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Economic Considerations of Aggressively Treating the Influenza Virus in Equines

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ECONOMIC CONSIDERATIONS OF AGGRESSIVLEY TREATING THE INFLUENZA VIRUS IN EQUINES

THESIS

A thesis submitted in partial fulfillment of the requirements for the degree of Master of Science in Agricultural Economics in the College of Agriculture at the University of Kentucky

By

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ABSTRACT OF THESIS

ECONOMIC CONSIDERATIONS OF AGGRESSIVLEY TREATING THE INFLUENZA VIRUS IN EQUINES

The equine influenza virus is a significant cause of respiratory disease in horses. Even though horses generally recover from this virus, sometimes horses with equine influenza develop secondary bacterial infections which can cause severe pneumonia, thereby increasing recovery times. Owners and managers are faced with the decision of whether to delay preventative treatment in hopes of the horse avoids contracting a secondary bacterial infection ("wait and see") or aggressively treat the horse with an antibiotic in hopes of avoiding a serious infection ("treat now"). From a decision making standpoint, the economic considerations include explicit treatment costs as well as nonmonetary costs the owner or manager bear when caring for an ill horse.

This study investigating horse owner/manager preferences for treatment alternatives is approached in two parts. The first part of the study collects data from field practitioners to estimate the cost of treatment strategies under different scenarios. The second part consists of a questionnaire presented to horse owners and managers and includes four choices between alternative treatment strategies. Analyzing the data using a conjoint analysis approach, respondents' willingness to pay for different elements of a treatment strategy are estimated. Based on treatment strategies and demographic interactions, a respondent was willing to pay to cover the cost of a horse who became ill with the equine influenza, but individual price sensitivities suggested horse owners and managers are willing to "treat now" versus "wait and see" in order to not see their horse feel poorly and miss training time.

KEYWORDS: Equine, Equine Influenza, Equine Secondary Bacterial Infection, Kentucky, Mixed Logit Model, Willingness to pay.

Charlotte Rose Hansen

April 15, 2016

ECONOMIC CONSIDERATIONS OF AGGRESSIVELY TREATING THE INFLUENZA VIRUS IN EQUINES

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Chapter I: Introduction

The equine influenza virus is a significant cause of respiratory disease in horses. Even though horses generally recover from this virus, it is highly contagious horse to horse and can cause physical distress (Thomas, 2006). There is no treatment for this virus; while symptoms can be managed, the virus must be allowed to run its course. However, sometimes horses with equine influenza develop secondary bacterial infections which can cause severe pneumonia and increases recovery times. Owners and managers are faced with the decision of whether to delay preventative treatment in hopes of the horse not contracting a secondary bacterial infection ("wait and see") or pre-emptively aggressively treat the horse with an antibiotic in hopes of avoiding a serious infection ("treat now"). The study was designed to characterize a situation in which horse owners either waited to see if a bacterial infection would develop or pre-emptively treat a horse with EXCEDE, an antibiotic marketed by Zoetis which is used for infection in horses' lower respiratory tract.[1, 2]

The purpose of this study is to address the economic considerations of the "wait and see" versus "treat now" alternatives of treating a horse diagnosed with equine influenza. These considerations include the possibility of treatment costs as well as the extent to which the owner/manager prefers to avoid seeing the horse feeling poorly and potentially losing training days. To investigate horse owner/manager preferences, a conjoint analysis is performed on equine influenza virus treatment strategies to estimate the willingness to pay for different attributes of treatment strategies.

[1] EXCEDE must be administered by a licensed veterinarian, and is given in two doses. This is compared to the standard antibiotic which is given daily for 10 days.

[2] A separate study in the University of Kentucky's Gluck Equine Research Center investigated whether this approach was effective in warding off secondary bacterial infections.

The structure of the thesis is as follows: Chapter 2 outlines the horse industry in Kentucky and provides background information about equine influenza and secondary bacterial infections. Chapter 3 provides the literature review. Chapter 4 provides an overview of the theory used to model discrete choices. Chapter 5 introduces the empirical model used in this research. Chapter 6 describes the survey design used in the conjoint analysis experiment. Chapter 7 presents the descriptive statistics of the demographic portion of the survey. Chapter 8 presents the results of the conditional and mixed logit models. Finally, in Chapter 9, the conclusions and implications of the study are addressed.

Chapter II: Background

2.1 *Kentucky*

The state of Kentucky is known as the horse capital of the world for good reason. It is a major breeding center for the Thoroughbred horse industry, is a home to Thoroughbred racing, and generates more revenue in the sale of horses than any other place in the world (“Horse Capital of the World,” n.d.). Kentucky is also known for developing two horse breeds, the American Saddlebred and the Rocky Mountain Horse. Horse enthusiasts come to Kentucky to bask in the breathtaking beauty of Kentucky horse farms laid on the beautiful bluegrass, as well as bring their passion of horses to the state whether just visiting, working for the equine industry, or living amongst other horse enthusiasts while taking care of their own horse.

Kentucky’s rich history with horses is unparalleled to any other state in the United States, which includes a strong history in Thoroughbred horse racing. Even though the Thoroughbred industry has had its ups and downs in Kentucky, in the mid 2000’s, horses became Kentucky’s number one agricultural industry, which is recognized today by people all over the world (Wall, 2011).

The 2012 Kentucky Equine Survey provides data on the importance of the equine industry to the state. Kentucky’s horse industry has a 3 billion dollar impact on the state’s economy, and an estimated 40,665 individuals are employed because of the presence of the equine industry in Kentucky. There are about 242,400 horses in this state, and while Kentucky is known for Thoroughbreds and horse racing, over fifty percent of the state’s horses are not involved in horse racing, but rather in showing and recreation (“2012 Kentucky Equine Survey,” 2012). According to the 2012 Kentucky Equine Survey, there were 54,000 Thoroughbred horses in Kentucky, which can be attributed to breeding, racing, and even people owning a Thoroughbred for recreational purposes. Quarter Horses are the next most populous breed in Kentucky with 42,000 horses, followed by Walking Horse Breeds (36,000), American Saddlebreds (14,000), donkeys and mules (14,000), and Mountain Horse Breeds (12,500). See Table 1 for the complete listing of equine inventory in Kentucky.

Table 2.1: Kentucky Equine Inventory, ***As of July 1, 2012***

Breed	Number	Percent
Thoroughbred	54,000	22
Quarter Horse	42,000	17
Tennessee Walking	36,000	15
American Saddlebred	14,000	6
Donkeys and mules	14,000	6
Mountain Horse breeds	12,500	5
Standardbred	9,500	4
Miniature Horses	7,000	3
Ponies	7,000	3
Paint	6,500	3
Arabian and Half-Arabs	5,500	2
Appaloosa	3,800	2
Belgian	3,300	1
Morgan	2,000	1
Percheron	1,600	1
Paso Fino	1,500	1
Hackney Horse	1,100	<1
Pinto (excludes Paint)	900	<1
Clydesdale	200	<1
Other	20,000	8

According to this survey, recreational riding (trail and pleasure riding) is the primary use of most horses at 32.8%, followed by breeding (stallions, broodmares, foals, yearlings, and weanlings) at 26.8%. 10% of the horses are primarily used for competition (non-racing). Equine use for horse racing is at 6% (Table 2).

Table 2.2: Primary Use of Kentucky Equine, *As of July 1, 2012*

Use	Number	Percent
Trail riding/pleasure	79,500	33
Broodmares	38,000	16
Idle/not working	33,000	14
Competition/show	24,500	10
Yearlings, weanlings, foals	23,000	9
Racing	15,000	6
Other activities	13,000	5
Work/transportation	12,500	5
Stallions at stud	3,900	2

When most people think of Kentucky, they think of horse racing. However, as the statistics show, the majority of people are recreational owners and horses are non-racing breeds. This is the target group for this study. While there is a lot of money invested into breeding and training a racehorse, the “backyard horse owners” constitute the majority of horse owners in Kentucky and therefore represent an important segment of the equine health care industry.

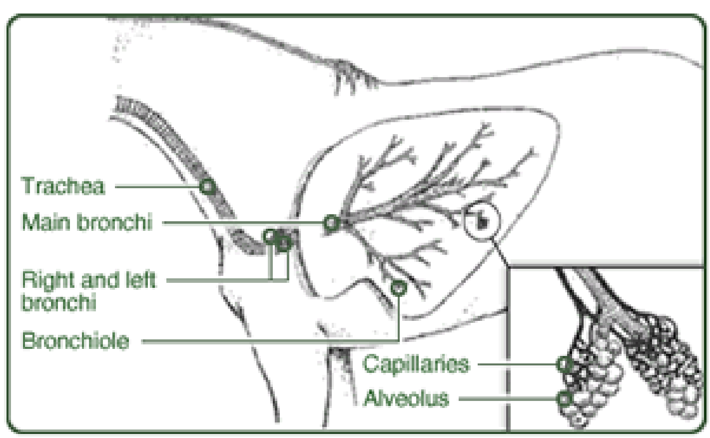
The next few sections provide an overview of the health-related issues concerning equine influenza and respiratory diseases.

2.2 *Respiratory Disease*

2.2.1 Horses Lungs

The function of breathing is to carry oxygen that is inhaled through the horse's nostrils to the lungs, blood, and eventually the muscles. The oxygen that is breathed through the nose enters a series of tubes that begin at the base of the larynx (located at the back of the throat). The first tube is the pharynx, which leads to the trachea. At the bottom of the trachea are the bronchi, each dividing into bronchioles. At the end of the bronchioles are the capillaries and alveoli. This is where gas exchange occurs passing the oxygen into the bloodstream to fuel the muscles the horses need. Anatomic structures of the horse including nerves, cartilage, and muscles, are important to ensure there is no obstruction of airflow to and from the alveoli, this is important while a horse is exercising, especially at high speeds (Oke, 2010; Sellnow, 2000). Respiratory diseases affect these airways and other structures of the lungs.

Figure 2.1: The Horse Respiratory System ("Horse Respiratory System," n.d.)



2.2.2 Causes of Respiratory Disease

Respiratory diseases can be caused by environmental allergens such as mold, pollen, and dust. They can also be caused by parasites, bacteria, and viruses (Pascoe, 2007), although the causation from parasites is not as common. The most common cause of respiratory disease comes in the form of a virus. Although the virus itself is not treatable, vaccinations can provide protection against specific viruses such as equine influenza, equine herpes 1 (EHV1) and equine herpes 4 (EHV4) (Rush, 2014). A bacterial cause of respiratory disease often follows an initial viral illness (Ballweber, 2014); a common sequel to an equine respiratory viral infection is a secondary bacterial infection caused by *Streptococcus equi zooepidemicus*.

2.3 *Equine Influenza*

Equine influenza is a highly contagious virus and is the most common equine respiratory disease in many countries (Timoney, 1996). It has a low mortality rate and horses usually recover, but due to the physical distress brought on by the virus, a horse may be kept out of training and competition for weeks or months (Thomas, 2006). The virus itself is not treatable, but symptoms of the virus can be alleviated by over-the-counter and prescription drugs. Even though there are extensive vaccination programs, transmission and outbreaks still occur, causing major economic losses and threatening equine welfare (Ault et al., 2012).

2.3.1 Transmission

Equine influenza is transmitted through contaminated items such as shanks, water buckets, head collars, twitches and lack of hygienic precautions in handling and transporting of infected and non-infected horses. The virus can travel and infect horses over distances of at least 20 miles (Timoney, 1996). In addition, transmission of the virus has been linked to the international transport of horses for competition and breeding purposes.

Outbreaks of equine influenza generally occur in the late fall, winter or spring. This is when young horses are weaned and are put into training, putting them in contact with other horses and increasing stress levels. The close proximity of horses at race tracks, sales, show, and training centers can also facilitate the spread of the virus (Timoney, 1996).

2.3.2 Symptoms

After an incubation period of 1-2 days, the virus starts by a rise in temperature greater than 102 degrees and can reach 106 °F (Timoney, 1996) and last as long as 4 to 5 days (Paillot, Kydd, & Daly, 2006), along with a loss of appetite, followed by a dry cough and clear nasal discharge (Timoney, 1996; Sarasola, Taylor, Love, & McKellar, 1992). There is also the presence of tender lymphatic glands. Other varying degree of symptoms include depression, conjunctivitis, watery eyes, rapid breathing, difficulty breathing, rapid heart rate, swelling of the limbs, and muscle stiffness or soreness (Timoney, 1996).

2.3.3 Treatment

Laboratory procedures confirm a flu case. This is done by taking a nasopharyngeal swab, usually at the onset of the fever to increase chances of a proper diagnosis. The treatment for equine influenza is symptomatic. Antiviral drugs amantadine and rimantadine may have therapeutic potential for the horse (Timoney, 1996).

The most important treatment for a horse with influenza is a clean stall with proper ventilation and rest (Timoney, 1996). Precautions should be taken to make sure a horse recovering has good stabling which includes good hygiene practices (sweeping, grooming, sanitizing, etc.), minimum dust exposure, and proper stable ventilation (Rush, 2014). The horse should also be kept well-hydrated to prevent dehydration (Timoney, 1996). A high quality and palatable feed should be provided to prevent weight loss (Rush 2014). Drugs can be administered to ease muscle stiffness and soreness, prolonged fever, and depression (Timoney, 1996). During horse transportation, it is important to reduce the amount of stress an animal takes on so that its immune system can fight away a respiratory disease as efficiently as possible.

Complete recovery of the respiratory tract takes up to a month or maybe even longer after the symptoms go away. Horses typically need one week of rest for every day they have a fever. An inadequate rest period will prevent the horse from returning to its full training potential; however, some horses never return to their performance capabilities pre-exposure to influenza (Timoney, 1996). Short-term illness of a horse can cause stress on the horse and owner, and it is during the first few days of illness where proper treatment can possibly prevent the illness from becoming a long-term problem.

2.3.4 Vaccination

Vaccines are an option for horse owners who want to protect against the possibility of their horse getting the equine flu. The first influenza vaccines for horses were developed in the 1960s. Just like that of human influenza, the vaccine only protects against the specific strain of flu that is identified to be most likely to develop in a given year, but does not protect against all influenza strains. The virus mutates and changes.

However, unlike human influenza virus vaccines, the equine flu vaccine provides protection five to seven years before a new strain develops (Thomas, 2006).

Horse owners may choose to vaccinate their horses or not depending on how much contact they come into with other horses. As with any vaccine, the time it takes for an immune response to develop in a horse depends on if the horse has had prior exposure to the influenza vaccine. If a horse has had prior exposure, the immunity from the influenza vaccine will kick in within a few days. If a horse has never been administered an influenza vaccine before, it will take a little longer since they will require a booster shot. If vaccinating too late, it may not protect against the equine influenza. Young horses under the age of four and senior horses over 16 years of age are more susceptible to the virus (Thomas, 2006). It is important that the vaccines are periodically updated to the virus strains that are currently circulating at the time (Timoney, 1996).

By reducing clinical signs of the virus through vaccination, a horse's welfare is improved, which leads to faster recovery, and reduces the chance of a secondary bacterial infection (Paillot, Kydd, & Daly, 2006). Vaccinated horses are less likely to get infections and will only shed the virus for a short period (Timoney, 1996).

A disadvantage of these vaccines is that they have made the diagnoses of the influenza virus less clear as clinical signs are less severe, and blood samples have moderate levels of the vaccine antibody (Newton, Daly, Spencer, & Mumford, 2006). In addition, equine influenza outbreaks still continue, and new vaccinating strategies are important in improving the efficiency of the vaccine. Approximately 70% of the horse population needs to be vaccinated to prevent future influenza outbreaks (Paillot, Kydd, & Daly, 2006).

2.4 *Secondary Bacterial Infections*

Unfortunately, horses can develop secondary bacterial infections after the onset of the influenza virus. This can lead to pneumonia, and/or, pleuritis (Paillot, Kydd, & Daly, 2006), especially in horses that are not vaccinated; these infections can be fatal (Timoney, 1996). The nature and severity of a horse coming down with an infection depends on several factors including age, history of past exposure (which can lead to a weaker immune system), past vaccinations against the influenza virus, and environmental factors (Timoney, 1996).

2.4.1 Secondary Bacterial Infection Symptoms

The secondary bacterial infection will occur a few days after the equine influenza virus fever subsides. The infection will cause the horse to have a second fever that is higher and lasts longer than the first fever from the influenza. A horse’s symptoms include mucopurulent (mucus and pus) nasal discharge, increased coughing, lack of appetite and “signs of bronchial and lung involvement” (Timoney, 1996). They also exhibit other similar symptoms to the equine influenza.

2.4.2. Treatment

Secondary bacterial infections should be treated with appropriate antibiotics and other antimicrobial drugs. Like the Equine Influenza, treatment for a secondary bacterial infection is symptomatic, and proper rest, ventilation, feeding, hydration, and good stabling minimizes recovery time (Rush, 2014). However, if an owner or manager chooses to do so, they have the option of applying aggressive antibiotic therapy in order to reduce the chance of a horse getting an infection.

2.5 *Horse Performance and Economic Loss*

There are monetary and nonmonetary costs associated with a horse that becomes ill with a respiratory virus and bacterial infection. The expense of treatment includes veterinarian visits, medications, as well as an owner's time needed to treat the horse. Damage to the respiratory tract can take weeks to heal. For many, there is a loss in training time for the horse, which may result in an economic loss for the owner and/or trainer. For example, a horse that missed competitions is missing valuable point shows (Giedt, n.d.), and a horse that is racing is missing valuable training time and potentially even races. Even though there are fewer economic losses from a horse that is used for pleasure riding not being able to be ridden, the owner bears the nonmonetary costs of forgone pleasure from riding. In addition, a horse feeling poorly can place stress on an owner. A horse that is put back to work too soon can develop significant complications, and may never be able to reach its full performance potential again (Ball, 1998).

Chapter III: Literature Review

3.1 *Treat Now or Wait and See*

Economic considerations of the treat now versus wait and see approach are studied extensively in the human medical field, but this approach is also seen in the energy field with regards to policy making (Webster, 2002). "Treat now" represents a level of certainty for the decision maker in which they pay a higher cost upfront but there is little to no probability of their horse contracting a secondary bacterial infection. The "wait and see" alternative is a more risky decision in that there is a probability that their horse could get sick which equates to increased monetary costs, time and effort, as well as additional stress on the horse, and other nonmonetary costs the owner must bear in the long run. The decision to treat now versus wait and see may not only be monetary in that it is cheaper or more expensive to treat now than its counterpart, but it also implies that something better may happen, or come along by waiting and delay unnecessary negative outcomes (Rosenbaum, 2002).

People's choices are influenced by different beliefs of expected cost verses the positive or negative effect of its attributes (Webster, 2002). In the equine industry, owners and managers are faced with decisions regarding their horse's health. It is expensive to care for a horse, and depending on a horse owner's or manager's financial situation, perceptions, values, etc., their decision to treat now versus wait and see may vary depending on their personal preferences, as well as the options available to them.

3.2 *Willingness-To-Pay*

Willingness-to-pay (WTP) is the maximum amount that an individual is willing to spend on a good or service or for specific attributes of a good or service (Gafni, 1998). WTP is of great importance in the marketing field; it is used to identify consumer preferences for a good or service (Vlosky, Ozanne, & Fontenot, 1999). WTP studies have centered on agricultural products including organic food, variations of processed products, example, blueberries, and types of labeling (Hu, Woods, & Bastin, 2005; Krystallis & Chryssohoidis, 2005; Loureiro, 2003). WTP is also utilized extensively in the health field and in the realm of environmental economics. For example, residents' WTP to protect rain forests have been investigated (Kramer & Mercer, 1997).

For a consumer to decide on their WTP, they must use their perceptions, emotions, and thinking process to derive a choice (Svenson, 1979). An individual evaluates a product from the intrinsic or extrinsic attributes of that product. Intrinsic attributes are those pertaining to the characteristics of the product or service itself, such as color, material, appearance, form, taste, values, etc. Extrinsic attributes are those that relate to the product but not in a physical sense, such as price, the country the product is produced in, brand name, label, store name and store location, production process, and packaging (Espejel, Fandos, & Flavián, 2007). An individual's own demographics such as age, gender, income, race, and education play a factor in evaluating the attributes of the product and the choice that they make (Hensher & Bradley, 1993), which influence their WTP. It is even suggested that the four demographic attributes of age, gender, income, and education are most important in determining a consumer's WTP when dealing with consumers across many countries (Krystallis & Chryssohoidis, 2005). A respondent’s general attitudes, feelings, or emotions (whether they are biased or not) also play a part in the decision making and their WTP.

3.3 *Revealed and Stated Preferences*

There are two approaches to estimate WTP: revealed and stated preferences. Revealed preferences are based on a consumer’s utility on past or present market buying behaviors (Ben-Akiva et al., 1994; Louviere, Flynn, & Carson, 2010). Utility is the satisfaction one gets from a good or service, whether it be a combination of goods or a single good. The theory was established by Paul Samuelson who stated that by comparing different bundles (or combinations) of goods and services at different price points, it can be discovered which bundles are preferred over the others, subject to an individual’s budget constraint. Furthermore, the bundles that could have been preferred as an alternative to what the consumer chose are “revealed” as inferior to the chosen bundle because they were not chosen (Samuelson, 1948). Revealed preference data is collected based on market observations either in the field, laboratory, or auctions (Breidert, Hahsler, & Reutterer, 2006). The revealed preference approach is founded on the actual buyer behavior in the real world.

In contrast, the stated preference approach is based on hypothetical questions based on the market in order to state their value of a good or service (Freeman, Herriges, & Kling, 2003). The stated preference technique has gained momentum extensively in environmental and resource economics, agriculture and food economics, and health economics within the last two decades (Louviere, Flynn, & Carson, 2010). In the stated preference approach, the consumer makes a choice among hypothetical alternatives based on its attributes (Adamowicz, Louviere, & Williams, 1994). Stated preference data is retrieved from the consumer in the form of direct and indirect surveys. Direct surveys explicitly ask the respondent how much they are willing to pay for a good or service, while an indirect survey asks a respondent to rank or choose the good or service that they prefer (Breidert, Hahsler, & Reutterer, 2006). The individual only states what they would choose given a hypothetical choice, but it may not be what they actually do in the real-world (Adamowicz, Louviere, & Williams, 1994).

Both approaches have advantages and disadvantages. Revealed preference studies are based on actual (rather than hypothetical) decisions, which make them attractive. However, individual preference may not be testable since individuals are not asked specifically for their preferences on a good (Adamowicz, Louviere, & Williams, 1994). These individuals may not know what alternatives are available to them, and new products on the market which often have new attributes associated with them may not be understandable to the individual. Collinearity may also arise amongst attributes within the model and the attributes of goods are often limited in their variation (Brownstone, Bunch, & Train, 2000). Under the stated preference approach, a respondent states what they would do in a hypothetical situation, but they may not actually respond that way in a real life situation. In addition, factors relating to a respondent's fatigue, boredom and not understanding the survey could affect their response (Bates, 1988). However, this preference technique provides an alternative to measuring values that may not be captured from revealed preferences (Adamowicz, Louviere, & Williams, 1994) and allows for more control over attributes, which are decided carefully when preparing the hypothetical questions. Weights can be derived from attributes that a consumer values more than others in a hypothetical question relating to their individual preferences (Bates, 1988). This done so using a method called conjoint analysis.

3.4 *Conjoint Analysis and the Choice Experiment*

The conjoint analysis method is used widely in economics, psychology, and decision making theory (Green & Srinivasan, 1978). Conjoint analysis is a stated preference approach that is used to create and analyze data based on evaluative rankings, also called judgment data. Over the past 25 years, theory and methods developed conjoint analysis further which allow choice experiments to be a form of conjoint analysis and which can forecast consumer behavior (Louivere, 1988). Conjoint analysis is used to predict consumer's preference for a large variety of goods and services which carry multiattribute options (Green & Srinivasan, 1978) and to derive a consumer's utility for the good or service, as well as their willingness to pay for these attributes.

In a choice experiment, respondents are first presented with choices among hypothetical alternatives of a good or service. These alternatives provide products with the same attributes but with varying levels of their attributes. These attributes are carefully selected by experts to help accurately reflect a product or service. Also included in the choice alternatives is a status quo option, meaning the respondent would choose neither (Hanley, Mourato, & Wright, 2001).

Each individual alternative is called a full profile (Breidert, Hahsler, & Reutterer, 2006). Using specialized software, these profiles are created through a process called factorial design. Factorial design creates alternatives with all possible combinations of attributes. Because the number of combinations can be very large, using fractional factorial designs reduces the number of combinations but still keeps the integrity of the combinations from the factorial design. After the full profiles are chosen, they are then placed in groups called choice sets and given to the respondent. The respondent then choses which alternative they would choose, or the status quo. The responses are then analyzed to see what preferences are significant amongst attributes (Hanley, Mourato, & Wright, 2001).

Chapter IV: Theoretical Model

Models in the logit family are typically associated with studying discrete choices in conjoint analysis (Hensher & Greene, 2003), which is fitting for this study. When studying choice experiments, it is important to understand the underlying theory behind utility maximization, which serves as the basis for conjoint analysis and the models that are applied to this method.

4.1 *Random Utility Model - Framework*

Historically, the Random Utility Model (RUM) was used to identify inconsistencies in behavioral patterns of individuals. Later, the RUM became popular in econometrics in order to represent maximizing behavior of an individual (Manski, 1977), and is now a recognized method in studying discrete choices (Baltas & Doyle, 2000). RUM provides the framework for consumer choice and the foundation for the logit model family.

RUM is built on the choice a consumer is faced with and implies that an individual's utility is not directly related to the good or service itself, but rather that the characteristics of that good or service, which may come in many combinations, determine an individual's utility (Lancaster, 1966). When an individual chooses an alternative amongst a set of full profiles they are presented with, they are choosing the alternative that gives them the greatest utility (Hensher & Greene, 2003). RUM allows for unobserved characteristics to be random, known as a stochastic element in the model (Baltas & Doyle, 2000).

4.2 *Random Utility Model - Equation*

There are two components to the RUM. One element is deterministic and is assumed known by everyone, and the second is stochastic, which is random and varies among a consumer's taste and preferences (Hanley, Mourato, & Wright, 2001). The RUM takes on the functional form

$$U_{ijt} = \beta X_{ijt} + \varepsilon_{jt} \qquad (1)$$

where *i* is the individual, *j* are the alternatives an individual faces (*j=1, 2, 3, 4…...J*) in the *t*-th choice set, and U_{ijt} is the overall utility of the individual. The first part of the equation, βX_{ijt}, is the deterministic component of unknown parameters (β) to be estimated where X_{ijt} are the attributes of the alternatives in the full profiles, and also include demographic information. These are the estimations from the choice experiment, and signify the taste and preferences of the population. The second part of the equation (ε_{jt}) is the stochastic element which is the random error term and accounts for any unobserved preferences in alternatives from the observed attributes (McFadden, 1973). This error term is assumed to be normally distributed, as well as independent and identically distributed (IID), meaning it does not allow for the error term of the alternatives presented to the individual to be correlated in any way (Hensher & Greene, 2003).

Chapter V: Empirical Model

The models used to empirically analyze discrete choices are presented in this chapter.

5.1 *Conditional Logit Model*

The conditional logit model is built from the RUM model. It is commonly used in studying discrete choices, where it is assumed an individual maximizes their utility. The model results in the choice probability of an individual (*i*) choosing the alternative (*j*) in the *t*-th choice set that gives an individual the greatest satisfaction (McFadden, 1973).

With the assumption that the error term is IID and the IIA assumption holds (explained below), the choice probability is specified in the conditional logit model and takes the functional form in which all coefficients are fixed and do not vary across individuals:

$$p_{ijt} = \frac{\exp(\beta X_{ijt})}{\Sigma_{k=1}^{j} \exp(\beta X_{ikt})} \qquad (2)$$

While widely used, it has some disadvantages. First it cannot account for heterogeneity among respondents. This means that it does not take into account different consumer tastes. Second, it assumes that when a consumer is deciding between two choices their decision should not be based on whether a third choice is present. This is called the Independence of Irrelevant Alternatives (IIA assumption) and can lead to unrealistic predictions as it has been shown to be too restrictive.

5.2 *Mixed Logit Model*

Two common models which relax the IIA assumption are used: the multinomial probit model and the mixed logit model (Dahlberg & Eklöf, 2003). The mixed logit is used in this study because it relaxes the IIA assumption and allows random parameters, which allows the coefficients β to be random and not fixed. This allows the variables in the conditional logit model to account for variation in preferences among respondents, and also allows the variables to be normally distributed (Dahlberg & Eklöf, 2003).

This model is called the mixed logit because the choice probability (p_{ijt}) is a mixture of logit probabilities over a density of parameters, either individually or jointly. This model specifies the utility to the *i*th individual for the *j*th alternative. $h(\beta)$ is the density function of the random parameters β. The functional form of the mixed logit is:

$$p_{ijt} = \int \frac{\exp(\beta X_{ijt})}{\Sigma_{k=1}^{J} \exp(\beta X_{ikt})} \, h(\beta) d\beta \qquad (3)$$

The mixed logit assumes heterogeneity in preferences. β can be specified as β~*h* (θ, ν), where the density function's parameters θ and ν represent the mean and variance of the distribution, respectively. Because of this, the IIA is relaxed and different distributions can be represented by *h* (Hensher & Greene, 2003).

Hensher and Green mention the *h* specifications are handled in two ways 1) identifying the random parameter β of an attribute and giving it a mean and standard deviation, and 2) the unobserved information is treated as a separate error component. Random parameters allow for heterogeneity amongst individuals. The researcher specifies which parameters are random, meaning the attribute varies among respondents.

5.3 *Willingness-to-Pay (WTP)*

From the results of the mixed logit, WTP for an attribute can be calculated as follows:

$$WTP = -\frac{\beta_{attribute}}{\beta_{price}} \qquad (4)$$

in which WTP is the negative ratio of the attribute coefficient(s) divided by the price coefficient(s). WTP estimates are calculated for all significant treatment attributes.

Chapter VI: Survey Design

This study relied on the feedback from horse owners in the form of a survey consisting of two parts: 1) demographic questions pertaining to the individual themselves and about their horse background, and 2) a dichotomous choice experiment which allows the research team to estimate owner/manager willingness-to-pay of attributes associated with equine influenza treatment strategies.

6.1 *Demographic information*

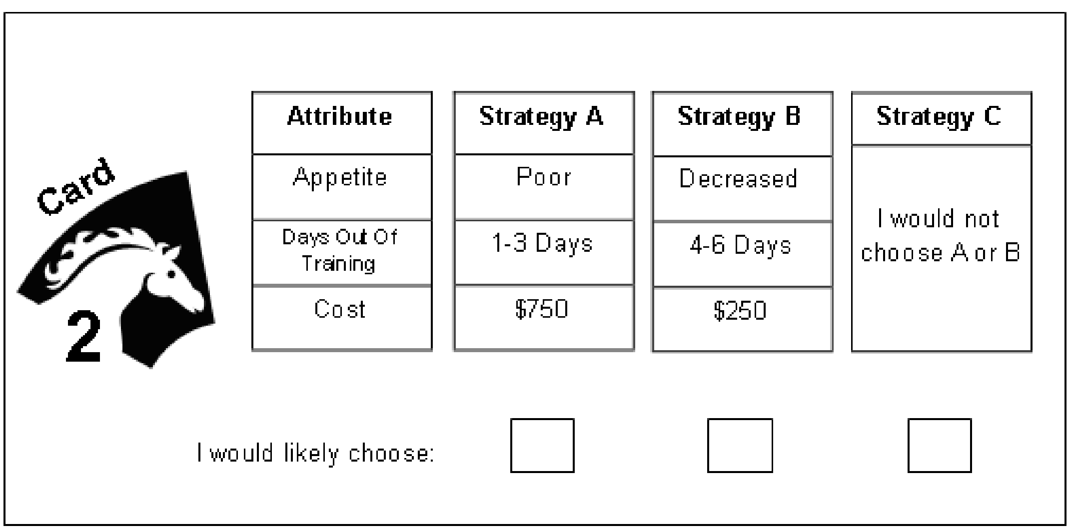
There were two parts to the demographic portion of the survey. The first part requested respondents' individual demographic information. Information collected included respondents' zip code, age range, and gender. In addition, socioeconomic factors education level and annual income were included.

The second part of the survey's demographic portion focused on respondents' horse background information. The number of years the person has been involved with horses was recorded. Involvement with horses suggests that a respondent has worked with a horse either by being an owner, rider, trainer, horse groomer, etc., and provides some measure of their experience with horses. If the respondent currently owned a horse, they were asked how many horses they owned, where the horses are kept, and whether or not one had ever become sick with a respiratory virus in the past. The respondent was then asked to provide more specific information regarding the horse that they use the most. Information requested included age of horse, breed of horse, number of years owned, primary discipline (eventing, trail riding, reining, etc.), number of days ridden per week, and if the horse had been competed in the past year. This information allows researchers to investigate if demographic characteristics (person or horse) influence a respondent's willingness-to-pay for attributes of influenza treatment alternatives.

6.2 *Choice Experiment*

The second part of the survey involved four dichotomous choice questions. In these questions, respondents were asked to state their preferences between two different hypothetical treatment strategies. These strategies represent what the respondent would choose if their horse became ill with the equine influenza and who would have the potential of getting a secondary bacterial infection. In each question, respondents were presented with two treatment strategies, Strategy A and Strategy B; the respondent also had the option of choosing Strategy C which meant that neither "A" or "B" strategy was preferred, and is interpreted as the respondent choosing the status quo. Each treatment strategy is described by three attributes: the horse's appetite, how many days the horse is out of training, and the cost associated with the horse becoming ill. Figure 2 gives an example of one of the choice cards.

Figure 6.1: Choice Card Example



6.3 *Survey Attributes*

Several intensive steps were taken in designing the questionnaire. The selection of the attributes and their corresponding levels are of high importance in choice experiments, and careful consideration was taken in selecting the attributes that would most comprehensively represent a horse that became ill. When designing a choice experiment, too many attributes can leave the respondent feeling overwhelmed having to compare, but too few attributes can leave the respondent not being well-informed on the situation, as well as not enough choice variation amongst the four choice experiments. Finding a medium right in between the two attribute extremes allows for a reliable estimation procedure (Srinivasan & Green, 1978).

Several research experts from the Gluck Equine Research Center at the University of Kentucky, as well as local equine veterinarians, were contacted to help define and refine the attributes and their levels. While many attributes were considered (high temperature, nasal discharge, heart rate, respiratory rate, lung sounds, attitude, appearance, and coughing), three attributes were ultimately chosen: Appetite, Days Out Of Training, and Cost. These attributes sufficiently account for consumer preferences (Srinivasan & Green, 1978). Table 3 presents the attributes, levels, and description.

Table 6.1: Treatment Strategy Attributes

Attribute	Level	Description
Appetite	Normal Decreased Poor	The horses desire to eat and other associated behaviors.
Days Out of Training	1-3 Days 4-6 Days 7-10 Days 11-14 Days	Days the horse is not able to train due to illness.
Cost	$50 $250 $750 $1,500	Total cost associated with caring and treating a sick horse.
Opt-Out	"I would not chose A or B".	Alternative option

6.3.1 Appetite

The first attribute, appetite, was chosen as a proxy for one of the first signs that might indicate a horse is sick. A horse's appetite is a highly visible gauge on whether a horse is feeling well or not, and its attitude and appearance are related to this attribute. This attribute is included to capture a horse feeling poorly. The levels chosen for this attribute were **normal**, **decreased**, and **poor**. In the survey tool, a normal appetite is defined as a horse eating normally, with alert ears, and aware of and caring that the human is present. A horse with a decreased appetite is a less-than-enthusiastic eater and may appear dull and lacking interest in things they normally would be interested in. Finally, a horse with a poor appetite is not eating; their head is hanging, they are not motivated, and they may or may not be aware of human presence.

6.3.2 Days Out of Training

The second attribute was days out of training. This attribute is important because when a horse comes down with a respiratory disease, they can be out of training for weeks. Typically, for each day the horse has a fever, a horse will be resting one week. This attribute is the days the horse is not able to train due to illness or recovery. The levels chosen for this attribute were **1-3 days**, **4-6 days**, **7-10 days**, and **11-14 days**. The salience of this attribute may depend on the type of rider as in whether they are actively riding to compete, or solely riding for pleasure every once in a while.

6.3.3 Cost

The third attribute was cost, also called price in the analysis. Veterinarians from different clinics in Central Kentucky were contacted to obtain cost estimates of treatment for influenza symptoms, symptoms of secondary bacterial infections, and treatment with an antibiotic at the first sign of fever after the equine influenza fever subsides. These veterinarians were presented with different detailed scenarios and they provided input on the cost of services for each scenario in treating a sick horse with the equine influenza.[3] The final stated cost in the choice experiment is comprehensive and includes farm visits, travel fees, ultrasounds, bloodwork, hospitalization, and pharmaceutical costs. All veterinary estimates were analyzed, and the average cost of treatment was used in the survey. The cost levels chosen for this experiment were **$50**, **$250**, **$750**, and **$1,500**, with $50 being the most basic farm visit services and $1,500 representing a horse requiring hospitalization, which also means a horse has a secondary bacterial infection.

[3] The cost estimate sheet provided to veterinarians is provided in Appendix 3.

6.4 *Choice Combinations*

Combining all attributes and their levels, there are 48 possible dichotomous choice combinations. This number is derived by taking the number of attributes and multiplying by the number of levels within each attribute, called a factorial design. In this study, there were three attributes; one had three levels, and two had four levels (3 x 4 x 4 = 48). Using the software JMP 11, all possible combinations for the choice experiments were derived. The number derived from full factorial design is often large, and usually too tedious for the survey taker (Kuhfeld, 2010). To address this, fractional factorial design is used (Scarpa & Rose, 2008). This is the minimum efficient set that still allows the willingness-to-pay of owners and managers to be estimated for specific attributes of equine influenza treatments. The minimum number of choice combinations that should be used is 9. This minimum optimal level is obtained by adding 1 to the number of levels (11) and subtracting by the number of attributes (3).

To determine validity of the fractional factorial design, the D-error from the computer computation is observed (Rose, Bliemer, Hensher, & Collins, 2008). The choice sets with the lowest D-error are chosen as the most efficient fractional factorial design (Scarpa & Rose, 2008). This is used because the process is faster to calculate than other methods of validity (A-efficiency and G-efficiency), and is consistent in choosing an efficient design set across different coding schemes (Kuhfeld, 2010). Ultimately, 16 choice profiles were chosen. This was too many for one respondent, so the 16 choice profiles were distributed across four different versions of the survey, each version having four different dichotomous choice experiments.

6.5 *Data Collection*

The focus of this study was on the decision-making of a typical backyard horse owner, which includes mostly recreational riders and even those which may have horses standing idle in their pastures. A useful sample of this population is obtained utilizing the Kentucky Horse Council (KHC) database. This database consists of Kentucky horse owners who are members of KHC. While many live in Kentucky, some have moved out of state but have maintained their membership. Using the KHC address database, 1,000 KHC members were randomly selected to complete the paper survey. Each of the four versions of the survey was sent to 250 KHC members.

The survey was distributed using a modified Dillman method[4] (Dillman, 1978). This Dillman method has been shown to optimize response rates for mail surveys. The first survey was mailed on November 20th, 2014, followed up by a reminder postcard on December 19th, 2014. On January 9th, 2015, a second mailing was sent out to the respondents who did not respond to the mailing back in November. Overall, out of 1,000 survey recipients, only 100 were returned with unusable addresses, with a total of 900 surveys reaching valid home addresses. 317 responded back with completed questionnaires. This corresponds to a 35% response rate, which is in line with reasonable response rates for paper surveys. However, after removing respondents who indicated they did not understand the survey or the survey did not apply to them, 269 surveys were available for analysis (30% response rate).

[4] Due to technical difficulties with the Kentucky Horse Council Database only half of the initial recipients of the survey were able to receive a second mailing and a second postcard mailing could not be completed as a follow up to the second survey mailing.

Chapter VII: Descriptive statistics

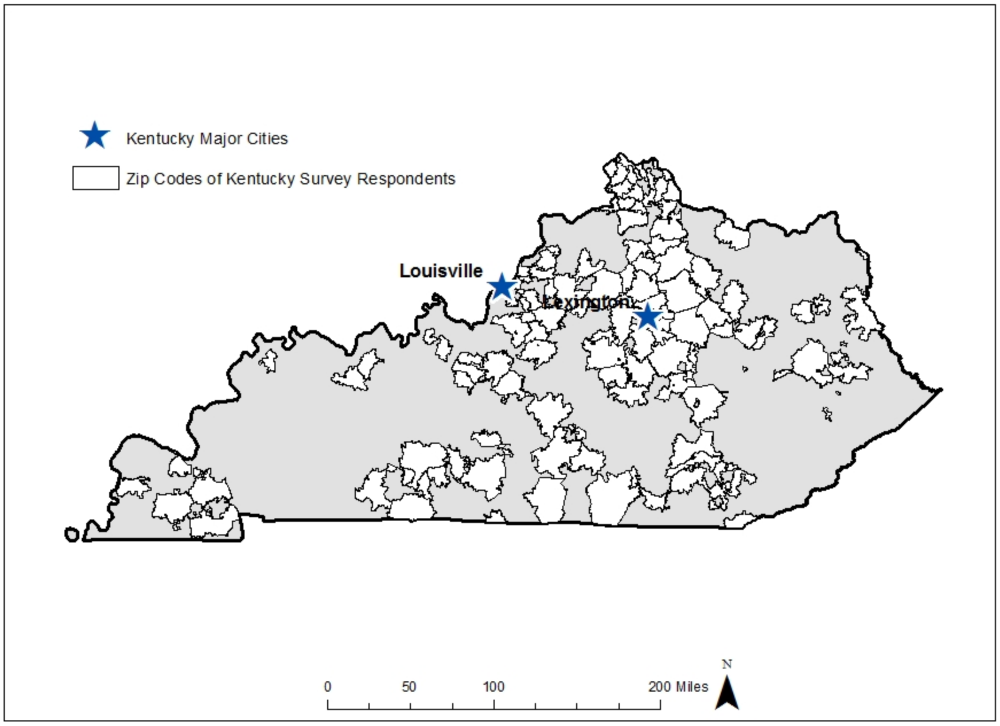
This chapter presents descriptive statistics for the sample utilized in this study.

7.1 *Individual Demographic Information*

7.1.1 Location

1,000 Kentucky Horse Council members were randomly selected for this survey. As mentioned earlier, not all respondents lived in Kentucky, and one respondent gave an invalid zip code. Overall, 247 respondents (92%) currently reside in the state of Kentucky (out of 269 total respondents). There was representation from across the state, except for southeastern Kentucky and part of western Kentucky. According to the 2012 Kentucky Equine Survey, it shows these are less densely populated equine areas. Out-of-state respondents resided in Florida, Indiana, Iowa, Michigan, Minnesota, Ohio, South Carolina, Tennessee, Washington, and Wisconsin. Figure 7.1 shows the zip code areas of the respondents who live in Kentucky.

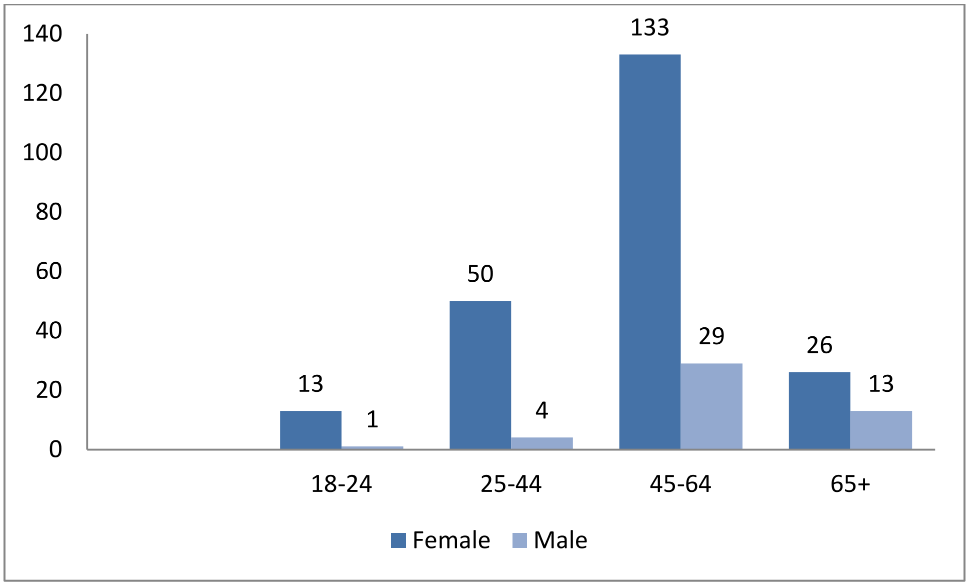
Figure 7.1: Location of Kentucky Respondents



7.1.2 Age and Gender

Out of 269 respondents, 14 (5%) of them were between the ages of 18-24, 54 (20%) from 25-44, 162 (60%) from 45-64, and 39 (15%) that were 65 and older. 222 (83%) were female and 47 (17%) were male. These statistics are comparable to the American Horse Publication studies (AHP) in which the majority of survey takers are from 45-54, and 55-64 years of age, and are female ("AHP Equine Industry Survey," 2010, 2012, 2015). Figure 7.2 shows gender with respect to age range.

Figure 7.2: Age Counts of Male and Female Respondents



7.1.3 Involvement with Horses

Out of 269 respondents to the survey, 268 answered the question concerning how much involvement they had with horses. Involvement included whether a respondent owned, managed, trained, rode, and/or groomed a horse. 240 (90%) respondents stated they had over ten years of horse experience, while 19 (7%) had 6 to 10 years, and 9 (3%) has 1-5 years of experience. The majority of respondents in this sample are very experienced in the horse industry.

7.1.4 Education

The majority of respondents in this survey had an undergraduate degree or graduate/postgraduate degree. 23 (9%) respondents finished high school, while 51 (19%) had some college education. 101 (37%) finished college with a bachelor's degree and 94 (35%) had some graduate education or had a postgraduate degree.

7.1.5 Income

205 (76%) respondents out of 269 reported their gross annual household income. Of those, 20 (10%) respondents made less than $25,000 a year, while 31 (15%) respondents made $25,000-40,000, 48 (23%) made $40,000-$60,000, 32 (16%) made $60,000-$80,000, 26 (13%) made $80,000-$100,000, and 48 (23%) made over $100,000.

Table 7.3: Education-Income Relationship of Individuals

	EDUCATION				
INCOME	**High School graduate**	**Some college**	**College graduate**	**Some gradate or postgraduate degree**	**Total**
Less than 25	4 (20%)	7 (35%)	6 (30%)	3 (15%)	20 (10%)
25-40	2 (6%)	7 (23%)	14 (45%)	8 (26%)	31 (15%)
40-60	4 (8%)	11 (23%)	17 (36%)	16 (33%)	48 (23%)
60-80	2 (6%)	6 (19%)	14 (44%)	10 (31%)	32 (16%)
80-100	0 (0%)	3 (12%)	13 (50%)	10 (38%)	26 (13%)
100+	2 (4%)	6 (13%)	12 (25%)	28 (58%)	48 (23%)
Total	**14 (7%)**	**40 (20%)**	**76 (37%)**	**75 (36%)**	**205 (100%)**

Table 7.3 shows the education level of individuals in relation to their income. As the table shows, individuals with a middle range of income between $25,000 and $60,000 in general are high school graduates or have graduated college. Respondents in the upper income levels ($60,000 and above) have had some graduate training or earned a postgraduate degree. Again, these statistics are comparable to AHP statistics where the majority of respondents have an annual income of less than $100,000 in annual income (“AHP Equine Industry Survey,” 2010, 2012, 2015).

7.2 *Horse Ownership Demographic Questions*

7.2.1 Horses Owned

Out of 249 respondents who answered this question, 35 (14%) respondents owned one horse, 59 (24%) owned two, 24 (10%) owned three, 38 (15%) owned four, 23 (9%) owned five, and 14 (6%) owned six, while the remaining 56 (22%) owned seven or more horses. The maximum number of horses owned was 80. The average number of horses owned by a respondent was 5.

7.2.2 Horse Location

The majority of the respondents' horses were located on their own property. 174 (70%) respondents kept their horses on their own property. 63 (25%) respondents boarded their horses at another location, while 11 (5%) keep horses both on their property or at a boarding facility.

7.2.3 Horse Breed and Riding Disciplines

Respondents were asked to provide more detailed information on one of their horses, referred to the in questionnaire as their "primary horse." The additional information included breed, riding discipline, and whether or not the horse had been to a competition in the past year. Out of 245 respondents who recorded breed, 224 (91%) of respondents own a "light horse" breed, which includes Thoroughbreds, Quarter Horses, Tennessee Walking Horses, Mountain Horses, Warmbloods, Paints, Saddlebreds, Standardbreds, etc.[5]; 9 (4%) respondents own a draft horse breed (such as Percheron,

[5] Distribution of breeds was found to roughly resemble the breed distribution found by the 2012 Kentucky Equine Survey.

Clydesdale, etc.) or a draft cross. 3 (1%) respondents own mules, and 9 (4%) respondents own ponies and miniature horses.

The majority of respondents (223/247, or 90%) participated in some type of riding. Respondents reported specific primary disciplines such as English disciplines (dressage, jumping, and eventing), Western disciplines (barrel racing, pole bending, and cutting), and leisurely riding such as pleasure and trail riding. That majority of riders were leisurely riders (128, or 57%), followed by English riders (78, or 35%), and Western riders (17, or 8%). The following table shows the breakouts of the other disciplines reported by respondents, and as it is shown riding constitutes the discipline majority (Table 7.4).

Table 7.4: Primary Riding Discipline of Respondents

Primary Discipline	Frequency	Percent
Breeding	5	2.02
Driving	7	2.83
Halter	2	0.81
Idle	7	2.83
Riding	223	90.28
Work	3	1.21
Total	**247**	**100**

7.2.4 Respiratory Virus

Out of 269 respondents, 107 (40%) people had a horse that became sick with a respiratory virus at some point. This response was cross-tabulated with owner experience (Table 7.5) and number of horses owned (Table 7.6).

Table 7.5: Horse Experience-Horse Sick Relationship of Individuals[6]

Involvement	Horses Sick		
	No	**Yes**	**Total**
1-5 years	8 (89%)	1 (11%)	9 (3%)
6-10 years	15 (79%)	4 (21%)	19 (7%)
10+ years	139 (58%)	101 (42%)	240 (90%)
Total	**162 (60%)**	**106 (40%)**	**268 (100%)**

Almost half of the horse owners with more than 10 years of horse experience reported that their horse came down with a respiratory virus. 79% of owners with 6-10 years of experience did not have a horse become sick, while only 1 respondent out of 8 with 1-5 years of experience had their horse come down with a respiratory virus. Initially, one may think that someone more inexperienced would be more likely to have a horse become sick; however, more experienced horse owners may be more actively involved in competitions or in other pursuits which might increase the chances of a horse contracting a respiratory virus. In addition, as seen in Table 7.6, it appears that the likelihood of experiencing a case of viral respiratory disease is influenced by owning more than one horse.

[6] 107 respondents answered whether or not they had a horse with a respiratory virus. Table 4 shows that 106 respondents had a horse sick with a respiratory virus. One respondent chose not to answer their level of involvement with horses and therefore the total for yes to horse sick in Table 4 is 106 respondents.

Table 7.6: Horse Ownership-Horse Sick Relationship of Individuals

Horses Owned	Horses Sick		
	No	Yes	Total
1	30 (86%)	5 (14%)	35
2	43 (74%)	15 (26%)	58
3	12 (50%)	12 (50%)	24
4	19 (51%)	18 (49%)	37
5	10 (43%)	13 (57%)	23
6	6 (43%)	8 (57%)	14
7 or more	19 (35%)	36 (65%)	55
Total	**139 (57%)**	**107 (43%)**	**246**

In general, if a horse is around other horses, the contracting of a virus is more likely since it is spread from contact with contaminated particles that can be found in the air and in the surrounding environment. So, it is not surprising that those with more horses were more likely to have experienced a case of equine influenza in the past.

Interestingly, owners who kept their horses at home were more likely to have a horse who experienced viral respiratory disease than those who keep their horse at a boarding facility. Out of the 107 respondents who had a horse sick with a respiratory virus, 78 (73%) of them keep their horses at home, while only 20 (19%) keep their horses at a boarding facility. Boarding facilities tend to have more transient populations of horses. 8% of the respondents had a respiratory virus when they listed that their horses were both boarded and kept on their own property.

Table 7.7: Primary Discipline-Horse Sick Relationship

Primary Horse Discipline	Horses Sick		
	No	**Yes**	**Total**
Breeding	2 (40%)	3 (60%)	5
Driving	6 (86%)	1(14%)	7
Halter	1 (50%)	1 (50%)	2
Idle	4 (57%)	3 (43%)	7
Riding	127 (57%)	96 (43%)	223
Work	1 (33%)	2 (67%)	3
Total	**138 (57%)**	**106 (43%)**	**244**

Table 7.7 shows the relationship between the discipline a respondent's primary horse was used for and whether one of their horses had ever contracted a respiratory virus. 96 (91%) out of 106 people who answered yes to a respiratory virus[7] answered that their primary discipline was riding. Overall, 43% (96/223) of respondents who reported riding as the use of their primary horse had a horse that became ill with a respiratory virus. Among respondents who used their primary horse for breeding, 60% (3/5) had a horse that contracted a respiratory virus, and among respondents whose primary horse was idle, 42% (3/7) had a horse contract a respiratory virus. Of respondents whose use of the primary horse was as a working animal, 66% (2/3) had a horse experience respiratory disease due to a virus, as did 50% (1/2) who use their primary horse for halter classes and 16% (1/7) who use their primary horse for driving.

[7] One respondent who had a horse sick with a respiratory virus did not state their primary discipline. This causes the yes to a horse sick total to be 106 respondents.

7.3 *Summary*

Demographics mirror national horse owners in AHP equine surveys. The sample population in this study is a similar demographic regarding age, gender, and income. Over half of the respondents are pleasure riders, followed by English riders. The average number of horses owned was 5, which was also consistent with AHP (“AHP Equine Industry Survey,” 2010, 2012, 2015). From these statistics it can be assumed that the respondents in this study are representative of “backyard” horse owners. These statistics also show that the represented demographic sample in this survey is also mirrored in national surveys. It can be concluded that the demographic information in this study can be used to investigate decision making regarding health care of horse, and represent the “backyard’ horse population.

Chapter VIII: Results

To obtain the results of the logit, conditional logit, and mixed logit models, and the subsequent willingness to pay of respondents, Stata 13 was used. Variables in the models include treatment attributes from the choice experiment and demographics (Table 8.1).

Table 8.1: Conditional and Mixed Logit Model Variable Descriptions

Variable	Description
Opt-Out	=1 if a respondent choose neither Strategy A or B, and 0 otherwise
Normal Appetite	=1 if a respondent chooses a treatment strategy in which their horse to has a normal appetite, and 0 otherwise
Decreased Appetite	=1 if a respondent chooses decreased appetite, and 0 otherwise
Poor Appetite	=1 if a respondent chooses a treatment strategy in which their horse to has a poor appetite, and 0 otherwise
Days Out of Training, 1-3 Days	=1 if a respondent chooses a treatment strategy in which their horse to is out of training 1-3 days, and 0 otherwise
Days Out of Training, 4-6 Days	=1 if a respondent chooses a treatment strategy in which their horse to is out of training 4-6 days, and 0 otherwise
Days Out of Training, 7-10 Days	=1 if a respondent chooses a treatment strategy in which their horse to is out of training 7-10 days, and 0 otherwise
Days Out of Training, 11-14 Days	=1 if a respondent chooses a treatment strategy in which their horse to is out of training 11-14 days, and 0 otherwise
Cost - $50	=1 if a respondent chooses a treatment strategy in which the cost is $50, and 0 otherwise
Cost - $250	=1 if a respondent chooses a treatment strategy in which the cost is $250, and 0 otherwise
Cost - $750	=1 if a respondent chooses a treatment strategy in which the cost is $750, and 0 otherwise
Cost - $1,500	=1 if a respondent chooses a treatment strategy in which the cost is $1,500, and 0 otherwise
18-24 years	=1 if a respondent is between the ages of 18 and 24 and 0 otherwise
25-44 years	=1 if a respondent is between the ages of 24 and 44 and 0 otherwise
65 years and older	=1 if a respondent is 65 years old or older and 0 otherwise

Table 8.1: Conditional and Mixed Logit Model Variable Descriptions (continued)

Variable	Description
Income < $100,000	=1 if a respondent's income is $100,000 or more and 0 otherwise
Income > $100,000	=1 if a respondent's income is less than $100,000 and 0 otherwise
Involvement < 10 years	=1 if respondent has less than 10 years of horse experience and 0 otherwise
Involvement > 10 years	=1 if respondent has more than 10 years of horse experience and 0 otherwise
Young horse	=1 if a respondent horse is between 1 and 4 years of age and 0 otherwise
Mature horse	=1 if a respondent horse is between 5 and 15 years of age and 0 otherwise
Senior horse	=1 if a respondent horse is over the age of 16 and 0 otherwise
Ride 0 or no days	=1 if a respondent does not ride or did not answer the question and 0 otherwise
Ride 1-3 days	=1 if a respondent rides their horse 1-3 days a week and 0 otherwise
Ride more than 4 days	=1 if a respondent rides their horse more than 4 days a week and 0 otherwise

8.1 *Conditional Logit and Mixed Logit without Interaction Variables*

All variables represented in the results are a dummy variable where 1=yes, and 0=no. The opt-out constant represents those individual who did not choose Strategy “A” or “B”, but chose neither by selecting Strategy C. The variables used in the mixed logit in which their coefficient estimates are treated as random are all variables presented in Table 8.1 except, cost (price), whose coefficient is assumed to be fixed. The model fit was based on the Log Likelihood and Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC). The objective is to maximize the log likelihood, and choose the model with the lower AIC/BIC.

The results of the conditional and mixed logit without interactions are compared side-by-side in Table 8.2.

Table 8.2: Conditional and Mixed Logit Results without Interactions

	Conditional Logit		Mixed Logit	
Variables	*Coefficient*	*Std. Err.*	*Coefficient*	*Std. Err.*
Price	-0.002***	0.000	-2.074***	0.250
Opt Out	-1.609***	0.178	-0.002***	0.000
Opt Out - SD			1.111***	0.231
Normal Appetite	0.701***	0.148	0.811***	0.174
Normal Appetite- SD			0.451	0.322
Decreased Appetite	0.724***	0.141	0.823***	0.172
Decreased Appetite-SD			0.746***	0.205
1-3 Days	0.0567	0.156	0.037	0.182
1-3 Days-SD			0.279	0.622
4-6 Days	0.431***	0.152	0.456***	0.177
4-6 Days-SD			0.034	0.245
7-10 Days	-0.080	0.137	-0.196	0.180
7-10 Days-SD			1.013***	0.295
N	3228		3228	
Log Liklihood	-817.71		-806.44	
AIC	1649.43		1638.89	
BIC	1691.98		1717.92	

Note: Decision is the dependent variable, and ***, **, and * represent significance at the 1, 5, and 10% levels, respectively.

The mixed logit model is based on 250 Halton Draws. Both models are equivalent in significant variables and signs. The *Price* coefficient is significantly greater in the mixed logit, but other coefficient ranges are similar. The mixed logit explains the variation in the data with a log likelihood that is greater than the mixed, as well as having a lower AIC then that of the conditional.

In the conditional and mixed logit models all significant variables are highly significant at the 1% level ($p<.01$). The *Opt Out* coefficient is negative which means that the majority of respondents chose Strategy A or Strategy B, and that an owner that is not able to choose Strategy A or Strategy B, his or her utility would be significantly reduced. *Price* is also negative and significant, meaning respondents are price sensitive. When a respondent is faced with two treatment strategies, they are more likely to choose the cheaper treatment strategy. In the mixed logit model, the magnitude of this coefficient is significantly higher than in the conditional logit model.

The variable representing a treatment where a horse has a normal or decreased appetite is positive and significant. This means individuals prefer a treatment strategy where their horse to has a normal or even decreased appetite, as compared to a poor appetite (the base case). From this, it can be inferred that owners and managers do not want to see their horse feeling poorly.

Variables representing treatment strategies that differ on days out of training show same statistical significance. Individuals prefer a treatment strategy where their horse to is out of training 4-6 days, as compared to their horse out of training 11-14 days (the base case). The magnitude of the coefficients between models is almost identical.

The significant standard deviations in the mixed logit show there is significant heterogeneity among respondents' preferences for a specific treatment strategy attribute. The mean and standard deviations of the coefficients provide information on the share of horse owners that hold a positive or negative view of the treatment strategy attributes. The distribution of the status quo option was 50/50, meaning, having a status quo option increased 50% of the respondents utility, while 50% of the respondents did not acquire additional utility by having that option present. The distribution of the coefficient of a horse with a decreased appetite reveals that 13% of respondents would rather choose a treatment strategy in which their horse had a poor appetite, while 87% of respondents prefer choosing a treatment strategy in which their horse only has a decreased appetite. Interestingly, the coefficient estimate for a treatment strategy where an individual's horse is out of training 7-10 days is not significant at the mean, but the significance of the standard deviation of this variable indicates about half of individuals do not receive more utility by choosing a treatment strategy that keeps their horse out of training 7-10 days compared to 11-14 days, while about 42% do improve their utility by choosing the treatment strategy in which their horse is out of training 7-10 days.

8.2 *Conditional Logit and Mixed Logit with Interaction Variables*

Demographic characteristics may help explain respondents' decision making among treatment strategies. To investigate this, demographic variables are interacted with price in the conditional and mixed logit; results are presented in Table 8.3. In the mixed logit, these variables, along with the choice attributes and the opt out constant, serve as the random variables in which difference preferences amongst individuals may exist. Price variable serves as the fixed variable in the equation. The mixed logit model is based on 250 Halton Draws.

Table 8.3: Conditional and Mixed Logit Results with Interactions

	Conditional Logit		Mixed Logit	
Variables	*Coefficient*	*Std. Err.*	*Coefficient*	*Std. Err.*
Price	-0.002***	0.001	-0.003***	0.001
Opt Out	-2.006***	0.226	-3.046***	0.407
Opt Out-SD			1.434***	0.322
Normal Appetite	0.559***	0.186	0.446**	0.220
Normal Appetite-SD			-0.083	0.495
Decreased Appetite	0.622***	0.177	0.484**	0.210
Decreased Appetite-SD			-0.361	0.340
1-3 Days	-0.040	0.190	0.045	0.222
1-3 Days-SD			-0.079	0.613
4-6 Days	0.411**	0.186	0.453*	0.230
4-6 Days-SD			0.108	0.333
7-10 Days	0.032	0.167	0.099	0.201
7-10 Days-SD			0.239	0.563
Price-18-24 years	-0.001	0.001	-0.001	0.002
Price-18-24 years-SD			-3E-05	0.001
Price-25-44 years	-6.7E-05	0.000	-0.000	0.001
Price-25-44 years-SD			-0.001	0.001
Price-65 years +	0.001**	0.000	0.001**	0.001
Price-65 years +-SD			7.68E-05	0.001
Price-Income < $100,000	-0.001***	0.000	-0.001***	0.001
Price-Income < $100,000-SD			0.002***	0.001
Price-Involvement 10+ years	-0.001*	0.000	-0.001**	0.001
Price-Involvement 10+ years-SD			-9.68E-06***	0.001
Price-Young	0.001**	0.000	0.001*	0.001
Price-Young-SD			-0.000	0.001
Price-Senior	0.000	0.000	0.000	0.001
Price-Senior-SD			0.001	0.001
Price-Ride 1 to 3	0.001*	0.001	0.002**	0.001
Price-Ride 1 to 3-SD			0.001	0.001
Price – Ride 4 or more	0.001	0.001	0.002**	0.001
Price – Ride 4 or more-SD			0.0001	0.001
N	2268		2268	
Log Liklihood	-533.61		-516.30	
AIC	1099.24		1094.59	
BIC	1190.86		1272.12	

Notes: Decision is the dependent variable, and ***, **, and * represent significance at the 1, 5, and 10% levels, respectively.

The conditional and mixed logit models are a better fit compared to the models with non-interacted variables. Again, both models here are similar in fit, but the mixed logit has a higher maximized log likelihood and a lower AIC. The conditional model has more robust significance, but when the riding variable is introduced, it becomes significant in the mixed logit. The mixed logit also shows heterogeneity amongst respondents.

Price and *Opt Out* are significant at the 1% level for the conditional and mixed logit. Again, individuals are price sensitive; more expensive treatment strategies reduce utility. The variable representing a treatment where a horse has a normal or decreased appetite is positive and significant at the 1% level in the conditional model ($p<.01$) and at the 5% level ($p<.05$) in the mixed logit. This means individuals prefer a treatment strategy where their horse has a normal or even decreased appetite, as compared to a poor appetite (base). The variable representing the treatment strategy where a horse is out of training 4-6 days is significant at the 5% level for the conditional model ($p<.05$), and at the 10% level ($p <.10$) for the mixed logit. This means individuals prefer a treatment strategy where their horse is out of training 4-6 days. Even though the significance for the mixed logit is not as robust (10% vs. 1%), it still shows that time out of training less is a salient attribute of treatment strategies.

The demographic-price interactions provide some interesting insight into horse owner decision making. Price interacted with age reveals at the 5% level for both models, individuals who are over the age of 65 are more likely than the base category (respondents age between 45 and 64) to choose a more expensive treatment strategy. Price for both models is significant at the 1% level when interacted with income. This reveals that respondents with income less than $100,000 are less likely to choose more expensive treatment strategy then an individual with more than $100,000 in the base category. This too shows price sensitivity in choosing a treatment strategy.

Price interacted with involvement over 10 years in the horse industry improves in significance from 10% to 5% from the conditional to the mixed logit model. The negative sign for horse involvement tells that individuals who are experienced in the horse industry are less likely to choose a more expensive treatment strategy than someone with less than 10 years of experience.

Price interacted with an owner of a young horse reveals that at the 5% level in the conditional model (and 10% in the mixed), these individuals are willing to choose more expensive treatment strategies which is denoted by the positive coefficient. Price interacted with individuals who ride 1-3 days a week increases in significance between the conditional and mixed logit (10% to 5%), and individuals who ride more than 4 days a week are significant at the 5% level in the mixed logit; these results reveal that individuals who ride, in general, are more likely to choose more expensive treatment strategies.

8.3 *Willingness-To-Pay (WTP)*

The conditional and mixed logit model provided useful insight into horse owner preferences for attributes regarding treatment strategies for a respiratory virus.

Next, horse owner WTP for these attributes can be estimated using equation 4 on page 23. Table 8.4 and 8.5 present the WTP of the conditional and mixed logit models without interactions, respectively.

Table 8.4: Conditional Logit – Willingness-to-pay without Interactions

Variables	*WTP*	Std. Err.	P-value	95% CI
Opt Out	-771.948***	89.450	0.000	-947.268, -596.629
Normal Appetite	336.385***	71.592	0.000	196.068, 476.702
Decreased Appetite	347.531***	69.154	0.000	211.991, 483.071
1-3 Days	27.113	74.719	0.717	-119.334, 173.559
4-6 Days	206.714***	72.167	0.004	65.270, 348.158
7-10 Days	-38.17	65.809	0.562	-167.153, 90.813

Notes: ***, **, and * represent significance at the 1, 5, and 10% levels, respectively.

Table 8.5: Mixed Logit - Willingness-to-pay without Interactions

Variables	*WTP*	Std. Err.	P-value	95% CI
Opt Out	-853.62***	105.15	0.000	-1059.72, -647.524
Normal Appetite	333.984***	71.478	0.000	193.899, 474.079
Decreased Appetite	338.61***	70.511	0.000	200.410, 476.809
1-3 Days	15.173	75.003	0.840	-131.829, 162.176
4-6 Days	187.71***	71.264	0.008	48.036, 327.384
7-10 Days	-80.870	73.997	.274	-225.902, 64.161

Notes: ***, **, and * represent significance at the 1, 5, and 10% levels, respectively.

The results from Tables 8.3 and 8.4 indicate general agreement toward WTP for attributes of treatment strategies with minor variations in WTP between the two models. In the following discussion, the conditional model WTP will be displayed in ($) after the mixed logit WTP estimation.

First, horse owners are willing to pay $330-$340 for strategies which avoid a poor appetite. This result can be interpreted as willing to pay to avoid a horse feeling poorly. The proxy for overall health and appearance of the horse, appetite, reveals this attribute of a treatment strategy has the greatest value among the ones studies here. Horse owners pay $333.98 ($336.39) and $338.61 ($347.53) for a treatment strategy which allows the horse to go from a poor appetite to one with a normal or decreased appetite, respectively. In addition, individuals are willing to pay $187.71 ($206.71) more for treatments that keep their horses out of training for 4-6 days than 11-14 days. An individual may not worry if their horse is out of training for 1-3 days, but additional days begin to decrease utility. Interestingly, they are willing to pay less to avoid days out of training than for normal or decreased appetite. Individuals may not care as much about riding or training their horse, but more about having their horse feeling well. Also, in practice, appetite and days out of training are commonly linked together. Individuals who chose the status quo felt strongly in not choosing a treatment strategy and therefore would have to be compensated $853.62 ($771.948) in order for them to make a decision between treatment strategies.

Other interactions were considered when measuring WTP, but demographic interactions influenced WTP very little. The attributes presented in the choice experiment are a genuine reflection of situations that a horse owner may face with their horse, and it is concluded, in general, that the main factor influencing WTP is the horse attributes themselves and not the demographic interactions. Even though there may be some variation among WTP of attributes of individuals in regards to lower income, experience, or age, the magnitude of these differences are slight, and the estimates presented are reasonably representative of the sample.

8.4 *Summary*

Overall, horse owners are willing to pay for treatment strategies which avoid poor appearance and days out of training. Individuals who are over 65 years old and those who have a young horse are more likely to choose expensive strategies than those who are between the ages of 45-64 or who have a mature horse. Higher income individuals can afford more expensive strategies; and younger horses are susceptible to serious illness. Individuals who ride one time, or more, during the week are also likely to choose more expensive treatment strategies than those who do not ride in order to avoid lost training or pleasure riding time.

Individuals who are less likely to choose expensive strategies are those who have more than 10 years of horse experience and make less than $100,000 a year. Individuals who have worked with horses longer may have more experience with equine influenza and understand how it runs its course, or they are able to identify the onset of a virus, and manage the symptoms because of their knowledge in the subject matter. Individuals who make less than $100,000 a year may be budget constrained and less likely to choose a more expensive strategy.

Chapter IX: Discussions and Conclusions

This study addressed the economic considerations of the “wait and see” versus the “treat now” alternatives of treating a horse diagnosed with equine influenza. A conjoint analysis was performed on equine influenza virus treatment strategies to estimate the willingness to pay of owners and managers for different attributes of treatment strategies.

For the conjoint analysis, respondents were presented with four choice cards of alternative treatment strategies. The conditional and mixed logit models were used to analyze the data collected and provide insight into the importance of treatment strategies that individuals chose in the choice experiments. WTP was then estimated for these attributes. Attributes selected were appetite, used as a proxy for overall health of a horse, days out of training, and the cost of treatment. These attributes were chosen after deliberation with clinicians at the University of Kentucky’s Gluck Equine Center, and veterinary practices in and around central Kentucky.

It was revealed that respondents were price sensitive. In addition, they preferred alternatives in which their horse did not have a poor appetite or who were out of training for two weeks. Individuals care that their horse is eating normally, alert, and aware of human presence, versus the alternative in which the horse is not eating, is depressed, and not aware of human presence. Individuals were also more likely to choose a strategy where their horse was only out of training for a week versus two weeks. These respondents are horse enthusiasts, and the majority of them ride their horse. Being able to ride derives non-monetary pleasure as seen in the significance of these attributes. Also, some individuals may be professionals, and their horse out of training affects their bottom line. The WTP of these attributes revealed that individuals greatest value of WTP was going from a horse who was in poor health to choosing a horse with normal (or even decreased) health, and were investing in paying for days out of training that were less than one week.

The introduction of demographic variables provided some insight into the price sensitivity of the respondent being surveyed. Individuals who were over the age of 65, owned a young horse (1-4 years old), or rode a horse regularly were more willing to pay for more expensive treatment strategies. Individuals who had more than 10 years in the horse industry, or less than $100,000 income, were less willing to spend on expensive treatment strategy.

The considerations individuals took in deciding among the alternatives included the possibility of treatment costs as well as the extent to which they preferred to avoid seeing the horse feel poorly and potentially losing training days. The study revealed that when owners and managers are faced with the decision in whether to delay preventative treatment in hope of the horse not getting a secondary bacterial infection or aggressively treat the horse with an antibiotic to avoid a serious infection, individuals would most likely choose to treat-now and pay the upfront costs, assuming that the aggressive treatment guarantees against the secondary bacterial infection. “Backyard horse owners,” as the majority of horse owners in the U.S are, are price sensitive, but when it comes to their horse’s health, they are more likely to consider prevention costs, than the “wait-and-see” approach, if they prefer a healthy horse, as seen in this study.

This study is not without limitations. The first limitation of this study is that there were technical difficulties with the Kentucky Horse Council (KHC) Database which did not allow the research team to properly obtain all of the remaining addresses of survey recipients for the second mailing. In addition to this, the team was not able to obtain any addresses for the second follow up postcard. Because of this, not all remaining recipients were contacted a second time with a second survey in the mail, nor did anyone get a second reminder postcard, possibly reducing response rate. Unfortunately there was nothing that could be done with the technical difficulties from the KHC database.

The second limitation was not everyone who filled out the survey understood what they were supposed to do. They either did not fill out the choice experiment portion, or they filled it out but wrote a note saying they did not understand, or were confused by the survey. For the respondents that did not understand the survey, they were left out of the study. A third limitation is that it may be difficult to accurately capture scenarios to treat equine influenza using the survey method used in this study which possibly led to misunderstanding of the survey.

The final limitation in this study is hypothetical bias. Hypothetical bias in literature is defined as an individual overstating (or understating) his or her actual willingness to pay in a hypothetical situation as compared to in a real-life situation (List, 2001). It is a case of an individual's intention in a situation verses their actual buying behavior (Ajzen, Brown, & Carvajal, 2004). In this study, respondents may have had the intention of choosing the cheaper (or more expensive) treatment strategy based on cost, but in real life, they may actually choose to pay more (or less) for a service in order for their horse not to feel poorly. In order to improve this, a section of the survey can be used in explaining the hypothetical bias problem, also called "cheap talk", in order for participants to be well informed of the situation (Ajzen, Brown, & Carvajal, 2004).

However, experienced individuals who have great knowledge about a good or service may not be persuaded by cheap talk because they already have an idea in their mind of what value they would place on a good or service (List, 2001). A few other ways to reduce hypothetical bias is asking the individuals to consider their real budget constraints before choosing between their alternatives, and let the individuals look at real situations and costs in order to compare to the hypothetical situations (Ajzen, Brown, & Carvajal, 2004). Consequentiality scripts can also be used which reminds the individuals the impact their choices have in a non-hypothetical situation, and finally instead of asking how much a respondent is willing to pay they are asked instead on what they think someone else would pay. This reduces a social desirability bias in which the individual chooses an answer based on what they think the interviewer or sponsor wants to hear (Loomis, 2013).

The implications of this study are important to the equine health care field because it provides preliminary information on the decision-making process on one of the horse's most important caregivers – its owner or manager. In other words, what factors impact health care decisions that owners make for their horses? Are they price-sensitive? Are they willing to pay to avoid loss of training time or even to avoid seeing their horse feel poorly? Using this research, pharmaceutical companies and veterinary practitioners can better understand what drives the health care decisions horse owners and managers make for their horses.

Appendices

Appendix 1. *Treatment Strategy Survey*

TREATMENT STRATEGIES FOR A HORSE WITH A RESPIRATORY VIRUS

HORSE OWNER BACKGROUND INFORMATION

1. What is your five digit zip code? ☐ ☐ ☐ ☐ ☐
2. What is your age range? ☐ 18-24 ☐ 25-44 ☐ 45-64 ☐ 65 or older
3. What is your gender? ☐ Male ☐ Female
4. How many years have you been involved with horses? (Involvement with horses suggests you have worked with a horse either by being an owner, rider, trainer, horse groomer, etc.)

   ☐ Less than 1 year ☐ 1-5 years ☐ 6-10 years ☐ More than 10 years
5. What is your education level?

   ☐ Some high school or less ☐ High school graduate or GED ☐ Some college
   ☐ College graduate ☐ Some graduate or postgraduate degree
6. What is your annual income? (**OPTIONAL**)

   ☐ Less than $25,000 ☐ $25,000 – $40,000 ☐ $40,000- $60,000
   ☐ $60,000 – $80,000 ☐ $80,000 – $100,000 ☐ $100,000 or more

HORSE BACKGROUND INFORMATION

7. Do you currently own a horse? ☐ Yes ☐ No

   If NO, please answer the following question, and then continue to the Choice of Treatment Strategy on the next page.

   Have you ever managed, or owned, a horse before? ☐ Yes ☐ No

   IF YES to question 7, please answer questions 8-11, and then continue to the Choice of Treatment Strategy on the next page.
8. How many horses do you own? ☐
9. Where do you keep your horse(s)? ☐ Own property ☐ Boarding farm
10. Have you ever had a horse which became sick with a respiratory virus? ☐ Yes ☐ No

11. Please fill in the following table using the horse that **YOU USE THE MOST**.

Age	**Breed**	**Years owned**	**Primary equine discipline** (Eventing, Trail Riding, Reining, etc.)	**Number of *days per week* the horse is ridden or trained**	**In the last year, has this horse been in a competition?**
					YES **NO** *(Please circle one)*

Please continue onto the next page

CHOICE OF TREATMENT STRATEGY FOR HORSES SICK WITH A RESPIRATORY VIRUS

Equine influenza is a common respiratory virus in horses. Equine influenza is a virus which itself is not treatable and must run its course. Symptoms can include a rise in body temperature, loss of appetite, nasal discharge, severe dry cough, and depression.

However, secondary bacterial infections may develop, resulting in infections like pneumonia. Such infections can be treated with antibiotics, and treated properly, veterinary costs and lost training days can be kept to a minimum.

In this section, you will be asked to choose between different hypothetical treatment strategies for a horse with equine influenza, with the potential for the onset of a secondary bacterial infection. These strategies differ according to the appetite of the horse during illness, days out of training, and cost of caring for and treating a sick horse.

Attributes

- **Appetite:** The horse's desire to eat and other associated behaviors.

  Normal - Eating normally, alert ears, aware/care human is present

  Decreased - Less than enthusiastic eater, dull, lacking interest in things that they normally would be interested in

  Poor - Not eating, head hanging, ears hanging, not motivated, may or may not be aware of human presence

- **Days Out of Training:** Days the horse is not able to train due to illness, or recovery (**1-3 Days, 4-6 Days, 7-10 Days, or 11-14 Days**)

- **Cost:** Total cost associated with caring and treating a sick horse (antibiotics, veterinarian services such as farm visits, ultrasounds, bloodwork, hospitalization, etc.). (**$50, $250, $750, or $1,500**)

Given the above information, you will now be asked to **choose between two different treatment strategies** on each of the following cards. These are hypothetical strategies that you as an owner/manager would choose if your horse became ill with influenza. In addition to the two treatment strategies, you also have the option of choosing neither of the strategies. There is no "right" or "wrong" answer; simply **pick the one that best reflects what you would actually choose**.

Please continue onto the next page

Note: Please place a **check mark** in the box under the treatment strategy that you would choose. Please select **only one** response per card, and do not compare across cards.

Card 1

Attribute	Strategy A	Strategy B	Strategy C
Appetite	Decreased	Normal	I would not choose A or B
Days Out Of Training	7-10 Days	1-3 Days	
Cost	$750	$50	

I would likely choose: ☐ ☐ ☐

Card 2

Attribute	Strategy A	Strategy B	Strategy C
Appetite	Poor	Decreased	I would not choose A or B
Days Out Of Training	1-3 Days	4-6 Days	
Cost	$750	$250	

I would likely choose: ☐ ☐ ☐

Please continue onto the next page

Appendix 2. *Choice Cards for the Four Surveys*

Survey A:

Attribute	Strategy A	Strategy B	Strategy C
Appetite	Decreased	Normal	I would not choose A or B
Days Out Of Training	7-10 Days	1-3 Days	
Cost	$750	$50	

I would likely choose: ☐ ☐ ☐

Attribute	Strategy A	Strategy B	Strategy C
Appetite	Poor	Decreased	I would not choose A or B
Days Out Of Training	1-3 Days	4-6 Days	
Cost	$750	$250	

I would likely choose: ☐ ☐ ☐

Card 3

Attribute	Strategy A	Strategy B	Strategy C
Appetite	Decreased	Normal	I would not choose A or B
Days Out Of Training	1-3 Days	7-10 Days	
Cost	$250	$750	

I would likely choose: ☐ ☐ ☐

Card 4

Attribute	Strategy A	Strategy B	Strategy C
Appetite	Decreased	Poor	I would not choose A or B
Days Out Of Training	7-10 Days	4-6 Days	
Cost	$1,500	$750	

I would likely choose: ☐ ☐ ☐

Survey B:

Card 1

Attribute	Strategy A	Strategy B	Strategy C
Appetite	Normal	Decreased	I would not choose A or B
Days Out Of Training	4-6 Days	1-3 Days	
Cost	$1,500	$50	

I would likely choose: ☐ ☐ ☐

Card 2

Attribute	Strategy A	Strategy B	Strategy C
Appetite	Normal	Decreased	I would not choose A or B
Days Out Of Training	11-14 Days	7-10 Days	
Cost	$50	$250	

I would likely choose: ☐ ☐ ☐

Card 3

Attribute	Strategy A	Strategy B	Strategy C
Appetite	Normal	Decreased	I would not choose A or B
Days Out Of Training	1-3 Days	4-6 Days	
Cost	$250	$50	

I would likely choose: ☐ ☐ ☐

Card 4

Attribute	Strategy A	Strategy B	Strategy C
Appetite	Decreased	Normal	I would not choose A or B
Days Out Of Training	11-14 Days	4-6 Days	
Cost	$50	$750	

I would likely choose: ☐ ☐ ☐

Survey C:

Card 1

Attribute	Strategy A	Strategy B	Strategy C
Appetite	Decreased	Normal	I would not choose A or B
Days Out Of Training	7-10 Days	11-14 Days	
Cost	$50	$250	

I would likely choose: ☐ ☐ ☐

Card 2

Attribute	Strategy A	Strategy B	Strategy C
Appetite	Poor	Decreased	I would not choose A or B
Days Out Of Training	7-10 Days	4-6 Days	
Cost	$250	$1,500	

I would likely choose: ☐ ☐ ☐

Card 3

Attribute	Strategy A	Strategy B	Strategy C
Appetite	Normal	Poor	I would not choose A or B
Days Out Of Training	1-3 Days	4-6 Days	
Cost	$750	$250	

I would likely choose: ☐ ☐ ☐

Card 4

Attribute	Strategy A	Strategy B	Strategy C
Appetite	Normal	Decreased	I would not choose A or B
Days Out Of Training	7-10 Days	1-3 Days	
Cost	$50	$750	

I would likely choose: ☐ ☐ ☐

Survey D:

Attribute	Strategy A	Strategy B	Strategy C
Appetite	Normal	Poor	I would not choose A or B
Days Out Of Training	7-10 Days	4-6 Days	
Cost	$250	$1,500	

I would likely choose: ☐ ☐ ☐

Attribute	Strategy A	Strategy B	Strategy C
Appetite	Normal	Poor	I would not choose A or B
Days Out Of Training	1-3 Days	11-14 Days	
Cost	$250	$750	

I would likely choose: ☐ ☐ ☐

Card 3

Attribute	Strategy A	Strategy B	Strategy C
Appetite	Decreased	Normal	I would not choose A or B
Days Out Of Training	11-14 Days	4-6 Days	
Cost	$1,500	$50	

I would likely choose: ☐ ☐ ☐

Card 4

Attribute	Strategy A	Strategy B	Strategy C
Appetite	Poor	Decreased	I would not choose A or B
Days Out Of Training	7-10 Days	11-14 Days	
Cost	$1,500	$750	

I would likely choose: ☐ ☐ ☐

Appendix 3. *Cost Estimate Scenarios*

Cost To Treat A Sick Horse					
Increasing level of severity...					
Scenario 1	**Scenario 2**	**Scenario 3**	**Scenario 4**	**Scenario 5**	**Scenario 6**
Owner monitors sick horse	Vet farm call	Vet farm call	Vet farm call	Vet farm call	Vet farm call
Gives Bute	Physical exam	Physical exam	Physical exam	Physical exam	Physical exam
	Antibiotic(s)	Bloodwork, AND (select option from cell E8)	Bloodwork	Bloodwork	Bloodwork
		Flu swab or Respiratory PCR Panel	Flu swab or Respiratory PCR Panel	Flu swab or Respiratory PCR Panel	Flu swab or Respiratory PCR Panel
		Vet farm call	Ultrasound of lungs (optional step)	Ultrasound of lungs (optional step)	Ultrasound of lungs - field veterinarian (optional step)
		Antibiotic(s)	Transtracheal wash (optional step)	Transtracheal wash (optional step)	Transtracheal wash (optional step)
			Culture/sensitivity (optional step)	Culture/sensitivity (optional step)	Culture/sensitivity (optional step)
			Antibiotic(s)	Antibiotic(s)	Antibiotic(s)
				Hospitalization - Overnight stay in-house	Hospitalization - Overnight stay in-house
					Physical exam in-house
					Ultrasound of lungs - in-house (optional step)
					Level of care in-house
					Catheter in-house
					Fluids in-house
					IV in-house
Total Estimated Cost					
$0	**$0**	**$0**	**$0**	**$0**	**$0**

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Available upon request.