

MSCI 446 - Assignment 2 - Question 2

M. Harper, H. Gomaa, K. Morris

20/02/2021

Question 2

```
library('glmnet')

## Loading required package: Matrix

## Loaded glmnet 4.1

health <- read.csv("mental_health.csv")
```

2.1

```
set.seed(123)
train_inds <- sample(1:nrow(health), size = floor(0.8*nrow(health)))
train <- health[train_inds,]
test <- health[-train_inds,]

# head(train)
# head(test)
#
# nrow(test)
# nrow(train)
```

2.2 fit models

```
library('ISLR')

x_train <- model.matrix(IsMentalHealthRelated ~ ., train)[, -1]
y_train <- train$IsMentalHealthRelated

#head(y_train)

fit.logreg <- glm(IsMentalHealthRelated ~ ., data = train, family = "binomial")
```

```
library('glmnet')
cv.fit.l1 <- cv.glmnet(x = x_train, y = y_train, family="binomial", alpha=1, nfolds = 10)
fit.l1 <- glmnet(x = x_train, y = y_train, alpha=1,
               family="binomial", lambda = cv.fit.l1$lambda.min)

cv.fit.l2 <- cv.glmnet(x = x_train, y = y_train, alpha=0, family="binomial", nfolds = 10)
fit.l2 <- glmnet(x = x_train, y = y_train, alpha=0,
               family="binomial", lambda = cv.fit.l2$lambda.min)
```

2.3 compare performance

```
x.test <- model.matrix(IsMentalHealthRelated ~ ., test)[, -1]

probs.logreg <- predict(fit.logreg, test, type = 'response')
preds.logreg <- ifelse(probs.logreg >= 0.5, 1, 0)
acc.logreg <- mean(preds.logreg == test$IsMentalHealthRelated)
acc.logreg
```

```
## [1] 0.976247
```

```
probs.l1 <- predict(fit.l1, newx = x.test, type = 'response')
preds.l1 <- ifelse(probs.l1 >= 0.5, 1, 0)
acc.l1 <- mean(preds.l1 == test$IsMentalHealthRelated)
acc.l1
```

```
## [1] 0.9952494
```

```
probs.l2 <- predict(fit.l2, newx = x.test, type = 'response')
preds.l2 <- ifelse(probs.l2 >= 0.5, 1, 0)
acc.l2 <- mean(preds.l2 == test$IsMentalHealthRelated)
acc.l2
```

```
## [1] 0.9699129
```

Based on the test data, it appears that L1 (lasso) regularization to the logistical regression fit on mental health data is the most accurate, at 99.5% prediction accuracy. This is followed by logistical regression without regularization, at 97.6% prediction accuracy. Close behind is the L2 (ridge) regularization at 96.69% accuracy.

2.4 Interpret models

```
#L1 Model
l1.coef.summary <- sort(coef(fit.l1)[,1], decreasing=TRUE)
head(l1.coef.summary, 20)
```

```
## (Intercept)      service      second mental.health      gt
## 68.053315      9.044038      8.253447      8.205860      6.808647
##      fine      realize      depression      hard      stay
## 6.718488      6.617889      6.002484      6.000261      5.852383
##      course      see      wait      want      stress
## 5.604724      5.017714      4.908567      4.904646      4.776616
##      break.      worry      great      current      problems
## 4.634962      4.632563      4.526137      4.456216      4.363956
```

```
tail(l1.coef.summary, 20)
```

```
##      three      routine      personal      healthy      run      years      half
## -6.234051 -6.515962 -6.530356 -7.095862 -7.208136 -7.357877 -7.863597
##      rep      press      however      pull      squat      buy      hi
## -8.015294 -8.016293 -8.019972 -8.149362 -8.572648 -8.989900 -9.051929
##      diet      short      body      search      question      progress
## -9.284543 -10.291076 -12.508255 -13.468724 -14.833469 -16.242355
```

#L2 Model

```
l2.coef.summary <- sort(coef(fit.l2)[,1], decreasing=TRUE)
head(l2.coef.summary, 20)
```

```
## (Intercept)      term      counsel      university mental.health
## 3.385598      2.547274      2.376485      2.327515      2.001776
##      service      mental      op      depression      anxiety
## 1.983106      1.879943      1.840401      1.783823      1.734018
##      co.op      deal      mark      study      happy
## 1.665985      1.618486      1.518662      1.485883      1.476747
##      actually      stress      job      life      grade
## 1.476323      1.463615      1.448510      1.435630      1.434761
```

```
tail(l2.coef.summary, 20)
```

```
##      legs      stretch      size      rep      ampnbsp suggestions
## -2.351032 -2.362199 -2.369773 -2.397494 -2.397842 -2.488672
##      recently      squat      hi      strength      gym      shoulder
## -2.497642 -2.537358 -2.605424 -2.623085 -2.631335 -2.673764
##      workouts      protein      sugar      time.week      muscle      workout
## -2.705410 -2.713222 -2.754558 -2.847288 -2.871474 -3.050107
##      however      fitness
## -3.152252 -3.538774
```

Based on the L1 (lasso) regularization results, it appears that “service” is the strongest indicator of whether a post will be mental health related, even more so than “mental.health” itself. This could be since many posts relating to mental health are part of a more general desire for better and more accessible health care options for the general public. It is not surprising at all to see words like “stress”, “worry”, and “problems” showing up in the top 20 indicators.

The bottom 20 results, however, are more puzzling. For example, “healthy”, “personal”, “body”, “question”, and “progress” are all strongly correlated against a post being mental health related, which seems odd since body image and mental health tend to go hand in hand. This leads to the conclusion that the dataset may

be biased, in that subreddits relating to weightlifting and fitness were scraped disproportionately compared to subreddits relating specifically to mental health problems.

Similarly, the L2 (ridge) regularization results make sense when it comes to relating terminology to whether the post is mental health. In fact, the results appear more in line with what a human with basic mental health knowledge would come up with, for example, “counsel”, and “university”. This could indicate a general tendency for younger people (university age) to speak out on their mental health struggles, or a bias in the dataset towards the r/uwaterloo subreddit. Again the bottom 20 indicators seem to be heavily biased towards fitness terminology, and notably, “progress” is not listed as one of the least probable indicators of a post being mental health related.

Overall then, L2 (ridge) regularization seems to provide better indications on whether a post is mental health related than L1 (lasso) regularization. One apparently strong indicator that may skew this slightly in the positive direction “op”, which denotes “original poster”, and comes up in comment threads. Many people responding in comments address the op directly, so the instances of op may be disproportionately high in this dataset if certain posts had a high number of responses, especially risky posts involving talk of suicide. It is very interesting that suicide does not show up as a strong indicator that a post is mental health related.

L1 regularization (lasso regression) is the method that tends to zero many coefficients, and L2 regularization (ridge regression) tends to shrink all the coefficients but does not zero any. This is apparent in the strong coefficients being significantly smaller in magnitude for L2 regularization than for L1 regularization.