A METHOD FOR DETECTING GEOGRAPHICAL CINEMA CIRCUITS USING MARKOV CHAINS

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Abstract

Recent advances in geographical technologies provide mechanisms for remapping cinema and providing new ways of examining past histories. A new research project that investigates the application of spatial information science to cinema and film studies is currently underway. Cinema venues exist in geographic space, and draw their audiences from geographic locations. The project seeks to draw together some of the social and cultural changes that have occurred in Australia since the introduction of television in 1956.

This paper presents a smaller earlier case study that has investigated the Greek cinema circuit in Australia that operated during the period from 1949 to 1960; a period of significant Greek immigration into Australian cities and one of change brought on by changes in the film industry. The case study investigates the geographical movement of Greek film from one venue to the next. Results from this study enable statistically significant movement patterns in the Greek cinema circuit to be identified. These patterns can then be examined by film researchers as a mechanism for extracting information relating to latent relationships between film producers and venue operators, patterns that have been to date largely noted as hearsay.

The case study demonstrates the spatial and temporal aspects relating to micro-historical studies in general, and to that of the diasporic Greek cinema circuit, in particular. Additionally, this research clearly shows the need for, and application of, multi-disciplinary research.

Key words: Geovisualisation, Greek cinema, Markov Chains, GIS

1. INTRODUCTION

With advances in geographical technologies, we have seen widespread application into non-traditional studies. These "new geographies", sometimes described as the "spatial turn", are resulting in collaboration between researchers from disparate areas. We are currently participating in an Australian Research Council (ARC) Discovery project that is attempting to account for the ways in which cinema industries responded to demographic, social and cultural changes in the three decades after broadcast television became available throughout Australia. Within this undertaking is the recognition that geospatial research into data with a temporal and spatial element is essential. Therefore this project is initiating inter-disciplinary research in the fields of cinema studies and geospatial science. The key issue in our research is to investigate the most appropriate geovisualisation approaches for portraying and measuring the spatial arrangement of social factors affecting cinema circulation. Embedded within this research issue is the questions of how we manage time within what is essentially a static technology, namely geographic information systems (GIS). This study then, has far reaching implications for the geographic analyses of micro-historical data.

This paper discusses a smaller preliminary study that builds upon research into the Greek film circuit in Australia (Verhoeven 2007). The current study has investigated whether or not a spatial pattern of film movement from one venue to the next existed for the diffusion of Greek cinema in Australia between 1949 to 1960. A Greek "cinema circuit", or sequence of venues, developed in Australia in the post-war period, coinciding with significant Greek immigration into Australian cities and changes in both the Australian and Greek film industries. It has been anecdotally noted that the movement of films within the Greek cinema circuit during this period conformed to agreed patterns determined by the prevenance of the films (Verhoeven et al. 2009). We wanted to test whether or not this was in fact the case and if so, which patterns were statistically significant. These patterns could then be examined by film researchers as a mechanism for extracting information relating to latent relationships between film producers and venue operators, patterns that have been to date largely noted as hearsay. The rationale for our study is to demonstrate the role of geographic analysis in understanding cinema circuit behaviour. For example why did particuar films show in particular cinemas first before moving to another? How can the role of geospatial analysis be used in micro-historical studies?

For the purposes of pattern extraction we have adopted a statistical process referred to as Markov Chains. Markov Chains provide a powerful technique for analysing time series events where an initial condition results in a number of alternative outcomes. For example Xia et al. (2009) have adopted Markov Chains to show patterns of movements of tourists visiting Phillip Island in Victoria where alternative attractions on the island result in a range of alternative visiting patterns. Geographic movements from attraction to attraction were ascertained using participant surveys. A Markov Chain is a stochastic process, where an initial condition can result in a number of alternative outcomes that can be predicted through a probability distribution.

2. OBJECTIVES

The objective for the research presented in this paper is to establish whether or not there exists a pattern of cinema venues, referred to as a "cinema circuit", for a popular Greek film production company in post-war Australia.

Further research needs to be undertaken to extend the study outlined in this paper, to see whether patterns of venue movement varied amongst the other major contemporary Greek film producers.

3. METHODOLOGY

We have restricted our research period to the years between 1949 and 1960, and for one particular well-known and popular Greek film production company, Finos Films. Data had already been collected and compiled for Greek films during this period for venues throughout Sydney, Melbourne and Adelaide (Verhoeven 2007). Between 1949 and 1960 some 22 venues made up a thriving Greek cinema circuit throughout Melbourne (Verhoeven 2007), a time when hundreds of thousands of Greek had migrated to Australia. Earlier studies by Verhoeven and Arrowsmith had shown significant spatial correlation of Greek cinema venues to demographic concentration (Arrowsmith et al. 2008 and Verhoeven et al, 2009). The objective for the research for this paper, however, was to interrogate collected data on Greek cinema circuits demonstrated by Greek film movements, and extract statistically valid patterns of movement from one venue to the next. This would enable us to test anedotal assertions that exclusive agreements between venue operators in Australia and Greek film production companies influenced the behaviour of film distribution.

For this project, data was collected by a research assistant employed by the School of Applied Communications at RMIT University. Data included film title, production company, date of screenings, venue and venue address including city of venue. Data was sourced from archival newspaper and oral history research as well as government records, including censorship records, and theatre licence and company records. The data was initially stored in a project database called the Cinema and Audience Research Project (CAARP) database. For valid (Finos films) a total of 12 cinema venues and for 24 different films were extracted and transferred to the GIS database. Venues were located via street address or actual GPS recorded locations for where street address was not given. For the 12 cinema venues, a letter was assigned from A through to L (table 1). For each of the 24 films number 1 to 24, patterns of cinema venues were derived based on the dates of screenings. These sequences were then drawn in the form of a tree-graph as shown in figure 1 where actual numbers of films following a particular pattern are shown in parenthesis.

CODE	**THEATRE NAME**	**SUBURB**	**CITY**
A	Melbourne Town Hall	Melbourne	Melbourne
B	Lawson Theatre	Redfern	Sydney
C	Doncaster Theatre	Kensington	Sydney
D	Nicholas Hall	Melbourne	Melbourne
E	Capitol/Koinoniko Theatre	Melbourne	Melbourne
F	Cathedral Theatre/Hall	Fitzroy	Melbourne
G	Odeon Theatre	Sydney	Sydney
H	Savoy Theatre	Melbourne	Melbourne
I	Community Hall	Adelaide	Adelaide
J	National Theatre	Richmond	Melbourne
K	Cosmopolitan Theatre	Brunswick	Melbourne
L	Pantheon Theatre	Adelaide	Adelaide

Table 1: *A list of the 12 cinema venues.*

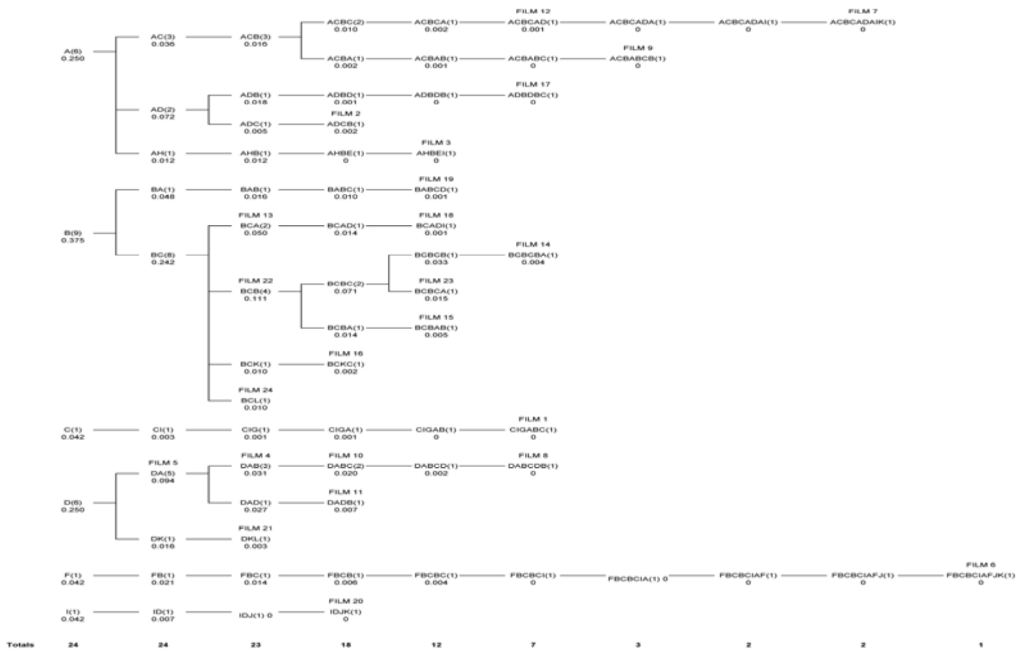

Figure 1: *Tree graph of venue probabilities for 12 films*

For each of the movements a probability was calculated. Initial probabilities were calculated for the number of films that commenced at each of the venues (table 2).

Path	Frequency	Probability
A	6	0.250
B	9	0.375
C	1	0.042
D	6	0.250
E	0	0.000
F	1	0.042
G	0	0.000
H	0	0.000
I	1	0.042
J	0	0.000
K	0	0.000
sum	24	1.000

Table 2: *Initial probabilities for one venue.*

From the patterns, for each successive movement, a set of calculated transition probabilities were determined (see table 3). This was done by counting the number of occurrences for a particular one-step sequence and dividing this by the total count from that venue to all subsequent venues occurring. For example in moving from venue A to another venue, the frequencies are shown in table 4.

These could then be used for determining the probabilities for each of the pathways shown in figure 1.

	A	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**J**	**K**	**L**	**X**	**SUM**
A	0	0.333	0.143	0.286	0.000	0.048	0.000	0.048	0.048	0.000	0.000	0.000	0.095	1
B	0.129	0	0.645	0.032	0.032	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.161	1
C	0.200	0.440	0	0.080	0.000	0.000	0.000	0.000	0.080	0.000	0.040	0.040	0.120	1
D	0.375	0.250	0.063	0	0.000	0.000	0.000	0.000	0.063	0.063	0.063	0.063	0.063	1
E	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	1.000	0.000	0.000	0.000	0.000	1
F	0.000	0.500	0.000	0.000	0.000	0	0.000	0.000	0.000	0.500	0.000	0.000	0.000	1
G	1.000	0.000	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	0.000	0.000	1
H	0.000	1.000	0.000	0.000	0.000	0.000	0.000	0	0.000	0.000	0.000	0.000	0.000	1
I	0.167	0.000	0.000	0.167	0.000	0.000	0.167	0.000	0	0.000	0.167	0.000	0.333	1
J	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0	1.000	0.000	0.000	1
K	0.000	0.000	0.200	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.200	0.600	1
L	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0	1	1

Table 3; *Transition probability matrix*

Path	**Frequency**	**probability**
AB	7	0.333
AC	3	0.143
AD	6	0.286
AE	0	0.000
AF	1	0.048
AG	0	0.000
AH	1	0.048
AI	1	0.048
AJ	0	0.000
AK	0	0.000
AL	0	0.000
AX	2	0.095
sum	21	1.000

Table 4: *Probabilities from venue A to all others*.

To calculate any particular sequence, one-step transitions are multiplied to find the resultant probability. For example to calculate the probability of moving along the three-step sequence ADCB, say for film 2 in figure 1 is:

Pr(ADCB) = Pr(A) x Pr(D|A) x Pr(C|D) x Pr(B|C)

where Pr(Y|X) is the probability of Y conditional on X being met first.

Hence from table 3:

Pr(ADCB) = 0.250 x 0.286 x 0.063 x 0.440 = 0.002

The fundamental assumption taken in this process is that each one-step transition probability is considered *stationary*; that is each one-step transition is independent of where it occurs in a Markov Chain. For example the assumption that the probability of moving from A to D in sequence pattern ADBC is the same as moving from A to D in the five-step sequence BCEFAD.

4. RESULTS

Table 5 shows key Markov Chains identified in this study.

Number of venues	Key Markov Chains identified
1	B then A and D
2	BC then DA
3	BCB then BCA followed by DAB
4	BCBC (films 14 and 23) DABC (films 8 and 10) BCAD (film 18) BCBA (film 15)

Table 5: Key Markov Chains for different numbers of venues visited.

These have been shown as animations both within Macro Media Flash (figure 2) and Google Earth (figure 3).

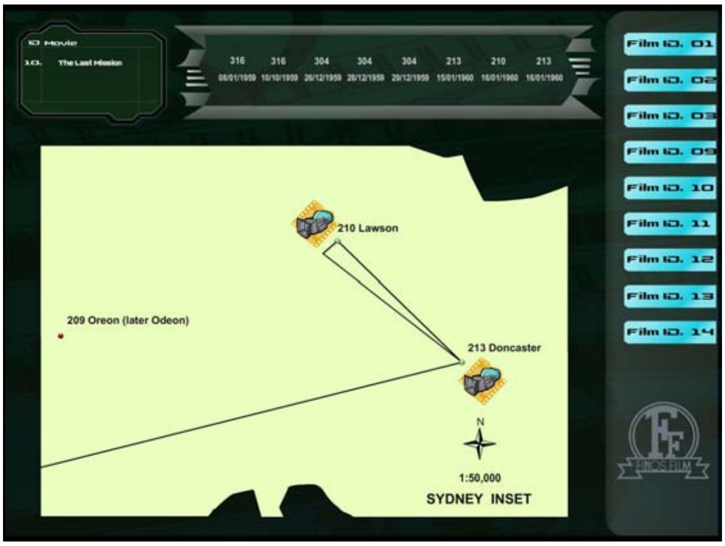

Figure 2: *Screen shot of Flash animation.*

Figure 3: *Google Earth animation screenshots*.

Analysis of these patterns shows that there was a strongly defined ‘primary’ release circuit for Finos Films made up of four venues (two in Melbourne and two in Sydney) demonstrating that the Greek circuit conformed in principle with contemporary mainstream practices of film distribution in which venues were sequentially divided between ‘first run’ and ‘move-over’ or ‘second-run’ exhibition. This is especially significant since venues A and D were not purpose-built cinemas but occasional venues. The analysis clearly shows that only single prints of these films were released in Australia. By regularizing and maximising first run release in either Sydney (venues B and C) or Melbourne (venues A and D) before transferring between cities, the Australian distributors of these films were able to minimise their costs relative to box-office returns. This practice also strongly suggests that first run releasing constituted a significant percentage of a film’s total rentals. The analysis also challenges aspects of the anecdotal record that proposed an exclusive arrangement between Finos Films and Melbourne venue operators; 12 Finos films premiered in Melbourne but 9 opened in Sydney. The data suggests instead a higher level of commercial cooperation between Melbourne and Sydney venue operators than otherwise supposed.

There are a number of limitations that have been noted with the research methodology so far. Firstly the limited number of records used in the Markov Chain determination has not enabled any model validation to take place. Normally data would be randomly selected as “training data” to be used in determining the transition probabilities, and “test data” to be used to validate the patterns using a chi-squared test (Xia et al. 2009). Secondly, limited screening times in the original advertisements used to source the database was available. This has impacted the detail of analysis because in the case of film titles screening at two venues on the same date, it was not possible to accurately determine which venue be allocated the first position in the chain. Finally the assumption of stationarity was adopted whereby one-step transition probabilities were calculated assuming the probability of moving from one venue to another was the same irrespective of where along the Markov Chain it occurred. This is possibly not always the case and the chance of a particular one-step transition may diminish as we move further along the Markov Chain.

Future research is required in two specific areas: temporal lag and determining difference in Markov Chain movements for different film producers. In this study we have shown probabilities for 24 Finos Films and how they circuited around 12 different cinema venues. Despite absolute time being implicitly shown in figure 1, there is no consideration to the relative time differences (‘windows’) between these movements. For example, following the Markov Chain sequence BCKC for film 16, we can infer that film 16 commenced its screening at venue B before moving onto C, K and then back to C. However there is no consideration in this figure of the time the film spent at venue B before moving to C, and whether or not there was any delay in that movement. The identification of ‘clearance periods’ is particularly significant for determining the distinctiveness of different forms of a release (e.g. first or second run) in the ordering of a film’s movement between venues.

Future research in this area should consider these limitations, in particular the temporal aspects. It may, for example, be possible to re-represent figure 1 where lengths of connectors between each venue correspond to the length of interval between screenings at consecutive venues.

5. CONCLUSIONS

In this paper we have discussed a multi-disciplinary research project that is attempting to use a statistical process known as Markov Chains to extract geographic patterns of movement in film screenings. We have applied this technique initially to films produced by Finos Films and distributed in Australia in the period 1949 to 1960 and have demonstrated the process is valid. Further research into exploring whether or not similar circuits exist for other contemporary film producers exist. Also further research is required to test and express geographically the effect of time lag on these movements.

6. REFERENCES

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