Big Data Analytics of Hotel Bookings

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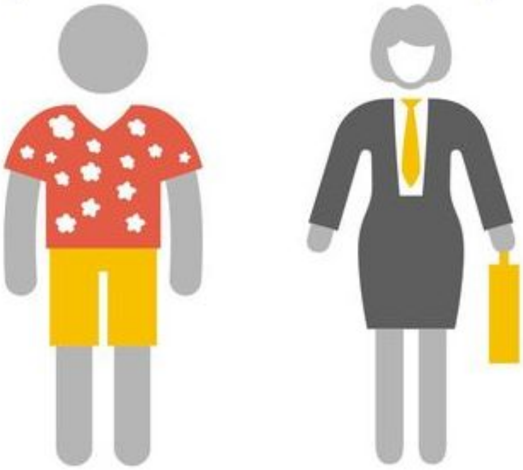
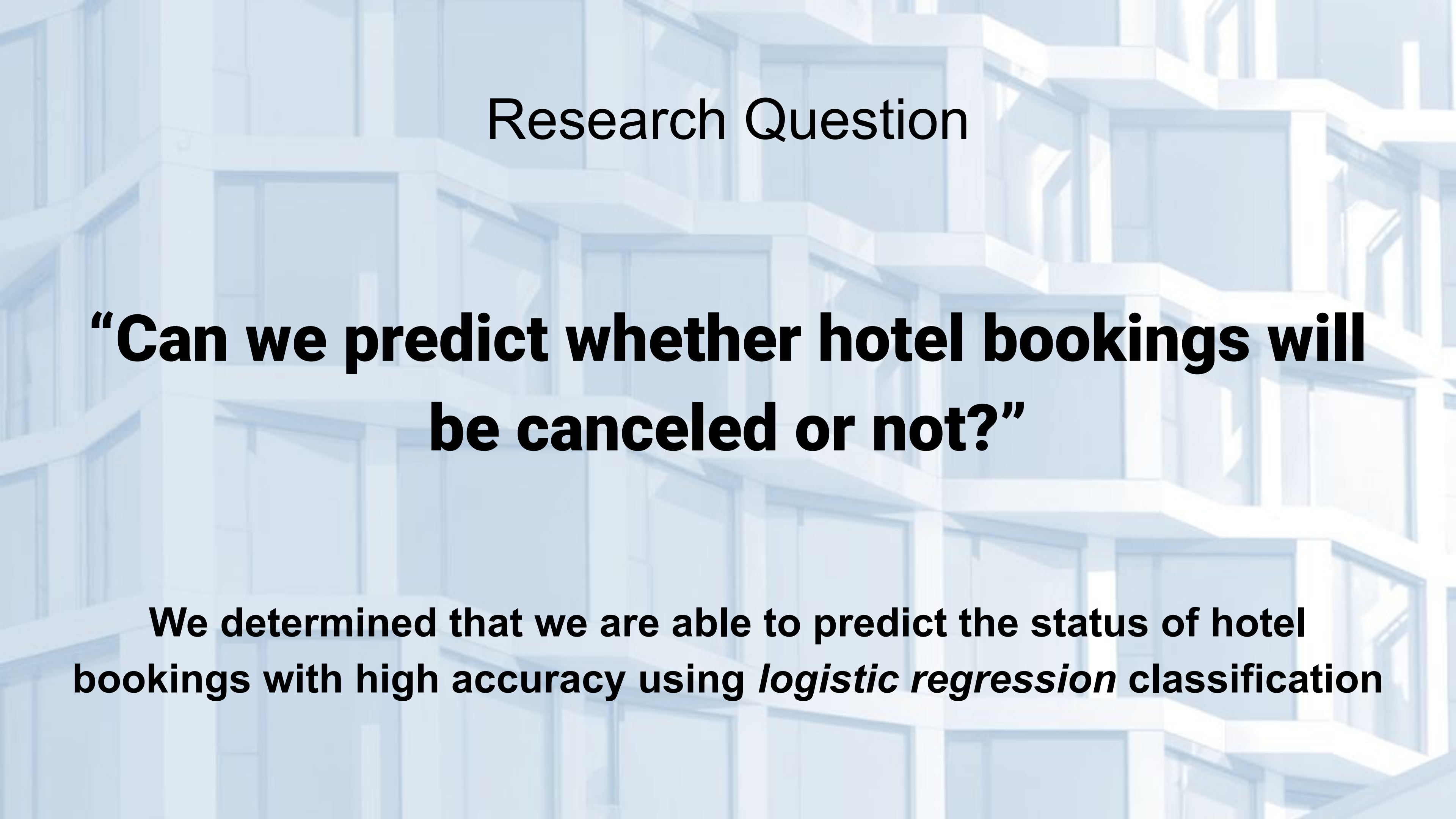
Fall 2020
PSTAT 135/235

Stays on
weekdays
vs.
Stays on
weekends

Booking hotel
5 days head
vs.
737 days ahead



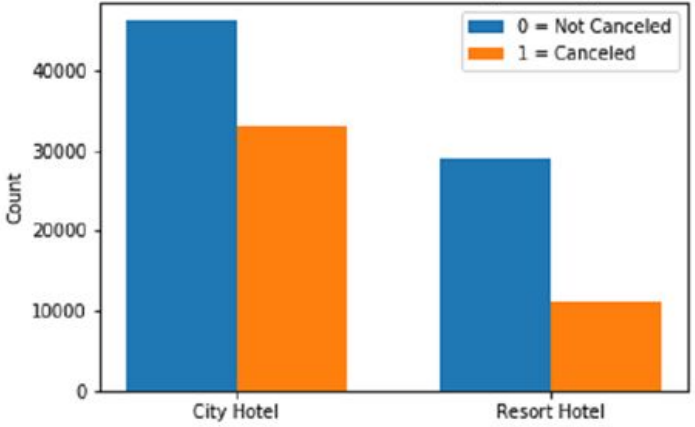
Number of adults
vs.
Number of
children



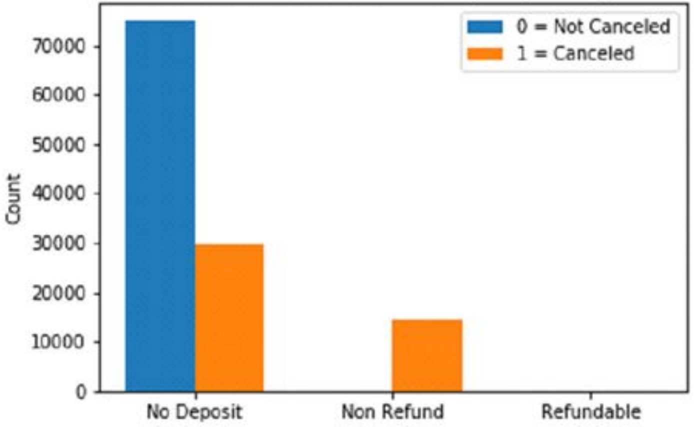
Research Question

“Can we predict whether hotel bookings will be canceled or not?”

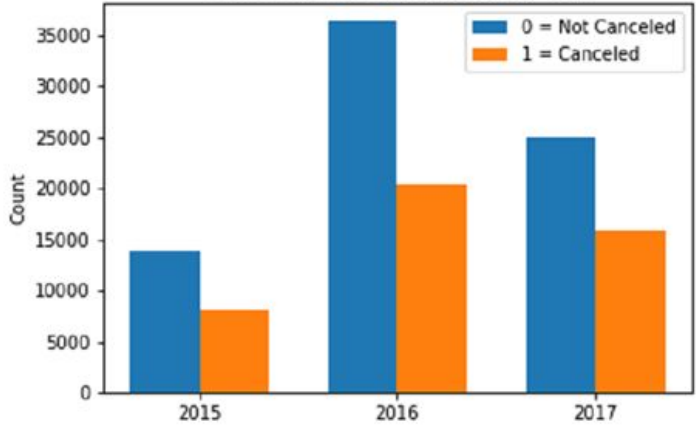
We determined that we are able to predict the status of hotel bookings with high accuracy using *logistic regression* classification



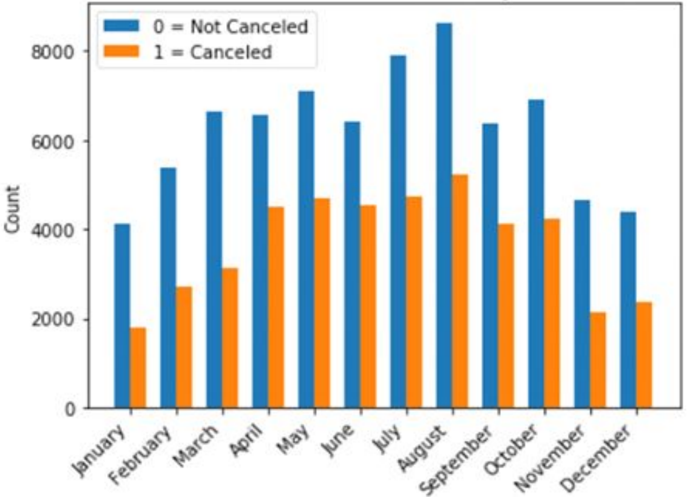
Count of hotel cancellations by hotel type



Count of Hotel Cancellations by Deposit Type



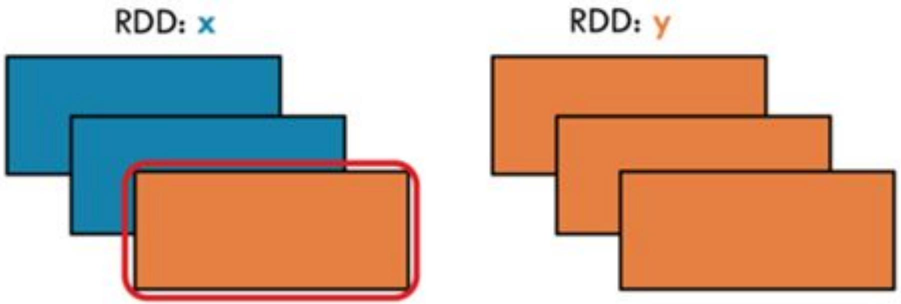
Count of Hotel Cancellations by Year

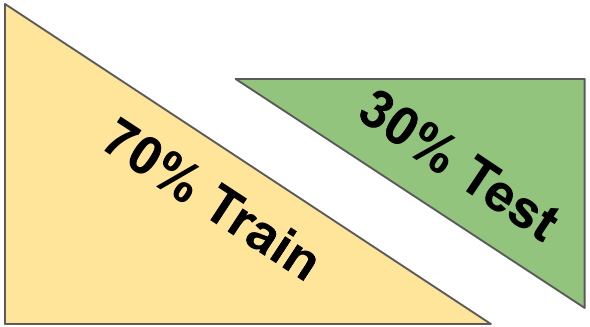


Count of Hotel Cancellations by Month

Variable Transformations and Preprocessing

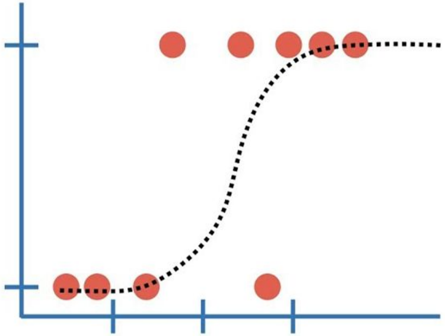
- Remove “NULL” and “N/A”
- Remove empty and redundant variables
- Normalize continuous variables
- Map to labeled point object
- Randomly split data for training and testing

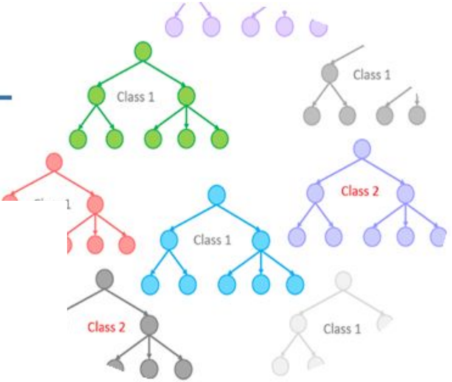


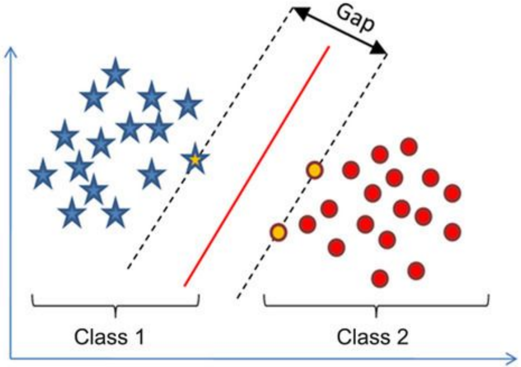


Models Constructed with Tuning Hyperparameters

- **Logistic Regression**
  - Intercept (False, True)
  - Iterations (10, 50, 200)
- **Random Forest**
  - Number of Trees (5, 50, 100)
  - Maximum Depth (5, 15, 30)
- **Support Vector Machine**
  - Intercept (False, True)
  - Iterations (100, 200)
  - Type of Regularizer (l2,l1)







Logistic Regression Model Performance

- Best Logistic Regression model is with no intercept and 100 iterations
- Model is indifferent to adding intercept term
- Not sensitive to iterations

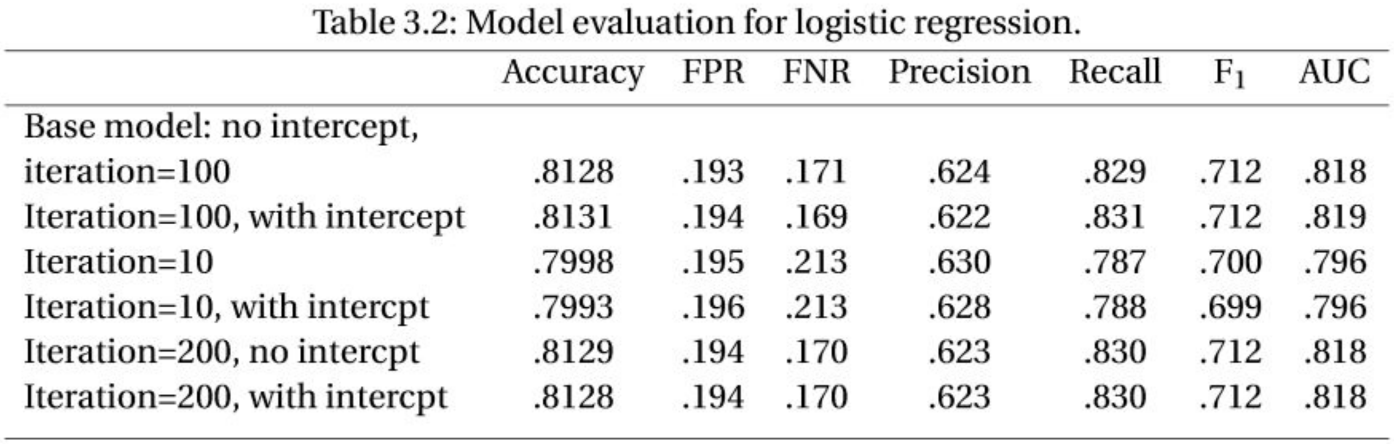


Table 3.2: Model evaluation for logistic regression.

	Accuracy	FPR	FNR	Precision	Recall	F_1	AUC
Base model: no intercept, iteration=100	.8128	.193	.171	.624	.829	.712	.818
Iteration=100, with intercept	.8131	.194	.169	.622	.831	.712	.819
Iteration=10	.7998	.195	.213	.630	.787	.700	.796
Iteration=10, with intercpt	.7993	.196	.213	.628	.788	.699	.796
Iteration=200, no intercpt	.8129	.194	.170	.623	.830	.712	.818
Iteration=200, with intercpt	.8128	.194	.170	.623	.830	.712	.818

Random Forest Model Performance

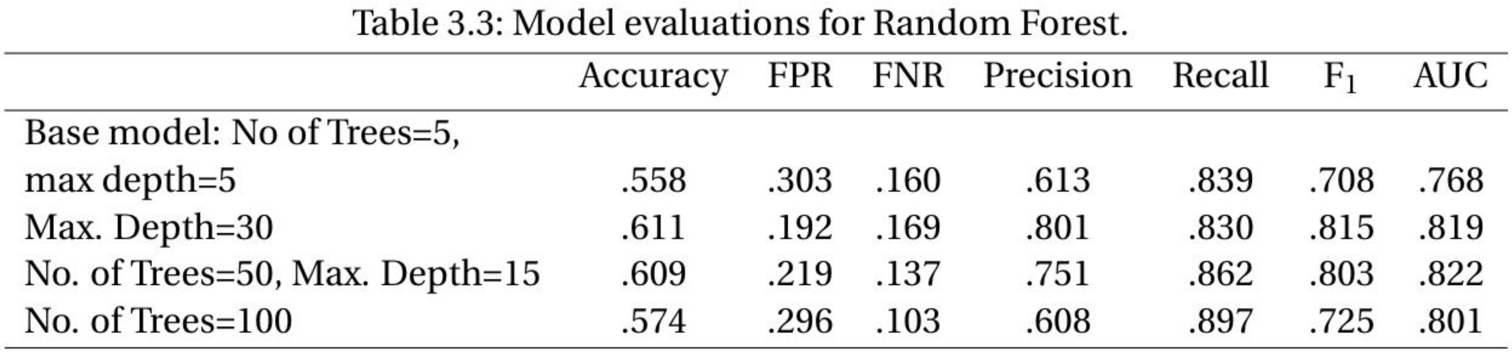


Table 3.3: Model evaluations for Random Forest.

	Accuracy	FPR	FNR	Precision	Recall	F_1	AUC
Base model: No of Trees=5, max depth=5	.558	.303	.160	.613	.839	.708	.768
Max. Depth=30	.611	.192	.169	.801	.830	.815	.819
No. of Trees=50, Max. Depth=15	.609	.219	.137	.751	.862	.803	.822
No. of Trees=100	.574	.296	.103	.608	.897	.725	.801

- Increasing maxDepth increases accuracy and decreases FPR
- Increasing numTrees increases accuracy slightly and decreases FNR
- Model with maxDepth = 30 is the best model for Random Forest with the highest accuracy and highest precision, which are what we want for this problem

Support Vector Machine Model Performance

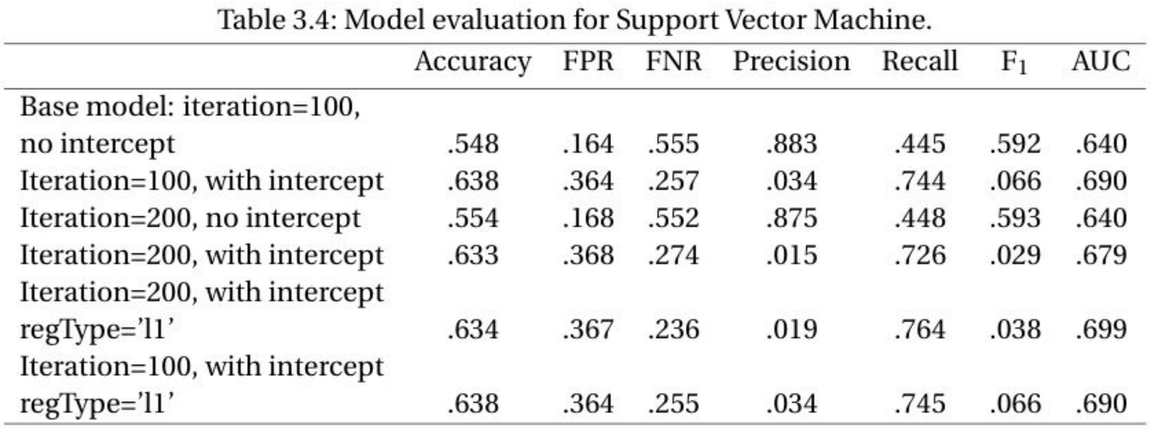


Table 3.4: Model evaluation for Support Vector Machine.

	Accuracy	FPR	FNR	Precision	Recall	F_1	AUC
Base model: iteration=100, no intercept	.548	.164	.555	.883	.445	.592	.640
Iteration=100, with intercept	.638	.364	.257	.034	.744	.066	.690
Iteration=200, no intercept	.554	.168	.552	.875	.448	.593	.640
Iteration=200, with intercept	.633	.368	.274	.015	.726	.029	.679
Iteration=200, with intercept regType='l1'	.634	.367	.236	.019	.764	.038	.699
Iteration=100, with intercept regType='l1'	.638	.364	.255	.034	.745	.066	.690

- Adding intercept improves the accuracy but decreases precision.
- Increasing iteration doesn't increase accuracy.
- Precision and F1 score shows that intercept should not be used for this model.
- Use less iteration for saving space

Comparison of models' best performance

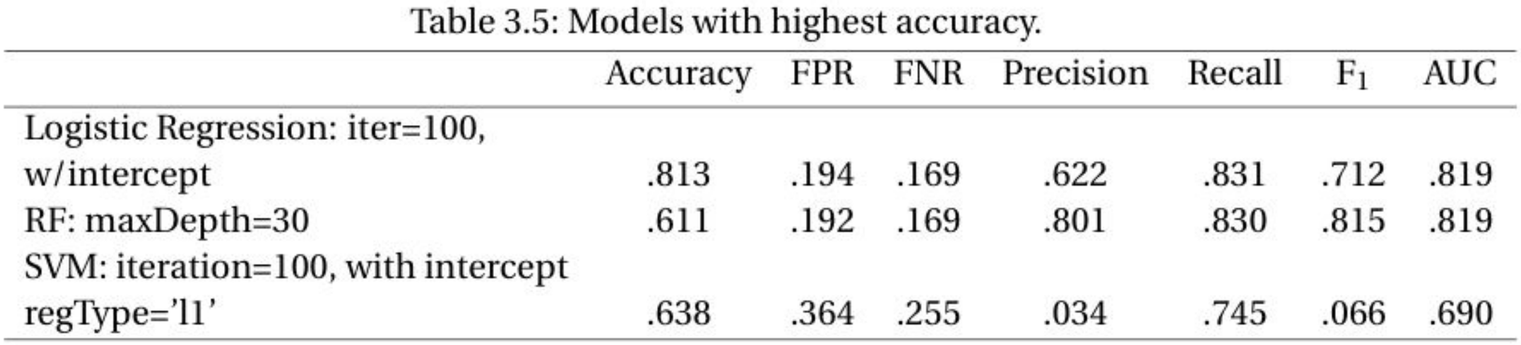


Table 3.5: Models with highest accuracy.

	Accuracy	FPR	FNR	Precision	Recall	F_1	AUC
Logistic Regression: iter=100, w/intercept	.813	.194	.169	.622	.831	.712	.819
RF: maxDepth=30	.611	.192	.169	.801	.830	.815	.819
SVM: iteration=100, with intercept regType='l1'	.638	.364	.255	.034	.745	.066	.690

The best design is logistic regression with 100 iterations and intercept.

This model has a high accuracy and a decent precision.

Conclusions and Future Research

- **Best performing model**
  - Logistic regression with intercept
- **Limitations**
  - Latent variables
  - Tools: server has limited memory
- **Future Directions**
  - Study the weights of different variables
  - Performance on more data
  - Tune other parameters of model
  - More visualizations

Thank you!