PetFinder Adoption Speed Prediction Model

By: Brennan, Spring & Rosie as well as Anusha
GitHub:

Tim from petfinder.com

Why pet adoption?

The Addams Family Litter from petfinder.com

The topic we chose was pet adoption speed. We chose this topic because the members of our group have pets and love animals! Our datasource was taken from a featured code competition on Kaggle for Petfinder.my, Malaysia's leading animal welfare platform. The competition calls for developing algorithms to predict how quickly a pet is adopted.

Link to Kaggle competition:

How is the data going to answer our question?

We will need to be able to predict the outcome of adoption speeds of the pets. Once we have that model, we can make other inferences based on the largest features that play into adoption speed prediction. As we have the adoption speed already, we can compare out model to actual results.

Wren from petfinder.com

Data Description

Baxter(adopted) from petfinder.com

Our data contains information including:

- Type - dog or cat
- Name - if given one
- Quantity - some come as a litter, some are bonded pairs, most are individuals
- Physical descriptors: color, breed, fur length, health, shots, sterilized, maturity size and age
- number of pictures or videos posted
- a written description of the pet(s)
- Fee from free and up
- RescuerID & State - who found, and where the pet is
- Adoption Speed - how long it took them to be adopted, and what we are trying to create a model to predict

Data Exploration

Calvin from petfinder.com

14993 rows, 24 columns before cleaning

12 nulls in the description dropped

We changed description to word count

We binned quantity of pets, fee and photo amount into categories, to scale the data before plugging it into the model.

Several columns were ID columns - we did not use in the model as they are just ‘noisy’ data.

Assumptions

- We expect the **type** of pet to have an impact on our model
- Black pets have been known to be less adoptable, so **color1** likely to have an impact
- The **health** of the pet might have a significant impact
- We assume **age** of pet to have a large impact. Everyone loves kittens and puppies!
- We expect **quantity of photos** to have an impact on adoption.
- **Description** will likely be a top half feature, as most people probably read them

Description of the analysis phase

Luca from petfinder.com

We used Supervised Machine Learning Model to predict adoption speed. We used the data we cleaned/transformed from exploration in the model.

We now have 14981 data points with **5 possible outcomes** for adoption speed

- 0 adopted on the same day as it was listed
- 1 adopted between 1 and 7 days after being listed
- 2 adopted between 8 and 30 days after being listed
- 3 adopted between 31 and 90 days after being listed
- 4 No adoption after 100 days of being listed.
- There are no pets in this dataset that waited between 90 and 100 days

Target Accuracy 42.3+% as that would at least get us in the ‘bronze’. The top 10 (non-cheating) finalists were all at 44.1+% in the initial contest 3 years ago.

RF Models

```
[(0.18681237377150112, 'word_count'),
 (0.109989718847057, 'photoamt'),
 (0.1096375481912168, 'age'),
 (0.07102324470634117, 'color2'),
 (0.07038042603872528, 'breed1'),
 (0.06954523537473632, 'color1'),
 (0.04714947730736535, 'breed2'),
 (0.03947020420601331, 'furlength'),
 (0.03847838738849204, 'gender'),
 (0.03736809253306168, 'maturitysize'),
 (0.034951310594454714, 'color3'),
 (0.0348944438725393, 'quantity'),
 (0.03189425025950297, 'fee_bins'),
 (0.031749929446407935, 'dewormed'),
 (0.029752953618307102, 'vaccinated'),
 (0.028470457630819665, 'sterilized'),
 (0.010272463142986228, 'videoamt'),
 (0.009109280747774512, 'health'),
 (0.009050202322697464, 'type')]
```

RandomForestClassifier Supervised Machine Learning Models:

75/25 train/test split

First model run all features: accuracy 41.4%

Feature importance: see image left used this to adjust net model run throughs

Comp ranking: around 632/633 out of 2023 entries, not in bronze

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631	▲994	[redacted]	0.41432
632	▲969	[redacted]	0.41416
633	▲10...	[redacted]	0.41385

RF Models cont.

Classification Report

	precision	recall	f1-score	support
0	0.11	0.01	0.02	99
1	0.38	0.37	0.37	785
2	0.37	0.38	0.37	998
3	0.34	0.27	0.30	801
4	0.51	0.64	0.57	1063
accuracy			0.42	3746
macro avg	0.34	0.33	0.33	3746
weighted avg	0.40	0.42	0.40	3746

Second model run less type, health and video amount features: accuracy 41.6% see image left of classification report.

Comp ranking: around 621/622 out of 2023 entries, not in bronze

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621	▲212	[redacted]	0.41612
622	▲294	[redacted]	0.41612
623	▲939	[redacted]	0.41571

Ran several other RF iterations 75/25 - dropping more features, changing word count feature, etc. - *but none produced as strong of model as the first two passes*

RF Models cont.

```
[(0.1891848531578467, 'word_count'),
 (0.1107985242009236, 'age'),
 (0.1094797140700821, 'photoamt'),
 (0.0708921344086997, 'color2'),
 (0.0695379736384916, 'breed1'),
 (0.0692631566908596, 'color1'),
 (0.0477387037105731, 'breed2'),
 (0.0397804752031432, 'furlength'),
 (0.0386963533815063, 'gender'),
 (0.03600166268534879, 'maturitysize'),
 (0.0355323968565842, 'quantity'),
 (0.0348773841111179, 'color3'),
 (0.0317048752961232, 'dewormed'),
 (0.03168186246530839, 'fee_bins'),
 (0.02909185558974804, 'vaccinated'),
 (0.0278422799296806, 'sterilized'),
 (0.01018459336205895, 'videoamt'),
 (0.00894878350600478, 'health'),
 (0.00876241776667287, 'type')]
```

Adjusted **split to 80/20**

First model run (technically model 9) all features: accuracy 42.2%

Feature importance - changed slightly from first model age and photo amount switched places, image left

Competition ranking: 245/246 out of 2023 entries, not in bronze (but only barely).

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245	▲883	[redacted]	0.42244
246	▲14...	[redacted]	0.42237

The Final Model – In the bronze!

Confusion Matrix

	Predicted 0	Predicted 1	Predicted 2	Predicted 3	Predicted 4
Actual 0	2	23	20	9	19
Actual 1	2	228	199	69	133
Actual 2	1	160	312	152	181
Actual 3	1	106	161	185	180
Actual 4	0	72	138	96	548

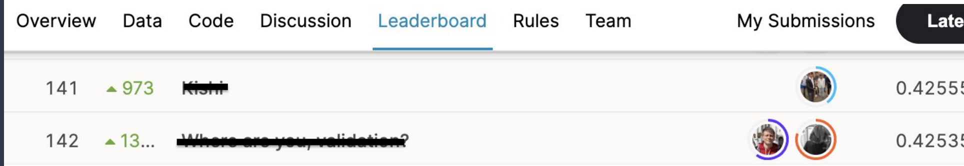
Accuracy Score : 0.42542542542542544

Classification Report

	precision	recall	f1-score	support
0	0.33	0.03	0.05	73
1	0.39	0.36	0.37	631
2	0.38	0.39	0.38	806
3	0.36	0.29	0.32	633
4	0.52	0.64	0.57	854
accuracy			0.43	2997
macro avg	0.39	0.34	0.34	2997
weighted avg	0.41	0.43	0.41	2997

Second model run (technically model 10) less type, health and video amount features: accuracy 42.5% our best model thus final model, image left

Competition ranking: 141/142 out of 2023 entries, **in bronze! Minimum target accuracy goal hit.**



Findings

Bonnie from petfinder.com

Top 3 features

- Word count
- Age
- Photo amount

Features that didn't matter/ held back model

- Type of pet
- Health
- Video Amount

Some of these results were surprising to us, especially the type and word_count features. Once we dropped the bottom three features, our models improved.

Suggestions based on findings:

Fluff from petfinder.com

- **Have a description,** between 40 and 200 words
- **Have photos of the pet(s)** between 1 and 5 images.
- Age matters, the bulk of all pets regardless of speed were under 65 months. **Perhaps consistent photos/descriptions would help with older pets.**
- **No video needed.** One of the least important features
- Focus on health of the pet not necessary.

Limitations - Time

<u>If we had more time, what we could have also done, or what we could have done differently:</u>

- **Different binning/categorization** of features for the in model
- **Other machine learning model types** to compare, for example k-means or SMV
- **Full NLP on description** - top feature when in 'word_count' form, looking at sentiment, etc. could have likely lead to better model results.

Limitations - Data

Mango from petfinder.com

<u>**The Data:**</u>

- **Limited amount of data points in Adoption Speed 0**
- **Adoption Speed already binned prior to our accessing the data.**
- Lastly, i**f there were images provided perhaps an analysis could have been done on those** to see how the image itself might impact the adoption timeline.

Technology Used

- Python and Pandas used for Data Cleaning and Analysis. Natural Language Toolkit(NLTK) to remove stop words in the description column within our dataset (second cleaning pass)
- AWS RDS Postgres for the database, pgAdmin 4 to interface
- SQLAlchemy to connect the database and Google Colab notebooks
- sklearn library to run our model, using RandomForestClassifier
  - Analytical functions used: accuracy_score, classification_report, confusion_matrix, and feature_importances_
- Using Tableau to create visuals, and as the platform from which we will present, integrating slides from Google Slides

Project sources