# Executive Summary

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This is a study of the approximate supply of near-adoption ready dogs and the capacity for those dogs in Travis county homes. These values are gathered from **three primary data sources**:

1. AAC/APA Intake/Outcome Data
2. Austin Human Population Demographic Data (both local and census data)
3. Statistics on pet ownership from the AVMA and AnimalSheltering.org

**Key Assumptions** (marked C for having a conservative effect on outcome; i.e. if the assumption were wrong, there would be an even larger capacity for dogs than estimated):

A. (C) The current households that want dogs already have them
B. (C) The only two drivers of capacity are human population growth and the capacity generated by the replacement of dogs that have died in households
C. Austin is near the US average in pet ownership (potentially (C); per this University of Denver study: https://www.maddiesfund.org/sources-of-pets-in-austin-texas-a-pilot-study.htm)
D. The supply is measured only in terms of the number of adoptable dogs in the largest two organizations in the city, i.e. AAC/APA; supply driven by smaller organizations does not impact the result
E. There is a linear relationship between population and adoption; as more people move to the city, the same proportion of people will engage in adoption in the same way

**Key Findings**:

1. No correlation is present between APA's intake of external animals and AAC's adoption numbers suggesting external intakes to APA are not negatively impacting AAC adoptions
2. There is a gap between projected supply of near-adoption ready dogs and capacity such that there may be many more potential adopters available than can be satisfied by the current supply
3. This gap could be as large as 5:1 (assuming 70% of households whose pet dies want a new pet), and the gap is likely growing, as the supply numbers are not rising as fast as the population growth of the city

**Future Work**:

A. Include more data from additional possible sources of supply of dogs (i.e. Austin Humane Society)
B. Examine the kinds of intakes from outside the community and their ease of adoption compared to the average animal
C. Perform a more thorough meta-analysis of margins of error for calculating yearly shelter dog capacity to help strengthen the accuracy of the dog capacity estimation
D. Replicated the result for cats and for combined cat and dog populations
E. More thorough examination of the sorts of animals that are not readily adoptable to help clear long stay shelter population members

# Analyzing the effect of APA!'s out-of-county dog intakes on Travis County's adoption capacity and AAC's adoption rate

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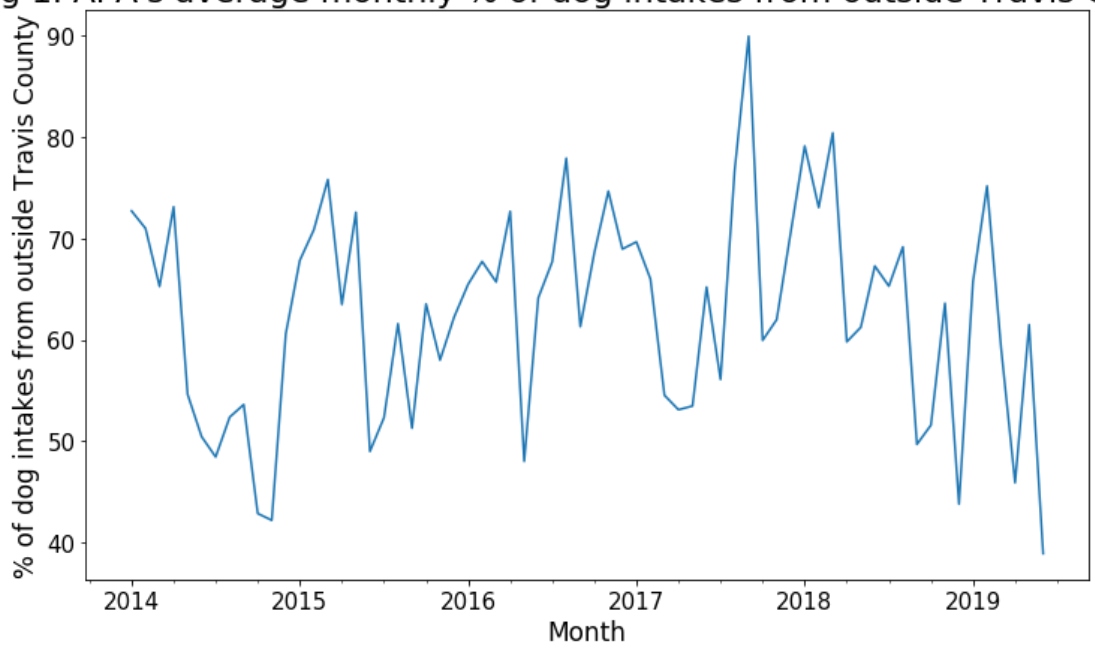
## Introduction

Austin Animal Center (AAC) and Austin Pets Alive! (APA!) are two largest animal shelters in Travis County that account for the vast majority of homeless animal intakes and shelter animal adoptions. AAC only accepts animals from Travis County, which includes Austin, Texas [1, 2]. Meanwhile, while APA!'s first priority is to provide a safety net for those animals most at risk of euthanasia at AAC, APA! also pulls animals from shelters outside of Travis county primarily into foster homes, which allows APA! to save even more lives from central Texas. On average, 199[1] dogs are brought in from outside Travis County every month, which is approximately 62.5% of APA!'s total monthly dog intakes (Fig. 1).

Fig 1. APA's average monthly % of dog intakes from outside Travis County




[1] Monthly average number of APA! intake dogs whose first intake source county is not Travis County, from January 2014 to June 2019 (ShelterLuv Animals data).

It is of interest for the stability of the regional shelter network if APA!'s numerous out-of-county animal intakes may oversaturate the Travis County's adoption market thereby negatively impacting AAC's adoption rates. Some parties in the Travis County are worried that there are not enough homes in Travis County to take in animals from outside the county.

In this report, data analysis was performed to search for evidence for the hypothesis that APA!'s external dog intakes are in fact potentially oversaturating Travis County's adoption market and negatively influencing AAC's adoption rate.

## Materials and Methods

The main data collected and used for the analysis are: AAC's intakes and outcomes dataset [3, 4], and APA!'s intakes, outcomes, and zipcodes dataset[2] stored in APA! shelter management system. Python 3.6 (along with pandas, numpy, matplotlib package) and jupyter notebook were used to conduct data analysis and visualization. All statistical analyses were conducted with a significance level of $\alpha = 0.05$.

## Q1. Is APA! saturating Travis County's adoption market?

In order to assess whether Travis County's adoption market is getting saturated or not, we first need to determine the net number of shelter dogs entering Travis County per month. Figure 2 visualizes monthly shelter dog flow rates within and outside Travis County through AAC and APA!. **N**et Monthly Dog Inflow Rate (NMDIR) is calculated as follows:

$$\text{NMDIR} = ( R_{aac} + R_{apa} ) - ( I_{aac} + I_{apa} )$$

where $R_{aac}$ is monthly average number of AAC dogs returning to Travis County through adoption, transfer, and RTO (return to owner); $R_{apa}$ is monthly average number of APA! dogs entering Travis County through adoption; $I_{aac}$ is monthly average number of stray or owner-surrendered dog intakes into AAC; and $I_{apa}$ is monthly average number of adoption returned or owner-surrendered dogs into APA!. AAC's public animal outcomes dataset does not provide details on whether the animals were transferred within or outside Travis County. We calculated how many AAC dogs are transferred to APA! by referring to APA!'s data, and for all

[2] Animals, Events, Applications, Zipcodes data from ShelterLuv database.

other transferred dogs we made a conservative assumption they all enter Travis County. We also made a conservative assumption that there are zero stray dogs that move outside Travis County by themselves (grey arrow in Figure 2). By assuming no stray dogs move outside of Travis County without the assistance of these organizations, we provide no additional outlets for the supply of these animals, making our results here an overestimate of the relative level of supply when compared to demand.

Fig 2. Average monthly shelter dog flow rate (2014.1 ~ 2019.6)

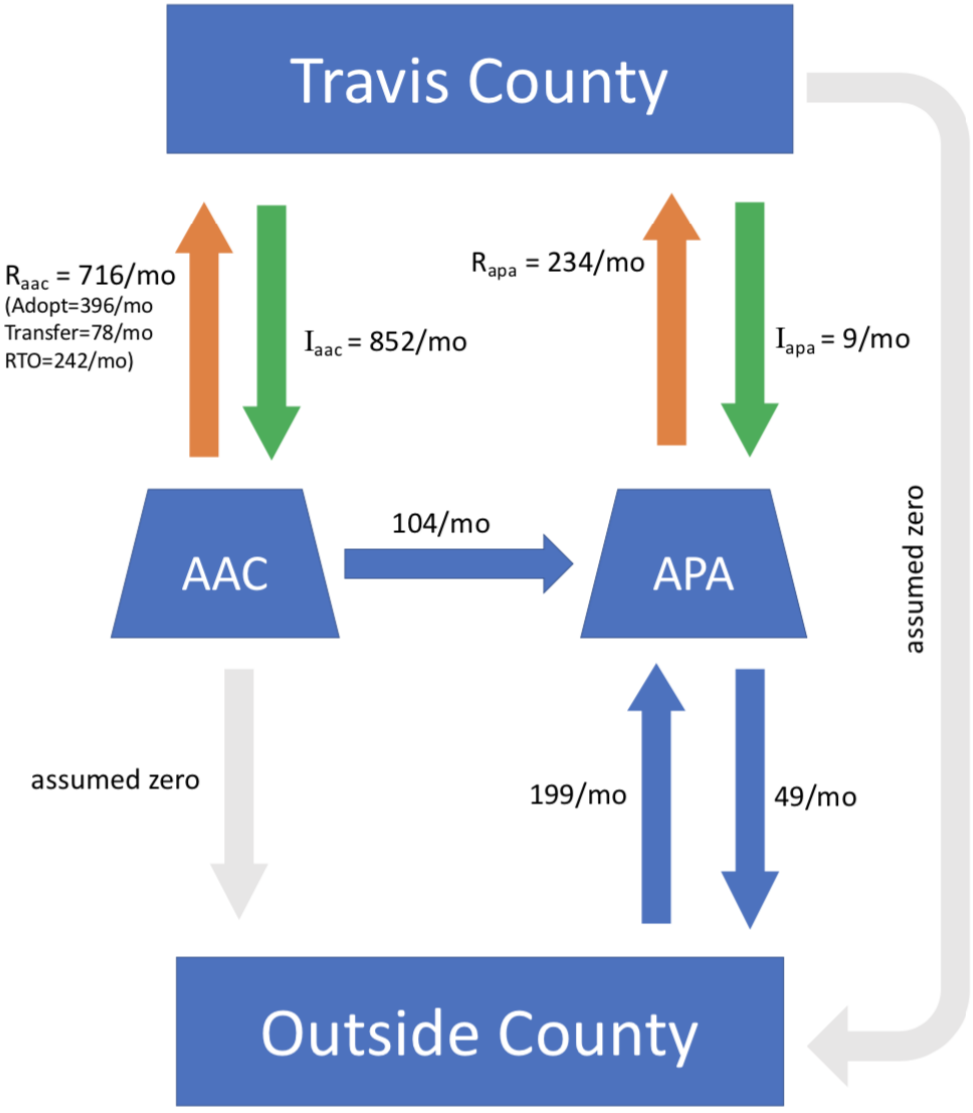
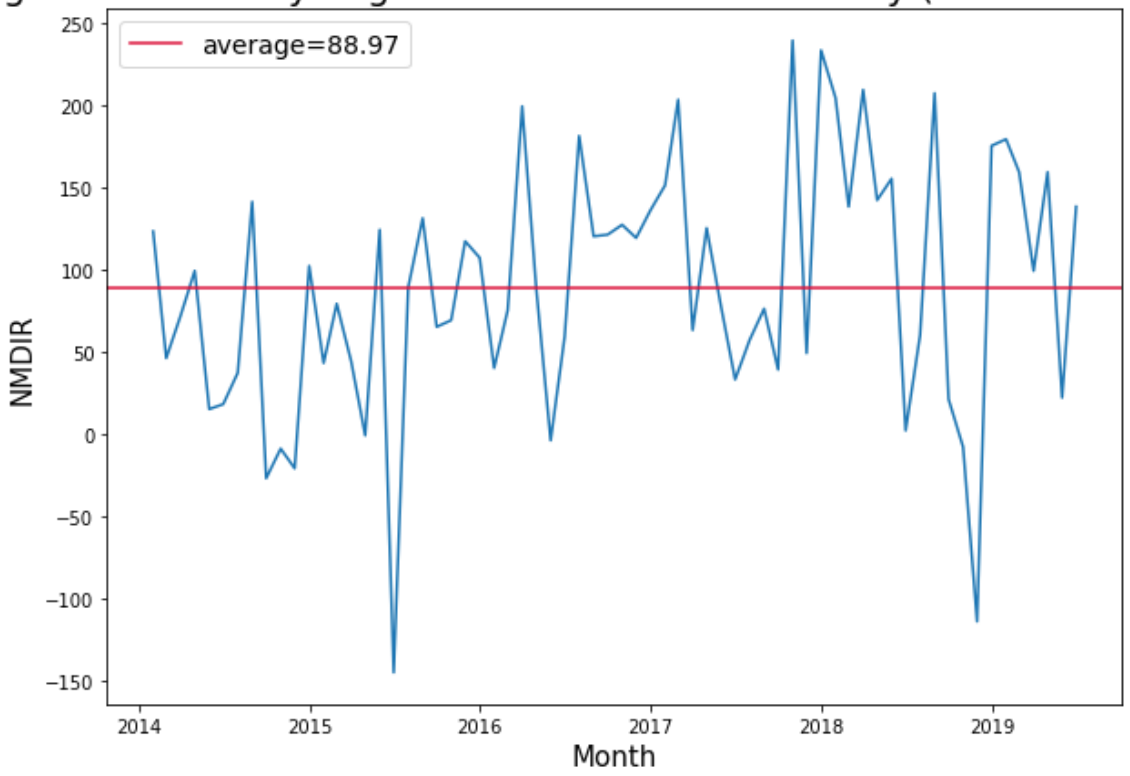


Fig 3. Net monthly dog inflow rate to Travis County (2014.1 ~ 2019.6)




The results showed that approximately 89 shelter dogs enter Travis County every month (Figure 3), which is 1,068 dogs entering Travis County per year.

The next step is to compare the net inflow rate of shelter dogs to actual shelter dog demands in Travis County. Yearly shelter dog demands (YDD) is calculated as follows:

YDD = YTD × (% of dogs who die due to aging or sickness=8%) × (% of households who get new dogs=70%) × (% of new dogs acquired from shelter=36% [5])[3],

where yearly total number of dogs living in the households (YTD) is calculated as:

YTD = (total number of households) × (% of dog-owning households=36.5% [8]) × (average number of dogs per dog-owning household=1.6 [8]).

[3] The YDD is calculated using conditional probabilities: it is the number of households getting new dogs after a dog dies, and then the number of the new dogs that are adopted from a shelter. We assumed independence between these variables.

## Travis County Adoption Capacity Analysis

To estimate the total number of households in Travis County each year from 2014 to 2018, we collected Travis County demographics data from census [6, 7] and divided population by average number of people in a household. We then referred to American Veterinary Medical Association's formulas [8] for estimating pet populations to get values for % of dog-owning households and average number of dogs per dog-owning household. Since the average lifespan of a dog is 10 to 13 years, we assumed that the % of dogs who die every year due to aging or sickness are 1/13 = 8% of the entire dog population, and also made a raw assumption that 70% of households who lose their dogs due to aging or sickness get a new dog (note that, as will be seen in a moment, this assumption has plenty of room for error without impacting the outcome). The % of new dogs acquired from animal shelter was calculated as 36%, which is an average of 28% and 44% as reported respectively in 2017-2018 AMVA Sourcebook and APPA Survey as % of dogs people acquired from animal shelters [5].

Fig 4. Yearly shelter dog demands vs. actual net number of shelter dogs entering Travis County

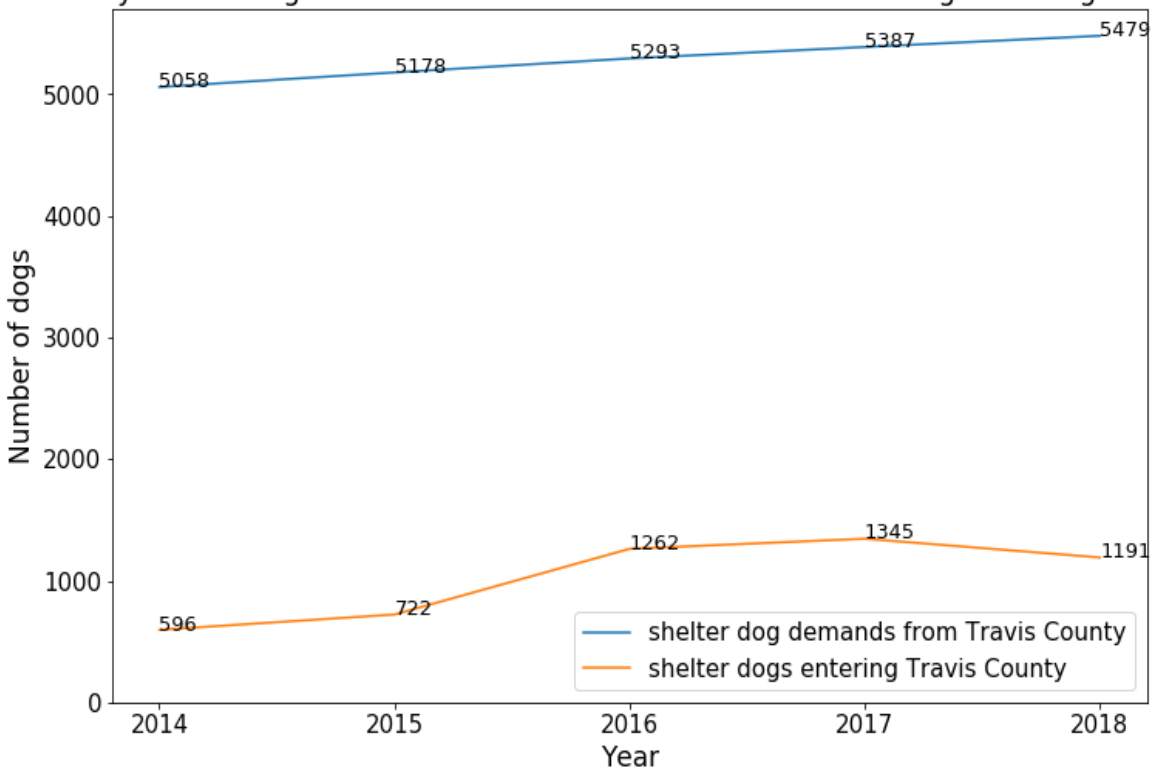
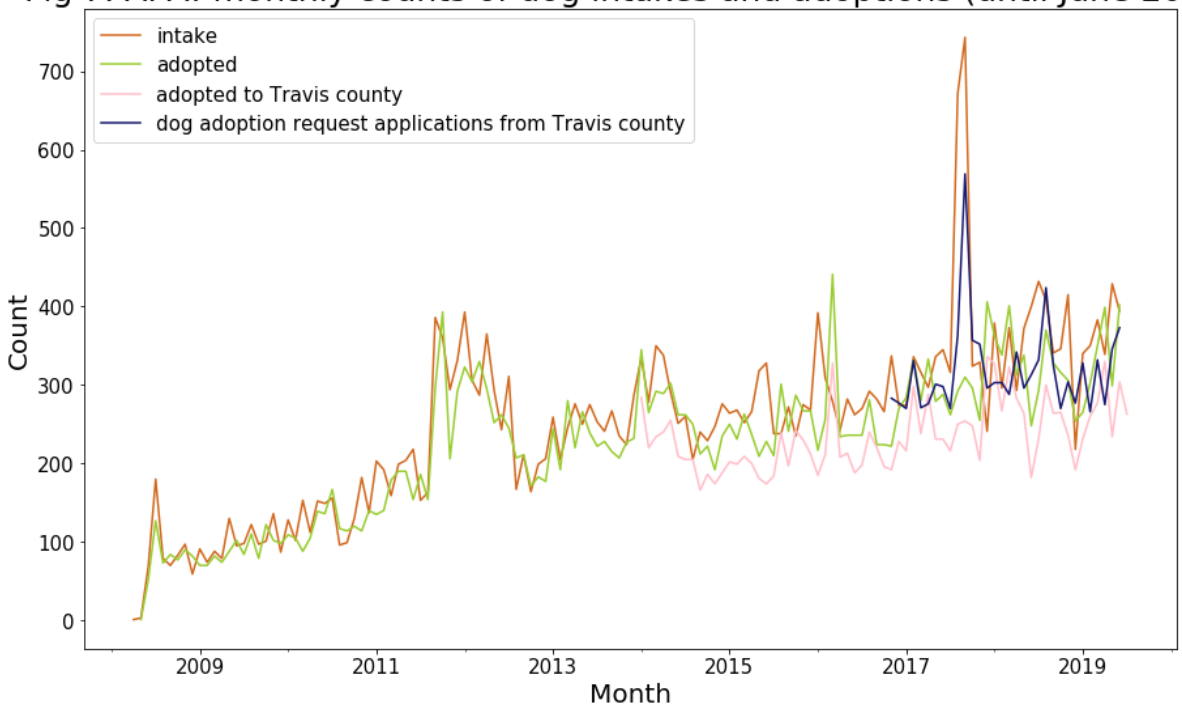



Figure 4 compares the annual net number of shelter dogs entering Travis County and shelter dog demands (YDD) from Travis County. The results demonstrate that the net number of

shelter dogs entering Travis County is very small compared to the number of shelter dog demands from the county. On average, the annual shelter dog demands are 5,279 dogs, which is greater than 1,068 shelter dogs entering Travis County. The actual shelter dog adoption capacity would be even larger if we included the number of new dog demands for households with no pets, or for households with pets but no dogs. In order to adjust the core assumption of how many households would choose to adopt a new pet after a previous pet dies, one can divide the annual shelter dog demand by 0.7 and multiply by a new assumed value. Note that, in the extreme, this value would have to be approximately 14% in order to meet the supply. If the year-over-year re-occurrence of adoption were 14%, it would mean the net population of pet owners would be decreasing unless a concordant number of new households were deciding to adopt pets. Given that this contradicts state and national trends in pet ownership, it is safe to assume the extreme case is incorrect.

We next investigated APA!'s dog adoption trends in Travis County. At APA!, there has been a total of 20,059 dog adoptions from Travis County, since 2008. And since November 2016 (when the data starts), there were a total of 10,396 dog adoption request applications from Travis County. Adoption request application is a final form filled out by APA! visitors who went through the adoption process on site. We compared the number of adoption applications from Travis County compared to the number of dog intakes and adoptions at APA!.

Fig 7. APA! monthly counts of dog intakes and adoptions (until June 2019)




The number of APA!'s dog adoption request applications per month from Travis County is highly positively correlated with the monthly number of APA! dog intakes (Pearson's correlation coefficient analysis, r = 0.7461, p = 9.48e-7, n = 32)[4], which also shows there are currently sufficient potential adopters in Travis County for the supply of dogs from APA!.

Additionally, we analyzed APA!'s dog adoption trends to explore and evaluate the adoption market in Travis County by geographical areas. Figure 5 is a heatmap of total number of dog adoption request applications from Travis County, and Figure 6 is a heatmap of total number of dog adoptions from Travis County. The heatmaps show that lots of residents from Zilker, South Lamar, South Congress, and Southeast Austin area have adopted dogs from APA! compared to other regions.

[4] Offset correlation analysis was performed to ensure that the peak correlation was at a 0-month lag, as apposed to 1 to 3 months lag between intakes and adoption applications.

# Travis County Adoption Capacity Analysis

Fig 6. Total number of APA dog adoptions into Travis County (2008 ~ Present)

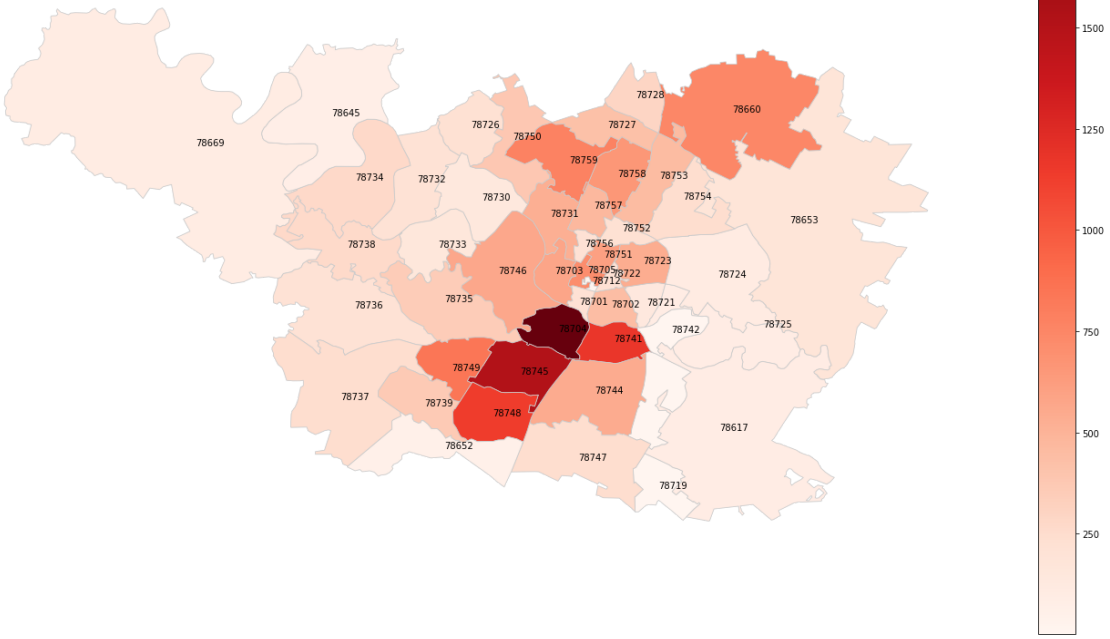
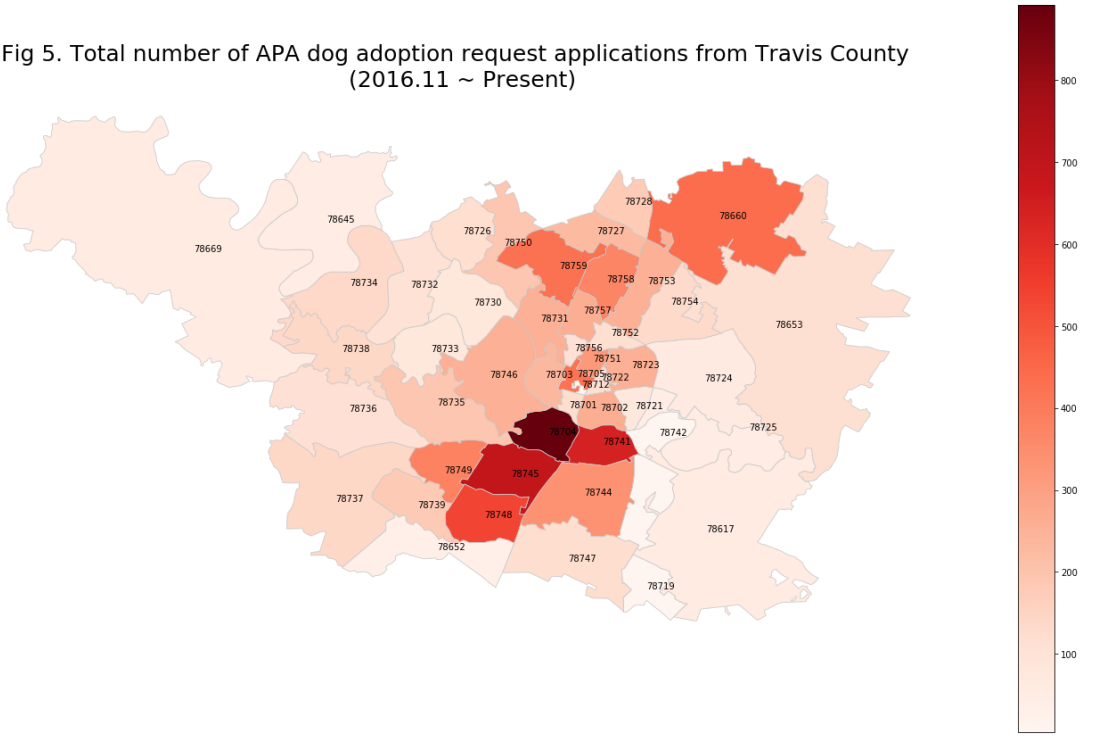



Fig 5. Total number of APA dog adoption request applications from Travis County (2016.11 ~ Present)



# Travis County Adoption Capacity Analysis

Fig 9. Number of APA dog adoptions per capita in Travis County (2008 ~ Present)

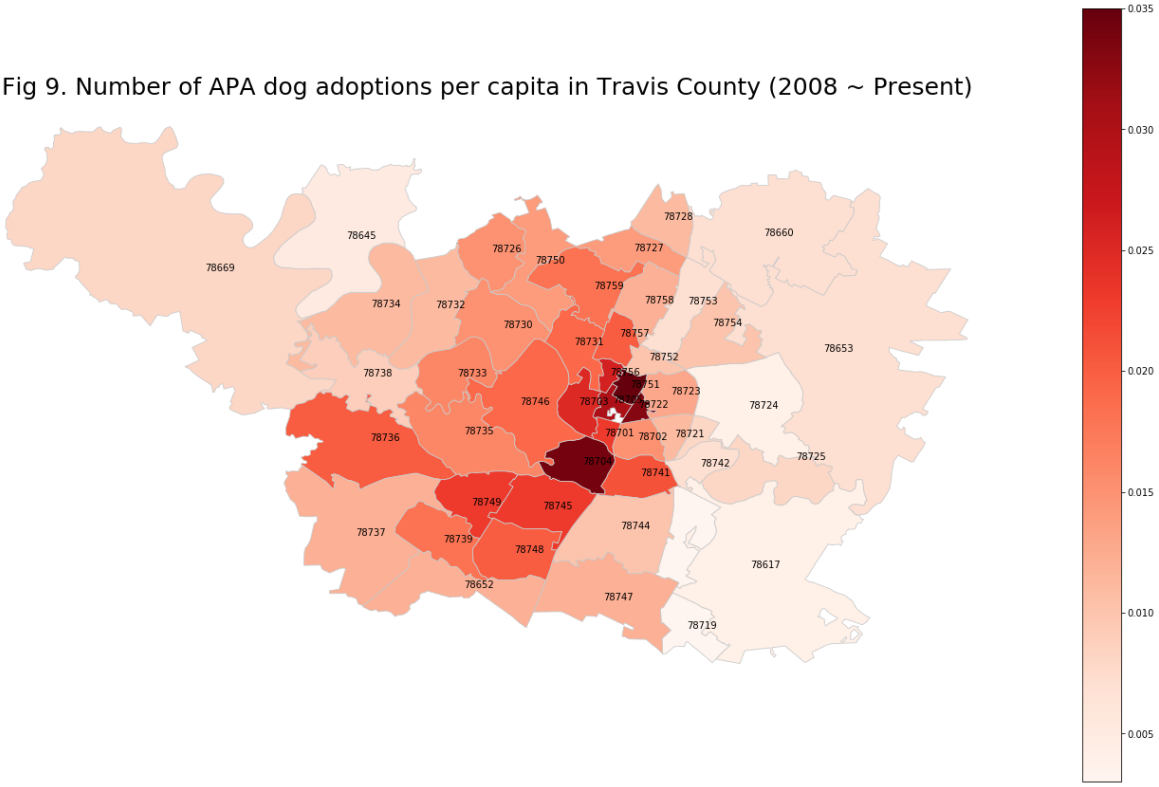
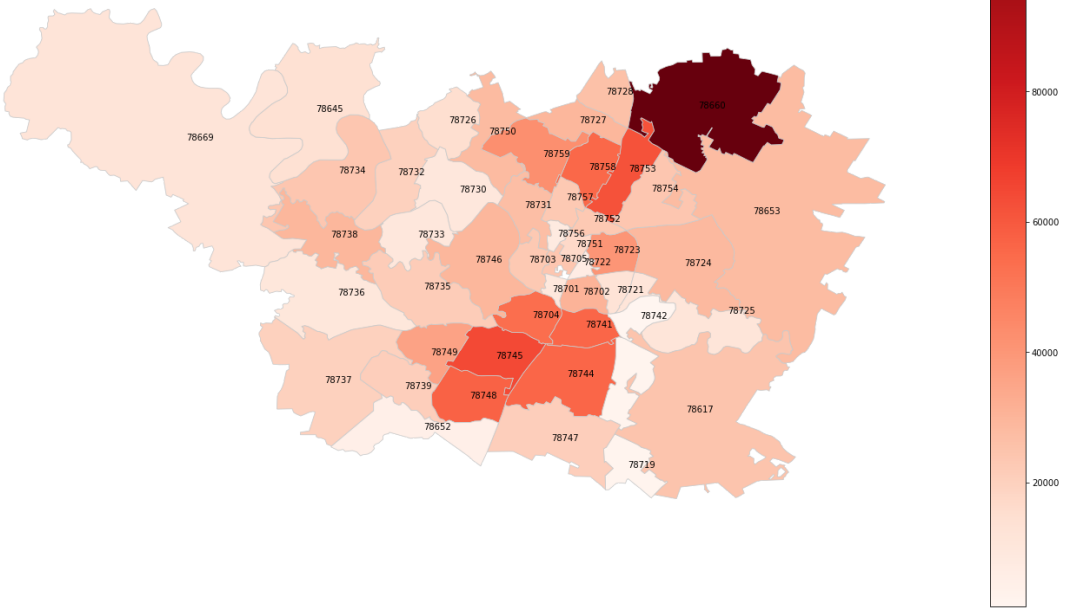



Fig 11. Estimated 2019 population in Travis County

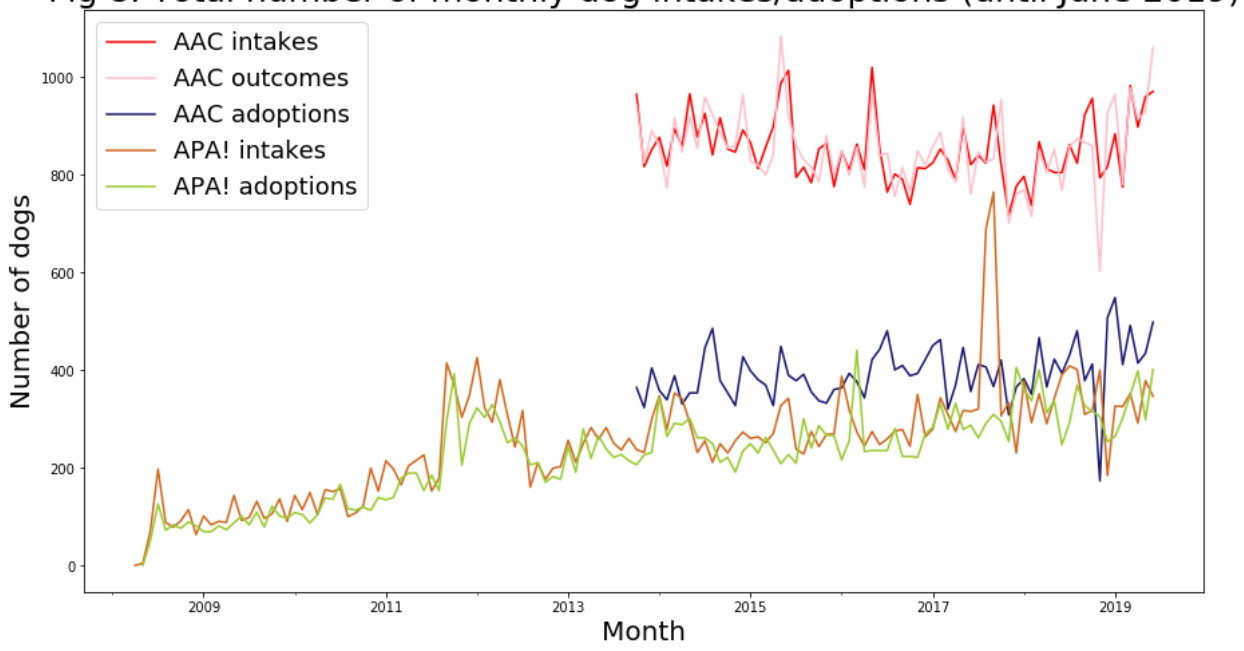


We then incorporated demographics information to better understand the adoption market in Travis County. Population data are estimated 2019 population by zipcode region based on 2010 Census data [9]. Figure 9 shows a heatmap of total number of APA! dog adoptions per capita by region, and Figure 11 shows a heatmap of estimated 2019 population by region in Travis County. On average, the number of adopted APA! dogs per capita in Travis County are 0.015, which means that about 3 dogs were adopted from APA! for every 200 residents in Travis County since 2008 (Figure 9). These heatmaps of APA! dog adoption data along with the demographics data could aid APA! in choosing target regions for their next marketing and outreach efforts in order to further boost adoption rates in Travis County.

## Q2. Is APA! affecting AAC's adoption rate?

We also observed whether AAC's adoption rate has changed over recent years. Figure 8 shows monthly counts of dog intakes and adoptions in both AAC and APA! locations. (AAC's public intakes and outcome data were available only from October 2013.)

Fig 8. Total number of monthly dog intakes/adoptions (until June 2019)



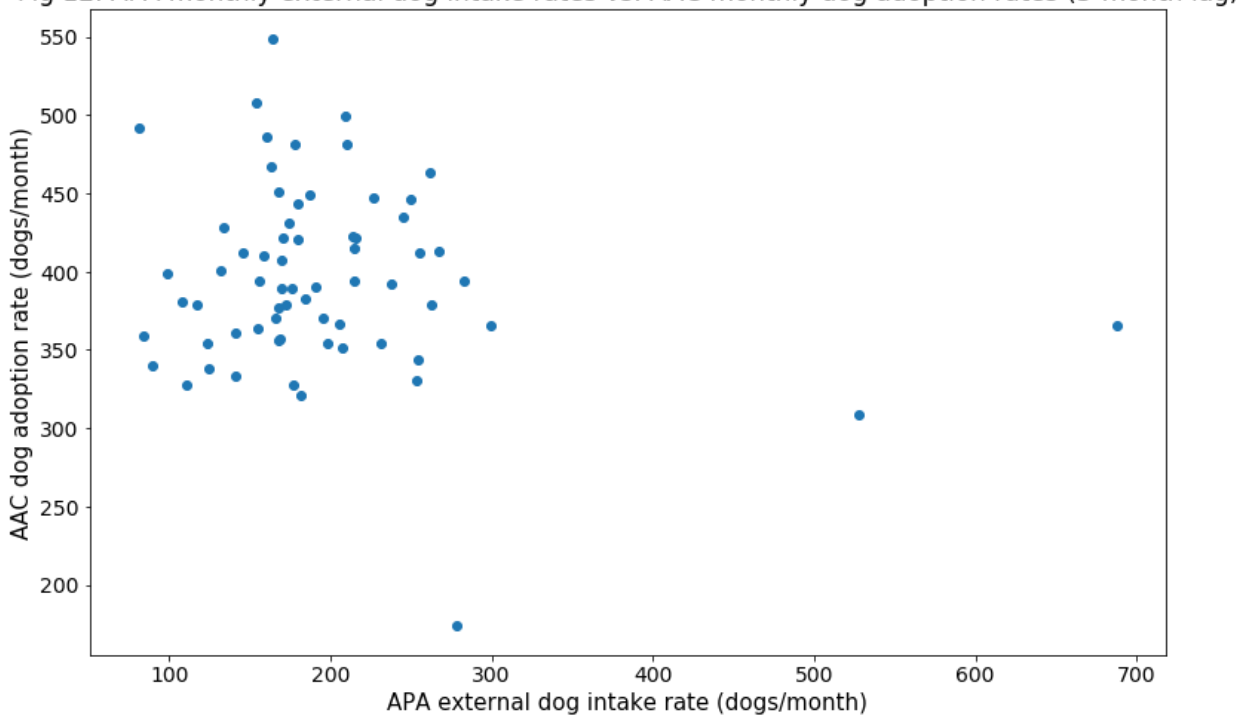
# Travis County Adoption Capacity Analysis

The number of dog adoptions at AAC per month is significantly positively increasing over time with a slope of 0.3129 (Pearson's correlation coefficient analysis, $p = 0.0088$, $n = 69$), while AAC's monthly dog intake rate is not significantly increasing nor decreasing over time (Pearson's correlation coefficient analysis, $r = -0.1108$, $p = 0.3649$, $n = 69$). Therefore, the results call into question the claims that APA!'s external dog intakes are negatively impacting city shelter's dog adoption rate.

Moreover, APA!'s monthly number of dog intakes and adoptions are highly positively correlated (Pearson's correlation coefficient analysis, $r = 0.7669$, $p = 3.37e\text{-}27$, $n = 134$), which means that almost all the dogs brought in to APA! are adopted. Likewise, the AAC's monthly count of dog intakes and outcomes are significantly highly positively correlated (Pearson's correlation coefficient analysis, $r = 0.7426$, $p = 2.78e\text{-}13$, $n = 69$), with 46.3% of the outcomes being adoptions, 50% of the outcomes being either transfer or RTO, and the other 3.7% of the outcomes being RTO-adopt, euthanasia, missing, or died.

We further examined whether APA!'s monthly external dog intake rates are correlated with AAC's monthly dog adoption rates. Offset correlation analysis was first performed to determine if there is a time-delayed effect of intake rates on adoption rates, and there was a peak correlation (highest correlation coefficient and lowest p-value) at a three-month lag. However, no statistically significant correlation was detected between APA!'s monthly out-of-county intake rates and AAC's monthly dog adoption rates even at the peak correlation level (Pearson's correlation coefficient analysis, $r = -0.1660$, $p = 0.1829$, $n = 66$; Figure 12).

Fig 12. APA monthly external dog intake rates vs. AAC monthly dog adoption rates (3-month lag)




## Conclusion

Our data analysis results do not support the argument that APA!'s out-of-county animal intakes are oversaturating Travis County's adoption market. On the contrary, there are many more households who can take in shelter dogs than the net number of shelter dogs entering Travis County, and, if anything, the current trends (e.g. population increase into Travis County) suggest that this gap will only widen. On average, there are 5,279 shelter dog demands every year from households who would like to get new dogs after losing their old dogs, whereas there are 1,068 shelter dogs every year entering the county.

The results further call into question the claims that AAC's dog adoptions rates are decreasing due to APA!'s out-of-county animal intakes. The results demonstrate that APA!'s monthly external dog intake rates are not statistically significantly correlated with AAC's monthly dog adoption rates. Furthermore, AAC's monthly dog adoption rates have been statistically significantly increasing over the recent years, while AAC's monthly dog intake rates have remained flat.

In conclusion, data analysis results do not support the hypothesis that APA!'s external dog intakes are oversaturating Travis County's adoption market and negatively influencing AAC's adoption rate.

## Future Work

Our current shelter dog flow rate system (Figure 2) does not include other shelters such as Austin Humane Society, which is the third largest animal shelter in the Austin community. Adding their dog intakes and adoption data into the flow rate system would provide even more accurate flow rate dynamics. Moreover, having a more thorough meta-analysis of margins of error for calculating yearly shelter dog demands (YDD) would help strengthen the accuracy of the dog demands estimation.

In the future, we plan to replicate this data analysis for cats and animals combining both cats and dogs. It would also be interesting to stratify this analysis for minority animal populations that are more difficult to place, such as behavior or sick dogs.

## References

[1] http://www.austintexas.gov/department/surrendering-pet
[2] http://www.austintexas.gov/department/about-austin-animal-center
[3] https://data.austintexas.gov/Health-and-Community-Services/Austin-Animal-Center-Intakes/wter-evkm
[4] https://data.austintexas.gov/Health-and-Community-Services/Austin-Animal-Center-Outcomes/9t4d-g238
[5] https://www.animalsheltering.org/page/pets-by-the-numbers
[6] https://www.census.gov/quickfacts/fact/table/traviscountytexas/PST045218
[7] https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=CF
[8] https://www.avma.org/KB/Resources/Statistics/Pages/Market-research-statistics-US-pet-ownership.aspx
[9] https://www.zip-codes.com/state/tx.asp