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THEORETICAL AND PRACTICAL IMPLICATIONS OF A HEDONIC PRICING MODEL: EMPIRICAL OBSERVATIONS FROM WHOLESALE AUTOMOBILE AUCTIONS

Jeffrey Roach

Clemson University, jeffreyanderica@gmail.com

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THEORETICAL AND PRACTICAL IMPLICATIONS OF A HEDONIC PRICING MODEL:
EMPIRICAL OBSERVATIONS FROM WHOLESALE AUTOMOBILE AUCTIONS

A Dissertation
Presented to
the Graduate School of
Clemson University

In Partial Fulfillment
of the Requirements for the Degree
Doctor of Philosophy
Applied Economics

by
Jeffrey Joseph Roach
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Accepted by:
Dr. Michael T. Maloney, Committee Chair
Dr. William R. Dougan
Dr. John T. Warner
Dr. Cotton M. Lindsay

ABSTRACT

Wholesale auto auctions are convenient structures for economists as they attempt to observe the marginal effects of quality changes on the market-clearing price. However, what may be categorized as a quality change might rather be a market signal of an environment with adverse selection. This dissertation analyzes the effects of seller type and tests their sensitivity to econometric model specification.

General hedonic attributes and their various applications are reviewed. This dissertation explores the basic auto auction environment and dispels inaccurate notions about the auction structure. Following Bartik's (1987) analysis, multi-market data are used to produce hedonic estimates for seller, mileage and other attributes. A section is devoted to the peculiarities of the auction environment; namely, the winner's curse, adverse selection, and variations in auction structure.

A three-part literature review covers adverse selection, the various technicalities of auction structure, and the econometric issues regarding hedonic regressions. A section presents the data and the econometric models with their results. Concluding remarks discuss areas for further research.

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CHAPTER ONE

INTRODUCTION

Hedonic pricing models attempt to disaggregate the overall market price of a good into the separate implicit prices for the individual characteristics of that particular good. A helpful application of a hedonic pricing method is in the housing market where the price of a property is determined by house characteristics such as size, appearance, features and conditions. It also includes surrounding characteristics of the neighborhood of the house such as accessibility to schools and value of other homes. A hedonic pricing model is used to estimate the extent to which each factor affects the price. Most goods and services are the sum of many parts but the observable market price is only for the aggregated good or service. Therefore, a method must be developed to estimate the market value for a sub-feature or component that is not market-traded as an individual product.¹

Preliminary Comments on Hedonic Pricing

The basic foundation for hedonic pricing analysis was published by Griliches (1967, 1971) and Rosen (1974). However, earlier analysis of a hedonic model was conducted by Court (1939) who was interested in modeling automobile prices to include a change in features and quality. To capture the value of the individual characteristics of a particular good, analysts estimate the shadow prices and then produce parameter estimates, which reveal the marginal value of those characteristics. Both the econometric and theoretical issues with hedonic models are not trivial.

¹ The modeling challenge is compounded due to the nature of intangible characteristics.

Practical Use of Hedonic Pricing by the Bureau of Labor Statistics

The Bureau of Labor Statistics (BLS) employs hedonic pricing in several categories within the Consumer Price Index (CPI). Since October 2000, BLS has applied a hedonic approach to create a quality adjustment in two items of the Major Appliances category of the CPI. The BLS also continues to apply a hedonic approach to other items in the CPI, including the Electronic Products category and the Educational Books and Supplies category.² The driving force behind this additional reporting of the BLS has been the need to adjust for changes in quality over time. Without this adjustment, changes in quality over time could magnify a bias in any price index. Merely comparing last year's prices with this year's prices might not measure pure price changes since this year's products may be "new and improved."³ Hedonic analysis, which is rooted in Jeremy Bentham's utilitarian philosophy, parses out quality improvements to yield a price estimate that is not affected by changes in individual characteristics.

Other Applications

Hedonic models have various forms and applications. Ward and Ireland (1996) introduce hedonic modeling to the valuation of life estimates for litigation cases. Brown and Rosen (1987) apply a hedonic model to optimal job choices. In particular, they model the effects of taxes on various job packages. In a more novel paper, Goram (1980) gives a hedonic procedure for testing quality differentials in the Iowan egg market. He postulates that there are premium quality eggs for direct eating, poor quality eggs for strictly baking and medium-grade eggs for miscellaneous use. Combris, et al. (1997) conclude that the market price of Bordeaux wine is mainly explained

² July 2000 BLS news release

³ There is a humorous illustration of this bias in price indices written by financial advisor, Scott Burns. In his September 4, 2001 article for the Dallas Morning News, entitled "The Hedonic Porsche," he compares his brand new VW Beetle with a 1965 Porsche 356 Carrera, which was his dream car when the Porsche was initially introduced to the market. In the end, the Beetle costs seventy five percent of the inflation-adjusted price of the Carrera while at the same time, the Beetle has more horsepower, better acceleration, power controls, air conditioning and various safety features that were nonexistent in 1965.

by the information that is printed on the label of the bottle. As will be shown later, their analysis is particularly relevant to this research, since their empirical evidence suggests that the variables that explain quality levels as defined by professional wine tasters do not influence market price. Rather, the labeling on the wine explains most of the price variability, as crucial information such as vintage year, vineyard, and grape type are all revealed on the label. The crux of the matter is the availability of information and the level of correlation between label and taste. As detailed in Rosen's (1974) seminal paper, a competitive market allows consumers to make decisions based on perfect, costless information. In the case of wine then, the label information and taste would be intricately tied together.

Research Approach

The purpose of this empirical research is to estimate the market valuation for specific characteristics in the auto auction environment. Specifically, this dissertation tests for a potential premium realized by one type of seller over another and investigates whether this premium is caused by an exaggerated lemon problem allegedly created in the auction environment. This research also focuses on the interaction effects between seller type and age, and seller type and mileage, of the vehicle. Regression results show whether this information is significant in the model.⁴

A hedonic model provides the framework for this experiment. The hedonic model is applied to multi-market data in an effort to produce unbiased estimates. To minimize the noise of extraneous variables, the ownership analysis is limited in scope to certain Ford models. The approach will be defended later in Chapter Four.

⁴ See details in the Model section.

Various issues are intertwined within the ensuing chapters; hence, the literature review and the modeling sections need to address the following three areas: adverse selection, general auction structures, and hedonic regression analysis.

CHAPTER TWO

REVIEW OF THE LITERATURE

This chapter is divided into three sections with the objective of laying a stable foundation for the model that follows in Chapter Four. Although this paper's contribution to the research is the analysis of the seller-type premium or discount, the model will be less meaningful without a cursory presentation of the issues surrounding asymmetric information, auction structure and hedonic regression models. Therefore, the next three sections contain pertinent discussions that support the descriptive nature of the empirical results found in Chapter Four.

Adverse Selection and the Lemon Problem

Akerlof (1970) provides the most common framework for the discussion of adverse selection. His pivotal paper, "*The Market for 'Lemons': Quality Uncertainty and the Market Mechanism*," illustrates adverse selection with a hypothetical world containing only four possible categories of cars: a well-performing new car, a poor-performing new car, a well-performing used car, and a poor-performing used car. Assuming that a buyer cannot distinguish a "lemon" from a "peach," both subsets of cars will be priced the same. As the owner gets to know his car, a disparity of information about the car builds up. When the owner becomes a seller, he now has more information than the buyer so is incentivized to sell his lemon at the market-clearing price of good cars.⁵ The replacement within marketplace of the "good" by the "bad" is the precise argument behind the aggregate social costs of corrupt and dishonest market participants. If those selling the "lemons" continue to capitalize on the ignorance of the buyer, the extent of lemon-

⁵ The lower quality vehicle eventually takes over the market because both good and bad will sell at the same price since the buyer does not have enough information to distinguish between the two types of vehicles.

dealing could potentially cause the market to completely dry up. There are various forms of controlling and limiting the detrimental effects of the oft-cited “lemon problem.” Once such control is the practice of a seller instituting a guarantee policy. This puts responsibility on the seller for the quality of the product, thus, removing some of the risk from the potentially uninformed buyer.⁶ In relation to the various types of auctions, there are some opportunities for the auction buyer to lower his risk and make more informed choices. One such opportunity, as practiced in some auto auction houses, is the post-sale inspection by independent auto mechanics. These mechanics do not work for the people who are selling the vehicles; rather, the mechanics work for the auction house. The mechanics are incentivized for the buyer to have a pleasant auction experience in hopes of turning the buyer into a repeat customer.

However, the tools to counteract asymmetric information might be abused. Akerlof’s paper may be summarized by the following main points: first, one side of the market has more information than the other side; second, both buyers and sellers desire to maximize consumer and producer surplus, respectively; third, price is not necessarily determined by the one who has more information, and fourth, the costly structure of warranties, guarantees, and reputations may not fully dispel uncertainty. Akerlof (1976) later addresses the tendency for the market to create “supergames”, the environment where sellers over-invest in brand names, whether or not the product is truly of high quality.

Akerlof’s research inspired Bond (1982) to test the lemon problem with data from the U.S. Census Bureau’s *1977 Truck Inventory and Use (TIU) Survey*.⁷ Bond’s interest lies in modeling vehicle maintenance and comparing these levels of maintenance for a used truck

⁶ Akerlof (1970) also cites brand names and chain stores as ways for the seller to communicate to the buyer that there is partial protection from the potential problem from imperfect information.

⁷ The following internet link reveals the latest survey:
<http://www.census.gov/svsd/www/vius/products.html> as of December 3, 2008.

relative to a newer truck. (A tangent of his research would be the interaction of maintenance levels and public information reports, such as CarFax, where independent statements on past history are recorded.⁸) Bond's assumption is that frequency of maintenance needs reveal the true quality of the vehicle. A lemon would need a lot more work done on it than a good quality vehicle. The asymmetry lies in the fact that the prospective buyer knows less about the vehicle maintenance history than the seller. Bond develops a logit model that describes the relationship between mileage and maintenance:

$$\text{Ln}[P_i/(1-P_i)] = \alpha_i + \beta_i x + \varepsilon \quad (2.1)$$

where P_i is the probability of maintenance levels on the *ith truck* (either used or new) and x is total mileage. This model has value when vehicle age, mileage, or other relevant variables are unavailable. The test for evidence of the lemon uses a separate estimation of Equation (2.1) for trucks bought new and for trucks bought used. If the lemon hypothesis were true in this market, then the majority of vehicles that come to market are the ones that need higher levels of maintenance. Those vehicles that were true "peaches" would not find themselves for sale. Bond finds no difference between maintenance levels on new and used trucks. His research, then, does not support the lemon model assumption that a used truck maintenance level would be greater than a new truck maintenance level. One caveat to Bond's model is that he did not have the actual nominal amount of the maintenance costs as reported by the *Truck Inventory and Use Survey*. Clearly, the extent of the maintenance serviced on the vehicle is a factor in vehicle quality.

⁸ Auto dealers know that a used vehicle will sell more quickly if the vehicle has maintenance records or a history report.

The conclusion stated by Bond (1982) generated a number of responses including Pratt and Hoffer (1984) and Kim (1985). Bond (1984) replied to some of the concerns and consequently, produced another updated model as follows:

$$\text{Ln}[P_i/(1-P_i)] = \alpha_i + \beta_1 \text{AGE} + \beta_2 \text{LM} + \beta_3 \text{TRADED} + \varepsilon \quad (2.2)$$

where P_i is the probability of maintenance on type i (used or new), LM is the log of total mileage, $TRADED$ is a dummy variable for the vehicle which was bought used within the last year. If β_3 is significantly positive, then the author found that a used vehicle has a lower quality for reasons other than age and lifetime mileage. Bond (1984) criticized the Pratt and Hoffer paper (1984) for not accounting for age differences and for including older model type trucks, resulting in potentially biased results. The data show that trucks older than ten years when traded will have higher maintenance needs but also will more likely be traded between two private parties. Bond (1984) asserts that trucks less than ten years old are most likely sold by actual retail dealers and fewer differences exist between the new and used vehicles.

Kim (1985) adds additional characteristics to the Akerlof model. The used vehicle market is unique in that a car owner can easily switch between the demand side and the supply side of the equation. This is not always the case in other markets. Kim takes the insurance market for an example. It makes little sense to suggest that an individual can be both one who needs insurance and one who supplies insurance. Another example is in the job market: an employee cannot easily switch to become the employer. So unlike other markets, each individual car owner can choose on which side of the market transaction to position himself. Also, Kim includes the quality of the vehicle in his model as one of the variables that affect price, rather than maintaining it as exogenous to the model. Vehicle quality is not only a

function of inherent characteristics of production but also of the level of care provided by the owner. Kim presents a multi-period model where quality is a function of maintenance during period one (when it is new) but not during period two (when it is used). An individual can buy a new car, a used car, or no car. In this model, the lemon problem potentially may not be accurately modeled since the quality of the used vehicle is solely determined by how much maintenance was performed in the previous period, and owners with higher preferences for “quality” select higher maintenance levels. Again, the unique contributions of Kim (1985) were to allow the individual the ability to choose to be either a buyer or a seller and to align himself accordingly and to allow vehicle quality to be an endogenous variable in his model.⁹ Additionally, the Akerlof model has homogeneous seller preferences, while Kim introduced sellers who have varying degrees of car-quality preferences. That is, there are some owners who obtain more utility (or less disutility) from more maintenance than other owners.

Wilson (1980) provides a segue into the auction structure by introducing a modification to Akerlof and by introducing the presence of an auctioneer who brokers the sale. Within his model of the auction environment, he examines the price function allowing for three possible scenarios. The three scenarios vary with differing individuals who are setting the initial price. These individuals are the auctioneer, the buyer, and the seller.

Auction Structure

Since this thesis assumes the auction structure as given and does not delve into the optimal auction structure, this section will be limited to a general presentation of various auction

⁹ The Akerlof model has vehicle quality as an independent variable; the quality level of the vehicle is merely a given. There are no measures for owner-treatment, which would affect quality at the time of sale.

structures. The four basic types of auctions are the English auction, the Dutch auction, the First-price Sealed-bid auction, and the Second-price Sealed-bid auction.¹⁰

In the English auction, the price is successively raised until only one top bidder remains in the bidding process. The distinguishing feature is that each auction participant is fully aware of the current highest bid and the price goes higher as the auction process continues. The bidding can take place with an auctioneer announcing the bids, the buyers announcing the bids themselves, or the auction house displaying the highest bid. The winning bidder pays highest valuation. The weakness with this structure is that it is possible for bidders to form “auction rings” which are ways to collude on price. An auction ring is a group of bidders who have previously made agreements in order to limit any competition against them. By strategizing beforehand, the bidders could theoretically select a designated winner by whoever has the highest valuation. Graham and Marshall (1987) proposed a structure that would have the designated winner distribute side-payments to member of the ring in the amount of the difference between the winning bid and the second highest bid. These payments must be made to stall any estimated incentives to cheat during the auction process as auction competitors could move into the ring leader’s position. The success of the ring hinges on the degree of control by the ring, a stable reserve price, and the right level of side-payments. In this structure, the designated bidder is attempting to place his bid near the seller’s reserve price,¹¹ while all other bidders in the ring will abstain from bidding. However, this structure is not self-enforcing since those not bidding could gain by bidding slightly higher than the designated bidder since the auction reserve price could be lower than the second-highest valuation. A fluctuating reserve price will likely break down this attempt to collude. But, Graham and Marshall find that in an English auction, the non-designated

¹⁰ The data set for this research were taken from English auctions, specifically Manheim Auto Auctions, which are located throughout the United States.

¹¹ The reserve price is the minimum price that a seller will accept for his product.

winner of the ring has no incentive to break any pre-auction agreement since he will not want to bid higher than the designated winner. This is not the case in the Dutch auction, as discussed next.¹²

The converse of the English auction is the Dutch auction, where bids are descending.¹³ As in the Netherlands' flower auctions, the auctioneer gradually lowers the price until there is one bidder who accepts the price. From the seller's point of view, the Dutch auction may be preferred over the English auction because the English auction may allow the winning bidder to pay a price higher than his valuation price. A bidder in a Dutch auction could end up bidding closer to his valuation price because he would be less inclined to wait before he enters the bidding process. There certainly is a 'time' component to the bidder's decision process.

The First-price Sealed-bid auction requires each potential buyer to submit a one-time, sealed bid, and the highest bidder is awarded the auctioned object. The unique characteristic of this process is that each bidder is unaware of the other bidders' amounts and cannot revise their first amount. After this first stage, there may be a second "resolution" stage of bidding if there are two or more high bidders. Before 1993, the U.S. Treasury had used this type of auction structure. However, Milton Friedman was influential in showing that this type of structure was subject to collusion.¹⁴

The fourth main structure is the Second-price Sealed bid auction, also known as the Vickrey auction or Uniform-Priced auction, where there are multiple units of the same item on

¹² The auctioneer may begin to "pull bids off the chandelier" in an attempt to limit collusive behavior among auction participants. If the auction management suspects collusive behavior, the auctioneer will make up imaginary bids during the auction.

¹³ Filene's Basement has an inventory control system that follows a modified Dutch auction strategy. Merchandise in the basement of the store is systematically discounted as time goes on.

¹⁴ Solomon Bothers was potentially offering questionable bids for Treasury bills during auctions in the early 1990s. In the past, the Treasury used a sealed bid auction, which is used when there are multiple units of the same product for sale. The sealed bids are sorted from highest to lowest and the T-bills are awarded accordingly, until all T-bills are matched with buyers. In this framework, there are different winning bid prices.

the auction block. Vickrey (1961) stated in his work that a “first rejected bid” has a higher probability of achieving a Pareto-optimal solution than what he termed the “last accepted bid” method. Again, bids are submitted in a sealed form such that the competitive bidders do not know the amount that the other bidders are offering. The unique feature is that the winner pays the second highest amount bid as the name suggests. But for this structure to work properly, the bidding levels must be done in secret, since it would be easily manipulated if everyone knows that the others are bidding since the second-highest amount wins.¹⁵

Auction structure is clearly an antitrust industrial organizational issue: pareto efficient structure should be one where it protects the marketplace from the destructive effects of conspiracy, predatory pricing behavior, and monopoly-type effects. Kempeter (2001) suggests various solutions to limit collusive behavior, especially in an ascending auction. He says that auction participants may find it helpful if the lots are bid in round numbers with specified increments, and bidders are able to remain somewhat anonymous. Moreover, the number of bidders should remain unknown for these types of auctions to remain healthy (Cramton and Schwartz, 2000 and Salant, 2000).

Klemperer (1998) introduced the Anglo-Dutch auction, where the auction process starts as a simple ascending auction until there are only a few bidders left. Then, the process moves into the First-price Sealed-bid arrangement where the bidders are required to bid at least as high as the last audible bid.

¹⁵ Suppose a \$5,000 violin is up for sale in a sparsely populated auction environment and someone bids \$1,000. Another bidder could bid \$10,000 and be guaranteed to get the violin for just \$1,000.

Hedonic Regressions

The core hedonic hypothesis is that each good is an aggregate of all individual characteristics (Brachinger, 2000). For a given good with K characteristics, let the vector of characteristics be such that

$$\mathbf{X}=(x_1, \dots ,x_K) \quad (2.3)$$

The preferences of the economic agent are a function of the characteristics vector. Additionally,

$$p = f(\mathbf{X}) \quad (2.4)$$

describes the relationship between the market price and its attributes. Given the above equations, the implicit prices of the i -th characteristic are defined as the partial derivative,

$$\frac{\partial p}{\partial x_k}(x) = \frac{\partial f}{\partial x_k}(x); (k = 1, \dots, K) \quad (2.5)$$

Hedonic regressions come in various forms. The linear model is shown as

$$p = \beta_o + \sum_{k=1}^K \beta_k x_k \quad (2.6)$$

where the regression coefficient represents the marginal change of the price with respect to a k -th characteristic of the good. Another functional form is the exponential form, and it is shown as

$$p = \beta_o \prod_{k=1}^K e^{\beta_k x_k} \quad (2.7)$$

or, performing a natural log transformation,

$$\ln p = \ln \beta_o + \sum_{k=1}^K \beta_k x_k \quad (2.8)$$

where the implicit price is

$$\frac{\partial p}{\partial x_k} = \beta_k p \quad (2.9)$$

and the coefficients are growth rates, since β_k illustrates the marginal effects on the price function.

In what is termed as a power form (Brachinger, 2000), the following model is a double-log function:

$$\ln p = \ln \beta_o + \sum_{k=1}^K \beta_k \ln x_k \quad (2.10)$$

which is a transformation of

$$p = \beta_o \prod_{k=1}^K x_k^{\beta_k} \quad (2.11)$$

and the implicit price for any individual characteristic is given by

$$\frac{\partial p}{\partial x_k} = \frac{\beta_k}{x_k} p \quad (2.12)$$

As is evident from this functional form, the regression coefficients are partial elasticities, since the coefficients show the percent change in price when the k -th characteristic, x_k , has a unit percent change.

A fourth, major approach found in the literature is the logarithmic function,

$$p = \beta_o + \sum_{k=1}^K \beta_k \ln x_k \quad (2.13)$$

with hedonic prices as

$$\frac{\partial p}{\partial x_k} = \frac{\beta_k}{x_k}. \quad (2.14)$$

The literature also includes the log-lin function,

$$\ln p = \beta_o + \sum_{k=1}^K \beta_k x_k \quad (2.15)$$

and the coefficients for the right hand side variables are approximately viewed as percentage effects on the dependent variable.

Given the various available forms, Freenstra (1995) finds that the linear model produces unbiased estimates. Freenstra models the auction environment as a perfectly competitive market with the auction sellers pricing their products at the marginal cost of production.¹⁶ This assumption, along with the traditional concave utility function, has the coefficients as the market value of the characteristics. This is especially helpful as the number of new characteristics is growing over time. For example, the option to include an iPod connection device in a vehicle did not exist in the last decade. More and more options are available for the consumer than were previously and this trend is continuing.

Rosen's (1974) paper introduced the notion that the estimation of the marginal bid function could be found from supplier and demander interaction. Therefore, the hedonic price for

¹⁶ In this case, the "firm" is the consignor of the vehicle at the auction block. He or she is usually seen standing right along side of the auctioneer during the bidding process.

a particular attribute is an estimate of both sides of the equation: the marginal offer from the seller and the marginal bid from the buyer.

Hedonic studies have largely been motivated by two main concerns: first to identify implicit prices of various individual characteristics and second, to measure the welfare effects from the differing demand equations (Follain & Jimenez, 1985; Bresnahan & Gordon, 1997). Pakes (2004) says that Griliches (1961) revived Court's (1939) perception that hedonics could correct the "new goods" problems in price indices. Since model characteristics change over time, price differentials, as measured by price indices, from one year to the next are not just due to overall price inflation. These price indices create the framework for hedonic modeling. This type of modeling can partially adjust for the "new characteristics" problem.

In general, the hedonic function is an empirical summary of the relationship between prices and characteristics. Formally, it is the expectation on price, which is conditional on characteristics and measured by regressing prices on characteristics. The hedonic function summarizes the market's marginal valuation for the different bundles of characteristics.

Bartik (1987) shows that data must be taken from multiple markets to produce robust estimates for the hedonic demand parameters. He shows that if the demand parameters are estimated from single-market data, the results are not consistent. Specifically, he analyzes Mendelsohn (1985) and the instrument variable approach as in Palmquist (1984), Diamond and Smith (1985), and Ohsfeldt and Smith (1985).

The approach in Mendelsohn (1985) may have inefficient hedonic results since there are unobserved tastes that alter the estimates to the demand parameters. Using only single market data requires the assumption that household tastes do not affect the marginal bidding price. In the instrumental variable approach, the author shows that the instrument may be correlated with the error term when there are unobserved shifts in tastes or preferences. Some might argue for

assuming away any unobserved tastes but, these “unobservables” are inevitably a factor in consumer behavior. Therefore, the better approach is to use data from multiple markets, as in Bartik (1987).¹⁷

Brown and Rosen (1982) raise the identification issue in Rosen’s 1974 paper and attempt to address the influence of functional forms on hedonic prices. They assert that there comes a point where additional data do not add greater opportunities for a robust model. Mere quantity, in spite of quality, of data may not be that helpful in reaching for that robust model. Marginal prices that are constructed only from quantities do not in themselves add any information to that already provided by the general observation on levels of consumption alone. The best way to correct this problem, as suggested by the author, is to estimate marginal prices using data from distinctly different geographic markets. Brown and Rosen (1982) as well as Brown and Mendelson (1984) use spatially distinct markets to avoid the problem of making assumptions regarding consumer preferences, utility functions, and demand functions. As Palmquist (1984) notes, a benefit of using data from a number of different markets is that demand estimation need not be limited to a linear function. His particular model seeks to estimate the demand for different characteristics within the housing market. Since the number of square feet did not have a linear effect on price, this particular model included the square of total living area as an endogenous variable. Following the example of Brown and Rosen (1982), the data in this research are taken from spatially distinct auctions across the United States.

¹⁷ In this particular topic, multi-market data would be data from differing days at one particular auction or data from differing auction sites.

CHAPTER THREE

THE AUTO AUCTION

Since 1959, Atlanta-based Manheim Auctions has been the largest and highest volume auto auction in the world with over 120 auctions worldwide and over 30,000 employees.¹⁸ This subsidiary of Cox Enterprises, Inc. owns 86 auctions in North America and additional operations in France, Spain, the United Kingdom, Australia, New Zealand and Thailand. Because of their market dominance, the assumption is that Manheim's policies and structure best replicate the industry standard (Table A.1).

The Auction Environment

Auto auctions are unusual. On one hand, there can be over five thousand vehicles sold in five hours or less; but on the other hand, only sixty percent of vehicles that come to the block are sold.¹⁹ The most common reason for this sales percentage is that the consignor has rejected the highest bid. If the seller rejects, he can participate in a later auction or he can attempt to sell the vehicle to someone who comes on the retail lot. Some have incorrectly stated that buyers at the auctions are not able to examine the vehicles before they are to start the bidding (Genesove, 1993, 1995). However, the typical auction structure is such that the dealer can start the engine, inspect the body, and drive the vehicle around the auction property. Typically, the only restriction is the prohibition of taking the vehicle off site before a paid receipt is in hand. Although there are

¹⁸ Total vehicles at all auctions in 2003 were 15 million. Of these, Manheim auctioned off approximately 10 million in addition to the 1 million in online auctions. This accounts for 74% of the market. Manheim is also the largest non-factory painter of automobiles in the world according to Manheim Auctions, Inc. March 2004 Newsletter

¹⁹ The data collected by the author support this statement.

various, smaller auctions that are open to the public,²⁰ the mainstream auto auctions are limited to dealers, whether wholesale or retail.²¹

The experienced dealer follows a multi-step process before the auction begins. The major auction houses, Manheim Auto Auctions and Adesa Auctions, as well as some smaller auction houses such as the regional Carolina Auto Auction, distribute via electronic mail, the list of upcoming vehicles for the next auction. This list is sent only to registered dealers. This list is circulated at least one day before the auction and is continually updated until the final hard-copy version is printed and waiting for the dealers when they arrive the morning of the auction. In addition to details of options, year, and mileage, the vehicle identification number (VIN) is also included on this list. The VIN is available for those dealers interested in checking the history of a vehicle before the day's activities begin.²² On auction days, each vehicle to be consigned is assigned a particular lane in the auction house and a specific "run" number so each attendee knows the lane location and order of each vehicle. To keep uniformity and continuity, lanes are dedicated to specific types of vehicles and specific consignors (Table A.2). As long as any auction employee is not busy with the vehicle, the potential bidder can test everything from the brakes to the wheel alignment both prior to and during the auction.²³

The auction begins with vehicles in the lane farthest from the main auction house offices. Meanwhile, all the other lanes in operation are already filled with the vehicles queued. Thus, each

²⁰ Penland's Auction, in Greer, SC is open to non-dealers. However, this auction volume is 80% smaller than the typical Manheim auction and of poorer quality.

²¹ The differences between wholesale dealers and retail dealers are many. There are less sales quotas for the wholesaler as well as less insurance requirements, and less general regulations. At least in South Carolina, the regulations for the retailer cover everything from the required size of signage, size of office, type of building structure, lot size, type of lot surfacing, etc. Although the following is outside the scope of this paper, it would be interesting to examine the correlation of state dealer regulations with the relative level of state vehicle property taxes. Anecdotal evidence suggests that there are many "dealers" in South Carolina that are just trying to avoid the yearly property tax as well as the sales tax for every transaction incurred.

²² The popular databases are Autocheck and Carfax.

²³ The large, Charlotte Adesa Auction has a small test track where interested parties can check the vehicle's acceleration and braking abilities. The track consists of a straightaway with a length of 1/8 mi., or 220 yards.

dealer who walks to the end must necessarily walk through the other lanes' inventory. The auction house assigns the large volume consignors to start the day since these attract the large purchasers. When the time comes for the vehicle to arrive on the block, the one consigning the vehicle is typically requested to be up in the raised desk along with the auctioneer. However, there are times where the consignor is in *absentia*. In certain cases, a consignor may have multiple vehicles in multiple lanes; or, he may be bidding on a vehicle in another lane.

At this point, the auctioneer has his assistants on the floor of the lane and is “working” the crowd and highlighting the bidding process. Before the bidding begins, the one who is selling the vehicle has written down an acceptable floor price on a sheet of paper that is in front of the auctioneer. While the bidding structure generally follows an English, or ascending bid auction, in reality, the auto auction utilizes a combination of both English and Dutch auction structures. The auctioneer starts out with a high price, typically higher than the minimum reserve, and then works his way down until he gets someone to start bidding. Then the auctioneer works the bidding price back up in ascending fashion.²⁴ All of this takes place in just a few minutes. Eventually, the sale volume (as well as the noise volume) in the auction house increases as other auctioneers start the bidding in their respective lanes throughout the auction house.²⁵ Most of the time, the vehicle is driven off and the next vehicle is in position before bidding has ended for the previous one.

As mentioned, about one out of three vehicles fails to be consummated with a sale, so if the seller chooses, the vehicle can be re-run through the auction process that very same day.²⁶

²⁴ It is intriguing to point out that the auctioneers in Manheim's flagship auction are compensated by salary. Further research should be pursued to examine the specific combination of pay structures. A cursory explanation might include the fact that these auctioneers are also involved in other aspects of the business, but personal observation suggests that only 15% of their time is off the block.

²⁵ Most major auctions have eighteen lanes, but typically the first lane closest to the offices is reserved for the transportation companies and food concessions. Depending on the day of the week, as many as twelve lanes could be running, and on other days, as few as four lanes could be operating.

²⁶ Unlike certain Ebay auctions, the seller's reserve is not known at the car auction. However, if the reserve price were known, theory would suggest that if the car does not sell in its first run and if the consignor decides to re-run the vehicle, then the reserve will fall but perhaps not to the level of a sale on the re-run.

After each lane has concluded all of its run numbers, the auction company regroups the unsold vehicles whose sellers desire another opportunity to make it to the auction block. The alternative to those sellers who did not find a buyer is taking the vehicle back to the auction house later or bringing the vehicle back to the lot, if available. If the seller wants to try his luck again, these regrouped vehicles are again brought to the block in the usual fashion but with two main differences: first, no other lanes are still in operation to compete for the potential buyer's attention and second, all of these vehicles are reaucted in the middle lane. It may be the case that the unsold vehicle was merely in the shadows of another auction so it is key that the re-auctioned group has no other simultaneous events to compete against it.

For those who are consumers at the auction event, they find that all vehicles must be paid for on the day of sale.²⁷ For those dealers who are purchasing more than the number of their available drivers, transportation companies are available. These transport services are allowed to rent a kiosk near the end of the lanes where they can advertise and negotiate.²⁸

Manheim offers a complete arbitration process, which is optional and only available on the day of the sale for some issues and extended to 7 days for other issues (Tables A.3 and A.4). The mere presence of these services suggests that quality is difficult to assess even though there are ample opportunities to drive and inspect the vehicle. The auction house announces a red light sale on those vehicles that are not arbitratable (Table A.5).

²⁷ <https://www.manheim.com/members/auctions/policies.mpl?aid=AAA> as of December 3, 2008.

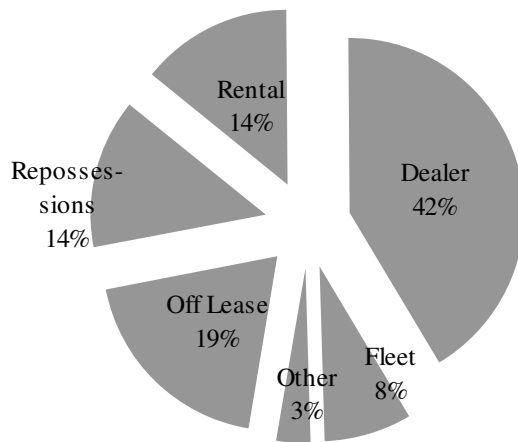
Approved methods of payment are cash, certified check, bank draft or an approved finance plan.

²⁸ The economics of vertically integrating with the transport company is left for further research. There are other renters during the week, including those selling food concessions. The rental data should be readily available; however, this research does not examine the transportation segment of the auction nor the food concession segment.

Role of Auctions in Used Car Sales

According to Manheim's 2004 Used Car Market Report, the average franchised dealership had \$32 million in revenues for 2003, and 29% of those revenues came from used car sales. As a result, dealers pay attention to their used vehicle inventory and use the auction environment to manage this inventory (Fig.3.1).

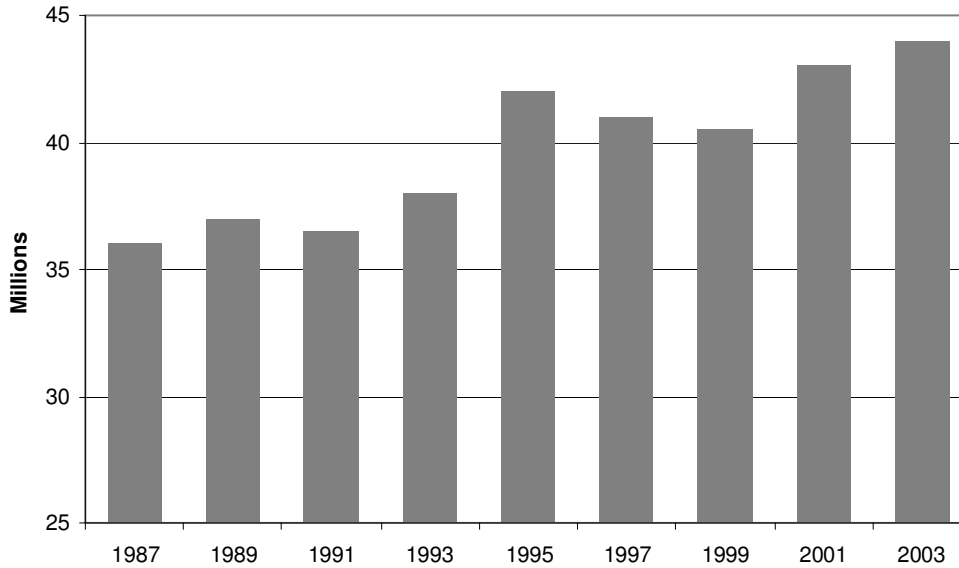
Figure 3.1 Distribution of Vehicle Sales at a Typical Auction



Source: Manheim Used Car Market Report, 2003.

Auctions are important to both the new and used vehicle markets, because they provide dealers with a quick source for inventory changes. Auctions also provide the administrative aspect by handling the title transfers and monies. Dealers attend auctions knowing that transactions are safe. If they discover a mechanical problem with a car before leaving the auction site, the sale can be nullified. Tables A.3 and A.4 list conditions for arbitration; therefore, these conditions act as a type of guarantee to quality. According to Manheim recommendations, a vehicle should not last more than forty-five to sixty days on a retail lot, so when it is time to change the inventory mix, dealers turn to the auctions (Fig A.1).

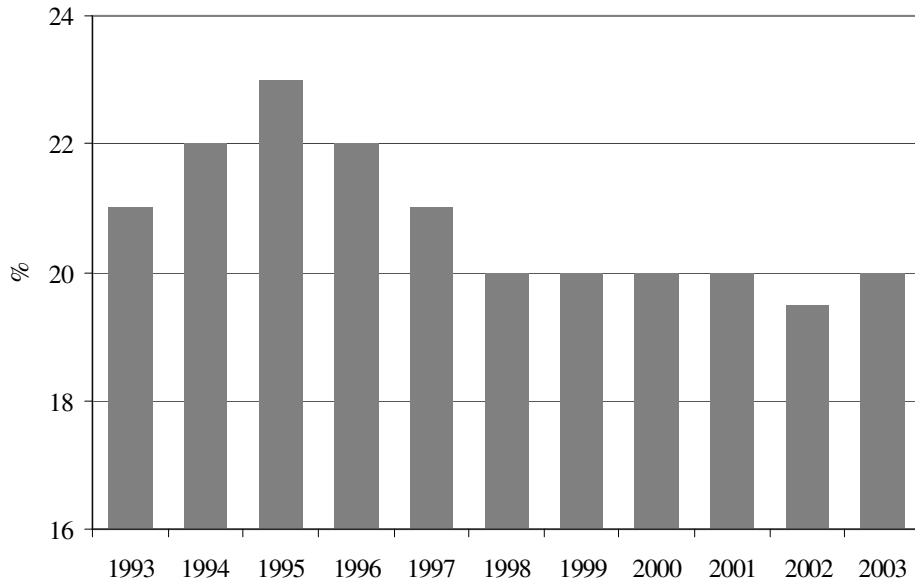
Figure 3.2 Total Vehicle Sales in Millions



Source: Manheim Used Car Market Report, 2004.

In 2003, Manheim reported that there were 43.6 million vehicles retailed, producing gross revenue of \$366 billion (Fig.3.2). In addition, the stability of the used vehicle market is noteworthy. Only twice in the past fifteen years has used vehicle sales fluctuated by more than 3% from one year to the next. According to CNW Marketing Research and R.L. Polk Company, the ratio of used vehicles to total operating vehicles has been stable at roughly 20% (Fig.3.3).

Figure 3.3 Total Used Vehicles Divided by Vehicles in Operation

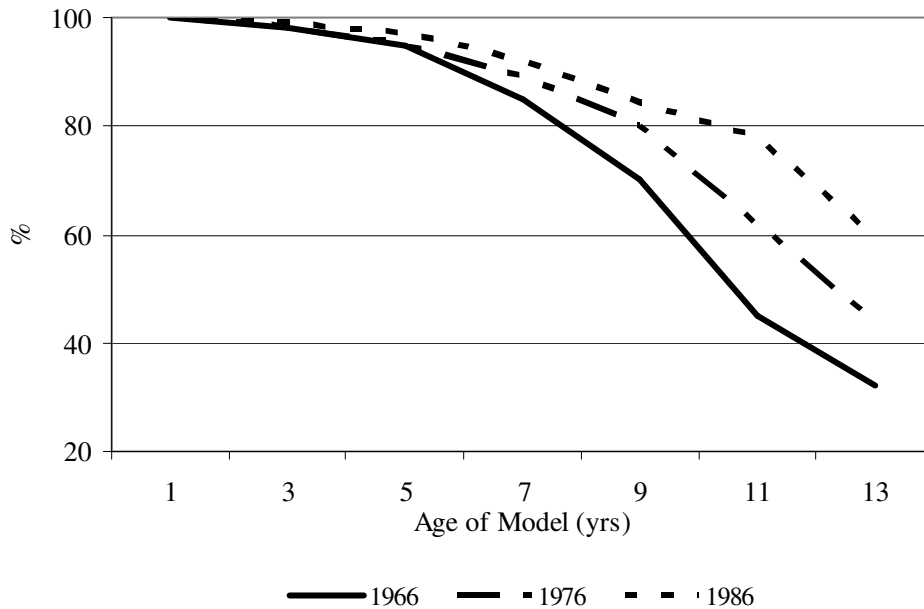


Source: CNW Marketing Research and R.L. Polk Company.

The stability in used vehicle sales is driven by the large number of vehicles in operation. It is also driven by the increased durability and growing longevity of used vehicles (Fig.3.4). The used vehicles purchased in this decade will stay on the road longer than the used vehicles from previous decades. Generally, one out of every five vehicles in operation will undergo a change of ownership in a given year, and that percentage has remained largely steady for decades.²⁹

²⁹ This captures the number of times that the vehicle's title has been retailed. That is, if one dealer sells to another dealer, that sale does not constitute a change of ownership.

Figure 3.4 Percentage of Model Year that Remain on Road by Age



Source: R.L. Polk Company.

As vehicles increase in durability, they will remain longer on the roads. So as the number of used vehicle sales increases as well as vehicle-life expectancy, the place of the auction will become greater and greater as dealers will need this highly liquid environment for inventory management.

The total number of operational vehicles increased from 201 million to 225 million from the six years proceeding July 1, 2003, and industry experts expect this growth to continue. A 2003 Department of Transportation study shows that, for the first time ever, the average household had more than one car per driver.³⁰ The growth in new unit sales, together with growth

³⁰ U.S. Department of Transportation, Bureau of Transportation Statistics and Federal Highway Administration, 2001 National Household Travel Survey, Preliminary Data Release Version 1 (day trip data only), available at http://www.bts.gov/publications/transportation_statistics_annual_report/2003/excel/table_031_a.xls as of December 3, 2008.

in vehicle ownership and durability, all point toward strong growth in the remarketing and auction industry for the foreseeable future.

Industry Segments

In general, those who come to the auction find various types of sellers. Within the auction framework, a seller is categorized as a consignor-type. Of course, large retail dealers bring the most volume and variety in both make/model and in age, since most dealer-consigned vehicles are part of excess inventory.³¹ Fleet and Lease vehicles also make up a relatively large portion of the auction inventory. These vehicles are relatively stable segments, since these vehicles are typically remarketed after twenty-six months for a car and thirty months for a truck.³² These vehicles come to the market in great condition and with relatively low miles. Factory vehicles make up the smallest portion of the remarketing market. Most of these sales are limited to franchised dealers only; consequently, the auction house will not indiscriminately permit just any dealer to attend.

Although the major auction houses are limited to licensed dealers, sprinkled across the county are auctions open to the general public.³³ The sections immediately following do not apply to the public auctions, since the general auction participant is completely different from the dealer auctions.

Rentals

The major auto manufacturers offered powerful incentives to rental car companies to reallocate their fleets faster than in previous years. As a result, these types of vehicles were

³¹ On average, half of the vehicles in a used-car auction are from dealers, and the vast majority of these are trade-ins.

³² The industry uses the term, “remarketing” to describe the life-cycled process of a used car or truck.

³³ There are many such auctions in the upstate of South Carolina where the public can participate. However, the selection is far from the quality of a dealer auction, and no arbitration policies exist.

remarketing at extremely high volumes and so auction prices were depressed across the board. The car rental industry, such as Enterprise and Budget, is one of the largest vehicle buyers in the country. According to industry reports, the rental industry bought 1.7 million new vehicles in the 2003 model year, a 4.5% increase from the 2002 model year.³⁴ Nearly 1.1 million of the sales consisted mostly of program (or rental repurchase) vehicles and the remaining were “risk” units.³⁵ Program vehicles are such that at the end of the contract period, the rental company simply returns the vehicle to the manufacturer, and then the manufacturer re-markets the vehicle.

The car rental industry reports that they have two segment types: shorter-term daily rental and long-term insurance rentals. “Program vehicles” are those vehicles that the rental companies do not give back to manufacturers but actually decide to purchase under specific contracts with the automakers. The terms of the agreements often change each year to correspond to the changing needs of the auto and rental companies. In some years, the manufacturers must deal with excess capacity, so the willingness of the rental industry to absorb these vehicles creates a benefit for the automobile manufacturers. Industry specialists indicate that these vehicle supply contracts typically specify everything from the number of vehicles, the different models, the purchase and remarketing schedule, the restrictions on mileage, and a host of other details for the particular arrangement.

The recycling time with the rental industry was reportedly small in 2003, so auto manufacturers shortened the cycle time incorporated into repurchase agreements. Large numbers of the rental repurchase vehicles sold that year were reportedly recycled much sooner than in

³⁴ The sources for these statistics are both the 2004 Manheim Used Car Market Report and the author’s conversations with dealers and auctioneers around the region.

³⁵ Risk units are the vehicles that are directly purchased by the rental company and not given back at the end of the agreement. The rental firms are completely responsible for re-marketing these vehicles at the end of the cycle.

previous years. For example, the long term average of six to nine months and this year's cycle was four to six months long.

Risk cars are the vehicles that the rental company must remarket themselves instead of just turning back in to the manufacturer. That is, the rental company will take these vehicles to the auction and will have the responsibility to find buyers for these vehicles. Since some observe used car prices falling faster than expected,³⁶ the rental companies are steering away from these arrangements and so have been cutting back on the amount of risk vehicles in their inventory. Therefore, some rental companies began operating their risk fleets longer. One way that these firms are reallocating inventory is by increasing the number of program vehicles and decreasing the number of risk vehicles in the fleet.

The remarketing process is completely different for risk vehicles and program vehicles, since the sellers are different with different motivations. For example, program cars are, by definition, remarketed by the manufacturer, and so they are sold in a market open only to all of their dealers on an equal basis. A manufacturer is not the typical auto dealer since they have no retail lots to sell these vehicles. Therefore, these vehicles cars come to be sold through the auction houses.

Risk cars, however, are remarketed in a variety of ways and many do not end up in the auction.³⁷ The rental company uses various remarketing tools: it may send the vehicle to its own branded used car retail lot; they may send it directly to a local dealer; they also may decide to sell to a special fleet resale dealer. Dealers treat risk cars and program cars as different vehicles at the time of remarketing. Program vehicles typically have fewer miles because of the shorter cycling time as required by the manufacturer. The standard program vehicle should be newer, have lower mileage, may be in better condition, and is remarketed by the manufacturer. Given that

³⁶ 2004 Manheim Used Car Market Report.

³⁷ Manheim reports that only 43% of risk cars end up going through the traditional auction process.

manufacturers have a vested interest in brand image and price optimization, program vehicles are generally fully reconditioned in order to achieve the maximum wholesale price available. Although risk cars have historically received less reconditioning relative to other types of vehicles, a growing number of rental companies are beginning to use the full services of the body shop, which includes detail and paintless dent removal services before they run the vehicle at the auction.³⁸ Since program vehicles are remarketed by the major manufacturers, these vehicles tend to be transported to other geographic locations and might be auctioned off in another state from where they were rented. In contrast, the risk vehicles do not have the special treatment and are typically sold locally and are rarely moved around to different geographic markets.

Leasing

New lease originations have continued to decline and the effects in the remarketing business are noticeable. In 2004 and beyond, this decline will lead to a substantial forecasted reduction in off-lease volumes. Today's new leases have various types of agreement lengths and are more likely to be originated by an auto manufacturer's internal finance company.³⁹ Retail leasing of mainstream models in addition to luxury models, grew the fastest in the 1990s. Annual new lease originations first grew above one million in 1992 and by 1999, lease originations grew to more than 3.7 million.⁴⁰

The growth in leasing contracts was fueled by the desire of consumers to keep monthly payments low during a time when the cost of new vehicles were dramatically increasing while

³⁸ Dent Wizard is a subsidiary of Cox Enterprises, the holding company of Manheim. Dent Wizard is the company that most firms use when they bring a vehicle to auction. These firms are the manufacturers, dealers, rental companies, and insurance companies. Each auction has a Dent Wizard facility at the auction complex. This is another example of horizontal integration with wholesale auto auctions.

³⁹ A "captive finance arm" is the financing division for a particular automotive manufacturer, such as Mercedes-Benz Credit.

⁴⁰ 2004 Manheim Used Car Market Report.

real disposable income was barely holding up against these inflationary times.⁴¹ In an earlier attempt to address this problem, the auto industry had in the 1970s and 1980s, moved from shorter leases that had a three-year time frame and moved to longer-termed five-year leases. But now, by allowing customers to finance only the first part of the arrangement, the industry was able to depress to a greater degree the relationship between monthly payments and the sticker price. In the late 1990s however, new vehicle prices flattened and real disposable income began to rise.

The change in the economic landscape, as indicated by such variables as income growth and interest rate volatility, has changed the role of leasing for the auto industry. It is possible that the percentage of revenue from leasing is rising and now leasing may have moved from a loss leader to a main revenue-generating strategy. Some of the lease agreements may overestimate residual value and in that way, lessors have created an incentive for consumers to trade in the leased vehicle and move to another.⁴²

With residuals too high, lessees had less of an incentive to actually purchase the vehicle at the end of the lease and so the number of off-lease vehicles that finance firms supplied to the used car market increased. Banks and independent lessors would be negatively affected by the increased supply of these types of vehicles as auction-clearing prices would decline in this category. The captive finance arms of the manufacturers have slightly different cost structures so they continued to lease, but cut back on incentives and instead, focused their efforts on the leasing of luxury models.

It is reported that new vehicle retail consumer leases totaled less than 1.7 million in 2003, a decline of 52% from the peak in the late 1990s.⁴³ Three trends existed in the 2003 leasing

⁴¹ BLS publishes personal income reports and Polk publishes leasing information.

⁴² Residual value is the value of the vehicle at the end of the leasing term.

⁴³ Author's conversation with auction managers

market: captive finance companies ended up with a large percentage of the market, leasing became more popular in the luxury car market, and leasing contracts were extended.⁴⁴

Fleet

The majority of fleet customers are commercial firms and government agencies and so this category remains a relatively stable industry segment. Although many fleet vehicles are sold to company individuals, those vehicles coming to auction remain desirable to sensitive buyers who are looking for vehicles that have been well maintained. According to recent reports, the number of non-rental fleet vehicles in operation has fallen in each of the past five years, but still remains above 10 million, which is a significant portion of the used vehicle market.⁴⁵ The decrease in fleet vehicles is a result of companies cutting back on costs and diminishing the number of employee who would be eligible for these benefits.

The fleet industry has very few companies but these few firms operate a large percentage of the total fleet units. Of all fleet vehicles, only about three million of these are for “small” fleets, which are those with only five to fourteen vehicles in operation. The various options of purchase, operation, and remarketing of these small fleets are quite similar to the purchase and sale of private-party vehicles, so the remaining discussion applies mostly to the rest of the vehicles operating in fleets of fifteen or more vehicles.

Three categories commonly comprise the established fleet segment: commercial, government, and police/taxi. In early 2003, commercial fleets had 3.1 million vehicles in operation where the most popular fleet vehicles are domestic, such as Ford economy models,

⁴⁴ The top five independent leasing firms accounted for 55% of all non-captive leasing in 2003, up from 35% in 2000.

⁴⁵ Bobit Auto Group Research Department

Chevrolet base models, such as Impala and Malibu Classic, Pontiac economy models, and Dodge sedans. These domestic makes comprise 98% of the commercial fleets.

The government segment consists of more than 3.4 million vehicles, or roughly 49% of the total nonrental fleets in service. The majority of government fleets are at the local and state levels. Governments usually own their fleets, which are typically large with little overall fluctuation and consistent vehicle recycle agreements. Although the police segment of the fleet industry could be considered as a subset of the government segment, police fleets are included with taxi fleets due to their similar characteristics of long life cycles and high mileage at the end of their use. There are no police or taxi fleet vehicles in this research, which is due to the fact that these vehicles rarely come through a standard dealer-only auction.

Auto remarketers continually shift their buying and selling patterns to keep up with the constantly changing trends in used vehicle prices. In an effort to minimize vehicle depreciation expense and maximize vehicle use, fleet managers have altered vehicle replacement schedules, encouraged employee sales, and changed driver eligibility requirements.

The remarketing strategy for fleet vehicles varies according to the seller. Generally, in 2003, the typical fleet vehicle sold at auction was two to five years old, had 80,000 miles, sold for approximately \$6,000, and was in good mechanical condition. Commercial fleets remarket their vehicles in a variety of ways. Buyers can be anyone from the vehicle's main driver, to other employees in the company, to fleet resale dealers, or dealers at auction. In recent years, fleet managers have made a concerted effort to increase sales to other employees in the company if the current main driver does not decide to purchase the vehicle. Most fleet management companies have established internet applications to help the ease at which vehicles can be remarketed. Today, approximately 30% of commercial fleet vehicles are sold within their organizations.

Although they utilize a wide array of remarketing outlets, commercial fleets still run a large number of units through the auction.

By law, government fleets are generally required to sell their end-of-service vehicles at public sales. Sometimes the government agency will decide to remarket vehicles at large and specially noted sales events, where a wide array of government property is sold (e.g., lawn mowers, construction equipment, office furniture, etc.). Increasingly, however, many government officials have found that vehicles are best remarketed separately. Often they will utilize the services of public auctions.

Remarketing of police vehicles and taxis is altogether different. Often police vehicles are remarketed to taxi companies, which then drive the vehicles to the end of their useful lives. The exception to this trend is the growing number of limousine and executive vehicles. Many of these vehicles are purchased new and then remarketed to economy limo or taxi services.

Repossessions

The number of repossessions hovers below one million, if the series follows trend.⁴⁶ Ford Motor Credit has repossessed approximately 200,000 vehicles in each of the past two years. The initial push to 0% financing kept repossession rates very low, since borrowing costs were unusually low but there also likely was an increased number of high-quality credit customers who also wanted to take advantage of 0% financing. That trend, however, is now being more than offset by the lengthening of loan terms. Generally speaking, there is a disproportionate rise in delinquencies and repossessions for every increase in contract duration. The majority of banks, especially those involved in direct auto lending as opposed to indirect, cater to prime credit customers and thus their repossession rates are even lower. Here again, however, some increase

⁴⁶ Bobit Auto Group (http://www.automotive-fleet.com/Statistics/StatsViewer.aspx?file=http://www.automotive-fleet.com/fc_resources/stats/AFFB05-k.pdf&channel=Remarketing as of Dec 3, 2008)

can be expected in the years ahead due to the significant lengthening of terms. Subprime lenders by definition deal with those that have credit blemishes; thus, these specialty lenders must accept and be willing to deal with the higher level of repossessions. Exactly how high a repossession rate they should expect depends on how deep, or how far down on the credit scale, they are willing to finance.

Buy-Here Pay-Here dealers, of course, interact with repossession risk on a daily basis. Some of their repossessions are simple where the driver simply brings back the car. In some respects, this is more like the return of a rental vehicle where the obligations cannot be met as opposed to what is normally considered a repossession. Some repossessions are not that simple, however, and some Buy-Here Pay-Here dealers are beginning to install inexpensive GPS tracking devices on vehicles at the time of sale of in order to make the recovery process easier.

When a repossession occurs, virtually all of the lender's recovery will be based on the value received when the vehicle is auctioned. As most of these types of dealers can attest, additional actions against defaulted borrower are rarely pursued but this risk is calculated during the initial transaction. It is not surprising, then, that auto dealers and financiers keep a close watch on prices of used vehicle price as they model various levels of business risk. This risk includes the estimation of residual value, depreciation rates, and loan-to-value calculations.

Dealers

Franchised, independent, and Buy-Here Pay-Here dealers all focus on successfully managing their inventory. The more successful dealers carefully monitor inventory turnover rates and seek out the most profitable remarketing channel for their unwanted inventory. Franchised and independent dealers retailed 29.9 million used units in 2003.⁴⁷ Gross revenue for these sales exceeded \$310 billion. And, of course, it is this rotation in retail demand that drives the

⁴⁷ 2004 Manheim Used Car Market Report

successful inventory management for retail dealers. Indeed, dealers are the main force in the overall automotive and auction industry.

The retail auto dealer business is a diverse industry. These dealers make a profit when meeting consumer demand on a timely basis. This is where the auto auction services come to play. There are various types of dealer structure and major differences show up in structure, operations, financing ability, vehicle type and profit growth levels.

Franchised dealers represent 37% of used car sales.⁴⁸ In 2003, the majority of the auto dealerships sold 16.7 million new vehicles and retailed 16.2 million used ones. Gross revenues, including auto servicing, finance and insurance, increased by 4% to \$700 billion.

In 2003, “certified used vehicle sales” at franchised dealers reached almost 1.5 million cars, a significant gain over the year. Manufacturers have promoted these pre-certified vehicles to consumers with national advertising campaigns, special incentives, such as extended warranties. Their goal has been to increase consumer demand for this type of vehicle, thereby improving residual values while building brand recognition among used car consumers. “Certified used cars” are late-model units brought to dealers through various channels, including manufacturers that work directly with dealers, auto auctions, trade ins, and dealer purchase of lease returns.

Independent dealers sold 200,000 vehicles in 2003, which was below its 2001 peak according to statistics reported by CNW Marketing Research. Even with a dip in sales, independent dealers purchased a record number of units last year. Typical reports suggest that there are approximately 54,000 independent dealers in the United States but this number has been declining slowly over time. But, of course, any count depends on the definition of “independent dealer,” and distinguishing between the differences among dealers, whether they are wholesale or retail, is nearly impossible. Many states do not make a distinction between these types of dealers,

⁴⁸ Author’s calculations based on sample auction data as well as conversation with auction managers

so data are not available. Recognition of the differences within the independent dealer ranks is more important than knowing the actual number of independent dealers. Independents range from one person selling a few vehicles a year all the way up to CarMax, which employs 8,300 people and retailed 190,100 used vehicles in its fiscal year ending February 28, 2003.⁴⁹ Furthermore, independent dealers range from those selling late-model, high-end luxury cars at an average price higher than the price of an economy class new car, to those selling used vehicles at an average price of less than \$2,000. The overwhelming majority of independent dealerships have just one lot, but some are part of a chain of used car stores. Ironically, some are even franchised in that they sell under the umbrella of a rental car company or some other entity. In addition, some rental car companies, such as Enterprise, Hertz, Budget, and Thrifty, operate their own retail used car lots.

No generally accepted statistics exist on the number of Buy-Here Pay-Here dealers in the United States, but the auction data suggest that this group had a great year in 2003. As some subprime lenders curtailed their loan originations in 2003, the only retail used vehicle market available to many credit-challenged customers was the Buy-Here Pay-Here lot. The potential customer base available to Buy-Here Pay-Here dealers is enormous and growing, but unless the dealer is very well financed and/or is willing to take the risk of putting ever larger amounts of personal money on the street, growth is restrained by that business reality.

At franchised dealerships, the used vehicle department usually provides a better net return than the new vehicle department. The retail gross margin on a used car was 11.8% in 2003 compared to 5.4% on a new car, according to NADA. What's more, due to greater auction access and the presence of an active wholesale market, dealers are generally able to turn their used

⁴⁹ Technically, South Carolina law classifies anyone who sells more than five vehicles a year as a "dealer."

vehicle inventory quicker than their new vehicle inventory (forty-five days versus sixty days). Thus, the return on investment for used vehicles is superior than for new vehicles.

The following Table 3.1 summarizes the specific segments of those who supply vehicles to sell at auction.

Table 3.1 Types of Vehicles Remarketed (2003)

SELLER TYPE	VEHICLES (MILLIONS)
RENTAL	
Manufacturers Program Vehicles	1.1
Rental Companies	0.6
OFF-LEASE	
Captive Finance Companies	2.3
Banks & Other Indep. Lessors	1.0
FLEET	
Fleet Mgmt. Companies	0.5
Comm. & Gov't Fleet Owners	1.2
REPOSSESSIONS	
Captive Finance Companies	0.5
Banks, Credit Unions & Other Finance Companies	0.3
Subprime Lenders	0.4
Buy-Here Pay-Here Dealers	0.3
DEALERS	14.7
TOTAL	22.9

Source: Manheim Auto Auctions

Recent Trends

Over the past few months, Manheim Auto Auctions have incorporated the new Simulcast system in the auction process. This is an internet-based process where the registered dealer, who may be unable to attend a physical auction, still has the ability of buying new inventory or selling old inventory. Simulcast allows the dealer to see live video from the auction lane as well as audio and text. Each bid is entered onto the screen as well as the attributes of the vehicle, including the identification of the consignor. For those in the physical auction lane, Manheim has installed large screens, which alert the auctioneer of the virtual participant. Manheim began offering its new Simulcast feature in 300 lanes at 70 different auctions at the end of 2003 with plans for

greater development in other auction houses. In the first year, it has been reported that Manheim sold almost 1 million vehicles over Simulcast and expectations are high for future growth with Simulcast.⁵⁰ The technological progress with the auction process has allowed Manheim to also provide Cinema-style sales, where bidders are able to sit in a theatre-type room and bid based on digital photographs.⁵¹ Similar to Simulcast, the prospective buyer is able to view still pictures and condition reports without having to physically walk to the vehicle of interest.

Trends to merge various methods of remarketing have grown stronger in the last year. For example, an auction company owns the online services of autotrader.com, which gives opportunities to sell outside the auction environment and sell to the general public. Also, Manheim's Dealer Exchange is another variation on the auction theme. Here, the bidding works like Ebay: the consignor is able to keep his inventory in his lot rather than incurring the expense and hassle of taking the vehicle to the physical auction. In the Dealer Exchange, the seller has an opportunity to spread the bidding on a vehicle over a number of days or a number of hours. Those on the demand side will be able to bid from any location via the internet. As with Simulcast, pictures and descriptions of the vehicle appear on the website. Dealer Exchange is advertised as the "largest dealer-to-dealer marketplace." Manheim is able to act as an mediator if needed and generates fees from this service.

As the structure of the marketplace continues to evolve, various geographic locations have increased the level of technology integration as these auction houses plan for the future. Auction companies are now producing dealer-tailored software that works with dealer needs such as inventory management, updates into Quickbooks, syncs with Autotrader and Dealer Exchange, downloads from auctions sale lists, and creates special dealer-specific reports.

⁵⁰ March 2004 Newsletter for Manheim Auctions

⁵¹ This feature is primarily employed by Manheim's auction houses outside of the US.

CHAPTER FOUR

THE HEDONIC MODEL

This chapter contains three sections. First, a section is devoted to the data set and the various forms and descriptions within the total collection. The observations are analyzed at various levels of detail. The second section is the presentation of the models. Finally, tables of results and explanations of the results are given in the empirical results section of this chapter.

The Data Set

Observations were taken over the course of just under two weeks at various Manheim Auto Auctions. Listed on the following pages is Table 4.1 showing the number of vehicles sold by seller category and vehicle manufacturer. The vehicle sample was taken from all major categories of consignors: Banking/Finance companies, Fleet/Lease companies, Dealer sales, and Other. Some within the automotive remarketing industry have even more specific categorization of consignors than just these four. However, many of these subcategories are included in other similar groupings. For example, the Factory Sales category is included in the Dealer category since Factory vehicles are typically auctioned off only to franchised dealers. This is confirmed by the data and in industry reports. These are the vehicles that will go to dealer lots and be marketed as pre-owned or pre-certified vehicles.

The Banking/Finance category includes vehicles sold by banks and lending institutions, which also includes auto manufacturers' financing arms. These financing arms are also known as captive finance companies since they are limited in scope. Ford Motor Credit Company is an example of such an institution. Most manufacturers have now built up an internal captive finance company. Even Kia has their own Kia Motors Finance Company. The Banking/Finance category

also includes vehicles that have been repossessed; however, the level of repossessions is low since banks historically have catered to prime borrowers which have a low rate of default.

Fleet/Lease vehicles are a large percentage of total auction activity as these vehicles have just come off of a lease, or a company fleet contract, or a part of a rental company's special fleet. These vehicles are driven by someone other than the direct title-holder of the vehicle.

Dealer sales vehicles are also a large portion of the auction. These are mostly trade-in vehicles which the established dealer is not interested in keeping on his particular lot. As shown in Table 4.1, the percentage of vehicles sold by seller type is categorized for analysis. For example, over eight thousand Chevrolet vehicles are included in the data set and forty six percent of these were sold by Dealers. The last category of seller type is Other. This category includes licensed individual wholesalers and smaller dealers who do not have the sales volume to be included in the Dealer category. These sellers usually come to auction with just one or two vehicles at a time.

These categories of consignors are important for the auction bidder. This information is included in the general hedonic models since it should be a function of the overall selling price of the vehicle. In other words, the market-clearing price should also be dependent on seller type. The data set is presented and organized by make and model.

For each day of buying and selling activity, the auction house publishes a pre-sale list giving perspective buyers information on the coming auction. Afterward, a post-sale list is compiled by the auction house so dealers may have a record of the selling prices from the recent buying activity. The post sale list is the source for the modeling in this research piece. The lists include the place and date of the auction, lane number assigned to the vehicle, order number within the lane, consignor, year, make, model, style, engine size, number of cylinders, number of

doors, four-wheel drive if applicable, cab size if applicable, fuel type, color, and mileage. The post-sale list also contains the winning bid for the vehicles sold.

Table 4.1 Number of Vehicles Sold by Seller Type

Make	Total	Bank/Finance	Fleet/Lease	Dealer	Other
Acura	736	275	13	265	183
Audi	519	317	3	142	57
BMW	1,138	467	6	529	136
Buick	948	102	66	550	230
Cadillac	828	122	25	532	149
Chevrolet	8,274	1,535	472	3,831	2,436
Chrysler	1,410	214	70	635	491
Daewoo	119	17	6	37	59
Dodge	6,018	1,058	634	2,184	2,142
Eagle	62	1	3	55	3
Ford	15,645	4,158	1,060	5,268	5,159
Geo	426	107	6	197	116
GMC	1,489	307	54	755	373
Honda	2,320	356	59	1,160	745
Hummer	42	3	-	33	6
Hyundai	766	46	220	175	325
Infinity	456	30	90	143	193
Isuzu	492	36	19	218	219
Jaguar	605	52	6	262	285
Jeep	2,364	697	68	879	720
Kia	623	100	59	198	266
LandRover	415	130	2	163	120
Lexus	992	279	20	347	346
Lincoln	1,547	569	58	427	493
Mazda	1,410	144	120	490	656
Mercedes	1,533	675	14	627	217
Mercury	2,084	598	185	636	665
Mitsubishi	2,057	67	833	606	551
Nissan	2,896	147	618	1,006	1,125
Oldsmobile	362	69	34	170	89
Plymouth	727	141	25	403	158
Pontiac	2,573	568	168	1,163	674
Porsche	241	20	4	120	97
Saab	381	3	2	42	334
Saturn	906	249	23	387	247
Subaru	575	48	12	162	353
Suzuki	396	58	10	78	250
Toyota	3,739	197	352	1,440	1,750
Volkswagen	1,232	648	23	418	143
Volvo	712	19	19	143	531
TOTAL	70,058	14,629	5,461	26,876	23,092

The next table illustrates the summary details of the sample. Below are listed the mean, standard deviation and minimum and maximum levels for the given variable. For example, there were 29,248 sedans in the dataset. These sedans ranged from a brand new car with virtually no mileage to a forty year old car and over 200,000 miles on it. The category with the largest average miles as well as the largest standard deviation of mileage is the Van category. One might surmise that the Van categories is the most likely choice for a courier service.

The data was broken down into make and model as shown below in Table 4.2. This table presents the number of vehicle observations selected from the broad data. Each model of vehicle has the number included in this sample, the mean, minimum and maximum prices, the range in years, mileage statistics, and other characteristics.

Table 4.2 Summary Statistics By Body Type

Variable	# of Obs.	Mean	Std. Dev.	Min	Max
ALL COUPES					
DATE	8,190	6/13	3.456	6/10	6/18
YR	8,190	1998	3.642	1964	2003
DOORS	8,190	2.000	0.022	2	4
ENG	8,190	5.355	1.430	3	12
MILEAGE	8,190	59,312	40,690	2	282,015
PRICE	8,190	\$10,610	\$11,387	\$100	\$129,000
ALL PICKUPS					
DATE	9,805	6/13	3.371	6/10	6/18
YR	9,805	1999	2.868	1976	2003
DOORS	9,805	2.542	0.889	2	4
ENG	9,805	6.823	1.423	4	10
MILEAGE	9,805	64,130	41,335	65	288,601
PRICE	9,805	\$10,242	\$5,721	\$150	\$35,500
ALL SEDANS					
DATE	29,248	6/13	3.422	6/10	6/18
YR	29,248	1999	3.042	1962	2003
DOORS	29,248	3.999	0.050	2	4
ENG	29,248	5.294	1.336	3	12
MILEAGE	29,248	53,884	38,502	43	297,933
PRICE	29,248	\$8,972	\$7,075	\$100	\$79,500
ALL SUVs					
DATE	15,938	6/13	3.396	6/10	6/18
YR	15,938	1999	2.473	1974	2003
DOORS	15,938	3.824	0.567	2	4
ENG	15,938	6.588	1.230	4	10
MILEAGE	15,938	56,440	35,156	105	286,436
PRICE	15,938	\$12,806	\$7,261	\$100	\$63,000
ALL VANS					
DATE	6,058	6/13	3.337	6/10	6/18
YR	6,058	1999	2.847	1978	2003
DOORS	6,058	3.998	0.057	2	4
ENG	6,058	6.179	0.811	3	10
MILEAGE	6,058	70,159	42,558	120	276,616
PRICE	6,058	\$7,473	\$4,678	\$100	\$35,300
ALL WAGONS					
DATE	819	6/14	3.521	6/10	6/18
YR	819	1999	3.395	1983	2003
DOORS	819	3.993	0.121	2	4
ENG	819	5.160	0.996	4	10
MILEAGE	819	59,478	42,225	104	279,906
PRICE	819	\$9,880	\$8,434	\$150	\$51,000

Table 4.3 Summary Statistics By Seller Type

BANK SELLER					
Variable	# of Obs.	Mean	Std. Dev.	Min	Max
DATE	945	6/13	2.985	6/10	6/18
YR	945	1999	1.636	1989	2003
DOORS	945	3.537	0.844	2	4
ENG	945	6.078	1.494	4	10
MILEAGE	945	58,319	29,413	931	224,388
PRICE	945	\$10,008	\$6,086	\$175	\$48,250
DEALER SELLER					
DATE	26,876	6/13	3.387	6/10	6/18
YR	26,876	1998	3.630	1962	2003
DOORS	26,876	3.421	0.907	2	4
ENG	26,876	5.993	1.492	3	12
MILEAGE	26,876	75,310	44,010	2	297,933
PRICE	26,876	\$8,699	\$8,614	\$100	\$129,000
FACTORY SELLER					
DATE	1,839	6/13	2.945	6/10	6/18
YR	1,839	2002	1.364	1994	2003
DOORS	1,839	3.682	0.731	2	4
ENG	1,839	5.472	1.320	3	10
MILEAGE	1,839	28,151	23,846	955	198,363
PRICE	1,839	\$11,246	\$5,050	\$400	\$37,000
FINANCE SELLER					
DATE	13,684	6/14	3.384	6/10	6/18
YR	13,684	2000	1.456	1974	2003
DOORS	13,684	3.513	0.859	2	4
ENG	13,684	6.048	1.414	4	12
MILEAGE	13,684	44,940	25,645	105	242,190
PRICE	13,684	\$12,174	\$7,444	\$100	\$107,500
LEASE SELLER					
DATE	2,045	6/14	3.119	6/10	6/18
YR	2,045	2000	2.173	1964	2003
DOORS	2,045	3.639	0.769	2	4
ENG	2,045	5.809	1.366	4	10
MILEAGE	2,045	57,181	33,032	326	239,869
PRICE	2,045	\$9,258	\$5,640	\$100	\$45,000
OTHER SELLER					
DATE	23,092	6/13	3.482	6/10	6/18
YR	23,092	2000	2.272	1972	2003
DOORS	23,092	3.595	0.804	2	4
ENG	23,092	5.754	1.419	3	12
MILEAGE	23,092	50,318	34,315	43	288,601
PRICE	23,092	\$10,421	\$6,689	\$100	\$88,500
RENTAL SELLER					
DATE	1,577	6/12	3.044	6/10	6/18
YR	1,577	2002	0.897	1990	2003
DOORS	1,577	3.877	0.481	2	4
ENG	1,577	4.992	1.172	4	8
MILEAGE	1,577	24,798	9,497	119	115,889
PRICE	1,577	\$10,855	\$3,925	\$1,000	\$33,000

Table 4.4 Summary Statistics For Broad Sample

Broad Sample					
Variable	# of Obs.	Mean	Std. Dev.	Min	Max
DATE	70,058	6/13	3.408	6/10	6/18
YR	70,058	1999	2.993	1962	2003
DOORS	70,058	4	0.853	2	4
ENG	70,058	6	1.452	3	12
MILEAGE	70,058	58,007	39,191	2	297,933
PRICE	70,058	\$10,095	\$7,627	\$100	\$129,000

Table 4.5 Frequency of Observations by Make and Model

Make	Model	No. of Obs.	Year				Price				Mileage			
			MIN	MAX	MEAN	Std. Dev.	MIN	MAX	MEAN	Std. Dev.	MIN	MAX	MEAN	Std. Dev.
ACURA	CL	79	1997	2003	2000	1.659	\$ 4,200	\$ 23,200	\$ 12,944	\$ 4,770	5,656	119,864	52,872	26,300
ACURA	INTEGRA	164	1987	2001	1998	3.305	\$ 450	\$ 18,500	\$ 8,013	\$ 3,976	12,796	268,401	68,860	48,761
ACURA	LEGEND	55	1987	1999	1992	2.052	\$ 200	\$ 9,600	\$ 3,607	\$ 2,130	49,940	239,084	131,872	38,417
ACURA	OTHER	48	1992	2003	2000	2.987	\$ 500	\$ 65,000	\$ 22,078	\$ 12,177	7,393	204,983	43,998	37,999
ACURA	RL	122	1996	2002	2000	1.076	\$ 6,500	\$ 29,500	\$ 18,353	\$ 4,296	4,693	147,828	48,999	22,413
ACURA	TL	268	1996	2003	2000	1.166	\$ 2,500	\$ 27,200	\$ 15,429	\$ 3,447	4,175	147,119	45,355	21,065
AUDI	ASERIES	439	1996	2003	2000	1.238	\$ 4,800	\$ 47,500	\$ 17,765	\$ 5,915	1,305	122,786	42,440	20,326
AUDI	OTHER	22	1984	1998	1992	3.270	\$ 500	\$ 13,600	\$ 3,302	\$ 3,747	42,994	164,799	102,856	34,820
AUDI	SCLASS	16	2000	2003	2001	1.088	\$ 17,500	\$ 55,700	\$ 27,400	\$ 10,903	1,433	64,949	35,104	19,884
AUDI	TT	42	2000	2002	2001	0.790	\$ 15,750	\$ 33,000	\$ 23,290	\$ 4,635	2,608	56,738	25,981	14,641
BMW	3SERIES	447	1983	2003	1999	3.498	\$ 300	\$ 42,000	\$ 18,934	\$ 8,604	1,262	252,800	51,199	39,751
BMW	5SERIES	249	1984	2003	1998	3.112	\$ 500	\$ 41,000	\$ 19,601	\$ 8,624	5,173	188,794	59,399	34,399
BMW	7SERIES	181	1986	2003	1999	3.294	\$ 600	\$ 66,000	\$ 29,916	\$ 16,247	2,153	237,753	55,223	39,560
BMW	M5SERIES	53	1995	2003	2000	1.992	\$ 10,300	\$ 62,200	\$ 32,140	\$ 13,883	1,585	96,743	35,096	25,187
BMW	XSERIES	123	2000	2003	2001	0.633	\$ 12,300	\$ 52,400	\$ 32,473	\$ 4,761	1,973	84,458	38,843	15,257
BMW	ZSERIES	85	1997	2003	2000	1.488	\$ 12,000	\$ 101,000	\$ 21,572	\$ 12,907	823	78,110	32,615	18,759
BUICK	CENTURY	269	1987	2003	2000	3.490	\$ 175	\$ 14,750	\$ 6,455	\$ 3,548	5,626	196,095	51,416	35,578
BUICK	LESABRE	245	1984	2003	1998	3.685	\$ 225	\$ 17,800	\$ 6,161	\$ 4,502	9,445	226,056	74,208	42,002
BUICK	OTHER	49	1983	2002	1996	4.312	\$ 400	\$ 22,500	\$ 6,717	\$ 5,961	12,790	211,505	77,661	46,011
BUICK	PARKAVE	122	1986	2003	1997	3.904	\$ 200	\$ 20,500	\$ 7,529	\$ 5,877	12,560	213,486	75,623	47,019
BUICK	REGAL	195	1984	2003	1998	3.857	\$ 225	\$ 14,100	\$ 5,716	\$ 3,843	1,473	188,768	71,105	42,594
BUICK	ROADMASTER	26	1991	2002	1994	2.240	\$ 900	\$ 16,400	\$ 3,634	\$ 2,847	27,177	147,562	96,377	32,515
BUICK	SKYLARK	42	1990	1998	1995	2.308	\$ 150	\$ 3,900	\$ 1,448	\$ 1,132	29,362	171,457	102,803	34,931
CADILLAC	CATERA	61	1997	2001	1998	1.206	\$ 2,700	\$ 13,700	\$ 7,861	\$ 2,989	12,873	125,642	53,742	27,473
CADILLAC	DEVILLE	389	1973	2003	1997	3.979	\$ 200	\$ 29,100	\$ 9,398	\$ 8,087	5,845	205,670	78,828	38,035
CADILLAC	ELDORADO	62	1982	2002	1996	4.592	\$ 150	\$ 36,500	\$ 9,866	\$ 8,220	6,690	223,199	74,445	41,250
CADILLAC	ESCALADE	120	1999	2003	2001	1.288	\$ 9,900	\$ 47,000	\$ 27,228	\$ 8,816	3,436	137,445	43,497	20,807
CADILLAC	OTHER	40	1976	2003	1994	6.419	\$ 220	\$ 31,200	\$ 9,554	\$ 10,676	1,346	213,821	84,185	56,805
CADILLAC	SEVILLE	156	1984	2003	1998	3.009	\$ 850	\$ 28,900	\$ 11,587	\$ 7,034	8,298	169,127	66,185	36,810
CHEVY	1500	1792	1987	2003	1999	2.888	\$ 400	\$ 35,500	\$ 11,358	\$ 5,475	413	288,601	74,109	45,544
CHEVY	ASTRO	380	1986	2003	1998	3.188	\$ 125	\$ 15,500	\$ 5,619	\$ 3,563	5,493	276,616	87,655	47,861
CHEVY	AVALANCHE	57	1997	2003	2002	1.139	\$ 7,500	\$ 26,400	\$ 21,018	\$ 4,128	6,439	106,628	32,783	23,534
CHEVY	BERETTA	28	1989	1996	1993	2.490	\$ 175	\$ 3,000	\$ 1,188	\$ 810	65,771	173,597	114,309	30,128
CHEVY	BLAZER	862	1982	2003	1998	3.076	\$ 200	\$ 15,700	\$ 6,992	\$ 3,552	3,259	286,436	72,847	42,272
CHEVY	CAMARO	291	1969	2002	1997	4.598	\$ 300	\$ 23,200	\$ 7,306	\$ 4,838	1,224	206,598	71,193	42,647
CHEVY	CAVALIER	834	1988	2003	2000	2.756	\$ 150	\$ 10,700	\$ 4,307	\$ 2,282	197	208,603	54,504	36,108
CHEVY	CORSICA	49	1988	1996	1995	1.695	\$ 100	\$ 3,900	\$ 1,146	\$ 852	29,866	204,681	100,907	35,622
CHEVY	CORVETTE	169	1964	2003	1997	6.501	\$ 2,800	\$ 44,750	\$ 22,743	\$ 10,583	216	178,930	49,063	35,634
CHEVY	G5SERIES	188	1984	2003	1997	4.140	\$ 275	\$ 35,300	\$ 6,655	\$ 5,260	7,458	242,414	85,512	47,490
CHEVY	IMPALA	289	1962	2003	2001	2.542	\$ 4,200	\$ 17,300	\$ 9,060	\$ 2,581	1,532	133,407	47,020	23,419
CHEVY	LUMINA	265	1990	2001	1996	2.559	\$ 150	\$ 7,700	\$ 2,345	\$ 1,544	28,886	279,906	102,521	39,775
CHEVY	MALIBU	651	1981	2003	2000	1.764	\$ 400	\$ 13,800	\$ 6,124	\$ 2,409	114	194,095	49,722	29,405
CHEVY	MONTECARLO	248	1978	2003	1999	2.545	\$ 700	\$ 19,600	\$ 8,248	\$ 4,337	4,631	181,034	56,731	33,129
CHEVY	OTHER	96	1968	2001	1995	6.177	\$ 200	\$ 14,300	\$ 5,455	\$ 3,696	7,958	228,858	86,151	44,341
CHEVY	S10	665	1983	2003	1999	2.932	\$ 250	\$ 16,600	\$ 6,177	\$ 3,512	296	207,295	60,087	39,486
CHEVY	SILVERADO	24	1999	2002	2000	0.974	\$ 4,800	\$ 25,600	\$ 13,215	\$ 5,049	10,713	177,667	73,145	37,895
CHEVY	SUBURBAN	572	1981	2003	1999	2.841	\$ 350	\$ 34,500	\$ 15,017	\$ 7,291	2,572	264,272	75,225	42,574
CHEVY	TAHOE	578	1995	2003	2000	1.834	\$ 1,200	\$ 32,000	\$ 15,775	\$ 6,559	5,055	172,756	65,156	33,384
CHEVY	TRAILBLAZER	100	2002	2003	2002	0.496	\$ 900	\$ 24,100	\$ 19,272	\$ 2,794	977	78,586	23,563	11,503
CHEVY	VENTURE	263	1997	2003	2000	1.678	\$ 1,700	\$ 17,000	\$ 7,876	\$ 3,659	5,640	193,630	60,819	30,349

Table 4.5 Frequency of Observations by Make and Model Continued

Make	Model	No. of Obs.	Year				Price				Mileage			
			MIN	MAX	MEAN	Std. Dev.	MIN	MAX	MEAN	Std. Dev.	MIN	MAX	MEAN	Std. Dev.
CHRYSLER	300M	158	1999	2003	2000	0.737	\$ 2,000	\$ 21,600	\$ 11,960	\$ 3,133	2,333	96,605	48,893	20,730
CHRYSLER	CIRRUS	82	1995	2000	1998	2.031	\$ 1,000	\$ 9,400	\$ 3,874	\$ 2,084	17,672	153,652	73,180	30,260
CHRYSLER	CONCORDE	222	1993	2003	1999	2.232	\$ 400	\$ 15,900	\$ 6,193	\$ 3,259	457	172,953	63,616	33,186
CHRYSLER	LEBARON	38	1987	1995	1992	2.264	\$ 100	\$ 4,100	\$ 1,161	\$ 999	33,572	149,062	98,242	29,141
CHRYSLER	LHS	82	1994	2001	1998	2.346	\$ 500	\$ 13,900	\$ 5,984	\$ 4,056	22,028	160,786	79,412	33,226
CHRYSLER	OTHER	86	1986	2003	1996	4.920	\$ 150	\$ 35,100	\$ 5,204	\$ 6,607	1,629	175,484	75,082	43,760
CHRYSLER	PTCRUISER	122	2001	2003	2002	0.728	\$ 6,000	\$ 15,000	\$ 11,016	\$ 1,568	115	93,659	26,454	15,657
CHRYSLER	SEBRING	346	1995	2003	2000	2.010	\$ 425	\$ 18,500	\$ 8,852	\$ 4,021	43	170,936	49,312	32,452
CHRYSLER	TWN&CNTRY	274	1992	2003	1999	2.191	\$ 900	\$ 27,600	\$ 9,030	\$ 4,721	2,812	204,156	66,495	35,897
DAEWOO	LANOS	21	1999	2002	2000	0.870	\$ 400	\$ 5,100	\$ 2,119	\$ 1,342	10,067	84,674	40,296	21,363
DAEWOO	LEGANZA	46	1999	2002	2000	0.822	\$ 500	\$ 6,200	\$ 3,218	\$ 1,686	10,024	84,678	38,622	19,857
DAEWOO	NUBIRA	52	1999	2002	2001	0.658	\$ 500	\$ 5,500	\$ 3,143	\$ 1,209	7,687	97,326	35,199	18,133
DODGE	AVENGER	65	1995	2000	1997	1.368	\$ 500	\$ 7,500	\$ 3,517	\$ 1,906	24,967	169,955	84,988	31,935
DODGE	CARAVAN	450	1989	2003	1998	2.786	\$ 200	\$ 16,200	\$ 4,983	\$ 3,295	3,162	222,812	79,064	41,087
DODGE	DAKOTA	413	1988	2003	1999	2.658	\$ 200	\$ 20,200	\$ 8,173	\$ 4,459	2,825	239,795	63,971	37,499
DODGE	DURANGO	755	1998	2003	2000	0.995	\$ 2,700	\$ 24,800	\$ 12,369	\$ 2,959	869	142,521	50,958	22,509
DODGE	GCARAVAN	668	1990	2003	2000	2.753	\$ 400	\$ 18,400	\$ 9,085	\$ 4,884	2,496	185,056	58,810	39,776
DODGE	INTREPID	719	1993	2003	2001	2.427	\$ 175	\$ 12,800	\$ 7,155	\$ 3,442	1,682	163,746	50,950	35,313
DODGE	NEON	727	1995	2003	2001	2.454	\$ 300	\$ 12,300	\$ 4,928	\$ 2,666	655	175,278	44,620	34,806
DODGE	OTHER	68	1978	2003	1993	4.083	\$ 100	\$ 84,500	\$ 6,356	\$ 15,715	13	179,576	93,598	43,363
DODGE	RAM	1477	1985	2003	1999	2.418	\$ 310	\$ 29,800	\$ 10,709	\$ 5,504	2,166	244,920	67,494	39,968
DODGE	STRATUS	676	1995	2003	2001	2.070	\$ 500	\$ 15,200	\$ 6,689	\$ 2,915	105	172,389	42,874	30,632
EAGLE	OTHER	62	1989	1998	1996	2.168	\$ 200	\$ 4,100	\$ 2,443	\$ 1,258	32,987	195,426	91,058	36,457
FORD	AEROSTAR	74	1989	1997	1995	2.049	\$ 100	\$ 4,400	\$ 1,456	\$ 1,092	19,287	209,270	111,531	37,355
FORD	BRONCO	67	1981	1996	1991	3.666	\$ 175	\$ 8,400	\$ 2,478	\$ 2,034	10,443	188,609	84,597	45,026
FORD	CONTOUR	304	1995	2000	1998	1.479	\$ 200	\$ 9,500	\$ 2,680	\$ 1,536	5,976	188,515	76,005	30,908
FORD	CROWNVIC	181	1984	2003	1997	4.030	\$ 100	\$ 18,000	\$ 5,554	\$ 4,287	1,581	198,052	73,921	40,638
FORD	E150	248	1978	2003	1998	3.531	\$ 350	\$ 22,000	\$ 7,146	\$ 4,362	6,663	242,148	78,316	45,470
FORD	E250	145	1988	2003	1998	2.855	\$ 325	\$ 17,200	\$ 5,954	\$ 3,934	4,257	271,123	103,281	61,055
FORD	E350	176	1992	2002	2000	2.619	\$ 450	\$ 26,000	\$ 10,824	\$ 4,954	4,894	239,756	68,043	51,848
FORD	ESCAPE	246	1998	2003	2002	0.707	\$ 1,350	\$ 19,300	\$ 14,223	\$ 2,519	2,927	117,590	29,217	15,319
FORD	ESCORT	591	1988	2002	1999	2.796	\$ 100	\$ 11,200	\$ 3,211	\$ 2,090	2,882	256,127	61,699	37,806
FORD	EXCUR	132	2000	2003	2001	0.973	\$ 2,500	\$ 37,500	\$ 18,158	\$ 4,756	2,273	123,937	47,591	22,661
FORD	EXPED	1129	1996	2003	2000	1.480	\$ 2,700	\$ 31,900	\$ 14,709	\$ 4,490	466	213,527	59,512	30,238
FORD	EXPLOR	2526	1991	2003	1999	2.601	\$ 200	\$ 23,300	\$ 10,036	\$ 5,049	1,059	219,329	55,547	33,225
FORD	F150	2156	1981	2003	1999	2.769	\$ 250	\$ 28,700	\$ 11,390	\$ 5,516	1,676	252,736	59,091	37,245
FORD	F250	382	1976	2003	1999	3.555	\$ 500	\$ 33,100	\$ 13,795	\$ 7,760	2,569	251,575	81,086	47,971
FORD	F350	216	1985	2003	1999	3.070	\$ 675	\$ 34,200	\$ 17,697	\$ 8,439	3,542	218,936	76,852	47,008
FORD	F500	18	1988	2002	1996	4.824	\$ 2,000	\$ 35,000	\$ 14,072	\$ 8,418	14,996	203,073	76,132	52,689
FORD	FOCUS	835	2000	2003	2001	0.895	\$ 700	\$ 12,800	\$ 5,942	\$ 1,679	303	176,176	37,332	21,504
FORD	MUSTANG	955	1969	2003	1999	3.032	\$ 400	\$ 28,600	\$ 9,445	\$ 4,277	474	203,949	46,298	32,066
FORD	OTHER	29	1985	1997	1993	2.939	\$ 100	\$ 1,725	\$ 580	\$ 324	7,752	175,923	84,790	31,855
FORD	PROBE	49	1989	1997	1994	2.096	\$ 150	\$ 3,900	\$ 1,108	\$ 794	65,316	184,770	117,581	32,445
FORD	RANGER	1524	1984	2003	2000	2.319	\$ 325	\$ 19,500	\$ 7,688	\$ 3,480	1,062	206,404	48,458	31,676
FORD	TAURUS	2055	1988	2003	2000	2.480	\$ 125	\$ 13,500	\$ 6,569	\$ 3,194	326	200,128	46,391	34,441
FORD	TBIRD	121	1979	2002	1995	3.828	\$ 200	\$ 25,500	\$ 4,618	\$ 7,663	125	184,119	92,365	44,633
FORD	WINDSTAR	1486	1995	2003	2000	1.855	\$ 500	\$ 23,500	\$ 8,259	\$ 4,140	2,824	203,994	54,541	32,976
GEO	METRO	73	1990	2001	1997	3.279	\$ 100	\$ 4,000	\$ 1,779	\$ 1,197	24,502	230,438	72,715	36,698
GEO	PRIZM	169	1990	2002	1999	2.826	\$ 150	\$ 8,600	\$ 3,991	\$ 2,030	6,575	240,571	61,021	39,060
GEO	TRACKER	184	1989	2003	1999	2.701	\$ 550	\$ 13,300	\$ 5,726	\$ 3,009	4,421	199,829	52,273	32,267
GMC		207	1985	2003	1998	3.376	\$ 700	\$ 27,600	\$ 11,172	\$ 6,179	1,772	235,962	80,681	48,436
GMC	1500	239	1984	2003	1999	2.598	\$ 450	\$ 25,600	\$ 10,867	\$ 4,840	5,845	212,499	71,057	42,289
GMC	2500	31	1991	2002	1999	2.695	\$ 2,350	\$ 30,100	\$ 12,547	\$ 6,771	11,921	176,886	73,936	41,454
GMC	3500	6	1993	2001	1998	3.347	\$ 5,650	\$ 25,200	\$ 14,975	\$ 8,616	33,860	151,348	79,902	44,728
GMC	ENVOY	25	2002	2003	2002	0.332	\$ 14,100	\$ 26,000	\$ 21,434	\$ 3,107	3,661	92,130	27,043	18,536
GMC	GSERIES	33	1988	2002	1999	2.772	\$ 1,500	\$ 25,000	\$ 10,467	\$ 5,461	11,906	160,847	61,048	31,232
GMC	JIMMY	266	1984	2001	1998	2.982	\$ 150	\$ 15,000	\$ 7,017	\$ 3,386	13,289	250,992	72,556	38,928
GMC	OTHER	6	1996	2003	2000	2.483	\$ 7,300	\$ 16,400	\$ 12,483	\$ 3,530	15,242	104,177	54,501	34,887
GMC	RALLYWAGON	27	1986	2002	1994	4.267	\$ 400	\$ 14,900	\$ 4,249	\$ 3,810	9,763	146,180	92,616	40,853
GMC	SAFARI	80	1987	2002	1997	3.265	\$ 450	\$ 14,800	\$ 4,667	\$ 3,419	6,586	208,706	101,378	47,175
GMC	SIERRA	30	1993	2003	1999	2.459	\$ 2,900	\$ 20,200	\$ 12,185	\$ 4,774	6,606	177,130	69,404	42,145
GMC	SONOMA	154	1991	2003	1999	2.466	\$ 250	\$ 16,000	\$ 6,086	\$ 3,220	4,273	187,105	63,377	35,192
GMC	SUBURBAN	73	1988	1999	1997	2.472	\$ 600	\$ 19,000	\$ 9,290	\$ 3,972	15,217	265,328	104,060	48,092
GMC	YUKON	312	1993	2003	2000	1.569	\$ 1,500	\$ 43,250	\$ 18,378	\$ 7,215	5,203	178,463	60,832	29,929
HONDA	ACCORD	1111	1986	2003	1998	3.527	\$ 150	\$ 20,000	\$ 8,135	\$ 4,640	3,740	278,352	78,307	49,566
HONDA	CIVIC	729	1984	2003	1998	3.324	\$ 175	\$ 17,700	\$ 6,538	\$ 3,542	428	282,015	70,908	45,690
HONDA	CRV	199	1997	2003	2000	1.208	\$ 4,750	\$ 20,000	\$ 11,174	\$ 2,901	1,559	149,397	52,695	26,988
HONDA	ODYSSEY	81	1995	2003	2000	1.583	\$ 2,750	\$ 25,000	\$ 15,324	\$ 5,095	6,077	169,720	55,819	32,126
HONDA	OTHER	22	1989	2003	1997	5.520	\$ 325	\$ 28,200	\$ 11,120	\$ 10,535	2,593	146,260	66,576	56,790
HONDA	PASSPORT	102	1994	2002	1998	1.989	\$ 1,150	\$ 17,600	\$ 8,790	\$ 4,112	14,017	167,723	67,966	35,212
HONDA	PRELUDE	58	1985	2001	1995	4.517	\$ 150	\$ 16,600	\$ 6,316	\$ 5,527	20,716	244,637	108,157	59,149
HONDA	S2000	18	2000	2002	2001	0.752	\$ 18,200	\$ 25,300	\$ 22,394	\$ 2,227	3,644	55,454	22,703	14,213

Table 4.5 Frequency of Observations by Make and Model Continued

Make	Model	No. of Obs.	Year				Price				Mileage			
			MIN	MAX	MEAN	Std. Dev.	MIN	MAX	MEAN	Std. Dev.	MIN	MAX	MEAN	Std. Dev.
HUMMER	H1	4	1995	2001	1997	2.630	\$ 27,600	\$ 52,000	\$ 37,025	\$ 10,903	6,242	76,987	40,994	29,393
HUMMER	H2	38	2003	2003	2003	0.000	\$ 15,700	\$ 51,500	\$ 47,318	\$ 5,563	554	34,746	12,140	8,311
HYUNDAI	ACCENT	164	1995	2003	2001	1.872	\$ 250	\$ 9,100	\$ 4,211	\$ 2,266	3,076	143,617	36,682	29,779
HYUNDAI	ELANTRA	258	1992	2003	2001	2.116	\$ 150	\$ 11,000	\$ 6,309	\$ 2,939	2,231	145,356	33,826	28,814
HYUNDAI	OTHER	36	1988	2003	1998	3.264	\$ 125	\$ 14,100	\$ 4,466	\$ 3,661	5,422	137,266	63,075	34,182
HYUNDAI	SANTAFE	44	2001	2003	2002	0.642	\$ 8,800	\$ 17,700	\$ 13,919	\$ 2,690	2,202	67,242	25,193	16,422
HYUNDAI	SONATA	235	1995	2003	2001	1.522	\$ 400	\$ 13,200	\$ 8,405	\$ 3,271	1,438	146,935	32,739	25,351
HYUNDAI	XGSERIES	29	2001	2002	2002	0.471	\$ 4,800	\$ 14,000	\$ 11,997	\$ 1,916	3,888	41,667	21,834	8,807
INFINITI	GSERIES	38	1991	2003	1997	3.745	\$ 1,200	\$ 27,200	\$ 7,880	\$ 7,339	8,600	179,795	82,128	50,713
INFINITI	ISERIES	194	1996	2003	1999	1.340	\$ 2,800	\$ 24,100	\$ 12,544	\$ 4,039	6,709	167,157	51,630	27,201
INFINITI	JSERIES	38	1990	2000	1995	2.062	\$ 625	\$ 16,000	\$ 4,053	\$ 3,003	33,928	176,801	108,852	28,451
INFINITI	QSERIES	186	1990	2003	1999	2.108	\$ 1,000	\$ 33,400	\$ 15,816	\$ 5,665	8,107	167,575	54,212	28,069
ISUZU	OTHER	61	1986	2002	1998	2.957	\$ 400	\$ 14,200	\$ 3,616	\$ 3,214	12,282	220,157	79,018	42,083
ISUZU	RODEO	347	1991	2002	1999	2.468	\$ 400	\$ 14,500	\$ 6,830	\$ 3,571	2,873	183,651	62,043	38,397
ISUZU	TROOPER	84	1986	2002	1998	3.455	\$ 300	\$ 14,300	\$ 6,616	\$ 3,539	7,925	197,761	74,159	43,316
JAGUAR	STYPE	297	2000	2003	2001	1.026	\$ 7,200	\$ 48,000	\$ 23,733	\$ 5,056	1,039	103,816	31,195	14,791
JAGUAR	XTYPE	308	1984	2003	1999	3.485	\$ 200	\$ 75,500	\$ 23,361	\$ 12,103	1,304	219,699	43,735	32,269
JEEP	CHEROKEE	466	1987	2002	1998	3.155	\$ 100	\$ 18,100	\$ 6,548	\$ 3,410	6,079	244,349	71,615	43,573
JEEP	GCHEROKEE	1468	1986	2003	1999	2.097	\$ 225	\$ 27,600	\$ 10,659	\$ 4,424	1,791	236,409	63,031	35,139
JEEP	OTHER	80	1987	2003	2002	2.821	\$ 225	\$ 19,500	\$ 14,917	\$ 3,318	2,374	168,356	26,811	24,948
JEEP	WRANGLER	350	1988	2003	1998	2.858	\$ 900	\$ 19,300	\$ 9,672	\$ 4,209	4,478	185,147	57,836	33,612
KIA	OPTIMA	99	2001	2003	2002	0.460	\$ 2,200	\$ 11,900	\$ 8,362	\$ 1,844	6,663	88,869	22,548	11,637
KIA	RIO	79	2001	2003	2002	0.543	\$ 350	\$ 6,400	\$ 3,791	\$ 1,214	1,983	69,894	27,179	14,146
KIA	SEPHIA	133	1994	2001	1999	1.456	\$ 200	\$ 5,300	\$ 1,956	\$ 1,070	16,445	137,190	58,790	25,618
KIA	SPORTAGE	226	1995	2002	2000	1.696	\$ 100	\$ 10,500	\$ 4,630	\$ 2,544	4,386	120,773	50,965	28,634
KIA	SSERIES	86	2000	2003	2002	0.807	\$ 1,800	\$ 15,800	\$ 5,086	\$ 2,790	2,405	96,078	24,760	17,312
LANDROVR	DISCOVERY	261	1995	2003	2001	2.252	\$ 3,200	\$ 32,000	\$ 18,310	\$ 6,573	3,084	130,245	36,083	29,420
LANDROVR	FREELANDER	60	2002	2003	2002	0.279	\$ 15,000	\$ 24,000	\$ 17,694	\$ 2,023	2,098	29,652	8,580	4,635
LANDROVR	RANGEROVER	94	1989	2003	1999	2.744	\$ 2,500	\$ 63,000	\$ 25,602	\$ 17,450	3,850	200,543	51,330	33,770
LEXUS	ECLASS	264	1990	2003	1998	2.573	\$ 1,750	\$ 32,700	\$ 13,415	\$ 6,324	2,279	221,006	62,932	38,392
LEXUS	GCLASS	132	1993	2002	1999	1.695	\$ 4,400	\$ 34,500	\$ 20,217	\$ 5,137	1,783	202,854	54,955	28,773
LEXUS	LSCLASS	106	1990	2003	1996	4.088	\$ 2,000	\$ 50,500	\$ 16,122	\$ 13,246	6,493	234,222	93,338	54,712
LEXUS	LXCLASS	72	1996	2002	2000	1.146	\$ 13,100	\$ 49,200	\$ 28,634	\$ 6,268	7,319	100,120	54,587	20,509
LEXUS	OTHER	27	2001	2003	2002	0.784	\$ 13,000	\$ 50,000	\$ 25,363	\$ 10,466	578	99,994	25,955	20,206
LEXUS	RXCLASS	356	1999	2003	2000	0.589	\$ 6,500	\$ 39,700	\$ 20,749	\$ 3,123	778	102,637	44,988	14,688
LEXUS	SCCLASS	35	1992	2003	1998	4.147	\$ 3,200	\$ 55,000	\$ 29,869	\$ 21,044	1,637	161,493	58,686	54,753
LINCOLN	CONTINENTAL	205	1962	2002	1999	4.113	\$ 125	\$ 23,600	\$ 11,758	\$ 6,146	4,805	153,649	48,939	32,357
LINCOLN	LS	374	2000	2002	2000	0.627	\$ 5,100	\$ 27,000	\$ 16,367	\$ 3,107	5,857	122,240	37,417	15,641
LINCOLN	MARK	52	1986	1998	1995	3.060	\$ 250	\$ 11,900	\$ 4,381	\$ 3,077	14,517	191,204	95,600	39,022
LINCOLN	NAVIGATOR	415	1998	2003	2000	1.088	\$ 8,900	\$ 43,600	\$ 21,212	\$ 5,015	1,747	161,674	51,512	23,288
LINCOLN	TOWNCAR	501	1986	2003	1999	3.395	\$ 100	\$ 30,000	\$ 12,772	\$ 7,295	4,757	297,933	59,223	43,745
MAZDA		15	1997	2002	2001	1.944	\$ 2,600	\$ 9,200	\$ 7,770	\$ 2,331	24,258	79,137	34,546	19,024
MAZDA	6SERIES	619	1988	2002	2000	2.869	\$ 225	\$ 11,000	\$ 7,025	\$ 3,309	2,263	230,189	50,061	40,420
MAZDA	BSERIES	142	1986	2003	1998	3.408	\$ 1,075	\$ 14,100	\$ 6,693	\$ 3,080	4,673	216,275	64,687	47,362
MAZDA	MIATA	59	1990	2003	1998	3.238	\$ 700	\$ 16,300	\$ 9,308	\$ 4,554	143	143,680	49,399	34,480
MAZDA	MILLENNIA	86	1995	2002	1998	2.139	\$ 200	\$ 17,100	\$ 7,490	\$ 4,503	7,281	175,420	72,766	36,299
MAZDA	MPV	97	1989	2003	1999	3.431	\$ 200	\$ 19,000	\$ 8,579	\$ 5,518	104	177,415	61,548	43,198
MAZDA	MXSERIES	31	1988	1996	1993	2.092	\$ 100	\$ 3,300	\$ 1,348	\$ 782	56,200	204,786	117,441	32,685
MAZDA	OTHER	24	1989	1995	1992	1.459	\$ 450	\$ 13,500	\$ 2,569	\$ 2,550	48,660	249,047	108,949	48,135
MAZDA	PROTEGE	300	1991	2003	2000	2.667	\$ 200	\$ 13,100	\$ 6,794	\$ 3,240	58	180,149	43,748	35,664
MAZDA	TRIBUTE	37	2001	2003	2001	0.599	\$ 9,000	\$ 22,400	\$ 15,173	\$ 3,180	7,172	83,278	34,596	21,067
MERCEDES	CCLASS	278	1975	2003	1999	3.364	\$ 175	\$ 109,000	\$ 19,653	\$ 16,789	2	238,729	50,722	34,285
MERCEDES	CLK	112	1998	2003	2000	1.179	\$ 15,200	\$ 59,200	\$ 33,720	\$ 9,182	104	111,790	34,322	19,050
MERCEDES	ECLASS	364	1979	2003	1998	3.680	\$ 500	\$ 52,400	\$ 21,401	\$ 10,416	1,984	268,308	61,661	40,936
MERCEDES	GCLASS	4	2002	2002	2002	0.000	\$ 52,250	\$ 56,250	\$ 54,225	\$ 1,826	9,610	25,179	16,514	6,813
MERCEDES	MLCLASS	280	1998	2003	2000	0.977	\$ 9,100	\$ 48,600	\$ 21,628	\$ 5,183	1,103	113,514	45,088	18,659
MERCEDES	ROADSTER	106	1993	2003	1999	2.720	\$ 14,400	\$ 129,000	\$ 46,200	\$ 27,335	29	112,221	35,695	25,126
MERCEDES	SCLASS	293	1970	2002	1996	5.568	\$ 350	\$ 79,500	\$ 28,178	\$ 16,592	5,116	265,302	69,747	42,138
MERCEDES	SLK	96	1998	2002	2000	1.053	\$ 15,700	\$ 37,700	\$ 25,264	\$ 4,186	5,347	87,171	32,345	16,142
MERCURY	COUGAR	222	1986	2002	1999	3.018	\$ 100	\$ 15,200	\$ 6,620	\$ 3,259	4,915	247,471	55,949	33,747
MERCURY	GMARQUIS	335	1985	2003	1999	3.174	\$ 400	\$ 17,600	\$ 8,775	\$ 4,408	5,710	197,594	53,558	35,938
MERCURY	MTNEER	330	1997	2003	2000	1.587	\$ 2,150	\$ 22,400	\$ 12,844	\$ 4,726	5,832	165,493	47,307	26,496
MERCURY	MYSTIQUE	81	1995	2000	1998	1.725	\$ 250	\$ 7,800	\$ 2,567	\$ 1,628	16,606	145,730	78,971	28,757
MERCURY	OTHER	17	1991	2003	1997	4.989	\$ 100	\$ 24,300	\$ 8,484	\$ 10,492	121	110,673	53,296	38,825
MERCURY	SABLE	857	1988	2003	2001	2.288	\$ 125	\$ 15,300	\$ 7,597	\$ 2,962	2,466	203,878	37,418	30,791
MERCURY	TRACER	27	1991	1999	1997	2.082	\$ 100	\$ 2,500	\$ 1,242	\$ 754	33,449	163,484	99,252	29,108
MERCURY	VILLAGER	215	1993	2002	1998	2.466	\$ 350	\$ 15,400	\$ 5,892	\$ 3,719	11,126	184,688	77,893	40,374

Table 4.5 Frequency of Observations by Make and Model Continued

Make	Model	No. of Obs.	Year				Price				Mileage			
			MIN	MAX	MEAN	Std. Dev.	MIN	MAX	MEAN	Std. Dev.	MIN	MAX	MEAN	Std. Dev.
MITSUB	3000GT	32	1991	1999	1995	2.590	\$ 300	\$ 17,100	\$ 6,986	\$ 4,291	14,466	169,203	94,602	37,641
MITSUB	DIAMANTE	171	1992	2003	2001	2.721	\$ 500	\$ 20,100	\$ 11,165	\$ 4,523	2,199	194,047	33,742	42,687
MITSUB	ECLIPSE	382	1990	2003	1999	2.958	\$ 100	\$ 19,500	\$ 8,318	\$ 4,545	263	197,465	55,758	36,615
MITSUB	GALANT	573	1988	2003	2001	2.359	\$ 200	\$ 12,800	\$ 6,907	\$ 2,801	1,072	155,918	43,214	30,537
MITSUB	LANCER	141	2002	2003	2002	0.420	\$ 900	\$ 10,600	\$ 7,714	\$ 1,425	898	52,402	20,955	8,755
MITSUB	MIRAGE	198	1989	2002	2000	2.507	\$ 125	\$ 7,900	\$ 3,889	\$ 1,758	3,538	167,279	47,024	37,297
MITSUB	MONTERO	469	1989	2003	2001	2.311	\$ 425	\$ 26,000	\$ 13,034	\$ 5,628	2,273	173,914	44,309	35,597
MITSUB	OTHER	7	1988	1995	1993	2.673	\$ 200	\$ 2,600	\$ 1,164	\$ 766	77,511	168,631	119,408	33,410
MITSUB	OUTLANDER	84	2003	2003	2003	0.000	\$ 7,100	\$ 15,700	\$ 14,933	\$ 993	2,102	24,805	7,976	3,896
NISSAN	2SERIES	48	1989	1998	1995	2.816	\$ 500	\$ 8,000	\$ 2,217	\$ 1,433	42,928	229,679	108,853	38,140
NISSAN	3SERIES	42	1984	2003	1994	6.652	\$ 100	\$ 30,250	\$ 11,361	\$ 11,264	1,280	175,837	77,147	56,485
NISSAN	ALTIMA	685	1993	2003	1999	2.281	\$ 400	\$ 19,600	\$ 7,589	\$ 3,876	4,511	225,820	53,296	36,183
NISSAN	ECONCLASS	18	1986	2002	1996	6.382	\$ 200	\$ 9,100	\$ 4,172	\$ 3,591	10,492	165,085	75,255	59,165
NISSAN	FRONTIER	234	1984	2003	1999	3.465	\$ 500	\$ 18,700	\$ 8,794	\$ 4,941	65	198,214	58,167	39,686
NISSAN	KINGCAB	21	1986	1996	1993	3.491	\$ 650	\$ 5,000	\$ 2,642	\$ 1,181	52,724	233,852	137,848	52,607
NISSAN	MAXIMA	735	1987	2003	2000	3.050	\$ 100	\$ 22,600	\$ 11,908	\$ 4,943	167	231,884	51,560	40,928
NISSAN	PATHFINDER	393	1988	2003	1999	2.811	\$ 475	\$ 24,000	\$ 11,254	\$ 5,454	4,701	241,188	65,488	39,656
NISSAN	QUEST	159	1993	2002	1998	2.339	\$ 650	\$ 18,900	\$ 7,072	\$ 3,853	9,597	251,560	78,843	42,539
NISSAN	SENTRA	386	1987	2003	1999	3.696	\$ 175	\$ 13,600	\$ 5,005	\$ 3,288	4,066	227,729	67,431	47,063
NISSAN	XE	23	1991	1997	1995	1.593	\$ 300	\$ 6,900	\$ 2,792	\$ 1,595	35,838	232,132	103,552	46,161
NISSAN	XTERRA	152	2000	2003	2001	0.924	\$ 7,500	\$ 17,600	\$ 13,847	\$ 2,331	6,366	100,516	38,157	18,157
OLDSMO	ALERO	169	1999	2003	2001	1.175	\$ 2,200	\$ 10,100	\$ 6,805	\$ 1,904	10,572	150,868	44,077	22,616
OLDSMO	AURORA	22	1994	2001	1998	2.262	\$ 200	\$ 12,100	\$ 4,952	\$ 3,851	24,926	150,337	87,918	32,482
OLDSMO	BRAVADA	23	1993	2003	1998	1.929	\$ 1,650	\$ 19,600	\$ 7,009	\$ 4,422	28,047	161,168	81,908	32,456
OLDSMO	CUTLASS	35	1983	1999	1993	4.059	\$ 225	\$ 6,200	\$ 1,847	\$ 1,410	10,812	219,666	101,645	42,342
OLDSMO	EIGHTYEIGHT	28	1987	1999	1993	3.395	\$ 200	\$ 6,450	\$ 2,046	\$ 1,758	36,686	161,243	97,961	35,941
OLDSMO	INTRIGUE	71	1992	2002	1999	1.516	\$ 300	\$ 9,600	\$ 4,765	\$ 2,105	20,513	161,526	70,388	28,554
OLDSMO	SILHOUETTE	14	1996	2002	1999	1.859	\$ 1,900	\$ 12,800	\$ 7,196	\$ 3,586	27,295	119,215	70,354	32,350
PLYMTH	ACCLAIM	35	1987	1995	1992	1.927	\$ 100	\$ 2,350	\$ 748	\$ 600	31,347	248,663	102,711	46,314
PLYMTH	BREEZE	153	1996	2000	1998	1.073	\$ 450	\$ 6,300	\$ 3,397	\$ 1,529	12,744	135,717	65,259	30,608
PLYMTH	ECONCLASS	10	1988	1999	1993	3.091	\$ 100	\$ 5,900	\$ 2,120	\$ 2,135	49,895	210,598	106,635	52,806
PLYMTH	GVOYAGER	203	1988	2000	1997	2.640	\$ 100	\$ 11,300	\$ 4,183	\$ 2,778	20,822	216,481	90,701	37,537
PLYMTH	LASER	10	1990	1994	1992	1.337	\$ 100	\$ 1,800	\$ 915	\$ 577	78,918	153,099	112,370	26,347
PLYMTH	NEON	139	1995	2001	1998	1.916	\$ 300	\$ 6,100	\$ 2,420	\$ 1,424	15,253	156,680	73,231	28,773
PLYMTH	PROWLER	6	1999	2001	2000	0.753	\$ 23,400	\$ 25,500	\$ 24,500	\$ 839	2,792	36,852	11,643	13,591
PLYMTH	VILLAGER	9	1993	1999	1996	2.007	\$ 1,650	\$ 11,400	\$ 4,611	\$ 2,928	31,594	136,030	95,214	36,375
PLYMTH	VOYAGER	162	1987	2002	1997	3.018	\$ 100	\$ 14,000	\$ 3,486	\$ 2,808	7,013	223,556	90,796	44,458
PONTIAC	AZTEK	30	2001	2003	2001	0.661	\$ 5,700	\$ 14,150	\$ 9,953	\$ 2,153	3,338	95,522	38,154	22,984
PONTIAC	BONNEVILLE	227	1987	2003	1998	3.427	\$ 200	\$ 17,600	\$ 6,788	\$ 4,770	10,057	235,027	78,810	46,411
PONTIAC	FIREBIRD	152	1987	2002	1998	2.996	\$ 100	\$ 26,500	\$ 8,734	\$ 5,527	3,880	208,232	65,893	36,657
PONTIAC	GRANDAM	919	1987	2003	1999	2.630	\$ 100	\$ 15,400	\$ 5,700	\$ 2,990	321	246,454	61,212	36,819
PONTIAC	GRANDPRIX	664	1990	2003	1999	2.557	\$ 100	\$ 16,600	\$ 6,890	\$ 3,360	1,177	187,307	64,379	34,871
PONTIAC	MONTANA	225	1990	2003	1999	2.379	\$ 400	\$ 16,700	\$ 8,007	\$ 4,105	1,802	223,509	65,160	34,730
PONTIAC	SIXTHOUS	8	1978	1991	1989	4.438	\$ 160	\$ 1,200	\$ 556	\$ 462	27,261	229,058	133,149	69,592
PONTIAC	SUNBIRD	27	1985	2002	1993	3.657	\$ 150	\$ 6,300	\$ 1,140	\$ 1,390	33,234	170,971	114,716	34,399
PONTIAC	SUNFIRE	293	1990	2003	2000	2.126	\$ 400	\$ 10,000	\$ 4,709	\$ 2,095	620	190,487	53,749	34,285
PONTIAC	TRANSAM	10	1996	2002	1999	1.897	\$ 5,000	\$ 22,200	\$ 14,700	\$ 5,145	3,872	89,455	42,166	26,920
PONTIAC	TRANSPORT	9	1994	2003	1997	2.635	\$ 1,400	\$ 16,400	\$ 4,678	\$ 4,678	24,896	156,449	98,956	39,193
PONTIAC	VIBE	9	2003	2003	2003	0.000	\$ 10,100	\$ 15,700	\$ 12,706	\$ 1,859	4,398	60,707	16,799	17,008
PORSCHE	9SERIES	138	1965	2003	1997	6.033	\$ 1,400	\$ 91,000	\$ 40,350	\$ 19,254	1,294	151,401	39,234	26,931
PORSCHE	BOXSTER	103	1997	2003	2000	1.318	\$ 16,500	\$ 42,700	\$ 26,711	\$ 5,537	2,130	80,066	29,876	16,442
SAAB	9-3	251	1999	2002	2000	0.599	\$ 5,300	\$ 30,750	\$ 14,192	\$ 4,109	8,329	91,352	36,677	12,942
SAAB	9-5	88	1999	2001	2000	0.525	\$ 5,500	\$ 22,100	\$ 14,021	\$ 3,530	10,112	94,149	42,416	15,503
SAAB	NINEHUNDR	42	1986	1998	1995	2.568	\$ 150	\$ 12,000	\$ 4,327	\$ 2,625	38,819	143,866	84,163	27,171
SATURN	LCLASS	181	2000	2003	2000	0.860	\$ 3,000	\$ 13,500	\$ 7,348	\$ 1,637	2,839	102,618	34,855	15,674
SATURN	SCLASS	720	1991	2002	1998	2.511	\$ 125	\$ 15,600	\$ 3,746	\$ 2,076	1,072	196,912	64,589	37,157
SATURN	VUE	5	2002	2003	2003	0.447	\$ 13,000	\$ 18,100	\$ 15,920	\$ 1,862	3,414	23,583	14,749	7,568
SUBARU	BAJA	7	2003	2003	2003	0.000	\$ 18,000	\$ 18,600	\$ 18,243	\$ 237	5,267	13,411	8,741	2,755
SUBARU	FORESTER	168	1998	2003	2001	1.316	\$ 4,400	\$ 20,200	\$ 12,692	\$ 3,246	5,123	115,334	37,773	22,767
SUBARU	IMPENZA	58	1985	2003	2000	3.633	\$ 225	\$ 19,300	\$ 10,617	\$ 5,906	2,449	220,315	47,065	43,121
SUBARU	LEGACY	128	1990	2003	1998	3.777	\$ 100	\$ 19,800	\$ 9,016	\$ 5,987	1,820	228,398	62,478	49,087
SUBARU	OUTBACK	214	1997	2003	2001	1.496	\$ 2,350	\$ 24,500	\$ 14,310	\$ 3,663	1,294	176,403	36,274	26,488

Table 4.5 Frequency of Observations by Make and Model Continued

Make	Model	No. of Obs.	Year				Price				Mileage			
			MIN	MAX	MEAN	Std. Dev.	MIN	MAX	MEAN	Std. Dev.	MIN	MAX	MEAN	Std. Dev.
SUZUKI	GVITARA	211	1999	2003	2001	1.538	\$ 3,000	\$ 17,700	\$ 10,919	\$ 3,685	931	114,297	30,262	22,077
SUZUKI	SIDEKICK	33	1992	1998	1996	1.691	\$ 875	\$ 5,100	\$ 2,565	\$ 1,257	22,689	167,451	86,707	32,141
SUZUKI	VITARA	25	1996	2002	2000	1.451	\$ 1,900	\$ 11,200	\$ 6,306	\$ 2,204	3,277	120,414	46,624	26,122
TOYOTA	4RUNNER	357	1987	2003	1998	2.881	\$ 500	\$ 26,700	\$ 12,798	\$ 5,863	4,588	250,427	74,763	42,679
TOYOTA	AVALON	173	1995	2003	1999	1.858	\$ 1,400	\$ 25,800	\$ 12,573	\$ 5,523	2,278	174,999	57,426	34,526
TOYOTA	CAMRY	1355	1984	2003	1999	3.457	\$ 100	\$ 24,200	\$ 9,450	\$ 4,577	198	238,695	57,236	44,410
TOYOTA	CELICA	119	1985	2002	1997	4.489	\$ 100	\$ 17,150	\$ 8,316	\$ 5,200	14,033	228,575	72,589	48,867
TOYOTA	COROLLA	704	1981	2003	1999	3.665	\$ 175	\$ 19,000	\$ 6,394	\$ 3,529	1,751	227,725	59,003	44,714
TOYOTA	ECHO	28	2000	2003	2001	1.243	\$ 1,000	\$ 10,900	\$ 6,307	\$ 2,742	3,231	81,621	36,633	24,798
TOYOTA	HIGHLAND	21	2001	2003	2002	0.902	\$ 15,300	\$ 26,600	\$ 22,071	\$ 2,467	105	51,339	24,668	12,949
TOYOTA	LANDCRSR	96	1974	2002	1998	3.429	\$ 3,100	\$ 35,200	\$ 21,274	\$ 8,093	16,608	212,136	69,317	36,828
TOYOTA	MR2	20	1985	2002	1998	5.753	\$ 300	\$ 19,400	\$ 11,875	\$ 6,885	3,832	219,234	61,464	65,366
TOYOTA	PASEO	10	1992	1996	1994	1.549	\$ 200	\$ 1,800	\$ 883	\$ 593	99,392	176,214	134,897	27,494
TOYOTA	PREVIA	33	1991	1996	1993	1.542	\$ 800	\$ 6,200	\$ 2,927	\$ 1,185	23,389	192,550	131,997	36,598
TOYOTA	RAV4	166	1996	2003	1999	1.733	\$ 2,750	\$ 19,100	\$ 9,452	\$ 3,886	151	185,311	60,464	34,050
TOYOTA	SEQUOIA	34	2001	2003	2002	0.719	\$ 16,500	\$ 35,800	\$ 28,559	\$ 4,698	3,626	176,860	37,340	36,986
TOYOTA	SIENNA	153	1998	2003	2000	1.174	\$ 4,950	\$ 25,400	\$ 12,735	\$ 3,935	120	175,985	54,232	27,250
TOYOTA	SOLARA	60	1999	2003	2000	1.295	\$ 4,800	\$ 24,600	\$ 11,269	\$ 3,721	7,562	129,259	50,147	24,368
TOYOTA	T100	44	1986	1998	1993	3.548	\$ 200	\$ 10,600	\$ 3,548	\$ 2,598	74,744	222,051	126,824	40,024
TOYOTA	TACOMA	257	1990	2003	1999	1.874	\$ 750	\$ 22,200	\$ 10,090	\$ 4,354	1,446	237,752	60,395	38,270
TOYOTA	TERCEL	48	1988	1998	1994	2.364	\$ 100	\$ 3,600	\$ 1,210	\$ 815	50,521	212,979	118,565	32,318
TOYOTA	TUNDRA	61	1999	2003	2001	0.985	\$ 9,400	\$ 25,000	\$ 16,343	\$ 3,744	1,223	148,985	43,081	26,942
VOLKS	BEEBLE	314	1998	2003	2000	0.990	\$ 3,000	\$ 24,500	\$ 9,540	\$ 2,518	119	106,677	35,789	15,885
VOLKS	CABRIO	65	1990	2002	1998	2.599	\$ 1,125	\$ 36,500	\$ 9,293	\$ 4,910	15,336	145,505	55,626	30,061
VOLKS	GOLF	83	1989	2003	1999	3.225	\$ 100	\$ 17,300	\$ 7,804	\$ 4,918	1,705	241,494	59,238	47,201
VOLKS	JETTA	516	1984	2003	1999	2.149	\$ 100	\$ 19,700	\$ 9,086	\$ 3,862	5,020	177,983	48,553	29,699
VOLKS	OTHER	11	1993	2003	2001	3.828	\$ 800	\$ 25,300	\$ 17,050	\$ 8,589	6,687	129,716	31,614	43,921
VOLKS	PASSAT	243	1990	2003	2000	1.753	\$ 1,000	\$ 37,500	\$ 12,164	\$ 5,410	2,197	133,364	43,722	23,941
VOLVO	C70	38	1998	2003	2000	1.260	\$ 4,100	\$ 33,400	\$ 19,521	\$ 6,220	5,818	110,830	39,074	21,788
VOLVO	OTHER	94	1981	2003	1993	4.222	\$ 100	\$ 34,000	\$ 3,505	\$ 5,028	2,300	232,529	119,873	49,205
VOLVO	S40	103	2000	2002	2001	0.939	\$ 7,500	\$ 31,000	\$ 13,154	\$ 3,082	7,344	72,184	25,758	17,611
VOLVO	S60	145	2001	2002	2002	0.164	\$ 11,900	\$ 24,800	\$ 19,983	\$ 1,286	4,214	58,556	16,794	5,472
VOLVO	S70	52	1998	2000	1999	0.866	\$ 4,400	\$ 15,800	\$ 10,921	\$ 3,160	15,941	110,813	55,818	22,443
VOLVO	S80	148	1998	2002	2001	1.197	\$ 7,500	\$ 30,100	\$ 18,606	\$ 5,249	2,076	106,393	35,546	22,331
VOLVO	VCLASS	132	1998	2003	2001	1.220	\$ 6,100	\$ 30,300	\$ 19,354	\$ 7,112	1,199	102,372	41,058	21,634
TOTAL		70,058												

Table 4.6 Frequency of Observations by Body Type

Make	Body Type	No. of Obs.	Year				Price				Mileage			
			MIN	MAX	MEAN	St Dev	MIN	MAX	MEAN	St Dev	MIN	MAX	MEAN	St Dev
ACURA	COUPE	236	1989	2003	1998	3.140	\$ 400	\$ 65,000	\$ 11,215	\$ 7,566	5,656	268,401	61,744	45,313
ACURA	SEDAN	477	1987	2003	1999	2.770	\$ 200	\$ 29,500	\$ 14,349	\$ 5,778	4,175	233,772	56,854	36,669
ACURA	SUV	23	1996	2002	2000	2.397	\$ 2,800	\$ 33,800	\$ 20,767	\$ 10,838	12,574	132,332	55,498	33,974
AUDI	COUPE	46	1990	2002	2000	2.092	\$ 5,200	\$ 33,000	\$ 22,139	\$ 5,909	2,608	77,016	29,214	18,032
AUDI	SEDAN	410	1984	2003	2000	2.220	\$ 500	\$ 55,700	\$ 17,075	\$ 6,710	1,305	164,799	45,580	25,081
AUDI	WAGON	63	1996	2003	2000	1.529	\$ 7,600	\$ 51,000	\$ 20,138	\$ 8,264	1,433	111,112	39,922	21,727
BMW	COUPE	308	1983	2003	1999	3.199	\$ 400	\$ 101,000	\$ 21,226	\$ 11,961	823	233,952	47,211	36,527
BMW	SEDAN	688	1983	2003	1999	3.185	\$ 300	\$ 66,000	\$ 22,396	\$ 12,054	1,585	252,800	53,461	37,443
BMW	SUV	123	2000	2003	2001	0.633	\$ 12,300	\$ 22,400	\$ 32,473	\$ 4,761	1,973	84,458	38,843	15,257
BMW	WAGON	19	1988	2002	1998	3.761	\$ 850	\$ 29,000	\$ 18,434	\$ 8,026	12,937	145,429	51,661	36,546
BUICK	COUPE	56	1983	1998	1994	3.808	\$ 275	\$ 9,300	\$ 2,985	\$ 2,295	38,898	211,505	102,519	41,093
BUICK	SEDAN	870	1986	2003	1998	3.692	\$ 150	\$ 20,500	\$ 6,187	\$ 4,344	1,473	226,056	67,390	41,834
BUICK	SUV	12	2002	2002	2002	0.000	\$ 13,800	\$ 22,500	\$ 16,175	\$ 2,614	12,790	41,556	23,930	8,541
BUICK	WAGON	10	1986	1996	1993	2.961	\$ 600	\$ 5,500	\$ 1,945	\$ 1,459	37,077	150,702	107,480	41,544
CADILLAC	COUPE	73	1976	2001	1995	4.946	\$ 150	\$ 26,260	\$ 8,036	\$ 6,653	6,690	223,199	77,668	38,146
CADILLAC	SEDAN	633	1973	2003	1997	3.769	\$ 200	\$ 31,200	\$ 9,924	\$ 7,787	1,346	213,821	73,490	39,444
CADILLAC	SUV	122	1999	2003	2001	1.286	\$ 9,900	\$ 47,000	\$ 27,340	\$ 8,791	3,436	137,445	43,284	20,914
CHEVY	COUPE	1082	1964	2003	1998	4.285	\$ 150	\$ 44,750	\$ 8,627	\$ 8,392	216	208,603	63,660	39,211
CHEVY	PICKUP	2356	1983	2003	1999	3.034	\$ 250	\$ 35,500	\$ 9,956	\$ 5,592	296	288,601	69,743	44,320
CHEVY	SEDAN	1758	1962	2003	2000	2.967	\$ 100	\$ 17,300	\$ 5,507	\$ 3,066	114	229,394	58,213	37,811
CHEVY	SUV	2161	1981	2003	1999	2.817	\$ 200	\$ 34,500	\$ 12,324	\$ 7,191	977	286,436	68,430	40,710
CHEVY	VAN	895	1981	2003	1998	3.294	\$ 125	\$ 35,300	\$ 6,668	\$ 4,086	5,493	276,616	78,359	43,958
CHEVY	WAGON	22	1990	1995	1992	1.469	\$ 350	\$ 3,600	\$ 1,332	\$ 774	39,710	279,906	124,030	48,057
CHRYSLER	COUPE	301	1987	2003	1999	2.850	\$ 100	\$ 34,000	\$ 8,249	\$ 5,124	3,173	170,936	57,530	36,083
CHRYSLER	SEDAN	789	1986	2003	1999	2.990	\$ 150	\$ 21,600	\$ 7,794	\$ 4,327	43	175,484	57,294	34,475
CHRYSLER	VAN	320	1992	2003	1999	2.208	\$ 400	\$ 35,100	\$ 8,791	\$ 4,827	1,629	204,156	64,183	35,592
DAEWOO	COUPE	6	2000	2002	2001	0.816	\$ 700	\$ 5,000	\$ 2,317	\$ 1,525	19,714	68,045	43,159	22,420
DAEWOO	SEDAN	108	1999	2002	2000	0.778	\$ 400	\$ 6,200	\$ 3,026	\$ 1,470	7,687	84,678	36,848	18,685
DAEWOO	WAGON	5	1999	2001	2000	0.707	\$ 600	\$ 5,500	\$ 3,060	\$ 1,756	18,827	97,326	42,921	31,150
DODGE	COUPE	151	1989	2003	1997	2.841	\$ 275	\$ 84,500	\$ 5,621	\$ 10,765	13	179,576	77,956	38,715
DODGE	PICKUP	1708	1978	2003	1999	2.446	\$ 200	\$ 29,800	\$ 10,554	\$ 5,347	2,166	244,920	65,718	38,547
DODGE	SEDAN	2099	1989	2003	2001	2.496	\$ 100	\$ 14,200	\$ 6,219	\$ 3,170	105	175,278	46,578	34,434
DODGE	SUV	761	1989	2003	2000	1.074	\$ 400	\$ 24,800	\$ 12,348	\$ 3,005	869	142,521	51,010	22,652
DODGE	VAN	1299	1985	2003	1999	2.959	\$ 200	\$ 20,000	\$ 7,257	\$ 4,707	2,496	236,084	68,348	42,284
EAGLE	COUPE	29	1990	1998	1996	1.831	\$ 400	\$ 4,100	\$ 2,659	\$ 1,090	54,197	195,426	96,001	33,467
EAGLE	SEDAN	33	1989	1998	1996	2.454	\$ 200	\$ 3,900	\$ 2,253	\$ 1,377	32,987	179,916	86,714	38,884
FORD	COUPE	1434	1969	2003	1999	3.383	\$ 100	\$ 28,600	\$ 7,628	\$ 5,032	125	203,949	53,751	37,644
FORD	PICKUP	4259	1976	2003	1999	2.755	\$ 250	\$ 35,000	\$ 10,648	\$ 5,974	1,062	252,736	58,296	38,506
FORD	SEDAN	3479	1984	2003	2000	2.546	\$ 100	\$ 18,000	\$ 5,733	\$ 3,097	303	200,784	49,924	34,646
FORD	SUV	4129	1981	2003	2000	2.558	\$ 175	\$ 37,500	\$ 11,683	\$ 5,450	466	219,329	55,201	32,456
FORD	VAN	2125	1978	2003	1999	2.507	\$ 100	\$ 26,000	\$ 7,954	\$ 4,452	2,824	271,123	63,683	42,320
FORD	WAGON	219	1990	2003	1998	3.044	\$ 150	\$ 13,500	\$ 4,641	\$ 3,569	1,472	256,127	60,628	40,937
GEO	COUPE	44	1990	2001	1995	2.922	\$ 100	\$ 3,000	\$ 1,208	\$ 780	31,790	230,438	88,381	36,791
GEO	SEDAN	207	1990	2002	1999	2.669	\$ 150	\$ 8,600	\$ 3,701	\$ 1,994	6,575	240,571	60,209	36,779
GEO	SUV	175	1989	2003	1999.3	2.602866	550	13300	5934.7143	2934.6863	4421	199829	50783.086	32127.8098
GMC	PICKUP	666	1984	2003	1999	2.924	\$ 150	\$ 30,100	\$ 9,988	\$ 6,000	1,772	235,962	72,626	43,219.354
GMC	SUV	678	1984	2003	1999	2.498	\$ 200	\$ 43,250	\$ 13,074	\$ 7,844	3,661	265,328	68,601	38,630
GMC	VAN	145	1986	2003	1997	3.669	\$ 400	\$ 25,000	\$ 6,197	\$ 4,882	6,586	208,706	89,107	45,551
HONDA	COUPE	675	1984	2003	1998	3.479	\$ 150	\$ 25,300	\$ 7,920	\$ 5,082	428	282,015	74,742	48,201
HONDA	SEDAN	1243	1986	2003	1998	3.554	\$ 150	\$ 20,000	\$ 7,440	\$ 4,259	3,740	278,352	76,271	49,191
HONDA	SUV	309	1994	2003	1999	1.710	\$ 1,150	\$ 28,200	\$ 10,720	\$ 4,170	1,559	167,723	56,559	31,481
HONDA	VAN	81	1995	2003	2000	1.583	\$ 2,750	\$ 25,000	\$ 15,324	\$ 5,095	6,077	169,720	55,819	32,126
HONDA	WAGON	12	1990	1997	1993	2.038	\$ 750	\$ 4,200	\$ 2,708	\$ 1,158	86,722	198,884	127,052	35,243
HUMMER	SUV	42	1995	2003	2002	1.851	\$ 15,700	\$ 52,000	\$ 46,338	\$ 6,781	554	76,987	14,888	14,108
HYUNDAI	COUPE	85	1992	2003	1999	2.562	\$ 200	\$ 14,100	\$ 3,481	\$ 2,815	3,076	137,266	51,075	32,363
HYUNDAI	SEDAN	632	1988	2003	2001	1.841	\$ 125	\$ 14,000	\$ 7,118	\$ 3,346	1,438	146,935	32,521	26,886
HYUNDAI	SUV	44	2001	2003	2002	0.642	\$ 8,800	\$ 17,700	\$ 13,919	\$ 2,690	2,202	67,242	25,193	16,422
HYUNDAI	WAGON	5	1996	1999	1997	1.304	\$ 675	\$ 2,700	\$ 1,440	\$ 830	64,374	126,120	89,129	23,511
INFINITI	SEDAN	333	1990	2003	1998	2.635	\$ 625	\$ 33,400	\$ 11,366	\$ 6,150	6,709	179,795	64,658	37,695
INFINITI	SUV	123	1997	2003	2000	1.169	\$ 6,600	\$ 25,600	\$ 16,617	\$ 3,955	9,664	110,866	47,365	19,030

Table 4.6 Frequency of Observations by Body Type

Make	Body Type	No. of Obs.	Year				Price				Mileage			
			MIN	MAX	MEAN	St Dev	MIN	MAX	MEAN	St Dev	MIN	MAX	MEAN	St Dev
ISUZU	PICKUP	28	1986	2000	1997	3.304	\$ 400	\$ 5,600	\$ 1,986	\$ 1,448	33,035	220,157	107,592	40,765
ISUZU	SEDAN	10	1998	2002	2001	1.075	\$ 750	\$ 4,300	\$ 2,955	\$ 1,393	28,489	112,906	49,967	24,689
ISUZU	SUV	454	1986	2002	1999	2.682	\$ 300	\$ 14,500	\$ 6,743	\$ 3,585	2,873	197,761	64,022	39,037
JAGUAR	COUPE	45	1989	2002	1999	3.017	\$ 3,650	\$ 75,500	\$ 31,880	\$ 13,671	1,304	94,309	40,366	22,341
JAGUAR	SEDAN	560	1984	2003	2000	2.712	\$ 200	\$ 55,500	\$ 22,874	\$ 8,560	1,039	219,699	37,355	26,274
JEEP	SUV	2364	1986	2003	1999	2.572	\$ 100	\$ 27,600	\$ 9,847	\$ 4,566	1,791	244,349	62,729	37,292
KIA	SEDAN	386	1994	2003	2001	1.499	\$ 200	\$ 11,900	\$ 4,444	\$ 2,872	1,983	137,190	36,678	24,919
KIA	SUV	226	1995	2002	2000	1.696	\$ 100	\$ 10,500	\$ 4,630	\$ 2,544	4,386	120,773	50,965	28,634
KIA	WAGON	11	2002	2003	2002	0.302	\$ 4,200	\$ 15,800	\$ 9,964	\$ 4,037	6,206	43,016	15,475	10,549
LANDROVR	SUV	415	1989	2003	2000	2.386	\$ 2,500	\$ 63,000	\$ 19,873	\$ 10,286	2,098	200,543	35,560	31,064
LEXUS	COUPE	35	1992	2003	1998	4.147	\$ 3,200	\$ 55,000	\$ 29,869	\$ 21,044	1,637	161,493	58,686	54,753
LEXUS	SEDAN	524	1990	2003	1998	3.058	\$ 1,750	\$ 50,500	\$ 15,979	\$ 8,424	1,783	234,222	65,731	42,457
LEXUS	SUV	433	1996	2003	2000	0.792	\$ 6,500	\$ 50,000	\$ 22,354	\$ 5,465	578	102,637	46,109	16,737
LINCOLN	COUPE	50	1986	1998	1995	3.040	\$ 250	\$ 11,900	\$ 4,528	\$ 3,045	14,517	191,204	93,891	39,348
LINCOLN	SEDAN	1082	1962	2003	1999	3.060	\$ 100	\$ 30,000	\$ 13,800	\$ 6,241	4,757	297,933	49,858	35,661
LINCOLN	SUV	415	1998	2003	2000	1.088	\$ 8,900	\$ 43,600	\$ 21,212	\$ 5,015	1,747	161,674	51,512	23,288
MAZDA	COUPE	97	1988	2003	1997	3.840	\$ 100	\$ 16,300	\$ 6,630	\$ 5,275	143	249,047	74,189	50,491
MAZDA	PICKUP	142	1986	2003	1998	3.408	\$ 1,075	\$ 14,100	\$ 6,693	\$ 3,080	4,673	216,275	64,687	47,362
MAZDA	SEDAN	1011	1988	2003	2000	2.913	\$ 200	\$ 17,100	\$ 6,869	\$ 3,414	58	230,189	51,267	40,062
MAZDA	SUV	45	1991	2003	2000	3.701	\$ 1,600	\$ 22,400	\$ 12,953	\$ 5,630	7,172	111,262	41,383	25,851
MAZDA	WAGON	115	1989	2003	1999	3.409	\$ 200	\$ 19,000	\$ 8,893	\$ 5,145	104	177,415	55,823	42,069
MERCEDES	COUPE	395	1973	2003	1999	3.923	\$ 600	\$ 129,000	\$ 34,425	\$ 20,689	2	194,575	39,451	29,447
MERCEDES	SEDAN	843	1970	2003	1998	3.997	\$ 175	\$ 79,500	\$ 22,291	\$ 13,236	101	268,308	60,941	39,436
MERCEDES	SUV	283	1998	2003	2000	1.004	\$ 9,100	\$ 56,250	\$ 22,107	\$ 6,431	1,103	113,514	44,615	18,840
MERCEDES	WAGON	12	1983	2002	1996	5.551	\$ 1,600	\$ 33,600	\$ 19,688	\$ 11,250	13,871	196,128	68,540	49,398
MERCURY	COUPE	227	1986	2002	1998	3.108	\$ 100	\$ 15,200	\$ 6,502	\$ 3,320	4,915	247,471	56,568	33,774
MERCURY	SEDAN	1270	1985	2003	2000	2.727	\$ 100	\$ 24,300	\$ 7,552	\$ 3,815	121	203,878	44,829	34,576
MERCURY	SUV	330	1997	2003	2000	1.587	\$ 2,150	\$ 22,400	\$ 12,844	\$ 4,726	5,832	165,493	47,307	26,496
MERCURY	VAN	215	1993	2002	1998	2.466	\$ 350	\$ 15,400	\$ 5,892	\$ 3,719	11,126	184,688	77,893	40,374
MERCURY	WAGON	42	1993	2002	1998	2.840	\$ 475	\$ 12,600	\$ 5,702	\$ 4,349	4,356	145,739	62,839	39,140
MITSUB	COUPE	532	1989	2003	1999	3.115	\$ 100	\$ 19,500	\$ 7,363	\$ 4,396	263	197,465	53,437	39,402
MITSUB	PICKUP	5	1988	1995	1993	3.050	\$ 700	\$ 2,600	\$ 1,290	\$ 775	80,015	168,631	122,879	32,708
MITSUB	SEDAN	965	1988	2003	2001	2.323	\$ 150	\$ 20,100	\$ 7,468	\$ 3,588	898	194,047	40,073	32,584
MITSUB	SUV	553	1989	2003	2001	2.286	\$ 425	\$ 26,000	\$ 13,322	\$ 5,241	2,102	173,914	38,790	35,312
MITSUB	WAGON	2	1994	1995	1995	0.707	\$ 1,500	\$ 2,600	\$ 2,050	\$ 778	102,460	143,953	123,207	29,340
NISSAN	COUPE	120	1984	2003	1994	4.776	\$ 100	\$ 30,250	\$ 5,131	\$ 8,124	1,280	229,679	100,754	48,458
NISSAN	PICKUP	279	1984	2003	1998	3.847	\$ 300	\$ 18,700	\$ 7,817	\$ 5,074	65	233,852	68,246	47,627
NISSAN	SEDAN	1793	1987	2003	1999	2.852	\$ 100	\$ 22,600	\$ 8,880	\$ 4,999	167	231,884	54,662	40,460
NISSAN	SUV	545	1988	2003	1999	2.642	\$ 475	\$ 24,000	\$ 11,977	\$ 4,929	4,701	241,188	57,866	37,084
NISSAN	VAN	159	1993	2002	1998	2.339	\$ 650	\$ 18,900	\$ 7,072	\$ 3,853	9,597	251,560	78,843	42,539
OLDSMO	COUPE	49	1988	2003	1999	3.698	\$ 700	\$ 9,400	\$ 5,594	\$ 2,673	10,572	219,666	56,691	40,864
OLDSMO	SEDAN	276	1983	2003	1999	3.512	\$ 200	\$ 12,100	\$ 5,236	\$ 2,798	10,812	185,368	64,867	35,289
OLDSMO	SUV	23	1993	2003	1998	1.929	\$ 1,650	\$ 19,600	\$ 7,009	\$ 4,422	28,047	161,168	81,908	32,456
OLDSMO	VAN	14	1996	2002	1999	1.859	\$ 1,900	\$ 12,800	\$ 7,196	\$ 3,586	27,295	119,215	70,354	32,350
PLYMTH	COUPE	40	1990	2001	1996	3.262	\$ 100	\$ 25,500	\$ 4,745	\$ 8,444	2,792	210,598	86,586	47,855
PLYMTH	SEDAN	313	1987	2001	1998	2.692	\$ 100	\$ 6,300	\$ 2,779	\$ 1,651	12,744	248,663	72,061	33,701
PLYMTH	VAN	374	1987	2002	1997	2.800	\$ 100	\$ 14,000	\$ 3,892	\$ 2,810	7,013	223,556	90,851	40,559
PONTIAC	COUPE	767	1978	2003	1998.3	2.990263	100	26500	6110.2412	4171.3156	620	246454	66834.885	38483.1171
PONTIAC	SEDAN	1540	1986	2003	1999.3	2.741724	\$ 100	\$ 17,600	\$ 6,261	\$ 3,407	321	241,828	62,429	38,026
PONTIAC	SUV	29	2001	2003	2001	0.670	\$ 5,700	\$ 14,150	\$ 9,959	\$ 2190.404	3,338	95,522	38,015	23377.667
PONTIAC	VAN	234	1990	2003	1999	2.412	\$ 400	\$ 16,700	\$ 7,879	\$ 4,167	1,802	223,509	66,459	35,422
PONTIAC	WAGON	3	2003	2003	2003	0.000	\$ 11,500	\$ 14,900	\$ 13,233	\$ 1,701	4,398	14,274	10,164	5,142
PORSCHE	COUPE	241	1965	2003	1998	4.866	\$ 1,400	\$ 91,000	\$ 34,521	\$ 16,442	1,294	151,401	35,235	23,462
SAAB	COUPE	162	1986	2002	1999	1.992	\$ 150	\$ 30,750	\$ 14,850	\$ 4,826	9,845	131,032	40,016	19,179
SAAB	SEDAN	196	1991	2002	1999	1.896	\$ 325	\$ 26,500	\$ 11,402	\$ 4,567	8,329	143,866	45,788	23,364
SAAB	WAGON	23	1999	2001	2000	0.475	\$ 5,500	\$ 22,100	\$ 14,670	\$ 3,435	19,573	74,906	44,185	15,973
SATURN	COUPE	166	1991	2002	1998	2.568	\$ 325	\$ 10,100	\$ 4,363	\$ 2,369	13,300	169,811	65,683	36,378
SATURN	SEDAN	687	1992	2003	1999	2.397	\$ 125	\$ 13,500	\$ 4,435	\$ 2,397	1,072	196,912	56,809	36,022
SATURN	SUV	7	2002	2003	2003	0.535	\$ 13,000	\$ 18,100	\$ 15,500	\$ 1,807	3,414	23,583	15,851	6,875
SATURN	WAGON	46	1994	2002	1998	2.098	\$ 800	\$ 10,400	\$ 4,933	\$ 2,893	18,766	123,120	61,842	30,558

Table 4.6 Frequency of Observations by Body Type

Make	Body Type	No. of Obs.	Year				Price				Mileage			
			MIN	MAX	MEAN	St Dev	MIN	MAX	MEAN	St Dev	MIN	MAX	MEAN	St Dev
SUBARU	SEDAN	400	1985	2003	2000	2.957	\$ 100	\$ 24,500	\$ 12,080	\$ 5,436	1,294	228,398	46,224	39,308
SUBARU	SUV	175	1998	2003	2001	1.357	\$ 4,400	\$ 20,200	\$ 12,914	\$ 3,362	5,123	115,334	36,611	23,028
SUZUKI	SEDAN	122	1995	2003	2002	1.542	\$ 500	\$ 11,600	\$ 7,607	\$ 2,745	3,023	122,689	21,443	24,149
SUZUKI	SUV	269	1992	2003	2000	2.349	\$ 875	\$ 17,700	\$ 9,466	\$ 4,441	931	167,451	38,707	30,201
SUZUKI	WAGON	5	1998	2001	2000	1.304	\$ 650	\$ 5,300	\$ 2,820	\$ 1,700	26,897	68,471	54,505	16,148
TOYOTA	COUPE	269	1985	2003	1997	4.223	\$ 100	\$ 24,600	\$ 8,080	\$ 5,700	198	228,575	74,079	49,864
TOYOTA	PICKUP	362	1986	2003	1999	3.093	\$ 200	\$ 25,000	\$ 10,348	\$ 5,323	1,223	237,752	65,552	43,725
TOYOTA	SEDAN	2236	1981	2003	1999	3.378	\$ 100	\$ 25,800	\$ 8,711	\$ 4,696	1,751	238,695	57,391	43,374
TOYOTA	SUV	670	1974	2003	1999	2.821	\$ 500	\$ 35,800	\$ 14,266	\$ 7,670	105	250,427	66,993	40,794
TOYOTA	VAN	186	1991	2003	1999	2.790	\$ 800	\$ 25,400	\$ 10,995	\$ 5,203	120	192,550	68,029	41,583
TOYOTA	WAGON	16	1987	1996	1992	2.469	\$ 475	\$ 5,900	\$ 2,139	\$ 1,592	64,563	184,452	124,972	34,776
VOLKS	COUPE	429	1987	2003	2000	1.887	\$ 100	\$ 36,500	\$ 9,501	\$ 3,328	119	241,494	40,931	26,374
VOLKS	SEDAN	758	1984	2003	1999	2.023	\$ 100	\$ 37,500	\$ 9,759	\$ 4,640	1,705	177,983	48,244	28,933
VOLKS	VAN	11	1993	2003	2001	3.828	\$ 800	\$ 25,300	\$ 17,050	\$ 8,589	6,687	129,716	31,614	43,921
VOLKS	WAGON	34	1990	2003	2000	2.847	\$ 1,000	\$ 28,100	\$ 12,306	\$ 5,429	6,800	111,821	38,815	26,056
VOLVO	COUPE	40	1983	2003	1999	4.210	\$ 1,100	\$ 33,400	\$ 18,593	\$ 7,306	5,818	77,972	38,780	19,072
VOLVO	SEDAN	517	1981	2002	2000	3.541	\$ 100	\$ 31,000	\$ 15,061	\$ 6,730	2,076	232,529	41,982	41,197
VOLVO	WAGON	155	1990	2003	2000	2.756	\$ 500	\$ 34,000	\$ 17,226	\$ 8,784	1,199	214,259	52,700	39,210
TOTAL		70,058												

Model

Before the specific model is presented, the groundwork must be laid. In light of what is commonly termed the Lemon Problem, a model should be generated that observes if there are any particular hints of this problem in the auction environment. This study is interested in the effects that different type of sellers have on the price and depreciation of a vehicle. One might expect that buyers in the market will infer some type of quality of a vehicle based on information surrounding the vehicle such as who is the one selling it. In essence, an important piece of the study is the consequential effects that seller information might have on mileage and age effects. The study will also produce results that will shed light on the effects of past purchase history on the sale price of a vehicle.

The log linear model is used for analysis on the broad data set since the broad set includes a vast array of makes, models and years. We would expect changes in characteristics to have a percentage effect on price rather than a constant dollar effect. Each model was tested for heteroscedasticity by White's test. The advantage with White's test is that because of its generality, the test may be used to identify specification errors other than heteroscedasticity, such as functional misspecification errors.⁵²

$$\mathbf{X}=(x_1, \dots ,x_K) \tag{4.1}$$

is the vector of characteristics: number of owners, mileage, year, make, engine size, and four-wheel drive option among other characteristics.

⁵² (Warner) Obtain the model by ols as usual. Obtain the ols residuals, u_i , and the fitted values, y_i . Compute the squared ols residuals and the squared fitted values. Regress u_i^2 on y_i and y_i^2 . Keep the R-squared from this regression and form either the F or LM statistic and compute the p-value (using $F_{2, n-3}$ distribution or X^2 distribution)

Since the analysis on the broad sample includes a wide variety of vehicle samples, log-price is the dependent variable as the point of interest will approximately be percentage effects on price. The model is given below.

$$\ln p = \beta_o + \sum_{k=1}^K \beta_k x_k \quad (4.2)$$

where the implicit price is

$$\frac{\partial \ln p}{\partial x_k} = \beta_k \quad (4.3)$$

where the coefficients are interpreted as the relative change in x_k for a unit change in β_k . For this paper, a unit change in an independent variable is approximately associated with a β_k (*100) percent change in the price of a vehicle, all other things being equal.

Dummy variables are incorporated so that the qualitative factors of the vehicle are included in the model. Dummy variables will also allow for the quantitative effects to vary by make and model. Dummy variables are also interacted with other variable so that the independent variable's incremental effect on price can be estimated.

This ownership variable, which tracks the number of owners that a vehicle has had over the course of its life, was found by using the VIN to track ownership across the life of the vehicle using the Carfax database.⁵³ The report that Carfax generates includes an accident check, mileage accuracy check, ownership history, recall information, and any warranty details.

⁵³Ownership is defined as the retailed transfer of title. Carfax is owned by R.L. Polk, a major automotive support firm.

Table 4.7 Variable Definitions

Name	Description
AGE	Age of vehicle
MILES1K	mileage/1000
NOWNERS	number of previous owners
<i>dummy variables</i>	
CYL4	vehicle with engsize less than 6 cylinders
CYL8	vehicle with engsize = to 8 cyl
CYL10	vehicle with engsize equal to or greater than 10 cyl
WHEEL4	4wheel drive vehicle
CONV	convertible
COUPENC	nonconvertible coupe
WAGON	wagon
VAN	van
PICKUPREG	regular cab pickup
PICKUP4D	4door pickup
PICKUPEXT	extended cab pickup
SUV2D	suv with only 2 doors
SUV4D	suv with 4 doors
DIESELENG	vehicles that have diesel engine
GM	General Motors vehicle
NONGM	A US made vehicle but not by General Motors
BANKFINANCE	Bank/Finance is selling the vehicle
DEALER	A dealer is selling the vehicle
FLEETLEASE	This vehicle was either leased or part of a fleet
ACURA	Dummy variable, 1 if vehicle is manufactured by Acura
AUDI	Dummy variable, 1 if vehicle is manufactured by Audi
BMW	Dummy variable, 1 if vehicle is manufactured by BMW
BUICK	Dummy variable, 1 if vehicle is manufactured by Buick
CADILLAC	Dummy variable, 1 if vehicle is manufactured by Cadillac
CHEVROLET	Dummy variable, 1 if vehicle is manufactured by Chevrolet
CHRYSLER	Dummy variable, 1 if vehicle is manufactured by Chrysler
DAEWOO	Dummy variable, 1 if vehicle is manufactured by Daewoo
DODGE	Dummy variable, 1 if vehicle is manufactured by Dodge
EAGLE	Dummy variable, 1 if vehicle is manufactured by Eagle
FORD	Dummy variable, 1 if vehicle is manufactured by Ford
GEO	Dummy variable, 1 if vehicle is manufactured by Geo
GMC	Dummy variable, 1 if vehicle is manufactured by GMC
HONDA	Dummy variable, 1 if vehicle is manufactured by Honda
HUMMER	Dummy variable, 1 if vehicle is manufactured by Hummer
HYUNDAI	Dummy variable, 1 if vehicle is manufactured by Hyundai
INFINITI	Dummy variable, 1 if vehicle is manufactured by Infinity
ISUZU	Dummy variable, 1 if vehicle is manufactured by Isuzu
JAGUAR	Dummy variable, 1 if vehicle is manufactured by Jaguar
JEEP	Dummy variable, 1 if vehicle is manufactured by Jeep
KIA	Dummy variable, 1 if vehicle is manufactured by Kia
LANDROVER	Dummy variable, 1 if vehicle is manufactured by Landrover
LEXUS	Dummy variable, 1 if vehicle is manufactured by Lexus
LINCOLN	Dummy variable, 1 if vehicle is manufactured by Lincoln
MAZDA	Dummy variable, 1 if vehicle is manufactured by Mazda
MERCEDES	Dummy variable, 1 if vehicle is manufactured by Mercedes
MERCURY	Dummy variable, 1 if vehicle is manufactured by Mercury
MITSUBISHI	Dummy variable, 1 of vehicle is manufactured by Mitsubishi
NISSAN	Dummy variable, 1 of vehicle is manufactured by Nissan
OLDSMOBIL	Dummy variable, 1 of vehicle is manufactured by Oldsmobile
PLYMOUTH	Dummy variable, 1 if vehicle is manufactured by Plymouth
PONTIAC	Dummy variable, 1 of vehicle is manufactured by Pontiac
PORSCHE	Dummy variable, 1 if vehicle is manufactured by Porsche
SAAB	Dummy variable, 1 if vehicle is manufactured by Saab
SATURN	Dummy variable, 1 if vehicle is manufactured by Saturn
SUBARU	Dummy variable, 1 if vehicle is manufactured by Subaru
SUZUKI	Dummy variable, 1 if vehicle is manufactured by Suzuki
TOYOTA	Dummy variable, 1 if vehicle is manufactured by Toyota
VOLKSWAGE	Dummy variable, 1 if vehicle is manufactured by Volkswagen
VOLVO	Dummy variable, 1 if vehicle is manufactured by Volvo
<i>interaction variables</i>	
BANKFINANCEMILES	interaction of BANKFINANCE and MILES1K variables
DEALERMILES	interaction of DEALER and MILES1K variables
FLEETLEASEMILES	interaction of FLEETLEASE and MILES1K variables
BANKFINANCEAGE	interaction of BANKFINANCE and AGE variables
DEALERAGE	interaction of DEALER and AGE variables
FLEETLEASEAGE	interaction of FLEETLEASE and AGE variables

Empirical Results

The first model, which considers the broad sample of vehicles auctioned off across the United States, has log-price as the dependent variable. The following table (Table 4.8) gives the parameter estimates as well as the relevant t- statistics in parentheses. Dummy variables are included to measure out the effects of a foreign vehicle, a General Motors vehicle and a nonGeneral Motors vehicle, any convertible effects, and various other effects. The model also tested for effects from the order in which the vehicle came to the auction block. The order statistic was insignificant at the 5% confidence level.

The omitted category in the first broad model is a 6 cyl sedan made by a foreign manufacturer. The R^2 is 0.78 and the signs on the parameter estimates are as expected. The market discounts the year of the vehicle, mileage and small engine. Model 1 suggests that a brand new foreign 6 cyl sedan is roughly \$30,000 and for each 1,000 mile increment, the sedan depreciated by 0.8%.

Model 2 adds dummy variables to account for the person who is selling the vehicle. The R^2 improves slightly while all other variables remain statistically significant. The depreciation from a unit change in age is roughly 14%. A five-year old car would depreciate to roughly half of the car's purchase price ($=EXP(5*0.14)-1$). The vehicle that is coming off of a Fleet/Lease arrangement is the only one that is discounted relative to the other consignors.

Along with the intercept shifters of Bank/Finance sellers, Dealers, and Fleet/Lease consignors, Model 3 adds slope shifters by interacting these consignors with mileage and with age. In the broad, pooled models, the estimated slope effects from the interaction variables are

fairly muted on miles. However, there are some noteworthy interaction effects on age, specifically the negative sign on dealer-age.

Table 4.8 Coefficients of Interest for Broad Sample (Dependent Var is Log Price)

Model	(1)	(2)	(3)	(4)
INTERCEPT	10.309	10.288	10.325	9.780
	(2142.57)	(1982.629)	(1529.11)	(1442.245)
AGE	-0.141	-0.145	-0.145	-0.164
	(-174.87)	(-177.153)	(-78.447)	(-105.769)
MILES1K	-0.008	-0.008	-0.008	-0.008
	(-125.414)	(-125.744)	(-69.138)	(79.036)
CYL4	-0.518	-0.512	-0.513	-0.373
	(-122.548)	(-122.183)	(-122.483)	(-92.314)
CYL8	0.540	0.533	0.534	0.462
	(119.869)	(119.172)	(119.621)	(111.788)
CYL10	0.636	0.635	0.638	0.574
	(22.691)	(22.866)	(23.036)	(24.834)
WHEEL4	0.117	0.125	0.123	0.102
	(21.01)	(22.608)	(22.358)	(21.861)
CONV	0.528	0.513	0.513	0.393
	(50.405)	(49.346)	(49.408)	(43.834)
COUPENC	0.116	0.106	0.106	0.074
	(19.404)	(17.913)	(17.879)	(14.413)
WAGON	0.097	0.080	0.079	0.048
	(6.388)	(5.322)	(5.272)	(3.700)
VAN	0.135	0.133	0.131	0.233
	(20.808)	(20.718)	(20.44)	(41.719)
PICKUP4D	0.151	0.137	0.137	0.312
	(15.04)	(13.7)	(13.748)	(35.894)
PICKUPEXT	0.218	0.206	0.205	0.339
	(28.792)	(27.523)	(27.327)	(50.820)
PICKUPREG	0.055	0.047	0.049	0.166
	(6.079)	(5.243)	(5.527)	(21.515)
SUV2D	0.221	0.199	0.201	0.298
	(17.756)	(16.13)	(16.323)	(28.056)
SUV4D	0.209	0.198	0.198	0.346
	(35.063)	(33.539)	(33.595)	(64.181)
DIESELENG	0.608	0.601	0.605	0.590
	(32.432)	(32.339)	(32.631)	(38.234)
GM	-0.539	-0.548	-0.546	
	(-114.943)	(-117.896)	(-117.454)	
NONGM	-0.620	-0.627	-0.624	
	(-148.333)	(-151.001)	(-150.321)	
BANKFINANCE		0.121	0.048	-0.046
		(26.594)	(4.15)	(-4.680)
DEALER		0.081	0.025	-0.049
		(19.781)	(3.125)	(-7.214)
FLEETLEASE		-0.085	-0.219	-0.083
		(-13.216)	(-18.267)	(-8.125)
BANKFINANCEMILES			-0.001	0.000
			(-3.985)	(-2.154)
DEALERMILES			0.001	0.001
			(9.885)	(11.444)
FLEETLEASEMILES			-0.001	-0.002
			(1.071)*	(-5.585)
BANKFINANCEAGE			0.027	0.028
			(7.553)	(9.428)
DEALERAGE			-0.005	0.009
			(-2.582)	(5.190)
FLEETLEASEAGE			0.037	0.048
			(7.673)	(11.917)
N	70,058	70,058	70,058	70,058
R-Sq	0.775	0.779	0.781	0.848

Model 4 includes MAKE dummies for each of the various vehicle manufacturers in the broad sample. The Table does not show each of those MAKE dummies; however, these intercept shifters allow the R^2 to increase significantly. Vehicles coming out of a Fleet/Lease arrangement continue to be the underperformers. This model drops the GM and nonGM dummies since the individual MAKE dummies are included. The omitted variable in this case is Chevy with an average new price of just under \$18,000 ($=\text{EXP}(9.780)$). The age depreciation effects have increased from Models 1, 2, and 3. This is expected since foreign made cars hold their value longer than domestic vehicles.

Table 4.9 illustrates the implicit price effects for the average five-year old car with 60,000 miles. The economy class vehicles experience a larger depreciation over the five-year interval than the more luxurious vehicles. In addition, domestic vehicles take a larger hit with mileage effects as well. For example, the lower end of the spectrum include Plymouth, Chrysler, Kia, and Daewoo. The upper end of the spectrum include Porsche and Toyota. Although, it is interesting that Porsche does well with holding up relative to its age but poorly relative to mileage. This indicates that the Porsche may be viewed as a “weekender” vehicle and not a vehicle for daily commutes.

Table 4.9 Estimated Depreciation for a Five-year, 60k Mile Vehicle

MAKE	NEW PRICE	5YR DEP EFFECT	60K DEP EFFECT	USED PRICE
ACURA	\$38,072	-0.371	-0.507	\$11,813
AUDI	\$45,411	-0.522	-0.382	\$13,430
BMW	\$46,946	-0.490	-0.300	\$16,759
BUICK	\$17,324	-0.468	-0.491	\$4,691
CADILLAC	\$38,823	-0.598	-0.535	\$7,264
CHEVROLET	\$14,794	-0.531	-0.349	\$4,521
CHRYSLER	\$30,018	-0.649	-0.373	\$6,602
DAEWOO	\$16,774	-0.748	-0.536	\$1,962
DODGE	\$15,736	-0.562	-0.368	\$4,355
FORD	\$15,106	-0.568	-0.367	\$4,136
GEO	\$11,776	-0.378	-0.548	\$3,309
GMC	\$25,439	-0.584	-0.271	\$7,716
HONDA	\$32,704	-0.542	-0.360	\$9,577
HUMMER	\$53,312	-0.378	-0.004	\$33,022
HYUNDAI	\$21,268	-0.624	-0.537	\$3,697
INFINITI	\$38,168	-0.551	-0.375	\$10,711
ISUZU	\$8,699	-0.524	-0.393	\$2,510
JAGUAR	\$41,442	-0.423	-0.368	\$15,122
JEEP	\$26,571	-0.495	-0.393	\$8,142
KIA	\$20,122	-0.646	-0.634	\$2,603
LANDROVER	\$23,826	-0.371	-0.395	\$9,074
LEXUS	\$39,736	-0.472	-0.296	\$14,758
LINCOLN	\$34,430	-0.638	-0.296	\$8,786
MAZDA	\$22,465	-0.514	-0.480	\$5,670
MERCEDES	\$47,802	-0.363	-0.401	\$18,226
MERCURY	\$16,576	-0.542	-0.459	\$4,106
MINI	\$20,036	-0.513	-0.371	\$6,141
NISSAN	\$26,919	-0.520	-0.350	\$8,399
OLDSMOBILE	\$18,170	-0.398	-0.579	\$4,604
PLYMOUTH	\$19,619	-0.527	-0.582	\$3,875
PONTIAC	\$19,608	-0.499	-0.471	\$5,187
PORSCHE	\$56,156	-0.223	-0.423	\$25,202
SAAB	\$45,193	-0.644	-0.378	\$10,002
SATURN	\$22,137	-0.631	-0.410	\$4,822
SUBARU	\$26,294	-0.409	-0.402	\$9,288
SUZUKI	\$11,943	-0.515	-0.461	\$3,117
TOYOTA	\$27,699	-0.524	-0.278	\$9,521
VOLKSWAGEN	\$42,087	-0.633	-0.405	\$9,201
VOLVO	\$39,848	-0.568	-0.333	\$11,484

Appendix A includes the complete regression results for each of the individual makes but in the body of this paper, highlights of significant estimates are in order.

Table 4.10 Coefficients of Interest for Ford Sample (Dependent Var is Log Price)

Variable	(1)	(2)	(3)	(4)
Intercept	9.623 (877.18)	9.483 (233.195)	9.498 (235.857)	9.512 (235.761)
age	-0.184 (-62.943)	-0.161 (-39.093)	-0.162 (-39.728)	-0.163 (-39.613)
miles1k	-0.008 (-43.45)	-0.004 (-14.129)	-0.004 (-14.153)	-0.004 (-14.255)
CYL4	-0.343 (-39.33)	-0.426 (-6.261)	-0.400 (-5.942)	-0.383 (-5.69)
cyl8	0.451 (67.258)	0.466 (23.575)	0.468 (23.944)	0.467 (24.012)
cyl10	0.428 (17.501)	0.45 (8.134)	0.447 (8.188)	0.445 (8.18)
WHEEL4	0.096 (13.381)	0.176 (9.457)	0.171 (9.286)	0.173 (9.429)
CONV	0.534 (28.729)			
COUPENC	0.175 (15.957)			
WAGON	0.003 (0.118)*	-0.341 (-2.089)	-0.359 (-2.224)	-0.362 (-2.256)
VAN	0.374 (40.230)			
PICKUP4D	0.462 (38.540)	0.45 (11.035)	0.439 (10.867)	0.432 (10.737)
PICKUPEXT	0.482 (47.033)	0.45 (9.967)	0.446 (10.008)	0.434 (9.725)
PICKUPREG	0.33 (28.210)	0.248 (5.885)	0.243 (5.843)	0.232 (5.580)
SUV2D	0.399 (28.135)	0.32 (6.604)	0.305 (6.355)	0.296 (6.185)
SUV4D	0.585 (61.918)	0.5 (12.791)	0.486 (12.551)	0.477 (12.36)
DIESELENG	0.477 (26.132)			
NOWNERS		-0.032 (-2.761)	-0.031 (-2.667)	-0.031 (-2.666)
BANKFINANCE	-0.062 (-3.798)			
DEALER	-0.056 (-4.002)			
FLEETLEASE	-0.190 (-9.478)		-0.334 (-5.248)	-0.726 (-5.317)
BANKFINANCEMILES	-0.001 (-3.095)			
DEALERMILES	0.003 (12.889)			
FLEETLEASEMILES	-0.002 (-3.505)			0.002 (1.474)*
BANKFINANCEAGE	0.037 (7.197)			
DEALERAGE	-0.007 (-2.016)			
FLEETLEASEAGE	0.076 (10.687)			0.048 (1.902)*
N	15,645	1,071	1,071	1,071
R-Sq	0.858	0.841	0.845	0.847

Notes: t-statistics in parentheses. All coefficients are significant at the 5% level except for those indicated by '*':

A random sampling of over 1,000 Ford vehicles was collected to test the effects of ownership within the models. Ownership is a continuous variable that is defined as the number of times the vehicle changed ownership. Within the random sample, the minimum number was 1 owner and the maximum number of owners was 6. The average over the entire sample is 1.5 owners and the standard deviation is 0.75.

The number of owners (NOWNERS) as an independent variable kept the R^2 around 0.85 from the unrestricted Ford regression. But, the inclusion of NOWNERS produces some noticeable effects from the SELLER variables. There are virtually no statistically significant effects from dealers or Bank/Finance sellers but there is a statistically significant effect from Fleet/Lease sellers. Also, in the model without an ownership variable, the depreciation effects from age and Fleet/Lease were higher. All Ford models have both favorable F-statistics and t-statistics.

It is fairly clear that the information that is gleaned from auction buyers about who is selling the vehicle is important to them. Although the ability to test drive the vehicles before they hit the auction block has improved the symmetry of information, there still remains uncertainty about the vehicle. Perhaps the Lemon problem is smaller than it was before buyers could “kick the tires” before they had to make a decision to purchase. Nevertheless, the risk of significant asymmetry of information has buyers looking for quality signals from previous ownership data.

As illustrated in earlier chapters, many believe that there will be a winner’s curse and adverse selection in the market with asymmetric information. A possible solution to the challenges of the lemon problem and adverse selection is for the seller to emit a signal of quality. One signal of quality is that of prior ownership.

In order to test the significance of ownership as a proxy for quality, a model was run with the entire set of Fords, then a second model was run on the random sample of Fords without

ownership data; finally, a third model was created which included the ownership variable. Running and retrieving the F statistic for the restricted model and the unrestricted model allowed the null hypothesis to be rejected.

Testing for adverse selection is equivalent to a null hypothesis that the estimated coefficients for the ownership variables are equal to zero and hence, there is no sign of adverse selection. The alternative hypothesis is that the coefficients differ significantly from zero and that there is evidence for adverse selection. The p -value of the likelihood ratio statistic is 0.10, which allows for the null hypothesis of no adverse selection to be rejected.⁵⁴ An F-test for the hypothesis that all coefficients are zero is rejected at the one percent level for most models. As auctions continue to provide arbitration and consignors continue to permit inspections, we expect that the lemon problem will be contained, but not obliterated.

⁵⁴ The likelihood ratio statistic is twice the difference in the log-likelihood function evaluated under the null hypothesis and the alternative hypothesis.

CHAPTER FIVE

CONCLUDING OBSERVATIONS

The auction environment is a paradise for observing and testing the lemon hypothesis. This paper analyzed the effects of multiple-ownership on the winning bid and tested the hypothesis that a single-owner vehicle will command a premium over a multiple-owner vehicle; moreover, this premium increases with age. In the end, this model suggests that the premium on a new car is for more than just that quintessential smell. It is for the comfort of being confident that no previous owner has mistreated the vehicle. However, we expect that as asymmetric information dissipates between buyer and seller, the premium will diminish.

Given the structure of the auction environment, there still are many intriguing areas for further research. Many topics within Industrial Organization could be tested within this environment, such as vertical integration between transport companies and the auction house, compensation structures for auctioneers, optimal time and position in the auction line-up, and search models for the retail dealer. As auctions disseminate more and more information and sellers dissipate risks of adverse selection, the wholesale auction environment will become even closer to the perfect competition model. Asymmetric information between buyer and seller still remains, but the relative ease for minimizing the risk of purchasing the “lemon” is done away by the very real possibility of purchasing the “peach.”

APPENDICES

Appendix A

Individual Regression Results for Individual Makes

Variable	Acura	Audi	BMW	Buick	Cadillac	Chevy	Chrysler	Daewoo
INTERCEPT	10.547 (232.185)	10.724 (182.477)	10.757 (241.614)	9.76 (190.044)	10.567 (154.007)	9.602 (558.715)	10.31 (260.599)	9.728 (24.488)
AGE	-0.097 (-6.876)	-0.16 (-8.375)	-0.145 (-10.878)	-0.135 (-10.492)	-0.201 (-14.975)	-0.164 (-38.843)	-0.235 (-19.8)	-0.322 (-2.926)
MILES1K	-0.012 (-11.858)	-0.008 (-6.11)	-0.006 (-5.457)	-0.011 (-9.907)	-0.013 (-10.769)	-0.007 (-27.378)	-0.008 (-9.562)	-0.013 (-3.243)
CYL4	-0.419 (-14.864)	-0.245 (-13.564)	-0.256 (-6.724)	-0.781 (-8.639)	0 (0)	-0.467 (-37.265)	-0.317 (-10.479)	-0.337 (-1.347)
CYL8		0.344 (11.902)	0.338 (19.144)	0.381 (4.284)	0.391 (8.769)	0.59 (57.652)	0.529 (2.508)	
CYL10			0.419 (3.888)					
WHEEL4	0.114 (1.973)*		0.104 (4.298)	0.135 (0.537)	0.084 (0.782)	0.108 (9.534)		
CONV	1.297 (4.674)	0.235 (6.07)	0.158 (7.415)			0.544 (19.491)	0.115 (4.036)	
COUPENC	0.015 (0.559)*	0.305 (7.815)	-0.004 (-0.15)	0.202 (3.246)	0.089 (1.991)	0.24 (15.702)	-0.022 (-0.621)	-0.385 (-1.685)
WAGON		0.05 (2.072)	-0.13 (-2.346)	-0.122 (-0.832)		-0.189 (-2.414)		0.12 (0.47)
VAN						0.231 (14.876)	0.246 (10.391)	
PICKUP4D						0.265 (10.954)		
PICKUPEXT						0.407 (26.164)		
PICKUPREG						0.207 (12.428)		
SUV2D						0.213 (7.897)		
SUV4D				0.3 (1.831)	0.273 (2.619)	0.451 (30.478)		
DIESELENG						0.213 (3.362)		
GM								
NONGM								
BANKFINANCE	-0.101 (-1.236)*	-0.155 (-2.206)	0.061 (-1.123)	0.154 (-1.324)	-0.308 (-3.17)	-0.049 (-1.677)	-0.196 (-2.186)	0.2 (-0.303)
DEALER	0.063 (-1.123)*	0.142 (-2.206)	-0.02 (-0.434)	0.223 (-3.267)	-0.15 (-2.195)	-0.094 (-4.662)	-0.052 (-1.068)	1.039 (-1.886)
FLEETLEASE	-0.041 (-0.212)*	0.62 (0.426)	0.065 (0.16)	0.047 (0.459)	-0.348 (-2.176)	-0.101 (-2.792)	-0.34 (-3.791)	-0.52 (-0.515)
BANKFINANCEMILES	0.005 (3.729)		0.001 (0.724)	0.001 (0.24)	0.004 (2.117)	-0.001 (-2.1)	-0.002 (-1.321)	0.01 (1.005)
DEALERMILES	0.005 (3.886)	0.001 (0.785)	0.001 (0.679)	0.002 (1.439)	0.003 (2.601)	-0.001 (-3.453)	-0.001 (-0.579)	0.009 (1.234)
FLEETLEASEMILES	0.012 (1.615)*	-0.023 (-0.584)	-0.005 (-0.961)		-0.001 (-0.206)	-0.005 (-6.807)	-0.003 (-1.321)	-0.027 (-1.282)
BANKFINANCEAGE	-0.014 (-0.598)*	0.039 (1.69)	-0.021 (-1.203)	0.007 (0.193)	0.048 (2.052)	0.041 (4.804)	0.08 (2.933)	-0.121 (-0.53)
DEALERAGE	-0.041 (-2.537)	-0.035 (-1.731)	-0.011 (-0.781)	-0.014 (-0.98)	0.028 (1.986)	0.056 (12.057)	0.038 (2.866)	-0.338 (-1.872)
FLEETLEASEAGE	-0.111 (-0.948)*	0.088 (0.325)	0.044 (0.666)	0.013 (0.221)	0.096 (1.980)	0.112 (12.524)	0.106 (3.862)	0.341 (0.994)
N	736	519	1,138	948	828	8,274	1,410	119
R-Sq	0.881	0.918	0.898	0.815	0.895	0.825	0.834	0.513

Variable	Dodge	Geo	GMC	Honda	Hyundai	Infinity	Isuzu	Jaguar
INTERCEPT	9.664 (625.308)	9.374 (50.675)	10.144 (258.469)	10.395 (307.067)	9.965 (188.851)	10.55 (236.344)	9.071 (74.51)	10.632 (389.908)
AGE	-0.18 (-36.4)	-0.1 (-3.604)	-0.193 (-24.577)	-0.17 (-20.339)	-0.218 (-7.505)	-0.174 (-13.501)	-0.161 (-9.316)	-0.116 (-14.015)
MILES1K	-0.008 (-25.17)	-0.013 (-6.568)	-0.005 (-10.975)	-0.007 (-14.304)	-0.013 (-7.008)	-0.008 (-9.642)	-0.008 (-7.303)	-0.008 (-11.033)
CYL4	-0.35 (-28.922)	-0.151 (-0.873)	-0.327 (-8.684)	-0.223 (-11.33)	-0.392 (-10.878)	-0.266 (-6.294)	-0.299 (-6.734)	
CYL8	0.252 (15.798)		0.532 (29.957)			0.304 (10.285)	0.257 (0.818)	0.154 (10.089)
CYL10	0.46 (8.107)							0.189 (2.987)
WHEEL4	0.232 (17.28)	0.098 (1.61)	0.156 (8.889)	0.213 (4.86)	-0.03 (-0.247)	0.153 (2.386)	0.052 (1.602)	
CONV	1.446 (11.378)			0.561 (7.729)				0.415 (17.126)
COUPENC	0.053 (1.925)	-0.477 (-6.898)		-0.017 (-1.102)	-0.199 (-4.365)			0.241 (2.986)
WAGON				0.19 (1.993)	0.038 (0.223)			
VAN	0.309 (23.55)		-0.256 (-8.396)	0.266 (6.59)				
PICKUP4D	0.45 (20.591)		-0.16 (-3.082)					
PICKUPEXT	0.493 (24.657)		-0.128 (-6.585)				0.465 (2.632)	
PICKUPREG	0.303 (15.136)		-0.241 (-9.153)				0.462 (3.731)	
SUV2D		0.086 (1.24)	-0.321 (-7.156)				0.743 (5.982)	
SUV4D	0.419 (18.258)	0.404 (6.933)		-0.049 (-1.237)	0.416 (5.729)	0.045 (0.72)	0.905 (8.176)	
DIESELENG	0.657 (21.53)		0.253 (3.049)					
GM								
NONGM								
BANKFINANCE	0.018 (-0.586)	0.058 (-0.413)	-0.146 (-2.28)	-0.139 (-2.213)	-0.141 (-0.916)	0.107 (0.574)	0.029 (-0.156)	-0.098 (-1.233)
DEALER	-0.003 (-0.128)	-0.005 (-0.046)	-0.123 (-2.859)	-0.091 (-2.568)	0.004 (-0.053)	0.008 (-0.126)	-0.147 (-1.989)	0.113 (-3.529)
FLEETLEASE	-0.003 (-0.116)	0.164 (0.147)	-0.105 (-0.88)	-0.161 (-1.214)	0.152 (1.59)	-0.095 (-0.975)	-0.313 (-1.485)	0.004 (0.021)
BANKFINANCEMILES		0.003 (1.054)	-0.002 (-2.164)	0.001 (1.109)	0.001 (0.339)	0.001 (0.343)	0.004 (1.472)	0.001 (0.647)
DEALERMILES	0.001 (3.294)	0.007 (2.949)		0.003 (5.551)	0.003 (1.382)	-0.001 (-0.72)	0.002 (1.366)	-0.001 (-1.104)
FLEETLEASEMILES		0.001 (0.066)	-0.001 (-0.716)	0.002 (1.224)	0.002 (0.744)	0.001 (0.851)	-0.002 (-0.656)	-0.003 (-0.314)
BANKFINANCEAGE	0.006 (0.677)	-0.032 (-0.657)	0.064 (3.594)	0.034 (1.705)	0.011 (0.17)	-0.034 (-0.548)	-0.046 (-0.838)	0.015 (0.846)
DEALERAGE	0.002 (0.266)	-0.05 (-1.686)	0.039 (4.316)	-0.005 (-0.531)		0.019 (1.105)	0.028 (1.35)	-0.02 (-2.084)
FLEETLEASEAGE	0.018 (1.335)	-0.057 (-0.210)	0.053 (1.581)	0.012 (0.360)	-0.051 (-0.914)	0.007 (0.261)	0.108 (1.578)	0.022 (0.291)
N	6,018	426	1,489	2,320	766	456	492	605
R-Sq	0.860	0.834	0.874	0.864	0.823	0.916	0.840	0.921

Variable	Jeep	Kia	LandRover	Lexus	Lincoln	Mazda	Mercedes	Mercury
INTERCEPT	10.188 (349.288)	9.91 (155.266)	10.079 (36.78)	10.59 (372.115)	10.447 (226.166)	10.02 (278.217)	10.775 (293.245)	9.716 (411.954)
AGE	-0.147 (-17.713)	-0.233 (-8.787)	-0.097 (-3.186)	-0.137 (-16.909)	-0.227 (-19.807)	-0.156 (-13.786)	-0.095 (-14.927)	-0.17 (-17.048)
MILES1K	-0.008 (-15.679)	-0.017 (-11.01)	-0.008 (-3.229)	-0.006 (-10.183)	-0.006 (-9.319)	-0.011 (-13.655)	-0.009 (-12.641)	-0.01 (-15.698)
CYL4	-0.152 (-4.885)	-0.574 (-10.814)			-0.736 (-3.261)	-0.324 (-12.311)	-0.326 (-15.908)	-0.516 (-15.868)
CYL8	0.242 (15.652)		0.387 (9.514)	0.354 (24.872)	0.192 (6.024)		0.357 (23.824)	0.409 (24.364)
CYL10							0.605 (8.402)	
WHEEL4	0.045 (3.318)	0.129 (2.525)	-0.003 (-0.009)	0.075 (2.965)	0.027 (0.823)	0.185 (3.718)	-0.14 (-7.612)	0.013 (0.307)
CONV		-0.053 (-0.276)		0.2 (4.345)	0 (0)	0.625 (12.514)	0.316 (16.515)	0 (0)
COUPENC				0.091 (2.018)	-0.086 (-1.788)	-0.016 (-0.261)	0.111 (4.466)	0.257 (11.837)
WAGON		0.186 (1.571)				-0.009 (-0.205)	0.113 (1.512)	0.096 (2.099)
VAN								0.465 (19.733)
PICKUP4D								
PICKUPEXT						0.312 (7.069)		
PICKUPREG						0.19 (3.872)		
SUV2D	0.112 (5.42)	0.402 (3.347)				0.222 (1.568)		
SUV4D		0.583 (13.219)		0.112 (4.445)	0.471 (16.53)	0.34 (5.256)		0.406 (9.953)
DIESELENG							0.007 (0.103)	
GM								
NONGM								
BANKFINANCE	-0.032 (-0.633)	-0.328 (-2.398)	0.316 (-2.727)	-0.029 (-0.552)	-0.098 (-1.624)	-0.075 (-0.827)	0.015 (-0.312)	0.064 (-1.612)
DEALER	-0.034 (-0.959)	-0.282 (-3.219)	0.03 (-0.574)	-0.003 (-0.107)	-0.112 (-2.245)	-0.13 (-2.994)	-0.032 (-0.807)	0.111 (-2.961)
FLEETLEASE	0.13 (1.732)	-0.278 (-1.879)	0.517 (1.473)	0.14 (0.821)	-0.05 (-0.658)	-0.171 (-2.406)	0.223 (1.087)	-0.033 (-0.804)
BANKFINANCEMILES	0.001 (0.859)	0.005 (1.916)		0.001 (1.219)	-0.002 (-2.176)	0.001 (0.747)	0.004 (4.568)	0.001 (1.028)
DEALERMILES	0.002 (2.935)	0.007 (3.398)	0.005 (1.786)	0.001 (1.077)	-0.003 (-4.418)	0.005 (4.747)	0.001 (0.7)	0.004 (5.15)
FLEETLEASEMILES	-0.003 (-1.445)	0.004 (0.746)			-0.01 (-4.301)	0.005 (1.638)	-0.004 (-1.524)	0.004 (2.703)
BANKFINANCEAGE	0.013 (0.874)	0.056 (1.121)	-0.059 (-1.488)	-0.008 (-0.532)	0.056 (2.783)	0.006 (0.178)	-0.038 (-3.883)	-0.004 (-0.247)
DEALERAGE	-0.004 (-0.39)	0.038 (1.104)	-0.072 (-2.174)	-0.005 (-0.493)	0.073 (5.936)	-0.006 (-0.439)	0.003 (0.421)	-0.04 (-3.635)
FLEETLEASEAGE	-0.011 (-0.431)	0.050 (0.692)		-0.033 (-0.674)	0.089 (2.676)	0.006 (0.142)	-0.022 (-0.534)	-0.048 (-2.393)
N	2,364	623	415	992	1,547	1,410	1,533	2,084
R-Sq	0.831	0.779	0.772	0.907	0.853	0.838	0.872	0.885

Variable	Mitsub	Nissan	Oldsmobile	Pontiac	Porsche	Saab	Saturn	Subaru
INTERCEPT	9.905 (309.679)	10.201 (508.73)	9.808 (123.212)	9.884 (324.938)	10.936 (121.431)	10.719 (177.546)	10.005 (151.662)	10.177 (111.046)
AGE	-0.155 (-11.668)	-0.159 (-23.518)	-0.107 (-6.307)	-0.149 (-16.844)	-0.052 (-2.23)	-0.232 (-19.682)	-0.222 (-11.274)	-0.111 (-6.122)
MILES1K	-0.008 (-8.385)	-0.007 (-14.858)	-0.015 (-9.642)	-0.011 (-17.718)	-0.009 (-4.024)	-0.008 (-8.409)	-0.009 (-7.708)	-0.009 (-6.823)
CYL4	-0.484 (-21.615)	-0.478 (-33.094)	-0.189 (-4.078)	-0.418 (-25.012)	-0.673 (-6.015)	-0.094 (-2.179)	-0.379 (-9.62)	-0.245 (-2.826)
CYL8			0.317 (3.314)	0.396 (8.285)	-0.885 (-3.62)			
CYL10								
WHEEL4	0.038 (1.166)	0.079 (3.286)	0.046 (0.136)				0.118 (0.341)	0.208 (6.876)
CONV	0.613 (12.054)	0.657 (7.144)	0.377 (0.999)	0.367 (8.275)		0.272 (10.665)		
COUPENC	0.142 (6.686)	0.022 (0.639)	0.054 (0.976)	0.057 (3.193)		0.032 (0.473)	0.212 (7.586)	
WAGON	0.147 (0.571)			0.133 (0.62)		0.176 (3.38)	0.194 (3.997)	
VAN		-0.01 (-0.374)	0.382 (4.12)	0.19 (7.133)				
PICKUP4D		-0.019 (-0.495)						
PICKUPEXT		0.155 (5.109)						
PICKUPREG	0.193 (1.168)	0.041 (0.978)						
SUV2D		0.087 (0.465)						
SUV4D	0.214 (6.666)	0.127 (5.429)	0.559 (1.67)	0.021 (0.295)			0.099 (0.308)	-0.069 (-2.326)
DIESELENG								
GM								
NONGM								
BANKFINANCE	-0.103 (-0.932)	0.008 (-0.102)	0.018 (-0.111)	0.09 (-1.526)	-0.765 (-2.635)	0.026 (-0.009)	0.01 (-0.103)	0.145 (-0.894)
DEALER	0.101 (-2.501)	-0.002 (-0.057)	0.053 (-0.548)	0.163 (-4.254)	0.032 (-0.313)	-0.24 (-2.494)	-0.207 (-2.962)	0.572 (-9.372)
FLEETLEASE	-0.1 (-2.539)	-0.081 (-2.223)	0.227 (1.686)	0.086 (1.339)	-0.346 (-0.399)	-11.137 (-1.139)	-0.092 (-0.473)	-0.228 (-0.918)
BANKFINANCEMILES	-0.001 (-0.39)	-0.002 (-1.329)	0.005 (1.963)	0.001 (0.695)	0.009 (1.624)	0.003 (0.04)	-0.002 (-1.36)	0.002 (0.037)
DEALERMILES	0.002 (1.501)	0.001 (0.981)	0.004 (2.493)	0.002 (3.328)	-0.003 (-1.201)	-0.002 (-1.372)	0.002 (-0.365)	0.001 (0.81)
FLEETLEASEMILES	0.005 (3.289)	-0.002 (-2.618)	0.005 (1.125)	-0.002 (-1.091)	0.037 (1.599)	0.254 (1.128)	0.002 (0.572)	0.001 (0.003)
BANKFINANCEAGE	0.047 (1.164)	0.02 (0.877)	-0.049 (-1.221)	0.008 (0.465)	0.09 (1.461)		0.041 (1.215)	-0.012 (-0.249)
DEALERAGE	-0.011 (-0.695)	0.005 (0.606)	-0.034 (-1.8)	-0.03 (-2.903)	0.033 (1.351)	0.078 (3.855)	0.083 (3.812)	-0.132 (-6.162)
FLEETLEASEAGE	-0.039 (-1.616)	0.060 (4.159)	-0.163 (-2.634)	0.007 (0.281)	-0.209 (-1.437)		0.012 (0.203)	0.079 (0.658)
N	2,057	2,896	362	2,573	241	381	906	575
R-Sq	0.793	0.868	0.845	0.819	0.675	0.862	0.831	0.878

Variable	Suzuki	Toyota	Volkswgn	Volvo
INTERCEPT	9.388 (222.404)	10.229 (480.52)	10.647 (171.245)	10.593 (426.991)
AGE	-0.156 (-9.982)	-0.161 (-27.343)	-0.224 (-12.937)	-0.184 (-18.895)
MILES1K	-0.01 (-9.519)	-0.005 (-14.187)	-0.009 (-7.016)	-0.007 (-10.08)
CYL4	-0.081 (-1.977)	-0.398 (-26.887)	-0.22 (-10.11)	-0.276 (-12.934)
CYL8		0.202 (6.74)	0.239 (2.186)	
CYL10				
WHEEL4	0.044 (1.256)	0.196 (8.99)		0.136 (3.048)
CONV		0.474 (7.215)	0.238 (7.261)	0.557 (12.161)
COUPENC		-0.039 (-1.699)	-0.055 (-3.161)	0.473 (6.772)
WAGON	-0.169 (-1.609)	0.065 (0.753)	0.124 (2.723)	0.32 (13.124)
VAN		0.198 (7.159)	0.023 (0.285)	
PICKUP4D		0.02 (0.284)		
PICKUPEXT		0.107 (3.908)		
PICKUPREG		0.018 (0.538)		
SUV2D	-0.111 (-0.859)	0.211 (2.201)		
SUV4D	0.537 (9.783)	0.304 (14.062)		
DIESELENG			0.037 (0.525)	
GM				
NONGM				
BANKFINANCE	-0.247 (-2.361)	-0.236 (-3.611)	-0.5 (-7.131)	-0.028 (-0.268)
DEALER	-0.037 (-0.572)	0.009 (0.381)	-0.195 (-2.942)	0.099 (-2.225)
FLEETLEASE	0.247 (2.042)	-0.003 (-0.084)	-0.431 (-3.077)	-0.02 (-0.149)
BANKFINANCEMILES	-0.002 (-0.867)	-0.003 (-3.442)	0.002 (1.159)	-0.006 (-1.445)
DEALERMILES	0.003 (1.924)	0.002 (0.087)	0.003 (2.055)	-0.001 (-1.69)
FLEETLEASEMILES	0.002 (0.284)	0.001 (-0.065)	0.003 (0.69)	0.0001 (0.003)
BANKFINANCEAGE	0.093 (2.699)	0.093 (7.412)	0.105 (4.995)	0.048 (1.386)
DEALERAGE	-0.021 (-1.063)	0.006 (0.888)	0.008 (0.442)	0.017 (1.554)
FLEETLEASEAGE	-0.216 (-3.012)	0.012 (0.686)	0.069 (1.290)	0.027 (0.437)
N	396	3,739	1,232	712
R-Sq	0.902	0.845	0.835	0.936

Appendix B

Manheim Auctions' Worldwide Locations

Name	Location
166 Auto Auction	Springfield, MO
Albuquerque Auto Auction	Albuquerque, NM
Aloha Auto Auction	Honolulu, HI
American Auto Auction	North Dighton, MA
Arena Auto Auction	Bolingbrook, IL
Arizona Auto Auction	Phoenix, AZ
Atlanta Auto Auction	College Park, GA
Auction Way	Alsip, IL
Aycock Auto Auction	Kenly , NC
Baltimore-Washington Auto Exchange	Elkridge, MD
Bay Cities Auto Auction	Hayward, CA
Big H Auto Auction	Houston, TX
Bishop Brothers Auto Auction	Atlanta, GA
Butler Auto Auction	Cranberry Township, PA
California Auto Dealers Exchange	Anaheim, CA
Caribbean Auto Dealers Exchange	Bayamon, PR
Central Florida Auto Auction	Orlando, FL
Cincinnati Auto Auction	Hamilton, OH
Clantons Auto Auction	Darlington, SC
Colorado Auto Auction	Commerce City, CO
DRIVE	Stockbridge, GA
Dallas Auto Auction	Dallas, TX
Dallas Ft. Worth Auto Auction	Ft. Worth, TX
Daytona Auto Auction	Daytona Beach, FL
Dealers Auto Auction of Dallas	Grand Prairie, TX
Denver Auto Auction	Aurora, CO
Detroit Auto Auction	Carleton, MI
Florida Auto Auction of Orlando	Ocoee, FL
Fort Wayne Vehicle Auction	Fort Wayne, IN
Fort Worth Vehicle Auction	Ft. Worth, TX
Fowles Auction Group	Melbourne, AU
Fredericksburg Auto Auction	Fredericksburg, VA

Name	Location
Fresno Auto Dealers Auction	Fresno, CA
Gateway Auto Auction	Granite City, IL
Georgia Dealers Auto Auction	Atlanta, GA
Greater Auto Auction of Phoenix	Tolleson, AZ
Greater Chicago Auto Auction	Matteson, IL
Greater Las Vegas Auto Auction	Las Vegas, NV
Greater Nevada Auto Auction	Las Vegas, NV
Greater New Orleans Auto Auction	Slidell, LA
Greater Tampa Bay Auto Auction	Tampa, FL
Harrisonburg Auto Auction	Harrisonburg, VA
Hatfield Auto Auction	Hatfield, PA
Imperial Auto Auction	Lakeland, FL
Kansas City Auto Auction	Kansas City, MO
Keystone Auto Auction	Grantville, PA
LA Dealer Auto Auction	Rosemead, CA
Lafayette Auto Auction	Scott, LA
Lakeland Auto Auction	Lakeland, FL
Lauderdale-Miami Auto Auction	Davie, FL
Louisville Auto Auction	Clarksville, IN
Manheim Auto Auction	Manheim, PA
Manheim's El Paso Auto Auction	El Paso, TX
Manheim France	Bordeaux, FR
Manheim United Kingdom	Leeds, UK
Manheim's Michigan Auto Auction	Mt. Morris, MI
Metro Detroit Auto Auction	Flat Rock, MI
Metro Milwaukee Auto Auction	Caledonia, WI
Mid-America Auto Auction	Louisville , KY
Minneapolis Auto Auction	Maple Grove, MN
Mississippi Auto Auction	Hattiesburg, MS
Nashville Auto Auction	Mt. Juliet, TN
National Auto Dealers Exchange	Bordentown, NJ
Newburgh Auto Auction	Newburgh, NY
Northstar Auto Auction	Shakopee, MN
Northway Exchange Auto Auction	Clifton Park, NY
Ohio Auto Auction	Grove City, OH

Appendix B (Continued)

<u>Name</u>	<u>Location</u>
Omaha Auto Auction	Omaha , NE
Orlando Orange Co Auto Auction	Orlando, FL
Oshawa Dealers Exchange	Courtice, ON
Pensacola Auto Auction	Pensacola, FL
Portland Auto Auction	Portland, OR
Remarketing Solutions	Nashville, TN
Riverside Auto Auction	Riverside, CA
San Antonio Auto Auction	San Antonio, TX
San Diego Auto Auction	Oceanside, CA
Skyline Auto Exchange	Fairfield, NJ
Skyline Port Newark Facility	Linden, NJ
South Seattle Auto Auction	Kent, WA
Southern California Auto Auction	Fontana, CA
St. Louis Auto Auction	Bridgeton, MO
St. Pete Auto Auction	Clearwater, FL
Statesville Auto Auction	Statesville, NC
Tennessee Auto Auction	Nashville, TN
Texas Hobby Auto Auction	Houston, TX
Toronto Auto Auctions	Milton, ON
Tucson Auto Auction	Tucson, AZ
Utah Auto Auction	West Bountiful, UT
West Palm Beach Auto Auction	West Palm Beach, FL

Source: Manheim Used Car Market Report, 2004.

Appendix C

Sample Auction Schedule

Lane	Start Time	Assignment
3	10:00 AM	Fleet/Lease
4	10:00 AM	Fleet/Lease
5	10:00 AM	Independent Dealer Express
6	10:00 AM	Independent Dealer Express
7	10:15 AM	1999 and Older Domestic and Imports
8	10:15 AM	2000 and Newer Domestic
9	10:30 AM	2000 and Newer Imports
10	10:30 AM	Franchised Dealer Consignment
11	10:30 AM	Franchised Dealer Consignment
12	10:30 AM	Franchised Dealer Consignment
13	10:00 AM	Fleet/Lease
14	9:30 AM	Fleet/Lease
15	10:00 AM	Rental Accounts
16	10:00 AM	Fleet/Lease

Source: Manheim Auto Auction, Inc

Appendix D

Sale Day Arbitratable Items

Item	SALE DAY ARBITRADABLE ITEMS
	“The following guarantees by the Seller apply for the day of sale only, unless announced differently at the time of sale.”
1	“Any single defect of a non-wearable item that has a wholesale repair cost of \$500 or more is arbitratable. Single defects of less than \$500 are deemed minor and not arbitratable.”
2	“Air Conditioning - Compressor engagement is guaranteed.”
3	“Engine Computers are guaranteed.”
4	“No major or excessive paint and body work on current calendar year vehicles and newer. Major or excessive paint and bodywork is defined as three or more panels. Bumpers are not included.”
5	“Supplemental restraint systems (SRS) are present on all vehicles manufactured with such ms. SRS warning lights, which are on or inoperative, must be announced.”
6	All OEM or equivalent emission control equipment is present.
7	“Vehicles are sold subject to any and all visible defects - including, but not limited to - body or hail damage, cracked windshields, etc.”
8	“Replacement VINS must be announced.”
9	“Vehicles 7 model years and newer without air conditioning must be announced.”

Source: Manheim Auto Auction, Inc.

Appendix E

Seven Day Arbitradable Items

Item	SEVEN DAY ARBITRADABLE ITEMS
	“All consigned vehicles must disclose if any of the following apply or if the vehicles have any of the following defects, conditions or discrepancies that were not disclosed or announced at the time of the sale, regardless of "Light" conditions or guarantee offered, must be reported to the Auction within 7 days after the vehicle was sold at the Auction, in order to be eligible for arbitration. Vehicles must be returned to the Auction in the same or better condition than when purchased. Expense reimbursements will be at the sole discretion of the auction and will, at times, be limited to reasonable and documented expenses and transportation only. Lost profit, commissions, floor-plan expenses, etc. will not be reimbursed. Sale day is Day 1.”
1	“Frame/ Unibody Damage - Defined by the Auction with reference to the NAAA standards.”
	“Minor components welded or removed from frame (trailer hitches, bumpers, etc.) are not considered frame damage unless they have compromised the structural integrity of the vehicle.”
	“Lowered/ Raised vehicles must be announced and are subject to frame damage guarantees if frame is altered.”
	“Minor dents in frame/ structure that do not affect the structural integrity of the frame will not be considered frame damage.”
2	“Flood and Fire Damage - Defined by the Auction with reference to the NAAA standards.”
3	“Fuel/ Engine Conversions and replacements- five year old vehicles and newer.”
4	“Former taxis, government or municipal vehicles (open to the public)”
5	“Title and odometer discrepancies including: Not actual miles (TMU), broken odometers, Salvage titles, Previous Salvage, Titles, Theft Recoveries, and Flood/ Fire vehicles.”

Source: Manheim Auto Auction, Inc.

Appendix F

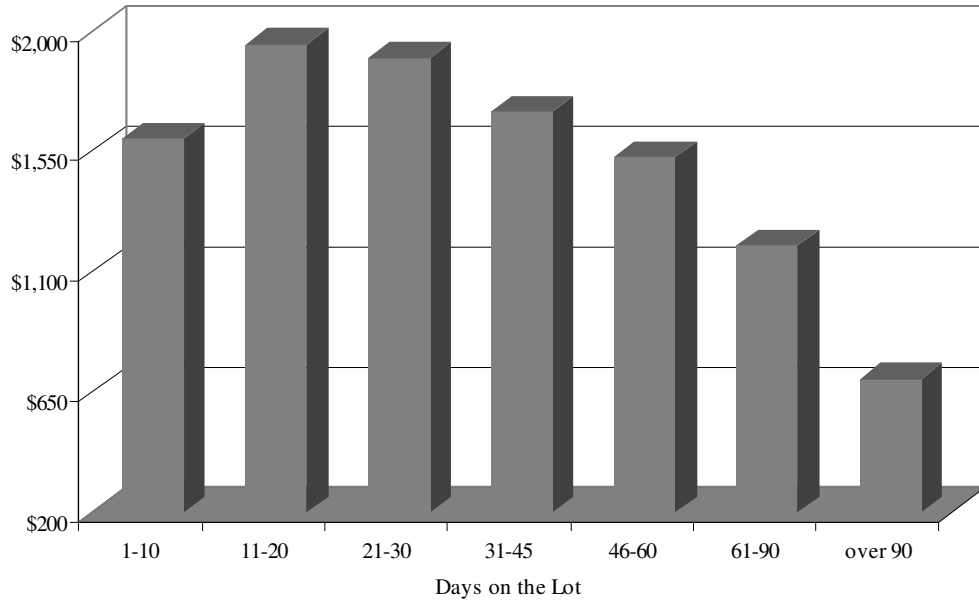
“As-Is” Vehicles

Item	AS IS VEHICLES - SOLD UNDER RED LIGHT
	“Vehicles that meet any one of the following conditions are sold "AS-IS" and are NOT subject to arbitration for ANY reason, except frame/unibody, title or odometer discrepancies unless specifically guaranteed by the Seller.”
1	“Any vehicle announced "As-Is".”
2	“Any vehicle sold for \$3500.00 or less.”
3	“All vehicles with more than 100,000 miles.”
4	“Vehicles 10 years old or older.”
5	“Recreational vehicles, boats, buses, motorcycles, dune buggies, trailers, snowmobiles, jet skis, antiques, and kit cars.”
6	“Push or tow through units.”
7	“All taxis, government and municipal vehicles.”
8	“Salvage/ Previous Salvage units.”
9	“TMU/ Not actual mileage units.”
10	“Theft recoveries.”
11	“Flood/ Fire units.”
12	“Donated charity vehicles.”

Source: Manheim Auto Auction, Inc.

Appendix G

Days on Retail Dealer Lot vs. Gross Profit



Source: National Auto Dealers Association.

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