Sales and Revenue Forecasts of Fishing and Hunting Licenses in Minnesota

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EXECUTIVE SUMMARY

Sales and Revenue Forecasts for Selected Fishing and Hunting Licenses and Tags in Minnesota

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<u>Objective</u>

This report uses historical data from the sales of fishing and hunting licenses from 1975 through 2009 to estimate license sales revenue for the Minnesota Department of Natural Resources (MDNR). The analysis estimates the potential change in license revenues and units sold over a range of license prices.

<u>NOTE</u>: The analysis is not intended to provide exact estimates of sales and revenues that will be received after future price changes. Instead, the results are best used to estimate the *relative* change in revenues. For example, the models are best used to see which licenses are better able to withstand price changes and which ones may generate losses if prices are raised.

<u>Procedures</u>

License sales were examined for eight resident hunting and fishing licenses and five non-resident fishing licenses and the Trout Stamp using estimated equations where the annual number of each license type sold is a function of the license price and other relevant variables. Reliable demand models could not be constructed for the Resident Dark House Shelter license, the Trout Stamp, or the Resident Small Game license. No statistical correlation between price and sales of these licenses could be found. Rather, sales of these licenses are apparently driven by factors that we were not able to control for in our regression analysis. However, reliable demand equations were estimated for eleven license types.

These equations were then used to predict license sales in 2010 at various price levels. License sales are predicted for 2010 with the assumption that the non-price factors included in the models (e.g., population, per capita income, etc.) continue to grow at historical rates. The predicted sales were multiplied by the respective license prices to predict annual revenues. Four license price scenarios are selected: no price change, total revenue maximizing, total direct license sales maximizing and one dollar increase in current price.

<u>Conclusions</u>

The demand models indicate that MDNR could collect more revenue by raising the price of the following licenses:

- Resident/Non-Resident 24-hour Angling
- Resident Individual Angling
- Resident Deer Firearm
- Resident Deer Archery

An additional four licenses are not able to withstand a price increase if the effect on federal aid is considered but are from the standpoint of increasing direct license revenue:

- Resident Combination (Husband/Wife) Angling
- Non-Resident 72-hour Angling
- Resident Individual Sports
- Resident Combination (Husband/Wife) Sports

However, the following licenses are not able to withstand a price increase from the standpoint of increasing either direct license revenue or total revenue including federal aid:

- Non-Resident Individual Angling
- Non-Resident Family Angling
- Non-Resident Seven-Day Angling

The estimates of licenses sold and revenue generated presented for each of these licenses are developed individually and assume that all other factors other than the price of license in question do not change. To fully estimate the effects of price increases on Federal Aid in Wildlife and Sport Fish Restoration funds, the effects on the numbers of hunters and anglers from all proposed license price changes should be considered.

CONTENTS

INTRODUCTION

The purpose of this report is to use historical sales data (1975 through 2009) for selected Minnesota hunting and fishing licenses to forecast changes in 2010 license revenues and unit sales based on a range of possible prices.

The forecasts are based on models often referred to as 'estimated demand equations.' [1] The models, or demand equations, express the quantity of an item sold (numbers of each specific license type) as a function of its cost (license price) and other variables that help to explain yearly variations in license sales. License prices are the key prediction variables that are under the control of policy makers in Minnesota. The effects of changes in license price on the number of licenses sold can then be used to determine whether the MDNR's revenues will increase or decrease in response to price increases. Separate models have been produced for each license type.

The accuracy of the equations to predict license sales and revenues is evaluated by comparing the predictions produced by the demand equation models to the MDNR's actual sales for the years in the study period. Subsequently, revenue predictions are reported for 2010 at various pricing levels.

MODELING THE DEMAND FOR FISHING AND HUNTING LICENSES

Estimated demand equations portray the statistical relationship between the quantity of licenses sold, the price of a license, and the other variables that may influence license sales. License prices are the key prediction variable that is under the control of policy makers in the state of Minnesota. The estimated equations are then used to predict license sales for each license type in 2010 at different price levels. License sales are predicted for 2010 with the assumption that the non-price factors included in the models (e.g., population, per capita income, etc.) continue to grow at historical rates. The predicted sales are multiplied by the respective license prices to predict annual revenues by license type.

Other variables investigated in the analysis include population, per capita income, and unemployment rates. These represent socioeconomic factors that are not under the direct control of MDNR, but may affect the number of licenses sold each year. The price of gasoline is included to account for year-to-year changes in travel costs that might affect sales of licenses. Precipitation and temperature data were investigated during the analysis to examine the influence of weather conditions on license sales, with the assumption that poor weather conditions may reduce the number of licenses sold.

Where appropriate, the price of a license that may serve as a substitute for the target license is included in the demand equations. For example, non-resident anglers have the option

[1] We only provide a general discussion of the demand equations here; for more detail see the attached appendices.

to purchase an annual license or a short-term license or to purchase a license in another state instead.

Finally, all dollar values in the models are adjusted for inflation and converted to real dollars. Adjusting prices for inflation results in the real price of fishing licenses changing every year while the nominal price only changes in years when license prices actually increase. The real price of a license declines in each year subsequent to a price increase due to inflation except in 2009 when deflation had the opposite effect.

Sales Prediction Comparisons

As an indication of the accuracy of the demand-equation predictions of license sales and revenues, the equations' predicted values during the study period were compared with the MDNR's actual sales. The equation predictions are based on all variables being set equal to their actual values for each year predicted. A close fit of the predicted values to the actual values is an indication of the model's ability to predict future license sales based on the included variables.

Revenue Predictions

The models predict revenues that can be expected from various fee levels assuming constant trends in the explanatory variables. Given that the variables used in the models constantly shift, such as gas price fluctuations, the models will not necessarily predict precise numbers of license sales in the future. The models are properly used when the potential revenues from different fee levels are compared to each other to see which ones produce more or less revenue, and which ones retain more or less sportsmen. For the same reason, the results should be used with caution to project future revenues. Instead, they should be used to compare the relative differences in revenue projection at varying price levels.

The revenue estimates include monies received by state government based on the price of the license (net of any agent fees), plus projected revenues from federal aid programs (Pitman-Robertson Wildlife Restoration and Dingell-Johnson Sport Fish Restoration financial assistance programs). Estimates of federal aid dollars per licensed hunter or angler in 2010 were provided by the US Fish and Wildlife Service.

MODEL RESULTS

Demand models were estimated for 11 resident and non-resident fishing and hunting licenses use regression analysis. The results of these regressions indicate that four of these eleven licenses are able to withstand at least a minimal price increase from the standpoint of increasing total revenue and direct license revenue. In an additional four licenses, a price increase would result in more direct sales revenue but would decrease total revenue once the loss in federal aid is factored in. Three of the non-resident licenses cannot withstand any price increase at all without a loss in revenue.

In this section, the summary results of each license model are presented including graphs that compare model fit to actual historical data, and the estimated effects of price changes on licenses sold, direct license sales revenue, and total revenue including federal aid. In this second graphic, the effect of price on the number of licenses sold (the demand curve) is represented by the downward sloping, blue line. Both total and direct license revenue generated by sales at each price is represented by an upward sloping or arced line. Theoretically, the price that would generate the maximum amount of revenue occurs at the top of this arc. However, in cases where this would require a price change larger than any in the past, this assumption may not be reliable. Lastly, estimated sales and revenues for four specific pricing scenarios are discussed. Details of each model and estimated parameter coefficients are presented in an appendix.

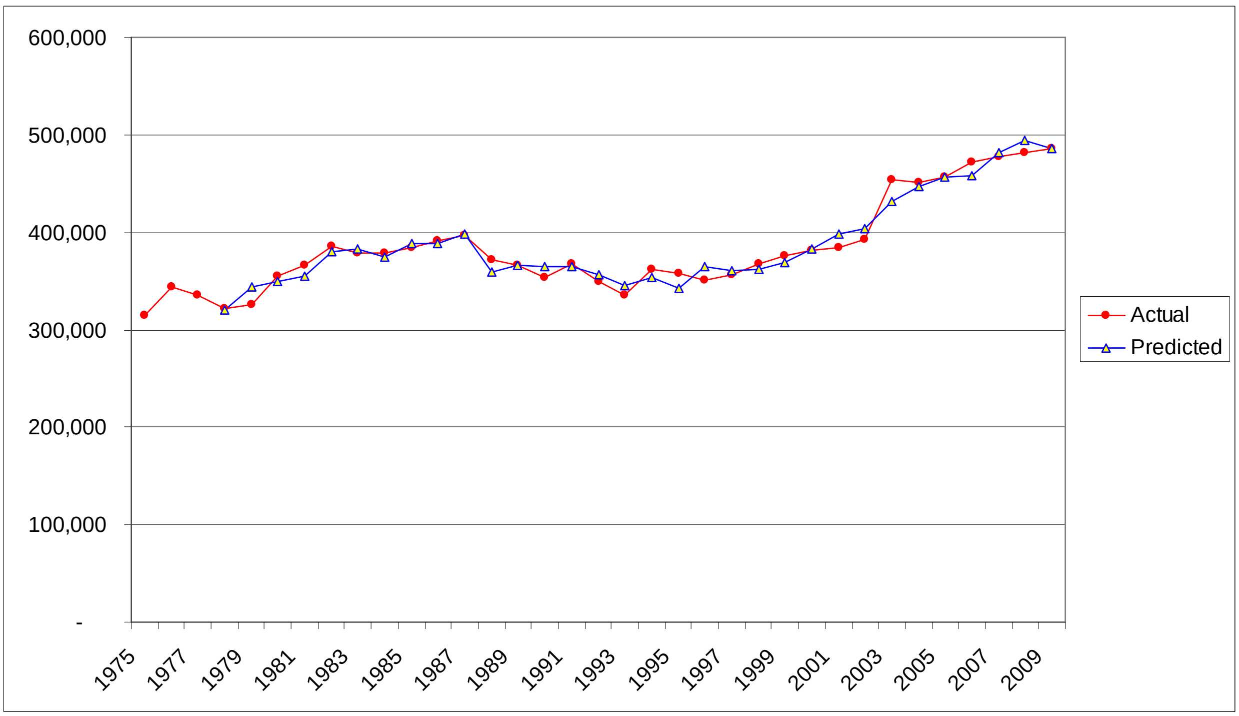
Reliable demand models could not be constructed for the Resident Dark House Shelter license, the Trout Stamp, or the Resident Small Game license. No statistical correlation between price and sales of these licenses could be found. Rather, sales of these licenses are apparently driven by factors that we were not able to control for in our regression analysis.

Resident Licenses

Resident Individual Angling Licenses

Since 1993 sales of Resident Individual Angling Licenses have generally been on an upward trend. There were 35 years of sales data for this license type, however, all the variables used in the regression analysis were only available for 32 of them. The license sales predicted by the demand model show a good fit to actual sales (Figure 1), with the greatest deviation (5.5 percent) occurring in 1979 when actual sales remained relatively stagnant despite conditions that were suggestive of potentially higher sales. The R-squared value for the model is 0.96 indicating that the independent variables used in the model account for 96 percent in the variation in licenses sold (see Table A1 in Appendix A for full statistical details).

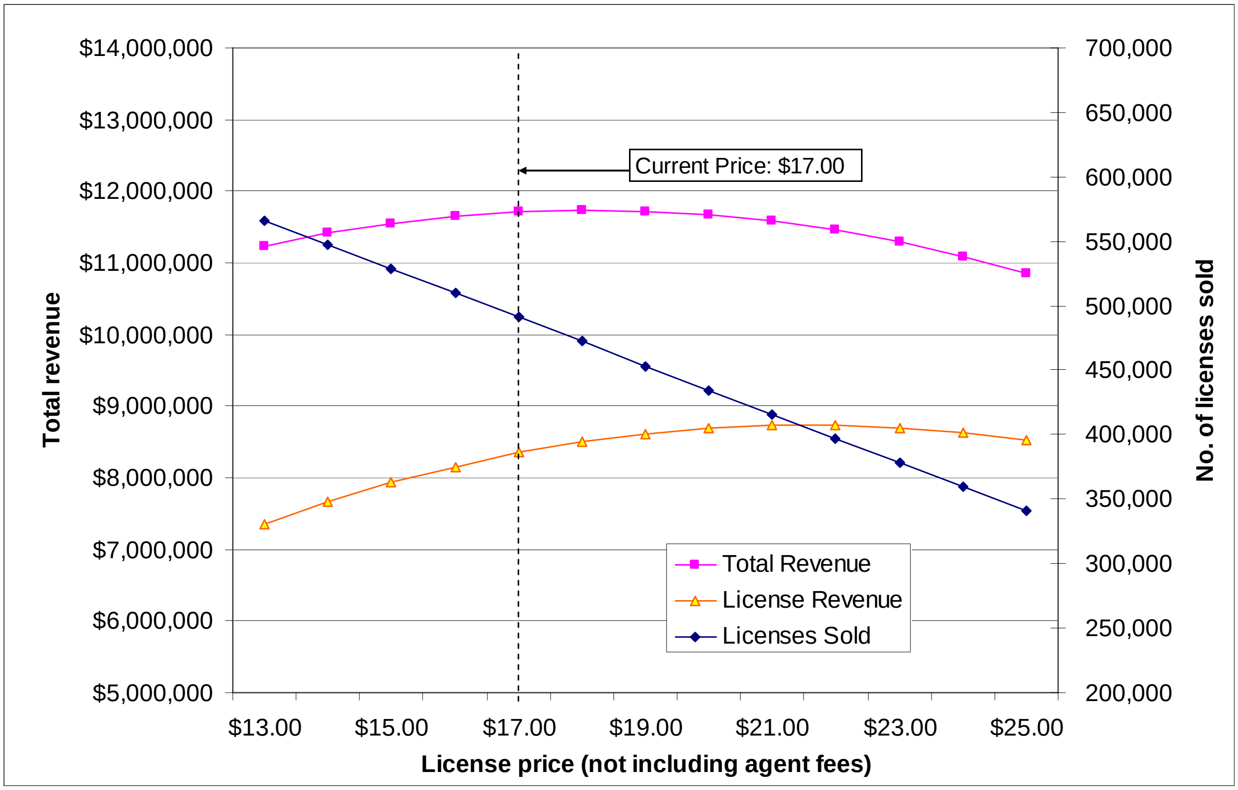
Figure 1. Actual and predicted sales of Resident Individual Angling Licenses.



In 2009, 485,413 Resident Individual Angling Licenses were sold which generated an estimated $11.58 million in total revenue to the State of Minnesota. This included $8.25 million in direct revenue from the license sales themselves plus an estimated additional $3.33 million in Federal Aid in Sport Fish Restoration funds.[2] Figure 2, below, shows the 2010 predictions for revenue and number of licenses sold across a range of prices assuming constant trends in all other factors. Estimated total revenue, including federal aid, is shown as the curved magenta line. Revenue from license sales alone is shown as the curved orange line. The number of licenses sold is represented by the downward sloping demand curve shown in blue. Complete statistical output and model details can be found in Appendix A.

[2] Federal aid resulting from sales of the Resident Individual Angling license is estimated on the basis of one angler per license sold.

Figure 2. Predicted 2010 sales and revenue at various prices – Resident Individual Angling Licenses.



The estimated price effect, which determines the slope of the demand curve in Figure 2, indicates that for every dollar that the price of this license is increased the number of Resident Individual Angling Licenses will decrease by 18,799 if all other factors are held constant. However, depending on the elasticity of demand, revenue could rise even as the number of licenses sold decreases. Table 1, below, shows predicted license sales and revenue for four different pricing scenarios.

- Assuming no price increase and constant trends in all other factors, the demand model estimates that 490,963 Resident Individual Angling Licenses will be sold in 2010, an increase of 1.1 percent over actual sales in 2009. The estimated total revenue resulting from these sales will be $11.71 million. This includes approximately $8.35 million in direct license revenues and $3.36 million in Federal Aid in Sport Fish Restoration funds.

- The model estimates the total revenue maximizing price to be $18.00. At this price total licenses sold would be 472,163 and total estimated revenue would be $11.73 million including $8.50 million in direct license revenue and $3.24 million in federal aid.

- The price at which direct license revenue is maximized in the model is $21.50. At this price total estimated licenses sold would be 406,365 and direct license revenue would be $8.74 million. However, a price increase of this magnitude is greater than that of any used in estimating this model so this prediction should be viewed with caution.

- In this case, a one dollar increase in the price of this license to $18.00 brings this license to the total revenue maximizing price. Licenses sold would decrease by 3.8 percent but total estimated revenue would increase by 0.2 percent.

Table 1. Predicted sales of Resident Individual Angling Licenses under four different pricing scenarios.

Pricing Scenarios	Baseline Scenario (no price change)	Total Revenue Maximizing Scenario	Direct License Revenue Maximizing Scenario*	$1 License Price Increase
Price	$17.00	$18.00	$21.50	$18.00
Licenses Sold	490,963	472,163	406,365	472,163
License Revenue	$8,346,364	$8,498,936	$8,736,846	$8,498,936
Federal Aid	$3,364,151	$3,235,334	$2,784,475	$3,235,334
Total Revenue	$11,710,516	$11,734,271	$11,521,321	$11,734,271

** Price change outside range of data used in regression model.*

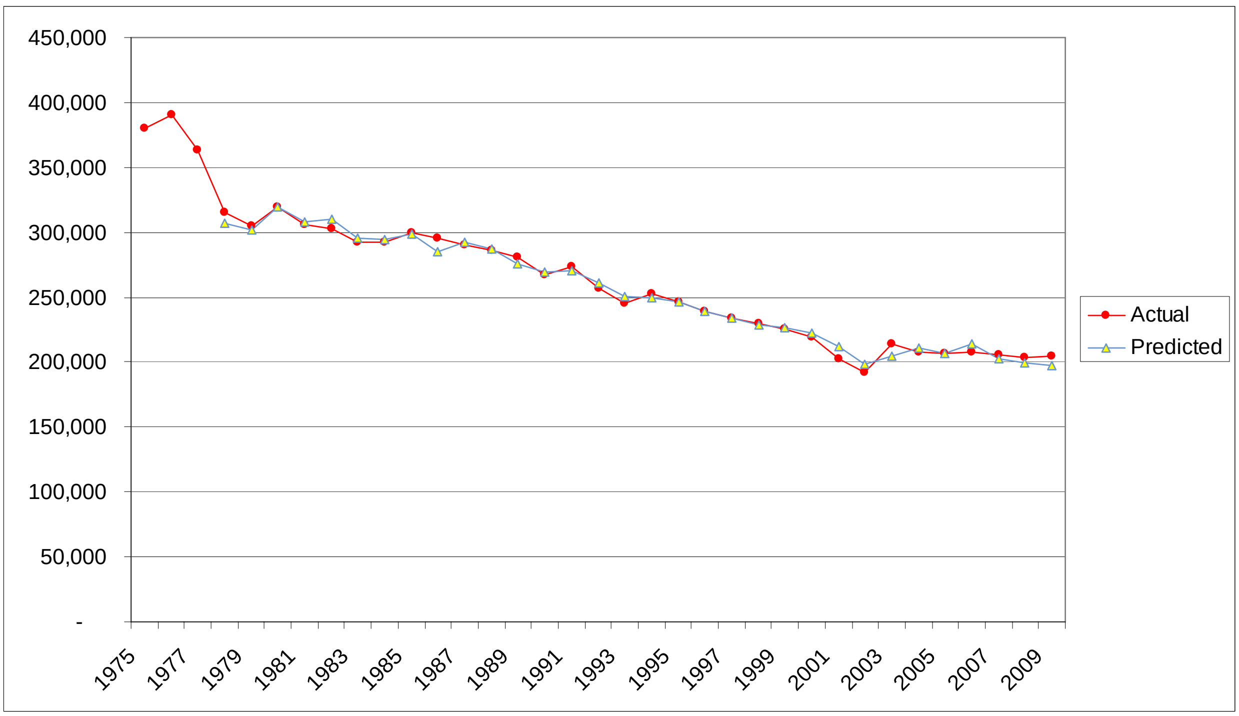
The Resident Individual license is already priced very close to the total revenue maximizing price. It would only be able to withstand a price increase of one dollar to $18.00 from the standpoint of maximizing revenue. A price increase of more than two dollars would result in lower total revenue, factoring in Federal Aid in Sport Fish Restoration funds. However, direct license sales revenue would continue to increase.

The model also found that there is a statistically significant substitution effect with the resident combination angling license. A one dollar increase in the price of that license would result in an increase of 14,838 individual angling licenses sold. There is also a reciprocal substitution effect in the combination model which indicates that if the price of the individual license is raised some anglers will purchase the combination license instead, partially offsetting the loss in Resident Individual Angling License buyers. Other factors that influence sales of resident individual angling license are population, unemployment, per capita income, the price of gas, and January temperatures (see Appendix A for further details of the model).

Resident Combination (Husband/Wife) Angling License

Beginning in 1976, sales of Resident Combination Angling Licenses have generally been on a downward trend hitting a low of approximately 192,000 licenses sold in 2002. A slight resurgence occurred in 2003 and current levels remain above the low in 2002. There were 35 years of sales data for this license type, however, all the variables used in the regression analysis were only available for 32 of them. The license sales predicted by the demand model show a good fit to actual sales (Figure 3), with the greatest deviation of 4.8 percent occurring in 2001. The R-squared value for the model is 0.98 indicating that the independent variables used in the model account for 98 percent in the variation in licenses sold (see Table A2 in Appendix A for full statistical details).

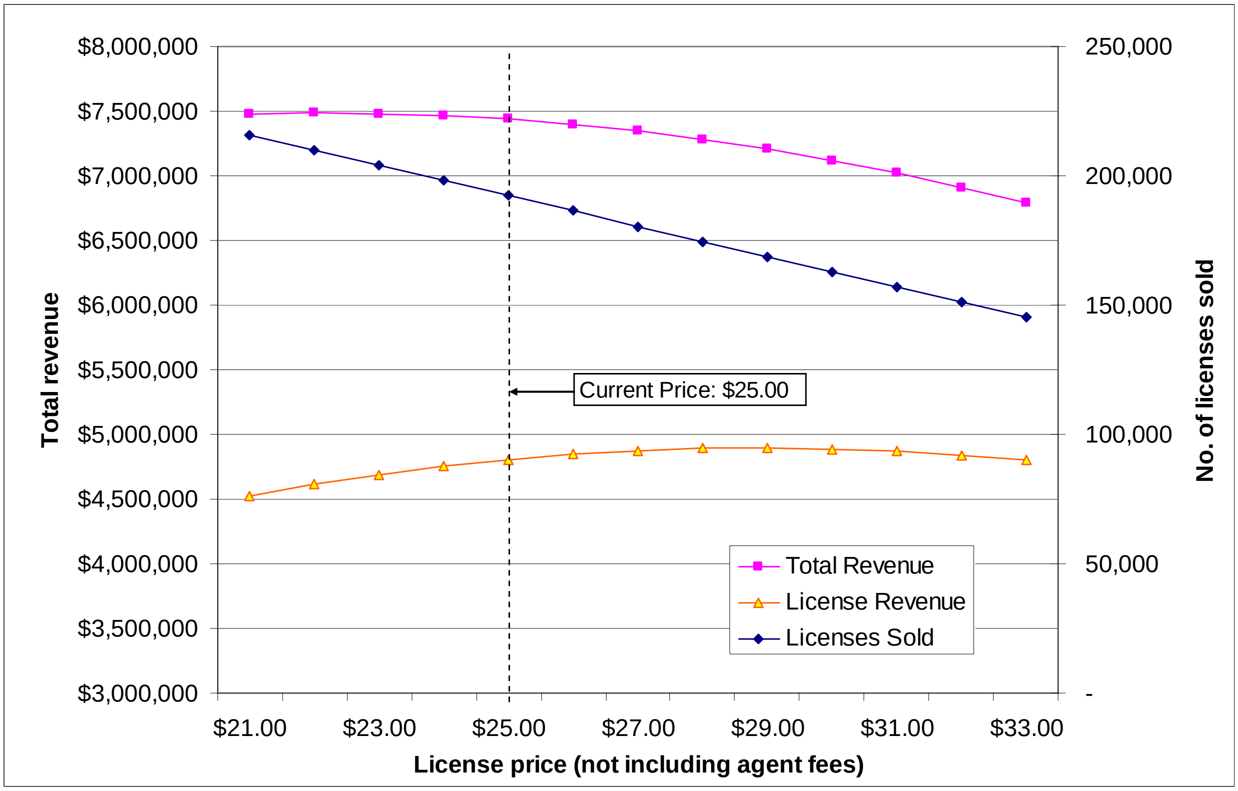
Figure 3. Actual and predicted sales of Resident Combination Angling Licenses.



In 2009, 204,383 Resident Combination Angling Licenses were sold which generated an estimated $7.91 million in total revenue to the State of Minnesota. This included $5.11 million in direct revenue from the license sales themselves plus an estimated additional $2.80 million in Federal Aid in Sport Fish Restoration funds.[3] Figure 4, below, shows the 2010 predictions for revenue and number of licenses sold across a range of prices assuming constant trends in all other factors. Estimated total revenue, including federal aid, is shown as the curved magenta line. Revenue from license sales alone is shown as the curved orange line. The number of licenses sold is represented by the downward sloping demand curve shown in blue. Complete statistical output and model details can be found in Appendix A.

[3] Federal aid resulting from sales of the Resident Combination Angling License is estimated on the basis of two anglers per license sold.

Figure 4. Predicted 2010 sales and revenue at various prices – Resident Combination Angling Licenses.



The estimated price effect, which determines the slope of the demand curve in Figure 4, indicates that for every dollar that the price of this license is increased the number of Resident Combination Angling Licenses will decrease by 5,845 if all other factors are held constant. However, depending on the elasticity of demand, revenue could rise even as the number of licenses sold decreases. Table 2, below, shows predicted license sales and revenue for four different pricing scenarios.

- Assuming no price increase and constant trends in all other factors, the demand model estimates that 192,186 resident combination angling licenses will be sold in 2010, a decrease of 6.0 percent over actual sales in 2009. The estimated total revenue resulting from these sales will be $7.44 million. This includes approximately $4.80 million in direct license revenues and $2.63 million in Federal Aid in Sport Fish Restoration funds.

- The model estimates the total revenue maximizing price to be $22.00. At this price total licenses sold would be 209,721 and total estimated revenue would be $7.49 million including $4.61 million in direct license revenue and $2.87 million in federal aid.

- The price at which direct license revenue is maximized in the model is $29.00. At this price total estimated licenses sold would be 168,806 and direct license revenue would be $4.90 million.

- A one dollar increase in the price of this license to $26.00 results in a 3.0 percent drop in the number of licenses sold in comparison to the baseline scenario. Direct sales license revenue is predicted to rise by 0.8 percent while federal aid is estimated to fall by 3.0 percent. Total license revenue is also predicted to drop by 0.5 percent

Table 2. Predicted sales of Resident Combination Angling Licenses under four different pricing scenarios.

Pricing Scenarios	Baseline Scenario (no price change)	Total Revenue Maximizing Scenario	Direct License Revenue Maximizing Scenario	$1 License Price Increase
Price	$25.00	$22.00	$29.00	$26.00
Licenses Sold	192,186	209,721	168,806	186,341
License Revenue	$4,804,641	$4,613,856	$4,895,361	$4,844,856
Federal Aid	$2,632,085	$2,872,238	$2,311,882	$2,552,035
Total Revenue	$7,436,727	$7,486,094	$7,207,243	$7,396,891

The resident combination license is currently priced between the total revenue maximizing price and the direct license revenue maximizing price. From the standpoint of total revenue maximization, the model suggests lowering the price by $3.00 from the baseline, thereby increasing both the number of licenses sold (9.1 percent) and revenue (0.6 percent). Alternatively, increasing the price by $4.00 from the baseline maximizes direct sales revenue, yet both the number of sales and total revenue will fall, 12.1 and 3.0 percent respectively.

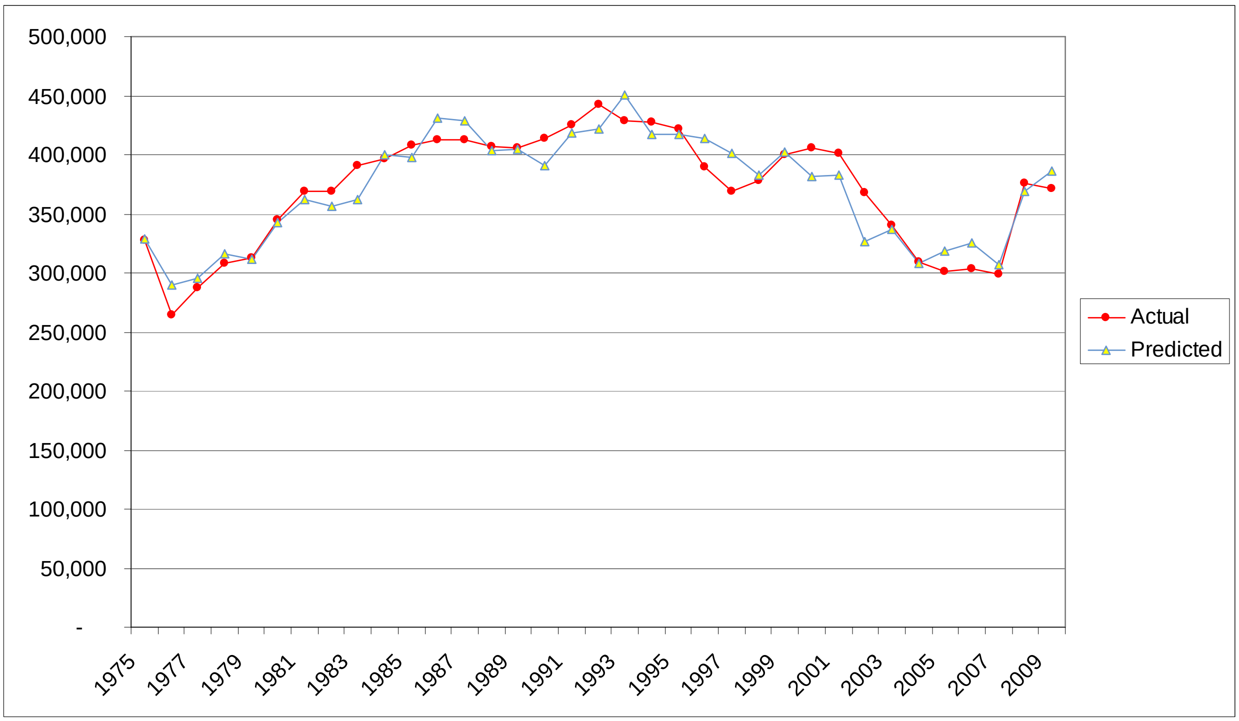
The model also found that there is a statistically significant substitution effect with the Resident Individual Angling License. A one dollar increase in the price of that license would result in an increase of 6,338 combination angling licenses sold. Again, there is also a reciprocal substitution effect in the individual model which indicates that if the price of the combination license is raised some anglers will purchase the individual license instead, partially offsetting the loss in Resident Combination Angling License buyers. This would also offset some of the decrease in federal aid and total revenue predicted by this model in the case of a modest price increase.

Other factors that influence sales of resident combination angling license are the price of gas, the average annual temperature in April and total rainfall for the state in the month of June (see Appendix A for further details of the model).

Resident Firearm Deer Hunting License

Between 1976 and 1992 the Resident Firearm Deer Hunting License saw significant growth of 68 percent. After 1992, sales of this license fell to just under 300,000 in 2007. Sales rebounded the following year but dipped again in 2009. The license sales predicted by the demand model show a good fit to actual sales (Figure 5), with the greatest deviation (11.4 percent) occurring in 2002 when actual sales decreased by 8.2 percent. The R-squared value for the model is 0.88 indicating that the independent variables used in the model account for 88 percent in the variation in licenses sold (see Table A3 in Appendix A for full statistical details).

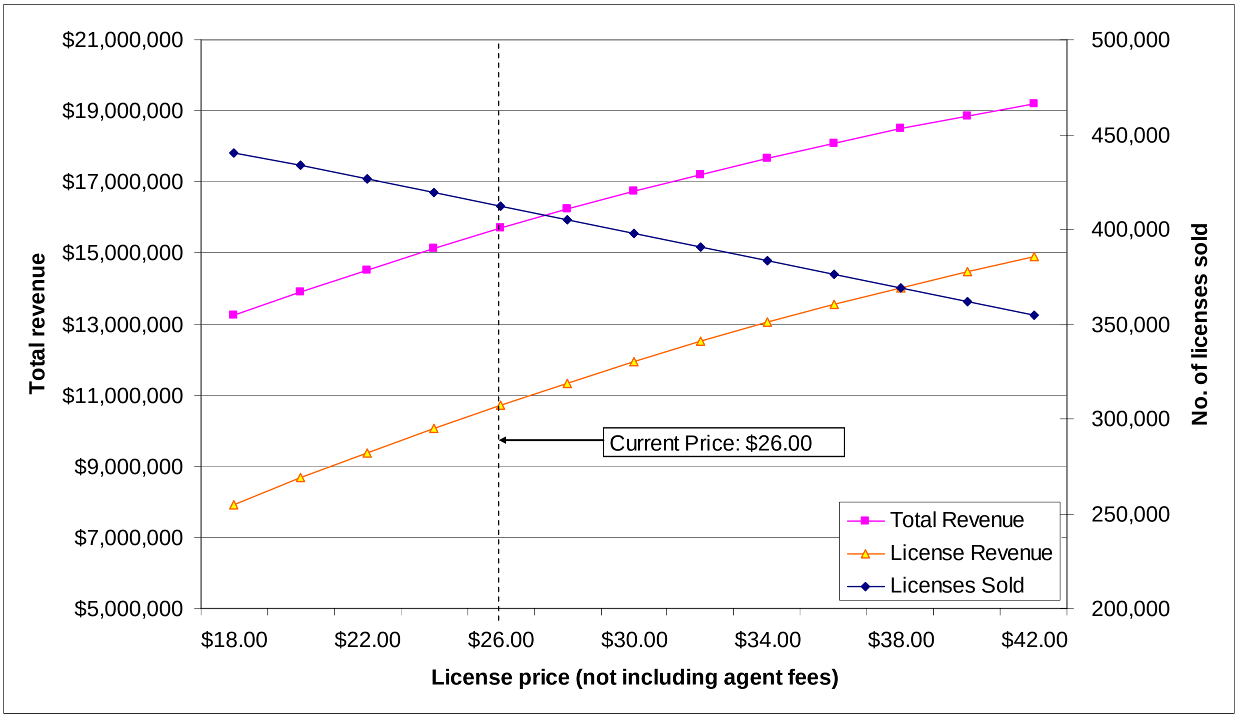
Figure 5. Actual and predicted sales of Resident Firearm Deer Hunting Licenses



In 2009, 371,418 Resident Firearm Deer Hunting Licenses were sold which generated an estimated $14.14 million in total revenue to the State of Minnesota. This included $9.66 million in direct revenue from the license sales themselves plus an estimated additional $4.48 million in Federal Aid in Wildlife Restoration funds.[4] Figure 6, below, shows the 2010 predictions for revenue and number of licenses sold across a range of prices assuming constant trends in all other factors. Estimated total revenue, including federal aid, is shown as the curved magenta line. Revenue from license sales alone is shown as the curved orange line. The number of licenses sold is represented by the downward sloping demand curve shown in blue. Complete statistical output and model details can be found in Appendix A.

[4] Federal aid resulting from sales of the Resident Firearm Deer License is estimated on the basis of one hunter per license sold.

Figure 6. Predicted 2010 sales and revenue at various prices – Resident Firearm Deer Hunting Licenses.



The estimated price effect, which determines the slope of the demand curve in Figure 6, indicates that for every dollar that the price of this license is increased the number of Resident Firearm Deer Hunting Licenses will decrease by 3,568 if all other factors are held constant. However, depending on the elasticity of demand, revenue could rise even as the number of licenses sold decreases. Table 3, below, shows predicted license sales and revenue for four different pricing scenarios.

- Assuming no price increase and constant trends in all other factors, the demand model estimates that 412,078 Resident Firearm Deer Hunting licenses will be sold in 2010, an increase of 10.9 percent over actual sales in 2009. The estimated total revenue resulting from these sales will be $15.69 million. This includes approximately $10.71 million in direct license revenues and $4.97 million in Federal Aid in Wildlife Restoration funds.

- The model estimates the total revenue maximizing price to be $64.50. At this price total licenses sold would be 274,692 and total estimated revenue would be $21.03 million including $17.72 million in direct license revenue and $3.32 million in federal aid. However, this would represent a price increase of $38.50 whereas the price of this license was never increased by more than five dollars during the period used to develop this model. *For this reason, this exact prediction should be viewed with extreme caution.* The model does indicate that any price increase within the historical range would result in greater total revenue.

- The price at which direct license revenue is maximized in the model is $70.50. At this price total estimated licenses sold would be 253,282 and direct license revenue would be

$17.86 million.   Again, though, a price increase of this magnitude is way outside the range of any that was used in estimating this model so this prediction should be viewed with caution.

- A one dollar increase in the price of this license to $27.00 would result in a 1.7 percent increase in total revenue to $15.96 million while the number of licenses sold would decrease by 0.9 percent to 408,510. Direct license revenue would increase by 2.9 percent while federal aid would decrease along with the number of licenses sold by 0.9 percent.

Table 3. Predicted sales of Resident Firearm Deer Hunting Licenses under four different pricing scenarios.

Pricing Scenarios	Baseline Scenario (no price change)	Total Revenue Maximizing Scenario*	Direct License Revenue Maximizing Scenario*	$1 License Price Increase
Price	$26.00	$64.50	$70.50	$27.00
Licenses Sold	412,078	274,692	253,282	408,510
License Revenue	$10,714,038	$17,717,663	$17,856,356	$11,029,768
Federal Aid	$4,973,862	$3,315,588	$3,057,156	$4,930,790
Total Revenue	$15,687,900	$21,033,251	$20,913,512	$15,960,558

** Price change outside range of data used in regression model.*

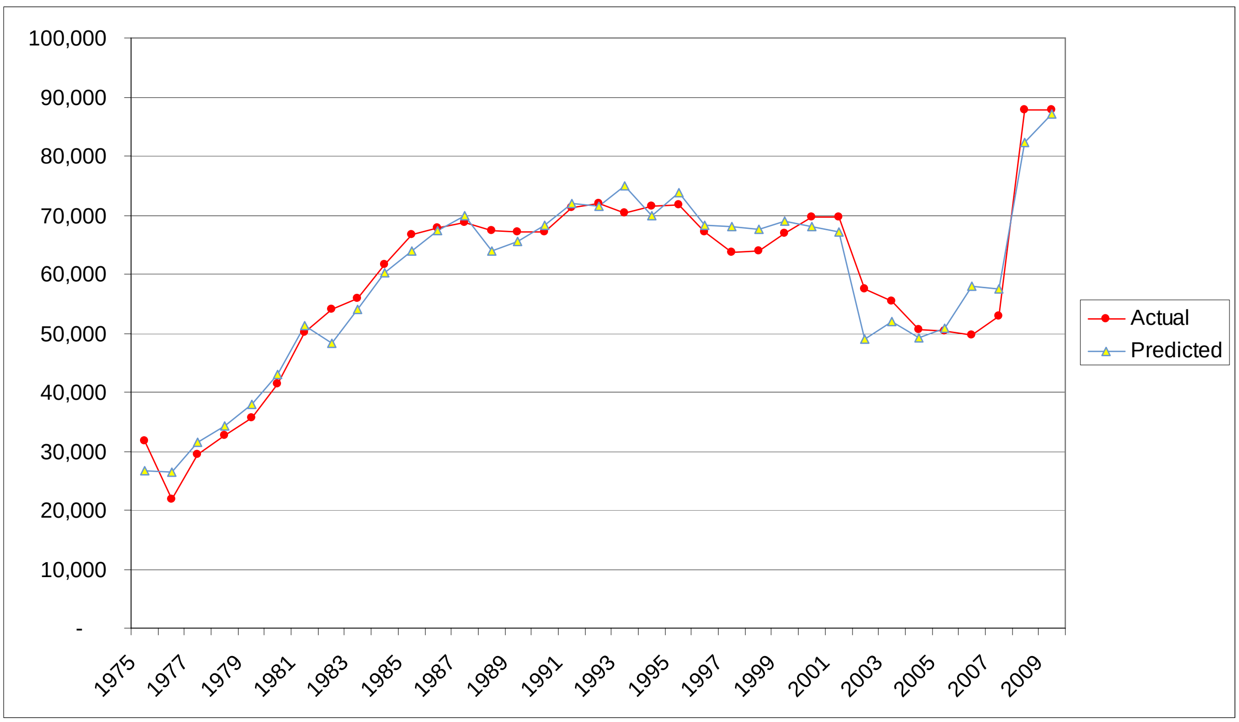
The Resident Firearm Deer Hunting License is able to withstand a price increase from the standpoint of maximizing revenue. However, caution should be used in making predictions about the effects of price increases that are outside the range of past price increases. There may be negative effects from a very large increase that are not captured in this model.

In the presence of rising per capita income, the model indicates that this has a significant and limiting effect on the sales of the firearm deer hunting license. This suggests that greater income is correlated with other lifestyle choices that do not include hunting.   Other factors that influence sales of this license are population, the price of gas, September temperatures and total rainfall in Minnesota for the month of March (see Appendix A for further details of the model).

Resident Archery Deer Hunting License

The overall trend in Resident Archery Deer Hunting Licenses has been on the rise over the period from 1975 to 2009. During this time, Minnesota experienced rapid growth in license sales of this type between 1976 and 1987. Sales remained relatively steady until 2001 when sales dropped by 28.7 percent. The last two years have brought another period of growth to levels, well above those experienced in the late 1980s. The license sales predicted by the demand model show a good fit to actual sales (Figure 7), with the greatest deviation (21.2 percent) occurring in 1976 when actual sales decreased by 30 percent from 31,836 to 21,773. The R-squared value for the model is 0.95 indicating that the independent variables used in the model account for 95 percent in the variation in licenses sold (see Table A4 in Appendix A for full statistical details).

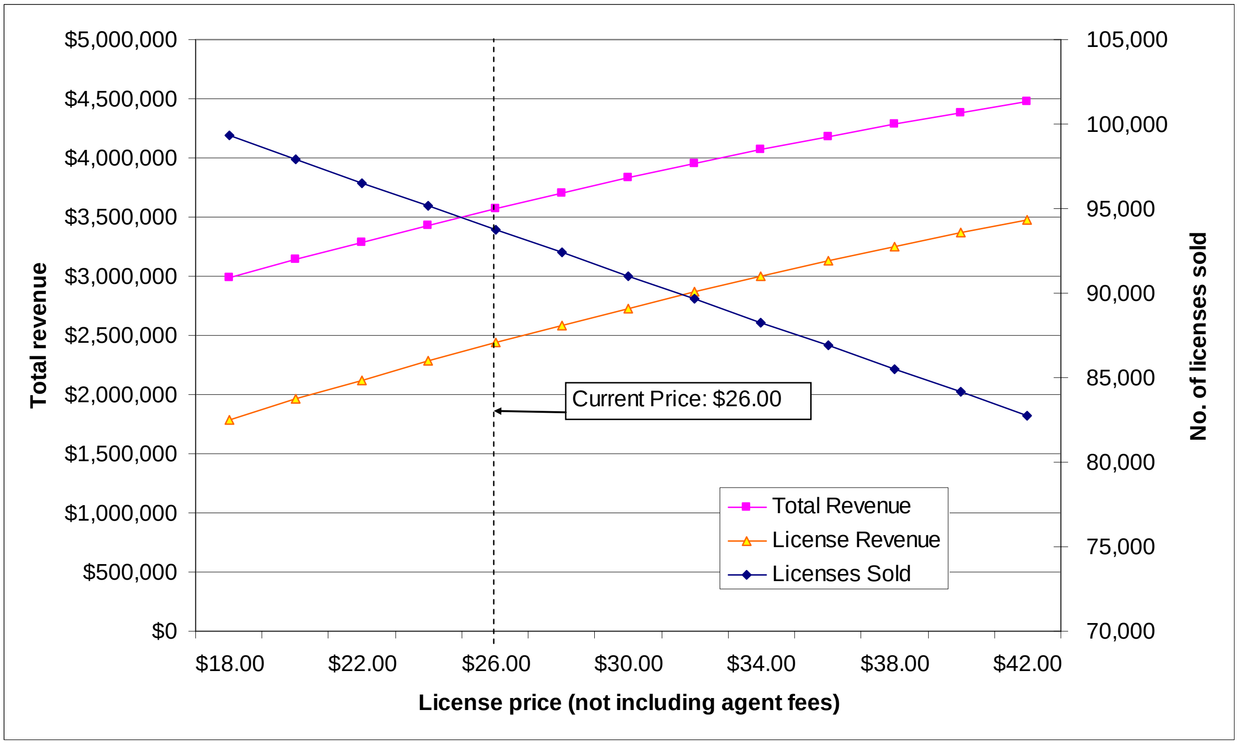
Figure 7. Actual and predicted sales of Resident Archery Deer Hunting Licenses



In 2009, 87,880 Resident Archery Deer Hunting Licenses were sold which generated an estimated $3.34 million in total revenue to the State of Minnesota. This included $2.28 million in direct revenue from the license sales themselves plus an estimated additional $1.06 million in Federal Aid in Wildlife Restoration funds.[5] Figure 8, below, shows the 2010 predictions for revenue and number of licenses sold across a range of prices assuming constant trends in all other factors. Estimated total revenue, including federal aid, is shown as the curved magenta line. Revenue from license sales alone is shown as the curved orange line. The number of licenses sold is represented by the downward sloping demand curve shown in blue. Complete statistical output and model details can be found in Appendix A.

[5] Federal aid resulting from sales of the Resident Archery Deer license is estimated on the basis of one hunter per license sold.

Figure 8. Predicted 2010 sales and revenue at various prices – Resident Archery Deer Hunting Licenses.



The estimated price effect, which determines the slope of the demand curve in Figure 8, indicates that for every dollar that the price of this license is increased, the number of Resident Archery Deer Hunting Licenses will decrease by 689 if all other factors are held constant. However, depending on the elasticity of demand, revenue could rise even as the number of licenses sold decreases. Table 4, below, shows predicted license sales and revenue for four different pricing scenarios.

- Assuming no price increase and constant trends in all other factors, the demand model estimates that 93,783 Resident Archery Deer Hunting licenses will be sold in 2010, an increase of 6.7 percent over actual sales in 2009. The estimated total revenue resulting from these sales will be $3.57 million. This includes approximately $2.44 million in direct license revenues and $1.13 million in Federal Aid in Wildlife Restoration funds.

- The model estimates the total revenue maximizing price to be $75.00. At this price total licenses sold would be 60,023 and total estimated revenue would be $5.22 million including $4.50 million in direct license revenue and $0.72 million in federal aid. However, this would represent a price increase of $49.00 whereas the price of this license was never increased by more than five dollars during the period used to develop this model. For this reason, this exact prediction should be viewed with extreme caution. But, the model does indicate that any price increase within the historical range would result in greater total revenue.

- The price at which direct license revenue is maximized in the model is $81.00. At this price total estimated licenses sold would be 55,889 and direct license revenue would be $4.53 million. Again, though, a price increase of this magnitude is way outside the range of any that was used in estimating this model so this prediction should be viewed with caution.

- A one dollar increase in the price of this license would result in decrease in the number of licenses sold of less than one percent in comparison to the baseline scenario. However, total revenue would increase by 1.9 percent to $3.64 million with $2.51 in direct license revenue. Direct license sales revenue would increase by 3.1 percent while federal aid would decrease along with licenses sold by 0.7 percent.

Table 4. Predicted sales of Resident Archery Deer Hunting Licenses under four different pricing scenarios.

Pricing Scenarios	Baseline Scenario (no price change)	Total Revenue Maximizing Scenario*	Direct License Revenue Maximizing Scenario*	$1 License Price Increase
Price	$26.00	$75.00	$81.00	$27.00
Licenses Sold	93,783	60,023	55,889	93,094
License Revenue	$2,438,364	$4,501,708	$4,526,996	$2,513,544
Federal Aid	$1,130,963	$723,835	$673,982	$1,122,654
Total Revenue	$3,569,327	$5,225,542	$5,200,978	$3,636,199

** Price change outside range of data used in regression model.*

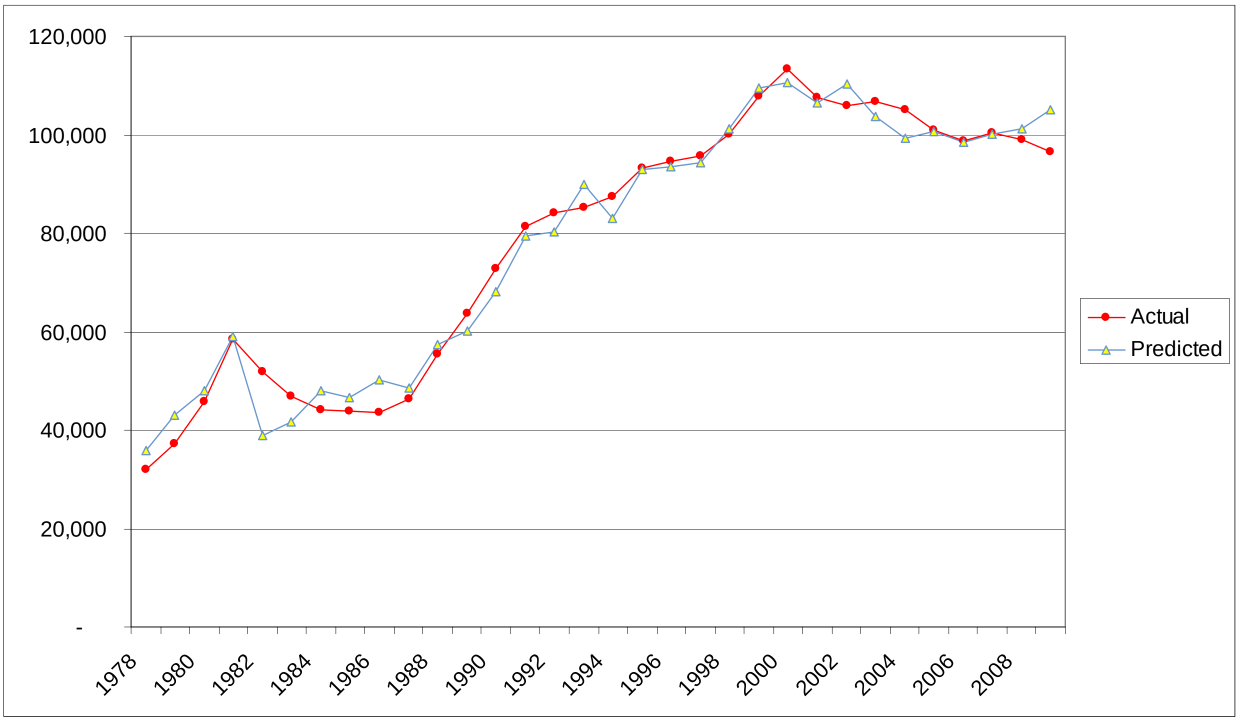
Similar to the Resident Firearm Deer Hunting license model, the Resident Archery Deer Hunting License is able to withstand a price increase from the standpoint of maximizing revenue. *But again, caution should be used in making predictions about the effects of price increases that are outside the range of past price increases.* There may be negative effects that are not captured in this model if the license price were to triple.

Also similar to the firearm deer license, in the presence of rising per capita income, the model shows that this has a significant and limiting effect on the sales of the archery deer hunting license. This suggests that greater income is correlated with other lifestyle choices that do not include hunting. Other factors that influence sales of Resident Archery Deer Hunting license are population, the price of gas, September temperatures and snowfall or rainfall in January (see Appendix A for further details of the model).

Resident Individual Sports License

Sales of Resident Individual Sports Licenses have experienced steady and consistent growth between 1986 and 2000. Over that period sales more than doubled from 43,630 to 113,402. Since 2000, sales have fallen slightly to 96,675. The license sales predicted by the demand model show a good fit to actual sales (Figure 9), with the greatest deviation (24.9 percent) occurring in 1982 when actual sales dipped but not as dramatically as the model predicted. The R-squared value for the model is 0.97 indicating that the independent variables used in the model account for 97 percent in the variation in licenses sold (see Table A5 in Appendix A for full statistical details).

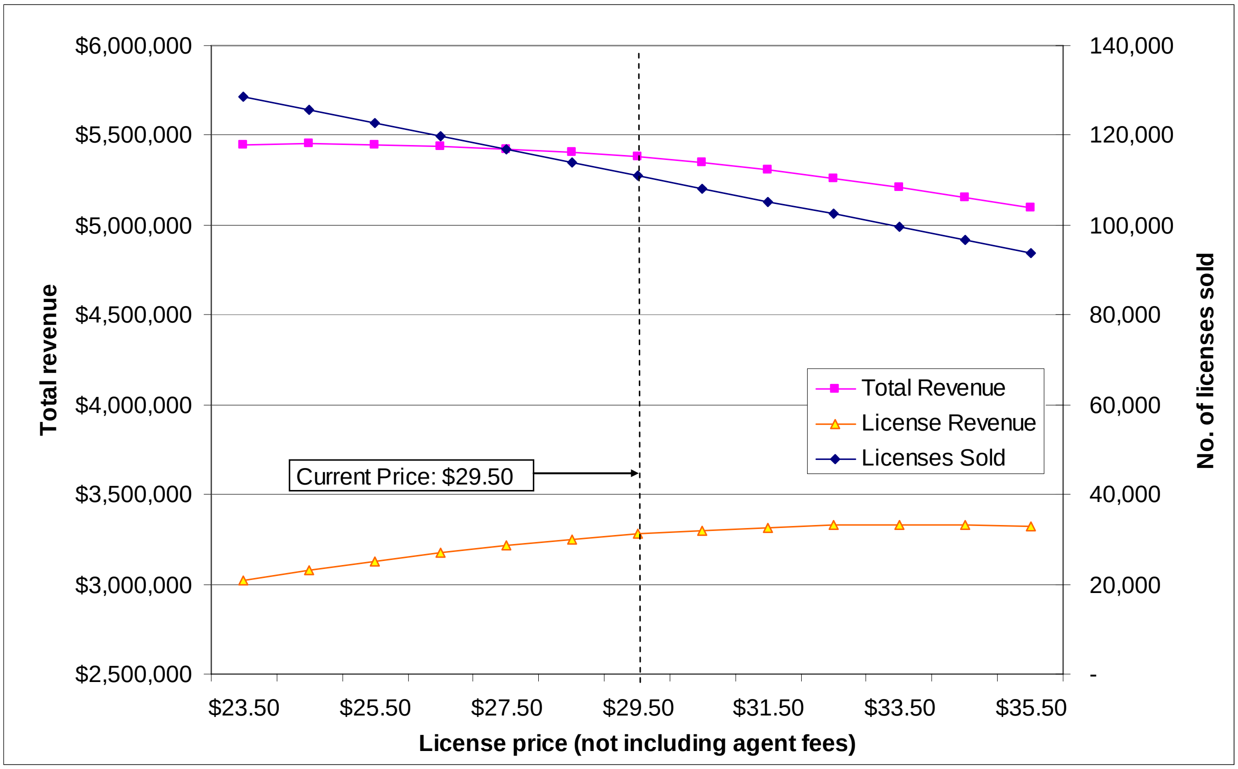
Figure 9. Actual and predicted sales of Resident Individual Sports Licenses.



In 2009, 96,675 Resident Individual Sports Licenses were sold which generated an estimated $4.68 million in total revenue to the State of Minnesota. This included $2.85 million in direct revenue from the license sales themselves plus an estimated additional $1.83 million in Federal Aid in Sport Fish and Wildlife Restoration funds.[6] Figure 10, below, shows the 2010 predictions for revenue and number of licenses sold across a range of prices assuming constant trends in all other factors. Estimated total revenue, including federal aid, is shown as the curved magenta line. Revenue from license sales alone is shown as the curved orange line. The number of licenses sold is represented by the downward sloping demand curve shown in blue. Complete statistical output and model details can be found in Appendix A.

[6] Federal aid resulting from sales of the Resident Sports License is estimated on the basis of one hunter and one angler per license sold.

Figure 10. Predicted 2010 sales and revenue at various prices – Resident Individual Sports License.



The estimated price effect, which determines the slope of the demand curve in Figure 10, indicates that for every dollar that the price of this license is increased the number of Resident Individual Sport Licenses will decrease by 2,907 if all other factors are held constant. However, depending on the elasticity of demand, revenue could rise even as the number of licenses sold decreases. Table 5, below, shows predicted license sales and revenue for four different pricing scenarios.

- Assuming no price increase and constant trends in all other factors, the demand model estimates that 111,133 Resident Individual Sports Licenses will be sold in 2010, an increase of 15.0 percent over actual sales in 2009. The estimated total revenue resulting from these sales will be $5.38 million. This includes approximately $3.28 million in direct license revenues and $2.10 million in Federal Aid in Sport Fish and Wildlife Restoration funds.

- The model estimates the total revenue maximizing price to be $24.50. At this price total licenses sold would be 125,669 and total estimated revenue would be $5.45 million including $3.08 million in direct license revenue and $2.37 million in federal aid.

- The price at which direct license revenue is maximized in the model is $34.00. Estimated license sales would total 98,051 contributing $3.33 million in direct sales revenue.

- A one dollar increase in the price of this license would result in a decline in both license sales and total revenue. The number of licenses sold is predicted to fall by 2.6 percent from the baseline scenario. While direct license sales revenue would increase by 0.7 percent, the loss in federal aid would result in a 0.6 percent decrease in total revenue.

Table 5. Predicted sales of Resident Individual Sports Licenses under four different pricing scenarios.

Pricing Scenarios	Baseline Scenario (no price change)	Total Revenue Maximizing Scenario	Direct License Revenue Maximizing Scenario	$1 License Price Increase
Price	$29.50	$24.50	$34.00	$30.50
Licenses Sold	111,133	125,669	98,051	108,226
License Revenue	$3,278,427	$3,078,884	$3,333,735	$3,300,893
Federal Aid	$2,099,340	$2,373,922	$1,852,215	$2,044,423
Total Revenue	$5,377,766	$5,452,807	$5,185,950	$5,345,316

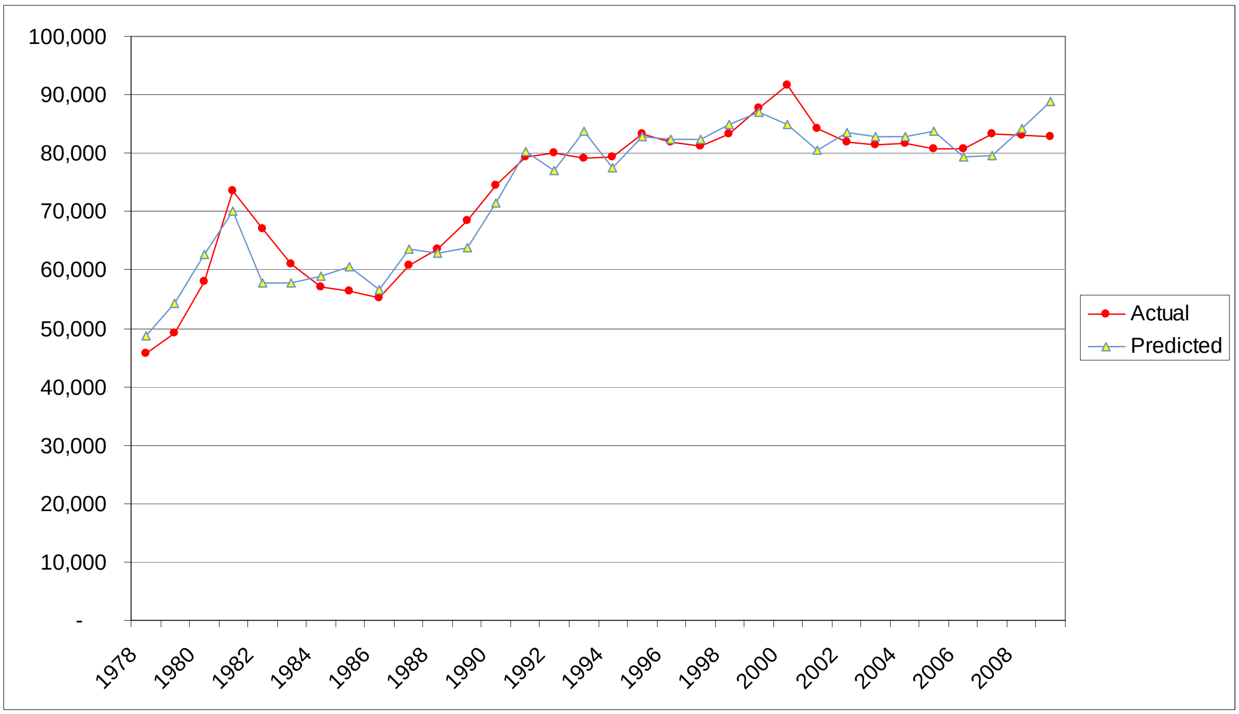
The Resident Individual Sport License is currently priced between the total revenue maximizing price and the direct license revenue maximizing scenarios. From the standpoint of total revenue maximization, the model suggests lowering the price by $4.00 from the baseline, thereby increasing both the number of licenses sold (13.0 percent) and revenue (1.4 percent), factoring in federal aid. Alternatively, increasing the price by $4.50 from the baseline maximizes direct sales revenue, however both the number of licenses sold and total revenue generated by this license will fall, 11.8 and 3.6 percent respectively. The effect of federal aid may be slightly exaggerated by this model since it counts each license sale as one hunter and one angler. If a price increase causes some buyers of this license switch to purchasing only an angling license or only a hunting license, the drop in federal aid will not be as dramatic as predicted by this model.

The model also found that there is a statistically significant substitution effect with the Resident Individual Angling License. A one dollar increase in the price of that license would result in an increase of 2,882 individual sports licenses sold. Population in Minnesota has a significant and positive impact on licenses sales. Other factors that influence sales of Resident Individual Sports Licenses are February and September temperatures as well as total rainfall in Minnesota (see Appendix A for further details of the model).

Resident Combination (Husband/Wife) Sports License

Between 1986 and 2000, sales of the Resident Combination Sports License increased by 65 percent over the period. Since 2000, sales have leveled off to an average of 82,232 licenses issued per year. The license sales predicted by the demand model show a good fit to actual sales (Figure 11), with the greatest deviation (13.7 percent) occurring in 1982 when actual sales began a short period of decline. The R-squared value for the model is 0.92 indicating that the independent variables used in the model account for 92 percent in the variation in licenses sold (see Table A6 in Appendix A for full statistical details).

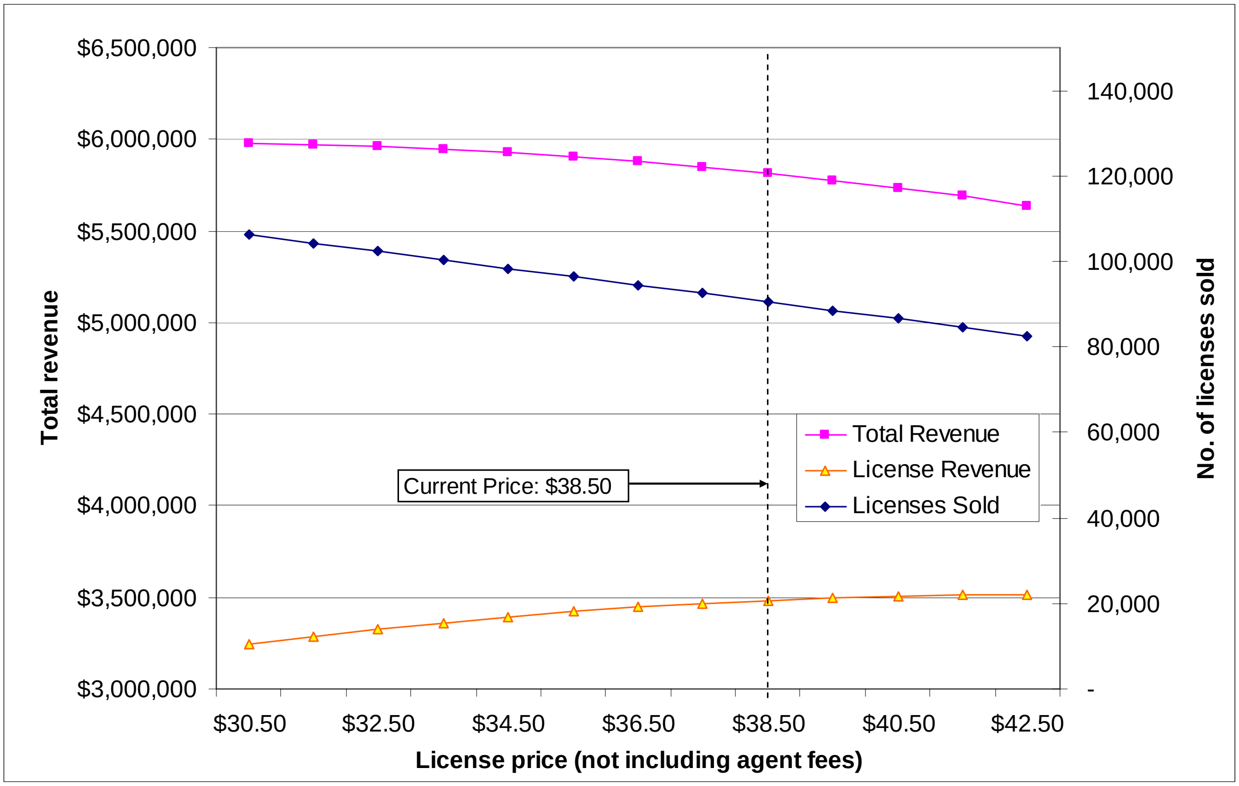
Figure 11. Actual and predicted sales of Resident Combination Sports Licenses.



In 2009, 82,917 Resident Combination Sports Licenses were sold which generated an estimated $5.32 million in total revenue to the State of Minnesota. This included $3.19 million in direct revenue from the license sales themselves plus an estimated additional $2.13 million in Federal Aid in Sport Fish and Wildlife Restoration funds.[7] Figure 12, below, shows the 2010 predictions for revenue and number of licenses sold across a range of prices assuming constant trends in all other factors. Estimated total revenue, including federal aid, is shown as the curved magenta line. Revenue from license sales alone is shown as the curved orange line. The number of licenses sold is represented by the downward sloping demand curve shown in blue. Complete statistical output and model details can be found in Appendix A.

[7] Federal aid resulting from sales of the Resident Combination Sports License is estimated on the basis of one hunter and two anglers per license sold.

Figure 12. Predicted 2010 sales and revenue at various prices – Resident Combination Sports Licenses.



The estimated price effect, which determines the slope of the demand curve in Figure 12, indicates that for every dollar that the price of this license is increased the number of Resident Combination Sports Licenses will decrease by 1,971 if all other factors are held constant. However, depending on the elasticity of demand, revenue could rise even as the number of licenses sold decreases. Table 6, below, shows predicted license sales and revenue for four different pricing scenarios.

- Assuming no price increase and constant trends in all other factors, the demand model estimates that 90,530 Resident Combination Sports Licenses will be sold in 2010, an increase of 9.2 percent over actual sales in 2009. The estimated total revenue resulting from these sales will be $5.81 million. This includes approximately $3.48 million in direct license revenues and $2.33 million in Federal Aid in Sport Fish and Wildlife Restoration funds.

- The model estimates the total revenue maximizing price to be $29.50. At this price total licenses sold would be 108,275 and total estimated revenue would be $5.98 million including $3.19 million in direct license revenue and $2.78 million in federal aid. However, a nine dollar price change is outside the range of the historical price changes used to develop this model and these predictions should be viewed with caution.

- The price at which direct license revenue is maximized in the model is $42.00. At this price total estimated licenses sold would be 83,630, a decrease of 7.6 percent, while direct license revenue would increase by 0.8 percent to $3.51 million. However, assuming that none of the anglers and hunters deciding not to purchase this license purchased any other type of angling or hunting license, federal aid would decrease by 7.6 percent and total revenue by 2.6 percent from the baseline scenario.

- A one dollar increase in the price of this license to $39.50 would result in a decline in both license sales and total revenue. Sales are predicted to fall by 2.2 percent from the baseline scenario. While direct license sales revenue would increase by 0.3 percent, both federal aid and total revenue will decrease, assuming that none of license anglers and hunters deciding not to purchase this license purchased any other form of license instead.

Table 6. Predicted sales of Resident Combination Sports license under four different pricing scenarios.

Pricing Scenarios	Baseline Scenario (no price change)	Total Revenue Maximizing Scenario*	Direct License Revenue Maximizing Scenario	$1 License Price Increase
Price	$38.50	$29.50	$42.00	$39.50
Licenses Sold	90,530	108,275	83,630	88,559
License Revenue	$3,485,423	$3,194,117	$3,512,449	$3,498,074
Federal Aid	$2,329,325	$2,785,891	$2,151,771	$2,278,595
Total Revenue	$5,814,748	$5,980,009	$5,664,220	$5,776,669

** Price change outside range of data used in regression model.*

The Resident Combination Sports license is currently priced between the total revenue maximizing price and the direct license revenue maximizing scenarios. From the standpoint of total revenue maximization, the model indicates that lowering the price will increase both the number of licenses sold and total revenue. Alternatively, increasing the price by $3.50 from the baseline maximizes direct sales revenue, however total revenue will fall 2.6 percent due to the loss in federal aid. It should be noted, though, that the effect of federal aid could be overstated in this model since it assumes that the loss of one license sale will result in the loss of two anglers and one hunter. If these anglers and hunters switch to an individual angling or hunting license as the price rises, the overall loss in federal aid will not be as great.

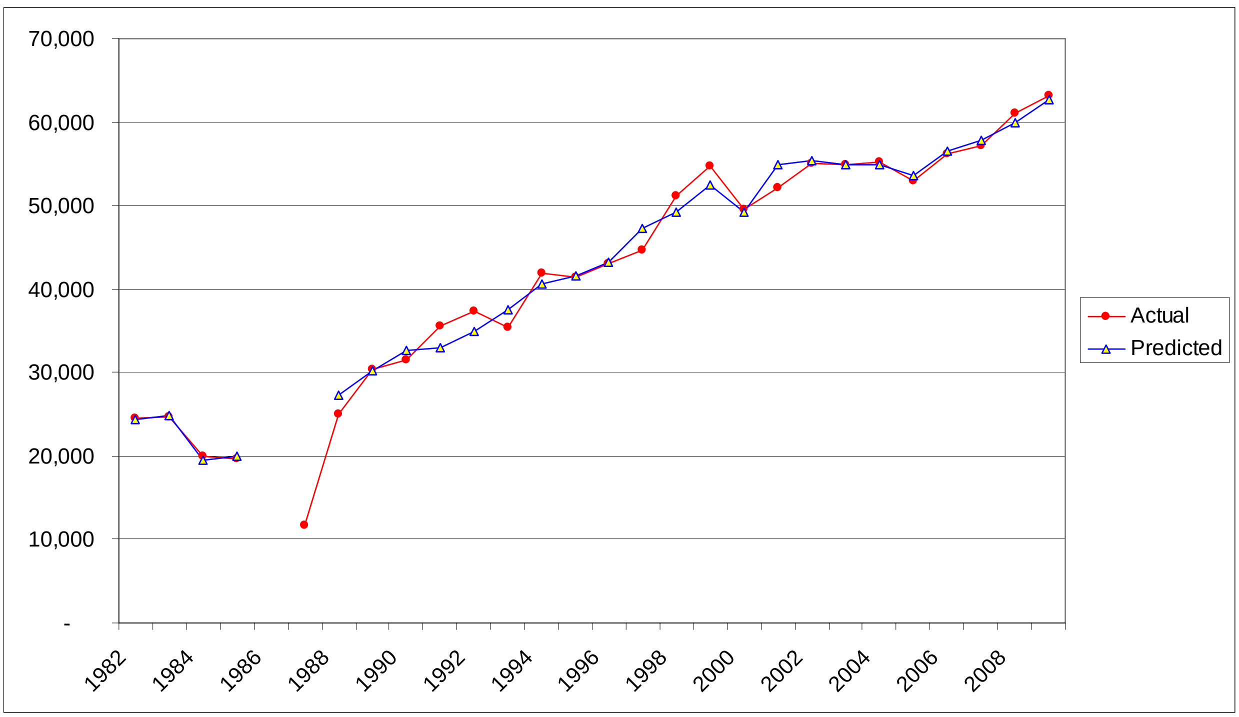
The model also found that there is a statistically significant substitution effect with the Resident Individual Angling License. A one dollar increase in the price of that license would result in an increase of 2,919 combination sports licenses sold. Population in Minnesota has a significant and positive impact on licenses sales. Per capita income has a significant impact on the model and in this case indicates that greater income is correlated with other lifestyle choices that do not include hunting. Two other factors that influence sales of resident sports licenses are February temperatures and May rainfall in Minnesota (see Appendix A for further details of the model).

Non-Resident Licenses

Resident/Non-Resident 24-Hour Angling Licenses [8]

The 24-hour Angling License is available to both Minnesota residents and non-residents. It is included in the non-resident section of this report because it is purchased predominantly by non-residents. Since the full reintroduction of this license in 1988, sales of 24-hour Angling Licenses have been on a more or less steady upward trend. Sales of this license have risen from 24,983 in 1988 to 63,253 in 2009 with an estimated 75 percent of these being purchased by non-residents. As shown in Figure 13, the price model for predicted sales of the resident fishing license shows a good fit to actual sales, with the greatest deviation occurring the same year as the license reintroduction. The R-squared value of the model is 0.99 indicating that the independent variables used in the model account for 99 percent of the variation in licenses sold (see Table A7 in Appendix A for full statistical details).

Figure 13. Actual and predicted sales of Resident/Non-Resident 24-hour Angling Licenses.



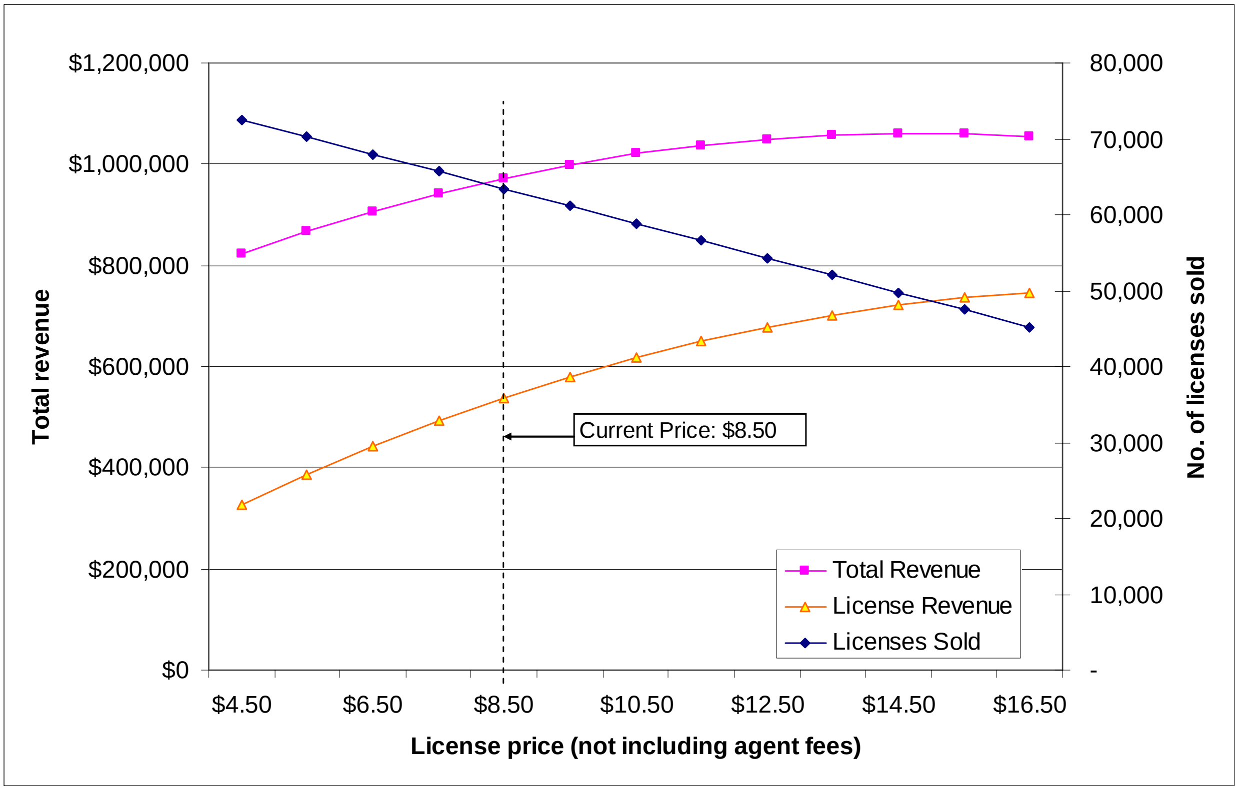
In 2009, 63,253 Resident/Non-Resident 24-hour Angling Licenses were sold which generated an estimated $970,430 in total revenue to the State of Minnesota. This included $537,651 in direct revenue from the license sales themselves plus an estimated additional $432,780 in Federal Aid in Sport Fish Restoration funds.[9] Figure 14, below, shows the 2010

[8] The 24-hour license has been included in the non-resident section of this report because 75 percent of these licenses are purchased by non-residents and the explanatory variables that proved statistically significant are consistent with a typical non-resident license model.

[9] Federal aid resulting from sales of the Resident/Non-resident 24-hour Angling license is estimated on the basis of one angler per license sold.

predictions for revenue and number of licenses sold across a range of prices assuming constant trends in all other factors. Estimated total revenue, including federal aid, is shown as the curved magenta line. Revenue from license sales alone is shown as the curved orange line. The number of licenses sold is represented by the downward sloping demand curve shown in blue. Complete statistical output and model details can be found in Appendix A.

Figure 14. Predicted 2010 sales and revenue at various prices – Resident/Non-Resident 24-hour Angling Licenses.



The estimated price effect, which determines the slope of the demand curve in Figure 14, indicates that for every dollar that the price of this license is increased the number of Resident/Non-Resident 24-hour Angling Licenses will decrease by 2,277 if all other factors are held constant. However, depending on the elasticity of demand, revenue could rise even as the number of licenses sold decreases. Table 7, below, shows predicted license sales and revenue for four different pricing scenarios.

- Assuming no price increase and constant trends in all other factors, the demand model estimates that 63,391 24-hour licenses will be sold in 2010, an increase of less than one quarter of one percent over 2009. The estimated total revenue resulting from these sales will be $972,542. This includes $538,820 in direct license revenues and $433,722 in Federal Aid in Sport Fish Restoration funds.

- The model estimates the total revenue maximizing price to be $14.50. At this price total licenses sold would be 49,729 and total revenue would be $1.06 million including $0.72

million in direct license revenue and $0.34 million in federal aid. The price at which direct license revenue is maximized in the model is $18.50. However, both of these price increases are outside the range of price changes used in the regression analysis and therefore, these predictions should be viewed with caution.

- A one dollar increase in the price of this license would result in a 3.6 percent decrease in the number of licenses sold in comparison to the baseline scenario. However, total revenue would increase by 2.7 percent to $998,722 with $580,579 in direct license revenue.

Table 7. Predicted sales of Resident/Non-Resident 24-hour Angling Licenses under four different pricing scenarios.

Pricing Scenarios	Basline Scenario (no price change)	Total Revenue Maximizing Scenario*	Direct License Revenue Maximizing Scenario*	$1 License Price Increase
Price	$8.50	$14.50	$18.50	$9.50
Licenses Sold	63,391	49,729	40,620	61,114
License Revenue	$538,820	$721,064	$751,478	$580,579
Federal Aid	$433,722	$340,245	$277,927	$418,142
Total Revenue	$972,542	$1,061,309	$1,029,405	$998,722

** Price change outside range of data used in regression model.*

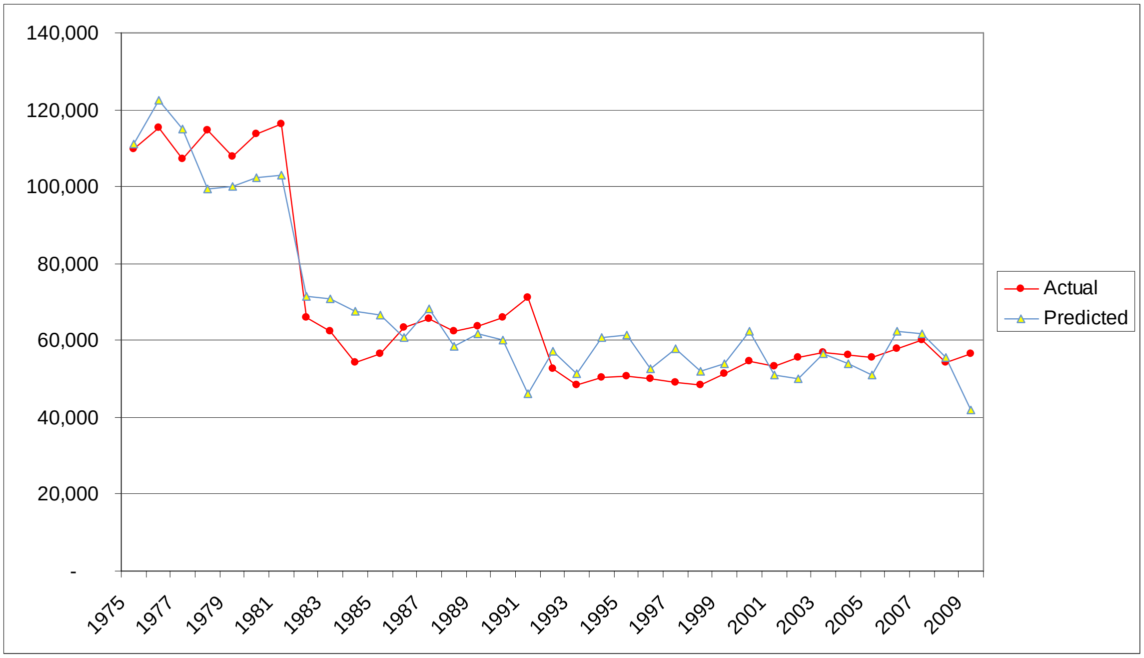
The Resident/Non-Resident 24-hour Angling License is able to withstand a price increase from the standpoint of maximizing revenue. *However, caution should be used in making predictions about the effects of price increases that are outside the range of past price increases.* There may be negative effects from a very large increase that are not captured in this model.

The model also found that there is a statistically significant substitution effect with the non-resident individual angling license. A one dollar increase in the price of that license results in an increase of 414 24-hour licenses sold. This is not surprising given the price of the non-resident license and the fact that three quarters of 24-hour licenses are purchased by non-residents. Sales of this license were also correlated to the population of the Plains region rather than Minnesota's population. Increases in the price of gasoline also have a negative impact on 24-hour license sales (see Appendix A for further details of the model).

Non-Resident Individual Angling License

Before 1992, sales of Non-Resident Individual Angling licenses have generally been on a downward trend showing significant reductions in the number of licenses sold between 1981-82. After 1992, sales have been relatively stable averaging 53,445 licenses per year. The license sales predicted by the demand model show a good fit to actual sales (Figure 15), with the greatest deviation occurring in 1991 when actual sales increased from 65,834 to 71,272 despite conditions that were indicative of a decrease in sales. The R-squared value for the model is 0.86 indicating that the independent variables used in the model account for 86 percent in the variation in licenses sold (see Table A8 in Appendix A for full statistical details).

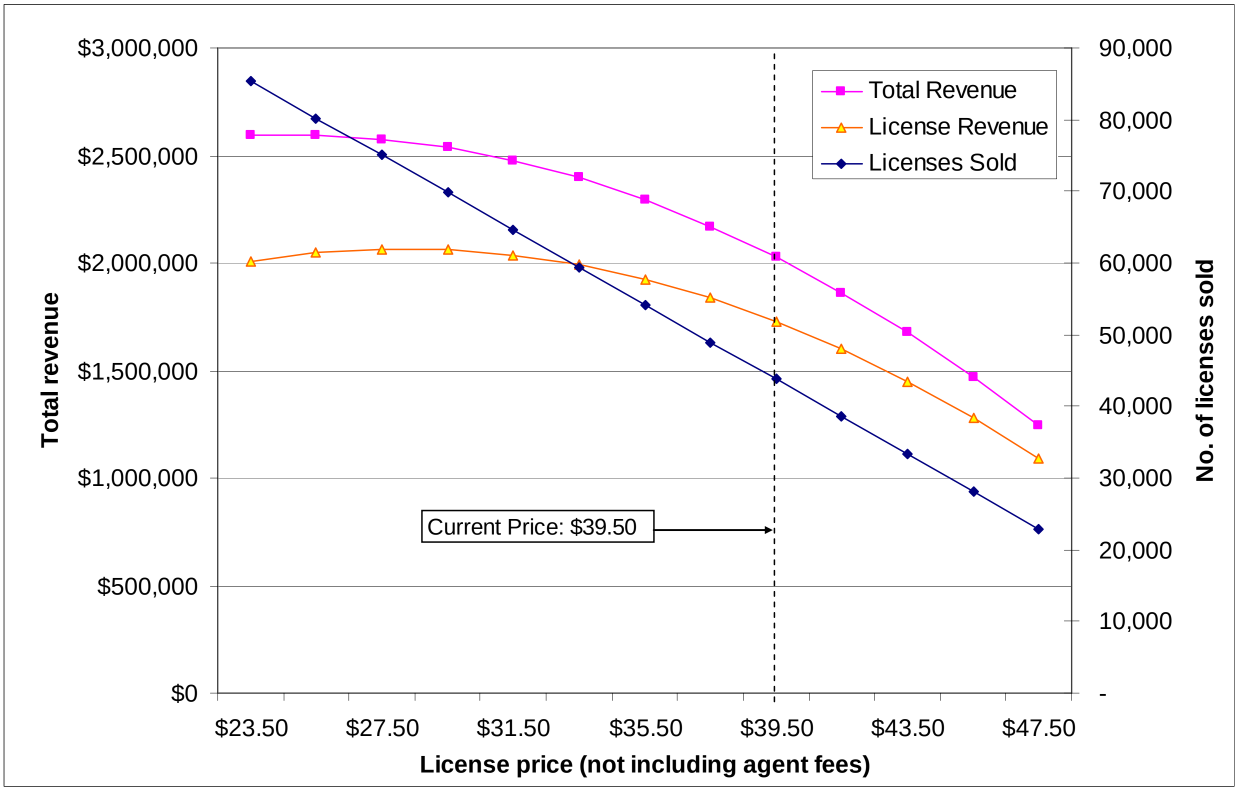
Figure 15. Actual and predicted sales of Non-Resident Individual Angling Licenses.



In 2009, 56,470 Non-Resident Individual Angling Licenses were sold which generated an estimated \$2.62 million in total revenue to the State of Minnesota. This included \$2.23 million in direct revenue from the license sales themselves plus an estimated additional \$0.39 million in Federal Aid in Sport Fish Restoration funds.[10] Figure 16, below, shows the 2010 predictions for revenue and number of licenses sold across a range of prices assuming constant trends in all other factors. Estimated total revenue, including federal aid, is shown as the curved magenta line. Revenue from license sales alone is shown as the curved orange line. The number of licenses sold is represented by the downward sloping demand curve shown in blue. Complete statistical output and model details can be found in Appendix A.

[10] Federal aid resulting from sales of the Non-Resident Individual Angling License is estimated on the basis of one angler per license sold.

Figure 16. Predicted 2010 sales and revenue at various prices – Non-Resident Individual Angling Licenses



The estimated price effect, which determines the slope of the demand curve in Figure 16, indicates that for every dollar that the price of this license is increased the number of Non-Resident Individual Angling Licenses will decrease by 6,389 if all other factors are held constant. However, depending on the elasticity of demand, revenue could rise even as the number of licenses sold decreases. Table 2, below, shows predicted license sales and revenue for four different pricing scenarios.

- Assuming no price increase and constant trends in all other factors, the demand model estimates that 43,751 non-resident individual angling licenses will be sold in 2010, a decrease of 22.5 percent from actual sales in 2009. The estimated total revenue resulting from these sales will be $2.03 million. This includes approximately $1.73 million in direct license revenues and $299,218 in Federal Aid in Sport Fish Restoration funds.

- The model estimates the total revenue maximizing price to be $24.50. At this price total licenses sold would be 82,850 and total estimated revenue would be $2.60 million including $2.03 million in direct license revenue and $566,621 in federal aid. However, a price change of this magnitude is outside the range of historical price changes that were used to develop this model and these predictions should be viewed with caution.

- The price at which direct license revenue is maximized in the model is $28.00. At this price total estimated licenses sold would be 73,727 and direct license revenue would be $2.06 million. Again, though a price change of this magnitude is outside the range of price changes used in the regression analysis and therefore, these predictions should be viewed with caution.

- A one dollar increase in the price of this license to $40.50 would result in a decline in both license sales and total revenue. Sales are predicted to fall by 6.0 percent from the baseline scenario. And, the effect of a reduction in both direct licenses sales revenue and federal aid is a 3.9 percent decline in total revenue.

Table 8. Predicted sales of Non-Resident Individual Angling Licenses under four different pricing scenarios.

Pricing Scenarios	Baseline Scenario (no price change)	Total Revenue Maximizing Scenario*	Direct License Revenue Maximizing Scenario*	$1 License Price Increase
Price	$39.50	$24.50	$28.00	$40.50
Licenses Sold	43,751	82,850	73,727	41,144
License Revenue	$1,728,161	$2,029,823	$2,064,350	$1,666,344
Federal Aid	$299,218	$566,621	$504,227	$281,391
Total Revenue	$2,027,378	$2,596,443	$2,568,577	$1,947,735

** Price change outside range of data used in regression model.*

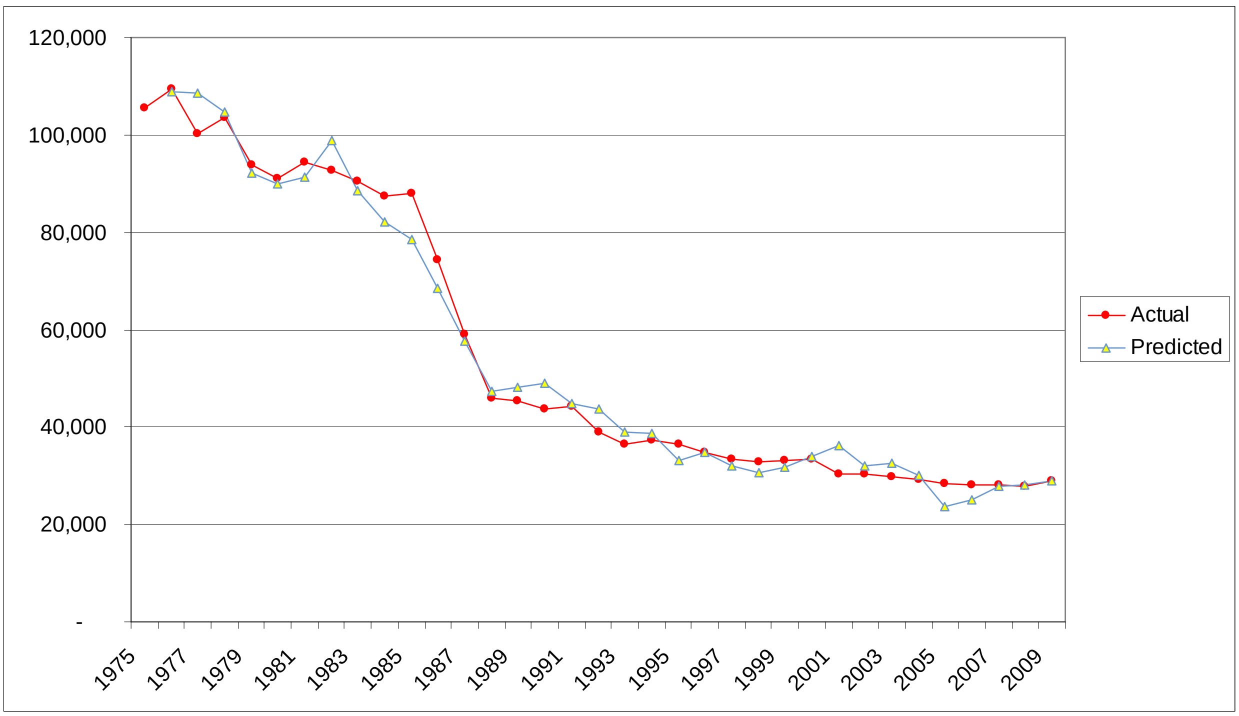
The Non-Resident Individual Angling License is not able to withstand a price increase without negatively impacting both total revenue and direct sales revenue. However, as far as maximizing revenue from this license is concerned, caution should be used in making predictions about the effects of price decreases that are outside the range of past price changes.

The model also indicates that population in the Plains States has a significant and positive impact on licenses sales. Per capita income in the same region also has a significant and positive effect indicating that this license is a normal good. As an individual’s wealth increases, they are more likely to travel to Minnesota and purchase a non-resident license. See Appendix A for further details of the model.

Non-Resident Family Angling License

The trend in Non-Resident Family Angling Licenses sales show a similar pattern as the Non-Resident Individual Angling License. The state saw sharp declines in the number of licenses sold between 1975 and 1993 with sales declining by 65.5 percent. Since 1993, sales have continued to fall but at a much slower rate (20.0 percent). The license sales predicted by the demand model show a good fit to actual sales (Figure 17), with the greatest deviation occurring in 2001 when actual sales decreased from 33,521 to 30,351 despite conditions that were indicative of an increase in sales. The R-squared value for the model is 0.98 indicating that the independent variables used in the model account for 98 percent in the variation in licenses sold (see Table A9 in Appendix A for full statistical details).

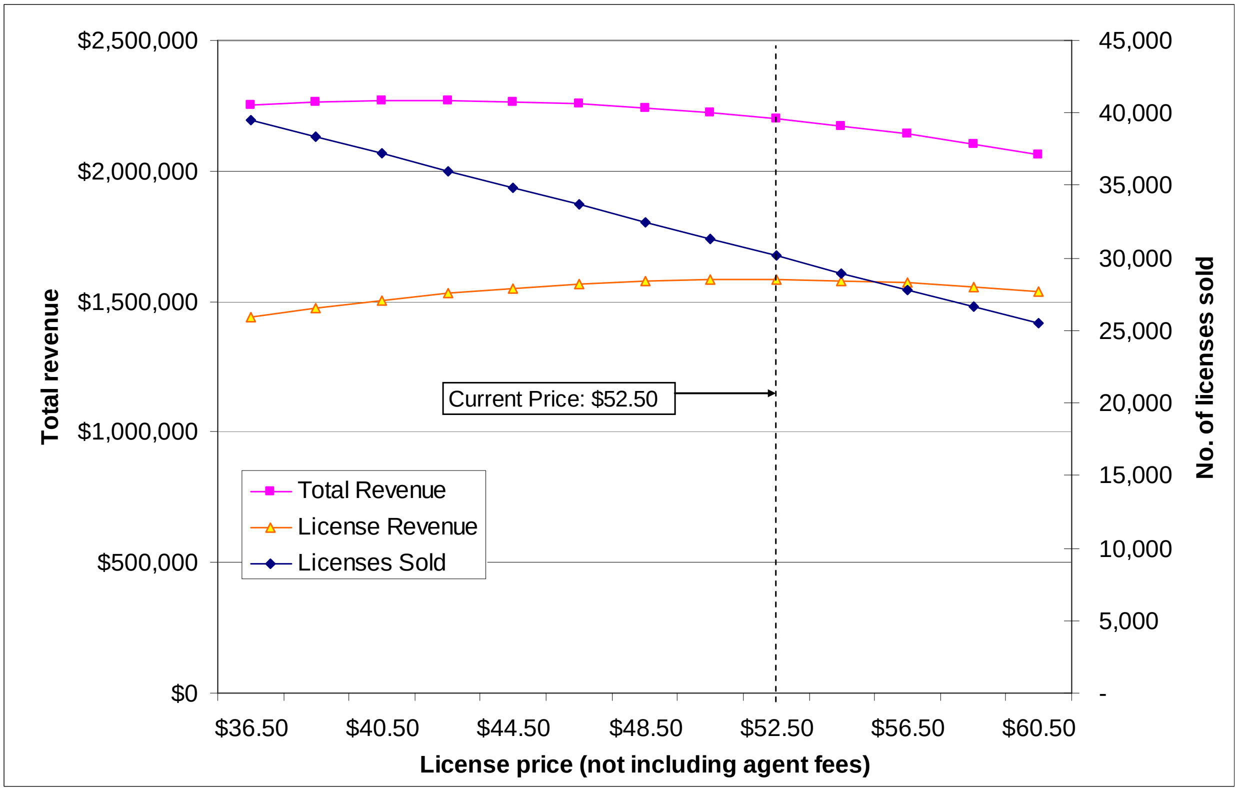
Figure 17. Actual and predicted sales of Non-Resident Family Angling Licenses.



In 2009, 29,094 Non-Resident Family Angling Licenses were sold which generated an estimated $2.12 million in total revenue to the State of Minnesota. This included $1.53 million in direct revenue from the license sales themselves plus an estimated additional $0.60 million in Federal Aid in Sport Fish Restoration funds.[11] Figure 18, below, shows the 2010 predictions for revenue and number of licenses sold across a range of prices assuming constant trends in all other factors. Estimated total revenue, including federal aid, is shown as the curved magenta line. Revenue from license sales alone is shown as the curved orange line. The number of licenses sold is represented by the downward sloping demand curve shown in blue. Complete statistical output and model details can be found in Appendix A.

[11] Federal aid resulting from sales of the Non-Resident Family Angling License is estimated on the basis of three anglers per license sold.

Figure 18. Predicted 2010 sales and revenue at various prices – Non-Resident Family Angling Licenses.



The estimated price effect, which determines the slope of the demand curve in Figure 18, indicates that for every dollar that the price of this license is increased the number of Non-Resident Family Angling Licenses will decrease by 586 if all other factors are held constant. However, depending on the elasticity of demand, revenue could rise even as the number of licenses sold decreases. Table 9, below, shows predicted license sales and revenue for four different pricing scenarios.

- Assuming no price increase and constant trends in all other factors, the demand model estimates that 30,145 Non-Resident Family Angling licenses will be sold in 2010, an increase of 3.6 percent over actual sales in 2009. The estimated total revenue resulting from these sales will be $2.20 million. This includes approximately $1.58 million in direct license revenues and $618,701 in Federal Aid in Sport Fish Restoration funds.

- The model estimates the total revenue maximizing price to be $41.50. At this price total licenses sold would be 36,592 and total estimated revenue would be $2.27 million including $1.52 million in direct license revenue and $751,010 in federal aid. However, a price change of this magnitude is outside the range of historical price changes that were used to develop this model and these predictions should be viewed with caution.

- The price at which direct license revenue is maximized in the model is $52.00, very close to the current price. At this price total estimated licenses sold would be 30,438 and direct license revenue would be $1.58 million. Total revenue would also be higher than the baseline scenario by 0.3 percent.

- A one dollar increase in the price of this license to $53.50 would result in a decline in both license sales and total revenue. Sales are predicted to fall by 1.9 percent from the baseline scenario. And, the effect of a reduction in both direct licenses sales revenue and federal aid is a 0.6 percent decline in total revenue.

Table 9. Predicted sales of Non-Resident Family Angling Licenses under four different pricing scenarios.

Pricing Scenarios	Baseline Scenario (no price change)	Total Revenue Maximizing Scenario*	Direct License Revenue Maximizing Scenario	$1 License Price Increase
Price	$52.50	$41.50	$52.00	$53.50
Licenses Sold	30,145	36,592	30,438	29,559
License Revenue	$1,582,616	$1,518,549	$1,582,780	$1,581,408
Federal Aid	$618,701	$751,010	$624,715	$606,673
Total Revenue	$2,201,317	$2,269,558	$2,207,496	$2,188,081

** Price change outside range of data used in regression model.*

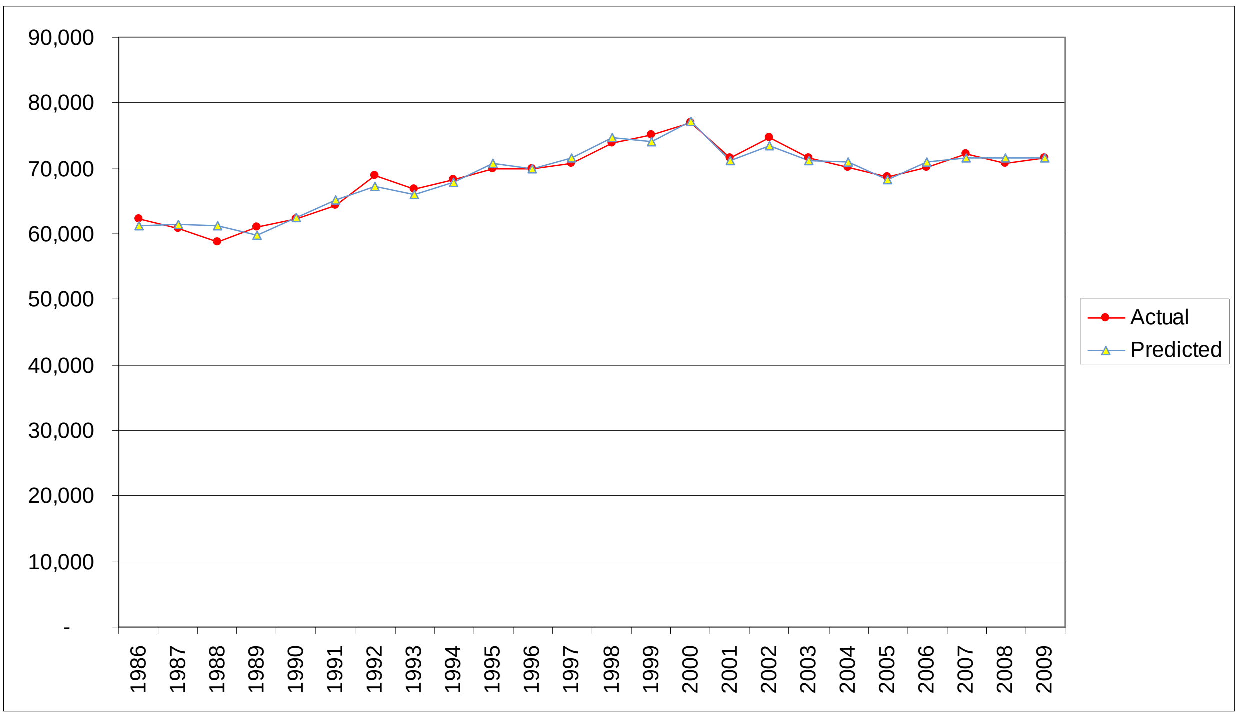
The Non-Resident Family Angling License is not able to withstand a price increase without negatively impacting both direct sales revenue and total revenue including federal aid. In fact, the model indicates that both of these could be increased with a reduction in the price. However, estimates of license sales based on price changes outside the range of historical price changes used to develop this model should be viewed with caution.

Other factors that have a statistically significant effect on sales of this license type are per capita income in the Plains States and the unemployment rate. See Appendix A for further details of the model.

Non-Resident Seven-Day Angling License

Since its introduction in 1982, sales of Non-Resident Seven-Day Angling Licenses have generally been on a slow upward trend. However, since reaching a peak of 76,906 in 2000 they have fallen off a bit and averaged approximately 71,000 since 2003. There were 28 years of sales data for this license type, however, all the variables used in the regression analysis were only available for 23 of them. The license sales predicted by the demand model show a good fit to actual sales (Figure 3), with the greatest deviation occurring in 1988 when actual sales dipped from 60,836 to 58,708. The R-squared value for the model is 0.96 indicating that the independent variables used in the model account for 96 percent in the variation in Licenses sold (see Table A10 in Appendix A for full statistical details).

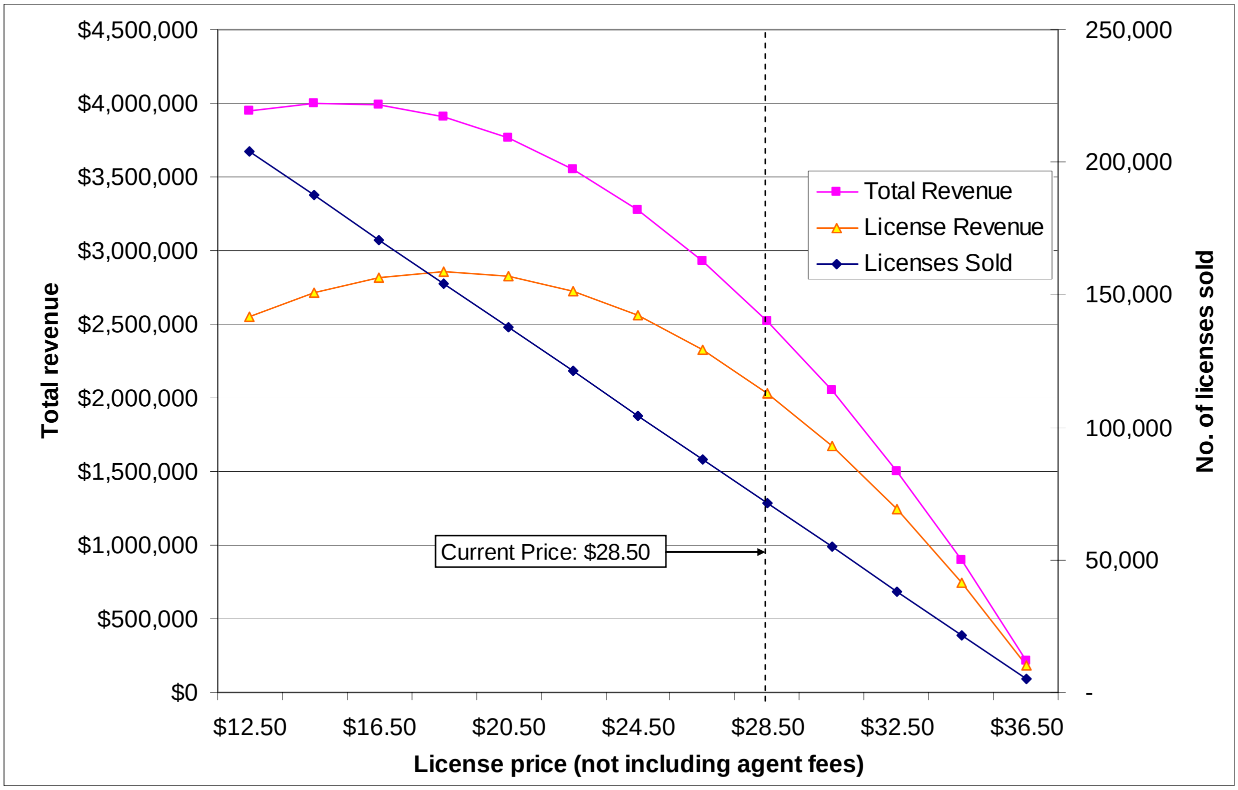
Figure 19. Actual and predicted sale of Non-Resident Seven-Day Angling Licenses.



In 2009, 71,576 Non-Resident Seven-Day Angling Licenses were sold which generated an estimated $2.53 million in total revenue to the State of Minnesota. This included $2.04 million in direct revenue from the license sales themselves plus an estimated additional $0.50 million in Federal Aid in Sport Fish Restoration funds.[12] Figure 20, below, shows the 2010 predictions for revenue and number of licenses sold across a range of prices assuming constant trends in all other factors. Estimated total revenue, including federal aid, is shown as the curved magenta line. Revenue from license sales alone is shown as the curved orange line. The number of licenses sold is represented by the downward sloping demand curve shown in blue. Complete statistical output and model details can be found in Appendix A.

[12] Federal aid resulting from sales of the Non-resident Seven Day Angling license is estimated on the basis of one angler per license sold.

Figure 20. Predicted 2010 sales and revenue at various prices – Non-Resident Seven-Day Angling Licenses.



The estimated price effect, which determines the slope of the demand curve in Figure 20, indicates that for every dollar that the price of this license is increased the number of Non-Resident Seven-Day Angling Licenses will decrease by 8,292 if all other factors are held constant. However, depending on the elasticity of demand, revenue could rise even as the number of licenses sold decreases. Table 10, below, shows predicted license sales and revenue for four different pricing scenarios.

- Assuming no price increase and constant trends in all other factors, the demand model estimates that 71,389 Non-Resident Seven-Day Angling Licenses will be sold in 2010, a decrease of 0.3 percent over actual sales in 2009. The estimated total revenue resulting from these sales will be $2.52 million. This includes approximately $2.03 million in direct license revenues and $487,995 in Federal Aid in Sport Fish Restoration funds.

- The model estimates the total revenue maximizing price to be $15.00. At this price total licenses sold would be 183,327 and total estimated revenue would be $4.00 million including $2.75 million in direct license revenue and $1.25 million in federal aid. However, a price change of this magnitude is well outside the range of historical price changes that were used to develop this model and these predictions should be viewed with caution.

- The price at which direct license revenue is maximized in the model is $18.50. At this price total estimated licenses sold would be 154,306 and direct license revenue would be $3.91 million. Again, though, a price change of this magnitude is well outside the range of historical price changes that were used to develop this model and these predictions should be viewed with caution.

- A one dollar increase in the price of this license to $29.50 would result in a decline in both license sales and total revenue. Licenses sold are predicted to fall by 11.6 percent from the baseline scenario. And, the effect of a reduction in both direct licenses sales revenue and federal aid is a 9.1 percent decline in total revenue.

Table 10. Predicted sales of Non-Resident Seven-Day Angling Licenses under four different pricing scenarios.

Pricing Scenarios	Baseline Scenario (no price change)	Total Revenue Maximizing Scenario*	Direct License Revenue Maximizing Scenario*	$1 License Price Increase
Price	$28.50	$15.00	$18.50	$29.50
Licenses Sold	71,389	183,327	154,306	63,097
License Revenue	$2,034,583	$2,749,908	$2,854,664	$1,861,366
Federal Aid	$487,995	$1,253,175	$1,054,795	$431,315
Total Revenue	$2,522,578	$4,003,083	$3,909,459	$2,292,681

** Price change outside range of data used in regression model.*

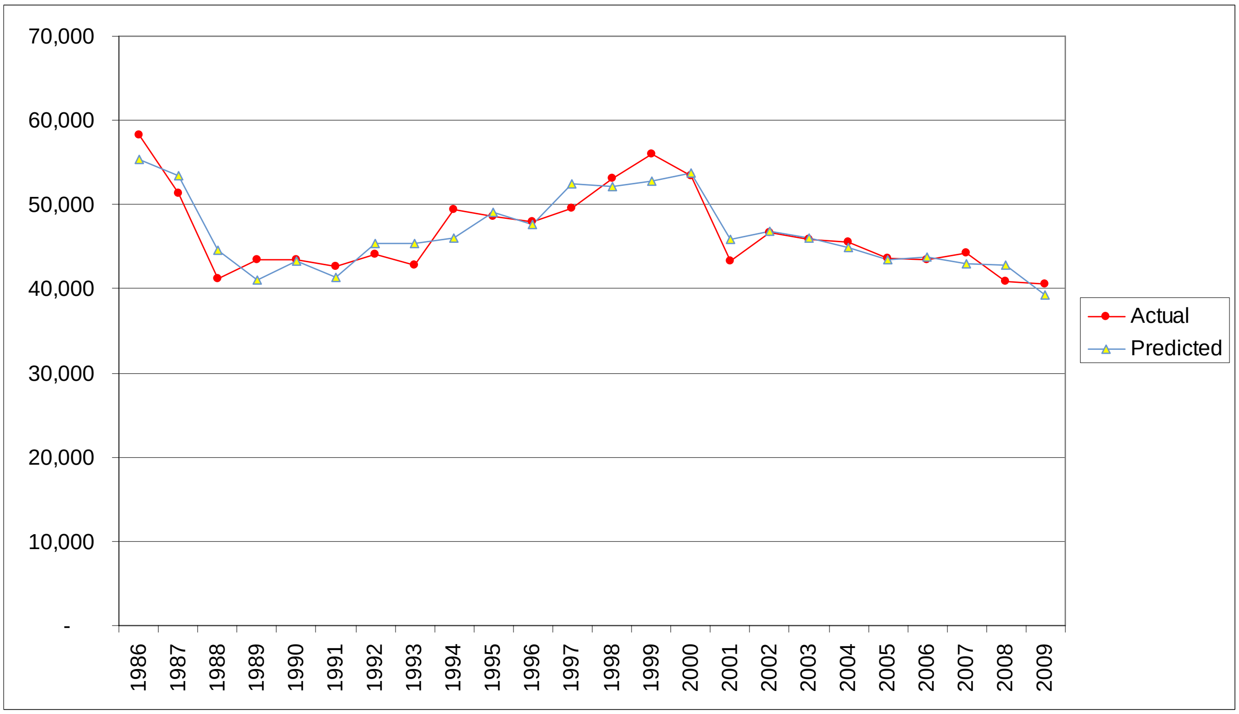
The Non-Resident Seven-Day Angling License is not able to withstand a price increase without negatively impacting both direct sales revenue and total revenue including federal aid. *However, as far as drawing conclusions about what the revenue maximizing price would be, it should be kept in mind that these models cannot accurately predict the result of a price change outside the range of historical price changes used to develop these models.*

The model also found that there is a statistically significant substitution effect with the Non-Resident Three-Day Angling License. A one dollar increase in the price of that license would result in an increase of 9,405 non-resident seven-day angling licenses sold. Population in the Plains States has a significant and positive impact on licenses sales. Per capita income in the same region also has a significant and positive effect indicating that this license is a normal good, meaning that as an individual's wealth increases they are more likely to purchase a license. Two other factors that influence sales of Non-Resident Seven-Day Angling Licenses are January rainfall and February temperatures, possibly due to their effects on the ice fishing season (see Appendix A for further details of the model).

Non-Resident 72-hour Angling License

Since its introduction in 1986, sales of the Non-Resident 72-hour Angling licenses have generally been on an erratic downward trend. Initial sales totaled 58,219 but sales quickly fell over the next two years to 41,188. Sales again peaked in 1999 at 53,046 but have again fallen to 40,491. The license sales predicted by the demand model show a good fit to actual sales (Figure 21), with the greatest deviation occurring in 1988 when actual sales decreased dramatically by 19.8 percent. The R-squared value for the model is 0.85 indicating that the independent variables used in the model account for 85 percent in the variation in licenses sold (see Table A11 in Appendix A for full statistical details).

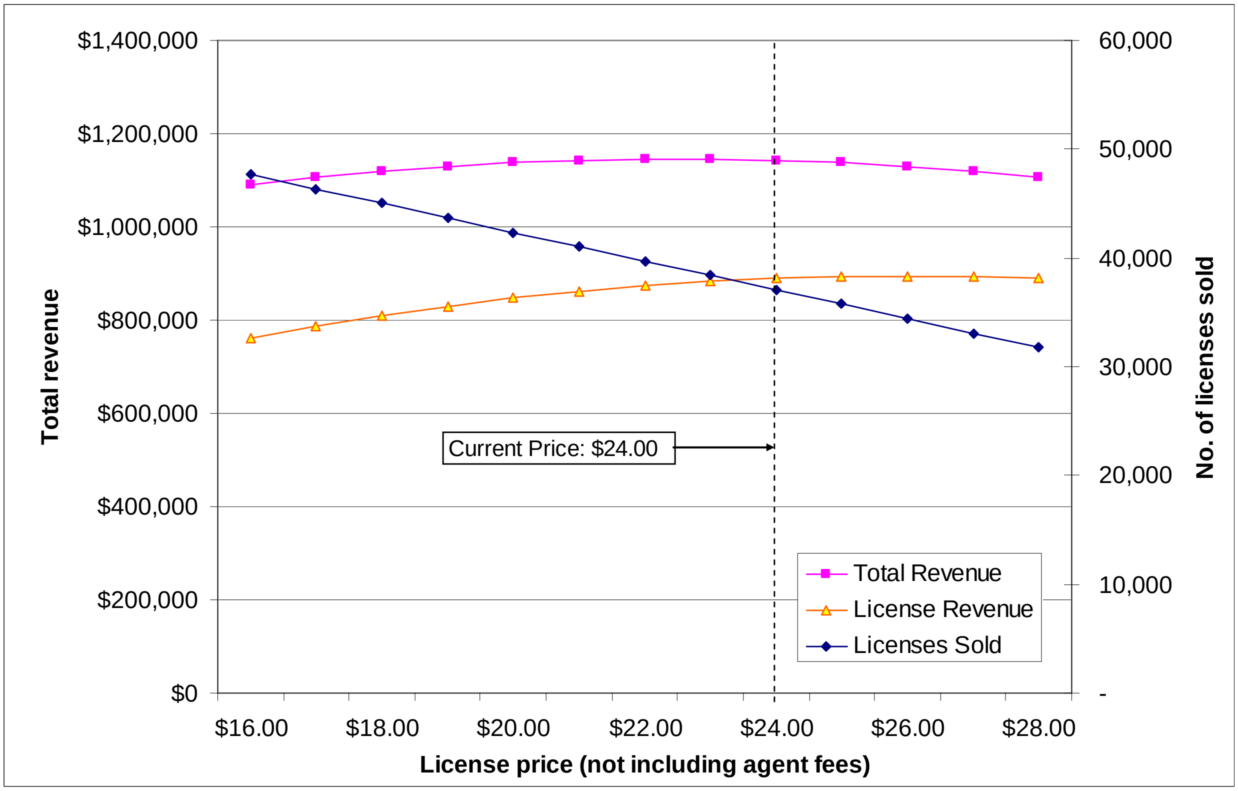
Figure 21. Actual and predicted sales of Non-Resident 72-hour Angling License



In 2009, 40,491 Non-Resident 72-hour Angling licenses were sold which generated an estimated $1.25 million in total revenue to the State of Minnesota. This included $0.97 million in direct revenue from the license sales themselves plus an estimated additional $0.28 million in Federal Aid in Sport Fish Restoration funds.[13] Figure 22, below, shows the 2010 predictions for revenue and number of licenses sold across a range of prices assuming constant trends in all other factors. Estimated total revenue, including federal aid, is shown as the curved magenta line. Revenue from license sales alone is shown as the curved orange line. The number of licenses sold is represented by the downward sloping demand curve shown in blue. Complete statistical output and model details can be found in Appendix A.

[13] Federal aid resulting from sales of the Non-Resident 72-hour Angling License is estimated on the basis of one angler per license sold.

Figure 22. Predicted 2010 sales and revenue at various prices – Non-Resident 72-hour Angling Licenses.



The estimated price effect, which determines the slope of the demand curve in Figure 22, indicates that for every dollar that the price of this license is increased the number of Non-Resident 72-hour Licenses will decrease by 1,325 if all other factors are held constant. However, depending on the elasticity of demand, revenue could rise even as the number of licenses sold decreases. Table 11, below, shows predicted license sales and revenue for four different pricing scenarios.

- Assuming no price increase and constant trends in all other factors, the demand model estimates that 37,069 Non-Resident 72-hour Angling licenses will be sold in 2010, a decrease of 8.5 percent from actual sales in 2009. The estimated total revenue resulting from these sales will be $1.14 million. This includes approximately $0.89 million in direct license revenues and $253,549 in Federal Aid in Sport Fish Restoration funds.

- The model estimates the total revenue maximizing price to be $22.50. At this price total licenses sold would be 39,057 and total estimated revenue would be $1.14 million including $0.88 million in direct license revenue and $267,145 in federal aid.

- The price at which direct license revenue is maximized in the model is $26.00. At this price total estimated licenses sold would be 34,419 and direct license revenue would be $235,422.

- A one dollar increase in the price of this license to $25.00 would result in a decline in both license sales and total revenue. The number of licenses sold is predicted to fall by

3.6 percent from the baseline scenario. While direct license sales revenue would increase by 0.4 percent, total revenue would decrease by 0.4 percent due to the loss in federal aid. The effect on total revenue, however, depends on the assumption that all of the anglers choosing not to purchase this license drop out of fishing in Minnesota altogether.

Table 11. Predicted sales of Non-Resident 72-hour Angling Licenses under four different pricing scenarios.

Pricing Scenarios	Baseline Scenario (no price change)	Total Revenue Maximizing Scenario	Direct License Revenue Maximizing Scenario	$1 License Price Increase
Price	$24.00	$22.50	$26.00	$25.00
Licenses Sold	37,069	39,057	34,419	35,744
License Revenue	$889,663	$878,783	$894,894	$893,604
Federal Aid	$253,549	$267,145	$235,422	$244,486
Total Revenue	$1,143,213	$1,145,928	$1,130,316	$1,138,089

The Non-Resident 72-hour Angling License is currently priced between the total revenue maximizing price and the direct license revenue maximizing scenarios. From the standpoint of total revenue maximization, the model suggests lowering the price by $1.50 from the baseline, thereby increasing both the number of licenses sold (5.4 percent) and revenue (0.2 percent), factoring in federal aid. Alternatively, increasing the price by $2.00 from the baseline maximizes direct sales revenue, however both the number of sales and total revenue will fall, 7.1 and 1.1 percent respectively. The results of the Non-Resident Seven-Day License, however, indicate that some of the anglers choosing to no longer purchase the 24-hour license will instead purchase the seven-day license. This would at least partially offset this decrease in federal aid from the loss in the number of 72-hour licenses sold.

The model also found a small substitution effect between this license and the Wisconsin two-day non-resident license. For every dollar that Wisconsin increases the price of their two-day license, 760 more Non-Resident 72-hour Angling licenses will be sold in Minnesota. Population in the Plains States does have a significant and positive impact on licenses sales. See Appendix A for further details of the model.

CONCLUSIONS

Based on the preceding demand models, four of the eleven licenses analyzed could withstand a price increase from the standpoint of increasing revenue. These are:

- Resident/Non-Resident 24-hour Angling
- Resident Individual Angling (minimal price increase only)
- Resident Deer Firearm
- Resident Deer Archery

An additional four licenses are not able to withstand a price increase if the effect on federal aid is considered, but are from the standpoint of increasing direct license revenue:

- Resident Combination (Husband/Wife) Angling
- Non-Resident 72-hour Angling
- Resident Individual Sports
- Resident Combination (Husband/Wife) Sports

However, the following licenses are not able to withstand a price increase from the standpoint of increasing either direct license revenue or total revenue including federal aid:

- Non-Resident Individual Angling
- Non-Resident Family Angling
- Non-Resident Seven-Day Angling

The demand models presented in this report should be used to gauge the relative change in licenses sales and not to make exact prediction of sales levels at a given price. This is especially true at prices that would involve a price change outside the range of any that have occurred in the past.

When looking at the impact of federal aid on total revenue generated by each of these licenses, it should be kept in mind that estimates of licenses sold and revenue generated presented for each of these licenses are developed individually and assume that all other factors other than the price of license in question do not change. In the case of combination and family licenses especially, it is likely that with a price increase, at least one of the individuals covered will buy an individual hunting or fishing license which will cause the decrease in overall federal aid to be less than is predicted by the individual license demand model. To fully estimate the effects of price increases on Federal Aid in Wildlife and Sport Fish Restoration funds, the effects on the numbers of hunters and anglers from all proposed license price changes must be taken into account.

Appendix A: License Sales Equations

A maximum of thirty-five years of data (1975-2008) were used to estimate the demand equations. Historical license sales and prices of Minnesota licenses were provided by the Minnesota Department of Natural Resources. Historical population, per capita income, and unemployment measures were obtained from the U.S. Bureau of the Census, the U.S. Bureau of Economic Analysis, and the U.S. Bureau of Labor Standards, respectively. Climate data were obtained from the National Oceanographic and Atmospheric Administration and gasoline prices were obtained from the U.S. Energy Information Office.

All prices in the model are adjusted for inflation and indexed to 2009 prices. The real price of a license declines in each year subsequent to a price increase due to inflation.[14] In other words, constant nominal license prices result in the price of an angling license being a better deal relative to other items an angler buys whose prices increase due to inflation. For modeling purposes, this also creates annual variation in the monetary variables while the nominal price only changes in years when license prices actually increase.

The following sections document the statistical equations used to analyze the sales of fishing and hunting licenses. The findings reported here are important for interpreting the previously reported revenue predictions, and the interpretations can help MDNR develop strategies to maintain and enhance revenues from license sales.

[14] With the exception of 2009 in which the economy experienced deflation.

Resident Individual Angling Licenses

Model Specification

$$q\_f\_r\_ann = a + b*year + c*p\_f\_r\_ann + d*pop + e*rate + f*persinc + g*gas + h*p\_h\_r\_sports + i*p\_r\_combo + j*jantemp$$

where:

a, b, c, d, e, f, g, h, i, and j are coefficients to be estimated.

q_f_r_ann is the number of Resident Individual Angling Licenses sold per year.

year is the trend in license sales not accounted for by other variables in the model.

p_f_r_ann is the inflation adjusted price of the Resident Individual Angling License.

pop is the population of Minnesota.

rate is the average annual unemployment rate in Minnesota.

persinc is the per capita personal income in Minnesota adjusted for inflation.

gas is the inflation adjusted price of a gallon of regular gasoline in the United States.

p_h_r_sports is the inflation adjusted price of the resident individual sports license.

p_r_combo is the inflation adjusted price of the resident combination angling license.

jantemp is the average temperate for the month of January.

The coefficients to be estimated reflect the effect that each of the variables has on annual license sales. The coefficient (b) on *year* is indeterminate and is included to account for the overall trend in sales. The coefficient on *p_f_r_ann* (c) is expected to be negative; as price increases, sales will decline. The coefficient (d) on *pop* is indeterminate; a larger population could mean more people who buy licenses to fish but it could also mean the loss of habitat and access which could discourage people from fishing. The coefficient (e) on *rate* is indeterminate; it is not clear whether license sales would increase due to more time available to the unemployed or decrease due to reduced income. The coefficient on *persinc* (f) is indeterminate; assuming a fishing license is a normal good, meaning people buy more of it when they have more money, the sign on the coefficient would be positive. However, greater income could be correlated with other lifestyle choices that do not include fishing. The coefficient on *gas* (g) is indeterminate; it would be negative if it significantly increases the cost of traveling to go fishing; it would be positive, though, if higher gas prices discourage travel to take part in competing recreational activities. The expected sign of the coefficient on *p_h_r_sports* (h) is expected to be positive; as the price of the substitute license increases, sales will increase. The expected sign on the coefficient on *p_r_combo* is expected to be positive for the same reason. The coefficient (j) on *jantemp* is expected to be indeterminate; colder temperatures tend to produce better ice conditions, thereby increasing the number of anglers during winter months. However, colder temperatures also have the potential to discourage anglers from heading out into inclement conditions.

Estimated Equations

Table A1 presents the coefficient estimates for each variable in the resident individual angling license demand equation. The variables marked with an asterisk have coefficient estimates statistically significant at the 95 percent confidence level.

Table A1. Coefficient estimates for the Resident Individual Angling License.

Dep. Var.: q_f_r_ann	Coefficient	P>t
_cons *	-43063050.3	0.000
year *	22959.96	0.000
p_f_r_ann *	-18799.48	0.003
pop *	-0.590944	0.000
rate *	7650.75	0.041
persinc *	11.325	0.002
gas *	23281.69	0.002
p_h_r_sports	-3206.98	0.189
p_r_combo *	14838.01	0.008
jantemp *	-856.17	0.034
R-squared	0.960	

**Indicates statistically significant effect.*

The coefficient on the trend variable (*year*) is positive and statistically significant indicating that there has been a clear trend in sales over time not accounted for by the other factors in the model. The coefficient on *p_f_r_ann* (the price of a resident individual angling license) is negative and statistically significant. Each dollar increase in the price of a license results in 18,799 fewer licenses sold. Population in Minnesota is a statistically significant negative factor in license sales. Unemployment has a positive effect on sales and suggests that an increase in the number of people who are not working leads to more fishing activity. Per capita income is a statistically significant positive factor in license sales indicating that the Resident Individual Angling License is a normal good. The price of gas has a statistically significant, positive effect on license sales suggesting that residents are postponing travel to take part in competing recreational activities including angling. The coefficient on the price of the Resident Individual Sports License is statistically insignificant suggesting that a change in the price of the individual sports license does not have a statistical impact on the number of individual angling licenses sold. The price of the Resident Combination Angling License is positive and significant; a one dollar increase in the price of this license will result in 14,838 more individual angling licenses being sold. January temperature is negatively correlated with sales of this license. The model is a very good fit as indicated by the R-squared value of 0.96 meaning that the independent variables included in the model account for 96.0 percent of the variation in the number of Resident Individual Angling Licenses sold.

Residential Combination (Husband/Wife) Angling License

Model Specification

q_r_combo = a + b**year* + c**p_r_combo* + d**p_h_r_csports* + e**p_f_r_ann* + f**rate* + g**gas* + h**aprtemp* + i**junrain*

where:

a, b, c, d, e, f, g, h, and i are coefficients to be estimated.

q_r_combo is the number of Resident Combination Angling Licenses sold per year.

year is the trend in license sales not accounted for by other variables in the model.

p_r_combo is the inflation adjusted price of the Resident Combination Angling License.

p_h_r_csports is the inflation adjusted price of the Resident Combination Sports License.

p_f_r_ann is the inflation adjusted price of the Resident Individual Angling License.

rate is the average annual unemployment rate in Minnesota.

gas is the inflation adjusted price of a gallon of regular gasoline in the United States.

aprtemp is the average temperature in Minnesota for the month of April.

junrain is the total rainfall in Minnesota in inches for the month of June.

The coefficients to be estimated reflect the effect that each of the variables has on annual license sales. The coefficient (b) on *year* is indeterminate and is included to account for the overall trend in sales. The coefficient on *p_r_combo* (c) is expected to be negative; as price increases, sales will decline. The coefficient (d) on *p_h_r_csports* is expected to be positive; as the price of the substitute license increases, sales will increase. The expected sign on the coefficient on *p_f_r_ann* is expected to be positive for the same reason. The coefficient (f) on *rate* is indeterminate; it is not clear whether license sales would increase due to more time available to the unemployed or decrease due to reduced income. The coefficient (g) on *gas* is indeterminate; it would be negative if it significantly increases the cost of traveling to go fishing or has a negative income effect; it would be positive, though, if higher gas prices discourage residents from traveling to fish out of state. The coefficient on *aprtemp* (h) is expected to be positive; warmer than normal temps may encourage people to engage in water activities such as fishing. The expected sign of the coefficient on *junrain* (i) is indeterminate; more rainfall in June could discourage people from fishing in the short term but it could also lead to better fishing conditions by raising the water levels of streams and ponds.

Table A2. Coefficient estimates for the Residential Combination Angling License.

Dep. Var.: q_r_combo	Coefficient	P>t
_cons *	8056051	0.000
year *	-3947.3	0.000
p_r_combo *	-5845.0	0.001
p_h_r_csports	916.4	0.339
p_f_r_ann *	6338.2	0.000
rate	2014.1	0.080
gas *	10311.6	0.004
aprtemp *	1004.1	0.002
junrain *	-2768.4	0.003
R-squared	0.986	

**Indicates statistically significant effect.*

Estimated Equations

Table A2 presents coefficient estimates for each variable in the Residential Combination Angling License demand equation. The variables marked with an asterisk have coefficient estimates statistically significant at the 95 percent confidence level.

The coefficient on the trend variable (*year*) is negative and statistically significant indicating that there has been a clear trend in sales over time not accounted for by the other factors in the model. The coefficient on *p_r_combo* (the price of a Resident Combination Angling License) is negative, as expected, and statistically significant. Each dollar increase in the price of a license results in 5,845 fewer licenses sold. The coefficient on the price of the Resident Combination Sports License is statistically insignificant suggesting that a change in the price of the Resident Combination Sports License does not have a statistical impact on the number of Resident Combination Angling Licenses sold. The price of the Resident Individual Angling License is positive and significant; a one dollar increase in the price of this license will result in 6,338 more combination angling licenses being sold. Unemployment has no statistically significant effect on sales of this license. The price of gas has a statistically significant, positive effect on license sales suggesting that residents are choosing to engage in activities closer to home, including fishing. April temperature is positively correlated with sales of the Resident Combination Angling Licenses. June rainfall is negatively correlated with sales of this license. The model is a very good fit as indicated by the R-squared value of 0.986 meaning that the independent variables included in the model account for 98.6 percent of the variation in the number of Resident Combination Angling Licenses sold.

Resident Firearm Deer Hunting License

<u>Model Specification</u>

q_h_r_DeerGun = a + b**year* + c**p_h_r_DeerGun* + d**pop* + e**persinc* + f**gas* + g**deer_mz* + h**septemp* + i**marrain*

where:

a, b, c, d, e, f, g, h, and i are coefficients to be estimated.

q_h_r_DeerGun is the number of Resident Firearm Deer Hunting Licenses sold per year.

year is the trend in license sales not accounted for by other variables in the model.

p_h_r_DeerGun is the inflation adjusted price of the Resident Firearm Deer Hunting License.

pop is the population of Minnesota.

persinc is the per capital personal income in Minnesota adjusted for inflation.

gas is the inflation adjusted price of a gallon of regular gasoline in the United States.

deer_mz is the control variable for the availability of a multi-zone deer firearm license.

septemp is the average temperature in Minnesota for the month of September.

marrain is the total rainfall or snow equivalent in Minnesota in inches (of rain) for the month of March.

The coefficients to be estimated reflect the effect that each of the variables has on annual license sales. The coefficient (b) on *year* is indeterminate and is included to account for the overall trend in sales. The coefficient on *p_h_r_DeerGun* (c) is expected to be negative; as price increases, sales will decline. The coefficient (d) on *pop* is indeterminate; a larger population could mean more people who buy licenses to hunt but it could also mean the loss of habitat and access which could discourage people from hunting. The coefficient on *persinc* (e) is indeterminate; assuming a hunting license is a normal good, meaning people buy more of it when they have more money, the sign on the coefficient would be positive. However, greater income could be correlated with other lifestyle choices that do not include hunting. The coefficient (f) on *gas* is indeterminate; it would be negative if it significantly increases the cost of traveling to go fishing or had a negative income effect; it would be positive, though, if higher gas prices discourage residents from traveling to take part in competing recreational activities including fishing in another state. The coefficient on *deer_mz* (g) is expected to be negative; during the period this license was offered (2002-2007) many deer hunters chose this license instead.[15] The coefficient on *septemp* (h) is expected to be negative; colder temperatures are generally more conducive to deer hunting. The expected sign of the coefficient on *marrain* (i) is negative. Greater snowfall in March would have a negative impact on the deer population which could discourage hunters from getting out into the field during the following deer season.

[15] The year it was introduced (2002), sales of Resident Firearm Deer licenses fell by 8.2 percent. The first year that it was no longer available (2008), sales of Resident Firearm Deer licenses increased by 25.6 percent.

Table A3. Coefficient estimates for the Resident Firearm Deer Hunting License.

Dep. Var.: q_h_r_DeerGu	Coefficient	P>t
_cons *	-37244735.36	0.000
year *	20047.72	0.000
p_h_r_DeerGun *	-3568.466	0.021
pop *	-0.3524223	0.000
persinc *	-7.76	0.029
gas *	-38291.160	0.000
deer_mz *	-49788.60	0.000
septemp *	-4048.06	0.010
marrain	-9731.434	0.092
R-squared	0.877	

**Indicates statistically significant effect.*

Estimated Equations

Table A3 presents the coefficient estimates for each variable in the Resident Firearm Deer Hunting License demand equation. The variables marked with an asterisk have coefficient estimates statistically significant at the 95 percent confidence level.

The coefficient on the trend variable (*year*) is positive and statistically significant indicating that there has been a clear trend in sales over time not accounted for by the other factors in the model. The coefficient on *p_h_r_DeerGun* (the price of a Resident Firearm Deer Hunting license) is negative, as expected, and statistically significant. Each dollar increase in the price of a license results in 3,568 fewer licenses sold. Population in Minnesota is a statistically significant negative factor in license sales. Per capita income is a statistically significant negative factor in license sales indicating that higher incomes are associated with lifestyles that don’t include hunting. The price of gas has a statistically significant, negative effect on license sales suggesting that travel costs, even within state, are a factor in a hunter’s decision to hunt. The availability of a multi-zone deer firearm license has the expected negative impact on sales of resident firearm deer hunting licenses. September temperature is negatively correlated with sales of the firearm deer licenses. March rainfall/snowfall is also negatively correlated with sales of this license as would be expected. The model is a good fit as indicated by the R-squared value of 0.877 meaning that the independent variables included in the model account for 87.7 percent of the variation in the number of firearm deer licenses sold.

Resident Archery Deer Hunting License

Model Specification

q_h_r_deerbow = a + b**year* + c**p_h_r_DeerBow* + d**pop* + e**persinc* + f**gas* + g**deerg_mz* + h**septemp* + i**janrain*

where:

a, b, c, d, e, f, g, h, and i are coefficients to be estimated.

q_h_r_deerbow is the number of Resident Archery Deer Hunting Licenses sold per year.

year is the trend in license sales not accounted for by other variables in the model.

p_h_r_DeerBow is the inflation adjusted price of the Resident Archery Deer Hunting License.

pop is the population of Minnesota.

persinc is the per capita personal income in Minnesota adjusted for inflation.

gas is the inflation adjusted price of a gallon of regular gasoline in the United States.

deerg_mz is the control variable for the availability of a multi-zone deer firearm license.

septemp is the average annual temperature in Minnesota for the month of September.

janrain is the total rain or equivalent snowfall in Minnesota in inches for the month of January.

The coefficients to be estimated reflect the effect that each of the variables has on annual license sales. The coefficient (b) on *year* is indeterminate and is included to account for the overall trend in sales. The coefficient on *p_h_r_DeerBow* (c) is expected to be negative; as price increases, sales will decline. The coefficient (d) on *pop* is indeterminate; a larger population could mean more people who buy licenses to hunt but it could also mean the loss of habitat and access which could discourage people from hunting. The coefficient on *persinc* (e) is indeterminate; assuming a hunting license is a normal good, meaning people buy more of it when they have more money, the sign on the coefficient would be positive. However, greater income could be correlated with other lifestyle choices that do not include hunting. The coefficient (f) on *gas* is indeterminate; it would be negative if it significantly increases the cost of traveling to go fishing for non-residents; it would be positive, though, if higher gas prices discourage residents from traveling to take part in competing recreational activities. The coefficient on *deerg_mz* (g) is expected to be negative; during the period this license was offered (2002-2007) many deer hunters chose this license instead.[16] The coefficient on *septemp* (h) is expected to be negative; colder temperatures are generally more conducive to deer hunting. The expected sign of the coefficient on *janrain* (i) is negative. Deeper snowfalls over the winter tend to stress the health and survival of the deer herd. Herds of poorer health tend to increase the likelihood of intervention to limit harvests and discourage hunters to go out into the field during deer season.

[16] The year it was introduced (2002), sales of Resident Archery Deer licenses fell by 17.3 percent. The first year that it was no longer available (2008), sales of Resident Archery Deer licenses increased by 66.5 percent.

Table A4. Coefficient estimates for the Resident Archery Deer Hunting License.

Dep. Var.: q_h_r_deerbov	Coefficient	P>t
_cons *	-12516428.93	0.000
year *	6620.62	0.000
p_h_r_DeerBow *	-688.9888	0.027
pop *	-0.1053167	0.000
persinc *	-1.72	0.024
gas *	-3833.839	0.047
deerg_mz *	-22020.06	0.000
septemp	-557.41	0.073
janrain	-3201.105	0.056
R-squared	0.949	

**Indicates statistically significant effect.*

Estimated Equations

Table A4 presents the coefficient estimates for each variable in the resident archery deer hunting license demand equation. The variables marked with an asterisk have coefficient estimates statistically significant at the 95 percent confidence level.

The coefficient on the trend variable (*year*) is positive and statistically significant indicating that there has been a clear trend in sales over time not accounted for by the other factors in the model. The coefficient on *p_h_r_DeerBow* (the price of an Archery Deer Hunting License) is negative, as expected, and statistically significant. Each dollar increase in the price of a license results in 689 fewer licenses sold. Population in Minnesota is a statistically significant negative factor in license sales. Per capita income is a statistically significant negative factor in license sales indicating that the Resident Firearm Deer Hunting License is not a normal good. The price of gas has a statistically significant, negative effect on license sales; each ten cent increase in the price of gas translates into 383 fewer Resident Archery Deer Hunting Licenses sold. The availability of a multi-zone deer firearm license shows the expected negative impact on sales of Resident Archery Deer Hunting licenses. September temperature is negatively correlated with sales of the Resident Archery Deer Hunting licenses as is January rainfall as was expected The model is a very good fit as indicated by the R-squared value of 0.949 meaning that the independent variables included in the model account for 94.9 percent of the variation in the number of Resident Archery Deer licenses sold.

Resident Individual Sports License

<u>Model Specification</u>

q_h_r_sports = a + b**year* + c**p_h_r_sports* + d**p_f_r_ann* + e**pop* + f*gas + g**febtemp* + h**septemp* + i**annrain*

where:

a, b, c, d, e, f, g, h, and i are coefficients to be estimated.

q_h_r_sports is the number of Resident Individual Sports Licenses sold per year.

year is the trend in license sales not accounted for by other variables in the model.

p_h_r_sports is the inflation adjusted price of the Resident Individual Sports License.

p_f_r_ann is the inflation adjusted price of the Resident Individual Angling License.

pop is the population of Minnesota.

gas is the inflation adjusted price of a gallon of regular gasoline in the United States.

febtemp is the average temperature in Minnesota for the month of February.

septemp is the average temperature in Minnesota for the month of September.

annrain is the total rainfall or snow equivalent in Minnesota in inches for the year.

The coefficients to be estimated reflect the effect that each of the variables has on annual license sales. The coefficient (b) on *year* is indeterminate and is included to account for the overall trend in sales. The coefficient on *p_h_r_sports* (c) is expected to be negative; as price increases, sales will decline. The expected sign of the coefficient on *p_f_r_ann* (d) is expected to be positive; as price of the substitute license increases, sales will increase. The coefficient (e) on *pop* is indeterminate; a larger population could mean more people who buy licenses to fish or hunt but it could also mean the loss of habitat and access which could discourage people from fishing or hunting. The coefficient (f) on *gas* is indeterminate; it would be negative if it significantly increases the cost of traveling to go fishing or hunting; it would be positive, though, if higher gas prices discourage residents from traveling to take part in competing recreational activities. The expected sign of the coefficient on *febtemp* (g) is indeterminate; colder temperatures tend to produce better ice conditions thereby increasing the number of anglers during winter months. However, colder temperatures also have the potential to discourage anglers from heading out into inclement conditions. The coefficient on *septemp* (h) is indeterminate; warmer than normal temps may encourage people to engage in outdoor recreational activities but colder temperatures tend to be more conducive to hunting. The coefficient on *annrain* (i) is indeterminate; more rainfall and snowfall over the course of the year could discourage people from fishing or hunting but it could also lead to better fishing conditions by raising the water levels of streams and ponds and fostering better habitat conditions.

Table A5. Coefficient estimates for the Resident Individual Sports License.

Dep. Var.: q_h_r_sports	Coefficient	P>t
_cons *	5846430	0.006
year *	-3112.958	0.006
p_h_r_sports *	-2907.128	0.000
p_f_r_ann *	2882.976	0.007
pop *	0.11	0.000
gas	-6107.249	0.051
febtemp *	307.97	0.036
septemp *	-903.34	0.033
annrain *	677.4047	0.036
R-squared	0.973	

**Indicates statistically significant effect.*

Estimated Equations

Table A5 presents the full statistical output including the coefficient estimates for each variable in the resident individual sports license demand equation. The variables marked with an asterisk have coefficient estimates statistically significant at the 95 percent confidence level.

The coefficient on the trend variable (*year*) is negative and statistically significant indicating that there has been a clear trend in sales over time not accounted for by the other factors in the model. The coefficient on *p_h_r_sports* (the price of a resident individual sports license) is negative, as expected, and statistically significant. Each dollar increase in the price of a license results in 2,907 fewer licenses sold. The price of the Resident Individual Angling License (*p_f_r_ann*) is positive and significant; a one dollar increase in the price of this license will result in 2,883 more Resident Individual Sports Licenses being sold. Population in Minnesota is a statistically significant positive factor in license sales. The price of gas has an insignificant effect on license sales in this model. February temperature is positively correlated with sales of the Resident Individual Sports Licenses. Conversely, September temperature is negatively correlated with sales of this license. Annual rainfall has a positive and significant effect on sales of this license. The model is a very good fit as indicated by the R-squared value of 0.973 meaning that the independent variables included in the model account for 97.3 percent of the variation in the number of Resident Individual Sports Licenses sold.

Resident Combination (Husband/Wife) Sports License

Model Specification

q_h_r_cspo~s = a + b**year* + c**p_h_r_Csports* + d**p_f_r_ann* + e**pop* + f**persinc*+ g**febtemp* + h**mayrain*

where:

a, b, c, d, e, f, g, h are coefficients to be estimated.

q_h_r_cspo~s is the number of Resident Combination Sports Licenses sold per year.

year is the trend in license sales not accounted for by other variables in the model.

p_h_r_Csports is the inflation adjusted price of the Resident Combination Sports License.

P_f_r_ann is the inflation adjusted price of the Resident Individual Angling License.

pop is the population of Minnesota.

persinc is the inflation adjusted per capital personal income in Minnesota.

febtemp is the average temperature in Minnesota for the month of February.

mayrain is the total rainfall in Minnesota in inches for the month of May.

The coefficients to be estimated reflect the effect that each of the variables has on annual license sales. The coefficient (b) on *year* is indeterminate and is included to account for the overall trend in sales. The coefficient on *p_h_r_Csports* (c) is expected to be negative; as price increases, sales will decline. The coefficient on *p_f_r_ann* (d) is expected to be positive; as the price of a substitute or alternative license increases, sales will increase. The coefficient (e) on *pop* is indeterminate; a larger population could mean more people who buy licenses to hunt and fish but it could also mean the loss of habitat and access which could discourage people from hunting and fishing. The coefficient on *persinc* (f) is indeterminate; assuming a sports license is a normal good, meaning people buy more of it when they have more money, the sign on the coefficient would be positive. However, greater income could be correlated with other lifestyle choices that do not include hunting and fishing. The coefficient (j) on *febtemp* is expected to be indeterminate; colder temperatures tend to produce better ice conditions thereby increasing the number of anglers during winter months. However, colder temperatures also have the potential to discourage anglers from heading out into inclement conditions. The coefficient on *mayrain* (h) is indeterminate; more rainfall in the month of May could discourage people from fishing but it could also lead to better fishing conditions by raising the water levels of streams and ponds and fostering better habitat conditions.

Table A6. Coefficient estimates for the Resident Combination Sports License.

Dep. Var.: q_h_r_cspo~s	Coefficient	P>t
_cons	488270.6	0.756
year	-283.9291	0.734
p_h_r_Csports *	-1971.634	0.000
p_f_r_ann *	2919.133	0.000
pop *	0.06	0.015
persinc *	-2.719	0.001
febtemp *	295.26	0.011
mayrain *	1943.04	0.021
R-squared	0.916	

**Indicates statistically significant effect.*

Estimated Equations

Table A6 presents the coefficient estimates for each variable in the Resident Combination Sports License demand equation. The variables marked with an asterisk have coefficient estimates statistically significant at the 95 percent confidence level.

The coefficient on the trend variable (*year*) is statistically insignificant indicating that there is no clear trend in sales over time not accounted for by the other factors in the model. The coefficient on *p_h_r_Csports* (the price of a Resident Combination Sports License) is negative, as expected, and statistically significant. Each dollar increase in the price of a license results in 1,972 fewer licenses sold. The price of the Resident Individual Angling license (*p_f_r_ann*) is positive and significant; a one dollar increase in the price of this license will result in 2,919 more combination sports licenses being sold. Population in Minnesota is a statistically significant positive factor in license sales. Per capita income is a statistically significant negative factor in license sales indicating that the higher incomes are correlated with lifestyle choices that don't include hunting or fishing. February temperature is positively correlated with sales of the resident combination sports licenses. May rainfall is positively correlated with sales of this license. The model is a very good fit as indicated by the R-squared value of 0.916 meaning that the independent variables included in the model account for 91.6 percent of the variation in the number of Resident Combination Sports Licenses sold.

Resident/Non-Resident 24-Hour Angling License

Model Specification

q_f_24hour = a + b**year* + c**p_f_24hour* + d**pl_pop* + e**gas* + f**p_f_nr_ann* + g**aprrain* + h**novrain*

where:

a, b, c, d, e, f, g, h are coefficients to be estimated.

q_f_24hour is the number of Resident/Non-Resident 24-hour Angling Licenses sold per year.

year is the trend in license sales not accounted for by other variables in the model.

p_f_24hour is the inflation adjusted price of the Resident/Non-Resident 24-hour Angling License.

pl_pop is the population of the Plains States.

gas is the inflation adjusted price of a gallon of regular gasoline in the United States.

p_f_nr_ann is the inflation adjusted price of the Non-Resident Individual Angling License.

aprrain is the total rainfall (or snow equivalent) in Minnesota in inches for the month of April.

novrain is the total rainfall (or snow equivalent) in Minnesota in inches for the month of November.

The coefficients to be estimated reflect the effect that each of the variables has on annual license sales. The coefficient (b) on *year* is indeterminate and is included to account for the overall trend in sales. The coefficient on *p_f_1day* (c) is expected to be negative; as price increases, sales will decline. The coefficient (d) on *pl_pop* is indeterminate; a larger population could mean more people who buy licenses to fish but it could also mean the loss of habitat and access, which could discourage people from fishing. The coefficient (e) on *gas* is indeterminate; it would be negative if it significantly increases the cost of traveling to go fishing for non-residents; it would be positive, though, if higher gas prices discourage residents from traveling to take part in competing recreational activities. The coefficient on *p_f_nr_ann* (f) is expected to be positive; as the price of the annual Non-Resident license increases, more non-residents will choose shorter-term licenses instead. The coefficient on *aprrain* (g) is indeterminate; more rainfall in April could discourage people from fishing in the short term but it could also lead to better fishing conditions by raising the water levels of streams and ponds. The expected sign of the coefficient on *novrain* (h) is also indeterminate for the same reason.

Estimated Equations

Table A7 presents the coefficient estimates for each variable in the 24-hour license demand equation. The variables marked with an asterisk have coefficient estimates statistically significant at the 95 percent confidence level.

Table A7. Coefficient estimates for the Resident/Non-Resident 24-hour Angling License.

Dep. Var.: q_f_1day	Coefficient	P>t
_cons	12143.19	0.986
year	-61.28027	0.867
p_f_1day *	-2277.018	0.000
pl_pop *	0.0091177	0.011
gas *	-2835.109	0.005
p_f_nr_ann *	413.8117	0.055
aprrain *	799.4743	0.042
novrain *	-861.9159	0.046
R-squared	0.988	

**Indicates statistically significant effect.*

Estimated Equations

The coefficient on the trend variable (*year*) is statistically insignificant indicating that there is no clear trend in sales over time not accounted for by the other factors in the model. The coefficient on *p_f_1day* (the price of a 24-hour angling license) is negative, as expected, and statistically significant. Each dollar increase in the price of a license results in 2,277 fewer licenses sold. Population in the Plains States is a statistically significant positive factor in license sales. The price of gas has a statistically significant, negative effect on license sales; each ten cent increase in the price of gas translates into 284 fewer 24-hour angling licenses sold. The coefficient on the price of the annual Non-Resident Individual Angling license is positive, as expected, and statistically significant;[17] a one dollar increase in the price of this license will result in 414 more 24-hour licenses being sold. April rainfall is positively correlated with sales of the 24-hour licenses. November rainfall is negatively correlated with sales of this license. The model is a very good fit as indicated by the R-squared value of 0.988 meaning that the independent variables included in the model account for 98.8 percent of the variation in the number of 24-hour licenses sold.

[17] Statistically significant using a one-tailed t-test.

Non-Resident Individual Angling License

Model Specification

q_f_nr_ann = a + b**year* + c**p_f_nr_ann* + d**pl_pop* + e**pl_persinc* + f**annrain.*

where:

a, b, c, d, e, and f are coefficients to be estimated.

q_f_nr_ann is the number of Non-Resident Individual Angling licenses sold per year.

year is the trend in license sales not accounted for by other variables in the model.

p_f_nr_ann is the inflation adjusted price of the Non-Resident Individual Angling license.

pl_pop is the population of the Plains States.

pl_persinc is the inflation adjusted per capita personal income in Plains States.

annrain is the total rainfall (or snow equivalent) in Minnesota in inches for the year.

The coefficients to be estimated reflect the effect that each of the variables has on annual license sales. The coefficient (b) on *year* is indeterminate and is included to account for the overall trend in sales. The coefficient on *p_f_nr_ann* (c) is expected to be negative; as price increases, sales will decline. The coefficient (d) on *pl_pop* is indeterminate; a larger population could mean more people who buy licenses to fish but it could also mean the loss of habitat and access which could discourage people from fishing. The coefficient on *pl_persinc* (e) is indeterminate; assuming a fishing license is a normal good, meaning people buy more of it when they have more money, the sign on the coefficient would be positive. However, greater income could be correlated with other lifestyle choices that do not include fishing. The coefficient on *annrain* (f) is indeterminate; more rainfall over the course of the year could discourage people from fishing during prime fishing periods but it could also lead to better fishing conditions by raising the water levels of streams and ponds.

Table A8. Coefficient estimates for the Non-Resident Individual Angling License.

Dep. Var.: q_f_nr_ann	Coefficient	P>t
_cons *	12276082	0.000
year *	-6389.5	0.000
p_f_nr_ann *	-2606.6	0.000
pl_pop *	0.02	0.036
pl_persinc *	6.5	0.007
annrain	-730.2	0.099
R-squared	0.862	

**Indicates statistically significant effect.*

Estimated Equations

Table A8 presents the coefficient estimates for each variable in the Non-Resident Individual Angling License demand equation. The variables marked with an asterisk have coefficient estimates statistically significantly at the 95 percent confidence level.

The coefficient on the trend variable (*year*) is negative and statistically significant indicating that there has been a clear trend in sales over time not accounted for by the other factors in the model. The coefficient on *p_f_nr_ann* (the price of a Non-Resident Individual Angling License) is negative, as expected, and statistically significant. Each dollar increase in the price of a license results in 2,607 fewer licenses sold. Population in the Plains States is a statistically significant positive factor in license sales. Per capita income in the same region is a statistically significant positive factor; if per capita income in the region increases by $1,000 sales of Non-Resident Individual Angling Licenses will increase by 6,481. The correlation between average annual rainfall and sales of this license is not statistically significant. The model is a good fit as indicated by the R-squared value of 0.862 meaning that the independent variables included in the model account for 86.2 percent of the variation in the number of Non-Resident Individual Angling Licenses sold.

Non-Resident Family Angling License

<u>Model Specification</u>

q_f_nr_fam= a + b**year* + c**p_f_nr_fam* + d**pl_pop* + e**pl_persinc* + f**rate* + g**aprrain*

where:

a, b, c, d, e, f, and g are coefficients to be estimated.

q_f_nr_fam is the number of Non-Resident Family Angling licenses sold per year.

year is the trend in license sales not accounted for by other variables in the model.

p_f_nr_fam is the inflation adjusted price of the Non-Resident Family Angling license.

pl_pop is the population of the Plains States.

pl_persinc is the inflation adjusted per capita personal income in the Plains States.

rate is the average rate of unemployment.

aprrain is the total rainfall (or snow equivalent) in Minnesota in inches for the month of April.

The coefficients to be estimated reflect the effect that each of the variables has on annual license sales. The coefficient (b) on *year* is indeterminate and is included to account for the overall trend in sales. The coefficient on *p_f_nr_fam* (c) is expected to be negative; as price increases, sales will decline. The coefficient (d) on *pl_pop* is indeterminate; a larger population could mean more people who buy licenses to fish but it could also mean the loss of habitat and access which could discourage people from fishing. The coefficient on *pl_persinc* (e) is indeterminate; assuming a fishing license is a normal good, meaning people buy more of it when they have more money, the sign on the coefficient would be positive. However, greater income could be correlated with other lifestyle choices that do not include fishing. The coefficient (f) on *rate* is indeterminate; it is not clear whether license sales would increase due to more time available to the unemployed or decrease due to reduced income. The coefficient on *aprrain* (g) is indeterminate; more rainfall in April could discourage people from fishing in the short term but it could also lead to better fishing conditions by raising the water levels of streams and ponds.

Table A9. Coefficient estimates for the Non-Resident Family Angling License.

Dep. Var.: q_f_nr_fam	Coefficient	P>t
_cons *	11927229.72	0.000
year *	-6165.0	0.000
p_f_nr_fam *	-586.0	0.013
pl_pop	0.013	0.077
pl_persinc *	5.338	0.000
rate *	5375.9	0.000
aprrain	1353.1	0.056
R-squared	0.984	

**Indicates statistically significant effect.*

Estimated Equations

Table A9 presents the coefficient estimates for each variable in the Non-Resident Family Angling License demand equation. The variables marked with an asterisk have coefficient estimates statistically significant at the 95 percent confidence level.

The coefficient on the trend variable (*year*) is negative and statistically significant indicating that there has been a clear trend in sales over time not accounted for by the other factors in the model. The coefficient on *p_f_nr_fam* (the price of a Non-Resident Family Angling License) is negative, as expected, and statistically significant. Each dollar increase in the price of a license results in 586 fewer licenses sold. Population in the Plains States is not a statistically significant factor in license sales. Per capita income in the same region is a statistically significant positive factor in license sales; if per capita income in the region were to increase by $1,000 the model indicates that the number of Non-Resident Family Angling Licenses sold would increase by $5,338. Unemployment has a positive effect on sales and suggests that an increase in the number of people who are not working leads to more fishing activity. April rainfall is not a statistically significant factor in sales of the Non-Resident Family Angling Licenses. However, its presence in the model helps improve the overall fit. The model is a very good fit as indicated by the R-squared value of 0.984 meaning that the independent variables included in the model account for 98.4 percent of the variation in the number of Non-Resident Family Angling Licenses sold.

Non-Resident Seven-Day Angling License

Model Specification

q_f_nr_7day = a + b**year* + c**p_f_nr_7day* + d**p_f_nr_72hour* + e**pl_pop* + f**pl_perinc* + g**janrain* + h**febtemp*

where:

a, b, c, d, e, f, g, h are coefficients to be estimated.

q_f_nr_7day is the number of Non-Resident Seven-day Angling licenses sold per year.

year is the trend in license sales not accounted for by other variables in the model.

p_f_nr_7day is the inflation adjusted price of the Non-Resident Seven-Day Angling license.

p_f_nr_72hour is the inflation adjusted price of the Non-Resident 72-hour Angling license.

pl_pop is the population of the Plains States.

pl_perinc is the inflation adjusted per capita personal income for Plain States.

janrain is the total rain or equivalent snowfall for the month of January.

febtemp is the average temperature in Minnesota for the month of February.

The coefficients to be estimated reflect the effect that each of the variables has on annual license sales. The coefficient (b) on *year* is indeterminate and is included to account for the overall trend in sales. The coefficient on *p_f_nr_7day* (c) is expected to be negative; as price increases, sales will decline. The coefficient on *p_f_nr_72hour* (d) is expected to be positive; as the price of the 72-hour non-resident license increases, more non-residents will choose substitute a 7-day license instead. The coefficient (e) on *pl_pop* is indeterminate; a larger population could mean more people who buy licenses to fish but it could also mean the loss of habitat and access which could discourage people from fishing. The coefficient on *pl_persinc* (f) is indeterminate; assuming a fishing license is a normal good, meaning people buy more of it when they have more money, the sign on the coefficient would be positive. However, greater income could be correlated with other lifestyle choices that do not include fishing. The coefficient (g) on *janrain* is expected to be negative. Snow can act as an insulator, slowing the growth of ice on lakes and ponds, thereby making conditions unsafe for fishing during winter months. The coefficient (h) on *febtemp* is expected to be indeterminate; colder temperatures tend to produce better ice conditions thereby increasing the number of anglers during winter months. However, colder temperatures also have the potential to discourage anglers from heading out into inclement conditions.

Table A10. Coefficient estimates for the Non-Resident Seven-Day Angling license

Dep. Var.: q_f_nr_7day	Coefficient	P>t
_cons *	8072708	0.000
year *	-4297.9	0.000
p_f_nr_7day *	-8291.7	0.000
p_f_nr_72hour *	9405.0	0.000
pl_pop *	0.029	0.000
pl_persinc *	1.531	0.003
janrain *	-2586.5	0.002
febtemp *	115.9	0.005
R-squared	0.963	

**Indicates statistically significant effect.*

Estimated Equations

Table A10 presents the coefficient estimates for each variable in the non-resident seven-day license demand equation. The variables marked with an asterisk have coefficient estimates statistically significant at the 95 percent confidence level.

The coefficient on the trend variable (*year*) is negative and statistically significant indicating that there has been a clear trend in sales over time not accounted for by the other factors in the model. The coefficient on *p_f_nr_7day* (the price of a Non-Resident Seven-day Angling license) is negative, as expected, and statistically significant. Each dollar increase in the price of a license results in 8,292 fewer licenses sold. The coefficient on the price of the 72-hour non-resident angling license is positive, as expected, and statistically significant; a one dollar increase in the price of this license will result in 9,405 more seven day licenses being sold. Population in the Plains States is a statistically significant positive factor in license sales. Per capita income in the same region is a statistically significant positive factor in license sales; if per capita income in the region were to increase by $1,000 the model indicates that the number of non-resident seven day angling licenses sold would increase by 1,531. January rainfall is negatively correlated with sales of the seven-day licenses. February temperature is positively correlated with sales of this license. The model is a very good fit as indicated by the R-squared value of 0.963 meaning that the independent variables included in the model account for 96.3 percent of the variation in the number of Non-Resident Seven-day Angling licenses sold.

Non-Resident 72-hour Angling License

Model Specification

q_f_nr_72hour = a + b**year* + c**p_f_nr_72hour* + d**sd_f_1d_nr* + e**wi_2d_nr* + f**pl_pop* + g**janrain* + h**febtemp*

where:

a, b, c, d, e, f, g, h are coefficients to be estimated.

q_f_nr_72hour is the number of Non-Resident 72-hour Angling licenses sold per year.

year is the trend in license sales not accounted for by other variables in the model.

p_f_nr_72hour is the inflation adjusted price of the Non-Resident 72-hour Angling license.

sd_f_1d_nr is the inflation adjusted price of the Non-Resident 24-hour Angling license in South Dakota.

wi_2d_nr is the inflation adjusted price of the non-resident 2-day Great Lakes Angling license in Wisconsin.

pl_pop is the population in the Plains States.

janrain is the total rain or equivalent snowfall in Minnesota in inches for the month of January.

febtemp is the average temperature in Minnesota for the month of February.

The coefficients to be estimated reflect the effect that each of the variables has on annual license sales. The coefficient (b) on *year* is indeterminate and is included to account for the overall trend in sales. The coefficient on *p_f_nr_72hour* (c) is expected to be negative; as price increases, sales will decline. The expected sign of the coefficient on *sd_f_1d_nr* (d) is expected to be positive; as the price of a substitute South Dakota angling license increases, sales will increase. The expected sign of the coefficient on *wi_2d_nr* is expected to be positive for the same reason. The coefficient (f) on *pl_pop* is indeterminate; a larger population could mean more people who buy licenses to fish but it could also mean the loss of habitat and access which could discourage people from fishing. The coefficient (g) on *janrain* is expected to be negative. Snow can act as an insulator, slowing the growth of ice on lakes and ponds, thereby making conditions unsafe for fishing during winter months. The coefficient (h) on *febtemp* is expected to be indeterminate; colder temperatures tend to produce better ice conditions thereby increasing the number of anglers during winter months. However, colder temperatures also have the potential to discourage anglers from heading out into inclement conditions.

Table A11. Coefficient estimates for the Non-Resident 72-hour Angling license.

Dep. Var.: q_f_nr_72hour	Coefficient	P>t
_cons *	12705941.12	0.000
year *	-6753.3	0.000
p_f_nr_72hour *	-1325.2	0.018
sd_f_1d_nr	477.5	0.191
wi_2d_nr *	760.4	0.092
pl_pop *	0.045	0.000
janrain	-1837.1	0.170
febtemp	146.6	0.059
R-squared	0.846	

**Indicates statistically significant effect.*

Estimated Equations

Table A11 presents the coefficient estimates for each variable in the Non-Resident 72-hour Angling license demand equation. The variables marked with an asterisk have coefficient estimates statistically significant at the 95 percent confidence level.

The coefficient on the trend variable (*year*) is negative and statistically significant indicating that there has been a clear trend in sales over time not accounted for by the other factors in the model. The coefficient on *p_f_nr_72hour* (the price of a 72-hour angling license) is negative, as expected, and statistically significant. Each dollar increase in the price of a license results in 1,325 fewer licenses sold. The coefficient on the price of the South Dakota one-day non-resident angling license (*sd_f_1d_nr*) was not statistically significant. However, the coefficient on the price of the Wisconsin two-day non-resident angling license (*wi_2d_nr)* is statistically significant using a one-tailed t-test. However, it only has a small impact on the number of 72-hour angling licenses sold. Population in the Plains States is a statistically significant positive factor in license sales. January rainfall is not significantly correlated with sales of the 72-hour licenses. February temperature is also not correlated with sales of this license. However, leaving these variables in the model improves its overall fit. The model is a very good fit as indicated by the R-squared value of 0.846 meaning that the independent variables included in the model account for 84.6 percent of the variation in the number of Non-Resident 72-hour Angling licenses sold.