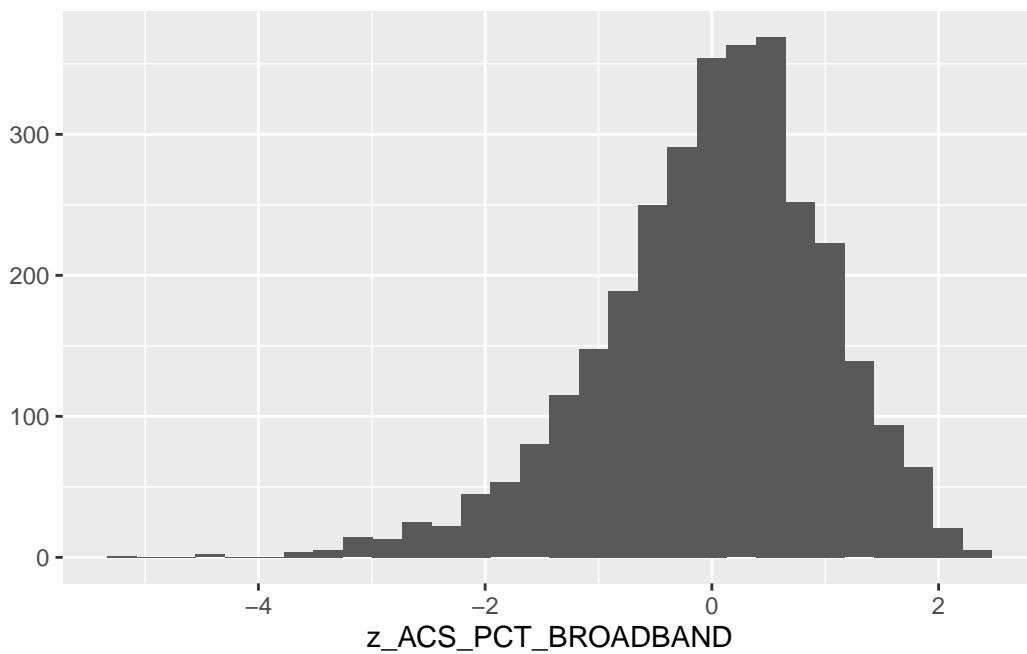# Infrastructure Model

S.Kelly

Updated 11-9-23; Change made: removed *z_uc_percent*

DV Histogram (Broadband)

```
ggplot(data = Z_and_Final_Variables_10.28.22, mapping = aes(x = z_ACS_PCT_BROADBAND)) +
    geom_histogram() + labs(y = NULL)
```



```
summary(Z_and_Final_Variables_10.28.22$ACS_PCT_BROADBAND)
```

```
  Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
  25.65   67.43   73.57   72.69   78.79   95.51
```

```
options(scipen = 990) #turning off scientific notation for coefficients
```

Infrastructure Model Groupings

IV: Demographics (9 variables), DV: Broadband

```
z_bb_just_demos <- lm(formula = z_ACS_PCT_BROADBAND ~ z_ACS_PCT_BLACK +
    z_ACS_PCT_HISPAN + z_SVI_RPL_THEME1_SOCIECO + z_SVI_RPL_THEME2_HH_DISB +
    z_SVI_RPL_THEME3_MINO + z_SVI_RPL_THEME4_HH_TRANS + z_ACS_PCT_ENGL_NOT_WELL +
    z_ACS_PCT_NON_CITIZEN + z_ACS_MEDIAN_AGE, data = Z_and_Final_Variables_10.28.22)
summary(z_bb_just_demos)
```

```
Call:
lm(formula = z_ACS_PCT_BROADBAND ~ z_ACS_PCT_BLACK + z_ACS_PCT_HISPAN +
    z_SVI_RPL_THEME1_SOCIECO + z_SVI_RPL_THEME2_HH_DISB + z_SVI_RPL_THEME3_MINO +
    z_SVI_RPL_THEME4_HH_TRANS + z_ACS_PCT_ENGL_NOT_WELL + z_ACS_PCT_NON_CITIZEN +
    z_ACS_MEDIAN_AGE, data = Z_and_Final_Variables_10.28.22)

Residuals:
    Min      1Q  Median      3Q     Max
-4.4496 -0.3385  0.0678  0.4291  1.6833

Coefficients:
                            Estimate Std. Error t value            Pr(>|t|)
(Intercept)                0.0005465  0.0115555   0.047               0.962
z_ACS_PCT_BLACK           -0.2094188  0.0155848 -13.437 < 0.0000000000000002
z_ACS_PCT_HISPAN          -0.1878035  0.0208245  -9.018 < 0.0000000000000002
z_SVI_RPL_THEME1_SOCIECO  -0.5889010  0.0186520 -31.573 < 0.0000000000000002
z_SVI_RPL_THEME2_HH_DISB  -0.0749303  0.0158309  -4.733          0.000002309
z_SVI_RPL_THEME3_MINO      0.2371591  0.0209542  11.318 < 0.0000000000000002
z_SVI_RPL_THEME4_HH_TRANS  0.0143331  0.0153964   0.931               0.352
z_ACS_PCT_ENGL_NOT_WELL   -0.1725060  0.0329589  -5.234          0.000000177
z_ACS_PCT_NON_CITIZEN      0.2597486  0.0298253   8.709 < 0.0000000000000002
z_ACS_MEDIAN_AGE          -0.1888626  0.0138262 -13.660 < 0.0000000000000002
```

```
(Intercept)
z_ACS_PCT_BLACK             ***
z_ACS_PCT_HISPAN            ***
z_SVI_RPL_THEME1_SOCIECO    ***
z_SVI_RPL_THEME2_HH_DISB    ***
z_SVI_RPL_THEME3_MINO       ***
z_SVI_RPL_THEME4_HH_TRANS
z_ACS_PCT_ENGL_NOT_WELL     ***
z_ACS_PCT_NON_CITIZEN       ***
z_ACS_MEDIAN_AGE            ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.6475 on 3130 degrees of freedom
  (1 observation deleted due to missingness)
Multiple R-squared:  0.5814,    Adjusted R-squared:  0.5802
F-statistic:   483 on 9 and 3130 DF,  p-value: < 0.00000000000000022
```

Confidence Intervals for Demographic IVs

```
confint(z_bb_just_demos)
```

```
                            2.5 %       97.5 %
(Intercept)             -0.02211055  0.02320360
z_ACS_PCT_BLACK         -0.23997621 -0.17886134
z_ACS_PCT_HISPAN        -0.22863466 -0.14697235
z_SVI_RPL_THEME1_SOCIECO -0.62547244 -0.55232966
z_SVI_RPL_THEME2_HH_DISB -0.10597027 -0.04389027
z_SVI_RPL_THEME3_MINO    0.19607364  0.27824455
z_SVI_RPL_THEME4_HH_TRANS -0.01585491  0.04452109
z_ACS_PCT_ENGL_NOT_WELL  -0.23712932 -0.10788270
z_ACS_PCT_NON_CITIZEN    0.20126945  0.31822785
z_ACS_MEDIAN_AGE        -0.21597188 -0.16175339
```

VIF for Demographic IVs

```r
vif(z_bb_just_demos)
```

z_ACS_PCT_BLACK	z_ACS_PCT_HISPAN	z_SVI_RPL_THEME1_SOCIECO
1.818786	3.226749	2.604590
z_SVI_RPL_THEME2_HH_DISB	z_SVI_RPL_THEME3_MINO	z_SVI_RPL_THEME4_HH_TRANS
1.875876	3.286010	1.775255
z_ACS_PCT_ENGL_NOT_WELL	z_ACS_PCT_NON_CITIZEN	z_ACS_MEDIAN_AGE
8.135213	6.661849	1.431619

IV: Food & Housing (14 variables), DV: Broadband

```r
z_bb_just_foodhouse <- lm(formula = z_ACS_PCT_BROADBAND ~ z_food_afford +
    z_fd_enviro_indx + z_fi_percent + z_ACS_PCT_FOOD_STAMP +
    z_childelig_lunch_perc + z_shp_percent + z_shcb_percent +
    z_ACS_PCT_NO_VEH + z_ACS_PCT_RENTER_HH_CHILD + z_ACS_PCT_RENT_COST_30PCT +
    z_ACS_PCT_MOBILE_HOME + z_ACS_PCT_OWNED_HH + z_ACS_PCT_OWNER_HH_CHILD +
    z_ACS_MEDIAN_HOME_VALUE, data = Z_and_Final_Variables_10.28.22)
summary(z_bb_just_foodhouse)
```

```
Call:
lm(formula = z_ACS_PCT_BROADBAND ~ z_food_afford + z_fd_enviro_indx +
    z_fi_percent + z_ACS_PCT_FOOD_STAMP + z_childelig_lunch_perc +
    z_shp_percent + z_shcb_percent + z_ACS_PCT_NO_VEH + z_ACS_PCT_RENTER_HH_CHILD +
    z_ACS_PCT_RENT_COST_30PCT + z_ACS_PCT_MOBILE_HOME + z_ACS_PCT_OWNED_HH +
    z_ACS_PCT_OWNER_HH_CHILD + z_ACS_MEDIAN_HOME_VALUE, data = Z_and_Final_Variables_10.28.2

Residuals:
    Min      1Q  Median      3Q     Max
-2.9795 -0.3011  0.0549  0.3613  3.2690

Coefficients:
                        Estimate Std. Error t value            Pr(>|t|)
(Intercept)             0.017909   0.010988   1.630             0.10323
z_food_afford          -0.305351   0.017277 -17.673 < 0.0000000000000002 ***
z_fd_enviro_indx        0.021469   0.018994   1.130             0.25846
z_fi_percent           -0.071075   0.022313  -3.185             0.00146 **
```

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```
z_ACS_PCT_FOOD_STAMP        0.012905    0.021193    0.609                    0.54264
z_childelig_lunch_perc     -0.198582    0.019500  -10.184 < 0.0000000000000002 ***
z_shp_percent               0.051305    0.019945    2.572                    0.01015 *
z_shcb_percent              0.069305    0.021856    3.171                    0.00154 **
z_ACS_PCT_NO_VEH           -0.121732    0.015052   -8.088   0.0000000000000009 ***
z_ACS_PCT_RENTER_HH_CHILD  -0.003632    0.013218   -0.275                    0.78350
z_ACS_PCT_RENT_COST_30PCT   0.020621    0.015748    1.309                    0.19050
z_ACS_PCT_MOBILE_HOME      -0.190954    0.015058  -12.681 < 0.0000000000000002 ***
z_ACS_PCT_OWNED_HH         -0.070983    0.015369   -4.619   0.0000040366975395 ***
z_ACS_PCT_OWNER_HH_CHILD    0.151136    0.012947   11.673 < 0.0000000000000002 ***
z_ACS_MEDIAN_HOME_VALUE     0.239520    0.016755   14.296 < 0.0000000000000002 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.5725 on 2777 degrees of freedom
  (349 observations deleted due to missingness)
Multiple R-squared:  0.683, Adjusted R-squared:  0.6814
F-statistic: 427.4 on 14 and 2777 DF,  p-value: < 0.00000000000000022
```

Confidence Intervals for Food & Housing IVs

```
confint(z_bb_just_foodhouse)
```

```
                             2.5 %       97.5 %
(Intercept)              -0.003635911  0.03945432
z_food_afford            -0.339229249 -0.27147353
z_fd_enviro_indx         -0.015775638  0.05871335
z_fi_percent             -0.114825708 -0.02732411
z_ACS_PCT_FOOD_STAMP     -0.028651901  0.05446127
z_childelig_lunch_perc   -0.236818410 -0.16034610
z_shp_percent             0.012197102  0.09041331
z_shcb_percent            0.026449119  0.11215997
z_ACS_PCT_NO_VEH         -0.151245411 -0.09221801
z_ACS_PCT_RENTER_HH_CHILD -0.029549525  0.02228555
z_ACS_PCT_RENT_COST_30PCT -0.010258057  0.05149930
z_ACS_PCT_MOBILE_HOME    -0.220480379 -0.16142764
z_ACS_PCT_OWNED_HH       -0.101118334 -0.04084835
z_ACS_PCT_OWNER_HH_CHILD  0.125749184  0.17652365
z_ACS_MEDIAN_HOME_VALUE   0.206667312  0.27237304
```

VIF for Food & Housing IVs

```
vif(z_bb_just_foodhouse)
```

z_food_afford	z_fd_enviro_indx	z_fi_percent
2.621112	3.130668	4.291634
z_ACS_PCT_FOOD_STAMP	z_childelig_lunch_perc	z_shp_percent
3.835126	2.604164	3.513064
z_shcb_percent	z_ACS_PCT_NO_VEH	z_ACS_PCT_RENTER_HH_CHILD
4.130954	2.031232	1.510216
z_ACS_PCT_RENT_COST_30PCT	z_ACS_PCT_MOBILE_HOME	z_ACS_PCT_OWNED_HH
2.111717	1.958472	1.985582
z_ACS_PCT_OWNER_HH_CHILD	z_ACS_MEDIAN_HOME_VALUE	
1.476876	2.335424	

IV: Education (3 variables), DV: Broadband

```
z_bb_just_ed <- lm(formula = z_ACS_PCT_BROADBAND ~ z_hsg_rate +
    z_sc_percent + z_ms_average, data = Z_and_Final_Variables_10.28.22)
summary(z_bb_just_ed)
```

```
Call:
lm(formula = z_ACS_PCT_BROADBAND ~ z_hsg_rate + z_sc_percent +
    z_ms_average, data = Z_and_Final_Variables_10.28.22)

Residuals:
    Min      1Q  Median      3Q     Max
-3.2411 -0.3963  0.0696  0.4650  2.7379

Coefficients:
              Estimate Std. Error t value          Pr(>|t|)
(Intercept)  -0.003253   0.015148  -0.215             0.830
z_hsg_rate    0.019587   0.016555   1.183             0.237
z_sc_percent  0.688808   0.016192  42.540 < 0.0000000000000002 ***
z_ms_average  0.062770   0.015715   3.994          0.0000669 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
```

```
Residual standard error: 0.7277 on 2323 degrees of freedom
  (814 observations deleted due to missingness)
Multiple R-squared:  0.4737,     Adjusted R-squared:  0.473
F-statistic:   697 on 3 and 2323 DF,  p-value: < 0.00000000000000022
```

Confidence Intervals for Education IVs

```
confint(z_bb_just_ed)
```

```
                    2.5 %      97.5 %
(Intercept)   -0.03295691 0.02645135
z_hsg_rate    -0.01287647 0.05205137
z_sc_percent   0.65705591 0.72056049
z_ms_average   0.03195359 0.09358651
```

VIF for Education IVs

```
vif(z_bb_just_ed)
```

```
 z_hsg_rate z_sc_percent z_ms_average
   1.022551     1.083295     1.098559
```

IV: Technology (2 variables), DV: Broadband

```
z_bb_just_tech <- lm(formula = z_ACS_PCT_BROADBAND ~ z_ACS_PCT_NO_PC +
    z_ACS_PCT_SMARTPHONE, data = Z_and_Final_Variables_10.28.22)
summary(z_bb_just_tech)
```

```
Call:
lm(formula = z_ACS_PCT_BROADBAND ~ z_ACS_PCT_NO_PC + z_ACS_PCT_SMARTPHONE,
    data = Z_and_Final_Variables_10.28.22)

Residuals:
    Min       1Q   Median       3Q      Max
-2.77959 -0.18062  0.04719  0.22725  1.56762
```

```
Coefficients:
                             Estimate           Std. Error t value
(Intercept)             0.000000000000000275 0.006313808623399291    0.00
z_ACS_PCT_NO_PC        -0.828010400949268033 0.007015150694798672 -118.03
z_ACS_PCT_SMARTPHONE   -0.204451831475379153 0.007015150694798676  -29.14
                             Pr(>|t|)
(Intercept)                         1
z_ACS_PCT_NO_PC        <0.0000000000000002 ***
z_ACS_PCT_SMARTPHONE   <0.0000000000000002 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.3539 on 3138 degrees of freedom
Multiple R-squared:  0.8749,    Adjusted R-squared:  0.8748
F-statistic: 1.097e+04 on 2 and 3138 DF,  p-value: < 0.00000000000000022
```

Confidence Intervals for Technology IVs

```
confint(z_bb_just_tech)
```

```
                         2.5 %      97.5 %
(Intercept)          -0.01237961  0.01237961
z_ACS_PCT_NO_PC      -0.84176515 -0.81425565
z_ACS_PCT_SMARTPHONE -0.21820658 -0.19069708
```

VIF for Technology IVs

```
vif(z_bb_just_tech)
```

```
    z_ACS_PCT_NO_PC z_ACS_PCT_SMARTPHONE
           1.234107             1.234107
```

IV: HWCC (7 variables), DV: Broadband

```
z_bb_just_HWCC <- lm(formula = z_ACS_PCT_BROADBAND ~ z_pphd_avgnum +
    z_pmhd_avgnum + z_lbw_percent_lbw + z_pi_phy_inact + z_cip_perc +
    z_csph_perc + z_ACS_PCT_CHILD_DISAB, data = Z_and_Final_Variables_10.28.22)
summary(z_bb_just_HWCC)
```

```
Call:
lm(formula = z_ACS_PCT_BROADBAND ~ z_pphd_avgnum + z_pmhd_avgnum +
    z_lbw_percent_lbw + z_pi_phy_inact + z_cip_perc + z_csph_perc +
    z_ACS_PCT_CHILD_DISAB, data = Z_and_Final_Variables_10.28.22)

Residuals:
    Min      1Q  Median      3Q     Max
-3.1516 -0.3543  0.0472  0.4080  2.0112

Coefficients:
                      Estimate Std. Error t value            Pr(>|t|)
(Intercept)            0.01145    0.01126   1.017            0.309150
z_pphd_avgnum         -0.29615    0.03696  -8.013  0.00000000000000159 ***
z_pmhd_avgnum          0.23196    0.03316   6.996  0.00000000000323655 ***
z_lbw_percent_lbw      0.02940    0.01498   1.962            0.049820 *
z_pi_phy_inact        -0.22720    0.01352 -16.807 < 0.0000000000000002 ***
z_cip_perc            -0.63233    0.02184 -28.954 < 0.0000000000000002 ***
z_csph_perc            0.06735    0.01674   4.024  0.00005861101315732 ***
z_ACS_PCT_CHILD_DISAB  0.04120    0.01250   3.296            0.000992 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.6189 on 3026 degrees of freedom
  (107 observations deleted due to missingness)
Multiple R-squared:  0.6171,    Adjusted R-squared:  0.6162
F-statistic: 696.6 on 7 and 3026 DF,  p-value: < 0.00000000000000022
```

Confidence Intervals for HWCC IVs

```
confint(z_bb_just_HWCC)
```

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```
                             2.5 %        97.5 %
(Intercept)            -0.01062039361  0.03351819
z_pphd_avgnum          -0.36862224638 -0.22367984
z_pmhd_avgnum           0.16694702375  0.29697542
z_lbw_percent_lbw       0.00002308705  0.05877472
z_pi_phy_inact         -0.25371169177 -0.20069785
z_cip_perc             -0.67515112593 -0.58950813
z_csph_perc             0.03453469235  0.10017159
z_ACS_PCT_CHILD_DISAB   0.01669288164  0.06571474
```

VIF for HWCC IVs

```r
vif(z_bb_just_HWCC)
```

```
        z_pphd_avgnum           z_pmhd_avgnum      z_lbw_percent_lbw
            10.749658                8.524377               1.777139
        z_pi_phy_inact              z_cip_perc             z_csph_perc
             1.467398                3.806888               2.125023
z_ACS_PCT_CHILD_DISAB
             1.164656
```

IV: Health A (7 variables), DV: Broadband

```r
z_bb_just_healthA <- lm(formula = z_ACS_PCT_BROADBAND ~ z_phys_per_cap +
    z_mhp_per_cap + z_dents_per_cap + z_uninsur_perc + z_opcp_rate +
    z_TeenBirths, data = Z_and_Final_Variables_10.28.22)
summary(z_bb_just_healthA)
```

```
Call:
lm(formula = z_ACS_PCT_BROADBAND ~ z_phys_per_cap + z_mhp_per_cap +
    z_dents_per_cap + z_uninsur_perc + z_opcp_rate + z_TeenBirths,
    data = Z_and_Final_Variables_10.28.22)

Residuals:
    Min      1Q  Median      3Q     Max
-4.5250 -0.4178  0.0661  0.5215  3.2943
```

```
Coefficients:
              Estimate Std. Error t value            Pr(>|t|)
(Intercept)   -0.01157    0.01472  -0.786               0.432
z_phys_per_cap 0.17264    0.02087   8.270 < 0.0000000000000002 ***
z_mhp_per_cap  0.02990    0.01925   1.553               0.121
z_dents_per_cap 0.32804   0.02025  16.198 < 0.0000000000000002 ***
z_uninsur_perc -0.25524   0.01529 -16.697 < 0.0000000000000002 ***
z_opcp_rate   -0.14182    0.01694  -8.370 < 0.0000000000000002 ***
z_TeenBirths   0.11218    0.01548   7.245    0.000000000000546 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.8079 on 3008 degrees of freedom
  (126 observations deleted due to missingness)
Multiple R-squared:  0.356, Adjusted R-squared:  0.3547
F-statistic: 277.1 on 6 and 3008 DF,  p-value: < 0.00000000000000022
```

Confidence Intervals for Health A IVs

```
confint(z_bb_just_healthA)
```

```
                       2.5 %       97.5 %
(Intercept)     -0.040429631   0.01728573
z_phys_per_cap   0.131710021   0.21356876
z_mhp_per_cap   -0.007849597   0.06764801
z_dents_per_cap  0.288331682   0.36775026
z_uninsur_perc  -0.285210170  -0.22526317
z_opcp_rate     -0.175043647  -0.10859703
z_TeenBirths     0.081821957   0.14253996
```

VIF for Health A IVs

```
vif(z_bb_just_healthA)
```

```
 z_phys_per_cap    z_mhp_per_cap z_dents_per_cap  z_uninsur_perc     z_opcp_rate
       1.991970         1.674408        1.900274        1.092448        1.325353
    z_TeenBirths
       1.148256
```

IV: Health B (5 variables), DV: Broadband

```
z_bb_just_healthB <- lm(formula = z_ACS_PCT_BROADBAND ~ z_phs_rate +
    z_ms_perc_ann + z_AMFAR_AMATFAC + z_MP_PERCPEN + z_AHRF_RURAL_H_CLINIC,
    data = Z_and_Final_Variables_10.28.22)
summary(z_bb_just_healthB)
```

```
Call:
lm(formula = z_ACS_PCT_BROADBAND ~ z_phs_rate + z_ms_perc_ann +
    z_AMFAR_AMATFAC + z_MP_PERCPEN + z_AHRF_RURAL_H_CLINIC, data = Z_and_Final_Variables_10.2

Residuals:
    Min      1Q  Median      3Q     Max
-4.5232 -0.5126  0.0766  0.5691  2.6969

Coefficients:
                       Estimate Std. Error t value          Pr(>|t|)
(Intercept)             0.00616    0.01588   0.388          0.698169
z_phs_rate             -0.30429    0.01662 -18.310 < 0.0000000000000002 ***
z_ms_perc_ann           0.26941    0.01682  16.022 < 0.0000000000000002 ***
z_AMFAR_AMATFAC         0.14072    0.01584   8.883 < 0.0000000000000002 ***
z_MP_PERCPEN            0.05686    0.01644   3.458          0.000551 ***
z_AHRF_RURAL_H_CLINIC  -0.05568    0.01591  -3.500          0.000472 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.874 on 3024 degrees of freedom
  (111 observations deleted due to missingness)
Multiple R-squared:  0.2398,    Adjusted R-squared:  0.2385
F-statistic: 190.8 on 5 and 3024 DF,  p-value: < 0.00000000000000022
```

Confidence Intervals for Health B IVs

```
confint(z_bb_just_healthB)
```

```
                           2.5 %       97.5 %
(Intercept)           -0.02498257   0.03730235
z_phs_rate            -0.33687575  -0.27170438
```

```
z_ms_perc_ann             0.23644020   0.30237989
z_AMFAR_AMATFAC           0.10966042   0.17178531
z_MP_PERCPEN              0.02462073   0.08908854
z_AHRF_RURAL_H_CLINIC    -0.08687332  -0.02448620
```

VIF for Health B IVs

```
vif(z_bb_just_healthB)
```

```
        z_phs_rate          z_ms_perc_ann        z_AMFAR_AMATFAC
          1.086643               1.082685               1.030124
      z_MP_PERCPEN z_AHRF_RURAL_H_CLINIC
          1.073504               1.026653
```

IV: Business (4 variables), DV: Broadband

```
z_bb_just_bus <- lm(formula = z_ACS_PCT_BROADBAND ~ z_unemp_perc +
    z_ACS_GINI_INDEX + z_ACS_MEDIAN_HH_INCOME + z_ACS_PCT_WORK_NO_CAR,
    data = Z_and_Final_Variables_10.28.22)
summary(z_bb_just_bus)
```

```
Call:
lm(formula = z_ACS_PCT_BROADBAND ~ z_unemp_perc + z_ACS_GINI_INDEX +
    z_ACS_MEDIAN_HH_INCOME + z_ACS_PCT_WORK_NO_CAR, data = Z_and_Final_Variables_10.28.22)

Residuals:
    Min      1Q  Median      3Q     Max
-3.8516 -0.3509  0.0848  0.4270  2.0331

Coefficients:
                        Estimate Std. Error t value            Pr(>|t|)
(Intercept)             0.001325   0.011662   0.114              0.9096
z_unemp_perc           -0.072382   0.013355  -5.420       0.0000000642 ***
z_ACS_GINI_INDEX       -0.028183   0.012827  -2.197              0.0281 *
z_ACS_MEDIAN_HH_INCOME  0.711314   0.013495  52.711 < 0.0000000000000002 ***
z_ACS_PCT_WORK_NO_CAR  -0.026035   0.012391  -2.101              0.0357 *
---
```

```
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.6534 on 3134 degrees of freedom
  (2 observations deleted due to missingness)
Multiple R-squared:  0.5729,    Adjusted R-squared:  0.5724
F-statistic:  1051 on 4 and 3134 DF,  p-value: < 0.00000000000000022
```

Confidence Intervals for Business IVs

```
confint(z_bb_just_bus)
```

```
                              2.5 %        97.5 %
(Intercept)             -0.02154170   0.024191473
z_unemp_perc            -0.09856802  -0.046196936
z_ACS_GINI_INDEX        -0.05333360  -0.003032267
z_ACS_MEDIAN_HH_INCOME   0.68485437   0.737773137
z_ACS_PCT_WORK_NO_CAR   -0.05032981  -0.001740552
```

VIF for Business IVs

```
vif(z_bb_just_bus)
```

```
        z_unemp_perc        z_ACS_GINI_INDEX z_ACS_MEDIAN_HH_INCOME
            1.311143                1.207590               1.338686
 z_ACS_PCT_WORK_NO_CAR
            1.128109
```

IV: Government (5 variables), DV: Broadband

```
z_bb_just_gov <- lm(formula = z_ACS_PCT_BROADBAND ~ z_soc_assoc_num +
    z_aeo_perc_w_acc + z_dwv_presence + z_ACS_PCT_HH_PUB_ASSIST +
    z_AHRF_TXC_SITE_NO_CNTRL, data = Z_and_Final_Variables_10.28.22)
summary(z_bb_just_gov)
```

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```
Call:
lm(formula = z_ACS_PCT_BROADBAND ~ z_soc_assoc_num + z_aeo_perc_w_acc +
    z_dwv_presence + z_ACS_PCT_HH_PUB_ASSIST + z_AHRF_TXC_SITE_NO_CNTRL,
    data = Z_and_Final_Variables_10.28.22)

Residuals:
    Min      1Q  Median      3Q     Max
-5.1354 -0.4244  0.0962  0.5453  2.1765

Coefficients:
                          Estimate Std. Error t value           Pr(>|t|)
(Intercept)              0.0006845  0.0147156   0.047              0.963
z_soc_assoc_num          0.1368460  0.0160048   8.550 <0.0000000000000002 ***
z_aeo_perc_w_acc         0.4931844  0.0158888  31.040 <0.0000000000000002 ***
z_dwv_presence           0.0160104  0.0149332   1.072              0.284
z_ACS_PCT_HH_PUB_ASSIST -0.1700766  0.0152156 -11.178 <0.0000000000000002 ***
z_AHRF_TXC_SITE_NO_CNTRL 0.0214847  0.0151363   1.419              0.156
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.8179 on 3085 degrees of freedom
  (50 observations deleted due to missingness)
Multiple R-squared:  0.3312,    Adjusted R-squared:  0.3301
F-statistic: 305.6 on 5 and 3085 DF,  p-value: < 0.00000000000000022
```

Confidence Intervals for Government IVs

```
confint(z_bb_just_gov)
```

```
                               2.5 %       97.5 %
(Intercept)              -0.028168919  0.02953800
z_soc_assoc_num           0.105464853  0.16822724
z_aeo_perc_w_acc          0.462030640  0.52433806
z_dwv_presence           -0.013269656  0.04529039
z_ACS_PCT_HH_PUB_ASSIST  -0.199910388 -0.14024281
z_AHRF_TXC_SITE_NO_CNTRL -0.008193434  0.05116293
```

VIF for Government IVs

```
vif(z_bb_just_gov)
```

```
      z_soc_assoc_num          z_aeo_perc_w_acc          z_dwv_presence
            1.197141                  1.153198                1.029896
z_ACS_PCT_HH_PUB_ASSIST z_AHRF_TXC_SITE_NO_CNTRL
            1.011419                  1.063773
```

Final Infrastructure Model

DV: Broadband, IVs: 56

```
z_bb_levels_12345678 <- lm(formula = z_ACS_PCT_BROADBAND ~ z_ACS_PCT_BLACK +
    z_ACS_PCT_HISPAN + z_SVI_RPL_THEME1_SOCIECO + z_SVI_RPL_THEME2_HH_DISB +
    z_SVI_RPL_THEME3_MINO + z_SVI_RPL_THEME4_HH_TRANS + z_ACS_PCT_ENGL_NOT_WELL +
    z_ACS_PCT_NON_CITIZEN + z_ACS_MEDIAN_AGE + z_food_afford +
    z_fd_enviro_indx + z_fi_percent + z_ACS_PCT_FOOD_STAMP +
    z_childelig_lunch_perc + z_shp_percent + z_shcb_percent +
    z_ACS_PCT_NO_VEH + z_ACS_PCT_RENTER_HH_CHILD + z_ACS_PCT_RENT_COST_30PCT +
    z_ACS_PCT_MOBILE_HOME + z_ACS_PCT_OWNED_HH + z_ACS_PCT_OWNER_HH_CHILD +
    z_ACS_MEDIAN_HOME_VALUE + z_hsg_rate + z_sc_percent + z_ms_average +
    z_ACS_PCT_NO_PC + z_ACS_PCT_SMARTPHONE + z_pphd_avgnum +
    z_pmhd_avgnum + z_lbw_percent_lbw + z_pi_phy_inact + z_cip_perc +
    z_csph_perc + z_ACS_PCT_CHILD_DISAB + z_phys_per_cap + z_mhp_per_cap +
    z_dents_per_cap + z_uninsur_perc + z_opcp_rate + z_TeenBirths +
    z_phs_rate + z_ms_perc_ann + z_AMFAR_AMATFAC + z_MP_PERCPEN +
    z_AHRF_RURAL_H_CLINIC + z_unemp_perc + z_ACS_GINI_INDEX +
    z_ACS_MEDIAN_HH_INCOME + z_ACS_PCT_WORK_NO_CAR + z_soc_assoc_num +
    z_aeo_perc_w_acc + z_dwv_presence + z_ACS_PCT_HH_PUB_ASSIST +
    z_AHRF_TXC_SITE_NO_CNTRL, data = Z_and_Final_Variables_10.28.22)
summary(z_bb_levels_12345678)
```

```
Call:
lm(formula = z_ACS_PCT_BROADBAND ~ z_ACS_PCT_BLACK + z_ACS_PCT_HISPAN +
    z_SVI_RPL_THEME1_SOCIECO + z_SVI_RPL_THEME2_HH_DISB + z_SVI_RPL_THEME3_MINO +
    z_SVI_RPL_THEME4_HH_TRANS + z_ACS_PCT_ENGL_NOT_WELL + z_ACS_PCT_NON_CITIZEN +
```

```
    z_ACS_MEDIAN_AGE + z_food_afford + z_fd_enviro_indx + z_fi_percent +
    z_ACS_PCT_FOOD_STAMP + z_childelig_lunch_perc + z_shp_percent +
    z_shcb_percent + z_ACS_PCT_NO_VEH + z_ACS_PCT_RENTER_HH_CHILD +
    z_ACS_PCT_RENT_COST_30PCT + z_ACS_PCT_MOBILE_HOME + z_ACS_PCT_OWNED_HH +
    z_ACS_PCT_OWNER_HH_CHILD + z_ACS_MEDIAN_HOME_VALUE + z_hsg_rate +
    z_sc_percent + z_ms_average + z_ACS_PCT_NO_PC + z_ACS_PCT_SMARTPHONE +
    z_pphd_avgnum + z_pmhd_avgnum + z_lbw_percent_lbw + z_pi_phy_inact +
    z_cip_perc + z_csph_perc + z_ACS_PCT_CHILD_DISAB + z_phys_per_cap +
    z_mhp_per_cap + z_dents_per_cap + z_uninsur_perc + z_opcp_rate +
    z_TeenBirths + z_phs_rate + z_ms_perc_ann + z_AMFAR_AMATFAC +
    z_MP_PERCPEN + z_AHRF_RURAL_H_CLINIC + z_unemp_perc + z_ACS_GINI_INDEX +
    z_ACS_MEDIAN_HH_INCOME + z_ACS_PCT_WORK_NO_CAR + z_soc_assoc_num +
    z_aeo_perc_w_acc + z_dwv_presence + z_ACS_PCT_HH_PUB_ASSIST +
    z_AHRF_TXC_SITE_NO_CNTRL, data = Z_and_Final_Variables_10.28.22)
```

Residuals:
```
     Min       1Q   Median       3Q      Max
-2.02639 -0.15993  0.02413  0.18159  1.14602
```

Coefficients:

	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	-0.0020324	0.0080539	-0.252	0.80080
z_ACS_PCT_BLACK	-0.0333348	0.0168045	-1.984	0.04742
z_ACS_PCT_HISPAN	-0.0189402	0.0170952	-1.108	0.26802
z_SVI_RPL_THEME1_SOCIECO	-0.0072905	0.0232244	-0.314	0.75362
z_SVI_RPL_THEME2_HH_DISB	-0.0158442	0.0128977	-1.228	0.21942
z_SVI_RPL_THEME3_MINO	0.0362292	0.0156818	2.310	0.02097
z_SVI_RPL_THEME4_HH_TRANS	0.0001211	0.0124115	0.010	0.99222
z_ACS_PCT_ENGL_NOT_WELL	0.0008694	0.0245429	0.035	0.97174
z_ACS_PCT_NON_CITIZEN	0.0135133	0.0224181	0.603	0.54672
z_ACS_MEDIAN_AGE	0.0011445	0.0180299	0.063	0.94939
z_food_afford	-0.0109440	0.0144467	-0.758	0.44881
z_fd_enviro_indx	0.0230225	0.0162970	1.413	0.15790
z_fi_percent	-0.0014164	0.0228086	-0.062	0.95049
z_ACS_PCT_FOOD_STAMP	0.0555212	0.0195952	2.833	0.00465
z_childelig_lunch_perc	-0.0272544	0.0160661	-1.696	0.08996
z_shp_percent	-0.0344132	0.0190883	-1.803	0.07156
z_shcb_percent	-0.0148547	0.0181383	-0.819	0.41290
z_ACS_PCT_NO_VEH	0.0138166	0.0277378	0.498	0.61846
z_ACS_PCT_RENTER_HH_CHILD	0.0275150	0.0109966	2.502	0.01242
z_ACS_PCT_RENT_COST_30PCT	0.0036242	0.0118723	0.305	0.76020
z_ACS_PCT_MOBILE_HOME	-0.0298014	0.0123214	-2.419	0.01566
z_ACS_PCT_OWNED_HH	-0.0485508	0.0160204	-3.031	0.00247

```
z_ACS_PCT_OWNER_HH_CHILD    -0.0055933  0.0159892   -0.350              0.72651
z_ACS_MEDIAN_HOME_VALUE     -0.0267534  0.0198393   -1.349              0.17764
z_hsg_rate                   0.0104250  0.0095047    1.097              0.27284
z_sc_percent                 0.0060852  0.0142363    0.427              0.66910
z_ms_average                -0.0227841  0.0164002   -1.389              0.16491
z_ACS_PCT_NO_PC             -0.7430277  0.0151637  -49.000 < 0.0000000000000002
z_ACS_PCT_SMARTPHONE        -0.1807171  0.0110610  -16.338 < 0.0000000000000002
z_pphd_avgnum               -0.0200945  0.0278549   -0.721              0.47075
z_pmhd_avgnum                0.0318225  0.0245729    1.295              0.19546
z_lbw_percent_lbw            0.0219252  0.0128512    1.706              0.08815
z_pi_phy_inact               0.0050174  0.0106334    0.472              0.63708
z_cip_perc                   0.0130030  0.0216604    0.600              0.54837
z_csph_perc                 -0.0219286  0.0151954   -1.443              0.14914
z_ACS_PCT_CHILD_DISAB        0.0081225  0.0086080    0.944              0.34549
z_phys_per_cap               0.0087861  0.0126743    0.693              0.48825
z_mhp_per_cap               -0.0146355  0.0110945   -1.319              0.18726
z_dents_per_cap              0.0341403  0.0126148    2.706              0.00686
z_uninsur_perc              -0.0309746  0.0137581   -2.251              0.02447
z_opcp_rate                  0.0055524  0.0098871    0.562              0.57446
z_TeenBirths                -0.0171942  0.0253402   -0.679              0.49751
z_phs_rate                   0.0124685  0.0091209    1.367              0.17177
z_ms_perc_ann                0.0196212  0.0105653    1.857              0.06343
z_AMFAR_AMATFAC             -0.0057069  0.0108246   -0.527              0.59810
z_MP_PERCPEN                 0.0148713  0.0084943    1.751              0.08014
z_AHRF_RURAL_H_CLINIC        0.0072329  0.0074299    0.973              0.33043
z_unemp_perc                 0.0204661  0.0125365    1.633              0.10272
z_ACS_GINI_INDEX             0.0070954  0.0112948    0.628              0.52994
z_ACS_MEDIAN_HH_INCOME       0.1019049  0.0264502    3.853              0.00012
z_ACS_PCT_WORK_NO_CAR        0.0106059  0.0232483    0.456              0.64829
z_soc_assoc_num              0.0302409  0.0285068    1.061              0.28889
z_aeo_perc_w_acc             0.0089384  0.0105357    0.848              0.39632
z_dwv_presence               0.0045710  0.0077263    0.592              0.55417
z_ACS_PCT_HH_PUB_ASSIST     -0.0083327  0.0101969   -0.817              0.41392
z_AHRF_TXC_SITE_NO_CNTRL     0.0032922  0.0079379    0.415              0.67837

(Intercept)
z_ACS_PCT_BLACK             *
z_ACS_PCT_HISPAN
z_SVI_RPL_THEME1_SOCIECO
z_SVI_RPL_THEME2_HH_DISB
z_SVI_RPL_THEME3_MINO       *
z_SVI_RPL_THEME4_HH_TRANS
z_ACS_PCT_ENGL_NOT_WELL
```

```
z_ACS_PCT_NON_CITIZEN
z_ACS_MEDIAN_AGE
z_food_afford
z_fd_enviro_indx
z_fi_percent
z_ACS_PCT_FOOD_STAMP        **
z_childelig_lunch_perc      .
z_shp_percent               .
z_shcb_percent
z_ACS_PCT_NO_VEH
z_ACS_PCT_RENTER_HH_CHILD *
z_ACS_PCT_RENT_COST_30PCT
z_ACS_PCT_MOBILE_HOME       *
z_ACS_PCT_OWNED_HH          **
z_ACS_PCT_OWNER_HH_CHILD
z_ACS_MEDIAN_HOME_VALUE
z_hsg_rate
z_sc_percent
z_ms_average
z_ACS_PCT_NO_PC             ***
z_ACS_PCT_SMARTPHONE        ***
z_pphd_avgnum
z_pmhd_avgnum
z_lbw_percent_lbw           .
z_pi_phy_inact
z_cip_perc
z_csph_perc
z_ACS_PCT_CHILD_DISAB
z_phys_per_cap
z_mhp_per_cap
z_dents_per_cap             **
z_uninsur_perc              *
z_opcp_rate
z_TeenBirths
z_phs_rate
z_ms_perc_ann               .
z_AMFAR_AMATFAC
z_MP_PERCPEN                .
z_AHRF_RURAL_H_CLINIC
z_unemp_perc
z_ACS_GINI_INDEX
z_ACS_MEDIAN_HH_INCOME      ***
z_ACS_PCT_WORK_NO_CAR
```

```
z_soc_assoc_num
z_aeo_perc_w_acc
z_dwv_presence
z_ACS_PCT_HH_PUB_ASSIST
z_AHRF_TXC_SITE_NO_CNTRL
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 0.3216 on 2044 degrees of freedom
  (1041 observations deleted due to missingness)
Multiple R-squared:  0.9006,    Adjusted R-squared:  0.8979
F-statistic: 336.7 on 55 and 2044 DF,  p-value: < 0.00000000000000022
```

Confidence Intervals for Final Model

```
confint(z_bb_levels_12345678)
```

```
                                2.5 %         97.5 %
(Intercept)                -0.017827162   0.0137624169
z_ACS_PCT_BLACK            -0.066290428  -0.0003790935
z_ACS_PCT_HISPAN           -0.052466055   0.0145856083
z_SVI_RPL_THEME1_SOCIECO   -0.052836455   0.0382555102
z_SVI_RPL_THEME2_HH_DISB   -0.041138295   0.0094498066
z_SVI_RPL_THEME3_MINO       0.005475185   0.0669831458
z_SVI_RPL_THEME4_HH_TRANS  -0.024219351   0.0244614742
z_ACS_PCT_ENGL_NOT_WELL    -0.047262248   0.0490011023
z_ACS_PCT_NON_CITIZEN      -0.030451470   0.0574780330
z_ACS_MEDIAN_AGE           -0.034214412   0.0365033307
z_food_afford              -0.039275813   0.0173879083
z_fd_enviro_indx           -0.008937930   0.0549829972
z_fi_percent               -0.046146954   0.0433142368
z_ACS_PCT_FOOD_STAMP        0.017092602   0.0939498848
z_childelig_lunch_perc     -0.058762078   0.0042532159
z_shp_percent              -0.071847772   0.0030213516
z_shcb_percent             -0.050426185   0.0207168648
z_ACS_PCT_NO_VEH           -0.040580582   0.0682138696
z_ACS_PCT_RENTER_HH_CHILD   0.005949367   0.0490805937
z_ACS_PCT_RENT_COST_30PCT  -0.019659014   0.0269073163
z_ACS_PCT_MOBILE_HOME      -0.053965309  -0.0056375053
z_ACS_PCT_OWNED_HH         -0.079968748  -0.0171327833
z_ACS_PCT_OWNER_HH_CHILD   -0.036950061   0.0257634892
```

```
z_ACS_MEDIAN_HOME_VALUE    -0.065660644   0.0121539005
z_hsg_rate                 -0.008214811   0.0290648855
z_sc_percent               -0.021833947   0.0340043777
z_ms_average               -0.054946920   0.0093787532
z_ACS_PCT_NO_PC            -0.772765589  -0.7132898439
z_ACS_PCT_SMARTPHONE       -0.202409145  -0.1590250500
z_pphd_avgnum              -0.074721540   0.0345325121
z_pmhd_avgnum              -0.016368066   0.0800130620
z_lbw_percent_lbw          -0.003277659   0.0471280414
z_pi_phy_inact             -0.015835952   0.0258708419
z_cip_perc                 -0.029475727   0.0554816575
z_csph_perc                -0.051728682   0.0078714481
z_ACS_PCT_CHILD_DISAB      -0.008758973   0.0250038961
z_phys_per_cap             -0.016069885   0.0336420331
z_mhp_per_cap              -0.036393176   0.0071222381
z_dents_per_cap             0.009401090   0.0588795256
z_uninsur_perc             -0.057955938  -0.0039932197
z_opcp_rate                -0.013837370   0.0249422064
z_TeenBirths               -0.066889456   0.0325010685
z_phs_rate                 -0.005418849   0.0303557568
z_ms_perc_ann              -0.001098617   0.0403410236
z_AMFAR_AMATFAC            -0.026935252   0.0155214468
z_MP_PERCPEN               -0.001787059   0.0315296458
z_AHRF_RURAL_H_CLINIC      -0.007338095   0.0218039764
z_unemp_perc               -0.004119498   0.0450516855
z_ACS_GINI_INDEX           -0.015055070   0.0292458922
z_ACS_MEDIAN_HH_INCOME      0.050032828   0.1537769432
z_ACS_PCT_WORK_NO_CAR      -0.034986949   0.0561986942
z_soc_assoc_num            -0.025664470   0.0861463366
z_aeo_perc_w_acc           -0.011723434   0.0296002413
z_dwv_presence             -0.010581217   0.0197231766
z_ACS_PCT_HH_PUB_ASSIST    -0.028330013   0.0116646518
z_AHRF_TXC_SITE_NO_CNTRL   -0.012274944   0.0188593567
```

VIF for Final Model

```r
vif(z_bb_levels_12345678)
```

```
          z_ACS_PCT_BLACK             z_ACS_PCT_HISPAN  z_SVI_RPL_THEME1_SOCIECO
                 6.697706                    5.896085                 10.972438
 z_SVI_RPL_THEME2_HH_DISB        z_SVI_RPL_THEME3_MINO  z_SVI_RPL_THEME4_HH_TRANS
```

```
        3.266089                 4.686639                 2.958719
z_ACS_PCT_ENGL_NOT_WELL    z_ACS_PCT_NON_CITIZEN         z_ACS_MEDIAN_AGE
       11.397228                 9.135654                 5.889493
        z_food_afford           z_fd_enviro_indx          z_fi_percent
        4.056264                 4.540344                10.626823
  z_ACS_PCT_FOOD_STAMP    z_childelig_lunch_perc          z_shp_percent
        6.964560                 4.018896                 4.640367
        z_shcb_percent          z_ACS_PCT_NO_VEH    z_ACS_PCT_RENTER_HH_CHILD
        5.439742                 6.811203                 2.250262
z_ACS_PCT_RENT_COST_30PCT    z_ACS_PCT_MOBILE_HOME        z_ACS_PCT_OWNED_HH
        2.264815                 3.227325                 4.370934
  z_ACS_PCT_OWNER_HH_CHILD    z_ACS_MEDIAN_HOME_VALUE          z_hsg_rate
        4.702623                 5.459869                 1.554262
        z_sc_percent            z_ms_average             z_ACS_PCT_NO_PC
        3.824488                 1.826075                 4.702913
  z_ACS_PCT_SMARTPHONE         z_pphd_avgnum             z_pmhd_avgnum
        2.520346                15.702720                12.044677
   z_lbw_percent_lbw          z_pi_phy_inact             z_cip_perc
        3.433424                 2.334510                 9.978569
        z_csph_perc          z_ACS_PCT_CHILD_DISAB        z_phys_per_cap
        4.511843                 1.375962                 2.680320
        z_mhp_per_cap          z_dents_per_cap           z_uninsur_perc
        2.041114                 2.554027                 4.015780
        z_opcp_rate            z_TeenBirths               z_phs_rate
        1.770324                14.462968                 1.640760
        z_ms_perc_ann          z_AMFAR_AMATFAC            z_MP_PERCPEN
        2.156945                 1.848241                 1.381057
 z_AHRF_RURAL_H_CLINIC        z_unemp_perc              z_ACS_GINI_INDEX
        1.197971                 2.534396                 2.490811
 z_ACS_MEDIAN_HH_INCOME     z_ACS_PCT_WORK_NO_CAR        z_soc_assoc_num
       12.661967                 3.156883                15.966848
        z_aeo_perc_w_acc        z_dwv_presence      z_ACS_PCT_HH_PUB_ASSIST
        2.052442                 1.181376                 1.499436
z_AHRF_TXC_SITE_NO_CNTRL
        1.069188
```