Outbreak of Severe Vomiting in Dogs Associated with a Canine Enteric Coronavirus

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Introduction

This project is surrounded around detecting anomalies within small animal data provided by SAVSnet from 320 veterinary surgeries around the United Kingdom. SAVSNet are a team based at the University of Liverpool whose main aim is to monitor disease trends over time and identify populations at risk while monitoring treatments and outcomes. The data is gathered via a questionnaire at the end of each veterinary consult where the veterinary surgeon identifies the main presenting complaint (MPC) of the consult. The research is beneficial to spotting any animal outbreaks eventually down to LSOA level at a point where intervention is fast and efficient. This research and this project will be beneficial in raising awareness to animal health and outbreaks within the animal population with the ultimate aim of creating an easily accessible platform displaying information down to the lower areas.

This poster displays research surrounding an outbreak in Gastroenteric disease in dogs in the United Kingdom December 2019 to February 2020 and also the effect of the coronavirus on the implementation of the method.

Methodology

Gaussian Process regression is the method used for this research. It is a stochastic process with predictive abilities and is applied to our data as below:

> Sample hyper-parameters 5000 times over the prior distributions through a Markov Chain Monte Carlo algorithm to obtain a posterior distribution

> To make predictions from the posterior, use the Gaussian Process prior and our previously observed data points

> Add in a yearly period (365 days) and inverse logit the Gaussian Process predictions

> Plot the obtained predictions and observed data points on a plot to determine any outliers/seasonality within the dataset

> Assess trace plots for the hyperparameters to ensure the Gaussian Process is running as it should be

Model

Let y_t be the number of cases observed out of N_t individuals tested. Then:

$$y_t \sim \text{Binomial}(N_t, p_t)$$

For each probability:

$$\text{logit}(p_t) = \alpha + \beta_t + u_t$$
$$u \sim GP(0, \Sigma^2)$$
$$\Sigma_{ij}^2 = \tau^2 + \sigma^2 \rho(t_i - t_j)$$

Where:
$$\sigma^2 \sim \text{HalfNormal}(5)$$
$$\tau^2 \sim \text{HalfNormal}(5)$$
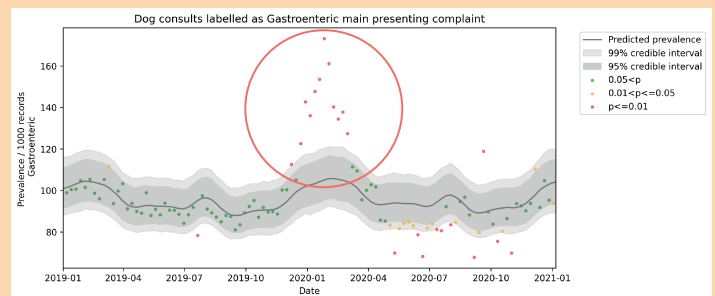$$\alpha \sim N(0,1000)$$
$$\beta \sim N(0,100)$$

Results

Figure 1: Gaussian Process plot of Gastroenteric main presenting complaint against consults recorded as unwell.

- National outbreak of Gastroenteric consults between December 2019 and February 2020—later determined to be Canine Enteric Coronavirus. (*Radford et al, 2021*)

- Seasonality shown with increase in cases around December and August.

- Drop in consults from May 2020 due to UK National lockdown.

Prevalence was calculated as:
$$\frac{\text{Total GI MPC consults}}{\text{Total consults}}$$

Now calculated as:
$$\frac{\text{Total GI MPC consults}}{\text{Total unwell consults}}$$

But even this change shows a drop in consults so further work form this research will be focussing on how to effectively explain the narrative with the drop in consults to ensure outbreaks are visible.

Acknowledgements

References

Radford, A. D., Singleton, D. A., Jewell, C., Appleton, C., Rowlingson, B., Hale, A. C....Pinchbeck, G. L. (2021). *Outbreak of Severe Vomiting in Dogs Associated with a Canine Enteric Coronavirus, United Kingdom.* Emerging Infectious Diseases, 27(2), 517–528. https://dx.doi.org/10.3201/eid2702.202452