

Lab8

2023-04-11

#Q1: Creating 10/90 training/test data set

#Set seed

HUID <- 21519588

set.seed(HUID)

#Store health variables from time t-1 which all end with _tm

all_predictors <- colnames(dat[,grep("[tm1]", names(dat))])

all_predictors

```
## [1] "tm1_dem_black" "tm1_dem_female"
## [3] "tm1_dem_age_band_1824" "tm1_dem_age_band_2534"
## [5] "tm1_dem_age_band_3544" "tm1_dem_age_band_4554"
## [7] "tm1_dem_age_band_5564" "tm1_dem_age_band_6574"
## [9] "tm1_dem_age_band_75" "tm1_alcohol_elixhauser"
## [11] "tm1_anemia_elixhauser" "tm1_arrhythmia_elixhauser"
## [13] "tm1_arthritis_elixhauser" "tm1_bloodlossanemia_elixhauser"
## [15] "tm1_coagulopathy_elixhauser" "tm1_compdiabetes_elixhauser"
## [17] "tm1_depression_elixhauser" "tm1_drugabuse_elixhauser"
## [19] "tm1_electrolytes_elixhauser" "tm1_hypertension_elixhauser"
## [21] "tm1_hypothyroid_elixhauser" "tm1_liver_elixhauser"
## [23] "tm1_neurodegen_elixhauser" "tm1_obesity_elixhauser"
## [25] "tm1_paralysis_elixhauser" "tm1_psychosis_elixhauser"
## [27] "tm1_pulmcirc_elixhauser" "tm1_pvd_elixhauser"
## [29] "tm1_renal_elixhauser" "tm1_uncompdiabetes_elixhauser"
## [31] "tm1_valvulardz_elixhauser" "tm1_wtloss_elixhauser"
## [33] "tm1_cerebrovasculardz_romano" "tm1_chf_romano"
## [35] "tm1_dementia_romano" "tm1_hemiplegia_romano"
## [37] "tm1_hiv aids_romano" "tm1_metastatic_romano"
## [39] "tm1_myocardialinfarct_romano" "tm1_pulmonarydz_romano"
## [41] "tm1_tumor_romano" "tm1_ulcer_romano"
## [43] "tm1_cost_dialysis" "tm1_cost_emergency"
## [45] "tm1_cost_home_health" "tm1_cost_ip_medical"
## [47] "tm1_cost_ip_surgical" "tm1_cost_laboratory"
## [49] "tm1_cost_op_primary_care" "tm1_cost_op_specialists"
## [51] "tm1_cost_op_surgery" "tm1_cost_other"
## [53] "tm1_cost_pharmacy" "tm1_cost_physical_therapy"
## [55] "tm1_cost_radiology" "tm1_lasix_dose_count"
## [57] "tm1_lasix_min_daily_dose" "tm1_lasix_mean_daily_dose"
## [59] "tm1_lasix_max_daily_dose" "tm1_cre_tests"
## [61] "tm1_crp_tests" "tm1_esr_tests"
## [63] "tm1_ghba1c_tests" "tm1_hct_tests"
## [65] "tm1_ldl_tests" "tm1_nt_bnp_tests"
## [67] "tm1_sodium_tests" "tm1_trig_tests"
## [69] "tm1_cre_minlow" "tm1_cre_minhigh"
```

```
## [71] "tm1_cre_minnormal"      "tm1_cre_meanlow"
## [73] "tm1_cre_meanhigh"      "tm1_cre_meannormal"
## [75] "tm1_cre_maxlow"        "tm1_cre_maxhigh"
## [77] "tm1_cre_maxnormal"     "tm1_crp_minlow"
## [79] "tm1_crp_minhigh"       "tm1_crp_minnormal"
## [81] "tm1_crp_meanlow"       "tm1_crp_meanhigh"
## [83] "tm1_crp_meannormal"    "tm1_crp_maxlow"
## [85] "tm1_crp_maxhigh"       "tm1_crp_maxnormal"
## [87] "tm1_esr_minlow"        "tm1_esr_minhigh"
## [89] "tm1_esr_minnormal"     "tm1_esr_meanlow"
## [91] "tm1_esr_meanhigh"     "tm1_esr_meannormal"
## [93] "tm1_esr_maxlow"        "tm1_esr_maxhigh"
## [95] "tm1_esr_maxnormal"     "tm1_ghba1c_minlow"
## [97] "tm1_ghba1c_minhigh"    "tm1_ghba1c_minnormal"
## [99] "tm1_ghba1c_meanlow"    "tm1_ghba1c_meanhigh"
## [101] "tm1_ghba1c_meannormal" "tm1_ghba1c_maxlow"
## [103] "tm1_ghba1c_maxhigh"    "tm1_ghba1c_maxnormal"
## [105] "tm1_hct_minlow"        "tm1_hct_minhigh"
## [107] "tm1_hct_minnormal"     "tm1_hct_meanlow"
## [109] "tm1_hct_meanhigh"     "tm1_hct_meannormal"
## [111] "tm1_hct_maxlow"        "tm1_hct_maxhigh"
## [113] "tm1_hct_maxnormal"     "tm1_ldl_minlow"
## [115] "tm1_ldl_minhigh"       "tm1_ldl_minnormal"
## [117] "tm1_ldlmeanlow"        "tm1_ldlmeanhigh"
## [119] "tm1_ldlmeannormal"     "tm1_ldl_maxlow"
## [121] "tm1_ldl_maxhigh"       "tm1_ldl_maxnormal"
## [123] "tm1_nt_bnp_minlow"     "tm1_nt_bnp_minhigh"
## [125] "tm1_nt_bnp_minnormal"  "tm1_nt_bnp_meanlow"
## [127] "tm1_nt_bnp_meanhigh"   "tm1_nt_bnp_meannormal"
## [129] "tm1_nt_bnp_maxlow"     "tm1_nt_bnp_maxhigh"
## [131] "tm1_nt_bnp_maxnormal"  "tm1_sodium_minlow"
## [133] "tm1_sodium_minhigh"    "tm1_sodium_minnormal"
## [135] "tm1_sodium_meanlow"    "tm1_sodium_meanhigh"
## [137] "tm1_sodium_meannormal" "tm1_sodium_maxlow"
## [139] "tm1_sodium_maxhigh"    "tm1_sodium_maxnormal"
## [141] "tm1_trig_minlow"       "tm1_trig_minhigh"
## [143] "tm1_trig_minnormal"    "tm1_trig_meanlow"
## [145] "tm1_trig_meanhigh"     "tm1_trig_meannormal"
## [147] "tm1_trig_maxlow"       "tm1_trig_maxhigh"
## [149] "tm1_trig_maxnormal"    "tm1_gagne_sum"
```

```
#Store predictor variables which all start with P_*, but EXCLUDE race
race <- c("tm1_dem_black")
exclude_race <- setdiff(all_predictors,race)
exclude_race
```

```
## [1] "tm1_dem_female"      "tm1_dem_age_band_1824"
## [3] "tm1_dem_age_band_2534" "tm1_dem_age_band_3544"
## [5] "tm1_dem_age_band_4554" "tm1_dem_age_band_5564"
## [7] "tm1_dem_age_band_6574" "tm1_dem_age_band_75"
## [9] "tm1_alcohol_elixhauser" "tm1_anemia_elixhauser"
## [11] "tm1_arrhythmia_elixhauser" "tm1_arthritis_elixhauser"
## [13] "tm1_bloodlossanemia_elixhauser" "tm1_coagulopathy_elixhauser"
## [15] "tm1_compdiabetes_elixhauser" "tm1_depression_elixhauser"
## [17] "tm1_drugabuse_elixhauser" "tm1_electrolytes_elixhauser"
```

## [19]	"tm1_hypertension_elixhauser"	"tm1_hypothyroid_elixhauser"
## [21]	"tm1_liver_elixhauser"	"tm1_neurodegen_elixhauser"
## [23]	"tm1_obesity_elixhauser"	"tm1_paralysis_elixhauser"
## [25]	"tm1_psychosis_elixhauser"	"tm1_pulmcirc_elixhauser"
## [27]	"tm1_pvd_elixhauser"	"tm1_renal_elixhauser"
## [29]	"tm1_uncompdiabetes_elixhauser"	"tm1_valvulardz_elixhauser"
## [31]	"tm1_wtloss_elixhauser"	"tm1_cerebrovascular dz_romano"
## [33]	"tm1_chf_romano"	"tm1_dementia_romano"
## [35]	"tm1_hemiplegia_romano"	"tm1_hiv aids_romano"
## [37]	"tm1_metastatic_romano"	"tm1_myocardial infarct_romano"
## [39]	"tm1_pulmonary dz_romano"	"tm1_tumor_romano"
## [41]	"tm1_ulcer_romano"	"tm1_cost_dialysis"
## [43]	"tm1_cost_emergency"	"tm1_cost_home_health"
## [45]	"tm1_cost_ip_medical"	"tm1_cost_ip_surgical"
## [47]	"tm1_cost_laboratory"	"tm1_cost_op_primary_care"
## [49]	"tm1_cost_op_specialists"	"tm1_cost_op_surgery"
## [51]	"tm1_cost_other"	"tm1_cost_pharmacy"
## [53]	"tm1_cost_physical_therapy"	"tm1_cost_radiology"
## [55]	"tm1_lasix_dose_count"	"tm1_lasix_min_daily_dose"
## [57]	"tm1_lasix_mean_daily_dose"	"tm1_lasix_max_daily_dose"
## [59]	"tm1_cre_tests"	"tm1_crp_tests"
## [61]	"tm1_esr_tests"	"tm1_ghba1c_tests"
## [63]	"tm1_hct_tests"	"tm1_ldl_tests"
## [65]	"tm1_nt_bnp_tests"	"tm1_sodium_tests"
## [67]	"tm1_trig_tests"	"tm1_cre_minlow"
## [69]	"tm1_cre_minhigh"	"tm1_cre_minnormal"
## [71]	"tm1_cre_meanlow"	"tm1_cre_meanhigh"
## [73]	"tm1_cre_meannormal"	"tm1_cre_maxlow"
## [75]	"tm1_cre_maxhigh"	"tm1_cre_maxnormal"
## [77]	"tm1_crp_minlow"	"tm1_crp_minhigh"
## [79]	"tm1_crp_minnormal"	"tm1_crp_meanlow"
## [81]	"tm1_crp_meanhigh"	"tm1_crp_meannormal"
## [83]	"tm1_crp_maxlow"	"tm1_crp_maxhigh"
## [85]	"tm1_crp_maxnormal"	"tm1_esr_minlow"
## [87]	"tm1_esr_minhigh"	"tm1_esr_minnormal"
## [89]	"tm1_esr_meanlow"	"tm1_esr_meanhigh"
## [91]	"tm1_esr_meannormal"	"tm1_esr_maxlow"
## [93]	"tm1_esr_maxhigh"	"tm1_esr_maxnormal"
## [95]	"tm1_ghba1c_minlow"	"tm1_ghba1c_minhigh"
## [97]	"tm1_ghba1c_minnormal"	"tm1_ghba1c_meanlow"
## [99]	"tm1_ghba1c_meanhigh"	"tm1_ghba1c_meannormal"
## [101]	"tm1_ghba1c_maxlow"	"tm1_ghba1c_maxhigh"
## [103]	"tm1_ghba1c_maxnormal"	"tm1_hct_minlow"
## [105]	"tm1_hct_minhigh"	"tm1_hct_minnormal"
## [107]	"tm1_hct_meanlow"	"tm1_hct_meanhigh"
## [109]	"tm1_hct_meannormal"	"tm1_hct_maxlow"
## [111]	"tm1_hct_maxhigh"	"tm1_hct_maxnormal"
## [113]	"tm1_ldl_minlow"	"tm1_ldl_minhigh"
## [115]	"tm1_ldl_minnormal"	"tm1_ldl_meanlow"
## [117]	"tm1_ldl_meanhigh"	"tm1_ldl_meannormal"
## [119]	"tm1_ldl_maxlow"	"tm1_ldl_maxhigh"
## [121]	"tm1_ldl_maxnormal"	"tm1_nt_bnp_minlow"
## [123]	"tm1_nt_bnp_minhigh"	"tm1_nt_bnp_minnormal"
## [125]	"tm1_nt_bnp_meanlow"	"tm1_nt_bnp_meanhigh"

```
## [127] "tm1_nt_bnp_meannormal"      "tm1_nt_bnp_maxlow"
## [129] "tm1_nt_bnp_maxhigh"        "tm1_nt_bnp_maxnormal"
## [131] "tm1_sodium_minlow"         "tm1_sodium_minhigh"
## [133] "tm1_sodium_minnormal"      "tm1_sodium_meanlow"
## [135] "tm1_sodium_meanhigh"       "tm1_sodium_meannormal"
## [137] "tm1_sodium_maxlow"         "tm1_sodium_maxhigh"
## [139] "tm1_sodium_maxnormal"      "tm1_trig_minlow"
## [141] "tm1_trig_minhigh"          "tm1_trig_minnormal"
## [143] "tm1_trig_meanlow"          "tm1_trig_meanhigh"
## [145] "tm1_trig_meannormal"       "tm1_trig_maxlow"
## [147] "tm1_trig_maxhigh"          "tm1_trig_maxnormal"
## [149] "tm1_gagne_sum"
```

```
#Define training and test data sets
#Use a uniformly distributed random number between 0 and 1
dat$random_number <- runif(length(dat$patient_id))
```

```
## Generate a training flag for 10% of the sample
dat$train_flag <- ifelse(dat$random_number<= 0.1, 1, 0)
```

```
#Report number of observations in training and test samples
sum(dat$train_flag)
```

```
## [1] 4818
```

```
sum(1-dat$train_flag)
```

```
## [1] 43966
```

```
#Data frame with training data (randomly selected 10% of the data)
training <- subset(dat, train_flag == 1)
summary(training)
```

```
##      patient_id      gagne_sum_t      cost_t      cost_avoidable_t
## Min.   :100035   Min.   : 0.000   Min.    :    0   Min.    :    0
## 1st Qu.:111954   1st Qu.: 0.000   1st Qu.:  1200   1st Qu.:    0
## Median :123972   Median : 1.000   Median :  2800   Median :    0
## Mean   :124122   Mean   : 1.398   Mean    :  7805   Mean    : 2555
## 3rd Qu.:135996   3rd Qu.: 2.000   3rd Qu.:  6600   3rd Qu.:   200
## Max.   :148778   Max.   :15.000   Max.    :527900   Max.    :642700
##      race      tm1_dem_black      tm1_dem_female      tm1_dem_age_band_1824
## Length:4818   Min.    :0.0000   Min.    :0.0000   Min.    :0.00000
## Class :character 1st Qu.:0.0000   1st Qu.:0.0000   1st Qu.:0.00000
## Mode  :character Median :0.0000   Median :1.0000   Median :0.00000
##              Mean   :0.1166   Mean    :0.6376   Mean    :0.03985
##              3rd Qu.:0.0000   3rd Qu.:1.0000   3rd Qu.:0.00000
##              Max.    :1.0000   Max.    :1.0000   Max.    :1.00000
## tm1_dem_age_band_2534 tm1_dem_age_band_3544 tm1_dem_age_band_4554
## Min.    :0.0000   Min.    :0.0000   Min.    :0.0000
## 1st Qu.:0.0000   1st Qu.:0.0000   1st Qu.:0.0000
## Median :0.0000   Median :0.0000   Median :0.0000
## Mean    :0.1129   Mean    :0.1845   Mean    :0.2343
## 3rd Qu.:0.0000   3rd Qu.:0.0000   3rd Qu.:0.0000
## Max.    :1.0000   Max.    :1.0000   Max.    :1.0000
## tm1_dem_age_band_5564 tm1_dem_age_band_6574 tm1_dem_age_band_75
## Min.    :0.0000   Min.    :0.0000   Min.    :0.00000
```

## 1st Qu.:0.0000	1st Qu.:0.0000	1st Qu.:0.00000
## Median :0.0000	Median :0.0000	Median :0.00000
## Mean :0.1959	Mean :0.1503	Mean :0.06891
## 3rd Qu.:0.0000	3rd Qu.:0.0000	3rd Qu.:0.00000
## Max. :1.0000	Max. :1.0000	Max. :1.00000
## tm1_alcohol_elixhauser	tm1_anemia_elixhauser	tm1_arrhythmia_elixhauser
## Min. :0.000000	Min. :0.00000	Min. :0.00000
## 1st Qu.:0.000000	1st Qu.:0.00000	1st Qu.:0.00000
## Median :0.000000	Median :0.00000	Median :0.00000
## Mean :0.009963	Mean :0.06227	Mean :0.09298
## 3rd Qu.:0.000000	3rd Qu.:0.00000	3rd Qu.:0.00000
## Max. :1.000000	Max. :1.00000	Max. :1.00000
## tm1_arthritis_elixhauser	tm1_bloodlossanemia_elixhauser	
## Min. :0.00000	Min. :0.000000	
## 1st Qu.:0.00000	1st Qu.:0.000000	
## Median :0.00000	Median :0.000000	
## Mean :0.04483	Mean :0.002698	
## 3rd Qu.:0.00000	3rd Qu.:0.000000	
## Max. :1.00000	Max. :1.000000	
## tm1_coagulopathy_elixhauser	tm1_compdiabetes_elixhauser	
## Min. :0.00000	Min. :0.00000	
## 1st Qu.:0.00000	1st Qu.:0.00000	
## Median :0.00000	Median :0.00000	
## Mean :0.01287	Mean :0.02221	
## 3rd Qu.:0.00000	3rd Qu.:0.00000	
## Max. :1.00000	Max. :1.00000	
## tm1_depression_elixhauser	tm1_drugabuse_elixhauser	tm1_electrolytes_elixhauser
## Min. :0.00000	Min. :0.000000	Min. :0.00000
## 1st Qu.:0.00000	1st Qu.:0.000000	1st Qu.:0.00000
## Median :0.00000	Median :0.000000	Median :0.00000
## Mean :0.06455	Mean :0.004981	Mean :0.03176
## 3rd Qu.:0.00000	3rd Qu.:0.000000	3rd Qu.:0.00000
## Max. :1.00000	Max. :1.000000	Max. :1.00000
## tm1_hypertension_elixhauser	tm1_hypothyroid_elixhauser	tm1_liver_elixhauser
## Min. :0.0000	Min. :0.0	Min. :0.00000
## 1st Qu.:0.0000	1st Qu.:0.0	1st Qu.:0.00000
## Median :0.0000	Median :0.0	Median :0.00000
## Mean :0.3371	Mean :0.1	Mean :0.01868
## 3rd Qu.:1.0000	3rd Qu.:0.0	3rd Qu.:0.00000
## Max. :1.0000	Max. :1.0	Max. :1.00000
## tm1_neurodegen_elixhauser	tm1_obesity_elixhauser	tm1_paralysis_elixhauser
## Min. :0.00000	Min. :0.00000	Min. :0.0000000
## 1st Qu.:0.00000	1st Qu.:0.00000	1st Qu.:0.0000000
## Median :0.00000	Median :0.00000	Median :0.0000000
## Mean :0.02781	Mean :0.09527	Mean :0.0006227
## 3rd Qu.:0.00000	3rd Qu.:0.00000	3rd Qu.:0.0000000
## Max. :1.00000	Max. :1.00000	Max. :1.0000000
## tm1_psychosis_elixhauser	tm1_pulmcirc_elixhauser	tm1_pvd_elixhauser
## Min. :0.00000	Min. :0.00000	Min. :0.00000
## 1st Qu.:0.00000	1st Qu.:0.00000	1st Qu.:0.00000
## Median :0.00000	Median :0.00000	Median :0.00000
## Mean :0.03466	Mean :0.00851	Mean :0.02677
## 3rd Qu.:0.00000	3rd Qu.:0.00000	3rd Qu.:0.00000
## Max. :1.00000	Max. :1.00000	Max. :1.00000

```

## tm1_renal_elixhauser tm1_uncompdiabetes_elixhauser tm1_valvulardz_elixhauser
## Min. :0.00000 Min. :0.00000 Min. :0.00000
## 1st Qu.:0.00000 1st Qu.:0.00000 1st Qu.:0.00000
## Median :0.00000 Median :0.00000 Median :0.00000
## Mean :0.03279 Mean :0.09402 Mean :0.03093
## 3rd Qu.:0.00000 3rd Qu.:0.00000 3rd Qu.:0.00000
## Max. :1.00000 Max. :1.00000 Max. :1.00000
## tm1_wtloss_elixhauser tm1_cerebrovasculardz_romano tm1_chf_romano
## Min. :0.0000000 Min. :0.00000 Min. :0.00000
## 1st Qu.:0.0000000 1st Qu.:0.00000 1st Qu.:0.00000
## Median :0.0000000 Median :0.00000 Median :0.00000
## Mean :0.0008302 Mean :0.02781 Mean :0.03238
## 3rd Qu.:0.0000000 3rd Qu.:0.00000 3rd Qu.:0.00000
## Max. :1.0000000 Max. :1.00000 Max. :1.00000
## tm1_dementia_romano tm1_hemiplegia_romano tm1_hivaidz_romano
## Min. :0.000000 Min. :0.000000 Min. :0.000000
## 1st Qu.:0.000000 1st Qu.:0.000000 1st Qu.:0.000000
## Median :0.000000 Median :0.000000 Median :0.000000
## Mean :0.008925 Mean :0.002283 Mean :0.003113
## 3rd Qu.:0.000000 3rd Qu.:0.000000 3rd Qu.:0.000000
## Max. :1.000000 Max. :1.000000 Max. :1.000000
## tm1_metastatic_romano tm1_myocardialinfarct_romano tm1_pulmonarydz_romano
## Min. :0.000000 Min. :0.00000 Min. :0.0000
## 1st Qu.:0.000000 1st Qu.:0.00000 1st Qu.:0.0000
## Median :0.000000 Median :0.00000 Median :0.0000
## Mean :0.007887 Mean :0.01764 Mean :0.1009
## 3rd Qu.:0.000000 3rd Qu.:0.00000 3rd Qu.:0.0000
## Max. :1.000000 Max. :1.00000 Max. :1.0000
## tm1_tumor_romano tm1_ulcer_romano tm1_cost_dialysis tm1_cost_emergency
## Min. :0.00000 Min. :0.000000 Min. : 0.00 Min. : 0.0
## 1st Qu.:0.00000 1st Qu.:0.000000 1st Qu.: 0.00 1st Qu.: 0.0
## Median :0.00000 Median :0.000000 Median : 0.00 Median : 0.0
## Mean :0.09755 Mean :0.003736 Mean : 15.31 Mean : 408.5
## 3rd Qu.:0.00000 3rd Qu.:0.000000 3rd Qu.: 0.00 3rd Qu.: 190.0
## Max. :1.00000 Max. :1.000000 Max. :40380.00 Max. :38360.0
## tm1_cost_home_health tm1_cost_ip_medical tm1_cost_ip_surgical
## Min. : 0.0 Min. : 0.0 Min. : 0
## 1st Qu.: 0.0 1st Qu.: 0.0 1st Qu.: 0
## Median : 0.0 Median : 0.0 Median : 0
## Mean : 208.6 Mean : 618.4 Mean : 1178
## 3rd Qu.: 0.0 3rd Qu.: 0.0 3rd Qu.: 0
## Max. :20460.0 Max. :98150.0 Max. :156920
## tm1_cost_laboratory tm1_cost_op_primary_care tm1_cost_op_specialists
## Min. : 0 Min. : 0.0 Min. : 0.0
## 1st Qu.: 30 1st Qu.: 170.0 1st Qu.: 130.0
## Median : 180 Median : 350.0 Median : 430.0
## Mean : 344 Mean : 468.1 Mean : 871.5
## 3rd Qu.: 380 3rd Qu.: 600.0 3rd Qu.: 1040.0
## Max. :34890 Max. :42210.0 Max. :37430.0
## tm1_cost_op_surgery tm1_cost_other tm1_cost_pharmacy
## Min. : 0.0 Min. : 0 Min. : 0.0
## 1st Qu.: 0.0 1st Qu.: 200 1st Qu.: 0.0
## Median : 0.0 Median : 500 Median : 0.0
## Mean : 860.3 Mean : 1608 Mean : 401.1

```

```

## 3rd Qu.: 530.0      3rd Qu.: 1300      3rd Qu.: 0.0
## Max. :45970.0      Max. :193200      Max. :97500.0
## tm1_cost_physical_therapy tm1_cost_radiology tm1_lasix_dose_count
## Min. : 0.0          Min. : 0.0          Min. :0.00000
## 1st Qu.: 0.0          1st Qu.: 0.0          1st Qu.:0.00000
## Median : 0.0          Median : 0.0          Median :0.00000
## Mean : 170.3          Mean : 232.9          Mean :0.01723
## 3rd Qu.: 0.0          3rd Qu.: 240.0          3rd Qu.:0.00000
## Max. :8110.0          Max. :6230.0          Max. :8.00000
## tm1_lasix_min_daily_dose tm1_lasix_mean_daily_dose tm1_lasix_max_daily_dose
## Min. : 0.0000          Min. : 0.0000          Min. : 0.0000
## 1st Qu.: 0.0000          1st Qu.: 0.0000          1st Qu.: 0.0000
## Median : 0.0000          Median : 0.0000          Median : 0.0000
## Mean : 0.3072          Mean : 0.3352          Mean : 0.3695
## 3rd Qu.: 0.0000          3rd Qu.: 0.0000          3rd Qu.: 0.0000
## Max. :120.0000          Max. :160.0000          Max. :160.0000
## tm1_cre_tests tm1_crp_tests tm1_esr_tests tm1_ghba1c_tests
## Min. : 0.000 Min. :0.0000000 Min. : 0.00000 Min. :0.0000
## 1st Qu.: 0.000 1st Qu.:0.0000000 1st Qu.: 0.00000 1st Qu.:0.0000
## Median : 0.000 Median :0.0000000 Median : 0.00000 Median :0.0000
## Mean : 1.239 Mean :0.0004151 Mean : 0.09983 Mean :0.3821
## 3rd Qu.: 1.000 3rd Qu.:0.0000000 3rd Qu.: 0.00000 3rd Qu.:1.0000
## Max. :57.000 Max. :1.0000000 Max. :10.00000 Max. :6.0000
## tm1_hct_tests tm1_ldl_tests tm1_nt_bnp_tests tm1_sodium_tests
## Min. : 0.000 Min. :0.0000 Min. :0.0000 Min. : 0.000
## 1st Qu.: 0.000 1st Qu.:0.0000 1st Qu.:0.0000 1st Qu.: 0.000
## Median : 0.000 Median :0.0000 Median :0.0000 Median : 0.000
## Mean : 1.111 Mean :0.5162 Mean :0.0301 Mean : 1.147
## 3rd Qu.: 1.000 3rd Qu.:1.0000 3rd Qu.:0.0000 3rd Qu.: 1.000
## Max. :77.000 Max. :6.0000 Max. :6.0000 Max. :55.000
## tm1_trig_tests tm1_cre_minlow tm1_cre_minhigh tm1_cre_minnormal
## Min. :0.0000 Min. :0.0000 Min. :0.00000 Min. :0.0000
## 1st Qu.:0.0000 1st Qu.:0.0000 1st Qu.:0.00000 1st Qu.:0.0000
## Median :0.0000 Median :0.0000 Median :0.00000 Median :0.0000
## Mean :0.4809 Mean :0.2208 Mean :0.03653 Mean :0.2354
## 3rd Qu.:1.0000 3rd Qu.:0.0000 3rd Qu.:0.00000 3rd Qu.:0.0000
## Max. :6.0000 Max. :1.0000 Max. :1.00000 Max. :1.0000
## tm1_cre_meanlow tm1_cre_meanhigh tm1_cre_meannormal tm1_cre_maxlow
## Min. :0.0000 Min. :0.00000 Min. :0.0000 Min. :0.000
## 1st Qu.:0.0000 1st Qu.:0.00000 1st Qu.:0.0000 1st Qu.:0.000
## Median :0.0000 Median :0.00000 Median :0.0000 Median :0.000
## Mean :0.1986 Mean :0.04961 Mean :0.2445 Mean :0.175
## 3rd Qu.:0.0000 3rd Qu.:0.00000 3rd Qu.:0.0000 3rd Qu.:0.000
## Max. :1.0000 Max. :1.00000 Max. :1.0000 Max. :1.000
## tm1_cre_maxhigh tm1_cre_maxnormal tm1_crp_minlow tm1_crp_minhigh
## Min. :0.0000 Min. :0.0000 Min. :0.0000000 Min. :0.0000000
## 1st Qu.:0.0000 1st Qu.:0.0000 1st Qu.:0.0000000 1st Qu.:0.0000000
## Median :0.0000 Median :0.0000 Median :0.0000000 Median :0.0000000
## Mean :0.0631 Mean :0.2553 Mean :0.0002076 Mean :0.0002076
## 3rd Qu.:0.0000 3rd Qu.:1.0000 3rd Qu.:0.0000000 3rd Qu.:0.0000000
## Max. :1.0000 Max. :1.0000 Max. :1.0000000 Max. :1.0000000
## tm1_crp_minnormal tm1_crp_meanlow tm1_crp_meanhigh tm1_crp_meannormal
## Min. :0 Min. :0.0000000 Min. :0.0000000 Min. :0
## 1st Qu.:0 1st Qu.:0.0000000 1st Qu.:0.0000000 1st Qu.:0

```

```

## Median :0          Median :0.0000000    Median :0.0000000    Median :0
## Mean :0           Mean :0.0002076      Mean :0.0002076      Mean :0
## 3rd Qu.:0         3rd Qu.:0.0000000      3rd Qu.:0.0000000    3rd Qu.:0
## Max. :0           Max. :1.0000000       Max. :1.0000000      Max. :0
## tm1_crp_maxlow    tm1_crp_maxhigh    tm1_crp_maxnormal    tm1_esr_minlow
## Min. :0.0000000   Min. :0.0000000     Min. :0              Min. :0
## 1st Qu.:0.0000000 1st Qu.:0.0000000   1st Qu.:0           1st Qu.:0
## Median :0.0000000 Median :0.0000000   Median :0            Median :0
## Mean :0.0002076   Mean :0.0002076     Mean :0              Mean :0
## 3rd Qu.:0.0000000 3rd Qu.:0.0000000   3rd Qu.:0           3rd Qu.:0
## Max. :1.0000000   Max. :1.0000000     Max. :0              Max. :0
## tm1_esr_minhigh   tm1_esr_minnormal   tm1_esr_meanlow      tm1_esr_meanhigh
## Min. :0.00000     Min. :0.00000       Min. :0              Min. :0.00000
## 1st Qu.:0.00000   1st Qu.:0.00000     1st Qu.:0           1st Qu.:0.00000
## Median :0.00000   Median :0.00000     Median :0            Median :0.00000
## Mean :0.02242     Mean :0.04878       Mean :0              Mean :0.02657
## 3rd Qu.:0.00000   3rd Qu.:0.00000     3rd Qu.:0           3rd Qu.:0.00000
## Max. :1.00000     Max. :1.00000       Max. :0              Max. :1.00000
## tm1_esr_meannormal tm1_esr_maxlow      tm1_esr_maxhigh      tm1_esr_maxnormal
## Min. :0.00000     Min. :0             Min. :0.0000         Min. :0.00000
## 1st Qu.:0.00000   1st Qu.:0           1st Qu.:0.0000       1st Qu.:0.00000
## Median :0.00000   Median :0            Median :0.0000       Median :0.00000
## Mean :0.04462     Mean :0             Mean :0.0276         Mean :0.04379
## 3rd Qu.:0.00000   3rd Qu.:0           3rd Qu.:0.0000       3rd Qu.:0.00000
## Max. :1.00000     Max. :0             Max. :1.0000         Max. :1.00000
## tm1_ghba1c_minlow tm1_ghba1c_minhigh tm1_ghba1c_minnormal
## Min. :0.0000000   Min. :0.0000        Min. :0.0000
## 1st Qu.:0.0000000 1st Qu.:0.0000       1st Qu.:0.0000
## Median :0.0000000 Median :0.0000        Median :0.0000
## Mean :0.0002076   Mean :0.1268         Mean :0.1393
## 3rd Qu.:0.0000000 3rd Qu.:0.0000       3rd Qu.:0.0000
## Max. :1.0000000   Max. :1.0000        Max. :1.0000
## tm1_ghba1c_meanlow tm1_ghba1c_meanhigh tm1_ghba1c_meannormal
## Min. :0.0000000   Min. :0.0000        Min. :0.0000
## 1st Qu.:0.0000000 1st Qu.:0.0000       1st Qu.:0.0000
## Median :0.0000000 Median :0.0000        Median :0.0000
## Mean :0.0002076   Mean :0.1326         Mean :0.1339
## 3rd Qu.:0.0000000 3rd Qu.:0.0000       3rd Qu.:0.0000
## Max. :1.0000000   Max. :1.0000        Max. :1.0000
## tm1_ghba1c_maxlow tm1_ghba1c_maxhigh tm1_ghba1c_maxnormal tm1_hct_minlow
## Min. :0.0000000   Min. :0.0000        Min. :0.0000        Min. :0.00000
## 1st Qu.:0.0000000 1st Qu.:0.0000       1st Qu.:0.0000       1st Qu.:0.00000
## Median :0.0000000 Median :0.0000        Median :0.0000       Median :0.00000
## Mean :0.0002076   Mean :0.1343         Mean :0.1322         Mean :0.06704
## 3rd Qu.:0.0000000 3rd Qu.:0.0000       3rd Qu.:0.0000       3rd Qu.:0.00000
## Max. :1.0000000   Max. :1.0000        Max. :1.0000        Max. :1.00000
## tm1_hct_minhigh   tm1_hct_minnormal   tm1_hct_meanlow      tm1_hct_meanhigh
## Min. :0.0000000   Min. :0.0000        Min. :0.00000        Min. :0.00000
## 1st Qu.:0.0000000 1st Qu.:0.0000       1st Qu.:0.00000       1st Qu.:0.00000
## Median :0.0000000 Median :0.0000        Median :0.00000       Median :0.00000
## Mean :0.004981     Mean :0.3778         Mean :0.04234         Mean :0.006019
## 3rd Qu.:0.0000000 3rd Qu.:1.0000       3rd Qu.:0.00000       3rd Qu.:0.00000
## Max. :1.0000000   Max. :1.0000        Max. :1.00000        Max. :1.00000
## tm1_hct_meannormal tm1_hct_maxlow      tm1_hct_maxhigh      tm1_hct_maxnormal

```


##	Min.	:0.0000	Min.	:0.00000	Min.	:0.000000	Min.	:0.0000
##	1st Qu.	:0.0000	1st Qu.	:0.00000	1st Qu.	:0.000000	1st Qu.	:0.0000
##	Median	:0.0000	Median	:0.00000	Median	:0.000000	Median	:0.0000
##	Mean	:0.4014	Mean	:0.02387	Mean	:0.009963	Mean	:0.4161
##	3rd Qu.	:1.0000	3rd Qu.	:0.00000	3rd Qu.	:0.000000	3rd Qu.	:1.0000
##	Max.	:1.0000	Max.	:1.00000	Max.	:1.000000	Max.	:1.0000
##	tm1_ldl_minlow		tm1_ldl_minhigh		tm1_ldl_minnormal		tm1_ldlmeanlow	
##	Min.	:0.00000	Min.	:0.0000	Min.	:0.0000	Min.	:0.00000
##	1st Qu.	:0.00000	1st Qu.	:0.0000	1st Qu.	:0.0000	1st Qu.	:0.00000
##	Median	:0.00000	Median	:0.0000	Median	:0.0000	Median	:0.00000
##	Mean	:0.01453	Mean	:0.2055	Mean	:0.2013	Mean	:0.01225
##	3rd Qu.	:0.00000	3rd Qu.	:0.0000	3rd Qu.	:0.0000	3rd Qu.	:0.00000
##	Max.	:1.00000	Max.	:1.0000	Max.	:1.0000	Max.	:1.00000
##	tm1_ldlmeanhigh		tm1_ldlmeannormal		tm1_ldl_maxlow		tm1_ldl_maxhigh	
##	Min.	:0.0000	Min.	:0.0000	Min.	:0.00000	Min.	:0.00
##	1st Qu.	:0.0000	1st Qu.	:0.0000	1st Qu.	:0.00000	1st Qu.	:0.00
##	Median	:0.0000	Median	:0.0000	Median	:0.00000	Median	:0.00
##	Mean	:0.2121	Mean	:0.1353	Mean	:0.01121	Mean	:0.22
##	3rd Qu.	:0.0000	3rd Qu.	:0.0000	3rd Qu.	:0.00000	3rd Qu.	:0.00
##	Max.	:1.0000	Max.	:1.0000	Max.	:1.00000	Max.	:1.00
##	tm1_ldl_maxnormal		tm1_nt_bnp_minlow		tm1_nt_bnp_minhigh		tm1_nt_bnp_minnormal	
##	Min.	:0.0000	Min.	:0.000000	Min.	:0.00000	Min.	:0.000000
##	1st Qu.	:0.0000	1st Qu.	:0.000000	1st Qu.	:0.00000	1st Qu.	:0.000000
##	Median	:0.0000	Median	:0.000000	Median	:0.00000	Median	:0.000000
##	Mean	:0.1283	Mean	:0.005604	Mean	:0.01059	Mean	:0.004359
##	3rd Qu.	:0.0000	3rd Qu.	:0.000000	3rd Qu.	:0.00000	3rd Qu.	:0.000000
##	Max.	:1.0000	Max.	:1.000000	Max.	:1.00000	Max.	:1.000000
##	tm1_nt_bnp_meanlow		tm1_nt_bnp_meanhigh		tm1_nt_bnp_meannormal			
##	Min.	:0.000000	Min.	:0.00000	Min.	:0.000000		
##	1st Qu.	:0.000000	1st Qu.	:0.00000	1st Qu.	:0.000000		
##	Median	:0.000000	Median	:0.00000	Median	:0.000000		
##	Mean	:0.006849	Mean	:0.01121	Mean	:0.002698		
##	3rd Qu.	:0.000000	3rd Qu.	:0.00000	3rd Qu.	:0.000000		
##	Max.	:1.000000	Max.	:1.00000	Max.	:1.000000		
##	tm1_nt_bnp_maxlow		tm1_nt_bnp_maxhigh		tm1_nt_bnp_maxnormal		tm1_sodium_minlow	
##	Min.	:0.000000	Min.	:0.00000	Min.	:0.000000	Min.	:0.00000
##	1st Qu.	:0.000000	1st Qu.	:0.00000	1st Qu.	:0.000000	1st Qu.	:0.00000
##	Median	:0.000000	Median	:0.00000	Median	:0.000000	Median	:0.00000
##	Mean	:0.006642	Mean	:0.01121	Mean	:0.002906	Mean	:0.03964
##	3rd Qu.	:0.000000	3rd Qu.	:0.00000	3rd Qu.	:0.000000	3rd Qu.	:0.00000
##	Max.	:1.000000	Max.	:1.00000	Max.	:1.000000	Max.	:1.00000
##	tm1_sodium_minhigh		tm1_sodium_minnormal		tm1_sodium_meanlow			
##	Min.	:0.0000000	Min.	:0.000	Min.	:0.00000		
##	1st Qu.	:0.0000000	1st Qu.	:0.000	1st Qu.	:0.00000		
##	Median	:0.0000000	Median	:0.000	Median	:0.00000		
##	Mean	:0.0004151	Mean	:0.435	Mean	:0.01785		
##	3rd Qu.	:0.0000000	3rd Qu.	:1.000	3rd Qu.	:0.00000		
##	Max.	:1.0000000	Max.	:1.000	Max.	:1.00000		
##	tm1_sodium_meanhigh		tm1_sodium_meannormal		tm1_sodium_maxlow		tm1_sodium_maxhigh	
##	Min.	:0.0000000	Min.	:0.0000	Min.	:0.00000	Min.	:0.000000
##	1st Qu.	:0.0000000	1st Qu.	:0.0000	1st Qu.	:0.00000	1st Qu.	:0.000000
##	Median	:0.0000000	Median	:0.0000	Median	:0.00000	Median	:0.000000
##	Mean	:0.0008302	Mean	:0.4566	Mean	:0.01142	Mean	:0.007472
##	3rd Qu.	:0.0000000	3rd Qu.	:1.0000	3rd Qu.	:0.00000	3rd Qu.	:0.000000

```
## Max. :1.0000000 Max. :1.0000 Max. :1.00000 Max. :1.000000
## tm1_sodium_maxnormal tm1_trig_minlow tm1_trig_minhigh tm1_trig_minnormal
## Min. :0.0000 Min. :0.00000 Min. :0.00000 Min. :0.0000
## 1st Qu.:0.0000 1st Qu.:0.00000 1st Qu.:0.00000 1st Qu.:0.0000
## Median :0.0000 Median :0.00000 Median :0.00000 Median :0.0000
## Mean :0.4568 Mean :0.03093 Mean :0.09236 Mean :0.2584
## 3rd Qu.:1.0000 3rd Qu.:0.00000 3rd Qu.:0.00000 3rd Qu.:1.0000
## Max. :1.0000 Max. :1.00000 Max. :1.00000 Max. :1.0000
## tm1_trig_meanlow tm1_trig_meanhigh tm1_trig_meannormal tm1_trig_maxlow
## Min. :0.00000 Min. :0.0000 Min. :0.0000 Min. :0.0000
## 1st Qu.:0.00000 1st Qu.:0.0000 1st Qu.:0.0000 1st Qu.:0.0000
## Median :0.00000 Median :0.0000 Median :0.0000 Median :0.0000
## Mean :0.02885 Mean :0.1005 Mean :0.2507 Mean :0.0276
## 3rd Qu.:0.00000 3rd Qu.:0.0000 3rd Qu.:1.0000 3rd Qu.:0.0000
## Max. :1.00000 Max. :1.0000 Max. :1.0000 Max. :1.0000
## tm1_trig_maxhigh tm1_trig_maxnormal tm1_gagne_sum random_number
## Min. :0.0000 Min. :0.0000 Min. : 0.000 Min. :4.752e-05
## 1st Qu.:0.0000 1st Qu.:0.0000 1st Qu.: 0.000 1st Qu.:2.587e-02
## Median :0.0000 Median :0.0000 Median : 1.000 Median :5.031e-02
## Mean :0.1104 Mean :0.2468 Mean : 1.459 Mean :5.017e-02
## 3rd Qu.:0.0000 3rd Qu.:0.0000 3rd Qu.: 2.000 3rd Qu.:7.456e-02
## Max. :1.0000 Max. :1.0000 Max. :18.000 Max. :9.997e-02
## train_flag
## Min. :1
## 1st Qu.:1
## Median :1
## Mean :1
## 3rd Qu.:1
## Max. :1
```

#Data frame with test data (remaining 90% of the data)

```
test <- subset(dat, train_flag == 0)
summary(test)
```

```
## patient_id      gagne_sum_t      cost_t      cost_avoidable_t
## Min. :100001 Min. : 0.00 Min. : 0 Min. : 0
## 1st Qu.:112214 1st Qu.: 0.00 1st Qu.: 1200 1st Qu.: 0
## Median :124444 Median : 1.00 Median : 2800 Median : 0
## Mean :124422 Mean : 1.35 Mean : 7644 Mean : 2422
## 3rd Qu.:136638 3rd Qu.: 2.00 3rd Qu.: 6700 3rd Qu.: 100
## Max. :148784 Max. :17.00 Max. :550500 Max. :455900
## race      tm1_dem_black      tm1_dem_female      tm1_dem_age_band_1824
## Length:43966 Min. :0.0000 Min. :0.0000 Min. :0.00000
## Class :character 1st Qu.:0.0000 1st Qu.:0.0000 1st Qu.:0.00000
## Mode :character Median :0.0000 Median :1.0000 Median :0.00000
## Mean :0.1142 Mean :0.6298 Mean :0.03655
## 3rd Qu.:0.0000 3rd Qu.:1.0000 3rd Qu.:0.00000
## Max. :1.0000 Max. :1.0000 Max. :1.00000
## tm1_dem_age_band_2534 tm1_dem_age_band_3544 tm1_dem_age_band_4554
## Min. :0.00 Min. :0.0000 Min. :0.0000
## 1st Qu.:0.00 1st Qu.:0.0000 1st Qu.:0.0000
## Median :0.00 Median :0.0000 Median :0.0000
## Mean :0.11 Mean :0.1954 Mean :0.2396
## 3rd Qu.:0.00 3rd Qu.:0.0000 3rd Qu.:0.0000
## Max. :1.00 Max. :1.0000 Max. :1.0000
```

```

## tm1_dem_age_band_5564 tm1_dem_age_band_6574 tm1_dem_age_band_75
## Min. :0.0000 Min. :0.0000 Min. :0.00000
## 1st Qu.:0.0000 1st Qu.:0.0000 1st Qu.:0.00000
## Median :0.0000 Median :0.0000 Median :0.00000
## Mean :0.1967 Mean :0.1414 Mean :0.07044
## 3rd Qu.:0.0000 3rd Qu.:0.0000 3rd Qu.:0.00000
## Max. :1.0000 Max. :1.0000 Max. :1.00000
## tm1_alcohol_elixhauser tm1_anemia_elixhauser tm1_arrhythmia_elixhauser
## Min. :0.000000 Min. :0.00000 Min. :0.00000
## 1st Qu.:0.000000 1st Qu.:0.00000 1st Qu.:0.00000
## Median :0.000000 Median :0.00000 Median :0.00000
## Mean :0.008802 Mean :0.06378 Mean :0.09214
## 3rd Qu.:0.000000 3rd Qu.:0.00000 3rd Qu.:0.00000
## Max. :1.000000 Max. :1.00000 Max. :1.00000
## tm1_arthritis_elixhauser tm1_bloodlossanemia_elixhauser
## Min. :0.00000 Min. :0.000000
## 1st Qu.:0.00000 1st Qu.:0.000000
## Median :0.00000 Median :0.000000
## Mean :0.04674 Mean :0.002434
## 3rd Qu.:0.00000 3rd Qu.:0.000000
## Max. :1.00000 Max. :1.000000
## tm1_coagulopathy_elixhauser tm1_compdiabetes_elixhauser
## Min. :0.00000 Min. :0.00000
## 1st Qu.:0.00000 1st Qu.:0.00000
## Median :0.00000 Median :0.00000
## Mean :0.01133 Mean :0.02168
## 3rd Qu.:0.00000 3rd Qu.:0.00000
## Max. :1.00000 Max. :1.00000
## tm1_depression_elixhauser tm1_drugabuse_elixhauser tm1_electrolytes_elixhauser
## Min. :0.0000 Min. :0.000000 Min. :0.000
## 1st Qu.:0.0000 1st Qu.:0.000000 1st Qu.:0.000
## Median :0.0000 Median :0.000000 Median :0.000
## Mean :0.0618 Mean :0.006369 Mean :0.033
## 3rd Qu.:0.0000 3rd Qu.:0.000000 3rd Qu.:0.000
## Max. :1.0000 Max. :1.000000 Max. :1.000
## tm1_hypertension_elixhauser tm1_hypothyroid_elixhauser tm1_liver_elixhauser
## Min. :0.0000 Min. :0.00000 Min. :0.00000
## 1st Qu.:0.0000 1st Qu.:0.00000 1st Qu.:0.00000
## Median :0.0000 Median :0.00000 Median :0.00000
## Mean :0.3311 Mean :0.09312 Mean :0.01565
## 3rd Qu.:1.0000 3rd Qu.:0.00000 3rd Qu.:0.00000
## Max. :1.0000 Max. :1.00000 Max. :1.00000
## tm1_neurodegen_elixhauser tm1_obesity_elixhauser tm1_paralysis_elixhauser
## Min. :0.00000 Min. :0.00000 Min. :0.0000000
## 1st Qu.:0.00000 1st Qu.:0.00000 1st Qu.:0.0000000
## Median :0.00000 Median :0.00000 Median :0.0000000
## Mean :0.02798 Mean :0.09264 Mean :0.0005686
## 3rd Qu.:0.00000 3rd Qu.:0.00000 3rd Qu.:0.0000000
## Max. :1.00000 Max. :1.00000 Max. :1.0000000
## tm1_psychosis_elixhauser tm1_pulmcirc_elixhauser tm1_pvd_elixhauser
## Min. :0.00000 Min. :0.000000 Min. :0.00000
## 1st Qu.:0.00000 1st Qu.:0.000000 1st Qu.:0.00000
## Median :0.00000 Median :0.000000 Median :0.00000
## Mean :0.03223 Mean :0.005254 Mean :0.02629

```

```

## 3rd Qu.:0.00000      3rd Qu.:0.000000      3rd Qu.:0.00000
## Max. :1.00000      Max. :1.000000      Max. :1.00000
## tm1_renal_elixhauser tm1_uncompdiabetes_elixhauser tm1_valvulardz_elixhauser
## Min. :0.0000      Min. :0.00000      Min. :0.00000
## 1st Qu.:0.0000      1st Qu.:0.00000      1st Qu.:0.00000
## Median :0.0000      Median :0.00000      Median :0.00000
## Mean :0.0371      Mean :0.09919      Mean :0.03155
## 3rd Qu.:0.0000      3rd Qu.:0.00000      3rd Qu.:0.00000
## Max. :1.0000      Max. :1.00000      Max. :1.00000
## tm1_wtloss_elixhauser tm1_cerebrovasculardz_romano tm1_chf_romano
## Min. :0.000000      Min. :0.00000      Min. :0.00000
## 1st Qu.:0.000000      1st Qu.:0.00000      1st Qu.:0.00000
## Median :0.000000      Median :0.00000      Median :0.00000
## Mean :0.001456      Mean :0.02836      Mean :0.03189
## 3rd Qu.:0.000000      3rd Qu.:0.00000      3rd Qu.:0.00000
## Max. :1.000000      Max. :1.00000      Max. :1.00000
## tm1_dementia_romano tm1_hemiplegia_romano tm1_hiv aids_romano
## Min. :0.000000      Min. :0.000000      Min. :0.000000
## 1st Qu.:0.000000      1st Qu.:0.000000      1st Qu.:0.000000
## Median :0.000000      Median :0.000000      Median :0.000000
## Mean :0.009553      Mean :0.002707      Mean :0.003048
## 3rd Qu.:0.000000      3rd Qu.:0.000000      3rd Qu.:0.000000
## Max. :1.000000      Max. :1.000000      Max. :1.000000
## tm1_metastatic_romano tm1_myocardialinfarct_romano tm1_pulmonarydz_romano
## Min. :0.000000      Min. :0.00000      Min. :0.0000
## 1st Qu.:0.000000      1st Qu.:0.00000      1st Qu.:0.0000
## Median :0.000000      Median :0.00000      Median :0.0000
## Mean :0.005936      Mean :0.01683      Mean :0.1019
## 3rd Qu.:0.000000      3rd Qu.:0.00000      3rd Qu.:0.0000
## Max. :1.000000      Max. :1.00000      Max. :1.0000
## tm1_tumor_romano tm1_ulcer_romano tm1_cost_dialysis tm1_cost_emergency
## Min. :0.00000      Min. :0.000000      Min. : 0.00      Min. : 0.0
## 1st Qu.:0.00000      1st Qu.:0.000000      1st Qu.: 0.00      1st Qu.: 0.0
## Median :0.00000      Median :0.000000      Median : 0.00      Median : 0.0
## Mean :0.09407      Mean :0.004913      Mean : 27.97      Mean : 425.4
## 3rd Qu.:0.00000      3rd Qu.:0.000000      3rd Qu.: 0.00      3rd Qu.: 160.0
## Max. :1.00000      Max. :1.000000      Max. :63410.00      Max. :67090.0
## tm1_cost_home_health tm1_cost_ip_medical tm1_cost_ip_surgical
## Min. : 0.0      Min. : 0      Min. : 0.0
## 1st Qu.: 0.0      1st Qu.: 0      1st Qu.: 0.0
## Median : 0.0      Median : 0      Median : 0.0
## Mean : 221.8      Mean : 641      Mean : 956.6
## 3rd Qu.: 0.0      3rd Qu.: 0      3rd Qu.: 0.0
## Max. :56830.0      Max. :282300      Max. :279930.0
## tm1_cost_laboratory tm1_cost_op_primary_care tm1_cost_op_specialists
## Min. : -490.0      Min. : 0.0      Min. : 0.0
## 1st Qu.: 30.0      1st Qu.: 180.0      1st Qu.: 130.0
## Median : 180.0      Median : 350.0      Median : 430.0
## Mean : 329.4      Mean : 474.5      Mean : 865.6
## 3rd Qu.: 380.0      3rd Qu.: 580.0      3rd Qu.: 1030.0
## Max. :62720.0      Max. :240290.0      Max. :41720.0
## tm1_cost_op_surgery tm1_cost_other tm1_cost_pharmacy
## Min. : 0.0      Min. : 0      Min. : -10.0
## 1st Qu.: 0.0      1st Qu.: 200      1st Qu.: 0.0

```

```

## Median :    0.0      Median :   500      Median :    0.0
## Mean   :   845.1      Mean   :  1565      Mean   :   336.1
## 3rd Qu.:   540.0      3rd Qu.:  1300      3rd Qu.:    0.0
## Max.   : 75790.0      Max.   :142500      Max.   :153250.0
## tm1_cost_physical_therapy tm1_cost_radiology tm1_lasix_dose_count
## Min.    :    0.0      Min.    :    0      Min.    :0.00000
## 1st Qu.:    0.0      1st Qu.:    0      1st Qu.:0.00000
## Median  :    0.0      Median  :    0      Median :0.00000
## Mean    :   166.9      Mean    :   242      Mean    :0.01826
## 3rd Qu.:    0.0      3rd Qu.:   240      3rd Qu.:0.00000
## Max.    :10240.0      Max.    :20710      Max.    :9.00000
## tm1_lasix_min_daily_dose tm1_lasix_mean_daily_dose tm1_lasix_max_daily_dose
## Min.    : 0.0000      Min.    : 0.0000      Min.    : 0.0000
## 1st Qu.: 0.0000      1st Qu.: 0.0000      1st Qu.: 0.0000
## Median  : 0.0000      Median  : 0.0000      Median  : 0.0000
## Mean    : 0.3575      Mean    : 0.3828      Mean    : 0.4235
## 3rd Qu.: 0.0000      3rd Qu.: 0.0000      3rd Qu.: 0.0000
## Max.    :200.0000      Max.    :160.0000      Max.    :200.0000
## tm1_cre_tests      tm1_crp_tests      tm1_esr_tests      tm1_ghba1c_tests
## Min.    : 0.000      Min.    :0.0000000      Min.    : 0.0000      Min.    :0.0000
## 1st Qu.: 0.000      1st Qu.:0.0000000      1st Qu.: 0.0000      1st Qu.:0.0000
## Median  : 1.000      Median :0.0000000      Median  : 0.0000      Median :0.0000
## Mean    : 1.237      Mean    :0.0004776      Mean    : 0.1146      Mean    :0.3859
## 3rd Qu.: 1.000      3rd Qu.:0.0000000      3rd Qu.: 0.0000      3rd Qu.:1.0000
## Max.    :166.000      Max.    :2.0000000      Max.    :13.0000      Max.    :9.0000
## tm1_hct_tests      tm1_ldl_tests      tm1_nt_bnp_tests      tm1_sodium_tests
## Min.    : 0.000      Min.    : 0.0000      Min.    : 0.00000      Min.    : 0.000
## 1st Qu.: 0.000      1st Qu.: 0.0000      1st Qu.: 0.00000      1st Qu.: 0.000
## Median  : 0.000      Median  : 0.0000      Median  : 0.00000      Median  : 0.000
## Mean    : 1.086      Mean    : 0.5202      Mean    : 0.03057      Mean    : 1.157
## 3rd Qu.: 1.000      3rd Qu.: 1.0000      3rd Qu.: 0.00000      3rd Qu.: 1.000
## Max.    :164.000      Max.    :10.0000      Max.    :10.00000      Max.    :122.000
## tm1_trig_tests      tm1_cre_minlow      tm1_cre_minhigh      tm1_cre_minnormal
## Min.    : 0.0000      Min.    :0.000      Min.    :0.00000      Min.    :0.0000
## 1st Qu.: 0.0000      1st Qu.:0.000      1st Qu.:0.00000      1st Qu.:0.0000
## Median  : 0.0000      Median :0.000      Median :0.00000      Median :0.0000
## Mean    : 0.4835      Mean    :0.222      Mean    :0.03937      Mean    :0.2355
## 3rd Qu.: 1.0000      3rd Qu.:0.000      3rd Qu.:0.00000      3rd Qu.:0.0000
## Max.    :12.0000      Max.    :1.000      Max.    :1.00000      Max.    :1.0000
## tm1_cre_meanlow      tm1_cre_meanhigh      tm1_cre_meannormal      tm1_cre_maxlow
## Min.    :0.0000      Min.    :0.00000      Min.    :0.0000      Min.    :0.0000
## 1st Qu.:0.0000      1st Qu.:0.00000      1st Qu.:0.0000      1st Qu.:0.0000
## Median :0.0000      Median :0.00000      Median :0.0000      Median :0.0000
## Mean    :0.2007      Mean    :0.05134      Mean    :0.2452      Mean    :0.1783
## 3rd Qu.:0.0000      3rd Qu.:0.00000      3rd Qu.:0.0000      3rd Qu.:0.0000
## Max.    :1.0000      Max.    :1.00000      Max.    :1.0000      Max.    :1.0000
## tm1_cre_maxhigh      tm1_cre_maxnormal      tm1_crp_minlow      tm1_crp_minhigh
## Min.    :0.00000      Min.    :0.0000      Min.    :0.0000000      Min.    :0.0000000
## 1st Qu.:0.00000      1st Qu.:0.0000      1st Qu.:0.0000000      1st Qu.:0.0000000
## Median :0.00000      Median :0.0000      Median :0.0000000      Median :0.0000000
## Mean    :0.06783      Mean    :0.2511      Mean    :0.0001592      Mean    :0.0001592
## 3rd Qu.:0.00000      3rd Qu.:1.0000      3rd Qu.:0.0000000      3rd Qu.:0.0000000
## Max.    :1.00000      Max.    :1.0000      Max.    :1.0000000      Max.    :1.0000000
## tm1_crp_minnormal      tm1_crp_meanlow      tm1_crp_meanhigh      tm1_crp_meannormal

```

```

## Min. :0.00e+00 Min. :0.0000000 Min. :0.0000000 Min. :0.00e+00
## 1st Qu.:0.00e+00 1st Qu.:0.0000000 1st Qu.:0.0000000 1st Qu.:0.00e+00
## Median :0.00e+00 Median :0.0000000 Median :0.0000000 Median :0.00e+00
## Mean :6.82e-05 Mean :0.0001592 Mean :0.0001592 Mean :6.82e-05
## 3rd Qu.:0.00e+00 3rd Qu.:0.0000000 3rd Qu.:0.0000000 3rd Qu.:0.00e+00
## Max. :1.00e+00 Max. :1.0000000 Max. :1.0000000 Max. :1.00e+00
## tm1_crp_maxlow tm1_crp_maxhigh tm1_crp_maxnormal tm1_esr_minlow
## Min. :0.0000000 Min. :0.0000000 Min. :0.00e+00 Min. :0
## 1st Qu.:0.0000000 1st Qu.:0.0000000 1st Qu.:0.00e+00 1st Qu.:0
## Median :0.0000000 Median :0.0000000 Median :0.00e+00 Median :0
## Mean :0.0001592 Mean :0.0001592 Mean :6.82e-05 Mean :0
## 3rd Qu.:0.0000000 3rd Qu.:0.0000000 3rd Qu.:0.00e+00 3rd Qu.:0
## Max. :1.0000000 Max. :1.0000000 Max. :1.00e+00 Max. :0
## tm1_esr_minhigh tm1_esr_minnormal tm1_esr_meanlow tm1_esr_meanhigh
## Min. :0.0000 Min. :0.0000 Min. :0 Min. :0.00000
## 1st Qu.:0.0000 1st Qu.:0.0000 1st Qu.:0 1st Qu.:0.00000
## Median :0.0000 Median :0.0000 Median :0 Median :0.00000
## Mean :0.0217 Mean :0.0517 Mean :0 Mean :0.02425
## 3rd Qu.:0.0000 3rd Qu.:0.0000 3rd Qu.:0 3rd Qu.:0.00000
## Max. :1.0000 Max. :1.0000 Max. :0 Max. :1.00000
## tm1_esr_meannormal tm1_esr_maxlow tm1_esr_maxhigh tm1_esr_maxnormal
## Min. :0.00000 Min. :0 Min. :0.00000 Min. :0.00000
## 1st Qu.:0.00000 1st Qu.:0 1st Qu.:0.00000 1st Qu.:0.00000
## Median :0.00000 Median :0 Median :0.00000 Median :0.00000
## Mean :0.04917 Mean :0 Mean :0.02636 Mean :0.04735
## 3rd Qu.:0.00000 3rd Qu.:0 3rd Qu.:0.00000 3rd Qu.:0.00000
## Max. :1.00000 Max. :0 Max. :1.00000 Max. :1.00000
## tm1_ghba1c_minlow tm1_ghba1c_minhigh tm1_ghba1c_minnormal tm1_ghba1c_meanlow
## Min. :0.00e+00 Min. :0.0000 Min. :0.0000 Min. :0.00e+00
## 1st Qu.:0.00e+00 1st Qu.:0.0000 1st Qu.:0.0000 1st Qu.:0.00e+00
## Median :0.00e+00 Median :0.0000 Median :0.0000 Median :0.00e+00
## Mean :2.27e-05 Mean :0.1227 Mean :0.1471 Mean :2.27e-05
## 3rd Qu.:0.00e+00 3rd Qu.:0.0000 3rd Qu.:0.0000 3rd Qu.:0.00e+00
## Max. :1.00e+00 Max. :1.0000 Max. :1.0000 Max. :1.00e+00
## tm1_ghba1c_meanhigh tm1_ghba1c_meannormal tm1_ghba1c_maxlow
## Min. :0.0000 Min. :0.0000 Min. :0.00e+00
## 1st Qu.:0.0000 1st Qu.:0.0000 1st Qu.:0.00e+00
## Median :0.0000 Median :0.0000 Median :0.00e+00
## Mean :0.1292 Mean :0.1402 Mean :2.27e-05
## 3rd Qu.:0.0000 3rd Qu.:0.0000 3rd Qu.:0.00e+00
## Max. :1.0000 Max. :1.0000 Max. :1.00e+00
## tm1_ghba1c_maxhigh tm1_ghba1c_maxnormal tm1_hct_minlow tm1_hct_minhigh
## Min. :0.0000 Min. :0.0000 Min. :0.00000 Min. :0.000000
## 1st Qu.:0.0000 1st Qu.:0.0000 1st Qu.:0.00000 1st Qu.:0.000000
## Median :0.0000 Median :0.0000 Median :0.00000 Median :0.000000
## Mean :0.1323 Mean :0.1374 Mean :0.06359 Mean :0.006983
## 3rd Qu.:0.0000 3rd Qu.:0.0000 3rd Qu.:0.00000 3rd Qu.:0.000000
## Max. :1.0000 Max. :1.0000 Max. :1.00000 Max. :1.000000
## tm1_hct_minnormal tm1_hct_meanlow tm1_hct_meanhigh tm1_hct_meannormal
## Min. :0.0000 Min. :0.00000 Min. :0.000000 Min. :0.0000
## 1st Qu.:0.0000 1st Qu.:0.00000 1st Qu.:0.000000 1st Qu.:0.0000
## Median :0.0000 Median :0.00000 Median :0.000000 Median :0.0000
## Mean :0.3748 Mean :0.04242 Mean :0.008074 Mean :0.3953
## 3rd Qu.:1.0000 3rd Qu.:0.00000 3rd Qu.:0.000000 3rd Qu.:1.0000

```

##	Max.	:1.0000	Max.	:1.00000	Max.	:1.000000	Max.	:1.0000
##	tm1_hct_maxlow		tm1_hct_maxhigh		tm1_hct_maxnormal		tm1_ldl_minlow	
##	Min.	:0.00000	Min.	:0.00000	Min.	:0.0000	Min.	:0.00000
##	1st Qu.:	:0.00000	1st Qu.:	:0.00000	1st Qu.:	:0.0000	1st Qu.:	:0.00000
##	Median	:0.00000	Median	:0.00000	Median	:0.0000	Median	:0.00000
##	Mean	:0.02422	Mean	:0.01215	Mean	:0.4097	Mean	:0.01565
##	3rd Qu.:	:0.00000	3rd Qu.:	:0.00000	3rd Qu.:	:1.0000	3rd Qu.:	:0.00000
##	Max.	:1.00000	Max.	:1.00000	Max.	:1.0000	Max.	:1.00000
##	tm1_ldl_minhigh		tm1_ldl_minnormal		tm1_ldl_meanlow		tm1_ldl_meanhigh	
##	Min.	:0.0000	Min.	:0.0000	Min.	:0.00000	Min.	:0.0000
##	1st Qu.:	:0.0000	1st Qu.:	:0.0000	1st Qu.:	:0.00000	1st Qu.:	:0.0000
##	Median	:0.0000	Median	:0.0000	Median	:0.00000	Median	:0.0000
##	Mean	:0.2038	Mean	:0.1974	Mean	:0.01271	Mean	:0.2108
##	3rd Qu.:	:0.0000	3rd Qu.:	:0.0000	3rd Qu.:	:0.00000	3rd Qu.:	:0.0000
##	Max.	:1.0000	Max.	:1.0000	Max.	:1.00000	Max.	:1.0000
##	tm1_ldl_meannormal		tm1_ldl_maxlow		tm1_ldl_maxhigh		tm1_ldl_maxnormal	
##	Min.	:0.0000	Min.	:0.00000	Min.	:0.0000	Min.	:0.0000
##	1st Qu.:	:0.0000	1st Qu.:	:0.00000	1st Qu.:	:0.0000	1st Qu.:	:0.0000
##	Median	:0.0000	Median	:0.00000	Median	:0.0000	Median	:0.0000
##	Mean	:0.1336	Mean	:0.01176	Mean	:0.2181	Mean	:0.1272
##	3rd Qu.:	:0.0000	3rd Qu.:	:0.00000	3rd Qu.:	:0.0000	3rd Qu.:	:0.0000
##	Max.	:1.0000	Max.	:1.00000	Max.	:1.0000	Max.	:1.0000
##	tm1_nt_bnp_minlow		tm1_nt_bnp_minhigh		tm1_nt_bnp_minnormal		tm1_nt_bnp_meanlow	
##	Min.	:0.000000	Min.	:0.000000	Min.	:0.00000	Min.	:0.000000
##	1st Qu.:	:0.000000	1st Qu.:	:0.000000	1st Qu.:	:0.00000	1st Qu.:	:0.000000
##	Median	:0.000000	Median	:0.000000	Median	:0.00000	Median	:0.000000
##	Mean	:0.004799	Mean	:0.009712	Mean	:0.00555	Mean	:0.006664
##	3rd Qu.:	:0.000000	3rd Qu.:	:0.000000	3rd Qu.:	:0.00000	3rd Qu.:	:0.000000
##	Max.	:1.000000	Max.	:1.000000	Max.	:1.00000	Max.	:1.000000
##	tm1_nt_bnp_meanhigh		tm1_nt_bnp_meannormal		tm1_nt_bnp_maxlow			
##	Min.	:0.00000	Min.	:0.000000	Min.	:0.000000		
##	1st Qu.:	:0.00000	1st Qu.:	:0.000000	1st Qu.:	:0.000000		
##	Median	:0.00000	Median	:0.000000	Median	:0.000000		
##	Mean	:0.01017	Mean	:0.003525	Mean	:0.006437		
##	3rd Qu.:	:0.00000	3rd Qu.:	:0.000000	3rd Qu.:	:0.000000		
##	Max.	:1.00000	Max.	:1.000000	Max.	:1.000000		
##	tm1_nt_bnp_maxhigh		tm1_nt_bnp_maxnormal		tm1_sodium_minlow		tm1_sodium_minhigh	
##	Min.	:0.00000	Min.	:0.000000	Min.	:0.00000	Min.	:0.0000000
##	1st Qu.:	:0.00000	1st Qu.:	:0.000000	1st Qu.:	:0.00000	1st Qu.:	:0.0000000
##	Median	:0.00000	Median	:0.000000	Median	:0.00000	Median	:0.0000000
##	Mean	:0.01051	Mean	:0.003503	Mean	:0.04035	Mean	:0.0006369
##	3rd Qu.:	:0.00000	3rd Qu.:	:0.000000	3rd Qu.:	:0.00000	3rd Qu.:	:0.0000000
##	Max.	:1.00000	Max.	:1.000000	Max.	:1.00000	Max.	:1.0000000
##	tm1_sodium_minnormal		tm1_sodium_meanlow		tm1_sodium_meanhigh			
##	Min.	:0.0000	Min.	:0.00000	Min.	:0.0000000		
##	1st Qu.:	:0.0000	1st Qu.:	:0.00000	1st Qu.:	:0.0000000		
##	Median	:0.0000	Median	:0.00000	Median	:0.0000000		
##	Mean	:0.4388	Mean	:0.01981	Mean	:0.0008643		
##	3rd Qu.:	:1.0000	3rd Qu.:	:0.00000	3rd Qu.:	:0.0000000		
##	Max.	:1.0000	Max.	:1.00000	Max.	:1.0000000		
##	tm1_sodium_meannormal		tm1_sodium_maxlow		tm1_sodium_maxhigh			
##	Min.	:0.0000	Min.	:0.00000	Min.	:0.00000		
##	1st Qu.:	:0.0000	1st Qu.:	:0.00000	1st Qu.:	:0.00000		
##	Median	:0.0000	Median	:0.00000	Median	:0.00000		

```

## Mean      :0.4592      Mean      :0.01087    Mean      :0.00489
## 3rd Qu.   :1.0000      3rd Qu. :0.00000    3rd Qu. :0.00000
## Max.      :1.0000      Max.     :1.00000    Max.     :1.00000
## tm1_sodium_maxnormal tm1_trig_minlow tm1_trig_minhigh tm1_trig_minnormal
## Min.      :0.0000      Min.     :0.00000    Min.     :0.00000    Min.     :0.0000
## 1st Qu.   :0.0000      1st Qu.  :0.00000    1st Qu.  :0.00000    1st Qu.  :0.0000
## Median    :0.0000      Median   :0.00000    Median   :0.00000    Median   :0.0000
## Mean      :0.4644      Mean     :0.03193    Mean     :0.08984    Mean     :0.2622
## 3rd Qu.   :1.0000      3rd Qu.  :0.00000    3rd Qu.  :0.00000    3rd Qu.  :1.0000
## Max.      :1.0000      Max.     :1.00000    Max.     :1.00000    Max.     :1.0000
## tm1_trig_meanlow tm1_trig_meanhigh tm1_trig_meannormal tm1_trig_maxlow
## Min.      :0.00000    Min.     :0.00000    Min.     :0.0000    Min.     :0.00000
## 1st Qu.   :0.00000    1st Qu.  :0.00000    1st Qu.  :0.0000    1st Qu.  :0.00000
## Median    :0.00000    Median   :0.00000    Median   :0.0000    Median   :0.00000
## Mean      :0.02889    Mean     :0.09689    Mean     :0.2567    Mean     :0.02798
## 3rd Qu.   :0.00000    3rd Qu.  :0.00000    3rd Qu.  :1.0000    3rd Qu.  :0.00000
## Max.      :1.00000    Max.     :1.00000    Max.     :1.0000    Max.     :1.00000
## tm1_trig_maxhigh tm1_trig_maxnormal tm1_gagne_sum random_number
## Min.      :0.0000    Min.     :0.000    Min.     : 0.000    Min.     :0.1000
## 1st Qu.   :0.0000    1st Qu.  :0.000    1st Qu.  : 0.000    1st Qu.  :0.3233
## Median    :0.0000    Median   :0.000    Median   : 1.000    Median   :0.5479
## Mean      :0.1069    Mean     :0.252    Mean     : 1.441    Mean     :0.5478
## 3rd Qu.   :0.0000    3rd Qu.  :1.000    3rd Qu.  : 2.000    3rd Qu.  :0.7711
## Max.      :1.0000    Max.     :1.000    Max.     :17.000    Max.     :0.9999
## train_flag
## Min.      :0
## 1st Qu.   :0
## Median    :0
## Mean      :0
## 3rd Qu.   :0
## Max.      :0

```

#Q2: Estimating random forest models using the training data set

#2A: random forest model predicting patient costs, excluding race

#2B: random forest model predicting patient costs, including race

#2C: random forest model predicting patient health, excluding race

#2D: random forest model predicting patient health, including race