

Background

As more American households continue to adopt new pets into their families, the need for pet health comprehension grows. Elanco's *Connected Pet, Connected Vet* Project aims to tackle this problem. Elanco uses an accelerometer device to track and record the movement of pets. The Elanco-Purdue team began to clean and analyze the data gathered by these accelerometers. The team then looked to compare the similarities and differences between healthy and unhealthy dogs to draw conclusions from the analysis and potentially recognize early signs of disease not seen by the eye.

Goal

Use accelerometer data sufficiently to understand pet behavior trends and their correlation to health conditions such as mild osteoarthritis.

Our Data

The data we worked with comes from an accelerometer that has been placed on dogs' collars to track their everyday movements. These dogs have varying health statuses: healthy, mild arthritis, osteoarthritis, and lumbar osteoarthritis.

Number	BTID	Breed	Condition	Dates
1	15C293AAA5DC	German Shepherd/Doberman/Lab mix (mutt)	Healthy	October '21
2	3DA599F0D0FD	German Shepherd	Healthy	October '21
3	6B2F64E6F2E4	Goldendoodle	Healthy	November '21
4	4C387B0518E5	Golden Retriever	Healthy	October '21
5	8BD19966B6DE	Labrador Retriever	Healthy	October '21
6*	48B0C1408FE6	German Shepherd/Goldendoodle Mix	Mild Arthritis	October '21
7	80242EFCC9E4	Labrador Mix	Osteoarthritis	November '21
8	A098083859DE	Large Mixed Breed	Osteoarthritis Lumbar	October '21
9	DA5E6C7A0AF9	mixed	Osteoarthritis	October '21
10	FA6BD90914DF	Retriever Mix	Osteoarthritis	October '21

Table 1: Data table

Introduction

Our Data

The data includes time stamps, 3 axis accelerometer data (x,y,z) and different activity calls throughout the day based on the accelerometer data.

Our project aims to analyze this data to:

- Compare dogs' activity levels on the weekdays vs, weekends
- Compare healthy dogs to unhealthy dogs to see where in the data diseases can be spotted.

We do this by looking at different statistical analysis' such as; t-tests, Fourier transform, Anova tests, pivot tables and an interactive Rshiny dashboard

Index	Timestamp	X	Y	Z	Activity	Duration
1	1.62363E+12	572	604	488	Shake	14
1	1.62363E+12	568	608	488	Shake	14
1	1.62363E+12	564	608	488	Shake	14
1	1.62363E+12	568	608	492	Shake	14

Table 2: Example of accelerometer data

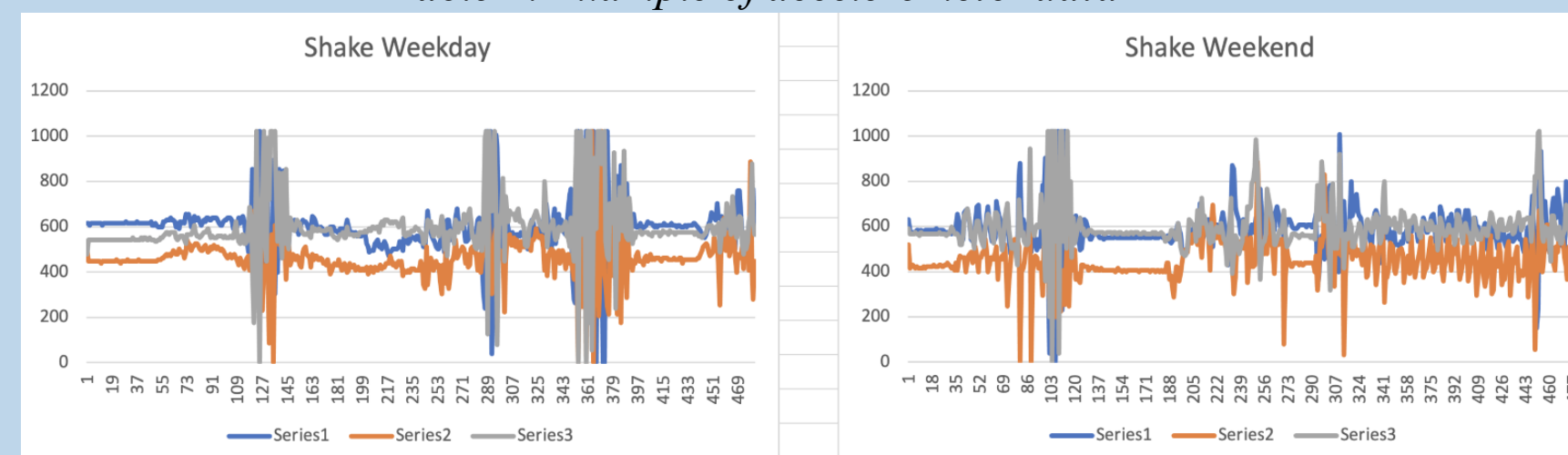


Figure 1: A general comparison of the raw accelerometer data for the "shake" index over the weekdays and weekends (healthy dog).

T test results

Activity	X	Y	Z
Walk	38.34	-17.75	48.6
Run	-6.64	-13.42	146.13
Sprint	-56.35	0.08	98.43
Eat	87.89	-11.1	7.65
Drink	62.87	-3.48	11.1
Itch	11.16	-36.09	135
Shake	32.2	-21.8	112.12
Other	8.52	-20.97	100.03

The mean of differences between the healthy and dogs with osteoarthritis along all 3 axes.

- The values along Z axis are high for Walk, Run and Sprint as expected.
- The Z values for Itch and Other are high too but these are not similar distributions, so these can be misleading.
- The values along the Z axis varies over a large range since the movement forward is larger than up-down movements or left-right lateral movement.
- Most of the p-values were less than 0.001
- With p-values this small, we can conclude that accelerometer values are significantly different for healthy dogs and dogs with osteoarthritis

Dashboard

One of the main components of our project is the dashboard. Our dashboard is based on the data from the 10 dogs (5 healthy, 5 with various types of Arthritis) and their corresponding accelerometer data.

Accelerometer Data:

- Collar on dogs
- 8 days read
- X, Y, and Z axis
- Large dogs
- 8 activities

Goals:

- Find patterns useful in predicting health of dog
- Distinguish predictors between conditions
- Insight into models

Demo:

- Action dashboard
- Accelerometer dashboard
- Combined role

Dashboard:

- Data to interactive graphics/tables
- Summary of behaviors and movements
- R-Shiny

Growth:

Last semester we also made an R-Shiny Dashboard, here is what is different...

- > 1 dog
- More time considered
- Considered health
- Focus on behaviors
- More division/filter options
- Two Dashboards complementing
- Distribution graphs
- More color
- Multiple tables
- More statistic-oriented

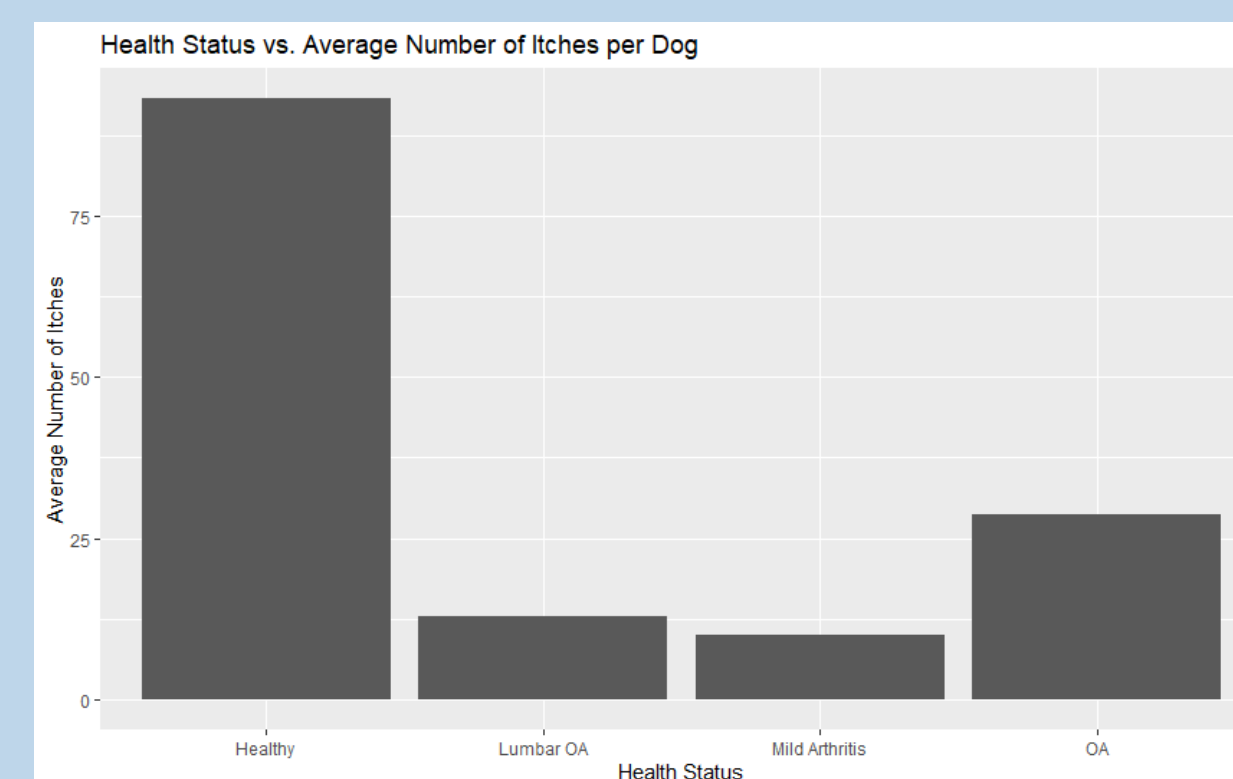


Figure 3: Comparison of occurrences of "Itch" by health status

Findings:

- Several obvious results
- Itching much more common in healthy dogs
- Wider range of acceleration readings for healthy
- Healthy dogs much more active
- Healthy dogs run much more frequently
- Difference in accelerometer data by health
- Difference in accelerometer patterns
- Regression data

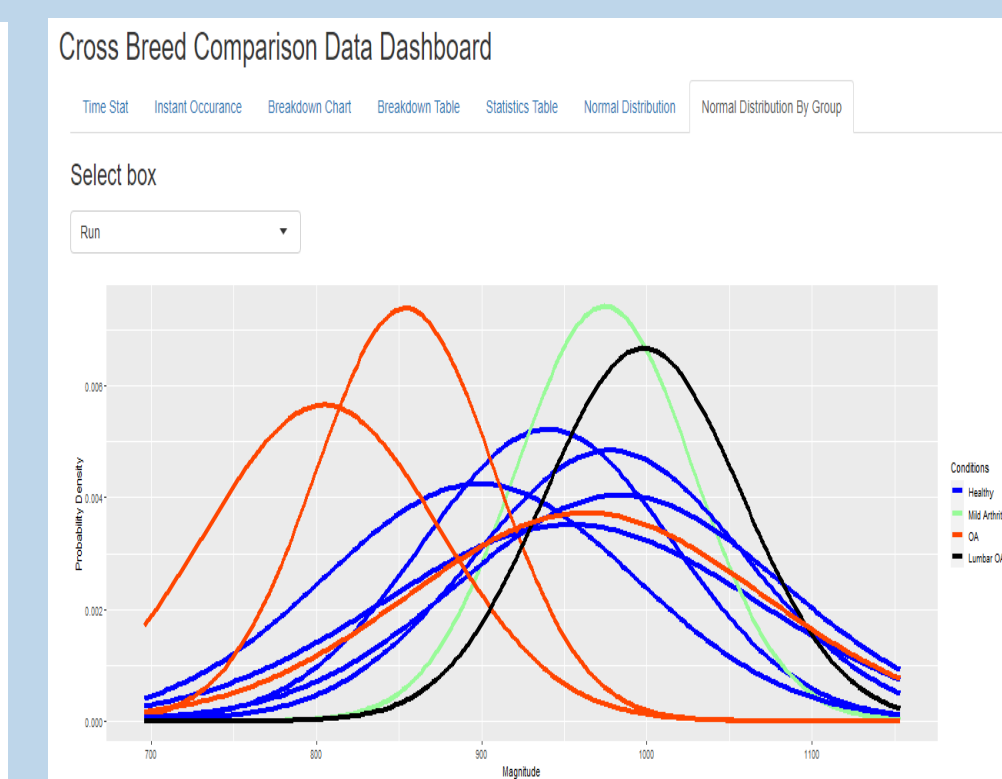


Figure 4: Normal distribution of accelerometer data for run

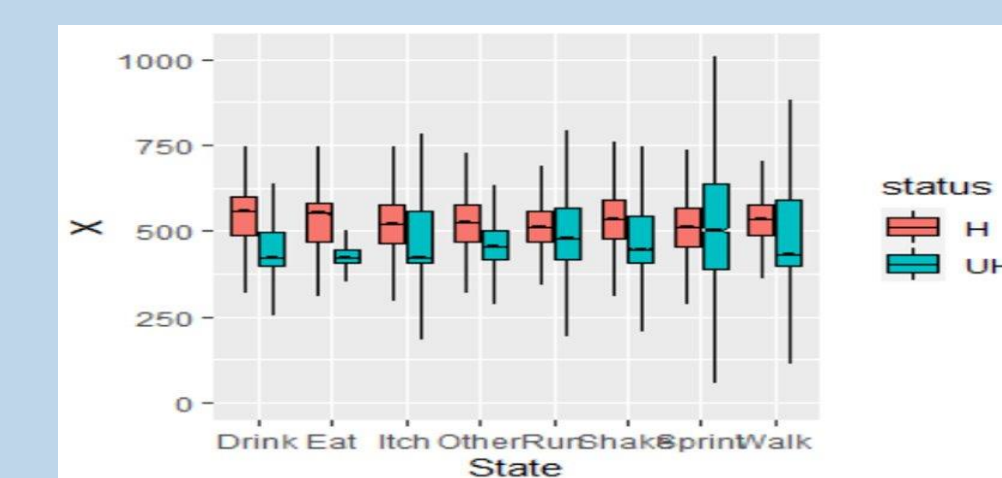


Figure 5: Boxplots for range of X accelerometer data

What's Next?

Results

From our Dashboard we concluded that the main patterns that separate the healthy dogs from the dogs with arthritis is the number of occurrence of certain high intensity activities (such as itch and run) rather than the time spent doing that activity, the distribution of acceleration on certain high intensity activities (i.e. run), and the percent of time spent active in a day.

Conclusion

Elanco's *Connected Pet, Connected Vet* Project has progressed in many ways. The team has created a functioning dashboard to compare and differentiate pet actions. Based upon the similarities and differences of these actions, the team achieved insight into the correlation between pet behaviors and pet conditions. Some limitations to this project were the sample sizes being used, information about the dogs, and manually cleaning the data for abnormalities.

Future Goals

- Incorporate larger datasets for analysis
- Predicting health conditions of datasets (machine learning)
- Add additional features to the dashboard
 - ANOVA testing
 - FFT analysis

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