Price Determinants of Ranch Horses Sold at Auction in Texas

Authors

Kelly Lange
Texas Tech University
Box 42132
Lubbock, Texas 79409-2132
(806) 742-2821
kelly.lange@ttu.edu

Dr. Jeffrey Johnson
Texas Tech University
Box 42132
Lubbock, Texas 79409-2132
(806) 742-2821
jeff.johnson@ttu.edu

Dr. Kris Wilson
Texas Tech University
Box 42132
Lubbock, Texas 79409-2132
(806) 742-2821

Wesley Johnson
Texas Tech University
Box 42132
Lubbock, Texas 79409-2132
(806) 742-2821

Selected Paper prepared for presentation at the Southern Agricultural Economics Association Annual Meeting, Orlando, FL, February 6-9, 2010

Abstract

A hedonic pricing model was used to determine parameters affecting ranch horse prices at two Texas auctions. Color, sex, age-sex interaction, sale order, and consigning ranch were all found to significantly affect price. Sire analysis found that progeny performance records did not significantly affect price.

Key Words: auction, hedonic model, ranch horses

JEL Classifications: C01, Q10

Introduction

With the growth of the ranch horse industry (specifically the recreational ranch horse industry) in the past decade, more sales have evolved focusing on ranch horses. Despite this growth, there is very little information available to the buyers and sellers of these ranch horses concerning the impact of characteristics of these horses on the price in auction markets.

The primary objective of this study is to determine the parameters affecting price in auction markets for sales of ranch horses in Texas. The objective is to develop an econometric model to describe the effects of parameters on sales price of ranch horses in Texas.

By conducting a hedonic analysis, we can find the implicit prices for characteristics of a good. With the computation of these values, we can compare the market's desire for one trait and how it compares with another similar trait seen in the same type of good (Day 2001). A hedonic model will consist of many different deciding factors, including physical characteristics, pedigree (or genealogy), performance, sale order, and economic conditions in the market (Taylor et al. 2004).

Literature Review

Hedonic price analysis has been reported in horses and other livestock species, but price studies do not exist for the ranch horse industry. Some ranch horses will never earn any money, but instead will simply be used for work or recreation, thus making ranch horse prices dependent on factors other than competitive performance parameters. Most of the hedonic price research in livestock has been in the race horse, show horse, and breeding cattle industries.

Hedonic prices are the implicit prices of attributes and are revealed to economic agents from observed prices of differentiated products and the specific amounts of characteristics

associated with them (Rosen 1974). Hedonic price analysis determines how characteristics of a certain good or service affect the price of that good or service and in which direction.

Hedonic Pricing Research in the Race Horse Industry

Robbins and Kennedy (2001) conducted research involving buyer behavior in a Thoroughbred race horse yearling market. In this project, they determined the impact of the dam on the yearling horse price. Their study analyzed data from the sale of 1581 yearlings offered in both summer and fall sales. Robbins and Kennedy used a regression model on selected explanatory variables and calculated how these variables affected the price of the yearlings. This study found that progeny performance affected price more than dam performance, and confirmed that sire and sire progeny performance also affect the price of the yearling for sale.

Vickner and Koch (2001) conducted research involving Thoroughbred yearlings using data from the 1999 Keeneland September Yearling Sale which sold 212 yearlings. The main goal of this study was to uphold the results of a previous study, which stated that the price penalty received by sellers who breed and race horses is not statistically significantly different from that received by sellers who just breed horses. They considered the following variables and how they affected price: day of sale, age of yearling, stud fee, racing performance of sire and dam, geographic origin of yearling, and yearling health information. They failed to reject the previous conclusion, and therefore stated that sellers who breed and race horses do not necessarily receive higher prices for their yearlings than those sellers who just breed horses.

Stoeppel and Maynard (2006) also conducted hedonic pricing research in the Thoroughbred market. They considered hedonic pricing of Thoroughbred broodmares in foal who were sold at Keeneland's 2005 sale. Their data represented 298 broodmares who were in

foal at the time of sale. Using a hedonic model and regression analysis, they concluded that the sire's stud fee and broodmare's age were the two largest factors on the day of sale.

In the mid-Atlantic region, Commer (1992) researched the factors of price and trends at sales in the region's Thoroughbred market. The project looked at "black-type" ancestry (black-type refers to those horses who excel in performance of higher quality races), sex of yearling, month of foaling, and nomination for restricted races. All of these factors were found to be significant in the pricing of these horses when sold. Commer used regression models and principles of hedonic pricing models to evaluate his data.

Quarter Horse Pricing Research

Taylor et al. (2004) conducted a study of price determinants of show quality Quarter Horses using data gathered from the American Quarter Horse Association World Show sale from 1995 through 2002. This study used regression analysis and hedonic pricing principles to analyze factors such as sex, color, age, points in different classes, sire and dam rankings in certain standings, and sale order. These factors were found to have a significant effect on the price of horses sold at the American Quarter Horse Association World Show sale.

Hedonic Pricing and Regression Analysis in Cattle Markets

Buccola (1982) considered the much more open and active cattle market and different buyer reactions to trends in the pricing in this market. With this being a much more open and active market, different buyers had different strategies for purchasing cattle in an auction market. Through the analysis of regression models looking at the effect of lot position, average weight, and price per hundredweight, he was able to analyze different factors including effects on buyer strategy, and which parameters were most effective to the price and strategy. In this study, cattle were considered breeding livestock rather than a recreational item or tool in the workplace, thus

this type of buyer strategy is less relevant in the horse industry, but the hedonic modeling is similar to the type needed to analyze data gathered for this project.

Chvosta et al. (2001) conducted a study of the information some sellers provide prior to a cattle sale and how this can affect the buyer strategy and price of the cattle they are trying to sell. Using regression models, the authors considered factors including age, expected progeny differences (EPDs), simple performance measures (SPMs), and other factors. The study determined how EPD and SPM data, when provided to potential buyers prior to the sale, affected the price of the cattle. Much like the expected progeny differences and simple performance measures, the lineage and performance of the horse for sale is provided to potential buyers prior to the sale. Performance is usually measured in dollars earned by the ancestors of the horse for sale or dollars earned by other offspring of individuals in the lineage. Therefore, this more closely relates to the horse market with the seller providing information prior to the sale which may affect the price of their animal in a positive manner at the sale.

Methods and Procedures

Data has been taken from the Return to the Remuda sale and the Western Heritage Classic sale for the years 2005 - 2009. These sales resulted in a total of 211 horses for 2005, 198 for 2006, 196 for 2007, 215 for 2008, and 218 for 2009. In total, there were 1038 horses consigned to these sales.

If the horse was scratched from the sale, pulled from the sale, or did not attain the reserve set, it was not included in the analysis. Additionally, there were two outliers not included in the analysis, due to high prices. One stallion sold for $75,000 in the 2006 Return to the Remuda sale, and a mare sold for $57,000 in the 2008 Return to the Remuda sale. The next highest seller

in regard to all sales was $29,500. Thus, the sample used in the analysis included 943 horses from the ten sales.

Factors included in the study were lot number at the sale, year of sale, status of the sale, color, age, sex, sire offspring earnings, and consigning ranch. Hedonic analysis was used to determine how these factors affected the price of the horse. From this description of the problem, the following equation was developed where price, P, is a function of the traits:

$P = f(O, Y, D, C, A, S, G, R)$

where *O* represents order in sale, *Y* represents year of sale, *D* represents the specific sale, *C* represents the color of the horse, *A* represents the age of the horse, *S* represents the sex of the horse, *G* represents the sire offspring earnings, and *R* represents the consigning ranch. Using the data from the sales, a regression analysis determined how each characteristic adds to the value of the horse and subsequently compares the significance of these characteristics with one another.

Since data was gathered from 2 different sales it was difficult to compare order number analysis because the Return to the Remuda sale averaged approximately 137 horses per sale and the Western Heritage Classic averaged approximately 69. In order to achieve accurate results from this part of the analysis, the lot number was converted to the quarter of the sale in which they were sold in (1^{st} quarter, 2^{nd} quarter, etc.).

Binomial variables were used for a number of different analysis areas, including year of sale, specific sale, color of horse, age of horse, sex of horse, and consigning ranch. Since there were a large number of different colors found in the data set (15 total), those that had less than 20 observations were compiled into one category, titled “other colors”. The Return to the Remuda sale had 5 ranches in each sale each year. The Western Heritage Classic had from 15 to 19 ranches in the sale each year. Therefore, in order to add more emphasis from the variability in

ranches, the ranches with 20 or fewer horses across all ten sales were again compiled into one category, titled “other ranches”. A more significant data analysis was able to be obtained by condensing the number of color possibilities and number of ranch variables.

In addition to comparing age and sex separately, an age-sex interaction term was created to analyze how the age coupled with the sex of the horse affected price. In order to get a better fitting result for this, an age-sex interaction term that was squared was also used. This allowed for computation of a non-linear second degree polynomial.

Sire listings were only available for horses sold in the Return to the Remuda sale, so sire offspring data was limited to 637 horses. In order to analyze how sire offspring earnings affected the price of the horse at auction, the top 300 sire listings were obtained from 3 different associations, the National Cutting Horse Association, the National Reining Horse Association, and the National Reined Cow-Horse Association. This data was then used to calculate the sire average offspring earnings from each association for comparison. In addition, by comparing the value of the sire offspring earnings from a sire ranked in the top 50 compared to a sire ranked in the top 100, the value of the genealogy of the horse could be evaluated.

Since the sire data was only available for those horses sold in the Return to the Remuda sale, those iterations were separated and analyzed separately. The data from the 5 years of the Return to the Remuda sale was compared to the complete data set to determine the true effect of sire offspring earnings. It was also possible to compare the data findings to the expected effects of the different factors.

In order to analyze the data using an ordinary least squares regression, it was necessary to choose base variables as shown in Table 1. Table 2 displays the averages, standard deviations,

minima and maxima, and a description of the variables used in the complete analysis. Table 3 contains similar data for the variables used in the sire analysis.

Results

A complete regression analysis of all the horses sold in both sales was conducted. The equation analyzed was as follows:

$$P=\beta_0 + \beta_1 2^{nd} \text{ quarter} + \beta_2 3^{rd} \text{ quarter} + \beta_3 4^{th} \text{ quarter} + \beta_4 DV2006 + \beta_5 DV2007 + \beta_6 DV2008 + \beta_7 DV2009 + \beta_8 DVRTTR + \beta_9 DVGelding + \beta_{10} DVStallion + \beta_{11}(M*Age) + \beta_{12}(M*Age^2) + \beta_{13}(G*Age) + \beta_{14}(G*Age^2) + \beta_{15}(S*Age) + \beta_{16}(S*Age^2) + \beta_{17} DVBay + \beta_{18} DVGray + \beta_{19} DVPalomino + \beta_{20} DVRoan + \beta_{21} DVDun + \beta_{22} DVChestnut + \beta_{23} DVBuckskin + \beta_{24} DVOther + \beta_{25} DVRanch2 + \beta_{26} DVRanch3 + \beta_{27} DVRanch4 + \beta_{28} DVRanch5 + \beta_{29} DVRanch6 + \beta_{30} DVRanch7 + \beta_{31} DVRanch8 + \beta_{32} DVRanch9 + \beta_{33} DVRanch10 + \beta_{34} DVOther\ Ranch + \mu_i.$$

In order to analyze the sire offspring data, a separate analysis was conducted using only the horses sold in the Return to the Remuda sale since these were the only horses for which sire data was available. For this analysis the following equation was used:

$$P=\beta_0 + \beta_1 2^{nd} \text{ quarter} + \beta_2 3^{rd} \text{ quarter} + \beta_3 4^{th} \text{ quarter} + \beta_4 DV2006 + \beta_5 DV2007 + \beta_6 DV2008 + \beta_7 DV2009 + \beta_8 DVGelding + \beta_9 DVStallion + \beta_{10}(M*Age) + \beta_{11}(M*Age^2) + \beta_{12}(G*Age) + \beta_{13}(G*Age^2) + \beta_{14}(S*Age) + \beta_{15}(S*Age^2) + \beta_{16} DVBay + \beta_{17} DVGray + \beta_{18} DVPalomino + \beta_{19} DVRoan + \beta_{20} DVDun + \beta_{21} DVChestnut + \beta_{22} DVBuckskin + \beta_{23} DVOther + \beta_{24} DVRanch2 + \beta_{25} DVRanch3 + \beta_{26} DVRanch4 + \beta_{27} DVRanch5 + \beta_{28} Sire\ AOE\ NCHA + \beta_{29} Sire\ AOE\ NRCHA + \beta_{30} Sire\ NCHA\ Rank + \beta_{31} Sire\ NRCHA\ Rank + \beta_{32} Sire\ NCHA\ Top\ 50 + \beta_{33} Sire\ NCHA\ Top\ 100 + \beta_{34} Sire\ NRCHA\ Top\ 50 + \beta_{35} Sire\ NRCHA\ Top\ 100 + \beta_{36} Sire\ TOAE + \beta_{37} Sire\ TOE + \mu_i.$$

In the case of the Return to the Remuda sale, it was not necessary to consolidate the ranches with fewer than 20 horses into a group called “other ranches” because all ranches consigned at least 20 horses. The color consolidation remained the same.

Table 4 contains all of the variables and the statistical analysis from all the horses being analyzed. Table 5 is the analysis of the horses sold at the Return to the Remuda sale with the sire analysis.

Some minor differences exist in the common factors between the two analyses. First, the 4th quarter sale order was significant for the complete analysis but was not significant for the progeny analysis. The binomial variable for the year 2009 sale was significant for the complete analysis but was not significant for the progeny analysis. The binomial variable for Ranch 2 was significant for the complete analysis but was not significant for the progeny analysis. The binomial variable for stallion was significant in the complete analysis but was not significant for the progeny analysis.

Sale order has an obvious impact on price. The 2nd and 3rd quarter sales both drew over $1600 more per horse than the 1st quarter. Additionally, the 4th quarter drew over $200 more per horse than the 1st quarter. Table 6 summarizes the maximum price of each sale, the lot number of the high selling horse, and the percentage of the sale that was completed when maximum price was attained.

The price of mares was expected to be the lowest value and the price of geldings was expected to be the highest, with the price of stallions between mares and geldings. This expectation was accurate with the average price of mares being $3551.76, average price of stallions being $4800, and the average price of geldings being $6395.92. When both age and sex were considered together through the use of an interaction term, it was found that sex and age are significant in determining price. The maximum price for mares was attained at approximately age 10 in general, while the maximum price for geldings was attained at approximately age 9 in general. The maximum price for stallions was attained at approximately age 7.

Gray and Palomino were the only colors with a significant value. Gray horses received a premium of slightly higher than $1000 over sorrel horses and palomino horses received approximately $400 over sorrel horses.

The significant results for consigning ranch variables include Ranch 2 and Ranch 9. Ranch 2 had the highest values overall, receiving a premium of $1121.44 over Ranch 1 horses. Ranch 9 had the lowest values overall, receiving $2778.08 less than Ranch 1 horses. No other ranches showed significant differences from Ranch 1.

Conclusions

The impact of sale order is interesting due to the fact that in most sales, the highest value items are placed near the end in order for the auctioneers to keep as many attendees as possible at the sale. In these cases, the highest value lots were generally kept in the middle half of the sale. The only sales in which the highest seller was sold in the last quarter were the 2005 and 2009 Western Heritage Classic sales. Other than these sales, the highest sellers were in the 2nd or 3rd quarter in every other sale. This could explain the differences in significance between the complete analysis and the progeny analysis. Since the progeny analysis only contained data from the Return to the Remuda sale and the only high sellers in the 4th quarter were from the Western Heritage Classic sales, the significance could have changed with the Return to the Remuda data only. Based on this data, a seller should have a horse consigned in either the 2nd or 3rd quarters in these two sales.

One reason that stallions may have been both a lower average price than geldings may be due to the much lower number sold. High value stallions are often sold through other outlets where the horse may bring a higher sale price. Additionally, in these two sales, many of the stallions sold were yearlings or two year olds which did not have any performance or breeding records, thus leading buyers to pay lower prices for unproven stallions. Further, trained geldings are often valued much higher than stallions or mares of equal training due to generally having

better temperaments. Evidence of the popularity of geldings for ranch work can be seen most prevalently in the existence of ranch horse competitions restricted to geldings.

It can be assumed that Gray is significant due to Ranch 1 being famous for their gray horses. Palomino color may be assumed to be significant due to some buyers having a preference for the flashy palomino color.

Ranch 2 is known for their horse breeding program, for both ranch-type performance horses and Quarter Horse race horses. Ranch 2 has some famous sires and that are actively promoted through the horses' offspring earnings. Therefore, with their highly respected breeding program including some famous names in today's performance horse world, it is expected that horses from Ranch 2 would obtain higher prices on average than most other ranches, which is what the data shows. Ranch 5 is an emerging ranch, and the main contribution to their high average was the sale of multiple stallions (four total) all of which had sires who were in the top 300 in NCHA, NRHA or NRCHA. These stallions with a high progeny value could be sold at a high price to a ranch needing a stallion for their breeding program.

Finally, the progeny analysis was quite different than expected. Most times when purchasing a horse, the sire and dam analysis (progeny analysis) is the main factor in purchasing that horse rather than factors like color. This study was quite different, with no progeny factors being significant. This could be attributed to simply being a sire analysis, and not analyzing the grand-sires on both the sire and dam side. If the information were available, the grand-sire offspring data could have been more beneficial to a complete analysis of how historical sire progeny data may affect the price of a horse at auction.

In conclusion, the parameters that significantly affect the price for ranch horses are color, order of sale, sex, age-sex interaction, and the ranch of origin. The results of this study indicate

that certain colors of horses consistently bring higher prices. Additionally, the results suggest that sale order has a significant impact on the price that a horse may bring at auction. The sex of a horse also significantly impacts price of ranch horses at auction, as well as sex when considered in tandem with the age of a horse. Finally, the consigning ranch significantly affects the price of ranch horses at auction. Prices may be significantly higher or lower than average depending on the consigning ranch. Thus, by looking at the significant factors found in this study, it would be possible to determine which variables significantly impact the price of ranch horses at auction.

References

Buccola, S.T. "Price Trends at Livestock Auctions." *American Journal of Agricultural Economics* 64(1982):63-69.

Chovsta, J., R. R. Rucker, and M. J. Watts. "Transaction Costs and Cattle Marketing: The Information Content of Seller-Provided Presale Data at Bull Auctions." *American Journal of Agricultural Economics* 83(2001):286-301.

Commer, M. *Price Factors and Sales Trends Affecting the Mid-Atlantic Thoroughbred Market*. University of Maryland, Maryland Cooperative Extension, Bulletin 665, no date.

Day, B.H. "The Theory of Hedonic Markets: Obtaining Welfare Measures for Changes in Environmental Quality Using Hedonic Market Data." *Report for the EU Working Group on Noise.* 2001.

Robbins, M. and P. E. Kennedy. 2001. "Buyer Behaviour in a Regional Thoroughbred Yearling Market." *Applied Economics* 33(2001):969-977.

Rosen, S. 1974. "Hedonic Prices and Implicit Markets: Product Differentiation in Pure Competition." *Journal of Political Economy* 82(1974):34-55.

Stoeppel, K.M., and L.J. Maynard. *Hedonic Price Analysis of Thoroughbred Broodmares in Foal*. University of Kentucky, Department of Agricultural Economics, Bulletin 460, June 2006.

Taylor, M.R., K.C. Dhuyvetter, T. L. Kastens, M. Douthit, and T. L. Marsh. "Price Determinants of Show Quality Quarter Horses." Paper presented at Western Agricultural Economics Association meeting, Honolulu, Hawaii, June 30-July 2, 2004.

Vickner, S.S. and S. I. Koch. "Hedonic Pricing, Information, and the Market for Thoroughbred Yearlings." *Journal of Agribusiness* 19(2001):173-189.

Table 1: Base Variables

Base Variables for Analysis	
Variable	**Base Variable**
Sale Order	1st quarter of sale
Year of Sale	2005
Which Sale	Western Heritage Classic
Sex	Mare
Color	Sorrel
Consigning Ranch	Ranch 1

Table 2: Variable Analysis – Complete

Variable	Average	Standard Deviation	Maximum	Minimum	Description
Price	4725.769	3987.307	29,500	350	Price of horse from auction data
Lot #	58.710	38.830	149	1	Lot number in sale
DV-1st Quarter	0.249	0.433	1	0	1 if in 1st Quarter of sale, 0 if in 2nd, 3rd, or 4th Quarter
DV-2nd Quarter	0.252	0.435	1	0	1 if in 2nd Quarter of sale, 0 if in 1st, 3rd, or 4th Quarter
DV-3rd Quarter	0.252	0.435	1	0	1 if in 3rd Quarter of sale, 0 if in 1st, 2nd, or 4th Quarter
DV-4th Quarter	0.246	0.431	1	0	1 if in 4th Quarter of sale, 0 if in 1st, 2nd, or 3rd Quarter
DV-2005	0.212	0.409	1	0	1 if sold in 2005, 0 if sold in 2006, 2007, 2008, or 2009
DV-2006	0.189	0.392	1	0	1 if sold in 2006, 0 if sold in 2005, 2007, 2008, or 2009
DV-2007	0.194	0.396	1	0	1 if sold in 2007, 0 if sold in 2005, 2006, 2008, or 2009
DV-2008	0.203	0.402	1	0	1 if sold in 2008, 0 if sold in 2005, 2006, 2007, or 2009
DV-2009	0.202	0.401	1	0	1 if sold in 2009, 0 if sold in 2005, 2006, 2007, or 2008
DV-RTTR	0.676	0.468	1	0	1 if sold in the Return to the Remuda Sale
DV-WHC	0.325	0.468	1	0	1 if sold in the Western Heritage Classic Sale
DV-Mare	0.542	0.499	1	0	1 if Mare, 0 if Gelding or Stallion
DV-Gelding	0.376	0.485	1	0	1 if Gelding, 0 if Mare or Stallion
DV-Stallion	0.080	0.271	1	0	1 if Stallion, 0 if Mare or Gelding
M*Age	1.680	3.200	21	0	DV-Mare variable * Age if horse is a mare
M*Age^2	13.052	47.0478	441	0	DV-Mare variable * (Age if horse is a mare)^2
G*Age	2.021	3.425	19	0	DV-Gelding variable * Age if horse is a gelding
G*Age^2	15.803	41.110	361	0	DV-Gelding variable * (Age if horse is a gelding)^2
S*Age	0.135	0.696	11	0	DV-Stallion variable * Age if horse is a stallion
S*Age^2	0.502	6.099	121	0	DV-Stallion variable * (Age if horse is a stallion)^2
DV-Bay	0.215	0.411	1	0	1 if horse is Bay in color, 0 if another color
DV-Gray	0.160	0.367	1	0	1 if horse is Gray in color, 0 if another color
DV-Palomino	0.047	0.211	1	0	1 if horse is Palomino in color, 0 if another color
DV-Roan	0.076	0.2656	1	0	1 if horse is Roan in color (red, blue, or bay), 0 if another color
DV-Dun	0.027	0.161	1	0	1 if horse is Dun in color, 0 if another color
DV-Chestnut	0.031	0.173	1	0	1 if horse is Chestnut in color, 0 if another color
DV-Buckskin	0.041	0.199	1	0	1 if horse is Buckskin in color, 0 if another color
DV-Other	0.027	0.161	1	0	1 if horse is not Bay, Gray, Palomino, Roan, Dun, Chestnut, or Buckskin, or Sorrel
DV-Ranch 2	0.257	0.437	1	0	1 if horse is consigned by Ranch 2
DV-Ranch 3	0.174	0.379	1	0	1 is horse is consigned by Ranch 3
DV-Ranch 4	0.094	0.293	1	0	1 if horse is consigned by Ranch 4
DV-Ranch 5	0.021	0.144	1	0	1 if horse is consigned by Ranch 5
DV-Ranch 6	0.045	0.206	1	0	1 if horse is consigned by Ranch 6
DV-Ranch 7	0.032	0.176	1	0	1 if horse is consigned by Ranch 7
DV-Ranch 8	0.021	0.144	1	0	1 if horse is consigned by Ranch 8
DV-Ranch 9	0.028	0.164	1	0	1 if horse is consigned by Ranch 9
DV-Ranch 10	0.047	0.211	1	0	1 if horse is consigned by Ranch 10
DV-Other Ranch	0.130	0.337	1	0	1 if horse is not consigned by any of the above consignors

Table 3: Variable Analysis – Variables for Sire Analysis Only

Variable	Average	Standard Deviation	Maximum	Minimum	Description
Price	5204.788	4366.030	29,500	550	Price of horse from auction data
Lot #	70.223	40.350	149	1	Lot number in sale
DV-1st Quarter	0.251	0.434	1	0	1 if in 1st Quarter of sale, 0 if in 2nd, 3rd, or 4th Quarter
DV-2nd Quarter	0.251	0.434	1	0	1 if in 2nd Quarter of sale, 0 if in 1st, 3rd, or 4th Quarter
DV-3rd Quarter	0.253	0.435	1	0	1 if in 3rd Quarter of sale, 0 if in 1st, 2nd, or 4th Quarter
DV-4th Quarter	0.245	0.430	1	0	1 if in 4th Quarter of sale, 0 if in 1st, 2nd, or 3rd Quarter
DV-2005	0.226	0.419	1	0	1 if sold in 2005, 0 if sold in 2006, 2007, 2008, or 2009
DV-2006	0.185	0.389	1	0	1 if sold in 2006, 0 if sold in 2005, 2007, 2008, or 2009
DV-2007	0.185	0.389	1	0	1 if sold in 2007, 0 if sold in 2005, 2006, 2008, or 2009
DV-2008	0.203	0.402	1	0	1 if sold in 2008, 0 if sold in 2005, 2006, 2007, or 2009
DV-2009	0.201	0.401	1	0	1 if sold in 2009, 0 if sold in 2005, 2006, 2007, or 2008
DV-Mare	0.548	0.498	1	0	1 if Mare, 0 if Gelding or Stallion
DV-Gelding	0.353	0.478	1	0	1 if Gelding, 0 if Mare or Stallion
DV-Stallion	0.099	0.299	1	0	1 if Stallion, 0 if Mare or Gelding
M*Age	1.688	3.237	21	0	DV-Mare variable * Age if horse is a mare
M*Age^2	13.308	48.842	441	0	(DV-Mare variable * Age if horse is a mare)^2
G*Age	1.981	3.483	19	0	DV-Gelding variable * Age if horse is a gelding
G*Age^2	16.038	42.477	361	0	(DV-Gelding variable * Age if horse is a gelding)^2
S*Age	0.173	0.816	11	0	DV-Stallion variable * Age if horse is a stallion
S*Age^2	0.694	7.395	121	0	(DV-Stallion variable * Age if horse is a stallion)^2
DV-Bay	0.225	0.418	1	0	1 if horse is Bay in color, 0 if another color
DV-Gray	0.188	0.391	1	0	1 if horse is Gray in color, 0 if another color
DV-Palomino	0.036	0.187	1	0	1 if horse is Palomino in color, 0 if another color
DV-Roan	0.086	0.281	1	0	1 if horse is Roan in color (red, blue, or bay), 0 if another color
DV-Dun	0.017	0.130	1	0	1 if horse is Dun in color, 0 if another color
DV-Chestnut	0.025	0.157	1	0	1 if horse is Chestnut in color, 0 if another color
DV-Buckskin	0.027	0.161	1	0	1 if horse is Buckskin in color, 0 if another color
DV-Other	0.019	0.136	1	0	1 if horse is not Bay, Gray, Palomino, Roan, Dun, Chestnut, Buckskin, or Sorrel
DV-Ranch 2	0.380	0.485745	1	0	1 if horse is consigned by Ranch 2
DV-Ranch 3	0.239	0.427	1	0	1 if horse is consigned by Ranch 3
DV-Ranch 4	0.137	0.344	1	0	1 if horse is consigned by Ranch 4
DV-Ranch 5	0.031	0.175	1	0	1 if horse is consigned by Ranch 5
Sire AOE NCHA	2396.500	5225.887	26666.92	0	Sire average offspring earnings in NCHA competition
Sire AOE NRHA	712.866	2504.454	24480.96	0	Sire average offspring earnings in NRHA competition
Sire AOE NRCHA	2193.870	4486.644	16688.85	0	Sire average offspring earnings in NRCHA competition
Sire NCHA Rank	21.735	51.083	233	0	Sire rank (by offspring earnings) in NCHA
Sire NRHA Rank	12.532	36.095	181	0	Sire rank (by offspring earnings) in NRHA
Sire NRCHA Rank	18.052	53.004	234	0	Sire rank (by offspring earnings) in NRCHA
NCHA Top 50	0.057	0.231	1	0	1 if sire is in top 50 sires for NCHA
NCHA Top 100	0.083	0.276	1	0	1 if sire is in top 100 sires for NCHA
NRHA Top 50	0.014	0.118	1	0	1 if sire is in top 50 sires for NRHA
NRHA Top 100	0.146	0.353	1	0	1 if sire is in top 100 sires for NRHA
NRCHA Top 50	0.130	0.337	1	0	1 if sire is in top 50 sires for NRCHA
NRCHA Top 100	0.146	0.353	1	0	1 if sire is in top 100 sires for NRCHA
TAOE	5303.237	9504.581	38664.390	0	Total average offspring earnings
TOE	363313.297	1293499.703	25346561.320	0	Total offspring earnings

Table 4: Statistical Analysis – Complete

Number of Observations: 943
R-Squared: 0.3928
Adjusted R-Squared: 0.37
Intercept: 562.45

Variable	Coefficient	Standard Error	t-statistic	P(>|t|)
2nd Quarter	1230.34	295.19	4.168	3.37e-05
3rd Quarter	1495.71	294.17	5.085	4.48e-07
4th Quarter	542.27	294.54	1.841	0.065936
DV-2006	154.72	331.79	0.466	0.641092
DV-2007	29.03	330.87	0.088	0.930111
DV-2008	-438.09	327.08	-1.339	0.180779
DV-2009	-611.18	327.20	-1.868	0.062094
DV-RTTR	716.07	725.17	0.987	0.323683
DV-Gelding	-1676.02	605.75	-2.767	0.005775
DV-Stallion	-2812.95	1178.21	-2.387	0.017168
M*Age	845.66	137.34	6.157	1.11e-09
M*Age^2	-48.93	8.44	-5.797	9.30e-09
G*Age	1864.36	168.64	11.055	< 2e-16
G*Age^2	-95.21	10.36	-9.187	< 2e-16
S*Age	4232.47	934.79	4.528	6.76e-06
S*Age^2	-317.83	83.43	-3.809	0.000149
DV-Bay	-178.69	284.93	-0.627	0.530742
DV-Gray	881.19	321.96	2.737	0.006322
DV-Palomino	1300.60	526.67	2.469	0.013714
DV-Roan	82.67	419.33	0.197	0.843767
DV-Dun	-283.86	670.62	-0.423	0.672193
DV-Chestnut	-409.79	624.23	-0.656	0.511692
DV-Buckskin	732.22	565.59	1.295	0.195781
DV-Other	197.33	665.84	0.296	0.767018
DV-Ranch 2	1312.77	349.19	3.759	0.000181
DV-Ranch 3	-41.70	383.34	-0.109	0.913397
DV-Ranch 4	-24.66	460.77	-0.054	0.957330
DV-Ranch 5	880.84	774.19	1.138	0.255524
DV-Ranch 6	64.65	897.83	0.072	0.942612
DV-Ranch 7	833.47	959.99	0.868	0.385514
DV-Ranch 8	-834.06	1027.92	-0.811	0.417346
DV-Ranch 9	-1651.70	989.34	-1.670	0.095362
DV-Ranch 10	-533.05	902.71	-0.591	0.554999
DV-Other Ranch	-296.72	802.25	-0.370	0.711577

Table 5: Statistical Analysis – Variables for Sire Analysis Only

Number of Observations: 637
R-Squared: .4048
Adjusted R-Squared: .368
Intercept: 841

Variable	Coefficient	Standard Error	t-statistic	P(>|t|)
2nd Quarter	1819	400.9	4.538	6.88e-06
3rd Quarter	2022	394.3	5.127	3.98e-07
4th Quarter	5324	397.7	1.339	0.181125
DV-2006	2463	448.2	0.550	0.582853
DV-2007	7077	449.8	1.573	0.116202
DV-2008	-383.7	434.6	-0.883	0.377631
DV-2009	-715.1	439.7	-1.626	0.104420
DV-Gelding	-2330	843.5	-2.763	0.005912
DV-Stallion	-2459	1522	-1.616	0.106665
M*Age	676.8	190.6	3.550	0.000415
M*Age^2	-37.48	11.39	-3.292	0.001054
G*Age	1944	235.8	8.242	1.07e-15
G*Age^2	-98.59	14.18	-6.950	9.54e-12
S*Age	3593	1240	2.897	0.003905
S*Age^2	-273.1	109.4	-2.498	0.012765
DV-Bay	324.1	387.6	0.836	0.403489
DV-Gray	1106	414.5	2.668	0.007836
DV-Palomino	1575	826.7	1.905	0.057241
DV-Roan	489.8	543	0.902	0.367403
DV-Dun	-623	1107	-0.563	0.573697
DV-Chestnut	-533.6	932.9	-0.572	0.567559
DV-Buckskin	410.8	912.1	0.450	0.652619
DV-Other	720.3	1053	0.684	0.494146
DV-Ranch 2	602.5	417.5	1.443	0.149549
DV-Ranch 3	-430.7	451.9	-0.953	0.340928
DV-Ranch 4	72.61	538.3	0.135	0.892757
DV-Ranch 5	376.5	880.5	0.428	0.669062
Sire AOE NCHA	.1048	.1727	0.607	0.543982
Sire AOE NRCHA	.2317	.2331	0.994	0.320655
Sire NCHA Rank	-15.29	10.58	-1.444	0.149141
Sire NRCHA Rank	-7.946	11.19	-0.710	0.477799
NCHA Top 50	506.3	1996	0.254	0.799860
NCHA Top 100	-271.7	2247	-0.121	0.903789
NRCHA Top 50	-297.2	1437	-0.207	0.836169
NRCHA Top 100	-491.3	2333	-0.211	0.833301
TOAE	.07149	.07290	0.981	0.327092
TOE	-.0001494	.0001958	-0.763	0.445871

Table 6: Maximum price in each sale, lot number, and percent of sale completed

Highest Value Horse in Each Sale			
Sale	**Max Price**	**Lot #**	**% of sale**
2005 Return to the Remuda	$29,500	56	37.58%
2006 Return to the Remuda	$22,000	67	56.30%
2007 Return to the Remuda	$25,000	40	32.00%
2008 Return to the Remuda	$27,000	51	36.43%
2009 Return to the Remuda	$25,000	78 & 96	54.17% & 66.67%
2005 Western Heritage Classic	$17,000	59	96.72%
2006 Western Heritage Classic	$8,400	24	36.36%
2007 Western Heritage Classic	$14,000	41	59.42%
2008 Western Heritage Classic	$16,000	37	49.33%
2009 Western Heritage Classic	$19,500	74	100%