Pure-bred Nellore Prices in Brazil: Morphological, Genetic, Physical, and Market Factors in Auctions

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Overview

Introduction - Pure-bred Nellore Prices in Brazil

Table 1: Why **Brazil**?

2017 Numbers	Brazil Statistics	Brazil Rank	U.S. Statistics	U.S. Rank
Cattle (Million Heads)	223.2	2nd	92.7	4th
Beef Production (million T* CWE**)	9.7	2nd	12.1	1st
Beef Consumption (million T CWE)	7.8	3rd	12.2	1st
Consumption per capita (kg/person/year)	37.5	2nd	37.2	3rd
Population (millions)	207.7	5th	327.1	3rd
Exports (million T CWE)	2.0	1st	1.4	4th
Exports/Production (%)	20.9%		11.3%	

Sources: Athenagro, USDA, FAO, FMI.
* T: ton; ** CWE: Carcass Weight Equivalent

Why Nellore Breed?

Nellore breed is in 80% of Brazilian beef cattle (Rosa and Menezes, 2016).

Introduction - Contrasting Brazil and U.S.

Brazil

Figure 1: Nellore

United States

Figure 2: Angus

Figure 3: Grassland

Figure 4: Feedlot

Introduction

Figure 5: Trip to Brazil

Introduction - Why Pure-bred?

- **Selective breeding process**
- Supplies bulls to the market
- Drive the genetic improvements
- Influences carcass weight, heifer pregnancy, marbling, among other performance measures.
- Seedstock imprints the desired results throughout the production system.

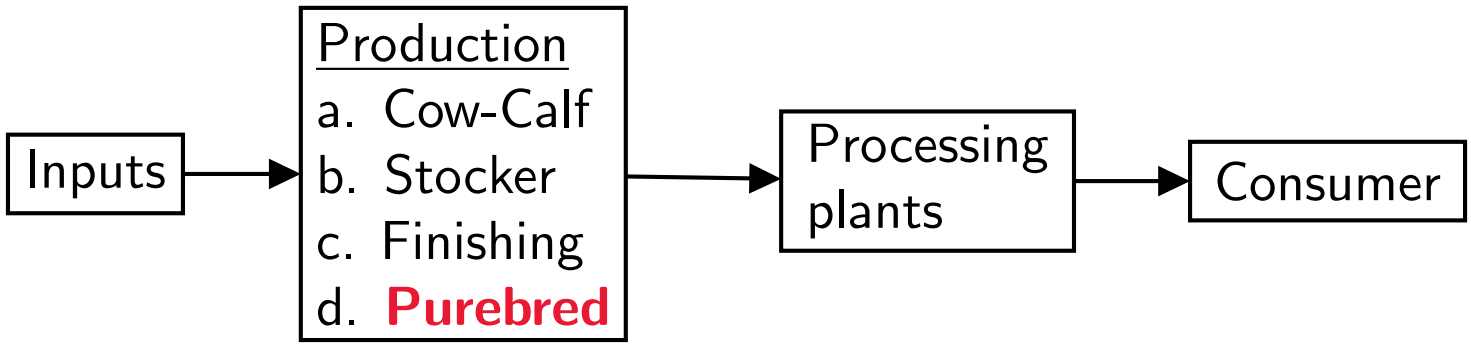

Figure 6: Study Environment

Introduction

Table 2: Variables*

Morphological (EPMURAS scores)	**Genetics (EPD in percentiles)**
Body Structure - E	Total Genetic Merit Index - MGT
Precocity - P	Maternal body weight at 120 days of age - MP120
Muscling - M	Body weight at 210 days of age - DP210
Navel – U	Body weight at 450 days of age - DP450
Conformation – R	Scrotal Circumference at 365 days of age - DPE365
Soundness of Feet and Legs – A	Scrotal Circumference at 450 days of age - DPE450
Reproductive Soundness - S	Stayability - DSTAY
EPMURAS quality Index	Probability of Precocious Calving - DP3
Physical	**Market Factors**
Age (months)	Number of heads in a lot (head)
Weight (pounds/lot)	Number of the lot (proxy for order)
Scrotal Circumference (cm)	Farm reputation
	Auction Type
	Auction Place

* Variables in the sale catalog

Introduction

Score	Morphological Variables
1- 6	Body Structure - E
1- 6	Precocity - P
1- 6	Muscling - M
1- 6	Navel – U
1- 4	Conformation – R
1- 4	Soundness of Feet and Legs – A
1- 4	Reproductive Soundness - S
6 - 34	EPMURAS quality Index

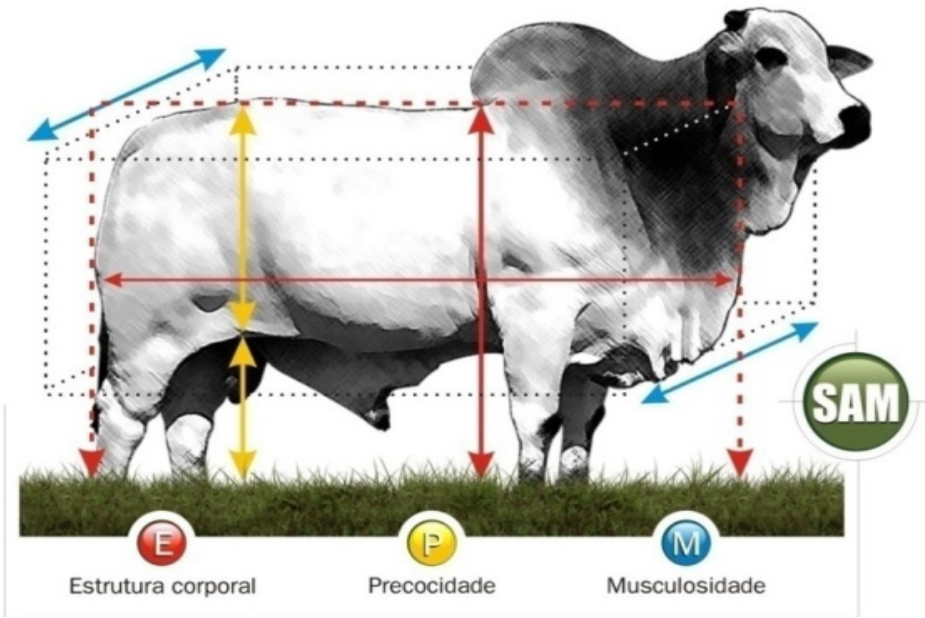

Figure 7: EPMURAS

Introduction

	Genetics Variables*
3%	Maternal body weight at 120 days of age
16%	Body weight at 210 days of age
24%	Body weight at 450 days of age
3%	Scrotal Circumference at 365 days of age
3%	Scrotal Circumference at 450 days of age
22%	Stayability
9%	Probability of Precocious Calving
6%	~~Age at first calving~~
5%	~~Maternal Body Weight at 210 days of age~~
9%	~~Ribeye area~~
100%	Total Genetic Merit Index - MGT

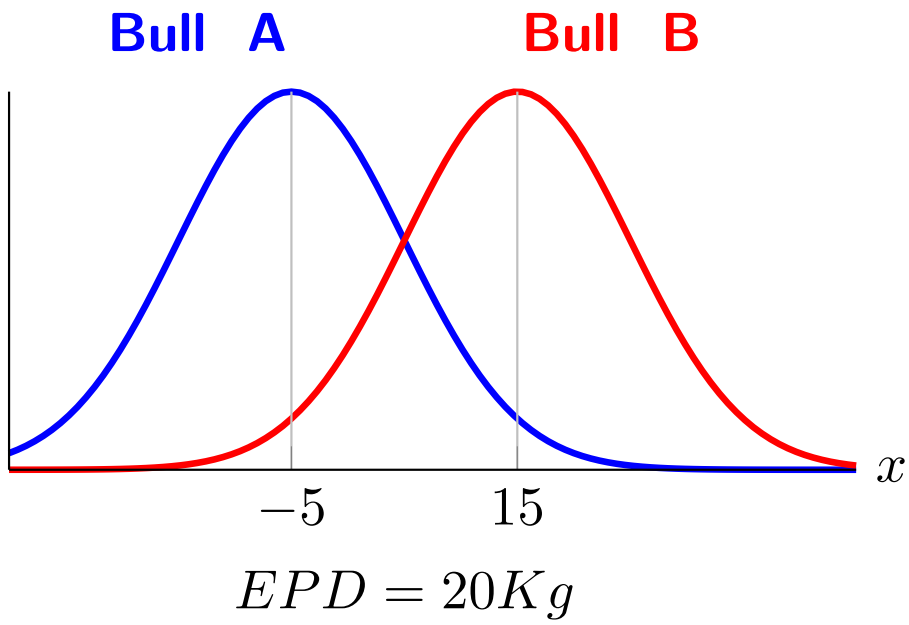

Figure 8: EPD** Concept

* Percentile, range: 0.1 - 100
** Expected Progeny Differences

Introduction

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Introduction - Problem

Problem

How physical, morphological, genetic characteristics and market factors influence the price of Nellore purebred bulls sold at auctions in Brazil?

Introduction - Literature

Feeder cattle

- Physical characteristics affecting price differentials
  - Avent, Ward, and Lalman (2004); Bailey, Peterson, and Brorsen (1991); Buccola (1980); Coatney, Menkhaus, and Schmitz (1996); Faminow and Gum (1986); Marsh (1985); Schroeder et al. (1988); Schulz, Dhuyvetter, and Doran (2015); Williams et al. (2012); Zimmerman et al. (2012).
- Regional, temporal factors and value-added programs
  - Blank, Saitone, and Sexton (2016); Mallory et al., (2016)

Others

- Cowcalf pairs
  - Parcell, Schroeder, and Hiner, (1995)
- Cull cow
  - Mintert et al. (1990); Peel and Doye (2008)
- Bred cows
  - Mitchell, Peel, Borsen (2018)
- Purebred bulls
  -

Introduction - Literature

Purebred Literature

- Dhuyvetter et al. (1996) investigate physical, market, and genetic characteristics in seven **taurines** breed under a hedonic model in Kansas auctions
- Chvosta et al. (2001) examine market, performance and genetic attributes of **Angus** with a hedonic model in Nebraska, South Dakota, and Montana auctions
- Jones et al. (2008) add ultrasound measures within the same scheme of **Angus** economic evaluation in eleven US states.
- Vestal et al. (2013) explore **Angus** performance and genetic features in Oklahoma auction combining revealed and stated preferences in a hedonic model.

Development - Methods

How to model supply and demand?

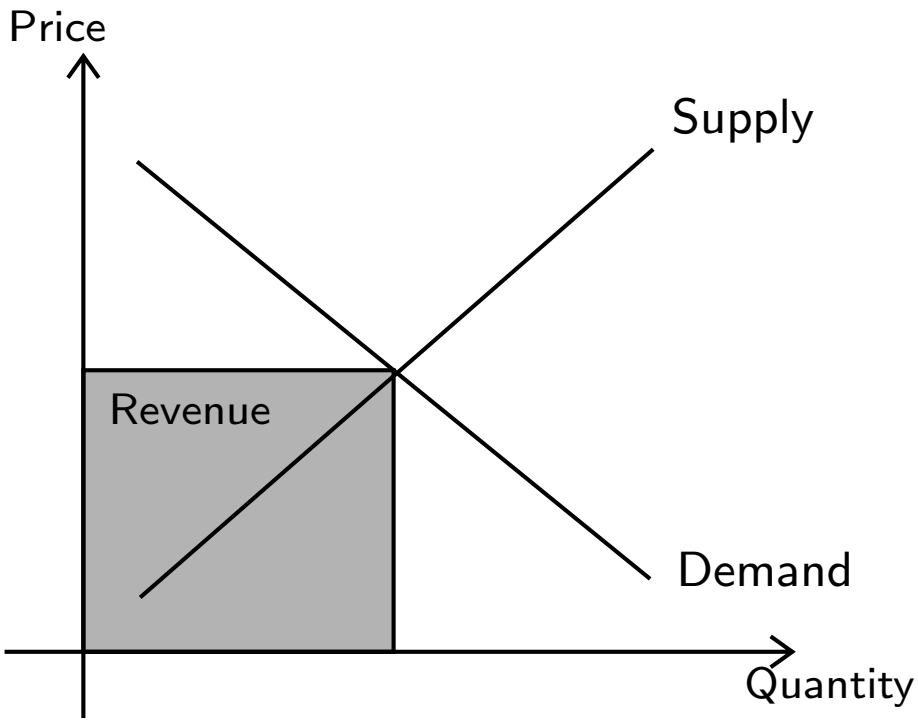
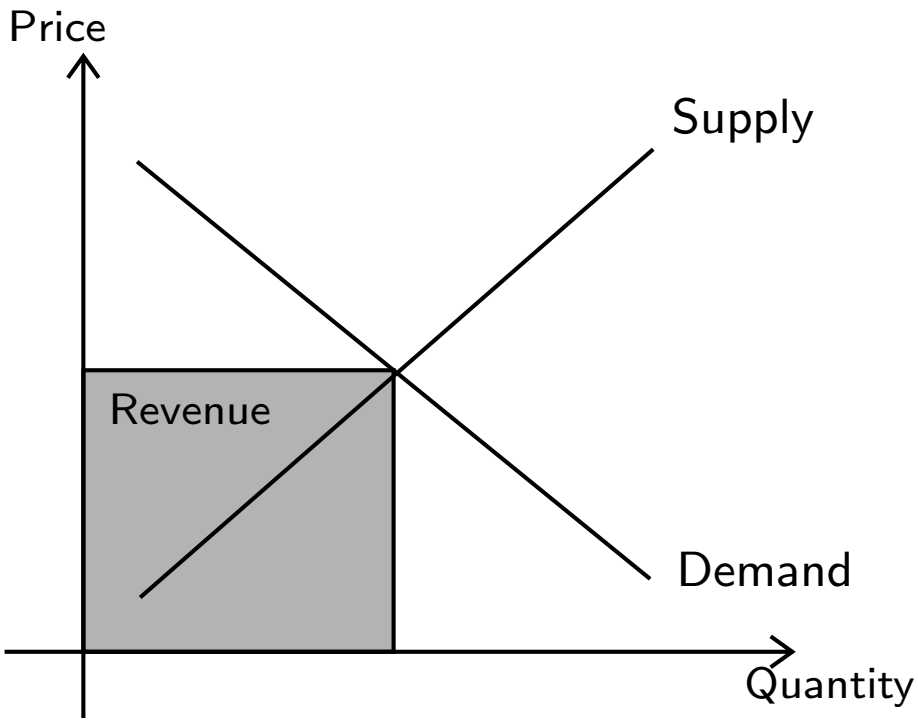


Figure 9: Marshallian Scissors Diagram

Development - Methods

How to model supply and demand?



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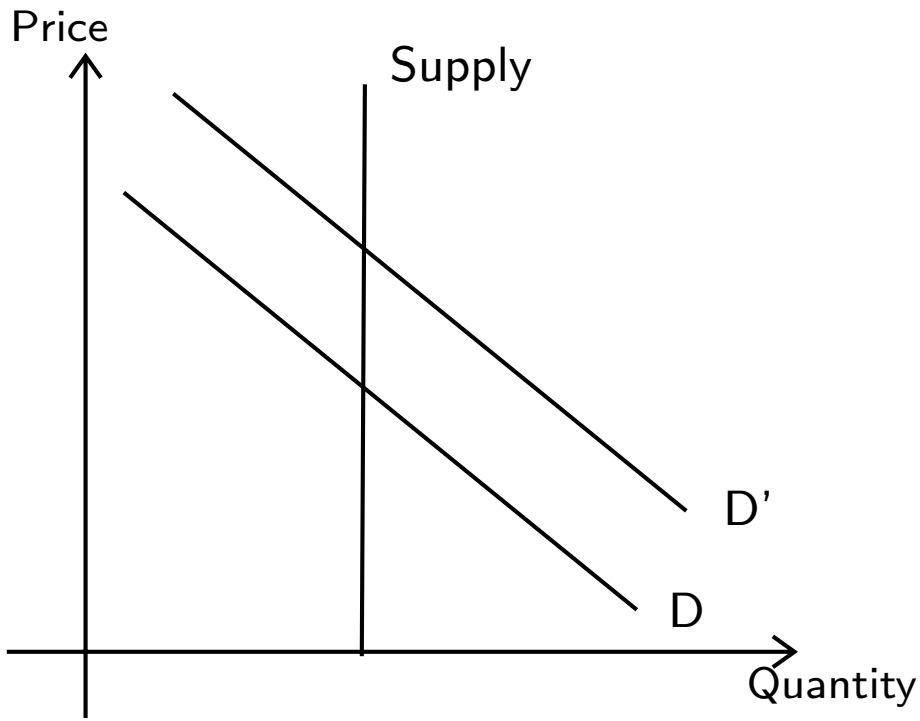

Figure 10: Auctions → Inelastic Supply

Faminow and Gum (1986)

Development - Methods

How to model supply and demand?

- Heterogeneous Product
  - Hedonic Framework
    - $price = f(characteristics)$
    - Lancaster (1966), Rosen (1974), and Ladd and Martin (1976)
- Different Regions
  - Hierarchical model

The Nellore Purebred Model

$$Price_i = \sum_k a_{ikt} P_{ikt} + \sum_l b_{ilt} MF_{ikt} + \sum_m c_{imt} G_{ikt} + \sum_h d_{ht} M_{ht} \qquad (1)$$

Empirical Models

Model 1

$$Log\_Price_i = \beta_0 + \sum_{j=3}^{5} beta_{1j} EPMURAS_{ij} + \sum_{j=2}^{5} \beta_{2j} MGTe_{ij} + \sum_{j=1}^{10} \beta_{3j} Wt_{ij} + \beta_{4j} SC_i + \sum_{j=1}^{2} \beta_{5j} Age_{ij} + \sum_{j=2013}^{2017} \beta_{6j} Year_{ij} + \sum_{j=1}^{7} \beta_{7j} FarmR_{ij} + \sum_{j=1}^{5} \beta_{8j} LotS_i + \beta_{9j} LotN_i + \sum_{j=1}^{2} \beta_{10j} AucT_{ij} + \mu_{s(i)} + \epsilon_i \quad (2)$$

Model 2

$$Log\_Price_i = \beta_0 + \beta_{1j} E_i + \beta_{2j} P_i + \beta_{3j} M_i + \beta_{4j} U_i + \beta_{5j} R_i + \beta_{6j} A_i + \beta_{7j} S_i + \beta_{8j} MP120_{ij} + \beta_{9j} DP210_{ij} + \beta_{10j} DP450_{ij} + \beta_{11j} DPE365_{ij} + \beta_{12j} DPE450_{ij} + \beta_{13j} DSTAY_{ij} + \beta_{14j} D3P_{ij} + \sum_{j=1}^{10} \beta_{15j} Wt_{ij} + \beta_{16j} SC_i + \sum_{j=1}^{2} \beta_{17j} Age_{ij} + \sum_{j=2013}^{2017} \beta_{18j} Year_{ij} + \sum_{j=1}^{7} \beta_{19j} FarmR_{ij} + \sum_{j=1}^{5} \beta_{20j} LotS_i + \beta_{21j} LotN_i + \sum_{j=1}^{2} \beta_{22j} AucT_{ij} + \mu_{s(i)} + \epsilon_i \quad (3)$$

Development - Results

Table 4: Parameters Estimates for The Nellore Hedonic Pricing Model

Dependent Variable:		Log of real Prices				
		Model 1			Model 2	
Lot Characteristics		Estimate	SE		Estimate	SE
EPMURAS	32 - 34 Excellent	0.210**	0.0741	E	-0.0232	0.0167
	29 - 31 Very Good	0.0868	0.0522	P	0.0465**	0.0175
	25 - 28 Good	0.0257	0.0272	M	0.00830*	0.0035
	20 - 24 Regular	base		U	0.000981	0.0132
				R	0.0337***	0.0052
				A	0.0501*	0.0239
				S	0.0407***	0.0061
MGTe	0.1 - 5% Excellent	0.0617**	0.0222	D3P	0.000554*	0.0003
	06 - 15% Very Good	-0.00883	0.0169	DSTAY	-0.000867**	0.0003
	16 - 30% Good	0.0155	0.0118	DPE450	-0.000217	0.0006
	31 - 50% Regular	base		DPE365	0.000288	0.0005
	100 - 51% Inferior	0.0211	0.0280	DP450	-0.000714***	0.0002
				DP210	-0.000346**	0.0001
				MP120	-0.00107***	0.0002

Development - Results

Table 4: Parameters Estimates for The Nellore Hedonic Pricing Model (*continued*).

Dependent Variable:		Log of real Prices			
		Model 1		Model 2	
Lot Characteristics		Estimate	SE	Estimate	SE
Weight	<1,200	-0.112**	0.0351	-0.222**	0.0821
	1,201–1,300	-0.0950***	0.0123	-0.184*	0.0918
	1,301–1,400	-0.121***	0.0270	-0.160***	0.0409
	1,401–1,500	-0.0494***	0.0050	-0.0489*	0.0222
	1,501–1,600	base		base	
	1,601–1,700	0.0269*	0.0129	0.0418	0.0235
	1,701-1,800	0.0322	0.0192	0.0523***	0.0123
	1,801-1900	0.161***	0.0073	0.201***	0.0197
	1,901-2,000	0.219***	0.0085	0.237***	0.0148
	>2,000	0.384***	0.0141	0.382***	0.0092
SC		0.0149***	0.0030	0.0159***	0.0024
Age	<=27 months	0.0860***	0.0118	0.0209*	0.0094
	>27 months	base		base	
Year	2013	base		base	
	2014	-0.0481***	0.0142	-0.0678***	0.0132
	2015	0.353***	0.0607	0.500***	0.0241
	2016	0.279***	0.0313	0.260***	0.0344
	2017	0.190	0.0998	0.173	0.1029

Development - Results

Table 4: Parameters Estimates for The Nellore Hedonic Pricing Model (*continued*).

Dependent Variable:		Log of real Prices			
		Model 1		Model 2	
Lot Characteristics		Estimate	SE	Estimate	SE
Lot size	1	0.0763**	0.0253	0.125***	0.0135
	2	base		base	
	3	-0.000816	0.0279	0.00658	0.0187
	4	-0.0543**	0.0187	0.0300	0.0217
	5	-0.0476	0.0534	-0.0184	0.0156
Lot number		-0.000468	0.0002	-0.000357	0.0002
Farm	A	base		base	
	B	0.197	0.1667		
	C	0.456***	0.0508	0.369**	0.1285
	D	0.456***	0.0656	0.311*	0.1367
	E	0.455***	0.0560	0.391**	0.1390
	F	0.381***	0.0520	0.222	0.1184
	G	0.587***	0.0553	0.397**	0.1428
Auction Type	1	base		base	
	2	0.160***	0.0378	0.180*	0.0736

Conclusion

Overall

1. Extends the knowledge of livestock prices
2. Morphological index brings higher premiums than the genetic index.
3. Visual scores and EPDs explains variations in prices, especially the ones related to precocity.
4. Younger, heavier and with a larger scrotal perimeter animal are more valued.
5. Over the years lots have been appreciating. Individual lots, auctions with the presence of animals (not only recorded videos), and reputation add value to the bulls.

Conclusion

Implications

1. Strategies to enhance the lot sale price might involve not only genetics and physical factors but also morphological and market factors.
2. Farmers may also use the results to establish their cattle operations goals.
3. Buyers can use the finding as a benchmark to evaluate their investments.
4. Policymakers can observe the country moving towards more precocity animals, following the U.S. path. Thus, more productivity.

Future Research

1. How do different buyers (purebred and commercial farms) evaluate values each lot attribute?
2. Add carcass EPDs measures to our model as well.

Thank You!

Main References

- Chvosta, J., Rucker, R. R., & Watts, M. J. (2001). Transaction costs and cattle marketing: The information content of seller-provided presale data at bull auctions. American Journal of Agricultural Economics, 83(2), 286-301. doi:Doi 10.1111/0002-9092.00156 item Dhuyvetter, K. C., Schroeder, T. C., Simms, D. D., Bolze, R. P., & Geske, J. (1996). Determinants of purebred beef bull price differentials. Journal of Agricultural and Resource Economics, 21(2), 396-410.
- Filho, W. K. (2001). Analise Genetica de Escores de Avaliacoes Visuais e suas Respectivas Relacoes com Desempenho Ponderal da Raca Nelore. (Master in Animal Science), Universidade de Sao Paulo, Pirassununga.
- Filho, W. K. (2005). Escores Visuais e suas relacoes com caracteristicas de crescimento em bovinos de corte. (Ph.D.), Universidade Estadual Paulista, Jaboticabal.
- Jones, R. D., Turner, T., Dhuyvetter, K., & Marsh, T. (2008). Estimating the Economic Value of Specific Characteristics Associated with Angus Bulls Sold at Auction. Journal of Agricultural and Applied Economics, 40(01), 315 - 333.
- Koury Filho, W., & Albuquerque, L. G. (2002). Proposta de Metodologia para a coleta de dados de escores visuais para programas de melhoramento. Paper presented at the Congresso Brasileiro das Racas Zebuinas, Uberaba.
- Rosa, A. d. N. F., & Menezes, G. R. d. O. (2016). Papel do Zebu na pecuária de corte brasileira. Retrieved from https://www.embrapa.br/en/busca-de-noticias/-/noticia/9523901/artigo-papel-do-zebu-na-pecuaria-de-corte-brasileira
- USDA. (2018). Foreign Agricultural Service. Retrieved 2/19/2018, from FAS - USDA https://apps.fas.usda.gov/psdonline/app/index.html#/app/downloads
- Vestal, M. K., Lusk, J. L., De Vuyst, E. A., & Kropp, J. R. (2013). The value of genetic information to livestock buyers: a combined revealed, stated preference approach. Agricultural Economics, 44(3), 337-347. doi:10.1111/agec.12016