Estimating the Indirect Effect of Sports Books on Other In-House Gaming Volumes

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Abstract

Using data from a repeater market hotel in Las Vegas, Nevada, the relationship between sports book and slot machine revenues is examined. Daily sports book write and daily slot handle are compared over a 250 day period. Though many industry leaders theorize that sports book gamblers also wager in slot banks, the results of this Autoregressive Integrated Moving Average (ARIMA) analysis fail to demonstrate a statistically significant relationship between sports book write and slot coin-in at the 0.05 alpha cutoff. This study advances literature currently available by establishing the lack of such a relationship and disputing the generally accepted assumption that sports books produce a substantial indirect contribution to slot revenues. While the sports book does generate a fairly constant direct profit for the casino, the absolute value of that profit is minimal and the results of the study show there is no indirect profit contribution from sports books to slot machines. Given these results, casino management may want to consider that a sports book is not an optimal use of casino floor space.

Keywords: Sports book, time series, ARIMA, operations analysis, casino management

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Introduction

It is fairly easy to determine the direct cash flow contribution of a sports book to its casino property. The property's income statements provide a detailed look at the revenues and costs of managing the book. A sports book, however, requires many operational costs, such as large-scale technological upgrades or promotions like trips to major sporting events and high-end car giveaways. There are also potential opportunity costs – the casino could be using the space for more profitable amenities.

The casino's decision to operate a sports book may not necessarily be maximizing their potential profit per square foot. It is possible, however, that the indirect benefits of having a sports book may justify the operational costs of such a facility. This study explores the effect of on-site indirect revenue generators by investigating sports books.

Practical Significance

Many industry leaders purport that sports gamblers take their winnings from the book and use them to play other in-house games and spend them on other property amenities (Lang & Roxborough, 1992; Manteris, 1993; Roxborough, 1996). The casino wants to optimize the allocation of space such that they will maximize their return on assets. Even if the sports book is slightly profitable, it may not be the optimal use of available floor space. While an income statement will report the direct revenue generated by the sports book, it will not provide any information on its indirect gaming contribution. Casino

industry leaders have discussed the indirect benefit of sports books on the casino floor for many years, but as yet none have provided any empirical proof of their claims. In addition, the current troubled economic times are leading some state governments to seek legalized sports betting. Delaware and New Jersey are pushing for legislation to permit sports betting in order to drive revenues for the states (McCarthy & Perez, 2009). Should this legislation come to fruition, casino operators in those states should heed advice and find empirical evidence of the value of a sports book before investing their time and money in a new addition to their business.

Academic Significance

This study presents a functional model and objective process for estimating the indirect gaming contribution of sports book volume to associated gaming volumes, most specifically slot coin-in. Lucas, Dunn, and Kharitonova (2006) first addressed the issue of indirect gaming contributions with respect to bingo, and also created the theoretical framework which opened the door to further analysis of other indirect gaming contributions. This study will expand on current gaming literature by concentrating on the sports book, a casino staple for many years.

Delimitation

No attempt was made to investigate the relationship of an indirect cash flow contribution between sports book revenue and the table games department. The only pit games wagering volume measured by the property was total drop. Total drop includes credit play, which can produce disproportionate increases in business volume, and can cause inaccuracies in correlation-based estimation techniques (Lucas & Santos, 2003). In addition, total drop represents the customers' total buy-in, not the actual dollar amount wagered by patrons. The casino is not guaranteed that the total drop will be used as wagers, and therefore have no guarantee at a chance to win the entire buy-in. An automated bet-tracking system would be necessary to capture actual wagering volume, but such facilities were unavailable at the property. As such, the true dollar amount wagered by table games customers is unknown.

Literature Review

Sports Book Operations Within the Casino

Kilby, Fox, and Lucas (2005) describe how ultimately, all games in the casino compete for floor space via profit per square foot. This does not necessarily relate to direct profit, as many casino operations departments will keep some poorly-grossing ventures and even some operations that consistently take a loss, like bingo (Lucas, Dunn, & Kharitonova, 2006), with the belief that they will drive other revenues on the property. When considering the concept of highest and best use of space, Kilby et al. (2005) inspire the question – does a sports book constitute the most valuable use of the property's facilities?

Does a sports book constitute the most valuable use of the property's facilities?

During the 1990s, sports books more frequently became a part of the typical casino layout, a new concept compared to the stand-alone sports books that had been in operation (Lang & Roxborough, 1992). Noting how the sports book provides access to other attractions within the casino-hotel, Lang and Roxborough (1992) postulate that the sports book serves the latent function of keeping pit players near the action. Roxborough (1996) later also declares the sports book to be a core profit center. Manteris (1993) argues in contrast to Roxborough's (1996) claim, stating that sports books are low on the casino revenue-generating list. Manteris (1993) goes on, however, to propose that while the sports book itself may not generate high revenues, the opening and expansion of sports books within casino-hotels runs hand-in-hand with increases in hotel, food and beverage, and slot and casino revenues. Eng (2008) further details from an interview with Manteris that a state-of-the-art race book is a big draw to the property, since it "gives the guests what they want," and that customers

who come to the property to use the race book will use the other facility services – most specifically, the "king of gambling profits": the slot machine. Eng (2008) additionally reports on an interview with the race and sports book director at Planet Hollywood, a Las Vegas Strip property, who indicates that it is no secret among casino managers that a casino establishment could generate higher revenues if the race and sports book floor space were used for slots, but that operators strive to offer a full-service model, and therefore keep the race and sports wagering facility.

Harrah's, whose properties in Las Vegas are primarily in the Strip market, has adapted their amenities to put the theory of the sports wagering facility driving wagering in other casino games into practice (Berosh, 2008). Concerned that their players were being forced to select between playing table games or placing wagers in the sports book and watching the games there, management created the Sports Pit. The Harrah's Sports Pit integrates the sports book with a sampling of casino games such as craps and blackjack. The new layout allows casino patrons to wager their money in two ways within close proximity.

Nover (2008) describes an integrated slot machine which provides a real-time dynamic betting environment. Las Vegas Gaming Inc.'s WagerVision allows the bettor is playing the video slot machine and may receive casino- generated prompts alerting them to a racing or sporting event whose start time is approaching. If the customer elects to place a wager on the event, they can select the details of their ticket from the interface on the slot machine, and the wager amount will be deducted from their cash balance. The customer then has the option to watch the event in real-time on the video screen while continuing their slot game (Nover, 2008).

Slot Machines as Revenue Drivers

Slot coin-in is preferred as the dependent variable in this study because slot performance has been reviewed to be central to the continued success of most casino operations (Lucas et al., 2006). The term "coin-in" originally referred to the actual, physical coins that gambling customers would drop into a slot machine in order to pull the handle. In our more modern age, very few machines still accept coins, but the terminology still stands to describe the amount of money wagered on the slot floor (Brewer & Cummings, 1995). The term "slot machine" is used by the casino industry to describe any video poker, reel slot, multi-game, or video keno machine (Lucas & Brewer, 2001). Brewer and Cummings (1995) found that slot revenues typically account for 50-80% of total casino revenue, a significant increase over their revenue contribution from years prior to 1995. The Nevada Gaming Control Board (2009) shows slot revenues reliably composing the vast majority of total gaming revenues of hotel casino properties outside the Las Vegas Strip and downtown markets, and still a very large portion of revenues in those two markets.

Indirect Drivers of Slot Revenues

Lucas and Brewer (2001) examined a theoretical model designed to explain the variation in daily slot handle at a locals market casino in Las Vegas, including, among other non-gaming independent variables, bingo headcount. Using a regression model, they determined that while each one-unit increase in bingo headcount produced a $17 increase in daily slot coin-in, the positive effect of the bingo gaming amenity could not ultimately overcome the annual loss the department incurred. Lucas et al. (2006) expanded upon Lucas and Brewer's (2001) conclusions, using regression analysis to determine that bingo was not a positive significant contributor to slot coin-in, and yet it was used as a loss-leader – that is, the bingo room had negative revenues and was using valuable floor space that could otherwise be used by more profitable gaming amenities. While there has been analysis on many different potential drivers of slot revenues, sports book performance has not been investigated. This study will add yet another important dimension to casino operations literature.

In addition to research specific to other gaming operations, there is some research

estimating the indirect gaming contribution of other non-gaming casino amenities. Similar to the loss-leader role of bingo and the borderline profitability of poker rooms, non-gaming amenities like restaurants can serve as an attraction to gamblers to keep them on the property for longer periods of time. Lucas and Santos (2003) tested the assumption that considerable food department losses are justified by operations executives in that they believe the food offers drive incremental slot play. Lucas and Brewer (2001) had previously found that food covers did not significantly increase slot coin-in. Lucas and Santos (2003) found that casino-operated restaurant business volume had a significant effect on slot coin-in – though they noted cash and complimentary (comp) food covers had been included in their model and postulated that the inclusion could have inflated the correlation between restaurant and gaming volumes.

General Theoretical Model

The theoretical model depicted in Figure 1 is derived from the literature review of models proposed in an attempt to describe the variations in daily gaming volumes (Lucas, 2004; Lucas & Bowen, 2002; Lucas & Brewer, 2001; Lucas et al., 2006; Lucas & Santos, 2003). Lucas and Santos (2003) used a very similar theoretical model to investigate the effect of match-play promotions on the daily cash drop of blackjack games in a Las Vegas Strip casino property. Lucas and Brewer (2001) and Lucas and Bowen (2002) both successfully account for variations in slot volume; both models explain 87% of the variations in slot volume, with very similar models. Most research designed to explain variations in gaming volume uses time series analysis and includes seasonality variables like day of the week and holiday periods. Variables which are known to contribute to multicollinearity in accordance with day of the week, such as hotel occupancy and restaurant headcount, are not included in the model. Such variables are related to associated business volumes and may exhibit collinear behaviors (Lucas & Kilby, 2002).

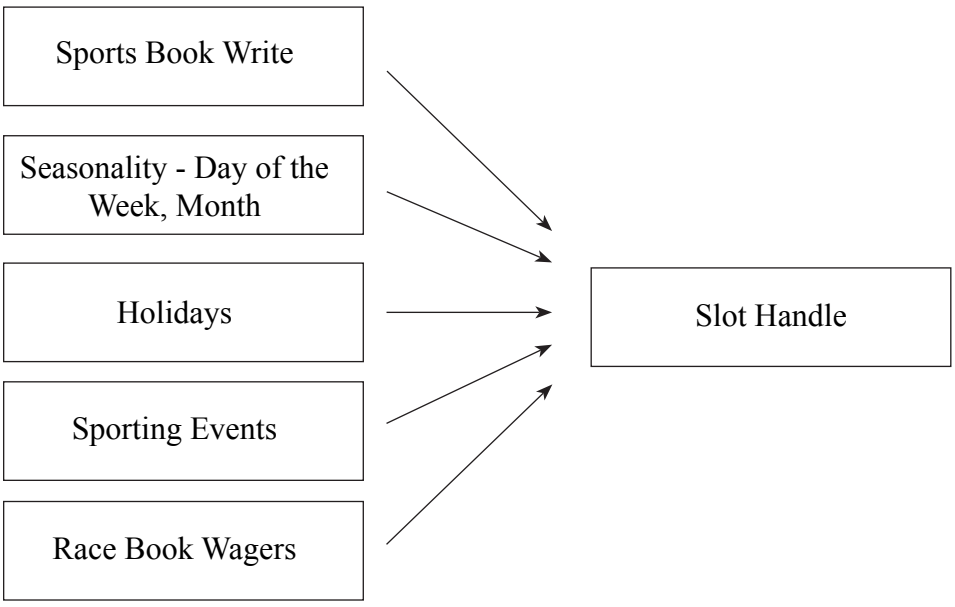

Figure 1. General theoretical model for analysis.

Hypothesis

Based on analysis of the literature, the null hypothesis is described as the following:

$$H_0: \beta_{SportsBookDailyWagers} = 0,$$

Null Hypothesis: There is no relationship between the dollar value of aggregate daily wagers for the sports book and aggregate daily slot handle.

Methods

Data Sources

One Las Vegas repeater market hotel casino - a hotel casino which depends primarily on repeat clientele - provided the secondary data applied to the theoretical model described in Chapter 2. The hotel casino operates a sports book but relies on slot machines as the primary source of their revenues. All variables presented in the data set were subject to both internal and external audits. The data set includes daily results across a 250-day period, beginning on January 1, 2009, and ending on September 7, 2009.

The casino property described its sports book as a profitable operation – the Sports/Race Book Department has a profit margin near 35%. The actual dollar amount of sports book profit, however, is minuscule when compared to that of slots; it totals approximately 2% of slot profit.

Data Analysis

The data were screened in R, an open source statistical software package, to ensure accuracy of data entry, missing values, normality of the distribution, and goodness-of-fit between distributions. Line graphs of aggregate daily sports book wagers were evaluated for occurrences of seasonality. The formal data analysis was also conducted using R, which allows for the user to address the serial correlation of error terms that is often present in time series data analysis. The hypothesis was initially tested via simultaneous multiple regression analysis at the 0.05 alpha level. Following hypothesis testing, the regression model was tested for assumptions via assessments of diagnostics and error-term scatter plots. Because these diagnostic tests determined the standard regression model was unfit for the data, an ARIMA analysis was run on the data set, and further diagnostic tests were administered to ensure the new model was appropriate for the data set.

Expression of Criterion Variable

Aggregate daily slot coin-in (ADSC) represents the dependent variable in the model data set, identified as "Daily Slot Handle," and is defined as the dollar amount of wagers made on all coin- or voucher-operated gaming devices currently active on the casino floor. The casino property analyzed offered a number of different slot machine systems at the time of data capture, including video keno, video poker, video blackjack, reel slots, and progressive systems.

Expression of Predictor Variables

Aggregate daily wagers placed at the sports book is represented by the *Daily Sports Book Write* variable. Unlike in most casino games, the casino is not betting against the patron in sports bets. In sports betting, the house isn't interested in the actual odds of the game. Rather, they are interested in offering a betting line that attracts an equal dollar amount of wagers to each side of the match, also known as the proposition. The casino's profit comes from the commission, usually referred to as the "juice" or "vigorish," which is charged on each bet made. If the casino fails to properly set the betting line, and a larger amount of wagers is placed on the winning side, the house will take a loss. Because of this, the casino will move the line as game time approaches to induce wagering on the

under-bet side.

It is proper to use the incoming wagers as a measure of sports book betting activity rather than the aggregate of paid out win tickets for all cases, because win tickets paid out to patrons are dependent on game outcome and on the casino's payoff odds, which vary as the line moves. In addition, the book will take many variants on the standard win/loss line bet, including but certainly not limited to point spreads, parlays, teasers, and futures.

Seasonality and *holiday periods* are described by day and month binary variables. Seasonality is innately present in sports book wagering, because unlike most casino game wagers, which do not change as time passes, sports wagering options are different not only by month, but by day. Holidays are theoretically tied to an increase in patron leisure time and as such to an increase in gaming volume. In past studies, holiday variables such as these have been found to produce significant effects on gaming volume (Lucas et. al., 2006).

Binary variables are additionally used to represent *major sporting events* to explain variations in gaming volume that occur when major sporting events draw in a crowd that may temporarily inflate that day's or set of day's sports write, such as the Superbowl. Because a sporting event could conceivably elevate gaming volume levels beyond the scope of a single day, some major sporting events were depicted within the indicator variable over a period of days, rather than just the day on which the event took place. A compilation of the sporting event indicator variables included in this model can be found in Table 1.

Aggregate race book win represents the revenue earned by the casino on race book wagers. The type of bet, and therefore the house advantage, in a race wager is very different from a sports wager. A race wager is a pari-mutuel wager, wherein all wagered money goes into a pool, and the proportion of money in the pool that is wagered on each entrant in the race determine its odds. All winning tickets are paid out from the pari-mutuel pool, after a cut is taken by the house. In essence, a race bettor is wagering against other race bettors. In a sports bet, the bettor is wagering against the house, and pays for their wager plus a vigorish, which is essentially a payment to the house for the privilege of placing the bet. A winning sports wager is paid by the house according to the odds at the time the wager was placed, unlike a race wager, which pays based on the odds at the time the race begins. Because the race bettor is not betting against the house, and there is no luck involved for the house's take from the race book, race book revenue is an accurate measure of house profit and is used in the model herein.

Table 1

Major Sporting Events Included in the Model as Indicator Variables

Event	Date(s)
Super Bowl – National Football League	February 1, 2009
National Basketball Association All Star Game	February 15, 2009
March Madness – NCAA Championships, Basketball	March 26 – March 29, April 4, April 6, 2009
The Masters Golf Tournament	April 6 – April 12, 2009
Kentucky Derby – Horse Racing	May 2, 2009
Preakness Stakes – Horse Racing	May 16, 2009
Indianapolis 500 – Motor Sport	May 24, 2009

National Basketball Association Championships	June 4, June 7, June 9, June 11, June 14, 2009
Belmont Stakes – Horse Racing	June 6, 2009
US Open – Professional Golfers Association Tour	June 15 – June 21, 2009
Wimbledon Championships – Tennis	July 4 – July 5, 2009
Major League Baseball All Star Game	July 14, 2009

Results

Preliminary diagnostic tests were run on the data set before performing initial analyses to screen for outliers and nonlinear conditions. One extreme outlier was identified, which happened to be the day of the Super Bowl. A histogram of the dependent variable, slot coin-in, was reviewed with regard to the normality of distribution, and was found to be slightly skewed in a positive direction. Reviews of a live graph plotting slot coin-in against time indicated a small but constant downward trend. Table 2 below comprises a summary of the descriptive statistics for daily slot handle, the dependent variable, and daily sports book write, the independent variable.

Table 2

Descriptive Statistics for Major Dependent and Independent Variables

Variable	Minimum	Maximum	Mean	Median	Standard Deviation
Daily Slot Handle	2,944,266	9,093,829	4,989,531	4,629,077	1,324,044
Daily Sports Book Write	1,221	707,252	60,867	50,474	54,284

The initial regression model produced a multiple R^2 value of 0.896 and an adjusted R^2 value of 0.889, both substantially high, and a significant F statistic ($F=117.8$, $df=17,232$, p-value < 0.00001). A screening of the autocorrelation function (ACF) and the partial autocorrelation function (PACF), however, revealed serial correlation in the model. Because the value of Daily Slot Handle observed at any given time t_1 may depend on values observed at other points in time, time series data tends to violate independence assumptions of a linear regression model. As a result, an Autoregressive Integrated Moving Average (ARIMA) analysis was run on the model.

ARIMA Time Series Analysis

The ARIMA model is used to uncover lags and shifts in the data that occur over time, and uses patterns like moving averages and seasonality to generate a prediction model. The ARIMA model accounts for temporal dependence found in seasonal and systematic trends in several ways, as described by Grimmer's research in R (as cited in Imai, King, & Lau, 2007). Within the R statistical program, a time series data set is differenced to render it stationary, then the time dependence of the stationary process is modeled, including autoregressive and moving average terms, as well as any other time-dependent covariates. When utilizing an ARIMA model, a trend variable is not used because the "integrated" ARIMA already accounts for trend found in time series during its formulations. The ARIMA model notation takes the form of ARIMA (p,d,q), in which p represents the order of the autoregressive (AR) part, d represents the order of

the integrated differencing (I), and *q* represents the order of the moving average (MA) process. When the trend variable is incorporated in the model, *d* will equal zero.

An examination of the regression model's ACF and PACF plots indicated no autoregressive component, and the presence of a moving average component of 2, due to significant spikes at early lag periods. An ARIMA(0,1,2) model was fitted on the data set, and included all independent variables that had been found significant in multiple regression. ARIMA (0,0,1) and ARIMA (0,0,2) models were also fitted, but an analysis of the Akaike Information Criterion (AIC) indicated the ARIMA (0,1,2) model was best. AIC is a measure of the information lost when a model is used to simulate reality, and lower values are considered more ideal. Several models using an AR component of 1 were considered due to the serial correlation seen in the ACF and PACF plots of the regression analysis, but were deemed to be a poorer fit than the (0,1,2) model. The first ARIMA (0,1,2) model (Table 3) run found that Daily Sports Write was not significant in the model (p=0.293). Race Book Win was deemed a non-contributor to the model early in analysis and was removed from consideration, and thus does not appear in Table 3.

Race Book Win was deemed a non-contributor to the model early in analysis.

Table 3

Summary of ARIMA Time Series Analysis for Variables Predicting Daily Slot Handle

Variable	β Estimate	β Standard Error	P-value
MA(1)	-0.6997	0.0592	$< 2x10^{-16}$ ***
MA(2)	-0.2399	0.0584	$3.95x10^{-5}$ ***
Daily Sports Write	0.5883	0.5592	0.2927
February	281,639.9	139,613.3	0.0436 *
April	116,971.0	143,283.3	0.4143
May	234,942.9	145,310.0	0.1059
August	-322,927.9	155,854.6	0.0382 *
Wednesday	640,385.1	83,971.2	$2.41x10^{-14}$ ***
Thursday	495,051.9	91,981.0	$7.36x10^{-8}$ ***
Friday	2,926,593.7	91,919.1	$< 2x10^{-16}$ ***
Saturday	2,565,578.2	93,707.8	$< 2x10^{-16}$ ***
Sunday	777,911.3	88,407.4	$< 2x10^{-16}$ ***
New Years Weekend	1,222,242.4	278,403.1	$1.13x10^{-5}$ ***
Martin Luther King, Jr. Weekend	743,465.1	290,725.4	0.0105 *
President's Day Weekend	1,599,555.5	292,866.5	$4.72x10^{-8}$ ***
Memorial Day Weekend	935,408.3	276,636.9	0.0007 ***
Labor Day Weekend	872,329.3	322,928.1	0.0069 **
Indianapolis 500	1,070,388.2	433,307.4	0.0135 *

Note. *** < 0.001, ** < 0.01, * < 0.05. Maximum Likelihood Error (MLE) of the innovations variance is estimated at $1.799x10^{11}$. Maximized log-likelihood = -3,580.8. AIC = 7,199.59.

A second model (Table 4) was run and analyzed to ensure goodness of fit without the primary investigative independent variable. All coefficients in the final model are significant at the 0.05 alpha level, with the exception of August, which is still well within a 0.10 cut off and was therefore kept in this exploratory model. Removing the August term from the model caused the AIC to increase dramatically. MA(1) and MA(2) represent the first- and second-period moving average terms that were included in the model to remove serial correlation in the error process. Without these two terms, coefficients would include bias due to dependent error terms.

Table 4

Summary of ARIMA Time Series for Variables Predicting Daily Slot Handle with Daily Sports Write Dropped

Variable	β Estimate	β Standard Error	P-value
MA(1)	-0.6831	0.0573	$< 2x10^{-16}$***
MA(2)	-0.2434	0.0563	$1.53x10^{-5}$***
February	283,037.6	143,662.7	0.0488*
August	-307,558.1	162,524.2	0.0584
Wednesday	649,057.9	83,944.9	$1.05x10^{-14}$***
Thursday	509,161.1	91,937.9	$3.05x10^{-8}$***
Friday	2,941,311.0	91,987.0	$< 2x10^{-16}$***
Saturday	2,592,085.0	91,937.5	$< 2x10^{-16}$***
Sunday	812,464.8	84,136.8	$< 2x10^{-16}$***
New Years Weekend	1,265,580.0	279,747.2	$6.07x10^{-6}$***
Martin Luther King, Jr. Weekend	760,431.9	292,317.0	0.0093**
President's Day Weekend	1,576,059.0	294,272.5	$8.52x10^{-8}$***
Memorial Day Weekend	1,026,654.0	273,979.6	0.0002***
Labor Day Weekend	905,906.7	328,930.3	0.0059**
Indianapolis 500	1,047,416.0	431,715.6	0.0153*

Note. *** < 0.001, ** < 0.01, * < 0.05. Maximum Likelihood Error (MLE) of the innovations variance is estimated at $1.82x10^{11}$. Maximized log-likelihood = -3,582.53. AIC = 7,197.06.

Model Diagnostics

An examinations of the normal Q-Q plot failed to indicate a departure from normality. Residual histograms were reviewed, and no problematic outliers were identified. Autocorrelation function (ACF) and partial autocorrelation function (PACF) residual plots for the final ARIMA model indicated elimination of peaks seen during the regression analysis. While both the ACF an PACF plot showed statistically significant peaks still remained in the model at lags 7, 10, and 14, the peaks fell just outside the cutoff, and were deemed not to take significant value away from the model once considered with the Ljung-Box statistics described below. It is still important to note that there could be issues with correlation between days of the week in the data set.

Ljung-Box statistics were also examined for the first ten lag values, as seen listed in Table 5. The Ljung-Box statistical test checks the null hypothesis that the residuals of the ARIMA model are independently distributed. In order for the model to be classified as "correctly specified," the residuals must not only be normally distributed but also independently distributed. If the residuals are autocorrelated, then the time series analysis can be used to improve the model. Table 5 shows significance levels above the 0.05 alpha level for the first six lags. The significance levels of lags 7, 8, and 9 are well above the 0.01 alpha level cut off. That is, for the first nine tested lag periods, the null hypothesis is not rejected at a 0.01 alpha level – the residuals are independently distributed. When reviewing Table 5 in conjunction with Figures 2 and 3, the small lag spikes seen on the ACF and PACF for the seven-period lag are far less of a concern.

Table 5

Ljung-Box Statistics ARIMA (0,1,2) Model

Lag Period	Ljung Box Test Statistic Value	Degrees of Freedom	P-Value
1	0.1389	1	0.7093
2	1.8198	2	0.4026
3	4.0799	3	0.2530
4	6.7891	4	0.1475
5	7.9323	5	0.1600
6	7.9912	6	0.2387
7	15.3091	7	0.0322
8	16.7894	8	0.0324
9	17.3768	9	0.0431
10	26.0667	10	0.0037

Discussion

With regard to the primary independent variable, Daily Sports Write, the ARIMA analysis failed to reject the null hypothesis. There was no support of the alternative hypothesis, that daily sports write had a significant impact on daily slot coin-in. In addition, it is important to note that race book win not only did not have a significant impact on daily slot coin-in, it was deemed a non-contributor to the model early in analysis and was removed from consideration. This finding comes in contradiction of the theories held by several casino operations managers (Eng, 2008; Lang & Roxborough, 1992; Manteris, 1991; Manteris, 1993).

There was no support of the alternative hypothesis, that daily sports write had a significant impact on daily slot coin-in.

Managerial Implications

The research conducted herein does not support the theory proposed by industry professionals that the floor is a full-service model, when considering the incorporation of either a sports or race book. The results of this research did not produce any evidence of a positive, significant, indirect contribution from sports nor race books to slot coin-in. At a very minimum, casino operators should give a second thought to sports and race book operations.

While the sports book does turn a profit, the actual dollar amount of this profit is minimal, as can be seen in Table 2. The maximum value of sports book write, $707,252, is large compared to the mean write, and occurs the day of the Super Bowl, a major event for American sports. This maximum value, however, is not even one third the amount of the minimum value of daily slot handle, $2,944,266. Casino managers would certainly want to consider both the lack of evidence of an indirect relationship between sports book write and slot coin-in, as well as the absolute profit differences, when determining the allocation of valuable floor space for a sports book. In addition, because the race book was found to have no significant impact on slot coin-in, it is crucial that casino operators consider the dollar value of race book win that is coming in from that channel and the operational costs associated with the book – they may find that the race book is being incorrectly used as a loss leader.

The race book is being incorrectly used as a loss leader.

As Lucas, Dunn, and Kharitonova (2006) describe, casino management ought to consider both the direct and indirect revenue contributions of gaming and facility amenities, and must ultimately decide what combination of each operational element maximizes the property's profit per square foot. The results demonstrated here fail to provide any empirical evidence that the sports book serves as a driver of slot revenues on the property. Ultimately, the decision must be made based on empirical proof and dedication to optimizing profit per square foot, rather than blindly following the declarations of unsupported theory. Lucas et al. (2006) further suggest that not all patrons offer the same profit potential - the sports book may serve the needs of many patrons, but their individual value to the casino may vary greatly. A sports book that covers prime casino floor space may not be the ideal choice for optimizing cash flows.

Because a slot machine requires very low operational cost, and because of the low variance generated by the large aggregate number of spins per hour, even an infrequently played machine may generate higher cash flows for the property than the sports book might. It is typical of a Las Vegas casino to experience attendance and volume peaks during holidays and weekends and troughs during midweek periods. Due to the timing of sporting events, sports books can generate patronage during slower periods. The property may be able to increase their profit per square foot by using some sports book floor space for extra slot capacity during peak slot volume periods that coincide with lulls in sports book volume periods. Unfortunately, it is difficult to quickly convert the space from sports book floor to slot floor and back again on a frequent basis. With the advent of innovative concepts like server-based gaming, management should consider incorporating slot terminals into their sports book operation. A bettor could make sports wagers from their slot terminal while playing the reels, without ever needing to leave their seat.

Following the same line of questioning that Lucas et al. (2006) put forth in their bingo analysis, managers must ask themselves a series of questions when determining the value and size of a sports book on their property. What would the impact be on slot revenue if a casino severely downsized or even removed the sports book from their property? Would patrons whose primary reason for coming to the property still patronize the establishment? Would the casino lose slot revenues due to the loss of the niche clientele? If so, how much revenue would be lost? What gains may occur if the space is used for an expansion of the slot floor? All these questions are certainly dependent on local competition. Several studies have been conducted on various United States casino markets, and have found that ease of access of location is a primary reason for a customer's choice to patronize a casino establishment (Pfaffenburg & Costello, 2001; Richard & Adrian, 1996; Shoemaker & Zemke, 2005; Turco & Riley, 1996). In a highly saturated market like Las Vegas, both on the Strip and in locals casinos, in which nearly all casinos have a sports book amenity, one might expect a decrease in patronage following the closing of an on-property sports book. Players who wager at both slot machines and at the sports book may still continue to patronize the casino, as the property

is still at least partially meeting their needs.

It is especially crucial that managers take heed of the results of this study, as literature shows they are currently adhering to conjecture without evidence – Eng (2008) writes of several race and sports directors from Las Vegas repeater market casinos, who state that sports books must offer state-of-the-art technology and customer service, for fear of losing their patrons. It may not be necessary to continue infusing cash into the sports book, but rather to consider a redistribution of space, to permit for more of an allocation for slot machines. As in any situation, casino management will have to weigh all options on a case-by-case basis, and cannot use the research provided here as an etched-in-stone truth.

Profit per Square Foot

Casino management teams who put an emphasis on profit per square foot may consider the research presented here to provide valuable insight as to their distribution of floor space among the various gaming amenities. The results demonstrated here fail to provide any empirical evidence that the sports book serves as a driver of slot revenues on the property. While further study is certainly recommended, such as longer-term time series analysis, casino management may want to begin considering a reallocation of the space currently used for the sports book. It seems likely that even a slot machine and sports book combination configuration would be preferable to the current sports-book-only set up, when considering the bottom line. Ultimately, the decision must be made based on empirical proof and dedication to optimizing profit per square foot, rather than blindly following the declarations of unsupported theory.

Limitations

The first and most evident limitation of the study is that the data come from a single Las Vegas repeater market property. Because of this, the results will not necessarily be generalizible to casinos in other cities, Las Vegas Strip casinos, nor to other Las Vegas repeater market casinos. The information derived from the study, however, will help the host property in casino marketing decision-making processes and provide a model and process for others to follow.

In addition, the data set used does not include any information on promotional events that occurred at the host property. There are major sporting event dates missing from the data set (i.e. Major League Baseball), because these events did not occur within the data time period.

The nature of timing of wagers at at sports book wagers provides an additional limitation. Bets are made not just moments before the game is played, but can be completed earlier in the day, week, or at any length of time before the event actually occurs, based on the house's willingness to accept the wager. The wager is counted as sports book write on the day it was placed, and was not incorporated in the indicator variables used for the major sporting events. In addition, the effects of the ever-growing population of online sports bettors is not acknowledged.

The research conducted here only delves into the seasonality variation that transpires by day and by month. Within the sports book, however, there are natural fluctuations that occur within a single day period due to the timing of sporting events. It is also possible that the effect of sports books on slot volume may be deflated due to large durations of time in which the sports book is extremely slow because there is no live feed of games.

Finally, the study cannot transcend fluctuations in the economy. The current poor economic situation may be influencing who sits in the sports book, how much disposable income they have, and how much of that disposable income they are willing to spend on the host property. Because of this, we may not be able to accurately compare these results with any past or future research.

Recommendations for Future Research

Replication of this research at a different property would provide a stronger foundation for the claims made here, and would become a balancing asset for industry decision-makers. It would certainly also be useful for a property to research ways to generate greater revenues from a sports book. Conversely, the casino would also want to analyze the expenses incurred for general sports book operations. An in-depth look at the net financial success of individual sports book promotions might help the casino create an interesting cost-benefit analysis.

Expanding the scope of their exploration by collecting data at an hourly grain, rather than the daily grain at which this data was collected, would also be beneficial. Over-aggregation of periodic results may be avoided with more sectionalized compilation of data.

It would also be beneficial to set up observation studies, in which researchers would discreetly follow patrons as they wagered in the sports book and record their actions after they left the amenity, in order to see how they spent the remainder of their time on the property. Qualitative studies like in-depth interviews, observation studies, or focus groups may also be beneficial, and would contribute greatly to the validity of the research claims.

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