Possible Implications of No Kill in the U.S.

By Joseph F. DeCarolis

Introduction

Each year roughly 4 million cats and dogs are euthanized in the U.S.[1] If there was a federal law that banned the killing of healthy animals, what would happen to U.S. shelter populations? The purpose of this analysis is to describe a mathematical model that can be used to explore the effects of such a policy. Note that this analysis addresses the issue of 'what' rather than 'how': what would happen under a specific set of conditions, rather than how to achieve those conditions.

In *Redemption*, Nathan Winograd quotes a shelter director:

> You build a shelter with 200 cages. Today, you get 50 homeless animals and you place 10. The other 40 go into cages. Tomorrow you get 50, but only 15 total go home. When the fictional shelter is full [people] suggest building more cages, which we do, but then those cages are quickly filled … The inflow of unwanted animals is an ongoing phenomenon. What do you do with the rest?

Intuitively, the idea expressed in the quote above seems to present an overwhelming challenge: saving animals requires ever-increasing shelter space. Following the thought to its logical conclusion, an infinite effort would be required to shelter a continuous wave of surrendered animals. In the analysis below, I test this sentiment with some mathematical rigor.

Modeling Approach

I begin by describing a very basic model that tracks the daily flow of animals into and out of U.S. shelters.[1] The model focuses exclusively on the 4 million dogs and cats that are killed annually. The residence time of each animal surrendered to a shelter is modeled as a random variable that follows a Weibull distribution.[2] I adjusted the Weibull distribution to have the following shape given in Figure 1. Note that the choice of Weibull parameters is based on my own judgment — not on a rigorous analysis of shelter data — which is generally not available. The functional form of the Weibull distribution is given by:

$$f(x,k,\lambda) = \frac{k}{\lambda}\left(\frac{x}{\lambda}\right)^{k-1} e^{(x/\lambda)^k} \qquad x \geq 0,$$

where x is the random variable (i.e., time spent in the shelter), λ is the scale parameter, and k is the shape parameter. A Weibull distribution was chosen for its skewness towards large values, representing the non-negligible probability that some animals will have very long shelter residence times. Note that better shelter data would enable a better fit to a probability distribution.

[1] While the initial model is simple, the idea is to build in complexity gradually as better data is identified and assimilated.

[2] For more information on the Weibull distribution, see: http://en.wikipedia.org/wiki/Weibull_distribution.

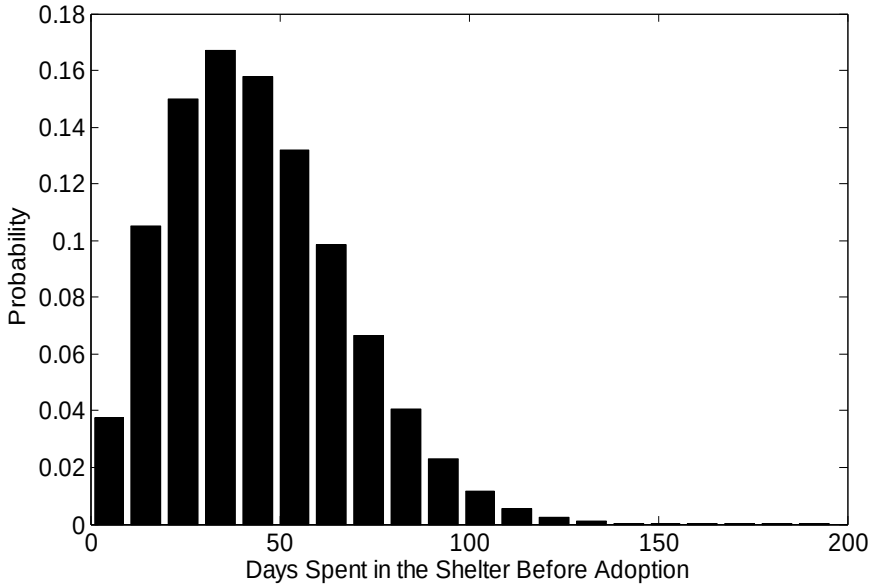

Figure 1. Weibull histogram representing the time to adoption. The average residence time for a shelter animal is 44 days, though a small fraction of animals may remain in the shelter for nearly 200 days. For this distribution, the scale parameter $\lambda = 2$ and the shape parameter $k = 50$.

For simplicity, I assume that the 4 million animals euthanized annually end up at the nation's shelters in equal numbers each day throughout the year, or roughly 11,000 animals per day. Each animal is assigned a residence time in the shelter by making random draws from the Weibull distribution given above. As shown in Figure 2, the amount of required shelter space converges to a limit.

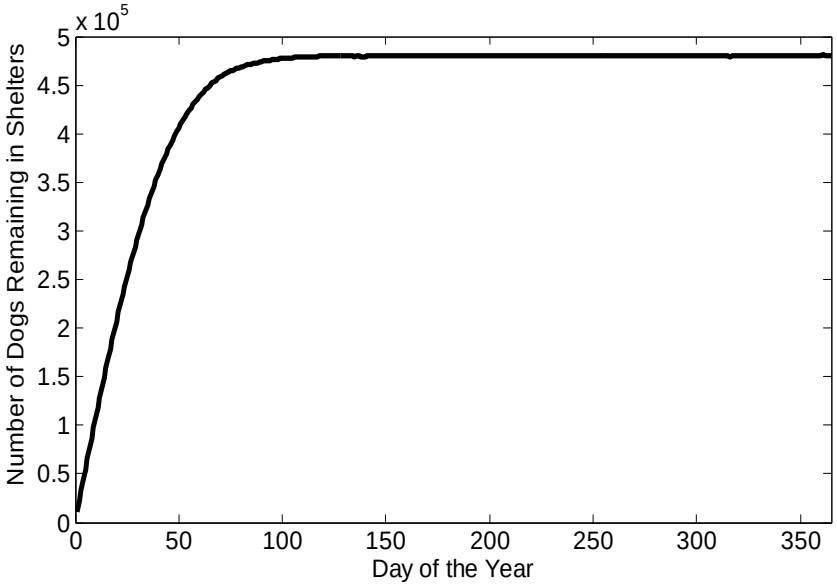

Figure 2. Number of animals remaining in shelters as a function of time. The theoretical no kill policy is assumed to start on Day 0.

With a daily intake of nearly 11,000 animals and a mean time to adoption of 44 days, the peak shelter space required is roughly 480,000 spaces. So the total space required is 44 times the

average daily intake. **More generally, we can conclude that the required shelter space is the product of the average daily intake and the average residence time**.

Cost analysis

Cost data appears hard to come by. By analyzing the LA Animal Services Annual Report for 2005-2006, I was able to estimate that the cost per intake was $339. Interestingly, salaries account for 93% of this cost. Unfortunately, I can't derive a daily cost because no information is provided on the average residence time in the shelter. Even if they provided such an estimate, it may be misleading as the more adoptable animals are probably adopted relatively quickly while the rest are killed.

Below, I derive my own cost estimate based on (very) conservative assumptions. Of course, real data would be much preferred. Table 1 presents key cost assumptions. Based on Table 1, the daily cost for food, shelter, and personal attention is $0.66+$0.50+$8 = $9.16 / animal / day. If we assume, consistent with the Weibull distribution above, that the average time to adoption is 44 days, then the total cost per animal is: (44 days)×(9.16 $/animal/day) + ($100/animal for medical) –(75 $/animal adoption fee) = **428 $/animal.** This is higher than the direct estimate from the LA County report and reflects conservative assumptions given the lack of data.

Table 1 – Assumptions used for cost analysis

	Parameter	**Value**	**Source**
1	Interest rate	8%	Conservative assumption
2	Building lifetime	20 years	Conservative assumption
3	Cost of building space	150 $/ft^2	Conservative assumption
4	Area per dog	40 ft^2	Conservative assumption
5	**Amortized daily space cost per animal**	**0.66 $/day**	**Calculation based on (1)-(4)**
6	**Daily food cost**	**0.50 $/day**	**Conservative assumption**
7	Staff time per animal (hours/day)	1	Conservative assumption
8	Staff wages	8 $/hr	Conservative assumption
9	**Staff cost per day per animal**	**8 $/animal/day**	**Calculation based on (7),(8)**
10	**Average adoption fee**	**75 $/animal**	**Conservative assumption**
11	**Average medical cost**	**100 $/animal**	**Conservative assumption**

If the average cost is roughly 430 $/animal, and 4 million animals are euthanized per year, then the **total annual cost to save these animals would be (430 $/animal) ×(4 million animals / year) = 1.72 $billion/year.**

How does this compare to large U.S expenditures?

- U.S. budget is $2.1 trillion. We can save 4 million animals for 0.08% of the annual federal budget.
- The American Recovery and Reinvestment Act of 2009 consisted of $787 billion in stimulus spending. We can save 4 million animals for 0.2% of the stimulus spending.
- One month in Afghanistan = $6.7 billion = $223 million / day. We can save 4 million animals for the cost of 1 week in Afghanistan.

Conclusions and caveats

This analysis represents an initial attempt to better quantify the challenge of no kill sheltering. If a major argument against no kill is the resource cost to house animals, this analysis demonstrates that the costs are trivial compared to other federal budget expenditures, even under very conservative cost assumptions.

The simple model presented here could be used to analyze shelter space at scales ranging from a single shelter to the nation as a whole. Given the dearth of available data, the estimates presented here can be best characterized as order-of-magnitude. Additional shelter data can be used to improve model accuracy.

Note that this analysis represents a hypothetical: how much additional shelter space would we need and what would it cost IF, as a nation, we chose a no kill pathway. How to achieve such an outcome is a much more difficult issue to address. Nonetheless, this analysis provides some insight into a no kill reality.