



HOKKAIDO UNIVERSITY

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Network Analysis of the Traffic Lines of the Tourists visiting Kamikawa Central District in Hokkaido, Japan

— Based on the Data from the “Kamui Mintara” Stamp Rally —

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The purpose of this study is to provide relevant information to managers and local government officers in designing promotional strategy for tourism by analyzing the traffic lines of the tourists visiting Kamikawa Central district.

There is no data for analyzing traffic lines of tourist and it is unlikely that the Japanese government will develop such a database in the near future, owing to the high cost. However, analysis of tourist traffic lines is essential to developing the tourism sector.

Luckily, we have been given the opportunity to gather data regarding the traffic lines of tourists in Kamikawa Central district. We obtained the data by tracing stamps on an application form, used by participants in the Kamui Mintara Stamp Rally. We also collected personal data, including gender, age, residence, accommodation type and length of stay, through the questionnaire, which the participants had to answer to be eligible for free gifts offered by the commission of the Kamui Mintara Stamp Rally. Using these data, we can analyze the traffic lines of tourist in Kamikawa Central district and the length of tourist stay. Since the number of samples from the stamp rally is sufficient size, the state of tourism in Kamikawa Central district reflected the result of the Kamui Mintara Stamp Rally.

First, we investigated the correlation between seven well-known tourist spots between 2009 and 2010 using the questionnaire. The spots are Asahiyama Zoo; Biei; Furano; Mt. Asahidake; Souunkyoku; Tenninkyoku; and Shirogane. Second, we use the data from the answers to question 8 in the questionnaire. With these, we can make the network graphs of the traffic lines of tourists going around Hokkaido. Third, we investigate the characteristics of the network of tourists' traffic lines in Kamikawa Central district using network analysis by year and by residence.

As a result, we obtained eleven findings in this study. In particular, we summarize three main findings below

- 1. Souunkyoku is isolated from the other six well-known spots because of geographical position and we found that the correlation coefficient between Asahiyama Zoo and Biei decreased between 2009 and 2010.*
- 2. There are seven well-known spots that are important for tourism in Kamikawa Central district. Additionally, we show that Sapporo;*

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Asahikawa; Abashiri; Shiretoko; Obihiro; Tomamu; Akanko; Teshikaga and Kushiro were closely linked with Kamikawa Central district and are also important for tourism in Kamikawa Central district using visualization of the networks.

3. *The average degree of node and the network density of the networks increased incrementally and both the clustering coefficient and the average path length of the networks are large compared to that of the random graph. The high average degree of nodes and density are better than a low average degree of nodes and density in terms of total economic activity and the large clustering coefficient means that 6 spots are closely related to each other. The large average path length means that Kamikawa Central district is divided into two areas in terms of tourism because traffic lines between two areas were often severed.*

We conclude that visualization and network analysis are both necessary to understand the traffic lines of the tourists.

JEL Classification: R11, R41, R58

Keywords: Network Analysis, Internal Tourism, Local Economy, Wide-Range Co-Operation

1. Introduction

In recent years, the Japanese government has promoted measures concerning the development of tourism statistics. As a result, we now have easy access to information about tourism in Japan, such as surveys of trends in well-known tourism sites¹⁾. However, it is still very difficult to gain information concerning the path of tourists. There is no data for analyzing traffic lines of tourist and it is unlikely that the Japanese government will develop such a database in the near future, owing to the high cost. However, analysis of tourist traffic lines is essential to developing the tourism sector.

Luckily, we have been given the opportunity to gather data regarding the traffic lines of tourists in Kamikawa Central district. We obtained the data by tracing stamps on an application form, used by participants in the Kamui Mintara Stamp Rally. We also collected personal data, including gender, age, residence, accommodation type and length of stay, through the questionnaire, which the participants had to answer to be eligible for free gifts offered by the committee of the Kamui Mintara Stamp Rally. Using these data, we can analyze the traffic lines of tourist in Kamikawa Central district and the length of tourist stay. Since the number of samples from the stamp rally is sufficient size, the state of tourism in Kamikawa Central district reflected the result of the Kamui Mintara Stamp Rally.

The purpose of this study is to assist managers and local government officers who engage with the tourism sector to design a proper strategy for promoting tourism. This paper introduces visualization of network and network analysis

¹⁾ [11]

of the traffic lines of tourists. The results obtained in this paper suggest that we have to consider the formulation of tourism promotional strategy from a trans-regional perspective.

2. The State of Tourism in Kamikawa District

Hokkaido prefecture is a leading tourist resort / region in Japan. The tourism sector in terms of number of nights stayed is the second-largest in the country. Various tours via Sapporo, the capital of Hokkaido, are very popular. The typical tourist visiting Hokkaido visits several cities and stays for a few days in each. This paper examines tourism in Kamikawa district, which is located in the middle of Hokkaido. Kamikawa district is controlled by the Kamikawa branch of the Hokkaido prefecture office. The population of Kamikawa district is around 520,000 and makes up around 9.5% of the total population of Hokkaido prefecture. Asahikawa (with a population of around 350,000) is the largest city in Kamikawa and is based in Kamikawa district. The group made up of Asahikawa; Higashikawa; Higashikagura; Biei; Tsuma; Takasu; Pippu; Aibetsu; and Kamikawa comprises Kamikawa Central district. The population of the group is around 420,000. A number of famed tourist sites are concentrated within the district; for example, Asahiyama Zoo and the permanent pedestrian precinct in Kaimono Koen in Asahikawa, the beautiful hills in Biei, and Souunkyo in Mount Daisetsu National Park in Kamikawa town.

Figure 1 shows the number of tourists²⁾ visiting all Kamikawa district and Kamikawa Central district in fiscal years 2008/11 (April-March). In 2008/09, the number of tourists visiting all Kamikawa district decreased by 4.7% year on year and the number of tourists visiting Kamikawa Central district decreased by 7.6% year on year, owing to the influence of the Lehman Shock and soaring oil prices. In 2009/10 the number of tourists visiting Kamikawa district decreased by 1.1% year on year, but the number of tourists visiting Central district decreased by 4.7% year on year. A popular television drama filmed in the district city of Furano that was broadcast in various Asian countries and a significant discount in the ex-

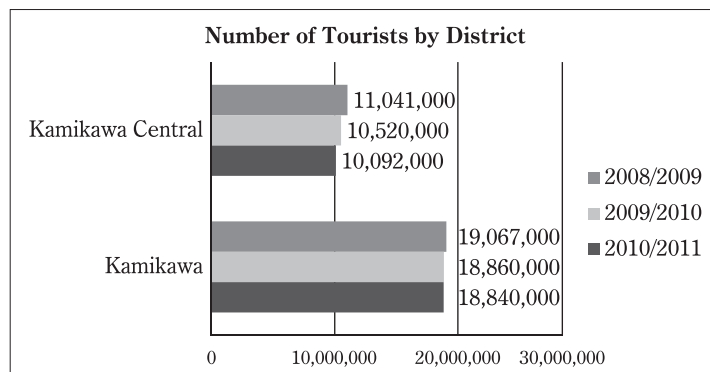


Figure 1 Number of Tourists in Kamikawa District and Kamikawa Central District

Note: Prepared by [1] [2] [3]

²⁾ [1] [2] [3]

pressway toll contributed to the breaks on the declining tourists. The decline of the number of tourists visiting Kamikawa Central district is attributable to multiple factors. For example, some events were called off because of a new influenza epidemic, depression after the Lehman Shock and the unusual weather in summer. In 2010/11, the number of tourists visiting Kamikawa district was not recovered to the level of 2008/09.

The number of tourists visiting Kamikawa Central district decreased from 2008/09 to 2010/11, not owing to structural reasons, but to the harmful effect of the business cycle.

Next, the structural problems for tourism in Kamikawa Central district are discussed. Figure 2 shows the proportion of day trips and overnight trips in Kamikawa Central district. As shown in Figure 2, we confirmed that the percentage of day trips in Hokkaido is around 70%³⁾ is higher than the percentage of day trips in Kamikawa Central district. This indicates that the number of tourists is not in proportion to the number of overnight trippers in Kamikawa Central district.

Figure 3 shows the division of tourists by residence. Distinction is made

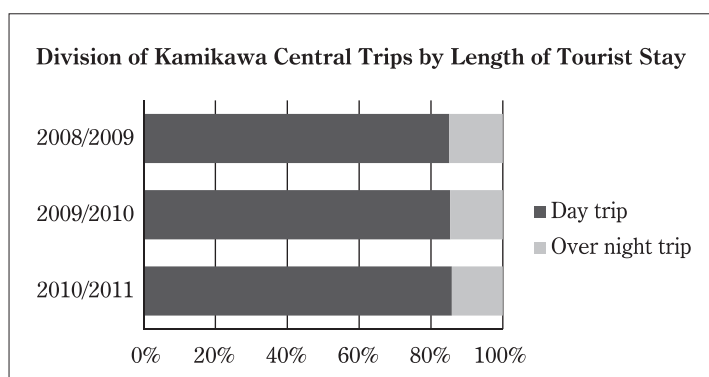


Figure 2 The Percentage of Day Trips to Overnight Trips in Kamikawa Central District

Note: Prepared by [1] [2] [3]

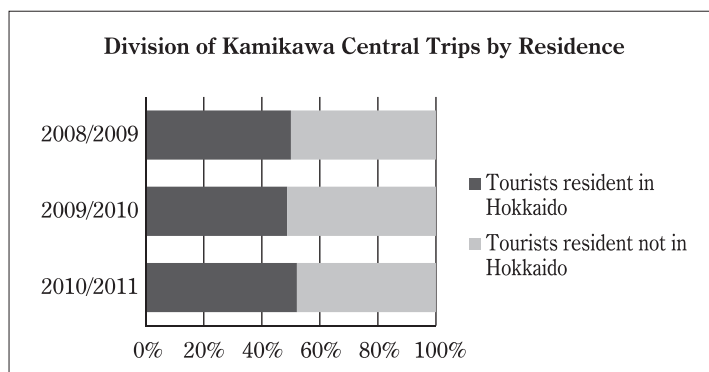


Figure 3 Division of Tourists by Residence

Note: Prepared by [1] [2] [3]

³⁾ [4] [5] [6]

between tourists who live in and outside Hokkaido. The number of tourists resident in Hokkaido is almost equal to the number of those who live outside Hokkaido. The ratio of tourists resident in Hokkaido to those living outside Hokkaido visiting Kamikawa Central district is lower than for those visiting Hokkaido. This illustrates that a greater proportion of tourists visiting Kamikawa Central district are resident outside Hokkaido than those visiting Hokkaido as a whole.

Figure 4 shows the number of overnight stays by foreigners, by district. Figure 4 demonstrates that around 30% of foreign tourists visiting Hokkaido visited Kamikawa Central district. From in 2009/10, the number of foreign tourists visiting Kamikawa Central district decreased faster year on year than that for Hokkaido as a whole, following the Lehman Shock. The 2010 data were not available at time of writing. In terms of foreign tourists in the region, most come from Taiwan, followed by Hong Kong, China and Korea. Numbers of tourists from Taiwan and Hong Kong have decreased in recent years, but the number from China is increasing rapidly. This upward trend is expected to continue in the medium term at least.

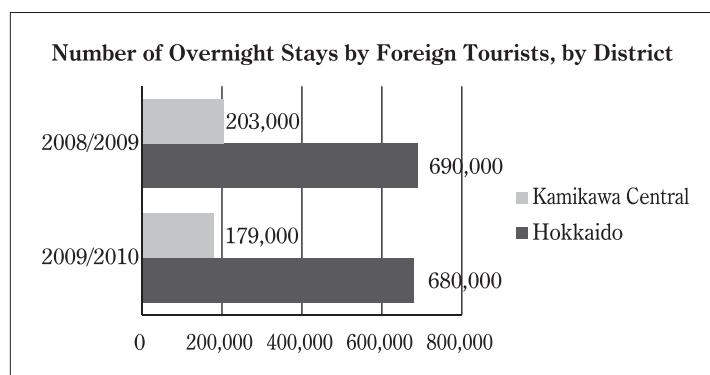


Figure 4 The Number of Overnight Stays by Foreigner

Note: Prepared by [1] [2] [3] [4] [5] [6]

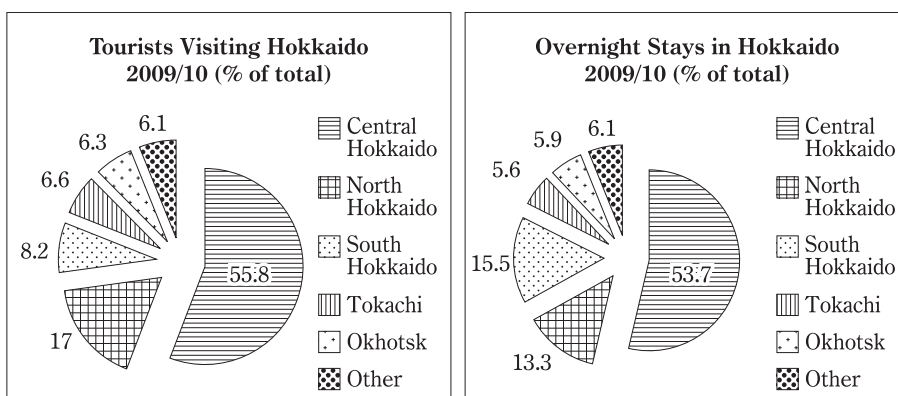


Figure 5 The Number of Tourist Visiting Hokkaido and Overnight Stays in Hokkaido by District

Note: Prepared by [5]

Figure 5 shows that the proportion of tourists visiting North Hokkaido to all Hokkaido in 2009 was 17% and the proportion of overnight stays in North Hokkaido to all Hokkaido was 13.3%. A significant problem with tourism in Kamikawa Central district is that the rate of overnight stays is lower than the rate of tourists visiting North Hokkaido, in spite of the higher proportion of visitors resident outside Hokkaido compared with those visiting South Hokkaido. A possible solution could be that the tourism sector in Kamikawa Central district tries to enhance the rate of overnight stays. We think mutual co-operation among the city and the eight towns in Kamikawa Central district is essential to promoting tourism.

3. What is the “Kamui Mintara” Stamp Rally?

A Stamp Rally is where one goes around to certain locations to have a book stamped with rubber stamps. Each location has a unique stamp. While there are prizes to be won from stamp rallying, some people just participate for fun. Locations include railway stations; roadside stations; tourist spots; shops; and so on.

In 2006, the Daisetsu Kamui Mintara Stamp Rally was started by the committee⁴⁾ of the Kamui Mintara Stamp Rally. The purpose of introducing the Stamp Rally was (1) to attract more tourists to the Kamikawa Central district; (2) to create a model project for promoting inter-regional tours (trying to include many of the tourists visiting Hokkaido); and (3) promoting food tourism. Participants deposit their postcards in mailboxes for the committee of the Kamui Mintara Stamp Rally after they have collected three to six stamps and answered the questionnaire printed on the front of the postcards. They are then entered into a prize lottery.

Table 1 shows a list of locations with stamps in 2010. The participants stamp their books free of charge from No.1 to No.20 and from No.101 to No.105. Otherwise, they can stamp their books only when they purchase goods or services in the stamp locations. Promoters expect to attract customers through stamp-collection and send the customers to other locations; participants are not eligible for free gifts unless they collect a minimum of 3 stamps.

Table 1 A List of Locations Participating in the Kamui Mintara Stamp Rally in 2010

Note: Prepared by the special advertisement of Hokkaido Shinbun (newspaper)

NO	Name of location
1	Asahikawa Kanko Jyouthou Center (旭川観光情報センター)
2	Machinaka Kouryu Kan (まちなか交流観 観光情報センター)
3	Kouyukai Asahiyama Doubutsuen (厚友会旭山動物園店(あざらし館))
4	Michi no Eki Asahikawa (旭川地場産業振興センター(道の駅あさひかわ))
5	Omocha no Yoshida (おもちゃのヨシダ)
6	JA Asahikawa Nousanbutsu Chokubaijyo "Asagao" (JAあさひかわ農産物直売所「あさがお」)
7	Ueno Farm (上野ファーム)
8	Asahikawa Hashin Land Sakuraoka (旭川発信ランド桜岡)
9	Chairs Gallery (コレクション館 チェアーズ・ギャラリー)

⁴⁾ The committee made up of the Kamikawa branch in the Hokkaido office; Asahikawa city office; Higashikagura town office; Biei; Tsuma; Takasu; Pippu; Aibetsu and Kamikawa.

10	Soba Izakaya Wakura (蕎麦居酒屋 和蔵)
11	Asahikawa Yokochō Gyouza no Pon (旭川横町 餃子のぼん)
12	Higashikagura Shinrin Koen (ひがしかぐら森林公園(管理棟))
13	YuYu Pippu (良佳プラザ 遊湯びっぷ)
14	Community hall Kura (コミュニティホール 蔵ら)
15	Taisetsu Zan Souunkyo Kurodake Ropeway (大雪山層雲峡・黒岳ロープウェイ)
16	Ryusei Ginga no Taki Kyukeisyo "Takimintara" (流星・銀河の滝休憩舎「滝ミントラ」)
17	Gurume Koubou Kamukamu (ぐるめ工房かまかむ)
18	Michino Eki Higashikawa "Michikusa Kan" (道の駅ひがしかわ「道草館」)
19	Taisetsu Zan Asahidake Ropeway (大雪山旭岳ロープウェイ)
20	Michi no Eki Biei "Okanokura" (道の駅びえい「丘のくら」)
21	Tezukuri Nyuseihin Kurimari Noumu (手づくり乳製品クリーマリー農夢)
22	Asahiyama Doubutsuen Higashimon restaurant Mogumogu terrace (旭山動物園東門レストランモグモグテラス)
23	Wanomi (和のみ)
24	Asahikawa Ramen Mura (あさひかわラーメン村)
25	Kateiryouri Kasube (家庭料理 かすべ)
26	Tezukuri Tofuryouri no Mise "Densyoukan" (手作り豆腐料理の店「伝承館」)
27	Pizza house cocoperi (ピザハウスココペリ)
28	Kourinbou (光林坊)
29	Variety Kichen Kamifusen Pippu branch (ばらえていきっちゃん紙風船 比布店)
30	Miso Ramen no Yoshino Kamikawa branch (みそラーメンのよし乃上川店)
31	Kiyoshi Syokudou (きよし食堂)
32	Ramen no Tetsujin Shibayama (ラーメンの鉄人 しばやま)
33	Asahi Syokudou (あさひ食堂)
34	Teuchi Soba Hibiya Hanabusa (手打ちそば 日比谷 英(はなぶさ))
35	Ekimae Antenna Shop (駅前アンテナショップ)
36	Goma Soba Tsuruki (ごまそば鶴)
37	Zerebu no Oka Restaurant (ぜるぶの丘レストラン)
38	Teuch Pasta Senmonten "Dagurasfa" (手打ちパスタ専門店 だふらすふぁー。)
39	Farm Restaurant Chiyoda (ファームレストラン千代田)
40	Roterudo Kitakurabu Honten (ロテル・ド・北倶楽部 本店)
41	The San Kuroudo (The Sun 蔵人)
42	Tsuboya Souhonten Nanakamado Kan (壺屋総本店 なな花窓館)
43	Roterudo Kitakurabu Chuwa (ロテル・ド・北倶楽部 忠和店)
44	Hokkaido Hatsu Hokkaido no Kanrintouya Kitakari (旭川発 北海道のかりんとう屋 北かり)
45	Hokkaido Hatsu Hokkaido no Kanrintouya Kitakari ya (旭川発 北海道のかりんとう屋 北かり屋)
46	Ice Koubou Tamura Farm Clover (アイス工房 田村ファーム clover)
47	Tanbo no Chiisana Purinya San" Pippurin" (田んぼの中の小さなプリン屋さん「びっぷりん」)
48	Kyouwa no Sato no Mochikoubou Aifukufuku (協和の里のもち工房 愛ふくふく)
49	Himeya Seipan Kashiho (ひめや製パン菓子舗)
50	Ice cream Koubou Bereru Taisetsukougen Asamogi Sijyyou (アイスクリーム工房ベレル 大雪高原 朝もぎ市場)
51	poire Tengetsuan (ポアール月庵)
52	Taisetsu Jibeer Kan (大雪地ビール館)
53	Takasago Meiji Syuzou (高砂明治酒蔵)
54	Jizakegura Taisetsu no Kura (地酒蔵 大雪乃蔵)
55	Otokoyama Sakazukuri Siryoukan (男山酒造り資料館)
56	Asahiyama Doubutsuen Higashimon Baiten tailn tail (旭山動物園東門売店「テイルン・テイル」)
57	Boku Yuuki Kubo Nouen Chokubaisyo (ぼく勇気 久保農園直売所)

58	Kitano Mori Garden (北の森ガーデン)
59	Hirata Toufu Ten (平田とうふ店)
60	JA Biei Biei Senka (JAびえい 美瑛選果)
61	Iyashi no Kukan Gallery & Zatsuka Jiyuugaoka (癒やしの空間～ギャラリー&雑貨時遊が丘)
62	Miura Ayako Kinen Bungakukan (三浦綾子記念文学館)
63	Hokkaido Dentou Bijyutsu Kougei Mura Yuukaraori Kougeikan (北海道伝統美術工芸村 優佳良織工芸館)
64	Craft Brown Box "Arashiyama Tougei no Sato" (クラフトブラウンボックス(嵐山陶芸の里))
65	Hokuchin Kinenkan (陸上自衛隊第2師団 北鎮記念館)
66	Craft Kan (クラフト館)
67	Seikai no Konchukan Papillon Château (世界の昆虫館 パピヨンシャトー)
68	Hokkaido Ice pavilion (北海道アイスパビリオン)
69	Takushinkan (前田真三フォトギャラリー「拓真館」)
70	Nishimi no Mori Bijyutsukan (西美の杜美術館)
71	Morinoyu Hanakagura (森のゆ花神楽)
72	Kyouwa Onsen (協和温泉)
73	Souunkaku Grand Hotel (層雲閣グランドホテル)
74	Hotel Taisetsu (ホテル大雪)
75	Souunkyoku Kankou Hotel (層雲峡観光ホテル)
76	Souunkyoku Chouyoutei (層雲峡朝陽亭)
77	Souunkyoku Onsen Chouyou Resort Hotel (層雲峡温泉朝陽リゾートホテル)
78	Hotel Souun (ホテル層雲)
79	Mount View Hotel (マウントビューホテル)
80	Yumoto Ginsenkaku (湯元銀泉閣)
81	Tenninkaku (天人閣)
82	Tenninkyoku Park Hotel (天人峡パークホテル)
83	Onyado Shikishima Sou (御やど しきしま荘)
84	Tenninkyoku Grand Hotel (天人峡グランドホテル)
85	Grando Hotel Taisetsu (グランドホテル大雪)
86	Asahidake Manseikaku Hotel Bearmonte (旭岳万世閣ホテルベアモンテ)
87	Yumoto Yukomanso (湯元 湧駒荘)
88	La Vista Taisetsusan (ラビスタ大雪山)
89	Lodge Nutapukaushipe (ロッジ スタパカウシペ)
90	Shirogane Shiki no Mori Hotel Park Hills (白金四季の森 ホテルパークヒルズ)
91	Asahikawa Grand Hotel (旭川グランドホテル)
92	Loisir Hotel Asahikawa (ロワジールホテル旭川)
93	Asahikawa Terminal Hotel (旭川ターミナルホテル)
94	Hotel Resol Asahikaswa (ホテルリソル旭川)
95	Hotel Crescent Asahikawa (ホテルクレセント旭川)
96	Fujita Kankou Washington Hotel Asahikawa (藤田観光ワシントンホテル旭川)
97	Asahikwa Washington Hotel (旭川ワシントンホテル)
98	Hotel Leoplace Asahikawa (ホテルレオパレス旭川)
99	Asahikawa Toyo Hotel (旭川トヨーホテル)
100	Wafu Ryokan Sensyoen (和風旅館 扇松園)
101	Souunkyoku Hanamonogatari (層雲峡花ものがたり)
102	Higashikawa Dontokoi Matsuri (東川どんとこい祭り)
103	Higashikagura Hana Matsuri (ひがしかぐら花まつり)
104	Takasu Nekka Festa 2010 (たかす熱夏フェスタ2010)
105	Asahikawa Kitano Megumi Tabe Marché (旭川「北の恵み 食べマルシェ」)

●アンケート項目

次の質問に当てはまる数字を右の回答欄に記入してください。
またカッコ内には必要事項を記入してください。

- Q1: カムイミントラロゴマークをこれまでに見たことがありますか?
①ある ②ない
- Q2: このスタンプラリーの移動手段は次のうちのどれですか?(複数回答可)
①自家用車 ②レンタカー ③オートバイ ④JR ⑤バス ⑥その他
- Q3: このスタンプラリーのことをどこで知りましたか?(複数回答可)
①新聞折り込み広告 ②インターネット ③ポイント施設 ④知人・友人
⑤リーフレット(タブロイド紙)(入手場所を記入してください) ⑥その他
- Q4: このスタンプラリーには、以前に参加したことがありますか?(複数回答可)
①2007年参加 ②2008年参加 ③2009年参加 ④参加したことはない
- Q5: どのようなグループで参加しましたか?
①家族 ②友人 ③単独 ④団体旅行 ⑤その他
- Q6: 今回の旅行で訪れた先はどこですか?(複数回答可)
①旭山動物園 ②美瑛 ③富良野 ④旭岳温泉 ⑤層雲峡温泉
⑥天岩温泉 ⑦白金温泉 ⑧その他
- Q7: 旅行の期間はどのくらいですか?
①日帰り ②1泊2日 ③2泊3日以上
- Q8: 7の質問で宿泊された方にお伺いします。今回の旅行の宿泊地はどこですか?
※宿泊地が複数ある場合は、宿泊した順番にすべて記入してください。
(市町村名もしくは温泉地名でも可)
- Q9: 道外から参加した方にお伺いします。来道手段は次のうちのどれですか?
①航空機 ②フェリー ③JR ④その他
- Q10: 9の質問で航空機、フェリーを回答した方にお伺いします。
どこの空港もしくはフェリー会社(港)を利用しましたか?
①旭川空港 ②新千歳空港 ③その他の空港 ④商船三井フェリー
⑤太平洋フェリー ⑥新日本海フェリー ⑦その他のフェリー
- Q11: 今回の旅行の申込方法は?
①個人手配 ②インターネット ③旅行代理店(会社名・店名) ④その他

※アンケートには必ず回答してください。

※(個人情報)の取り扱いについて

取得した個人情報は、次の目的の範囲内で利用します。

(1) 抽選会での当選者の発表 (2) 賞品の発送 (3) 個人を特定できない統計的な資料の作成

(The text of the questionnaire; 1) Do you know the logo? 2) Means of transport; 3) How did you find out about the stamp rally? 4) How often did you participate in stamp rallies? 5) What kind of groups do you belong to? 6) How many of the following seven tourist spots did you visit? 7) What is the length of your stay? 8) What is the name of the place of your overnight stay? 9) What is your means of transport from outside Hokkaido? 10) Which airport or ferry did you use? 11) How did you arrange this trip?

Figure 6 The Questionnaire on the Front of the Postcard in 2010

The committee of the Kamui Mintara Stamp Rally carried out a questionnaire survey. The questionnaire is written on the front of postcards (see Figure 6). The committee can collect personal data regarding age, gender, address, etc, through the questionnaire and use the information to analyze the trends of tourists participating in the stamp rally.

We noticed two important areas of data for analyzing the trends of tourists in Kamikawa Central district in 2009. One regards how many tourist spots a participant visits out of seven well known spots. We can use these data for analyzing the correlation between the seven tourist spots. The correlation is explained in Section 5. Another data set was derived that involved the use of a unique stamp at each location. We can use various network analyses of the traffic lines of tourists visiting Kamikawa Central district based on the stamp data. These network analyses are explained in Section 7.

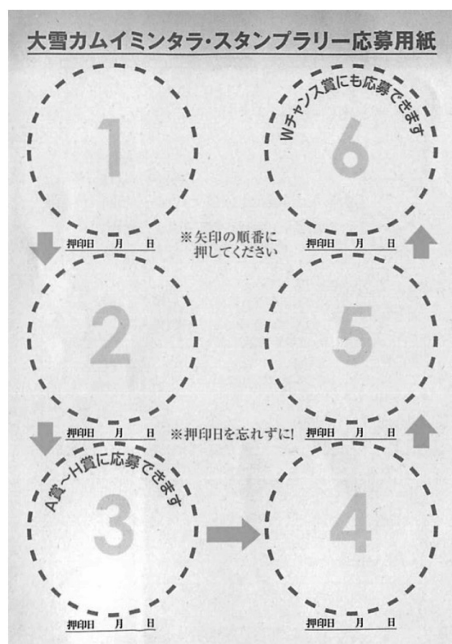


Figure 7 Reverse Side of Postcard to the Committee of the Kamui Mintara Stamp Rally in 2010

4. Characteristics of the Tourists Visiting Kamikawa Central District by Residence

The Kamui Mintara Stamp Rally held for the fifth time in 2010. Table 2 shows that the number of applicants increased gradually between 2006 and 2008. However, the number decreased year on year in 2009 because of the Lehman Shock. In 2010, the number increased year on year because of economic recovery in Japan. Table 3 shows the applicants by residence. In 2007, the proportion of applicants outside Hokkaido of all applicants is a little less than 60%. The proportion decreased over the following two years and was 31.2% in 2009.

Table 2 Changes in the Number of Applicants

Note: Prepared by [7] [8] [9]

Year	2006	2007	2008	2009	2010
No. applicants	584	2376	5652	4062	4891

Table 3 Changes in Applicants by Residence

Note: Prepared by [7] [8] [9]

	2007	Component ratio	2008	Component ratio	2009	Component ratio	2010	Component ratio
Kamui Central	456	20.0%	1776	31.4%	1830	45.1%	2181	44.6%
Hokkaido	491	21.5%	1614	28.6%	949	23.4%	1268	25.9%
Outside Hokkaido	1337	58.5%	2262	40.0%	1266	31.2%	1441	29.5%
Unidentified					17	0.4%	1	0.0%
Sum	2284	100.0%	5652	100.0%	4062	100.0%		100.0%

The reason why the ratio decreased is that an influenza epidemic and soaring oil prices prevented tourists from making long-haul trips. Tourists favored “cheap”, “near home”, “short period of stay” trips in and after 2009. As a result, the ratio of applicants in Kamikawa Central district to all applicants increased to around 45% after 2009. In 2010 applicants in Asahikawa accounted for 87% of applicants in Kamikawa Central district. The number of applicants in Sapporo (41%) accounts for the highest percentage in Hokkaido outside Kamikawa Central district. Outside Hokkaido, the largest number of applicants come from Tokyo; Kanagawa; Chiba; Saitama; and Osaka.

Family trips account for 85% of all trips. Trips with friends account for 8% and solo trips account for 5%. Group tours account for 1% of all trips. The reason for the low ratio of group tours to all trips is that group tourists⁵⁾ find it difficult to participate in the rally because of group bus travel.

Figure 8 shows means of traffic by residence during the stamp rallying in 2010. Over 85% of tourists resident in all area used cars (including rental car) as their means of transport. Around 10% of tourists resident outside Hokkaido used buses. Namely the main means of traffic is a car.

Figure 9 shows means of traffic by the resident not in Hokkaido. Over 70% of them traveled by plane. The rate of ferry use is 21%. It is worthy of note that the rate of ferry use during the stamp rally is higher than the average rate of ferry use in Hokkaido⁶⁾. Since 2010, the committee of the Kamui Mintara Stamp Rally had asked the tourists which ferry they used. See Figure 10 in detail.

Figure 10 shows airport and ferry use by the applicants for the stamp rally in 2010. Many applicants resident outside Hokkaido used Asahikawa airport and/or Shinchitose airport. More used Asahikawa airport than Shinchitose airport. Typical tourists resident outside Hokkaido visiting Kamikawa Central district arrived at Asahikawa airport first and then went on tours around Kamikawa Central dis-

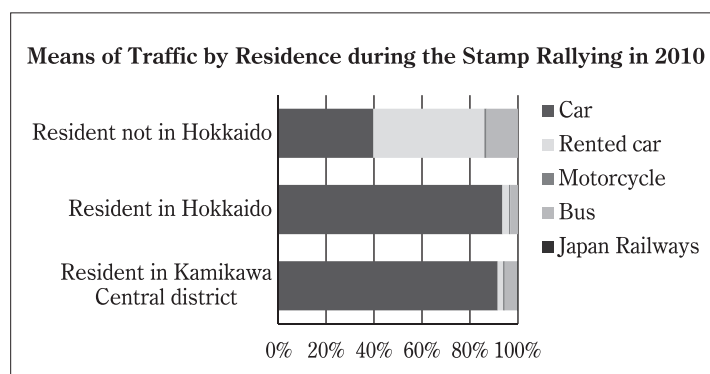


Figure 8 Means of Traffic by Residence during the Stamp Rallying in 2010

Note: Prepared by the questionnaire

⁵⁾ It should be noted that the effect of group tourists is likely to be underestimated in the data of the stamp rally, since the ratio of tourists using cars (including rental cars) is very high to those using buses. This is especially applicable to Souunkyo, where many group tourists visit.

⁶⁾ 7.8% in 2010 prepared by [4] [5] [6].

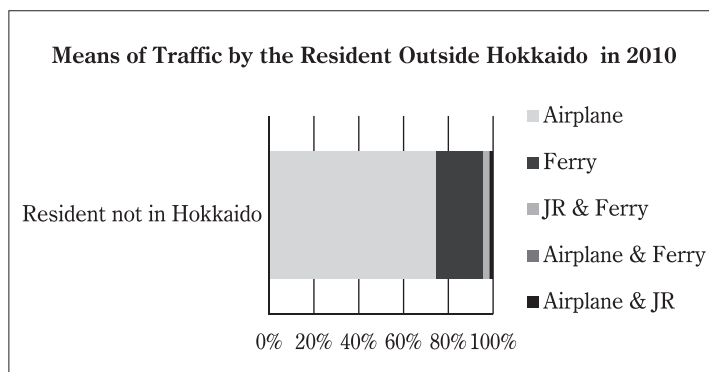


Figure 9 Means of Traffic by the Resident not in Hokkaido

Note: Prepared by the questionnaire

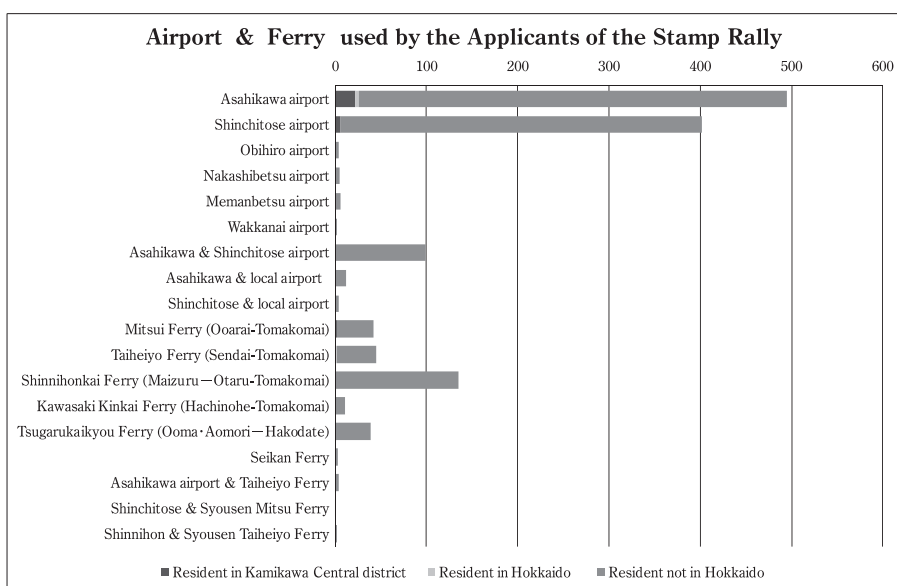
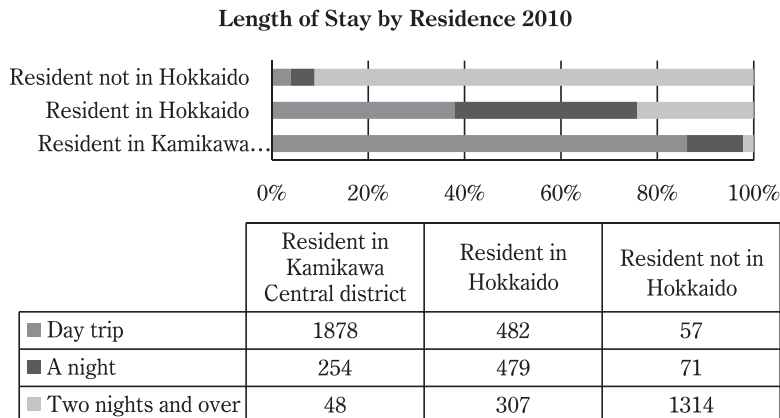


Figure 10 Airport & Ferry used by the Applicants of the Stamp Rally

Note: Prepared by the questionnaire

trict. Using this data, we found that the tourists resident outside Hokkaido used more sea routes from Maizuru on the Sea of Japan than Sendai or Ooarai on the Pacific Ocean. The result shows that many tourists who arrived by ferry used private cars and went on tours around Hokkaido. This kind of trip is likely to increase following the discount on the toll of expressways.

Figure 11 shows the length of stay by residence in 2010. Day trips by tourists visiting the Kamikawa Central district accounted for 49.4% of all trips. Overnight trips by the tourists accounted for 50.6%. Day trips by tourists resident in Kamikawa Central district accounted for 86.1% of all their trips. Ninety-one percent of tourists resident outside Hokkaido stayed more than two nights. The ratio of Day trips to overnight trips by tourists resident in Hokkaido is around 50%.

**Figure 11 Length of Stay by Residence in 2010**

Note: Prepared by the questionnaire

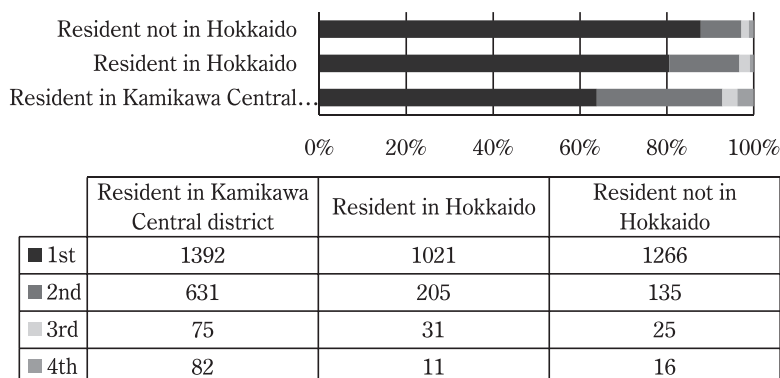
Table 4 shows the average length of touring around the stamp rally by residence. After 2010, the committee of the Kamui Mintara Stamp Rally decided to add a date and time field to the stamp. As a result, we can obtain the time-series data for the stamp rally. The longest average length of touring in the Kamikawa Central district is the tourists from this area. The average length of touring in Hokkaido is around 11 days. The average outside Hokkaido is around four days. However, we do not rely on these numerical data, since the standard deviations are larger than the averages. In fact, we think the medians better reflect the length of touring. Typical tourists in and outside Hokkaido stayed overnight. Typical tourists in Kamikawa Central district went around this area for one month. This information is important for managers and local government officers to design proper strategies for promoting tourism.

Figure 12 shows that the number of applicants joining the stamp rally by residence in 2010 and the number of the regular (repeaters) tourists are very low, especially outside Hokkaido. This should be addressed in devising future promotion strategies.

Table 4 Average Length of Touring during the Stamp Rally by Residence in 2010

Note: Prepared from stamp data

All applicants		Resident not in Hokkaido	Resident in Hokkaido	Resident in Kamikawa Central district
Average	19.07	4.16	11.27	33.19
Standard Deviation	24.39	9.83	19.54	25.72
Mode	1	1	0	0
Median	5	1	1	28
Minimum	0	0	0	0
Maximum	91	79	91	86

The Number of Participating in the Stamp Rally by Residence 2010**Figure 12 The Number of Participating in the Stamp Rally by Residence, 2010**

Note: Prepared by the questionnaire

5. The Correlation among Well-Known Tourist Spots

We investigated the correlation between seven well-known tourist spots using the questionnaire. The spots are Asahiyama Zoo; Biei; Furano; Mt. Asahidake; Souunkyou; Tenninkyou; and Shirogane.

Table 5 and Table 6 show the correlation between seven spots. The shading behind the number indicates a relatively high positive correlation. To take an example, Asahiyama Zoo is correlated with Biei, which means that tourists who visited Asahiyama Zoo are likely to visit Biei. Significant correlations were also obtained using chi-square tests. Table 5 shows that the tourists visiting Asahiyama Zoo tend to visit Biei and Furano. Moreover, the tourists visiting Biei are particularly likely to visit Furano and visit Shirogane (a famed spa). On the other hand, the tourists visiting Souunkyo are unlikely to visit any of the other six spots. In Kamikawa Central district, Souunkyo is isolated. The correlations are affected by the geographical locations of the seven spots.

Table 5 The Correlation⁷⁾ between Seven Well-Known Tourist Spots in 2009

Note: Prepared by the questionnaire

	Asahiyama Zoo	Biei	Furano	Asahidake	Souunkyo	Tenninkyo	Shirogane
Asahiyama Zoo	1	0.13065	0.24494	0.05622	0.04208	0.00331	0.06990
Biei		1	0.52067	0.06583	-0.06008	-0.00036	0.22093
Furano			1	0.09306	0.02502	0.03737	0.1568
Asahidake				1	0.00929	0.21681	0.09259
Souunkyo					1	0.01741	-0.04942
Tenninkyo						1	0.07452
Shirogane							1

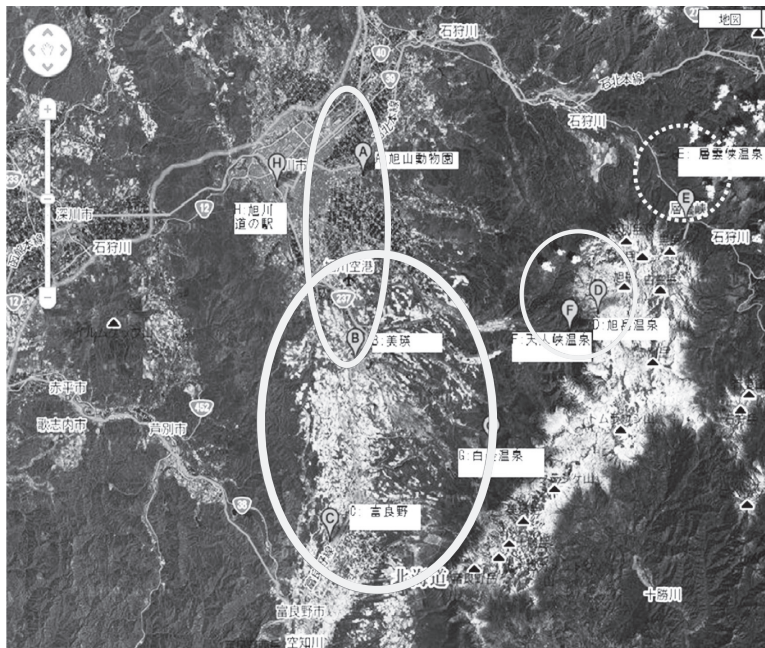
⁷⁾ There are subtle differences in the correlation coefficients between this paper and [12]. The reason for the difference is that the data of Asahiyama Zoo and Biei has defects. We fixed the defects and made Table 5.

Table 6 The Correlations between Seven Well-Known Tourist Spots in 2010

Note: Prepared from the questionnaire

	Asahiyama Zoo	Biei	Furano	Asahidake	Souunkyo	Tenninkyo	Shirogane
Asahiyama Zoo	1	0.05533	0.17883	-0.04432	0.01725	-0.01318	-0.00059
Biei		1	0.43043	0.04251	-0.04448	0.01601	0.16413
Furano			1	0.04729	0.06083	0.03421	0.12918
Asahidake				1	0.07197	0.17339	0.12024 ⁸⁾
Souunkyo					1	0.08897	0.01494
Tenninkyo						1	0.10075 ⁹⁾
Shirogane							1

Figure 13 shows the map of Kamikawa Central district. Red outlines show the areas of high correlation. In the red outlines, a tourist visiting a spot can easily reach another spot. The yellow broken outlines show the isolated spot. Tourists visiting Souunkyo cannot easily reach other spots in Kamikawa Central district. Tourists visiting Souunkyo are likely to move to Kitami or Abashiri in East Hokkaido for geographical reasons. If they stay at another spot among the six spots, the number of overnight stays increases. This problem of geography must be tackled to encourage day-trippers.

**Figure 13 Map of Kamikawa Central District**

(Source: @2011 google, @2011 TerraMetrics, @2010 ZENRIN)

Note: Prepared by the questionnaire

⁸⁾ There were no significant differences between two correlations.⁹⁾ There were no significant differences between two correlations.

In addition, Table 5 and Table 6 show that tourists changed their pattern of behavior between 2009 and 2010. The correlation coefficient between Asahiyama Zoo and Biei decreased between 2009 and 2010. Significance of the difference between two correlation coefficients was tested. Tests were two-sided and Z-value¹⁰⁾ $p < 0.01$ were regarded as statistically significant. The result shows that the tourists¹¹⁾ visiting Biei in 2010 did not go to Asahiyama Zoo, and vice versa, more than usual. This is a big problem for tourism in Kamikawa district.

Moreover, the result shows that we have to consider the tourism in Kamikawa Central district in transregional perspective because Furano is not in Kamikawa Central district but closely related with the tourism in Kamikawa Central district. Co-operation among wider areas in Hokkaido is important for promoting tourism in Hokkaido.

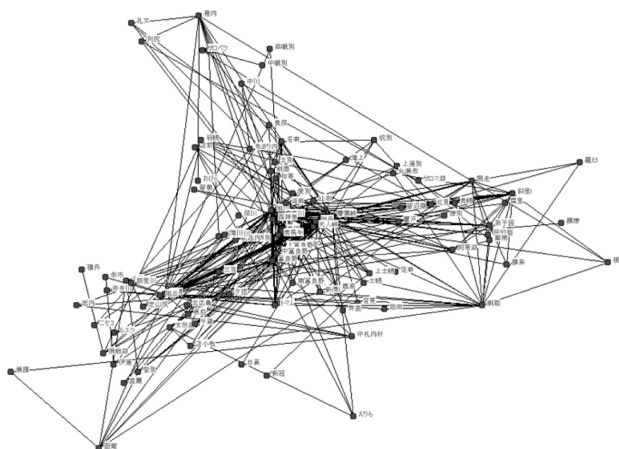
6. Visualization of Tourists' Traffic Lines

To visualize the tourists' traffic lines, we have two methods of making network graphs. One method is that we use the data from the answers to question 8 in the questionnaire. With these, we can make the network graphs of the traffic lines of tourists going around Hokkaido. Another method is that we use the data from the stamps. We can obtain the time-series data of stamps, which the tourists collected, since each locations has a unique stamp. We regard locations or places of overnight stay as nodes and traffic lines as links. We can make network graphs of the tourists' traffic lines.

Figure 14 shows the network graph of the traffic lines of tourists visiting Hokkaido. We found that tourists traveled throughout Hokkaido. However, it is very difficult to understand the relation among nodes at a glance. Therefore, we

Figure 14 Network Graph of the Traffic Lines of Tourists Visiting Hokkaido in 2010 based on the data of Kamui Mintara Stamp Rally

Note: Prepared using the questionnaire



¹⁰⁾ $r_{2009} = 0.13065$, $r_{2010} = 0.05533$, $n_{2009} = 4005$, $n_{2010} = 4892$, $Z\text{-value} = 3.57$.

¹¹⁾ These data by residence show that tourists resident in Hokkaido including Kamikawa Central district visiting Biei did not go to Asahiyama Zoo, vice versa in particular.

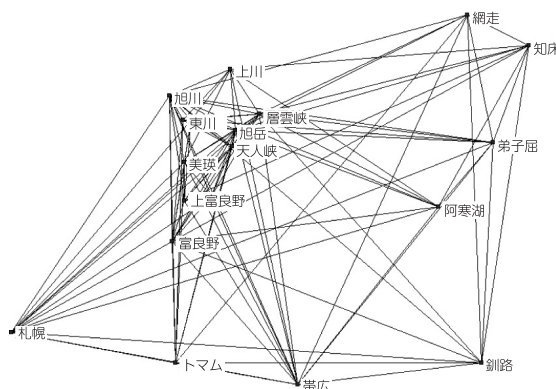


Figure 15 Enlarged Graph of Figure 14 in 2010

Note: Prepared using the questionnaire.

made Figure 15, which demonstrates the important relations between nodes. We pruned the links by method a method of K-cores. As a result, we found the main network of traffic lines could be detected at a glance. The traffic lines include seven well-known tourist spots. The traffic lines from Sapporo to Asahikawa; Souunkyo; Asahidake, Tenninkyo; Higashikawa; Higashikagura and Furano represent the characteristics of tourism in Kamikawa district. Figure 15 shows that Souunkyo is closely linked with Abashiri and Shiretoko (a World Heritage site). The findings agree with the results of Table 5 and Table 6. We were surprised that Tomamu; Obihiro; Akanko; Teshikaga and Kushiro were closely linked with Kamikawa Central district. The information may be helpful for managers and local government officers in designing tourism strategies.

Figure 16 shows the network graph of the traffic lines of tourists participating in the Kamui Mintara Stamp Rally in 2010 made using method 2. This network is so complicated that the relation between nodes cannot be understood at a glance. Therefore, we made Figure 17, which shows the important relation between nodes. We deleted the links with a weight smaller than 50 persons. As a result, the important network of the traffic lines may be seen at a glance. Many tourists passed through three roadside stations: Asahikawa, “Okanokura” in Biei and “Michikusakan” in Higashikawa. In Figure 17, the size of the link from A to B indicates the number of tourists moving from A to B. The size of the links from the roadside station in Asahikawa to Okanokura, from Okanokura to Michikusakan and from Asahikawa to Michikusakan is very large. This network graph shows that the network hubs are the three roadside stations. However, since there are so many locations around Asahikawa, Figure 18 shows an enlarged version of the area around Asahikawa. Figure 18 demonstrates the network of traffic lines centered on the roadside station in Asahikawa. The tourists visiting the roadside station at Asahikawa as a center location went around the other locations free of charge, except location No. 41, “The Sun Kuroudo.” The data given by the traffic

¹²⁾ K-cores in graph theory were introduced by Seidman [13] in 1983 and by Bollobas [14] in 1984 as a method of (destructively) simplifying graph topology to aid in analysis and visualization.

lines is very important for managers and local government officers in designing tourism strategies.

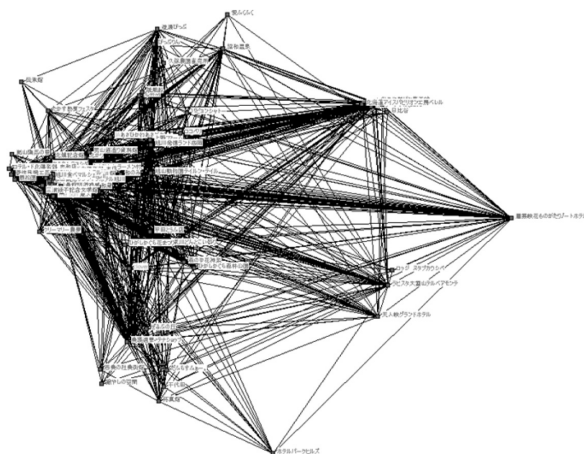


Figure 16 Network Graph of the Traffic Lines of Tourists Participating in the Kamui Mintara Stamp Rally in 2010

Note: Prepared using stamp data.

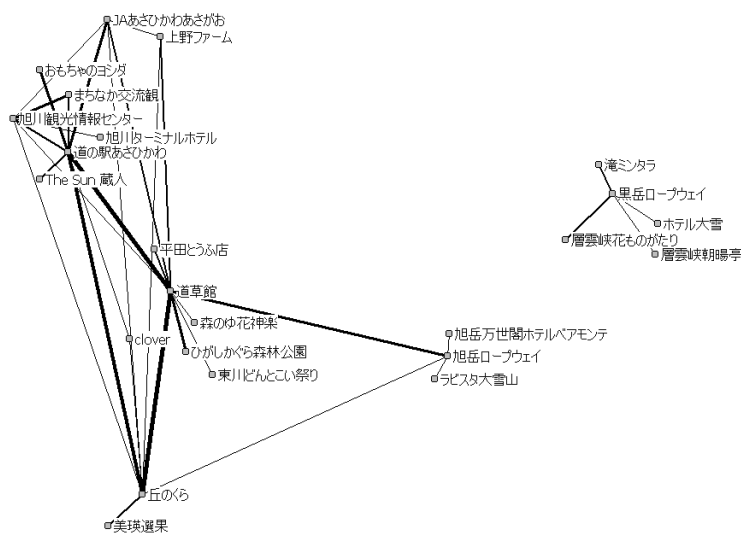


Figure 17 Enlarged Network Graph of the Traffic Lines of Tourists Participating in the Kamui Mintara Stamp Rally in 2010

(We deleted the links with a weight smaller than 50 persons for simplifying graph topology¹³⁾.)

Note: Prepared using stamp data.

¹³⁾ A method of K-cores attaches a high value to the vertex connectivity. However, we stress the weights of links for visualizations in Figure 17 and Figure 22.

Figure 19-Figure 21 show the network of traffic lines by residence. The three graphs look alike and the differences cannot be recognized at a glance. Therefore, we will analyze the three networks in detail in the next section.

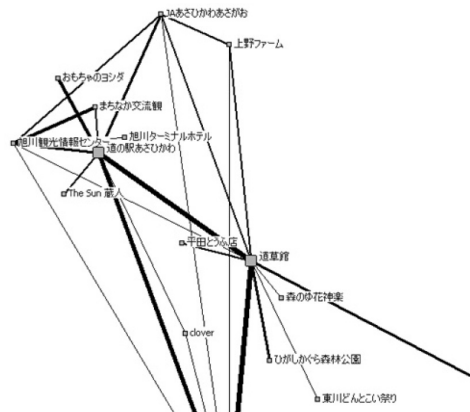


Figure 18 Magnification of Figure 17 around Roadside Station at Asahikawa

Note: Prepared using stamp data.

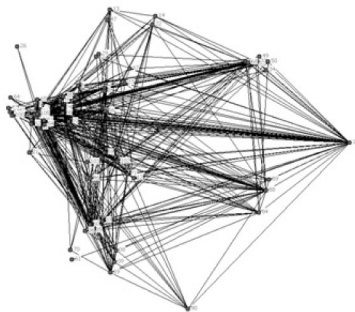


Figure 19 Resident not in Hokkaido

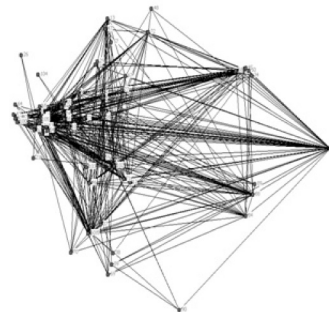


Figure 20 Resident in Hokkaido

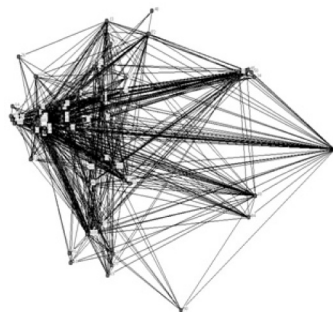


Figure 21 Resident in Kamikawa Central District

Note: Prepared using stamp data.

Figure 22 shows the traffic lines of tourists outside Hokkaido. We deleted the links with a weigh smaller than 46 persons. This network demonstrates that a typical tourist outside Hokkaido went through three roadside stations and Mt. Asahidake and Mt. Kurodake by car (including rental cars). We firstly recognized that many tourists moved a restaurant “Taisetsu no kura” to the ropeway of Kurodake as a important traffic line. This turned out to be an important traffic line. A new scenic route may be established. The route may be helpful for enhancing the correlation between Souunkyo and the other six spots. This finding is an example of the merit of visualization of the network of traffic lines.

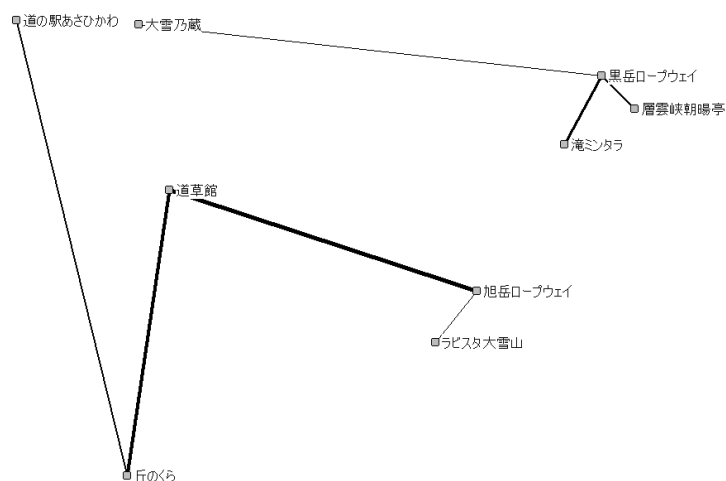


Figure 22 Network of the Traffic Lines of the Tourists outside Hokkaido

Note: Prepared using stamp data.

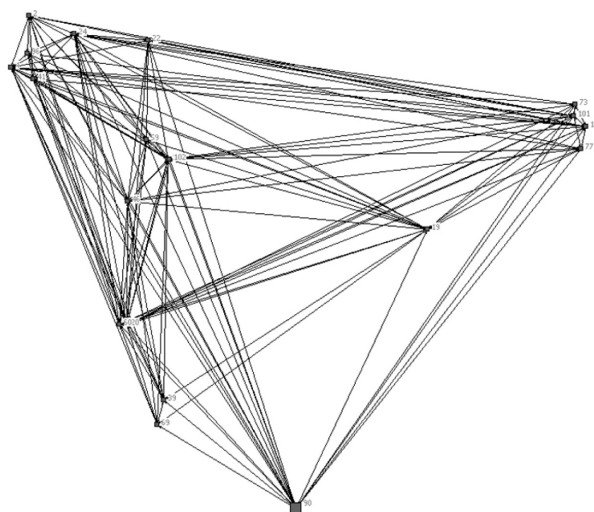


Figure 23 The Ego Network of a Hotel in Shirogane

Note: Prepared using stamp data.

Next, we made ego networks. Ego networks consist of a focal node (“ego”) and the nodes to which the ego is directly connected (these are called “alters”), plus the ties, if any, among the alters. To take an example, a focal node (“ego”) is the location No. 90, a hotel in Biei. Figure 23 shows that tourists stayed at the hotel and went through Okanokura, Takushinkan (a famous photo studio), Asahiyama Zoo, Village Ramen in Asahikawa and Souunkyo. Moreover, we were able to make 105 ego networks. These networks are available for managers developing promotional strategies.

7. Network Analyses of the Tourists’ Traffic Lines

In this section, we investigate the characteristics of the network of tourists’ traffic lines in Kamikawa Central district using network analysis by year and by residence. As described above, we regard locations as nodes and traffic lines as links. We indicated the number of nodes, the average node degree, the density¹⁴⁾ of the network, the clustering coefficient¹⁵⁾ and the average path length¹⁶⁾ by year in Table 7 and by residence in Table 8. For comparison, we included the clustering coefficient and the average path length of a random graph of the same size and average degree in two tables.

We analyzed the topology of the traffic lines of the Kamui Mintara Stamp Rally. Table 7 shows that the average degree of node and the network density increased incrementally each year. The degree of a node means the number of links connected to this node. A link is generated by a tourist moving from location “A” to location “B”, and vice versa. A high degree of a location means many tourists

Table 7 General Characteristics of the Networks of the Stamp Rally by Year

Note: Prepared using stamp data.

Year	2008	2009	2010
Size	95	113	105
$\langle k \rangle$	21.8	30.32	33.68
Density	0.24	0.276	0.323
$C(C_{rand})$	0.652(0.229)	0.608(0.268)	0.649(0.32)
$l(l_{rand})$	1.785(1.478)	1.751(1.386)	1.677(1.323)

¹⁴⁾ Density is simply the ratio of the number of adjacencies that are present divided by the number of pairs—what proportion of all possible dyadic connections are actually present.

¹⁵⁾ The clustering coefficient defines a measure of the level of cohesiveness around any given node. It is expressed as the fraction of connected neighbors $C_i = \frac{2e_i}{k_i(k_i - 1)}$ where e_i is the number of links between the neighbors of the node i , and $k_i(k_i - 1)$ is the maximum number of possible inter-connections among the neighbors of the node. C in Table 7 indicates the average value of the clustering coefficient.

¹⁶⁾ For non-directional, unweighted graphs, the number of edges in a path connecting vertices i and j is called the length of the path. A geodesic path (or the shortest path) between vertices i and j is one of the paths connecting these vertices with minimum length (many geodesic paths may exist between two vertices); the length of the geodesic path is the geodesic distance d_{ij} between vertices i and j .

Table 8 General Characteristics of the Networks of the Stamp Rally by Residence

Note: Prepared using stamp data.

Residence	Kamikawa Central district			Hokkaido			Outside Hokkaido		
Year	2008	2009 ¹⁷⁾	2010	2008	2009	2010	2008	2009	2010
Size	92	111	104	92	107	102	92	104	100
$\langle k \rangle$ ¹⁸⁾	12.2	19.59	22.32	9.2	13.39	16.13	12.72	14.79	17.41
Density	0.134	0.178	0.214	0.101	0.122	0.155	0.14	0.135	0.167
$C(C_{rand})$	0.579 (0.133)	0.586 (0.181)	0.613 (0.215)	0.612 (0.1)	0.579 (0.125)	0.554 (0.158)	0.622 (0.138)	0.51 (0.142)	0.603 (0.174)
$l(l_{rand})$	2.032 (1.819)	1.916 (1.574)	1.832 (1.495)	2.149 (2.038)	2.074 (1.801)	1.938 (1.663)	1.945 (1.778)	2.027 (1.724)	1.915 (1.611)

went through this location (shops, restaurants, hotels, etc). A high density means that the traffic lines of the tourists are not skewed, but dispersive. Dispersive traffic lines are better than concentrated traffic lines because more locations will benefit from the stamp rally. Therefore, a high average degree of nodes and high density are better with regard to total economic activity. The results show that the economic benefit of the stamp rally is rising.

Both the clustering coefficient and the average path length are large compared to that of the random graph. This is not a characteristic of “small-world” networks ([10]). The large clustering coefficient means that 6 spots are closely related to each other. The large average path length means that Kamikawa Central district is divided into two areas in terms of tourism because traffic lines between two areas were often severed. One area made up of Asahikawa, Biei, Furano, Asahidake and Shirogane. Another area made up of only Souunkyo. Moreover, these results agree with the results of Table 5 and Table 6.

Next, we analyzed the networks by residence. Table 8 shows that the average degree of nodes and the network density increased every year by residence. The only exception is the density of the network of the tourists outside Hokkaido in 2009. This is a result of the Lehman Shock and the new influenza epidemic in 2009. However, the economic benefit of the stamp rally for all residents is rising.

Moreover, Table 8 shows that both the average degree of nodes and the density of the network outside Hokkaido are higher than that in Hokkaido, except for Kamikawa Central district. The results show that tourists outside Hokkaido tend to go to more spas and vacation accommodation compared with tourists in Hokkaido.

The merit of using network analyses of tourists’ traffic lines is that we can understand the structure of tourism not only by intuitive, but also by numerical means. In the case of analyzing large networks, we have to use conventional network analysis, since an understanding of visualization is difficult. In this paper, the understandings of visualization in section 6 are supported by the statistical data of

¹⁷⁾ There are subtle differences in the clustering coefficients and the average path length between this paper and [12]. The reason for the difference is that the data of Asahiyama Zoo and Biei has defects. We fixed the defects and made Table 8.

¹⁸⁾ $\langle k \rangle$ represents the average degree of all nodes.

the networks.

8. Concluding Remarks

The traffic lines of the tourists visiting Kamikawa Central district have been investigated by means of the questionnaire, visualization and network analysis. The main findings are summarized below:

1. Typical tourists in and outside Hokkaido stayed overnight. Typical tourists in Kamikawa Central district went around this district during one month.
2. Tourists outside Hokkaido used more sea routes from Maizuru on the Sea of Japan than Sendai or Ooarai on the Pacific Ocean.
3. The number of regular tourists (repeaters) is very low, especially outside Hokkaido.
4. Souunkyo is isolated from the other six well-known spots because of geographical position.
5. Tourists visiting Hokkaido traveled throughout Hokkaido.
6. There are seven well-known spots that are important for tourism in Kamikawa Central district. Additionally, Sapporo; Asahikawa; Abashiri; Shiretoko; Obihiro; Tomamu; Akanko; Teshikaga and Kushiro were closely linked with Kamikawa Central district and are also important for tourism in Kamikawa Central district.
7. Three roadside stations are very important for Kamikawa Tours and/or the Kamui Mintara Stamp Rally.
8. The ego networks of the traffic lines are available for managers to open a branch and to make effective publicity for attracting customers.
9. High average degree of nodes and density are better than a low average degree of nodes and density in terms of total economic activity.
10. The large clustering coefficient means that 6 spots are closely related to each other. The large average path length means that Kamikawa Central district is divided into two areas in terms of tourism because traffic lines between two areas were often severed.
11. Tourists outside Hokkaido tend to go to more spas and vacation accommodation compared with tourists in Hokkaido.

We conclude that visualization and network analysis are both necessary to understand the traffic lines of the tourists. It should be emphasized that the main findings No.10 illustrates the need for wide-range co-operation¹⁹⁾ between Souunkyo and the other areas in Kamikawa Central district for promoting the tourism. The information acquired from this network analysis might provide relevant direction to managers and local government officers in designing promotional

¹⁹⁾ Managers and/or local government officers should come up with some kind of strategy to encourage tourists staying one night in Souunkyo to extend stay one more night. For example, a manager of a tourist agency said that if Asahiyama Zoo opened and ran a special show in the early morning, visitors would stay at a hotel around Asahikawa on the previous day to catch the morning show. This is a good idea.

strategy for tourism.

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