Evaluation of Bovine Respiratory Disease Morbidity in the Feedlot and its Effect on Net Return Distributions

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INTRODUCTION

One of the most important determinants of profitability in feedlot cattle is the cost associated with morbidity (Gardner et al., 1996). Bovine respiratory disease (BRD) is responsible for a large portion, approximately 75%, of feedlot morbidity and 50-80% of feedlot deaths (Edwards, 1996; Kelly & Janzen, 1986). BRD is associated with poor productive performance, impaired carcass quality, lower average daily gain, and suppressed net returns (Babcock et al., 2009; Cernicchiaro et al., 2013; Wittum et al., 1996). This disease costs the beef industry an estimated $6 billion annually (Abell et al., 2017; Griffin, 1997; O'Connor et al., 2016; U.S. Department of Agriculture, 2013). Risk factors for BRD are well documented across epidemiological literature. Mixed gender groups, intermingled calves from multiple sources, and increased shipping distance are all associated with a higher risk of respiratory morbidity.

OBJECTIVE

❖ Evaluate the impact of the percentage of a pen of cattle individually treated one time, two times, or three or more times for BRD on mortality, performance, and overall expected net returns per head.

DATA & METHODS

Dataset 1: Proprietary feedlot dataset with 1,157 pens and BRD treatment information placed between February 2014 – August 2015

Dataset 2: Midwestern feedlot dataset with 2,592 pens with closeout information placed between February 2001 – February 2006

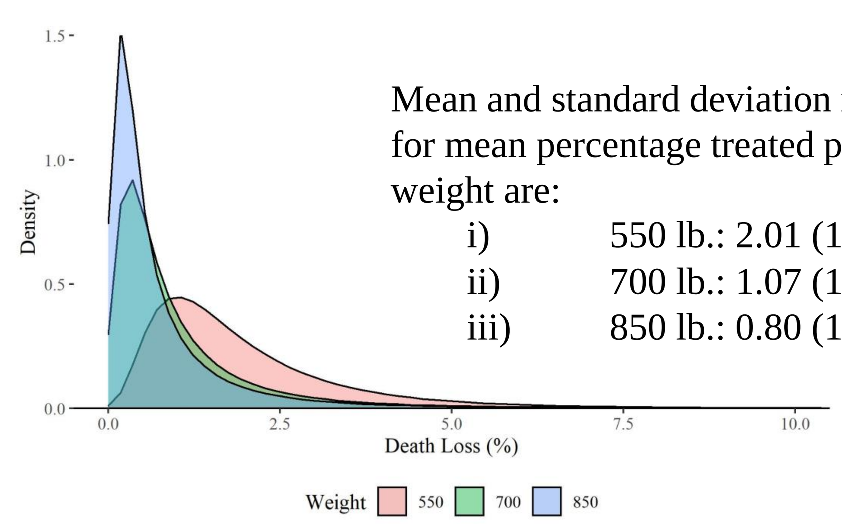
Mortality Rate Model

The conditional mean equation for the Tobit model with multiplicative heteroskedasticity model is specified as,

$$y_i^* = x_i{}'\beta + \varepsilon_i$$
$$y_i = 0 \; if \; y_i^* \le 0,$$
$$y_i = y_i^* \; if \; y_i^* > 0.$$

The conditional variance is specific to each observation and is

$$\sigma_i^2 = \sigma^2[exp(z_i'\alpha)]^2.$$



Mean and standard deviation mortality parameters for mean percentage treated per pen by placement weight are:
i) 550 lb.: 2.01 (1.60)
ii) 700 lb.: 1.07 (1.42)
iii) 850 lb.: 0.80 (1.38)

Model Structural Equations

$$ADG = -1.2175 + 0.2881\,STEER + 0.6703\,lnPWT - 0.0062\,TRT1X - 0.0071\,TRT2X - 0.0059\,TRT3X$$

$$AFC = -0.3272 - 0.3206\,STEER + 1.0199\,lnPWT - 0.0139\,TRT1X + 0.0280\,TRT2X + 0.0309\,TRT3X$$

$$VCPH = 20.2466 + 0.3886\,STEER - 0.8346\,lnPWT + 0.3421\,TRT1X + 0.5113\,TRT2X + 1.0126\,TRT3X$$

$$DOF_{w,k} = \frac{CSW_{w,k} - CPW_w}{ADG_{w,k}}$$

$$YC_{w,k} = 0.40 \times DOF_{w,k}$$

$$FC_{w,k} = \{AFC_{w,k}[CSW_k \times (1 - \varphi_{w,k} - CULL_w) - CPW_w]\}$$

$$FDRC_w = FRP_w \times CPW_w$$

$$IC_{w,k} = \{0.5 \times [YC_{w,k} + FC_{w,k} + VCPH_w] + FDRC_w\} \times DOF_{w,k} \times (IR/365)$$

$$TR_{w,k} = FP \times CSW_{w,k} \times (1 - SHRINK) \times (1 - \varphi_{w,k} - CULL_w) + (CULL_w \times CULLW_w \times CULLP)$$

$$\rho_{w,k} = TR_{w,k} - FDRC_w - YC_{w,k} - FC_{w,k} - VCPH_w - IC_{w,k}$$

Fixed Variables for Simulation

Variable	Description	Value
CPW_w	Cattle purchase weight[1]	550, 700, 850
$CSW_{w,k}$	Finished animal weight[1] if animal reaches maturity (i.e., k = *alive*); 0 otherwise (i.e., k = *dead*)	$N_k \sim (\gamma_k, \sigma)$
$CULL_w$	Proportion of chronically ill animals culled from the remaining cohort based on CPW—550, 700, and 850	0.0226, 0.0079, 0.0050
$CULLP$	Dressed price[2] received for cull animals	1.05
$CULLW_w$	Average dressed weight[3] of culled animals by CPW_w	444, 524, 624
$FEED$	Corn price when cattle are placed on feed[4]	0.0923
FP	Fed cattle sale price[4]	1.2628
FRP_w	Purchase price[4] for 550-, 700-, and 850-pound calves	1.7397, 1.5570, 1.4558
IR	Annualized interest rate	0.05
$SHRINK$	Percentage shrink in live weight when marketed	4%

1: (lb./head); 2: ($/dressed lb.); 3: (dressed lb./head); 4: ($/lb.)

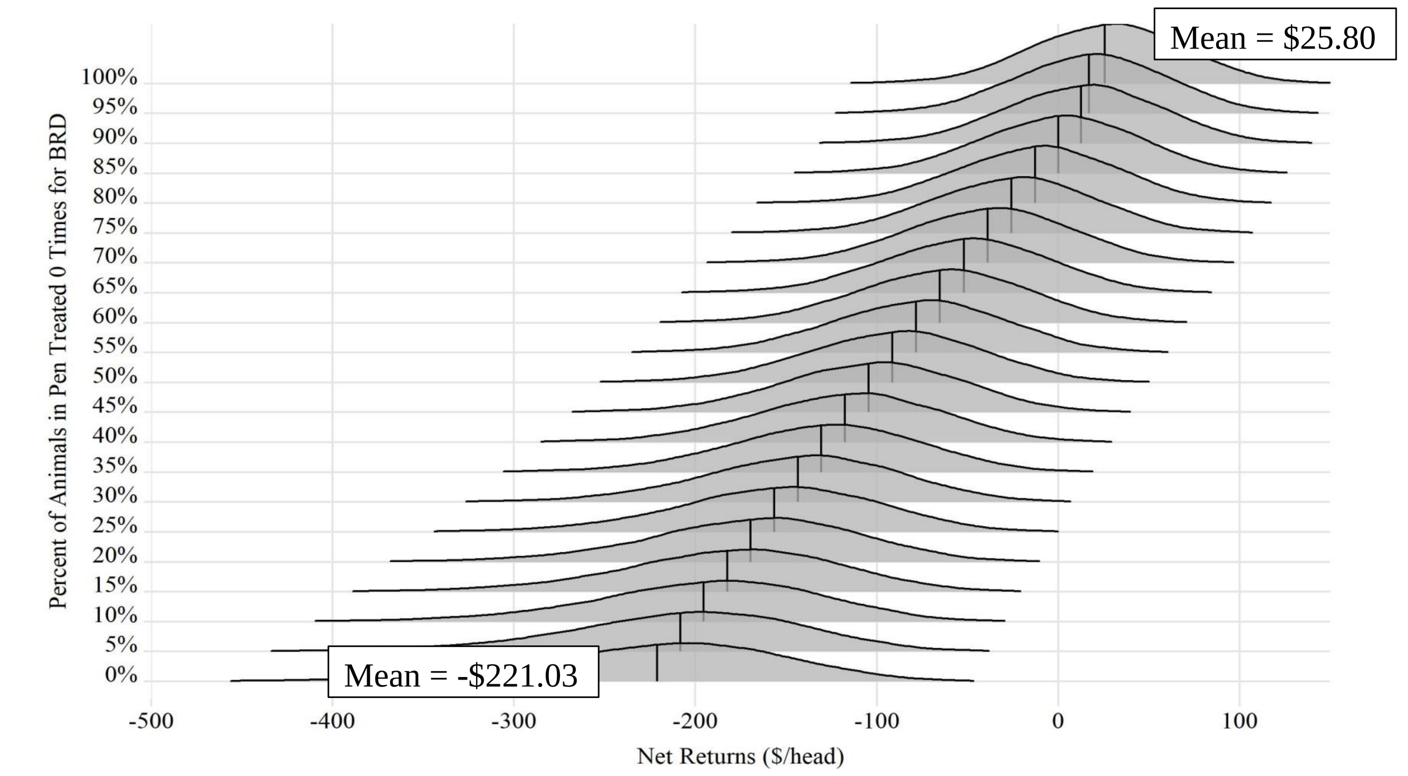
Simulation

Given a value (φ_w) drawn from the log-normal death loss distribution using Halton Draws and a representative pen of 120 head, $\varphi_w \times 120$ net returns are calculated for k = *dead* animals, $CULL_w \times 120$ net returns are calculated for the animals that are culled, $(1 - \varphi_w - CULL_w) \times 120$ net returns are calculated for k = *alive*. The mean of each iteration is calculated, and this is repeated 10,000 times to determine the weighted-average net return distribution.

RESULTS & CONCLUSION

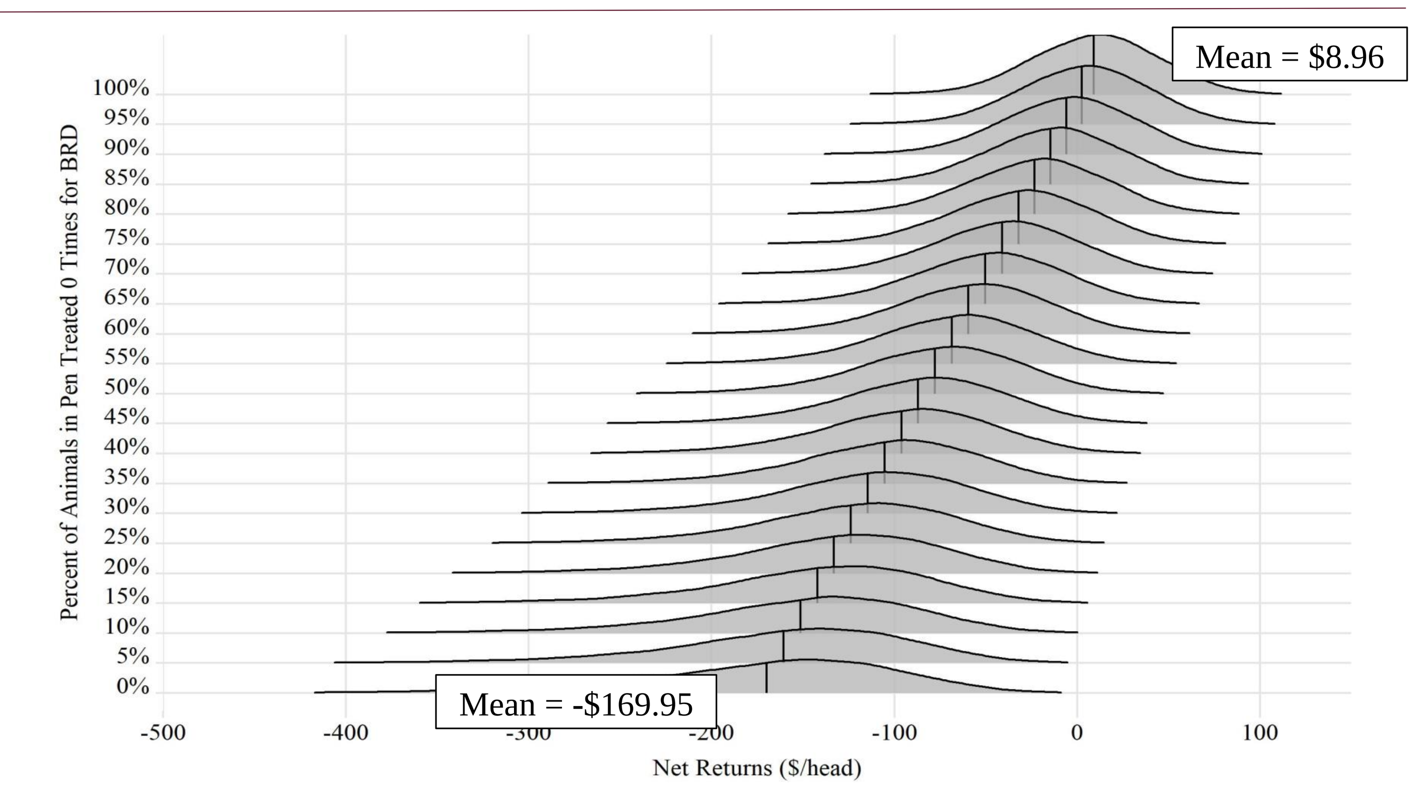
550-POUND SENSITIVITY RESULTS

For 550-pound calves, if no animals are treated for BRD (i.e., TRT 0X = 100), the mean expected net return is $25.80 a head given a purchase price of $1.7397 and a fed cattle price of $1.2628 a pound. Conversely, if all cattle in a pen have received at least one BRD treatment (i.e., TRT 0X = 0.00), the mean net return decreases to a loss of $221.03 per head for cattle with a 550 lb. placement weight.



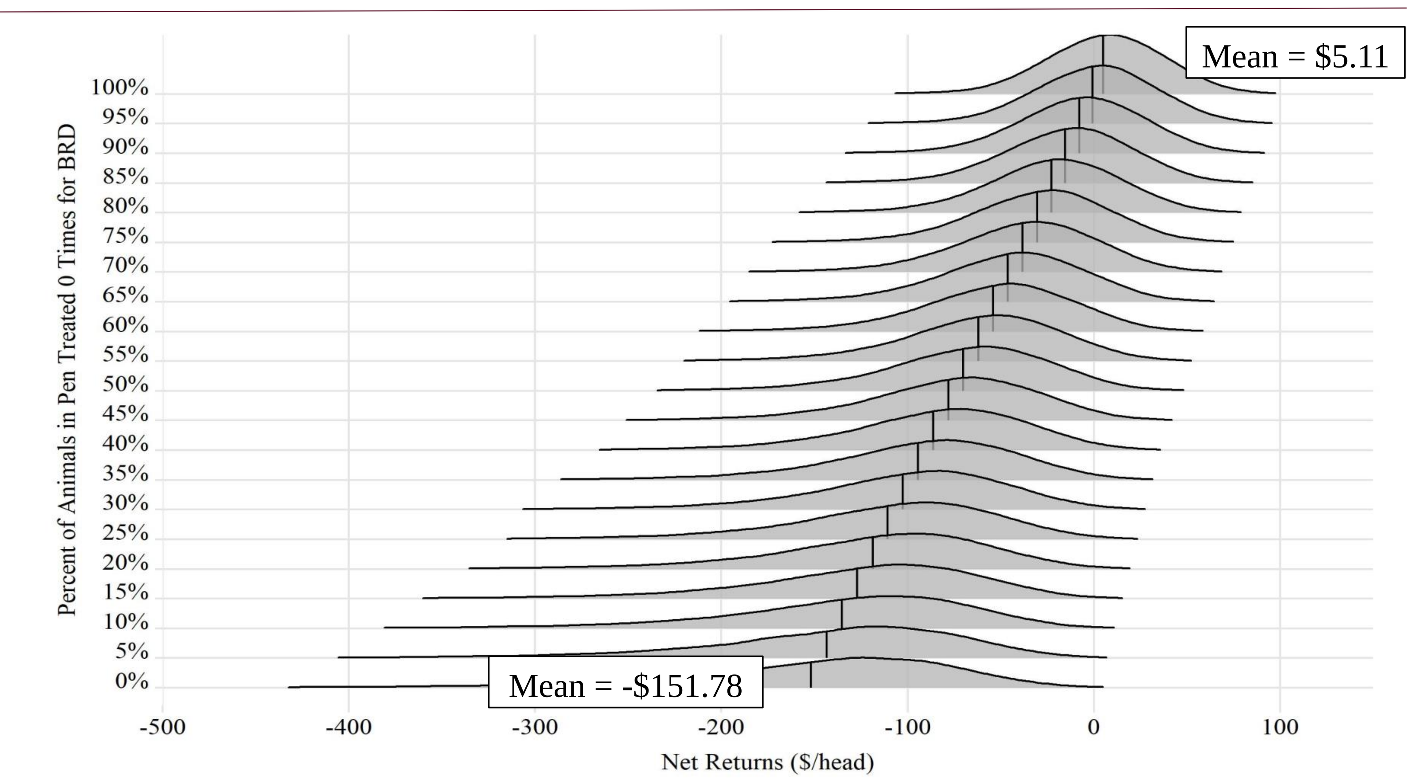
700-POUND SENSITIVITY RESULTS

For 700 lb. cattle, when no animals are treated for BRD, the expected net return mean is $8.96 per head. For pens where all cattle have been treated at least once, the mean of the net returns distribution is -$169.95 per head.



850-POUND SENSITIVITY RESULTS

When pens of cattle with a placement weight of 850 pounds have zero animals treated for BRD, the expected net return per head is $5.11. When all animals have been treated at least once, the mean net return per head is -$151.78. As the placement weight of the animals increase and the number of animals treated for BRD begins to increase, the risk of retreat decreases for heavier placement weights.



Across all placement weights, as the percentage of animals treated within the pen increases (i.e., TRT 0X ↓), the mean net return per head decreases.

- **❖ Decreased animal performance due to BRD related sickness**
- **❖ Increased veterinary cost per head**
- **❖ Increased mean and standard deviation of mortality distribution**