Los Angeles Convention Center

INTERDEPARTMENTAL CORRESPONDENCE

DATE: October 28, 2009

TO: Sharon Gin, Legislative Assistant
Office of the City Clerk

FROM: Mary Jane Aquino
Acting Assistant General Manager & CFO
Los Angeles Convention Center

SUBJECT: **FLEXIBLE DEMAND BASED SPACE RENTAL PRICING (FDBSRP)**

Pursuant to the memorandum from your Office dated October 19, 2009, the Los Angeles Convention Center (LACC) hereby submits copies of various documents in support of the application of Flexible Demand Based Space Rental Pricing (FDBSRP) at the LACC. The intent of the FDBSRP at the LACC is to build revenue capacity and to position the LACC within a very competitive industry in a very challenging economic environment.

The process started in November 2008, with the request for assistance from the LACC on the practical means whereby the business concept could be implemented at the LACC. A Motion was introduced on January 16, 2009 for the option to adjust the rental rate of $0.32 per square foot of net space used or occupied by **thirty percent above or below this rate**. Further, the Motion instructed the City Attorney to prepare an ordinance to amend the Los Angeles Administrative Code Section 8.149 to implement the FDBSRP at the LACC. This matter has repeatedly been discussed and referenced at City Council, Budget and Finance Committee and the Trade, Commerce and Tourism Committee.

A committee of representatives from various concerned Departments of the City of Los Angeles as well as the active participants from LA INC., the Los Angeles Convention and Visitors Bureau, was convened to discuss the establishment and implementation of the FDBSRP at the LACC. The LACC presented various information and sources attesting to the successful application of the business concept elsewhere as well as the development of the circumstances as to its practical application at the LACC and the procedure that would be followed to approve and monitor the usage of the FDBSRP at the LACC.

Various correspondence and information in support of the management of the FDBSRP model at the LACC are attached for your review:

- Copy of reference documents to provide additional background information in the wide spread use and acceptance of the FDBSRP business concept in various industries, including copy of the Presentation of "Yield Management" Information at the International Convention Center Conference in Portland Oregon on September 25-27, 2008

- Copy of the Motion presented by Councilmember Jan Perry and seconded by Councilmember Janice Hahn dated January 16, 2009 with the instruction to the City Attorney to prepare an ordinance to amend the Los Angeles Administrative Code Section 8.149 to implement the FDBSRP at the LACC

- Copy of Interdepartmental Correspondence dated March 4, 2009 from the LACC providing additional information on the various conditions wherein the FDBSRP will be applicable at the LACC

- Copy of Interdepartmental Correspondence dated May 13, 2009 from the LACC providing additional information on the various criteria wherein the FDBSRP will be applicable and the approval process that would be followed in its implementation at the LACC

- Copy of Interdepartmental Correspondence dated May 28, 2009 from the LACC providing additional details to augment the information previously submitted

- Copy of Interdepartmental Correspondence dated August 21, 2009 from the LACC providing additional details to augment the information previously submitted regarding the procedure to be followed for the approval of the use of the FDBSRP at the LACC

In the course of the various meetings and discussions, as well as in response to the complexity of the rapidly changing financial condition, it was determined to alter the request to modify the $0.32 per square foot of net space used or occupied from thirty percent above or below this rate to **fifty percent above or below this rate.** Also incorporated in the FDBSRP as it would be utilized at the LACC is an option to modify the rate per square foot of net space used or occupied **in excess of fifty percent** with an additional approval process, through the Office of the Mayor. A pilot program is being considered to assess the outcome of the employment of the FDBSRP at the LACC. Additionally, the LACC will report, on agreed-upon frequency, on the results of the pilot program, to the Office of the Mayor.

The LACC recommends the following actions be taken in consideration of FDBSRP at the LACC:

1. Approval of the Flexible Demand Based Space Rental Pricing (FDBSRP) at the LACC subject to the conditions as will be identified in the Ordinance amending Section 8.149.2 of the Los Angeles Administrative Code

2. Approval of an option to modify the rate per square foot of net space used or occupied **in excess of fifty percent** with an additional approval process, through the Office of the Mayor.

3. Approval of either a "sunset clause" in the ordinance or a Pilot Program of at least three whole fiscal years to determine the feasibility of the FDBSRP at the LACC

4. Approval of a Reporting mechanism of the results of the utilization of FDBSRP at the LACC

A primary impact of the Flexible Demand-Based Space Rental Pricing is to provide the LACC with an additional set of tools to fill the space and thus, maximize revenue and increase market share. The LACC is appreciative of the hard work by all members of the committee in the discussions of the events that will be suitable for the application of the FDBSRP at the LACC.

Your support of the business of the Los Angeles Convention Center and the tools necessary to ensure that we are able to compete at the highest levels is both acknowledged and very much appreciated. If you have any comments or questions, please contact me at (213) 741-1151, Ext. 5384.

MJA:dh:rg
Ref. EXEC 09-445

Attachments

cc: Honorable Jan Perry, Councilmember, CD 9
Honorable Janice Hahn, Councilmember, CD 15
Miguel A. Santana, City Administrative Officer
Pete Echeverria, Chief Assistant City Attorney, Office of the City Attorney
John Wickham, Office of the Chief Legislative Analyst
Terry Martin Brown, Office of the City Attorney
Diana Mangioglu, Office of the City Administrative Officer
Barbara Kirklighter, LA INC.
Pouria Abbassi, P.E., LACC
Phillip C. Hill, LACC
Patricia Gunness, LACC

Yield Management: Next Steps for Convention Centers

Warren Lieberman

www.veritecsolutions.com

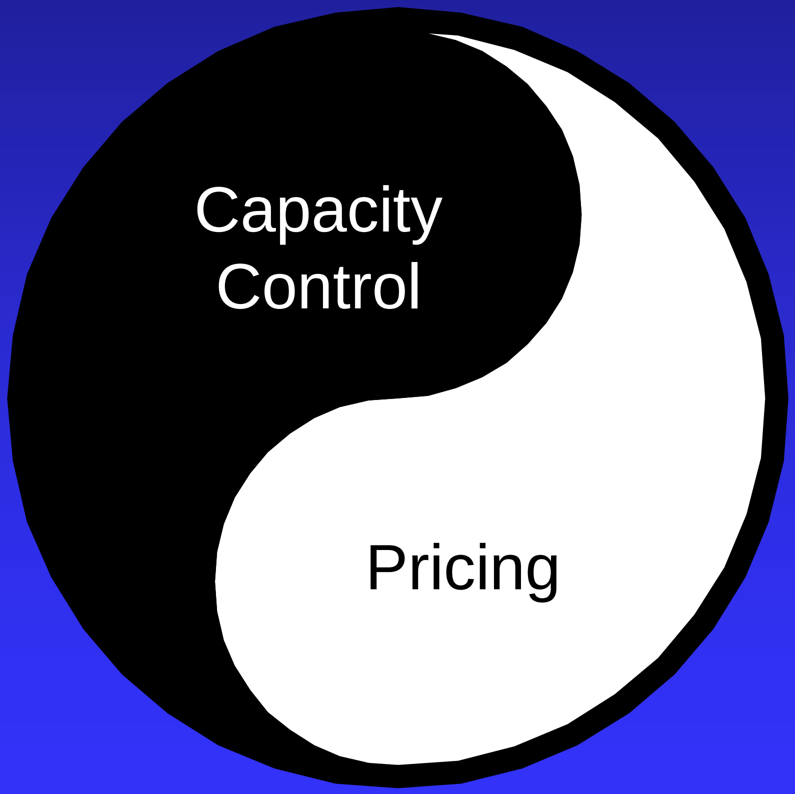
VERITEC SOLUTIONS

Agenda

- Quick Refresher on Dynamic Pricing and RM
- Illustrative Method for Implementing Dynamic Pricing and RM Concepts
- Discussion

Two Sides of Revenue Management

Revenue Benefits of 4 – 8 percent are commonly reported



Revenue Benefits may even be greater than for capacity control

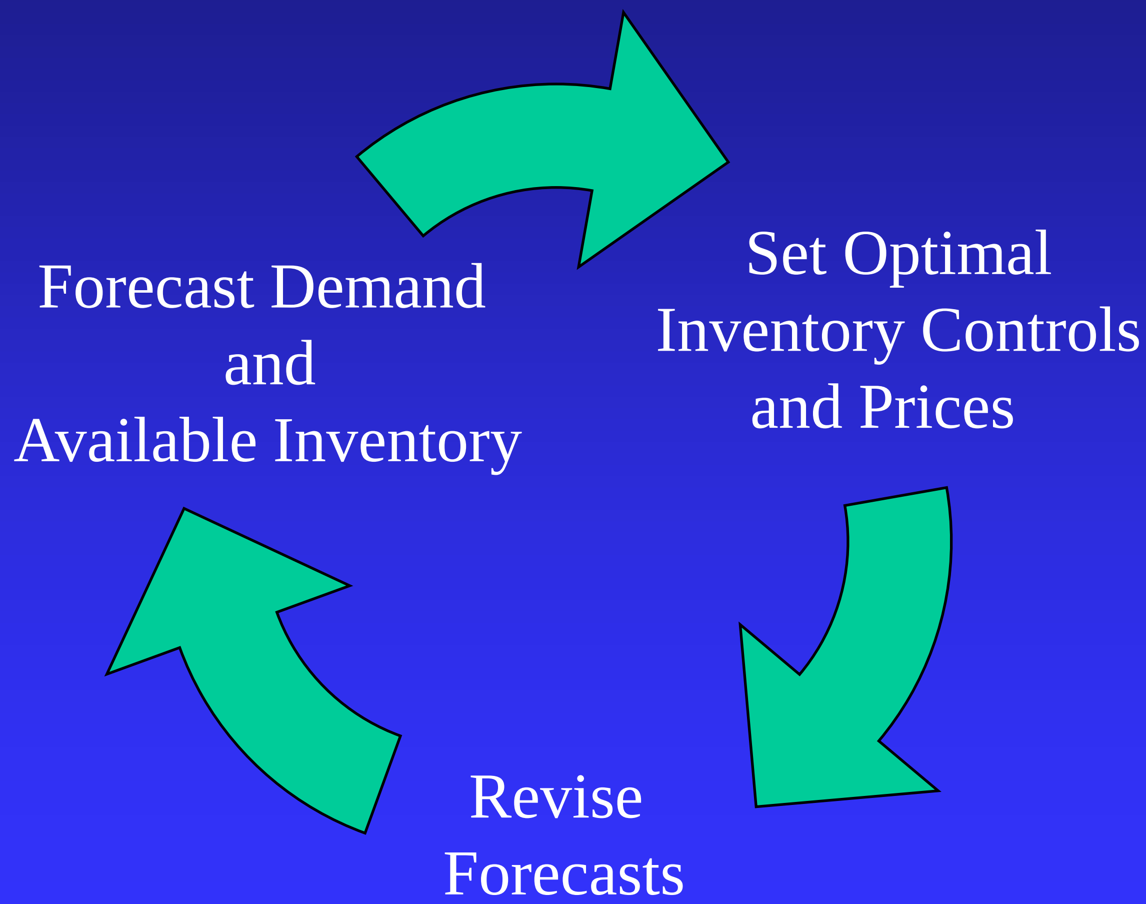
What is Revenue Management?

- Disciplined Pricing (process and technology)
- Data-Driven decision-making
- Leveraging market segmentation principles
- Focused on incremental revenue/profit opportunities
- Playing the odds
- HIGHLY PROFITABLE

Fundamental Principles of YM

Fundamental Principles of YM

Fundamental Principles of YM



What's Different About the RM Product Structure?

- One of the cornerstones of RM is a differentiated product and price offering.
- Product differentiation often goes beyond physical and service characteristics (e.g., purchase- and usage-based)
- Products are targeted to multiple market segments and are priced according to each segment's willingness to pay
- Prices and discounts are not static but managed dynamically over time in response to the market dynamics.

Elements of a Convention Center RM System

- Revenue Management Calendar
  - Highlights and prioritizes opportunities
  - Provides guidance to sales staff and Convention Center Management
- Demand Forecast, serving as a key input to establishing profit maximizing prices
- Rental Request Profitability Evaluator
- Meeting Room Availability Calendar

Ask Yourself:

What do we have today?

How can we improve what we currently have?

The RM Calendar

Convention Center Pricing and Proposal Request Calendar

			Monthly Calendar															
DAY OF WEEK	Sun	Mon	Tue	Wed	Th	Fri	Sat	Sun	Mon	Tue	Wed	Th	Fri	Sat	Sun	Mon	Tue	Wed
DATE	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Contracted																		
Exp Booked (TBB)																		
Tentative																		
TARGET DATES																		
Able to Move			FLEX	FLEX	FLEX	FLEX							FLEX	FLEX	FLEX			
Proposed Event Dates																		
Operational/Layering Considerations				LHA					LES, LHA	LES,L HA	LES				LHA	LHA	LHA	
Operational/Layering Preferences				MI														
Requested Space (000)											100	100	100	100	100	100		
Exhibition Space Avail (000)	375	400	175	500	500	500	500	300	50	50	450	450	250	250	300	350	450	500
Min $/Sq Ft (NET)	$0.21	$0.21	$0.14	$0.14	$0.21	$0.21	$0.21	$0.21	$0.21	$0.21	$0.14	$0.14	$0.14	$0.14	$0.21	$0.21	$0.09	$0.14
Incentives																		
Proposed Daily Net Rev/Sq Ft	$0.199			**Total Net Rev**					$119,109		**Working Capital**				$21,109			
Target Daily Net Rev/Sq Ft	$0.163			**Target Net Rev**					$98,000									
Proposed Impact to Community				**Room Rev (Tax)**		$52,624	**Economic Impact**			$2,660,000								
Total Exhibit Space (000)	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500	500
Demand Fcst	H	H	M	M	H	H	H	H	H	H	M	M	M	M	H	H	L	M
Contracted	25%	20%	65%	0%	0%	0%	0%	40%	90%	90%	10%	10%	50%	50%	40%	30%	10%	0%

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Contracted	25%	20%	65%	0%	0%	0%	0%	40%	90%	90%	10%	10%	50%	50%	40%	30%	10%	0%

Notes for The RM Calendar

LEGEND								
Demand Fcst		High				Med		Low
Exp Booked (TBB)		> 80%				> 60%		<60%
Tentative		Solid				Discussion		None
LHA	Low Hotel Availability							
MI	Move Ins							
MO	Move Outs							
LES	Limited Exhibition Space Available							
Target Dates		Desired			Highly Desired			
Able to Move	FLEX	Some Flexibility Possible						
Start Date of Proposed Event	11							
End Date of Proposed Event	16							

High Dmd, $/Sq Ft	$0.21
Med Dmd, $/Sq Ft	$0.14
Low Dmd, $/Sq Ft	$0.09

Demand Forecast

Threshold (Bid) Prices are driven by the demand forecast

						Monthly Demand Forecast By Day															
Sun	Mon	Tue	Wed	Th	Fri	Sat	Sun	Mon	Tue	Wed	Th	Fri	Sat	Sun	Mon	Tue	Wed	Th	Fri	Sat	Sat
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**
H	H	M	M	H	H	H	H	H	H	M	M	M	M	H	H	L	M	L	M	M	M

High Dmd, $/Sq Ft	$0.21
Med Dmd, $/Sq Ft	$0.14
Low Dmd, $/Sq Ft	$0.09

Evaluating a Rental Request

	Exhibit Space Rental Request					
	START DATE	11			Estimated Attendance	1,400
	END DATE	16			Rooms	2,300
	Set-up Days				Average Room Rate	$160.00
	Revenue per Sq Ft	$232,750			Avg Nights/Room	2.2
	Cost per Sq Ft	$113,641			Tax Rate	6.50%
	Net Rev per Sq FT	$1.191				
	Total Net Revenue	$119,109			Benefit Per Attendee	$1,900
	Daily Net Rev per Sq Ft	$0.199			Economic Impact	$2,660,000
					Estimated Tax Rev	$52,624
		Sq Ft				
	Rental Area	100,000				
		Revenue	Cost	Net	Net per Sq Ft	Daily Net per Sq Ft
	Rental	$63,000	$0	$63,000	$0.630	$0.105
Ancillary Services	Food and Beverage	$100,000	$75,000	$25,000		
	Audio/Video	$15,000	$9,750	$5,250		
	Cleaning	$400	$320	$80		
	Water	$360	$108	$252		
	Electrical Services	$23,310	$11,655	$11,655		
	Equipment	$0	$0	$0		
	Security and Personnel	$0	$0	$0		
	Telephone and ISP/Data	$22,680	$13,608	$9,072		
	OTHER	$8,000	$3,200	$4,800		
	TOTAL	$232,750	$113,641	$119,109		
	Total Per Sq Foot	$2.328	$1.136	$1.191		0.199
	Total Target Rev per Sq Ft	0.98				
	Actual Daily Net Rev Per Sq Ft	$0.199				
	Target Daily Net Rev Per Sq Ft	$0.163				
	Working Capital	$21,109				

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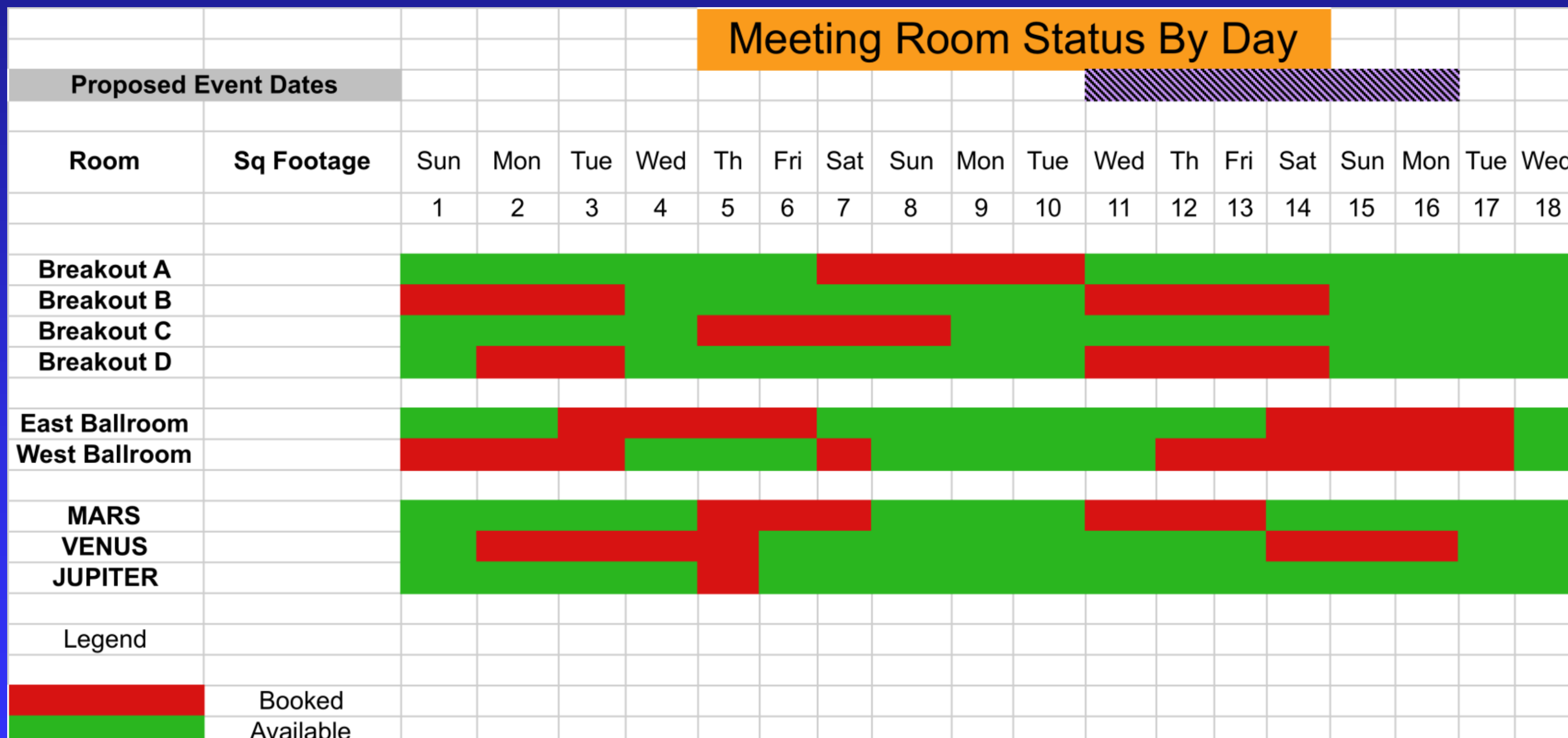
Meeting Room Availability



Getting Started: Data Collection

- Historical Sales Summary Report
  - Date/Day of Week
  - Services Required
  - Space required (e.g., square footage, meeting rooms, etc.)
  - Financials (Overall costs and revenues as well as detailed line items)
  - Type of Event
  - When Event was Booked
- As appropriate, data to support regional impact statements

Data Supporting Advanced System

- Lost Business Report
  - Requested Date
  - Actual Date (if available)
  - Pricing Offered
  - Reason Lost
  - Actual Venue (if available)
  - Pricing Accepted (if available)

Summary Thoughts

- Regardless of the extent to which you are currently practicing revenue management or dynamic pricing, opportunities to earn incremental profits exist
- If your pricing is currently static (or relatively so):
  - Identify highest and lowest demand days
  - Modify your prices (or promotions) for these days OR selectively choose what types of events to accept
  - Track your results; broaden your efforts where appropriate
- If you currently vary your prices:
  - Identify how you might expand/improve your efforts
  - Develop feedback mechanisms and performance metrics

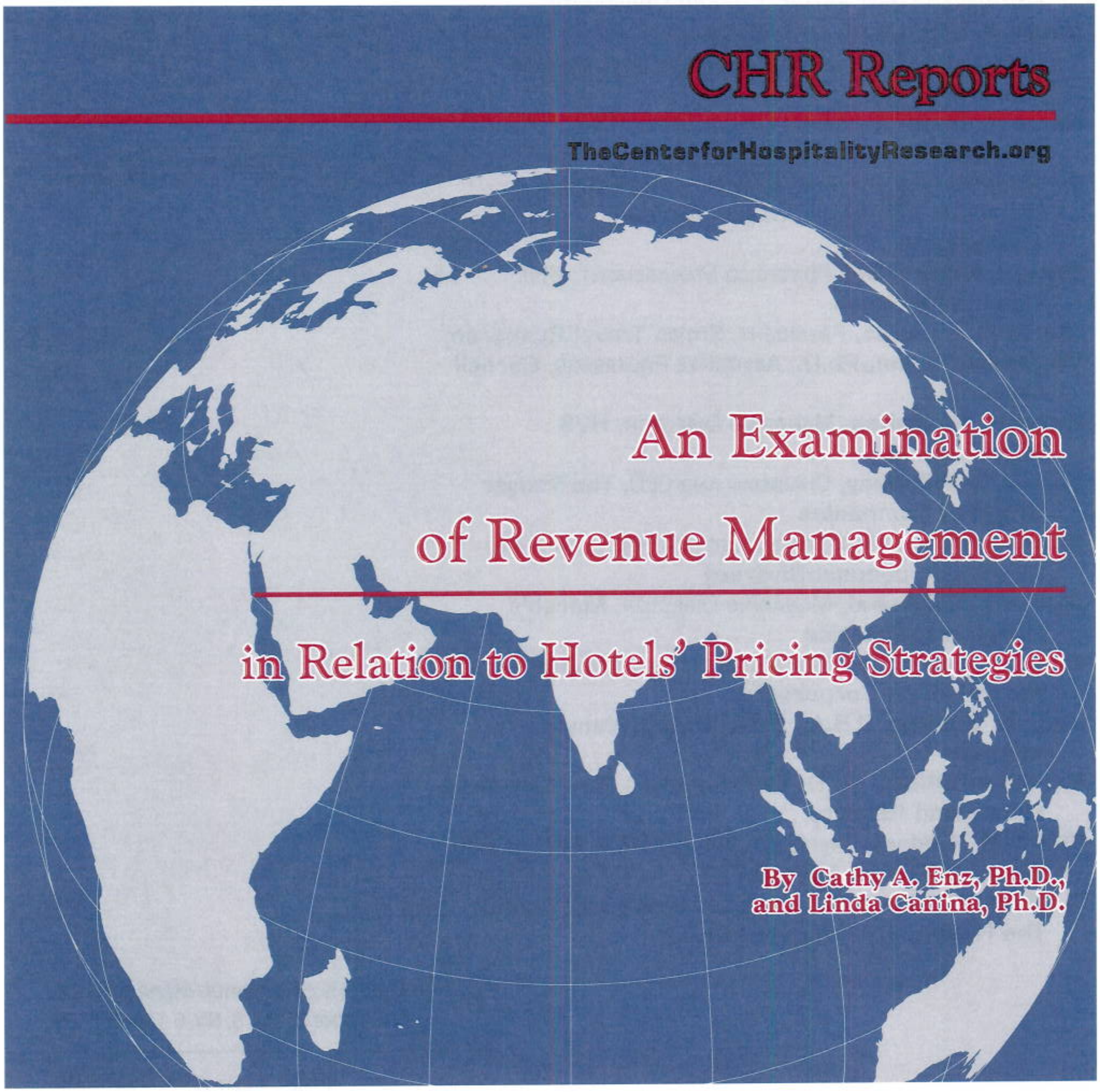
Thank You! Let's Talk!

Yield Management: Next Steps for Convention Centers

Warren Lieberman

www.veritecsolutions.com

Cornell University
School of Hotel Administration
The Center for Hospitality Research



CHR Reports

TheCenterforHospitalityResearch.org

An Examination of Revenue Management in Relation to Hotels' Pricing Strategies

By Cathy A. Enz, Ph.D.,
and Linda Canina, Ph.D.

Five-Star Research℠ for the Hospitality Industry

An Analysis of Revenue Management

in Relation to Hotels' Pricing Strategies

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Gary M. Thompson, Executive Director
Glenn Withiam, Director of Publication Services

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CHR Reports, Vol. 5, No. 6 (April 2005)

Single copy price US$50.00

Executive Summary

An Examination of Revenue Management

in Relation to Hotels' Pricing Strategies

By Cathy A. Enz and Linda Canina

MOST HOTELS IN THE UNITED STATES USE REVENUE MANAGEMENT, regardless of their pricing strategy relative to their competitive set. However, revenue management is executed more closely on average by hotels that price above their competitive set than by those who price below their competitive set.

A study of over 6,000 hotels in all market segments found that virtually all hotels adjusted their rates in association with changes in occupancy. Although revenue management was nearly universal, hotels in certain market segments were less likely to adjust rates with occupancy and some simply did not do so. Midmarket hotels were heavily involved in revenue management, for instance, while many economy-segment properties apparently did not use this strategy.

When the sample was divided according to pricing strategy, revenue management remained a nearly universal strategy. With regard to pricing strategy, some properties maintain their rates at a premium to those of their immediate competitors, while other hotels set room rates slightly below those of competitors (and others, much lower). Hotels that priced below competitors demonstrated strong use of revenue management, as did hotels that set their room rates above those of their competitors. The chief exception to the use of revenue management was certain groups of economy hotels. At the other end of the scale, luxury properties that price well below their competition constitute another group that does not seem to be applying revenue-management strategies.

About the Authors

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Linda Canina, Ph.D., is a associate professor of finance (lc29@cornell.edu). Focusing much of her research on asset pricing and valuation, her recent publications have included *Review of Financial Studies, Journal of Finance, Financial Management, Journal of Hospitality and Tourism Research*, and *Cornell Hotel and Restaurant Administration Quarterly*.

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An Examination of Revenue Management

in Relation to Hotels' Pricing Strategy

By Cathy A. Enz, Ph.D., and Linda Canina, Ph.D.

Maximizing revenue through the strategic use of pricing is a challenge for all hotel managers. Fundamental revenue-management principles suggest that care must be taken to decide what price to charge for specific market segments in various demand periods.[1]

In conjunction with that determination, tracking competitors' prices is an important practice, especially since many hotel operators engage in the practice of reference pricing (that is, pricing just slightly below most direct competitors).[2] During low-demand periods, such as those experienced in recent years, effective comparative pricing becomes even more challenging and effective revenue management more important.

Our objective in this study is to examine the degree of linkage between a hotel's rate and its occupancy levels for hotels in different market segments under various competitive situations. We are primarily interested in the extent to which revenue management is deployed by hotels. For this determination, we divided the sample into groups in two different ways. First, we divided subjects by whether they set room rates higher or lower than those of their

[1] For a comprehensive summary of revenue management, see: G. Withiam, "The '4-C' Strategy for Yield Management," *CHR Reports* (TheCenterforHospitalityResearch.org, 2001).

[2] See: "Developing a Pricing Strategy," in *Marketing Strategy*, second edition, ed. O.C. Ferrell, Michael D. Hartline, and George H. Lucas (Belmont, CA: South-Western Publishing, 2002), Chapter 7.

competitors. Then we divided the sample into six groups, by whether the hotel in question sets prices slightly, moderately, or well above their competitors' rates or whether that property undercuts its competitors' prices, again by a small amount, a moderate amount, or by several percentage points. In a previous study, we found that hotels that price slightly above their competitors perform relatively better in terms of revenue.[3] A related question, then, is whether those high-rate hotels are more effective revenue managers than those who do not price as aggressively in relation to their competitors. Knowledge of these empirical relationships may be useful to both groups of managers, whether they attempt a premium-price strategy or a strategy of undercutting competitors.

In previous studies we found that, in relation to their competitors, hotels in direct competition make more money when they maintain comparatively higher prices and avoid discounting to fill rooms.[4] Using data from 2001 through 2003, our previous studies reveal that hotels that drop their prices relative to their competitive set capture market share from the competition, but do not gain higher RevPARs than those same competitors. Those findings suggest that there is nothing wrong with holding relative rates constant even when demand drops. Those findings, in turn, seem to imply that hotels might alter their revenue-management policies under certain competitive conditions. The earlier work did find that raising prices above those of a hotel's competitive set will lead to a loss of occupancy, but that loss does not diminish RevPAR. On the other hand, by offering a lower relative price a hotel gains occupancy (as expected), but the discounting property's RevPAR performance is lower than that of its competitive set. The findings that we just outlined seem to run counter to certain revenue-management practices. Consequently, we wondered whether there were particular circumstances under which revenue management might be considered ineffective.

In the study described in this report, we build on the earlier studies of relative competitive pricing and its impact on occupancy and RevPAR, by considering the revenue-management activity of hotels in local markets. In particular we are interested in whether there are strong positive relationships between a given hotel's pricing activity and its occupancy levels. We tested this relationship for hotels for which the relative pricing strategy is to offer prices below those of competitors and for those that set rates above those of competitors. Thus, our question is, To what extent does a strong rate-to-demand relationship exist for hotels that position themselves either above or below their competitors?

If hotel managers are carefully watching their competitors' rates, are those managers also maintaining a revenue-management strategy? Mostly, the answer is, yes.

Specifically, we compared the relationship between average daily rate and occupancy for hotels that were pricing above their competition and for those that kept their rates below those of their direct competitors. In so doing, we seek to determine the degree to which hotels in various market segments and with contrasting competitive stances employ a revenue-management strategy. We can conclude that a hotel is using revenue management when it maintains an approach to pricing in which there is a strong positive association (statistically significant, positive correlation) between occupancy and ADR.

As a starting point to the discussion, a revenue-management strategy would be in effect if

[3] See: C. Enz, L. Canina, and M. Lomano, "Hotel Price-discounting Strategies: When Occupancies Rise and Revenues Fall," Cornell University Center for Hospitality Research, 2004 (TheCenterforHospitalityResearch.org).

[4] Also see: C. Enz, "Hotel Pricing in a Networked World," *Cornell Hotel and Restaurant Administration Quarterly*, Vol. 44, No. 1 (February 2003), pp. 4–5.

prices fluctuated in concert with demand levels. Under such an approach the hotel would adjust its rates downward during low-demand periods and move them upward in high-demand periods. Many factors shape the pricing decision, but at its core is the idea that good revenue management exists when hotel rates and occupancies are positively correlated. Conversely, if no relationship or a negative relationship exists between rate and occupancy, we can conclude that a hotel is not practicing revenue management.

In this study we explore the relationship between annual ADR and annual occupancies during 2003 for over 6,000 United States hotels in various price segments. The focus is on individual hotels and their direct competitors in local markets. The data were drawn from the Smith Travel Research database, which is effectively a census of brand-name hotels in the United States. This comprehensive sample is widely considered to be representative of all branded hotels in the U.S.

Whether hotels maintain a strategy of pricing above their competitors or below their competitors, overall they implement revenue management.

The Study

In this study we categorize hotels' pricing strategies relative to those of their competitive set of hotels to determine whether revenue-management strategies differ for hotels that use one or the other of the two contrasting pricing strategies that we have outlined. The competitive-set data used in this study are drawn from the aggregate performance of each subject hotel's direct competition. Typically, a competitive set consists of a group of six or more properties selected by a hotel's managers or its parent company. The three key factors used by operators to select hotels in their competitive set are: (1) product offering, (2) proximity, and (3) price. Usually a hotel's managers will select for inclusion in their competitive set hotels in reasonable proximity that offer comparable products and features and maintain rate parity. While proximity may vary by hotel segment, a three-mile distance is a reasonable standard, although a luxury hotel may have to extend that distance, because it will have fewer closely proximate competitors than does the typical budget hotel.

Determining the competitive set is a key element of this study, because revenue-management decisions often are driven by whether competing hotels boost or drop their prices. In exploring the relationship between ADR and occupancy, this study focuses on such local pricing dynamics. We believe that by analyzing each hotel's pricing strategy relative to that of its individually selected competitive set, we can understand the price–occupancy relationship in a novel, insightful way.

We chose to analyze annual data rather than monthly data to avoid the influences of pricing irregularities that may have occurred in a particular month. Even though revenue-management programs adjust prices each day, the overall revenue-management program of adjusting prices according to demand conditions will become apparent in an analysis of annual data. Properties were eliminated from the sample if they had less than 12 months of data for 2003. Extended-stay hotels were excluded from this study because they have unusual demand characteristics, given that the typical traveler stays more than ten days at these complexes. We also excluded resorts because of their seasonality and their frequent inclusion of meals in room pricing.

Percentage differences in ADR. As explained below, in addition to the first analysis, where we divided hotels into "above" or "below" with regard to their rates, for a second analysis, we grouped hotels by percentage difference in ADR relative to their competitive set. Specifically, the pricing strategy of a given

EXHIBIT 1

Pearson correlation coefficients of average daily rate to occupancy

Price segments	Pricing up to 15 percent below competitive set	Pricing up to 15 percent above competitive set
Overall	0.23 (2,717)	0.28 (2,391)
Luxury and Upper Upscale	0.21 (231)	0.29 (294)
Upscale	0.27 (284)	0.28 (264)
Midscale with food & beverage	0.29 (533)	0.32 (432)
Midscale without food & beverage	0.21 (1,157)	0.21 (1,181)
Economy	*0.09* (394)	0.25 (108)

Notes: Correlations are based on annual data from 2003. The number of observations for each group is given in parentheses. All correlations are significant at $p < .001$, except economy hotels that price above competitors, shown in red, which is significant at $p < .01$, and economy hotels that price below competitors, shown in *italics*, which is not significant.

hotel in 2003 was categorized into one of six different pricing-strategy groups based on that percentage difference in ADR.[5] So, the initial pricing-strategy groups were simply those that priced lower than the competitive set and those that priced higher. Then, we refined the analysis with the six pricing-strategy groups, subdividing the properties by the percentage deviation of their ADRs above or below those of competitors. For each of these groups, we calculated the Pearson product moment correlation coefficients between ADR and occupancy. The data summarized in the following results are these correlation coefficients.

[5] We eliminated from the data sample all properties with significant differences in RevPAR performance from 2002 to 2003. We did this to ensure that the categories of difference in ADR relative to the competitive set were due in fact to differences in their relative pricing strategies. We used a parameter of one standard deviation from zero because of the importance of evaluating hotels that were able to achieve past RevPAR performance similar to that of their competitive set.

The ADR–Occupancy Relationship

The initial analysis examined all hotels by price segment for 2003, divided by whether they maintained rates above or below those of their competitors (by any percentage). Exhibit 1 shows the Pearson correlation coefficients for those two sets of hotels overall and by market segment. In this correlation analysis the value of the coefficient measures the degree of association between a hotel's ADR and its occupancy.

Overall analysis. The table shows that overall both sets of hotels showed positive, significant correlations between ADR and occupancy, indicating the use of revenue management. As a group, this positive, significant relationship held for hotels with low prices relative to their competitive set (coefficient = .23; $p < .001$). Moreover, with one price-segment

Exhibit 2

Pearson correlation coefficients for specific pricing groups

	Pricing below the competition		Pricing above the competition	
Price segments	**More than 5 and up to 10 percent below**	**More than 1 and up to 5 percent below**	**More than 1 and up to 5 percent above**	**More than 5 and up to 10 percent above**
Overall	0.22 (895)	0.29 (1,007)	0.29 (955)	0.30 (800)
Luxury and Upper Upscale	0.19 (60)	*0.25* (105)	0.49 (106)	0.32 (109)
Upscale	0.24* (96)	0.31 (105)	0.19 (103)	0.40 (93)
Midscale with food & beverage	0.23 (192)	0.32 (200)	0.38 (180)	0.36 (140)
Midscale without food & beverage	0.23 (378)	0.28 (478)	0.26 (472)	0.25 (392)
Economy	0.17* (130)	- 0.002 (79)	0.18 (58)	- 0.04 (26)

Notes: Correlations are based on annual data from 2003. The number of observations for each group is given in parentheses. Correlation coefficients shown in red are significant at $p < .001$. The coefficient shown in *italics* is significant at $p < .01$. The two coefficients that are starred (*) are significant at $p < .05$. Remaining coefficients are not significant.

exception, this pattern of a positive relationship between price and occupancy was the case for hotels with low prices relative to their competition, regardless of price segment. The exception here was economy hotels that undercut their competitors, for which the relationship of ADR and occupancy was not significant. Thus, our findings suggest that most hotels that offered low rates relative to their competitors were actively engaged in altering their rates with shifts in demand. Overall, economy hotels that priced below their competitive set, on the other hand, did not shift rates according to demand fluctuations and thus were not actively engaged in revenue management.

Repeating this analysis for hotels that priced above their competition, the relationship between their own rate and occupancy was also positive and statistically significant (coefficient = .28; $p < .001$). This pattern of a positive relationship between price and occupancy was the case for all hotels that maintained high prices relative to their competition regardless of market segment. Even economy hotels that priced higher than their competitive set relied on revenue management. Two observations are noteworthy. First, a stronger relationship exists between rate and occupancy for hotels that priced above their competitive set than applies to those that priced below the competition, as shown by the correlation coefficient of .23 for the below-competitor properties and .28 for the above-competitor group (again, see Exhibit 1). Second, since the correlation coefficients are positive and statistically significant, it is clear that industrywide, hotel operators are employing revenue management approaches by varying their rates as occupancy rises or falls. These results permit us to observe that hotels that price above their competitors are adjusting prices more closely to demand than are those hotels that price below their competitive set.

Subdivided Sample

Turning to the analysis that is based on the extent of underpricing or overpricing, hotels that price just below or just above their competitors' rates (by less than 1 percent), the results (not presented in the tables) show strong positive correlations between ADR and occupancy. Pricing just below the competitive set is the best example of reference pricing. For all hotels that followed this practice we obtained the strongest correlations between a hotel's own ADR and occupancy (coefficient = .30; $p < .001$). For all the hotels that price just above the competition the correlation between rate and occupancy was also statistically significant and positive (coefficient = .23; $p < .001$). The larger correlation between rate and occupancy for those that price just below their competitors suggests that this group of hotels is the most actively engaged in raising and lowering their rates with shifts in demand. The implication of this finding is that hotels that choose the strategy of pricing just under their competitors are the most active in managing revenue in response to fluctuations in demand.

Large Pricing Gaps Among Competitors

In Exhibit 2 we show the results for the other four groups that we analyzed according to the extent of their under- or overpricing. Looking at the group of hotels that priced substantially higher than their comparative sets in 2003, these properties showed positive relationships between their own hotel pricing and occupancy levels, indicating that overall the hotels in our subdivided groups were managing revenue. However, as the table also shows, differences in revenue management showed up when we analyzed the hotels in the various market segments. Luxury and upper upscale hotels, for example, carefully fit their rates to occupancy if they were in the group that priced between 1 and 5 percent above the competition. In contrast, luxury and upper upscale hotels that priced substantially below the competitive set (over 5 and up to 10 percent lower) were not found to have a significant rate–occupancy relationship.

Subdividing the sample isolated a few certain hotel types that showed only a weak correlation between occupancy and rates and, thus, are apparently not actively using revenue management.

For upscale hotels the strongest levels of revenue management were found among hotels that priced substantially above their competition, that is, in the group that priced over 5 to 10 percent higher. Hotels in the midscale segments showed a positive relationship between rate and occupancy regardless of their competitive pricing strategy. Thus, we conclude that mid-market hotels were busy managing their revenue by adjusting rate to demand levels. In contrast, the economy segment's hotel operators were the least likely to adjust their rates to occupancy. With the exception of the lowest-price economy hotels (relative to their competition), economy hotels as a group did not adjust their own hotel rates to occupancy, as revealed by the insignificant and negative correlation coefficients. Economy hotels generally appear to maintain relatively consistent prices rather than increase or decrease rates according to demand fluctuations.

Conclusion

Our study found that hotels that set rates just slightly below most of their competitors were likely to have strong and positive correlations between their ADRs and occupancies. In essence, they were practicing good revenue management and raising rates as demand increased. Weaker relationships were found between rate and occupancy when hotels priced substantially lower than their competitors. For example, the luxury-segment hotels that priced substantially below their competitors were not practicing revenue management at all, as indicated by the insignificant correlations between rate and occupancy for these operators (see Exhibit 2). This finding, in conjunction with our previous results that showed hotels that priced substantially below their competitors experienced much lower RevPARs, would suggest that a hotel manager who decides to price his or her hotel products substantially below those of the competition may enhance the property's RevPAR performance by adjusting rates upward in relatively aggressive fashion when occupancy rises.

During the period of this study (2003 data), most hotels in the United States carefully set rates in relation to fluctuations in their occupancy.

Economy hotels that price below their competitors do not appear to be using the revenue-management strategy of raising rates as demand increases; instead those hotels maintain rate stability. That may be the result of their being unable to offer still lower prices and also cover costs. In addition, given economy hotels' stance of competing on the basis of price, they may be strategically unable to raise their rates much as demand increases. In short, this group of economy hotels appears to be a pure price play in which fixed pricing is part of the positioning strategy needed to attract guests. Interestingly, there is modest revenue management in those instances when an economy hotel is pricing substantially below the competition (with rates over 5-percent lower). This practice may reflect opportunistic pricing by operators with relatively low-quality products. In previous research we have found that low-end hotels obtain RevPAR spillover benefits from locating next to high-end hotels.[6] In some markets it may be possible for economy hotels to raise their rates as demand for the entire market increases simply because most markets have the largest proportion of high-price hotels.

In contrast to the low-end economy properties, economy hotels that price above their competitors were, as a group, far more likely to engage in revenue-management strategies, particularly those hotels that price just above their competitors. Although the sample size was too small to draw meaningful inferences, we found a strong positive correlation between rate and occupancy (coefficient = .59; $p < .05$) for economy hotels that price less than 1 percent above their competitors (not shown in Exhibit 2). The strategy of these economy hotels with slightly higher rates seems to involve carefully monitoring demand and actively managing revenue.

Overall, hotels that price above their competitors were found to be more active in adjusting rate to fluctuations in demand. Put simply, high-price players are more aggressive revenue managers. In addition, luxury and upper upscale hotels and midscale hotels appear to be the strongest revenue managers when their strategy is to maintain rates at 1 to 5 percent above their competitors. As room-rate disparities increase, the relationship between rate and occupancy remains significant, but the correlations are not as strong. However, when com-

[6] See: L. Canina, C.A. Enz, and J. Harrison, "Agglomeration Effects and Strategic Orientations: Evidence from the U.S. Lodging Industry," *Academy of Management Journal*, forthcoming.

pared to the hotels that price below competitors, revenue management is more likely to be found in all hotels in this sample that position themselves as pricing above their competitors. This result suggests that those hotels which are best able to extract high RevPARs are also most likely to engage in revenue-management practices.

This study clearly shows that in 2003 most hotels in the United States carefully set rates in relationship to fluctuations in occupancy. Generally speaking, hotels that priced above their competitors evidenced more revenue management than did those who priced below competitors. Economy hotels, perhaps because they position themselves on the basis of price, were the least likely to alter rate with demand, although some low-price hotels did take some advantage of revenue-management strategies. In contrast, midscale hotels consistently set rates in alignment with demand, regardless of whether they set rates above or below those of competitors.

While this study extends previous pricing studies by looking at the role of effective revenue management—as defined by the relationship between rate and occupancy—it has not addressed other important questions around revenue management, such as which hotel segments most particularly would benefit from revenue management. By examining the practice of revenue management (i.e., the rate–occupancy relationship) in the context of competitive pricing strategies, this study has revealed that the industry does set prices in relationship with demand shifts. We also found, though, that this practice is not pursued as strongly by economy hotels or by hotels that price below their competitive set. Future studies should continue to expand our understanding of this topic by investigating the profitability of hotels with strong rate-to-demand relationships. ■

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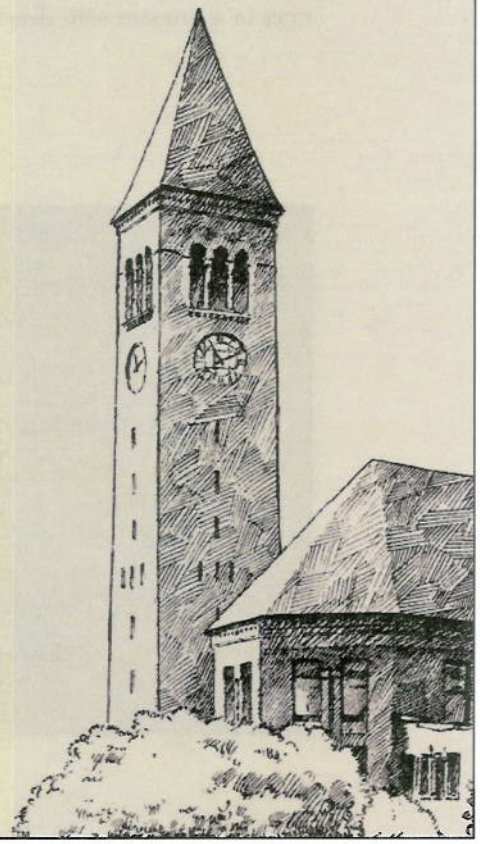

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Revenue Management Saves National Car Rental

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In 1993, National Car Rental faced liquidation. General Motors Corporation (National's parent) took a $744 million charge against earnings related to its ownership of National Car Rental Systems. National faced liquidation, with the loss of 7,500 jobs, unless it could show a profit in the short term. National initiated a comprehensive revenue management program whose core is a suite of analytic models developed to manage capacity, pricing, and reservation. As it improved management of these functions, National dramatically increased its revenue. The initial implementation in July 1993 produced immediate results and returned National Car Rental to profitability. In July 1994, National implemented a state-of-the-art revenue management system, improving revenues by $56 million in the first year. In April 1995, General Motors sold National Car Rental Systems for an estimated $1.2 billion.

In the late 1980s, the car rental industry was in turmoil. Low profit margins were subsidized by tax credits. When these tax credits disappeared, the low profit margins were eroded. Automobile manufacturers purchased almost all of the major car rental companies and, in the early 1990s, flooded them with cheap fleet deals. These cars

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came with large manufacturer cash incentives and could be disposed of quickly and easily, as often as every four months, by simply returning them to designated auctions. The car manufacturers placed more emphasis on using their car rental subsidiaries to soak up excess production than to produce profits.

This excess supply in the marketplace led to low pricing. Several major competitors, the price leaders, paid undue attention to market share and made emotion a variable in the pricing equation. Companies still use very low pricing during periods of low demand. These are the rates quoted in Sabre on February 9, 1996 for a weekend rental of a subcompact car at Greensboro, North Carolina for pickup on February 29, 1996:

Alamo	$14.99
National	$15.99
Budget	$16.95
Avis	$16.99
Hertz	$16.99

These prices include unlimited mileage. A comparison of these rates with the cost of renting a tuxedo underscores the frequent irrationality of pricing. In the early 1990s, economic conditions and improvements in design and production quality improved demand for American-made cars. The manufacturers dramatically raised the costs of cars to their car rental companies.

These market pressures, combined with the fact that the car rental industry was slow to apply technology, precipitated an industry in crisis. By comparison, the airline industry has successfully demonstrated how to apply the technology of revenue management in a service industry with high equipment and labor costs. Airlines regularly sell cheaper seats to customers willing to accept booking and travel restrictions, such as advance payment, Saturday night stopovers, and penalties for no-shows and cancellations.

The major car rental companies depend largely on corporate customers. They contract at fixed rates with companies who have numbers of employees who travel. Demand peaks for rental cars midweek, forcing all companies to regularly turn down customers. The business customer, who typically travels on these days, pays a fixed corporate rate. This leads to a large excess fleet that is idle on weekends. The car rental industry allows price-sensitive leisure customers to book multiple reservations with no prepayment required. There are rarely penalties for cancellations or no-shows. Customers arriving as much as 12 hours after the specified time of reservation are given the reserved car at the reserved rate. These policies result in no-shows that sometimes exceed 50 percent of reservations. This is a major problem for the industry, which must maintain high utilization to make a profit.

National Car Rental Background

Before National began using revenue management, it struggled with the same challenges as its competitors. But other factors made it critical for National to change quickly. National's business was predominantly composed of corporate customers, who rented cars midweek. National's strategy focused on these business renters and neglected the leisure customers. For several years, starting in 1987, National had no significant advertising campaign. It planned its fleet in one-year cycles, and made very few changes in fleet deployment to meet changing customer demand.

National had three legacy systems to build on: The newly-developed Vehicle Information System (VIS) accurately tracked the fleet, National's Reservation System (RES) was efficient at booking reservations, and the Expressway System (NEX) provided the most rapid rental-and-return process in the industry. By contrast, pricing changes were manual and extremely time consuming. Changes were keyed into National's rates system and then keyed in again to the airlines' computerized reservation systems (CRS). Setting pricing was a shared responsibility. City managers, marketing, regional VPs, senior management, and the pricing group all shared input, with no single person ultimately responsible for a location's pricing. Inventories in the CRS were controlled by field managers with no sophisticated system advising them when to increase or restrict availability. No demand forecasts existed at either the city or the corporate level.

Revenue Management at National Car Rental

In February 1992, several National executives identified two key issues: (1) National was turning down large numbers of customers when cars were available to meet their needs; (2) competitors were raising their leisure prices as the date of rental approached, while National's pricing remained stagnant. National formed the rates automation team (RAT) with a limited mission to determine whether, during periods of high demand, National could raise its prices in the seven booking days before rental. It selected a limited number of cities for a pilot test, for which all processes were manual. It quickly determined that it could raise prices and increase revenues without eroding customer satisfaction. Roll-out of these processes in the organization was met with stiff resistance. "We can't do this; we'll confuse our customers," and "If we do this, we'll confuse ourselves" were typical comments. Deciding that it needed help breaking through these barriers, National asked Aeronomics Incorporated, a revenue management consulting company, to evaluate its unrealized revenue opportunities.

National was at a critical juncture. General Motors had mandated that the company either become immediately profitable, so that it could be sold, or be liquidated. National had already undertaken cost-cutting measures. It had to make more money with the existing operation. Larry Ramaekers, assigned by turnaround specialists Jay Alix and Associates, led the turnaround and acted as president. "We decided to go for a revenue-based turnaround as opposed to a cost-cutting turnaround" said Ramaekers [1995].

Senior management agreed to conduct a needs assessment with Aeronomics Incorporated between January and April 1993. The mission was to understand National's business, quantify revenue potential, recommend organizational structure and staffing requirements, define automation requirements, estimate costs, provide cost/benefit analysis, and prioritize an implementation plan. The assessment identified opportunities for increasing revenue and was presented to senior management in April 1993. National's owner, General Motors, agreed that implementing a revenue management program would be the key impetus to National's turnaround and committed over $10 million to design and build a revenue management system (RMS), acquire the necessary hardware, make changes to legacy systems and bridge them to RMS, and build a dedicated revenue management department. The department would comprise 30 specialists, focusing all of their talents and energies on generating revenue. The application would be phased in beginning July 1993 and would be rolled out to all locations by early 1995. The extremely rapid development of RMS and its immediate implementation to control National's largest demand centers was the single most important factor in keeping National alive.

Revenue management achieves its revenue gains by applying analytic models and methodologies to a planning horizon. By consistently managing capacity, price, and booking requests in a manner that improves revenue per car (RPC), revenue per day (RPD), and utilization levels, a company can make and sustain revenue improvements. There are a couple of basic prerequisites for applying revenue management in a new industry. Perishability is one of the most important prerequisites as Weatherford and Bodily [1992] discuss in their paper on perishable-asset revenue management. The unit of inventory at National is the car rental day, which is lost if it is not utilized. Another prerequisite is a segmentable market. (For a discussion of how revenue management capitalizes on consumers' differential willingness to pay, see Cross [1986].)

The rental car problem exhibits a similar structure to the airline problem, and techniques developed to solve the airline problem have been particularly useful. For example, allocating airline seats at discount prices translates to planning to upgrade a customer's rental car. Overbooking and reservation control are common to any industry that allows advanced bookings. There are important differences. Airlines can target low rates precisely at underutilized capacity. In the car rental situation, the problem is more complex. Rate cuts designed to stimulate demand on low utilization days may increase demand on a day when capacity is constrained and compound the problem. Managing the problem of days when supply is constrained by controlling the length of rentals is a more effective solution, but it requires surgical precision. Conversely, it is reasonably straightforward to increase RPD by increasing rental rates. However, the rental car market is extremely competitive. A price move that makes the company more expensive than its competitors can damage utilization levels. A high RPD is not worth much if most of the fleet is sitting on the lot.

Information Systems

The revenue management system was developed jointly by Aeronomics Incorporated, a revenue management firm; EDS, National's information services provider; and National. It is central to the flow of information at National Car Rental. EDS implemented a comprehensive set of data links with existing information management systems. In particular, the link between RES and RMS is unparalleled in the industry. It is a continuous transaction-level data feed of all advanced booking activity, including availability and booking restrictions. The continuous feed approach provides up-to-the-minute booking levels, forecasts, and system recommendations to revenue managers through the RMS graphical user interface. Transactions include bookings, cancellations, turndowns, and shoppers. Turndowns are booking requests that the company did not accept because of availability controls or booking restrictions. Shoppers are booking inquiries that did not convert to booking requests (Figure 1).

Revenue Management Organization

A major issue during the design phase of RMS was to determine whether a decentralized or centralized solution would have the largest revenue impact, short and long term. A decentralized organization would have been the least painful solution culturally, because city operations managers controlled inventories (that is, reservations system inventories) and leisure pricing. But decentralization would cause a number of difficulties:

—City managers would not make revenue generation the highest priority, because their most immediate problems are customer service and vehicle maintenance.

—Recruiting and training personnel and equipping city offices would be very expensive with a long lead time.

—The revenue manager would be a generalist and would be assigned to "burning problems" not related to revenue generation.

—Pricing practices would not be consistent across locations.

—Managers might be parochial concerning

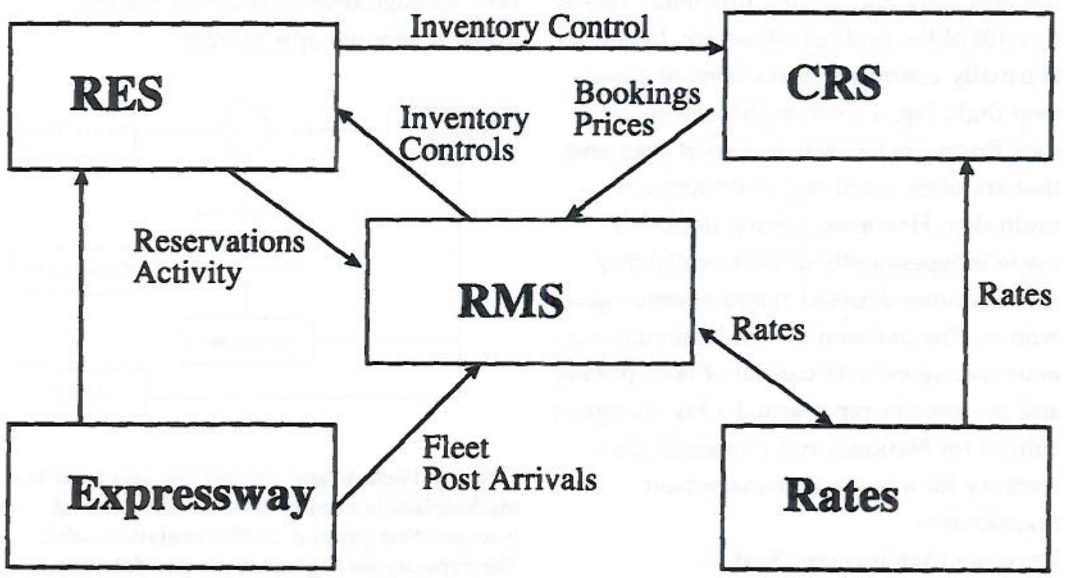

Figure 1: RMS synthesizes information from four principal information systems. Expressway provides current fleet levels to support the capacity-management model and post-arrival data, such as no-shows and walk-ups, for the forecast of day-of-arrival activity. RES provides transaction-level information on booking activity. RMS availability and length-of-rent controls are communicated to RES after review and action by a revenue manager. The Rates system maintains current rate-level information. RMS recommends rate adjustments and provides an interactive rate update interface to the Rates system. Availability and rates are available on a number of airline CRS (central reservation systems). RES updates the CRS whenever availability controls or booking restrictions change. Rates from RMS update CRS rates at regular intervals throughout the day.

fleet disbursement.
—Revenue managers would vary in levels of skills in the field.

The decision to create a centrally located team addressed all of these issues and allowed for the rapid change needed for immediate impact. Corporate revenue managers were given responsibility for pricing and inventory management at the location level. This allowed the revenue management department to share its expertise and information directly with marketing, corporate sales, fleet, strategic analysis, and senior management.

Traditional revenue management organizations in the airline, hotel, and car rental industries have left a dichotomy between the inventory and pricing functions. This is a result of the problem structure. Inventory is usually controlled at the level of a nonstop flight leg, a room night, or a rental day. Pricing is focused at market segments that are often multi-leg, multi-night, or multi-day. However, pricing decisions made independently of fleet availability and customer demand retard revenue generation. The decision to vest National's revenue managers with control of both pricing and inventories represented a big change in culture for National and pioneered new territory for a revenue management organization.

Revenue Management System

The National RMS supports three primary business functions: capacity management, pricing, and reservations control. The capacity management function targets high-valued fleet utilization. Pricing enhances corporate revenues through sensitivity to consumer price tolerance. Reservations control maximizes revenues by accepting or rejecting booking requests based on length-of-rent controls. A sophisticated set of forecasts of demand and consumption patterns supports the analytic model (Figure 2).

RMS functions as both an automated decision management system and an interactive decision support tool. Overnight processes execute the forecasting and analytic models to generate recommendations concerning availability, rate, and length-of-rent control. Revenue managers review thousands of recommendations each day and make, accept, reject, or override decisions based on their knowledge of current market conditions and forecasted demand. Revenue priority indicators assist workflow management by pointing out the greatest revenue opportunity.

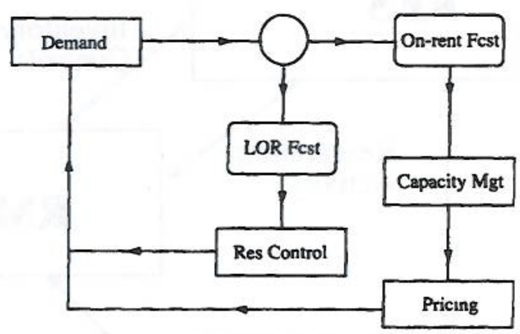

Figure 2: Historic and current demand from the marketplace is used to produce the demand forecasts that support RMS's analytic models. The capacity-management process determines availability levels from the on-rent forecast. Pricing recommendations complement the availability settings. The reservations control process uses more detailed length-of-rent (LOR) forecasts to generate booking restrictions. The combination of availability controls, price adjustments, and booking restrictions changes booking pace. The new booking pace results in new forecasts and system recommendations.

Revenue managers have a wealth of support tools at their fingertips during the review process. The multiple document interface allows them access to reports with historical data and demand and revenue forecasts at all levels of aggregation. They can cut and paste information into spreadsheets, word processors, or electronic fax. One of the more striking features of RMS is the degree of interaction it permits between the revenue manager and the system models. A refresh feature accesses the most recent data on the reservations system and recomputes forecasts based on intraday booking-pace profiles. Recomputed forecasts generate new system recommendations, which the revenue manager can compare to the overnight recommendations as part of the review process. An analyst who disagrees with the forecast can override values. The refresh feature will revise the RMS recommendations according to the user-supplied forecasts.

The logical flow of the models within RMS matches the logical flow of marketing activities within the company. Results from each model depend on the output of logically precedent models. Users can adjust output of any of the models for what-if analysis. All downline models will then produce new recommendations. For example, the analyst can experiment with different rate levels. New length-of-rent controls will reflect the change in the relative valuation of different demand elements. If the analyst wants to try different availability levels, the pricing model will generate new rates. New rates will cause the system to recommend new length-of-rent controls (Figure 3).

Forecasting

A comprehensive set of demand and revenue forecasts supports the analytic models. Demand levels are forecasted at two primary levels of aggregation: length-of-rent and on-rent. Both forecasts represent unconstrained demand, which is the number of cars that can be rented if there are no capacity restrictions. The length-of-rent forecast is a forecast of unconstrained demand for each potential length of rent, for each arrival day in the planning horizon. National intensively manages the booking process at least 60 days in advance of day of pickup. The system generates forecasts for all days within this horizon. It uses demand levels to derive optimal reservations controls. The term *on-rent* refers to the number of cars in use on a specific date. It combines cars that are picked up on that day with cars that are already in use. Capacity management and pricing models rely on the on-rent forecast.

The demand forecasting methodology for all levels of aggregation is based on a combination of long-term and short-term forecasting. The long-term forecast is a time-series model with seasonality factors derived from spectral analysis of historic seasonality. Demand during special events does not distort seasonality. The analyst with the best knowledge of the market defines special events and can override the system-generated factors (Figure 4).

Curry [1993] pioneered the use of Kalman filtering for revenue management. The variable gain approach has several benefits. System initialization uses the same processes as the nightly update. The initial gain is set to unit value and the initialization process adjusts the gain level as it works its way

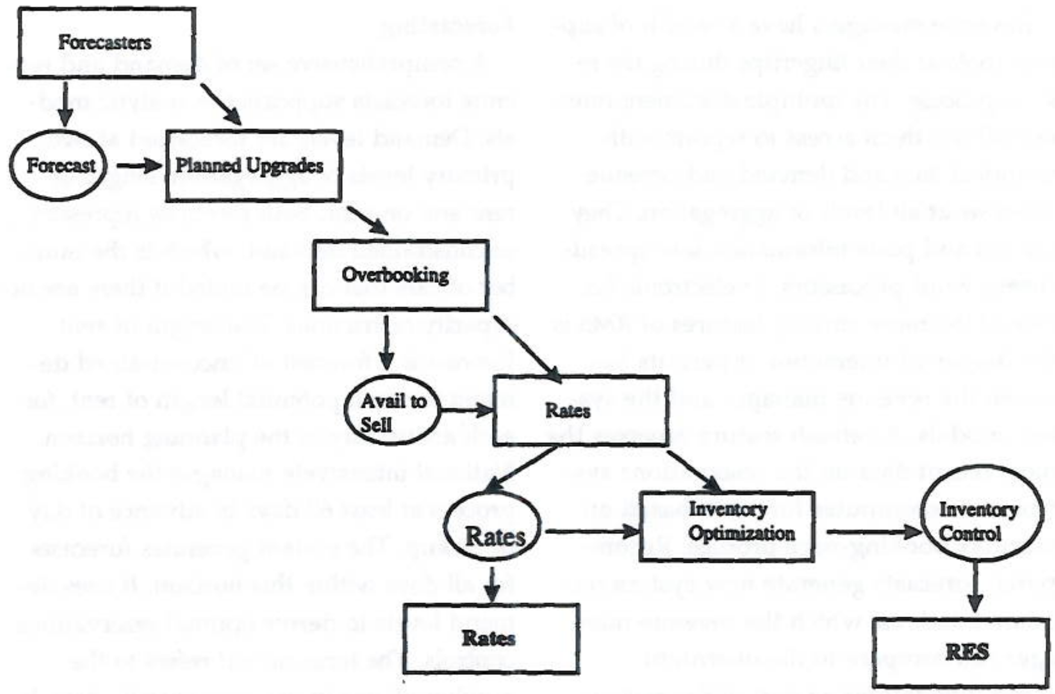

Figure 3: Business processes, analytic models, and revenue manager expertise are tightly integrated in RMS. Each of the ovals represents a point where analysts can adjust system forecasts and recommendations. If the analyst requests a refresh, RMS updates down-line results to reflect the user adjustments. Underlying the decision-making process are expectations of consumer behavior. RMS provides demand forecasts at the on-rent and length-of-rent levels. The analyst can refresh the forecast with real-time booking levels from the reservations system. The capacity management models produce availability recommendations, which can also be adjusted. A refresh at this stage produces new rates and length-of-rent controls. Finally, rate revisions can result in new MLRs (minimum length-of-rent controls). The analyst reviews system recommendations before sending them to the electronic distribution channels.

through the available historical data. Another benefit of the variable gain approach is that the revenue manager can adjust the responsiveness of the forecast temporarily to respond to expected changes in the marketplace. Once the change has taken place, the Kalman filter gains tend toward the steady state smoothing constant.

In generating the short-term forecast, the system considers the offset of the actual reservations level from a booking curve. The booking curve represents the rate at which bookings are expected to accumulate in the reservation system. This offset provides information about the current booking pace, that is, the rate at which bookings are accumulating. The short-term forecast is the expected change in the number of bookings. The final demand forecast is a combination of the long-term and short-term forecasts. The long-term forecast provides stable predictions early in the planning horizon. As more information becomes available from the actual booking

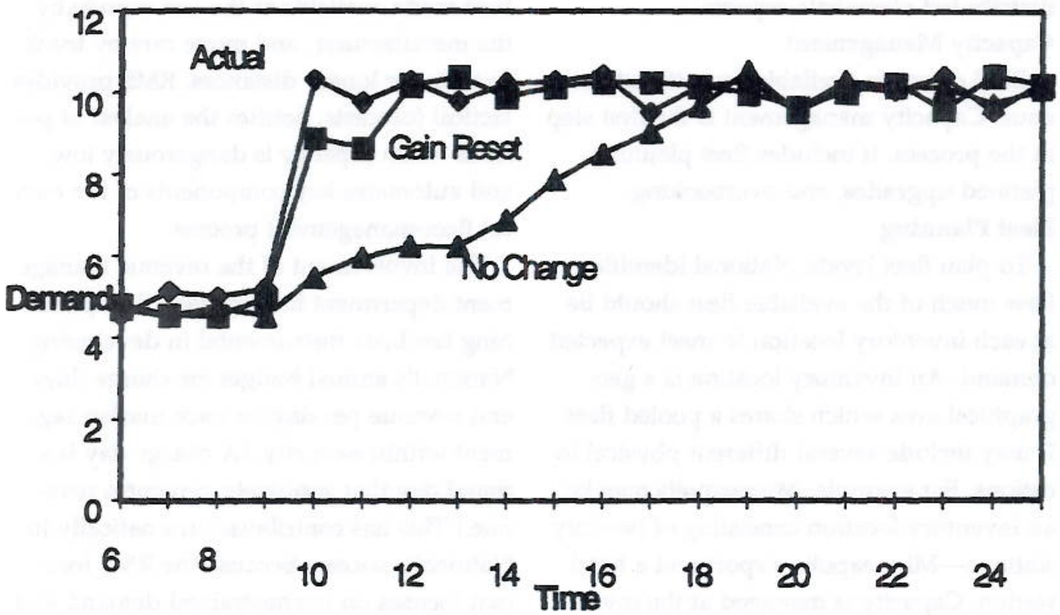

Figure 4: One attractive feature of variable gains is proactive response. The analyst often has advance knowledge that a significant change in the market is about to occur. By proactively increasing the gain, the analyst can ensure that the demand forecast responds to the new demand level quickly.

behavior, the short-term model dominates the forecast of final unconstrained demand.

The system also generates additional forecasts of day-zero activity, such as walk-ups and no-shows. Day-zero is the day a car is picked up by the customer. Day-zero activity includes reservations that do not materialize, that is, no-shows, and requests for cars that do not come through the reservations process, that is, walk-ups. No-shows are a big management problem. The no-show rate is a day-zero effect, but it affects down-line rental days by reducing expected on-rent demand and creating extra availability.

Walk-ups, on the other hand, introduce significant opportunity. A manager can avert an impending oversale situation by turning away walk-up demand. Walk-ups represent a significant revenue opportunity during periods of high demand and low product availability. By predicting walk-up activity, managers can set aside inventory. Walk-ups during these periods represent an opportunity to achieve high revenue per day. Conversely, managers can stimulate walk-ups through aggressive pricing to compensate for underutilization identified late in the booking process. The management of day-zero activity is the responsibility of the field managers. Hand-off of the booking process from corporate revenue managers to field staff on day-zero requires constant communication and information sharing. RMS contributes to this process with distributed electronic reports.

Capacity Management

RMS converts available capacity into revenue. Capacity management is the first step in the process. It includes fleet planning, planned upgrades, and overbooking.

Fleet Planning

To plan fleet levels, National identifies how much of the available fleet should be at each inventory location to meet expected demand. An inventory location is a geographical area which shares a pooled fleet. It may include several different physical locations. For example, Minneapolis may be an inventory location consisting of two city stations—Minneapolis airport and a hotel station. Capacity is managed at the inventory location level because fleet can easily be moved to meet demand at the various stations. In contrast, pricing is managed at the physical location level as a means of further segmenting the market. National relies on long-term forecasts of demand for each inventory location in its fleet planning. It matches current fleet and expected fleet adjustments to the demand forecasts to determine the placement of cars.

National plans its fleet in three stages: for the short term, it looks at a five-day horizon; for the medium term, it considers 60 days in the future; and for the long term, it looks over the coming 18 months. Short-term planning targets fleet movements between locations, accelerates or retards turnbacks to manufacturers, regulates car-sales activities, and resets one-way pricing to effectively place cars in the proper locations to satisfy demand. In mid-term fleet planning, managers consider the same actions as in the short-term process, but they also redirect new car deliveries, acquire new fleet made available at the last minute by the manufacturer, and move cars by truck or train for longer distances. RMS provides tactical forecasts, notifies the analyst of periods when capacity is dangerously low and automates key components of the tactical fleet-management process.

The involvement of the revenue management department in long-term fleet planning has been instrumental in developing National's annual budget for charge days and revenue per day for each market segment within each city. (A charge day is a rental day that genuinely generates revenue.) This has contributed dramatically to National's success because the RMS forecast focuses on unconstrained demand and has helped break the pre-RMS fleet-planning paradigm. In the past, National would plan its long-term fleets based on historical rental patterns, which restricted growth. With accurate information illustrating unconstrained demand, National was able to increase its fleet in a cost-effective manner to capture a much larger volume of profitable business with resulting increases in revenue and market share.

Planned Upgrades

Revenue management exploits the relationship between segmenting the market and generating revenue. Firms can achieve differential pricing for commodities by instituting fences, such as advanced purchase restrictions, that capitalize on each market segment's willingness to pay. In this way a firm presents a variety of products, all of which are based on a single commodity. The fences discourage revenue dilution because the lower-valued products have restrictions that are unacceptable to the higher-valued market segments. National

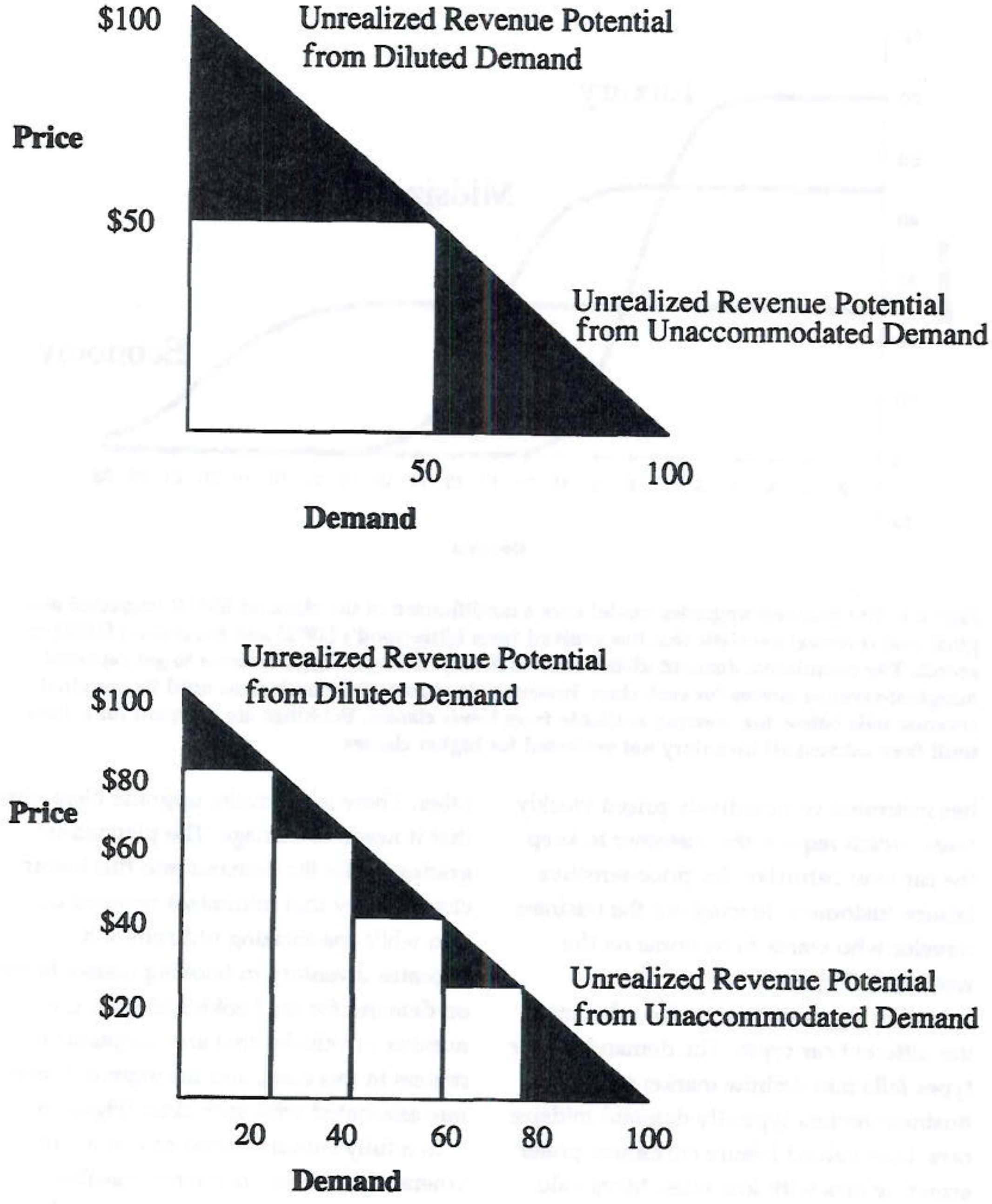

Figure 5: If fences can be found that effectively segment the market, the firm can take advantage of revenue opportunities that arises from differential pricing. It can maximize revenues by setting prices at the willingness-to-pay level of each market segment. The business benefits from the increased revenues, and the consumer benefits because the commodity is available to a broader market. Revenue management has been an important driver in the expansion of National's customer base.

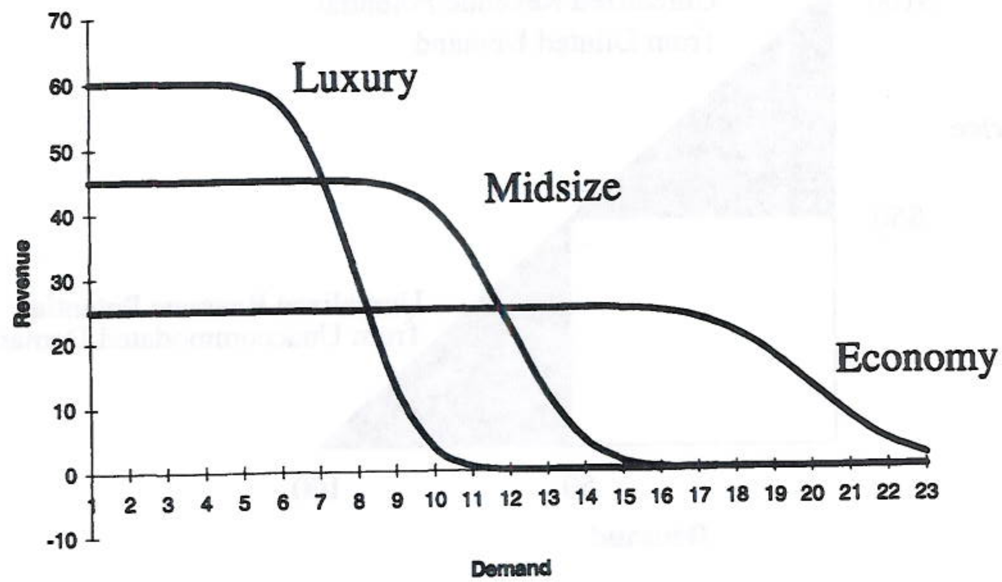

Figure 6: The planned-upgrades model uses a modification of the classical EMSR (expected marginal seat revenue) heuristic that has evolved from Littlewood's [1972] and Belobaba's [1989] research. The cumulative demand distribution is multiplied by average revenue to get expected-marginal-revenue curves for each class. Inventory is protected for each class until its marginal revenue falls below the revenue available from lower classes. Bookings are accepted for a class until they exhaust all inventory not protected for higher classes.

has instituted competitively priced weekly rates, which require the customer to keep the car over Saturday, for price-sensitive leisure customers, fencing out the business traveler who wants to be home on the weekends (Figure 5).

Market segmentation is also inherent in the different car types. The demand for car types falls into definite market segments. Business renters typically demand midsize cars. Low-valued leisure customers prefer economy cars with low rates. More valuable leisure customers want specialty vehicles, such as minivans or four-wheel-drive vehicles. The drawback of accomplishing market segmentation with different products is that a car rental company cannot directly substitute one vehicle type for another. There is a definite upgrade hierarchy that it needs to manage. The planned-upgrades model fits demand into this hierarchy in a way that minimizes revenue dilution while maximizing utilization. It allocates inventory to booking classes based on demand for the booking classes, the number of vehicles that are acceptable to renters in this class, and the expected revenue associated with each class (Figure 6).

In a fully commoditized environment, where all inventory is interchangeable, firms usually adopt a nesting approach. Nesting allows the most valuable booking class access to all available inventory. Subsequent booking classes are allowed access to inventory nominally set aside for the next lower classes. The planned-upgrades hierarchy interferes with a simple nesting approach. It is inappropriate to put higher class customers in economy cars. However, if the company restricts economy bookings to economy cars only, it would miss a large revenue opportunity. Typical fleeting policy is to acquire more large and midsize cars than expected demand requires and fewer economy level cars. The difference in the costs of different sized cars is small enough that the advantages derived from having enough high-valued inventory to meet the high-valued, high-demand periods justify the extra cost. Also, few economy customers complain about getting a better car than they booked for the same rate. The planned-upgrade model decides how many high-valued vehicles to make available to lower booking classes (Table 1).

Fleet in the higher classes that is not required for that class's demand enters the available pool. Classes with more demand than fleet extract fleet from the available pool of higher classes to cover their excess demand requirements. The result is a set of allocations of the number of cars available for rent in each booking class. The actual planned-upgrades model takes account of forecast variability and expected revenues to compute the marginal revenue for each class (appendix). The availability calculation is based on the relative marginal revenues.

Planned-upgrades activity produces a change in availability in the reservations system because customers are driving cars in a class different from that which they booked. When an economy customer arrives at the rental counter and drives away in a midsize car, the availability for midsize demand is decreased for each day the car is on rent. This is because the rental contributes to the current on-rent value for midsize cars even though it is an economy rental. This planned-upgrade effect is particularly pronounced on booking days close to the day of pickup. The model handles the change in availability by revising the on-rent allocation to allow for the number of bookings from other classes it expects to impact the current class.

Overbooking

The airlines have instituted a creative solution to the problem of oversales, which

Class	Fleet	Forecast on Rent Demand	Available Pool	Excess Demand	Available to Sell
Fullsize 4 door	230	165	65		165
Fullsize 2 door	50	60		10	60
Midsize	400	370	30		370
Economy	100	40	60		40
Subcompact	20	165		145	165

Table 1: This table illustrates a simple deterministic case of the planned upgrades process. Available pool represents cars that are available to lower-class bookings. It is computed by a marginal revenue heuristic. Excess Demand represents the fleet requirement for a class with insufficient inventory to meet demand. The revenue manager influences these values through system parameters that provide a throttle to the flow of cars between classes. Available to Sell is the number of bookings National is willing to accept in each car class. The system generates Available to Sell by borrowing cars from the next higher classes so that it satisfies demand.

occur when more passengers show up than can be accommodated. When a flight is overbooked, the airlines in effect hold an auction, offering rewards to any passengers willing to give up their seats and take a later flight. Unfortunately, this is not possible in the car-rental business: customers flow to our counters at different times, expecting and receiving immediate service. They would find it intolerable to be herded into an enclosed area, forced to wait until a certain time, and then to take part in an auction to determine those willing to wait for a vehicle until a later time. Thus, it is critical that our forecast and planning be extremely accurate during peak periods (Figure 7).

The overbooking model revises the results of the capacity management process to account for the impact of no-shows and cancellations. It may be regarded as a mapping from demand space to reservations space where demand space represents actual materialized demand on the day of pickup and reservations space is the number of bookings required, at a given number of days prior to arrival, to achieve that demand level. The overbooking process produces an adjusted, sometimes called overbooked, availability allocation for each car class. The overbooking model identifies optimal overbooking levels by balancing the expected cost of an oversale against the opportunity cost of an unrented car, subject to service-level constraints (appendix). National identifies acceptable oversale risk levels at the corporate level. Individual locations set target utilization levels that adjust available capacity to compensate for the resulting oversale rate and for such operational issues as car turnaround time and

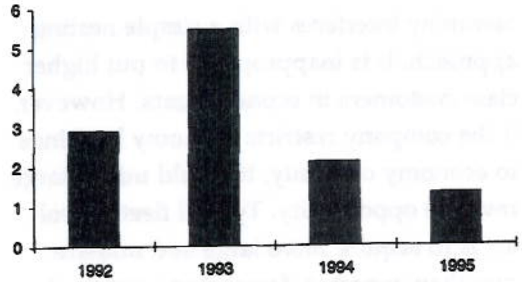

Figure 7: Overbooking compensates for cancellations and no-shows, which are part of the advance booking process. More aggressive overbooking policy results in fewer cars sitting on the lot but increases the instances of "Reservations-No Car." National's record of management of Res/No Car incidents led the industry in 1992. Unfortunately, turndowns were high and utilization was not optimal. In 1993, with GM's direction to turn the company around, utilization improved, revenues improved, but without the tools provided by RMS, Res/No Car incidents rose. When the revenue managers and field managers had the use of RMS (in limited locations) in July 1993, National was not only able to continue to reduce turndowns and improve utilization, but also to reduce service problems. The graph illustrates the great advances made in 1994 and 1995, after the full corporate-wide implementation of the system and department.

discrepancies in checkout/return time of day. (For a discussion of the benefit of overbooking see Smith, Leimkuhler, and Darrow [1992].)

Pricing

The car-rental customer population is made up principally of two segments: corporate and leisure. A corporate customer generally books close to the date of rental, is inflexible in rental and return dates and times, does not shop competitors extensively, is unwilling to prepay, is not willing to stay over a Saturday night, and most important, expects to pay an authorized fixed rate, negotiated and reimbursed by his or her company. The leisure customer, on the other hand, is often willing to stay over a Saturday night, books in advance, is somewhat flexible on time of pickup, for example, willing to wait until noon on Thursdays to qualify for cheaper weekend rates, is willing to prepay rental charges and shops competitors extensively looking for the best value.

The National pricing model links rate levels with availability and consumer booking activity to achieve revenue and utilization objectives. Our initial analysis of National's rate behavior indicated that competitive positioning was the determining factor in its pricing decisions prior to the revenue management program. At times of low demand, sensitivity to competitor behavior is crucial. Utilization levels can suffer drastically from poor rate positioning in the marketplace. During high-demand periods however, the firm can lose large revenue opportunities by following competition-based pricing rules that cause the firm to exhaust inventory by accepting low-valued bookings. RMS implements a demand-based pricing policy. We developed a simple, but extremely effective pricing model to support this policy (appendix).

The pricing model recommends increased or decreased rates based on on-rent demand for a each arrival date. The rates are designed to encourage maximum utilization of rentable capacity. Therefore if remaining demand plus current on-rents exceeds rentable capacity, the model will increase the rate to extract high-valued consumers from the total demand. If remaining demand plus current on-rents is below rentable capacity, it will reduce the rates to stimulate demand. An elasticity model relates historic rate and demand variability. The discrepancy between the demand forecast and the target utilization indicates the required change in booking pace. The elasticity model provides a rate adjustment that will induce this change.

The model relies on the revenue analyst to provide an appropriate base rate for each individual product. The base-rate level embodies the analyst's expertise about such areas as the price tolerance of the market segment and the degree of competition at the location. When the analyst disagrees with a system-generated rate, he or she will either reject it or override it in the process of reviewing the recommendations. When this happens, the pricing model recalibrates around a new base rate. The system infers the new base rate by working backwards from the actual rate the analyst sent to the reservations system and the demand-based rate offset recommended by the elasticity model. The system maintains demand and availability information at a higher level of aggregation than price. RMS-generated price recommendations cause groups of rates to move together. This simplifies rate management by maintaining consistent differentials. The analyst adjusts rate differentials by overriding the current system recommendation. The recomputed base rate will maintain the new

> A comparison of these rates with the cost of renting a tuxedo underscores their irrationality.

differential. The pricing model is more than just a price-management system that mimics analyst behavior. By making frequent adjustments in response to market behavior, it extracts the maximum revenue potential from each market segment over the course of the booking process. Gallego and van Ryzin [1994] suggest that one possible reason for revenue management's success is its ability to capitalize on statistical fluctuations.

Traditional revenue management models capitalize on a reduction in customers' price sensitivity later in the booking process, primarily by using restrictions on advance purchases. This kind of market segmentation has been difficult to implement in the car rental industry, but rate premiums for late booking are an alternate means of capturing at least some of this revenue. The pricing model supports rate-premium profiles that offset base-rate levels by different amounts depending on the number of days left before pickup (Figure 8).

The National RMS bases its rate recommendations on forecasts of demand. At times when on-rent demand exceeds availability, the pricing model extracts the most valuable customers from this mix by discouraging lower-valued demand. When competitors undercut National's price at times of high demand, they end up with the low-end customers and leave the higher-valued, later-booking customers for National. RMS allows National to break the "competition paradigm" by recommending when it can price above the competition and when it should price extremely competitively.

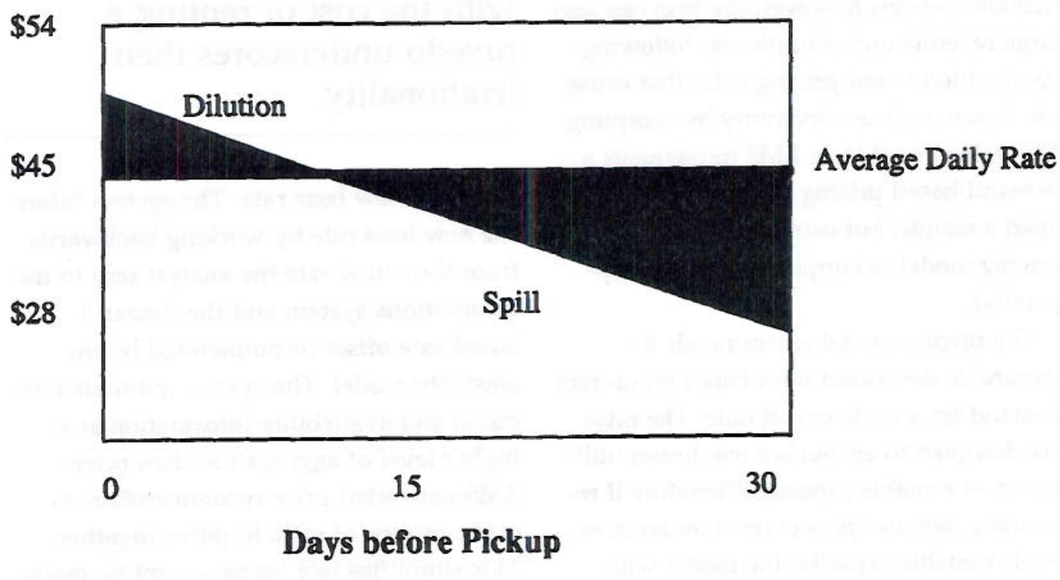

Figure 8: Before RMS, National would set a base price, for example, $45 per day, and it would remain in effect regardless of demand or how far in advance customers would book. Price-sensitive leisure customers would search for a lower rate. The price-insensitive late-booking customer would have been willing to pay more, causing revenues to be diluted.

Reservations Inventory Control

The capacity management and pricing models work closely together to manage on-rent demand. The availability allocations from the planned upgrades model provide a degree of reservations control but do not provide adequate protection for constrained days. The pricing model tries to compensate by adjusting rate levels to achieve utilization targets. Both of these models are limited because they function at an aggregate demand level. By controlling length of rent, National can more precisely trade off between demand elements that are competing for inventory (Figure 9).

Demand forecasts for each length-of-rent category, revenue forecasts based on system rate recommendations, and remaining on-rent capacity provide input for a mathematical programming model that generates minimum length-of-rent restrictions for each arrival day (appendix). The first phase of the model solves a deterministic linear program to identify the length-of-rent categories on each arrival day that provide the greatest revenue. (Williamson [1988] discusses optimization for reservation control.) To implement the LP recommendations, National would need a reservations system with the ability to switch availability on and off for each possible length of rent on each arrival day. The existing reservations controls at National allow specification of minimum length-of-rent controls for each arrival day. Therefore, the second phase of the reservation-control model degrades the full-pattern solution to a set of minimum length-of-rent values and constrained arrival-day indicators. The degradation algorithm reconciles conflicting open/close recommendations within the full-pattern control by weighting each recommendation by the amount of demand it impacts and its proximity to a future constrained day.

For example, the reservation system processes a booking request for a four-day

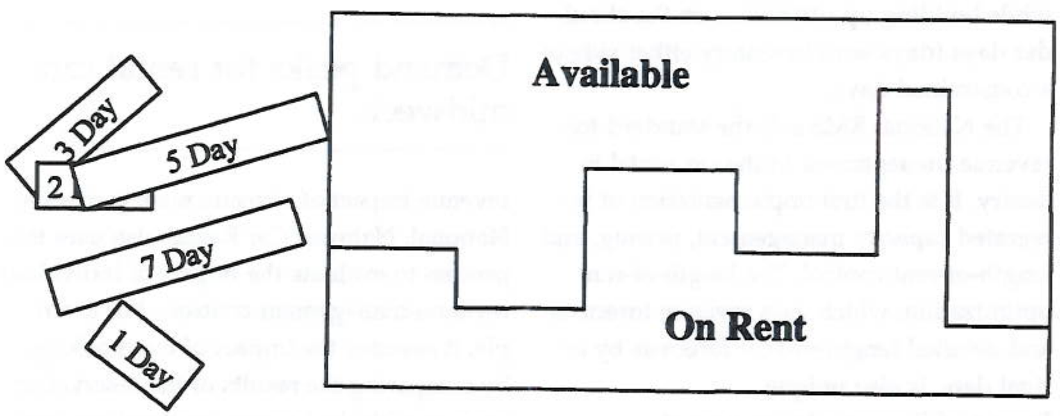

Figure 9: National fits demand for each length-of-rent into remaining capacity using a deterministic linear program. The result is a set of allocation recommendations for each demand element. The linear program's allocations are used to determine minimum length-of-rent (MLRs) controls that can be implemented on the reservations system. The MLRs protect arrival days with constrained capacity while building up utilization on shoulder days (arrival days with availability adjacent to constrained days).

rental arriving on Sunday. It tests availability for all days the booking request requires. Once this test is passed, the length-of-rent specified for the arrival day is considered. The reservation system has a five-day minimum length-of-rent specified for Sunday rentals, but it does not automatically reject the booking. It needs to check if the booking request demands inventory from a constrained day. The reservation system finds that Wednesday is a constrained day so it rejects the booking. Next the reservation system processes a two-day booking request with arrival on Sunday. Because this does not impact Wednesday's inventory, the reservation system accepts the booking. The constrained-day indicator functions as a maximum length-of-rent control. A booking must have a length-of-rent that fits between the arrival date and the next constrained-day indicator, or else have a length-of-rent greater than the specified minimum. In this way, the reservation system protects constrained inventory while building up utilization on the shoulder days (days with inventory either side of a constrained day).

The National RMS sets the standard for revenue management in the car rental industry. It is the first implementation of integrated capacity management, pricing, and length-of-rent control. The length-of-rent optimization, which uses revenue forecasts and detailed length-of-rent forecasts by arrival date, is also unique.

Impact of Revenue Management

When it comes to evaluating revenue management performance, National Car Rental has an advantage over many of its competitors. Traditional revenue opportunity models use demand untruncation strategies to estimate lost demand. There are two principal types of lost demand: *turndowns* are reservations requests that were rejected due to revenue management controls, and *shoppers* are customer inquiries that do not result in reservations requests. Turndowns are key indicators of the effectiveness of capacity management and reservations control. Shoppers provide useful insight into the effectiveness of rate levels. National's reservation system tracks turndowns and shoppers at the transaction level. By combining the reservations that actually occurred with appropriate turndown and shopper transactions, it can compile an accurate reservations history. Analysis of the reservations history with perfect hindsight provides an estimate of the total revenue potential in the marketplace. Conversely, National can estimate the revenue that would be realized in the absence of revenue-management controls. We subtract the revenue from the no-controls scenario from the actual revenue realized to get the revenue impact of revenue management at National. National Car Rental also uses this process to evaluate the impact of individual revenue-management controls. For example, it assesses the impact of overbooking by comparing the results of the reservation process with the historic overbooking levels to the results of that process with inventory levels set at the fleet level.

Demand peaks for rental cars midweek.

The integration of the revenue management system and the revenue management department have catalyzed change in the organization. It has supported more flexible fleet strategies and tactics. It has led in the development and implementation of new products (Saturday-night keep rates, prepaid rates, guaranteed rates). It has helped National to give customers a higher level of service, especially our late-booking corporate clients. It has upheld our ability to serve customers who suffer broken reservations by our competitors. But most important, in its first year of coast-to-coast deployment, the operational revenue management department allowed the creation and realization of $56 million in incremental revenue.

APPENDIX: Length-of-Rent Control

Reservations are accepted or rejected based on length-of-rent controls. Optimal length-of-rent controls are determined by a revised simplex algorithm with upper bounds for the following formulation:

maximize

$$\sum_{i=1}^{N} \sum_{j=1}^{L} r_{ij} x_{ij},$$

subject to

$$\sum_{k=\max(1,i-L)}^{i} \sum_{j=1}^{L} \delta_{kj} x_{kj} \leq C_i$$

$$\delta_{kj} = \begin{cases} 1 \text{ if } k + j > i \\ 0 \text{ otherwise} \end{cases}$$

$$x_{ij} \leq \mu_{ij},$$

where

N = the number of arrival days in the planning horizon,

L = the number of length-of-rent categories,

$i = \{i: 1, \ldots, N\}$ arrival days within the planning horizon,

$k = \{k: 1, \ldots, N\}$ arrival days that impact day i availability,

$j = \{j: 1, \ldots, L\}$ length-of-rent categories,

x_{ij} = the decision variable for arrival day i and length-of-rent category j,

μ_{ij} = mean remaining demand for length-of-rent category j,

C_i = remaining capacity for arrival day i, and

r_{ij} = expected revenue for length-of-rent category j on arrival day i.

The LP solution is degraded to maximum and minimum length-of-rent recommendations by a voting scheme that weights the LOR recommendations for each arrival day according to its proximity to a future constrained day.

Planned Upgrades

The planned upgrades algorithm is based on a heuristic that was developed for allocating airline reservations inventory on a single flight leg (see Belobaba [1989]). This EMSR (expected marginal seat revenue) heuristic computes protection levels for each booking class. A protection level is the number of cars that should be reserved for the demand in the current class. The optimality conditions for a constrained revenue maximization problem are as follows:

$$\frac{dR}{d\pi_i} = \frac{dR}{d\pi_j} = \lambda \; \forall i \neq j,$$

where

R is the revenue function,

λ represents the expected marginal revenue of the last car allocated to each class, and

π_j is the protection level for class j.

Once the EMSR heuristic determines protection levels for each class, the planned-upgrades algorithm determines the availability in each class. The availability number that appears on the reservations system is the sum of the availability for future bookings and the current bookings for the car class. Availability for car classes with excess demand is computed as the fleet in that class plus any cars available from higher classes to cover the excess demand. The availability for car classes with excess fleet is computed as the fleet less any cars used by lower car classes. Fleet not used by lower car classes is returned to the availability of the original car class. The final avail-to-sell number is the sum of availability, current bookings, and adjustments for planned upgrades that are expected to pick up a car in the next 24 hours.

Pricing

The pricing model recommends rate changes in response to the bookings for each arrival date, relative to the expected booking pace. The magnitude of these recommended changes depends on the responsiveness of demand to rate changes, or the demand elasticity. The basic assumption behind the model is that the historical variance in demand is correlated with the elasticity: the greater the variance, the more responsive demand is to price changes.

The rate changes are limited to a maximum range; for example, between 80 percent and 120 percent of the P_B, base price. The slope of the rate-response function depends on σ, the variance in demand. This relationship can be expressed as an inverse demand function of the following form:

$$P = 1.2P_B - \frac{.4P_B}{2\sigma} Q,$$

where P and Q represent price and demand, respectively, and μ represents the mean demand level. This in turn implies a demand elasticity given by

$$\varepsilon_D = -5 \frac{\sigma}{P_B} \frac{P}{Q},$$

where ε_D represents the own-price elasticity of demand. It is clear that, holding other factors constant, an increase in σ will increase the elasticity of demand and induce smaller price adjustments for a given desired change in demand.

Expected booking pace is maintained at a higher level of aggregation (inventory location) than prices, and there is an operational requirement to maintain constant absolute price relationships across programs and city stations. Therefore the percentage price adjustments returned by this model are converted to absolute dollar changes based on a median rate for the inventory location.

Overbooking

The overbooking model identifies optimal overbooking levels subject to service level constraints. The optimal overbooking level is the point at which the marginal oversale cost is balanced against the marginal increase in revenue due to overbooking.

A = authorization, that is, maximum acceptable on-rent bookings,
C = capacity,
S = number of on-rent cars,
$p(S|A)$ = probability density function of the on-rent demand for a given authorization level,
U = number of empty cars,
O = number of oversales,
OS_Cost = cost of an oversale, and
$Spoilage\_Cost$ = opportunity cost of an empty car.

The expected number of empty cars is given by

$$E(U|A) = \int_0^C (C - S)p(S|A)dS.$$

The expected number of oversales is given by

$$E(O|A) = \int_C^\infty (S - C)p(S|A)dS.$$

The optimum expected revenue for authorization level occurs at the minimum value of

$$Spoilage\ Cost*E(U|A) + OS\_Cost*E(O|A).$$

Since expected oversales increase and expected unused cars decrease with respect to authorization, we can find a global minimum by increasing authorization from capacity until the value of this equation starts increasing. The authorization is constrained above by the following service-level requirement, which is set at the corporate level:

$$1 - \int_0^C p(S \mid A)dS \leq \text{Maximum probability}$$

of one or more oversales.

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Revenue Management: A Real Options Approach

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Abstract: Revenue management is the process of actively managing inventory or capacity to maximize revenues. The active management typically occurs through managerial levers such as price, promotion, or availability. We present a novel real options approach to revenue management that is specifically suited to the car rental business. We illustrate the concept with actual car rental data. The model produces minimally acceptable prices and inventory release quantities (number of cars available for rent at a given price) as a function of remaining time and available inventory. The pricing and inventory release recommendations of the developed model confirm earlier empirical analysis that suggested current practises discount too deeply early in the booking cycle. © 2004 Wiley Periodicals, Inc. Naval Research Logistics 51: 686–703, 2004.

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1. INTRODUCTION

In this paper we derive a new revenue management procedure for the rental car industry. This procedure is obtained by considering the operator of a car rental business to be the holder of a real option very similar to the swing option used in the energy industry. This analogy allows us to determine, under reasonable and broad assumptions, both the value of such a business and the optimal way to manage it.

Revenue management is a process of managing perishable inventories to maximize the total revenue from these inventories. The concept has its origins in the airline industry where, upon departure, unfilled seats are lost revenue opportunities. Revenue management is not limited to airlines, but suitable for numerous retail and service industries, including advertising, car rentals, cruise ships, and flexible manufacturing (Harris and Peacock [17]).

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In recent years a new theory of pricing and operating assets in the face of uncertainty and in the presence of some flexibility in operating strategies has been developed. This is the theory of real options (Dixit and Pindyck [10]; Amram and Kulatilaka [1]). The theory of real options in turn uses the framework of modern financial options pricing to frame and solve its problems. This formulation allows these problems to be framed as partial differential equations, normally of diffusive type. For general mathematical references on options pricing see (Merton [24], Hull [18], and Wilmott [33]).

Different types of real options exist, depending on the flexibility possessed by the business operator. For example, consider a project with known start-up costs that may be initiated any time in the next year. Such a project may be modeled as an American call option—the real option holder is allowed to "buy into" the project or exercise his option on any date in the next year. Pricing such an option requires a decision about the optimal way in which to exercise it. The two problems are solved in tandem.

We show that the car rental problem corresponds to a different kind of option. We consider the problem of booking cars for a particular future date. The price at which cars may be reserved fluctuates with both deterministic and random components. Now the "exercise" decision occurs at every instant—should I allow bookings at this price or not? Each exercise decision affects subsequent ones, for every car that gets reserved decreases the number of cars which may be rented in the future. It turns out that this problem is very similar to the problem of pricing the "swing" contracts prevalent in the electricity and gas industries (Keppo [20]) and (Jaillet, Ronn, and Tompaidis [19]).

As an example of a swing option contract consider a typical natural gas supply contract. Under such a contract the buyer takes a certain base supply every week at a preset price. The buyer is also able, at his option, to decide each week whether or not he would like to buy more gas at another preset price. If he does decide to take more gas, he is said to "swing up." The complicating factor here is that the option holder is given only a finite number of opportunities to swing up. Pricing this option requires an exercise strategy which tells the option holder how best to deploy these swing opportunities.

In this paper we show how a car rental operator may be considered as the holder of a swing-like option on car rentals. We are able to solve the resulting set of equations to determine both the operator's optimal rental strategy and the value of the business to the operator.

In Section 2 we provide a detailed description of revenue management in the car rental industry. In Section 3 we derive a partial differential equation model to describe the financial aspects of a car rental business. A numerical procedure for extracting generally applicable model solutions is discussed in Section 4. In Section 5 we present analytic solutions for some special cases of this model. We use the analytic results to validate the model of Section 4. Numerical examples for a general case are presented in Section 6. In the final section we discuss model extensions and future work.

2. REVENUE MANAGEMENT IN CAR RENTALS

Revenue management has been a topic of research and practical interest for airlines since the early 1970s. Revenue management is a process of controlling inventories, enabling the airline to maximize its profits. For an airline, controlling inventory equates to determining how many seats should be made available to willing purchasers for reservation, at what prices. In the short term, most of an airline's costs are fixed with very little or negligible variable costs. Thus, maximizing revenue becomes a close proxy for maximizing profit.

The concept of revenue management is not specific to the airline industry. It has been applied to numerous other businesses which have similar characteristics. These include: car rental, broadcasting, cruise lines, internet service provision, lodging, and railways. Common characteristics of yield management practice are (Kimes [21]): ability to segment markets, relatively fixed capacity, perishable inventory, product sold in advance, fluctuating demand, and low marginal sales cost/high marginal capacity change cost.

In 1992, R.L. Crandall, Chairman and CEO of AMR (American's parent company) estimated that "yield (revenue) management has generated $1.4 billion in incremental revenue in the last three years" (Smith, Leimkuhler, and Darrow [30]). By 1998 Tom Cook, President of SABRE Decision Technologies, had increased the estimated impact to "almost $1 billion in annual incremental revenue" (Cook [8]).

Since the early 1990s the car rental industry has also given attention towards revenue management. Most work in the area of car rental revenue management has been the application of airline revenue management methods to the car rental setting. Carroll and Grimes [7] and Geraghty and Johnson [15] provide accounts of the state-of-the-art in car rental revenue management.

One of the distinct differences of car rental revenue management from its application to airlines is the degree to which price changes. Airlines typically have several discrete price classes, across which prices are fairly constant. These price or fare classes often have restrictions on advanced booking or Saturday night stay in an effort to segment business and leisure travellers. Airlines change prices by opening or closing these different fare classes. Car rental firms also have discrete price classes for the different types of cars (economy versus luxury) but actively change the prices within these classes on a daily basis. Blair and Anderson [6] give an accurate account of pricing activity at Dollar Rent A Car. The active or dynamic price changes in car rental revenue management add a new complexity to airline revenue management.

Weatherford and Bodily [31] and McGill and VanRyzin [23] summarize recent research in airline revenue management. Airline revenue management typically looks at allocating plane capacity across a finite set of fare classes (across which price is fairly constant). Early methods of application (Littlewood [22] and Belobaba [3]) involved newsboy-like heuristics to partition capacity across fare classes. These methods have been extended to include other elements of buyer behaviour such as diversion to other fare classes (Pfeifer [27] and Belobaba and Weatherford [4]). A second stream of research has looked at the complexities resulting from hub-and-spoke networks. Early mathematical programming approaches (Glover et al. [16]) included full passenger itineraries from a deterministic standpoint, with later approaches (Williamson [32], Smith and Penn [29], and Simpson [28]) using dual prices in the allocation decision.

More closely related to car rental revenue management is the field of dynamic pricing. Typically dynamic pricing approaches assume that demand is a stochastic function of price, and that only one price is available (posted) at a given time. Gallego and VanRyzin [13] look at dynamic pricing of inventories, providing structural results for certain classes of stochastic demand. They later extend their results to network effects (Gallego and VanRyzin [14]). Feng and Gallego [11] provide a dynamic pricing approach that fits the airline model more closely. They model cases with two predetermined prices where demand follows a Poisson process. Later they extend their work to allow for multiple classes (Feng & Xiao [12]).

We develop a new approach to dynamic pricing, one in which price itself is a random variable. Current practice assumes prices are set by firms to control demand. We illustrate that the commodity nature of the rental car business requires a more detailed approach to modeling price as an exogenous variable.

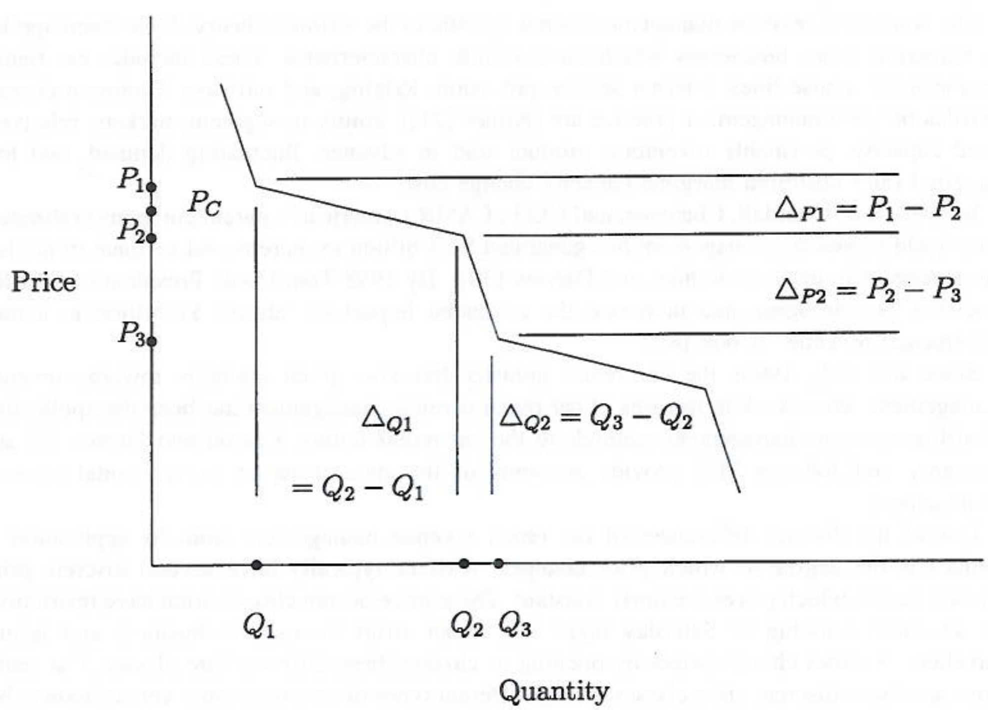

Figure 1. Car rental price elasticity.

3. PRICING MODEL

The car rental industry is not as price sensitive as the airline industry. Price changes do generate subtle changes in demand, but what is more important is one car rental firm's price against its competition's (Blair [5]). Figure 1 is a simplified illustration of price elasticity within the car rental industry. Price elasticity, the percentage change in demand per percentage change in price describes the sensitivity of sales volume to price changes. In Figure 1, demand is relatively inelastic over price changes from P_2 to P_3 as very little additional sales result (Δ_{Q2} is small), while very elastic from P_1 to P_2 (Δ_{Q1} is quite large). Over the range P_1 to P_2 the price has crossed a competitor's price P_C, generating the volume increase (decrease) whereas from P_2 to P_3 it is still priced between two competitors, or already has the lowest price.

For simplicity, we consider a single type of business; car rental for equal duration (e.g., daily, weekly, or over the weekend) on an average daily revenue basis. All the cars are assumed identical so that at any given time the price is uniform across all cars available for rent at the same point in the future. The window over which reservations are accepted is of duration T, this window is typically of the order 90 days. We suppose that during the period $0 \leq t \leq T$ cars can be reserved for use on the first day after $t = 0$ but that the full rental cost is paid at the time of reservation. At time $t = T$ reservations stop and no unreserved cars can be rented, representing a lost revenue opportunity.

We will derive a model of this process. This model will be discrete in that we divide the time period into I subintervals. For example, the period of three months may be divided into 12 one week intervals, or more representative of current practice into 90, daily periods (Geraghty and Johnson [15]) allowing for daily price changes. We utilize subintervals of equal length, noting that the hypothesis of equal intervals may be relaxed at little computational cost. In addition, we will separately follow each available car, solving a subproblem for each car for each subperiod. We require a submodel for the demand for cars as a function of time.

Given the response to price as shown in Figure 1 we will model price as a random process, in essence modeling the rental car firm as a price taker, unable to arbitrarily price, rather having to price relative to competition. We will assume that the price to rent a car can be modeled by a general stochastic differential equation of the form

$$dP = \mu(P, t)\, dt + b(P, t)\, dX, \tag{1}$$

where $P = P(t)$ is the price of a one day rental, t is the time, and μ and b are given functions of P and t.

In the PDE framework which follows we have wide flexibility to choose μ and b to fit the data. The numerical solution of the differential equations will not be appreciably more difficult for most reasonable choices of μ and b. To be concrete in what follows, we choose

$$\mu(P, t) = \alpha(L(t) - P), \tag{2}$$

$$b(P, t) = \sigma P. \tag{3}$$

Equation (2) states that the random process governing rental cars is mean-reverting with rate α to a time-dependent mean price $L(t)$. Mean reversion appears a reasonable model as, while rental car prices fluctuate from day to day, they seem to be bounded both below and above. The lower bound exists because prices cannot stay significantly below the marginal cost of renting the car for too long or the rental operator would have to exit the market. The upper bound exists both because of the competitive, winner take all, nature of the rental car market and because of the price elasticity of consumers. Both of these effects support a mean reverting price model. We choose (3) with constant volatility parameter σ to represent a constant relative fluctuation in the prices, σ may be constant or a function of time without any change in formulation. This price process is really for the price of a reservation, the price price paid in the future for a reservation today. The model is then similar to a forward price for a commodity, which are also often modelled as mean reverting.

The only choice which remains is how to represent the mean rental car price as a function of days before rental. We choose a simple linear increasing function of time for this. To motivate this choice, we examine Figure 2 which plots the average realized price per day of single day, 3-day, and week-long car rentals for Dollar Rent A Car against weeks before pickup. These data, provided by Dollar, are for economy cars for weekday pickup rented at Denver International airport during calender year 2001. In every case a subtle but noticeable upward trend in the average rental price is observed. In any event, the large fluctuations in the dataset we present make it difficult to justify a more complicated model for the mean.

Consider a time interval $0 \leq t \leq T$ such that $t = 0$ corresponds to the start of the reservation time and $t = T$ to the time of rental. We suppose that we have M cars to rent and that they can be rented at a daily varying price given by the stochastic differential equation (1). The number of cars available at the start of the booking cycle, $t = 0$, will be both a function of fleet size and how that fleet is allocated across different lengths-of-rent, typically determined using linear programming (Geraghty and Johnson [15]). Linear programming is used to maximize expected revenue by allocating cars to the different lengths-of-rent, while constraining the allocation such

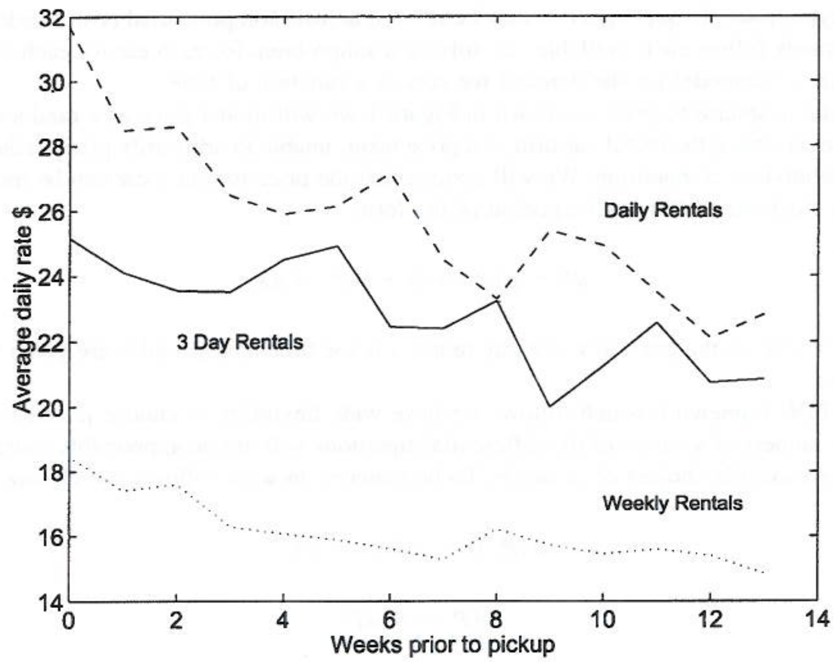

Figure 2. Average daily rental rates—weekday pickup for Denver economy cars.

that allocated cars (by length-of-rent class) is no more than expected demand, and total cars allocated no more than available fleet. We suppose that cars can only be rented at fixed intervals given by $0 < t_1 < t_2 < \cdots < t_N < T$, where $t_j = j * \Delta t$. The total number of cars that can be rented in a period (the demand) is a given function of price $F(P)$. For period j, for generality, we suppose both additive forms of demand

$$F(P_j) = \beta_0 + \beta_1 * P_j$$

and multiplicative

$$F(P_j) = \beta_0 * P_j^{\beta_1}$$

with coefficients β_0 and β_1 constant or indexed with time.

Write the value of the cash flow for the remaining cars as

$$V_m^j$$

at the beginning of a time interval j, where m cars have been rented. We now consider the interval $t_j \leq t \leq t_{j+1}$ where we will be renting cars at $t = t_{j+1}$. The car rental firm is faced with the decision to accept a reservation or wait for potential future (higher) revenues. The firm has the option of renting or holding the car.

Since the price is given by a stochastic differential equation, the cash value V_m^j can be considered as a European option starting at $t = t_j$ with a payout of ϕ at $t = t_{j+1}$. It is a European

$m \backslash j$	0	1	2	3	4
0					
1					
2					
3					

t_1 t_2 t_3 t_4 T

Figure 3. Subproblem layout.

option as we are assuming it can be exercised only at time $t = t_{j+1}$. If we rent a car at t_{j+1}, the expected cash flow is given by

$$\phi = V_{m+1}^{j+1} + P_{j+1},$$

where P_{j+1} is the rental price we get when the car is picked up (rented) and V_{m+1}^{j+1} is the expected future cash flow from the remaining cars. In general, if we rent k cars, the payout is

$$\phi = V_{m+k}^{j+1} + kP_{j+1},$$

where $m + k \leq M$; i.e., we cannot rent more cars than we have available. If we do not rent any cars, the payout is just the cash flow at t_{j+1}, i.e., V_m^{j+1}. Thus the complete payout at t_{j+1} is

$$\phi = \max(V_m^{j+1}, V_{m+1}^{j+1} + P_{j+1}, V_{m+2}^{j+1} + 2P_{j+1}, \ldots, V_{m+k}^{j+1} + kP_{j+1}), \tag{4}$$

with $m + k \leq M$ and $k \leq F(P_{j+1})$; i.e., we cannot rent more cars than we have, and the number we rent, k, is limited by demand at price P_{j+1}, $k \leq F(P_{j+1})$.

For the final period $j = N$, the payout is just the number of cars that can still be rented out; i.e.,

$$\phi = kP_N,$$

where $m + k \leq M$ and $k \leq F(P_N)$.

We can now represent the problem as a collection of subproblems; this is shown on Figure 3 as a grid with $0 \leq j \leq 4$ and $0 \leq m \leq 3$. For each cell in the grid we can derive a Black-Scholes-like partial differential equation. We can use the payout at the right-hand side of the cell to calculate the value at the left-hand side. This standard derivation may be found for instance in Dixit and Pindyck [10]. To illustrate this, consider the cell that corresponds to $j = 3$ and $m = 1$. Here the payout is

$$\phi = \max(V_1^4, V_2^4 + P_4, V_3^4 + 2P_4). \tag{5}$$

We use this as the initial condition for an equation for V_1^3.

Now consider a general cell located between $t_j \leq t \leq t_{j+1}$ and $0 \leq m \leq M$. Using the pricing model (1) we can develop the governing partial differential equation for the cash flow $V(P, t)$.

Starting with a model for rental prices P,

$$dP = \mu(P, t)\, dt + b(P, t)\, dX,$$

the goal is to determine the value of the option to rent the car at time t given that if it is not rented at time T a revenue opportunity is lost, this option value is $V(P, t; T)$.

If this were a financial option we could establish a hedging argument to price this in a risk-neutral measure. This argument may be expressed in PDE form by a simple application of Bellman's principle using a risk-free discount rate r (Dixit and Pindyck [10])

$$\frac{\partial V}{\partial t} + \frac{1}{2} b^2 \frac{\partial^2 V}{\partial P^2} + \mu \frac{\partial V}{\partial P} - rV = 0. \tag{6}$$

However, unlike financial options, it is less clear that risk can be hedged away in this setting. Perhaps something could be done along the lines of hedging midsize cars against luxury cars, but there are practical difficulties with this idea. We can, however incorporate a risk-adjustment as follows. We use a Sharpe ratio $\lambda = (\mu - r)/\sigma$ to denote the riskiness of the investment, we derive a PDE using Bellman's principle. Thus pricing in a risk-neutral measure corresponds to $\lambda = 0$, and recovers the earlier PDE [Eq. (6)]

$$\frac{\partial V}{\partial t} + \frac{1}{2} b^2 \frac{\partial^2 V}{\partial P^2} + (\mu - \lambda b) \frac{\partial V}{\partial P} - rV = 0. \tag{7}$$

In our model of rental car prices $b = \sigma P$. Now,

$$\frac{\partial V}{\partial t} + \frac{1}{2} \sigma^2 P^2 \frac{\partial^2 V}{\partial P^2} + (\mu - \lambda \sigma P) \frac{\partial V}{\partial P} - rV = 0, \tag{8}$$

where λ is the market price of risk.

If we set $\lambda = 0$, then the solution follows that of a risk-neutral or expected value maximizing decision-maker. Note that our numerical results indicate that the solution is quite insensitive to the choice of λ. With $\lambda = 0$ and Eq. (2) we have $\mu = \alpha(L(t) - P)$. We will replace the time variable t with a local time variable τ within the rectangle which starts at t_{j+1} and ends at t_j. We also replace the variable t with $t_{j+1} - \tau$ in order to get a forward problem. Thus the governing partial differential equation becomes

$$\frac{\partial V}{\partial \tau} = \frac{1}{2} \sigma^2 P^2 \frac{\partial^2 V}{\partial P^2} + \alpha(L - P) \frac{\partial V}{\partial P} - rV. \tag{9}$$

Here $V_m(P, j\Delta t) = V_m^j(P)$ and for convenience $L(t)$ is expressed as L.

The initial condition for this equation which is obtained from (4) is

$$V(P, 0) = \max(V_m^{j+1}, V_{m+1}^{j+1} + P_{j+1}, V_{m+2}^{j+1} + 2P_{j+1}, \ldots, V_{m+k}^{j+1} + kP_{j+1}), \tag{10}$$

with $m + k \leq M$ and $k \leq F(P_{j+1})$.

We also require boundary conditions. The situation at $P = 0$ is quite interesting and the analysis outlined below is similar to that treated by d'Halluin, Forsyth, and Labahn [9] in their discussion of the single factor interest rate model.

If we let $P \to 0$, Eq. (9) becomes

$$\frac{\partial V}{\partial t} = \alpha L \frac{\partial V}{\partial P} - rV. \tag{11}$$

Since $\alpha L > 0$, this is a hyperbolic equation with outgoing characteristic, so we can expect that no boundary condition is required at $P = 0$. However, for finite but small values of P, Eq. (9) has a diffusive term and the question is whether this term tends to zero sufficiently rapidly that no boundary condition is required. If it does not, we require a boundary condition. This question has been answered by Oleinik and Radkevic [26], who showed that, for any equation of the form

$$\frac{\partial \phi}{\partial t} = a(x) \frac{\partial^2 \phi}{\partial x^2} + b(x) \frac{\partial \phi}{\partial x} + c(x)\phi,$$

no boundary condition is required at $x = 0$ if

$$\lim_{x \to 0} (b(x) - a'(x)) \geq 0.$$

For (9) this condition is satisfied provided $\alpha L > 0$ which is always the case.

Thus we see that no boundary condition is required at $P = 0$ and we will obtain a finite difference equation there by discretizing (11).

For large values of P it is clear that V will depend linearly on P, so we will use

$$\frac{\partial^2 V}{\partial P^2} \to 0 \quad \text{as} \quad P \to \infty. \tag{12}$$

For the last time interval we can write down an exact solution of the form

$$V_m^N(\tau) = A(\tau) + B(\tau)P,$$

since the initial condition is $V_m^N(0) = KP$, where K is a given constant.

The next section details numerical solution procedures for the above model.

4. NUMERICAL PROCEDURE

In general, the mathematical model developed above cannot be solved analytically. To generate pricing recommendations, we employ a numerical approach. We use a standard implicit procedure with $P_j = j\Delta P$ and $V_j^n = V(j\Delta P, n\Delta\tau)$ for $j = 0, \ldots, J$ and $n = 0, \ldots, nt$. Here $I\Delta P = P_{max}$ and $n\Delta\tau = \Delta T$, where $P = P_{max}$ is the price at which we impose the boundary condition $V_{PP} = 0$, ΔT is the length of each period, and I is an identity matrix. If we use central difference formulae, the resulting difference equations can be written in the form

$$(I + \theta\,\Delta t A)V^{n+1} = (I - (1 - \theta)\,\Delta t A)V^n \tag{13}$$

for $0 < j < J$, where

$$A = \begin{pmatrix} r + b_0 & -b_0 & & & \\ -a_1 & r + a_1 + b_1 & -b_1 & & \\ & & -a_{J-1} & r + a_{J-1} + b_{J-1} & -b_{J-1} \\ & & & a_J & r + a_J \end{pmatrix}.$$

For $j = 1, \ldots, J - 1$,

$$a_j = \frac{\sigma^2 P_j^2}{2\,\Delta P^2} - \frac{\alpha(L - P_j)}{2\,\Delta P}, \tag{14}$$

$$b_j = \frac{\sigma^2 P_j^2}{2\,\Delta P^2} + \frac{\alpha(L - P_j)}{2\,\Delta P}, \tag{15}$$

$$b_0 = \frac{\alpha L}{\Delta P}, \tag{16}$$

$$a_j = \frac{\alpha(L - P_j)}{\Delta P}. \tag{17}$$

It is possible for a_j to be negative for small values of j, i.e., near $P = 0$; this corresponds to the governing equation being convection-dominated. In this case the system of difference equations are no longer diagonally dominant, and we can expect their solution to oscillate. In order to circumvent this problem, we will use upstream weighting for the convective term and get

$$a_j = \frac{\sigma^2 P_j^2}{2\,\Delta P^2}, \tag{18}$$

$$b_j = \frac{\sigma^2 P_j^2}{2\,\Delta P^2} + \frac{\alpha(L - P_j)}{\Delta P}. \tag{19}$$

This approximation is only first order, but since it will only be used away from the region of interest, this should not cause any problems.

We define θ in (13) to be a parameter between 0 and 1. Setting $\theta = 1/2$ gives the standard Crank-Nicolson procedure, which is second order in both Δt and ΔP, while $\theta = 1$ produces a fully implicit procedure. While it is well known that in certain cases the Crank-Nicolson procedure has a tendency to produce solutions with unphysical oscillations, this seems not to be the case for this problem so we have mainly used $\theta = 1/2$.

At $P = 0$, i.e., $j = 0$, we will discretize Eq. (11) using an upstream weighting for the diffusive term. Hence we have

$$a_0 = 0,$$

$$b_0 = \frac{\alpha L}{\Delta P}.$$

For large values of P we truncate the region at $P = P_{max}$, and there we appeal to boundary condition (12) to set the second derivative to zero. Then a standard central difference approximation gives

$$V_{J+1} = 2V_J - V_{J-1},$$

yielding

$$a_J = -\frac{\alpha(L - P_J)}{\Delta P}.$$

The set of difference equations (13) is tridiagonal so a very fast form of Gaussian elimination can be applied. For details see Morris [25].

5. MODEL VALIDATION

As mentioned in Section 4 our model does not typically admit exact solutions. However, for special cases we can derive an exact solution. We can use these different cases to validate our numerical approach.

5.1. Analytic Solution

Let us first derive an expression for the mean as a function of time for our pricing model. In order to simplify the analysis, we will only consider the case where the mean of the price equals a constant, m. Thus the pricing model (1), (2), and (3) becomes

$$dP = \alpha(m - P)\,dt + \sigma P\,dX, \tag{20}$$

with initial condition $P(0) = P_0$.

It is well known that the mean of this process follows the path

$$\bar{P}(t) = P_0 \exp(-\alpha t) + m(1 - \exp(-\alpha t)). \tag{21}$$

We now use this result to derive an exact solution for the situation in which we are in an unconstrained environment in which we can rent k cars per period for N periods, each spaced by time ΔT. The initial price of the cars is P_0. There is no optionality here so the present value of the expected value of the cash flows arising from the business is:

$$V = k\bar{P}(0) + k\bar{P}(\Delta T)\exp(-r\Delta T) + \cdots + k\bar{P}((N-1)\Delta T)\exp(-r(N-1)\Delta T)$$

$$= k\sum_{j=0}^{N-1}\exp(-jr\Delta T)[P_0\exp(-j\alpha\Delta T) + 1 - \exp(-j\alpha\Delta T)] = k(P_0 - m)\sum_{j=0}^{N-1}\exp[-j(r+\alpha)\Delta T]$$

$$+ km\sum_{j=0}^{N-1}\exp(-jr\Delta T) = k(P_0 - m)\frac{1-\exp[-N(r+\alpha)\Delta T]}{1-\exp[-(r+\alpha)\Delta T]} + km\frac{1-\exp(-Nr\Delta T)}{1-\exp(-r\Delta T)}. \quad (22)$$

If V is plotted against P_0, the solution is seen to be a straight line.

5.2. Validation

In order to validate our numerical approach, we look at situations in which the car rental problem can be solved exactly in the form above. Two such cases follow.

- There is a surplus of cars and the price is large compared with the mean.
- Small volatility and small values of P

5.2.1. Case 1

Let us consider the case where there is a surplus of cars available so that the full number of cars, say K, can be reserved in every period. In addition we write the expression for the mean price in the form

$$L = a + b\tau,$$

where a and b are positive constants. Then the governing equation for each period is

$$V_\tau = \frac{1}{2}\sigma^2P^2\frac{\partial^2 V}{\partial P^2} + \alpha(a + b\tau - P)\frac{\partial V}{\partial P} - rV,$$

where $\tau = 0$ is the beginning of the period and $\tau = \Delta T$ is the end of the period.

In the last period we denote the value of the cash flow as $V_N(P, \tau)$, and it is clear that the initial condition is $V_N(P, 0) = KP$, so the solution can be written in the form

$$V_N(P, \tau) = A_N + B_NP.$$

We substitute this into Eq. (22) for V to see

$$A_N = -K\left(a + \frac{b}{\alpha} + bt\right)e^{-(\alpha+r)\tau} + K\left(a + \frac{b}{\alpha}\right)e^{-r\tau},$$

and

$$B_N = Ke^{-(\alpha+r)\tau}.$$

Table 1. Validation Case 1—excess supply.

P	$V(P, 0)$ $N = 3$	$V(P, 0)$ $N = 6$	$V(P, 0)$ $N = 12$	$V(P, 0)$ Analytic
1	20.5621	22.1741	24.7186	20.0000
2	32.3604	32.6211	33.2656	32.3018
3	44.6130	44.6079	44.8372	44.6036
4	56.9067	56.9166	56.9557	56.9054

In the $N - 1$ period the cash flow is V_{N-1} with initial condition $A_N(\tau) + B_N(\tau)P + KP$, so, using the same procedure as above, we see that the solution can be written in the form

$$V_{N-1}(P, t) = A_{N-1} + B_{N-1}P.$$

Here

$$A_{N-1} = -(B_N + K)\left(a + \frac{b}{\alpha} + b\tau\right)e^{-(\alpha+r)\tau} + (B_N + K)\left(a + \frac{b}{\alpha}\right)e^{-r\tau}$$

and

$$B_N = (B_N + K)e^{-(\alpha+r)\tau}.$$

The subsequent solutions all have the same form.

This is, of course, the same solution we derived in subsection 5.1 using the mean of the pricing process.

Now consider the case where $\sigma = 1$, $T = 0.0833$, $\alpha = 4$, the total number of cars that can be rented out over one period is 10 and the total number of cars available is 20. Thus it is clear that if the total number of periods is greater than 2 and if the price at which cars can be rented out is considerably greater than 1, all the cars will be rented out in the first two periods, and the exact solution derived above will be applicable.

Here Table 1 indicates that as price increases from a low of 1 to a high of 4, the numerical solution approaches the analytical. Similarly, as the number of periods in the numerical solution approaches that of the analytical solution (2), then the results converge. As expected, as the number of periods in the numerical solution increases, more opportunities for price increases are available, and the numerical result will diverge from the analytical. These results are less pronounced as prices increase.

5.2.2. *Case 2*

The mean reverting pricing model that we are using is not easy to solve. However, if we assume that the volatility is small compared to the mean reversion term, we get, as in subsection 5.1 with units selected such that $m = 1$,

$$P(t) = 1 - (1 - P_0)e^{-\alpha t},$$

where $P_0 = P(0)$ and $P(t)$ should now be interpreted as the mean. If we apply this to the case where there is 3 periods, each of length 1/12 years, we see that

$$P_1 = 1 - e^{-\alpha/12},$$

$$P_2 = 1 - (1 - P_1)e^{-\alpha/12},$$

$$P_3 = 1 - (1 - P_2)e^{-\alpha/12},$$

where $P_0 = 0$. For $\alpha = 4$ we get that

$$P_1 = .283, \qquad P_2 = .48, \qquad P_3 = .632.$$

Thus for the case where, as above, we can rent out 10 cars per period but only a total of 20 cars, an estimate of the cash flow when $r = 0$ is $10P_2 + 10P_3$, which equals 11.18. The numerical procedure generates the same result. We can proceed in this manner, and for $N = 6$ we find that an approximate value for the cash flow at $t = 0$ is 15.47 while the numerical result is 16.89. As N becomes larger, it is clear that the expected value of P tends to 1 so the value of the cash flow should tend to 20. However, the numerical result for $N = 12$ is 21.74.

In general, these results can be interpreted as at least partial validation of the numerical procedure.

6. NUMERICAL EXAMPLE

We require representative values of the different parameters that appear in the model. Two of these, which originate in the pricing model, are not easy to estimate with any degree of accuracy. We will show how to get reasonable values of the parameters and then show that our computational model is not overly sensitive to reasonable changes in them.

Let us first consider the volatility σ. If we consider the pricing with P being close to the mean L, we get approximately that

$$dP = \sigma\, dX,$$

where X is a Wiener process; one can think of dX as being a random variable, drawn from a normal distribution with mean zero and variance dt. Since dX scales as $\sqrt{dt}$ we see that an estimate for σ is given by

$$\sigma = \frac{dP}{\sqrt{dt}}.$$

If we suppose that the change in the price of rental cars over a 1 week period is 10%, and we estimate $\sqrt{52} = 7$, this implies that σ should be of the order 70% per year.

In order to get an estimate for α, the rate at which the car rental price reverts to its mean, let us consider the pricing model with no stochastic noise. Then

$$dP = -\alpha(P - L)\, dt,$$

Table 2. Parameter values—numerical example.

Parameter	Estimate
Number of periods N	12
Length of each period	1 week
Total number of cars	50
Discount rate r	5% per year
Average minimum rental price	25$
Average maximum rental price	30$
Demand at zero price	20 cars
Slope of demand curve	$-\frac{1}{15}$
Volatility σ	1
Return rate α	180

where we will assume that the mean price L is constant. This equation can be integrated to get

$$P = L + (P_0 - L)e^{-\alpha t},$$

where $P_0 = P(0)$. Approximate $e^{-\alpha t}$ by $1 - \alpha t$ so

$$P = L + (P_0 - L)(1 - \alpha t).$$

Thus we see that the time t^* that it takes the price to return to the mean is given by $1 - \alpha t^* = 0$. The data indicates t^* is usually of the order of two days so α is approximately 180/year.

The remaining parameters are easily found and we will use the set of parameter values given in Table 2.

Using these parameters values, we generate the plots shown in Figure 4 which shows the number of cars that should be rented out for different prices at time $t = 0$, i.e., at the beginning of the first of 12 rental periods of a week each, in order for the franchise to maximize the total cash flow. The price model underlying the figure is relatively flat with an average price at time zero of $25 rising to a maximum (average) of $30 at the end of the reservation period. Price volatility is moderate, representing about a 12% change on a weekly basis ($\sigma = 1$) with quick price reversion, $\alpha = 180$. Base demand is 20 units with elasticity $-1/15$. The three series plotted in Figure 4 are for three different levels of risk adjustment. The series with $\lambda = 0$ is equivalent to a risk neutral or expected value approach, whereas $\lambda = 5$ and $\lambda = 10$ represent increasing value in risk. The increased value placed on risk means the options are worth more to the firm resulting in them holding on to the options longer, requiring larger rates to rent the cars.

It is important to note that Figure 4 is a merging of supply and demand. At lower prices the car rental firm is limiting supply, not making cars available till prices exceed certain limits. At higher prices, the firm is willing to rent but sales are capped by a lack of demand.

The interesting part is that even if the mean price is $25 per car, the risk neutral franchise should not rent cars out for less than about $23 a car. This confirms earlier results where Anderson and Blair [2] indicated that early rentals at deeply discounted rates are costly, from a revenue standpoint, to the car rental firm, indicating that perhaps car rental firms are discounting too deeply early in the booking cycle.

Let us now consider the sensitivity of our results to changes in σ and α. If we change σ from 0.1 to 2.0, we see that the minimum rental price changes from $22.60 to $22.80. Similarly, if we change α but keep the other parameters at the values given in Table 2, we get the results in

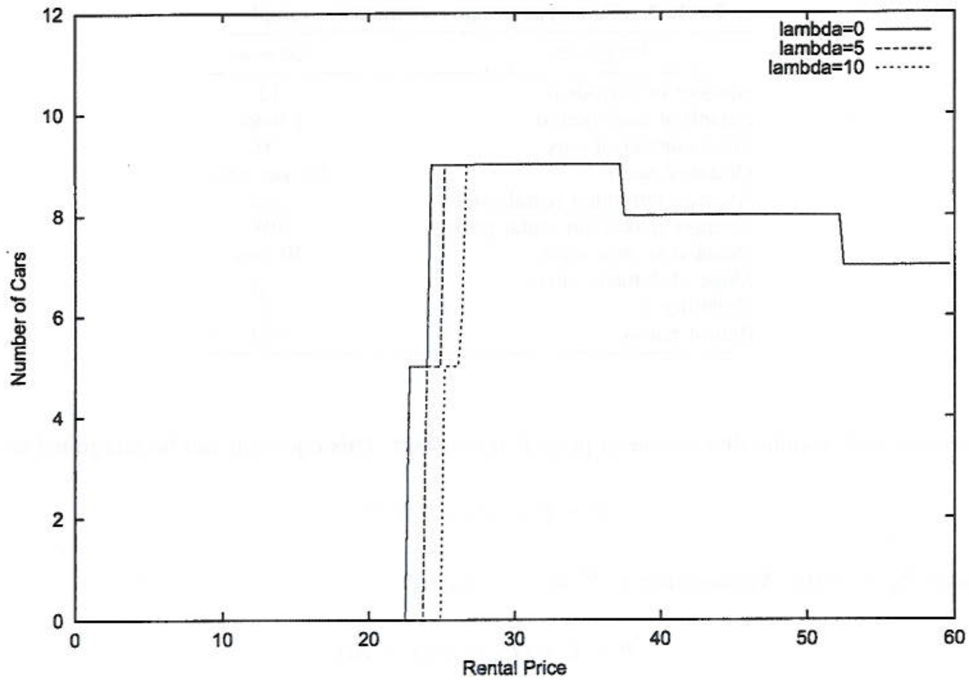

Figure 4. Rates and availability at initial booking.

Table 3. Table 3 shows that the slower prices tend to revert, the more likely a firm is to rent early at deeply discounted rates.

The procedure is implemented in C^{++} in about 600 lines of code. Execution time for a problem with 12 periods is about five seconds on a standard PC (Pentium III, 550 MHz). Since the routine must be run once per period the total execution time will be around 35 seconds.

7. DISCUSSION

We have derived a new model for revenue management and applied it to car rentals. This model is based on the concepts of real option theory and is related to the swing options used in the power industries. We have derived some exact results and used these in the validation of a computational model of the process.

Table 3. Sensitivity analysis—rate of reversion to mean.

α	First rental price
2	26.0
5	25.5
10	24.0
100	22.8
180	22.8

The method provides an approach to including competitive effects in revenue management settings. For commodity based service businesses, like car rentals (where customer switching costs are low), a firm's pricing decisions may be impacted by their price relative to competition. Our approach to modeling price as a stochastic differential equation is a novel approach to including these competitive effects in revenue management applications.

We suppose that the management of the business has a database which allows calibration of stochastic models of rental price development. At present our approach does not include impacts of inventory sharing across multiple rental periods, i.e., a car may be rented overnight or for 3 days. Similarly our model does not include effects created by multiple car classes, i.e., the ability to rent a higher valued car to a customer desiring a lower valued car. These limitations may be relaxed by jointly modeling the price process for different lengths of rent for different classes of cars. These price processes would need to be correlated as prices would tend to move together across classes and rental lengths.

While we have illustrated the application of Real Options to revenue management using car rentals as an example, the general approach is extendible to any industry with active price changes. Intense competition only helps to motivate the application of our methods.

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PRICING

I- Establishing Room Rates:

• The front office manager shall assign to each room category a rack rate. In accordance, front office employees are expected to sell rooms at rack unless a guest qualifies for an alternative room rate (ex: corporate or commercial rate, group rate, promotional rate, incentive rate, family rate, day rate, package plan rate, complementary rate…).

• While pricing rooms, the hotel shall keep in mind that rate should be between a minimum (determined by cost structure) and a maximum (determined by competition structure) boundary as depicted below:

> Minimum (**Hurdle Rate**) < Room Rate < Maximum (**Rack Rate**)
> **Cost Structure** < Room Rate < **Competition Structure**

• While establishing room rates, management shall be careful about its operating costs, inflationary factors, and competition. Generally, there are three popular approaches to pricing rooms:

1. Cost Approach
2. Market Condition Approach
3. Rule-of-thumb Approach
4. Hubbart formula Approach

1. **Cost Approach**:

- This Approach's starting Point is on finding the Per Room occupied daily Direct and Indirect Expenses.

- Consider the Following Example:
- Jamel Hotel has estimated the Following Indirect Expenses (i.e. Undistributed Expenses and Fixed Charges) for the upcoming Year:

Expense Type	**Amount**	**Allocation to Rooms Division**	**Rooms Division Expense**
Administrative & General Expenses	**$ 500,000**	**30 %**	**$ 150,000**
Utility Expenses	**$ 260,000**	**70 %**	**$ 182,000**
Debt Expenses	**$ 300,000**	**70 %**	**$ 210,000**
Depreciation Expenses	**$ 350,000**	**60 %**	**$ 210,000**
Rent Expenses	**$ 100,000**	**70 %**	**$ 70,000**
Marketing Expenses	**$ 65,000**	**80 %**	**$ 52,000**
Maintenance Expenses	**$ 140,000**	**70 %**	**$ 98,000**
Insurance Expenses	**$ 100,000**	**70 %**	**$ 70,000**
TOTAL	**$ 1,815,000**	**N/A**	**$ 1,042,000**

- Furthermore, suppose that Jamel Hotel has **150** Rooms (**90** of them are single and the remaining are double) and that the Forecasted Single Room Occupancy Rate is **80 %** and the Double Room Occupancy Rate is **85 %**.

Answer:

- Total Number of Expected Single Rooms Sold per Year = 90 * 0.80 * 365 = **26,280 Rooms**.
- Total Number of Expected Double Rooms Sold per Year = 60 * 0.85 * 365 = **18,615 Rooms**
- Daily per Room Indirect Expenses = $ 1,042,000 / (26,280 + 18,615) = **$ 23.21**.
- Moreover, suppose that Jamel Hotel estimated the following daily per room Operating Expenses (i.e. Direct Expenses):

    - Frills Expenses (Single): $ 7.5
    - Frills Expenses (Double): $ 8.25
    - Staff Expenses (Single): $ 8
    - Staff Expenses (Double): $ 9
    - Laundry Expenses (Single): $ 6.5
    - Laundry Expenses (Double): $ 7.25

- Total Single Daily per room Direct Expense = $ 7.5 + $ 8 + $ 6.5 = **$ 22**
- Total Double Daily per Room Direct Expense = $ 8.25 + $ 9 + $ 7.25 = **$ 24.5**

- Total Daily Single Room Expense = $ 23.21 + $ 22 = **$ 45.21** (Hurdle Rate)
- Total Daily Double Room Expense = $ 23.21 + $ 24.5 = **$ 47.71** (Hurdle Rate)

Determining Rack Rate:
The answer found above is the minimum price of Single and Double rooms as to have no loss or profit from our operations! This condition is refereed to as the Break-Even price!
In order to find the rack rate (i.e. the maximum price potential guests can be charged), the hotel shall apply some of the above-mentioned methods:

a) **Multiplier Method:**

Under this very method, hotels shall try to set a Multiplier, by which the Room Cost shall be multiplied, in order to come up with the hotel Room Rack Rate (for each room type):

- ***Multiplier = 1 / (Desired Room Cost Percentage)***
- ***Desired Room Cost Percentage = (Forecasted Total Room Cost) / (Forecasted Total Room Revenue)***

- Suppose that Jamel Hotel's Management decided, prior to a certain price demand analysis, to have a Desired Room Single Cost Percentage of 75 % and a Desired Double Cost Percentage of 60 %.

- Single Multiplier = 1 / 0.75 = **1.33**
- Double Multiplier = 1 / 0.60 = **1.67**
- Single Rack Rate = $ 45.21 * 1.33 = **$ 60.28**
- Double Rack Rate = $ 47.71 * 1.67 = **$ 79.52**

b) **Mark-up Method**

Under this very method, an addition (or add-on) to the Cost of a Product will be applied to come up with the Single and Double Rack Rates.

- Suppose Jamel Hotel decided to have a 25 % Mark-up on Room Costs for both Single and Double Rooms.

- Single Rack Rate = \$ 45.21 * (1 + 0.25) = \$ 45.21 * 1.25= **\$ 56.51**
- Double Rack Rate = \$ 47.71 * 1.25 = **\$ 59.64**

- Later, the hotel might adjust this figure to a whole number and communicate it as its List Price (for guest and accounting convenience!)
- The most important handicap of the Cost Approach pricing is that it does not take into consideration how much Customers are actually willing to pay for the Hotel Services, and how other Hotels are actually charging for their Hotels.

2. **Market condition approach**:

• Under this very approach, management shall look at comparable hotels in the geographical market, see what they are charging for the same product, and "charge only what the market will accept".

• Some drawbacks of this approach are that it does not take into consideration the value of the property, and what a strong sales effort may accomplish. Last but not least, there is always subjectivity in coming up with sets of criteria against which hotel rooms can be compared and measured for similarity!

3. **Rule of thumb approach**:

• In this very approach, the rate of a room shall be **\$ 1 *for each* \$ 1,000** of construction and furnishing cost per room, assuming **a 70%** occupancy rate.

• To illustrate suppose a **150**-room hotel has costed **\$ 9,500,000** of Construction and Furnishing Costs. Therfeore, the cost per room is **\$ 63,333.33** which would mean that the price per room shall be **\$ 63.33**.

• This approach, however, fails to take into consideration the inflation term, the contribution of other facilities and services towards the hotel's desired profitablity, and assumes a ceratin level of occupancy rate.

4. **Hubbart formula approach**:

• This very approach considers operating costs, desired profits, and expected number of rooms sold (i.e. demand). The procedure of calculating a room rate is as follows:

a) Calculate the hotel's desired profit by multiplying the desired rate of return (ROI) by the owner's investment.
b) Calculate pre-tax profits by dividing the desired profit by 1 minus hotel's tax rate.
c) Calculate fixed charges and management fees. This calculation includes estimating depreciation, interest expense, preperty taxes, insurance, amortization, building mortgage, land, rent, and management fees.
d) Calculate undistributed operating expenses. This includes estimating administrative and general expenses, data processing expenses, human resourecs expenses, transportation expenses, marketing expenses, property operation and maintenance expenses, and energy costs.

e) Estimate non-room operating department income or loss, that is, F&B department income or loss, telephone department income or loss …
f) Calculate the required room department income which is the sum of pre-tax profits, fixed charges and management fees, undistributed operating expenses, and other operating department losses less other department incomes.
g) Determine the rooms department revenue which is the required room department income, plus other room department direct expenses of payroll and related expenses, plus other direct operating expenses.
h) Calculate the average room rate by dividing rooms department revenue by the expected number of rooms to be sold.

- Doubles sold daily = double occupancy rate * total number of rooms * occupancy %
- Singles sold daily = rooms sold daily – number of double rooms sold daily
- Singles sold daily * x + doubles sold daily * (x + y) = (average room rate) * (total number of rooms sold daily)
- Where: x = price of singles; y = price differential between singles and doubles; x + y = price of doubles.

II- **Discounting**:

- In all Computations done so far, the Room Price that we have found is what is called the Room Rack Rate (i.e. The Maximum Rate a Hotel can charge a Guest). Yet, most often, only Walk-ins (i.e. Guests without a Reservation) are charged a Rack Rate, which would mean that a big proportion of guests actually pay a Discount on the Rack Rate.
- Discounting is a method used by Management to make their Products and Services attractive to Customers. This very method may differ according to seasonality, type of Customer, Market Segment, and Type of Product…
- There is an important relation between Occupancy and Discount Percentage:

- **Equivalent Occupancy = (Current Occupancy) * ((Rack Rate - Marginal Cost) / (Rack Rate* (1-Discount Percentage) - Marginal Cost))**

To illustrate, suppose that an Occupied Single Room has a daily variable cost of **$ 10** and that management are right now selling at Single Rack Rate **$ 50** and managing to have Single Occupancy of **70 %**. Suppose, furthermore that management decided to discuss the effect of a 10 % discount on Single Rack Rate on the eventual demand! And hence, whether to discount or not!

Answer:

- In order not to be economically affected by the discount, the minimum Occupancy at that discounted price (i.e. at **$ 45**), shall be:
- Equivalent Occupancy = 70 % * (($ 50 - $ 10) / ($ 50 * (1 – 10 %) - $ 10)) = 70 % * (40 / 35) = **80 %**
- Management, shall at this very stage, conduct a feasibility study on the effect of that pre-determined Discount on Demand and if the effect proves to yield an occupancy which is more than **80 %**, discounting can be applied. If, not than the discounting idea shall be discarded!

III- **<u>Other Pricing Techniques</u>**:

1. **Market-skimming Pricing:**
Setting a High Price for a new Product to skim maximum Revenues layer by layer from the Segments that are willing to pay the High Price

2. **Market-penetration Pricing:**
Setting a Low Price for a New Product in order to attract a Large Number of Customers and a Large Market Share.

3. **Optional Product Pricing**:
Pricing Optional or accessory Products that are being sold along with a Main Product.

4. **Captive Product Pricing**:
Setting a Price for Products that must be used along with a Main Product (ex. Frills no more free of Charge but Charged a Price to Customers)

5. **Product Bundle Pricing**:
Combining Several Products and Offering the Bundle at a Reduced Price (i.e. Packaging & Discounting)

General Criteria for Flexible Demand Based Pricing at LACC
Yield Management

The goal is to maximize the utilization of the space asset with the highest returns/revenues at most optimum periods (high or low demand) and market conditions through solicitation and retention of clients based on demand and space inventory.

Considerations:

A. Criteria applicable to only events booked through LACC.

B. Citywide bookings, those events booked through LA Inc., the Los Angeles Convention and Visitors Bureau window of booking will not be impacted and are excluded.

C. Criteria are not to be used to displace/compete with licensed or pending citywide bookings.

D. When **fully employed** Demand Based Pricing/Yield Management/Revenue Management has the potential to result in 2% to 8% in revenue gain opportunities.

E. LACC to report 9 months after implementation with results and recommendations.

Criteria to be considered when implementing yield management (including but not limited to)

1. Target slow months (low occupancy/low demand) based on historical trends and forecast, ex. December, April, September.

2. Target slow periods in high demand months, i.e. fill in days between move-in/move outs.

3. Target new events replacing cancelled events within a 12 month period, i.e. filling space that has been vacated on short notice.

4. Target events that can occur under special circumstances, i.e. road closures for Grammy's and Emmy's, Superbowl Sunday, etc.

5. Target events that will execute multiple licenses within two years.

6. Target multiple events (non citywides) competing for the same dates and space.

7. Target new events that are determined as value added to capture market share.

8. Target new events to enhance market penetration.

9. Target events that can co-exist with special content events (Erotica LA, DUB Show, Tatoo Show) when pricing is considered.

10. Target events with strong ancillary services potential.

Hotel Marketing Coach

Neil L. Salerno, CHME, CHA

Internet Marketing Articles 2008

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What the Heck is Hotel Revenue Management, Anyway?

A Hotel Marketer's Guide to Revenue Management

By: Neil Salerno – Hotel Marketing Coach

February 2008

Revenue management has become a somewhat controversial buzzword in our industry. As with many common terms, revenue management seems to have various definitions depending upon whom one asks. Since its inception in the early 80's, thousands of hotels and just about every airline have used revenue management successfully.

As is my practice, I looked for a simple definition of revenue management; how it came about, and how it is being utilized. In straightforward terms, revenue management is a technique to optimize income revenue from a fixed, but perishable inventory. The challenge is to sell the right rooms to the right customer at the right time for the right price.

The Brief History of Revenue Management

The airline industry launched revenue management practices after government deregulation in the early 1980s. Although yield management techniques became a common practice among airlines during that time, revenue management may reasonably be assigned an inception date of January 17, 1985 when American Airlines launched its Ultimate Super Saver fares in an effort to compete with the low cost carrier PeopleExpress.

Revenue management was born out the need to fill at least a minimum number of seats without selling every seat at discount prices; the idea was to sell enough seats to cover fixed operating expenses. Once fixed expenses were covered, and there were now fewer remaining seats to sell, they could then sell the remaining seats at higher rates to maximize revenue and profits.

Revenue management uses the basic principles of supply and demand economics, in a tactical way, to generate incremental revenues. There are three essential conditions for revenue management to be applicable:

- There is a fixed amount of resources available for sale.
- The resources to sell are very perishable.
- Customers are willing to pay a different price for using the same resources.

The hotel industry fits these criteria extremely well. Obviously, hotels have a fixed inventory of rooms to sell; these rooms are also extremely perishable. You may not have thought about it, but hotel rooms perish every day; any room that is unsold tonight is gone forever. There is also no question that different segments of business are willing to pay different rates under various circumstances.

Revenue management is of especially high relevance in cases where fixed costs are high as compared to variable costs. The less variable costs there are, the more added revenue will contribute to overall profit. This makes revenue management perfect for the hotel industry.

Effective market segmentation is the key to successful revenue management for hotels. Market segmentation begins with seasonal demand. For years, hoteliers recognized that almost all hotels experience periods of high and lower demand. This is even more obvious in hotels, located in resort and attraction areas.

Hotels quickly recognized that consumers would also pay more for rooms with a superior view, such as ocean or mountain views and other unique features of their location; larger or unusual rooms; and rooms with unique features.

Hotel revenue management hit its stride when hoteliers examined airline RM and realized that the factors of supply and demand, beyond natural seasonal demand, present opportunities to generate higher revenue. As room demand increases and room supply decreases, hotel rate opportunities also increase.

The airlines have taught us that supply & demand opportunities appear all year long because of conventions, group bookings, room production through web site marketing, special events and local attractions; all create revenue management opportunities.

How Revenue Management is Applied

Most hotels start with market segmentation to begin the revenue management process; what types of business can your hotel serve and based upon market conditions, room supply vs. room demand. What rates are marketable for each segment of business?

I have seen many different market segmentation breakdowns; it largely depends on the location, type of hotel, franchise or independent, number of rooms, public space, and other factors. A sample might include corporate transient, leisure transient, Internet bookings, conference groups, association groups, etc. Each market segment has its own level of rate tolerance.

Remember to concentrate on occupancy first and average rate, second. As advance reservations increase, rates should also increase. The strange part is that many hoteliers think the opposite. How many times have you seen hotel rates suddenly decrease a week or so before the arrival dates? This is the direct opposite of good revenue management.

Too many hoteliers set rates blindly for the future and then, panic when reservations are disappointing just a week or two in advance. Most hotels should take a picture of reservations at least six months in advance; many hotels should lookout a year or more into the future. Advance reservations represent occupancy demand for each night in the future. Use special rates, packages, and group discounts to build future demand; then adjust rates upwards to match that demand.

When reviewing future reservations remember to check past history for those dates, movable holiday dates, current and past booking pace. There is little room for guesswork when planning your sales strategy. Revenue management can benefit almost every hotel. Get to know the business flow of your hotel and adjust rates and promotions based upon knowledge and not guesswork.

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Revenue Management for the Hospitality Industry

Introduction

When you stayed in that luxury hotel during your last vacation, did you check what your neighbor paid for her room? If she were a business visitor, she could have paid well above $300 for the same room that you paid $180. It is also possible that she paid $120 provided she planned well in advance and managed to get that ‼ better¶ deal which was elusive to you. So why do hotels charge different customers different rates for the same type of room?

Such differences are the result of an increasingly common strategy to maximize revenue (and profits) in the Hotel industry -- a practice referred to as Revenue or Yield Management. Revenue Management (RM) is a scientific technique that combines Operations Research, Statistics and Customer Relationship Management (CRM) and categorizes customers into price bands, based on various services. Statistical analysis of past data helps in forecasting demand and establishing the appropriate price bands. Applied correctly, Revenue Management helps hotels expand market size and increase revenues. Some industry practitioners also refer to RM as the art of selling the right room to the right customer at the right time and for the right price.

To understand the need for an RM system, let us take the following two examples. At the peak of the SARS epidemic in Canada, a resort experienced a 25% drop in number of visitors. Amazingly, this resort managed to limit decline in revenue to a bare 3%. During economic depression, a travel management company reduced its marketing budget by half, but still managed a revenue increase of 6%. How were these successes possible? The answer to both of these questions lies with the implementation of Revenue Management strategy.

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Why Revenue Management?

- **Segmented Market**: Hotels typically segment their market (customer base) into a set of categories based on the price each category is willing to pay. Typical categories include the business traveler and the vacation traveler. Because demand patterns for each of these categories may vary significantly, hotels find it difficult to satisfy all of the demand simultaneously. A good example is the comparison between the time-conscious business executive and the pricesensitive vacation customer. The former is willing to pay a higher price in exchange for flexibility of being able to book a room at the last minute while the latter is willing to give up some flexibility for the sake of a more inexpensive room. RM tries to maximize revenues by managing the tradeoff between a low occupancy and higher room rate scenario (business customers) versus a high occupancy and lower room rate (vacation customers). Such a strategy allows hotels to fill rooms that would otherwise have been empty.
- **Fixed Capacity**: A hotel! s capacity is relatively fixed - it is nearly impossible to add or remove rooms based on fluctuations in demand. If at all hotel capacity were flexible, there would be no need to manage capacity.
- **Perishable Inventory**: In the hotel industry, hotel rooms are the inventory. A hotel room that remains unoccupied for a night loses all its value for that night. This inventory cannot be stored and is lost forever. Because RM tries to manage demand instead of supply, it proves to be good business sense for the hotel.
- **Low Marginal Cost**: The fixed cost of adding a room in a hotel is heavily capital intensive. However, once the hotel manages to cover its initial fixed costs, the cost of serving an additional customer is low enough that the hotel can sell the room at a lower margin if it wishes. Such a strategy will obviously need to be balanced by one that also seeks to sell the room(s) at higher margins. Thus, the high fixed cost/low marginal cost nature of the business makes price differentiation a necessity ┬ something that is made possible by application of RM.
- **Advanced Sales**: More often than not, requests for bookings start early. Therefore, hotels have enough leeway to adjust room prices based on the variation between realized bookings and expected demand. If all hotel rooms are sold at the same time, the hotel does not have the flexibility to adjust prices upward if demand picks up later. The tradeoff occurs when a manager is faced with the option of accepting an early reservation from a customer who wants a low price, or waiting to see if a higher paying customer will eventually show up. ..
- **Demand Fluctuations**: Demand for hotel rooms is characterized by crests and troughs, which the hotel factors in during the room pricing process. In peak season, the hotel can increase its revenues by raising room prices, while during lean seasons it can increase its utilization rate by lowering prices. Past data will offer the manager a way to forecast when these periods of high and low demand may occur. Unfortunately, it is very difficult to predict the actual demand with a high degree of certainty.

Therefore, the most critical challenge facing the hotel industry is predicting potential capacity, and developing a pricing strategy that will encourage maximum capacity and revenue. Revenue Management is the most effective technique to solve this challenge, similar to aggregate and hierarchical production planning techniques often employed in the manufacturing industry.

Revenue Management is based on complex optimization methodologies developed from advanced statistical and analytical models. In order to arrive at a solution, managers need to evaluate several millions of decisions, which requires a significant investment of skills, hardware and time. Many RM practitioners prefer to breakdown the actual business scenario into four sub-problems, and then identify an individual solution to some or all of these sub-problems. This would significantly reduce the number of potential non-optimal decisions thereby providing fewer choices, leading to quicker results. These four sub-problems are: a) Market segment identification, b) Forecasting and Pricing, c) Inventory allocation, and d) Overbooking.

How does it all work?

Market Segment Identification: The first and foremost step in a hotel RM system is the identification of the various market segments for the hotel room, followed by implementation of a differential pricing scheme. The objective in front of the hotel is the expansion of its market and in motivating the customer to pay more than he/she will usually spend. It is further observed that customers in the business class segment are less sensitive to higher prices as opposed to those in the vacation segment. An RM system helps hotels create additional price-points by building physical and logical fences around the different market segments, as shown in the table below.

CHARACTERISTICS	HIGHER PRICE	LOWER PRICE
Physical Fences		
View	Pool view, ocean view, hill view	Non-scenic view
Size	Bigger room with more facilities and gadgets	Smaller rooms with fewer facilities
Temporal	Weekday bookings	Weekend bookings
Logical Fences		
Length of Stay	Short stay. Often one or two days	Longer stay. One night revenue can spoil three nights revenue when demand is high
Flexibility	Cancellations and rescheduling are allowed at a low penalty	High penalty for cancellation and schedule changes
Time of Purchase	Bookings are made very close to date of check-in	Bookings are made quite early
Privileges	Are rewarded loyalty privileges either as free services or free stay vouchers	No privileges
Size of Business Provided	Corporate business customers booking frequently	Self funding vacationers booking rarely
Point of Sale	Physical delivery and confirmations	By email or phone

Demand Forecasting: The next step in an RM process is forecasting demand and pricing of the different market segments. Pricing and demand are inter-related and need to be coordinated. In the hotel industry, demand for a room is cyclic in nature (day of a week, months of a year) and follows a trend (demand growth due to economic growth). These forecasts are seldom precise but provide the decision-maker with an approximate set of inputs that are used in the planning process. RM models help pinpoint demand by minimizing uncertainty and producing the best possible forecast.

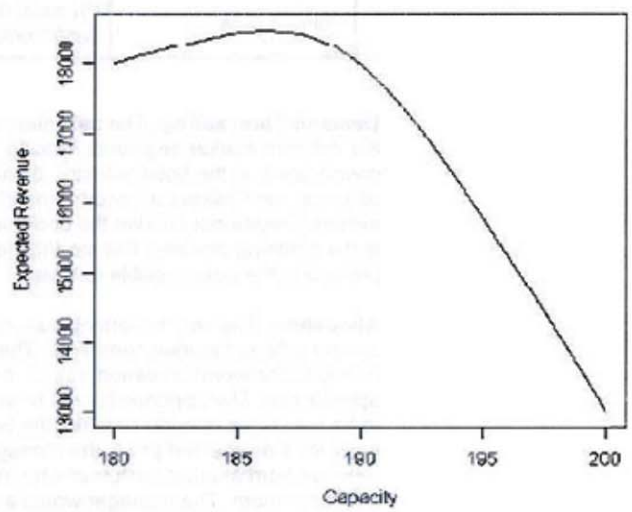
Allocation: The next important step in a RM process is the allocation of inventory (hotel rooms) among different market segments. The ratio of discounted versus full priced rooms is not fixed during the reservation period; rather, it is ‼ tweaked¶ appropriately as the date of stay approaches. The opportunity cost of selling a discounted room instead of a full priced one has to be measured in order to make the best decision. Thus, when a customer approaches the hotel for a discounted price, the manager needs to evaluate this scenario with the expected revenue from another customer who might come at a later date, willing to pay a higher price for the same room. The manager would accept the request only if the discounted price now is more than the expected price at which the room might be booked by the second customer. The key word here is ‼ expected¶. RM systems use complicated mathematical algorithms to arrive at this decision using techniques such as Littlewoods and Expectation Maximization, referred to as the EM algorithm.

To explain these techniques, let us consider a simple two class scenario. A hotel has two price categories of rooms, say $60 and $100. Since the pricing is different for the two rooms, these rooms are each targeted at a different customer set. Based on the historical preference pattern of customers in each segment, it would be possible to estimate the number of customers who would be willing to buy these rooms at the given price, with a reasonable ‼ variance¶. The term variance refers to a tolerance level. For example, an average 50 customers may be willing to pay $100 for some rooms, but it could also mean that the actual number of customers who turn up for the $100 room could be 60 (or even 40) with some probability, or 80 (or 30) with a lesser probability. In statistical terms, this sort of pattern for the different customer segments is said to mimic a normal distribution.

Using the past data and applying statistical know-how, we can actually estimate an ‼ expectation¶ of revenue by quantifying the probability of a specific demand value and the actual revenue. In the same example, let us assume that this hotel has 100 rooms, which are similar, but priced at the time of booking. If the booking is done fairly closely to the actual date of stay, the customers may need to pay $100, whereas, they might have paid only $60 had they booked in advance. Remember that, on an average, 50 persons are willing to pay $100 for this room. Obviously, many more than 50 (say, 120) are willing to $60 for the same room. We can use the Littlewoods rule to actually estimate the number of rooms that must be protected for those customers who are willing to pay $100. If we protect too many rooms, some rooms may go vacant thereby resulting in a loss of potential revenue of at least $60 per room. On the other hand if we protect too few rooms for $100 customers, we lose the opportunity of $40 per room on that number of rooms. The Littlewoods rule guides us to arrive at an optimal number of rooms that would maximize the expectation of revenues.

Overbooking: Overbooking is the practice of intentionally selling more rooms than are available in order to offset the effect of cancellations and no-shows. Studies estimate that although a hotel is fully booked, about 5-8% of the rooms are vacant on any given date. Poor overbooking decisions can prove to be very expensive for the hotel. In the short run, it is only a loss of room revenue, but over the long-term, casualties may include decreased customer loyalty, loss of hotel reputation, etc. American Airlines developed an optimization model that maximizes net revenues associated with overbooking decisions for the airline industry.

To illustrate the overbooking model developed by the American Airlines, let us consider a B757 jet flying from Chicago to Boston. The aircraft has about 180 seats. Based on the past travel pattern, it is observed that an average of 5% (or nine passengers) do not turn up at the time of boarding the flight. If the airlines book all seats for this leg, it is likely to fly with only 171 occupied seats. However it does not mean that it never flies with 172 or more (even 180) seats occupied. There is a lesser chance of the flight flying with 172 passengers, an even lesser chance of it flying with 175 and a miniscule chance of it flying with all 180 passengers. Therefore, if we book 181 passengers instead of 180, we are likely to end up with only 173 passengers (and almost always with lesser than 180 passengers). In an odd event of exactly 181 passengers reporting, the airline would need to bump one passenger. IATA has defined rules to compensate bumped passengers. If we can quantify all costs (including the cost of lost goodwill), the expected revenue would be the revenue from 181 passengers minus the expected cost of compensating the one additional passenger at that odd chance. Since the probability of exactly 181 passengers turning up is so low, the revenue from that additional passenger generally compensates more than the expected cost. For this example, the optimal number of passengers that can be booked would be 186 as illustrated in the figure below.



This model can be directly applied to the hotel industry as well. The driving force behind the model is the evaluation of the tradeoff between additional revenue accrued by selling an already-reserved room versus the downside from doing so. It has been found that net revenue increases with overbooking until the point where the downside from overbooking a room exceeds customer revenues. Beyond that point, the negative impact of overbooking increases rapidly because fewer and fewer customers appreciate being turned away.

Challenges

It is quite clear that while an RM system can guarantee increased revenues, it can be quite complicated to design and requires high levels of expertise for implementation. Some of the challenges facing hotels in the implementation of a robust and accurate RM system include:

- Measuring performance of an RM system is a major issue. Occupancy rates and yield are measures that are affected by external competition. An ideal measurement can be done using an opportunity model that indicates where the hotel stands in comparison to its maximum and
- Differential pricing is here to stay ┬ customers seem resigned to the fact that hotels charge different prices for the same room. However, some customers do not like this practice and penalize the hotel by not becoming a patron. Therefore, in a fiercely competitive environment where quality of service is the key to success, RM may not work. In evaluating the efficiency of a RM system, the tradeoff between generating short-term profits and creating long-term customer loyalty and ‼ mindshare¶ needs to be studied carefully.
- From an operational point of view, RM can impact the motivational level of the employees. In many cases, RM takes much of the guess work out of employees, thereby reducing their decision-making responsibilities. Sometimes, employees taking reservations are paid a percentage of the sales they make, motivating them to make group bookings, which in turn may be contradictory with the objectives of an RM system.

Conclusion

As part of ongoing changes in the industry, companies throughout the entire hospitality spectrum are placing a strong emphasis on implementing major operational changes. Beyond recognizing that meaningful cost reductions must be achieved without compromising safety, capacity and service levels, they are also looking at reducing costs by increasing flexibility and improving asset utilization through an RM strategy. In doing so, they continue to reassess their true core competencies, and are looking to outsource many of these processes, as they look to optimize business efficiencies and increase profitability

About the Author
Dr. Prem Kumar is a General Manager and Profit Center Head within the Research & Analytics business unit at KARVY Global Services. His expertise includes Supply Chain Optimization, Revenue Management and application of sophisticated Operations Research techniques in the Hospitality, Retail, Airline and Logistics industries.

KARVY Global Services' KPO Offerings for the Hospitality Industry

KARVY Global Services is pioneering the next-generation of outsourcing services for the global market with a unique combination of domain expertise, technology advantage and offshore capabilities. The company provides value-added outsourced services in the design, implementation and maintenance of Revenue Management systems to clients across a wide spectrum of industries, most notably Hospitality and Airlines. The KPO team has experience in solving large-scale optimization problems in these markets with hands-on experience in the design and implementation of Revenue Management solutions, for both large and small companies. KARVY Global Services↕ process-driven approach, governed by best practices such as Six-Sigma, delivers a high-quality service with a cost savings averaging 40%.

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Headquartered in Hyderabad, India, with three global delivery centers in Hyderabad, KARVY Global Services also has business development offices in New York, Los Angeles, San Francisco, Toronto, London, and Zurich. Additional information on KARVY Global Services is available at www.KARVYGlobal.com.

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Issue No: 05/07/01

Revenue Management

On a flight to Goa, two passengers were discussing about the price they paid for the flight and hotel. They were amazed at the price difference as one of them was charged 6800 INR for a round trip airfare and 30000 INR for a hotel and the other 4600 INR for the airfare and just 18000 INR for the same hotel. The first passenger had booked his flight and hotel only one day in advance while the other a month in advance. *How can the same airline or hotel manage profit by charging so discriminately?* The answer to this amusing question is *"Revenue Management"*.

Revenue Management, also known as yield management, is a process for capacity-constrained industries to maximize profitability by allocating the right inventory to the right customers at the right price. RM concepts are pertinent to virtually everything that is sellable in advance, transient, capacity constrained, allows discrimination among market segments, has inconsistent demand patterns and low marginal servicing cost.

Airline Industries, Hotels, Television Broadcasters, Theaters, Car Rental Agencies, Hospitals, Telecommunications are only some of the industries where RM techniques have been successfully utilized. Revenue gains of 2-8% due to RM are frequently reported; most of this goes to the bottom line leading to profit increase of 50-100%.

Know Your Customers

RM works on the fundamental concepts of market segmentation and price discrimination. Purchase regulations and refund requirements help to segment the market. For example, higher fares may be fully or partially refundable and purchasable at all times whereas lower fares are non-refundable and must be purchased a number of days in advance. Price-sensitive customers are willing to put up with the lower flexibility & have lesser assessment for service while those who have higher assessment for the service are willing to pay more. In airlines and hotels, business travelers constitute price-insensitive market segment and leisure travelers form the price-sensitive market segment.

Price discrimination helps industries to achieve objective of increasing revenues in two ways. By charging premium prices to the less price sensitive market segments, the industry can extract greater revenue; at the same time charging discounted prices to a price sensitive market segment results in increased consumption of the service that offsets the price reduction.

Occasionally, a time element is added to the pricing of a service. Demand is managed by elevating prices during intensive demand and offering discounts during moderate demand. Types of discount

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http://bear.cba.ufl.edu/shugan/profile/SSPYM.pdf

http://pubsonline.informs.org/feature/Edelman/1526-551X-2002-32-01-0047R.pdf

About DecisionCraft Analytics

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We analyze business processes and transactional data to identify underlying patterns, unravel hidden relationships and recommend areas for improvement that can improve ROI and reduce costs.

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We use historical data intelligently to develop a view of future market trends and help our clients focus on the right audiences thereby developing their competitive edge.

vary among industries. In airlines and hotels, discounts are offered for early bookings, including typically group bookings, as well as travel during off-peak days and hours. In telecommunication industries, rates are reduced for long distance calls on nights and weekends.

Demand Forecasting

After segmenting the market and defining the price structure for each segment, other essentials of RM come in to play. Demand forecasting is first of these essentials. Demand is forecasted with the help of historical data of demand patterns for the particular service. Usually, demand exhibits definite patterns such as trends and cycles. For example demand may vary by time of day, day of week or season of year. These demand patterns can be used to predict the potential future demand in each market segment.

In airline, car rental and hotel industry, little information is available for millions of customers. Hence they use statistical techniques for demand forecasting. Media broadcasters on the other hand have detailed knowledge of their customers since they usually number in the hundreds. Therefore, they estimate the demand for commercial spots during various shows by monitoring historical buying patterns of customers.

Inventory Allocation

The next step is to allocate inventory amongst the market segments. As stated earlier, industries such as airlines, hotels, car rental companies and broadcasters sell their inventory at premium and concession prices. Typically price-sensitive customers book early while the demand for premium inventory arrives late. Therefore industries, which practice RM, need to set a booking limit to restrict maximum amount of inventory to be sold at concession price. If this limit is set too high, the industry may suffer an opportunity loss by being forced to turn away some of their premium customers; if it is too low, some inventory may remain unsold.

Fig.1 CONCEPTS OF RM

One way of defining the booking limit is based on the expected marginal revenue generated from selling an additional unit of inventory. Industries define floor price, which is the lowest adequate price for next additional unit to be sold. This floor price is derived by using value of the expected marginal revenue of the last unit of inventory. The sale is acceptable as long as requested price is above expected marginal revenue floor price.

Overbooking

Another important element of the revenue management is the use of overbooking when there is a chance that a customer may not

Forecasting

We use advanced time-series and regression techniques for forecasting behavior of critical business variables that allows our clients to plan for their resources intelligently.

appear. Capacity-constrained industries overbook to redeem for customer cancellations and no-shows. For this reason, it is obligatory to forecast cancellations and no-shows . Insufficient overbooking results in unsold inventory; on the other hand excessive overbooking results in penalty cost which includes both the financial remuneration given to bumped customers and the prospective loss of future revenue due to customer dissatisfaction. The optimal level of overbooking is where the anticipated cost of overbooking for the next unit to be sold is equal to the expected marginal revenue from that unit.

Conclusion

Revenue management is a process that can significantly increase revenues of capacity-constrained firms through better inventory management and pricing. By using RM concepts, these firms can protect premium inventory for sale at higher prices, stimulate market growth by offering discounts and minimize wastage of perishable inventory.

Next Issue: Warehouse Activity Profiling & Order Picking Productivity
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Los Angeles Convention Center

INTERDEPARTMENTAL CORRESPONDENCE

DATE: August 21, 2009

TO: John Wickham, Legislative Analyst
Office of the Chief Legislative Analyst

Terry Martin Brown, Assistant City Attorney
Office of the City Attorney

FROM: Mary Jane Aquino
Interim Assistant General Manager & CFO
Los Angeles Convention Center

SUBJECT: **FLEXIBLE DEMAND BASED SPACE RENTAL PRICING (FDBSRP)**

Pursuant to our meeting on August 13, 2009, the Los Angeles Convention Center (LACC) hereby submits the procedure to be followed for the approval of the use of the Flexible Demand Based Space Rental Pricing (FDBSRP) at the LACC.

The primary impact of the Flexible Demand-Based Space Rental Pricing is to maximize revenue by providing the LACC with an additional set of tools to fill the space. The events that will be suitable for the application of the FDBSRP at the LACC are local and regional events, such as trade and consumer shows as well as meeting room bookings. The following considerations will be adhered to:

a. Criteria applicable only to LACC-booked events
b. Citywide bookings, handled by the Los Angeles Convention and Visitors' Bureau (LACVB or LA Inc) will be excluded
c. Criteria will not displace or compete with licensed or pending citywide bookings

When an event is determined to be eligible, the Sales and Marketing Representative (Sales Representative) will fill out the FLEXIBLE DEMAND BASED SPACE RENTAL PRICING (FDBSRP) APPROVAL form (FORM).

The Sales Representative will fill out the information for the Organization and the Event and will describe the situation that gives rise to the application of the FDBSRP. Documents in support of the criterion / criteria should be attached to the FORM. FDBSRP rates may be applied for the show under consideration based on the following criterion / criteria, among others:

■if Show Management cancels, moves, or changes space or period needs of a licensed event and the vacated space remains unsold within a twelve (12) month period.

■any time any of the halls are not licensed within a twenty four (24) month period.

■when the anticipated ancillary revenue from the prospective show exceeds discounted space rental by fifty percent (50%).

The FORM will also require filling out the "Current" space rental and the "Proposed FDBSRP" space rental as well as the "Projected Revenue" anticipated from the event. The FORM and the supporting documents will constitute a "package".

The Sales Representative will sign and then present the "package" to the Sales and Marketing Director (Sales Director) to discuss all aspects of the prospective event. The Sales Director will approve the proposed FDBSRP if the event qualifies.

The Sales Director will present to and discuss the "package" with the General Manager & CEO, who has final approval. . It is recommended that when a new license with FDBSRP is ready for approval, a one (1) day turn-around time is requested to enable the LACC to execute the license with the client, due to the nature of the business capture. The "package" will be forwarded to the Interim Assistant General Manager& CFO for review as to completeness of the requirements

To ensure that the licensee is aware of the limited application or of the unique circumstances of the demand-based pricing, it is recommended that the proposed license agreement would incorporate the following or similar language, as deemed appropriate by the City Attorney:

"The tenant fully understands and accepts that the pricing reflected in this license is applicable only to this license for the specific event within the space and dates selected by the tenant. The execution of this license does not in any way prohibit the City and the Los Angeles Convention Center from maximizing the utilization and/or revenue generation capacity of any other space at the Los Angeles Convention Center, i.e. taking advantage of yield management practices."

Additionally, the LACC will report, on agreed-upon frequency, on the results of the pilot program.

Your support of the business of the Convention Center and the tools necessary to ensure that we are able to compete at the highest levels is both acknowledged and very much appreciated. If you have any comments or questions, please contact me at (213) 741-1151 ext 5384.

cc: Diana Mangiuglo, Office of the City Administrative Officer
Barbara Kirklighter, LA Inc.
Pouria Abbassi, LACC
Phillip C. Hill, LACC
Patricia Gunness, LACC

LOS ANGELES CONVENTION CENTER

FLEXIBLE DEMAND BASED SPACE RENTAL PRICING (FDBSRP) APPROVAL FORM

LACC Sales Representative ______________________ **Date** ____________

NAME OF ORGANIZATION ______________________

CONTACT & TITLE ______________________

ADDRESS & PHONE NUMBER ______________________

EVENT NAME ______________________

OVER-ALL DATES ______________________

ATTENDANCE / OTHER INFO ______________________

REQUIRED EXHIBIT SPACE - GROSS SQ FT ____________ **NET SQ FT** ____________

EXHIBIT SPACE - # OF SHOW DAYS ____________ **ADD'L MOVE IN/OUT DAYS** ____________

GENERAL SESSION - # OF SESSION DAYS ____________ **ADD'L MOVE IN/OUT DAYS** ____________

MEETING ROOMS - # OF USAGE DAYS ____________ **ADD'L MOVE IN/OUT DAYS** ____________

	1	2	3	4	5	6	7	8	9
	Book space after previously executed license event cancels within 12 months	Exhibit Hall has not been licensed within 24 months	Book space during Low Demand Period	Book space during "Special Content" Events	Level and Degree of Competition with other Comparable Facilities	Anticipated Ancillary fees for Utility Services Exceed Discounted Space Rental by 50%	Client will execute multiple licenses within 2 years	New Events to enhance market share	Other
Criteria Applicable									
Document(s) Attached									

1. **Letter from Show Management cancelling the event**
2. **Space Booking Information from EBMS showing unbooked spaces**
3. **Space Booking Information from EBMS showing unbooked spaces**
4. **Client commits to license event to co-exist with "special content" events**
5. **History of Events Locations**
6. **Client provides estimate of ancillary fees & commits to revenue estimates**
   Note: Client is responsible to make LACC whole should revenue not meet estimates
7. **Client commits to multiple events**
8. **Client commits to new event in segments that LACC is "under-represented"**
9. **Other - Please descibe** ______________________

LOS ANGELES CONVENTION CENTER

FLEXIBLE DEMAND BASED SPACE RENTAL PRICING (FDBSRP) APPROVAL FORM

LACC Sales Representative ______________________ **Date** ______________

NAME OF ORGANIZATION ______________________

CONTACT & TITLE ______________________

ADDRESS & PHONE NUMBER ______________________

EVENT NAME ______________________

OVER-ALL DATES ______________________

SPACE RENTAL:	**LACC RENTAL RATES (CURRENT)**	**LACC FDBSRP RATES (PROPOSED)**
WEST HALL	$	$
ADD'L MOVE IN/OUT DAYS	$	$
SOUTH HALL	$	$
ADD'L MOVE IN/OUT DAYS	$	$
KENTIA HALL	$	$
ADD'L MOVE IN/OUT DAYS	$	$
CONCOURSE HALL	$	$
ADD'L MOVE IN/OUT DAYS	$	$
PETREE HALL	$	$
ADD'L MOVE IN/OUT DAYS	$	$
MEETING ROOMS	$	$
ADD'L MOVE IN/OUT DAYS	$	$
TOTAL	$ 0	$ 0

PROJECTED REVENUE:

RENTAL REVENUE	$ 0	**ANCILLARY REVENUES**	$ 0
PARKING	$ 0	**PARKING OCCUP.TAX**	$ 0
TOTAL VALUE	$ 0		

Submitted By:

SALES & MARKETING REPRESENTATIVE ______________________ **DATE** ______________

Approved By:

SALES & MARKETING DIRECTOR ______________________ **DATE** ______________

Approved By:

GENERAL MANAGER & CEO ______________________ **DATE** ______________

Documents Reviewed By:

INTERIM ASSISTANT GEN MANAGER & CFO ______________________ **DATE** ______________

Los Angeles Convention Center

INTERDEPARTMENTAL CORRESPONDENCE

DATE: May 28, 2009

TO: John Wickham, Legislative Analyst
Office of the Chief Legislative Analyst

Terry Martin Brown, Assistant City Attorney
Office of the City Attorney

FROM: Mary Jane Aquino
Interim Assistant General Manager & CFO
Los Angeles Convention Center

SUBJECT: **FLEXIBLE DEMAND BASED SPACE RENTAL PRICING (FDBSRP) – ADDITIONAL INFORMATION**

Pursuant to discussions on May 18, 2009 with Terry Martin Brown the following additional details one provided to augment Los Angeles Convention Center (LACC) submittal of May 13, 2009. The additional information is organized under the conditions when the Flexible Demand Based Space Rental Pricing (FDBSRP) would likely be employed.

<u>BOOK SPACE AFTER PREVIOUSLY EXECUTED EVENT LICENSE CANCELLATION</u>

Criteria: Show Management cancels, moves or changes space/period needs of licensed event within 12 months of the event.

<u>Additional Information:</u>

When a citywide event cancels within two (2) years or more of the event, LA INC., the Convention and Visitors Bureau (LACVB) and the LACC will attempt to find a replacement event. Likewise, if a local or regional event booked by the LACC Sales Team cancels, the LACC Sales Team will endeavor to find an alternate event. However, if the space remains unsold within a twelve (12) month period, the LACC may utilize the Flexible Demand-Based Space Rental Pricing to fill the space.

The date of cancellation of hall events drives LACC's ability to resale space. If an event cancels within 12 months, the resale potential revolves around one- or two-day events. Examples are faith based events, motivational seminars, auctions, and sports related events such as tournaments or custom car shows. On rare occasions, there could be a likelihood to capture an event that is pulling out of other cities because they were bumped, or negotiations are stalled, or due to force majeure events such as typhoons like Katrina or pandemic such as SARS.

Typically, the "sales window" for placing business in large exhibits halls is 13 - 18 months for annual events and 18 - 24 months for new business. These periods stem directly from the minimum number of months needed to produce a trade show, a convention or a large event.

Association conventions typically book three to five years ahead, although events that need an entire building and the full city inventory of hotel rooms may book seven to ten years ahead. Associations may also be required to rotate from the east coast to central to the west coast to bring the show closer to the home city of members.

For new trade or consumer shows, producers are starting from zero to sell booth space and to convince each exhibiting company that the new event will be worth their marketing dollars. As exhibitors incur considerable costs, staff and resources, new shows must prove that they can deliver targeted buyers and show attendance. The time line to build a new exhibition is 18 to 24 months.

Additionally, annual events have developed their shows and will sell dates at the current years show for the following year. They chose dates 13 to 18 months ahead and prepare collateral material, banners and floor plans for on-site sales and promotion.

Following are examples of projected space rental revenue lost from cancelled events:

CA World 2010, scheduled on April 9 to 15, 2010, was cancelled on February 23, 2009. The organization, CA Inc. (Computer Associates), offers enterprise information technology management solutions and products. The event had booked West Hall, South Hall, as well as Petree Hall, Concourse, Kentia Hall, the Theater and the 300, 400 and 500 series meeting rooms. The projected rental revenue lost from the cancellation is approximately $687,000. This event had projected $350,000 in ancillary services.

CA World 2011, scheduled on November 1 through 10, 2011, was also cancelled by the same organization, CA Inc. on February 23, 2009. The event had booked West Hall South Hall, as well as Petree Hall, Concourse, Kentia Hall, the Theater and the 300, 400 and 500 series meeting rooms. The projected rental revenue lost from the cancellation is approximately $677,000. This event had projected $340,000 in ancillary services.

On February 10, 2009, World Financial Group, a finance services and products marketing company, cancelled the "2010 Annual Convention of Champions" event scheduled on February 23, 2010. The event had booked West Hall, South Hall as well as Petree Hall, Concourse, Kentia Hall, the Theater and the 300, and 400 series meeting rooms. The projected rental revenue lost from the cancellation is approximately $181,000. This event had projected $90,000 in ancillary services.

On the same day, World Financial Group also cancelled the "2011 Annual Convention of Champions" event, tentatively scheduled on February 17, 2011. The event had booked West Hall, South Hall as well as Petree Hall, Concourse, Kentia Hall, the Theater and the 300, and 400 series meeting rooms. The projected rental revenue lost from the cancellation is approximately $181,000. This event had projected $90,000 in ancillary service.

SAP (Systems Applications and Products), a business software solutions company offering applications, services and support, cancelled "America's SAP Users Group Annual Conference", tentatively scheduled on April 24 through 28, 2010 on April 5, 2007. The event had booked West Hall, South Hall, as well as Petree Hall, Concourse, Kentia Hall, the Theater and the 300, and 400 series meeting rooms. The projected rental revenue lost from the cancellation is approximately $300,000. This event had projected $150,000 in ancillary services.

BOOK SPACE DURING LOW DEMAND PERIOD

Additional Information:

Instead of the prior criteria of employing the FDBSRP whenever occupancy falls below 65% for the month, the LACC would like to change the criteria, as follows:

Criteria: Any time a hall in either West Hall or South Hall is not licensed within 12 months.

For every day that the LACC is unable to resell the West Hall or the South Hall, the following amount of revenue is lost:

West Hall A	$16,000 representing 15% of the total physical availability of LACC
West Hall B	8,000 representing 8% of the total physical availability of LACC
West Hall A & B	24,000 representing 23% of the total physical availability of LACC
South Hall G	$11,200 representing 11% of the total physical availability of LACC
South Hall H	8,960 representing 9% of the total physical availability of LACC
South Hall J	8,960 representing 9% of the total physical availability of LACC
South Hall K	11,200 representing 11% of the total physical availability of LACC
South Hall G & H	20,160 representing 19% of the total physical availability of LACC
South Hall J & K	20,160 representing 19% of the total physical availability of LACC
South Hall H & J	17,920 representing 28% of the total physical availability of LACC
South Hall G,H,J &K	40,000 representing 38% of the total physical availability of LACC

To assure that the major outlay that the City of Los Angeles has made in the convention center facility is being returned, the LACC has to be in a better position to invest in the infrastructure to continue the economic and jobs impacts it generates. Earning additional revenue to the maximum extent possible through the utilization of the FDBSRP will make this investment in the facility possible.

CORRECTION:

Please note the corrected year of the examples in FY 2009-2010 that show little or no business activity in the West Hall and the South Hall as follows:

Period:	**Spaces with Little or No Activity**
July 23-Sept 7, 2009	All spaces
Sept. 14 – 30, 2009	South Hall
Oct. 16 – Nov. 14, 2009	South Hall
Oct. 26 – Nov. 6, 2009	West Hall
Dec. 17 – Jan. 10, 2010	All spaces
Jan. 25 – Feb. 10, 2010	West and South Halls
Feb. 17 – Mar. 4, 2010	West Hall
Mar. 13 – Apr. 12, 2010	West Hall
Mar. 28 – May 3, 2010	South Hall
Apr. 18 – May 3, 2010	West Hall

These periods occurring in short term in the next fiscal year will be candidates for the application of the FDBSRP.

ADJUSTMENTS ON A CASE-BY-CASE BASIS DUE TO MARKET CONDITIONS

Criteria: Ancillary revenue exceeds discounted space rental by 50%.

Please refer to schedule of anticipated ancillary revenue.

Please note that Parking Revenue is ancillary revenue that brings in at least $500,000 of Parking Occupancy Tax (POT) per year to the General Fund. For every additional $500,000 in Parking Revenue, the City General Fund will receive $45,455 in POT. The LACC transfers the POT to the City on a DAILY basis.

Criteria: Client will execute multiple licenses within 2 years.

Additional Information:

To clarify the above criteria, the LACC would like to include in the criteria the following:

Criteria: Client will execute more than one event in a two-year period. Or, Client will execute multiple events licensed and schedule within two (2) years.

VERIFICATION AND APPROVAL

It is recommended that when a new license with FDBSRP is ready for approval, the form (please refer to attached sample) and documents will be forwarded to the Office of the Mayor for approval. Due to the nature of the business capture, a three (3) day turn-around time is requested, after which the LACC would be able to execute the license with the client. Additionally, the LACC will report, on agreed-upon frequency, on the results of the pilot program.

Additional Information:

If it is determined that another Office, other than the Office of the Mayor, will verify and approve the new license with FDBSRP, the LACC recommends the Office of the City Administrative Officer, subject to the terms identified above, as they are already familiar with a similar process.

Your support of the business of the Convention Center and the tools necessary to ensure that we are able to compete at the highest levels is both acknowledged and very much appreciated. If you have any comments or questions, please contact me at (213) 741-1151, Ext. 5384.

MJA:rg

cc: Diana Mangioglu, CAO
Barbara Kirklighter, LA INC.
Pouria Abbassi, LACC
Phillip C. Hill, LACC
Agnes H. Ko, LACC

Los Angeles Convention Center

INTERDEPARTMENTAL CORRESPONDENCE

DATE: May 13, 2009

TO: John Wickham, Legislative Analyst
Office of the Chief Legislative Analyst

Terry Martin Brown, Assistant City Attorney
Office of the City Attorney

FROM: Mary Jane Aquino
Interim Assistant General Manager & CFO
Los Angeles Convention Center

SUBJECT: **FLEXIBLE DEMAND BASED SPACE RENTAL PRICING (FDBSRP)**

Pursuant to various meetings, discussions, inquiries and previously submitted correspondence and in accordance with the 2009-10 FY Budget deliberations regarding Flexible Demand-Based Space Rental Pricing (FDBSRP), also referenced as Yield Management, Revenue Management, or Dynamic Pricing in many industries, the Los Angeles Convention Center (LACC) hereby submits additional details as referenced in the CAO Budget Memo of May 5, 2009. To further clarify, the purpose of the FDBSRP is to maximize the space utilization at the LACC and generate returns in support of maintenance, upkeep and operations of this public facility in serving its envisioned purpose. Additionally, the attraction and hosting of events at LACC generates significant economic impact, including support of related industry jobs. Increases in number of events hosted tend to also increase the public benefits component of the business of LACC. In contrast during instances when LACC space assets are available and not utilized, the public vested interest in LACC is not adequately addressed.

As such, the primary purpose of the data provided is to illustrate the situations that would trigger the use of the FDBSRP based on historical events, examples and trends that are anticipated to occur on an ongoing basis. The criteria are classified under the main alternatives that were identified by your respective Offices:

I. REDUCED RATES FOR IDENTIFIED PERIODS OF TIME

A. BOOK SPACE AFTER PREVIOUSLY EXECUTED EVENT LICENSE CANCELLATION

Criteria: Show Management cancels, moves or changes space/period needs of licensed event within 12 months of the event.

Supporting documentation: Letter from Show Management canceling the event.

When a citywide event cancels within two (2) years of the event, the LACVB and the LACC will collaborate to find a replacement event. However, if these efforts do not come to fruition, opportunities for the use of FDBSP can be pursued. Likewise, if a local or regional event booked by the LACC Sales Team cancels, and space remains unsold within a twelve (12) month period, the LACC may utilize the Flexible Demand-Based Space Rental Pricing to fill the space.

B. BOOK SPACE DURING LOW DEMAND PERIOD

Criteria: Occupancy below 65% for the month

Supporting documentation: Occupancy information from EBMS based on historical trends as well as forecast.

Criteria: Occupancy dates considered "undesirable" between shows, and slow periods in high demand months

Supporting documentation: Space booking information from EBMS, such as fill in days between move-in and move-outs, or road closures for Grammy's, Emmy's, Holidays, etc.

Examples:

In January 2009, the LACC experienced 56% occupancy because the Gift Show has reduced its space occupancy.

In July 2007, the LACC experienced 58% occupancy due to the July 4th Holiday and the Gift Show with its reduced space requirements.

In December 2007, the LACC experienced 31% occupancy due to the Holidays.

In April 2008, the LACC experienced 52% occupancy because Westec has reduced its space occupancy.

Other examples in FY 2009-2010 that show little or no business activity in the West Hall and the South Hall are as follows:

Period:	**Spaces with Little or No Activity**
July 23-Sept 7, 2009	All spaces
Sept. 14 – 30, 2009	South Hall
Oct. 16 – Nov. 14, 2009	South Hall
Oct. 26 – Nov. 6, 2009	West Hall
Dec. 17 – Jan. 10, ~~2009~~ 2010	All spaces
Jan. 25 – Feb. 10, ~~2009~~ 2010	West and South Halls
Feb. 17 – Mar. 4, ~~2009~~ 2010	West Hall

(1) Level and degree of competition with other comparable facilities
(2) Anticipated hotel occupancy tax revenues to the City
(3) Estimated food and beverage expenditure by the licensee and/or attendees at the facility
(4) Anticipated fees for telecommunications, utilities, audio-visual services, exhibitor booth cleaning, parking and other, related revenue to the department and
(5) Economic benefit to the community.

The following considerations will be adhered to:

a. Criteria applicable only to LACC-booked events
b. Citywide bookings, handled by the LACVB will be excluded
c. Criteria will not displace or compete with licensed or pending citywide bookings

Additional Information:

A Convention Sports & Leisure (CSL) Organizational Structure and Research study dated June 5, 2008 identified other **City-owned convention centers** that offered pricing concessions and flexibility to discount rent to maximize revenue and economic benefit. Among them are convention centers in **Anaheim, Phoenix, San Antonio and Nashville.**

V. VERIFICATION AND APPROVAL

It is recommended that when a new license with FDBSRP is ready for approval, the form (please refer to attached sample) and documents will be forwarded to the Office of the Mayor for approval. Due to the nature of the business capture, a three (3) day turn-around time is requested, after which the LACC would be able to execute the license with the client. Additionally, the LACC will report, on agreed-upon frequency, on the results of the FDBSRP program.

VI. ADDITIONAL CONTRACTUAL LANGUAGE

To ensure that the licensee is aware of the limited application or of the unique circumstances of the demand-based pricing, it is recommended that the proposed license agreement would incorporate the following or similar language, as deemed appropriate by the City Attorney:

"The tenant fully understands and accepts that the pricing reflected in this license is applicable only to this license for the specific event within the space and dates selected by the tenant. The execution of this license does not in any way prohibit the City and the Los Angeles Convention Center from maximizing the utilization and/or revenue generation capacity of any other space at the Los Angeles Convention Center, i.e. taking advantage of yield management practices."

The primary impact of the Flexible Demand-Based Space Rental Pricing is to maximize revenue by providing the LACC with an additional set of tools to fill the space. Beyond the revenue aspect, the consideration of serving the public good is also taken into account. By

LOS ANGELES CONVENTION CENTER
FLEXIBLE DEMAND BASED SPACE RENTAL PRICING (FDBSRP) APPROVAL

LACC Sales Representative ______________________
Date ______________________

NAME OF ORGANIZATION ______________________
CONTACT & TITLE ______________________
ADDRESS ______________________

EVENT NAME ______________________
OVER-ALL DATES ______________________
ATTENDANCE / OTHER INFO ______________________

PLEASE CHECK ALL THAT APPLY:

Classification	Reduced Rates for Identified Periods of Time				Adjustments on a Case-By-Case Basis Due to Market Conditions			Other
Criteria	Book space after previously executed license event cancellation within 12 months	Occupancy Rate Below 65% for the Month of the Proposed Event	Book space during Low Demand Period - "Undesirable" Dates Between Shows	Level and Degree of Competition with other Comparable Facilities	Anticipated Ancillary fees for Utility Services Exceed Discounted Space Rental by 50%	Client will execute multiple licenses within 2 years	New Events to enhance market share	______
	1	2	3	4	5	6	7	8
Criteria Applicable								
Doc. Attached								

Supporting Documentation

1 Letter from Show Management cancelling the event
2 Occupancy rate Information from EBMS
3 Space Booking Information from EBMS showing unbooked spaces
4 History of Events Locations
5 Client provides estimate of ancillary fees & commits to revenue estimates
Note: Client is responsible to make LACC whole should revenue not meet estimates
6 Client commits to multiple events
7 Client commits to new event in segments that LACC is "under-represented"
8 Other - Please descibe ______________________

Los Angeles Convention Center

INTERDEPARTMENTAL CORRESPONDENCE

DATE: March 4, 2009

TO: John Wickham, Legislative Analyst
Office of the Chief Legislative Analyst

FROM: Mary Jane Aquino
Interim Assistant General Manager & CFO
Los Angeles Convention Center

SUBJECT: **FLEXIBLE DEMAND-BASED SPACE RENTAL PRICING**

Pursuant to the Motion introduced in Council (copy attached) and subsequent Council action, the Los Angeles Convention Center (LACC) has met with representatives from various Offices to discuss the establishment and implementation of a flexible demand-based space rental pricing model for LACC. This concept is widely known and practiced as yield management, revenue management or dynamic pricing in the industry. It is our understanding that the intent of the Motion is to build revenue capacity and strongly position LACC within a very competitive industry in a most challenging economic environment. As such the implementation of this program in an expeditious manner is of paramount importance.

Flexible demand-based space rental pricing is a business concept widely used in an array of industries dealing with capacity. In the hospitality industries the goal is to maximize occupancy and thereby, increase revenue, potentially between 2% to 8% when fully implemented. LACC has provided support documentation (attached) on the implementation of this practice in the hospitality industry. Also note that space rental discounting is already in place at LACC, in accordance to existing discount and booking policies, for attracting and booking citywide events. The requested change will build on these policies and allow for flexibility to attract more events, increase occupancy and generate additional revenues. The implementation of this business approach at LACC is supported by the Office of the Mayor, the City Council, LA INC., the Los Angeles Convention and Visitors Bureau (LACVB), which handles citywide bookings, and the LACC Commissioners.

Additionally and through the LACVB survey of convention centers, the LACC ascertained that City of Houston-owned George R. Brown Convention Center (GRBCC) codified its negotiation of rates in the Municipal Code (See attached). As such, there is precedence already set for this approach in publicly owned and operated venues. The GRBCC sets a maximum license fee that a licensee may be charged, but the Director of GRBCC is enabled to set or agree to lower the license fee based on the following factors:

Condition 4: Anticipated ancillary fees for utility services (electrical, telecommunications, audio-visual services, parking, etc.)

Criteria: Ancillary revenue exceeds discounted space rental by 50%

Supporting documentation: Client provides estimate of anticipated ancillary fees. Calculation of revenue in comparison to rental discount (Client commits to revenue estimates. Client is responsible to make LACC whole should revenues not meet estimates.)

Condition 5: Client will execute multiples licenses within 2 years

Criteria: Multiple licenses to be executed within 2 years

Supporting documentation: Client commits to multiple events

Condition 6: Target new events to enhance market share

Criteria: New events in desired segments of the industry that are determined to be value-added and that captures or enhances market share in the segment

Supporting documentation: Client commits to license new event in desired segment

The following considerations will also be adhered to:

A. Criteria applicable only to LACC-booked events

B. Citywide bookings handled by the LACVB will be excluded

C. Criteria will not displace or compete with licensed or pending citywide bookings

To further ensure that the licensee is aware of the limited application or of the unique circumstances of the demand-based pricing, the proposed license agreement may incorporate the following or similar language as deemed appropriate by the City Attorney.

"The tenant fully understands and accepts that the pricing reflected in this license is applicable only to this license for the specific event within the space and dates selected by the tenant. The execution of this license does not in any way prohibit the City and the Los Angeles Convention Center from maximizing the utilization and/or revenue generation capacity of any other space at the Los Angeles Convention Center, i.e. taking advantage of yield management practices."

When a new license is issued, utilizing this pricing methodology, and is ready for approval, form and documents will be forwarded to the oversight entity (Mayor or CAO) for approval prior to execution of the license. The LACC will also periodically report on the results of the pilot program with a final report to Mayor and Council on the outcome of the program at the conclusion of the pilot period.

George R. Brown
grb
Convention
Center
Houston

1001 Avenida de las Americas Houston, Texas 77010

Contract No.__________
ID No.______________

THE STATE OF TEXAS §
COUNTY OF HARRIS §

LICENSE AGREEMENT
GEORGE R. BROWN CONVENTION CENTER

THIS **LICENSE AGREEMENT** ("Agreement") is made by and between the **CITY OF HOUSTON, TEXAS** (the "City"), acting through the Director of its Convention and Entertainment Facilities Department (the "Director") whose address is P.O. Box 61469, Houston, Texas 77208 (the "Department"), or such other person as may be designated by the Director and ______________ ____ ("Licensee"), whose address is ____ ________.

WITNESSETH:

License. The City hereby grants and the Licensee hereby accepts a license to use and to occupy that portion of the **GEORGE R. BROWN CONVENTION CENTER** (the "Facility"), **"AS IS"**, that is described as follows for the License Period(s) and License Fees described below:

Portion of Facility ("Premises")*	**License Period(s)**	**License Fee(s)**

whenever the Licensee, its agents, employees, contractors, subcontractors, patrons or attendees is physically present in the Premises and such presence interferes with the use of the Premises by another licensee as determined by the Director.

The City acknowledges that the sum of $__________________ Dollars has been paid upon Licensee's execution of this Agreement toward the License Fee. Licensee shall pay the remainder of $__________________ on or before ____________________________. Licensee may not occupy any part of the Premises unless the License Fee set forth above has been paid in full and Licensee has provided the insurance certificate described in this Agreement. Late payments shall be subject to a ten (10%) late charge. If Additional Time is required before or after the License Period, there will be an additional charge of up to $500.00 per hour. All remaining fees above the minimum rental of the Premises (Equipment Rental Charge, Additional Time charges, damages, etc.) shall be deducted from the Deposit described below and the remainder shall be due within **thirty (30) days** of receipt of the post-Event invoice. If payment is not received within the time period stated herein, the Director may, in his or her sole discretion, assess a ten (10%) late charge in addition to the invoice amount or the Licensee's dates may be released.

Equipment Rental Charge. The License Fee is for the Premises only and does not include rental charges for tables, chairs, lecterns, risers, portable dance floor, pianos, podiums, microphones and sound systems and other equipment. Use of this equipment is at the option and additional expense of the Licensee. Set-up changes by the Licensee after the initial equipment set-up are subject to additional charge.

INSURANCE. LICENSEE SHALL, AT ITS SOLE COST AND EXPENSE, PROCURE AND MAINTAIN THROUGH THE DURATION OF THE LICENSE PERIOD PLUS ANY ADDITIONAL TIME, THE FOLLOWING MINIMUM INSURANCE COVERAGES. NEITHER THE ISSUANCE OF ANY INSURANCE POLICY REQUIRED UNDER THIS AGREEMENT NOR THE MINIMUM LIMITS SPECIFIED BELOW SHALL BE DEEMED TO LIMIT OR RESTRICT IN ANY WAY LICENSEE'S LIABILITY ARISING UNDER OR OUT OF THIS AGREEMENT. LICENSEE SHALL BE LIABLE FOR ANY LOSSES, DAMAGES OR LIABILITIES SUFFERED OR INCURRED BY THE CITY AS THE RESULT OF LICENSEE'S FAILURE TO MAINTAIN OR CAUSE TO BE MAINTAINED THE TYPES OR AMOUNTS OF INSURANCE REQUIRED TO BE MAINTAINED BY LICENSEE UNDER THE TERMS OF THIS AGREEMENT.

(i) COMMERCIAL GENERAL LIABILITY INSURANCE AGAINST CLAIMS FOR BODILY INJURY OR DEATH AND PROPERTY DAMAGE OCCURRING IN OR UPON OR RESULTING FROM THE PREMISES, SUCH INSURANCE TO AFFORD IMMEDIATE PROTECTION TO THE LIMITS OF NOT LESS THAN $__________________ PER OCCURRENCE, AND $__________________ AGGREGATE AND SUCH INSURANCE SHALL INCLUDE (a) ADVERTISING INJURY AND (b) PERSONAL INJURY; AND

(ii) WORKERS' COMPENSATION (STATUTORY AMOUNT); AND

George R. Brown Convention Center Houston
1001 Avenida de las Americas Houston, Texas 77010

Standard Terms and Conditions. The Standard Terms and Conditions attached hereto are made a part hereof for all purposes.

Department Rules and Regulations. The Department's Rules and Regulations are incorporated herein and made a part hereof for all purposes as though set out herein at length and Licensee has read and agrees to abide by the terms thereof.

Definitions. All terms either defined herein or capitalized herein shall have the same meaning in the Standard Terms and Conditions. All terms capitalized herein, but not defined herein, shall have the meaning assigned to such terms in the Department's Rules and Regulations.

Rejection of Licensee's Offer. The execution and delivery of this Agreement to the City constitutes an OFFER by Licensee which the City may reject at any time prior to the Director's execution of this Agreement. The City may reject such offer by depositing written notice to such effect in the United States mail, postage prepaid, addressed to Licensee.

Entire Agreement. This Agreement, the Standard Terms and Conditions, and the provisions of Chapter 12, Code of Ordinances, Houston, Texas, constitute the entire agreement between the City and Licensee; no prior written or contemporaneous oral promises or representations shall be binding upon the City. This Agreement shall not be amended or changed except by written agreement signed by both parties hereto. In the event of a conflict between this

IN WITNESS OF WHICH this Agreement has been executed by the Licensee on this ____________day of _________________________, 200_______.

All copies of the signed Agreement must be received in the Convention and Entertainment Facilities Department office no later than ________________________, or the License Period dates are subject to being released at the sole discretion of the Director.

CITY OF HOUSTON, "City"

____

"Licensee"

By: ____________________________________ By: ____________________________________

Name: Name:

Title: Title:

____

Date

FORM APPROVED BY CITY LEGAL DEPARTMENT

Sec. 12-47. Ticket surcharge.

(a) In addition to the rental fees specified in this division for occupancy of the George R. Brown Convention Center, there is imposed a surcharge of not less than $1.00 nor more than $2.00 per ticket for each event, as determined by the director on the basis of the needs of the facility for maintenance, operation, and improvements. The proceeds of the ticket surcharge for the George R. Brown Convention Center shall be deposited in the department's operating fund and shall be utilized for any lawful purpose relating to maintenance, operation or improvement of the George R. Brown Convention Center as directed by the city council.

(b) Surcharges within the same range and based on the same factors as those provided in subsection (a) of this section for the George R. Brown Convention Center are also imposed for occupancy of the Jesse H. Jones Hall for the Performing Arts and the Gus S. Wortham Theater Center in accordance with contractual provisions established between the city and operating companies using those facilities. If any one or more of the agreements with the operating companies expires or is terminated, the director shall implement the surcharge in accordance with rules that the director may prescribe for any facility for which no agreement has been reached. Proceeds from the surcharge, whether imposed contractually or by the director, shall be retained and utilized for backstage operation and maintenance, theatrical equipment and depreciable capital improvements of the respective facilities and in accordance with the contract with the operating company, if a contract exists.

(c) As used herein, the term *"ticket"* includes all forms of entry control utilized to impose a fee of any sort for admission to an event with the exception of registration fees for a convention, entry charges for seated meal functions or fees charged for other functions of like character, as determined by the director in his sole discretion. The surcharge shall be imposed in accordance with rules adopted by the director. In addition to any other deposits, the director may require a deposit for the anticipated surcharge and may require the licensee to use serially numbered tickets to ensure an accurate accounting of the surcharge. To the extent that the amount of the surcharge is subject to any tax or fee imposed by law, the licensee shall ensure that entry charges are adjusted or take whatever other action may be required to ensure that the director receives the full amount of the surcharge fee.

(d) The financial officers of the city shall be given access to box office records, ticket receipts and all other documents reasonably required to verify the licensee's accounting of the surcharge.

(Ord. No. 96-50, § 3, 1-17-96; Ord. No. 96-1379, § 4, 12-18-96; Ord. No. 03-1174, § 7, 12-3-03; Ord. No. 08-893, § 2(Exh. A), 10-8-08)

Sec. 12-48. Negotiation of rates.

Whenever in this division a single figure license fee is stated, that amount, or the higher amount in a range of license fees, shall represent the maximum license fee a licensee may be charged. The director may, however, set or agree to lower the license fee under sections 12-50 or 12-52 (other than the tax-exempt rate) or any license fee under section 12-53, taking into account the following factors, provided that the director will endeavor to recover the established license fee for such occupancy:

(1) Level and degree of competition with other comparable facilities;

(2) Anticipated hotel occupancy tax revenues to the city;

(3) Estimated food and beverage expenditure by the licensee and/or attendees at the facility;

Sec. 12-51. Reserved.

Sec. 12-52. Licensing of the Gus S. Wortham Theater Center.

(a) *Alice and George Brown Theater.* License fees for occupancy of the Alice and George Brown Theater shall be as follows:

LICENSE TABLE 12-52(a) FOR THE
ALICE AND GEORGE BROWN THEATER

TABLE INSET:

Category	License Fee	Tax-Exempt Rate
Per event day (for one presentation, performance or occurrence of one event)	$7,000.00	$2,871.00
Per event period (for one presentation, performance or occurrence of one event)	$5,075.00	$2,122.00
Per student event	$1,922.00	$935.00
Per non-event day	$3,144.00	$1,373.00
Per non-event period	$2,304.00	$1,022.00
Additional events in same time period	N/A	N/A
Holiday premium	1 1/2 times regular rate	1 1/2 times regular rate

(b) *Lillie and Roy Cullen Theater.* License fees for occupancy of the Lillie and Roy Cullen Theater shall be as follows:

LICENSE TABLE 12-52(b) FOR THE
LILLIE AND ROY CULLEN THEATER

TABLE INSET:

Category	License Fee	Tax-Exempt Rate
Per event day (for one presentation, performance or occurrence of one event)	$2,246.00	$1,874.00
Per event period (for one presentation, performance or occurrence of one event)	$1,997.00	$1,499.00
Per student event	$873.00	$873.00
Per non-event day	$1,248.00	$1,248.00
Per non-event period	$624.00	$624.00
Additional events in same time period	1/2 regular rate	1/2 regular rate
Holiday premium	1 1/2 times regular rate	1 1/2 times regular rate

All license fees that are expressed in dollar amounts in the foregoing license table are for license agreements executed through and including July 31, 2009. On August 1 of each year, (Ord. No. 96-50, § 3, 1-17-96; Ord. No. 96-1379, § 2, 12-18-96; Ord. No. 03-1174, § 12, 12-3-03; Ord. No. 08-893, § 2(Exh. A), 10-8-08)

Secs. 12-54—12-60. Reserved.

DIVISION 4. PARKING RATES FOR PARKING FACILITIES

Sec. 12-61. Parking in the parking facilities.

Rates for use of the parking facilities shall be as provided in this division.

(Ord. No. 96-50, § 3, 1-17-96; Ord. No. 08-893, § 2(Exh. A), 10-8-08)

Sec. 12-62. Contract parking.

(a) Subject to the provisions of section 12-64 of this Code, rates for unreserved noncontract parking shall be as follows:

(1) *Rates for contract parking in the Margaret Westerman City Hall Annex Parking Garage* shall be an amount not to exceed $101.62, plus any applicable sales tax, per month.

(2) *Rates for contract parking in the Theater District Garage* shall be an amount not to exceed $145.00, plus any applicable sales tax, per month.

(3) *Rates for contract parking in Lots C and H* shall be an amount not to exceed $46.19, plus any applicable sales tax, per month.

(b) Subject to the provisions of section 12-64 of this Code, the director is authorized to make reserved parking spaces available for an amount not to exceed $250.00, plus any applicable sales tax, per space, per month.

(c) The director, for the mayor and on behalf of the city, may execute written contractual parking agreements upon standard forms, including such terms, conditions and stipulations as the city attorney may approve. The director may agree to hold a number of parking spaces or an established rate in the parking agreement for a period not to exceed three years. The contractual rates established by the director shall include the uniform terms, conditions and rates under which contractual parking agreements will be entered into. The provisions of this subsection shall apply to all parking facilities that are operated by the department.

(d) The director is authorized to extend reduced parking rates for use of the parking facilities to those non-city employees who are permanently assigned by their employers to work in city owned or operated office buildings and other city facilities.

(e) The fees set forth in this section shall not be applicable to elected officials of the city or employees of the city who, consistent with city policies for personnel parking, are authorized to park vehicles in the parking facility while at work. Those persons shall be entitled to park in their assigned parking facility without charge, if the parking is incidental to the performance of their duties of office or employment.

(Ord. No. 96-50, § 3, 1-17-96; Ord. No. 96-1379, §§ 5, 6, 12-18-96; Ord. No. 98-894, §§ 2, 5, 10-7-98; Ord. No. 07-1261, § 2, 11-7-07; Ord. No. 08-893, § 2(Exh. A), 10-8-08)

TO CITY CLERK FOR PLACEMENT ON NEXT REGULAR COUNCIL AGENDA TO BE POSTED #58

MOTION

JAN 1 6 2009

Since January 2006, the Los Angeles Administrative Code has fixed the daily rate to be charged to all licensees at the Los Angeles Convention and Exhibition Center at $0.32 per net square foot of space used or occupied (Chapter 11, Section 8.149.2 "Daily Rates to Be Charged for Use of the Various Halls for Trade Shows"). The Administrative Code does not offer the Convention Center the flexibility to adjust this rate upward or downward to reflect market conditions, seasonality or demand.

With the challenging economic conditions, the competitive nature of the convention center industry, and emerging opportunities with the completion of LA Live, there is an urgent need for a flexible pricing policy for the L.A. Convention Center, similar to the airline and hotel industries, to enable management to offer various pricing options to event planners in order to attract top quality events while maximizing City revenues.

Based on hospitality industry practices, and local market conditions, options for a rental rate ranging up to thirty percent above or below the current rate of $0.32 per net square foot of space used or occupied (a range of $0.22 - $0.42/square foot) will allow the Convention Center to be more responsive to the current market conditions and stay competitive in a fiscally responsible manner, even during periods of traditionally low occupancy. This flexible demand-based pricing option would give the Convention Center the flexibility to react more effectively to the changing dynamics of many event requirements and market conditions, thereby improving last-minute response times and meeting clients' needs in a more efficient manner, providing clients with the greatest value for their money.

I THEREFORE, MOVE that the City Council instruct the City Attorney to prepare and present an ordinance within 30 days to amend Los Angeles Administrative Code Section 8.149.2 to implement a flexible demand-based pricing policy for the Los Angeles Convention and Exhibition Center and authorize the General Manager to offer pricing options up to 30 % above or below the current rate of $0.32 per net square foot of space used or occupied (range of $0.22 - $0.42/square foot of space used or occupied) based on demand and seasonal requirements.

PRESENTED BY: ______________________
JAN PERRY
Councilmember, 9th District

SECONDED BY: ______________________

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JAN 1 6 2009