BeefTrader (part II): optimal economical endpoint identification using nonparametric bootstrapping technique decreases greenhouse gases emission and other pollutants in feedlots

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Introduction

Nowadays there is no decision support system (DSS) that monitor individuals on real time during their growth based on optimal economical endpoint (OEE) in large commercial feedlot operations. This challenge will be overcome by this study based on nonparametric bootstrapping technique to create a large synthetic population to test the following hypothesis: traditional slaughter endpoint (TSE) vs. OEE methods have different marginal profit, greenhouse gases emission (GHG), water intake and manure production by kg of meat produced. This simulation study is relevant not just to test this hypothesis, but to evaluate if environmental and economic benefits from OEE animal identification in an experimental scenario is also observed in a large commercial feedlot. The current study is the second from three sequential abstracts based on BeefTrader DSS to

maximize profitability of farmers and the meat industry.

Material and Methods

In the BeefTrader (part I) abstract two datasets (DS) were created. The DS1 was formed by experimental feedlot variables (diet chemical composition, intake, daily weight gain and body chemical composition). The system of differential equations proposed by Oltjen et al. [1986, 2000, named Davis Growth Model (DGM)] reparameterized by Biase et al. (2016) were used to predict the animal growth and body chemical composition. Variables from DGM, exogenous information (i.e., commercial prices, GHG emission factors, manure and water functions) to predict OEE, marginal net value, GHG, water intake and manure production constitute the DS2. Nonparametric bootstrap (NB) resampling was used to create a synthetic population DS3 from DS1 and DS2. The NB performed 100,000 resampling nonparametric for each experimental unit and the confidence of biased corrected percentile bootstrap was determined using the R software (Development Core Team, version 3.1.0, 2014). The mean, median, lower and upper limit were calculated from NB. Biased corrected percentile booststrap interval (95% confidence level) was used to compare the methods from DS3 according to its symmetric and asymmetric distributions probabilities (Efron, 1981).

Results and Conclusions

There was no overlap for confidence intervals for all female variables evaluated (Figure 1). In this situation, there was difference ($P < 0.05$) where OEE was confirmed as the best method bring direct benefits for economic and environmental variables analysed. Similar behavior was identified by males where OEE improved the identification of less impactful environmentally population ($P < 0.05$), however, marginal net value (MNV) was similar between the methods. It is important to highlight that median is considered the best distribution symmetric and asymmetric estimator. Based on median, the accumulated MNV/daily weight gain ratio was 91 and 27 R$/kg to OEE and TSE (more

than 300% of difference, $P = 0.07$). The feedlot median period for female (F) and male (M) for TSE and OEE methods where, respectively: 80 (F) and 115 (M); 41 (F) and 61 (M) days.

In conclusion, OEE and TSE differ and there was no confidence inter-

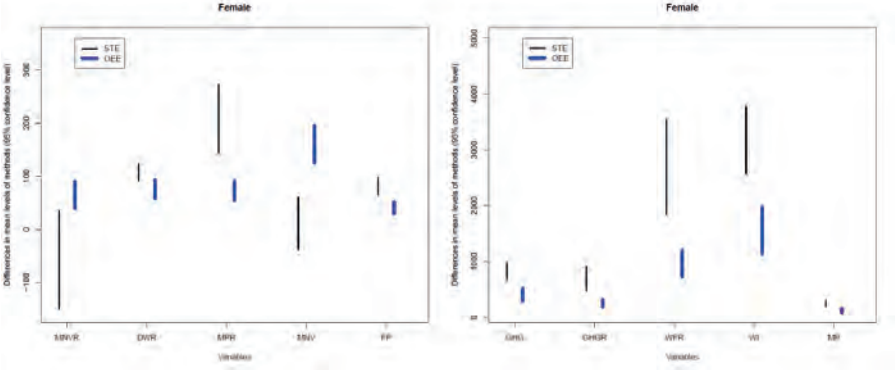

Figure 1. Differences of the mean levels for traditional slaughter endpoint (TSE) and optimal economical endpoint (OEE; 95% confidence level), among variables of female beef cattle synthetic population created using nonparametric bootstrap technique. Variables: marginal net value/DWG ratio (MNVR, R$/kg gain); body weight gain (DWR, kg); manure production/DWG ratio (MPR, kg DM/kg gain); marginal net value (MNV, R$); feedlot period (FP, day); greenhouse gases emission (GHG, kg CO_2-eq); GHG/DWG ratio (GHGR, kg CO_2- eq/kg gain); water intake/DWG ratio (WFR, l/kg gain); water intake (WI, l/kg gain) and manure production (MP, kg DM). The variables were grouped on the left or right side according to its fit in the scale of y-axis.

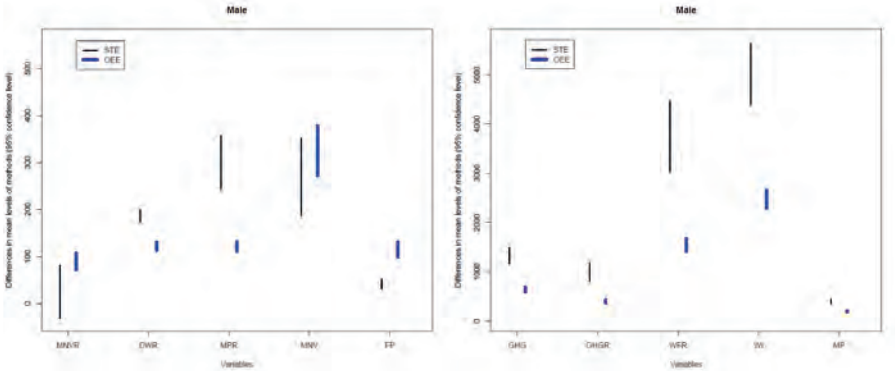

Figure 2. Differences of the mean levels for traditional slaughter endpoint (TSE) and optimal economical endpoint (OEE; 95% confidence level) among variables of male beef cattle synthetic population created using nonparametric bootstrap technique. See Figure 1 for the variables description.

vals overlap from data generated by NB for the most part of variables analyzed between these methods contemplating better precision and accuracy of the inferences. However, what about when the feedlot is owned by the meat packer or is rented? In those situation, does the optimal economical endpoint improve the net economical margins and minimizes the environmental impact? This will be dealt in abstract III.

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