

Assignment 5
Prescriptive Analysis - NYC Real Estate

Moiz Deshmukh
BU ID: U63698143

Metropolitan College, Boston University
AD517: Applied Business Analytics (Summer 2)
Professor Prasad Kothapalli
Aug 2nd, 2024

Table of Contents

Executive Summary	3
Assumptions for the Model	4
Development of the Model.....	4
Model Results Breakdown	5
Conclusion	6
Appendix.....	7
Figure 1	7
Figure 2	7
Figure 3	8
Figure 4	8
Figure 5	9
Figure 6	9
Figure 7	9
Figure 8	10
Figure 9	10

Executive Summary

This report evaluates the feasibility of opening a residential sales office in the Bayside neighborhood of Queens Borough, New York City. A non-linear model created in Microsoft Excel aimed to determine the maximum net present value of potential profit over the next eight quarters. The model included constraints such as a 6% internal rate of return, a baseline market penetration rate of 5.5%, a minimum office space requirement of 250 square feet, and an increase in market penetration with each reduction in commission fees. The analysis also considered the impact of hiring up to three employees, requiring additional office space and covering their salaries. Using Power BI, the average price per square foot was calculated to be \$226.57, indicating favorable commercial rent costs compared to nearby neighborhoods.

A regression analysis in R forecasted sales for the next eight quarters, providing a baseline prediction. An optimization model in Excel was then developed to maximize potential profits while considering Bayside's specific market conditions. To account for uncertainties, additional models were created using low and high 95% confidence values from the regression analysis. These models consistently recommend charging a 5% commission and hiring two employees, projecting significant market penetration and profitability. Even in less favorable scenarios, the firm is expected to remain profitable, demonstrating resilience and strong market potential. This comprehensive evaluation highlights Bayside as an attractive location for a new office, with consistent recommendations across all models underscoring the stability and potential of the market.

Assumptions for the Model

To evaluate the viability of opening a residential sales office in Bayside, a non-linear model was crafted using Microsoft Excel. This model seeks to identify the maximum net present value of potential profit generated over the next eight quarters by establishing an office in this neighborhood. Several initial constraints were applied to the model, including an internal rate of return of 6%, a baseline market penetration rate of 5.5%, meaning the firm will earn 5.5% of the total sales commissions in the neighborhood, a minimum office space requirement of 250 square feet, and an anticipated market penetration increase of 0.15% for each 0.1% reduction in commission fees.

Furthermore, the model incorporates the effect of hiring up to three employees, with each new hire expected to boost market penetration by 0.5%. The firm must also lease an additional 125 square feet of office space per employee and cover their monthly wages. To estimate the commercial rent costs in Bayside, the average price per square foot was calculated using Power BI. The sum total of sale prices for the last five years of commercial properties in Bayside was divided by the sum total of the gross square footage for the same period. The average cost per square foot obtained was \$226.57, as seen in Figure 1.

This rate is relatively low compared to those in nearby neighborhoods and other highly desirable areas of New York City. This refined analysis provides a clearer picture of the financial feasibility and potential profitability of opening a residential sales office in Bayside, taking into account the specified conditions and assumptions.

Development of the Model

A regression analysis was performed in R to prepare the forecast for the next eight quarters, as seen in Figure 2. This regression model provides a baseline prediction of future total sales, helping to outline the expected market trajectory. Following this initial analysis, an optimization model was created using Microsoft Excel, as depicted in Figure 3. This

model was designed to maximize the potential net present value of profits over the forecast period by incorporating various business constraints and market conditions specific to the Bayside neighborhood. The optimization model serves as a crucial tool in strategizing the firm's operational and investment decisions to align with predicted market trends.

To account for uncertainty and variability in the market, two additional models were developed using the low 95% confidence values and high 95% confidence values from the regression analysis, as shown in Figure 4 and Figure 5. These models represent the potential lower and upper bounds of the forecast, providing a range within which the actual market performance may fall. Reviewing these three models will offer comprehensive insights into the expected market conditions and guide the firm's strategic decisions. The range of predictions helps the firm prepare for different scenarios, ensuring flexibility in business planning to adapt to real estate market conditions that may be better or worse than the baseline forecast provided by the regression model.

Model Results Breakdown

Running all three models provided valuable insights into different scenarios for the firm's operations in the Bayside neighborhood. The results from the model with the best fit values, determined by the regression analysis, suggest that the firm should charge a 5% commission and hire two employees. This model forecasts a 7% market penetration in Bayside, resulting in a total profit of \$2.6 million over the next eight quarters, as seen in Figure 6.

When using the low 95% confidence values, the recommendations remain consistent, with a 5% commission and 7% market penetration. Even in the worst-case scenarios, this model predicts a profit of \$2.2 million for the next eight quarters and also advises hiring two employees. This demonstrates the firm's resilience and ability to maintain profitability under less favorable market conditions.

The high 95% confidence model also aligns with the previous recommendations, advocating for a 5% commission and the hiring of two employees. This model, reflecting more optimistic market conditions, forecasts a potential profit of \$2.9 million over the next eight quarters.

The consistency in recommendations across all models highlights the stability of the 5% commission rate, as the variations in forecast values from the regression analysis remain constant over the eight-quarter period, as illustrated in Figure 9.

Furthermore, the suggestion to hire two employees in all three models underscores the projected revenue growth in Bayside. This consistent recommendation indicates that Bayside presents a significant opportunity not only for opening an office but also for achieving substantial revenue growth.

Conclusion

After conducting a comprehensive analysis, including optimization models with varying confidence levels and forecasts from the regression analysis, it is evident that opening a sales office in the Bayside neighborhood is feasible. The models consistently recommend charging a 5% commission and hiring two employees, projecting significant market penetration and profitability. Even under less favorable conditions, the firm is expected to remain profitable, demonstrating resilience and strong market potential.

This thorough evaluation underscores that Bayside offers a promising opportunity for substantial revenue growth. The consistency in recommendations across all models highlights the stability and potential of the market in Bayside, making it an attractive location for establishing a new office. By strategically aligning with the forecasted market trends, the firm can optimize its operations and capitalize on the significant opportunities available in this neighborhood.

Appendix

Figure 1

Average Price Per Square Foot

Avg Sale Price Per Sq Foot	
Total Sale Price (Last 5 Years)	219,550,000
Total Gross Square Feet (Last 5 Years)	969,430
Average Sale Price per Sq Foot	226.4732884

Figure 2

Forecast of 8 Quarters done through Regression on R

	fit	lwr	upr
1	102065776	88529208	115602343
2	111286084	97749516	124822651
3	128839195	115302627	142375763
4	127901672	114365104	141438240
5	107069802	92598602	121541001
6	116290110	101818910	130761309
7	133843221	119372021	148314421
8	132905698	118434499	147376898

Figure 3

Optimization Model

MARKET PENETRATION		FORECAST				MONTHLY COSTS	
Base Market Penetration	5.50%	Quarter	Forecast (total sale Forecasted revenues)			1	\$ 12,531.86
Base Sales Commission	5.00%	1	\$ 102,065,776.00	\$ 331,713.77		2	\$ 12,531.86
MP increase step per employee	0.50%	2	\$ 111,286,084.00	\$ 361,679.77		3	\$ 12,531.86
MP change factor by commission	1.50%	3	\$ 128,839,195.00	\$ 418,727.38		4	\$ 12,531.86
Commission charge change step	0.10%	4	\$ 127,901,672.00	\$ 415,680.43		5	\$ 12,531.86
Commision	5.00%	5	\$ 107,069,802.00	\$ 347,976.86		6	\$ 12,531.86
Market Peentraion Factual	7%	6	\$ 116,290,110.00	\$ 377,942.86		7	\$ 12,531.86
		7	\$ 133,843,221.00	\$ 434,990.47		8	\$ 12,531.86
		8	\$ 132,905,698.00	\$ 431,943.52		9	\$ 12,531.86
						10	\$ 12,531.86
OFFICE		CONSTRAINTS				11	\$ 12,531.86
Office space - base	250	Commission	>=	4%		12	\$ 12,531.86
offie space - additional per employee	125	Commission	<=	5%		13	\$ 12,531.86
office space factual (required)	500	Employees	<=	0		14	\$ 12,531.86
Avg price per sq foot commercial	\$ 226.47	Employees	<=	3		15	\$ 12,531.86
Rent & Utilities per sq foot monthly	1.50%	Employees	int	integer		16	\$ 12,531.86
Rent & Utilities - monthly per sq foot	\$ 3.40	Operating Bdgt	<=	\$ 15,000.00		17	\$ 12,531.86
Rent & Utilities Total Yearly	\$ 20,382.30					18	\$ 12,531.86
Rent & Utilities Total Quarterly	\$ 5,095.58					19	\$ 12,531.86
Rent & Utilities Total Monthly	\$ 1,698.53					20	\$ 12,531.86
						21	\$ 12,531.86
EMPLOYEES		NPV				22	\$ 12,531.86
Employee Salary Yearly - given	\$ 65,000.00	IRR Annual		6.00%		23	\$ 12,531.86
Employees	2	IRR Quarterly		1.50%		24	\$ 12,531.86
Payroll budget yearly	\$ 130,000.00	IRR Monthly		0.50%			
Payroll budget quarterly	\$ 32,500.00	NPV Revenue		US\$2,914,000.91			
Payroll budget monthly	\$ 10,833.33	NPV Costs		US\$282,823.65			
		NPV Profit		US\$2,631,177.27	maximize		
TOTAL COST (office & payroll)							
Total Cost Per Year	\$ 150,382.30						
Total Cost Per Quarter	\$ 37,595.58						
Total Cost Per Month	\$ 12,531.86						
Operating budget monthly - given	\$ 15,000.00	<=	\$ 15,000.00				

Figure 4

Model with Low 95% confidence values

MARKET PENETRATION		FORECAST				MONTHLY COSTS	
Base Market Penetration	5.50%	Quarter	Forecast (total sale Forecasted revenues)			1	\$ 12,531.86
Base Sales Commission	5.00%	1	\$ 88,529,208.00	\$ 287,719.93		2	\$ 12,531.86
MP increase step per employee	0.50%	2	\$ 97,749,516.00	\$ 317,685.93		3	\$ 12,531.86
MP change factor by commission	1.50%	3	\$ 115,302,627.00	\$ 374,733.54		4	\$ 12,531.86
Commission charge change step	0.10%	4	\$ 114,365,104.00	\$ 371,686.59		5	\$ 12,531.86
Commision	5.00%	5	\$ 92,598,602.00	\$ 300,945.46		6	\$ 12,531.86
Market Peentraion Factual	7%	6	\$ 101,818,910.00	\$ 330,911.46		7	\$ 12,531.86
		7	\$ 119,372,021.00	\$ 387,959.07		8	\$ 12,531.86
		8	\$ 118,434,499.00	\$ 384,912.12		9	\$ 12,531.86
						10	\$ 12,531.86
OFFICE		CONSTRAINTS				11	\$ 12,531.86
Office space - base	250	Commission	>=	4%		12	\$ 12,531.86
offie space - additional per employee	125	Commission	<=	5%		13	\$ 12,531.86
office space factual (required)	500	Employees	<=	0		14	\$ 12,531.86
Avg price per sq foot commercial	\$ 226.47	Employees	<=	3		15	\$ 12,531.86
Rent & Utilities per sq foot monthly	1.50%	Employees	int	integer		16	\$ 12,531.86
Rent & Utilities - monthly per sq foot	\$ 3.40	Operating Bdgt	<=	\$ 15,000.00		17	\$ 12,531.86
Rent & Utilities Total Yearly	\$ 20,382.30					18	\$ 12,531.86
Rent & Utilities Total Quarterly	\$ 5,095.58					19	\$ 12,531.86
Rent & Utilities Total Monthly	\$ 1,698.53					20	\$ 12,531.86
						21	\$ 12,531.86
EMPLOYEES		NPV				22	\$ 12,531.86
Employee Salary Yearly - given	\$ 65,000.00	IRR Annual		6.00%		23	\$ 12,531.86
Employees	2	IRR Quarterly		1.50%		24	\$ 12,531.86
Payroll budget yearly	\$ 130,000.00	IRR Monthly		0.50%			
Payroll budget quarterly	\$ 32,500.00	NPV Revenue		US\$2,573,635.28			
Payroll budget monthly	\$ 10,833.33	NPV Costs		US\$282,823.65			
		NPV Profit		US\$2,290,811.63	maximize		
TOTAL COST (office & payroll)							
Total Cost Per Year	\$ 150,382.30						
Total Cost Per Quarter	\$ 37,595.58						
Total Cost Per Month	\$ 12,531.86						
Operating budget monthly - given	\$ 15,000.00	<=	\$ 15,000.00				

Figure 5

Model with High 95% confidence values

MARKET PENETRATION		FORECAST		MONTHLY COSTS	
Base Market Penetration	5.50%	Quarter	Forecast (total sale Forecasted revenues)	1	\$ 12,531.86
Base Sales Commission	5.00%	1	\$ 115,602,343.00 \$ 375,707.61	2	\$ 12,531.86
MP increase step per employee	0.50%	2	\$ 124,822,651.00 \$ 405,673.62	3	\$ 12,531.86
MP change factor by commission	1.50%	3	\$ 142,375,763.00 \$ 462,721.23	4	\$ 12,531.86
Commission charge change step	0.10%	4	\$ 141,438,240.00 \$ 459,674.28	5	\$ 12,531.86
Commission	5.00%	5	\$ 121,541,001.00 \$ 395,008.25	6	\$ 12,531.86
Market Penetration Factual	7%	6	\$ 130,761,309.00 \$ 424,974.25	7	\$ 12,531.86
OFFICE		7	\$ 148,314,421.00 \$ 482,021.87	8	\$ 12,531.86
Office space - base	250	8	\$ 147,376,898.00 \$ 478,974.92	9	\$ 12,531.86
Office space - additional per employee	125	CONSTRAINTS		10	\$ 12,531.86
Office space factual (required)	500	Commission	>= 4%	11	\$ 12,531.86
Avg price per sq foot commercial	\$ 226.47	Commission	<= 5%	12	\$ 12,531.86
Rent & Utilities per sq foot monthly	1.50%	Employees	<= 0	13	\$ 12,531.86
Rent & Utilities - monthly per sq foot	\$ 3.40	Employees	<= 3	14	\$ 12,531.86
Rent & Utilities Total Yearly	\$ 20,382.30	Employees	int integer	15	\$ 12,531.86
Rent & Utilities Total Quarterly	\$ 5,095.58	Operating Bdgt	<= \$ 15,000.00	16	\$ 12,531.86
Rent & Utilities Total Monthly	\$ 1,698.53	NPV		17	\$ 12,531.86
EMPLOYEES		IRR Annual	6.00%	18	\$ 12,531.86
Employee Salary Yearly - given	\$ 65,000.00	IRR Quarterly	1.50%	19	\$ 12,531.86
Employees	2	IRR Monthly	0.50%	20	\$ 12,531.86
Payroll budget yearly	\$ 130,000.00	NPV Revenue	US\$3,254,366.54	21	\$ 12,531.86
Payroll budget quarterly	\$ 32,500.00	NPV Costs	US\$282,823.65	22	\$ 12,531.86
Payroll budget monthly	\$ 10,833.33	NPV Profit	US\$2,971,542.89 maximize	23	\$ 12,531.86
TOTAL COST (office & payroll)				24	\$ 12,531.86
Total Cost Per Year	\$ 150,382.30				
Total Cost Per Quarter	\$ 37,595.58				
Total Cost Per Month	\$ 12,531.86				
Operating budget monthly - given	\$ 15,000.00				

Figure 6

NPV of the model with best fit values

NPV	
IRR Annual	6.00%
IRR Quarterly	1.50%
IRR Monthly	0.50%
NPV Revenue	US\$2,914,000.91
NPV Costs	US\$282,823.65
NPV Profit	US\$2,631,177.27

Figure 7

NPV of the model with Low 95% confidence values

NPV	
IRR Annual	6.00%
IRR Quarterly	1.50%
IRR Monthly	0.50%
NPV Revenue	US\$2,573,635.28
NPV Costs	US\$282,823.65
NPV Profit	US\$2,290,811.63

Figure 8

NPV of the model with High 95% confidence values

NPV	
IRR Annual	6.00%
IRR Quarterly	1.50%
IRR Monthly	0.50%
NPV Revenue	US\$3,254,366.54
NPV Costs	US\$282,823.65
NPV Profit	US\$2,971,542.89

Figure 9

Forecast of the 8 Quarters with Best Fit Values, Lower 95% Confidence Values and Higher 95% Confidence Values

