Heart Failure

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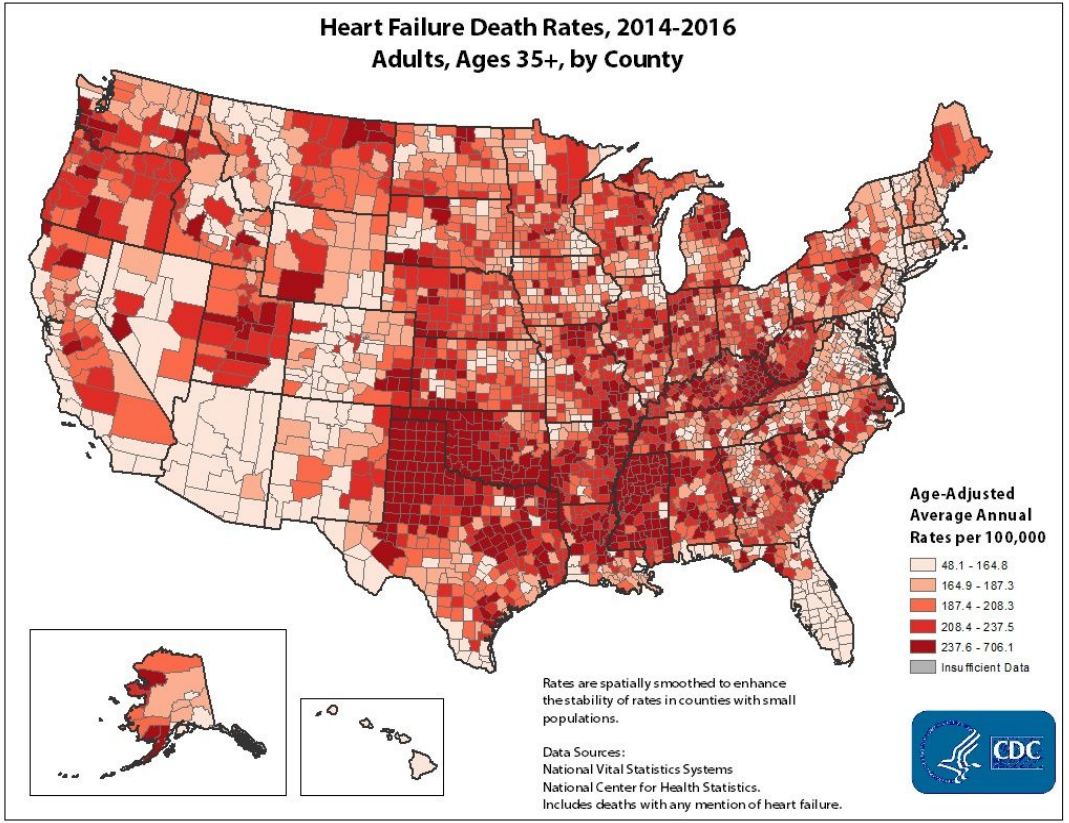
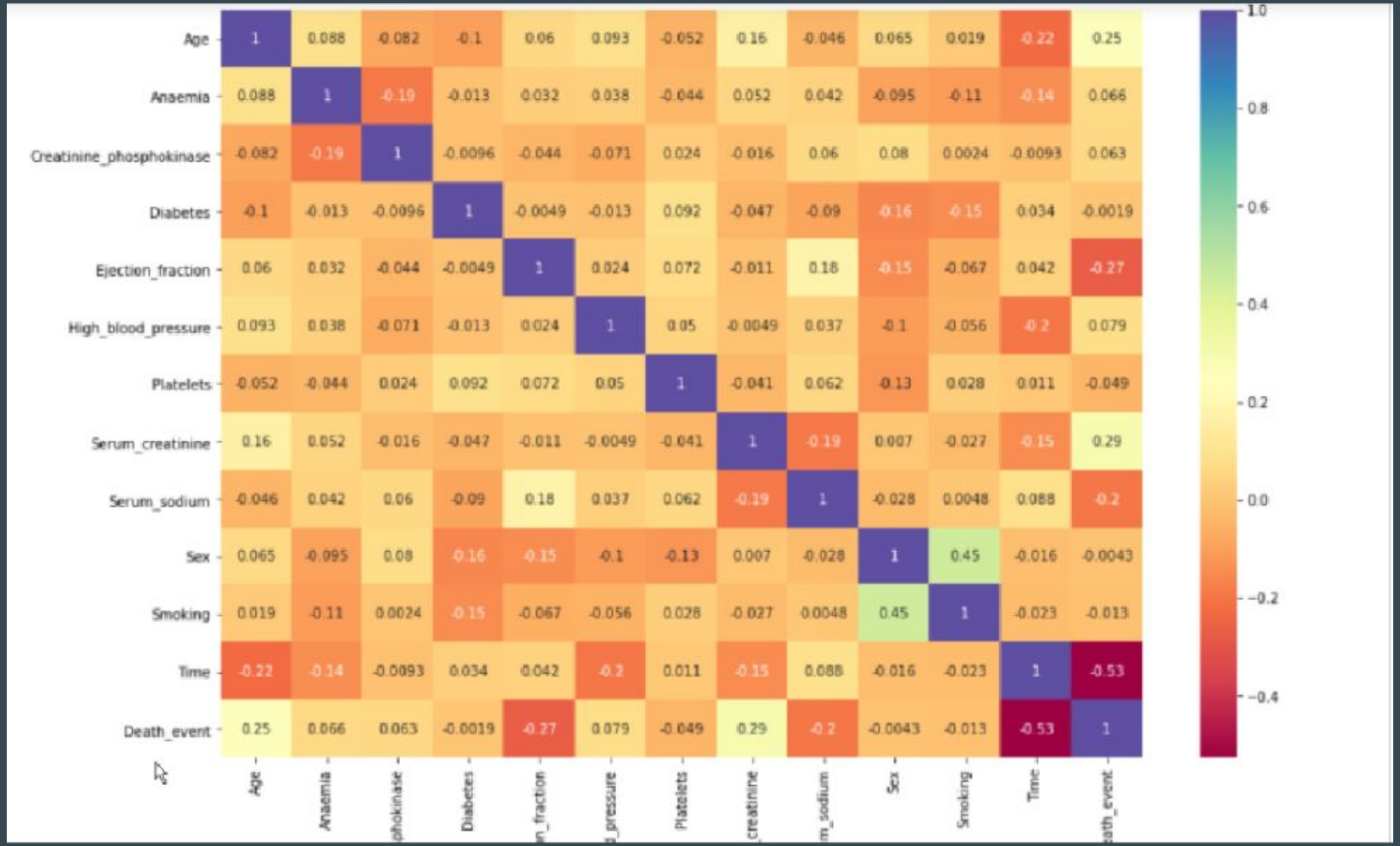
Heart Failure greatly affects us

About 6.2 million in United States.



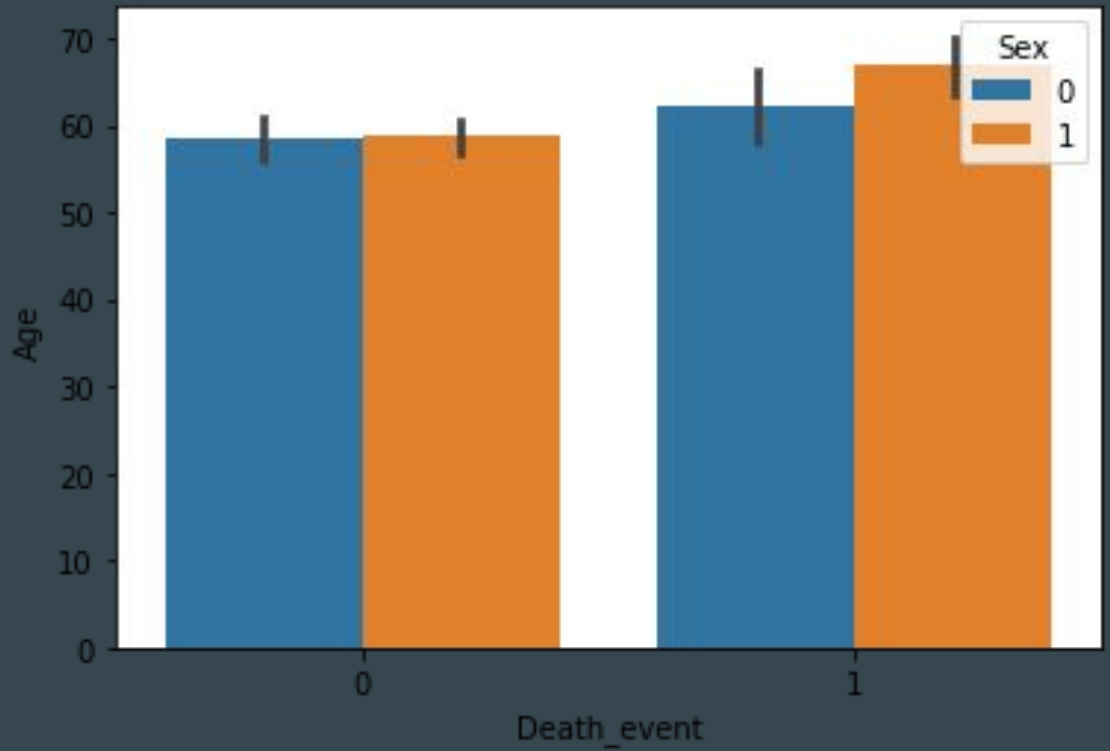
Can we predict what causes heart failure?

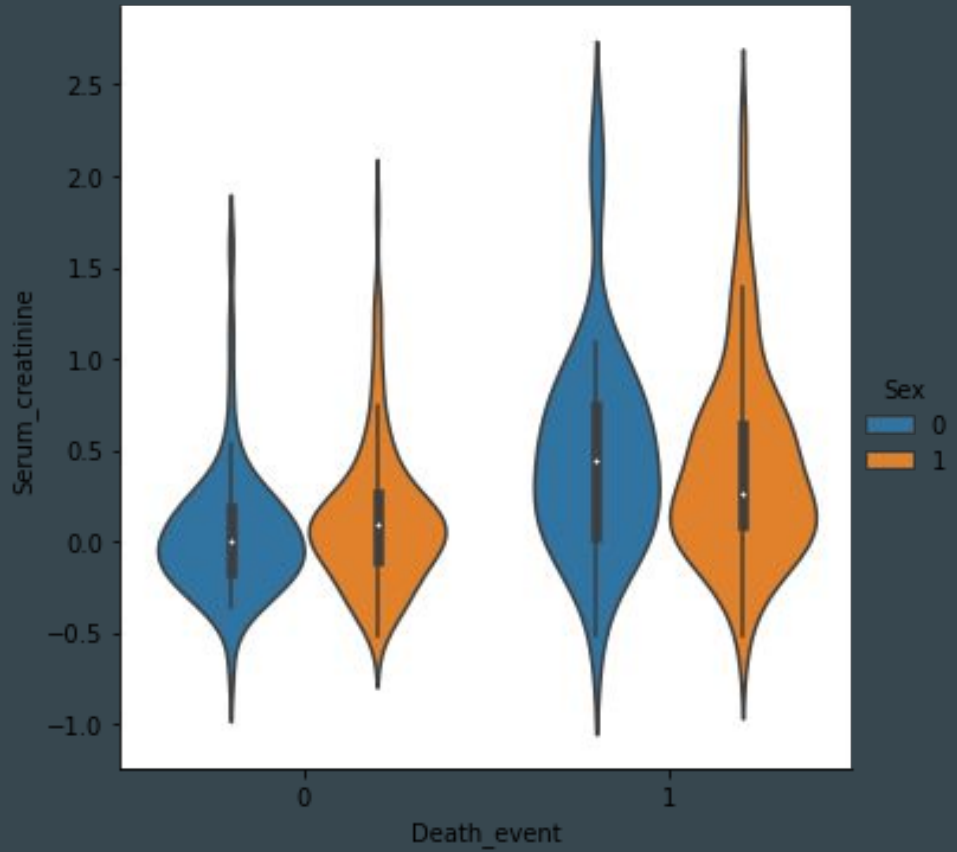
```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 299 entries, 0 to 298
Data columns (total 13 columns):
 #   Column                    Non-Null Count  Dtype  
---  ------                    --------------  -----  
 0   age                       299 non-null    float64
 1   anaemia                   299 non-null    int64  
 2   creatinine_phosphokinase  299 non-null    int64  
 3   diabetes                  299 non-null    int64  
 4   ejection_fraction         299 non-null    int64  
 5   high_blood_pressure       299 non-null    int64  
 6   platelets                 299 non-null    float64
 7   serum_creatinine          299 non-null    float64
 8   serum_sodium              299 non-null    int64  
 9   sex                       299 non-null    int64  
 10  smoking                   299 non-null    int64  
 11  time                      299 non-null    int64  
 12  DEATH_EVENT               299 non-null    int64  
dtypes: float64(3), int64(10)
memory usage: 30.5 KB
```

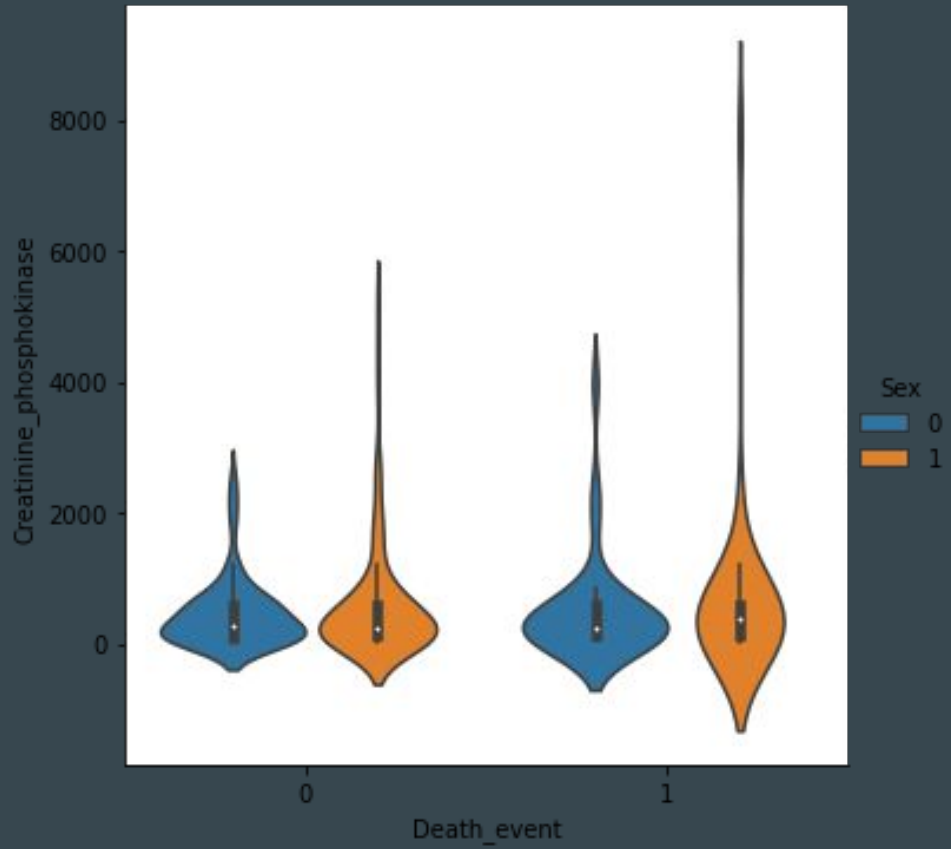

Age 1 0.088 -0.082 -0.1 0.06 0.093 -0.052 0.16 -0.046 0.065 0.019 -0.22 0.25
Anaemia 0.088 1 -0.19 -0.013 0.032 0.038 -0.044 0.052 0.042 -0.095 -0.11 -0.14 0.066
Creatinine_phosphokinase -0.082 -0.19 1 -0.0096 -0.044 -0.071 0.024 -0.016 0.06 0.08 0.0024 -0.0093 0.063
Diabetes -0.1 -0.013 -0.0096 1 -0.0049 -0.013 0.092 -0.047 -0.09 -0.16 -0.15 0.034 -0.0019
Ejection_fraction 0.06 0.032 -0.044 -0.0049 1 0.024 0.072 -0.011 0.18 -0.15 -0.067 0.042 -0.27
High_blood_pressure 0.093 0.038 -0.071 -0.013 0.024 1 0.05 -0.0049 0.037 -0.1 -0.056 -0.2 0.079
Platelets -0.052 -0.044 0.024 0.092 0.072 0.05 1 -0.041 0.062 -0.13 0.028 0.011 -0.049
Serum_creatinine 0.16 0.052 -0.016 -0.047 -0.011 -0.0049 -0.041 1 -0.19 0.007 -0.027 -0.15 0.29
Serum_sodium -0.046 0.042 0.06 -0.09 0.18 0.037 0.062 -0.19 1 -0.028 0.0048 0.088 -0.2
Sex 0.065 -0.095 0.08 -0.16 -0.15 -0.1 -0.13 0.007 -0.028 1 0.45 -0.016 -0.0043
Smoking 0.019 -0.11 0.0024 -0.15 -0.067 -0.056 0.028 -0.027 0.0048 0.45 1 -0.023 -0.013
Time -0.22 -0.14 -0.0093 0.034 0.042 -0.2 0.011 -0.15 0.088 -0.016 -0.023 1 -0.53
Death_event 0.25 0.066 0.063 -0.0019 -0.27 0.079 -0.049 0.29 -0.2 -0.0043 -0.013 -0.53 1
Age
Anaemia
Diabetes
Platelets
Sex
Smoking
Time
1.0
0.8
0.6
0.4
0.2
0.0
−0.2
−0.4

Interesting correlations

- Death_event - Serum_creatinine
- Death_event - Age
- Death_event - high_blood_pressure


Sex
0
1
70
60
50
40
30
20
10
0
Age
0
1
Death_event


2.5
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
Serum_creatinine
0
1
Death_event
Sex
0
1


8000
6000
4000
2000
0
Creatinine_phosphokinase
0
1
Death_event
Sex
0
1

Modeling

Model	Accuracy	Balanced Accuracy	ROC AUC	F1 Score	Time Taken
LinearSVC	0.79	0.76	0.76	0.78	0.01
LogisticRegression	0.79	0.76	0.76	0.78	0.01
NearestCentroid	0.77	0.75	0.75	0.76	0.01
XGBClassifier	0.77	0.74	0.74	0.76	1.16
CalibratedClassifierCV	0.78	0.74	0.74	0.76	0.03
RandomForestClassifier	0.77	0.74	0.74	0.76	0.11
ExtraTreesClassifier	0.77	0.72	0.72	0.75	0.09
LinearDiscriminantAnalysis	0.76	0.72	0.72	0.74	0.02
LGBMClassifier	0.74	0.72	0.72	0.74	0.03
RidgeClassifierCV	0.76	0.72	0.72	0.74	0.01
BaggingClassifier	0.74	0.72	0.72	0.74	0.02
RidgeClassifier	0.74	0.71	0.71	0.73	0.02
GaussianNB	0.73	0.70	0.70	0.72	0.01
SGDClassifier	0.72	0.70	0.70	0.72	0.01
SVC	0.73	0.70	0.70	0.72	0.01
AdaBoostClassifier	0.71	0.67	0.67	0.69	0.07
BernoulliNB	0.71	0.67	0.67	0.69	0.01
NuSVC	0.71	0.67	0.67	0.69	0.01
PassiveAggressiveClassifier	0.69	0.66	0.66	0.68	0.01
ExtraTreeClassifier	0.68	0.66	0.66	0.67	0.01
QuadraticDiscriminantAnalysis	0.69	0.65	0.65	0.67	0.01
DecisionTreeClassifier	0.68	0.65	0.65	0.67	0.01
Perceptron	0.67	0.63	0.63	0.65	0.01
KNeighborsClassifier	0.68	0.62	0.62	0.63	0.01
LabelPropagation	0.64	0.59	0.59	0.61	0.01
LabelSpreading	0.64	0.59	0.59	0.61	0.01
DummyClassifier	0.62	0.59	0.59	0.60	0.01

Hyperparameter tuning

- Selected certain parameters to tune and used RandomizedSearchCV.

How accurately can we predict?

Random Forest

```
In [31]: from sklearn.metrics import classification_report
         print(classification_report(y_pred,y_test))
```

```
              precision    recall  f1-score   support

           0       0.94      0.72      0.82        69
           1       0.49      0.86      0.62        21

    accuracy                           0.76        90
   macro avg       0.71      0.79      0.72        90
weighted avg       0.84      0.76      0.77        90
```

Linear Regression

	precision	recall	f1-score	support
0	0.94	0.76	0.84	66
1	0.57	0.88	0.69	24
accuracy			0.79	90
macro avg	0.76	0.82	0.76	90
weighted avg	0.84	0.79	0.80	90

XGBClassifier

	precision	recall	f1-score	support
0	0.89	0.77	0.82	61
1	0.62	0.79	0.70	29
accuracy			0.78	90
macro avg	0.75	0.78	0.76	90
weighted avg	0.80	0.78	0.78	90

In [46]:
```
for feature_list_index in sfm.get_support(indices=True):
    print(feat_labels[feature_list_index])
```

```
Serum_creatinine
Time
```

In [48]:
```
for feature_list_index in sfm.get_support(indices=True):
    print(feat_labels[feature_list_index])
```

```
Time
```

Further Analysis

- Accumulate more data
- Explore other models
- Explore more hyperparameters