Prediction of H1N1 Vaccination Status

as a means to steer public health interventions

Summary

Accurately predict whether individuals chose to receive the vaccination for the H1N1 virus.

Identify targets for future public health campaigns.

Analysis and predictive models are based upon survey results from the 2009 H1N1 Flu Survey.

Takeaways:

- Logistic Regression and Decision Tree models predict with ~85% accuracy, generalize well
- With optimization, Regression > Decision Tree models
- Future campaigns should focus on conveying risk, vaccine effectiveness, and encourage doctor recommendations

Outline

- Scientific | Business Problem
- Data
- Methods
- Results
- Conclusions

Scientific Problem

Find a model that accurately predicts whether individuals received the H1N1 vaccine.

Confirm the model's performance in generalizing to unseen data, and explore alternative models and hyperparameters.

Business Problem

With Public Health Agencies as our stakeholders, identify key factors that we can focus on to increase the effectiveness of future vaccination campaigns.

Data

data set: 2009 H1N1 Flu Survey
[26,707 respondents to 35 survey questions]

survey topics:
- behavioral: (exposure | infection prevention | medication)
- opinion: (infection risk | vaccine effectiveness)
- background: (sex, race, education, housing situation)

entries: binary (yes/no), ordinal (rating 1-5), categorical (label)

methods: pandas, scikit-learn

target variable: received H1N1 vaccine (yes/no)

Methods

Model Classes:

- Logistic Regression
- Decision Tree

Preprocessing steps:

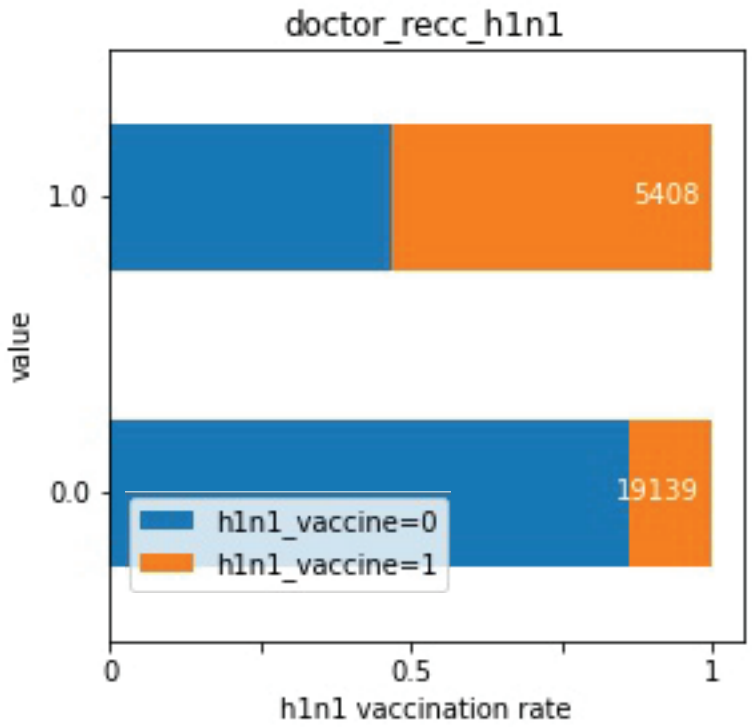
- -convert categorical variables to one-hot numerical encodings
- -scale each variable to have unit variance

Cross-validated evaluation of model fits (3-fold)

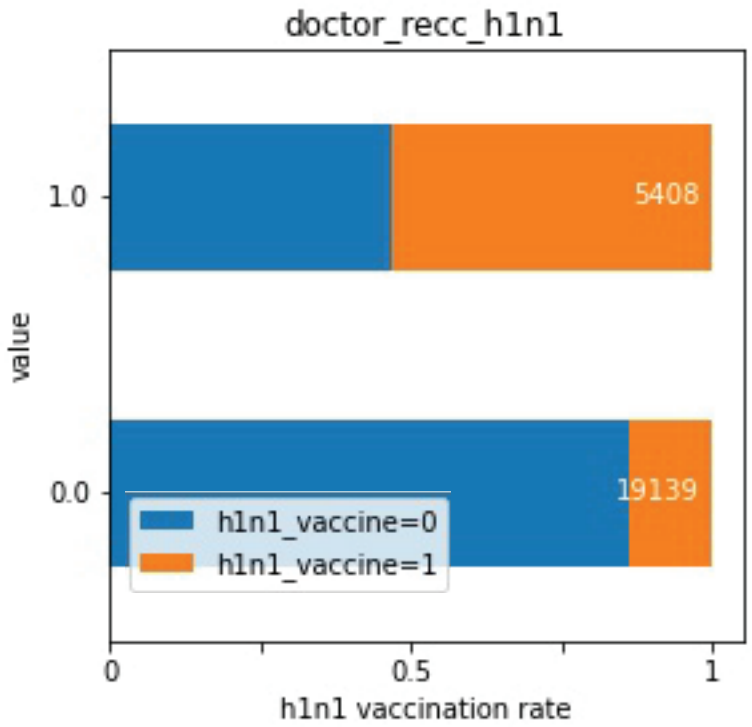
Hyperparameter Tuning

- -Regularization/Fitting (regression)
- -Depth, Features, etc (decision tree)

Doctor recommendation is predictive of vaccination

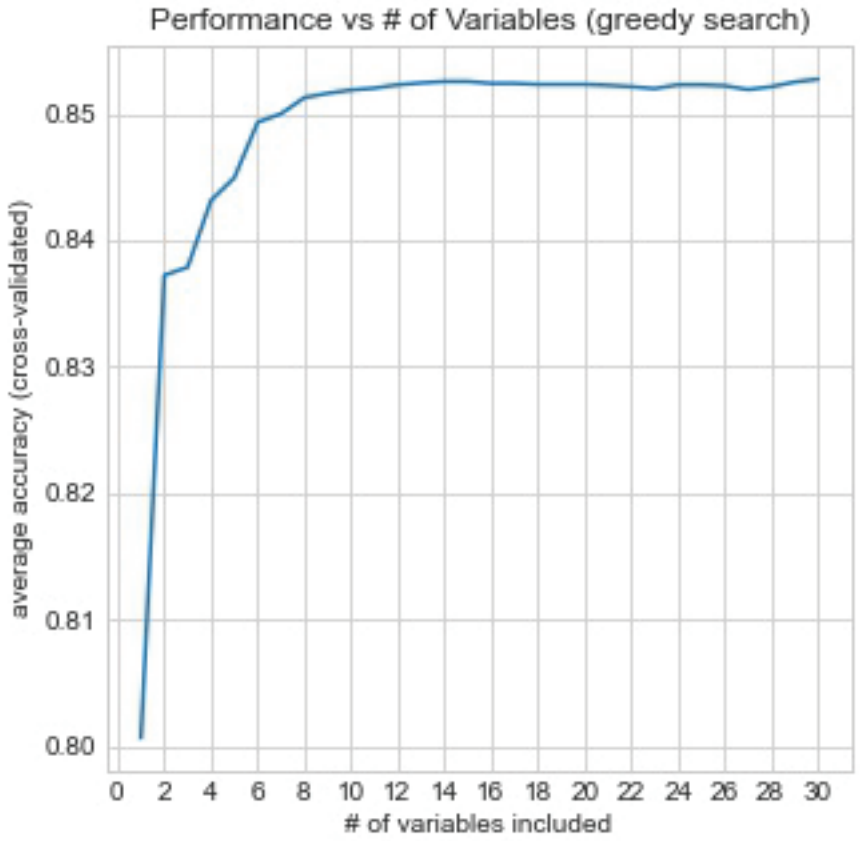


Doctor recommendation is predictive of vaccination



variable	accuracy	accuracyBASE
doctor_recc_h1n1	0.800652	0.787546
opinion_h1n1_risk	0.788969	0.787546
h1n1_concern	0.787546	0.787546
health_worker	0.787546	0.787546
household_children	0.787546	0.787546
household_adults	0.787546	0.787546

Logistic Regression identifies 10-14 optimal variables



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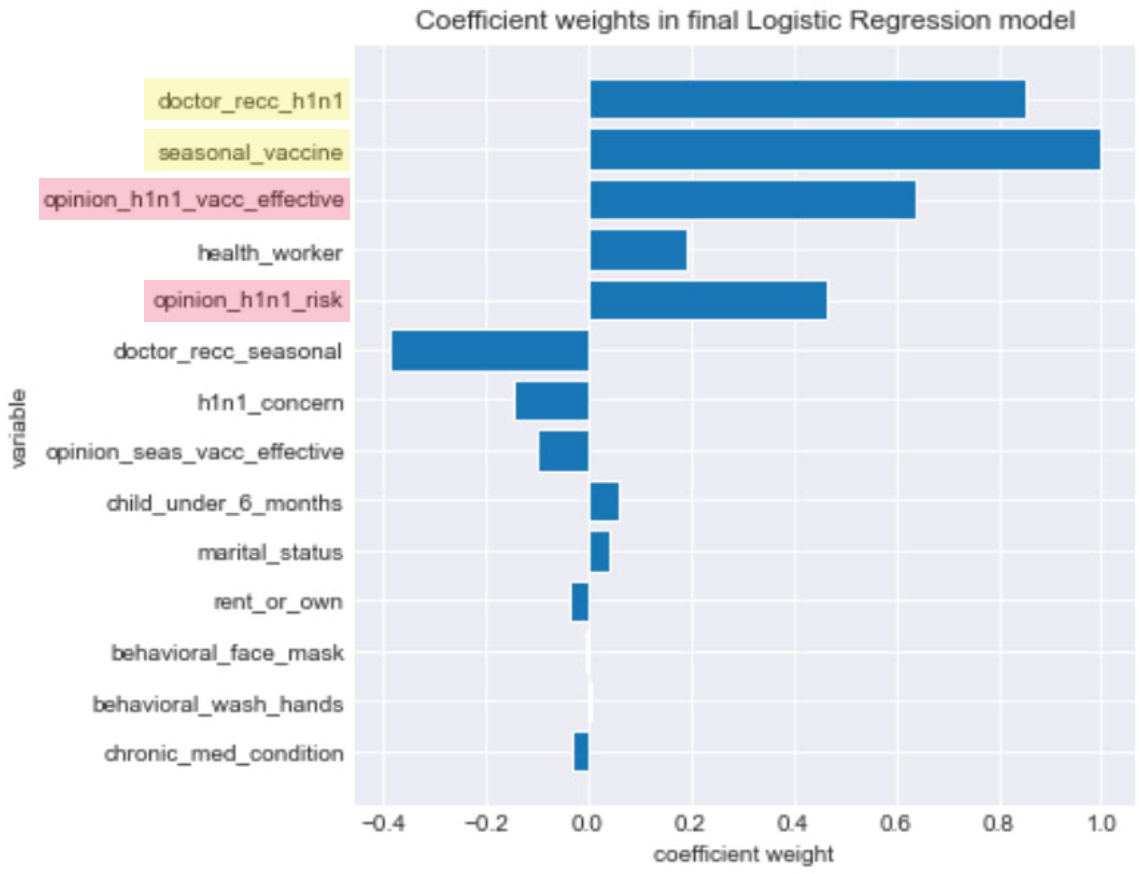
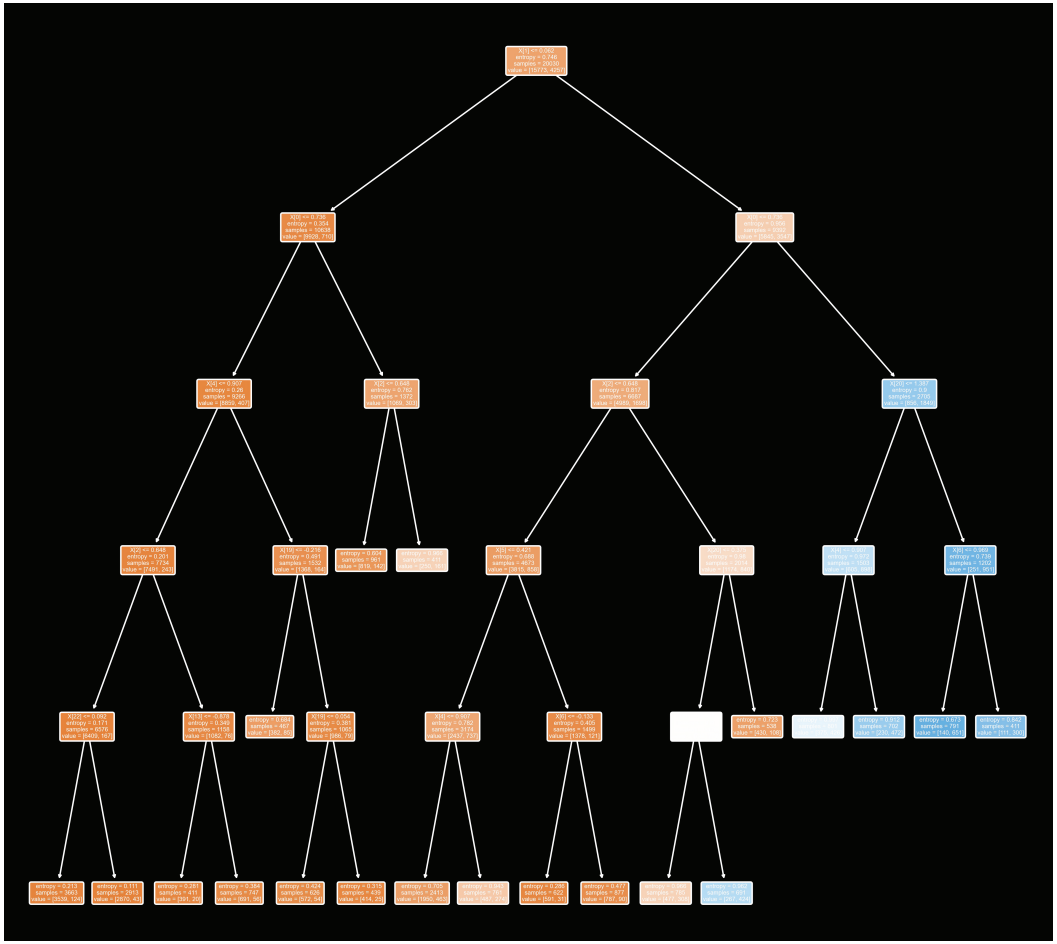
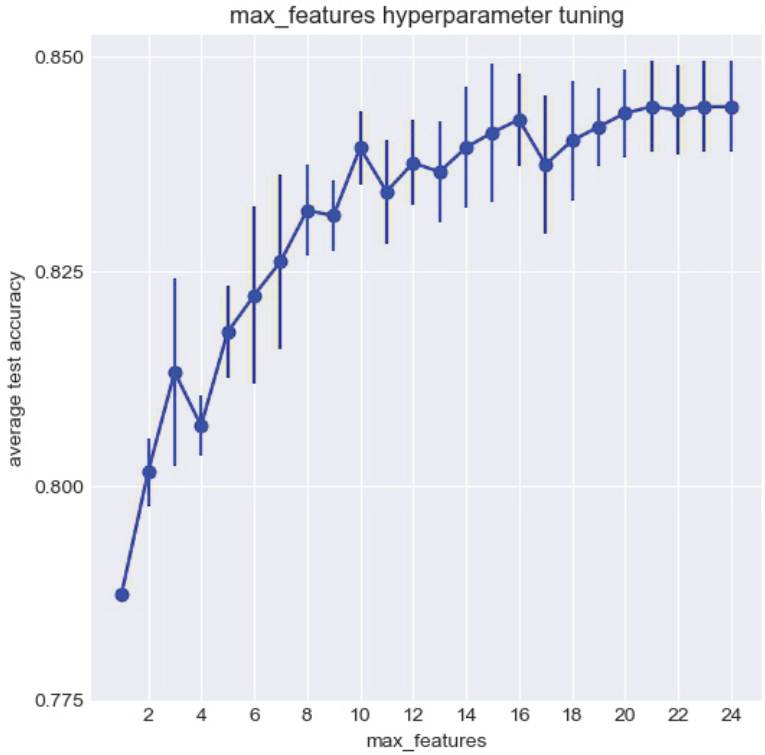
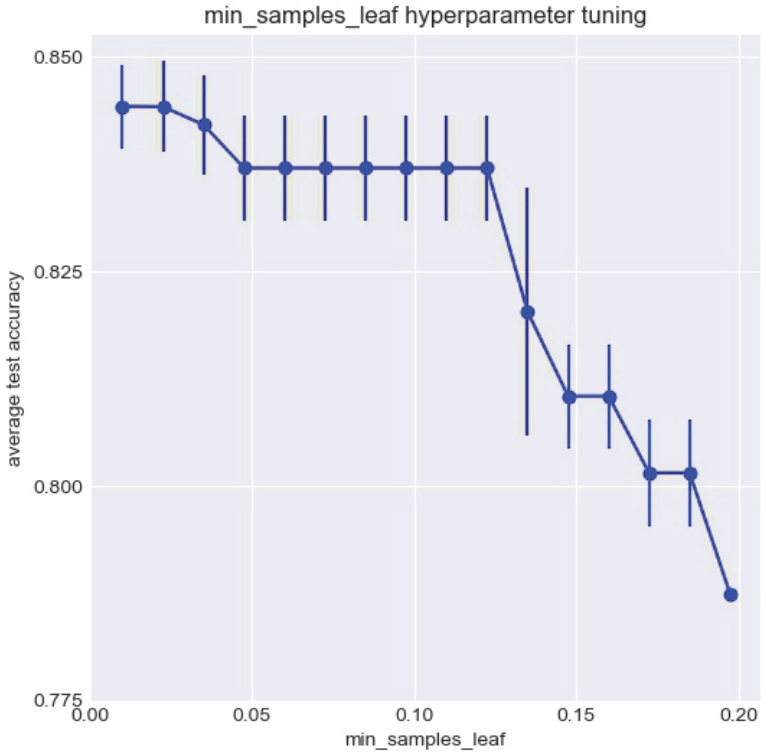


Decision tree optimal model architecture

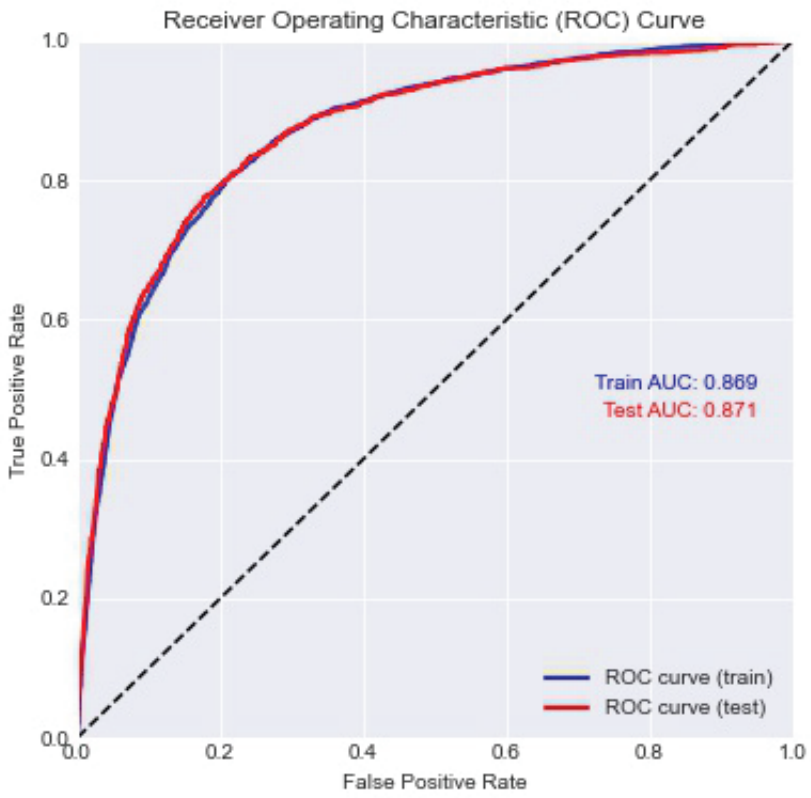


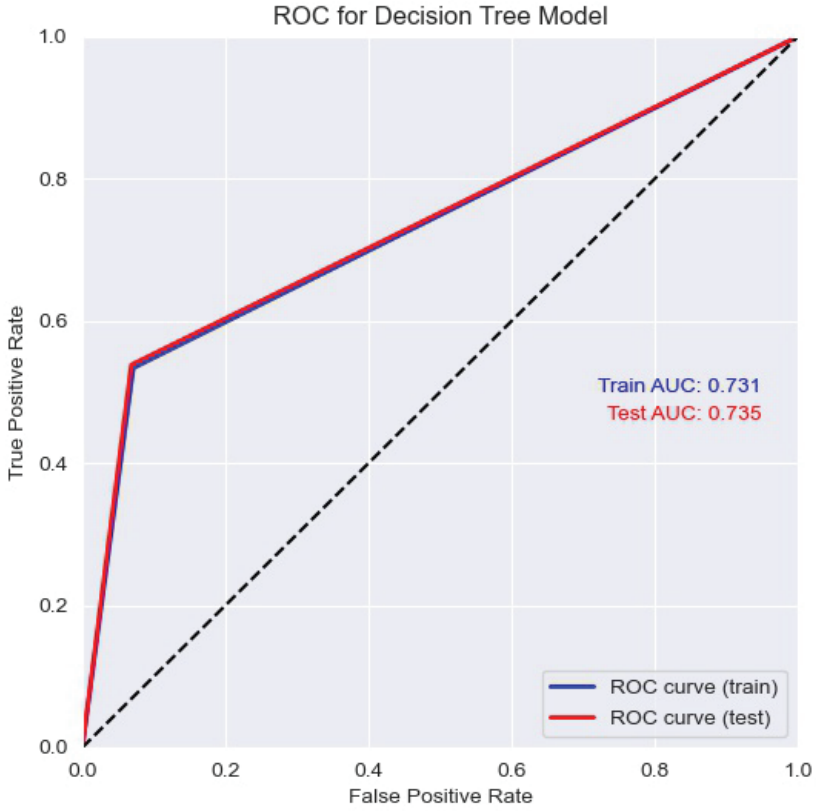
Optimal decision tree has many features, small min_samples_leaf





Logistic Regression slightly outperforms Decision Tree





Conclusions

We were able to predict individual's H1N1 vaccination status with > 85% accuracy (and significantly above the null model).

- Both Logistic Regression and Decision Tree models did well

Future public health campaigns should:

- Focus on getting doctors to recommend vaccination
- Encourage individuals to get seasonal flu vaccines
- Strengthen communication on risk and vaccine effectiveness

Thanks for your attention.

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Additional Considerations

- Inclusion of nonlinear transformations of the data (pairwise products) did not further increase accuracy
- Other nonlinear transformations (squaring, higher-order-products) could possibly prove informative
- Stable performance (across models, regularization, and training/test sets) suggests that we may be in a near optimal regime for classifying these data