Exploratory Data Analysis: Ticket Price and Stadium Attendance for Montreal Canadiens'

Brief Description of Dataset and Summary of its Attributes:

One method to increase profits for a National Hockey League (NHL) team is to raise ticket prices for stadium attendance. This study analyzes the variables that dictate an individual's price sensitivity to purchasing NHL season tickets. For purposes of this analysis, the study is focused on the Montreal Canadiens' ("Canadiens") market a top NHL team. The exploratory data analysis will demonstrate that certain variables significantly influence an individual's purchase behavior. The findings suggest that an organization can increase profits by raising ticket prices if the correct market conditions are present.

The Canadiens organization is one of the most prestigious team in the NHL. It was one of the original six teams in the league and has won 24 Stanley Cups, the most among any team. After the last season, the ownership wanted to increase its realized profits from the team. The question raised was whether this could be accomplished through an increase in ticket prices.

The goal of the study is to analyze the price sensitivity of the Montreal Canadiens' fan base. In doing so, it is important to understand if there is a causal relationship between stadium attendance and ticket prices. In other words, is stadium attendance dependent on the price of season tickets? In an attempt to answer this market research question, the variables that influenced the price sensitivity of the Canadiens' season ticket holders are analyzed. The dataset is based on a questionnaire that was submitted to the Canadiens current season ticket holders to (1) understand the season ticket holder's current socio, economic, and fan outlook and (2) apply this information in conjunction with earlier conclusions drawn from the historical analysis.

Initial Plan for Data Exploration:

There are two research objectives that analyzed the ticket holders' price sensitivity. Firstly, we wanted to understand which variables influenced the willingness of a fan to purchase tickets. We identified several socio and economic variables that might influence ticket sales. A regression analysis using 20 years of historical information analyzed how the economy, the price of tickets, the actual team performance, the expected team performance, and the cost of the ticket as a percentage of the ticket holder's income influenced the number of individuals who attended the Canadiens home games.

Actions Taken for Data Cleaning and Feature Engineering:

Another variable that would have been useful would be the presence of other professional teams within the area and specifically teams within a league that operated in the same season as the Canadiens, such as the National Basket League ("NBA"). However, this variable is not present in the Canadiens market. If this analysis addressed the New York

Rangers, which compete against the New York Islanders (NHL), and the New York Knicks and New Jersey Nets of the National Basketball Association (NBA), then this variable would have been incorporated in the analysis.

Secondly, we wanted to determine the optimal range of the variables that are deemed significant from the regression analysis. For instance, if the cost of tickets as a percentage of ticket holders' income is significant, then what is the optimal percentage? Specifically how does the stadium attendance change as tickets as a percentage of income increase? A cross tabulation of these variables should allow the Canadiens' organization to set the correct ticket price and thereby maximize profits.

The analysis of historical information has enabled us to gain an understanding of the primary factors that influences stadium attendance. It has allowed us to estimate an optimal ticket price level while maximizing attendance.

In applying this information for the upcoming season, we recommend conducting a survey of the current season ticket holder fan base. The survey is intended to provide insight on the current ticket holders' salary and future expectations of the team. When this information is analyzed against the historical information, it should inject a higher degree of certainty of how stadium attendance might behave based on the ticket price levels. To ensure that the information gathered from the questionnaire is accurate and valid, a number of quality checks will be performed. The conditions of the survey include:

- *The medium used to deliver the survey*. The questionnaire will be delivered to current season ticket holders via the internet. This method provides a number of benefits rather than conducting the questionnaire over the telephone. First, the online questionnaire allows us to quickly receive responses and analyze the information in a real time format. Second, it provides the recipient the flexibility of taking the questionnaire at their convenience. Third, we can monitor the time and responses of the individual who completes the questionnaire. This allows us to prevent inconsistent and possibly incorrect information from being assessed in future analyses. Finally, the online venue allows us to assess the questionnaire as it receives responses and modify the questionnaire if it is deemed necessary in order to receive the appropriate information.

- *The time allotted for the questionnaire.* The length of the questionnaire should not take longer than 20 minutes. If the questionnaire takes too long, individuals who are providing information may not be inclined to answer all of the information and rush through the final questions. Therefore, it is appropriate to keep the questions on target and minimize the length of the overall questionnaire. For analyzing future season ticket holders for the 2007 hockey season, the questionnaire will run approximately 15-20 minutes.

- *The questionnaire should use an appropriate sample size.* Of the responses received from the questionnaires one can expect 5% of the respondents to be accurate. Therefore, if this figure holds one can presume that the information received from the questionnaire would have a confidence interval of approximately 4%.[i]

- *Appropriate monitoring of the sample.* The internet medium will allow us to filter out the "garbage" received from their questionnaire. This filtering occurs as we can ask questions that should result in the respondent effectively answering the same question more than once. This one method should allow us to ensure the integrity of the information. It is important to note that the questionnaire should not pose the same question multiple times. This may result in the respondent becoming frustrated and rushing through the remaining questions. Therefore, we should ask questions in a similar manner in order to derive the same response. This way they can ensure that the respondent is reading the questions and providing thoughtful responses.

- *Incentive.* Finally, Montreal Canadiens organization should provide an incentive so that the current season ticket holders respond to the questionnaire. The incentive for this questionnaire will include a coupon for two food items and a non-alcoholic drink. This incentive requires that the respondents attend the game and may result in the respondents spending additional money after using the coupons.

The aforementioned aspects of the questionnaire are used to ensure that the information gathered is honest and meets the survey's overall objective, which is to determine whether season ticket prices should be increased. The survey results in conjunction with the analysis of the historical data should allow us and the Montreal Canadiens organization to set ticket prices at a specific level and understand the implications as it relates to overall stadium attendance.

Key Findings and Insights:

In order to understand which variables influenced stadium attendance, we performed a regression analysis using data from the past 20 years. The regression analysis attempted to identify which variables influenced stadium attendance. It was concluded that two variables should be considered when determining ticket price levels. These variables are ticket costs as a percentage of an individual's salary and expected team performance. These variables explain approximately 81% of what influences stadium attendance.

The study demonstrated which variables influence stadium attendance. There are now two questions that must be answered to assist the Canadiens organization in maximizing profits. Firstly, what is the optimal ticket cost as a percentage of ticket holder's income? Specifically, what is the highest ticket price that can be charged without sacrificing stadium attendance? The second question pertains to how expected team performance

influences stadium attendance and in turn affects the Canadiens' ability to increase ticket prices. With regard to the aforementioned questions, one can perform a cross tabulation to answer the relationship between ticket holders income and stadium attendance and expected team performance and stadium attendance. We can then perform a questionnaire to gain insight on the current season ticket holders' annual salary and their future expectations of the team. When compared with the historical information this will allow the Canadiens organization to effectively price tickets and maximize profits.

The purpose of the survey is to provide Montreal Canadiens with information on the current season ticket holder's annual salary and expectation for the upcoming season. Based on this information, we can advise the Montreal Canadiens on the proper ticket prices given the season ticket holder's annual salaries and their expectations for the upcoming season. If the information obtained from the questionnaire is valid, then the Montreal Canadiens can effectively adjust ticket prices to maximize profits.

In order to understand which variables influenced stadium attendance, we performed a regression analysis using data from the past 20 years. The regression analysis attempted to identify which variables influenced stadium attendance. It was concluded that two variables should be considered when determining ticket price levels. These variables are ticket costs as a percentage of an individual's salary and expected team performance. These variables explain approximately 81% of what influences stadium attendance.

Formulating Hypotheses:

The purpose of the hypothesis testing is twofold. In the first instance, we want to determine which variables influenced stadium attendance. Once established, we would attempt to provide specific insights and interpret the significant variables in order to assist the Canadiens' organization in understanding the optimal ticket price levels to increase profits.

Hypothesis 1: Ticket prices are inversely related to stadium attendance

One can presume that as ticket prices rise, stadium attendance will drop since it becomes more expensive for patrons to attend the game. Likewise, as ticket prices fall, stadium attendance should rise. Therefore, one can expect an inverse relationship between both variables. If this is true, one can set the ticket prices and know approximately how many season tickets would be sold. When analyzing this hypothesis, two questions must be answered. First, what is the relationship between both variables? Are they inversely related? Second, do ticket prices sufficiently explain stadium attendance? If not, what other variables should be considered?

Hypothesis 2: Stadium attendance is influenced by the ticket price and the economy

Given that ticket prices do not effectively explain stadium attendance, one must infer what other variable(s) affect stadium attendance. Furthermore, what variable can explain why stadium attendance and ticket prices are not inversely related? In an attempt to answer each question, this section analyzes how the economy influences stadium attendance and ticket prices. The reason for analyzing the economy is based on the supposition that people may be more willing to spend money during periods when they have greater disposable income. This would most likely occur when the economy is strong. This belief is based on the fact that at periods of high unemployment the economy is not operating at full capacity. As a result, people have less money at their disposal. As the economy improves, the unemployment rate decreases, and more individuals have money to invest in the economy. Therefore, when the economy improves people can afford higher ticket prices. This can explain why stadium attendance was high when ticket prices increased.

Hypothesis 3: Stadium Attendance is dictated by ticket prices in relation to the ticket holder's income (or the percentage of ticket holder's income)

It is evident that the strength and weakness of the economy does not fully explain the affordability of a ticket. This is because the strength of the economy is not a true indicator of an individual's disposable income. The strength of the economy may mean more individuals are employed, but does not mean that current ticket holders have higher salaries. Therefore, it would be more appropriate to regard the percent a ticket's cost in regards to a ticket holder's salary. As the percent decreases, one can presume that the ticket holder's salary has increased and the burden of purchasing the tickets is less. Likewise, if the percentage increases, then the cost of the ticket in relation to the individual's salary has increased at a faster rate. By regarding this figure, one may be able to better understand the positive correlation between a tickets price and stadium attendance.

Conducting Formal Significance Tests for Hypotheses:

This section analyzes the relationship among all three variables and determines whether the combination of the economy and ticket prices influence stadium attendance. In doing so, this section hopes to demonstrate that there is a positive relationship between ticket prices and the economy; that is the economy and ticket prices rise and fall together. If this assumption is proven true, then this section will attempt to demonstrate that the combination of the economy and the ticket prices more accurately explains the changes in stadium attendance.

With regard to the first hypothesis, one must evaluate the relationship between stadium attendance and ticket prices by analyzing both variables through the Pearson Correlation and Cross Tabulation reports. The Pearson Correlation illustrates that both variables are not inversely related. The correlation between both variables is 0.61, rather than -1 (Table 1). This suggests a relatively strong positive correlation. Therefore, the hypothesis does not hold.

Table 1

Correlations

		Stadium_ Attendance	Average_ Ticket_Prices
Stadium_Attendance	Pearson Correlation	1	.614**
	Sig. (2-tailed)		.004
	N	20	20
Average_Ticket_Prices	Pearson Correlation	.614**	1
	Sig. (2-tailed)	.004	
	N	20	20

**. Correlation is significant at the 0.01 level (2-tailed).

A cross tabulation analysis of stadium attendance and the average ticket price further demonstrates that there is no negative correlation between both variables. This is evident because at a ticket price of $55, attendances vary from 93% to 99%, while a ticket price of $80, witnessed stadium attendance grow to 100% (Table 2).

Table 2

Average_Ticket_Prices * Stadium_Attendance Crosstabulation

Count

		Stadium_Attendance								
		.93	.94	.95	.96	.97	.98	.99	1.00	Total
Average_Ticket_Prices	50.00	0	0	1	1	0	0	0	0	2
	52.00	0	0	0	1	0	0	0	0	1
	55.00	1	1	1	0	2	0	1	0	6
	60.00	0	1	1	0	0	0	0	1	3
	65.00	0	0	0	1	0	0	0	0	1
	70.00	0	0	0	0	1	1	2	1	5
	75.00	0	0	0	0	0	1	0	0	1
	80.00	0	0	0	0	0	0	0	1	1
Total		1	2	3	3	3	2	3	3	20

With regard to the second hypothesis, one must perform a regression analysis to understand how reliable the ticket price variable is in explaining stadium attendance. The regression analysis only explains 38% of what influences stadium attendance (Table 3). Therefore, there must be additional variables in conjunction with ticket price that influences individual price sensitivity in the purchase of ticket. This makes sense, particularly since it is shown that ticket prices and stadium attendance are not inversely related.

Table 3

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.614[a]	.377	.342	.01763

a. Predictors: (Constant), Average_Ticket_Prices

The Pearson Correlation of ticket prices and economy is positive at 0.36 (Table 4). This may better explain why there was 100% attendance when ticket prices were $80 compared to 93% attendance when ticket prices were at $55. At $80, the economy would be strong and individuals could afford the higher price. Likewise, the economy could have experienced a downturn and resulted in lower attendance when ticket prices dropped.

Table 4

Correlations

		Average_ Ticket_Prices	Economy
Average_Ticket_Prices	Pearson Correlation	1	.361
	Sig. (2-tailed)		.118
	N	20	20
Economy	Pearson Correlation	.361	1
	Sig. (2-tailed)	.118	
	N	20	20

Given that ticket prices and the economy are positively correlated, one must question whether the economy along with ticket prices explains stadium attendance more effectively then ticket prices alone. A regression analysis of these two independent variables explains 38% of what influences stadium attendance (Table 5.1). This R^2 figure is no different from the regression analysis that used average ticket prices. The t-statistic also demonstrates that the economy is not a significant variable in the analysis (Table 5.2). Therefore, one can conclude that the economy is not an important variable that influences a patron's ability to purchase tickets.

Despite the positive correlation between ticket prices and the economy, there must be some other variable that can more accurately explain a patron's ability or willingness to purchase tickets.

Table 5.1

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.614[a]	.377	.304	.01814

a. Predictors: (Constant), Economy, Average_Ticket_ Prices

Table 5.2

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.878	.030		29.266	.000
	Average_Ticket_Prices	.001	.001	.604	2.943	.009
	Economy	3.52E-005	.000	.027	.131	.898

a. Dependent Variable: Stadium_Attendance

Initially, this hypothesis section will attempt to demonstrate that the percentage of ticket holder's income is not influenced by the economy. In doing so, this will hopefully confirm that the economy does not influence an individual's ability to purchase a ticket and enable the percentage of ticket holder's income variable to be considered as a viable option in explaining the positive correlation between ticket prices and stadium attendance. The second aspect of this section is to determine whether the ticket holder's income variable is significant and whether it increases the R^2 value in a regression analysis.

A correlation of the economy and the percentage of tickets in relation to the ticket holder's income demonstrates that these two variables are negatively correlated (Table 6). This suggests that the ability of a patron to purchase a ticket is not necessarily related to the economy. That is, although the economy may improve, the ticket price as a percentage of ticket holder's income decreases or stay constant.

Table 6

Correlations

		Economy	Percent_ Ticketholders_Income
Economy	Pearson Correlation	1	-.330
	Sig. (2-tailed)		.155
	N	20	20
Percent_ Ticketholders_Income	Pearson Correlation	-.330	1
	Sig. (2-tailed)	.155	
	N	20	20

Second, a regression analysis demonstrates that the percentage of ticket holder's income is a significant variable (Table 7.2). It also drastically increases the R^2 figure, or what is explained through the regression analysis (Table 7.1). Therefore, one can conclude that the percentage of ticket holder's income is an important variable in the analysis of evaluating the price sensitivity of the Montreal Canadiens' fan base. It also helps explain why individuals still attend games even though it becomes more expensive.

Table 7.1

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.854[a]	.729	.679	.01233

a. Predictors: (Constant), Percent_Ticketholders_ Income, Economy, Average_Ticket_Prices

Table 7.2

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	1.004	.034		29.234	.000
	Average_Ticket_Prices	.000	.000	.059	.319	.754
	Economy	-6.5E-005	.000	-.049	-.351	.730
	Percent_ Ticketholders_Income	-.464	.102	-.828	-4.562	.000

a. Dependent Variable: Stadium_Attendance

Suggestions for Next Steps in Analyzing Data:

An analysis of historical data suggests that the optimal ticket price as percent of ticket holder's income should not exceed 12% of a ticket holder's annual income. This level is because when ticket costs as a percentage of income is 12% or less, stadium attendance is at 98.0%. However, when the ticket costs exceed 12%, stadium attendance drops to 94.8%. Therefore, it can be inferred that the Montreal Canadiens should not charge a price for the tickets that is any higher than 12% of the ticket holder's annual income. Any higher than that and there is a significant decrease in stadium attendance

It is important to note that the percent of income variable is not dependent on changes in ticket prices. This means that the percent of ticket holders' income can increase while the price of a ticket remains flat. This can occur when an individual earns less money, while the ticket price remains constant, thereby increasing the cost of the ticket as a percent of ticket holders' income. Therefore, one cannot presume that an increase in ticket prices and a slight decrease in stadium attendance would be more profitable then lower ticket prices and a sellout.

Quality of Dataset and Request for Additional Data

A cross tabulation analysis of expected team performance and stadium attendance does not demonstrate a large decrease in stadium attendance when expectations decrease. For example, when ticket holders expected the team to win at least 49% of their games, the stadium was at approximately 97% capacity. When expected performance dropped below 49%, stadium attendance fell approximately 1%.

The purpose of the additional data is to provide Montreal Canadiens with information on the current season ticket holder's annual salary and expectation for the upcoming season. Based on this information, we can advise the Montreal Canadiens on the proper ticket prices given the season ticket holder's annual salaries and their expectations for the upcoming season. If the information obtained from the questionnaire is valid, then the Montreal Canadiens can effectively adjust ticket prices to maximize profits.