QMSS Final Project

The Physician Compare website was created by the Centers for Medicare & Medicaid Services (CMS) in December 2010 as required by the Affordable Care Act (ACA) of 2010 to help patients assess and find doctors and hospitals. This dataset contains the information supplied to patients via that website, including patient satisfaction surveys and performance scores across over 100 metrics.

Looking at individual physician scores:

- MIPS
- Performance by measure category
- Organization MIPS

Possible project:
* Prediction of whether to see a physician based on threshold * Predict physician score based on all factors (predict MIPS?) + classification of whether you should go to a doctor based on MIPS score + train on several classification methods to analyze best approach for this data

Question/Problem: How can we better help patients assess and find doctors, where the scoring and rating come in a format not easily accessible or understandable by the average individual?

Approach/Methods: Supervised learning for binary classification utilizing the MIPS as a target with other physician scoring methods as predictors (which we know some of the metrics are direct factors of the individual MIPS scoring, such as the IA, ACI, and Quality category scorings). Potential methods outlined below, including generalized linear models and tree methods.

```
dr_scores <- read.csv("full_doctor_scoring.csv", sep = ",", na = "NA")
head(dr_scores)
```

```
##       PAC_id Professional.Enrollment.ID last_name first_name Gender
## 1 4385734086            I20071219000090    KANTER      DAVID      F
## 2 7214189315            I20121219000307  GOTESMAN  ALEXANDER      M
## 3 6507956612            I20071213000113   HARTMAN    MATTHEW      M
## 4 8325134752            I20110720000797 NASAJPOUR    HOSSEIN      M
## 5 8325216575            I20180518001359  MCCOPPIN      HOLLY      F
## 6 9133275274            I20090915000481      JOHN  JAYASHREE      F
##   Credential                                Medical.school.name
## 1       <NA>                                              OTHER
## 2       <NA>                                              OTHER
## 3       <NA>         UNIVERSITY OF PITTSBURGH SCHOOL OF MEDICINE
## 4       <NA>           UNIVERSITY OF FLORIDA COLLEGE OF MEDICINE
## 5       <NA> UNIVERSITY OF MISSOURI, COLUMBIA SCHOOL OF MEDICINE
## 6       <NA>                                              OTHER
##   Graduation.year                    Primary.specialty Num.Secondaries
## 1            1998 PHYSICAL MEDICINE AND REHABILITATION              0
## 2            1999                              UROLOGY              0
## 3            2002                 DIAGNOSTIC RADIOLOGY              0
## 4            2003   PLASTIC AND RECONSTRUCTIVE SURGERY              0
## 5            2006                           DERMATOLOGY              0
## 6            1984                            PSYCHIATRY              0
##   Group.Practice.PAC.ID State
## 1            8123911500    NY
## 2            9032293709    NJ
```

```
## 3            8426364738    PA
## 4            4385876655    MS
## 5            1456329655    CO
## 6            8729381033    GA
##                            Organization.legal.name Score_Source_Org
## 1 PHYSICAL MEDICINE and REHAB MEDICAL SERVICE GROUP            group
## 2        LAKEWOOD UROLOGY LIMITED LIABILITY COMPANY            group
## 3                       ALLEGHENY CLINIC RADIOLOGY            group
## 4                       SOUTH CENTRAL CLINICS, INC            group
## 5                     LAKE LOVELAND DERMATOLOGY PC            group
## 6                ST FRANCIS PHYSICIAN PRACTICES LLC            group
##   Quality_Score_Org ACI_Score_Org IA_Score_Org MIPS_Score_Org
## 1               100           100           40         100.00
## 2                 0             0            0           0.00
## 3               100             0           40         100.00
## 4                 0             0           20           7.50
## 5                 0             0            0           0.00
## 6                 0             0           10           3.75
##   Score_Source_Dr Quality_Score_Dr ACI_Score_Dr IA_Score_Dr MIPS_Score_Dr
## 1           group            100.0          100          40         100.0
## 2      individual             67.0            0           0          40.2
## 3           group            100.0          N/A          40         100.0
## 4      individual             69.2          100          40          81.5
## 5      individual             72.6          100          40          83.6
## 6      individual             22.9          N/A           0          19.5
##   Age.Related.Macular.Degeneration..AMD. Biopsy.Follow.Up Care.Plan
## 1                                     NA               NA        NA
## 2                                     NA               NA        NA
## 3                                     NA               NA        NA
## 4                                     NA               NA        NA
## 5                                     NA               NA        NA
## 6                                     NA               NA        NA
##   Colorectal.Cancer.Screening Coronary.Artery.Disease..CAD. Diabetes
## 1                          NA                             NA       NA
## 2                          NA                             NA       NA
## 3                          NA                             NA       NA
## 4                          NA                             NA       NA
## 5                          NA                             NA       NA
## 6                          NA                             NA       NA
##   Diabetes.Mellitus Diabetic.Retinopathy
## 1                NA                   NA
## 2                NA                   NA
## 3                NA                   NA
## 4                NA                   NA
## 5                NA                   NA
## 6                NA                   NA
##   Documentation.of.Current.Medications.in.the.Medical.Record e.Prescribing
## 1                                                         NA            NA
## 2                                                        100            NA
## 3                                                         NA            NA
## 4                                                         NA            48
## 5                                                         NA            89
## 6                                                         NA            NA
##   Falls Functional.Outcome.Assessment Health.Information.Exchange
```

```
## 1    NA                            NA                           NA
## 2    NA                            NA                           NA
## 3    NA                            NA                           NA
## 4    NA                            NA                           NA
## 5    NA                            NA                           NA
## 6    NA                            NA                           NA
##   Medication.Reconciliation Medication.Reconciliation.Post.Discharge
## 1                        NA                                       NA
## 2                        NA                                       67
## 3                        NA                                       NA
## 4                        64                                       NA
## 5                        NA                                       NA
## 6                        NA                                       NA
##   Melanoma Nuclear.Medicine Pain.Assessment.and.Follow.Up
## 1       NA               NA                           NA
## 2       NA               NA                           96
## 3       NA               NA                           NA
## 4       NA               NA                           NA
## 5       NA               NA                           NA
## 6       NA               NA                           NA
##   Patient.Specific.Education
## 1                         NA
## 2                         NA
## 3                         NA
## 4                         78
## 5                         88
## 6                         NA
##   Pneumococcal.Vaccination.Status.for.Older.Adults
## 1                                               NA
## 2                                               NA
## 3                                               NA
## 4                                               NA
## 5                                               NA
## 6                                               NA
##   Post.Anesthetic.Transfer.of.Care.Measure
## 1                                       NA
## 2                                       NA
## 3                                       NA
## 4                                       NA
## 5                                       NA
## 6                                       NA
##   Prevention.of.Central.Venous.Catheter..CVC....Related.Bloodstream.Infections
## 1                                                                           NA
## 2                                                                           NA
## 3                                                                           NA
## 4                                                                           NA
## 5                                                                           NA
## 6                                                                           NA
##   Prevention.of.Post.Operative.Nausea.and.Vomiting..PONV....Combination.Therapy
## 1                                                                            NA
## 2                                                                            NA
## 3                                                                            NA
## 4                                                                            NA
## 5                                                                            NA
```

```
## 6                                                                            NA
##   Preventive.Care.and.Screening Primary.Open.Angle.Glaucoma..POAG.
## 1                            74                                 NA
## 2                            80                                 NA
## 3                            NA                                 NA
## 4                            NA                                 NA
## 5                            NA                                 NA
## 6                            99                                 NA
##   Provide.Patient.Access Radiation.Consideration.for.Adult.CT Radiology
## 1                     NA                                   NA        NA
## 2                     NA                                   NA        NA
## 3                     NA                                  100       100
## 4                     85                                   NA        NA
## 5                     54                                   NA        NA
## 6                     NA                                   NA        NA
##   Screening.for.Osteoporosis.for.Women.Aged.65.85.Years.of.Age
## 1                                                           NA
## 2                                                           NA
## 3                                                           NA
## 4                                                           NA
## 5                                                           NA
## 6                                                           NA
##   Secure.Messaging Tobacco.Use.and.Help.with.Quitting.Among.Adolescents
## 1               NA                                                   NA
## 2               NA                                                   NA
## 3               NA                                                   NA
## 4                2                                                   NA
## 5               24                                                   NA
## 6               NA                                                   NA
##   Urinary.Incontinence View..Download..or.Transmit..VDT. avg.perf
## 1                   NA                                NA     74.0
## 2                   95                                NA     87.6
## 3                   NA                                NA    100.0
## 4                   NA                                 5     47.0
## 5                   NA                                17     54.4
## 6                   NA                                NA     99.0
```

Potential Methods for Binary Classification:
Using overall MIPS for individuals where MIPS>= 75, the positive payment adjustment threshold.

- could apply spline to other MIPS, ACI scorings since they're somewhat discrete in nature.
  - ACI >= 0 : clinician reported ACI category
  - ACI >= 50: clinician achieved base score for ACI
  - MIPS < 30: Negative Payment Adjustment
- Predictive MIPS >= 75, essentially.
- Methods to try:
  - glmnet for binary classification (elastic model/penalized logit)
  - glm logit model with polynomials?
  - tree model if we can make it work? (Single Tree, Random Forest, Boosting, Dbarts???)
  - PLSDA or LDA
  - nnet or MARS
- PCA to look at similar variables? like an inverted version