# Data Science Project
October, 27 2016

## Question

Can you predict if a sitter will have churned 180 days after they were approved at the point when you approve their profile?

## Defining Churn

At 180 Days after your profile was first approved, you meet the following conditions:

- Your profile is inactive (Explicit)

OR

- You have not had an **Event** in the past 100 days* (Implicit)

*Less than 10% of sitters return who haven’t had an event in the past 100 days

Events:

- Booked a Stay
- Sent a Message
- Uploaded a Photo
- Scheduled a Meet and Greet
- Activated a Service
- Set Affirmative Weekend Availability

# Creating Churn Prediction

```
SELECT DISTINCT p.id

FROM people_person p

LEFT JOIN (SELECT provider_id,
        MIN(approved_on) AS first_approved,
        MIN(searchable_date) AS first_searchable_date,
        MAX(active) AS currently_active,
        MAX(searchable) AS currently_searchable,
        MAX(deactivated_at) AS deactivated_at
        FROM services_service serv
        GROUP BY 1) serv ON serv.provider_id = p.id

LEFT JOIN (SELECT provider_id,
        MAX(stay_added) as last_booking
        FROM [b_stays]
        GROUP BY 1) booking ON booking.provider_id = p.id

LEFT JOIN (SELECT ss.provider_id,
        MAX(cd.added) as last_activated
        FROM common_deactivatableauditlog cd
        JOIN services_service ss on ss.id = cd.object_id AND cd.content_type_id = 155 AND
cd.activated = 1
        GROUP BY 1) activated ON activated.provider_id = p.id

LEFT JOIN (SELECT ss.provider_id,
        MAX(ss.searchable_date) as last_searchable
        FROM services_service ss
        WHERE searchable_date is not null
        GROUP BY 1) searchable ON searchable.provider_id = p.id

LEFT JOIN (SELECT person_id,
        MAX(added) as last_weekend_availability
        FROM marketing_weekendavailabilitysurvey
        WHERE is_available = 1
        GROUP BY 1) weekend_availability ON weekend_availability.person_id = p.id

LEFT JOIN (SELECT uploader_id,
        MAX(added) AS last_photo_added
        FROM images_image ii
        WHERE content_type_id in (17, 36)
        GROUP BY 1) photos ON photos.uploader_id = p.id

LEFT JOIN (SELECT provider_id,
        MAX(cmg.added) AS last_meet_and_greet
        FROM conversations_meetandgreet cmg
        JOIN conversations_conversation cc on cc.id = cmg.conversation_id
        GROUP BY 1) meet_greet ON meet_greet.provider_id = p.id

LEFT JOIN (SELECT cc.provider_id,
        MAX(cm.sent) as last_message_sent
        FROM conversations_message cm
        JOIN conversations_conversation cc ON cc.id = cm.conversation_id AND cm.sender_id = cc.provider_id
        GROUP BY 1) message ON message.provider_id = p.id

WHERE
p.id > 121934
AND
COALESCE(serv.first_approved,serv.first_searchable_date) < CURDATE() - INTERVAL 180 DAY
AND
(serv.deactivated_at < COALESCE(serv.first_approved,serv.first_searchable_date) + INTERVAL 180 DAY
 OR
(booking.last_booking BETWEEN COALESCE(serv.first_approved,serv.first_searchable_date) + INTERVAL 80 DAY AND
COALESCE(serv.first_approved,serv.first_searchable_date) + INTERVAL 180 DAY
 OR
 activated.last_activated BETWEEN COALESCE(serv.first_approved,serv.first_searchable_date) + INTERVAL 80 DAY AND
COALESCE(serv.first_approved,serv.first_searchable_date) + INTERVAL 180 DAY
 OR
 searchable.last_searchable BETWEEN COALESCE(serv.first_approved,serv.first_searchable_date) + INTERVAL 80 DAY AND
COALESCE(serv.first_approved,serv.first_searchable_date) + INTERVAL 180 DAY
 OR
 weekend_availability.last_weekend_availability BETWEEN COALESCE(serv.first_approved,serv.first_searchable_date) + INTERVAL 80
DAY AND COALESCE(serv.first_approved,serv.first_searchable_date) + INTERVAL 180 DAY
 OR
 photos.last_photo_added BETWEEN COALESCE(serv.first_approved,serv.first_searchable_date) + INTERVAL 80 DAY AND
COALESCE(serv.first_approved,serv.first_searchable_date) + INTERVAL 180 DAY
 OR
 meet_greet.last_meet_and_greet BETWEEN COALESCE(serv.first_approved,serv.first_searchable_date) + INTERVAL 80 DAY AND
COALESCE(serv.first_approved,serv.first_searchable_date) + INTERVAL 180 DAY
 OR
 message.last_message_sent BETWEEN COALESCE(serv.first_approved,serv.first_searchable_date) + INTERVAL 80 DAY AND
COALESCE(serv.first_approved,serv.first_searchable_date) + INTERVAL 180 DAY)
)
```

## Data Set Sizing

All sitters approved > 180 days ago that have data sufficiency due to lack of data availability from very early sitters:

- 93,213

Of that group, number that were churned 180 days after approval:

- 47,657 (51.12%)

## Feature Set

We can only look at variables known to us at the point at which the sitter's profile is sent for approval.

Initial Set:

| | |
|---|---|
| Number of Photos | Location |
| Services Listed | Time to Complete Profile |
| Day of Week Availability | Dog owner |
| Protection Package | Children in Home |
| Building Type | Number of Testimonials Requested |
| Dogs Allowed on Furniture | Years of Dog Sitting Experience |

# Creating the Feature Set

```
SELECT DISTINCT p.id,
CASE WHEN photos.images_count IS NOT NULL THEN photos.images_count ELSE 0 END AS photos,
ppl.zip AS zip_code,
CASE WHEN servhome.id IS NOT NULL THEN 1 ELSE 0 END AS listed_boarding,
CASE WHEN servtravel.id IS NOT NULL THEN 1 ELSE 0 END AS listed_traveling,
CASE WHEN servwalk.id IS NOT NULL THEN 1 ELSE 0 END AS listed_walking,
CASE WHEN servdropin.id IS NOT NULL THEN 1 ELSE 0 END AS listed_dropin,
CASE WHEN servdaycare.id IS NOT NULL THEN 1 ELSE 0 END AS listed_daycare,
datediff(COALESCE(serv_info.first_approved,serv_info.first_searchable_date),serv_info.first_service) AS
service_added_to_complete,
datediff(COALESCE(serv_info.first_approved,serv_info.first_searchable_date),p.added) AS account_added_to_complete,
aap.monday,
aap.tuesday,
aap.wednesday,
aap.thursday,
aap.friday,
aap.saturday,
aap.sunday,
CASE WHEN pet.id IS NOT NULL THEN 1 ELSE 0 END AS has_dog,
CASE WHEN iip.id IS NOT NULL THEN 1 ELSE 0 END AS protection_package,
CASE WHEN spp.years_of_experience IS NOT NULL THEN spp.years_of_experience ELSE 0 END AS years_of_experience,
COALESCE(shsp.dogs_allowed_on_bed,shsp.dogs_allowed_on_furniture) AS dogs_on_furniture,
CASE WHEN children_0_5 = 1 OR children_6_12 = 1 THEN 1 ELSE 0 END AS children_in_home,
CASE WHEN building_type = 'hs' THEN 1 ELSE 0 END AS building_home,
CASE WHEN building_type = 'apt' THEN 1 ELSE 0 END AS building_apartment,
CASE WHEN building_type = 'farm' THEN 1 ELSE 0 END AS building_farm,
CASE WHEN building_type IS NULL THEN 1 ELSE 0 END AS building_unknown,
CASE WHEN testimonials.testimonial_requests IS NOT NULL THEN testimonials.testimonial_requests ELSE 0 END AS
testimonial_requests

FROM people_person p
JOIN people_personlocation ppl ON ppl.person_id = p.id
LEFT JOIN services_service servhome ON (servhome.provider_id = p.id AND servhome.service_type_id = 1)
LEFT JOIN services_service servtravel ON (servtravel.provider_id = p.id AND servtravel.service_type_id = 2)
LEFT JOIN services_service servwalk ON (servwalk.provider_id = p.id AND servwalk.service_type_id = 3)
LEFT JOIN services_service servdropin ON (servdropin.provider_id = p.id AND servdropin.service_type_id = 4)
LEFT JOIN services_service servdaycare ON (servdaycare.provider_id = p.id AND servdaycare.service_type_id = 5)
LEFT JOIN (SELECT provider_id,
                              MIN(added) AS first_service,
      MIN(approved_on) AS first_approved,
      MIN(searchable_date) AS first_searchable_date,
      MAX(active) AS currently_active,
      datediff(MIN(serv.added), MIN(serv.met_requirements_on)) AS added_to_complete
      FROM services_service serv
      GROUP BY 1) serv_info ON serv_info.provider_id = p.id

LEFT JOIN (SELECT uploader_id,
      COUNT(ii.id) AS images_count
      FROM images_image ii
      JOIN (SELECT provider_id,
         MIN(approved_on) AS first_approved,
         MIN(searchable_date) AS first_searchable_date
         FROM services_service serv
         GROUP BY 1) serv ON serv.provider_id = ii.uploader_id
      WHERE ii.added <= COALESCE(serv.first_approved, serv.first_searchable_date)
      GROUP BY 1) photos ON photos.uploader_id = p.id

LEFT JOIN (SELECT aap.provider_id,
      MAX(aap.monday) AS monday,
      MAX(aap.tuesday) AS tuesday,
      MAX(aap.wednesday) AS wednesday,
      MAX(aap.thursday) AS thursday,
      MAX(aap.friday) AS friday,
      MAX(aap.saturday) AS saturday,
      MAX(aap.sunday) AS sunday
      FROM availability_availabilitypreferences aap
      GROUP BY 1) aap ON aap.provider_id = p.id

LEFT JOIN pets_pet pet ON pet.owner_id = p.id
LEFT JOIN insurance_insurancepurchase iip ON iip.person_id = p.id
LEFT JOIN services_providerprofile spp ON spp.provider_id = p.id
LEFT JOIN services_hostingservicepreferences shsp ON shsp.provider_id = p.id

LEFT JOIN (SELECT requester_id,
      COUNT(ptr.id) AS testimonial_requests
      FROM people_testimonialrequest ptr
      JOIN (SELECT provider_id,
         MIN(approved_on) AS first_approved,
         MIN(searchable_date) AS first_searchable_date
         FROM services_service serv
         GROUP BY 1) serv ON serv.provider_id = ptr.requester_id
      WHERE ptr.added <= COALESCE(serv.first_approved, serv.first_searchable_date)
      GROUP BY 1) testimonials ON testimonials.requester_id = p.id

WHERE p.id > 121934
AND COALESCE(serv_info.first_approved, serv_info.first_searchable_date) < CURDATE() - INTERVAL 180 DAY
GROUP BY 1
```

## Creating the Feature Set

I ran into difficulties when attempting to create the data set:

- The data set was too large to run in our regular analytics tool, meaning that I would need to run it in MySQL and export as a CSV rather than constantly having the list refreshed with the API.
- If I tried to put the churn query inside the feature set query so they would export as one file it would time out. I had to run them separately and merge in Excel, which took Excel about 30 minutes to accomplish.

## Evaluating the Feature Set

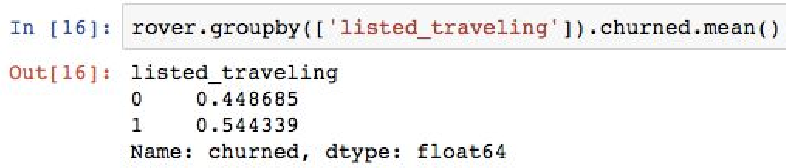
I ran into a few issues when evaluating the feature set:

- I did a lot of data cleaning while writing the SQL queries, but a few things managed to get through and caused some issues:
  - People input erroneous data for the number of years since they have been a dog sitter. One person put in 10,000 years and really screwed up the box plot.
  - Some people upload an insane amount of photos, or request an insane amount of testimonials. These data points caused evaluating via box plots to be difficult, but evaluating via groupby/mean was also difficult because there are so many possibilities for the number of photos or number of testimonials requested
- For location, I initially have used zip code, which I learned is too granular. Also, sometimes in our database a 9 digit zip code is used which gave an error re: multiple types of data in 1 column.

## Evaluating the Feature Set

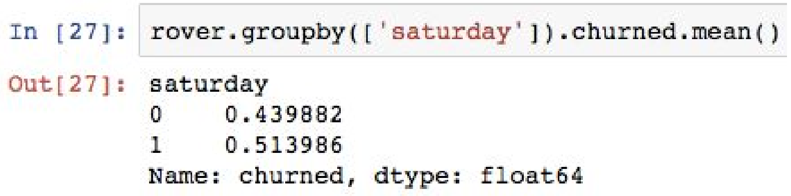
After initial analysis, only a couple features which were initially evaluated stand out as likely to be an indicator for churn.

Services Listed



```
In [16]: rover.groupby(['listed_traveling']).churned.mean()
Out[16]: listed_traveling
         0     0.448685
         1     0.544339
         Name: churned, dtype: float64
```

Saturday Availability



```
In [27]: rover.groupby(['saturday']).churned.mean()
Out[27]: saturday
         0     0.439882
         1     0.513986
         Name: churned, dtype: float64
```

## First Model Run

I used logistic regression and train/test/split to create an initial model.

My initial model accuracy was .578

When I ran the model against the holdout data, it .512

## Next Steps

Given the initial outcome and difficulties I encountered, here are my next steps:

- Add to & revise data set
  - Find new potential features to use in the model which might help it become more accurate
  - Determine how to deal with erroneous & ridiculous data points

- Review with internal teams at Rover
  - Gather feedback on if there are any other features the recommend
  - Review churn definition

- Improve model!