Alternate Transformation - New Public/Private Feature

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Concept

The idea behind this notebook is to determine if the process of converting the initial input format (with columns for public and private data) into a new format (with columns for mean/median values and a public/private indicator) yields better results with simple regression models. No other supplementary features will be included at this time. Standard filtering of rows (remove private rows with invalid counts, etc. will be applied.)

Data Load and Transformation

Data Load

```
original_data <- read.csv("priv_mcare_f_pay.csv")
```

Data Filtering

Note: I presume that all data from forbidden MSAs is off limits. Therefore, we will simply drop all rows where priv_count is NA or 0

```
filtered_data <- original_data %>%
  filter(!is.na(priv_count) & (priv_count > 0) & !is.na(lon) & !is.na(lat))
```

Data Preprocessing

One thing we will do before much of the transformation is deal with the categorical variables.

```
filtered_data_important_fields <- filtered_data %>% select(!c(CBSA_NAME, FIPS.State.Code))
cat_encoder <- dummyVars(" ~ .", data=filtered_data_important_fields)
cat_encoded <- data.frame(predict(cat_encoder, filtered_data_important_fields))

cat_encoded$index <- 1:nrow(cat_encoded)
```

Data Splitting

For filters applied, we have:

- Public (mcare):
  - Drop all NAs
- Private:
  - Drop all NAs
  - Drop all rows with no mcare_los
  - Drop all rows with priv_count < 50

For general transformations:

- public_private column added
- SD/IQR columns dropped. They aren't exactly comparable
- Columns renamed for dataset recombination.

```
filtered_data_public <-
  cat_encoded %>%
  select(!c(priv_count, priv_pay_iqr, priv_pay_mean, priv_pay_median, mcare_pay_sd)) %>%
  mutate(public_private = 'public') %>%
  rename(pay_mean = mcare_pay_mean) %>%
  rename(pay_median = mcare_pay_median) %>%
  filter(!is.na(pay_mean))

filtered_data_private <-
  cat_encoded %>%
  filter(priv_count >= 50) %>%
  select(!c(priv_count, priv_pay_iqr, mcare_pay_mean, mcare_pay_median, mcare_pay_sd)) %>%
  mutate(public_private = 'private') %>%
  rename(pay_mean = priv_pay_mean) %>%
  rename(pay_median = priv_pay_median) %>%
  filter(!is.na(pay_mean) & !is.na(mcare_los))
```

Separate out test set

I arbitrarily grabbed 25% of the private records post-filtering (we are only interested in predicting using these).

```
test_set <-
  filtered_data_private %>%
  sample_frac(0.25)

filtered_data_private <- anti_join(filtered_data_private,
                                   test_set,
                                   by = ('index'))
```

Data Recombination

```
dev_set <- rbind(filtered_data_public, filtered_data_private)
```

Create Development and Test Sets for Original Data

```
untransformed_data <- cat_encoded %>%
  filter((priv_count >= 50) & !is.na(mcare_los)) %>%
  select(!c(priv_pay_iqr, mcare_pay_sd))

untransformed_test_set <-
  untransformed_data %>%
  sample_frac(0.25)

untransformed_dev_set <- anti_join(untransformed_data,
                                   untransformed_test_set,
                                   by = ('index'))
```

Comparing Performance

Original Dataset

```
orig_lm <- lm(formula = priv_pay_median ~ ., data = (untransformed_dev_set %>% select(!c(priv_pay_mean,
#train(
#  priv_pay_median ~ .,
#  data = (untransformed_dev_set %>% select(!c(priv_pay_mean, msa, index))),
#  method = 'lasso'
#)
summary(orig_lm)
```

```
##
## Call:
## lm(formula = priv_pay_median ~ ., data = (untransformed_dev_set %>%
##     select(!c(priv_pay_mean, msa, index))))
##
## Residuals:
##    Min     1Q Median     3Q    Max
## -33140  -2764   -215   2557  43138
##
## Coefficients: (25 not defined because of singularities)
##                                             Estimate Std. Error t value
## (Intercept)                                -1.128e+06  3.277e+05  -3.440
## year                                        5.340e+02  1.623e+02   3.289
## siteASC                                            NA         NA      NA
## siteInpatient                               1.903e+03  1.078e+03   1.765
## siteOutpatient                                     NA         NA      NA
## groupankle_fix                             -1.739e+04  4.575e+03  -3.801
## groupant_cerv_fusion                       -1.043e+04  4.486e+03  -2.326
## groupant_tls_fusion                         3.255e+04  5.250e+03   6.200
## groupbariatric                             -1.601e+04  4.503e+03  -3.557
## groupbreast.reconstruction                 -1.679e+04  4.541e+03  -3.697
## groupbsp                                   -1.519e+04  6.282e+03  -2.418
## groupbunionectomy                          -2.005e+04  4.583e+03  -4.374
## groupcardiac.ablation                      -4.960e+03  4.471e+03  -1.109
## groupcardiac.ablation_additional_discrete   1.383e+03  4.807e+03   0.288
## groupcardiac.ablation_linear_focal                 NA         NA      NA
## groupcardiac_ablaton_anesthesia            -1.586e+03  4.841e+03  -0.328
## groupcardiac_ablaton_ice                   -2.930e+03  4.501e+03  -0.651
## groupclavicle.fixation                     -1.770e+04  7.650e+03  -2.314
## groupcolorect                              -1.833e+04  4.848e+03  -3.781
## groupfemoral.shaft.fixation                        NA         NA      NA
## groupfess                                  -1.897e+04  4.551e+03  -4.168
## grouphepat                                 -1.704e+04  5.489e+03  -3.105
## grouphernia                                -1.887e+04  4.614e+03  -4.090
## grouphip_fracture_fixation                         NA         NA      NA
## grouphysterect                             -1.813e+04  4.497e+03  -4.032
## groupintracranial_thromb                           NA         NA      NA
## groupkidney.ablation                               NA         NA      NA
## grouplaac                                          NA         NA      NA
## grouplap.appendectomy                      -1.905e+04  4.569e+03  -4.169
## groupliver.ablation                                NA         NA      NA
## grouplung.ablation                                 NA         NA      NA
## groupmastectomy                            -1.810e+04  4.562e+03  -3.967
```

```
## groupnavigation                          4.269e+02  6.225e+03   0.069
## grouporthovisc_monovisc                 -2.071e+04  5.544e+03  -3.736
## grouppartial.shoulder.arthroplasty             NA         NA      NA
## grouppka                                       NA         NA      NA
## grouppnn                                       NA         NA      NA
## grouppost_cerv_fusion                    9.462e+03  7.680e+03   1.232
## grouppost_tls_fusion                     1.795e+04  4.570e+03   3.928
## groupprostatectomy                      -1.469e+04  5.125e+03  -2.867
## groupprox_tibia_fixation                -7.135e+03  6.269e+03  -1.138
## groupproximal.humerus                          NA         NA      NA
## groupradius.ulna.internal.fixation      -1.716e+04  4.586e+03  -3.742
## grouprevision_tha                              NA         NA      NA
## grouprevision_tka                              NA         NA      NA
## grouprobotic_assisted_surgery           -1.672e+04  4.582e+03  -3.648
## grouprtc_slap_bank                      -1.760e+04  4.535e+03  -3.881
## groupseptoplasty                        -1.950e+04  4.585e+03  -4.254
## grouptha                                -1.007e+04  4.457e+03  -2.260
## groupthoracic                           -2.012e+03  7.613e+03  -0.264
## grouptka                                -8.836e+03  4.426e+03  -1.996
## grouptpa                                -1.742e+04  7.668e+03  -2.272
## grouptsa                                       NA         NA      NA
## priv_count                               2.359e+00  8.464e-01   2.787
## mcare_los                                1.128e+03  3.845e+02   2.934
## mcare_pay_mean                           3.355e-01  1.646e-01   2.039
## mcare_pay_median                         4.346e-01  1.811e-01   2.400
## StateAlabama                            -3.229e+03  1.872e+03  -1.725
## StateAlaska                                    NA         NA      NA
## StateArizona                            -1.319e+04  3.389e+03  -3.892
## StateArkansas                           -5.347e+03  1.967e+03  -2.718
## StateCalifornia                         -1.348e+04  3.868e+03  -3.486
## StateColorado                           -8.784e+03  2.437e+03  -3.604
## StateDelaware                            6.654e+03  2.126e+03   3.130
## StateFlorida                             1.274e+04  2.194e+03   5.805
## StateGeorgia                             2.067e+03  1.771e+03   1.167
## StateHawaii                                    NA         NA      NA
## StateIllinois                           -6.677e+03  1.372e+03  -4.865
## StateIowa                               -6.767e+03  1.894e+03  -3.572
## StateKansas                             -8.188e+03  1.746e+03  -4.689
## StateMaryland                           -3.647e+03  2.034e+03  -1.793
## StateMassachusetts                       2.774e+03  2.304e+03   1.204
## StateMichigan                           -6.281e+03  1.395e+03  -4.501
## StateMinnesota                          -9.255e+03  1.657e+03  -5.585
## StateMississippi                         7.605e+02  3.038e+03   0.250
## StateMissouri                           -3.227e+03  4.635e+03  -0.696
## StateNebraska                           -5.644e+03  4.644e+03  -1.215
## StateNevada                             -1.731e+04  3.721e+03  -4.652
## StateNew.Jersey                          3.940e+03  1.948e+03   2.023
## StateNew.York                            7.640e+03  1.966e+03   3.885
## StateNorth.Carolina                      9.231e+03  1.746e+03   5.286
## StateNorth.Dakota                              NA         NA      NA
## StateOhio                               -1.552e+03  1.436e+03  -1.080
## StateOklahoma                           -4.432e+03  2.087e+03  -2.124
## StateOregon                             -2.085e+04  3.958e+03  -5.267
## StatePennsylvania                        4.869e+02  1.830e+03   0.266
```

```
## StatePuerto.Rico                                    NA         NA      NA
## StateRhode.Island                                2.367e+03  2.968e+03   0.798
## StateSouth.Dakota                               -8.843e+03  3.424e+03  -2.583
## StateTennessee                                   6.974e+00  1.751e+03   0.004
## StateTexas                                       1.574e+03  2.292e+03   0.687
## StateUtah                                       -1.652e+04  3.097e+03  -5.333
## StateVermont                                         NA         NA      NA
## StateVirginia                                    2.996e+03  1.766e+03   1.696
## StateWashington                                 -2.013e+04  3.826e+03  -5.262
## StateWest.Virginia                                   NA         NA      NA
## StateWisconsin                                       NA         NA      NA
## StateWyoming                                         NA         NA      NA
## lon                                             -5.282e+02  1.058e+02  -4.991
## lat                                              7.588e+02  1.212e+02   6.261
##                                                 Pr(>|t|)
## (Intercept)                                     0.000591 ***
## year                                            0.001018 **
## siteASC                                               NA
## siteInpatient                                   0.077642 .
## siteOutpatient                                        NA
## groupankle_fix                                  0.000147 ***
## groupant_cerv_fusion                            0.020118 *
## groupant_tls_fusion                             6.59e-10 ***
## groupbariatric                                  0.000383 ***
## groupbreast.reconstruction                      0.000223 ***
## groupbsp                                        0.015692 *
## groupbunionectomy                               1.27e-05 ***
## groupcardiac.ablation                           0.267406
## groupcardiac.ablation_additional_discrete       0.773689
## groupcardiac.ablation_linear_focal                    NA
## groupcardiac_ablaton_anesthesia                 0.743285
## groupcardiac_ablaton_ice                        0.515073
## groupclavicle.fixation                          0.020771 *
## groupcolorect                                   0.000160 ***
## groupfemoral.shaft.fixation                           NA
## groupfess                                       3.18e-05 ***
## grouphepat                                      0.001926 **
## grouphernia                                     4.46e-05 ***
## grouphip_fracture_fixation                            NA
## grouphysterect                                  5.71e-05 ***
## groupintracranial_thromb                              NA
## groupkidney.ablation                                  NA
## grouplaac                                             NA
## grouplap.appendectomy                           3.16e-05 ***
## groupliver.ablation                                   NA
## grouplung.ablation                                    NA
## groupmastectomy                                 7.49e-05 ***
## groupnavigation                                 0.945339
## grouporthovisc_monovisc                         0.000191 ***
## grouppartial.shoulder.arthroplasty                    NA
## grouppka                                              NA
## grouppnn                                              NA
## grouppost_cerv_fusion                           0.218083
## grouppost_tls_fusion                            8.79e-05 ***
```

```
## groupprostatectomy                      0.004182 **
## groupprox_tibia_fixation                0.255132
## groupproximal.humerus                         NA
## groupradius.ulna.internal.fixation      0.000187 ***
## grouprevision_tha                             NA
## grouprevision_tka                             NA
## grouprobotic_assisted_surgery           0.000270 ***
## grouprtc_slap_bank                      0.000107 ***
## groupseptoplasty                        2.18e-05 ***
## grouptha                                0.023901 *
## groupthoracic                           0.791628
## grouptka                                0.045999 *
## grouptpa                                0.023168 *
## grouptsa                                      NA
## priv_count                              0.005360 **
## mcare_los                               0.003382 **
## mcare_pay_mean                          0.041574 *
## mcare_pay_median                        0.016459 *
## StateAlabama                            0.084683 .
## StateAlaska                                   NA
## StateArizona                            0.000102 ***
## StateArkansas                           0.006607 **
## StateCalifornia                         0.000499 ***
## StateColorado                           0.000320 ***
## StateDelaware                           0.001771 **
## StateFlorida                            7.25e-09 ***
## StateGeorgia                            0.243161
## StateHawaii                                   NA
## StateIllinois                           1.22e-06 ***
## StateIowa                               0.000361 ***
## StateKansas                             2.90e-06 ***
## StateMaryland                           0.073019 .
## StateMassachusetts                      0.228646
## StateMichigan                           7.09e-06 ***
## StateMinnesota                          2.60e-08 ***
## StateMississippi                        0.802335
## StateMissouri                           0.486315
## StateNebraska                           0.224366
## StateNevada                             3.47e-06 ***
## StateNew.Jersey                         0.043226 *
## StateNew.York                           0.000105 ***
## StateNorth.Carolina                     1.36e-07 ***
## StateNorth.Dakota                             NA
## StateOhio                               0.280135
## StateOklahoma                           0.033797 *
## StateOregon                             1.51e-07 ***
## StatePennsylvania                       0.790263
## StatePuerto.Rico                              NA
## StateRhode.Island                       0.425164
## StateSouth.Dakota                       0.009863 **
## StateTennessee                          0.996822
## StateTexas                              0.492445
## StateUtah                               1.05e-07 ***
## StateVermont                                  NA
```

```
## StateVirginia                                0.089961 .
## StateWashington                              1.55e-07 ***
## StateWest.Virginia                                 NA
## StateWisconsin                                     NA
## StateWyoming                                       NA
## lon                                          6.44e-07 ***
## lat                                          4.49e-10 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 6161 on 2454 degrees of freedom
## Multiple R-squared:  0.8493, Adjusted R-squared:  0.8447
## F-statistic: 186.9 on 74 and 2454 DF,  p-value: < 2.2e-16
```

```
orig_lm_pred <- predict(orig_lm, newdata = untransformed_test_set)
```

```
## Warning in predict.lm(orig_lm, newdata = untransformed_test_set): prediction
## from a rank-deficient fit may be misleading
```

```
print("MAPE is:")
```

```
## [1] "MAPE is:"
```

```
MAPE(orig_lm_pred, untransformed_test_set$priv_pay_median)
```

```
## [1] 0.3173783
```

Transformed Dataset

```
transformed_lm <- lm(formula = pay_median ~ ., data = (dev_set %>% select(!c(pay_mean, msa, index))))
#train(
#  priv_pay_median ~ .,
#  data = (untransformed_dev_set %>% select(!c(priv_pay_mean, msa, index))),
#  method = 'lasso'
#)
summary(transformed_lm)
```

```
##
## Call:
## lm(formula = pay_median ~ ., data = (dev_set %>% select(!c(pay_mean,
##     msa, index))))
##
## Residuals:
##    Min     1Q Median     3Q    Max
## -37797  -1501    168   1557  79622
##
## Coefficients: (4 not defined because of singularities)
##                                          Estimate Std. Error  t value
## (Intercept)                            -1.357e+06  5.234e+04  -25.925
## year                                    6.775e+02  2.591e+01   26.147
## siteASC                                        NA         NA       NA
## siteInpatient                           3.429e+03  8.193e+01   41.857
## siteOutpatient                                 NA         NA       NA
## groupankle_fix                         -3.164e+03  1.791e+02  -17.665
## groupant_cerv_fusion                    2.596e+03  1.776e+02   14.616
## groupant_tls_fusion                     1.598e+04  2.251e+02   70.980
```

```
## groupbariatric                              -4.240e+03  1.835e+02  -23.107
## groupbreast.reconstruction                  -3.306e+03  1.830e+02  -18.069
## groupbsp                                    -3.228e+03  2.757e+02  -11.708
## groupbunionectomy                           -3.482e+03  2.062e+02  -16.887
## groupcardiac.ablation                        8.785e+03  1.853e+02   47.399
## groupcardiac.ablation_additional_discrete    1.072e+04  2.292e+02   46.797
## groupcardiac.ablation_linear_focal           1.066e+04  2.421e+02   44.037
## groupcardiac_ablaton_anesthesia              1.034e+04  5.037e+02   20.522
## groupcardiac_ablaton_ice                     1.086e+04  2.112e+02   51.423
## groupclavicle.fixation                      -2.635e+03  2.360e+02  -11.167
## groupcolorect                               -5.157e+03  1.924e+02  -26.804
## groupfemoral.shaft.fixation                 -3.898e+03  2.484e+02  -15.690
## groupfess                                   -4.629e+03  1.938e+02  -23.881
## grouphepat                                  -7.934e+03  2.243e+02  -35.370
## grouphernia                                 -5.698e+03  1.800e+02  -31.657
## grouphip_fracture_fixation                  -4.278e+03  2.214e+02  -19.323
## grouphysterect                              -3.541e+03  1.711e+02  -20.690
## groupintracranial_thromb                     1.243e+04  2.985e+02   41.638
## groupkidney.ablation                        -2.892e+03  3.652e+02   -7.919
## grouplaac                                    6.063e+03  4.417e+02   13.728
## grouplap.appendectomy                       -4.480e+03  1.950e+02  -22.980
## groupliver.ablation                         -1.310e+03  3.046e+02   -4.300
## grouplung.ablation                          -4.195e+03  7.820e+02   -5.365
## groupmastectomy                             -4.565e+03  1.818e+02  -25.110
## groupnavigation                              2.141e+03  2.747e+02    7.795
## grouporthovisc_monovisc                     -7.233e+03  3.929e+02  -18.411
## grouppartial.shoulder.arthroplasty          -4.070e+02  2.431e+02   -1.674
## grouppka                                     3.301e+02  2.079e+02    1.588
## grouppnn                                    -5.109e+03  3.127e+02  -16.340
## grouppost_cerv_fusion                        2.650e+03  2.310e+02   11.472
## grouppost_tls_fusion                         1.283e+04  1.853e+02   69.249
## groupprostatectomy                          -2.995e+03  1.916e+02  -15.635
## groupprox_tibia_fixation                    -3.411e+03  2.020e+02  -16.884
## groupproximal.humerus                        3.273e+02  1.999e+02    1.638
## groupradius.ulna.internal.fixation          -3.395e+03  1.849e+02  -18.359
## grouprevision_tha                           -2.011e+03  2.618e+02   -7.683
## grouprevision_tka                            5.624e+03  5.369e+02   10.476
## grouprobotic_assisted_surgery               -3.610e+03  2.771e+02  -13.030
## grouprtc_slap_bank                          -3.878e+03  1.907e+02  -20.337
## groupseptoplasty                            -4.755e+03  2.010e+02  -23.659
## grouptha                                    -1.371e+03  1.780e+02   -7.706
## groupthoracic                               -2.386e+03  2.267e+02  -10.525
## grouptka                                     4.995e+02  1.699e+02    2.941
## grouptpa                                    -3.776e+03  2.293e+02  -16.467
## grouptsa                                            NA         NA       NA
## mcare_los                                    1.343e+03  1.672e+01   80.293
## StateAlabama                                -2.640e+03  5.167e+02   -5.110
## StateAlaska                                 -2.477e+03  8.392e+02   -2.951
## StateArizona                                -1.309e+03  5.027e+02   -2.604
## StateArkansas                               -2.478e+03  4.937e+02   -5.020
## StateCalifornia                              7.465e+02  5.070e+02    1.472
## StateColorado                               -1.731e+03  4.536e+02   -3.816
## StateDelaware                                4.883e+02  6.289e+02    0.776
## StateFlorida                                -5.720e+02  5.584e+02   -1.024
```

```
## StateGeorgia                                -1.184e+03  5.353e+02   -2.212
## StateHawaii                                  1.641e+03  1.285e+03    1.277
## StateIllinois                               -1.943e+03  4.961e+02   -3.916
## StateIowa                                   -2.234e+03  4.863e+02   -4.595
## StateKansas                                 -2.101e+03  4.753e+02   -4.420
## StateMaryland                                3.803e+03  6.031e+02    6.305
## StateMassachusetts                           1.438e+03  6.649e+02    2.162
## StateMichigan                               -1.595e+03  5.341e+02   -2.987
## StateMinnesota                              -9.916e+02  4.971e+02   -1.995
## StateMississippi                            -1.920e+03  5.467e+02   -3.512
## StateMissouri                               -2.181e+03  5.132e+02   -4.249
## StateNebraska                               -2.135e+03  5.503e+02   -3.879
## StateNevada                                 -1.801e+03  5.252e+02   -3.429
## StateNew.Jersey                              5.835e+02  6.166e+02    0.946
## StateNew.York                               -4.282e+02  6.142e+02   -0.697
## StateNorth.Carolina                         -6.114e+02  5.632e+02   -1.086
## StateNorth.Dakota                           -2.349e+03  7.356e+02   -3.193
## StateOhio                                   -1.966e+03  5.434e+02   -3.618
## StateOklahoma                               -2.481e+03  4.879e+02   -5.085
## StateOregon                                 -1.869e+03  5.130e+02   -3.644
## StatePennsylvania                           -1.051e+03  5.910e+02   -1.778
## StatePuerto.Rico                            -1.218e+03  1.280e+03   -0.952
## StateRhode.Island                            5.211e+01  7.119e+02    0.073
## StateSouth.Dakota                           -2.033e+03  5.313e+02   -3.827
## StateTennessee                              -2.068e+03  5.333e+02   -3.877
## StateTexas                                  -1.267e+03  4.772e+02   -2.655
## StateUtah                                   -2.490e+03  4.806e+02   -5.180
## StateVermont                                -3.838e+03  7.746e+02   -4.955
## StateVirginia                               -6.575e+02  5.761e+02   -1.141
## StateWashington                             -2.273e+03  4.951e+02   -4.591
## StateWest.Virginia                          -1.703e+03  6.022e+02   -2.828
## StateWisconsin                              -1.499e+03  5.117e+02   -2.929
## StateWyoming                                        NA         NA       NA
## lon                                         -5.175e+01  1.409e+01   -3.674
## lat                                          1.029e+02  1.842e+01    5.589
## public_privatepublic                        -1.109e+04  8.986e+01 -123.445
##                                            Pr(>|t|)
## (Intercept)                                 < 2e-16 ***
## year                                        < 2e-16 ***
## siteASC                                          NA
## siteInpatient                               < 2e-16 ***
## siteOutpatient                                   NA
## groupankle_fix                              < 2e-16 ***
## groupant_cerv_fusion                        < 2e-16 ***
## groupant_tls_fusion                         < 2e-16 ***
## groupbariatric                              < 2e-16 ***
## groupbreast.reconstruction                  < 2e-16 ***
## groupbsp                                    < 2e-16 ***
## groupbunionectomy                           < 2e-16 ***
## groupcardiac.ablation                       < 2e-16 ***
## groupcardiac.ablation_additional_discrete   < 2e-16 ***
## groupcardiac.ablation_linear_focal          < 2e-16 ***
## groupcardiac_ablaton_anesthesia             < 2e-16 ***
## groupcardiac_ablaton_ice                    < 2e-16 ***
```

```
## groupclavicle.fixation                    < 2e-16 ***
## groupcolorect                             < 2e-16 ***
## groupfemoral.shaft.fixation               < 2e-16 ***
## groupfess                                 < 2e-16 ***
## grouphepat                                < 2e-16 ***
## grouphernia                               < 2e-16 ***
## grouphip_fracture_fixation                < 2e-16 ***
## grouphysterect                            < 2e-16 ***
## groupintracranial_thromb                  < 2e-16 ***
## groupkidney.ablation                     2.45e-15 ***
## grouplaac                                 < 2e-16 ***
## grouplap.appendectomy                     < 2e-16 ***
## groupliver.ablation                      1.71e-05 ***
## grouplung.ablation                       8.16e-08 ***
## groupmastectomy                           < 2e-16 ***
## groupnavigation                          6.58e-15 ***
## grouporthovisc_monovisc                   < 2e-16 ***
## grouppartial.shoulder.arthroplasty       0.094078 .
## grouppka                                 0.112328
## grouppnn                                  < 2e-16 ***
## grouppost_cerv_fusion                     < 2e-16 ***
## grouppost_tls_fusion                      < 2e-16 ***
## groupprostatectomy                        < 2e-16 ***
## groupprox_tibia_fixation                  < 2e-16 ***
## groupproximal.humerus                    0.101524
## groupradius.ulna.internal.fixation        < 2e-16 ***
## grouprevision_tha                        1.59e-14 ***
## grouprevision_tka                         < 2e-16 ***
## grouprobotic_assisted_surgery             < 2e-16 ***
## grouprtc_slap_bank                        < 2e-16 ***
## groupseptoplasty                          < 2e-16 ***
## grouptha                                 1.32e-14 ***
## groupthoracic                             < 2e-16 ***
## grouptka                                 0.003278 **
## grouptpa                                  < 2e-16 ***
## grouptsa                                       NA
## mcare_los                                 < 2e-16 ***
## StateAlabama                             3.24e-07 ***
## StateAlaska                              0.003168 **
## StateArizona                             0.009231 **
## StateArkansas                            5.20e-07 ***
## StateCalifornia                          0.140930
## StateColorado                            0.000136 ***
## StateDelaware                            0.437496
## StateFlorida                             0.305683
## StateGeorgia                             0.026967 *
## StateHawaii                              0.201687
## StateIllinois                            9.01e-05 ***
## StateIowa                                4.34e-06 ***
## StateKansas                              9.90e-06 ***
## StateMaryland                            2.91e-10 ***
## StateMassachusetts                       0.030586 *
## StateMichigan                            0.002822 **
## StateMinnesota                           0.046075 *
```

```
## StateMississippi                          0.000445 ***
## StateMissouri                             2.15e-05 ***
## StateNebraska                             0.000105 ***
## StateNevada                               0.000606 ***
## StateNew.Jersey                           0.343956
## StateNew.York                             0.485750
## StateNorth.Carolina                       0.277665
## StateNorth.Dakota                         0.001409 **
## StateOhio                                 0.000297 ***
## StateOklahoma                             3.69e-07 ***
## StateOregon                               0.000269 ***
## StatePennsylvania                         0.075464 .
## StatePuerto.Rico                          0.341246
## StateRhode.Island                         0.941650
## StateSouth.Dakota                         0.000130 ***
## StateTennessee                            0.000106 ***
## StateTexas                                0.007932 **
## StateUtah                                 2.23e-07 ***
## StateVermont                              7.28e-07 ***
## StateVirginia                             0.253769
## StateWashington                           4.43e-06 ***
## StateWest.Virginia                        0.004686 **
## StateWisconsin                            0.003398 **
## StateWyoming                                    NA
## lon                                       0.000239 ***
## lat                                       2.30e-08 ***
## public_privatepublic                       < 2e-16 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 4206 on 39623 degrees of freedom
##   (2142 observations deleted due to missingness)
## Multiple R-squared:  0.7683, Adjusted R-squared:  0.7677
## F-statistic:  1413 on 93 and 39623 DF,  p-value: < 2.2e-16
```

```
transformed_lm_pred <- predict(transformed_lm, newdata = test_set)
```

```
## Warning in predict.lm(transformed_lm, newdata = test_set): prediction from a
## rank-deficient fit may be misleading
```

```
print("MAPE is:")
```

```
## [1] "MAPE is:"
```

```
MAPE(transformed_lm_pred, test_set$pay_median)
```

```
## [1] 0.6621433
```