COMMUNITY RADIO BROADCASTS IN NORTH QUEENSLAND, AUSTRALIA: A MARKET STRUCTURE ANALYSIS USING MARKOV CHAINS

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Abstract

This paper examines competition between commercial radio and community radio in regional Australia. Based on radio listening information obtained from a sample of 528 respondents, probability measures of "switching" among radio stations are derived, and inferences about competitive market structure for radio in the region is drawn. The results of this research should help radio broadcasters fine-tune their broadcasts to either maintain or enhance station loyalty among listeners.

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Introduction

The focus of this paper is on competition among radio stations. The advertising industry in Australia classifies radio as either commercial or community broadcasts, and assumes, that competition among radio stations is intra-segment only (see Table 1 for definitions of different types of radio; Australian Broadcasting Authority, 2003). In other words, the assumption is that commercial radio does not compete with community radio for advertising revenues. As far the author is aware, little or no research has tested this assumption. This paper attempts to bridge this gap in knowledge by providing empirical tests for the assumption that commercial radio and community radio do not compete with each other.

Table 1
Radio Industry in Australia: Categories of Services and their Numbers

Concept	Definition
Commercial radio (# as at August, 2003 = 256)	Provides programs that are: i. appealing to the general public; ii. able to be received by commonly available equipment; iii. made available free to the general public; iv. usually funded by advertising revenue, and v. operated for profit

Community radio (#as at August, 2003 = 230)	Provides programs that are: i. appealing to the general public; ii. able to be received by commonly available equipment; iii. made available free to the general public, and iv. not operated for profit
National broadcasts (# as at August, 2003 = 5)	Radio services provided in accordance with the Australian Broadcasting Corporation Act 1983. This act allows up to five services in each market: metropolitan and regional.
Narrowcasting services (# as at August, 2003= ~1500)	Narrowcasting radio provides services: i. whose reception is limited; ii. that target special interest groups, or iii. that are intended for limited locations such as business premises, or iv. during a limited period to cover a special event, or v. that are of limited appeal, or vi. for some other reason.

Source: Nielsen media Research: www.Acnielsen.com.au.

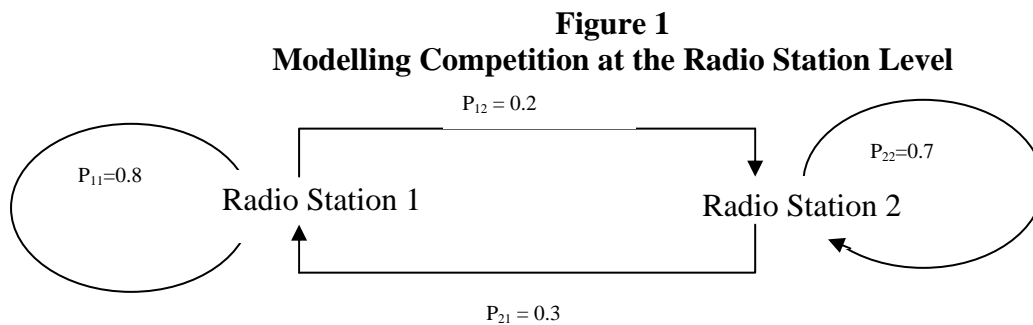**Conceptualising Competition at the Radio Station Level**

First, let's start with a <u>lexical</u> definition. A lexical definition is nothing more than a basic definition of the concept (Fredericks and Miller 1987). Accordingly, competitors for firm "x" could be defined as, 'all other firms functioning in the industry(s) in which "x" operates' (Urban and Hauser 1984). This definition could be 'operationalised' using standard industrial classification systems (SIC). For example, the manufacturing industry in Australia is represented by the SIC code "C". Each of the 17 sub-divisions within the manufacturing sector is represented by a 2-digit SIC code: for instance, C21 for "Food Beverage and Tobacco Manufacturing". Further classifications and refinements to industry groups can also be obtained (see Table 2).

Table 2
SIC Codes: How they are defined

Term	Definition
Industry Division	The industry division is represented by an alphabetical letter (for example "C" for manufacturing)
Industry subdivision	The industry subdivision is represented by the alphabetical letter of the division and a two-digit code: for instance, C21 for "food beverage and tobacco manufacturing".
Industry group	The industry group is represented by a three-digit code: for example, C218 to represent "Beverage and Malt Manufacturing".
Industry class	The industry class is a sub-section of the industry group and is represented by a four-digit code. For instance, C2181 for "Soft drink, cordial, and syrup manufacturing".

However, as observed by Davis and Divenney (1997), a firm is seldom in competition with all the other firms in the industry. For example, in Townsville: a large regional area in North Queensland, Australia, with a population of ~150,000 residents, there are four commercial radio stations, two community stations, and a number of narrowcasting services targeting special interest groups such as tourists, and religious groups. It is unlikely that all of these stations compete with each other.

Consider the following conceptualisation of competition (Figure 1). It suggests that competition for radio stations could be defined using listener behaviour. Specifically, by analysing listeners' "radio station-switching" patterns, it is possible to identify radio stations that compete with one another.

Figure 1
Modelling Competition at the Radio Station Level

$P_{12} = 0.2$

$P_{11}=0.8$

Radio Station 1

$P_{22}=0.7$

Radio Station 2

$P_{21} = 0.3$

Briefly, a radio listener can be characterised as being tuned into one of the station at a given point in time. This state: that is, listening to a radio station, may not remain constant, but change from one time period to another. Each possible change is associated with a probability measure. For instance, in Figure 1, the probability of a listener to radio station 2 in time period 1 switching to radio station 1 in time period 2 = p_{21} = 0.3. Similarly, there is a 20% chance that a listener to radio station 1 in time period 1 will switch to radio station 2 in time period 2. These transition or switching probabilities are determined on the basis of empirical evidence. An ideal situation from the viewpoint of a radio station is p_{ii} = 1: that is, no listener ever switches to another station.

The competition model given in Figure 1 is an example of a Markov process (Norris 1998). Although probability measures are used to highlight changes in radio listening habits, we do not posit that the behaviour of listeners is random. Reasons for switching may exist. The transition probabilities should be viewed as a summary description of the behaviour of a large number of listeners in the marketplace. In the following pages, the loyalty and switching probabilities of radio listeners in North Queensland are analysed to understand the competitive landscape of radio in the region.

Method

The research was conducted in the northern region of Queensland. The major city in the region, Townsville, houses two community radio stations (4TTT, and 4KIG), and four commercial radio stations (4TO, HotFM, Mix 106.3FM, and SeaFM). While AC Neilsen provides radio ratings for commercial radio stations in the region on an annual or a bi-annual basis, the community radio stations had to commission their own survey to assess their share of the radio listening market. This research utilises data gathered from a listener survey conducted for a community radio station in the region in early 2003 (Athiyaman & Thistlethwaite 2003). Briefly, the radio listening study obtained responses from 528

respondents who lived in the Townsville, Thuringowa, Burdekin, and Hinchinbrook areas during March/April, 2003 (Table 3).

Table 3
Geographical Areas Covered by the Study

Area	Area (Km^2)	Estimated Resident Population as at 1998
Burdekin shire	5,027	18,930
Hinchinbrook shire	2,869	15,577
Townville City	1,866	87,235
Thuringowa City	1,861	47,864

Respondents were asked to list radio stations listened to at specific time periods in the last 24 hours (for instance, stations listened to from 6am to 6.15am). This information was summarised into seven mutually exclusive and wholly exhaustive categories. These were: (i) listen to 4TO only, (ii) listen to HotFM only, (iii) listen to Mix106.3FM only, (iv) listen to SeaFM only, (v) listen to 4TTT only, (vi) listen to 4KIG only, and (vii) did not listen. In line with the terminology of Markov process, these seven categories will be referred to as "states" in further discussions. These states serve as the building blocks for our analysis of competition in the radio industry.

Markov Chain Analysis

Table 4 highlights the distribution of listeners in each of the six states over 18-one hour time periods. On average, commercial radio 4TO has the largest percentage of daily listeners (20%), followed by community radio 4TTT (15%).

In order to gain insights into the switching behaviour of listeners, information on successive, hourly listening patterns were analysed. The first transition probability matrix: that is, the likelihood of listeners switching between one radio station in time period "one" to another station in time period "two", is shown in Table 5. For instance, of the 112 people who tuned in to 4TO during the 6am - 7am time period, 41% stayed tuned-in to the station during the next 7am – 8am time period, 20% switched to commercial radio Mix106.3 FM, and 39% did not listen to radio during the 7am – 8am time slot. Similar two-period matrices were constructed for the remaining time periods: 17 two-period matrices to cover the 18 time periods. These matrices are shown in Table 6.

Table 4
Percentage Share of Radio Listeners

	4TO	HotFM	Mix1063	Sea FM	4tttFM	4KIG
6-7am	22	1	6	6	9	6
7–8am	24	2	7	7	10	4
8–9am	23	4	7	6	13	2
9– 10am	19	6	3	7	17	2
10–11am	17	3	3	8	18	1

11–12pm	16	4	4	7	18	0
12– 1pm	21	2	3	6	17	1
1-2pm	23	2	2	8	18	2
2-3pm	19	2	2	8	18	2
3-4pm	18	2	3	9	17	3
4-5pm	15	2	3	8	15	0
5-6pm	16	3	6	11	13	0
6-7pm	19	2	4	2	9	3
7-8pm	21	3	4	3	14	1
8-9pm	23	2	6	3	23	0
9-10pm	26	2	4	4	15	1
10-11pm	21	3	4	3	13	1
11-12am	16	7	4	2	12	5

Table 5
First Transition Probability Matrix

		Second Time Period: 7am – 8am						
		4TO	HotFM	Mix1063	Sea FM	4tttFM	4KIG	Did Not Listen
First Time Period 6am – 7am	4TO	0.41		0.20				0.39
	HotFM							1.00
	Mix106.3	1.00						
	SeaFM				0.67			0.33
	4tttFM					1.00		
	4KIG						0.50	0.50
	Did Not Listen	0.04	0.08	0.04	0.04	0.08		0.72

Table 6
Transition Frequency Matrices

F1:

	C1	C2	C3	C4	P1	P2	DN
C1	46		22				44
C2		19					5
C3	10		30				
C4				20			10
P1					46		
P2						15	15
DN	10			10	19		186

F2:

	C1	C2	C3	C4	P1	P2	DN
C1	49		24				49
C2		18					10
C3	12		23				
C4				32			12
P1					25		26
P2					10	10	
DN	9			5	18		171

F3:

	C1	C2	C3	C4	P1	P2	DN
C1	88	29					
C2		13		7			
C3			18				18
C4				30			
P1					50		16
P2						10	
DN					20		208

F4:

	C1	C2	C3	C4	P1	P2	DN
C1	64						32
C2		10					21
C3			16				12
C4				27			9
P1					69		17
P2						10	
DN							233

F5:

	C1	C2	C3	C4	P1	P2	DN
C1	43						43
C2		7					8
C3				13			5
C4				7	20		14
P1					53		18
P2						10	
DN							22

F6:

	C1	C2	C3	C4	P1	P2	DN
C1	40						41
C2	6	16					
C3			12				8
C4				18			18
P1	12				80		
P2					6	7	
DN	9			9			240

F7:

	C1	C2	C3	C4	P1	P2	DN
C1	64						43
C2		10					
C3			12				5
C4	12			18			
P1	12				82		
P2						5	
DN				9			245

F8:

	C1	C2	C3	C4	P1	P2	DN
C1	117						
C2		10					5
C3			10				5
C4	7			21			12
P1					68	23	
P2						10	
DN				8			220

F9:

	C1	C2	C3	C4	P1	P2	DN
C1	32			32	12		21
C2		8	5	5			
C3			7		5		
C4				41			
P1	6				68	12	5
P2						10	
DN			8	9	9		222

F10:

	C1	C2	C3	C4	P1	P2	DN
C1	30			13	5		44
C2		7					6
C3			8	5	5		5
C4	7	6		15	6		16
P1	12				52		44
P2						15	
DN							243

F11:

	C1	C2	C3	C4	P1	P2	DN
C1	38						38
C2		7			5		7
C3	8		11				6
C4	7			31	5		6
P1					51	10	15
P2						7	7
DN	10	20					254

F12:

	C1	C2	C3	C4	P1	P2	DN
C1	81						
C2	6	11			5		5
C3	7		17				6
C4	16			40			
P1	13				33		20
P2					5	10	
DN	8						251

F13:

	C1	C2	C3	C4	P1	P2	DN
C1	39				10		38
C2		10					5
C3			12	6			5
C4				10			
P1					46		
P2						6	13
DN					9		300

F14:

	C1	C2	C3	C4	P1	P2	DN
C1	77						30
C2	7	12					5
C3	5		12		5		5
C4	5			8			5
P1					71		
P2						5	5
DN	8	8			7		250

F15:

	C1	C2	C3	C4	P1	P2	DN
C1	39		39				39
C2		10					
C3			20				10
C4				15			
P1					51	30	
P2							5
DN					7		211

F16:

	C1	C2	C3	C4	P1	P2	DN
C1	132						
C2		7					5
C3			12				8
C4				13			7
P1					25		51
P2							5
DN							244

F17:

	C1	C2	C3	C4	P1	P2	DN
C1	17						100
C2		12					6
C3			10				10
C4				9			6
P1					66		
P2							5
DN							279

Note: i. F_i = transition from period "k" to period "k+1"; k = 1,2,…,17;
   ii. C1 = 4TO, C2 = HOTFM, C3 = MIX106.3; C4 = SEAFM, P1 = 4TTT, and P2 = 4KIG;
   iii. Only cell entries $\geq$ 5 are shown.

 Information presented in Tables 5 and 6 suggest that listening to a specific radio station in any one-hour is dependent upon listening to the same radio in the previous hour. We test this assumption statistically using the χ^2 test of homogeneity for order. The test is based on Anderson and Goodman's (1957) discussion about statistical inferences for Markov Chains. Specifically, let $F_k = [f_{ij}(k)]$ denote a transition frequency matrix where $f_{ij}(k)$ denotes the frequency of occurance of state "j" in period "k+1" and state "i" in period "k" (i,j = 1,2,…..,m:k = 1,2,..,t).

Let $\Sigma_{i=1 \text{ to } m} f_{ij}(k) = f_{.j}(k)$; $\Sigma_{j=1 \text{ to } m} f_{ij}(k) = f_{i.}(k)$

$\Sigma_{i=1 \text{ to } m} \Sigma_{j=1 \text{ to } m} f_{ij}(k) = \Sigma_{i=1 \text{ to } m} f_{i.}(k)$

Anderson and Goodman (1957) demonstrate that:

$\Sigma_{i=1 \text{ to } m} \Sigma_{j=1 \text{ to } m} f_{i.}(k) \, [f_{ij}(k)/f_{i.}(k) - f_{.j}(k)/f_{..}(k)]^2 / f_{.j}(k) / f_{..}(k)$ $\sim \chi^2{}_{(m-1)2}$

where $\sim$ highlights that the ratio of the distribution function converges to 1 as $f_{..}(k)$ tends to infinity.

In this paper, m = number of states = 7, $f_{..}(k)$ = 507. Simplifying the above mathematical formulation results in:

$507 \, [(\Sigma_{i=1 \text{ to } 4} \Sigma_{j=1 \text{ to } 4} f^2_{ij}(k) / f_{i.}(k) \, f_{.j}(k)) - 1]$ $\sim \chi^2{}_{36}$

Consider the following hypothesis:

   H_1: Listening to a specific radio station is dependent on listening behaviour exhibited immediately previously.

In other words, we subject the null hypothesis of "independent trials sequence" to statistical tests.

The χ^2 test of homogeneity for order was implemented on all the 17 transition frequency matrices shown in Table 6. The results support the hypothesis. In short, the null hypothesis that radio listening at successive one-hour time periods is statistically independent is rejected at α = 0.01 level (ν = 36; Expected χ^2 = 61.58; see Table 7).

Table 7
Results of Hypothesis Testing: Statistical Independence versus Time Dependence (First-Order)

Transition Time	Observed χ^2	Transition Time	Observed χ^2
6-7 to 7-8	806	3-4 to 4-5	910
7-8 to 8-9	750	4-5 to 5-6	818
8-9 to 9-10	1979	5-6 to 6-7	696
9-10 to 10-11	1720	6-7 to 7-8	497
10-11 to 11-12	1096	7-8 to 8-9	466
11-12 to 12-1	903	8-9 to 9-10	829
12-1 to 1-2	1149	9-10 to 10-11	649
1-2 to 2-3	1173	10-11 to 11-12	507
2-3 to 3-4	1242		

In order to assess the competitive structure of the NQ radio industry, the "loyalty" probabilities for each of the radio station for all of the time periods were graphed (Figure 2).

Figure 2
Loyalty Probabilities of Radio Stations

4TTT: Loyalty

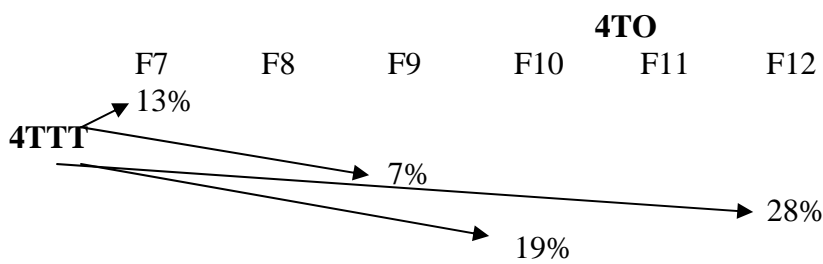Share

Time

4TTT

4KIG: Loyalty

Share

Time

4KIG
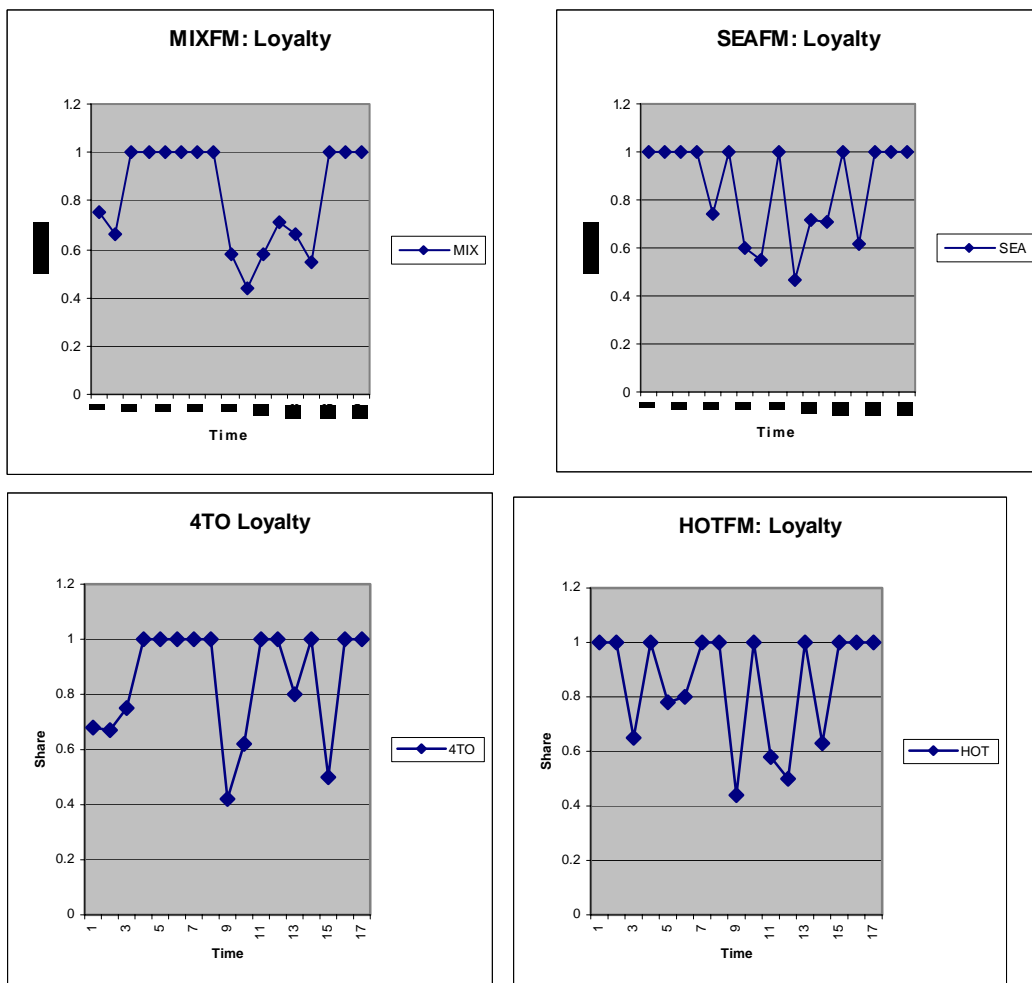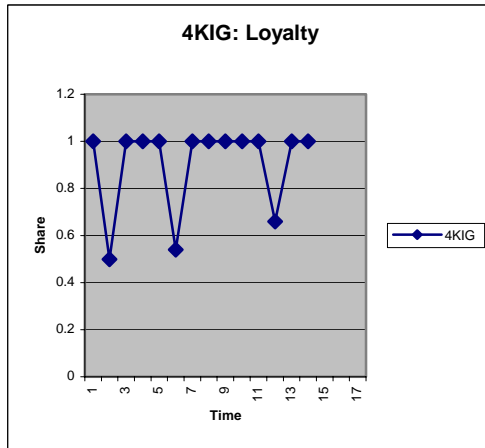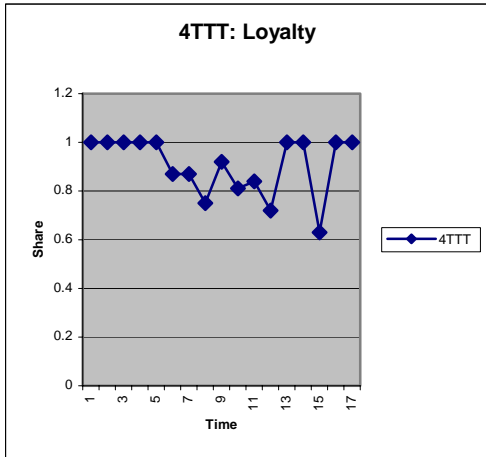
While, on average, the commercial radio stations loyalty has a range of 60% (a low of 40% and a high of 100%), community radio 4ttt's loyalty exhibits a range of 40%. In other words, 4ttt has a much higher proportion of loyal listeners than commercial radio stations.
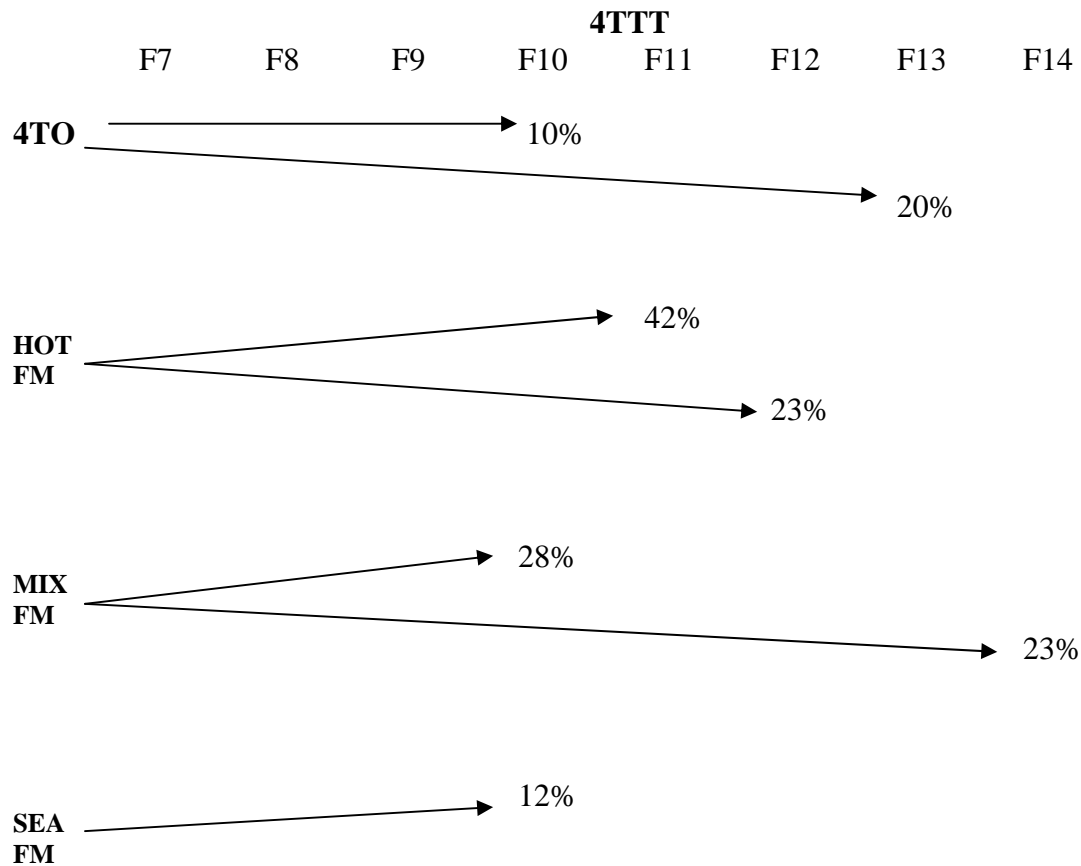
If loyalty is fleeting, what is the pattern of switching among radio listeners? The data reveal that switching between commercial and community radio happens only in the afternoon, and the evening time periods. Specifically, during the "6am to Noon" time period, the four commercial radio stations in the region compete only among themselves. In the afternoon and evening time slots, commercial stations compete with the community radio 4ttt for listeners.

The pattern of competition is as follows:

(i) From Community Radio to Commercial Radio

4TO

F7   F8   F9   F10   F11   F12

13%

4TTT

7%

28%

19%

(ii) From Commercial Radio to Community Radio

4TTT

| F7 | F8 | F9 | F10 | F11 | F12 | F13 | F14 |

4TO → 10%
→ 20%

HOT FM → 42%
→ 23%

MIX FM → 28%
→ 23%

SEA FM → 12%

Note: F_i = transition from period "k" to period "k+1"; k = 1,2,…,17. For example, F7 captures the transition between the "12 Noon –1pm" time period to the "1pm-2pm" time slot

Summary

This paper tested the commonly held belief in the community that commercial radio does not compete with community radio. A time series analysis of radio listening habits of 528 residents in the Townsville region revealed that commercial radio and community radio do compete with one another. Specifically, on average, a maximum of four listeners to commercial radio switched to community radio "4TTT" in the afternoon and/or the evening time period. The "drive time" programming in 4tttt (that is, the broadcast that commences at 3pm in the afternoon) tends to be attractive for commercial radio listeners. This is not surprising given the fact that the community radio in the region (4TTT) holds the second largest market share (15%) in the region. Finally, this paper provides information that can be used by regional radio broadcasters to understand the relationships they have with their listeners.

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