

Analysis of Frederick County Animal Control Data

Understanding and Predicting Animal Shelter Outcomes

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Meet Scooby

- Scooby is a senior dog that was surrendered by his previous owner
- He waited 39 days, but he was adopted!
- Unfortunately, not every dog or cat that enters a shelter will end up finding their forever home for a variety of reasons

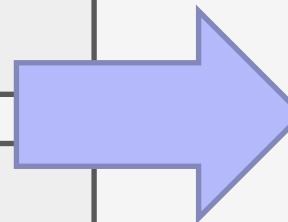


Descriptive Analysis

- Identify peak intake months
- Identify areas where the most dogs and cats are coming from
- Identify popular adoption times
- Identify trends in how long animals wait to be adopted

Predictive Analysis

- Determine if machine learning can be used to predict a dog or cat's shelter outcome (adoption/return vs. euthanasia)
- Identify the top determinants for predicting the outcome



Actionable
Insights

Data

- Covers October 2011 – September 2019
- ~34,000 unique animals
 - 85% are dogs and cats
- Examples of fields:
 - Species
 - Primary Breed
 - Primary Color
 - Age Group
 - Gender
 - Name
 - Intake Type
 - Outcome Type

Animal Intakes

Animal ID	Animal Name	Species	...	Operation Type	Age Group	...
A12167351	NYLA	Dog		Stray	Adult (1yr-4yrs)	
A12183835	MAZDA	Cat		Return	Juvenile (8wks-11mon)	
...						

Animal Outcomes

Animal ID	Animal Name	Species	...	Outcome Type	Outcome Subtype	..
A12167351	NYLA	Dog		Return to Owner/Guardian	Stray Reclaim	
A12183835	MAZDA	Cat		Euthanasia	Temperament	
...						

Data Pre-Processing



Join

Combined intakes and outcomes by joining on intake date and animal ID



Clean

Removed irrelevant features, cleaned animal name and jurisdiction fields for consistency



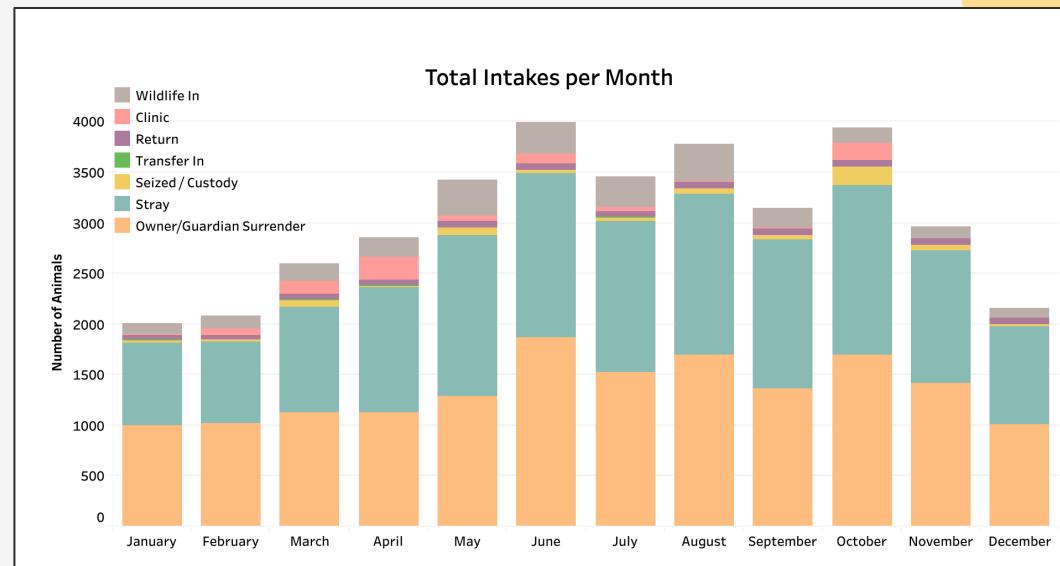
Feature Engineer

Created new features: date/time, time in shelter, is mix, is black, energy level, shedding level, etc.

Descriptive Analysis

Animal Intakes per Month

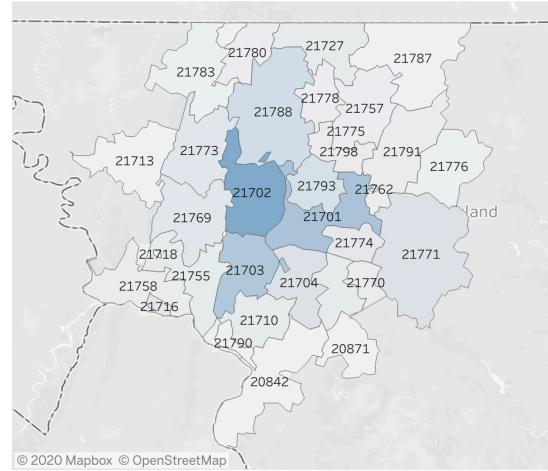
- Intakes are highest in the Summer months and October
 - Driven by strays and surrenders
 - People surrender their animals in the summer to avoid pet sitting/kennel fees
- **Suggestion:** Potentially lower/waive adoption fees during months of high intake



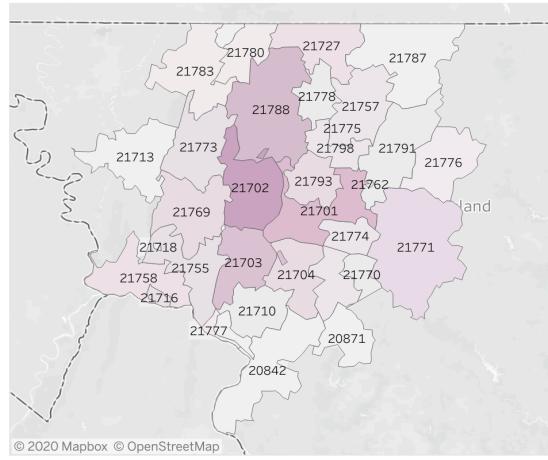
Analysis of Jurisdiction

- Majority of cats and dogs are coming from cities in Frederick (21702, 21701, 21703)
 - Thurmont (21788) is a huge problem for cats
 - Very rural area
 - Top contributor for seized cats
 - 2nd top contributor to stray cats
 - **Suggestion:** Implement spay/neuter programs to help control the number of cats or work with local vets to reduce costs

Where are the dogs coming from?

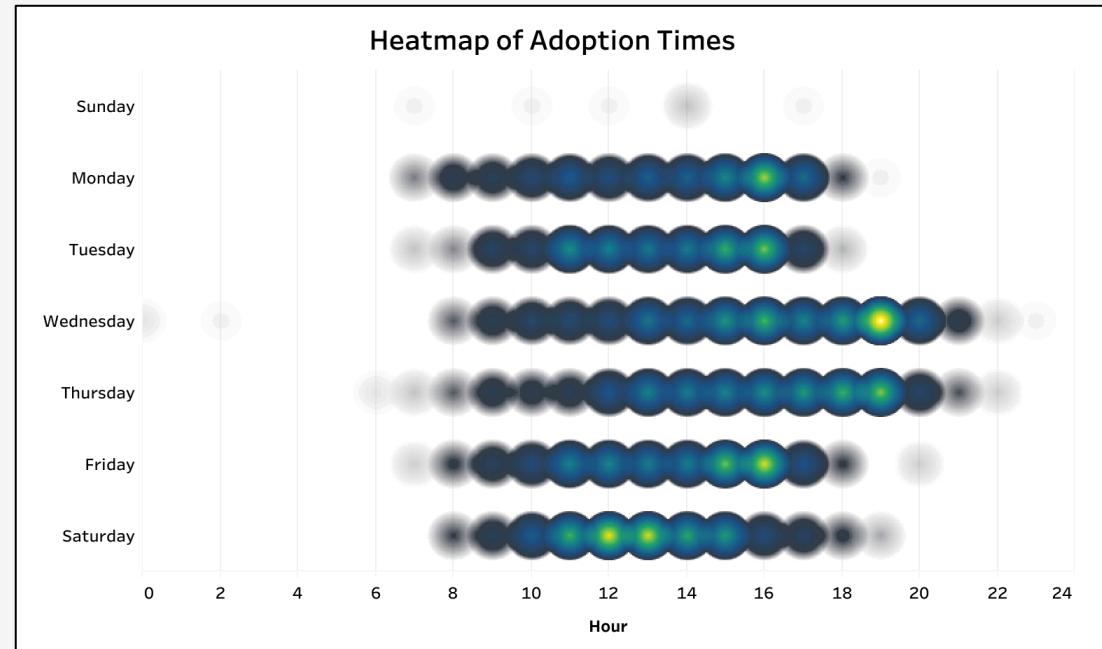


Where are the cats coming from?



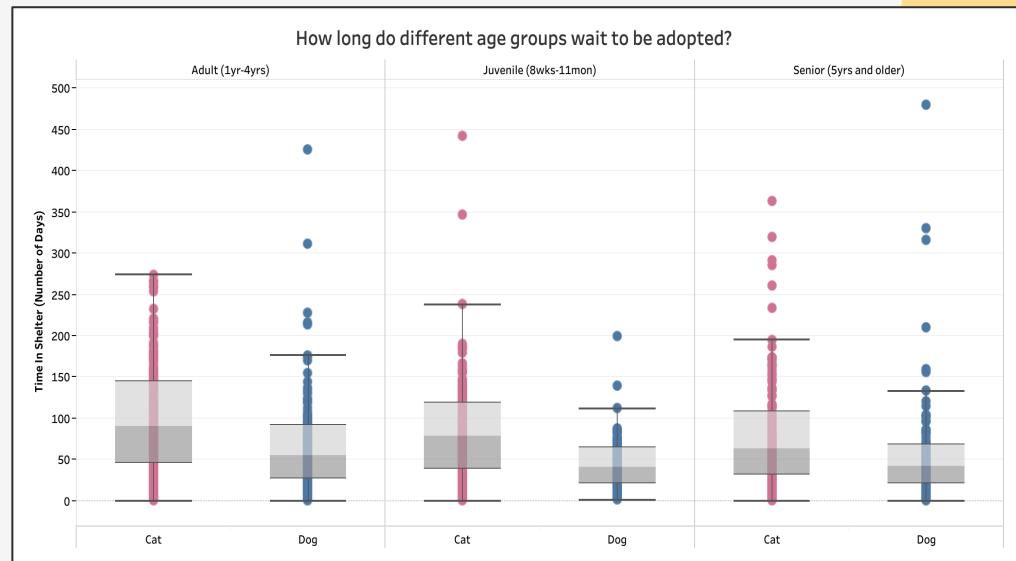
Analysis of Adoption Times

- Weekday evenings, especially Wednesdays, and Saturdays between 11-1 are the most common adoption times
- **Suggestion:** Schedule adoptions on weekday evenings and Saturday afternoons; potentially extend hours on Wednesdays and add more staff to assist with adoptions



Adoption Wait Times

- Hypothesis testing showed a significant difference in the distribution of wait times for each age group for both dogs and cats (Kruskal Wallis)
- Juvenile dogs are adopted the fastest
- Adult cats wait a median of 91 days to be adopted
- **Suggestion:** Promote adult cats on social media more often or place them in the front to potentially encourage speedier adoptions



For each age group, cats typically wait longer to be adopted than dogs

Predictive Analysis

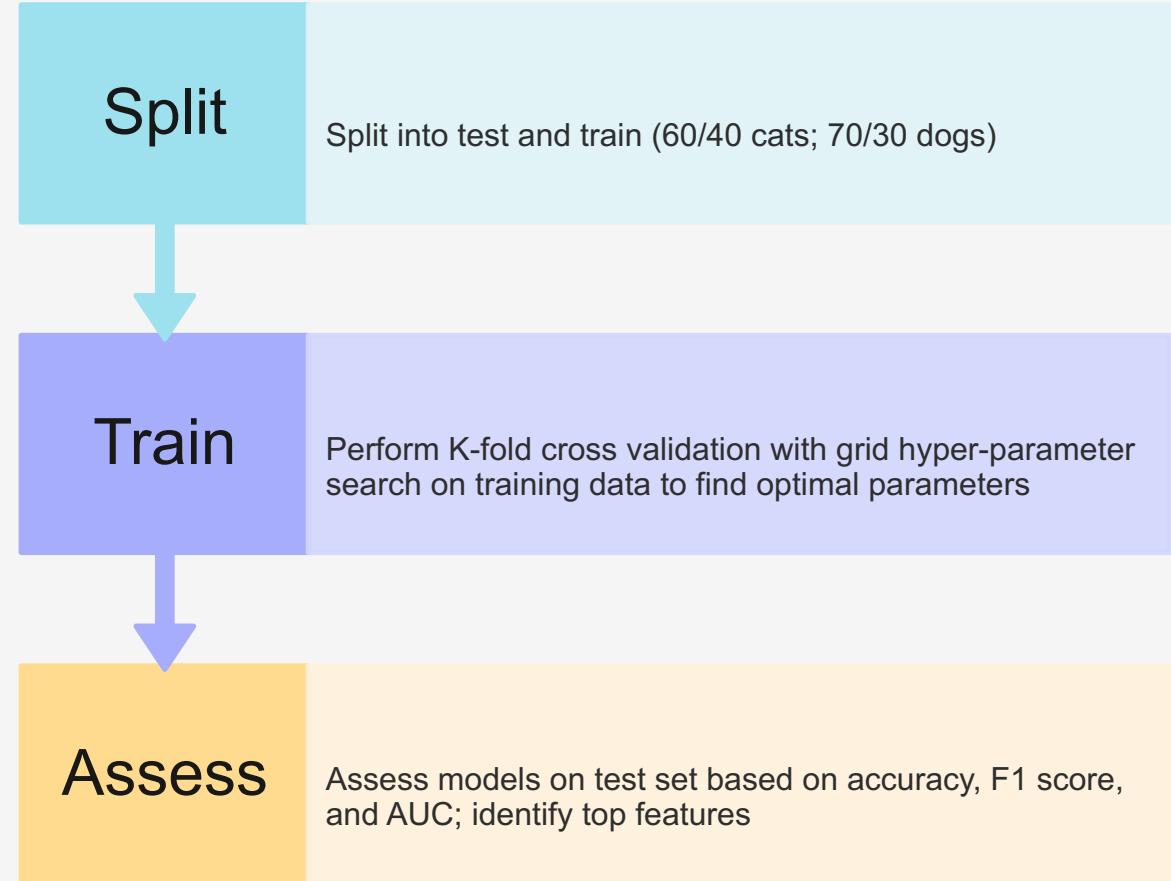
Predicting Shelter Outcomes

- **Goal:** Predict a cat or dog's shelter outcome
 - euthanasia vs. adoption/return to owner
 - Removed all other outcomes (13% of dogs and 13% of cats)
 - Separate models for dogs and cats
- **Algorithms:**
 - Random Forest
 - XGBoost
 - Logistic Regression with Lasso Regularization
- Chosen algorithms provide insight into important features

Datasets			
	# Adoption/Return	# Euthanasia	Total
Cat Dataset	5,959	9,807	15,757
Dog Dataset	6,510	2,418	8,928

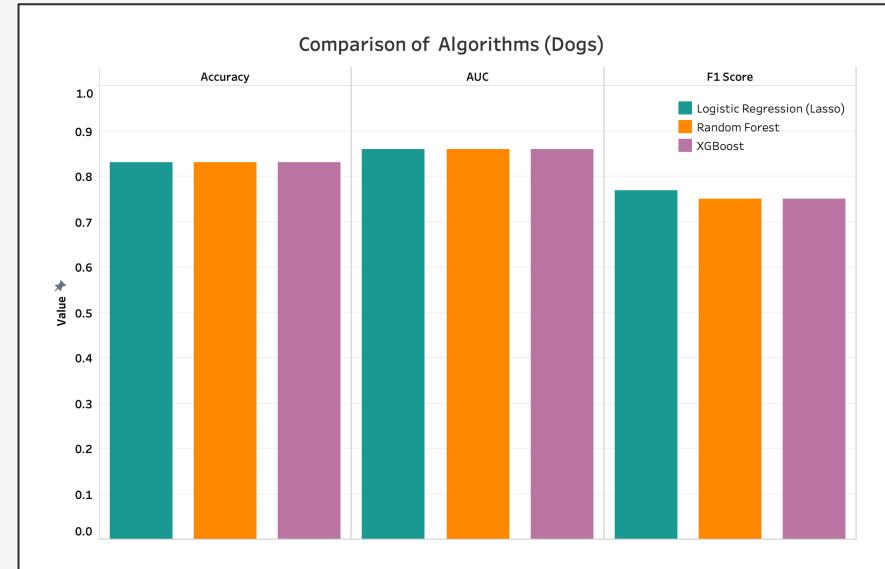
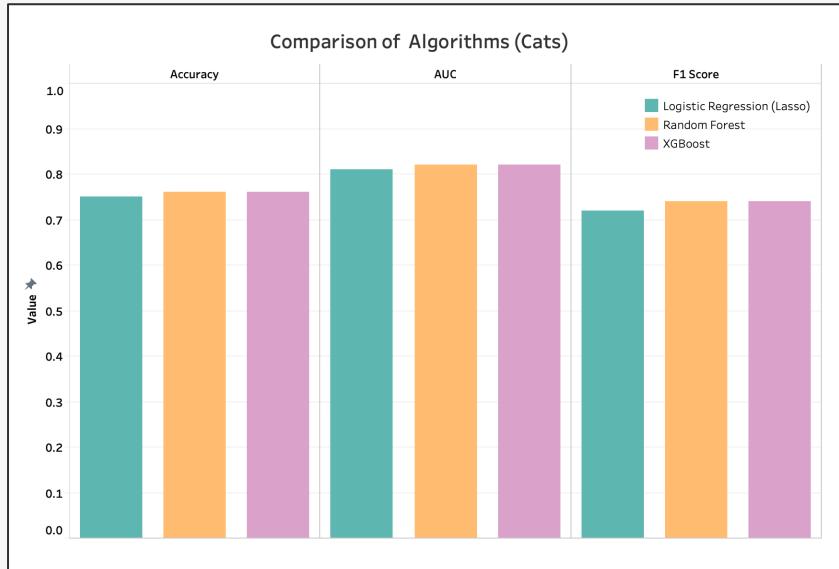
Both datasets have imbalanced classes

Approach



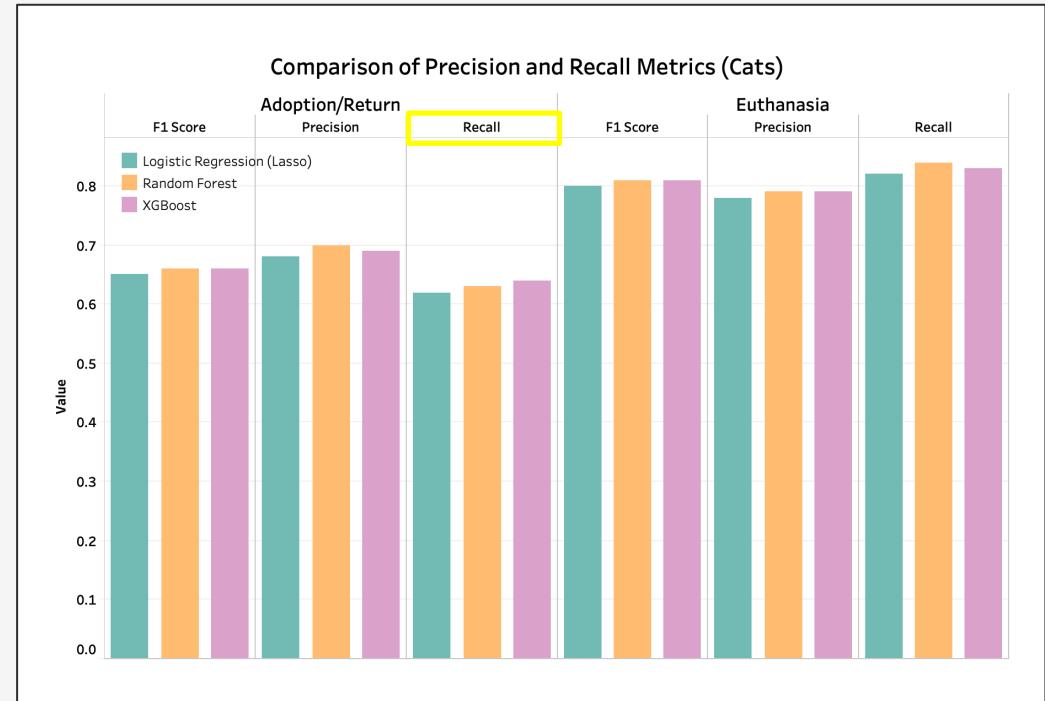
Results

- For both cats and dogs, the algorithms performed nearly the same
- F1 score for cat model was ~0.74 and ~0.76 for dog model
 - Metrics are close to 1, but still show room for improvement



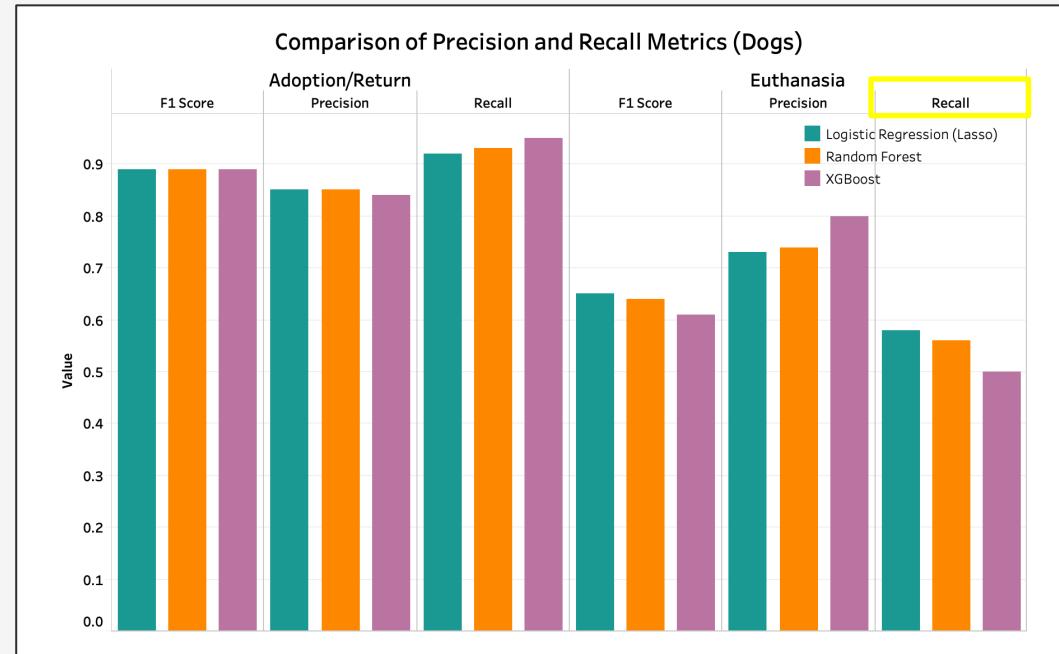
Model Assessment - Cats

- Cat model has low recall for adoption/return class
- Model misclassifies cats that have a higher chance of adoption/return more often



Model Assessment - Dogs

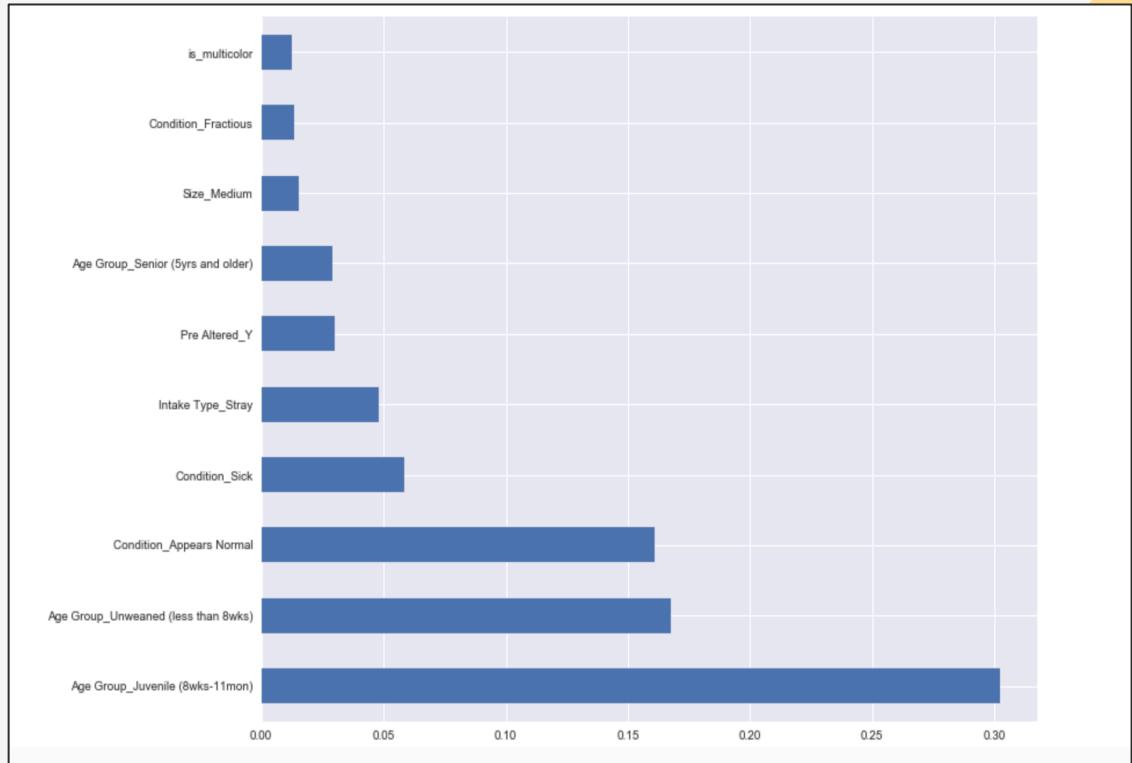
- Dog model has low recall for euthanasia class
- Model misclassifies dogs that have a higher chance of euthanasia more often
- Low recall for euthanasia is more detrimental than the opposite



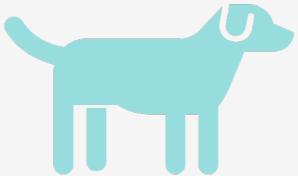
Top Predictive Features - Cats



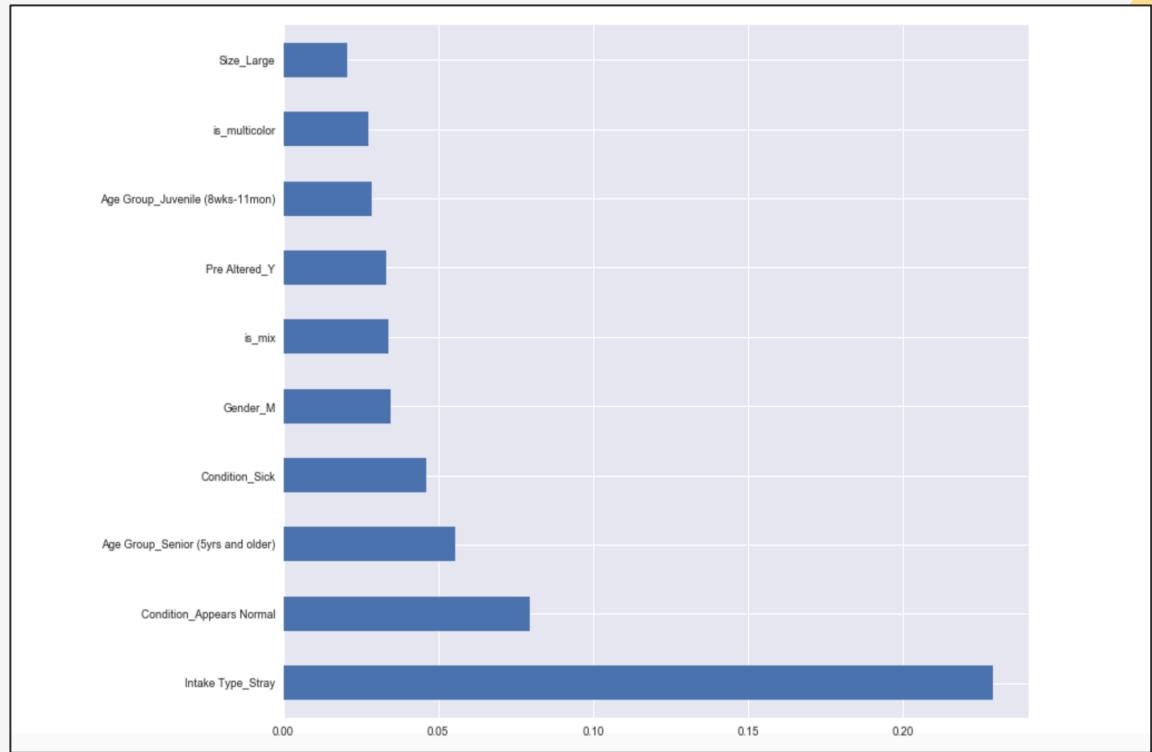
Age Group
Condition
Intake Type



Top Predictive Features - Dogs



Intake Type
Condition
Age Group



Conclusions

- Recommendations based on descriptive analysis:
 - Lower adoption fees in Summer months and October
 - Focus on Thurmont for spay/neuter programs to control number of cats
 - Schedule adoptions on weekday evenings/Saturdays; potentially extend Wednesday hours
 - Adult cats wait the longest to be adopted so highlight them more often on social media
- Machine learning models can predict the binary outcome of euthanasia vs. adoption/return with some success
 - Most predictive features are related to age, general condition of the animal, and the intake type
 - More data from additional shelters and detailed behavioral data could improve model performance
 - Can eventually be used to identify animals with high risk of being euthanized

Questions?

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Backup Slides

Frederick County Animal Control

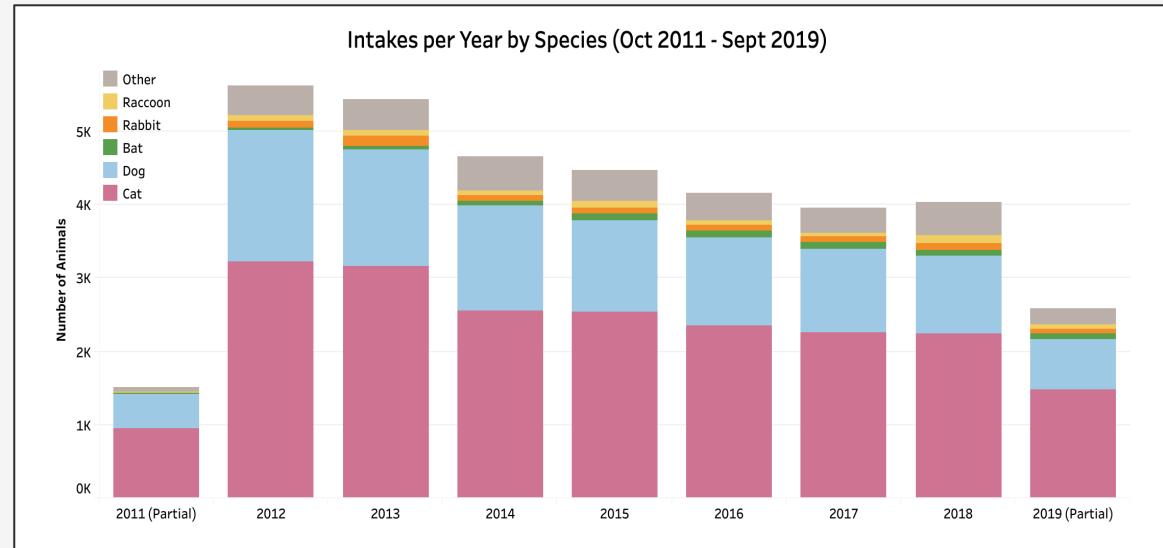
Mission:

- Prevent animal cruelty, abuse, and neglect
- Shelter animals without homes and help them find suitable homes
- Educate the public on animal issues to create a more aware community



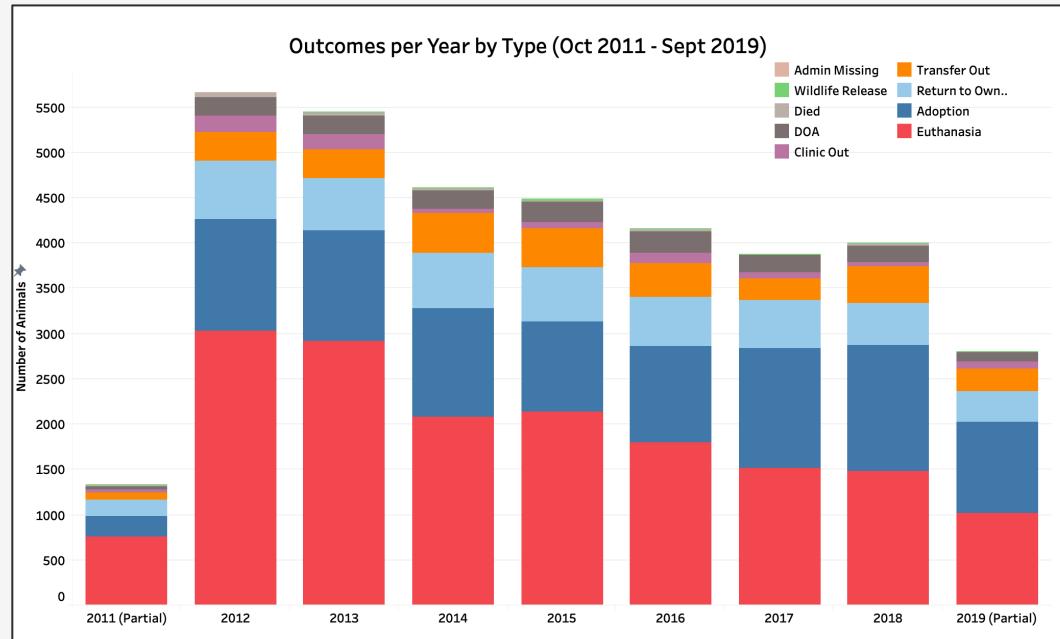
Animal Intakes per Year

- Total intakes per year is decreasing
- Roughly 2,000 cats and 1,000 dogs
- Cats are almost double the amount of dogs



Outcomes per Year

- There is a downward trend in the number of euthanized animals per year
- In recent years, the number of adoptions/returns outweigh the number of euthanized animals



Discussion

Areas of Improvement:

- An increase in the volume of data would likely improve models
- Including more detailed animal behavior features could potentially provide additional insights

Future Work:

- Analyze how advertising/marketing/social media impacts adoption rates
- Predict length of time an animal spends at the shelter