A GIS Approach To Casino Market Modeling

Devlin Fung, (E-mail: dsfung@cc.memphis.edu), University of Memphis
Susan Wilkes, Harrah's Entertainment, Inc. (Memphis)

Abstract

The casino entertainment industry has emerged as one of the greatest contributors to nation's economy in terms of revenues, employment opportunities, and the building and construction industry. As a high investment business, information from market research is a critical part of in the initial investment plan. The use of Geographic Information Systems has played an important role to assist decision making in business applications. It provides a whole new dimension to information processing by introducing spatial aspect to market research. The case study in this research paper demonstrates the application of GIS for analyzing the casino center markets in Louisiana and Mississippi, and its use as a decision support tool in an executive information system.

Introduction

In the last decade the gaming/entertainment industry in the country has undergone significant changes, and has emerged as one of the greatest contributors to the nation's economy (AGA (a), 1997). Recent survey indicated that the industry is responsible for one million jobs, either directly or indirectly, providing better or higher paying jobs than other service- or entertainment-oriented industries. It has been estimated that for every \$1 million in revenues generated by the casino industry, thirteen jobs, with an average wage of \$26,000, are created. Additionally, the gaming industry has infused state and local governments with much-needed taxes. Today, casinos directly employ almost 375,000 people with a payroll of \$9.4 billion. Another 500,000 additional jobs are created indirectly through the industry's wide network of suppliers and vendors (AGA (b), 1997; Harrah's, 1997).

Readers with comments or questions are encouraged to contact the authors via e-mail.

In the early 1990s, casino gambling was legalized in Louisiana and Mississippi; since then, the gaming industry has developed beyond expectation, contributing to a great share of casino visitations in the south. The casino industry has been responsible for contributing to higher property values, leading to increased returns for property sellers. Casino businesses stimulate local construction industry, which in turn increases property tax revenues through new construction start-ups and create opportunities for property tax reduction (AGA (a), 1997).

To date, most research on the gaming industry has primarily concentrated on survey of respondents and casino players to predict consumer behavior and its socio-demographic profile (Harrah's, 1997). A very important aspect of the research, as in the case of any businesses, should also focus on the analysis of competition and revenue potential within the casino market areas. The objective of this research paper therefore, is to identify the territories/market areas of

the casino centers in the states of Louisiana and Mississippi by applying the use of geographic information systems (GIS) technology. It is beyond the scope of this paper to present an analysis of the socio-demographic characteristics of all the casino centers in the two states; instead, a case study of the Tunica/North Mississippi Casino Center is presented. In doing so, the research project also serves to demonstrate the use of GIS as a decision-support tool in identifying the potentials of a market area as a casino center.

Geographic Information Systems – An Overview

Geographic Information Systems originated from the technique of overlaying map layers conceived in the 1960s. The technology has since evolved with the advent of computing technologies, and today, a GIS represents a hardware/software system (Figure 1), designed to capture, manipulate, analyze, display and output spatial data in the form of map layers (Fung, 1995). The collection of the map layers in a digital format comprises the GIS database.

A GIS database may be conceptualized as a stack of floating map layers. Each map layer is registered to a common map base tied to a coordinate system such that information from individual layers can be spatially referenced to one another (Figure 2). In a GIS database, each map layer is also linked to a data file or files through a relational database management system. Information in the data files is associated to features on the map layer such that by querying the data files, map features can be accessed for analysis. Conversely, querying the map features can likewise access information in the data file (Fung, 1995; 1997).

In a GIS, the analysis component represents the crux of the system, and may be categorized as a) map reclassification, b) map overlay, c) neighbor characterization, and d) network analysis (Berry, 1987). The map reclassification operation allows the user to re-code information

in map layers to isolate features of interest. For instance, using the query function, the user can query a census map based on annual median income to identify various income levels. Map overlay operation provides the user the opportunity to overlay two or more map layers to identify spatial coincidence among the map features. Thus, by overlaying a property ownership map over a landuse map, the user can identify landuse type within each property. In neighbor characterization, information in a map layers are characterized based on its neighboring characteristics. Slope and aspects maps for instance, are created based on elevation data. Network analysis performs routing and resource allocation along defined network. The operation allows the use to identify best path to solve the “traveling salesman” dilemma, or identify allocation ranges of selected centers based on travel time, distance, or resource availability.

GIS analysis operations are performed with the help of GIS software. The case study presented in this paper demonstrates the combined use of these operations in a modeling process to identify and analyze the territories/market areas of the gaming and casino industry.

Study Area

The study area is located in the casino gaming centers within the state of Louisiana and Mississippi. In Louisiana, riverboat gambling is regulated by the State Riverboat Gaming Commission, and the first riverboat gambling was authorized in 1991 by the State Legislature. In 1992, one land-based casino was authorized at the Rivergate site in New Orleans. As of November 1997, a total of 14 gambling licences have been issued by the Commission, and casino gambling centers have been established in seven major centers: Shreveport/Bossier City, Marksville, Lake Charles, Charenton, Kinder/West lake, Baton Rouge, and New Orleans (Figure 3) (Ader et al, 1996). In addition to local patronage, the casino centers, particularly the Shreveport/Bossier City Center and Lake Char-

Figure The components of a GIS includes Data Input, Data analysis, and Data Output

Figure 2. A GIS Database may be conceptualized as a stack of floating layers, registered to a common map base.

Figure 3. Casino Centers in Louisiana and Mississippi.

les Center, draw their patrons from neighboring Texas. Shreveport located 20 miles from the Texas border is the closest gaming center available to the population of the Dallas/Fort Worth metropolitan area 180 miles to the west. Likewise, the Lake Charles Center benefit from the Houston metropolitan area located approximately 100 miles to the west.

In Mississippi, gambling was legalized in 1990, and the first casino was opened in 1992 (Ader et al, 1996). Legalized gambling is only allowed dockside; thus casinos can only be built on the water, and therefore casino centers are restricted to locations along the Mississippi River

or the Gulf Coast. At most of these centers, the gambling halls are elaborately built on stationary barges on the waters, with hotels, restaurants, and ancillary entertainment facilities on adjacent lands. The only exception is the casino center at Philadelphia, located within an Indian Reservation. The primary casino centers in the state include Tunica/North Mississippi, Greenville, Philadelphia, Vicksburg/Natchez, and Gulf Coast.

The Tunica/North Mississippi Casino Center, strategically located to provide the primary source of gaming entertainment to southwest Tennessee, east Arkansas, and north Mis-

Mississippi, is the primary focus of this research. In effect, it is located less than 30 miles away from the Memphis metropolitan population. Presently, there are a total of nine casinos established in the center, all of them within an hour's drive from Memphis. All the casinos provide hotel accommodations, and the recently completed 31-storey hotel at one of the casinos, Gold Strike, is the tallest building in Mississippi. Although the center attracts visitors from all over the United States, the majority of the patronage are from Tennessee, Arkansas and Mississippi (Mid-South Gaming Guide, 1997).

Geographic Information Systems Applications to Market Areas Analysis

The research was undertaken using facilities at the Laboratory for Remote Sensing and Geographic Information Systems (LRSGIS), The University of Memphis. The GIS software employed in the analysis include the ARC/INFO system and the ArcView software operating in Pentium-based personal computers, in the Windows 95 environment.

Development of GIS Database

The initial task of the analysis involves the establishment of the GIS database. The primary map layers include: transportation network of Louisiana and Mississippi, locations of casino centers in Louisiana and Mississippi, and census data by zip codes in Louisiana and Mississippi.

The transportation network data for Louisiana and Mississippi and the other surrounding states (Texas, Arkansas, Tennessee, and Alabama) were obtained from the Bureau of Census TIGER/Line files, and converted into ARC/INFO coverages. Each coverage includes a map layer of the transportation features and information of the map features in a relational data file.

To create a cover of the casino centers, the latitude and longitude coordinates of each ca-

sino center were first obtained. The data were then used to generate a map layer showing the locations of the casino centers. In the associated attribute information file, information about each casino center (e.g. number of casinos, total square footage, etc.) was coded.

The census data summarized based on zip code boundaries were obtained from the Bureau of Census. Again the data were converted into an ARC/INFO coverage, which include a map layer of the zip code boundaries and an attribute data file of census information linked to each of the zip code boundaries.

GIS Analysis

a. Identification of Territories/Market Areas

Market area for each casino center was determined based on a maximum 2-hour driving distance from each center. The tolerance distance averages approximately 120 miles, taking into consideration speed limits and road conditions. Using the resource allocation function of the network analysis, a 2-hour driving distance zone was established for each center along the transportation network (Figure 4). Once the travel zone for each center has been established, the potential market area for each center is determined by outlining each with a polygon (Figure 5).

b. Characterizing Territories/Market Areas

For each of the potential market areas, the socio-demographic information can be determined and summarized by overlaying each travel zone map with the census map layers. In Table 1, the socio-economic and demographic data associated with each of the market areas are determined. The data identified the market potential for each center, and can be mapped accordingly. In Figure 6 for instance, the concentration of adult population is mapped for the Tunica/North Mississippi Casino Center market area. It is evident that the high concentration of

Figure 4. Casino Territories based on 2-hour driving distance in Louisiana and Mississippi.

adult population located at Memphis provides the potential customers for the center. Additionally, the economic characteristics defined for the market area can be summarized and mapped. Figure 7 shows the distribution pattern of the adult population in relation to household income. This not only presents information about location of potential customers, but also identifies their economic standings. To a decision-maker, this provides critical information to target his/her marketing and advertising efforts.

Market Areas and Competition

From Figure 5, it is apparent that a high degree of overlap exists among individual casino center market areas, particularly along the Gulf Coast regions of Mississippi and Louisiana. Overlapping polygons are an indication of competition for potential customers, and the competition varies directly with the degree of overlap. The two centers with the least amount of competition are the Shreveport Casino Center located at the northwest corner of Louisiana and the Tu-

Figure 5. Casino Market Areas in Louisiana and Mississippi

nica/North Mississippi Casino center. The Philadelphia Casino Center, due to its inland location faces competition primarily from the Greenville and the Vicksburg/Natchez Casino Centers to the west, but enjoys exclusive market monopoly in the eastern part of its market, with a good portion of the customers coming from Alabama. The Greenville Casino Center shares its northern market area with the Tunica/North Mississippi Casino Center and its southern market area with the Vicksburg/Natchez Casino Center.

Defining Effective Market Characteristics

Because of the presence of competition for market resources, it is therefore necessary to analyze each effective market area, taking into consideration the segments of market areas that overlap with those of adjacent casino centers. Figure 8(a) shows the overlapping of the market extent of the Tunica/North Mississippi Casino Center with those of its two adjacent centers, Greenville and Philadelphia. In Figure 8(b), the Tunica/North Mississippi Casino Center market

area is segmented based on the overlap. Segment 1 represents the market area where Tunica/North Mississippi Casino Center enjoys exclusive monopoly. Segment 2 and Segment 3 are the portions of the market area shared with the Greenville Casino Center and the Philadelphia Casino Center, respectively, and Segment 4 is shared among the three casino centers. Therefore, to present an effective market, the overlap areas have to be shared among the respective centers. In the Tunica/North Mississippi Casino Center for instance, the potential customers will include those from Segment 1, and a portion of those from the other segments, weighted based on proximity from the respective centers. Figures 9 shows the breakdown and proportion of the effective customer shares of the Tunica/North Mississippi Casino Center. In Segment 4 where the market areas for the three casino centers overlap, the Greenville Casino Center being the closest, captures approximately 63% of the market, with the remaining almost equally divided between the Tunica/North Mississippi Casino Center (17%) and the Philadelphia Casino Center (20%).

Conclusions

Casino entertainment business is a high investment venture with tremendous financial risks. Therefore, analyzing the competition and revenue potential of the market areas is a critical part in its market research. This research project demonstrates the application of GIS for identifying casino center market areas and analyzing the area's demographic and economic features to determine the area's gaming potential.

In the analysis, a combination of GIS operations, including network analysis, map overlay, database query, and map reclassification, were employed. Market areas for individual casino centers based on 2-hour travel time along transportation network were delineated. The results indicated a saturation of casino centers, and hence, a fierce competition for market resources particularly in the Gulf Coast regions of Louisi-

Table 1. Selected Socio-Economic and Demographic Data for the Louisiana and Mississippi Casino Centers

Casino Centers	Population	Adult Pop	Households	Avg Med. HH Inc.	<=\$25K	\$25K-\$50K	\$50K-\$100K	\$100K-\$150K	>\$150K
Vicksburg	1,477,656	957,068	516,664	\$16,968	310,399	138,166	57,949	5,942	4,208
Shreveport	1,824,642	1,229,816	673,958	\$19,827	380,868	200,305	79,390	7,835	5,560
New Orleans	2,757,379	1,830,496	987,154	\$22,632	518,960	300,286	141,929	16,022	9,957
Marksville	1,818,984	1,184,426	633,408	\$19,274	365,288	179,355	75,350	8,077	5,338
Lake Charles	1,551,255	1,024,080	550,209	\$19,856	308,283	163,567	67,491	6,486	4,382
Kinder	1,943,547	1,284,776	690,276	\$20,371	381,829	203,657	89,207	9,388	6,195
Charenton	1,858,439	1,221,584	652,251	\$21,904	342,142	202,085	92,180	9,808	6,036
Baton Rouge	3,210,505	2,123,040	1,141,212	\$20,782	623,772	335,585	152,816	17,621	11,418
Tunica/N MS	2,130,435	1,418,605	770,870	\$19,862	423,605	231,051	97,260	11,194	7,760
Philadelphia	1,342,666	882,614	476,829	\$18,063	280,568	134,082	53,320	5,189	3,670
Greenville	1,300,924	842,266	453,109	\$16,364	273,337	121,084	49,595	5,275	3,818
Gulf Coast	2,525,692	1,687,812	913,731	\$21,652	491,260	276,114	123,730	13,718	8,909

Figure 6. Household Income for the Tunica/North Mississippi Casino Center Territory.

ana and Mississippi. Within the Tunica/North Mississippi market area, the socio-demographic profile was established to identify revenue potentials for the casinos. The incorporation of census information provides the opportunity to identify economic characteristics within each market areas. Where competition between adjacent casino centers exists, the effective market, and its resources are apportioned based on proximity to the respective centers. The project demonstrates the use of GIS for delineating market areas for the casino industry in Louisiana and Mississippi. It also demonstrates its usefulness as a functional information system that can be incorporated into a decision support system.

Suggestions For Future Research

The casino industry is a very dynamic and high investment economic undertaking. Analysis of the industry should focus on timely information of the market potential, competition, and existing infrastructures. The findings in this research have demonstrated the effectiveness of the use of GIS. Attempts should, and have been made, to analyze the clientele characteristics and to correlate the information to the socio-economic data of the potential markets. Although clientele information is highly proprietary, it can be obtained through secondary sources such as the sampling of patrons, vehicular information,

Figure 7. Adult Population and Household Income for the Tunica/North Mississippi Casino Center Territory.

and public access data from the Office of Planning and Development. Research should also be directed at the incorporation and use of GIS as part of the decision support system that provides high-level managers the essential tool to access, query, and analyze information from the database.

References

1. Ader, Jason N., Christine J. Lumpkins, and Christine M. Holm, 1996, *Global Gaming Almanac*, Bear Stearns, New York, New York. 526 pp.
2. American Gaming Association (AGA) (a), 1997, *Gaming Industry Myths & Facts*, URL://www.americangaming.org/media/Myths_Facts/
3. American Gaming Association (AGA) (b), 1997, *Did You Know?*, URL://www.americangaming.org/media/Myths_Facts/
4. Berry, J., 1987. Computer-Assisted Map Analysis: Potential and Pitfalls. *Photogrammetric Engineering and Remote Sensing*, Vol. 52, No. 10, pp. 1405-1410.
5. Fung, D.S., 1995. "Managing By the Map", *Business Perspectives*. The Bureau of Business and Economic Research, The

Figure 8a. Market Overlap among the Casino Centers in Northern Mississippi.

- University of Memphis. vol. 8, no. 2,
6. Fung, D.S. and A. Remsen, 1997. "Geographic Information Systems Technology for Business Applications", *The Journal of Applied Business Research*, vol. 13, no. 3. pp. 17-24.
7. Harrah's, 1997, Casino Survey, URL://www.harrah.com/survey/cc97/
8. *Mid-South Gaming Guide*, 1997. Dixie Gaming, Travel & Entertainment, vol. 1, no. 8.

Figure 8b. Segmentation of overlapping Market among the Casino Centers in Northern Mississippi.

Figure 9. Tunica/North Mississippi Casino Center's share of Market Segments