

Influences on Revenues of The Seattle Japanese Garden

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Executive Summary

The Seattle Japanese Garden is an authentic Japanese garden located in south end of the Washington State Arboretum and is open nine months of the year. Opening during the tail end of winter, patrons can visit during the first third of the season to witness the spring blossoms bloom, in the middle of the season to spend a sunny summer afternoon feeding the koi in the pond and come again during the autumn color displays. As an outdoor facility it is subject to the various weather conditions of Seattle, such as temperatures from near freezing to the low nineties.

This paper describes a model that attempts to predict the revenues generated from admission sales. The model assumes that attendance therefore revenues could be affected by the season of the year, the day of the week, rainfall and the average daily temperature to name a few. Over 200 days of the current 2003 garden season was used as data to predict future revenues. Select days in each season were removed to be used as unbiased data to compare the model to actual results in a given day.

By running a least-squares regression of the profit earned against influences such as the average daily temperature, daily rainfall, the season of the year, and the number of hours operated. The model surprising states that the temperature has very little effect on daily revenues, it only increasing the base profit by 0.6% for every degree. Rainfall has a negative effect of 98% less profit for every inch of precipitation. The most popular season by far was shown to be spring, with summer slightly generating more revenue than the fall months. Also, surprisingly the model states that selling fish food acts as a negative influence of 5%. The regression accounted for 80% of the actual revenue generated and in some cases the predicted value was accurate to within \$50 of the actual money earned.

Data

The data for the 207 observed days was obtained from four resources. The Daily Financial Reports of the Japanese Garden provided the total revenue on a given date. The administrators at the Montlake Community Center granted access to those documents. Garden special events were found at the Japanese Garden website¹. The term “special events” encompass the monthly tea demonstrations and additional Japanese cultural events held at the garden. In order to find the average temperatures in Fahrenheit and the total precipitation in inches of each observed day data was taken from the National Climatic Data Center website², specifically from the Boeing Field Station³. Finally, official dates of seasonal changes were obtained from the Science World website⁴.

Model

The ordinary least-squares regression model considered the natural log of the revenues. The earnings as the week progressed generally followed exponential growth. Scatter plots of all the data showed a non-linear increase in money.⁵ The full regression⁶ reads that by opening the garden in a winter day with no precipitation the Parks Department will make \$145.33. The model’s R-squared statistic states that all the variables in the regression account for almost 80% of the earnings.

The linear regression model assumed that a total of nine variables influenced the daily revenues. The day of the week was considered to be an influence on attendance to the garden it was mapped to grow as the week progressed. In addition however, the model assumed that more free time on the weekends would yield higher profits, so an additional

¹ The Seattle Japanese Garden <<http://www.seattlejapanesegarden.org>>

² National Climatic Data Center <<http://lwf.ncdc.noaa.gov/oa/ncdc.html>>

³ The Boeing Field Weather Station <<http://www.ncdc.noaa.gov/servlets/ULCD?state=WA&callsign=BFI>>

⁴ Science World <<http://scienceworld.wolfram.com/>>

⁵ Appendix B

⁶ Appendix C

true/false variable kept track of those days. As the week progresses, each day closer to the weekend generates 7.3% more dollars. When the weekend hits, a huge jump of an additional 67% of revenue is taken in the garden and if there is a special event that weekend, a 19% increase is also expected.

While the year progresses the garden's operating hours change as the daylight hours vary. At the beginning of the season, the garden is open for eight hours. During the long summer nights ten hours, and towards the end of the operating season it stays open for six hours. Since this is the case, it is necessary to ensure that the revenues for the varying hours are accounted. The model predicts every hour the gates are open 23% of additional revenue will be generated. In addition to daylight hours, the seasons also affect the conditions in the garden that could influence revenues. Blooming flowers and trees in the spring, active wildlife in the summer, and autumn leaves can all bring flocks of people to the garden. Dummy variables for the yearly seasons were created to track the profits during each season. The most popular time of year by far is spring with an 86% increase of profit over winter. Where summer is a distant second with a 61% increase and autumn is 56% higher than winter.

Another element that must be accounted for is the Seattle weather. One can assume that as an outdoor facility the temperature and precipitation would have some effect on attendance and therefore money made during a day. Surprisingly the model states that the average temperature has a relatively low effect on attendance by only increasing by 0.6% for every degree in Fahrenheit. Rainfall was an obvious negative effect, by causing a negative 98% drop in revenue for every inch of rainfall. However realistically, Seattle does not receive inches of rainfall, but more like tenths of an inch, so for every tenth of an inch, there is a 9.8% drop in revenue.

Hypotheses

From looking at the regression⁷, it seems to be that the average temperature of Seattle has very little effect on the attendance at the Japanese Garden since it only increases revenues by 0.6%. When holding all else constant, it may be the case that a weekday in March would have the same attendance or grand total as a weekday in the middle of the summer. If people are visiting the garden in equal quantity when they are wearing their fleece lined overcoats and when its time for Bermuda shorts and sandals, then maybe it could also be true that the season of the year does not matter as well. By looking at a scatter of each day and their revenue, one could almost fit a horizontal line through the graph⁸. One could also question the placement of the special events maybe they are not scheduled correctly to draw the most people to the garden. The model also showed that fish food sales had a negative effect on the revenues (-5%). This seems counter-intuitive, so maybe this result is also incorrect.

Results

It turns out that the first hypothesis holds up. By running a student's two-tailed t-test, the t-value generated was 1.43 and with a 95% confidence level we cannot reject the assumption that the average temperature has no effects. In other words, regardless of the outside temperature people still show up to see the plants and animals of the Japanese Garden. To test the likelihood of all the seasons generating the same amount of profit, an F-test was used and resulted to reject that assumption. However, there is a probability of 0.58 (58%) that summer and fall could generate the same amount of money⁹.

Also, by looking at the regression results in Appendix C, it is unclear that special events have any actual influence on revenue; they may or may not be correctly placed. The probability of special events not being significant in generating revenue is about four percent.

⁷ Appendix C

⁸ Appendix B

⁹ Appendix C

With this in hand, administrators of the Japanese Garden could hold more fund raising events during spring to generate even more profits, and it could also benefit from extending the hours during this time of year as it gets closer to summer. Finally the fish food sales coefficient (-5%) had a standard error (8%) which means that the coefficient has a possibility of being positive, so one can assume that this variable is actually insignificant.

Accuracy and Critiques

A total of nine days were removed from the sample to test the accuracy of the model. Summer had the most number of observations for the model, so a total of three test days were taken for that season; two days were taken from the other three seasons. Three of the test dates were extremely off. The most inaccurate date could possibly be 'explained' by the time of the season, the regression model severely overstated the revenue generated on March 11 by over one hundred percent. Perhaps people were not aware that the garden season started since the garden opened only within two weeks prior. All the other test dates were on average within 20%¹⁰ of the actual take for the day, within \$50 to \$200 of the real revenue, one day happened to be within 0.9% or \$11.

Access to previous Garden seasons would help with the accuracy of the model. In one season of the garden there are only roughly 20 special events. Modeling based on such few observations may not accurately state the importance of events to revenues. Also more dates could help with the climatic effects on attendance. Perhaps this current season was dry compared to previous years, one can observe that only one day (March 12)¹¹ had precipitation exceed one inch of rainfall. Broad stroke estimates can be made using this model, and the major piece of information that can be taken from this model is that by far, spring is the most profitable despite the summer months longer hours.

¹⁰ Appendix A

¹¹ The Boeing Field Weather Station

<<http://www.ncdc.noaa.gov/servlets/ULCD?state=WA&callsign=BFI>>

Appendix A – Test Data

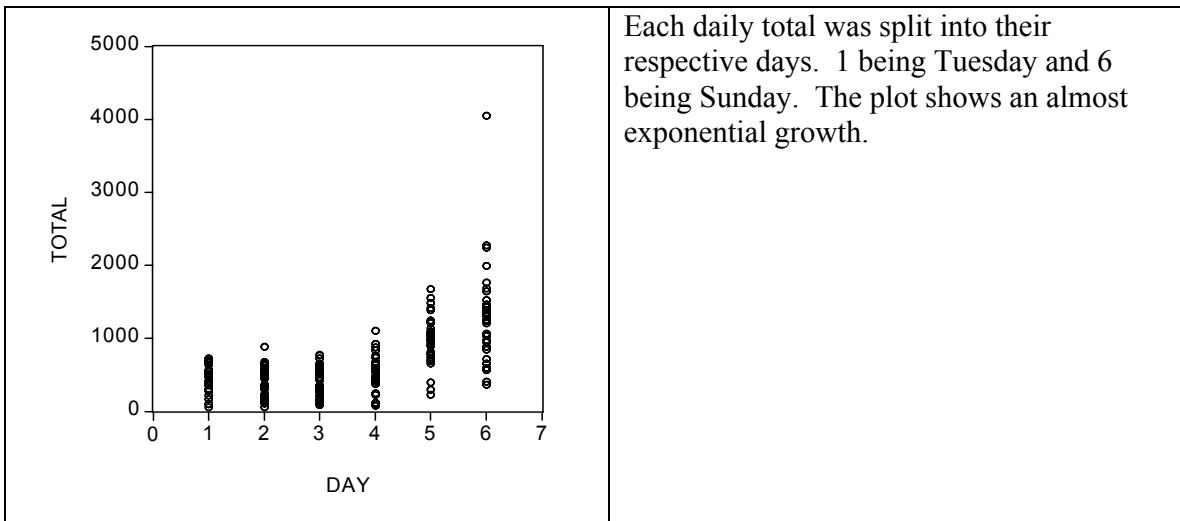
Day of Week	Hours Open	Day-Month	Temp	Rain	In total	regression	difference
6	8	9-Mar	48	0.36	5.899897	5.70004	0.199857
1	8	11-Mar	51	0.12	3.828641	4.91548	-1.08684
5	8	5-Apr	43	0.15	6.161207	6.60985	-0.44864
6	9	6-Apr	48	0.16	7.124478	7.13324	-0.00876
4	10	8-Aug	70	0	6.930006	6.3898	0.540206
5	10	9-Aug	68	0.15	6.765039	6.97585	-0.21081
6	10	10-Aug	68	0.09	6.795706	7.10791	-0.3122
6	6	2-Nov	40	0.18	6.045005	5.92262	0.122385
1	6	4-Nov	36	0	5.354225	5.0372	0.317025

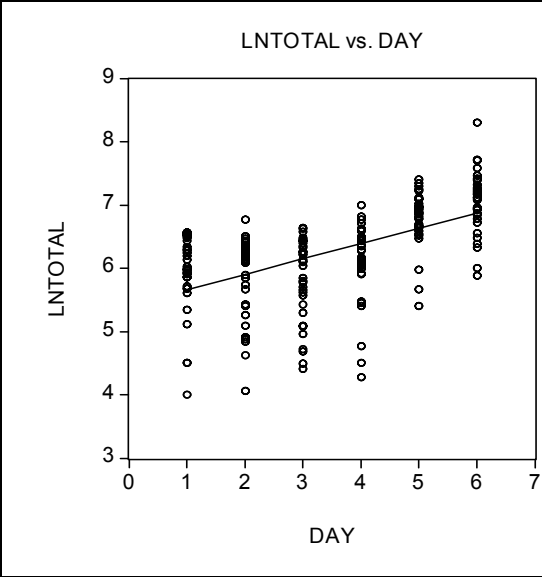
0.360748 total average difference in percentages

0.269987 average difference minus extreme outlier

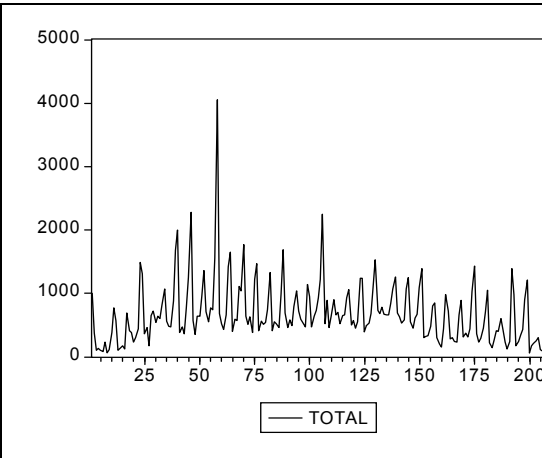
0.195174 average difference minus outliers

Appendix B – Graphs





By taking the natural log of each daily total the results almost become linear.



The total revenues look relatively consistent throughout the current season. The only major aberration is Mother's Day, with revenue of over \$4,000. Maybe the seasonal changes do not affect revenues.

Appendix C – The Regression Models

$$\text{Intotal} = c + \beta_1 \cdot \text{day} + \beta_2 \cdot \text{weekend} + \beta_3 \cdot \text{spring} + \beta_4 \cdot \text{summer} + \beta_5 \cdot \text{fall} + \beta_6 \cdot \text{hours} + \beta_7 \cdot \text{event} +$$

$$\beta_8 \cdot \text{temp} + \beta_9 \cdot \text{rain} + \beta_{10} \cdot \text{fish}$$

Dependent Variable: LNTOTAL

Method: Least Squares

Date: 12/03/03 Time: 16:00

Sample: 1 207

Included observations: 207

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.790590	0.320603	8.704205	0.0000
DAY	0.073156	0.025619	2.855529	0.0048
WEEKEND	0.672419	0.095873	7.013652	0.0000
SPRING	0.861831	0.112185	7.682247	0.0000
SUMMER	0.612287	0.131073	4.671330	0.0000
FALL	0.560108	0.124939	4.483064	0.0000
HOURS	0.233246	0.042482	5.490419	0.0000
EVENT	0.197464	0.095252	2.073081	0.0395
TEMP	0.006014	0.004697	1.280338	0.2019
RAIN	-0.980618	0.172651	-5.679755	0.0000
FISH	-0.054652	0.080687	-0.677333	0.4990
R-squared	0.786878	Mean dependent var	6.261802	
Adjusted R-squared	0.776005	S.D. dependent var	0.743256	
S.E. of regression	0.351769	Akaike info criterion	0.799994	
Sum squared resid	24.25336	Schwarz criterion	0.977095	
Log likelihood	-71.79935	F-statistic	72.36613	
Durbin-Watson stat	1.510313	Prob(F-statistic)	0.000000	

$$\text{Intotal} = c \text{ day weekend hours event temp rain (the season doesn't matter)}$$

Dependent Variable: LNTOTAL

Method: Least Squares

Date: 12/03/03 Time: 16:50

Sample: 1 207

Included observations: 207

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.152569	0.297058	10.61264	0.0000
DAY	0.079516	0.029527	2.692991	0.0077
WEEKEND	0.665856	0.110529	6.024277	0.0000
HOURS	0.300393	0.036429	8.245919	0.0000
EVENT	0.131692	0.109417	1.203572	0.2302
TEMP	-0.000769	0.004396	-0.174973	0.8613
RAIN	-1.130667	0.197703	-5.719025	0.0000
FISH	0.075158	0.088981	0.844659	0.3993
R-squared	0.712041	Mean dependent var	6.261802	
Adjusted R-squared	0.701912	S.D. dependent var	0.743256	
S.E. of regression	0.405799	Akaike info criterion	1.071962	
Sum squared resid	32.76986	Schwarz criterion	1.200763	
Log likelihood	-102.9481	F-statistic	70.29576	
Durbin-Watson stat	1.134686	Prob(F-statistic)	0.000000	

Summer = fall

Wald Test:

Equation: Untitled

Test Statistic	Value	df	Probability
F-statistic	0.296583	(1, 196)	0.5867
Chi-square	0.296583	1	0.5860

Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(5) - C(6)	0.052179	0.095813

Restrictions are linear in coefficients.