112
## 169      -52.2718778
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## 171      -68.9385445
## 172      -73.2863706
## 173      -18.9385445
## 174      -2.2718778
## 175      -57.8274334
## 176      -54.6528302
## 177       6.0614555
## 178      -43.9385445
## 179      -18.9385445
## 180      -2.2718778
## 181      -68.9385445
## 182      -28.9385445
## 183      -35.6052112
## 184      -68.9385445
## 185       31.0614555
## 186      -35.6052112
## 187      -68.9385445
## 188      -18.9385445
## 189      -28.9385445
## 190      -18.9385445
## 191      -54.6528302
## 192      -68.9385445
## 193      -35.6052112
## 194      -18.9385445

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## 195      -18.9385445
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## 197      -35.6052112
## 198      -33.6444269
## 199      -35.6052112
## 200      -43.9385445
## 201      -93.9385445
## 202      -68.9385445
## 203      -54.6528302
## 204      -68.9385445
## 205      -76.6308522
## 206      -54.6528302
## 207      -68.9385445
## 208      -88.9385445
## 209      -18.9385445
## 210      -111.7956874
## 211      -85.6052112
## 212      -83.2242588
## 213      -2.2718778
## 214      -35.6052112
## 215      -28.9385445
## 216      -35.6052112
## 217      -18.9385445
## 218      -18.9385445
## 219      1.0614555
## 220      31.0614555
## 221      131.0614555
## 222      -18.9385445
## 223      131.0614555
## 224      -43.9385445
## 225      64.3947888
## 226      64.3947888
## 227      197.7281222
## 228      191.0614555
## 229      -18.9385445
## 230      131.0614555
## 231      31.0614555
## 232      -35.6052112
## 233      31.0614555
## 234      231.0614555
## 235      231.0614555
## 236      68.5614555
## 237      91.0614555
## 238      -18.9385445
## 239      231.0614555
## 240      119.9503444
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## 245      -68.9385445
## 246      -68.9385445
## 247      -18.9385445
## 248      -68.9385445

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```
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## 250      -41.6658172
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## 255      -43.9385445
## 256      -31.4385445
## 257      -28.9385445
## 258      -35.6052112
## 259      -11.0438077
## 260      131.0614555
## 261      -35.6052112
## 262      -28.1978038
## 263      -40.3671159
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## 265      -48.9385445
## 266      -68.9385445
## 267      -68.9385445
## 268      -18.9385445
## 269      -47.7264233
## 270      31.0614555
## 271      -18.9385445
## 272      131.0614555
## 273      -18.9385445
## 274      0.2922247
## 275      25.7982976
## 276      131.0614555
## 277      -68.9385445
## 278      31.0614555
## 279      6.0614555
## 280      -35.6052112
## 281      -18.9385445
## 282      14.3947888
## 283      -18.9385445
## 284      -48.9385445
## 285      -43.9385445
## 286      -35.6052112
## 287      -68.9385445
## 288      31.0614555
## 289      -18.9385445
## 290      -35.6052112
## 291      -68.9385445
## 292      -45.8616214
## 293      -48.9385445
## 294      -43.9385445
## 295      16.7757412
## 296      131.0614555
## 297      31.0614555
## 298      -18.9385445
## 299      -18.9385445
## 300      -18.9385445
## 301      -35.6052112
## 302      -28.9385445
```

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## 303      -68.9385445
## 304      -40.3671159
## 305      -35.6052112
## 306      -18.9385445
## 307      -35.6052112
## 308      131.0614555
## 309      231.0614555
## 310      31.0614555
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## 312      -18.9385445
## 313      2.4900269
## 314      -18.9385445
## 315      31.0614555
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## 321      -35.6052112
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## 329      -42.2718778
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## 331      -43.9385445
## 332      -18.9385445
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## 339      -18.9385445
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## 351      11.0614555
## 352      -68.9385445
## 353      231.0614555
## 354      231.0614555
## 355      81.0614555
## 356      -35.6052112

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## 357      -2.2718778
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## 359      97.7281222
## 360      -18.9385445
## 361      -35.6052112
## 362      -18.9385445
## 363      31.0614555
## 364      -43.9385445
## 365      -28.9385445
## 366      -52.2718778
## 367      -35.6052112
## 368      -68.9385445
## 369      -68.9385445
## 370      -57.8274334
## 371      -68.9385445
## 372      -6.4385445
## 373      -48.9385445
## 374      -0.1885445
## 375      -28.9385445
## 376      -18.9385445
## 377      -43.9385445
## 378      -35.6052112
## 379      -8.0689793
## 380      -43.9385445
## 381      -2.2718778
## 382      -18.9385445
## 383      -43.9385445
## 384      131.0614555
## 385      -68.9385445
## 386      -18.9385445
## 387      -40.3671159
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## 395      -8.9385445
## 396      -18.9385445
## 397      -68.9385445
## 398      31.0614555
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## 400      16.7757412
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## 402      -2.2718778
## 403      31.0614555
## 404      -68.9385445
## 405      -43.9385445
## 406      -68.9385445
## 407      6.0614555
## 408      -43.9385445
## 409      14.3947888
## 410      59.6328841

```

```

## 411      -68.9385445
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## 413      -48.9385445
## 414      -54.6528302
## 415      -68.9385445
## 416      -47.8859129
## 417      -43.9385445
## 418      -68.9385445
## 419      -53.5539291
## 420      -18.9385445
## 421      -18.9385445
## 422      -43.9385445
## 423      -43.9385445
## 424      -68.9385445
## 425      -57.8274334
## 426      -68.9385445
## 427      -68.9385445
## 428      -46.7163223
## 429      -68.9385445
## 430      -54.6528302
## 431      -32.5749081
## 432      -45.1290207
## 433      -68.9385445
## 434      -38.9385445
## 435      -35.6052112
## 436      122.7281222
## 437      -35.6052112
## 438      16.7757412
## 439      -2.2718778
## 440      1.0614555
## 441      -18.9385445
## 442      -2.2718778
## 443      156.0614555
## 444      -18.9385445
## 445      -2.2718778
## 446      31.0614555
## 447      231.0614555
## 448      -18.9385445
## 449      -93.9385445
## 450      -2.2718778
## 451      -18.9385445
## 452      -2.2718778
## 453      181.0614555
## 454      -18.9385445
## 455      31.0614555
## 456      31.0614555
## 457      231.0614555
## 458      31.0614555
## 459      -35.6052112
## 460      31.0614555
## 461      181.0614555
## 462      291.0614555
## 463      81.0614555
## 464      16.7757412

```

```

## 465      -18.9385445
## 466      -48.9385445
## 467      -43.9385445
## 468      31.0614555
## 469      -68.9385445
## 470      -31.4385445
## 471      -68.9385445
## 472      -50.7567263
## 473      -24.4941001
## 474      -11.7956874
## 475      -88.9385445
## 476      -40.3671159
## 477      -52.2718778
## 478      131.0614555
## 479      -54.6528302
## 480      -28.9385445
## 481      -2.2718778
## 482      -18.9385445
## 483      -18.9385445
## 484      -32.5749081
## 485      -43.9385445
## 486      -41.6658172
## 487      -35.6052112
## 488      -68.9385445
## 489      -43.9385445
## 490      -68.9385445
## 491      -40.3671159
## 492      -40.3671159
## 493      -35.6052112
## 494      31.0614555
## 495      -18.9385445
## 496      -18.9385445
## 497      -18.9385445
## 498      -43.9385445
## 499      -57.3106375
## 500      -58.9385445
## 501      -18.9385445
## 502      -58.9385445
## 503      -46.7163223
## 504      -18.9385445
## 505      -46.2112718
## 506      -63.6753866
## 507      -35.6052112
## 508      -18.9385445
## 509      -50.1885445
## 510      -53.5539291
## 511      -54.6528302
## 512      -68.9385445
## 513      -43.9385445
## 514      6.0614555
## 515      -45.4091327
## 516      -18.9385445
## 517      -18.9385445
## 518      -68.9385445

```

```

## 519      -40.3671159
## 520      -18.9385445
## 521      -18.9385445
## 522      -35.6052112
## 523       3.7887282
## 524     131.0614555
## 525      -18.9385445
## 526      -43.9385445
## 527      -93.9385445
## 528      -68.9385445
## 529      -18.9385445
## 530      -28.9385445
## 531      -49.7896083
## 532      -35.6052112
## 533      -43.9385445
## 534      -12.6885445
## 535      -35.6052112
## 536       6.0614555
## 537      -43.9385445
## 538      -52.2718778
## 539      -68.9385445
## 540      -68.9385445
## 541      -48.2488893
## 542      -40.3671159
## 543      -18.9385445
## 544      -68.9385445
## 545     131.0614555
## 546      -35.6052112
## 547      -35.6052112
## 548       6.0614555
## 549      -2.2718778
## 550      -41.6658172
## 551      -68.9385445
## 552      -2.2718778
## 553      -26.0814016
## 554      -18.9385445
## 555      -18.9385445
## 556      -18.9385445
## 557      -35.6052112
## 558      -43.9385445
## 559      -68.9385445
## 560      -68.9385445
## 561      -31.4385445
## 562      -28.9385445
## 563      -18.9385445
## 564      -68.9385445
## 565      -37.6885445
## 566      -43.9385445
## 567      -93.9385445
## 568      -43.2242588
## 569      -8.9385445
## 570      -38.9385445
## 571      -35.6052112
## 572      -35.6052112

```

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## 573      -23.4839990
## 574      -40.3671159
## 575      -68.9385445
## 576      -2.2718778
## 577      -56.4385445
## 578      6.0614555
## 579      -35.6052112
## 580      -68.9385445
## 581      -68.9385445
## 582      -8.9385445
## 583      71.0614555
## 584      -68.9385445
## 585      -18.9385445
## 586      -35.6052112
## 587      -35.6052112
## 588      -26.0814016
## 589      31.0614555
## 590      -35.6052112
## 591      -18.9385445
## 592      -2.2718778
## 593      131.0614555
## 594      -2.2718778
## 595      -35.6052112
## 596      -35.6052112
## 597      11.0614555
## 598      -18.9385445
## 599      -35.6052112
## 600      -35.6052112

mutate(atlas2, PCH_CONVS_16_20 = PCH_CONVS_16_20 - 2.6007777) |>
select(PCH_CONVS_16_20)

```

```

##      PCH_CONVS_16_20
## 1      -2.600777700
## 2       0.216123708
## 3     -1.511453081
## 4      15.766569239
## 5     -10.434879082
## 6     -12.060237159
## 7     -6.200777700
## 8     -1.258495821
## 9     -7.863935595
## 10    12.493561923
## 11   -12.757027700
## 12    0.789052808
## 13   -8.850777700
## 14   -2.806963267
## 15    3.992628893
## 16   -9.618321560
## 17   -8.607844838
## 18   -6.215235531
## 19   -1.366209799
## 20   -7.146232245
## 21  -16.181024614
## 22  -10.293085392

```

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## 23      -0.517444367
## 24      -2.600777700
## 25      -2.600777700
## 26      -27.952890376
## 27      -3.206838306
## 28      -8.006183105
## 29      0.986666246
## 30      -4.567990815
## 31      47.399222300
## 32      14.859539760
## 33      -5.417679108
## 34      18.329454858
## 35      6.869690732
## 36      14.065888967
## 37      -3.899478999
## 38      1.464262950
## 39      4.705158373
## 40      -8.661383761
## 41      16.039573177
## 42      -3.642444367
## 43      12.160137061
## 44      -4.315817278
## 45      28.118176548
## 46      -12.383386396
## 47      -2.600777700
## 48      2.449727351
## 49      -2.326052425
## 50      -11.831546931
## 51      -16.731212483
## 52      14.213381592
## 53      -2.600777700
## 54      10.362185263
## 55      9.899222300
## 56      8.864190453
## 57      -7.676919832
## 58      -9.743634843
## 59      16.599222300
## 60      3.095424832
## 61      -10.600777700
## 62      -5.934111033
## 63      8.448946057
## 64      -6.172206271
## 65      -0.036675136
## 66      4.375966486
## 67      -8.850777700
## 68      -8.661383761
## 69      7.788832690
## 70      -1.810263866
## 71      -1.330936430
## 72      -2.600777700
## 73      4.631926703
## 74      -0.846391735
## 75      4.542079443
## 76      4.671949573

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## 77      -3.756847064
## 78      -3.750202987
## 79       4.861908867
## 80       0.677910825
## 81       0.732555633
## 82      -0.594088737
## 83      -2.343377443
## 84      14.348374842
## 85      -9.953718876
## 86     -17.074461911
## 87       6.310113389
## 88      -0.003375103
## 89      -8.347904137
## 90       5.595943611
## 91      -0.441309261
## 92     -12.600777700
## 93       3.447609397
## 94     10.165179747
## 95      4.295774024
## 96      7.121444522
## 97      1.649781584
## 98     -19.673948432
## 99      -6.446931546
## 100     -2.791253890
## 101     3.486178822
## 102     -0.422559878
## 103     7.761916601
## 104     -8.231408331
## 105     -2.916235113
## 106     15.660091865
## 107     8.308313209
## 108     -1.130189465
## 109     -2.015982378
## 110     -3.302532086
## 111     3.247175516
## 112     1.723546624
## 113     8.666827934
## 114     7.846983494
## 115     5.627070401
## 116     5.873798571
## 117     2.571636093
## 118     2.277271080
## 119     16.446841348
## 120     10.979469214
## 121     11.891975923
## 122     6.314884951
## 123     -1.062316162
## 124     9.335561823
## 125     -1.666198261
## 126     -6.838065836
## 127     3.715011774
## 128     22.002396903
## 129     13.085496810
## 130     5.669898992

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```

## 131      -4.295692954
## 132     -14.721989821
## 133     -16.510552136
## 134     -24.634676005
## 135      -7.957920557
## 136      9.163928182
## 137      3.920961430
## 138      -7.957920557
## 139      12.783837685
## 140      20.732555633
## 141     -9.545222144
## 142     -4.328801742
## 143     -7.668345268
## 144     -2.600777700
## 145     -17.184111033
## 146     -22.600777700
## 147     -3.600777700
## 148     -2.600777700
## 149      0.732555633
## 150     -5.775380875
## 151      6.833184564
## 152      4.478868318
## 153      11.891975923
## 154     -16.685284742
## 155     -8.245938990
## 156     -2.600777700
## 157     -14.881479454
## 158      4.140795334
## 159      1.497582956
## 160      8.251935478
## 161      3.281575241
## 162      0.177000078
## 163     -13.711888811
## 164     13.341251286
## 165     -18.600777700
## 166      5.595943611
## 167     -0.328050427
## 168     -0.815063414
## 169      4.375966486
## 170     -7.362682462
## 171      4.671949573
## 172      10.827793729
## 173      1.654541449
## 174      4.065888967
## 175     13.560838462
## 176     14.065888967
## 177     12.264087165
## 178     12.153320661
## 179      8.037520172
## 180     -6.856096849
## 181      6.701547881
## 182      1.794826696
## 183    -18.927308312
## 184     -0.402975502

```

```

## 185 -2.600777700
## 186 -12.600777700
## 187 -5.934111033
## 188 -10.293085392
## 189 -3.501678601
## 190 -24.822999922
## 191 -10.809732924
## 192 -16.663277700
## 193 14.706914608
## 194 -7.146232245
## 195 21.641646542
## 196 -9.022796049
## 197 -4.641594027
## 198 2.268136158
## 199 -33.156333256
## 200 -8.723226680
## 201 -2.600777700
## 202 -8.600777700
## 203 -7.747836524
## 204 5.452913575
## 205 -0.219825319
## 206 7.555472300
## 207 -10.443914955
## 208 -3.882828982
## 209 2.662380195
## 210 -3.590876710
## 211 3.224465018
## 212 5.581040482
## 213 -2.600777700
## 214 6.629991531
## 215 -4.655572221
## 216 -0.003375103
## 217 -11.450335222
## 218 -20.618795718
## 219 -14.600777700
## 220 -5.155522226
## 221 -4.452629552
## 222 -16.554266072
## 223 -5.457920557
## 224 -1.085626185
## 225 -1.424307112
## 226 -5.069913502
## 227 -11.159336259
## 228 0.543876388
## 229 -2.600777700
## 230 -13.127093489
## 231 -16.062316162
## 232 7.014606915
## 233 -12.288277700
## 234 3.325148226
## 235 -17.306660053
## 236 -3.574803674
## 237 8.065888967
## 238 -3.417104231

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```

## 239      4.946392111
## 240      0.369519330
## 241     -2.600777700
## 242     -2.202371325
## 243     -1.312117906
## 244      4.826278003
## 245    -22.600777700
## 246     -4.071365935
## 247     -8.483130641
## 248      1.399222300
## 249    -14.228684677
## 250    -14.881479454
## 251      0.256365157
## 252    -41.062316162
## 253    -19.694794794
## 254     -5.303480403
## 255    -11.051481925
## 256    -10.495514542
## 257     -6.533361970
## 258    -19.267444367
## 259     -1.607400217
## 260      7.076641655
## 261      0.101925003
## 262     -7.269082368
## 263    -11.424307112
## 264     -1.302076401
## 265      1.102926004
## 266     -9.497329424
## 267    -13.315063414
## 268    -12.216162315
## 269     -5.394724149
## 270     -8.795467965
## 271     -2.600777700
## 272    -2.600777700
## 273      3.113508014
## 274    -2.600777700
## 275     -5.658881676
## 276    -13.127093489
## 277      7.655632556
## 278    -10.725777700
## 279     -9.267444367
## 280    -2.600777700
## 281      42.399222300
## 282     -0.713985247
## 283     -0.219825319
## 284      7.925538089
## 285     -4.163277700
## 286      5.091529992
## 287    -21.205428863
## 288      8.210033111
## 289     -11.556001581
## 290    -10.600777700
## 291    -12.249900507
## 292     -9.418959518

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```

## 293 -16.886491986
## 294 -8.414731188
## 295 -2.600777700
## 296 -24.222399322
## 297 -2.600777700
## 298 -13.127093489
## 299 -16.114291214
## 300 -6.948603787
## 301 -11.424307112
## 302 4.946392111
## 303 -2.600777700
## 304 2.553861475
## 305 -2.600777700
## 306 -2.600777700
## 307 6.549549097
## 308 -5.378555478
## 309 15.177000078
## 310 -4.188079287
## 311 4.628137963
## 312 -9.179725068
## 313 -3.907967242
## 314 15.256365157
## 315 -3.899478999
## 316 -9.428086937
## 317 -2.600777700
## 318 2.065888967
## 319 -13.470342917
## 320 2.775566386
## 321 4.806629707
## 322 4.065888967
## 323 -3.352657399
## 324 1.632026533
## 325 7.048345107
## 326 -6.718424759
## 327 22.772356628
## 328 -2.600777700
## 329 -15.934111033
## 330 -5.934111033
## 331 -15.934111033
## 332 -18.816993916
## 333 -15.836071818
## 334 -5.631080730
## 335 5.840780742
## 336 117.278740372
## 337 -3.571651486
## 338 7.655632556
## 339 -12.034739964
## 340 12.846376772
## 341 10.219735121
## 342 -19.267444367
## 343 0.677910825
## 344 89.640601610
## 345 -2.943243453
## 346 66.068750197

```

```

## 347 -8.624874086
## 348 14.570939472
## 349 10.796351487
## 350 17.853767755
## 351 1.149222300
## 352 -11.860036959
## 353 18.827793729
## 354 27.487717875
## 355 10.586035487
## 356 0.970650871
## 357 7.708500651
## 358 1.346590721
## 359 9.770356321
## 360 6.490131391
## 361 -5.430966379
## 362 -9.122516830
## 363 18.248643149
## 364 -11.242753009
## 365 -1.715821948
## 366 17.947167505
## 367 3.146348737
## 368 -1.437987002
## 369 -5.934111033
## 370 -7.926221487
## 371 2.116203432
## 372 -0.670275769
## 373 -2.600777700
## 374 6.621124317
## 375 -0.328050427
## 376 7.121444522
## 377 -6.172206271
## 378 12.467715451
## 379 -2.032595882
## 380 1.624574413
## 381 -11.691686791
## 382 -6.109549630
## 383 -12.278197055
## 384 -16.393881148
## 385 -4.684111033
## 386 -2.600777700
## 387 3.874042444
## 388 6.019911955
## 389 -5.069913502
## 390 -0.473118126
## 391 -9.557299439
## 392 17.399222300
## 393 -19.673948432
## 394 5.891791302
## 395 12.493561923
## 396 -5.395808756
## 397 15.917740819
## 398 -11.775089627
## 399 -4.188079287
## 400 -8.964414064

```

```

## 401    19.884429401
## 402     7.399222300
## 403     4.671949573
## 404     2.399222300
## 405     7.399222300
## 406     2.050385091
## 407    -8.055323155
## 408     1.172807206
## 409   -13.549682809
## 410    -2.095727195
## 411     7.076641655
## 412    -9.545222144
## 413    -5.164880264
## 414    22.700427119
## 415    -2.600777700
## 416    22.303436859
## 417    -6.392246894
## 418    -2.600777700
## 419    10.362185263
## 420     1.944676845
## 421     2.161127062
## 422   -13.315063414
## 423    13.308313209
## 424     5.211722300
## 425     9.087533988
## 426    13.615438516
## 427    21.537153334
## 428    -6.948603787
## 429     8.510333411
## 430     7.925538089
## 431     2.471686068
## 432    -0.028430433
## 433     3.281575241
## 434    -0.457920557
## 435    13.528254558
## 436    -1.904722016
## 437     9.899222300
## 438    -0.181422861
## 439    14.420498896
## 440    -5.010416254
## 441    -4.050053062
## 442   -17.494394721
## 443    -2.600777700
## 444    -8.850777700
## 445     9.899222300
## 446     5.810437253
## 447    10.947609397
## 448     1.522933640
## 449    -5.879466225
## 450   -14.365483582
## 451    -8.315063414
## 452     2.301183084
## 453     0.732555633
## 454     1.565888967

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```

## 455      7.799222300
## 456     -4.408006616
## 457     -0.559961373
## 458     -4.774690743
## 459      1.035585936
## 460      1.965432346
## 461     13.240806458
## 462     15.120741287
## 463     -2.600777700
## 464     -8.949984049
## 465     -1.843201942
## 466     -2.600777700
## 467     -3.325415381
## 468    -15.934111033
## 469     10.075278638
## 470     -0.390832949
## 471     14.380354375
## 472     -4.487570153
## 473      6.539007246
## 474      6.843666744
## 475      7.744049886
## 476     10.664528422
## 477     -0.328050427
## 478     -2.600777700
## 479     -2.600777700
## 480      2.161127062
## 481     -4.295692954
## 482    -15.276834038
## 483     -6.350777700
## 484      6.939858342
## 485     -3.585999375
## 486   -16.822999922
## 487      4.861908867
## 488     -0.748925848
## 489     13.113508014
## 490    -14.365483582
## 491     29.174923235
## 492     17.440544614
## 493     -3.916567174
## 494     28.827793729
## 495      5.595943611
## 496      5.873798571
## 497   -28.407229313
## 498     -2.600777700
## 499     -0.899207019
## 500      7.603303933
## 501     -2.600777700
## 502     -5.321866135
## 503     10.660871046
## 504     -4.684111033
## 505      3.699852363
## 506     11.092168358
## 507     -0.782595882
## 508    25.247323566

```

```

## 509 -4.260528737
## 510 30.732555633
## 511 6.542079443
## 512 2.483968063
## 513 8.904451950
## 514 -1.108240387
## 515 1.089259200
## 516 0.625028752
## 517 -3.866600485
## 518 -4.452629552
## 519 -5.792267062
## 520 5.926354083
## 521 14.065888967
## 522 -2.600777700
## 523 20.148037466
## 524 -6.109549630
## 525 30.732555633
## 526 -4.240121962
## 527 -9.122516830
## 528 10.732555633
## 529 12.399222300
## 530 -13.000777700
## 531 8.570006403
## 532 -7.664068839
## 533 -5.990608208
## 534 2.522561958
## 535 -19.549930242
## 536 -12.012542406
## 537 -4.324915631
## 538 22.954777856
## 539 -6.172206271
## 540 -1.130189465
## 541 -2.600777700
## 542 -7.025556461
## 543 7.399222300
## 544 -4.873504973
## 545 -1.525508883
## 546 -20.378555478
## 547 -4.487570153
## 548 -10.934111033
## 549 14.966789868
## 550 3.136927218
## 551 18.827793729
## 552 -9.743634843
## 553 3.113508014
## 554 4.716295471
## 555 -16.554266072
## 556 13.528254558
## 557 16.003873463
## 558 6.973690385
## 559 -5.826584152
## 560 2.756365157
## 561 -0.725777700
## 562 -1.085626185

```

```

## 563    11.684936586
## 564    -6.304481404
## 565    -8.983756423
## 566    -11.075353971
## 567    164.065888967
## 568    -7.901131057
## 569    -3.952129051
## 570    -0.426864657
## 571    -8.483130641
## 572    -10.895708576
## 573    1.372732234
## 574    11.288111189
## 575    -14.365483582
## 576    -7.502738484
## 577    6.094874474
## 578    -7.306660053
## 579    11.684936586
## 580    1.747048387
## 581    1.944676845
## 582    0.887594393
## 583    -7.926221487
## 584    -0.517444367
## 585    -16.446931546
## 586    -5.232356647
## 587    4.946392111
## 588    3.053984205
## 589    -17.415592515
## 590    4.806629707
## 591    -5.010416254
## 592    3.748428649
## 593    -5.039802090
## 594    -4.728437274
## 595    5.091529992
## 596    -9.873504973
## 597    1.600902972
## 598    -16.886491986
## 599    -12.278197055
## 600    -15.504003506

mutate(atlas2, PCH_SPECS_16_20 = PCH_SPECS_16_20 + 0.6579917) |>
select(PCH_SPECS_16_20)

##      PCH_SPECS_16_20
## 1    8.0653991
## 2   -32.6753416
## 3   -16.8420083
## 4   -24.3420083
## 5   -8.0376605
## 6   -24.3420083
## 7   -15.3420083
## 8   -22.4189314
## 9    25.6579917
## 10  -10.4531194
## 11  125.6579917
## 12  -32.6753416

```

```

## 13      25.6579917
## 14      0.6579917
## 15      0.6579917
## 16      33.9913250
## 17      -13.8347619
## 18      0.6579917
## 19      39.1195302
## 20      0.6579917
## 21      -21.5642305
## 22      25.6579917
## 23      14.9437060
## 24      -34.6361259
## 25      -10.4531194
## 26      -7.0343160
## 27      -9.8683241
## 28      46.8118379
## 29      -15.1314820
## 30      -15.7803645
## 31      8.3502994
## 32      -13.6277226
## 33      13.1579917
## 34      40.6579917
## 35      -0.3585267
## 36      7.3246584
## 37      17.3246584
## 38      -1.6147356
## 39      9.0300847
## 40      -8.4329174
## 41      8.1579917
## 42      6.6103727
## 43      5.9211496
## 44      -7.2715237
## 45      -10.8804698
## 46      3.5151346
## 47      2.5447842
## 48      6.0633971
## 49      -12.2207962
## 50      -29.3420083
## 51      -30.1112391
## 52      -8.7170083
## 53      -5.1391097
## 54      -12.6753416
## 55      -49.3420083
## 56      3.5991682
## 57      2.2973360
## 58      -27.1197861
## 59      -3.1881621
## 60      -16.0086750
## 61      -7.3420083
## 62      5.6579917
## 63      -3.9931711
## 64      -49.3420083
## 65      -25.8125965
## 66      12.0865631

```

```

## 67      -27.1197861
## 68      -27.9134369
## 69      -24.3420083
## 70      -12.1079657
## 71      -9.7897695
## 72      -14.7266237
## 73      -26.7613631
## 74      0.6579917
## 75      -49.3420083
## 76      -13.6277226
## 77      -6.6590815
## 78      4.1062676
## 79      -26.7613631
## 80      -7.6753416
## 81      -4.8975639
## 82      -22.1991512
## 83      -6.5788504
## 84      -10.4531194
## 85      0.6579917
## 86      -19.3420083
## 87      22.8802139
## 88      -8.9164764
## 89      -28.5086750
## 90      33.9913250
## 91      -8.1139381
## 92      -7.0343160
## 93      -10.0562940
## 94      -3.8874628
## 95      -16.0086750
## 96      40.6579917
## 97      -9.4166352
## 98      20.6579917
## 99      8.9913250
## 100     -16.8858679
## 101     -6.4848654
## 102     -8.1257921
## 103     -2.7902842
## 104     4.9590670
## 105     -7.0343160
## 106     -13.6277226
## 107     50.6579917
## 108     3.0970161
## 109     -33.9573929
## 110     14.4510951
## 111     -43.7864527
## 112     15.8095069
## 113     -13.6277226
## 114     33.9913250
## 115     0.6579917
## 116     -12.2452341
## 117     20.6579917
## 118     -15.7056447
## 119     -19.3420083
## 120     50.6579917

```

```

## 121      -21.5642305
## 122       0.6579917
## 123      13.1579917
## 124     -1.2650852
## 125     -17.5238265
## 126      20.6579917
## 127     -14.7266237
## 128     -56.4848654
## 129      50.6579917
## 130     -26.0086750
## 131      33.9913250
## 132     -9.3420083
## 133     -4.6517428
## 134     -7.6753416
## 135      14.9437060
## 136      20.6579917
## 137     -13.6277226
## 138      0.6579917
## 139      72.0865631
## 140      60.6579917
## 141     -13.6277226
## 142     -6.1978003
## 143     -17.1991512
## 144     -7.0343160
## 145     -19.3420083
## 146      0.6579917
## 147      2.8319047
## 148     -16.0086750
## 149      5.9211496
## 150     -16.0086750
## 151      0.6579917
## 152      18.3050505
## 153      22.8802139
## 154     -11.8420083
## 155      6.5403446
## 156      23.7349148
## 157      17.3246584
## 158      26.5839176
## 159      0.6579917
## 160      0.6579917
## 161     -49.3420083
## 162      40.6579917
## 163     -32.6753416
## 164     -19.3420083
## 165      0.6579917
## 166      25.6579917
## 167     125.6579917
## 168     -32.6753416
## 169      17.3246584
## 170      14.4510951
## 171      14.9437060
## 172     -20.4958545
## 173      0.6579917
## 174      17.3246584

```

```

## 175      -16.0086750
## 176      -9.3420083
## 177      -32.6753416
## 178      -35.7056447
## 179      -13.6277226
## 180      -36.8420083
## 181      -10.4531194
## 182      -6.7494157
## 183      33.9913250
## 184      -10.4531194
## 185      50.6579917
## 186      -36.8420083
## 187      -36.8420083
## 188      -19.3420083
## 189      18.8398099
## 190      25.6579917
## 191      7.1096046
## 192      -5.5920083
## 193      -10.4531194
## 194      17.3246584
## 195      25.6579917
## 196      0.6579917
## 197      -49.3420083
## 198      0.6579917
## 199      0.6579917
## 200      20.6579917
## 201      0.6579917
## 202      17.3246584
## 203      75.6579917
## 204      33.9913250
## 205      -34.1246170
## 206      38.1579917
## 207      0.6579917
## 208      -27.9134369
## 209      -39.3420083
## 210      -36.8420083
## 211      17.3246584
## 212      45.1024361
## 213      -17.5238265
## 214      -8.4329174
## 215      -3.9931711
## 216      67.3246584
## 217      33.9913250
## 218      7.1096046
## 219      -7.4501164
## 220      -16.5295083
## 221      -21.5642305
## 222      33.9913250
## 223      0.6579917
## 224      0.6579917
## 225      -24.3420083
## 226      -4.6051662
## 227      3.7829917
## 228      -5.2243612

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```

## 229      17.3246584
## 230     -17.5238265
## 231      -7.6753416
## 232      25.6579917
## 233     -13.3770960
## 234     -20.9106358
## 235      10.6579917
## 236     -8.8658178
## 237      3.5991682
## 238      0.6579917
## 239     -7.6753416
## 240     -12.3854866
## 241     -9.8683241
## 242     -3.1881621
## 243      1.9079917
## 244      7.4761735
## 245     -13.6277226
## 246      10.6579917
## 247     -49.3420083
## 248      0.6579917
## 249     -26.6147356
## 250      0.6579917
## 251     -41.4472715
## 252      40.6579917
## 253      50.6579917
## 254      0.6579917
## 255     -26.6147356
## 256     -16.7333126
## 257      4.7120458
## 258     -24.3420083
## 259     -0.4172771
## 260      33.9913250
## 261     -4.6051662
## 262     -17.8035468
## 263     -11.3420083
## 264     -20.1753416
## 265      0.6579917
## 266     -49.3420083
## 267      20.6579917
## 268      3.8837982
## 269      2.2123958
## 270     -36.1841136
## 271      0.6579917
## 272     -19.3420083
## 273      80.6579917
## 274     -4.8975639
## 275     -5.9457819
## 276     -24.3420083
## 277     -42.1991512
## 278     -17.9466595
## 279     -15.1314820
## 280     -49.3420083
## 281      0.6579917
## 282     -22.0692810

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```

## 283      -18.3896273
## 284      -29.3420083
## 285       0.6579917
## 286       0.6579917
## 287      -39.3420083
## 288      -32.6753416
## 289      -49.3420083
## 290      -19.3420083
## 291      -34.6361259
## 292      -11.5371303
## 293      -19.3420083
## 294      -32.6753416
## 295       -8.4329174
## 296      -32.6753416
## 297       0.6579917
## 298      -11.8420083
## 299      33.9913250
## 300      25.6579917
## 301      -20.7705797
## 302       0.6579917
## 303      -32.6753416
## 304      -4.3420083
## 305      -26.6147356
## 306      -24.3420083
## 307      -10.4531194
## 308      -39.3420083
## 309     150.6579917
## 310       0.6579917
## 311      -11.3420083
## 312      -27.9134369
## 313      -11.1067142
## 314      13.1579917
## 315       0.6579917
## 316      4.2724495
## 317      2.7856513
## 318      4.8246584
## 319      -34.6361259
## 320      -25.0562940
## 321     39.1195302
## 322     16.0426071
## 323      -8.8156925
## 324     11.5013652
## 325      -16.3231404
## 326      -13.4596554
## 327      2.9835731
## 328      -32.6753416
## 329      6.7804407
## 330     20.6579917
## 331     57.8008488
## 332      -16.0086750
## 333      -54.8975639
## 334     18.3050505
## 335      4.1062676
## 336      -2.8975639

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```

## 337      11.7691028
## 338     -10.4531194
## 339      0.6579917
## 340     -20.7705797
## 341     -0.4914336
## 342      50.6579917
## 343      0.6579917
## 344     -7.6622595
## 345     -32.6753416
## 346     -15.1314820
## 347     -11.1067142
## 348     -12.6753416
## 349     -15.4710406
## 350     -9.3420083
## 351     -13.6277226
## 352     -16.0086750
## 353      0.6579917
## 354     -13.6277226
## 355     -9.7586750
## 356      33.9913250
## 357     -40.2510992
## 358      0.6579917
## 359     -3.1076987
## 360     -49.3420083
## 361     -8.8658178
## 362     -32.6753416
## 363     -6.7744407
## 364     -11.8420083
## 365     -22.4189314
## 366     -30.5920083
## 367     -32.6753416
## 368      33.9913250
## 369      6.2135473
## 370      0.6579917
## 371     -24.3420083
## 372     -36.8420083
## 373     -32.6753416
## 374     -17.5238265
## 375      4.5041455
## 376     -26.6147356
## 377      0.6579917
## 378     -16.0086750
## 379      14.4510951
## 380     -27.9134369
## 381      60.6579917
## 382      22.8802139
## 383     -13.6277226
## 384      0.6579917
## 385      0.6579917
## 386     100.6579917
## 387      5.4198965
## 388     -36.8420083
## 389      0.6579917
## 390     17.3246584

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```

## 391      -6.2985300
## 392       8.3502994
## 393      67.3246584
## 394      0.6579917
## 395     167.3246584
## 396     -11.8420083
## 397     -19.3420083
## 398      -6.4848654
## 399      50.6579917
## 400     -19.3420083
## 401     -16.0086750
## 402      16.0426071
## 403      60.6579917
## 404     67.3246584
## 405      3.8837982
## 406      0.6579917
## 407      0.6579917
## 408      0.6579917
## 409     -8.0376605
## 410      4.2294203
## 411     -61.8420083
## 412     27.9307190
## 413     40.6579917
## 414      0.6579917
## 415     -43.7864527
## 416     -14.2356253
## 417      3.7829917
## 418     67.3246584
## 419     33.9913250
## 420     -26.6147356
## 421     33.9913250
## 422      0.6579917
## 423     -3.8874628
## 424     -42.1991512
## 425     -24.3420083
## 426     -19.3420083
## 427      0.6579917
## 428     -14.9670083
## 429      50.6579917
## 430     17.3246584
## 431     -30.7705797
## 432     -10.8003416
## 433      50.6579917
## 434      7.8008488
## 435      0.6579917
## 436     -12.0002361
## 437     40.6579917
## 438     -9.7586750
## 439     13.1579917
## 440     -18.0086750
## 441      0.6579917
## 442     -32.6753416
## 443     -12.8555218
## 444     40.6579917

```

```

## 445      31.9079917
## 446     -30.9209557
## 447     -15.0562940
## 448      50.6579917
## 449      13.1579917
## 450     -21.5642305
## 451      0.6579917
## 452      15.6579917
## 453      11.7691028
## 454     -16.0086750
## 455     -26.3690353
## 456     -16.0086750
## 457     -9.3420083
## 458      0.6579917
## 459     -16.0086750
## 460      4.2724495
## 461     -13.6277226
## 462     -4.2870632
## 463      10.6579917
## 464     -7.6753416
## 465     -9.6868359
## 466      0.6579917
## 467     -16.0086750
## 468     -20.7705797
## 469      33.9913250
## 470     -1.3420083
## 471     -6.0086750
## 472     -11.3420083
## 473      24.4675155
## 474      0.6579917
## 475      50.6579917
## 476      0.6579917
## 477      10.6579917
## 478     -13.6277226
## 479     -27.9134369
## 480     -27.9134369
## 481      11.7691028
## 482     -39.3420083
## 483      0.6579917
## 484     -13.2954967
## 485     -4.6051662
## 486      0.6579917
## 487      0.6579917
## 488      25.6579917
## 489     -27.9134369
## 490     -39.3420083
## 491      33.9913250
## 492     -14.4363479
## 493     -16.0086750
## 494      75.6579917
## 495      19.4079917
## 496     -49.3420083
## 497      50.6579917
## 498      0.6579917

```

```

## 499      -19.0950947
## 500      25.6579917
## 501     -11.8420083
## 502      24.1874035
## 503      19.7056107
## 504     -59.3420083
## 505     -11.2231964
## 506     -17.1991512
## 507     -19.3420083
## 508      300.6579917
## 509     -5.5920083
## 510      5.2034462
## 511      7.3246584
## 512     -24.3420083
## 513     -5.2943893
## 514      50.6579917
## 515      15.7523313
## 516     -20.3946399
## 517      0.6579917
## 518      33.9913250
## 519     -37.8035468
## 520     -16.0086750
## 521      0.6579917
## 522      133.9913250
## 523     -3.3420083
## 524      0.6579917
## 525     -24.3420083
## 526     -32.6753416
## 527      67.3246584
## 528     -16.0086750
## 529      33.9913250
## 530     -37.8035468
## 531     -3.9397094
## 532      40.6579917
## 533     -24.3420083
## 534     -27.9134369
## 535      25.6579917
## 536     -32.6753416
## 537      13.1579917
## 538      20.6579917
## 539      20.6579917
## 540      16.4474654
## 541      12.1334015
## 542      42.5934756
## 543      42.3246584
## 544     -14.7266237
## 545     -16.9890671
## 546      0.6579917
## 547      60.6579917
## 548      4.6579917
## 549      25.6579917
## 550      5.6579917
## 551     -19.3420083
## 552      50.6579917

```

```

## 553      13.1579917
## 554      150.6579917
## 555      0.6579917
## 556     -16.0086750
## 557     -49.3420083
## 558     -35.7056447
## 559      0.6579917
## 560      0.6579917
## 561     -15.4710406
## 562     -20.7705797
## 563      73.3852644
## 564      0.6579917
## 565     -5.2243612
## 566      0.6579917
## 567     -39.3420083
## 568      1.6889195
## 569      5.4198965
## 570     -1.0369236
## 571      0.6579917
## 572     -4.6991512
## 573     -7.9134369
## 574     -9.6868359
## 575     -13.6277226
## 576     -13.6277226
## 577      5.9211496
## 578     -19.3420083
## 579      33.9913250
## 580      50.6579917
## 581      33.9913250
## 582     -32.6753416
## 583     -7.6753416
## 584     167.3246584
## 585     -66.0086750
## 586     -44.7965538
## 587     -7.0343160
## 588     -14.5962456
## 589      6.9079917
## 590     -14.7266237
## 591      0.6579917
## 592     18.8398099
## 593     -16.0086750
## 594      0.6579917
## 595      0.6579917
## 596     22.8802139
## 597     -13.6277226
## 598     -36.1841136
## 599     -24.3420083
## 600      75.6579917

mutate(atlas2, PCH_SNAPS_17_23 = PCH_SNAPS_17_23 - 11.6952787) |>
select(PCH_SNAPS_17_23)

```

```

##      PCH_SNAPS_17_23
## 1      1.811100428
## 2     -12.183083590

```

```

## 3      -16.685766276
## 4      -13.933416660
## 5       1.160959665
## 6       3.536508982
## 7      -14.018458899
## 8      -2.136168059
## 9     -15.085109289
## 10      8.545201723
## 11     -6.389156397
## 12     -3.673888739
## 13     -2.116048391
## 14     -9.499862488
## 15     -1.579192694
## 16     -7.766707237
## 17     -8.975411232
## 18     -5.042155321
## 19     -4.967798765
## 20    -12.372479613
## 21      5.537730638
## 22     -5.572829779
## 23      2.770130579
## 24     -3.318315085
## 25     -0.521303709
## 26    -10.453042682
## 27     -3.728572424
## 28     -5.718472059
## 29     12.090890352
## 30     -7.670510824
## 31      1.923398439
## 32      1.398246233
## 33     -0.991552885
## 34     -6.368947085
## 35     -8.698850449
## 36     -2.102032240
## 37      1.553360407
## 38     -4.050396021
## 39     -1.390072401
## 40     -6.707155283
## 41      3.015605394
## 42      3.685243074
## 43     -0.639971312
## 44     -2.826404150
## 45      3.868923609
## 46     10.563857500
## 47      5.771132891
## 48      0.030307238
## 49     -2.858688887
## 50    -10.151904519
## 51     -1.946534689
## 52      5.388507311
## 53      0.256143038
## 54     -4.054082449
## 55     -6.289873179
## 56    -10.779561992

```

```

## 57      -2.079893644
## 58      -2.850207861
## 59      10.129977648
## 60      12.629044954
## 61      2.083712046
## 62      20.517608110
## 63      12.122147982
## 64      18.034451906
## 65      1.447578852
## 66      38.185389940
## 67      8.693070833
## 68      -14.397981461
## 69      22.111541216
## 70      -3.728572424
## 71      0.878011171
## 72      -1.565408285
## 73      1.722857897
## 74      -4.355829294
## 75      -6.176101740
## 76      11.879851763
## 77      3.526621286
## 78      -11.867692496
## 79      -0.741054114
## 80      -10.164255317
## 81      -11.449578460
## 82      -8.948221977
## 83      -9.686005171
## 84      -4.809051092
## 85      -19.208231981
## 86      -8.510565336
## 87      -4.267600592
## 88      -10.524057325
## 89      -6.449649866
## 90      5.968142931
## 91      -7.360183294
## 92      -18.223468836
## 93      -1.397406157
## 94      -13.366861756
## 95      -6.289873179
## 96      -6.416468199
## 97      -15.390096243
## 98      -0.104981955
## 99      -8.946864422
## 100     -6.046534594
## 101     -1.985852774
## 102     -9.180729445
## 103     2.975380365
## 104     -13.000761684
## 105     0.999735300
## 106     0.216548387
## 107     1.361101572
## 108     -5.753687437
## 109     -7.037907179
## 110     -9.259018000

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```

## 111 -13.487952169
## 112 3.078117792
## 113 -1.985852774
## 114 -9.985241469
## 115 -1.610698279
## 116 -0.163857039
## 117 -3.455903586
## 118 -6.589806135
## 119 -3.160246428
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## 121 15.784966890
## 122 -9.334511812
## 123 3.781866495
## 124 3.487628404
## 125 -13.759609039
## 126 4.621360247
## 127 -0.379489477
## 128 -13.948311623
## 129 0.544906084
## 130 2.014398996
## 131 9.369023744
## 132 -8.873318728
## 133 -14.054191883
## 134 -0.535541113
## 135 1.782982294
## 136 7.952815477
## 137 7.159137194
## 138 2.153229181
## 139 6.389827196
## 140 -13.419416602
## 141 -3.404246863
## 142 -6.253987368
## 143 8.468049471
## 144 1.690548365
## 145 2.916965906
## 146 35.113231127
## 147 9.971793596
## 148 15.277835314
## 149 13.270238344
## 150 -0.784924086
## 151 0.237493936
## 152 -5.758501585
## 153 -0.205448683
## 154 10.996015016
## 155 -5.512898501
## 156 -5.678086813
## 157 -6.126271303
## 158 8.568715517
## 159 0.024760668
## 160 4.893287126
## 161 14.347886507
## 162 -0.311741408
## 163 6.685834352
## 164 -1.052136953

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## 165 -11.062367316
## 166 3.148471300
## 167 3.870231096
## 168 -8.598375614
## 169 -5.611628588
## 170 7.689061586
## 171 2.697245066
## 172 5.653605883
## 173 -0.067371901
## 174 -1.182680662
## 175 -0.872044142
## 176 5.401496355
## 177 9.157802050
## 178 1.152403299
## 179 0.400529329
## 180 25.013583605
## 181 2.441935007
## 182 2.932381098
## 183 -1.067878302
## 184 4.129637186
## 185 -7.969496306
## 186 5.203330461
## 187 0.926080171
## 188 39.272464220
## 189 -5.507653769
## 190 -8.838135775
## 191 8.466664736
## 192 0.499843065
## 193 -11.502600472
## 194 -6.906546171
## 195 -16.120057638
## 196 2.612295572
## 197 10.359101717
## 198 -6.222920473
## 199 -5.028612192
## 200 9.264720384
## 201 1.532234613
## 202 3.994702761
## 203 -11.195854958
## 204 -7.679374273
## 205 -13.945084866
## 206 2.657113497
## 207 -28.838135298
## 208 9.535975878
## 209 -24.666425284
## 210 4.851483766
## 211 -22.464509543
## 212 -6.963996943
## 213 -1.905068930
## 214 -12.706951793
## 215 -1.680551108
## 216 -24.905081328
## 217 -13.363580998
## 218 -7.011437948

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## 219      7.394481127
## 220     -4.244976099
## 221      0.645146791
## 222      0.033862535
## 223      1.201127474
## 224      4.406415407
## 225     -3.474420126
## 226      3.219975893
## 227     -1.108835753
## 228     11.074803774
## 229      7.154561464
## 230     29.288329546
## 231      8.897801821
## 232      5.325997774
## 233    -25.736211355
## 234      0.475013201
## 235     -1.325576361
## 236     -2.754709776
## 237     -0.176953848
## 238     -0.458709295
## 239     -0.566114958
## 240      1.254507486
## 241      2.675091211
## 242     -4.915617521
## 243     -5.946948107
## 244      0.065065805
## 245     -8.961465653
## 246      1.125234072
## 247    -1.186070021
## 248     18.739503328
## 249      0.992034380
## 250     -6.320204790
## 251     -1.836123999
## 252     -6.389156397
## 253     -1.916099127
## 254      4.246750299
## 255      2.733830873
## 256      2.866974298
## 257      7.814197008
## 258     13.304721300
## 259    -10.432734187
## 260      2.487844889
## 261     -9.322739657
## 262    -12.859911140
## 263      1.909737055
## 264      3.783613626
## 265     -5.603634413
## 266     -1.771614607
## 267     -8.805105265
## 268     -5.070181425
## 269    -12.804702933
## 270     13.279443209
## 271      6.853108827
## 272     14.479216997

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```

## 273 -2.242542799
## 274 -4.370683249
## 275 -5.318917807
## 276 15.436503832
## 277 0.105963175
## 278 2.283792917
## 279 -5.621525820
## 280 6.161864702
## 281 10.285607759
## 282 -4.089193876
## 283 3.558958475
## 284 -10.705179687
## 285 4.998401110
## 286 16.979419176
## 287 -0.789548453
## 288 -1.417165335
## 289 2.297019426
## 290 0.454253618
## 291 2.201397364
## 292 0.020618860
## 293 1.154685442
## 294 -6.175381239
## 295 -9.342337425
## 296 5.279511873
## 297 -7.901651915
## 298 -12.923779901
## 299 14.733293001
## 300 -16.791939314
## 301 -0.857840117
## 302 -7.688737448
## 303 32.625434343
## 304 5.200704042
## 305 24.216323320
## 306 -13.449664648
## 307 -5.140657004
## 308 -13.547130521
## 309 0.574659769
## 310 -12.530933316
## 311 -2.039475973
## 312 -2.864729460
## 313 -3.024758871
## 314 -3.043366964
## 315 -2.268576201
## 316 -1.408364828
## 317 -7.295675810
## 318 -4.896761950
## 319 -11.469545062
## 320 -2.243483122
## 321 22.498271410
## 322 -10.654966648
## 323 -4.556635435
## 324 -5.374035414
## 325 1.378228609
## 326 -10.147291120

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```

## 327    10.238849108
## 328     1.108611528
## 329    -1.650493200
## 330    -5.471212443
## 331    -6.891785200
## 332     0.709784929
## 333    44.826461260
## 334   19.159739916
## 335   -0.777662809
## 336   -1.532677229
## 337   -3.242041166
## 338   -0.698361929
## 339   -14.868442829
## 340   -13.138782914
## 341     3.035688822
## 342   18.795127336
## 343   -7.969496306
## 344   -6.062564905
## 345   -2.705645140
## 346  -10.670268472
## 347     0.693224375
## 348     0.751073305
## 349   -0.827058371
## 350   -9.626313265
## 351     3.025885050
## 352   -2.802356299
## 353   -3.587170179
## 354   -9.638078507
## 355   -6.600831087
## 356   -0.994171675
## 357   -0.005528029
## 358   -4.892557676
## 359   -2.374818380
## 360   17.109069292
## 361   -9.627942618
## 362  -10.878475900
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## 365   -11.614698525
## 366  -15.113139685
## 367  -19.726485785
## 368   -5.066707190
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## 371  -13.793180760
## 372   -2.138774450
## 373  -10.658060845
## 374  -12.901215609
## 375   -7.849124964
## 376  -11.381010945
## 377   -3.646989401
## 378   -9.491586025
## 379  -9.198563870
## 380  -9.695278700

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## 381      9.075599138
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## 383      1.789835398
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## 386     -5.471212443
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## 388      0.304721300
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## 390     11.189851229
## 391     -7.024638231
## 392     24.153777544
## 393     14.325725023
## 394     -2.690705832
## 395      8.304721300
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## 399     -2.999626692
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## 401     -3.469809111
## 402     10.183688585
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## 413     -4.950410898
## 414     -4.105145987
## 415     -3.540772017
## 416     -7.593159254
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## 419     -7.799174841
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## 423     -0.494634207
## 424      6.614579622
## 425      3.137257044
## 426      3.373214189
## 427     18.671212618
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## 430     -9.148031290
## 431     -0.143672522
## 432     -8.884249743
## 433     14.386304323
## 434     -6.960538443

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```

## 435 -3.381739195
## 436 1.395002787
## 437 -1.304809149
## 438 -3.623646315
## 439 -10.298630651
## 440 10.863643114
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## 445 4.369201128
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## 452 8.757125322
## 453 0.431349222
## 454 6.630301897
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## 482 -8.282309349
## 483 -13.419416602
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## 485 -7.335417326
## 486 -6.897578295
## 487 -10.847167667
## 488 -18.062991675

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```

## 489      13.690415804
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## 491      2.590435449
## 492     -4.440358217
## 493     -5.749332960
## 494     -4.856568869
## 495     -6.695278700
## 496      7.510018770
## 497     12.595719759
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## 502     -4.123477038
## 503     11.299153749
## 504     -0.676567610
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## 507     26.661918108
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## 512     14.689086382
## 513     17.130536501
## 514     23.546222154
## 515      4.336785738
## 516     18.911002581
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## 518     14.142558519
## 519     23.051707689
## 520      3.629396860
## 521      0.645146791
## 522     67.542010729
## 523     19.273843233
## 524      4.395539705
## 525     40.269786302
## 526    -10.480703767
## 527     32.422366564
## 528     18.900203173
## 529     11.338429872
## 530      8.573478166
## 531      7.698865358
## 532     10.654485170
## 533     13.304721300
## 534     -4.145823534
## 535      5.768569414
## 536      4.575288240
## 537      0.899818842
## 538     25.115451280
## 539     -4.302282389
## 540      4.549132769
## 541     -0.520145949
## 542      8.139050905

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```

## 543 11.050347750
## 544 1.226069872
## 545 -9.626313265
## 546 -1.086582716
## 547 -6.280116137
## 548 -6.164533194
## 549 24.978980486
## 550 1.120685999
## 551 -0.175433691
## 552 11.231549684
## 553 -5.164666231
## 554 -27.522616919
## 555 -3.180427130
## 556 -0.755371626
## 557 -17.025769289
## 558 -0.695278700
## 559 -13.508859451
## 560 -5.433419283
## 561 -8.502871569
## 562 11.562241976
## 563 5.848580782
## 564 -9.277071055
## 565 -3.040152128
## 566 1.512268488
## 567 -9.163633164
## 568 -5.846428927
## 569 -6.536795195
## 570 -2.068159636
## 571 -10.102655109
## 572 -0.163437422
## 573 -0.111354406
## 574 -4.923158224
## 575 -0.067371901
## 576 -3.985267218
## 577 1.818234865
## 578 -8.724981602
## 579 0.761864130
## 580 -14.068160113
## 581 -2.604369696
## 582 6.317143862
## 583 11.018962328
## 584 4.019007151
## 585 3.617221300
## 586 -13.610987480
## 587 4.564198915
## 588 -1.887130316
## 589 -4.349824007
## 590 31.894465868
## 591 -14.455114182
## 592 10.959184114
## 593 18.739503328
## 594 -0.277461584
## 595 20.820060198
## 596 28.169585649

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```

## 597      4.542437975
## 598      1.831692163
## 599     -3.347749289
## 600     -1.401160772
mutate(atlas2, PCH_WICS_16_22 = PCH_WICS_16_22 + 5.6402305) |>
select(PCH_WICS_16_22)

##      PCH_WICS_16_22
## 1     -1.25632122
## 2      1.09477595
## 3     -0.68888342
## 4     -27.69310283
## 5      7.91295777
## 6     -0.60976950
## 7     -1.63249677
## 8     13.64023050
## 9    -12.00682832
## 10   -21.28284642
## 11   10.18568505
## 12   -12.00682832
## 13    8.58140697
## 14   -14.97201440
## 15    9.34393420
## 16   -6.85976950
## 17   -1.13943052
## 18   -11.85976950
## 19   -14.35976950
## 20   -6.35976950
## 21    2.51523050
## 22   -2.05207719
## 23   -2.05207719
## 24   -6.55489145
## 25    36.89023050
## 26   -5.07405521
## 27    0.81264429
## 28   -3.05542167
## 29    8.76523050
## 30   -15.65606580
## 31   18.68370876
## 32   -19.35976950
## 33   -10.50560283
## 34   19.27659414
## 35   -19.17366528
## 36    11.89023050
## 37   -13.00383730
## 38   -18.24036651
## 39   -12.10170498
## 40    10.29139329
## 41    3.21108070
## 42   -0.64907768
## 43   -5.08938323
## 44   -13.18928604
## 45   -10.40915222
## 46   -21.38679653

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## 47      -11.75107385
## 48      -0.60976950
## 49       4.93600515
## 50     -13.59053873
## 51      10.64023050
## 52      -0.74274822
## 53       9.27659414
## 54     -13.92498689
## 55     -22.93119807
## 56      -5.85402237
## 57     -10.35976950
## 58       9.34393420
## 59      -4.61617976
## 60      34.21165907
## 61      5.64023050
## 62      17.40493638
## 63      5.64023050
## 64      5.64023050
## 65     -11.43294023
## 66      -2.69310283
## 67      -8.64548379
## 68     -23.77153421
## 69      12.30689717
## 70      -9.15266891
## 71     -13.08123069
## 72      46.54932141
## 73     -14.90031004
## 74       7.96581190
## 75      5.64023050
## 76     -22.13754728
## 77     -16.80874909
## 78      23.82204868
## 79      20.34611285
## 80       9.21165907
## 81     -16.23476950
## 82       1.93652680
## 83       2.39698726
## 84     -15.41240108
## 85      12.30689717
## 86       0.64023050
## 87      11.89023050
## 88       0.64023050
## 89       8.41800828
## 90      5.64023050
## 91       0.84570995
## 92      12.30689717
## 93       7.04868120
## 94      5.64023050
## 95     -2.25450634
## 96      0.64023050
## 97       7.65635953
## 98      16.75134161
## 99       9.80689717
## 100     11.42535447

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## 101      2.86245272
## 102      6.33953120
## 103     -0.02014686
## 104     -3.36877851
## 105     19.43333395
## 106      9.64023050
## 107     29.16964226
## 108     23.03153485
## 109      9.80689717
## 110     14.26092016
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## 112     -7.40324776
## 113    -11.02643617
## 114     -0.24212244
## 115    -17.88918126
## 116     -3.15097829
## 117      5.64023050
## 118    -23.39202756
## 119      5.64023050
## 120    -25.60976950
## 121    -22.48476950
## 122     20.27437684
## 123     -6.85976950
## 124     -1.35976950
## 125    -16.23476950
## 126     9.21165907
## 127      5.64023050
## 128     -3.45067859
## 129    -14.35976950
## 130     -5.47088061
## 131     -3.45067859
## 132     -1.25632122
## 133      4.27036749
## 134      1.47356383
## 135     11.04563591
## 136    -19.35976950
## 137     -5.47088061
## 138     -6.85976950
## 139     -4.88608529
## 140      5.64023050
## 141    11.70083656
## 142     -2.96543399
## 143      1.53064146
## 144     33.27180945
## 145    -10.14924318
## 146    -19.35976950
## 147     12.78308764
## 148     -3.88357902
## 149     23.14023050
## 150     -1.76717691
## 151      1.93652680
## 152     -6.85976950
## 153     -5.47088061
## 154     -9.98476950

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```

## 155 -23.30713792
## 156 -8.90522405
## 157 -2.35976950
## 158 -1.02643617
## 159 -4.65388715
## 160 2.19195464
## 161 -37.21691236
## 162 -5.47088061
## 163 -27.69310283
## 164 5.64023050
## 165 -6.85976950
## 166 -27.69310283
## 167 -21.02643617
## 168 -8.64548379
## 169 27.86245272
## 170 23.64023050
## 171 -4.35976950
## 172 -17.61558345
## 173 -16.58199172
## 174 12.78308764
## 175 -3.45067859
## 176 -11.02643617
## 177 -25.39425226
## 178 5.64023050
## 179 -10.14924318
## 180 0.64023050
## 181 -7.51766424
## 182 5.64023050
## 183 -15.41240108
## 184 -5.07405521
## 185 -9.74438488
## 186 -4.35976950
## 187 5.64023050
## 188 5.64023050
## 189 10.90338839
## 190 5.64023050
## 191 -3.05542167
## 192 -5.47088061
## 193 -10.14924318
## 194 -15.78834093
## 195 -17.43669258
## 196 -15.04942467
## 197 -1.50262664
## 198 -14.73013987
## 199 -30.07405521
## 200 13.33253819
## 201 28.71715358
## 202 14.73113959
## 203 -1.50262664
## 204 19.27659414
## 205 -32.69310283
## 206 5.64023050
## 207 -17.43669258
## 208 -39.81431495

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## 210 41.35451621
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## 214 -17.43669258
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## 216 16.16654629
## 217 53.64023050
## 218 -1.50262664
## 219 -21.34389648
## 220 -28.35976950
## 221 -15.78834093
## 222 5.64023050
## 223 -24.79455211
## 224 -16.94041466
## 225 -19.35976950
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## 230 -16.58199172
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## 255 -25.39425226
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## 263    17.17869204
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## 271    18.97356383
## 272    13.33253819
## 273    13.97356383
## 274    -0.70897585
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## 276   -17.43669258
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## 295     5.64023050
## 296    18.14023050
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## 298     5.64023050
## 299    42.00386686
## 300    15.64023050
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## 303   -19.35976950
## 304    10.76843563
## 305    17.40493638
## 306   -12.54158768
## 307    15.01523050
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## 310   -26.61783402
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## 349 2.78308764
## 350 -11.02643617
## 351 0.46781671
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## 353 5.64023050
## 354 -19.64712582
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## 356 5.64023050
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## 359 31.26523050
## 360 14.73113959
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## 365 3.36750323
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## 368 -7.47452360
## 369 -22.93119807
## 370 -11.20187476
```

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## 374    -13.05135829
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## 376      9.48638435
## 377   -13.27868842
## 378     -5.47088061
## 379      2.32531337
## 380     -5.89823104
## 381     -2.69310283
## 382     -0.24212244
## 383      5.64023050
## 384   -17.88918126
## 385     -8.64548379
## 386   -12.54158768
## 387      5.64023050
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## 412   -24.35976950
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## 417     41.03846059
## 418      5.64023050
## 419   -12.87828802
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## 421     -8.64548379
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## 423     -5.07405521
## 424   -10.14924318
```

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## 430     -6.85976950
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## 432     11.38735694
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## 434   -20.11734526
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## 444    -2.05207719
## 445      5.64023050
## 446    -19.35976950
## 447   -34.10335924
## 448   -18.04398003
## 449   -12.00682832
## 450   -25.60976950
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## 453   -18.97515412
## 454     1.09477595
## 455   -53.79373176
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## 461   -10.57598572
## 462   -60.73476950
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## 466   -4.88608529
## 467     -6.85976950
## 468    19.27659414
## 469   -27.69310283
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## 471    13.64023050
## 472    -7.26299531
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## 476    -7.12572695
## 477   -13.10976950
## 478    13.33253819
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## 485      2.51523050
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## 487     -2.69310283
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## 490     14.73113959
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## 494     -4.88608529
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## 506    -16.09889993
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## 514      5.64023050
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## 517    -36.46503266
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## 520     12.30689717
## 521      5.64023050
## 522      5.64023050
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## 527    -74.35976950
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## 529      5.64023050
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## 531     14.42401428
## 532     -7.69310283

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## 562 0.37707261
## 563 12.78308764
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## 565 -2.05207719
## 566 5.64023050
## 567 -22.93119807
## 568 -11.20759559
## 569 -15.78834093
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## 571 5.64023050
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## 576 -18.49770053
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## 578 9.21165907
## 579 -12.54158768
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## 581 45.64023050
## 582 8.34293320
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## 584 -27.69310283
## 585 -17.27643617
## 586 -6.12447538

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## 587 -24.79455211
## 588 -34.79039151
## 589 5.64023050
## 590 5.64023050
## 591 -28.23073724
## 592 -1.02643617
## 593 16.75134161
## 594 -6.85976950
## 595 5.64023050
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## 598 -2.69310283
## 599 -5.47088061
## 600 -8.64548379

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select(PCH_FFR_16_20)

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## 3    -10.43882164
## 4     1.82006313
## 5     2.37836791
## 6    10.86935890
## 7    10.03602557
## 8     8.04825798
## 9    -2.18619666
## 10    3.24590211
## 11   -1.95227853
## 12    3.71418649
## 13   -2.72439110
## 14    4.13858967
## 15    0.74640808
## 16   11.11129438
## 17    1.32731686
## 18    5.49057102
## 19   -5.91121664
## 20    4.93960683
## 21   16.68224234
## 22    7.65507319
## 23   -4.24968872
## 24   -2.52105206
## 25   -3.71801974
## 26   -1.39808296
## 27   -0.28880042
## 28   -7.26355249
## 29    4.92428044
## 30    8.82677215
## 31  -20.03270296
## 32    0.16547540
## 33    1.99290782
## 34    9.09969598
## 35   -0.87071854
## 36   -1.33963581

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```

## 37 -3.13413760
## 38 2.08148011
## 39 -5.07692209
## 40 -0.64261715
## 41 5.82880082
## 42 5.36935890
## 43 4.31300241
## 44 -2.68327268
## 45 1.95304989
## 46 4.90782044
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## 48 2.96238216
## 49 -8.05551157
## 50 0.79793033
## 51 -1.71260831
## 52 -4.90650317
## 53 1.96042419
## 54 -0.34648809
## 55 1.84393517
## 56 2.46026799
## 57 -4.10698179
## 58 -3.99906215
## 59 -2.46397443
## 60 -7.22352648
## 61 -0.79122504
## 62 -3.87834752
## 63 6.01044242
## 64 -6.63064110
## 65 -8.69960662
## 66 -1.09558575
## 67 10.95177648
## 68 -8.51743355
## 69 6.49435890
## 70 -4.97318254
## 71 6.07838900
## 72 6.96159191
## 73 -6.77878925
## 74 -5.64054209
## 75 1.18185890
## 76 17.28240238
## 77 10.15768007
## 78 7.56688976
## 79 -12.33189538
## 80 3.01402895
## 81 -4.65695689
## 82 -6.09730777
## 83 -2.50389092
## 84 -5.33193980
## 85 12.33487614
## 86 11.79041153
## 87 10.55685890
## 88 1.05181729
## 89 7.19914613
## 90 14.29959146

```

```

## 91      1.66375142
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## 96     -0.08858503
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## 105     20.31741085
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## 107     19.50572254
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## 112     -7.90048237
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## 114     2.14128872
## 115     3.67863725
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## 138     -2.04348514
## 139     8.18417371
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## 158     -4.03583072
## 159     -3.34425612
## 160      7.76935890
## 161    -12.26444392
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## 164     -3.18236524
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## 167     -0.33142850
## 168      1.36935890
## 169   -14.83959632
## 170      4.37180389
## 171     -8.01952999
## 172     -8.19314110
## 173     -3.82690278
## 174      3.01848171
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## 176     -5.20206967
## 177    -1.10916871
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## 196     -7.61748321
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```

## 199 -2.46397443
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## 207 8.75397428
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## 229 7.84304311
## 230 -14.52537794
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## 232 1.50889378
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## 249 16.98047001
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```
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## 274 0.51221604
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## 283 -0.91635539
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## 285 -5.27928975
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## 306 15.95000406
```

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select(PCH_FSR_16_20)

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## 15      5.259435943
## 16      2.116578800
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## 532  0.389306073
## 533 -7.501398728
## 534  4.436660349
## 535 -0.188505946
## 536 -5.308078734
## 537 -15.744807339
## 538  18.116578800
## 539 -6.645325962
## 540 -1.883421200
## 541  2.969519976
## 542 -0.883421200
## 543 -6.691113508
## 544 -9.854435693
## 545 -1.883421200
## 546  7.005467689
## 547  1.820282504
## 548 -5.416990105
## 549  4.783245467
## 550  1.591482275
## 551 -11.093947516
## 552 -9.236362376
## 553  0.748157747
## 554 -5.965053853
## 555  2.610960822
## 556  1.688007371
## 557 -0.617598415
## 558 -7.216754533
## 559 -1.883421200
## 560 -1.883421200
## 561 -1.692945010
## 562  7.965063648
## 563  3.116578800
## 564 -14.674118874
## 565  14.116578800
## 566 -0.412832965

```

```

## 567 13.116578800
## 568 0.846815149
## 569 1.781500266
## 570 3.445175603
## 571 1.477923338
## 572 8.079678431
## 573 4.568191703
## 574 -1.883421200
## 575 9.480215164
## 576 1.564854662
## 577 0.406655136
## 578 -8.650338493
## 579 -7.824015259
## 580 -8.860165386
## 581 1.506409308
## 582 -3.368569715
## 583 -0.817323119
## 584 0.616578800
## 585 -7.815624590
## 586 -14.504780423
## 587 -0.014262321
## 588 0.199912133
## 589 -9.621516438
## 590 0.748157747
## 591 -0.308618050
## 592 -1.883421200
## 593 2.226167841
## 594 -1.883421200
## 595 5.456028341
## 596 6.653164166
## 597 0.070976194
## 598 -1.883421200
## 599 -0.031569348
## 600 -6.108773313

mutate(atlas2, PCH_DIRSALES_12_17 = PCH_DIRSALES_12_17 - 106.6679969) |>
select(PCH_DIRSALES_12_17)

##      PCH_DIRSALES_12_17
## 1      -27.655651
## 2      -17.697409
## 3      -70.602423
## 4     -114.452428
## 5     -122.301420
## 6      51.551181
## 7     -93.928032
## 8     -147.631852
## 9     -145.393487
## 10    -31.969202
## 11    -139.360305
## 12     17.112491
## 13    -176.677640
## 14     616.898882
## 15    -151.416855
## 16    -140.630261

```

```

## 17      -157.503863
## 18      -106.460097
## 19       243.783616
## 20       335.251195
## 21      -96.358719
## 22      -55.780423
## 23      -1.667997
## 24     -129.426618
## 25      366.502735
## 26      -52.103682
## 27      725.114949
## 28      211.537692
## 29      -78.608295
## 30      -59.575908
## 31      -50.727121
## 32      377.765965
## 33      93.129983
## 34     1803.824508
## 35     -148.246722
## 36     -108.739971
## 37     -116.544112
## 38     1107.909382
## 39     -131.528332
## 40      23.919526
## 41      395.552616
## 42      13.020062
## 43      -82.466523
## 44      -65.530814
## 45      -80.207631
## 46      479.888767
## 47      227.940382
## 48      853.236538
## 49      67.456517
## 50     -100.207684
## 51     -127.903518
## 52      147.460104
## 53      576.013225
## 54      286.983836
## 55      959.747504
## 56     -53.489893
## 57      758.758884
## 58     -22.878479
## 59     -15.432937
## 60     -86.132283
## 61     -139.525955
## 62     -135.239425
## 63     -66.504062
## 64     142.220892
## 65     146.273180
## 66     -124.471657
## 67      25.636646
## 68     -124.473380
## 69     -59.823199
## 70     -162.255844

```

```

## 71      -43.383938
## 72      -15.850119
## 73      -39.438359
## 74       68.521258
## 75      -97.430883
## 76      421.532374
## 77      321.787288
## 78      -38.304760
## 79     -106.667997
## 80      -79.923811
## 81      171.109781
## 82      -64.706144
## 83      -98.667997
## 84      -33.940724
## 85      182.107513
## 86     -163.334664
## 87       11.959454
## 88      21.238980
## 89     -88.211621
## 90      -97.306295
## 91      -85.216209
## 92      295.529805
## 93     -114.408583
## 94      -16.350802
## 95     -72.022328
## 96     -93.402691
## 97     -61.820179
## 98     -124.667997
## 99      -29.203208
## 100     79.152899
## 101     900.474860
## 102    -113.616965
## 103    -136.793896
## 104    -74.525140
## 105     18.162703
## 106     199.046289
## 107    -63.451916
## 108    1040.501814
## 109    -159.004445
## 110     668.441173
## 111    -126.667997
## 112    -155.820539
## 113     -38.063346
## 114      10.979062
## 115    -106.667997
## 116    -165.491526
## 117    -131.438639
## 118     -3.542997
## 119    -193.830159
## 120    -139.167997
## 121     -5.288687
## 122    -110.221296
## 123    -166.667997
## 124     11.513821

```

```

## 125      -107.467997
## 126      -149.320327
## 127       307.915336
## 128      -106.667997
## 129       488.570098
## 130      1493.332003
## 131      -162.223552
## 132       75.285893
## 133        3.504629
## 134      -108.807637
## 135      -100.651737
## 136       -90.970322
## 137      -137.082743
## 138      -30.607148
## 139      -112.700479
## 140      -112.713337
## 141      -34.016640
## 142      162.507630
## 143        -6.031054
## 144      -3.568486
## 145       40.892979
## 146      -126.060182
## 147      -120.678004
## 148      -185.974217
## 149      -73.976704
## 150      -54.174559
## 151      -146.029699
## 152      -99.325002
## 153      -110.029341
## 154      -160.667997
## 155       178.858319
## 156      -156.165484
## 157       27.406077
## 158      -157.901181
## 159      -100.074590
## 160      -111.889516
## 161       30.421205
## 162      -176.796477
## 163       19.400379
## 164      -115.777901
## 165      -85.334664
## 166      -138.526404
## 167       -77.362441
## 168       178.156906
## 169      -122.100096
## 170      -40.448158
## 171      -84.554975
## 172      -37.976408
## 173      -117.554073
## 174       -75.527646
## 175      -118.999230
## 176      -177.828607
## 177      -171.121662
## 178      -59.445775

```

```

## 179      -66.450606
## 180      392.259617
## 181     -100.707732
## 182      -66.641750
## 183      -68.986837
## 184     -159.022046
## 185      42.394503
## 186     -156.841007
## 187     -83.327957
## 188     -188.486179
## 189     -140.868740
## 190     -154.494084
## 191     -160.514151
## 192     -137.917997
## 193     -98.593463
## 194     -33.241423
## 195      66.114878
## 196     -86.242465
## 197      6.189146
## 198    -123.762014
## 199     -22.008906
## 200      115.736375
## 201    -149.525140
## 202      29.382160
## 203    -117.487669
## 204    -137.280242
## 205    -191.213451
## 206     -73.940724
## 207     -34.590075
## 208     -43.334664
## 209      293.332003
## 210      92.647072
## 211    -119.814549
## 212    -132.249392
## 213      123.766786
## 214     -71.885388
## 215     -20.477049
## 216     -49.701705
## 217    -122.161643
## 218     -3.199789
## 219    -101.667997
## 220      62.390827
## 221    -113.800061
## 222      147.389974
## 223    -132.940909
## 224      205.747272
## 225     -7.356465
## 226      30.028009
## 227     -7.384390
## 228     -90.442370
## 229     -53.696229
## 230      73.977164
## 231      26.536407
## 232    -137.615365

```

## 233	-106.667997
## 234	-84.792997
## 235	-37.787130
## 236	-147.726269
## 237	-41.408494
## 238	-114.922714
## 239	-97.769120
## 240	115.190642
## 241	-65.848325
## 242	50.162910
## 243	-98.047307
## 244	86.038663
## 245	-123.155933
## 246	-32.510120
## 247	-59.263153
## 248	-90.953711
## 249	-106.024220
## 250	-71.093529
## 251	124.271813
## 252	-21.511747
## 253	-120.455082
## 254	-59.065865
## 255	-85.806097
## 256	-70.379908
## 257	-86.435824
## 258	-96.788965
## 259	-27.996572
## 260	-27.866154
## 261	545.896106
## 262	90.992822
## 263	-60.405434
## 264	-122.797029
## 265	-128.415209
## 266	-54.730012
## 267	-77.265012
## 268	-2.132723
## 269	-33.131961
## 270	-107.141183
## 271	-155.540177
## 272	-121.353312
## 273	-121.603062
## 274	43.071586
## 275	-151.515970
## 276	-171.875874
## 277	-119.518079
## 278	-36.362320
## 279	-114.451415
## 280	14.288723
## 281	-117.518798
## 282	-101.925851
## 283	-46.092917
## 284	-149.276693
## 285	53.700667
## 286	-61.213451

```

## 287      -149.945308
## 288      -89.640970
## 289      -70.260230
## 290      -32.891089
## 291      -58.591074
## 292      73.678824
## 293      109.836857
## 294      63.676831
## 295      30.639695
## 296      269.522479
## 297      -179.923811
## 298      27.519195
## 299      -78.814116
## 300      -50.535921
## 301      -110.124787
## 302      -33.007283
## 303      190.629300
## 304      -125.119022
## 305      -72.484323
## 306      -15.363649
## 307      -20.001330
## 308      -18.216114
## 309      -97.441567
## 310      -68.169973
## 311      -13.089653
## 312      -63.214554
## 313      -43.959727
## 314      22.587777
## 315      450.996237
## 316      -52.927839
## 317      130.064397
## 318      176.350871
## 319      -39.615974
## 320      -6.874876
## 321      32.452253
## 322      331.445211
## 323      -37.078181
## 324      173.318105
## 325      167.145872
## 326      320.889984
## 327      557.207601
## 328      -1.877299
## 329      -177.442645
## 330      1206.489898
## 331      -100.651284
## 332      654.652758
## 333      -110.841620
## 334      -101.057436
## 335      96.375871
## 336      -106.667997
## 337      -54.901212
## 338      -74.747093
## 339      18.052361
## 340      -68.173829

```

```
## 341      -111.829473
## 342      -9.811415
## 343      -141.195684
## 344      -17.296016
## 345      -66.025019
## 346      -106.667997
## 347      -85.677898
## 348      -38.582142
## 349      -75.233398
## 350      154.990034
## 351      -110.012788
## 352      -28.827088
## 353      -36.257462
## 354      -106.667997
## 355      -40.684390
## 356      -56.776144
## 357      108.800040
## 358      -123.705034
## 359      102.681142
## 360      -129.828431
## 361      100.780633
## 362      -106.229400
## 363      98.253263
## 364      -58.457074
## 365      -67.404193
## 366      189.277949
## 367      -53.655949
## 368      -12.808348
## 369      208.114612
## 370      -129.242624
## 371      -119.882283
## 372      363.005708
## 373      33.434831
## 374      60.700424
## 375      -130.197409
## 376      -141.313666
## 377      -143.432703
## 378      -38.824860
## 379      475.900810
## 380      -174.925258
## 381      149.332003
## 382      -113.119610
## 383      121.903432
## 384      -183.435674
## 385      -84.341794
## 386      -60.488595
## 387      -70.736438
## 388      39.511405
## 389      -65.636056
## 390      -46.725085
## 391      3.766786
## 392      -75.721705
## 393      -49.427792
## 394      -86.126596
```

```
## 395      -88.970402
## 396      -15.415512
## 397      -122.566614
## 398      -97.779108
## 399      -124.504254
## 400      -104.683870
## 401      -23.142651
## 402      -21.387927
## 403      -122.683323
## 404      -106.551311
## 405      146.540559
## 406      -71.467997
## 407      -106.594522
## 408      -46.864075
## 409      -135.971746
## 410      -57.412678
## 411      -55.362313
## 412      11.513821
## 413      -124.103894
## 414      33.058030
## 415      210.255080
## 416      385.764436
## 417      -117.278076
## 418      -101.890669
## 419      -19.380123
## 420      -147.577088
## 421      -137.800072
## 422      -112.608591
## 423      -19.112931
## 424      59.657954
## 425      195.368797
## 426      -67.317472
## 427      -100.530813
## 428      -30.139013
## 429      -173.891647
## 430      -108.902379
## 431      -117.696713
## 432      -146.436844
## 433      835.285388
## 434      -71.332416
## 435      705.930995
## 436      50.854939
## 437      -37.667268
## 438      38.540182
## 439      -123.819451
## 440      53.410230
## 441      -97.611552
## 442      85.833976
## 443      129.111820
## 444      -145.129535
## 445      188.273864
## 446      1186.907422
## 447      -177.256232
## 448      -29.728939
```

```
## 449      -50.227319
## 450      18.211308
## 451     -89.401810
## 452      328.707820
## 453     -40.798578
## 454     -35.422168
## 455      55.559757
## 456     -120.335115
## 457     -106.750984
## 458      -3.164209
## 459     -79.138585
## 460      125.704509
## 461     -84.940024
## 462     -12.223552
## 463     -162.420685
## 464     -88.038002
## 465     -24.344436
## 466     -53.159225
## 467     -130.494084
## 468      -54.716045
## 469     -165.794981
## 470     -108.919182
## 471     -130.775140
## 472     -137.239196
## 473      -27.399704
## 474     -194.909008
## 475      50.212737
## 476     -114.480497
## 477     -89.460790
## 478      173.766786
## 479     -69.189736
## 480     -150.953711
## 481     -160.211304
## 482      63.099445
## 483     -84.727069
## 484      524.828066
## 485     -144.133562
## 486     -63.101820
## 487      785.784833
## 488      -5.001330
## 489     -73.101563
## 490     -132.634848
## 491     -60.326533
## 492      22.257623
## 493      3.858319
## 494     -4.681242
## 495     -95.934815
## 496     -135.071753
## 497     -154.667997
## 498     -122.754953
## 499     -160.077088
## 500     -195.788367
## 501     -138.136528
## 502     -144.167997
```

```
## 503      -39.707644
## 504      153.072263
## 505     -169.539284
## 506     -77.096012
## 507    -102.501330
## 508    -123.994730
## 509    -147.727600
## 510     -30.448485
## 511      24.727352
## 512   -130.001330
## 513   -138.514151
## 514     871.572744
## 515      93.990475
## 516   -111.575972
## 517     -80.505206
## 518   -168.572759
## 519     -26.495583
## 520     587.852551
## 521   -161.530840
## 522     254.870465
## 523   -152.892253
## 524     -68.370125
## 525     22.832003
## 526   -190.758906
## 527     -95.304361
## 528   -152.122542
## 529   -137.917997
## 530   -151.235216
## 531     507.381590
## 532   -142.223552
## 533     -96.141681
## 534     650.825861
## 535   -154.919745
## 536   -99.525140
## 537   -128.334664
## 538     -48.930892
## 539     267.877458
## 540   -141.461594
## 541      19.612627
## 542   -152.504020
## 543   -139.239425
## 544     -69.233902
## 545     -42.736551
## 546     -54.127581
## 547     599.266069
## 548     -50.971794
## 549     288.697082
## 550     -88.951461
## 551   -107.540090
## 552     214.165336
## 553     -73.843569
## 554   -106.667997
## 555   -106.667997
## 556   -106.667997
```

```

## 557      -106.667997
## 558      -106.667997
## 559      -106.667997
## 560      -106.667997
## 561      188.570098
## 562      28.830843
## 563      -108.322843
## 564      92.846566
## 565      -77.714342
## 566      -140.041783
## 567      -147.165509
## 568      -31.791337
## 569      -93.587428
## 570      -12.537907
## 571      67.824983
## 572      40.801639
## 573      -138.329576
## 574      -99.234013
## 575      417.209072
## 576      -17.537562
## 577      -100.288103
## 578      -157.334664
## 579      -92.526583
## 580      -130.521208
## 581      -39.646720
## 582      -78.426239
## 583      -69.512502
## 584      -75.008608
## 585      -115.085847
## 586      -92.194313
## 587      -3.037634
## 588      -29.309506
## 589      -164.617477
## 590      -118.466836
## 591      -36.217246
## 592      -75.759964
## 593      -97.425573
## 594      -21.909054
## 595      -121.161993
## 596      -62.605700
## 597      -76.213451
## 598      -47.952401
## 599      29.010395
## 600      3.476931

cor(atlas2)

##          PCH_LACCESS_POP_15_19 PCH_GROC_16_20 PCH_SUPER_C_16_20
## PCH_LACCESS_POP_15_19      1.00000000 -0.12825303   0.01054011
## PCH_GROC_16_20            -0.12825303   1.00000000 -0.03476868
## PCH_SUPER_C_16_20          0.01054011  -0.03476868   1.00000000
## PCH_CONVS_16_20           -0.04837386  -0.10194873   0.08313836
## PCH_SPECS_16_20           -0.01327074  -0.03113158  -0.03446943
## PCH_SNAPS_17_23           -0.07170763   0.14143289  -0.01624929
## PCH_WICS_16_22            -0.04365784  -0.00269269  -0.03008571

```

```

## PCH_FFR_16_20          -0.17928865    0.14941098    -0.09015193
## PCH_FSR_16_20          0.04399629    0.08591949    -0.11639025
## PCH_DIRSALES_12_17     -0.04141853    0.05904253    0.06667660
##                               PCH_CONVS_16_20 PCH_SPECS_16_20 PCH_SNAPS_17_23
## PCH_LACCESS_POP_15_19   -0.048373860   -0.01327074   -0.071707633
## PCH_GROC_16_20          -0.101948734   -0.03113158   0.141432885
## PCH_SUPERC_16_20         0.083138361   -0.03446943   -0.016249294
## PCH_CONVS_16_20          1.000000000   0.03017534   0.001181517
## PCH_SPECS_16_20          0.030175344   1.000000000  0.078258999
## PCH_SNAPS_17_23          0.001181517   0.07825900   1.000000000
## PCH_WICS_16_22           0.018046555   -0.03976880   -0.031334023
## PCH_FFR_16_20            -0.012903865   0.06940831   0.095304847
## PCH_FSR_16_20            0.095275731   0.06975211   0.090492833
## PCH_DIRSALES_12_17      0.026334746   -0.01929969   -0.036825560
##                               PCH_WICS_16_22 PCH_FFR_16_20 PCH_FSR_16_20
## PCH_LACCESS_POP_15_19   -0.043657843   -0.17928865   0.043996289
## PCH_GROC_16_20           -0.002692690   0.14941098   0.085919490
## PCH_SUPERC_16_20          0.030085712   -0.09015193   -0.116390245
## PCH_CONVS_16_20           0.018046555   -0.01290386   0.095275731
## PCH_SPECS_16_20           0.039768796   0.06940831   0.069752112
## PCH_SNAPS_17_23           0.031334023   0.09530485   0.090492833
## PCH_WICS_16_22            1.000000000   -0.01633849   0.005264114
## PCH_FFR_16_20             -0.016338491   1.000000000  0.063304297
## PCH_FSR_16_20              0.005264114   0.06330430   1.000000000
## PCH_DIRSALES_12_17       -0.029665757   0.06431184   -0.024182203
##                               PCH_DIRSALES_12_17
## PCH_LACCESS_POP_15_19     -0.04141853
## PCH_GROC_16_20            0.05904253
## PCH_SUPERC_16_20           0.06667660
## PCH_CONVS_16_20            0.02633475
## PCH_SPECS_16_20            -0.01929969
## PCH_SNAPS_17_23            -0.03682556
## PCH_WICS_16_22             -0.02966576
## PCH_FFR_16_20              0.06431184
## PCH_FSR_16_20              -0.02418220
## PCH_DIRSALES_12_17        1.000000000

mshapiro.test(t(atlas2[,1:9]))

```

```

##
##  Shapiro-Wilk normality test
##
## data:  Z
## W = 0.12859, p-value < 2.2e-16
atlas2_long <- atlas2 |>
  pivot_longer(cols = c("PCH_GROC_16_20", "PCH_SUPERC_16_20", "PCH_CONVS_16_20", "PCH_SPECS_16_20", "PCH_WICS_16_22"),
                names_to = "sources",
                values_to = "food")
atlas2_long

## # A tibble: 5,400 x 3
##       PCH_LACCESS_POP_15_19 sources      food
##   <dbl> <chr>          <dbl>
## 1      -1.32 PCH_GROC_16_20      0

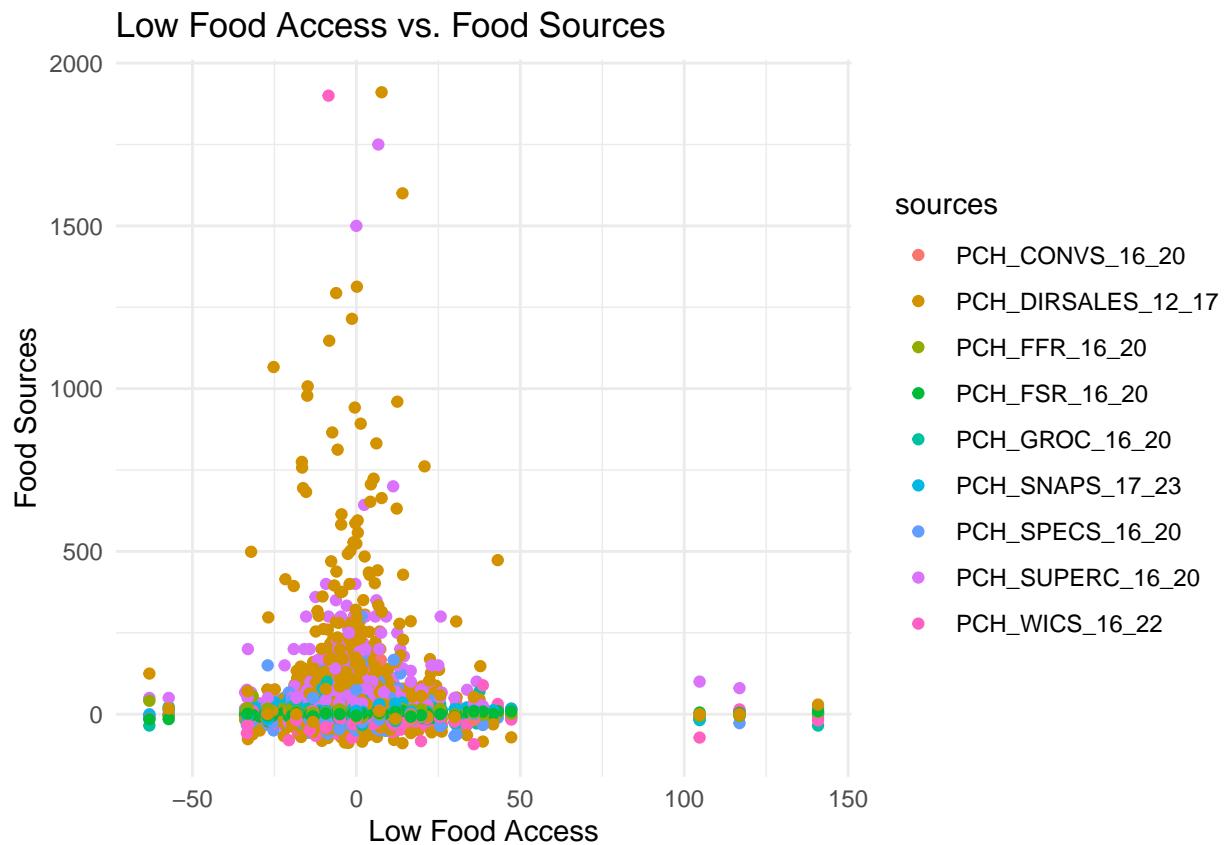
```

```

## 2          -1.32 PCH_SUPERC_16_20    28.6
## 3          -1.32 PCH_CONVS_16_20     0
## 4          -1.32 PCH_SPECS_16_20   7.41
## 5          -1.32 PCH_SNAPS_17_23  13.5
## 6          -1.32 PCH_WICS_16_22  -6.90
## 7          -1.32 PCH_FFR_16_20   10.3
## 8          -1.32 PCH_FSR_16_20   4.24
## 9          -1.32 PCH_DIRSALES_12_17 79.0
## 10         -8.19 PCH_GROC_16_20     0
## # i 5,390 more rows

options(repr.plot.width = NULL, repr.plot.height = NULL)
ggplot(atlas2_long, aes(x = PCH_LACCESS_POP_15_19, y = food, color = sources)) +
  geom_point() +
  labs(title = "Low Food Access vs. Food Sources",
       x = "Low Food Access",
       y = "Food Sources") +
  theme_minimal()

```



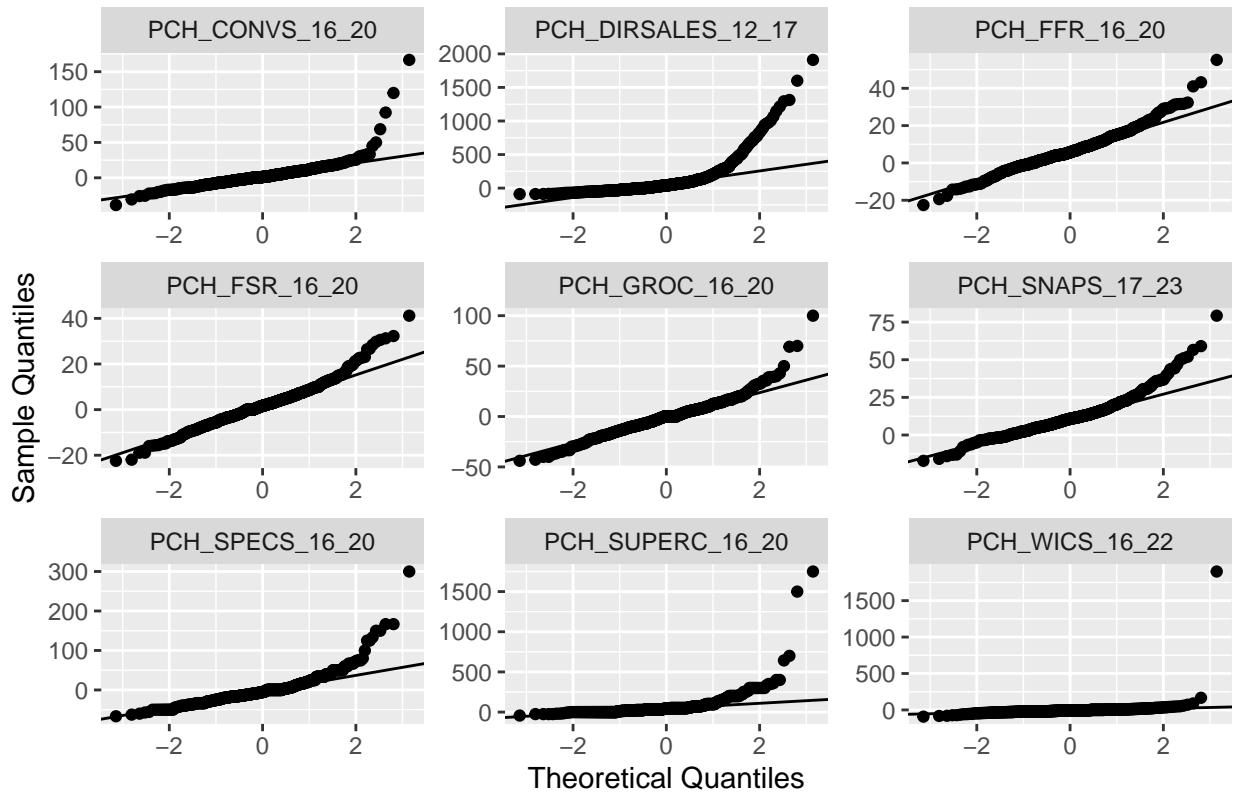
```

options(repr.plot.width = 8, repr.plot.height = 3)

ggplot(atlas2_long, aes(sample = food)) +
  stat_qq() +
  stat_qq_line() +
  facet_wrap(~sources, scales = "free") +
  labs(title = "Q-Q Plots for Food Sources",
       x = "Theoretical Quantiles", y = "Sample Quantiles")

```

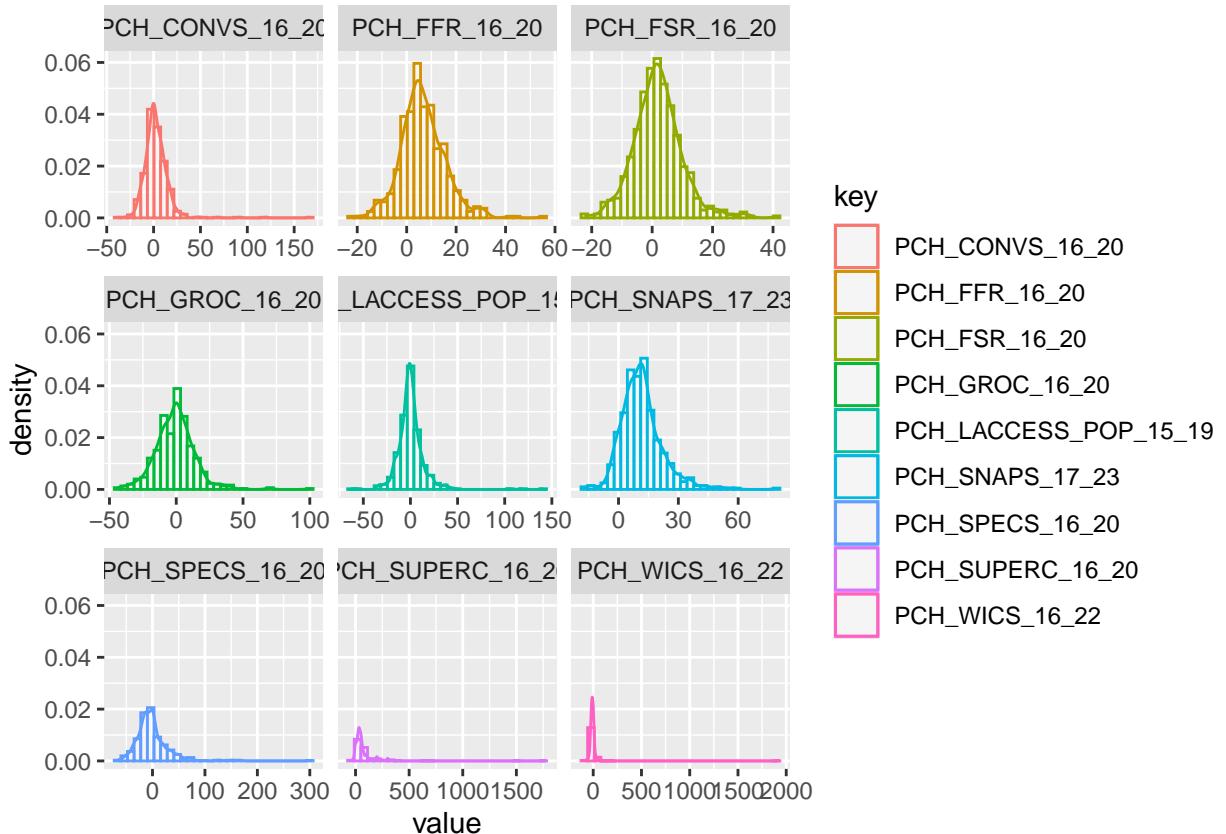
## Q-Q Plots for Food Sources



```
options(repr.plot.width = 8, repr.plot.height = 3)

d <- gather(atlas2[,c(1:9)])
ggplot(d,aes(x = value, color=key)) +
  facet_wrap(~key,scales = "free_x") +
  geom_histogram(aes(y=after_stat(density)), alpha=0.5,
                 position="identity",fill="white")+
  geom_density(alpha=.2)

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



```

model <- lm(PCH_LACCESS_POP_15_19 ~ ., data = atlas2)
model

##
## Call:
## lm(formula = PCH_LACCESS_POP_15_19 ~ ., data = atlas2)
##
## Coefficients:
##             (Intercept)      PCH_GROC_16_20      PCH_SUPERC_16_20      PCH_CONVS_16_20
##             2.7315104       -0.1089864        0.0007048       -0.0718614
##     PCH_SPECS_16_20      PCH_SNAPS_17_23      PCH_WICS_16_22      PCH_FFR_16_20
##            -0.0032387       -0.0692429       -0.0089636       -0.2667556
##     PCH_FSR_16_20  PCH_DIRSALES_12_17
##            0.1400873       -0.0016520

predict(model, newdata=data.frame(PCH_GROC_16_20=1, PCH_SUPERC_16_20=1, PCH_CONVS_16_20=1, PCH_SPECS_16_20=1))

##
##           1
## 2.341602
summary(model)

##
## Call:
## lm(formula = PCH_LACCESS_POP_15_19 ~ ., data = atlas2)
##
## Residuals:
##    Min     1Q   Median     3Q    Max 
## -110    -20     10     20    110 
## 
```

```

## -57.382 -6.965 -0.849 5.095 134.086
##
## Coefficients:
##                               Estimate Std. Error t value Pr(>|t|)
## (Intercept)           2.7315104  1.0976782  2.488  0.01311 *
## PCH_GROC_16_20      -0.1089864  0.0412257 -2.644  0.00842 **
## PCH_SUPERC_16_20     0.0007048  0.0050674  0.139  0.88944
## PCH_CONVS_16_20      -0.0718614  0.0433000 -1.660  0.09752 .
## PCH_SPECS_16_20      -0.0032387  0.0187694 -0.173  0.86306
## PCH_SNAPS_17_23      -0.0692429  0.0572575 -1.209  0.22702
## PCH_WICS_16_22      -0.0089636  0.0074607 -1.201  0.23006
## PCH_FFR_16_20       -0.2667556  0.0673227 -3.962 8.33e-05 ***
## PCH_FSR_16_20        0.1400873  0.0760650  1.842  0.06602 .
## PCH_DIRSALES_12_17  -0.0016520  0.0026964 -0.613  0.54033
## ---
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.65 on 590 degrees of freedom
## Multiple R-squared: 0.05645, Adjusted R-squared: 0.04206
## F-statistic: 3.922 on 9 and 590 DF, p-value: 7.339e-05
confint(model)

##          2.5 %    97.5 %
## (Intercept) 0.575678184 4.887342592
## PCH_GROC_16_20 -0.189953410 -0.028019341
## PCH_SUPERC_16_20 -0.009247625 0.010657134
## PCH_CONVS_16_20 -0.156902236 0.013179402
## PCH_SPECS_16_20 -0.040101685 0.033624247
## PCH_SNAPS_17_23 -0.181696180 0.043210305
## PCH_WICS_16_22 -0.023616370 0.005689086
## PCH_FFR_16_20 -0.398976856 -0.134534329
## PCH_FSR_16_20 -0.009303806 0.289478395
## PCH_DIRSALES_12_17 -0.006947646 0.003643666

anova(model)

## Analysis of Variance Table
##
## Response: PCH_LACCESS_POP_15_19
##             Df Sum Sq Mean Sq F value    Pr(>F)
## PCH_GROC_16_20   1  2207   2207.5 10.2855 0.001413 **
## PCH_SUPERC_16_20  1      5      5.0  0.0232 0.879120
## PCH_CONVS_16_20   1   524   523.5  2.4393 0.118862
## PCH_SPECS_16_20   1    31    31.0  0.1443 0.704169
## PCH_SNAPS_17_23   1   362   361.8  1.6859 0.194647
## PCH_WICS_16_22   1   269   268.8  1.2524 0.263550
## PCH_FFR_16_20    1  3358   3358.4 15.6481 8.557e-05 ***
## PCH_FSR_16_20    1   740    739.5  3.4457 0.063915 .
## PCH_DIRSALES_12_17 1    81     80.6  0.3754 0.540330
## Residuals      590 126628   214.6
## ---
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
# rerunning the regression after omitting insigificant variables

```

```

atlas3 = select(atlas2, PCH_LACCESS_POP_15_19, PCH_GROC_16_20, PCH_CONVS_16_20, PCH_FFR_16_20, PCH_FSR_16_20)

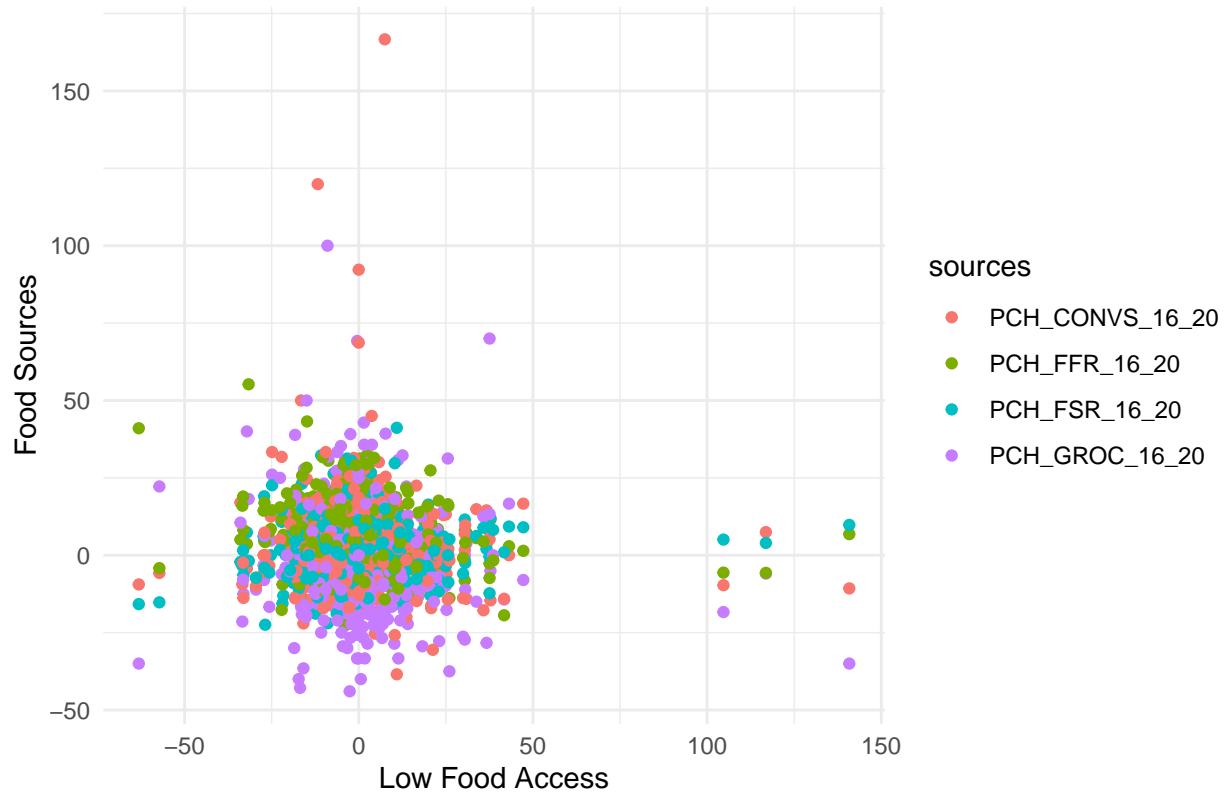
atlas3_long <- atlas3 |>
  pivot_longer(cols = c("PCH_GROC_16_20", "PCH_CONVS_16_20", "PCH_FFR_16_20", "PCH_FSR_16_20"),
               names_to = "sources",
               values_to = "food")
atlas3_long

## # A tibble: 2,400 x 3
##   PCH_LACCESS_POP_15_19 sources      food
##   <dbl> <chr>        <dbl>
## 1 -1.32  PCH_GROC_16_20    0
## 2 -1.32  PCH_CONVS_16_20   0
## 3 -1.32  PCH_FFR_16_20   10.3
## 4 -1.32  PCH_FSR_16_20   4.24
## 5 -8.19   PCH_GROC_16_20    0
## 6 -8.19   PCH_CONVS_16_20  2.82
## 7 -8.19   PCH_FFR_16_20   4.31
## 8 -8.19   PCH_FSR_16_20   2.74
## 9 -0.0797 PCH_GROC_16_20   5.61
## 10 -0.0797 PCH_CONVS_16_20  1.09
## # i 2,390 more rows

options(repr.plot.width = NULL, repr.plot.height = NULL)
ggplot(atlas3_long, aes(x = PCH_LACCESS_POP_15_19, y = food, color = sources)) +
  geom_point() +
  labs(title = "Low Food Access vs. Food Sources",
       x = "Low Food Access",
       y = "Food Sources") +
  theme_minimal()

```

## Low Food Access vs. Food Sources



```
colMeans(atlas3)
```

```
## PCH_LACCESS_POP_15_19          PCH_GROC_16_20          PCH_CONVS_16_20
##      0.2320956                 -0.7079341            2.6007777
## PCH_FFR_16_20                  PCH_FSR_16_20
##      6.6306411                 1.8834212
```

```
cor(atlas3)
```

```
##                                     PCH_LACCESS_POP_15_19 PCH_GROC_16_20 PCH_CONVS_16_20
## PCH_LACCESS_POP_15_19           1.00000000 -0.12825303 -0.04837386
## PCH_GROC_16_20                  -0.12825303  1.00000000 -0.10194873
## PCH_CONVS_16_20                 -0.04837386 -0.10194873  1.00000000
## PCH_FFR_16_20                  -0.17928865  0.14941098 -0.01290386
## PCH_FSR_16_20                  0.04399629  0.08591949  0.09527573
##                                     PCH_FFR_16_20 PCH_FSR_16_20
## PCH_LACCESS_POP_15_19   -0.17928865  0.04399629
## PCH_GROC_16_20              0.14941098  0.08591949
## PCH_CONVS_16_20             -0.01290386  0.09527573
## PCH_FFR_16_20                1.00000000  0.06330430
## PCH_FSR_16_20               0.06330430  1.00000000
```

```
mshapiro.test(t(atlas3[,1:3]))
```

```
##
##  Shapiro-Wilk normality test
##
## data: Z
```

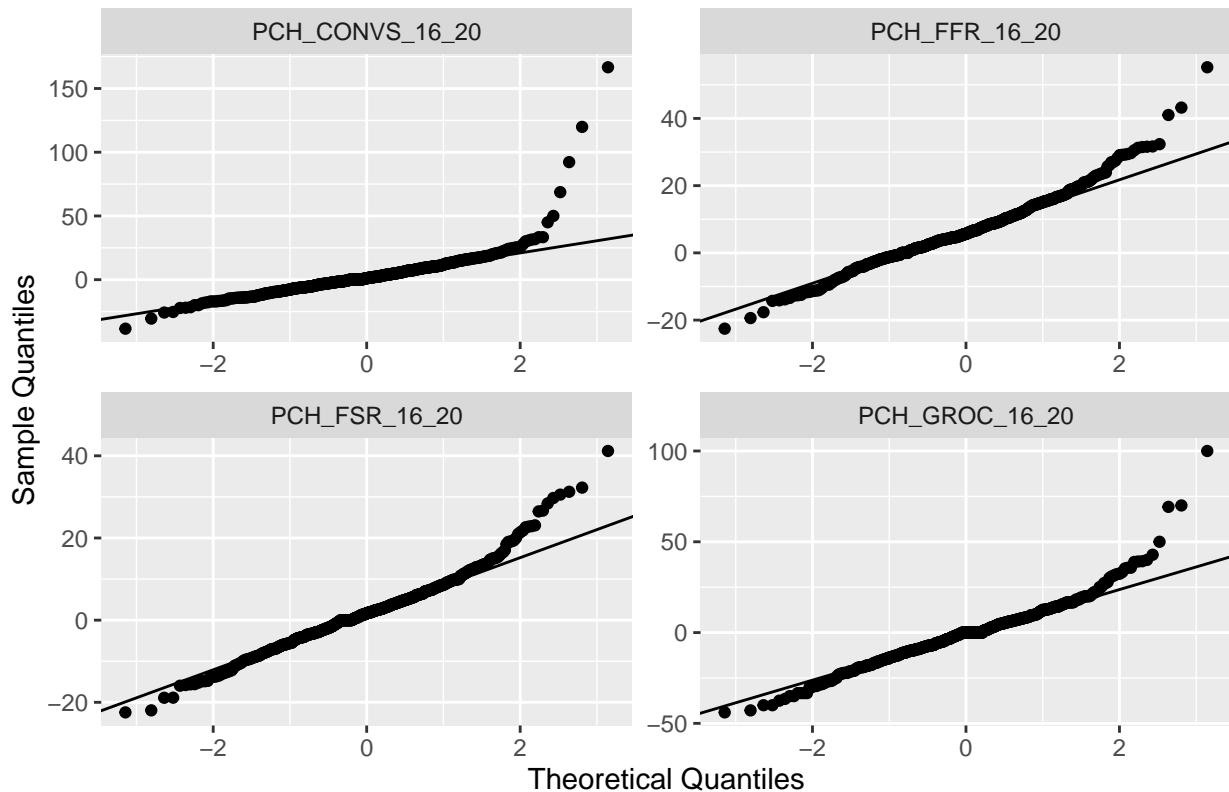
```

## W = 0.74753, p-value < 2.2e-16
options(repr.plot.width = 8, repr.plot.height = 3)

ggplot(atlas3_long, aes(sample = food)) +
  stat_qq() +
  stat_qq_line() +
  facet_wrap(~sources, scales = "free") +
  labs(title = "Q-Q Plots for Food Sources",
       x = "Theoretical Quantiles", y = "Sample Quantiles")

```

## Q-Q Plots for Food Sources



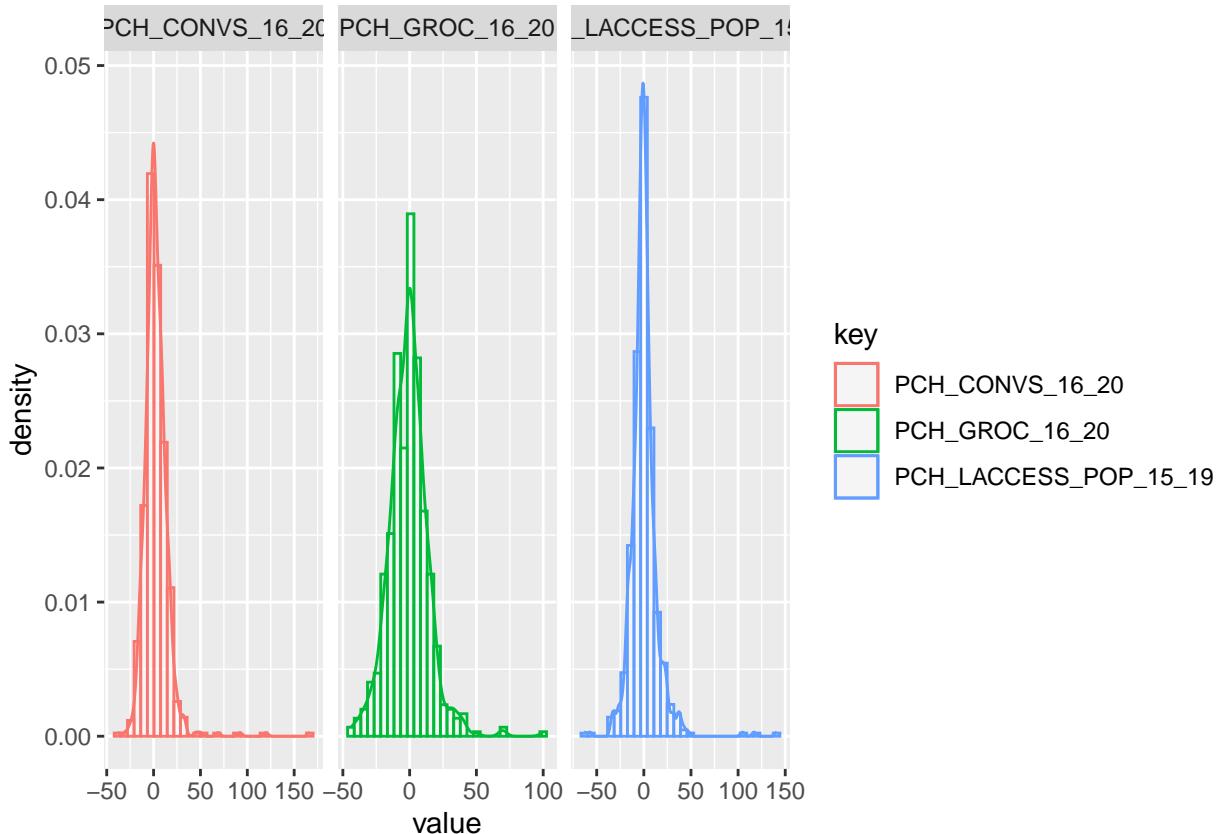
```

options(repr.plot.width = 8, repr.plot.height = 3)

d <- gather(atlas3[,c(1:3)])
ggplot(d,aes(x = value, color=key)) +
  facet_wrap(~key,scales = "free_x") +
  geom_histogram(aes(y=after_stat(density)), alpha=0.5,
                 position="identity",fill="white")+
  geom_density(alpha=.2)

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

```



```
model12 <- lm(PCH_LACCESS_POP_15_19 ~ ., data = atlas3)
model12
```

```
##
## Call:
## lm(formula = PCH_LACCESS_POP_15_19 ~ ., data = atlas3)
##
## Coefficients:
## (Intercept)    PCH_GROC_16_20    PCH_CONVS_16_20    PCH_FFR_16_20
##           1.91722          -0.11632          -0.07371          -0.27525
##   PCH_FSR_16_20
##           0.13238
predict(model12, newdata=data.frame(PCH_GROC_16_20=1,PCH_CONVS_16_20=1,PCH_FFR_16_20=1,PCH_FSR_16_20=1))

##           1
## 1.584319
summary(model12)

##
## Call:
## lm(formula = PCH_LACCESS_POP_15_19 ~ ., data = atlas3)
##
## Residuals:
##    Min     1Q   Median     3Q    Max 
## -56.438 -6.769 -0.806  5.038 134.614
##
```

```

## Coefficients:
##                               Estimate Std. Error t value Pr(>|t|)
## (Intercept)           1.91722   0.76076  2.520  0.01199 *
## PCH_GROC_16_20      -0.11632   0.04071 -2.857  0.00442 **
## PCH_CONVS_16_20     -0.07371   0.04300 -1.714  0.08702 .
## PCH_FFR_16_20       -0.27525   0.06653 -4.137 4.02e-05 ***
## PCH_FSR_16_20        0.13238   0.07505  1.764  0.07825 .
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.63 on 595 degrees of freedom
## Multiple R-squared:  0.0514, Adjusted R-squared:  0.04503
## F-statistic: 8.061 on 4 and 595 DF,  p-value: 2.476e-06
confint(model2)

##                   2.5 %      97.5 %
## (Intercept)    0.4231130  3.41132362
## PCH_GROC_16_20 -0.1962705 -0.03636466
## PCH_CONVS_16_20 -0.1581687  0.01074280
## PCH_FFR_16_20   -0.4059103 -0.14459048
## PCH_FSR_16_20   -0.0150061  0.27976852

anova(model2)

## Analysis of Variance Table
##
## Response: PCH_LACCESS_POP_15_19
##             Df Sum Sq Mean Sq F value    Pr(>F)
## PCH_GROC_16_20   1   2207   2207.5 10.3174  0.001389 **
## PCH_CONVS_16_20   1     512    512.1  2.3933  0.122385
## PCH_FFR_16_20    1   3513   3513.3 16.4204 5.747e-05 ***
## PCH_FSR_16_20    1     666    665.8  3.1117  0.078245 .
## Residuals      595 127305   214.0
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

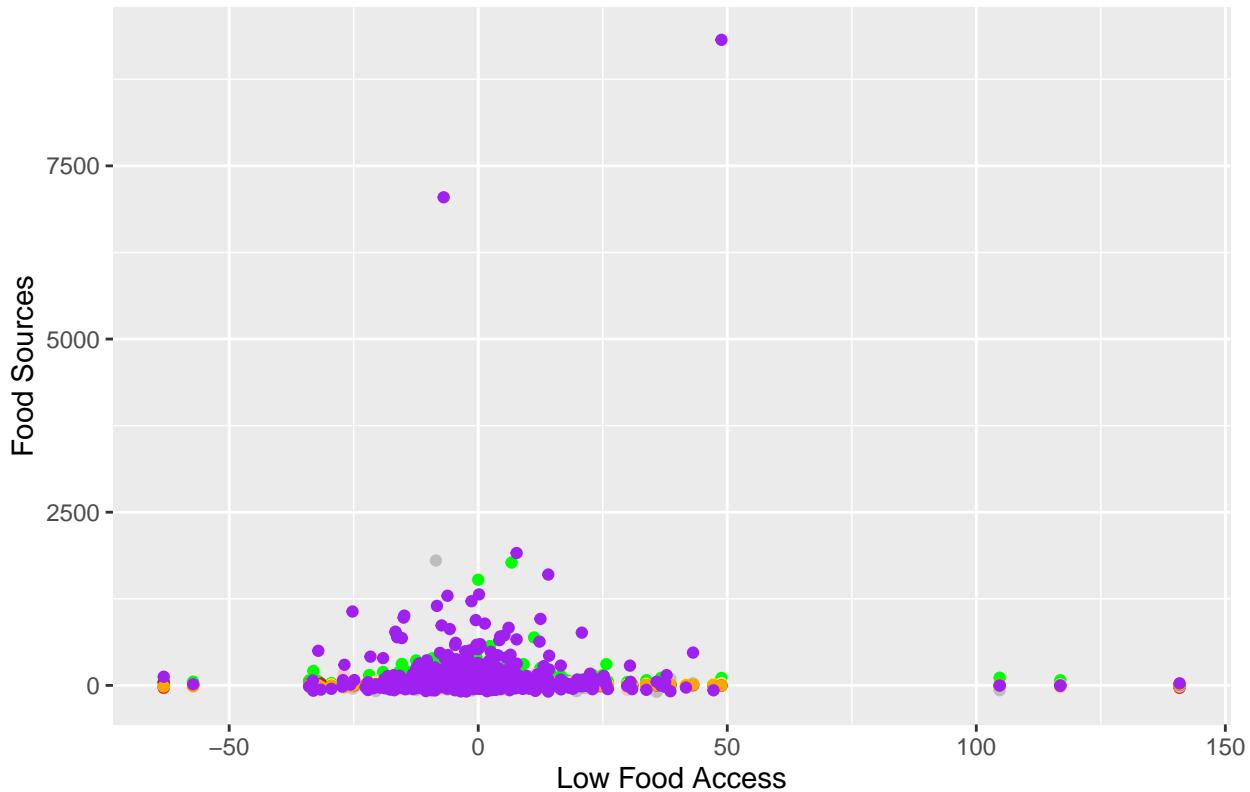
#per capita variables
atlaspc = select(atlasog, PCH_LACCESS_POP_15_19, PCH_GROCPTH_16_20, PCH_SUPERCPTH_16_20, PCH_CONVSPTH_16_20)
atlaspc = filter(atlaspc, PCH_LACCESS_POP_15_19 != -9999, PCH_GROCPTH_16_20 != -9999, PCH_SUPERCPTH_16_20 != -9999)
atlaspc = filter(atlaspc, PCH_LACCESS_POP_15_19 != -8888, PCH_GROCPTH_16_20 != -8888, PCH_SUPERCPTH_16_20 != -8888)

# adjust Jupyter plot size
options(repr.plot.width=4, repr.plot.height=4)
ggplot(atlaspc) +
  geom_point(aes(y = PCH_GROCPTH_16_20, x = PCH_LACCESS_POP_15_19), color="red")+
  geom_point(aes(y = PCH_SUPERCPTH_16_20, x = PCH_LACCESS_POP_15_19), color="green")+
  geom_point(aes(y = PCH_CONVSPTH_16_20, x = PCH_LACCESS_POP_15_19), color="blue")+
  geom_point(aes(y = PCH_SPECSPTH_16_20, x = PCH_LACCESS_POP_15_19), color="pink")+
  geom_point(aes(y = PCH_SNAPSPTH_17_23, x = PCH_LACCESS_POP_15_19), color="yellow")+
  geom_point(aes(y = PCH_WICSPTH_16_22, x = PCH_LACCESS_POP_15_19), color="gray")+
  geom_point(aes(y = PCH_FFRPTH_16_20, x = PCH_LACCESS_POP_15_19), color="brown")+
  geom_point(aes(y = PCH_FSRPTH_16_20, x = PCH_LACCESS_POP_15_19), color="orange")+
  geom_point(aes(y = PCH_PC_DIRSALES_12_17, x = PCH_LACCESS_POP_15_19), color="purple")+
  labs(title = "Low Food Access vs. Food Sources",
       x = "Low Food Access",
       y = "Food Sources")

```

```
y = "Food Sources")
```

## Low Food Access vs. Food Sources



```
#There are two points that are clearly outliers at thousands of percents higher than the others, so I am going to remove them
```

```
atlaspc2 = filter(atlaspc, PCH_LACCESS_POP_15_19 < 5000, PCH_GROCPTH_16_20 < 5000, PCH_SUPERCPTH_16_20 < 5000)
```

```
#normalize predictors
```

```
colMeans(atlaspc2)
```

```
## PCH_LACCESS_POP_15_19          PCH_GROCPTH_16_20          PCH_SUPERCPTH_16_20
##      0.24494421                  -3.19971535          64.48811454
## PCH_CONVSPTH_16_20            PCH_SPECSPTH_16_20          PCH_SNAPSPTH_17_23
##      0.01554808                  -3.02762626          9.07525966
## PCH_WICSPTH_16_22            PCH_FFRPTH_16_20          PCH_FSRPTH_16_20
##     -9.98176367                  3.86165602         -0.73829191
## PCH_PC_DIRSALES_12_17
##      107.15593946
```

```
mutate(atlaspc2, PCH_GROCPTH_16_20 = PCH_GROCPTH_16_20) |>
select(PCH_GROCPTH_16_20)
```

```
## PCH_GROCPTH_16_20
## 1      -9.3768965
## 2      -2.0876384
## 3       6.4398125
## 4      -0.9071651
## 5      -7.9663482
## 6      2.5330160
```

```

## 7      7.7796674
## 8     -7.7037021
## 9     -28.2555126
## 10    24.9284656
## 11    17.7105537
## 12    -19.7476888
## 13    -11.1824702
## 14    -7.2106130
## 15     5.9466123
## 16   -10.0773599
## 17   -1.7981701
## 18   -32.8075213
## 19   -12.8642936
## 20   -14.0985083
## 21   19.0059297
## 22  -18.5220484
## 23  -19.9167767
## 24   9.1433776
## 25   16.6556968
## 26   1.2258812
## 27   -2.5639313
## 28   -5.4797150
## 29   10.5348978
## 30   -3.9844677
## 31  -15.7405819
## 32  -28.7243775
## 33   -0.1576572
## 34   36.1632495
## 35   -2.1649987
## 36   8.5543146
## 37  -22.5591385
## 38   8.6700315
## 39   2.5373632
## 40   -4.4624425
## 41   -3.3604451
## 42   3.6352613
## 43   -2.9852467
## 44   -1.1517980
## 45   9.7132174
## 46  -13.1559296
## 47   0.7121896
## 48   3.1813897
## 49   -2.9641749
## 50   -6.9071589
## 51   16.8582269
## 52   -0.4488572
## 53   3.3103831
## 54   -7.2527054
## 55   4.0923659
## 56   -7.8280476
## 57   5.4796502
## 58   -8.5819209
## 59   -4.2601913
## 60   -3.7386242

```

```

## 61      -3.2658071
## 62       5.6878227
## 63      -3.8924849
## 64     -22.0236505
## 65      -5.1790142
## 66      -0.6045026
## 67     -22.0239682
## 68      -31.4651157
## 69      -19.5919984
## 70     -11.6263610
## 71      5.0606103
## 72     -20.7097482
## 73      -9.2454596
## 74      -4.8792831
## 75     10.9616612
## 76      -0.3632131
## 77      -3.3174283
## 78      -4.2045003
## 79      -1.3582302
## 80      2.4275044
## 81      -0.7852842
## 82      -1.3500113
## 83      -1.1188930
## 84     12.7728778
## 85      -4.3333447
## 86      3.4285498
## 87      -0.8866161
## 88      8.2348066
## 89     -15.1594969
## 90      0.6148278
## 91      -1.5688683
## 92     -12.0125554
## 93      6.2052389
## 94      0.9904026
## 95      -7.4450040
## 96      1.7470727
## 97      -2.0145420
## 98      -0.1837310
## 99      -3.3138086
## 100     -3.1325993
## 101     2.8564738
## 102     -18.3021779
## 103     11.2589245
## 104     6.7018982
## 105     -22.8377009
## 106     13.3016154
## 107     -3.4356506
## 108     1.9619453
## 109     -0.8013946
## 110     2.6854030
## 111     2.0542176
## 112     -3.2208176
## 113     -3.9086231
## 114     -30.7533142

```

```

## 115      -14.4015644
## 116      -14.6701989
## 117       8.7735098
## 118       5.3118987
## 119       0.3848501
## 120      -14.4151875
## 121      10.6030328
## 122     -17.1103215
## 123     -10.3507733
## 124     -22.1837368
## 125     -2.1376963
## 126     -4.6106077
## 127     -7.5501452
## 128      0.7250149
## 129     -2.3470336
## 130    -13.2199311
## 131     10.2022351
## 132    -17.8887602
## 133    -14.6916441
## 134     -5.1622556
## 135     -2.0749083
## 136    -10.7988828
## 137     -4.0873322
## 138     -2.7888184
## 139     -2.8374525
## 140     16.5254841
## 141      9.3704443
## 142    -11.5449304
## 143     -1.7728725
## 144      4.7211120
## 145    -26.2167107
## 146     -9.3463126
## 147    -25.2895116
## 148      6.8456729
## 149     -6.9695415
## 150     15.3507544
## 151      2.4675581
## 152     -1.1557629
## 153     -3.5286624
## 154    -17.1252421
## 155    -10.5846473
## 156     -44.5848565
## 157     -5.8681872
## 158      6.7787830
## 159    -31.8933122
## 160    -20.5525158
## 161    -15.1015479
## 162     -0.4073471
## 163    -31.3418411
## 164     -4.0739460
## 165    -29.5736065
## 166     -2.0837679
## 167     -1.5402912
## 168     -1.9674883

```

```

## 169      14.0252645
## 170     -10.6457890
## 171     -15.4244240
## 172      14.5283126
## 173     -0.7900406
## 174      34.0144409
## 175     -12.5305865
## 176      15.4632935
## 177     -8.7782278
## 178     -8.4541173
## 179      15.2118565
## 180     -11.5282429
## 181      2.9831634
## 182      2.5336264
## 183      1.2599940
## 184     -15.0456167
## 185      4.0707705
## 186     -13.1100566
## 187      7.4701007
## 188      14.9064938
## 189     -24.5046078
## 190     -3.5229480
## 191      3.0971708
## 192     -3.8311390
## 193     -9.5008279
## 194     -15.6868004
## 195      7.4372148
## 196     -18.5069903
## 197      4.8614793
## 198      5.1269299
## 199      0.8037897
## 200     -0.1412874
## 201     -7.4908271
## 202     -14.8832557
## 203     -2.9596786
## 204      12.7634178
## 205      9.8687786
## 206     -9.1361154
## 207     -9.1719022
## 208      2.9237508
## 209     -0.9063819
## 210     -8.4744941
## 211      6.5006728
## 212     -9.7874722
## 213      5.6538374
## 214      8.5461480
## 215     11.2338993
## 216     -13.1853211
## 217      36.8087608
## 218      1.2454669
## 219      26.7819500
## 220      3.1908343
## 221     -0.2041611
## 222      6.2091104

```

```

## 223      -13.9196757
## 224      -14.9314621
## 225       18.1019338
## 226        8.1552048
## 227     -14.1248528
## 228     -12.8967547
## 229    -24.1572577
## 230       2.8101289
## 231      -7.7913418
## 232      -5.9492138
## 233       6.0214319
## 234       0.6114309
## 235      -7.4205082
## 236     -8.9665613
## 237     -4.7322822
## 238      -7.8546391
## 239      37.9818445
## 240     -17.4193778
## 241       0.5711993
## 242     -41.5904060
## 243      -0.8425001
## 244     -13.9183403
## 245       3.0649725
## 246       1.6235141
## 247     -10.3022618
## 248       2.5077647
## 249       0.9081088
## 250      25.1654528
## 251     -1.1591735
## 252     -7.3969558
## 253     -14.6420167
## 254     -20.5585268
## 255     -22.9676921
## 256     -0.5835028
## 257       8.7075979
## 258     -16.7525326
## 259     -12.3989266
## 260       8.9349347
## 261     -35.1644935
## 262     -3.0459307
## 263     -9.8291570
## 264       7.0645417
## 265     -16.6006155
## 266       9.9052296
## 267     -2.8746001
## 268      10.2975635
## 269     -1.7004164
## 270     -18.3571358
## 271     -11.0833426
## 272      18.2395366
## 273       7.0447097
## 274      61.0370335
## 275     12.7183658
## 276     13.4725909

```

```

## 277      2.2643078
## 278     -12.6124930
## 279     -0.4884965
## 280      74.9941152
## 281      8.6552989
## 282     -3.8958497
## 283     -14.8894579
## 284     -6.5559211
## 285      4.8131019
## 286     -3.6920071
## 287      15.9046088
## 288     -9.9466657
## 289     -8.1831206
## 290     -2.5684470
## 291      20.4558302
## 292      18.1809547
## 293      4.8737510
## 294     17.4198247
## 295     -13.7315611
## 296     -8.4087645
## 297      0.6161133
## 298      9.7673882
## 299     -5.5063069
## 300     -18.8447322
## 301      4.4271629
## 302      18.4851631
## 303     -7.8424657
## 304      6.3319636
## 305     -3.1515906
## 306     11.7577207
## 307     -16.3829899
## 308      13.9596084
## 309      7.2684875
## 310     -8.0119569
## 311      0.1110558
## 312     -3.3422756
## 313     37.6515652
## 314      6.6018646
## 315      9.6809068
## 316     -2.3592611
## 317      2.2040618
## 318     -10.0394227
## 319     -0.4673497
## 320     -6.3846755
## 321     -6.7545652
## 322     -7.9184957
## 323     -1.8299050
## 324      1.5036076
## 325      1.6379239
## 326      2.2794848
## 327     38.4142085
## 328     -23.0119325
## 329     -13.6860923
## 330     -13.2622904

```

```

## 331      -4.6157793
## 332      10.6300999
## 333     -34.3946283
## 334     -19.2547413
## 335     -11.0846056
## 336     -16.7031945
## 337     -13.6968280
## 338     -16.8722103
## 339      0.4386573
## 340     -21.3282728
## 341      7.4873943
## 342     -25.7857389
## 343     -12.2924665
## 344     -21.5854489
## 345     -9.1716086
## 346     -2.6655326
## 347     -7.1939361
## 348     -19.6193148
## 349     -10.7367284
## 350     -38.7007504
## 351     -4.8732060
## 352      1.5918735
## 353     -10.2478038
## 354     -2.8921650
## 355     -3.5393175
## 356     -21.2840991
## 357     -12.5699569
## 358     -16.0941939
## 359      10.7050249
## 360      8.7158931
## 361     -19.1017744
## 362      13.1049186
## 363     -7.6766388
## 364      6.2087232
## 365      7.6135487
## 366     -4.5912113
## 367     -7.0894165
## 368     -6.2792210
## 369     -4.9409753
## 370      8.6856341
## 371     -10.2587214
## 372      8.0507961
## 373      4.5778629
## 374     -15.7282836
## 375     -1.6318172
## 376      0.8526819
## 377      1.7054954
## 378     -10.3299449
## 379      37.9912628
## 380     -19.0253294
## 381      10.9561284
## 382      0.9072301
## 383     -13.7464332
## 384     14.8683643

```

```

## 385      9.0360548
## 386     -7.5446939
## 387    -17.0667935
## 388     -9.5209289
## 389    -21.2498472
## 390     -8.3048222
## 391     -8.5821521
## 392      9.7226291
## 393   -16.5138636
## 394      3.5979422
## 395     -1.5715042
## 396      1.8524772
## 397     -2.1618248
## 398   -11.5962445
## 399     -3.4089125
## 400     -7.2097835
## 401     -5.0111061
## 402   -13.3270310
## 403      5.9908414
## 404     10.0034756
## 405     -8.8283668
## 406     -1.5650772
## 407      5.2572954
## 408   -38.5289712
## 409     17.1050090
## 410   -45.3052836
## 411     -4.8492994
## 412      4.0124288
## 413   -13.4370647
## 414   -16.1603579
## 415   -27.7474701
## 416     10.1964895
## 417   -24.5331912
## 418      0.7983143
## 419      7.7900244
## 420      3.2888603
## 421      2.4599378
## 422      2.7220004
## 423      5.7371100
## 424   -11.1785125
## 425   -10.4504219
## 426     -5.3613585
## 427      5.6931984
## 428   -12.3569652
## 429     10.5481568
## 430   -12.5918635
## 431   -13.7519102
## 432      2.7921082
## 433     13.0582267
## 434     -5.7379949
## 435   -14.1502616
## 436      6.4009620
## 437      5.6497083
## 438   -9.9935369

```

```

## 439      -8.3082825
## 440       6.7610798
## 441      -0.5104500
## 442      17.3735339
## 443     -15.1356335
## 444     -10.6634213
## 445      24.5289373
## 446     -10.7318729
## 447      14.0690214
## 448       0.7160629
## 449     -22.8506545
## 450      21.7472638
## 451      1.5449235
## 452     -3.6302907
## 453     14.9989434
## 454      1.0440101
## 455     -1.3936238
## 456      2.8227031
## 457      0.3220471
## 458     -3.8008871
## 459     -10.6698502
## 460     -13.9732237
## 461     -18.7559209
## 462     -2.8160588
## 463     -0.4615727
## 464      3.6308625
## 465     -18.7235680
## 466      6.6171858
## 467     -3.2159935
## 468     13.9973928
## 469     -3.7528369
## 470     -16.9233204
## 471     -9.7691614
## 472     -15.0792725
## 473      3.3876778
## 474     -2.0740880
## 475     -41.1046677
## 476     -17.4463513
## 477     -4.2192719
## 478     -8.2942707
## 479      4.6761054
## 480     -13.4978885
## 481     -27.2817559
## 482     -33.9352060
## 483     -9.0678709
## 484     -22.6790643
## 485     -14.7930203
## 486     -8.5206923
## 487     -17.0535184
## 488     -21.9921684
## 489     -23.4539181
## 490     -25.3757920
## 491      19.3596094
## 492     -10.6684291

```

## 493	-8.2221828
## 494	4.8454987
## 495	-5.4498958
## 496	-0.7746730
## 497	-4.8701118
## 498	-8.2536466
## 499	-0.4795884
## 500	-3.2448882
## 501	-5.9349694
## 502	19.1583658
## 503	-19.6565287
## 504	11.7493908
## 505	-15.6530384
## 506	13.2054209
## 507	-1.0348041
## 508	27.1400145
## 509	11.3220094
## 510	-9.9433483
## 511	-9.3325887
## 512	-2.5811704
## 513	26.6061303
## 514	-4.6806321
## 515	9.7167597
## 516	-7.8346774
## 517	-19.3977985
## 518	2.1405025
## 519	-22.6164350
## 520	3.8240032
## 521	-5.3138295
## 522	70.3170439
## 523	-21.9253488
## 524	32.8614635
## 525	-1.9014047
## 526	6.0997417
## 527	-18.2415321
## 528	-3.5592559
## 529	0.5297242
## 530	-23.0210443
## 531	-15.4561984
## 532	-8.2541620
## 533	-5.8898113
## 534	-24.0034357
## 535	0.5018013
## 536	-11.1401188
## 537	-18.2640979
## 538	-9.1478342
## 539	14.5331770
## 540	4.6019527
## 541	-3.6180744
## 542	-11.9084599
## 543	-4.0402170
## 544	3.5664989
## 545	4.4002557
## 546	16.6303931

```

## 547      9.9573982
## 548     11.0816075
## 549     38.9514367
## 550      0.9040715
## 551    -34.7147115
## 552      7.2898509
## 553      6.4007014
## 554     -6.8382005
## 555     13.0568739
## 556    -25.6278679
## 557     -6.9288053
## 558      9.8922943
## 559     -1.5413530
## 560     -5.9360217
## 561    -22.4042075
## 562     -8.7289333
## 563     -9.7319550
## 564     -9.9606135
## 565    -26.1328068
## 566     -5.7390377
## 567     -7.0424178
## 568     -12.1556645
## 569     22.5934826
## 570    -13.1464650
## 571      1.8170543
## 572     -4.4774890
## 573    -25.6691201
## 574     12.7121404
## 575     -5.9275435
## 576     -7.6686038
## 577     -2.5543621
## 578    -34.7716724
## 579     -27.0362587
## 580     17.4857027
## 581     -0.3399883
## 582     -2.9028650
## 583      1.8710551
## 584     14.5547091
## 585     -8.3119830
## 586      3.2466551
## 587    -14.1110429
## 588     -11.2630678
## 589    -22.0285287
## 590     -1.5544674
## 591     -10.4582660
## 592     29.8566833
## 593    -35.0272558
## 594      0.2598512

mutate(atlaspc2, PCH_SUPERCPTH_16_20 = PCH_SUPERCPTH_16_20) |>
select(PCH_SUPERCPTH_16_20)

```

```

##      PCH_SUPERCPTH_16_20
## 1     16.51542505
## 2     30.54981677

```

```

## 3      -4.51649887
## 4      32.12377610
## 5      -5.92115393
## 6      -1.92494095
## 7      0.59436029
## 8      18.09955735
## 9      49.00777732
## 10     33.74694950
## 11     -1.90787691
## 12     31.69608572
## 13     64.47690782
## 14     23.66512341
## 15     89.58867061
## 16     -3.16023211
## 17     35.31056016
## 18     -13.20971755
## 19     -6.40979486
## 20     10.95609599
## 21     567.54347430
## 22     92.58425762
## 23     -1.43603143
## 24     30.44394000
## 25     19.98870770
## 26     9.66137132
## 27     346.87119355
## 28     325.34127127
## 29     215.81397807
## 30     95.06712065
## 31     102.22260608
## 32     24.73234801
## 33     95.50281670
## 34     46.63734878
## 35     190.07681339
## 36     305.26945323
## 37     123.40514910
## 38     60.93941465
## 39     177.55145833
## 40     135.16938323
## 41     62.77950999
## 42     49.81288812
## 43     116.28829617
## 44     138.79272719
## 45     43.10420427
## 46     399.35340109
## 47     1773.46942242
## 48     249.48537418
## 49     221.69197032
## 50     306.74409612
## 51     33.00936575
## 52     35.00772691
## 53     310.31074150
## 54     193.94906123
## 55     49.04134389
## 56     144.83175955

```

```

## 57      168.42058976
## 58      194.32160348
## 59      4.44343100
## 60      16.74251508
## 61      37.68500762
## 62      21.48024960
## 63      7.16505482
## 64      192.41127587
## 65      33.04785015
## 66      15.08952519
## 67      28.43111290
## 68      21.36386265
## 69      -11.27392788
## 70      26.89547608
## 71      137.45738479
## 72      36.34056064
## 73      73.62640163
## 74      192.15649991
## 75      43.01723630
## 76      34.43058025
## 77      43.55023377
## 78      -8.55883696
## 79      -6.54989257
## 80      16.90095834
## 81      33.01313076
## 82      23.29279818
## 83      61.29540657
## 84      10.26681794
## 85      14.87177561
## 86      24.11425091
## 87      1.65474660
## 88      25.56928760
## 89      6.46651972
## 90      46.61016980
## 91      60.49947209
## 92      163.96232960
## 93      32.16653106
## 94      35.65037799
## 95      -2.48036666
## 96      26.91032689
## 97      -3.07960166
## 98      73.97526719
## 99      30.16167979
## 100     5.79843026
## 101     19.99922847
## 102     33.17044726
## 103     44.33589728
## 104     13.07629841
## 105     0.31099242
## 106     28.39021179
## 107     -8.80033964
## 108     46.57028976
## 109     -4.54474777
## 110     55.39118651

```

```

## 111      55.29989586
## 112      5.07454305
## 113      92.18277418
## 114      -1.90053188
## 115      0.62183652
## 116      52.04218399
## 117      47.62119654
## 118      20.04894511
## 119      -5.04135705
## 120      -7.56839872
## 121      29.03687816
## 122      49.93280482
## 123      -10.35077596
## 124      50.07423015
## 125      46.79345784
## 126      388.30283162
## 127      77.96343233
## 128      195.87972434
## 129      10.76173637
## 130      -4.54192518
## 131      14.79399536
## 132      24.95188020
## 133      25.71757772
## 134      26.45032929
## 135      29.30649766
## 136      102.50150208
## 137      59.52822595
## 138      39.87607875
## 139      36.36849734
## 140      33.47463726
## 141      56.24347634
## 142      36.56220483
## 143      18.66630358
## 144      26.38754647
## 145      37.72880975
## 146      51.79223335
## 147      108.40294236
## 148      2.88843646
## 149      138.24872399
## 150      22.60137583
## 151      22.96107937
## 152      31.17453554
## 153      45.33344959
## 154      14.26671375
## 155      30.05869580
## 156      61.62750851
## 157      35.96817774
## 158      18.52445416
## 159      45.94291284
## 160      4.98417295
## 161      13.19792868
## 162      32.79020730
## 163      10.13914360
## 164      116.15337761

```

```

## 165      0.60913795
## 166     -6.34099378
## 167      47.68956245
## 168      63.38752729
## 169      10.52093583
## 170     10.99900507
## 171     74.12618383
## 172     27.25368313
## 173     48.81494891
## 174     59.54099902
## 175     -2.43796146
## 176     34.42357737
## 177     33.79192643
## 178     -0.49360233
## 179     97.50602947
## 180     32.70764135
## 181     -2.16599770
## 182     53.80041745
## 183     35.24610022
## 184     52.91788794
## 185     12.83864447
## 186     1.37160701
## 187     33.05822664
## 188     43.63312295
## 189     48.08711642
## 190     53.97566442
## 191     28.29870382
## 192     35.35018235
## 193     32.73211158
## 194     17.79049774
## 195     -29.09144053
## 196     -1.04419562
## 197     19.84169424
## 198     -1.24439985
## 199     -6.16178303
## 200     12.01082503
## 201     0.91909768
## 202     -22.17897665
## 203     51.07414304
## 204     -41.16691063
## 205     -14.54650453
## 206     -17.78982347
## 207     59.34753837
## 208     37.23167086
## 209     36.90564221
## 210     31.79672662
## 211     49.76658380
## 212     45.46770139
## 213     65.52433519
## 214     100.70797663
## 215     196.62373750
## 216     48.82516937
## 217     187.29841341
## 218     16.56550341

```

```

## 219      127.55736673
## 220      124.36187249
## 221      262.31298122
## 222      259.86145410
## 223      46.33654584
## 224      201.60661472
## 225      98.10645860
## 226      31.09721546
## 227      110.37686148
## 228      301.20281283
## 229      308.38399628
## 230      134.00012078
## 231      156.37205163
## 232      51.25692938
## 233      300.52541370
## 234      186.41209274
## 235      124.71889906
## 236      258.82348917
## 237      691.45489071
## 238      147.35741951
## 239      1.98658318
## 240      0.93187706
## 241      50.85679897
## 242      -2.65067661
## 243      38.82049842
## 244      28.61213403
## 245      22.97526222
## 246      52.43527730
## 247      82.71761033
## 248      36.67703528
## 249      26.13513218
## 250      35.22339109
## 251      36.92054798
## 252      30.73370417
## 253      57.44832230
## 254      203.32200106
## 255      32.91848965
## 256      40.52784812
## 257      23.79355767
## 258      18.36749876
## 259      20.13861973
## 260      -0.14297548
## 261      -0.25306965
## 262      50.19932473
## 263      22.61963259
## 264      92.71617698
## 265      45.94891517
## 266      182.61341916
## 267      45.68809987
## 268      63.73457667
## 269      89.78937360
## 270      199.35716395
## 271      -3.67362392
## 272      97.71200873

```

```
## 273      76.30893807
## 274      26.87766027
## 275      45.59454330
## 276      74.47936398
## 277      41.59673675
## 278      16.51667852
## 279      20.62000379
## 280      37.25028404
## 281      -1.22246105
## 282      92.20830818
## 283      41.34429944
## 284      31.14958469
## 285      -2.33324695
## 286      20.79069842
## 287      17.68775298
## 288      23.28729709
## 289      78.63690725
## 290      192.29467530
## 291      100.75971095
## 292      38.73416032
## 293      34.83767691
## 294      43.10541816
## 295      27.80510015
## 296      35.77053356
## 297      0.61610910
## 298      24.52602857
## 299      25.99158026
## 300      46.07949256
## 301      25.76174672
## 302      196.21291456
## 303      299.34931736
## 304      98.94365531
## 305      96.58781845
## 306      46.68200165
## 307      67.81671086
## 308      46.51951137
## 309      103.24555662
## 310      116.19789012
## 311      333.81461179
## 312      350.27527503
## 313      160.19502170
## 314      55.82996125
## 315      33.52457475
## 316      167.16771260
## 317      73.26515080
## 318      56.73131466
## 319      221.78805030
## 320      111.72810443
## 321      133.80944619
## 322      50.67882080
## 323      25.96371549
## 324      52.25542074
## 325      21.27251990
## 326      41.61774919
```

```

## 327      73.01775870
## 328      63.30802744
## 329      41.91611864
## 330      174.76216385
## 331      36.96195639
## 332      55.57357773
## 333      51.39699656
## 334      33.22968966
## 335      78.11715772
## 336      52.71081557
## 337      39.72893477
## 338      259.54109338
## 339      55.22337901
## 340      1524.54802865
## 341      69.19310191
## 342      26.66376523
## 343      85.29956628
## 344      -0.67489438
## 345      76.57040042
## 346      2.20118689
## 347      303.04348278
## 348      299.01793487
## 349      147.70557291
## 350      36.22055392
## 351      64.41669373
## 352      148.57585959
## 353      168.91428956
## 354      52.94484517
## 355      34.33043469
## 356      51.80924372
## 357      100.96478943
## 358      16.98405346
## 359      35.61365558
## 360      6.26733761
## 361      30.18105238
## 362      -0.78515938
## 363      -5.86637347
## 364      7.51994465
## 365      -4.34350782
## 366      57.68952490
## 367      11.49270276
## 368      58.15381246
## 369      33.08262814
## 370      41.76387386
## 371      21.15072516
## 372      23.48662250
## 373      49.02915326
## 374      25.40434531
## 375      63.94697364
## 376      42.38025200
## 377      27.13187702
## 378      207.44018535
## 379      1.67777412
## 380      56.16544424

```

```

## 381      26.19735558
## 382      0.90722726
## 383     -1.98458417
## 384      54.16543422
## 385     113.59343398
## 386      47.92848983
## 387      33.96903469
## 388      60.44954762
## 389      55.64736259
## 390      48.85957683
## 391      0.55963113
## 392      99.93902066
## 393      45.00224960
## 394      82.44466080
## 395      41.57523728
## 396      69.75413837
## 397      95.67636205
## 398     -2.75587093
## 399      25.15613490
## 400     -0.07208118
## 401      74.97954782
## 402      25.44772712
## 403      85.20795449
## 404     129.57247555
## 405      2.56808171
## 406      42.73065375
## 407      18.87882750
## 408      10.70107266
## 409      0.37573067
## 410      18.13832790
## 411      22.85941905
## 412     -3.41702206
## 413      11.40495795
## 414      43.72510492
## 415      44.50505988
## 416      22.44054392
## 417     12.02104808
## 418     -2.80161974
## 419      7.48293313
## 420     -2.78695712
## 421     -3.56711450
## 422      17.82301813
## 423     -5.39311447
## 424      7.14972543
## 425      31.04817162
## 426      21.98692100
## 427     -1.35302326
## 428      26.08910397
## 429      28.97285010
## 430     195.40714782
## 431      36.90173447
## 432      83.46197506
## 433      70.48463638
## 434     69.56200794

```

## 435	47.85233584
## 436	67.48298549
## 437	218.83574113
## 438	53.01098464
## 439	61.30951713
## 440	96.02035659
## 441	297.95816805
## 442	54.58953287
## 443	-22.51513849
## 444	64.84724790
## 445	52.83097837
## 446	68.35655501
## 447	244.94473234
## 448	46.63073635
## 449	95.44500207
## 450	100.13250529
## 451	306.17971784
## 452	107.56552588
## 453	30.33213109
## 454	96.69900525
## 455	245.12229200
## 456	359.45126421
## 457	150.80512595
## 458	89.82145155
## 459	47.85680643
## 460	16.13614885
## 461	19.68995660
## 462	87.88893411
## 463	-11.52139737
## 464	30.74047743
## 465	0.78277525
## 466	10.88186987
## 467	27.09010791
## 468	48.13398257
## 469	-23.00227651
## 470	25.66220860
## 471	7.66179232
## 472	202.53010586
## 473	2.04498239
## 474	32.81202490
## 475	57.05421940
## 476	42.88130718
## 477	43.67110037
## 478	34.84004673
## 479	20.46059117
## 480	22.13508734
## 481	32.21499412
## 482	-9.91163756
## 483	13.66516607
## 484	-6.11029925
## 485	16.61969997
## 486	28.66744164
## 487	31.33193118
## 488	83.54785411

```

## 489      33.95564730
## 490      34.32356434
## 491      51.49489374
## 492      15.38661772
## 493      6.15265250
## 494      2.14946486
## 495      41.82516650
## 496      9.14785712
## 497      7.65728263
## 498      22.32847124
## 499      20.66000757
## 500      -7.53319710
## 501      25.42003770
## 502      31.70134361
## 503      17.73736614
## 504      2.30077997
## 505      8.96998687
## 506      -9.43566497
## 507      21.95517308
## 508      48.33002048
## 509      19.65626899
## 510      53.33971298
## 511      36.00110996
## 512      -17.56867809
## 513      23.48775511
## 514      42.97905857
## 515      41.06440699
## 516      22.88709261
## 517      53.14420218
## 518      206.42149946
## 519      30.58475601
## 520      29.78000395
## 521      -28.98537637
## 522      -14.84147662
## 523      50.57253489
## 524      33.69184728
## 525      13.57095539
## 526      30.58429294
## 527      22.63770190
## 528      44.92985495
## 529      34.03961636
## 530      71.45311927
## 531      23.29304581
## 532      -0.26114982
## 533      -5.88982066
## 534      -5.00428525
## 535      16.05411737
## 536      16.73208314
## 537      29.41518380
## 538      -5.90311375
## 539      195.49559625
## 540      23.97268676
## 541      28.50923688
## 542      71.02145827

```

```
## 543      52.06740824
## 544      22.26032295
## 545     -5.09068176
## 546      52.73028553
## 547      37.44673825
## 548      56.82108657
## 549      50.06755160
## 550      51.35609711
## 551      30.57057375
## 552      25.98430054
## 553      1.33399657
## 554      0.32809089
## 555      37.58502014
## 556      31.28297572
## 557      46.58713233
## 558     -4.76001427
## 559      23.07330240
## 560      17.57997920
## 561     -28.87052615
## 562      19.83008497
## 563      54.50531263
## 564      22.90375948
## 565      26.06667522
## 566      26.50813191
## 567      36.90116789
## 568      19.71927843
## 569     -1.92521091
## 570      56.18398933
## 571      11.36240460
## 572      85.07486654
## 573      32.14378206
## 574      4.66127917
## 575      3.47970795
## 576      56.96337440
## 577     130.98224336
## 578     -2.15751489
## 579      48.53332820
## 580      32.54797955
## 581      32.88001630
## 582      44.38470361
## 583      95.59241482
## 584      30.91966909
## 585      49.32048800
## 586      64.90786121
## 587     186.29653001
## 588      66.38175189
## 589      31.68515507
## 590      31.26070743
## 591      76.67274188
## 592      48.40763802
## 593      29.94548549
## 594     33.67980396
```

```
mutate(atlaspc2, PCH_CONVSPTH_16_20 = PCH_CONVSPTH_16_20) |>  
select(PCH_CONVSPTH_16_20)
```

```
##      PCH_CONVSPTH_16_20  
## 1      -9.376894496  
## 2       0.670459257  
## 3      1.886046076  
## 4     17.293556500  
## 5    -13.291383385  
## 6   -11.202313574  
## 7    -3.027049456  
## 8      2.586963093  
## 9    -5.889824854  
## 10     9.953694149  
## 11   -11.870355903  
## 12     2.120275978  
## 13    -7.481746816  
## 14   -7.203223807  
## 15     1.044520987  
## 16    -9.956001401  
## 17   -9.912482421  
## 18   -16.346710782  
## 19    -5.254368141  
## 20    -9.217739549  
## 21   -22.341811569  
## 22   -11.114961915  
## 23      0.617385730  
## 24      0.341486005  
## 25     -0.009410248  
## 26   -29.834374757  
## 27   -1.297136242  
## 28      0.587459917  
## 29      2.232390955  
## 30     -4.385126066  
## 31     51.666947634  
## 32     17.208806806  
## 33     -5.002161253  
## 34     18.219254766  
## 35     11.141958662  
## 36     18.203599749  
## 37     -5.498380221  
## 38      4.676046309  
## 39      7.218513664  
## 40   -11.633324735  
## 41     13.354316012  
## 42    -4.072022060  
## 43     11.696497309  
## 44    -2.510333362  
## 45     24.709538818  
## 46    -9.899280828  
## 47     1.268613268  
## 48      4.896037611  
## 49     1.380939357  
## 50    -7.700377357
```

```

## 51      -14.339079349
## 52       14.696818450
## 53        2.577685309
## 54       10.684536165
## 55       11.781013927
## 56        9.160659307
## 57      -4.451803397
## 58      -8.900448450
## 59      14.121857445
## 60       2.827009147
## 61      -9.521282230
## 62     -11.926814444
## 63        5.005734245
## 64      -6.010655254
## 65        0.548992516
## 66        0.733753040
## 67      -9.696877089
## 68      -8.793223767
## 69      -2.055633661
## 70       2.093190067
## 71      -2.203246770
## 72     -10.151053911
## 73        3.657555283
## 74        0.578465669
## 75      10.838366122
## 76      -3.203635832
## 77      -2.012098045
## 78        6.939661759
## 79     -13.421230029
## 80     -20.015132142
## 81        1.406053115
## 82      -1.614837969
## 83      -8.784663140
## 84      -0.579100357
## 85      -4.651176633
## 86     -16.222883959
## 87      -2.977095527
## 88        2.981380481
## 89      -0.417098698
## 90        7.242625515
## 91        3.580038492
## 92     -27.034808203
## 93      -9.226291607
## 94      -5.635881305
## 95      -6.889947289
## 96      -1.626083324
## 97      -1.264031397
## 98      -7.202968845
## 99     -10.796125454
## 100      7.244125311
## 101      -0.182464516
## 102      -5.409823710
## 103      -3.213347842
## 104      -6.431010276

```

```

## 105      6.177133745
## 106      4.177273767
## 107      1.475683205
## 108      7.922395841
## 109      3.309166485
## 110      6.458905234
## 111      -2.000413126
## 112      2.853453573
## 113      14.394508231
## 114      11.421619203
## 115      0.804122750
## 116      3.498597620
## 117      -0.071807831
## 118      7.502717658
## 119      -4.153889513
## 120      -11.484992378
## 121      2.889935434
## 122      24.547355918
## 123      3.711848751
## 124      8.324253699
## 125      -3.796387535
## 126      -14.177077529
## 127      -11.299979005
## 128      -23.104695013
## 129      -14.827192492
## 130      6.688441192
## 131      -2.175552161
## 132      -15.529972280
## 133      3.613395258
## 134      16.966550507
## 135      -6.412424803
## 136      0.486281535
## 137      -3.626532863
## 138      -0.088509040
## 139      -12.638936566
## 140      -23.728776651
## 141      0.542684528
## 142      2.421657567
## 143      3.756960763
## 144      -2.099807793
## 145      13.041573403
## 146      8.359050338
## 147      19.303138853
## 148      -11.602901968
## 149      -3.657484454
## 150      2.167819175
## 151      -10.116174007
## 152      6.680202723
## 153      5.902812440
## 154      7.180404097
## 155      3.281899670
## 156      -0.329699496
## 157      -9.354553441
## 158      14.516384937

```

```

## 159      -18.271967175
## 160      -0.609246174
## 161      -5.278580009
## 162      1.371107133
## 163      0.991372516
## 164      -4.987525899
## 165      7.926168910
## 166      11.064991194
## 167      2.649487263
## 168      4.568019129
## 169      15.544616221
## 170      13.311497986
## 171      14.291320835
## 172      16.823060093
## 173      9.764219144
## 174      -8.348791362
## 175      6.637575610
## 176      0.237362301
## 177      -16.038739175
## 178      1.693346386
## 179      -1.246984241
## 180      -10.422351790
## 181      -5.427129126
## 182      -5.353583271
## 183      -4.265956170
## 184      -20.709239496
## 185      -9.371198628
## 186      -12.883776772
## 187      17.065649817
## 188      -8.597099783
## 189      22.658007479
## 190      -8.308073413
## 191      -5.739731133
## 192      4.912364084
## 193      -30.868695465
## 194      -11.536929188
## 195      -5.455255318
## 196      -6.981546375
## 197      -0.535799103
## 198      6.709064534
## 199      4.078496296
## 200      7.963558823
## 201      -6.996128140
## 202      -3.970860349
## 203      6.016938962
## 204      1.938515242
## 205      8.517647170
## 206      3.759216955
## 207      -4.391476617
## 208      12.424404205
## 209      -4.219634405
## 210      1.415014371
## 211      -8.991403065
## 212      -20.495136365

```

```
## 213      -14.316810925
## 214      -2.209805523
## 215      -2.956437781
## 216      -14.627423454
## 217      -6.970037899
## 218      -5.334690753
## 219      -1.328070646
## 220      -6.219104855
## 221      -9.644306226
## 222      3.104967204
## 223      -2.442297857
## 224      -10.047144774
## 225      -14.280852825
## 226      7.777041509
## 227      -5.001696760
## 228      6.244447610
## 229      -12.918120969
## 230      -2.433298792
## 231      9.122461930
## 232      0.014786046
## 233      7.688432868
## 234      2.087486615
## 235      -1.685489221
## 236      -1.749157836
## 237      0.206759533
## 238      6.291520873
## 239      -18.410735571
## 240      -0.552420741
## 241      -5.344760302
## 242      1.243281585
## 243      -12.372443360
## 244      -11.357552974
## 245      1.191063367
## 246      -37.462450436
## 247      -17.372453739
## 248      -0.262718551
## 249      -7.619336269
## 250      -9.419739361
## 251      -6.045694796
## 252      -18.291433902
## 253      0.707837888
## 254      10.891910859
## 255      2.383163885
## 256      -4.812504107
## 257      -12.211762885
## 258      2.775490283
## 259      3.823492135
## 260      -7.029673827
## 261      -10.940234523
## 262      -9.495271592
## 263      -1.665199979
## 264      -9.610989424
## 265      -2.700723888
## 266      -5.795518352
```

```

## 267      2.675426267
## 268     -3.247750348
## 269     -5.521002764
## 270    -10.718039388
## 271      6.206012267
## 272     -9.176040618
## 273     -5.968569867
## 274     -4.841760983
## 275      40.741396381
## 276     -3.033768245
## 277     -3.354605696
## 278      7.317996475
## 279     -5.011748862
## 280     10.855996518
## 281    -19.599675006
## 282      6.493787918
## 283    -14.208932813
## 284     -9.506783888
## 285    -11.757230163
## 286     -8.549090267
## 287    -15.937318943
## 288     -7.104449529
## 289     -3.810886758
## 290    -23.634728308
## 291      0.379853906
## 292    -17.246290116
## 293    -22.255748980
## 294     -8.744374491
## 295    -12.603866453
## 296      4.298117991
## 297      0.616109107
## 298      1.846030714
## 299     -5.506312182
## 300     -2.613670953
## 301      2.952021079
## 302     -4.005080232
## 303     17.586186632
## 304     -2.107079857
## 305      5.399492305
## 306     -8.645421185
## 307     -3.386573614
## 308     15.122461335
## 309      0.302997114
## 310     -7.028904409
## 311      0.111062625
## 312      4.730692149
## 313     -7.234818022
## 314      4.495952481
## 315      7.561466870
## 316      6.867082599
## 317     -0.442826053
## 318      5.020643440
## 319     10.261793197
## 320     -7.722775437

```

```

## 321      25.628966557
## 322      0.452552773
## 323     -13.814299806
## 324     -1.879847633
## 325     -15.917718307
## 326     -20.898190174
## 327     -9.928984429
## 328     -4.984424137
## 329      9.925759365
## 330     126.554654040
## 331      1.724165110
## 332      14.353224955
## 333     -8.590491994
## 334     15.357406653
## 335     13.035883009
## 336    -15.160662884
## 337      8.232664674
## 338     97.481921630
## 339      0.094686857
## 340      71.257354658
## 341     -4.599548331
## 342     18.731285982
## 343     14.613303439
## 344     19.641600432
## 345      1.773213585
## 346    -7.261884372
## 347     22.352488576
## 348     29.769110833
## 349     12.148018453
## 350      5.814170470
## 351      8.820115495
## 352      3.355234006
## 353     13.318260297
## 354     11.232611894
## 355     -2.103534880
## 356     -5.394234861
## 357     21.432402436
## 358    -14.500541861
## 359     -2.275871794
## 360      9.802646452
## 361      3.247044861
## 362      0.368500515
## 363     -9.004162618
## 364     -8.385371771
## 365      0.168591246
## 366     -1.086937103
## 367     -7.089411358
## 368      2.363612737
## 369    -2.780547502
## 370      3.697652740
## 371     -6.540873066
## 372      6.570643507
## 373     -6.833886818
## 374      4.562500444

```

```

## 375      -10.574375376
## 376      -8.410360860
## 377      -8.136967067
## 378      -11.655123830
## 379      -0.440506229
## 380      4.110290832
## 381      4.508757411
## 382      9.606138633
## 383      -4.404716652
## 384      4.963696439
## 385      -4.952941230
## 386      10.946367374
## 387      -20.645520754
## 388      4.445508277
## 389      11.963305508
## 390      -3.534060316
## 391      19.181789382
## 392      -9.202008434
## 393      -4.866254953
## 394      -8.012172029
## 395      23.863363662
## 396      12.037737253
## 397      4.953675552
## 398      2.106340037
## 399      10.137393416
## 400      4.575734623
## 401      -5.465595247
## 402      4.145271851
## 403      -10.038333218
## 404      0.945222087
## 405      12.494031987
## 406      -11.454130564
## 407      -3.474458090
## 408      21.371059532
## 409      0.375725433
## 410      21.897188976
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## 412      -3.417022064
## 413      9.066824402
## 414      0.172043692
## 415      0.924176228
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## 418      4.791997051
## 419      8.041285202
## 420      12.977324552
## 421      19.709785822
## 422      -7.790676933
## 423      5.118762815
## 424      3.625062155
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## 426      1.062380693
## 427      4.449746991
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## 429	12.331193580
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## 435	-2.860303656
## 436	-14.476771899
## 437	-1.896695558
## 438	-4.368134601
## 439	8.883915791
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## 441	12.968774614
## 442	7.309577261
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## 444	-12.727925965
## 445	-3.934821324
## 446	5.965583721
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## 467	-3.972852731
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## 476	-16.820268006
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## 478	8.316746128
## 479	-4.580966047
## 480	-17.684829572
## 481	6.561333442
## 482	-8.243333214

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## 536     -13.225709318

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## 539      -0.442342484
## 540      -23.550178427
## 541      -5.436594616
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## 543      7.269169368
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## 545      15.247029882
## 546      -14.907413174
## 547      1.710593690
## 548      12.197198181
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## 550      17.178923721
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## 553      -1.934830955
## 554      5.702819750
## 555      1.937990331
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## 558      -8.287426620
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## 560      -13.907540591
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## 566      -12.989218294
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## 570      -10.883257661
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## 572      0.780263705
## 573      13.266094656
## 574      9.211766872
## 575      8.183325883
## 576      1.524280951
## 577      -8.882754694
## 578      -0.119127648
## 579      -14.688545387
## 580      -3.205103864
## 581      7.181516546
## 582      6.784522896
## 583      -16.692113670
## 584      5.463061989
## 585      -2.851731663
## 586      5.226924127
## 587      -6.895440815
## 588      -2.294975535
## 589      6.361079765
## 590      -8.714152185

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## 591      2.275532586
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## 593     -11.972410764
## 594     -12.676897710

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## 4      -25.68037166
## 5      -14.10192422
## 6      -26.44370789
## 7      -15.50074028
## 8      -22.13215923
## 9      24.17315146
## 10     -15.08129995
## 11     120.70728177
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## 13     23.35768087
## 14     -7.01149693
## 15     -5.20565460
## 16     29.11968603
## 17     -18.04558994
## 18     -13.20971229
## 19     29.58643283
## 20     -4.89478271
## 21     -30.10762719
## 22     20.36516101
## 23     12.64454141
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## 28     55.41314646
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## 30     -18.49935301
## 31      8.88909052
## 32     -14.46925028
## 33      9.97032609
## 34     36.86152558
## 35      0.49484540
## 36      8.07185419
## 37     11.70256528
## 38     -1.69893888
## 39      8.28381065
## 40     -14.48386064
## 41      2.71032811
## 42      2.70785069
## 43      2.45235075
## 44     -8.67452790
## 45     -15.60522185
## 46      2.72412668

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## 47      3.17933477
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## 52     -11.01763779
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## 72     -5.97203079
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```

## 533      12.93222006
## 534      9.99503668
## 535      7.19377751
## 536      28.86551627
## 537      22.22544917
## 538      -20.37956049
## 539      -18.88355770
## 540      -7.02048738
## 541      54.21108226
## 542      1.63561273
## 543      14.05055345
## 544      0.86476878
## 545      -24.07254355
## 546      37.45724934
## 547      8.23930587
## 548      161.36848279
## 549      0.04503440
## 550      -15.91327378
## 551      -51.03603361
## 552      -35.86254329
## 553      1.33400678
## 554      0.32809089
## 555      -16.07717607
## 556      -26.32077737
## 557      68.79730184
## 558      -4.76001814
## 559      -11.74575122
## 560      -5.93601274
## 561      -43.09642092
## 562      -3.69794664
## 563      1.16419149
## 564      -7.06104303
## 565      -5.44999095
## 566      -10.20182404
## 567      -13.94783960
## 568      -16.51759003
## 569      -15.93589327
## 570      -19.67680857
## 571      4.19874077
## 572      -15.39434919
## 573      32.14378206
## 574      56.99190760
## 575      37.97294748
## 576      -34.59858786
## 577      -11.77762036
## 578      160.91328511
## 579      -66.99259373
## 580      -45.77582982
## 581      -8.00614465
## 582      -14.34805604
## 583      3.90847633
## 584      -16.91635844
## 585      -0.45300333
## 586      16.93466962

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## 587      -20.47319009
## 588      -0.17095124
## 589      -1.23612740
## 590      20.32231054
## 591      -15.87012857
## 592      -37.51257684
## 593      -26.90566207
## 594      75.45473575

mutate(atlaspc2, PCH_SNAPSPTH_17_23 = PCH_SNAPSPTH_17_23) |>
select(PCH_SNAPSPTH_17_23)

##      PCH_SNAPSPTH_17_23
## 1      3.39574075
## 2     -2.99234033
## 3     -6.83735704
## 4     -4.09431648
## 5      4.53637838
## 6     12.43699074
## 7     -2.30500865
## 8      8.84546280
## 9     -6.75190210
## 10     14.70357990
## 11     -5.49335194
## 12      7.37758398
## 13      6.60395432
## 14     -0.66083485
## 15      6.50310469
## 16      5.71973896
## 17      0.78607303
## 18      5.88990259
## 19      2.39160466
## 20      0.85851246
## 21      8.95672035
## 22      5.30743980
## 23     12.90557194
## 24      7.18904829
## 25     11.10718632
## 26     -5.03497887
## 27      7.92563057
## 28     13.76066303
## 29     22.16687393
## 30      2.06194949
## 31     14.13780689
## 32     15.14154816
## 33      9.02354431
## 34      3.65922999
## 35      5.34744453
## 36      9.79098892
## 37      9.39050388
## 38      7.71818781
## 39     10.83230782
## 40     -0.29009572
## 41     14.41715336
## 42     11.82999229

```

```

## 43      9.87582493
## 44     10.45685577
## 45     10.52009010
## 46     22.99387360
## 47     20.13890266
## 48     12.46262169
## 49     10.04724026
## 50      4.31324768
## 51      8.58337307
## 52     15.64630890
## 53     15.56848717
## 54      6.82930040
## 55      2.79635286
## 56     -0.99263138
## 57     11.20543766
## 58      9.83506775
## 59     17.84786224
## 60     22.15851021
## 61     11.65198612
## 62     23.07081795
## 63     18.54633141
## 64     24.33510017
## 65     11.99177837
## 66     43.46316528
## 67     16.90695763
## 68     -3.66331983
## 69     22.97482300
## 70     19.79741859
## 71     13.04616642
## 72     -6.53784084
## 73     14.82347012
## 74     -3.10944891
## 75      1.63432193
## 76     -0.88033092
## 77      1.74496675
## 78      2.45824814
## 79     -13.19069099
## 80     -0.30096617
## 81      5.35355568
## 82     -4.69903708
## 83      2.69585490
## 84     11.63844872
## 85      0.07276759
## 86     -10.36203003
## 87      5.49181604
## 88     -6.40462303
## 89     -1.24734759
## 90      5.62489986
## 91     -1.41783917
## 92      0.84184605
## 93     -1.63782704
## 94     -0.15607955
## 95     -1.87185395
## 96      0.89228082

```

## 97	5.89364958
## 98	-0.20340464
## 99	5.08036661
## 100	4.83094263
## 101	4.24966717
## 102	1.05357909
## 103	2.73396492
## 104	-1.20032883
## 105	-4.10869265
## 106	12.54003239
## 107	1.13339221
## 108	0.28932729
## 109	5.93883514
## 110	10.06645393
## 111	5.05714130
## 112	4.00693417
## 113	2.42841053
## 114	7.21599483
## 115	14.76469421
## 116	0.38275081
## 117	16.45486641
## 118	10.64798164
## 119	-4.74885941
## 120	9.05328178
## 121	8.71026134
## 122	-7.27674723
## 123	5.33458853
## 124	11.30865002
## 125	16.76038170
## 126	1.91561615
## 127	-4.43237209
## 128	12.16834545
## 129	4.20714045
## 130	16.68542671
## 131	9.40735435
## 132	4.97969770
## 133	7.35300541
## 134	-7.65592670
## 135	9.79800797
## 136	5.15669441
## 137	20.10767555
## 138	17.20288277
## 139	16.94244957
## 140	39.53746033
## 141	20.02263260
## 142	27.63641357
## 143	24.15780258
## 144	11.56176472
## 145	14.37483788
## 146	5.90326405
## 147	12.61281109
## 148	23.53500175
## 149	8.53435135
## 150	6.19558048

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## 151      7.37840414
## 152     19.55409050
## 153     11.79344654
## 154     12.78380966
## 155     25.53667259
## 156      7.24758911
## 157    21.57718468
## 158      9.67547131
## 159    -3.28242397
## 160      6.37324238
## 161    7.70011425
## 162      1.75154436
## 163      0.80736864
## 164    16.49569702
## 165    12.16410542
## 166    14.73378658
## 167    17.14375687
## 168      7.35637474
## 169    10.02823544
## 170    19.37163353
## 171    22.00585175
## 172    14.23157215
## 173    10.08672333
## 174    33.00944901
## 175    11.55241585
## 176    11.94468498
## 177    10.44172955
## 178    14.62490368
## 179      2.59879947
## 180    13.46784115
## 181    14.22802258
## 182    46.60715866
## 183      2.78609848
## 184      3.94724274
## 185    18.08997154
## 186    11.92001534
## 187    -1.41826022
## 188      0.61565191
## 189    -5.07548237
## 190    14.55058002
## 191    18.82832718
## 192      4.37950897
## 193      3.21281695
## 194    15.18318748
## 195      9.63823700
## 196    14.57416439
## 197      4.89018059
## 198    -0.09251536
## 199    -3.99260521
## 200    14.02792740
## 201    -16.11503029
## 202    16.83844185
## 203    -10.02357578
## 204    13.83657932

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## 205      -9.31438255
## 206       0.85906500
## 207       8.59684467
## 208       1.91991198
## 209       6.07735491
## 210     -14.73699093
## 211      -2.10829377
## 212       0.50024718
## 213      16.07783127
## 214      5.14287519
## 215      8.80986023
## 216      10.51371574
## 217      7.93879700
## 218      6.85566425
## 219      4.53181696
## 220      11.14325523
## 221      10.78524399
## 222      17.07106400
## 223      17.65208435
## 224      38.88736725
## 225      17.42160606
## 226      16.01580238
## 227     -10.05582333
## 228      4.35186768
## 229      8.26967239
## 230      6.06620789
## 231      8.62724209
## 232      12.49193954
## 233      16.83466911
## 234      11.54673767
## 235      10.91919708
## 236      3.87478781
## 237      7.43073606
## 238      7.49472761
## 239      3.21603537
## 240      13.05577755
## 241      10.60568714
## 242      29.10820198
## 243      12.64082146
## 244      5.92238712
## 245      5.81586504
## 246      3.99785161
## 247      12.74998283
## 248      26.87776756
## 249      13.00655270
## 250      15.24543762
## 251      17.92279434
## 252      22.00787735
## 253      0.44663414
## 254      14.39987850
## 255      1.06107700
## 256     -2.82925987
## 257      9.84608841
## 258      16.76435280

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```

## 259      5.49119806
## 260     10.03199100
## 261      2.50519586
## 262      5.87515450
## 263     -2.66496158
## 264     20.64437103
## 265     15.02913475
## 266     20.17621613
## 267      5.94343233
## 268      3.06561351
## 269      4.80572653
## 270     27.36599159
## 271      6.71977806
## 272     14.13987732
## 273      6.00908470
## 274     13.55860233
## 275     21.36568069
## 276      2.67821670
## 277      8.57797432
## 278     -0.81008232
## 279     13.03390217
## 280     35.55558777
## 281      6.09772873
## 282      5.71126509
## 283      9.39315414
## 284     10.51527882
## 285     10.32469845
## 286      9.11928177
## 287     10.48705292
## 288      4.04437304
## 289     -0.35741243
## 290     15.21190262
## 291      0.38928378
## 292     -6.77536869
## 293     13.88448334
## 294     -10.02722359
## 295      9.80892849
## 296     -0.10536308
## 297     41.88519287
## 298     14.09937000
## 299     28.92459488
## 300     -4.07172346
## 301      0.84301323
## 302     -6.65683079
## 303     11.31737900
## 304     -2.41859674
## 305      6.27429867
## 306      5.50591278
## 307      5.63420057
## 308      6.70063257
## 309      7.66327667
## 310     9.72728920
## 311     1.40292263
## 312     4.37431192

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```

## 313      -0.45945489
## 314       5.68490267
## 315      29.99411774
## 316     -1.32920837
## 317      4.97768021
## 318      3.55799508
## 319     11.04611969
## 320     -4.93069124
## 321      18.56005096
## 322      9.78075218
## 323     10.38420486
## 324      6.49495792
## 325      2.75814319
## 326      7.17589045
## 327     63.11169434
## 328     26.00050354
## 329      9.00620937
## 330     12.29458809
## 331      5.86936617
## 332     13.61700153
## 333     -1.78938210
## 334     -1.74236095
## 335     11.63073158
## 336     29.93440437
## 337      0.84836042
## 338      4.41662121
## 339      7.72684240
## 340      2.18265676
## 341     11.91084099
## 342     12.58115673
## 343      9.17013836
## 344     -0.10262012
## 345      9.28556538
## 346      9.29975986
## 347      7.28793955
## 348     -0.73106438
## 349      2.45934534
## 350     11.67191410
## 351      8.63719559
## 352      4.20243549
## 353      7.05923748
## 354     31.62648010
## 355      0.53424984
## 356     -0.95137876
## 357      9.82146168
## 358      0.77822894
## 359     -4.31785631
## 360    -11.74693394
## 361     -9.76593304
## 362      5.78211355
## 363     -7.28171968
## 364      2.22584224
## 365     -5.85626507
## 366      6.99727249

```

```

## 367      -5.48634434
## 368      -4.62182283
## 369       3.42008662
## 370      -4.50873184
## 371      13.00019550
## 372      -1.51780808
## 373      -2.92642474
## 374       7.81020880
## 375      16.58377647
## 376      16.74866295
## 377      10.16740608
## 378      57.69583130
## 379       8.45930481
## 380       8.57825375
## 381      17.61345863
## 382      10.91195869
## 383       2.23007035
## 384      24.52081680
## 385       3.99544978
## 386      26.03481293
## 387      22.35354805
## 388       6.84060144
## 389      19.41635132
## 390       2.86411524
## 391      23.04321861
## 392      15.02909756
## 393       5.41613245
## 394      14.51672840
## 395       8.44517994
## 396      22.85034561
## 397      17.67764091
## 398      27.84487915
## 399      11.70793056
## 400      -1.03218496
## 401      25.26266479
## 402      11.20062923
## 403      17.46315384
## 404      11.61153698
## 405      15.80156898
## 406      17.38976288
## 407       5.87509871
## 408       1.96777833
## 409       7.93158531
## 410       3.07342219
## 411      12.57319736
## 412       0.61547935
## 413       1.85903418
## 414       3.38116264
## 415      15.17901707
## 416      -2.76694608
## 417       4.24084520
## 418      16.27252579
## 419      12.18875122
## 420      12.92127609

```

```

## 421      25.54428482
## 422      2.74532247
## 423      8.92878151
## 424      -0.28440508
## 425      10.09066010
## 426      2.74194288
## 427      21.47564888
## 428      2.88580751
## 429      6.34994411
## 430      11.06860447
## 431      9.40990353
## 432      5.39079523
## 433      2.07212877
## 434      19.36331558
## 435      22.55143356
## 436      29.92908287
## 437      12.40990925
## 438      7.68202400
## 439      11.08773136
## 440      13.55150890
## 441      2.89205909
## 442      19.88762665
## 443      3.06970716
## 444      12.23830509
## 445      15.28936195
## 446      17.70961952
## 447      10.03915501
## 448      15.43141270
## 449      8.25668144
## 450      2.67614913
## 451      9.91698265
## 452      9.54180527
## 453      19.54950905
## 454      9.38832474
## 455      7.35114765
## 456      -6.78764391
## 457      20.34013367
## 458      19.77317810
## 459      11.70918846
## 460      -0.70389885
## 461      1.29418457
## 462      5.55688906
## 463      11.38757610
## 464      -2.26886725
## 465      7.90233517
## 466      -0.56378198
## 467      -1.71001136
## 468      10.13410473
## 469      -6.41731739
## 470      6.57206821
## 471      -2.15006089
## 472      -1.82113099
## 473      -5.05241442
## 474      1.91810989

```

## 475	13.08179283
## 476	-1.16774523
## 477	-4.70241642
## 478	-5.84726095
## 479	2.77396894
## 480	0.54271472
## 481	-0.17525624
## 482	-15.39937878
## 483	12.90776157
## 484	-4.77295923
## 485	5.45146227
## 486	8.47294331
## 487	4.90198278
## 488	-0.37993681
## 489	-4.55093670
## 490	9.08816814
## 491	26.00881195
## 492	5.78906155
## 493	8.81494904
## 494	31.46523094
## 495	5.65101242
## 496	8.04889870
## 497	10.50867748
## 498	-5.23884678
## 499	17.23491287
## 500	16.21567535
## 501	33.91323090
## 502	16.73945236
## 503	0.13901883
## 504	24.94648933
## 505	14.48230934
## 506	16.08256912
## 507	26.83061790
## 508	18.22765732
## 509	14.37018204
## 510	31.30147171
## 511	-4.58753157
## 512	3.24511981
## 513	32.02876663
## 514	10.98227978
## 515	9.35673428
## 516	74.64083862
## 517	18.69211197
## 518	16.48252678
## 519	34.14896393
## 520	3.40617394
## 521	36.93972015
## 522	14.25437450
## 523	19.95170212
## 524	16.71194839
## 525	16.04031372
## 526	16.58509636
## 527	23.68268013
## 528	2.34691525

## 529	18.59071732
## 530	19.53836441
## 531	14.69435120
## 532	21.33222389
## 533	-0.58789855
## 534	11.31486130
## 535	6.93827248
## 536	9.11147690
## 537	10.93626785
## 538	8.11567020
## 539	-1.53145516
## 540	3.96907258
## 541	1.03689516
## 542	3.87644601
## 543	29.30318069
## 544	8.57382107
## 545	5.14624786
## 546	14.38078213
## 547	2.69447327
## 548	-18.55408096
## 549	6.49982595
## 550	16.14798737
## 551	-3.14330721
## 552	7.56419373
## 553	1.38923371
## 554	6.93019295
## 555	1.51009119
## 556	17.68194962
## 557	13.76377583
## 558	-0.04381015
## 559	2.30770850
## 560	9.40977859
## 561	-0.42163488
## 562	2.76302075
## 563	1.72321332
## 564	4.58960295
## 565	-1.43679571
## 566	7.93626833
## 567	4.83993959
## 568	1.80709374
## 569	8.78467274
## 570	5.27596140
## 571	10.87668324
## 572	4.91527748
## 573	11.44066525
## 574	-1.42818058
## 575	10.16794205
## 576	15.22427940
## 577	17.56909943
## 578	13.49627209
## 579	15.19492435
## 580	-3.50019121
## 581	14.49812126
## 582	12.04676342

```

## 583      4.78192759
## 584      38.39988327
## 585     -3.25179172
## 586     21.52538300
## 587     23.41023445
## 588      9.14954472
## 589     29.93756485
## 590     38.08540344
## 591     14.33442783
## 592     13.00773430
## 593      6.19929171
## 594     10.35099602

mutate(atlaspc2, PCH_WICSPTH_16_22 = PCH_WICSPTH_16_22) |>
select(PCH_WICSPTH_16_22)

##      PCH_WICSPTH_16_22
## 1     -20.4221193
## 2      -7.3536209
## 3     -8.1640348
## 4     -34.5263194
## 5     -8.1722998
## 6     -9.4945766
## 7     -7.1801952
## 8      7.6496762
## 9     -20.0199382
## 10    -32.7861114
## 11    -8.5869486
## 12    -15.8930975
## 13    -1.7831437
## 14    -26.7456184
## 15    -1.4275310
## 16    -11.6022071
## 17    -10.2723181
## 18    -24.3031316
## 19    -26.4731933
## 20    -12.4658904
## 21    -17.0874984
## 22    -10.7990828
## 23    -10.3705133
## 24    -13.6314882
## 25      30.3970784
## 26    -20.6059602
## 27    -8.1799080
## 28    -4.3049411
## 29    -1.7288408
## 30    -24.8182468
## 31     12.2546060
## 32    -25.3220013
## 33    -19.4325650
## 34     11.9569450
## 35    -23.9023974
## 36      5.7903069
## 37    -23.6267521
## 38    -25.1691741

```

```

## 39      -18.8563170
## 40      -4.6238955
## 41      -6.6699623
## 42      -12.2180480
## 43      -13.7512894
## 44      -19.7262975
## 45      -23.0055534
## 46      -27.8124180
## 47      -17.3367607
## 48      -7.4751179
## 49      -2.3502339
## 50      -18.5210284
## 51      3.4849237
## 52      -10.8249561
## 53      5.6181276
## 54      -22.6980320
## 55      -31.2346574
## 56      -14.7987851
## 57      -15.8901638
## 58      0.1361245
## 59      -17.1874592
## 60      21.3447799
## 61      -4.4718189
## 62      -2.4982407
## 63      -8.9209817
## 64      -6.7895506
## 65      -20.1742911
## 66      -17.0405231
## 67      -18.6584160
## 68      -31.9210923
## 69      -10.5179196
## 70      -32.1039874
## 71      -24.9729963
## 72      3.7231234
## 73      12.7254331
## 74      -4.9992657
## 75      -23.0374606
## 76      -11.5938078
## 77      -7.0881232
## 78      -29.4745175
## 79      -3.4519306
## 80      -13.3490972
## 81      -2.6879723
## 82      -14.0465377
## 83      -0.9719124
## 84      -10.0823423
## 85      -14.2272230
## 86      -3.6987875
## 87      -10.6534689
## 88      -12.7528924
## 89      -17.1202426
## 90      -8.4609084
## 91      1.1122162
## 92      -6.3084899

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## 93	-3.8037481
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## 96	-5.7710837
## 97	-19.0687122
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## 99	-1.4371387
## 100	-8.9101174
## 101	7.1295423
## 102	6.3356436
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## 104	-0.6587048
## 105	-11.0390044
## 106	-17.0507475
## 107	-28.4384005
## 108	-10.8685495
## 109	-30.2504501
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## 111	-8.0190461
## 112	-32.5103989
## 113	-8.1872208
## 114	-32.8839664
## 115	-42.1420799
## 116	7.5973787
## 117	-14.5104101
## 118	-15.1289581
## 119	-27.3911281
## 120	-7.9023466
## 121	-3.6860443
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## 123	-29.4494380
## 124	-13.1527423
## 125	-14.9857653
## 126	-10.8032866
## 127	-3.6255377
## 128	-5.5096663
## 129	-9.7850178
## 130	-28.1043415
## 131	-22.1792032
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## 133	-23.7773974
## 134	-10.6378029
## 135	6.0066849
## 136	-8.5670438
## 137	-4.1142259
## 138	29.9413915
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## 140	-31.4063007
## 141	5.6000737
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## 143	15.9705127
## 144	-6.3424638
## 145	0.8180667
## 146	-12.0890481

## 147	-8.3480825
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## 149	-26.5185429
## 150	-13.4487449
## 151	-5.1098478
## 152	-8.1931690
## 153	-8.9371413
## 154	-8.4307090
## 155	-44.3611400
## 156	-16.5922188
## 157	-30.7732077
## 158	-2.5144893
## 159	-16.7565567
## 160	-42.1996031
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## 162	-15.0293403
## 163	11.3661305
## 164	16.1069970
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## 169	-10.6568560
## 170	-18.2526122
## 171	-30.3475089
## 172	1.3583540
## 173	-17.8799963
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## 176	-6.9356553
## 177	-21.3438002
## 178	-12.3528443
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## 180	-12.6438944
## 181	-2.3023836
## 182	-3.1529043
## 183	-1.3403693
## 184	2.5609325
## 185	-11.2248221
## 186	-11.1399716
## 187	-18.9034606
## 188	-27.4846053
## 189	-24.4531174
## 190	-23.0958039
## 191	-10.0137722
## 192	-22.3638904
## 193	-37.8843202
## 194	-3.6422569
## 195	13.4186632
## 196	5.5721200
## 197	-0.5139931
## 198	6.3379090
## 199	-39.5591501
## 200	-3.3769893

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## 201      -22.7066265
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## 205      -4.6225509
## 206      -14.5933258
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## 217      -35.7148010
## 218      -31.1654229
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## 220      -22.5811276
## 221      -30.7637820
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## 223      -23.5955797
## 224      -22.2118965
## 225      -48.1862848
## 226      -11.0944708
## 227      -70.1067739
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## 234      -4.0589086
## 235      6.5581414
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## 237      -23.2015850
## 238      -19.3085405
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## 240      -16.4991121
## 241      -46.1567398
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## 243      -43.1337607
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## 245      0.7723650
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## 248      189.8107989
## 249      -31.5299224
## 250      -16.4667776
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## 252      -8.7020840
## 253      -6.4840129
## 254      74.1197307

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## 255      -35.5682357
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## 257       4.1573688
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## 260     -15.3345840
## 261     -19.4971403
## 262     -17.3862491
## 263     -26.0460021
## 264     -17.4968397
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## 267      3.0646214
## 268     -12.2723876
## 269     -17.8334035
## 270     -22.5613006
## 271     -18.6162551
## 272     -23.2508737
## 273     -2.4516326
## 274      31.6652651
## 275     -6.0630898
## 276     -7.4096101
## 277     -3.7905163
## 278    1802.4853341
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## 281      7.5237464
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## 285     -4.5920957
## 286      24.6931679
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## 290      7.7979910
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## 292     -10.6219885
## 293     11.6088817
## 294      1.5399990
## 295     22.6711221
## 296      8.2882710
## 297     -26.7618831
## 298     -1.5164253
## 299      0.7724131
## 300     -21.5718944
## 301     -1.1338352
## 302     -5.5105316
## 303     -31.5102481
## 304     -33.5049782
## 305     -28.1553607
## 306     -23.2240547
## 307     -17.9336677
## 308     -8.4357344

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## 309      22.4407898
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## 319     -18.8691548
## 320      -9.7793774
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## 322     -2.4093498
## 323     -1.4801279
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## 328      7.2850377
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## 330     -33.2317841
## 331      4.4791407
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## 333     -12.4971142
## 334     -3.7542255
## 335     -0.3914167
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## 340     -18.5745302
## 341     -21.0050436
## 342      3.8342841
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## 349     -2.4010831
## 350      2.6309016
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## 352     -38.6649846
## 353     23.4531445
## 354     10.9130800
## 355     10.7535356
## 356     18.5877788
## 357     -24.3988505
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## 359     -9.2861258
## 360     -35.3733386
## 361     -26.9964876
## 362     -15.5424084

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## 363      -35.2689074
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## 365      -7.5201315
## 366      -30.4371895
## 367      -20.4714419
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## 372      -19.4388119
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## 374      -6.2923675
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## 384      37.9301282
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## 388      -23.3940229
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## 390      -14.7947205
## 391      -21.6005941
## 392      -24.5073748
## 393      -38.9788208
## 394      -7.6153404
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## 396      -5.9677414
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## 399      -14.5389814
## 400      -18.5625317
## 401      -5.2163679
## 402      -23.0230300
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## 404      -8.8923382
## 405      -20.1982924
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## 408      1.1105668
## 409      21.7907289
## 410      6.4987233
## 411      27.4839116
## 412      -8.5342244
## 413      -23.5433977
## 414      17.5528013
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## 416      4.4337301

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## 417      -23.4963285
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## 419       1.0660517
## 420      -31.7623908
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## 422      -26.6878253
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## 425      -0.7353730
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## 430      -11.1802468
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## 432      -43.2923751
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## 434      -19.1134619
## 435      -49.6915872
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## 441      -41.1047494
## 442      -21.2471400
## 443      -13.9198655
## 444      -32.7374622
## 445       4.9128275
## 446      -12.2098997
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## 448      -8.7485540
## 449      -61.0949450
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## 455      -19.8893325
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## 459      -17.6570543
## 460      -13.0119722
## 461      -17.5821257
## 462       5.3692621
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## 464       2.1716551
## 465       9.2296498
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## 467      -30.4600777
## 468      -16.3607394
## 469      -27.6516704
## 470      -15.7882020

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## 471	-27.5833687
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## 474	-24.3906210
## 475	-31.3864385
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## 478	-26.7036434
## 479	-7.3166677
## 480	-18.7896325
## 481	-8.8128370
## 482	-9.9103807
## 483	-9.6428975
## 484	1.5987930
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## 489	-21.7260196
## 490	-28.7100538
## 491	23.7025801
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## 493	-16.1034330
## 494	-24.2297695
## 495	-17.9678940
## 496	-5.4547611
## 497	-6.8034913
## 498	-17.9617536
## 499	0.8137699
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## 503	-5.6215420
## 504	-17.8777018
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## 507	-1.3097447
## 508	-24.3182230
## 509	-18.0707283
## 510	9.1590629
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## 512	-17.8670400
## 513	13.5178761
## 514	-0.5629217
## 515	-6.8284330
## 516	-8.0145010
## 517	-34.5356153
## 518	11.1594635
## 519	-28.4659651
## 520	95.2618126
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## 522	-20.4472486
## 523	-3.2433083
## 524	2.1540418

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## 525      0.2243176
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## 528     -10.9287895
## 529      19.7105498
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## 532     -17.0791126
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## 535     -9.4758030
## 536     -21.6445523
## 537     -21.4601649
## 538     -20.7409331
## 539     -51.0942260
## 540     -93.1174968
## 541     -14.6367064
## 542     -83.4334605
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## 545     -75.0305228
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## 548     -0.3458292
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## 551     19.3770097
## 552     -7.6679263
## 553     -0.8155591
## 554     58.5184563
## 555     -8.0527070
## 556     -14.4104936
## 557      1.2963130
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## 559     -17.4337714
## 560     -7.0212684
## 561     -33.6785482
## 562     -23.2960715
## 563     -26.5417841
## 564     -25.9631039
## 565     -6.9547416
## 566     -33.5994251
## 567     -20.8866925
## 568     -16.4631565
## 569     -32.6366853
## 570     -29.7622049
## 571     -17.8080807
## 572      9.1796373
## 573     -20.6219749
## 574     15.5486284
## 575     43.3059606
## 576     -1.8019437
## 577     -8.9238678
## 578     -35.7238139

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## 579      -23.2808495
## 580      -13.7302869
## 581      -31.6729437
## 582      -39.0105640
## 583      -4.6230280
## 584      -4.4907109
## 585      -34.6075321
## 586      -8.2796065
## 587      2.7841759
## 588      -14.3370808
## 589      -2.0032909
## 590      -8.2345708
## 591      -12.1077195
## 592      -9.2489424
## 593      -14.5287548
## 594      -12.8141307

mutate(atlaspc2, PCH_FFRPTH_16_20 = PCH_FFRPTH_16_20) |>
select(PCH_FFRPTH_16_20)

##      PCH_FFRPTH_16_20
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## 3      -3.050058848
## 4      7.466878513
## 5      2.554422868
## 6      15.238194594
## 7      17.360082207
## 8      16.087377144
## 9      3.753566313
## 10     4.968951206
## 11     2.681228625
## 12     8.989863453
## 13     2.541064523
## 14     3.002646973
## 15     1.787364216
## 16     14.021007239
## 17     3.472288658
## 18     -2.689679643
## 19     -5.736484480
## 20     6.109128374
## 21     10.810955199
## 22     10.048144227
## 23     0.910728405
## 24     4.465115866
## 25     2.902945071
## 26     -1.086177468
## 27     5.602449832
## 28     5.662300108
## 29     10.095634229
## 30     12.609730999
## 31     -12.439702858
## 32     6.567431904
## 33     6.181041657
## 34     13.135925782

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## 35      7.374752446
## 36      6.678069422
## 37      -0.907198894
## 38      9.350406482
## 39      1.470980300
## 40      -0.299450654
## 41      7.448801563
## 42      8.570278337
## 43      7.981149232
## 44      3.106261952
## 45      3.591881005
## 46      11.394217192
## 47      -0.609887834
## 48      9.431873989
## 49      -0.337395156
## 50      9.239844993
## 51      4.663099865
## 52      -0.119679725
## 53      11.390203219
## 54      4.140427085
## 55      7.781310675
## 56      6.835674825
## 57      3.197974668
## 58      0.688972268
## 59      -0.271032142
## 60      -3.291362904
## 61      4.089286463
## 62      -6.382188282
## 63      6.510479839
## 64      -2.529572573
## 65      -3.993059228
## 66      -0.623798876
## 67      13.259303699
## 68      -4.740816067
## 69      0.371368146
## 70      17.930036780
## 71      15.551034010
## 72      3.798361650
## 73      -9.040265033
## 74      6.778013420
## 75      9.379964767
## 76      -4.601727518
## 77      1.769659620
## 78      -7.371289366
## 79      11.173397385
## 80      10.748271317
## 81      9.112338068
## 82      3.261448946
## 83      10.161334768
## 84      11.121589623
## 85      1.074750238
## 86      -11.918921398
## 87      -2.106477042
## 88      -0.648478633

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```

## 89      7.953921524
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## 91      4.001303890
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## 93      3.186491931
## 94      10.148590965
## 95      25.708904157
## 96      2.133551481
## 97     18.409531734
## 98      8.542556147
## 99     13.600940318
## 100     12.369761177
## 101     13.521993145
## 102     4.808733628
## 103     11.860329316
## 104     9.720155019
## 105    -1.857893329
## 106    -1.409005669
## 107     0.553472705
## 108     6.284891563
## 109     5.296011785
## 110     13.016420420
## 111     22.605173117
## 112     8.435989077
## 113     6.454179924
## 114     11.916294179
## 115     5.775212252
## 116     3.142495931
## 117    -4.903199536
## 118     18.689892737
## 119     15.076994942
## 120     7.836870593
## 121     3.168633522
## 122     12.509960790
## 123     17.664607453
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## 129     6.867767129
## 130    -15.297761181
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## 132    -6.654556507
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## 136     1.239959817
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## 141     3.349419411
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```

## 143      2.148658011
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## 151      0.552278041
## 152      2.535820794
## 153      5.076767857
## 154      10.610177633
## 155      -7.951414977
## 156      15.230901356
## 157      10.576523792
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## 160      1.902657312
## 161      -1.549399487
## 162      7.560074023
## 163      -13.344683033
## 164      10.739474244
## 165      -0.788208070
## 166      -3.613706506
## 167      1.220264363
## 168      7.491792077
## 169      -1.979731223
## 170      -1.488379478
## 171      4.994578521
## 172      21.193988366
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## 174      -0.794505130
## 175      -1.262522497
## 176      -2.417666315
## 177      1.777433400
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## 179      4.239293247
## 180      -7.726720716
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## 182      15.350321087
## 183      3.153808116
## 184      5.866229328
## 185      0.875544274
## 186      -18.288346938
## 187      -1.105379070
## 188      -2.760004773
## 189      0.058854504
## 190      -2.982440784
## 191      7.066169325
## 192      4.285617511
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## 194      7.832954259
## 195      13.245908353
## 196      -0.144597823

```

```

## 197      13.126428912
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## 199      12.293828707
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## 214      5.216365370
## 215      -3.442796053
## 216      2.469790351
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## 218      0.614435344
## 219      -5.800119966
## 220      4.670664077
## 221      0.396548166
## 222      8.558984606
## 223      11.677893715
## 224      -7.401470675
## 225      7.819001277
## 226      6.325942698
## 227      -0.722732786
## 228      -2.919954618
## 229      -5.132038279
## 230      -0.707880144
## 231      2.397122032
## 232      -1.270162174
## 233      4.260476409
## 234      2.910545050
## 235      4.868813240
## 236      4.711216409
## 237      1.679971955
## 238      -4.394054484
## 239      -12.411524344
## 240      5.604645210
## 241      5.755271678
## 242      23.659941886
## 243      22.569685462
## 244      -11.698698881
## 245      19.027902334
## 246      6.041930628
## 247      8.800033319
## 248      21.901131974
## 249      4.234739375
## 250      -5.715795629

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## 251      12.726643753
## 252      2.507110920
## 253      20.110050159
## 254      7.847820073
## 255      -7.212665619
## 256      3.928165545
## 257      -0.193546225
## 258      1.457854247
## 259      6.220120487
## 260      -3.079957878
## 261      6.547868965
## 262      1.871308015
## 263      10.365001839
## 264      -4.088013448
## 265      11.713989164
## 266      2.927113262
## 267      4.596582030
## 268      3.663121249
## 269      2.868358449
## 270      -12.687495251
## 271      0.870086972
## 272      3.978078353
## 273      12.404748465
## 274      9.497150257
## 275      1.515461915
## 276      10.453430089
## 277      -0.208011463
## 278      -5.758562595
## 279      -2.199994553
## 280      0.192706352
## 281      27.650977642
## 282      -10.096119593
## 283      1.041305501
## 284      12.413942152
## 285      9.311639516
## 286      1.334065897
## 287      3.234879408
## 288      2.394343001
## 289      2.242971659
## 290      -4.165680759
## 291      10.563324796
## 292      -10.271434564
## 293      0.085695298
## 294      14.018953488
## 295      10.176804151
## 296      10.084221130
## 297      4.897646394
## 298      -10.272769866
## 299      1.183506645
## 300      19.376793916
## 301      0.069423832
## 302      15.544034742
## 303      -11.908243433
## 304      -1.803450194

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## 305      2.254468440
## 306     -2.211999275
## 307      2.327257860
## 308      6.121128837
## 309      3.686180327
## 310      7.047578274
## 311      4.833280581
## 312      1.334202651
## 313     -5.994057885
## 314     10.182796423
## 315    -11.452127097
## 316     -4.503180917
## 317      2.963491345
## 318     11.523644912
## 319     3.338026602
## 320     2.717747317
## 321     -1.644736269
## 322     -5.598812214
## 323      5.397727576
## 324     -0.803292575
## 325      8.946453674
## 326      4.275757540
## 327    13.247994434
## 328     -1.124414849
## 329     -1.275732201
## 330      1.216904850
## 331      0.053378965
## 332     -4.111882397
## 333     42.339061571
## 334      0.696852741
## 335      2.205461230
## 336      1.807214510
## 337    -18.833923153
## 338      4.666084667
## 339      1.870934341
## 340      1.766600233
## 341     14.757067578
## 342      6.059789121
## 343     -4.042026560
## 344    -12.298047361
## 345     -2.546475564
## 346     -7.532254253
## 347     11.853818163
## 348      5.472900299
## 349     -3.421653767
## 350      6.171904371
## 351      0.511332889
## 352     -9.964649012
## 353      4.756160272
## 354     -9.652836178
## 355      4.320437146
## 356     -3.394115123
## 357      3.875306404
## 358     -7.138234757

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## 359      5.238110948
## 360      5.318525007
## 361     -0.178339742
## 362      7.811074679
## 363     -0.600159219
## 364     -0.871859179
## 365     -2.065977741
## 366     -2.307557989
## 367    -10.805832832
## 368      0.033015563
## 369     -6.197263252
## 370      0.726964902
## 371     -4.254217036
## 372     -2.280278910
## 373     -2.799215789
## 374     16.424776986
## 375     15.328217826
## 376      8.268318826
## 377    -11.238830675
## 378     10.845781981
## 379     -7.206686519
## 380      8.038986702
## 381     12.430372741
## 382     -8.579770456
## 383     13.697882378
## 384      8.116021987
## 385      6.701615791
## 386      5.588159912
## 387      3.424864501
## 388      2.789320189
## 389     -1.378608567
## 390      1.554344175
## 391      0.559628552
## 392      1.556324567
## 393     -7.793449881
## 394      7.910671549
## 395      2.688955331
## 396      8.713007992
## 397     -4.454904045
## 398      1.987745610
## 399      3.208827776
## 400      27.327513372
## 401    -11.199190575
## 402     -0.744666987
## 403      5.699485248
## 404      9.609346514
## 405      6.783216674
## 406      7.316285371
## 407     -7.594187386
## 408     -0.964735590
## 409     -3.941511898
## 410      6.913172486
## 411      1.148639761
## 412      5.781357791

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## 413      -3.449035004
## 414      -4.183258480
## 415      -14.367370421
## 416      0.599798923
## 417      -5.603595942
## 418      -5.578717169
## 419      -1.393072491
## 420      4.690966912
## 421      14.373877005
## 422      -8.801921111
## 423      -22.088447449
## 424      14.265137680
## 425      -0.367733866
## 426      3.137392352
## 427      11.626849672
## 428      -4.165805865
## 429      5.140913184
## 430      5.742048794
## 431      14.084779137
## 432      1.815186095
## 433      7.456976973
## 434      -1.700200866
## 435      19.880267611
## 436      5.275023029
## 437      -3.037430960
## 438      -2.242982037
## 439      2.448696760
## 440      -1.144912472
## 441      -0.741285723
## 442      1.974849115
## 443      12.599715590
## 444      2.987053293
## 445      -2.357993413
## 446      6.128558455
## 447      2.323933016
## 448      -10.022047856
## 449      3.151540240
## 450      -3.237824148
## 451      17.733254803
## 452      7.934077350
## 453      -3.123659827
## 454      -5.590316581
## 455      8.369378574
## 456      -0.749228279
## 457      18.025942294
## 458      3.032522577
## 459      3.080996506
## 460      10.098497264
## 461      9.328722693
## 462      23.519578388
## 463      5.682780259
## 464      4.126557184
## 465      4.550350393
## 466      0.870865027

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```

## 467      -4.872858127
## 468       4.167269400
## 469      10.893457750
## 470     -0.759084649
## 471     -2.707693807
## 472      16.357729933
## 473     -4.874735554
## 474      5.617181972
## 475     -18.799633266
## 476      23.532797583
## 477      8.551498895
## 478      9.611916216
## 479      2.832209608
## 480      5.016420659
## 481      7.424678335
## 482     -1.929120909
## 483      6.684154082
## 484     -15.775410650
## 485      1.330646275
## 486      8.855598406
## 487      3.095560821
## 488      5.540013299
## 489      1.638534730
## 490      3.325819845
## 491     -3.270873701
## 492      5.608084939
## 493      2.325335507
## 494      8.340340172
## 495      5.733456407
## 496     16.029611032
## 497      8.266683919
## 498      6.447232372
## 499      7.269452352
## 500     10.444698447
## 501     15.901565082
## 502      7.938717432
## 503      5.911047362
## 504      1.546281105
## 505      2.773429337
## 506      4.595430602
## 507      6.153446792
## 508      8.726632555
## 509     18.472855471
## 510     12.509604327
## 511      9.924205437
## 512     27.953091196
## 513      1.441872701
## 514      4.068488413
## 515     21.472125033
## 516     21.350995375
## 517      6.239814651
## 518      0.283400546
## 519     -8.846720606
## 520      2.121965876

```

```
## 521      13.623400612
## 522      1.979961029
## 523      4.396963660
## 524     -1.683335967
## 525      5.694473245
## 526      9.415348393
## 527      5.494791421
## 528      0.599096309
## 529      8.680770538
## 530     13.648930112
## 531      3.469459063
## 532     -1.817687958
## 533     -9.981564370
## 534     -3.008573472
## 535     -2.865628120
## 536      1.605510643
## 537      0.771290655
## 538      8.761339044
## 539      4.766615190
## 540     -2.888062214
## 541     10.517938086
## 542     13.175970687
## 543      1.755147733
## 544      8.761356604
## 545     -1.855133196
## 546      3.237937175
## 547      7.179972383
## 548     22.267294003
## 549      7.943322767
## 550     30.257973944
## 551      8.058413029
## 552     10.541059595
## 553      4.656426037
## 554     -2.979426574
## 555      5.747169322
## 556      5.289608122
## 557     -2.275247215
## 558     -2.185960689
## 559     -5.491520717
## 560      8.412723527
## 561     -18.709172743
## 562     -5.336485757
## 563      1.042379797
## 564     -5.109132882
## 565     -2.994159861
## 566     -6.159644939
## 567      0.002019645
## 568     -7.442579596
## 569     -1.925210977
## 570     -0.912779580
## 571      5.637307745
## 572     17.507840237
## 573     16.097751583
## 574     8.933158690
```

```

## 575      3.479708259
## 576      3.118697203
## 577      -0.894349478
## 578      -12.678209830
## 579      -1.854080369
## 580      14.138530521
## 581      3.812516864
## 582      6.311135937
## 583      -5.799231770
## 584      27.069088444
## 585      18.426594035
## 586      -3.636451225
## 587      -4.567824290
## 588      11.748940578
## 589      2.936984341
## 590      -1.554477433
## 591      4.400871068
## 592      15.258153209
## 593      -11.015587876
## 594      -7.031773146

mutate(atlaspc2, PCH_FSRPTH_16_20 = PCH_FSRPTH_16_20) |>
select(PCH_FSRPTH_16_20)

```

```

##      PCH_FSRPTH_16_20
## 1      -5.53692430
## 2       0.59489169
## 3       5.41615894
## 4      -9.52393436
## 5      -3.38988501
## 6      -0.34308525
## 7      -1.25140984
## 8      -7.84743494
## 9      -0.66148549
## 10     -8.44702656
## 11     -5.92804476
## 12     -7.03805389
## 13     -4.81750855
## 14     -2.09186277
## 15      1.56537181
## 16      0.71336107
## 17     -12.90936786
## 18     -11.71333065
## 19     -5.97245799
## 20     -0.19822819
## 21     -5.88457477
## 22     -6.27567105
## 23     -12.11378750
## 24      2.87821860
## 25      9.26807295
## 26     -2.16799187
## 27     -0.50432224
## 28      8.75201977
## 29      1.95117784
## 30      3.35926937

```

```

## 31      -0.31279499
## 32      -3.06514730
## 33       0.39929743
## 34      -0.06935804
## 35       2.16509950
## 36      -4.83288629
## 37      17.84007273
## 38      -4.97162829
## 39       4.21456845
## 40      -1.91716616
## 41       3.35531322
## 42       4.64533278
## 43       3.51781684
## 44      -1.65074328
## 45      -2.40122777
## 46      -2.47922359
## 47      -1.05517901
## 48      -1.37073134
## 49       1.28036133
## 50      -6.36106808
## 51      22.58278608
## 52       0.04002445
## 53       0.42021186
## 54       2.33038998
## 55      -0.63910506
## 56      -1.60534658
## 57      -1.87986558
## 58       0.83240439
## 59       2.75523069
## 60       3.68850230
## 61       2.12897814
## 62      -7.93578343
## 63       9.03285866
## 64       4.35069920
## 65      -3.24904710
## 66      -4.57189170
## 67      -6.48219664
## 68      -13.12902214
## 69      -10.16484657
## 70      22.20899652
## 71      -3.40399048
## 72      -3.75960741
## 73       0.29119596
## 74      -1.22987193
## 75       1.18100851
## 76      -1.55170834
## 77       3.25779986
## 78      -5.86938905
## 79      -6.54989767
## 80       7.77154625
## 81      -6.89080471
## 82      -0.62340238
## 83      -6.55990481
## 84      -0.32379391

```

```

## 85      1.00599058
## 86      2.24166095
## 87     -1.26544976
## 88    -10.85866810
## 89      1.58209139
## 90      11.16596044
## 91      6.37237609
## 92    -12.01255431
## 93     -4.23373644
## 94     -0.24405729
## 95     -0.78437868
## 96     -2.33459653
## 97      4.31824662
## 98      0.28750424
## 99    -14.11731068
## 100     -1.63051251
## 101     13.82279660
## 102     -2.85566637
## 103      2.63886884
## 104      1.52421790
## 105      6.06653742
## 106      5.32683602
## 107     11.95545007
## 108     -8.34622878
## 109     16.30181096
## 110      2.32546820
## 111     -3.14191533
## 112     -2.95375591
## 113     -3.90861548
## 114     -11.24333964
## 115     -11.30372002
## 116      3.33201489
## 117      5.37269963
## 118      3.32488314
## 119      0.78943141
## 120      5.20669985
## 121     -15.84551733
## 122      2.79081315
## 123     -7.54923183
## 124      0.04948190
## 125     -0.71939990
## 126     -6.07168633
## 127     -0.37856436
## 128     -4.58950267
## 129     -9.22804658
## 130     -7.83358059
## 131      6.14716839
## 132      6.25160590
## 133     -0.47357530
## 134      0.85918683
## 135     -1.05917091
## 136      5.06432562
## 137      5.29863106
## 138     13.09000126

```

```

## 139      14.48847272
## 140     -0.32738511
## 141      2.16277339
## 142      5.83571114
## 143      1.76076443
## 144      7.31853917
## 145     -13.18689238
## 146     -3.67031623
## 147      6.29949231
## 148     10.17257217
## 149     -7.01005852
## 150     -2.42399945
## 151      2.46756444
## 152     13.46413355
## 153      2.70694062
## 154     -2.93656872
## 155      0.69060486
## 156    -16.39955813
## 157      4.88974054
## 158     -1.22961856
## 159     27.70006131
## 160      7.54476687
## 161      3.79435136
## 162     -2.18577505
## 163      5.29785689
## 164      4.08616228
## 165     -2.82072116
## 166      2.97857303
## 167      6.33648969
## 168      9.01892521
## 169      3.59190599
## 170      5.88722060
## 171      5.67657725
## 172     -7.71135238
## 173     -2.06195864
## 174      2.79151640
## 175     -0.84727607
## 176      2.93005809
## 177     -3.44261986
## 178     18.64224415
## 179    -10.65202694
## 180     -7.66426452
## 181    -12.35703713
## 182    -10.28308868
## 183     -3.61224294
## 184     -3.88018648
## 185      8.14984746
## 186      2.35579475
## 187     -6.00829192
## 188     -5.23175281
## 189     17.59858620
## 190     -5.52747385
## 191      5.38822005
## 192     -3.15477246

```

```

## 193      -7.26934775
## 194      -7.73077225
## 195      -1.74761681
## 196      -1.04420027
## 197      -1.78467050
## 198      3.54956023
## 199      -2.71793874
## 200      -1.99052391
## 201      5.84198155
## 202      8.72054417
## 203      6.14389963
## 204      -0.19386453
## 205      19.32415848
## 206      -4.51251464
## 207      0.10774759
## 208      -19.66926529
## 209      -0.22467165
## 210      -1.15245966
## 211      -10.30928166
## 212      -2.26091585
## 213      -4.63515556
## 214      3.35308130
## 215      -4.06228611
## 216      -19.50337030
## 217      0.05416667
## 218      -8.42279030
## 219      4.71901599
## 220      -0.70941656
## 221      -3.97956801
## 222      2.22602726
## 223      -5.64091598
## 224      9.84438132
## 225      -3.86009058
## 226      3.15846484
## 227      10.51797730
## 228      -2.70368805
## 229      -9.14393246
## 230      -3.46629385
## 231      0.43629616
## 232      -3.33876479
## 233      -13.65919520
## 234      -3.37366232
## 235      -3.11957155
## 236      -7.54962508
## 237      -1.17184198
## 238      -2.90799927
## 239      -6.88181480
## 240      -3.90732159
## 241      -8.45442745
## 242      0.29929644
## 243      -6.85205163
## 244      -2.91910659
## 245      3.84576522
## 246      43.46849886

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```

## 247      -6.25198599
## 248      14.15637891
## 249      -8.96334089
## 250      -2.14498827
## 251      0.21793059
## 252      -6.28822779
## 253      -4.93193113
## 254      10.82919312
## 255      0.77243965
## 256      -0.78956367
## 257      -6.54800525
## 258      5.98721725
## 259      -0.81148519
## 260      19.27366242
## 261      9.52604350
## 262      -2.63895370
## 263      3.34846593
## 264      -2.40654635
## 265      -8.10623626
## 266      -0.02790335
## 267      -5.49960740
## 268      -9.39074860
## 269      -4.45748622
## 270      26.39524508
## 271      5.86365166
## 272      2.68975480
## 273      0.74797266
## 274      8.13436564
## 275      -2.93696984
## 276      -16.44909757
## 277      -8.08632907
## 278      -3.96393638
## 279      -7.46958512
## 280      -9.70376778
## 281      4.42197546
## 282      -0.84492191
## 283      -4.54670921
## 284      -5.85333040
## 285      1.86337725
## 286      3.06714633
## 287      5.29957565
## 288      -3.32322396
## 289      -1.43166236
## 290      -2.56844394
## 291      -2.66195608
## 292      -10.54299312
## 293      -2.45784904
## 294      7.54588831
## 295      -11.59113685
## 296      -1.48169035
## 297      -21.97118025
## 298      -3.61887673
## 299      -5.50631005
## 300      -13.43437763

```

```

## 301      1.29773978
## 302     -8.23208193
## 303      1.52949048
## 304     -2.00182549
## 305      6.03133367
## 306      6.01315624
## 307      0.28071746
## 308     -9.76258833
## 309      4.75928583
## 310      1.62580613
## 311      0.11106892
## 312     -9.82859908
## 313     -11.29715048
## 314      6.60186463
## 315     -5.49845881
## 316     -0.51766264
## 317      2.78211985
## 318     -5.08104465
## 319      0.96670938
## 320     -1.31505583
## 321     -6.36671152
## 322     14.09425249
## 323     -1.00190721
## 324     -5.92348422
## 325    -12.34337103
## 326      0.43812673
## 327     -3.47429650
## 328      1.70575180
## 329     -6.40592773
## 330      3.20225921
## 331     -5.59125068
## 332    -11.70148847
## 333    -15.00518969
## 334     -8.37988798
## 335     -6.33540527
## 336     -5.33715702
## 337      0.24033649
## 338      3.20182920
## 339     -3.75300659
## 340     -7.20500632
## 341     -0.74004695
## 342      0.37052224
## 343     -8.36834823
## 344     -1.48241008
## 345     -7.31000232
## 346     -5.92844906
## 347      6.25691620
## 348     -6.32810808
## 349     -4.38880450
## 350     -8.78087769
## 351     -8.27995065
## 352    -16.05470771
## 353      1.43086041
## 354      5.08454914

```

```
## 355      -3.25010596
## 356      -0.93199705
## 357      -3.80703793
## 358      -3.41796237
## 359       1.84294263
## 360       1.35917104
## 361       7.70931999
## 362       2.47541983
## 363       0.04159288
## 364       4.66737854
## 365      10.08089089
## 366      -0.12701786
## 367      -6.46163204
## 368       5.17443049
## 369       7.38149242
## 370       0.57865136
## 371       2.26265631
## 372      -4.81240102
## 373       5.79300590
## 374      -9.29658182
## 375      19.44708731
## 376     -8.14176647
## 377      8.19733806
## 378     -4.06121100
## 379      11.84555364
## 380      7.00224105
## 381     -1.41219946
## 382      10.80010130
## 383     -0.13524711
## 384      0.59020799
## 385     -1.42915222
## 386       1.63961155
## 387     -10.98402670
## 388      1.79341034
## 389      4.15795411
## 390     -3.95708181
## 391      0.55962854
## 392     -1.60068920
## 393     -7.62819585
## 394      6.09858863
## 395     -0.68064686
## 396     -1.67997213
## 397      4.68684194
## 398     -10.72670051
## 399     -2.28774109
## 400     -13.02569206
## 401     -0.01168254
## 402      9.76676123
## 403     -1.51360645
## 404     -4.47477235
## 405      0.04592656
## 406      3.08324475
## 407      1.21929474
## 408      5.87399066
```

```

## 409      -13.25554511
## 410       4.58381295
## 411      10.43332858
## 412       2.54488752
## 413      2.42032245
## 414      5.39840970
## 415     27.41306475
## 416     -8.57772771
## 417     -6.05385390
## 418     -2.80162839
## 419      3.95365121
## 420      3.96394744
## 421     -7.75985239
## 422     -3.31329495
## 423      4.80958292
## 424     -3.95725363
## 425      8.01546104
## 426     -1.39264847
## 427    -16.76661494
## 428      2.97055375
## 429      8.52593326
## 430      1.00546717
## 431      7.34340063
## 432     -0.52436944
## 433      0.06706584
## 434      0.77917340
## 435     -9.83682713
## 436      0.48979667
## 437     -5.17590773
## 438     -0.90716593
## 439      5.22632003
## 440     -2.86883452
## 441      4.85882222
## 442      1.44095468
## 443    -16.20155256
## 444      4.00672625
## 445    -13.61727972
## 446     -4.21093909
## 447      0.35848542
## 448     -6.62321555
## 449     -1.54821741
## 450     -3.63991118
## 451     -7.32792755
## 452      3.78276072
## 453      3.06877715
## 454      3.06792146
## 455      0.48817087
## 456      3.87593352
## 457    -11.48054783
## 458     -1.13355382
## 459     -7.27624196
## 460     -6.06634839
## 461     -4.84277243
## 462     -3.14001088

```

```
## 463      -3.82760213
## 464      -1.24610017
## 465      -6.75238351
## 466       5.94281674
## 467      -8.01519879
## 468      -0.81852911
## 469     14.07069953
## 470      -0.90053851
## 471       0.63081933
## 472      -4.46417556
## 473      -0.20600504
## 474       2.89283231
## 475      -0.91011970
## 476     -18.90520342
## 477       0.65093669
## 478     11.11710095
## 479       0.05134469
## 480     -3.47388309
## 481     -0.83875599
## 482     -3.69865074
## 483       2.21053345
## 484     -7.64947238
## 485       4.02797898
## 486       5.10356017
## 487    -14.74461171
## 488       5.29849752
## 489     -0.82581829
## 490     -8.31883887
## 491     31.02260647
## 492     -2.04958638
## 493     -2.53276786
## 494       2.05272905
## 495       7.26272211
## 496       1.20983709
## 497     -0.51365483
## 498    -16.37431947
## 499       5.91097508
## 500       1.02925795
## 501     13.80706832
## 502     -0.56283791
## 503       6.91625811
## 504       8.70364922
## 505     -0.24439429
## 506     -7.84682059
## 507       5.94933120
## 508    -11.82224838
## 509     -0.71378573
## 510       2.22646761
## 511     -9.33258791
## 512    -19.06743545
## 513       5.01736161
## 514    -10.01318385
## 515     -2.71421107
## 516       1.02736943
```

```

## 517      -4.85008349
## 518      13.18270743
## 519      -4.38056265
## 520      12.31869412
## 521      -11.98187676
## 522      -3.92371335
## 523      31.05388220
## 524      -4.50582276
## 525      0.67774370
## 526      0.16408780
## 527      -7.40164788
## 528      -1.38269475
## 529      2.23360114
## 530      -5.38203174
## 531      -15.03766388
## 532      2.58853826
## 533      -10.37125254
## 534      -5.00429218
## 535      0.82568213
## 536      -8.30045973
## 537      -17.87113260
## 538      -13.40359531
## 539      -1.50146423
## 540      1.24435542
## 541      -0.04837347
## 542      -5.72668013
## 543      -2.67686246
## 544      -0.60027089
## 545      -13.83233081
## 546      -15.09992918
## 547      -1.25536766
## 548      0.28015366
## 549      4.54144281
## 550      4.50778640
## 551      -0.83247465
## 552      -4.58789046
## 553      1.33400117
## 554      0.32808837
## 555      0.25243032
## 556      3.00883537
## 557      2.61099164
## 558      -16.94187820
## 559      8.77335458
## 560      -4.55271633
## 561      9.06519170
## 562      -2.07816637
## 563      0.10488430
## 564      -0.42091687
## 565      -2.27184478
## 566      4.33419794
## 567      0.19178171
## 568      -6.88500295
## 569      9.21965856
## 570      -3.05821627

```

```

## 571      1.25572701
## 572     -1.39943068
## 573     -6.77975833
## 574     -2.64067521
## 575      6.98749926
## 576     -3.35485359
## 577     -2.73135939
## 578      0.28854597
## 579     -6.85196792
## 580    -13.13603680
## 581      1.52281138
## 582      3.17490372
## 583     -9.77135053
## 584      0.77369359
## 585      1.11465389
## 586     -1.05528684
## 587     -0.64595681
## 588     -0.17094259
## 589      6.01259537
## 590      6.84940896
## 591      0.06979283
## 592     -1.06157517
## 593     -0.73608544
## 594     -3.97647383

mutate(atlaspc2, PCH_PC_DIRSALES_12_17 = PCH_PC_DIRSALES_12_17) |>
select(PCH_PC_DIRSALES_12_17)

```

```

##      PCH_PC_DIRSALES_12_17
## 1      79.01234568
## 2      88.97058824
## 3      36.06557377
## 4     -7.78443114
## 5     -15.63342318
## 6     158.21917808
## 7     12.73996510
## 8     -40.96385542
## 9     -38.72549020
## 10     74.69879518
## 11     -32.69230769
## 12     123.78048780
## 13     -70.00964320
## 14     723.56687898
## 15     -44.74885845
## 16     -33.96226415
## 17     -50.83586626
## 18      0.20790021
## 19     350.45161290
## 20     441.91919192
## 21     10.30927835
## 22     50.88757396
## 23     105.00000000
## 24     -22.75862069
## 25     473.17073171
## 26     54.56431535

```

```

## 27      831.78294574
## 28      318.20568928
## 29      28.05970149
## 30      47.09208848
## 31      55.94087550
## 32      484.43396226
## 33      199.79797980
## 34      1910.49250535
## 35      -41.57872520
## 36      -2.07197383
## 37      -9.87611539
## 38      1214.57737852
## 39      -24.86033520
## 40      130.58752271
## 41      502.22061308
## 42      119.68805932
## 43      24.20147420
## 44      41.13718253
## 45      26.46036551
## 46      586.55676411
## 47      334.60837887
## 48      959.90453461
## 49      174.12451362
## 50      6.46031338
## 51      -21.23552124
## 52      254.12810070
## 53      682.68122164
## 54      393.65183246
## 55      1066.41550054
## 56      53.17810352
## 57      865.42688081
## 58      83.78951835
## 59      91.23505976
## 60      20.53571429
## 61      -32.85795779
## 62      -28.57142857
## 63      40.16393443
## 64      248.88888889
## 65      252.94117647
## 66      -17.80366057
## 67      132.30464326
## 68      -17.80538302
## 69      46.84479818
## 70      528.20037106
## 71      428.45528455
## 72      68.36323691
## 73      0.00000000
## 74      26.74418605
## 75      277.77777778
## 76      41.96185286
## 77      8.00000000
## 78      72.72727273
## 79      288.77551020
## 80      -56.66666667

```

```

## 81      118.62745098
## 82      127.90697674
## 83      18.45637584
## 84      9.36170213
## 85      21.45178765
## 86      402.19780220
## 87      -7.74058577
## 88      90.31719533
## 89      34.64566929
## 90      13.26530612
## 91      44.84781812
## 92      -18.00000000
## 93      77.46478873
## 94      185.82089552
## 95      1007.14285714
## 96      -6.94896851
## 97      -30.12589928
## 98      32.14285714
## 99      124.83069977
## 100     305.71428571
## 101     43.21608040
## 102     1147.16981132
## 103     -52.33644860
## 104     775.10917031
## 105     -20.00000000
## 106     -49.15254237
## 107     68.60465116
## 108     117.64705882
## 109     0.00000000
## 110     -58.82352941
## 111     -24.77064220
## 112     103.12500000
## 113     -87.16216216
## 114     -32.50000000
## 115     101.37931034
## 116     -3.55329949
## 117     -60.00000000
## 118     118.18181818
## 119     -0.80000000
## 120     -42.65232975
## 121     414.58333333
## 122     0.00000000
## 123     595.23809524
## 124     1600.00000000
## 125     -55.55555556
## 126     181.95388953
## 127     110.17262639
## 128     -2.13963964
## 129     6.01626016
## 130     15.69767442
## 131     -30.41474654
## 132     76.06084868
## 133     -6.03248260
## 134     -6.04534005

```

```

## 135      72.65135699
## 136      269.17562724
## 137      100.63694268
## 138      103.09951060
## 139      147.56097561
## 140      -19.39218524
## 141      -14.01000715
## 142      -79.30622010
## 143      32.69129288
## 144      52.49343832
## 145      -39.36170213
## 146      7.34299517
## 147      -3.36134454
## 148      -54.00000000
## 149      285.52631579
## 150      -49.49748744
## 151      134.07407407
## 152      -51.23318386
## 153      6.59340659
## 154      -5.22151899
## 155      137.08920188
## 156      -70.12847966
## 157      126.06837607
## 158      -9.10990389
## 159      21.33333333
## 160      -31.85840708
## 161      29.30555556
## 162      284.82490272
## 163      -15.43209877
## 164      66.21983914
## 165      22.11302211
## 166      68.69158879
## 167      -10.88607595
## 168      31.14035088
## 169      -12.33123312
## 170      -71.16060961
## 171      -64.45366528
## 172      47.22222222
## 173      40.21739130
## 174      498.92761394
## 175      5.96026490
## 176      40.02624672
## 177      37.68115942
## 178      -52.35404896
## 179      149.06250000
## 180      -50.17301038
## 181      23.34004024
## 182      -81.81818182
## 183      -34.20074349
## 184      -47.82608696
## 185      -53.84615385
## 186      -31.25000000
## 187      8.07453416
## 188      73.42657343

```

```

## 189      172.78287462
## 190      20.42553191
## 191      112.85714286
## 192      -17.09401709
## 193      84.65909091
## 194      222.40437158
## 195      -42.85714286
## 196      136.05015674
## 197      -10.81967213
## 198      -30.61224490
## 199      -84.54545455
## 200      32.72727273
## 201      72.07792208
## 202      63.33333333
## 203      400.00000000
## 204      199.31506849
## 205      -13.14655172
## 206      -25.58139535
## 207      230.43478261
## 208      34.78260870
## 209      86.19094813
## 210      56.96629213
## 211      -15.49364614
## 212      103.46820809
## 213      5.00000000
## 214      169.05882353
## 215      -7.13206407
## 216      254.05797101
## 217      -26.27291242
## 218      312.41526935
## 219      99.31153184
## 220      136.69600542
## 221      99.28360725
## 222      16.22562674
## 223      52.97176820
## 224      180.64516129
## 225      133.20440345
## 226      -30.94736842
## 227      0.00000000
## 228      21.87500000
## 229      68.88086643
## 230      -41.05827194
## 231      65.25950292
## 232      -8.25471698
## 233      8.89887640
## 234      221.85863874
## 235      40.81967213
## 236      156.83090705
## 237      8.62068966
## 238      192.70666037
## 239      -16.48793566
## 240      74.15787683
## 241      47.40484429
## 242      15.71428571

```

```

## 243      0.64377682
## 244      35.57446809
## 245      230.93980993
## 246      85.15625000
## 247      -13.78708551
## 248      47.60213144
## 249      20.86190010
## 250      36.28808864
## 251      20.23217247
## 252      9.87903226
## 253      78.67142465
## 254      78.80184332
## 255      652.56410256
## 256      197.66081871
## 257      46.26256281
## 258      -16.12903226
## 259      -21.74721190
## 260      51.93798450
## 261      29.40298507
## 262      104.53527436
## 263      73.53603604
## 264      -0.47318612
## 265      -48.87218045
## 266      -14.68531469
## 267      -14.93506494
## 268      149.73958333
## 269      -44.84797297
## 270      -65.20787746
## 271      -12.85008237
## 272      70.30567686
## 273      -7.78341794
## 274      120.95671982
## 275      -10.85080148
## 276      4.74214582
## 277      60.57507987
## 278      -42.60869565
## 279      160.36866359
## 280      45.45454545
## 281      -43.27731092
## 282      17.02702703
## 283      36.40776699
## 284      73.77690802
## 285      48.07692308
## 286      180.34682081
## 287      216.50485437
## 288      170.34482759
## 289      137.30769231
## 290      376.19047619
## 291      -73.25581395
## 292      134.18719212
## 293      27.85388128
## 294      56.13207547
## 295      -3.45679012
## 296      73.66071429

```

```

## 297      297.29729730
## 298      -18.45102506
## 299      34.18367347
## 300      91.30434783
## 301      86.66666667
## 302      88.45188285
## 303      9.22643030
## 304      38.49802372
## 305      93.57834420
## 306      43.45344274
## 307      62.70827022
## 308      129.25577417
## 309      557.66423358
## 310      53.74015748
## 311      236.73239437
## 312      283.01886792
## 313      67.05202312
## 314      99.79312128
## 315      139.12024987
## 316      438.11320755
## 317      69.58981612
## 318      279.98610146
## 319      273.81386861
## 320      427.55798090
## 321      663.87559809
## 322      104.79069767
## 323      -70.77464789
## 324      1313.15789474
## 325      6.01671309
## 326      761.32075472
## 327      -4.17362270
## 328      5.61056106
## 329      203.04386750
## 330      0.00000000
## 331      51.76678445
## 332      31.92090395
## 333      124.72035794
## 334      38.49416755
## 335      -5.16147636
## 336      96.85658153
## 337      -34.52768730
## 338      89.37198068
## 339      40.64297800
## 340      0.00000000
## 341      20.99009901
## 342      68.08585503
## 343      31.43459916
## 344      261.65803109
## 345      -3.34479112
## 346      77.84090909
## 347      70.41053447
## 348      0.00000000
## 349      65.98360656
## 350      49.89185292

```

```

## 351      215.46803653
## 352      -17.03703704
## 353      209.34913890
## 354      -23.16043426
## 355      207.44863014
## 356      0.43859649
## 357      204.92125984
## 358      48.21092279
## 359      39.26380368
## 360      295.94594595
## 361      53.01204819
## 362      93.85964912
## 363      314.78260870
## 364      -22.57462687
## 365      -13.21428571
## 366      469.67370441
## 367      140.10282776
## 368      167.36842105
## 369      -23.52941176
## 370      -34.64566929
## 371      -36.76470588
## 372      67.84313725
## 373      582.56880734
## 374      -68.25726141
## 375      256.00000000
## 376      -6.45161290
## 377      228.57142857
## 378      -76.76767677
## 379      22.32620321
## 380      46.17940199
## 381      35.93155894
## 382      146.17940199
## 383      41.03194103
## 384      59.94291151
## 385      110.43478261
## 386      30.94629156
## 387      57.24020443
## 388      20.54140127
## 389      17.69759450
## 390      91.25248509
## 391      -15.89861751
## 392      8.88888889
## 393      -17.83625731
## 394      1.98412698
## 395      83.52534562
## 396      85.28006947
## 397      -16.01532567
## 398      0.11668611
## 399      253.20855615
## 400      35.20000000
## 401      0.07347539
## 402      59.80392157
## 403      -29.30374904
## 404      49.25531915

```

```

## 405      51.30568356
## 406      118.18181818
## 407      -17.43589744
## 408      139.72602740
## 409      316.92307692
## 410      492.43243243
## 411      -10.61007958
## 412      4.77732794
## 413      87.28787411
## 414      -40.90909091
## 415      -31.13207547
## 416      -5.94059406
## 417      87.55506608
## 418      166.32595116
## 419      302.03679369
## 420      39.35052531
## 421      6.13718412
## 422      76.52898422
## 423      -67.22365039
## 424      -2.23438212
## 425      -11.02871568
## 426      -39.76884686
## 427      941.95338513
## 428      35.33558075
## 429      812.59899208
## 430      157.52293578
## 431      69.00072939
## 432      145.20817935
## 433      -17.15145436
## 434      160.07822686
## 435      9.05644482
## 436      192.50197316
## 437      235.77981651
## 438      -38.46153846
## 439      294.94186047
## 440      1293.57541899
## 441      -70.58823529
## 442      76.93905817
## 443      56.44067797
## 444      124.87930480
## 445      17.26618705
## 446      435.37581699
## 447      65.86941927
## 448      71.24582870
## 449      162.22775358
## 450      -13.66711773
## 451      -0.08298755
## 452      103.50378788
## 453      27.52941176
## 454      232.37250554
## 455      21.72797263
## 456      94.44444444
## 457      -55.75268817
## 458      18.62999481

```

## 459	82.32356135
## 460	53.50877193
## 461	-23.82608696
## 462	51.95195195
## 463	-59.12698413
## 464	-2.25118483
## 465	-24.10714286
## 466	-30.57119871
## 467	79.26829268
## 468	-88.24101069
## 469	156.88073394
## 470	-7.81250000
## 471	17.20720721
## 472	280.43478261
## 473	37.47826087
## 474	-44.28571429
## 475	-53.54330709
## 476	169.76744186
## 477	21.94092827
## 478	631.49606299
## 479	-37.46556474
## 480	43.56617647
## 481	892.45283019
## 482	101.66666667
## 483	33.56643357
## 484	-25.96685083
## 485	46.34146341
## 486	128.92561983
## 487	110.52631579
## 488	101.98675497
## 489	10.73318216
## 490	-28.40375587
## 491	-48.00000000
## 492	-16.08695652
## 493	-53.40909091
## 494	-89.12037037
## 495	-31.46853147
## 496	-37.50000000
## 497	66.96035242
## 498	259.74025974
## 499	-62.87128713
## 500	29.57198444
## 501	4.16666667
## 502	-17.32673267
## 503	-41.05960265
## 504	76.21951220
## 505	131.39534884
## 506	-23.33333333
## 507	-31.84615385
## 508	978.24074074
## 509	200.65847234
## 510	-4.90797546
## 511	26.16279070
## 512	-61.90476190

```

## 513      80.17241379
## 514      694.52054795
## 515     -54.86284289
## 516      361.53846154
## 517     -46.22425629
## 518      38.29787234
## 519     129.50000000
## 520     -84.09090909
## 521      11.36363636
## 522     -45.45454545
## 523     -31.25000000
## 524     -44.56721915
## 525      614.04958678
## 526     -35.55555556
## 527      10.52631579
## 528      757.49385749
## 529     -48.25174825
## 530      7.14285714
## 531     -21.66666667
## 532      57.73710483
## 533      374.54545455
## 534     -34.79359730
## 535      126.28062361
## 536     -45.83602324
## 537     -32.57142857
## 538      37.43409490
## 539      63.93144638
## 540      52.54041570
## 541      705.93406593
## 542      55.69620253
## 543      395.36507937
## 544      17.71653543
## 545     -0.87209302
## 546      320.83333333
## 547      32.82442748
## 548      0.00000000
## 549      0.00000000
## 550      0.00000000
## 551      0.00000000
## 552      0.00000000
## 553      0.00000000
## 554      0.00000000
## 555      295.23809524
## 556      135.49883991
## 557     -1.65484634
## 558      199.51456311
## 559      28.95365504
## 560     -33.37378641
## 561     -40.49751244
## 562      74.87666034
## 563      13.08056872
## 564      94.13008990
## 565      174.49297972
## 566     147.46963563

```

```

## 567      -31.66157872
## 568       7.43398393
## 569      523.87706856
## 570      89.13043478
## 571       6.37989367
## 572     -50.66666667
## 573     14.14141414
## 574    -23.85321101
## 575      67.02127660
## 576      28.24175824
## 577      37.15549507
## 578      31.65938865
## 579     -8.41784990
## 580     14.47368421
## 581    103.63036304
## 582      77.35849057
## 583     -57.94947994
## 584     -11.79883946
## 585      70.45075125
## 586      30.90803260
## 587      9.24242424
## 588     84.75894246
## 589     -14.49399657
## 590      44.06229721
## 591      30.45454545
## 592      58.71559633
## 593     135.67839196
## 594     110.14492754

cor(atlaspc2)

##          PCH_LACCESS_POP_15_19 PCH_GROCPTH_16_20
## PCH_LACCESS_POP_15_19      1.000000000 -0.084206775
## PCH_GROCPTH_16_20     -0.084206775  1.000000000
## PCH_SUPERCPTH_16_20      0.018425037  0.008091590
## PCH_CONVSPTH_16_20     -0.001400242 -0.119616952
## PCH_SPECSPTH_16_20      0.006932067 -0.063737757
## PCH_SNAPSPTH_17_23     -0.004985344  0.098718445
## PCH_WICSPTH_16_22     -0.032020566 -0.005017603
## PCH_FFRPTH_16_20      -0.109084416  0.061274962
## PCH_FSRPTH_16_20      0.141752309  0.013515837
## PCH_PC_DIRSALES_12_17   -0.041513549  0.050895256
##          PCH_SUPERCPTH_16_20 PCH_CONVSPTH_16_20 PCH_SPECSPTH_16_20
## PCH_LACCESS_POP_15_19      0.018425037 -0.001400242  0.006932067
## PCH_GROCPTH_16_20      0.008091590 -0.119616952 -0.063737757
## PCH_SUPERCPTH_16_20      1.000000000  0.147948020 -0.007705825
## PCH_CONVSPTH_16_20      0.147948020  1.000000000  0.026224555
## PCH_SPECSPTH_16_20     -0.007705825  0.026224555  1.000000000
## PCH_SNAPSPTH_17_23      0.037958390 -0.007140006  0.040959877
## PCH_WICSPTH_16_22     -0.022902150  0.023093921 -0.039133197
## PCH_FFRPTH_16_20      -0.016784759 -0.043905615  0.034036418
## PCH_FSRPTH_16_20      -0.029449275  0.080128354  0.047073748
## PCH_PC_DIRSALES_12_17   0.067257365  0.020570372 -0.025135601
##          PCH_SNAPSPTH_17_23 PCH_WICSPTH_16_22 PCH_FFRPTH_16_20
## PCH_LACCESS_POP_15_19     -0.004985344 -0.032020566 -0.10908442

```

```

## PCH_GROCPTH_16_20          0.098718445   -0.005017603   0.06127496
## PCH_SUPERCPTH_16_20        0.037958390   -0.022902150   -0.01678476
## PCH_CONVSPTH_16_20         -0.007140006   0.023093921   -0.04390562
## PCH_SPECSPTH_16_20         0.040959877   -0.039133197   0.03403642
## PCH_SNAPSPTH_17_23         1.000000000   -0.020451183   0.02622866
## PCH_WICSPTH_16_22          -0.020451183   1.000000000   -0.02190272
## PCH_FFRPTH_16_20           0.026228664   -0.021902718   1.00000000
## PCH_FSRPTH_16_20           0.048516764   0.007131612   -0.08847977
## PCH_PC_DIRSALES_12_17     -0.048479520   -0.032939935   0.05535931
##                               PCH_FSRPTH_16_20 PCH_PC_DIRSALES_12_17
## PCH_LACCESS_POP_15_19       0.141752309   -0.04151355
## PCH_GROCPTH_16_20          0.013515837   0.05089526
## PCH_SUPERCPTH_16_20         -0.029449275   0.06725736
## PCH_CONVSPTH_16_20          0.080128354   0.02057037
## PCH_SPECSPTH_16_20          0.047073748   -0.02513560
## PCH_SNAPSPTH_17_23          0.048516764   -0.04847952
## PCH_WICSPTH_16_22           0.007131612   -0.03293993
## PCH_FFRPTH_16_20            -0.088479766   0.05535931
## PCH_FSRPTH_16_20            1.000000000   -0.03822234
## PCH_PC_DIRSALES_12_17      -0.038222337   1.00000000

mshapiro.test(t(atlaspc2[,1:9]))

##
## Shapiro-Wilk normality test
##
## data: Z
## W = 0.13286, p-value < 2.2e-16

atlaspc2_long <- atlaspc2 |>
  pivot_longer(cols = c("PCH_GROCPTH_16_20", "PCH_SUPERCPTH_16_20", "PCH_CONVSPTH_16_20", "PCH_SPECSPTH_16_20", "PCH_SNAPSPTH_17_23", "PCH_WICSPTH_16_22", "PCH_FFRPTH_16_20", "PCH_FSRPTH_16_20", "PCH_PC_DIRSALES_12_17"), names_to = "sources", values_to = "food")
atlaspc2_long

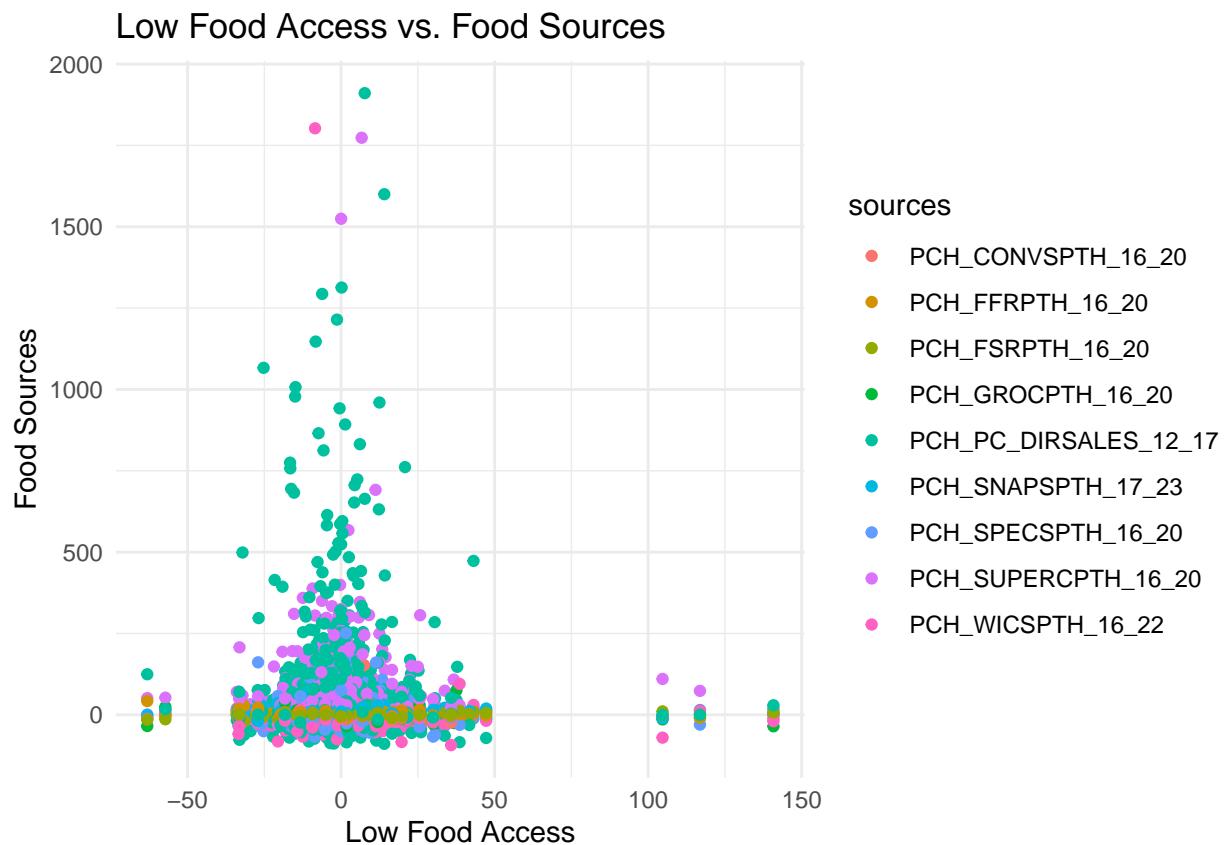
## # A tibble: 5,346 x 3
##   PCH_LACCESS_POP_15_19 sources          food
##   <dbl> <chr>          <dbl>
## 1 1    PCH_GROCPTH_16_20    -9.38
## 2 2    PCH_SUPERCPTH_16_20   16.5 
## 3 3    PCH_CONVSPTH_16_20   -9.38
## 4 4    PCH_SPECSPTH_16_20   -2.66
## 5 5    PCH_SNAPSPTH_17_23   3.40 
## 6 6    PCH_WICSPTH_16_22   -20.4 
## 7 7    PCH_FFRPTH_16_20    -0.0822
## 8 8    PCH_FSRPTH_16_20    -5.54 
## 9 9    PCH_PC_DIRSALES_12_17 79.0 
## 10 10   PCH_GROCPTH_16_20   -2.09 

## # i 5,336 more rows

options(repr.plot.width = NULL, repr.plot.height = NULL)
ggplot(atlaspc2_long, aes(x = PCH_LACCESS_POP_15_19, y = food, color = sources)) +
  geom_point() +
  labs(title = "Low Food Access vs. Food Sources",
       x = "Low Food Access",
       y = "Food Sources") +

```

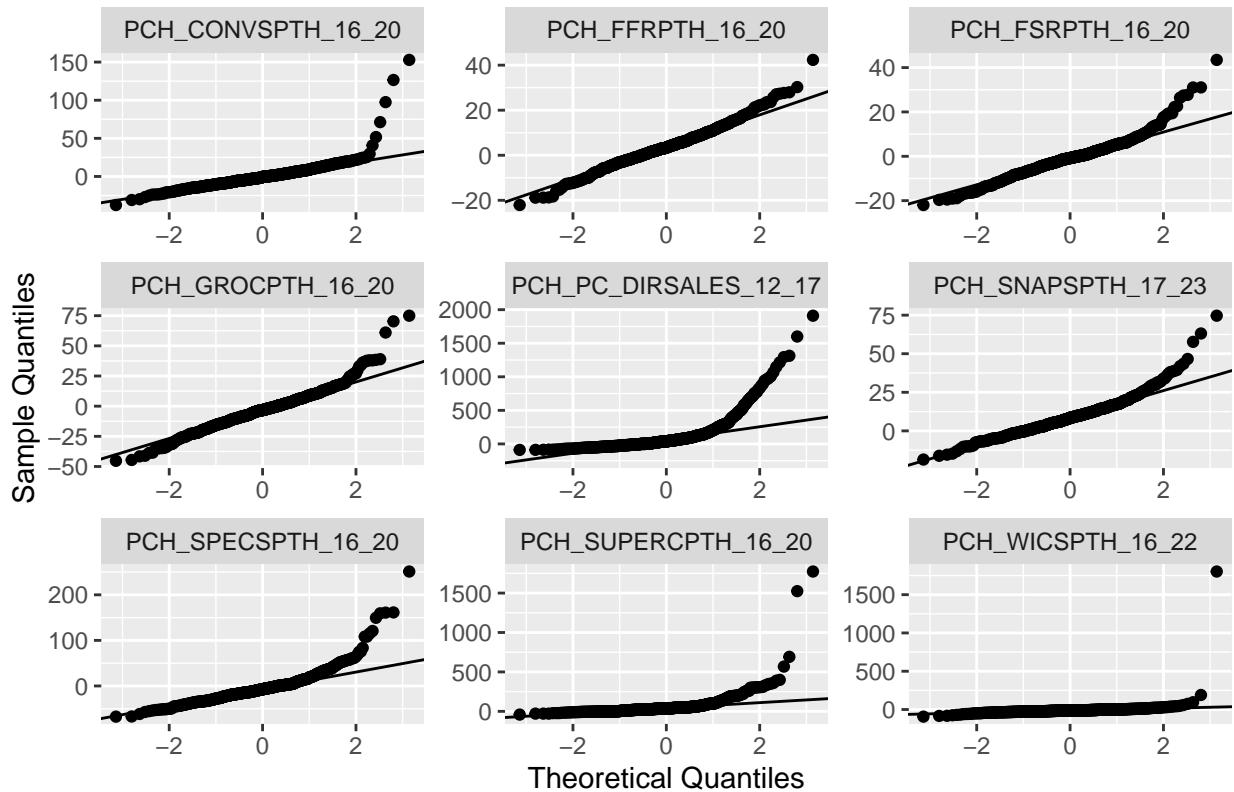
```
theme_minimal()
```



```
options(repr.plot.width = 8, repr.plot.height = 3)

ggplot(atlaspc2_long, aes(sample = food)) +
  stat_qq() +
  stat_qq_line() +
  facet_wrap(~sources, scales = "free") +
  labs(title = "Q-Q Plots for Food Sources",
       x = "Theoretical Quantiles", y = "Sample Quantiles")
```

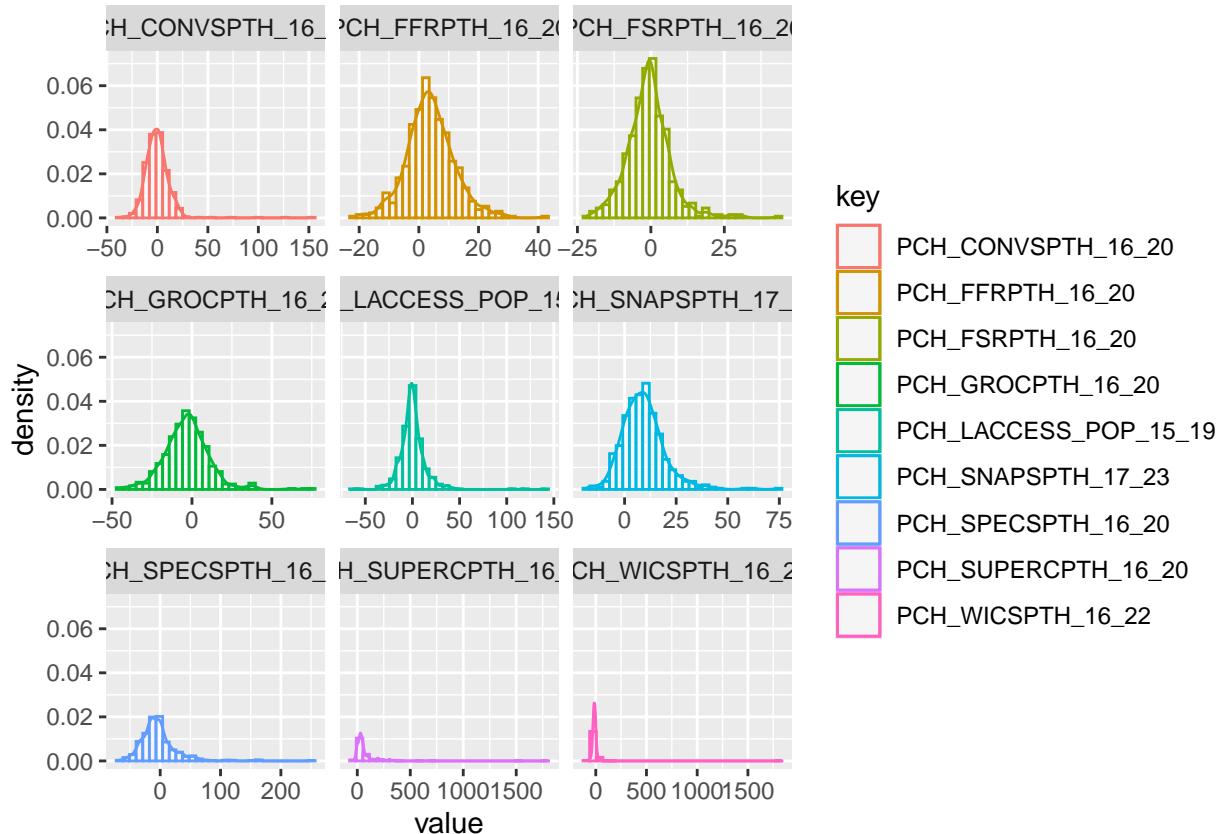
## Q–Q Plots for Food Sources



```
options(repr.plot.width = 8, repr.plot.height = 3)

d <- gather(atlaspcl[,c(1:9)])
ggplot(d,aes(x = value, color=key)) +
  facet_wrap(~key,scales = "free_x") +
  geom_histogram(aes(y=after_stat(density)), alpha=0.5,
                 position="identity",fill="white")+
  geom_density(alpha=.2)

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



```
pcmodel <- lm(PCH_LACCESS_POP_15_19 ~ ., data = atlaspc2)
pcmodel
```

```
##
## Call:
## lm(formula = PCH_LACCESS_POP_15_19 ~ ., data = atlaspc2)
##
## Coefficients:
##             (Intercept)      PCH_GROCPHTH_16_20      PCH_SUPERCPHTH_16_20
##                 0.811170          -0.087606          0.003371
##     PCH_CONVSPTH_16_20      PCH_SPECSPTH_16_20      PCH_SNAPSPTH_17_23
##                 -0.030915          -0.001288          -0.006356
##     PCH_WICSPTH_16_22      PCH_FFRPTH_16_20      PCH_FSRPTH_16_20
##                 -0.006885          -0.171426          0.275960
## PCH_PC_DIRSALES_12_17
##                 -0.001984
## 
## predict(pcmodel, newdata=data.frame(PCH_GROCPHTH_16_20=1, PCH_SUPERCPHTH_16_20=1, PCH_CONVSPTH_16_20=1, PCH_WICSPTH_16_22=1))
## 
##           1
## 0.7840411
## 
## summary(pcmodel)
##
## Call:
## lm(formula = PCH_LACCESS_POP_15_19 ~ ., data = atlaspc2)
## 
```

```

## Residuals:
##      Min     1Q Median     3Q    Max
## -55.850 -6.839 -1.093  4.933 135.044
##
## Coefficients:
##                               Estimate Std. Error t value Pr(>|t|)
## (Intercept)               0.811170  0.987088  0.822 0.411537
## PCH_GROCPTH_16_20        -0.087606  0.043835 -1.999 0.046120 *
## PCH_SUPERCPTH_16_20       0.003371  0.005105  0.660 0.509348
## PCH_CONVSPTH_16_20        -0.030915  0.044485 -0.695 0.487365
## PCH_SPECSPTH_16_20        -0.001288  0.019792 -0.065 0.948144
## PCH_SNAPSPTH_17_23        -0.006356  0.059314 -0.107 0.914704
## PCH_WICSPTH_16_22         -0.006885  0.007928 -0.868 0.385538
## PCH_FFRPTH_16_20          -0.171426  0.076598 -2.238 0.025598 *
## PCH_FSRPTH_16_20           0.275960  0.082413  3.348 0.000865 ***
## PCH_PC_DIRSALES_12_17     -0.001984  0.002735 -0.726 0.468319
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 14.85 on 584 degrees of freedom
## Multiple R-squared:  0.03932,   Adjusted R-squared:  0.02451
## F-statistic: 2.656 on 9 and 584 DF,  p-value: 0.005046

```

```
confint(pcmodel)
```

```

##                               2.5 %      97.5 %
## (Intercept)             -1.127503890  2.749844070
## PCH_GROCPTH_16_20        -0.173699347 -0.001512995
## PCH_SUPERCPTH_16_20       -0.006655960  0.013397398
## PCH_CONVSPTH_16_20        -0.118284205  0.056455076
## PCH_SPECSPTH_16_20        -0.040160353  0.037584775
## PCH_SNAPSPTH_17_23        -0.122850914  0.110139426
## PCH_WICSPTH_16_22         -0.022456220  0.008686580
## PCH_FFRPTH_16_20          -0.321867890 -0.020984265
## PCH_FSRPTH_16_20           0.114097906  0.437821843
## PCH_PC_DIRSALES_12_17    -0.007355228  0.003386331

```

```
anova(pcmodel)
```

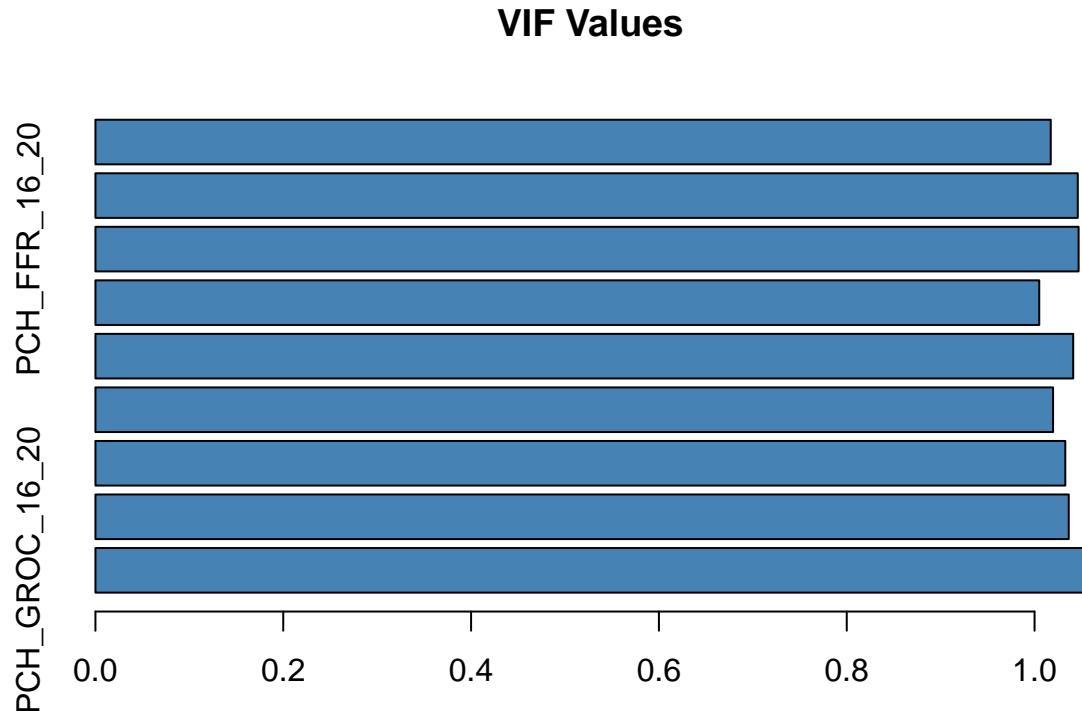
```

## Analysis of Variance Table
##
## Response: PCH_LACCESS_POP_15_19
##                               Df Sum Sq Mean Sq F value    Pr(>F)
## PCH_GROCPTH_16_20          1    951  951.05  4.3105 0.0383149 *
## PCH_SUPERCPTH_16_20         1     49   48.97  0.2219 0.6377481
## PCH_CONVSPTH_16_20          1     29   28.54  0.1293 0.7192410
## PCH_SPECSPTH_16_20          1      1    0.54  0.0024 0.9607049
## PCH_SNAPSPTH_17_23          1      1    0.86  0.0039 0.9503561
## PCH_WICSPTH_16_22           1    133  133.48  0.6050 0.4369922
## PCH_FFRPTH_16_20            1   1485 1485.09  6.7309 0.0097133 **
## PCH_FSRPTH_16_20            1   2509 2508.65 11.3701 0.0007957 ***
## PCH_PC_DIRSALES_12_17       1    116  116.19  0.5266 0.4683191
## Residuals                  584 128852  220.64
##
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

```

Assumptions: testing linearity, independence, homoskedasticity, etc.

```
#create vector of VIF values
vif_values <- vif(model)
barplot(vif_values, main = "VIF Values", horiz = TRUE, col = "steelblue") #create horizontal bar chart
#add vertical line at 5 as after 5 there is severe correlation
abline(v = 5, lwd = 3, lty = 2)
```



```
# independent variables
data_x <- atlas2[,1:3]
# independent variables correlation matrix
var <- cor(data_x)
## or solve independent variables inverse correlation matrix
var_inv <- ginv(var)
# rename the row names and column names
colnames(var_inv) <- colnames(data_x)
rownames(var_inv) <- colnames(data_x)
var_inv

##          PCH_LACCESS_POP_15_19 PCH_GROC_16_20 PCH_SUPER_C_16_20
## PCH_LACCESS_POP_15_19      1.016762202   0.13018761   -0.006190331
## PCH_GROC_16_20            0.130187605   1.01787972    0.034018141
## PCH_SUPER_C_16_20         -0.006190331   0.03401814    1.001248013

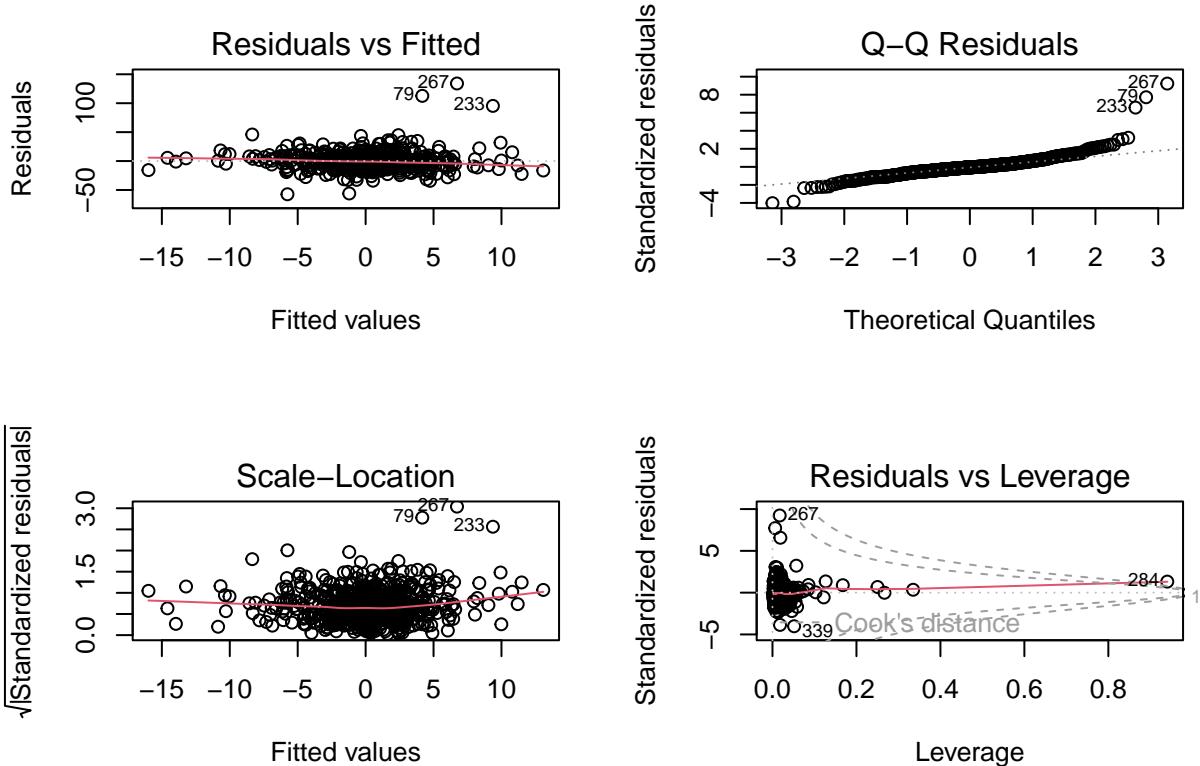
model.arg <- augment(model, se_fit = TRUE)
head(model.arg)

## # A tibble: 6 x 17
```

```

##   PCH_LACCESS_POP_15_19 PCH_GROC_16_20 PCH_SUPERC_16_20 PCH_CONVS_16_20
##   <dbl>           <dbl>           <dbl>           <dbl>
## 1      -1.32            0             28.6            0
## 2     -8.19            0             33.3            2.82
## 3    -0.0797          5.61           -5.26           1.09
## 4      10.3             0             33.3            18.4
## 5     -3.73           -2.17            0            -7.83
## 6     -4.41            4.55            0            -9.46
## # i 13 more variables: PCH_SPECS_16_20 <dbl>, PCH_SNAPS_17_23 <dbl>,
## # PCH_WICS_16_22 <dbl>, PCH_FFR_16_20 <dbl>, PCH_FSR_16_20 <dbl>,
## # PCH_DIRSALES_12_17 <dbl>, .fitted <dbl>, .se.fit <dbl>, .resid <dbl>,
## # .hat <dbl>, .sigma <dbl>, .cooksdi <dbl>, .std.resid <dbl>
par(mfrow = c(2, 2))
plot(model)

```

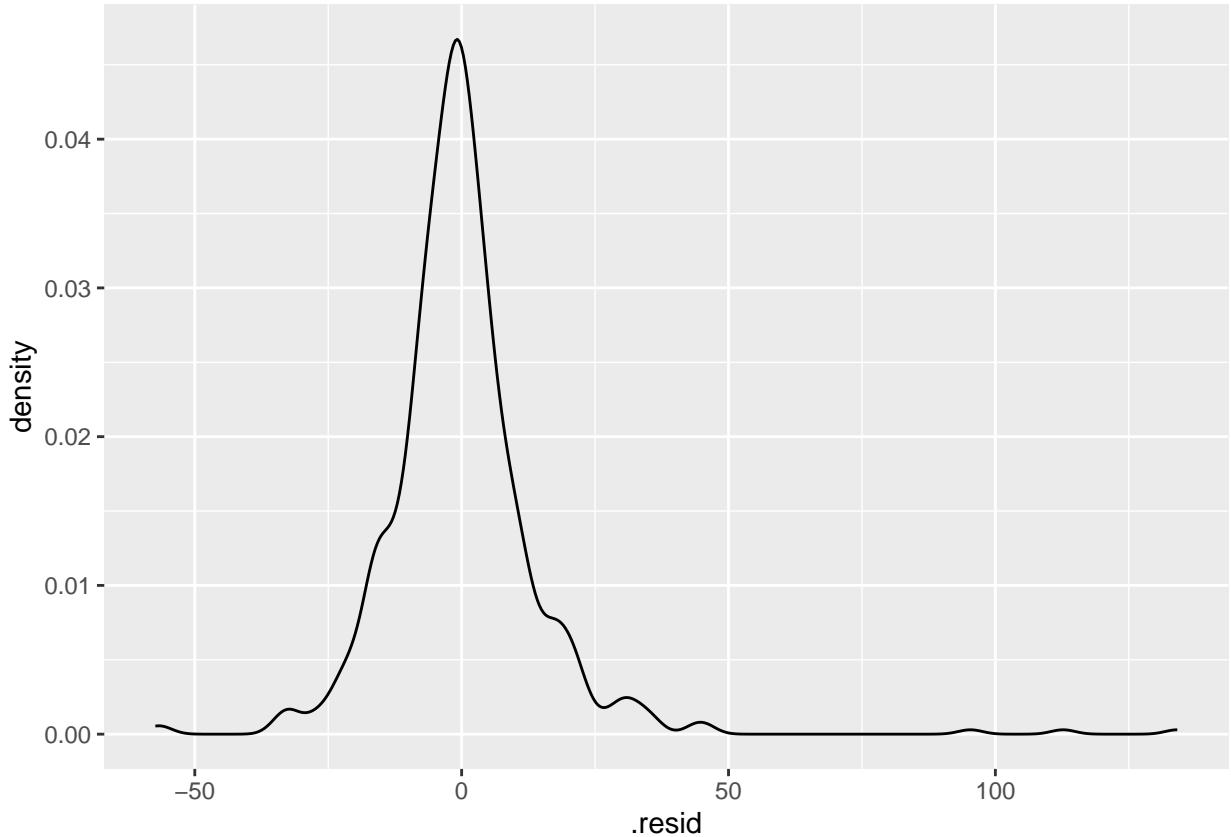


```

mshapiro.test(t(model.arg$resid))

##
##  Shapiro-Wilk normality test
##
##  data:  Z
##  W = 0.82313, p-value < 2.2e-16
ggplot(model.arg) +
  geom_density(aes(x=.resid))

```



```

# Add observations indices and
# drop some columns (.se.fit, .sigma) for simplification
model.args %>%
  mutate(index = 1:nrow(model.args)) %>%
  filter(index %in% c(6,76,131))

## # A tibble: 3 x 18
##   PCH_LACCESS_POP_15_19 PCH_GROC_16_20 PCH_SUPERC_16_20 PCH_CONVS_16_20
##   <dbl>           <dbl>           <dbl>           <dbl>
## 1 -4.41            4.55            0             -9.46
## 2 -0.875           -7.14           33.3           7.27
## 3  4.47             0              50            -1.69
## # i 14 more variables: PCH_SPECS_16_20 <dbl>, PCH_SNAPS_17_23 <dbl>,
## #   PCH_WICS_16_22 <dbl>, PCH_FFR_16_20 <dbl>, PCH_FSR_16_20 <dbl>,
## #   PCH_DIRSALES_12_17 <dbl>, .fitted <dbl>, .se.fit <dbl>, .resid <dbl>,
## #   .hat <dbl>, .sigma <dbl>, .cooks <dbl>, .std.resid <dbl>, index <int>

# again for model2
vif_values2 <- vif(model2)
barplot(vif_values2, main = "VIF Values", horiz = TRUE, col = "steelblue")
abline(v = 5, lwd = 3, lty = 2)
data_x2 <- atlas3[,1:3]
var2 <- cor(data_x2)
var_inv2 <- ginv(var2)
colnames(var_inv2) <- colnames(data_x2)
rownames(var_inv2) <- colnames(data_x2)
var_inv2

```

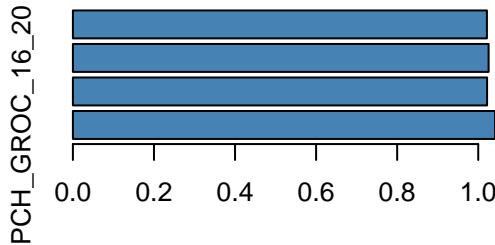
```

##          PCH_LACCESS_POP_15_19 PCH_GROC_16_20 PCH_CONVS_16_20
## PCH_LACCESS_POP_15_19           1.02068363    0.1373672    0.06337882
## PCH_GROC_16_20                  0.13736716    1.0289901    0.11154921
## PCH_CONVS_16_20                 0.06337882    0.1115492    1.01443818
model2.arg <- augment(model2, se_fit = TRUE)
head(model2.arg)

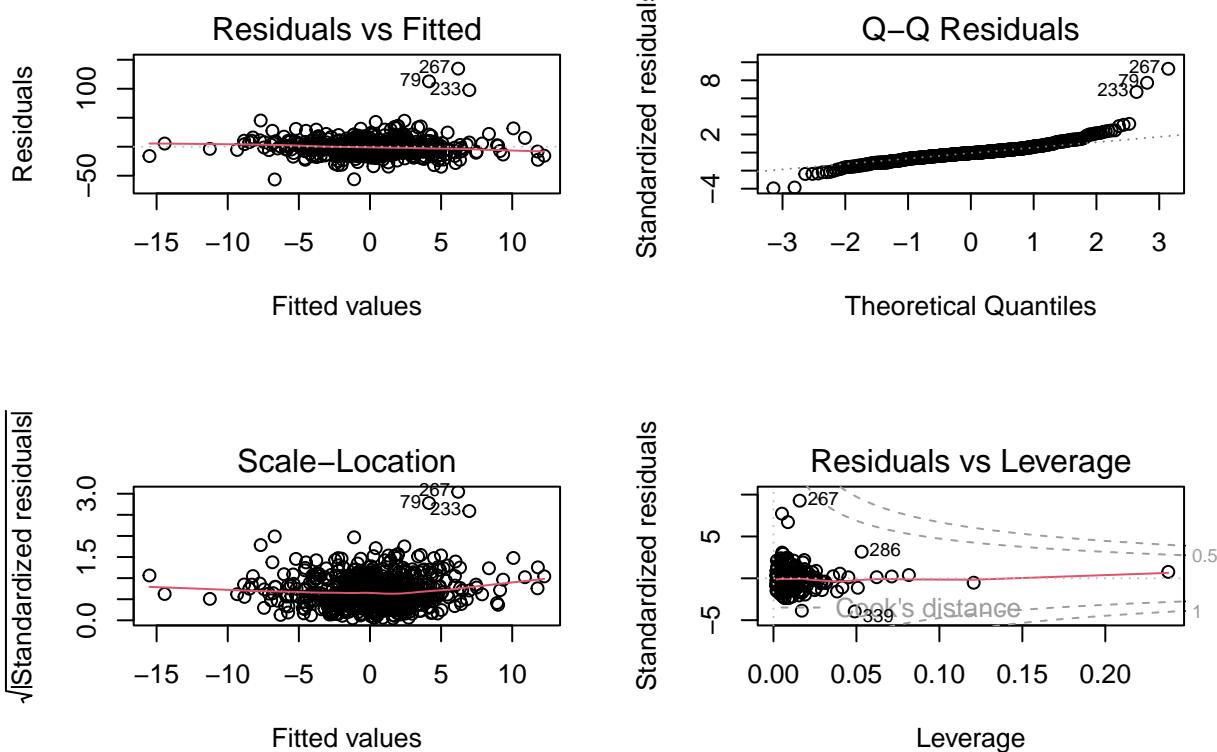
## # A tibble: 6 x 12
##   PCH_LACCESS_POP_15_19 PCH_GROC_16_20 PCH_CONVS_16_20 PCH_FFR_16_20
##   <dbl>             <dbl>             <dbl>             <dbl>
## 1 -1.32              0                 0                10.3
## 2 -8.19              0                 2.82             4.31
## 3 -0.0797            5.61              1.09             -3.81
## 4 10.3               0                 18.4              8.45
## 5 -3.73              -2.17             -7.83             9.01
## 6 -4.41              4.55              -9.46             17.5
## # i 8 more variables: PCH_FSR_16_20 <dbl>, .fitted <dbl>, .se.fit <dbl>,
## #   .resid <dbl>, .hat <dbl>, .sigma <dbl>, .cooks.d <dbl>, .std.resid <dbl>
par(mfrow = c(2, 2))

```

### VIF Values

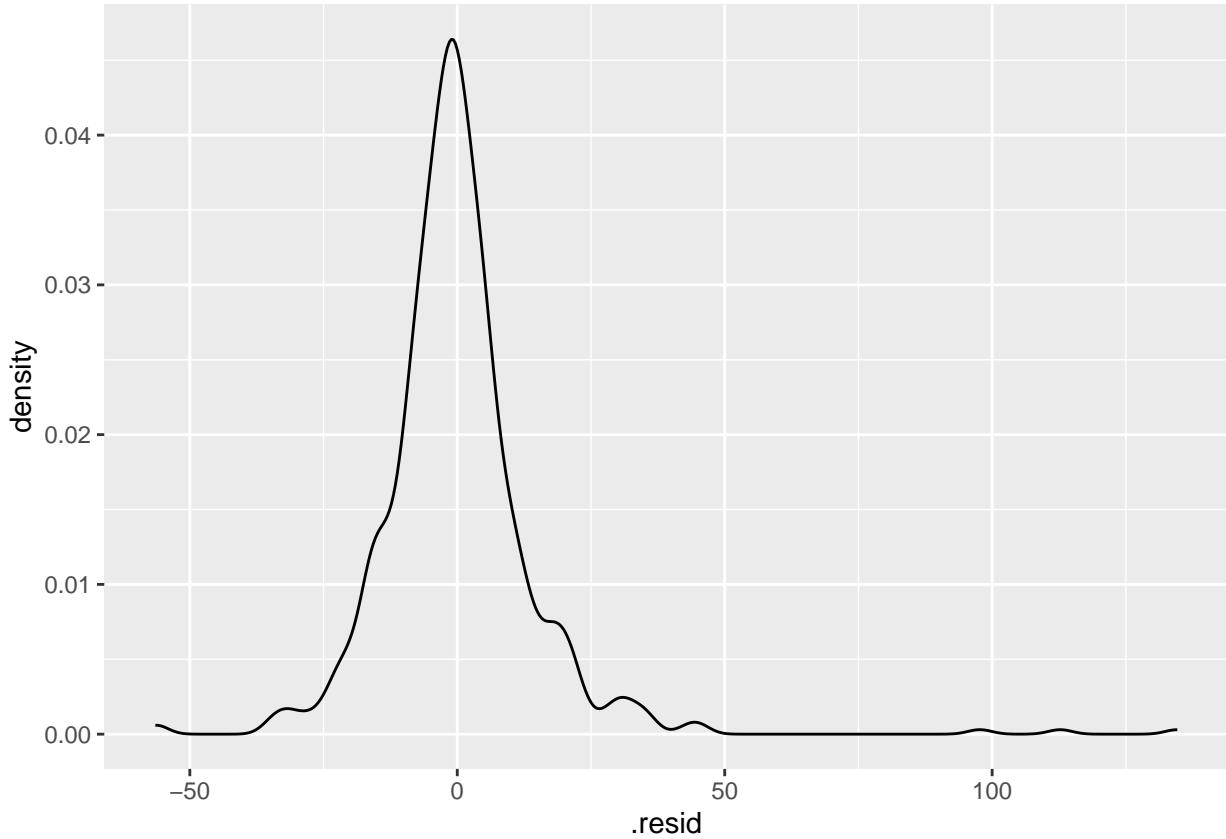


```
plot(model2)
```



```
mshapiro.test(t(model2.arg$resid))
```

```
##  
## Shapiro-Wilk normality test  
##  
## data: Z  
## W = 0.82107, p-value < 2.2e-16  
ggplot(model2.arg) +  
  geom_density(aes(x=.resid))
```



```

model2.arg %>%
  mutate(index = 1:nrow(model2.arg)) %>%
  filter(index %in% c(6,76,131))

## # A tibble: 3 x 13
##   PCH_LACCESS_POP_15_19 PCH_GROC_16_20 PCH_CONVS_16_20 PCH_FFR_16_20
##   <dbl>             <dbl>             <dbl>             <dbl>
## 1     -4.41              4.55            -9.46             17.5
## 2    -0.875             -7.14              7.27            23.9
## 3      4.47               0            -1.69             19.2
## # i 9 more variables: PCH_FSR_16_20 <dbl>, .fitted <dbl>, .se.fit <dbl>,
## #   .resid <dbl>, .hat <dbl>, .sigma <dbl>, .cooks.d <dbl>, .std.resid <dbl>,
## #   index <int>

# again for pcmodel
pcvif_values <- vif(pcmodel)
barplot(pcvif_values, main = "VIF Values", horiz = TRUE, col = "steelblue")
abline(v = 5, lwd = 3, lty = 2)
pcdata_x <- atlaspca2[,1:3]
pcvar <- cor(pcdata_x)
pcvar_inv <- ginv(pcvar)
colnames(pcvar_inv) <- colnames(pcdata_x)
rownames(pcvar_inv) <- colnames(pcdata_x)
pcvar_inv

##                               PCH_LACCESS_POP_15_19 PCH_GROCPHT_16_20
## PCH_LACCESS_POP_15_19           1.00751187        0.084995097

```

```

## PCH_GROCPTH_16_20          0.08499510    1.007235782
## PCH_SUPERCPTH_16_20        -0.01925119   -0.009716176
##                               PCH_SUPERCPTH_16_20
## PCH_LACCESS_POP_15_19      -0.019251188
## PCH_GROCPTH_16_20          -0.009716176
## PCH_SUPERCPTH_16_20         1.000433323

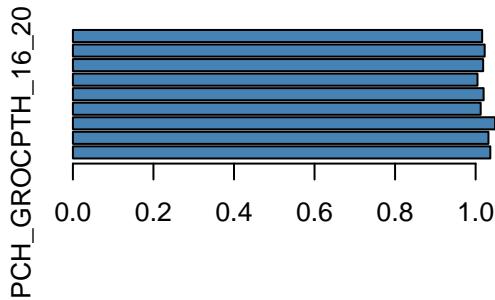
pcmodel.arg <- augment(pcmodel, se_fit = TRUE)
head(pcmodel.arg)

## # A tibble: 6 x 17
##   PCH_LACCESS_POP_15_19 PCH_GROCPTH_16_20 PCH_SUPERCPTH_16_20 PCH_CONVSPTH_16_20
##   <dbl>                <dbl>                <dbl>                <dbl>
## 1 -1.32                 -9.38                16.5               -9.38
## 2 -8.19                 -2.09                30.5               0.670
## 3 -0.0797                6.44                -4.52               1.89
## 4 10.3                  -0.907               32.1               17.3
## 5 -3.73                 -7.97                -5.92              -13.3
## 6 -4.41                 2.53                -1.92              -11.2
## # i 13 more variables: PCH_SPECSPTH_16_20 <dbl>, PCH_SNAPSPTH_17_23 <dbl>,
## # PCH_WICSPTH_16_22 <dbl>, PCH_FFRPTH_16_20 <dbl>, PCH_FSRPTH_16_20 <dbl>,
## # PCH_PC_DIRSALES_12_17 <dbl>, .fitted <dbl>, .se.fit <dbl>, .resid <dbl>,
## # .hat <dbl>, .sigma <dbl>, .cooksdi <dbl>, .std.resid <dbl>

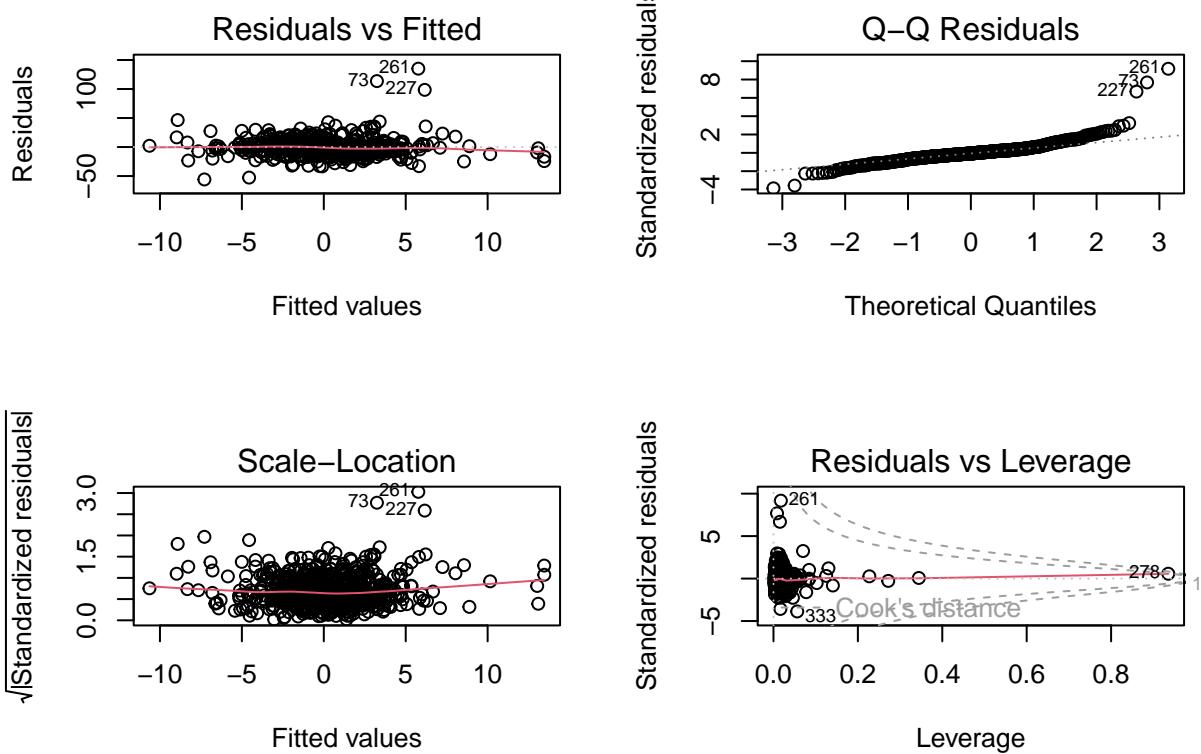
par(mfrow = c(2, 2))

```

### VIF Values

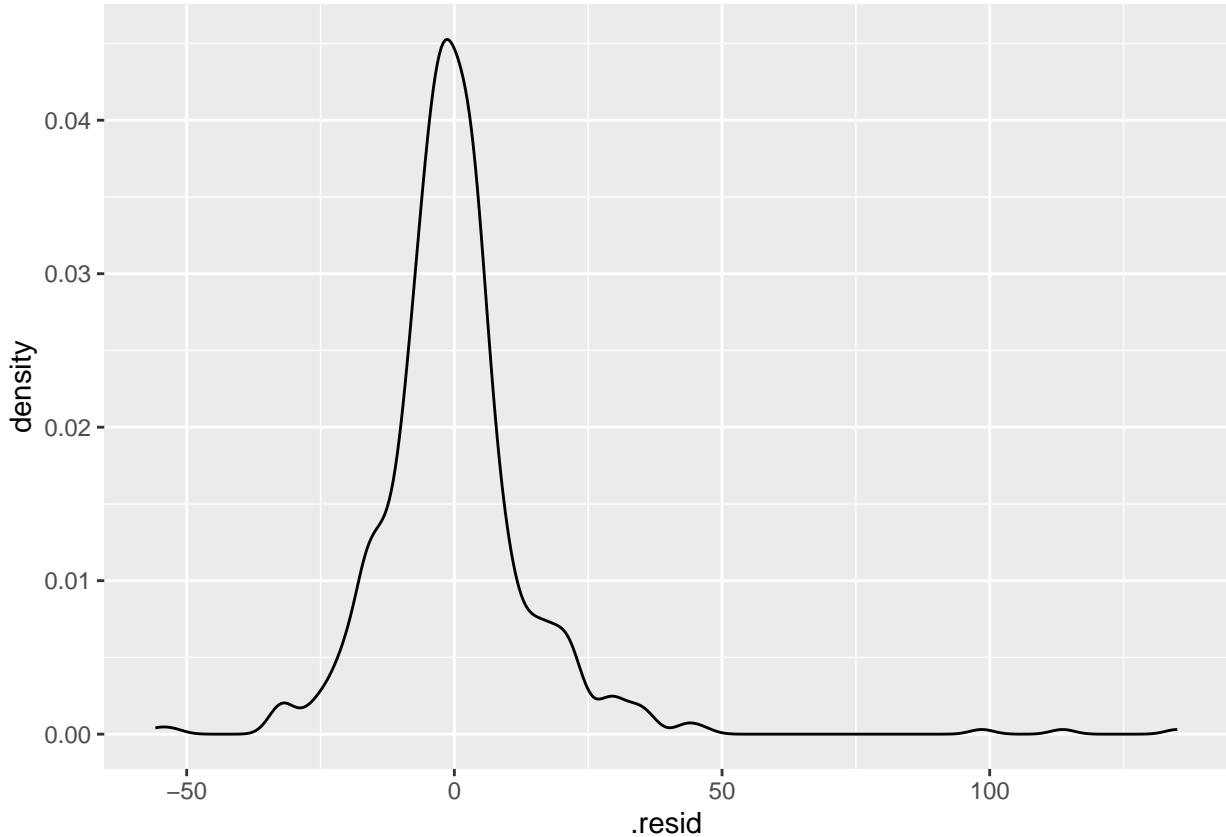


```
plot(pcmodel)
```



```
mshapiro.test(t(pcmodel.arg$resid))
```

```
##  
## Shapiro-Wilk normality test  
##  
## data: Z  
## W = 0.82102, p-value < 2.2e-16  
ggplot(pcmodel.arg) +  
  geom_density(aes(x=.resid))
```



```

pcmodel.arg %>%
  mutate(index = 1:nrow(pcmodel.arg)) %>%
  filter(index %in% c(6,76,131))

## # A tibble: 3 x 18
##   PCH_LACCESS_POP_15_19 PCH_GROCPTH_16_20 PCH_SUPERCPTH_16_20 PCH_CONVSPTH_16_20
##   <dbl>                <dbl>                <dbl>                <dbl>
## 1 -4.41                 2.53                -1.92               -11.2
## 2 -2.67                -0.363               34.4                -3.20
## 3 -2.61                 10.2                 14.8                -2.18
## # i 14 more variables: PCH_SPECSPTH_16_20 <dbl>, PCH_SNAPSPTH_17_23 <dbl>,
## # PCH_WICSPTH_16_22 <dbl>, PCH_FFRPTH_16_20 <dbl>, PCH_FSRPTH_16_20 <dbl>,
## # PCH_PC_DIRSALES_12_17 <dbl>, .fitted <dbl>, .se.fit <dbl>, .resid <dbl>,
## # .hat <dbl>, .sigma <dbl>, .cooksrd <dbl>, .std.resid <dbl>, index <int>

```

For models 1 and 2 and the per capita model, the VIF looks to be slightly higher than 1, suggesting moderate multicollinearity. The Residual v. Fitted Plot suggests linearity because there is a horizontal line without any distinct patterns. The Normal Q-Q Plot suggests that the residuals are normally distributed because they follow the red line. The Scale-Location suggests that we have homoscedasticity because there is a horizontal line with equally spread points.

Results, interpretation, and insights:

Comparing the first and second models, the first model's Shapiro-Wilk test had a W of 0.12859 with a significant p-value, so we cannot say that the data are multivariate normal. The second model's W is much closer to 1 at 0.74753 with a significant p-value, so we can say that the data are multivariate normal.

In the first model, the intercept for grocery stores was -.109 with a p-value of .00842, the intercept for

convenience stores was -.072 with a p-value of .09752, the intercept for fast food was -.267 with a p-value of 8.33e-05, and the intercept for full-service restaurants was .140 with a p-value of .06602. In the second model, the intercept for grocery stores was -.116 with a p-value of .00442, the intercept for convenience stores was -.0737 with a p-value of .08702, the intercept for fast food was -.275 with a p-value of 4.02e-05, and the intercept for full-service restaurants was .132 with a p-value of .07825.

The first model had a residual standard error of 14.65 on 590 df, an adjusted  $R^2$  of .04206—very low. Its F-statistic was 3.922 with a p-value of 7.339e-05. (Need to fix code for second model) The second model had a residual standard error of 14.63 on 595 df, an adjusted  $R^2$  of .04503—again, very low. Its F-statistic was 8.061 with a p-value of 2.476e-06.

For the per capita variables, the model's Shapiro-Wilk test had a W of 0.13286 with a significant p-value, so we cannot say that the data are multivariate normal. The intercept for grocery stores was -.088 with a p-value of .046, the intercept for fast food was -.171 with a p-value of .026, and the intercept for full service restaurants was .276 with a p-value of .000865. The first model had a residual standard error of 14.85 on 584 df, an adjusted  $R^2$  of .0245—even lower. Its F-statistic was 2.656 with a p-value of .005. I am deciding against using the per capita models for now.