Influences on Revenues of The Seattle Japanese Garden

Paul Corcoro
pongo@u.washington.edu
Econometrics
Autumn 2003
Final Paper
Your 482 paper has been received

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 every year. Opening during the tail end of winter, patrons can visit during the first third of the season to witness the spring blossoms bloom, return 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 varying 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 revenues are affected by the season of the year, the day of the week, rainfall and the average daily temperature to name a few. A total of 208 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 rain fall, 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 0.5% for every degree. However, rainfall has an enormous negative effect of 95% less profit for every inch of precipitation. The most popular season by far was shown to be spring, with summer barely generating more revenue than the fall months. 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 value.

Data

The data of 208 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 website[1]. 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 website[2], specifically from the Boeing Field Station[3]. Finally, official dates of seasonal changes were obtained from the Science World website[4].

Model

The linear regression model assumed that nine variables influenced the total revenues. The day of the week was considered an influence on attendance to the garden it was mapped to grow as the week progressed[5]. In addition, however, the model assumed that more free time on the weekends would yield higher profits, so an additional true/false variable kept track of those days. As the week progresses towards the weekend, each day closer to the weekend generates 7% 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 expected.

While the year progresses and the seasons change the garden's operating hours change as the daylight hours change. 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

[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

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 22% of additional revenue will be generated. In addition to daylight hours, the seasons also affect the conditions of 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 each season were created to track the profits during each season of the year. The most popular season by far is spring with an 87% increase of profit over winter, where summer and autumn are both about 55% 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 0.5% for every degree in Fahrenheit. Rainfall was the largest and only negative effect, by causing a negative 95% drop in revenue for every inch of rainfall.

Finally, the 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.[6] The full regression[7] reads that by opening the garden in a winter day with no precipitation the Parks Department will make $59.01. The model's R-squared statistic states that all the variables account for almost 80% of the earnings generated.

---

[6] Appendix B
[7] Appendix C

Hypotheses

From looking at the regression[8], it seems to be that the average temperature of Seattle has very little effect on the attendance at the Japanese Garden. When holding all else constant, that a weekday in March would have the same attendance or grand total as a regular 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 graph[9]. One could also question the placement of the special events maybe they are not scheduled correctly to draw the most people to the garden.

Results

It turns out that the first hypothesis holds up. By running a student's two tailed t-test, with a 95% confidence level we can not reject the assumption. 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[10] and resulted to reject that assumption. However, summer and fall could be considered to generate the same amount of money. In addition, by looking at the regression results,[11] the placement of special events are borderline, they may or may not be correctly placed. With this in hand, administrators of the Japanese Garden could hold more fund raising events during this time of year to generate even more profits, and it

[8] Appendix C
[9] Appendix B
[10] Appendix C
[11] Appendix C

could also benefit from extending the hours during this time of year as it gets closer to summer.

Accuracy and Critiques

A total of nine days were removed from the sample to test the accuracy of the model. Two dates from each season except summer, three days were taken for nine test dates. Summer had the most number of observations for the model. Three of the test dates were extremely misestimated. Maybe another regression should be run to see if there is a difference between cold winter rain and warm summer showers or other possible interactions. All the other test dates were on average within 20% of the actual take for the day, within $50 to $200 of the real revenue[12].

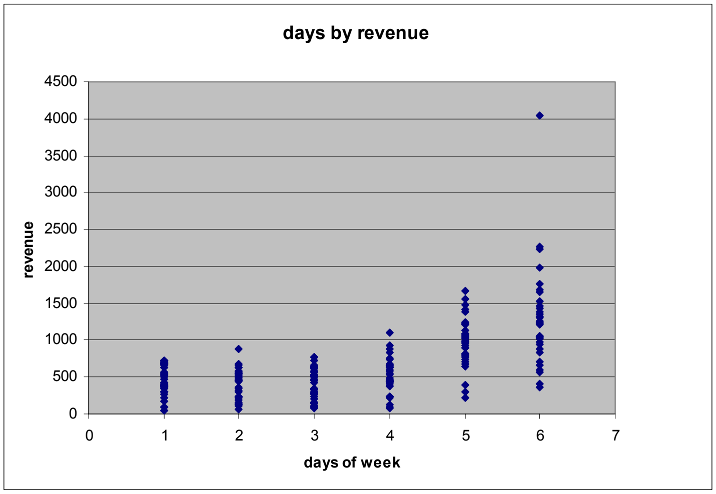
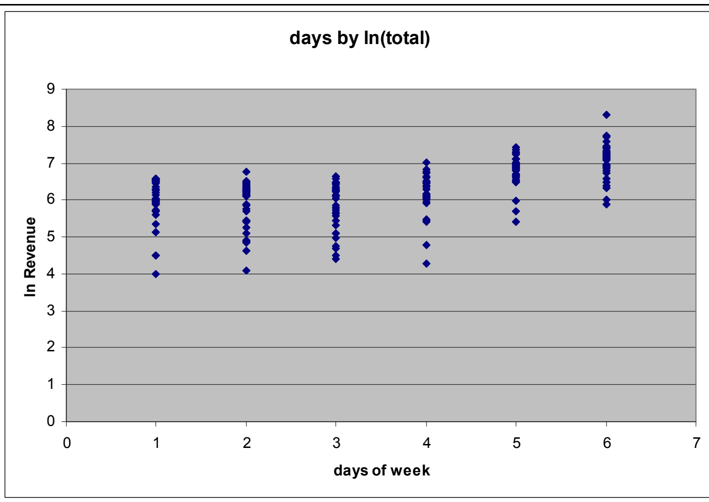
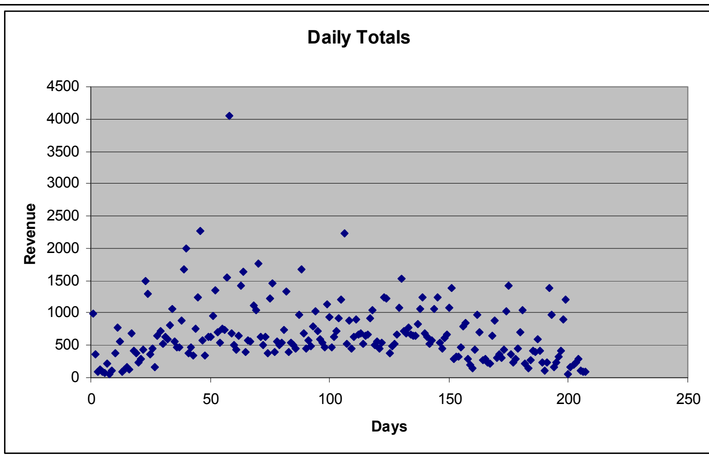
Access to previous Garden seasons would help with the accuracy of the model. In one season of the garden, there are only roughly 20 special events. Modeling based on such few observations may understate the importance of events to revenues. Also more dates could help with the climatic effects on attendance. Perhaps this current season was dry compared to previous years, one can observe that only one day (March 12) 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 time is the most profitable season of the year despite the summer months longer hours.

[12] Appendix A

Appendix A – Test Data

Day of Week	Hours Open	Day-Month	Temp	Rain	ln total	regression	difference
6	8	09-Mar	48	0.36	5.899897	5.70648	0.193417
1	8	11-Mar	51	0.12	3.828641	4.91206	-1.08342
5	8	05-Apr	43	0.15	6.161207	6.64935	-0.48814
6	9	06-Apr	48	0.16	7.124478	7.15888	-0.0344
4	10	08-Aug	70	0	6.930006	6.3884	0.541606
5	10	09-Aug	68	0.15	6.765039	6.97985	-0.21481
6	10	10-Aug	68	0.09	6.795706	7.11087	-0.31516
6	6	02-Nov	40	0.18	6.045005	5.92234	0.122665
1	6	04-Nov	36	0	5.354225	5.0334	0.320825

Appendix B – Scatter Plots

	Each daily total was split into their respective days. 1 being Tuesday and 6 being Sunday. The plot shows an almost exponential growth.
	By taking the natural log of each daily total the results almost become linear
	The totals look relatively equal 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

lntotal = c + β_1*day + β_2*weekend + β_3*spring + β_4*summer + β_5*fall + β_6*hours + β_7*event + β_8*temp + β_9*rain

Dependent Variable: LNTOTAL
Method: Least Squares
Date: 11/12/03 Time: 15:03
Sample: 1 207
Included observations: 207

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.875228	0.294843	9.751737	0.0000
DAY	0.073570	0.025577	2.876457	0.0045
WEEKEND	0.672421	0.095741	7.023327	0.0000
SPRING	0.842340	0.108282	7.779118	0.0000
SUMMER	0.587509	0.125692	4.674196	0.0000
FALL	0.537952	0.120415	4.467487	0.0000
HOURS	0.226148	0.041113	5.500631	0.0000
EVENT	0.193088	0.094902	2.034615	0.0432
TEMP	0.005300	0.004571	1.159435	0.2477
RAIN	-0.957397	0.168981	-5.665710	0.0000

R-squared	0.786379	Mean dependent var	6.261802
Adjusted R-squared	0.776620	S.D. dependent var	0.743256
S.E. of regression	0.351286	Akaike info criterion	0.792670
Sum squared resid	24.31013	Schwarz criterion	0.953671
Log likelihood	-72.04133	F-statistic	80.57721
Durbin-Watson stat	1.504616	Prob(F-statistic)	0.000000

lntotal = c day weekend hours event temp rain (the season doesn't matter)
Dependent Variable: LNTOTAL
Method: Least Squares
Date: 11/12/03 Time: 15:51
Sample: 1 207
Included observations: 207

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.043059	0.267081	11.39378	0.0000
DAY	0.079205	0.029503	2.684606	0.0079
WEEKEND	0.664975	0.110445	6.020892	0.0000
HOURS	0.309074	0.034924	8.849811	0.0000
EVENT	0.137055	0.109155	1.255602	0.2107
TEMP	0.000733	0.004017	0.182335	0.8555
RAIN	-1.171479	0.191570	-6.115154	0.0000

R-squared	0.711009	Mean dependent var	6.261802
Adjusted R-squared	0.702339	S.D. dependent var	0.743256
S.E. of regression	0.405508	Akaike info criterion	1.065879
Sum squared resid	32.88735	Schwarz criterion	1.178580
Log likelihood	-103.3185	F-statistic	82.01031
Durbin-Watson stat	1.132899	Prob(F-statistic)	0.000000