

READMISSIONS REDUCTION

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PROJECT

TAHOE HEALTHCARE SYSTEMS CARETRACKER PROGRAM

HRRP READMIT PENALTY



\$8000 PER PATIENT 

Medicare Reimbursements

- * 23% readmitted within 30 days
- * symptomatic of quality problems within hospitals:
 - * lack of coordination in follow up care
 - * misaligned financial incentives to discharge early
- * HRRP links Medicare reimbursements to hospital's risk-adjusted readmission rate
- * exceeding risk-adjusted readmission rate for AMI, HF, and pneumonia => penalty

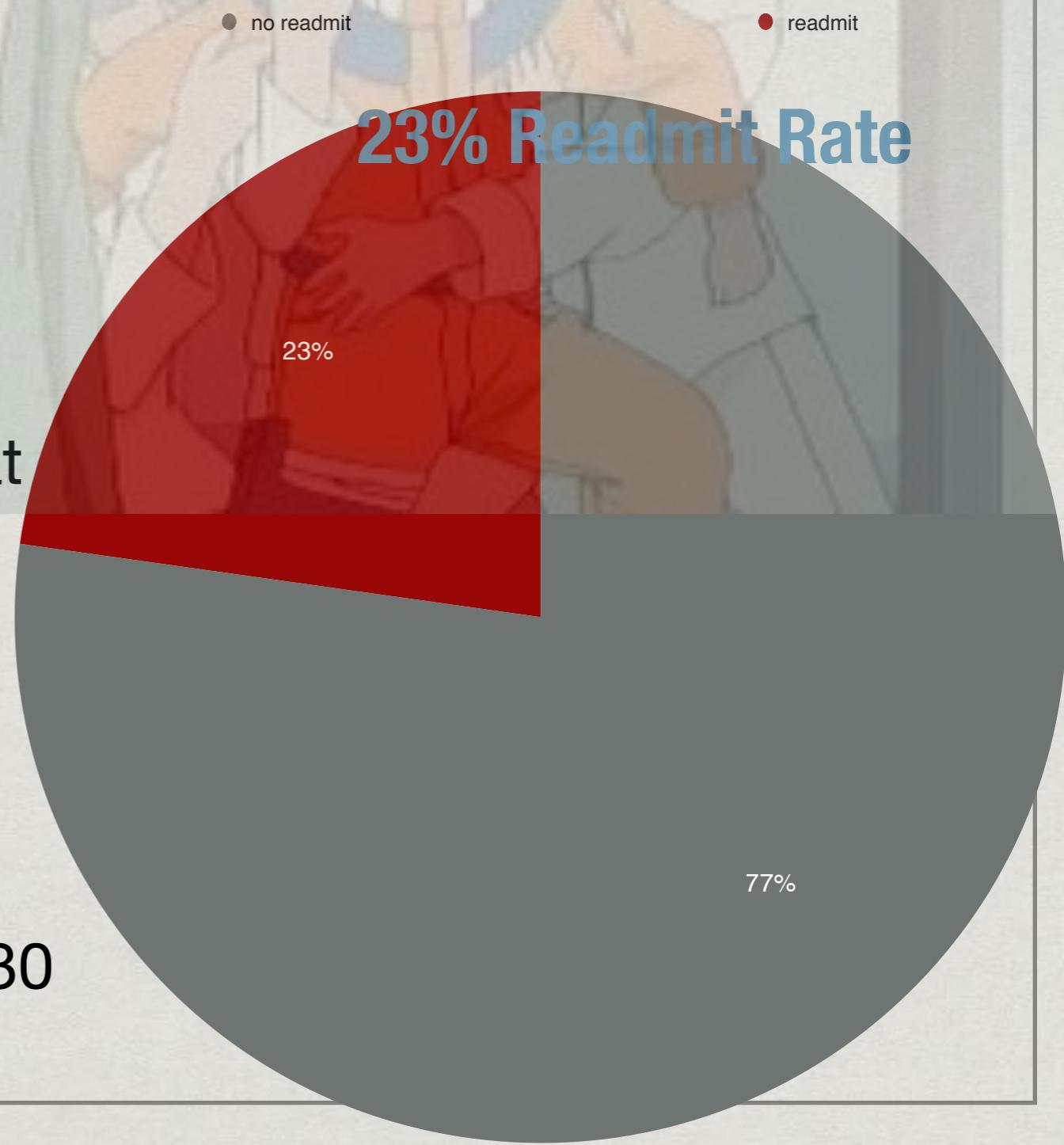
- * max penalty increased to 3% of total reimbursements in 2014
- * 18% of Tahoe's total revenues were reimbursements for the 3 conditions
- * ESTIMATED LOSS PER READMIT = \$8,000

Care Tracker

- * PATIENT EDUCATION +
- * AT-HOME MONITORING
- * REDUCED READMISSIONS
40%
- * COSTS \$1.2K PER PATIENT

Rolling Out: Costs and Benefits

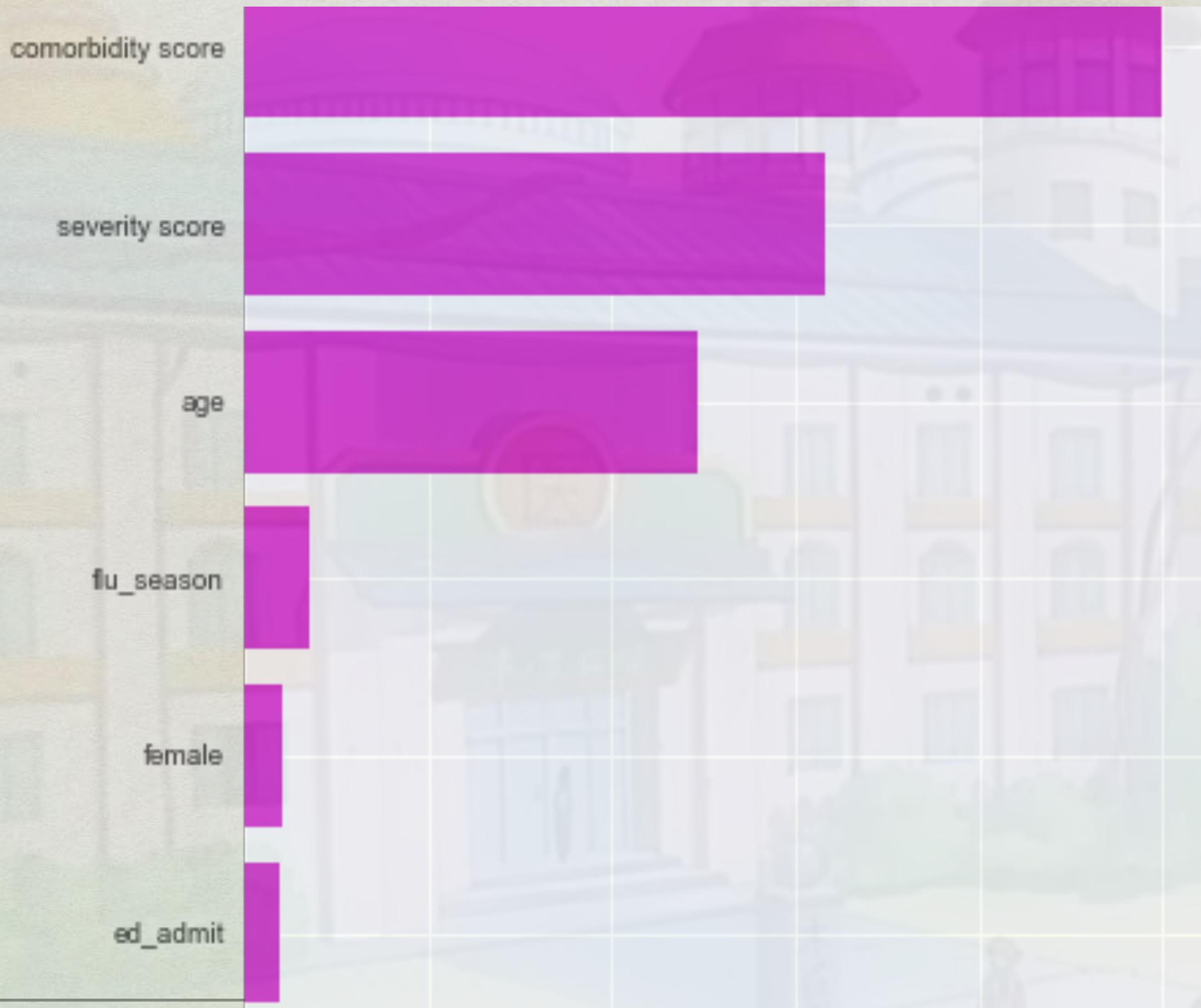
- * Assumptions:
- * sans intervention, 23% of patients are readmitted within 30 days
- * CareTracker is 40% effective at reducing readmits for all patients
- * patient demographics reflect 2012 AMI data
- * consider only readmits within 30 days



Strategies

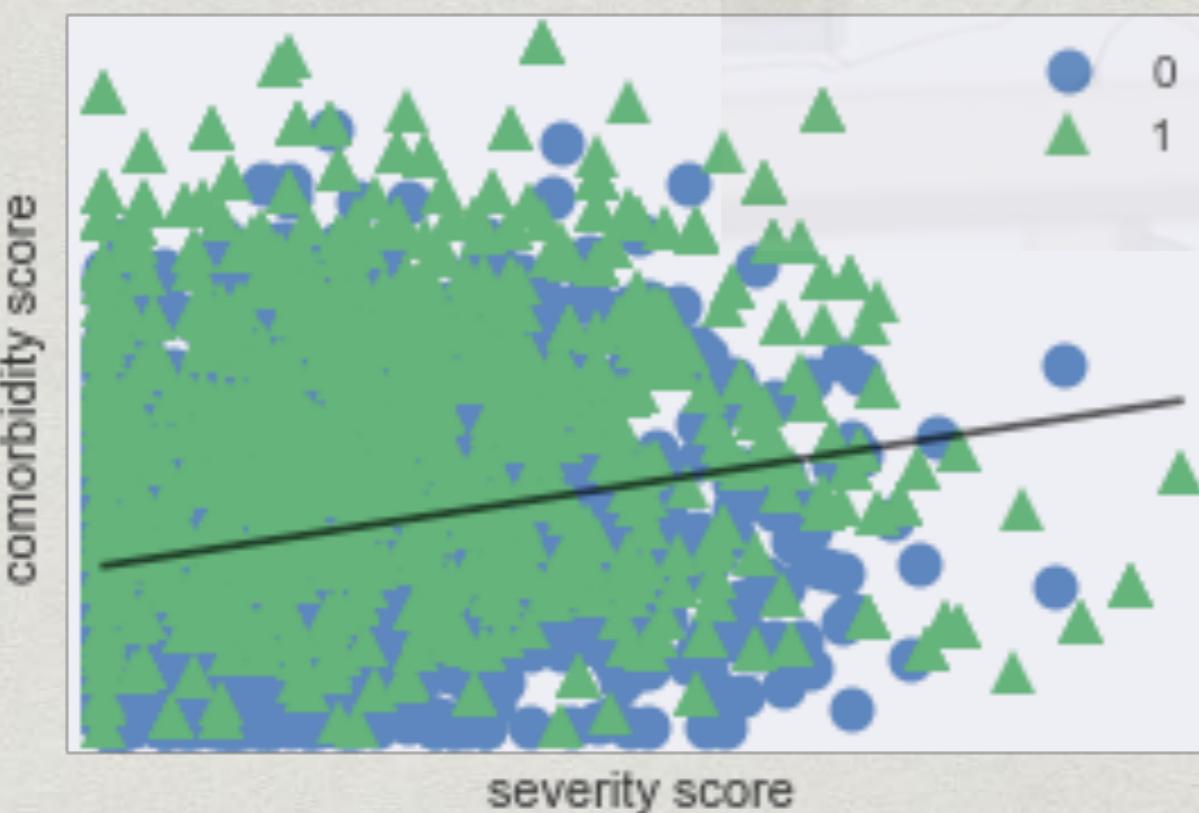
- * 1. EAT PENALTIES
- * spend nothing on CareTracker
- * $-[998 * 8000 = 8M]$
- * 2. RACK UP PROGRAM COST
 - * treat everyone
 - * $-[4382 * 1200 + (60\% * 998 * 8000) = 10M]$
- * 3. PREDICT READMITS
 - * treat patients predicted to readmit
 - * $-[fn * 8000 + fp * 1200 + tp * 6000]$

Variable Importance in Predicting Readmission



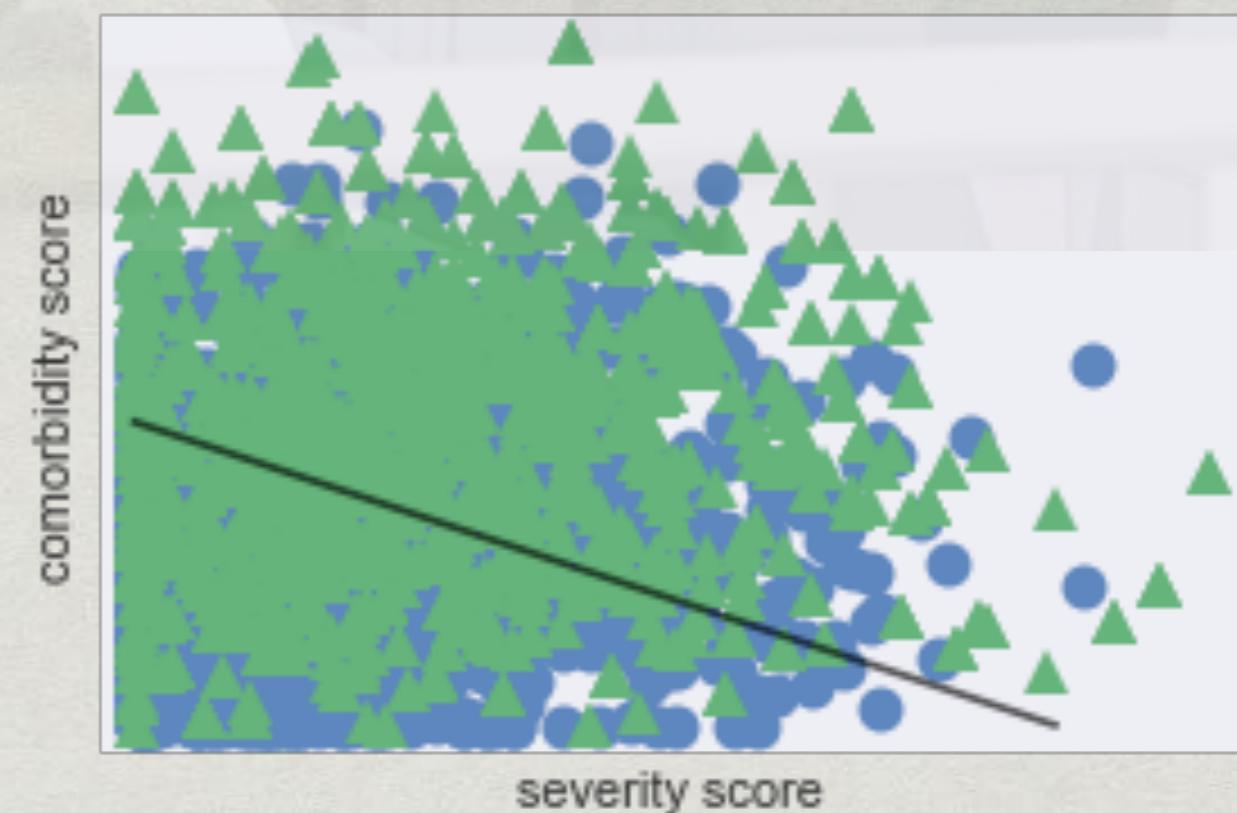
Linear Methods have Low Accuracy

LinearSVC



Test set score: 0.72

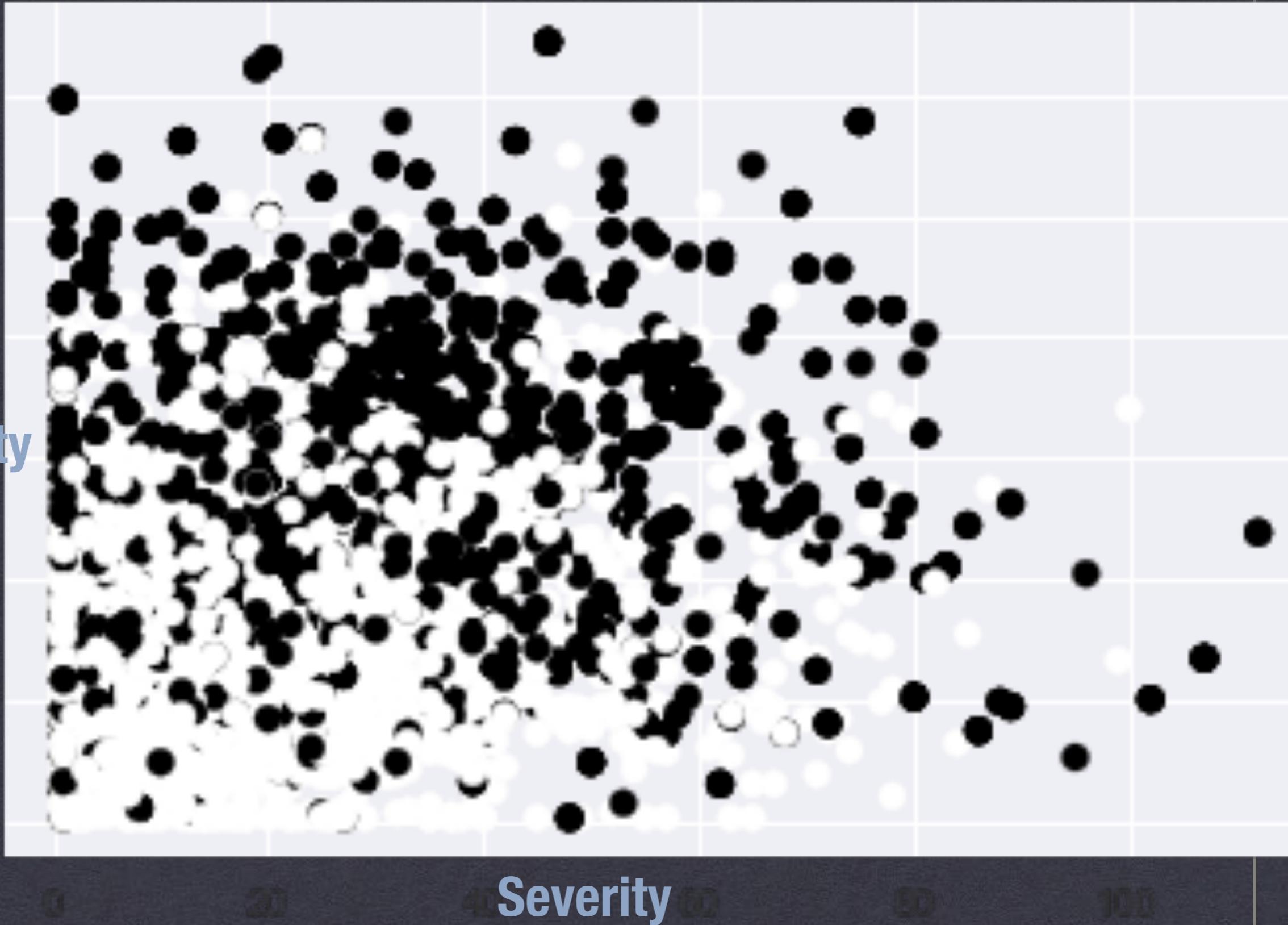
LogisticRegression



Test set score: 0.72

*models trained on balanced classes and tested on imbalanced set

Comorbidity



CLASSIFYING THE POINTS

FINDING THE BOUNDARY

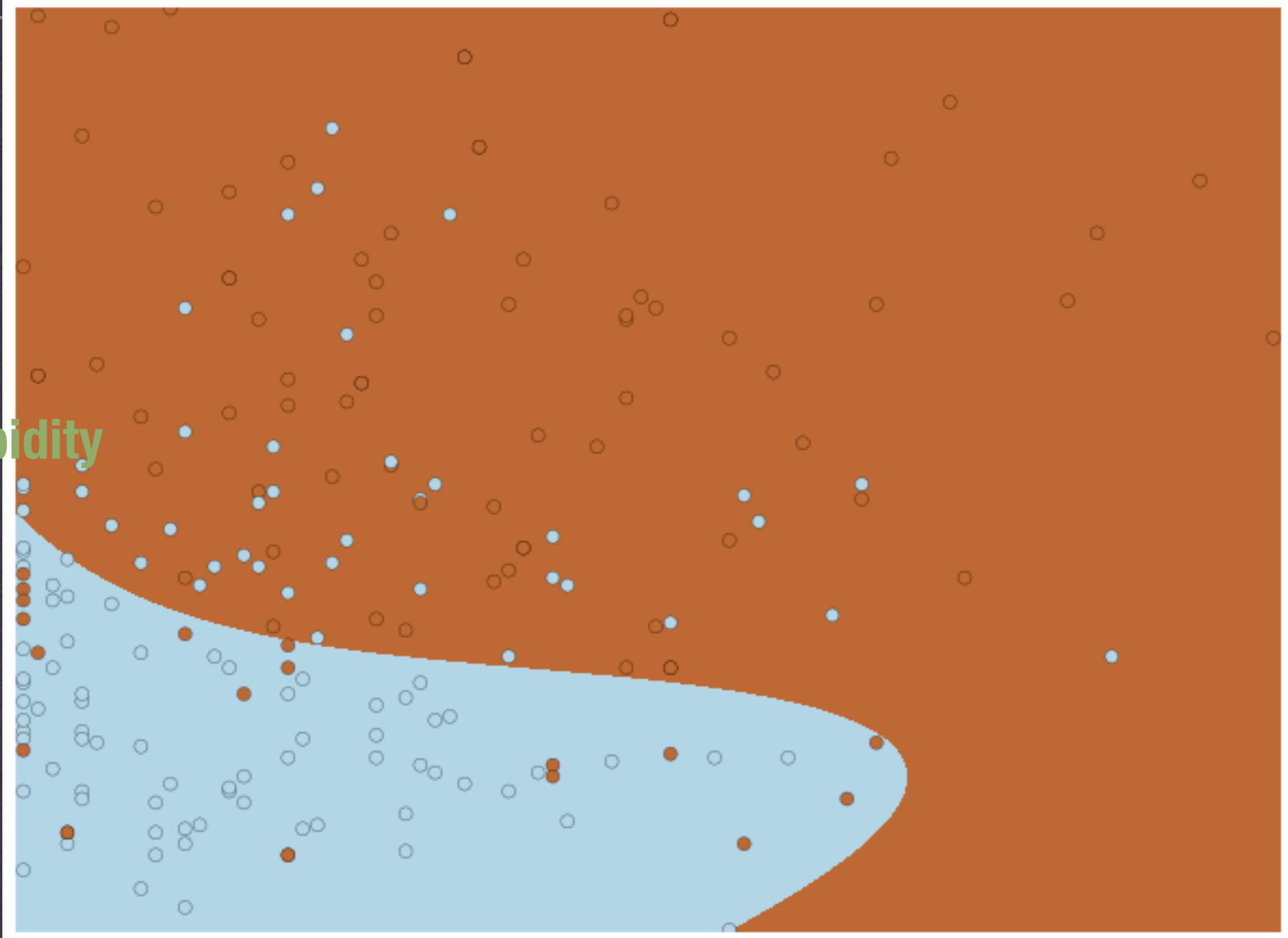
Comorbidity

Severity

NONLINEAR BOUNDARY CURVE
SVC WITH POLYNOMIAL KERNEL

using all features

Test set score: 0.74



Comorbidity



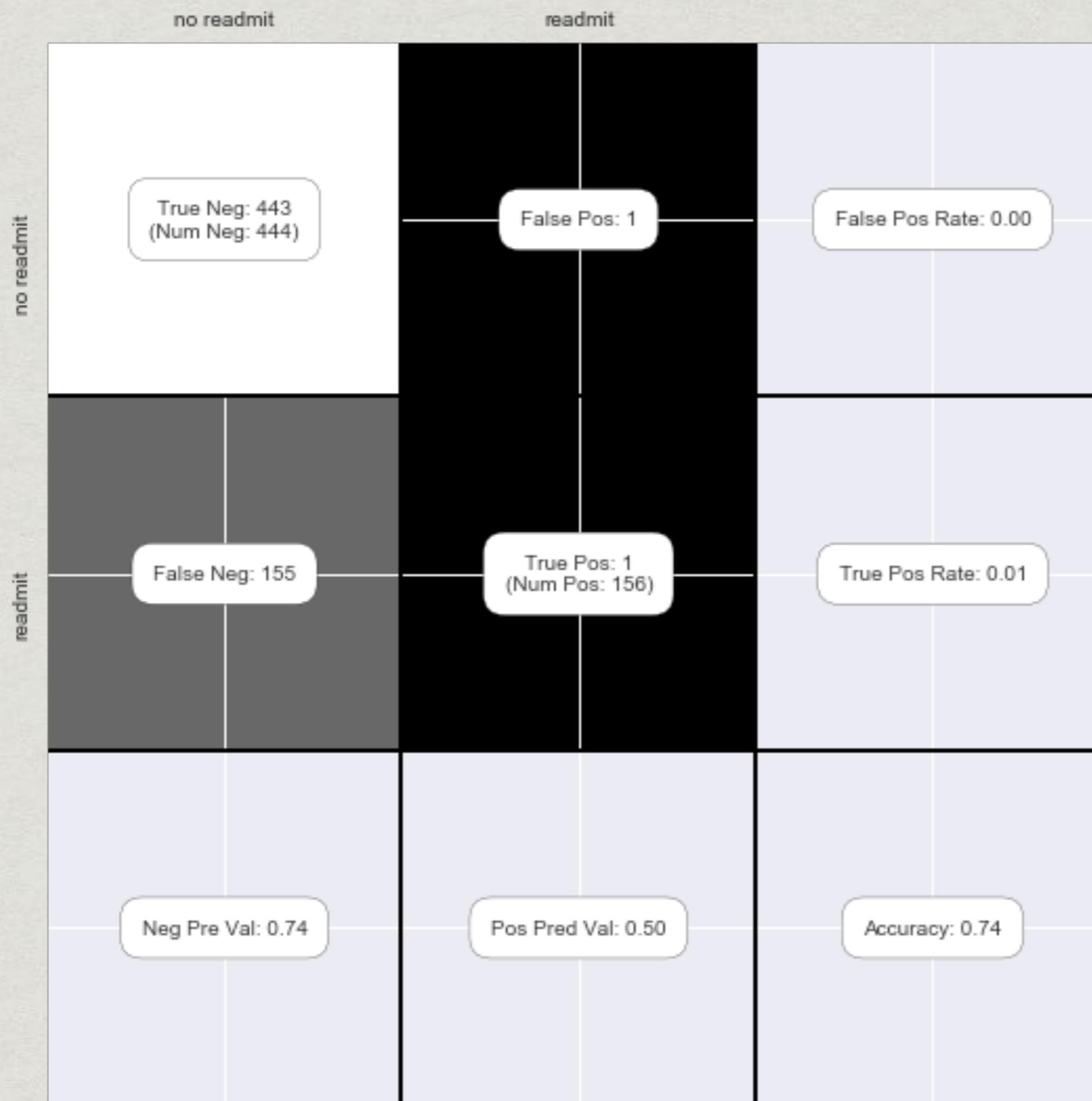
BOUNDARY REGIONS
SVC WITH RBF KERNEL

Severity

using all features and parameter tuning

Test set score: 0.79

Predicted Label



SVC WITH RBF KERNEL

	cost	count	total
tp	6000	7	42000
tn	0	3235	0
fp	1200	7	8400
fn	8000	1132	9056000
			9106400

- \$9.1 M

**Do not roll out
CareTracker**

Predicted Label

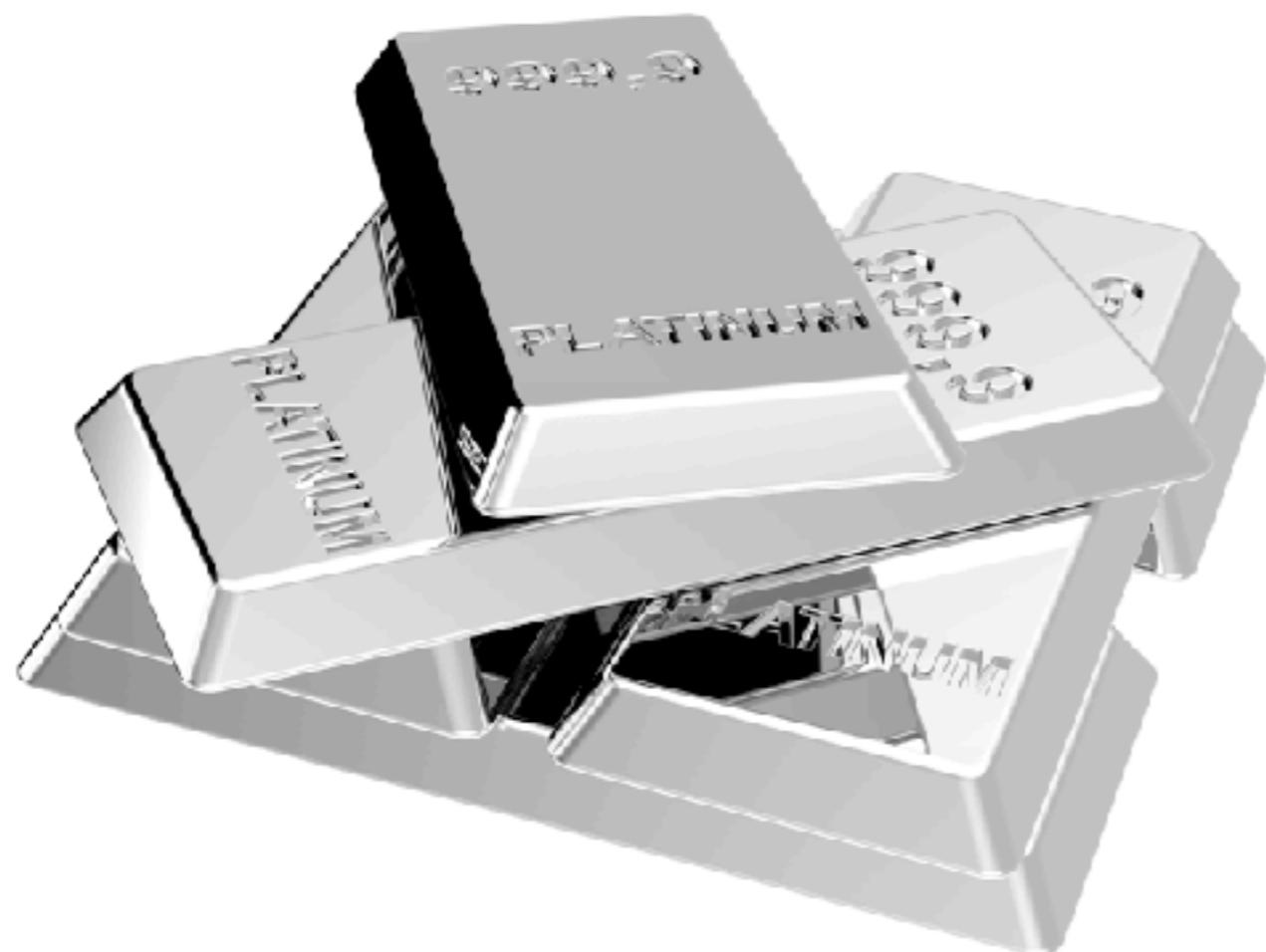
no readmit

readmit

True Label

no readmit

readmit



THEORETICAL PERFECT MODEL

	cost	count	total
tp	6000	998	5988000
tn	0	3384	0
fp	1200	0	0
fn	8000	0	0
			5988000

- \$6 M

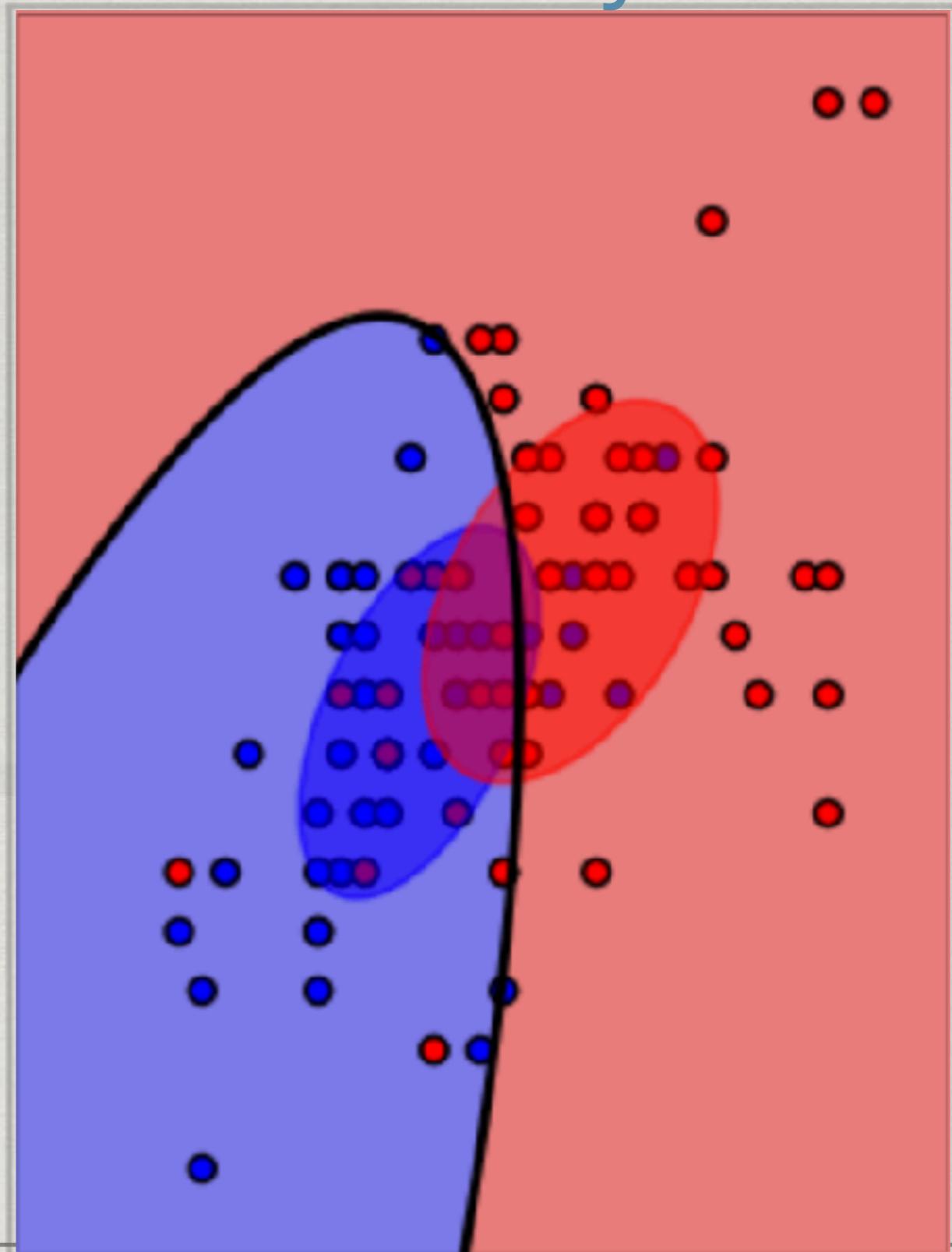
Much better
than eating
penalties

Another Model: Quadratic Discriminant Analysis

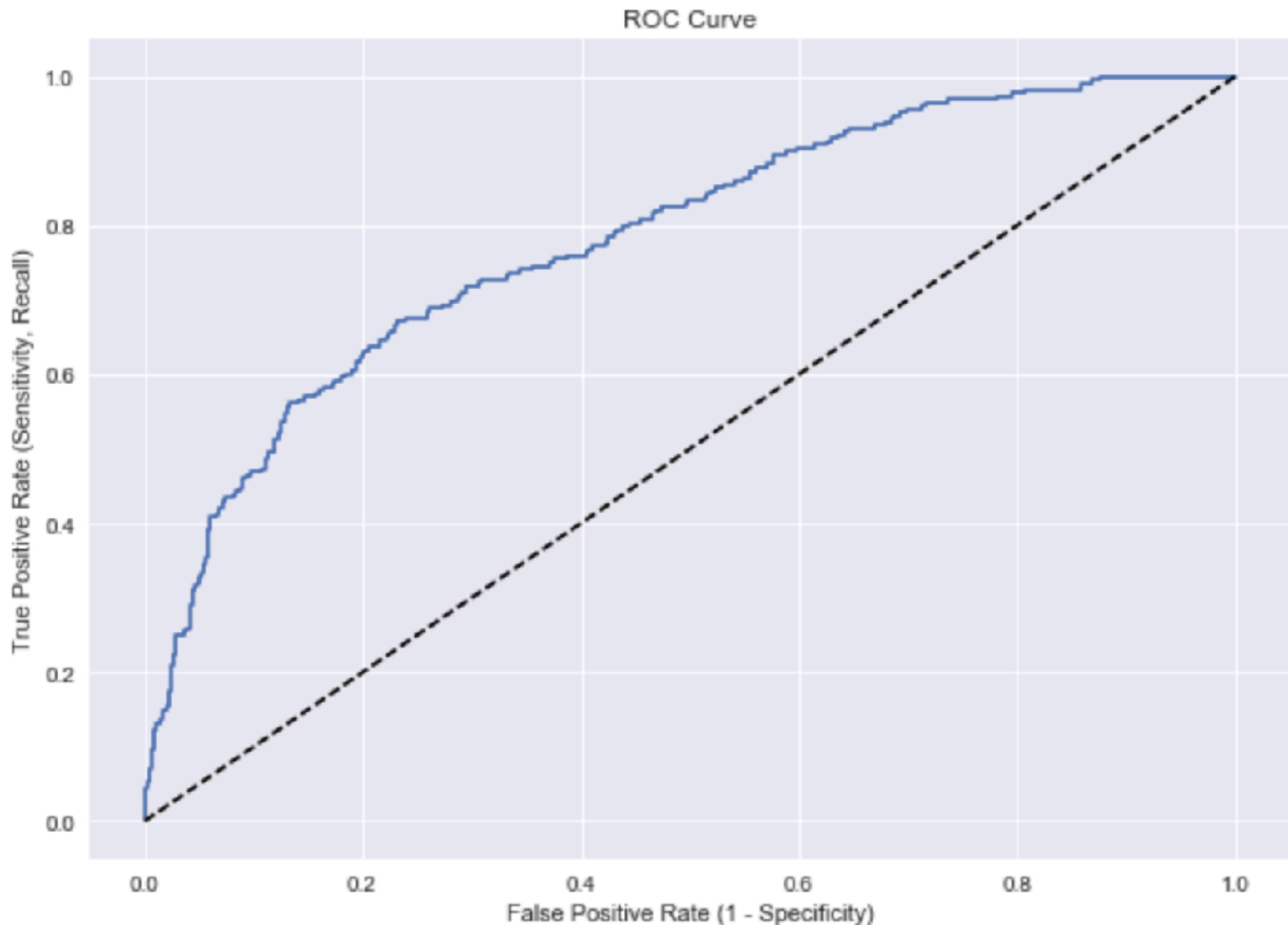
- * classifier with a quadratic decision boundary, generated by fitting class conditional densities using Bayes' rule
- * the model fits a Gaussian density to each class.

Test set score: 0.80

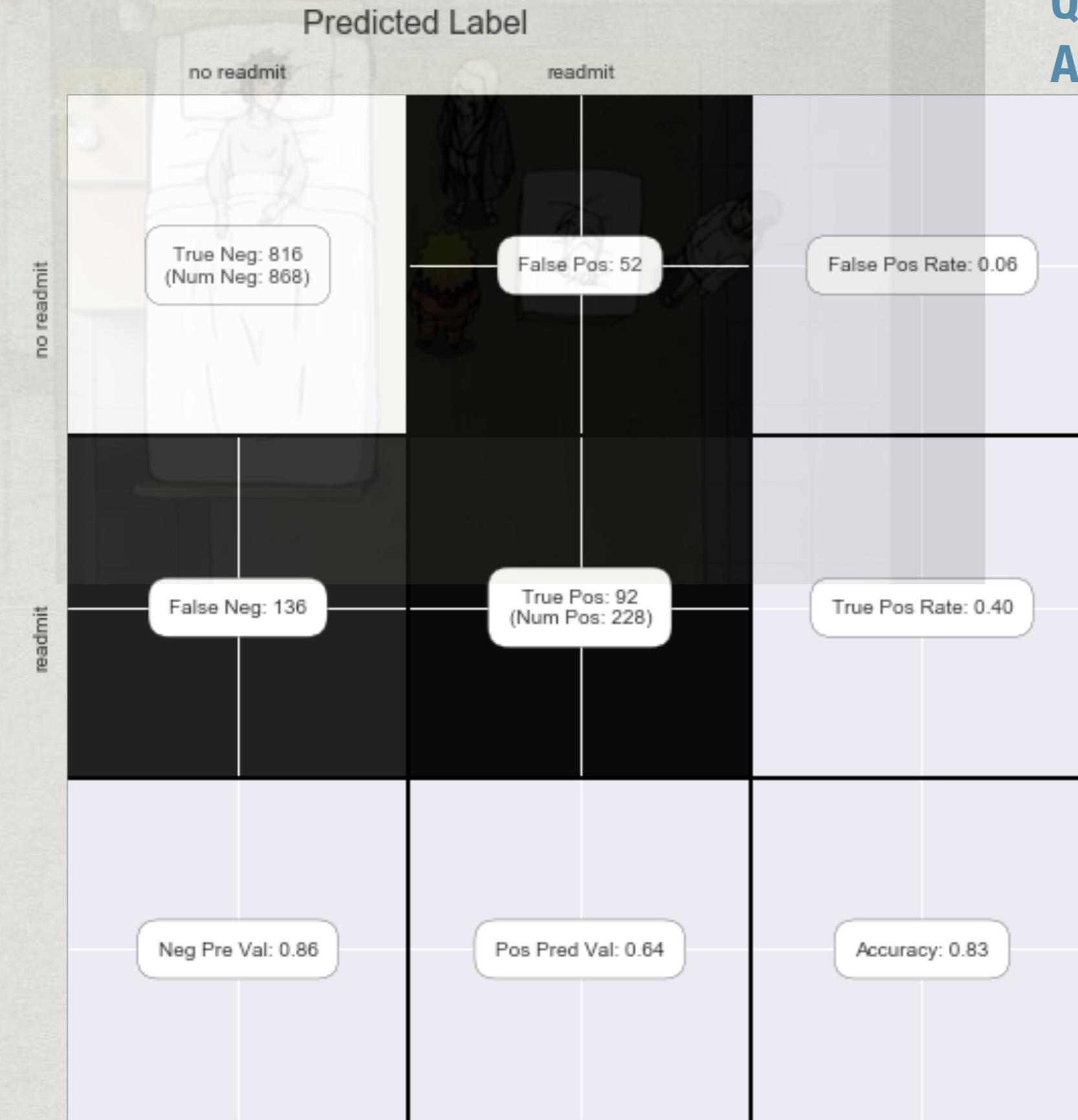
Test set score: 0.83



ROC AUC: 0.78



QUADRATIC DISCRIMINANT ANALYSIS

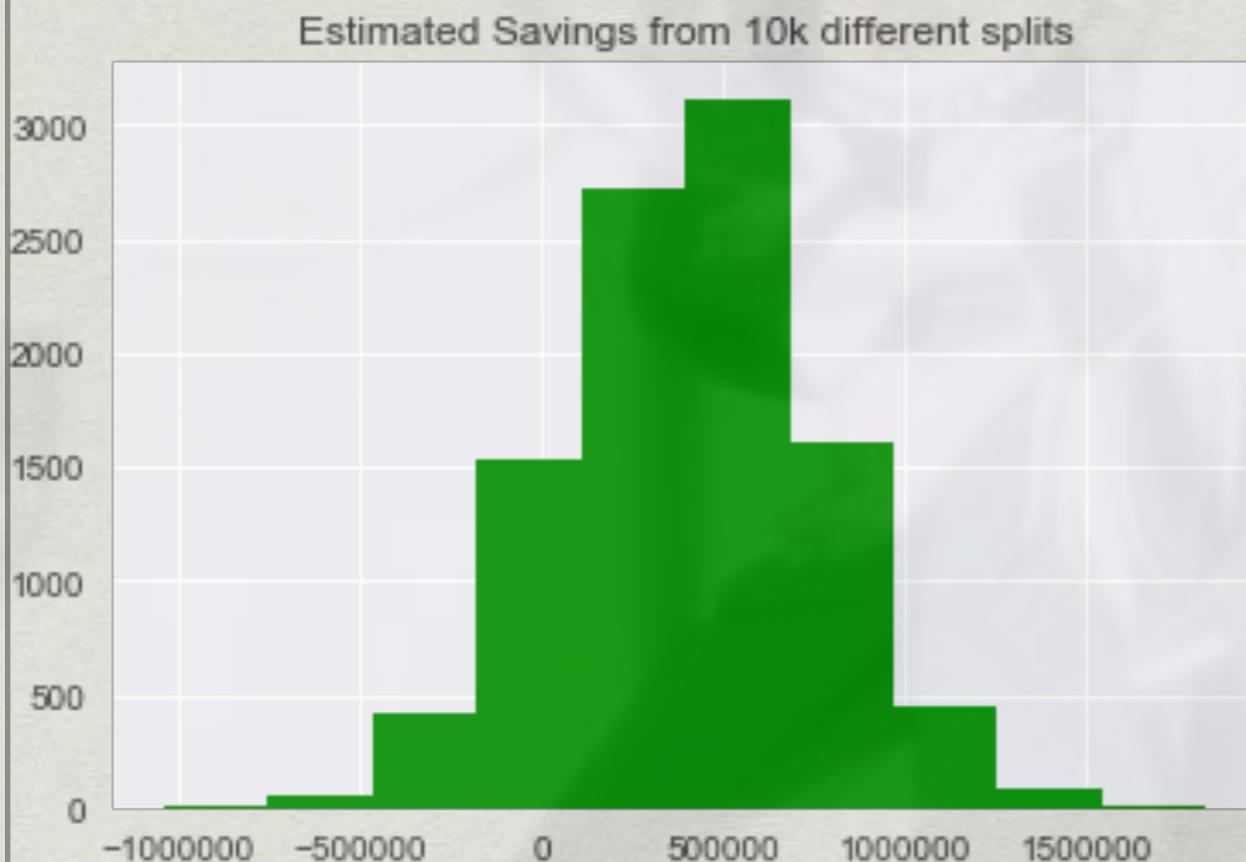


	cost	count	total
tp	6000	368	2208000
tn	0	3261	0
fp	1200	208	249600
fn	8000	544	4352000
			6809600

- \$6.8 M

\$1.2M
improvement
over eating
penalties

Run Model with 10,000 different random splits



- * MIN: -1.03M
- * MAX: 1.83M
- * MEAN: 350k
- * STD: 740k

CALL TO ACTION

- * PULL DATA FOR HF,
PNEUMONIA, AND THE
PAST 3 YEARS OF DATA
- * CONTINUE TO REFINE
MODEL FOR BETTER
ACCURACY
- * ASSESS WHETHER
POTENTIAL SAVINGS
OUTWEIGH THE RISK



I'VE KEPT
CALM
ARE THERE
ANY
QUESTIONS