Assignment: Mortality and longeviy of companion dogs
ACTL3141/ACTL5104, T1 2023

Due time: Thursday 6th April 2023 11.55 am (sharp)

1 Skills developed

This assignment provides you with an opportunity to apply some of the techniques you have learned in the course lectures to a business task involving data on the lifespan of dogs. In addition, the assignment aims to develop the course learning outcomes associated with the course aim "Understand and discuss ethical issues and implications of the modelling introduced in the course", as well as all the UNSW Business School Program Goals but in particular "5. Responsible business practice" and "3. Business communication".

2 Background

An increase in pet and dog ownership has been one of the many consequences of the COVID-19 pandemic. For example, in 2022 it is estimated that 48% of Australian households had at least one dog (up from 40% in 2019) (Animal Medicines Australia 2022). Moreover, it is estimated that Australian household spent in 2022 about $11 billion in pet insurance. In Australia most of pet insurance plans would cover accidental injury and illness with the option of also covering additional expenses such as surgery, hospitalisation, euthanasia, and medication. In other markets, such as in Sweden and the UK, pet insurance policies may also be designed to cover liability to third parties for the action of pets (NAIC 2019). It is also possible to purchase life and (theft) insurance on pets (Tedder and Paul 2021).

3 Task

You work as an actuary for a UK insurance company which is looking to expand it's business into the pet insurance market. Your role is to assess the mortality of dogs as part of the initial investigations of setting up the dog insurance segment.

Your boss has just emailed you a recent study by Teng et al. (2022) about life tables and life expectancy for companion dog in the UK. The study applies life table techniques to a dataset of 30563 dogs. The dataset and codes associated with the study is publicly available in the github page of one of the authors (See details in Section 4.1). Your boss believes that the analysis of the data can be enriched by using other survival modelling tools. Interestingly, the dataset has information on insured status of the dog, which was not analysed in the study. However, your boss is also concerned that the dataset only contains information on dead dogs. To inform decision making your boss has asked you to re-analyse the data. In particular, your boss has asked you to do the following tasks and write a short report to comment and summarise on your results:

1. Perform a brief descriptive analysis of the profile of dogs available in the dataset

2. Using the methods learned in the course (e.g. KM, Cox regression), analyse the mortality and survival of dogs in the given dataset. In particular, but not limited to, the study of differences in dog mortality by age, sex, breed, neutering status and insured status.
3. The article did not provide a life table by insured status. Your boss has asked you to produce life tables for insured and uninsured dogs and compare with the results reported in Teng et al. (2022).
4. The dataset only contains data on dead dogs. Your boss has asked you to discuss and evaluate the possible impact that this could have on the analysis.
5. Your company is considering offering pet insurance only to dogs which have been neutered (desexed). Discuss from an ethical perspective whether the insurer should offer insurance products only to neutered dogs.

See more details on the tasks below.

4 Additional information and mark allocation

4.1 Data

For the assignment you have access to the data used in the original study available at https://github.com/kendyteng/OpenAccess/tree/main/lifetable_dog_vc_2016. The file "the_dataset.xlsx" contains data on 30563 dogs which died between January 1st 2016 and July 31st 2020 from the VetCompass^{tm} program, which collates de-identified electronic patient record data from veterinary practces in the UK for epidemiological research[1].

The data is described below:

Variable	Description
`date_birth`:	Date of birth of the dog
`date_death`:	Date of death of the dog.
`lifespan`:	Exact age at death of the dog.
`sex`:	Sex of the dog
`neuter`:	Neutering status of the dog. `Neutered` if the dog has been neutered (desexed) or `Entire` if not
`breed_vc`:	Breed of the dog
`pure_cross`:	Categorical variable indicating whether the dog is `Crossbreed` or `Purebreed`
`breed_group`:	Breed group of the dog according to the Kennel Club breed standards (https://www.thekennelclub.org.uk/breed-standards/)

4.2 Analysis, Modelling and Discussion [85 Marks]

Mark allocation for the assignment can be found in the rubric attached, refer as well to the below for more details on the tasks.

4.2.1 Descriptive analysis of the profile of dogs in the data [10 Marks]

For this part you should use several summary metrics, e.g. including the average age at death, the number of individuals per subgroup, and others metrics of your choice.

Your calculations of the different metrics should be accompanied by a discussion of the insights you get from the summary metrics.

[1] https://www.rvc.ac.uk/vetcompass

4.2.2 Survival analysis [30 Marks]

Your survival analysis should be accompanied by a discussion of the insights you get from each task. Provide the results and analysis associated with each of the estimation and modelling tasks in the technical appendix. Note that, when applicable, you should also provide in the main report the key assumptions, results and analysis for your selected modelling techniques, along with justification of why a particular modelling technique was chosen. Moreover, you should emphasise how your new analysis complements or improves the results already available in Teng et al. (2022).

4.2.3 Life tables for insured and uninsured dogs [20 Marks]

For this part you should construct life tables for insured and uninsured dogs using the techniques used in the course. The life tables should include at least the following life table quantities l_x, d_x, q_x and $\mathring{e}_x$.

Note that you are not required to graduate the mortality rates underlying the life table and crude (unsmoothed) estimates are enough. Include the life tables as an appendix (not counted in the page limit). In the main report include graphs of the mortality rates (or mortality probabilities) associated with the life table along with justification of any assumption you make for the calculation, and an analysis of the results including a comparison with the results reported in Teng et al. (2022). For this comparison, you may find useful to consider the life tables reported in the Supplementary File 2 of Teng et al. (2022).

4.2.4 Impact of having only death data for the analysis [10 Marks]

Your boss is concerned that there might be some bias in the analysis arising from the fact that the database only has data of death dogs. For this she has sent you the paper by Urfer (2008) who discusses possible problems with veterinary life span studies. For this part, discuss and evaluate to what extent these problem may apply to the current analysis. Also, discuss what might be the implications of these data issues for the results presented in other parts of the report.

4.2.5 Ethical implications of insuring only neutered dogs [15 Marks]

In this part you should discuss from an ethical perspective whether the insurer should offer insurance products only to neutered dogs. This discussion should:

1. provide pros and cons of insuring only neutered dogs.
2. formulate a recommendation based on the above.

To help complete this part of the assignment you should do the activities of week 5 which focus on ethical perspectives in actuarial work.

In this task, you can also assume that the health insurance provider is operating in a regulatory environment which does not mandate desexing of dogs (see the following link for a discussion on desexing laws in Australia https://kb.rspca.org.au/knowledge-base/is-desexing-mandatory-for-cats-and-dogs/).

4.3 Presentation Format and Communcation [15 Marks]

Communication of quantitative results in a concise and easy-to-read manner is a skill that is vital in practice. As such, marks will be given for the presentation of your results. In order to maximize your marks for presentation you may wish to consider issues such as: table size/readability, figure axis/formatting, ease of reading, grammar/spelling, and report structure. You may also wish to consider the use of executive summaries and appendixes, where appropriate. Provide sufficient details in the main body of the reader so that they can judge what you are doing, using appendices for non-essential but useful results as necessary.

Note that sufficient detail must be provided (in either the report body and/or appendices) so that the reviewer can follow all the steps and derivations required in your work.

Note that a **maximum page limit of 6 pages** (including tables and graphs but excluding references) is applicable to the main body of the report.[2] You should also consider the rubric for the presentation component. There is no limit to the size of the appendix. Furthermore your answer should satisfy the following formatting requirements: (i) font: Times, 12 pt or equivalent size and (ii) margins: all four of at least 2cm.

4.4 Software

You may choose which software packages to use (e.g. `R`, `Excel` or other), however, most functions you will be required to use for this task are available in `R`. Note also that most of the code enabling you to perform the calculation and analysis are in the `R` tutorials.

4.5 Assignment submission procedure

4.5.1 Turnitin submission

Your assignment report must be uploaded as a **unique document**. As long as the due date is still future, you can resubmit your work; the previous version of your assignment will be replaced by the new version.

Assignments must be submitted via the Turnitin submission box that is available on the course Moodle website. Turnitin reports on any similarities between their own cohort's assignments, and also with regard to other sources (such as the internet or all assignments submitted all around the world via Turnitin). More information is available at: [click]. Please read this page, as we will assume that you are familiar with its content.

Please **also attach any programming code and/or sample spreadsheet output** used in your analysis as a separate file in the dedicated "code_sample" Moodle assignment box on the course webpage. These will be referred to by the marker only if needed, and in particular the **main assignment (with appendix) should be self contained**.

4.5.2 Late submission

Please note that it is School policy that late submission of assignments will incur in a penalty.

When an assessment item had to be submitted by a pre-specified submission date and time and was submitted late, the School of Risk and Actuarial Studies will apply the following policy. Late submission will incur a penalty of 5% per day or part thereof (including weekends) from the due date and time. An assessment will not be accepted after 5 days (120 hours) of the original deadline unless special consideration has been approved. An assignment is considered late if the requested format, such as hard copy or electronic copy, has not been submitted on time or where the 'wrong' assignment has been submitted. Students who are late must submit their assignment to the LIC via e-mail. The LIC will then upload documents to the relevant submission boxes. The date and time of reception of the e-mail determines the submission time for the purposes of calculating the penalty.

You need to check your document once it is submitted (check it on-screen). **We will not mark assignments that cannot be read on screen.**

Students are reminded of the risk that technical issues may delay or even prevent their submission (such as internet connection and/or computer breakdowns). Students should then consider either submitting their assignment from the university computer rooms or **allow enough time (at least 24 hours is**

[2] Please kindly note that this is a maximum - you should feel free to use less pages if it is sufficient!

recommended) between their submission and the due time. The Turnitin module will not let you submit a late report. **No paper copy will be either accepted or graded.**

4.5.3 Plagiarism awareness

Students are reminded that the work they submit must be their own. While we have no problem with students working together on the assignment problems, the material students submit for assessment must be their own.

Students should make sure they understand what plagiarism is—cases of plagiarism have a very high probability of being discovered. For issues of collective work, having different persons marking the assignment does not decrease this probability.

4.5.4 Generative AI policy

You are allowed to use Generative AI to help you with editing, planning, idea generation, or coding. However, this must comply with the Generative AI Guidelines for the course available in Moodle/Assessment Hub/Generative AI/ Generative AI Guidelines ACTL3141-5104.

In addition, please include an Appendix in the report titled **"Generative AI usage"** explaining what you used AI for and outlining what prompts you used. If you did not use Generative AI write in this Appendix that generative AI was not used.

References

Animal Medicines Australia. 2022. "Pets in Australia: A National Survey of Pets and People." *Animal Medicines Australia: Canberra, ACT, Australia*. https://animalmedicinesaustralia.org.au/wp-content/uploads/2022/11/AMAU008-Pet-Ownership22-Report_v1.6_WEB.pdf.

NAIC. 2019. "A Regulators Guide to Pet Insurance." *National Association of Insurance Commissioners*. https://content.naic.org/sites/default/files/publication-pin-op-pet-insurance.pdf.

Tedder, Michael, and Reynolds Paul. 2021. "What to Know about Life Insurance for Pets (Yes, Pets)." *Money*. https://money.com/life-insurance-for-dogs-and-cats/.

Teng, Kendy Tzu-yun, Dave C Brodbelt, Camilla Pegram, David B Church, and Dan G O'Neill. 2022. "Life Tables of Annual Life Expectancy and Mortality for Companion Dogs in the United Kingdom." *Scientific Reports* 12 (1): 6415.

Urfer, SR. 2008. "Right Censored Data ('Cohort Bias') in Veterinary Life Span Studies." *The Veterinary Record* 163 (15): 457.