

Visualization & Visual Analysis

Project Report

Introduction

Located at China's gigantic underbelly on its southeastern coast, Macau is well-known as a gambling and shopping mecca -- spurred by the grand openings of ever larger and grander casinos with equally ostentatious shopping malls. With its unique mixture of Portuguese and Chinese cultures, the city also has its fair share of beaches, fortresses, churches, temples, gardens, and excellent museums to explore, and is a good place for tourist to take a day trip or overnight stay.

The main objective of the project is to depict Macau's tourism industry through visualize visitors, hotels industry and gaming industry. More specifically, through this project we try to:

- A. identify geographical distribution of arrivals and their entry sites distribution
- B. visualize hotel industry performance in recent years
- C. visualize revenue of gaming industry and explore its relation to number of visitors

Problem Statement

1. What's the geographic distribution of visitors? How does it change with time? Is there a specific connection between the number of visitors and seasons
2. What's the proportion distribution of visitors from each entry site? For visitors from different entry site, what is any geographical distribution characteristics? What is the trend of visitor numbers broken down by site?
3. How many hotels are there in Macau? Is it still worth opening new hotels? Which month is the most popular for tourism?
4. How much profits does the gaming industry create? Which kind of game

contributes the most gaming revenue? Are there any underlying relations between revenue of gaming industry and number of visitors? Any relationship with the country? as well as the time?

The Dataset

All the dataset we use is downloaded from official website of Statistical Information System of Macao. <http://www.dsec.gov.mo>

The dataset is about several measures: number of visitors, hotel related measures, and revenue of gaming industry.

Number of visitors dataset contains monthly tourists number from January, 2008 to September, 2016 with several attributes including time, visitor's' home country, visitors' entry transport, and their entry site.

Hotel dataset including several measures: hotel's quantity, hotel occupancy rate and number of hotel guest, and the data is from 2000 to 2016.

As for gaming industry, attributes include the receipt and expenditure every year (2004-2015), operational cost, purchase of goods, interest .etc

The Tools

Several visualization softwares, such as Tableau and D3.js, are used in this project. Excel is used as a data processing tool here to convert data from different sources.

- ⇒ Tableau, <http://www.tableau.com/>, is a very powerful data visualization software, which allows users to easily connect to data. In this project, we combined several worksheets into one dashboard, which enabled us to do comparison conveniently.
- ⇒ D3.js, <https://d3js.org/>, is a JavaScript tool, providing powerful, dynamic and interactive data visualization in web browsers. In our project, via using HTML, SVG and CSS, we easily customized the dynamic pie chart.
- ⇒ Excel is used in this project as a data processing tools to combine raw data into a one dimension dataset.

Division of labour

Proposal		All
Visualization	Exit and Entry-Country	
	Exit and Entry-Transportation & Harbour	
	Tourism & Hotel	
	Gaming industry	
Presentation		All
index.htm		All

Part1 Geographical Distribution of Visitors

1. 1 Problem Statement

To evaluate the tourism industry of one region, start with the number of visitors could be an effective choice. So in the first part, we focus on the global volume variance. And it is easy to get most visitors will come from China when domestic travelling is usually much easier. So we will further search for province distribution data and try to answer the following questions.

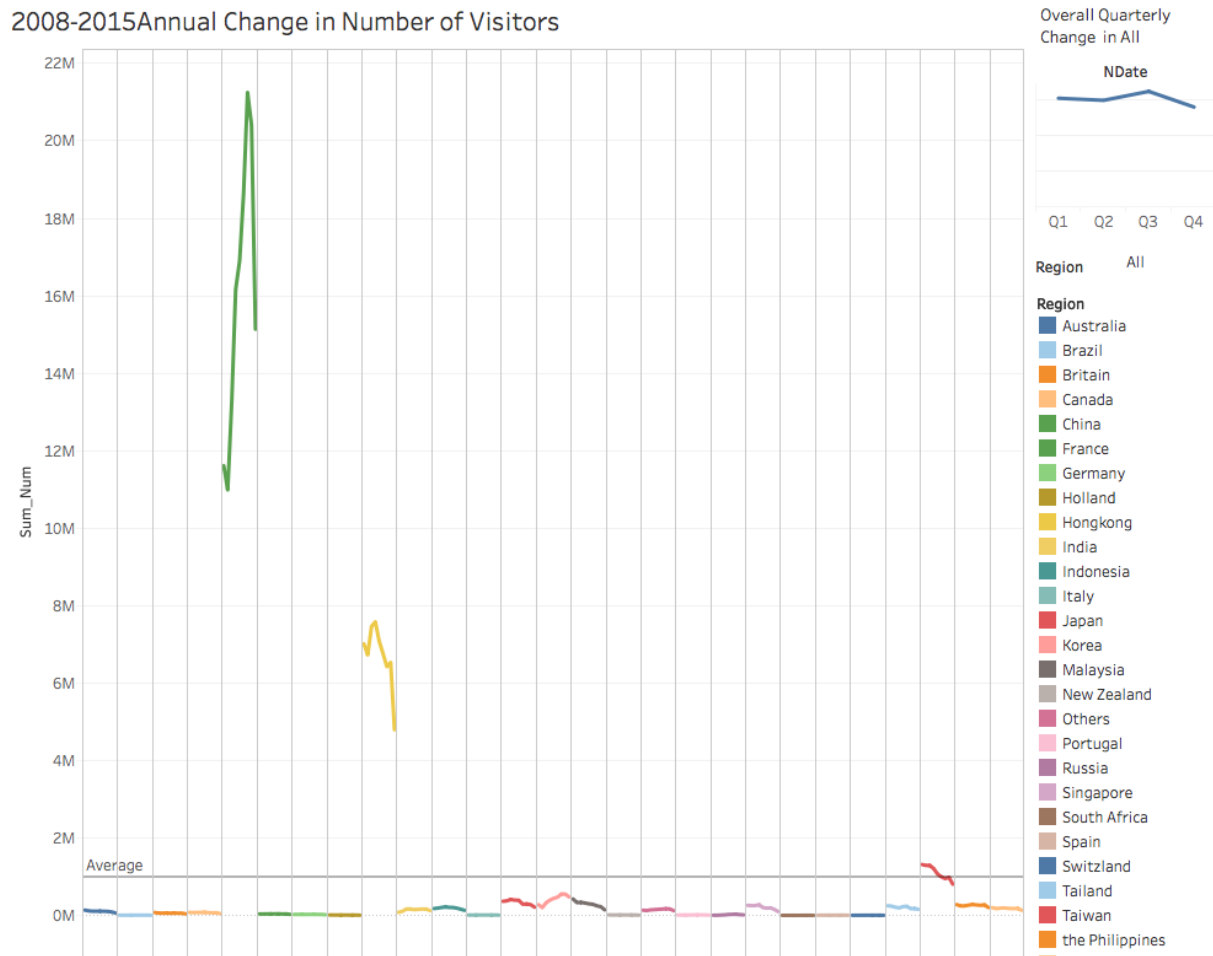
- People from which country have a growing enthusiasm in visiting Macau?
- Which witness the most decrease and growth in number?
- And which part of China have more visitors?
- Is there a specific connection between the number of visitors and seasons

1.2 Method and tools

There are 4 attributes being gathered and used from the dataset provided by Macau Government. Number : Date, Region, Chinese Provinces and number of visitors from the passport issuing country. As it's some discipline we want to get from the simple dataset , Tableau is chosen to create a more interactive presentation for readers.

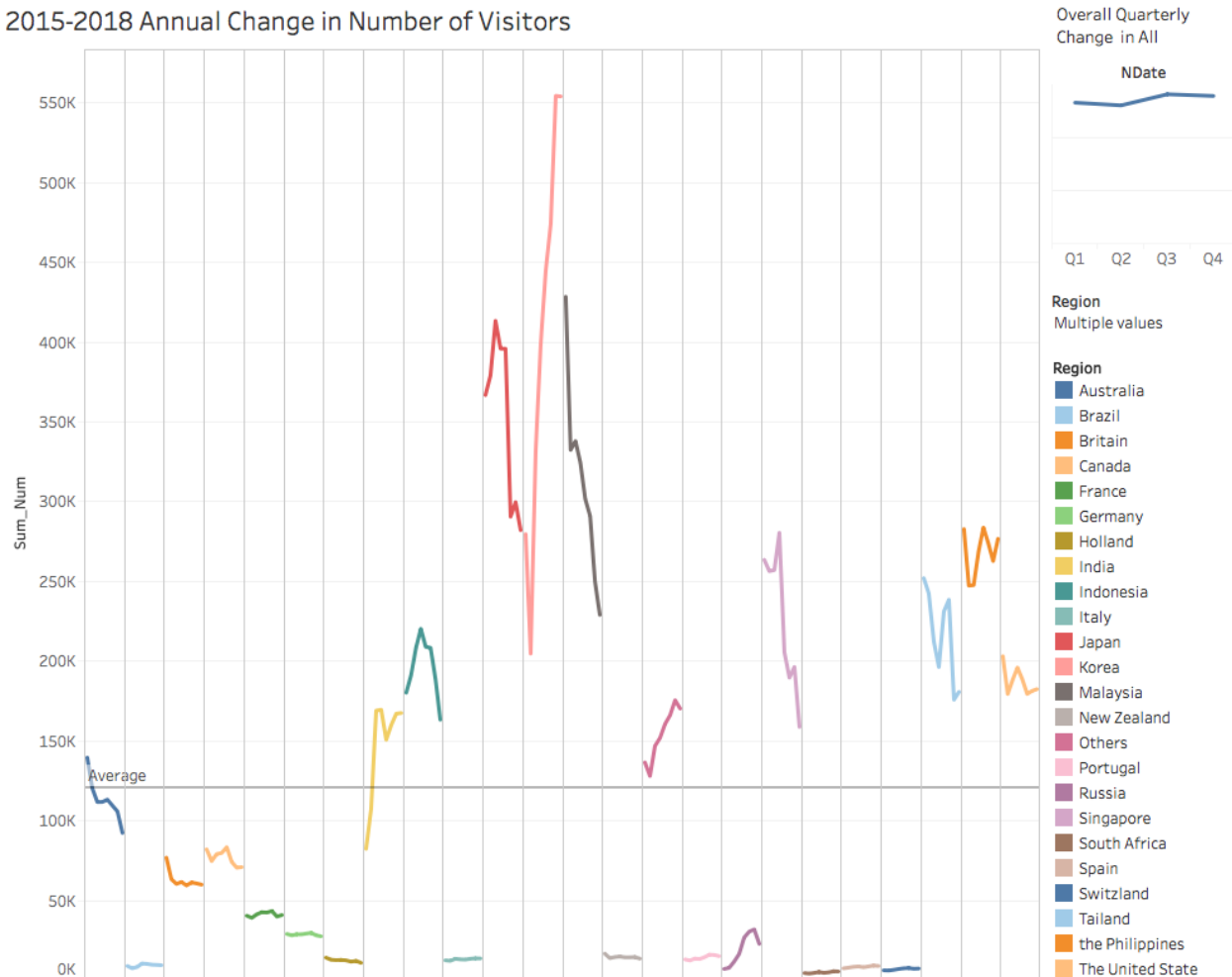
Ø Who loves Macau and who loved ?

As what we care here is how the number to visitors vary among different regions, the horizontal axis stands for the time (2008-1015) in each cell. And a reference line is marked as the average number of visitors of these 26 regions. Firstly we got graph like this:



From graph above, Mainland China, Hong Kong and Taiwan are biggest customers but all appear to decrease in number. Detail should be observed. Besides, we are met with the biggest barrier in visualizing the global change, since that China is too standing-out to notice the difference among others. So to take a better look at the layout of other regions, filter is in use..

2015-2018 Annual Change in Number of Visitors



Now it's clear Macau is getting very popular in Korea and India, so does in other part of world, while Japanese and Malaysians are losing interest with it ! ! As well as Americans and Italian tend to not visit after a high fluctuation. To locate the possible reason, the quarterly number changes are located in the right for us to have a glance for season effect.

Ø how large could the number gap reach between provinces?

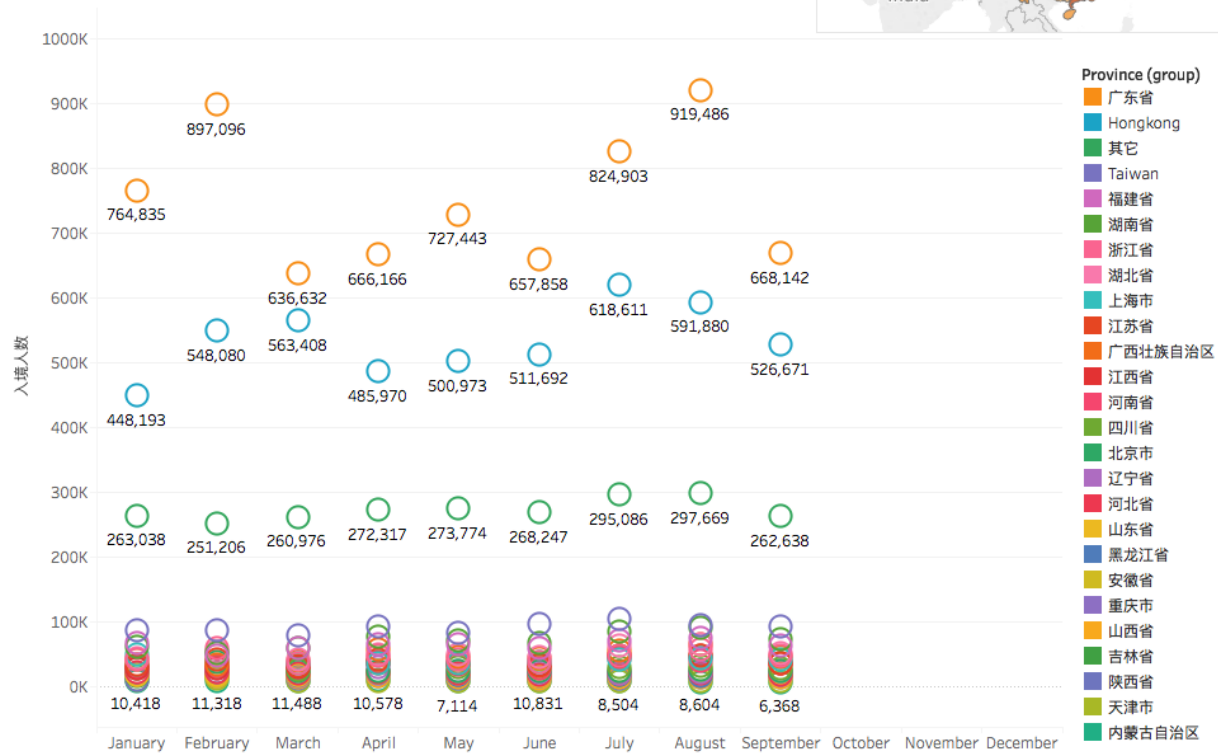
Because Mainland china and Hong Kong, Taiwan make a considerable proportion, visualization will be more meaningful to further explore the comparison inside China, so with dataset from 2010.07-2016.9, one China map is presented to show the difference via color brightness, and Guangzhou and Hong Kong clearly stand out in the circle view, which is quite understandable as neighbors.

Year of NDate
2016
☐ Show history

入境人数
31,444 9,043,931



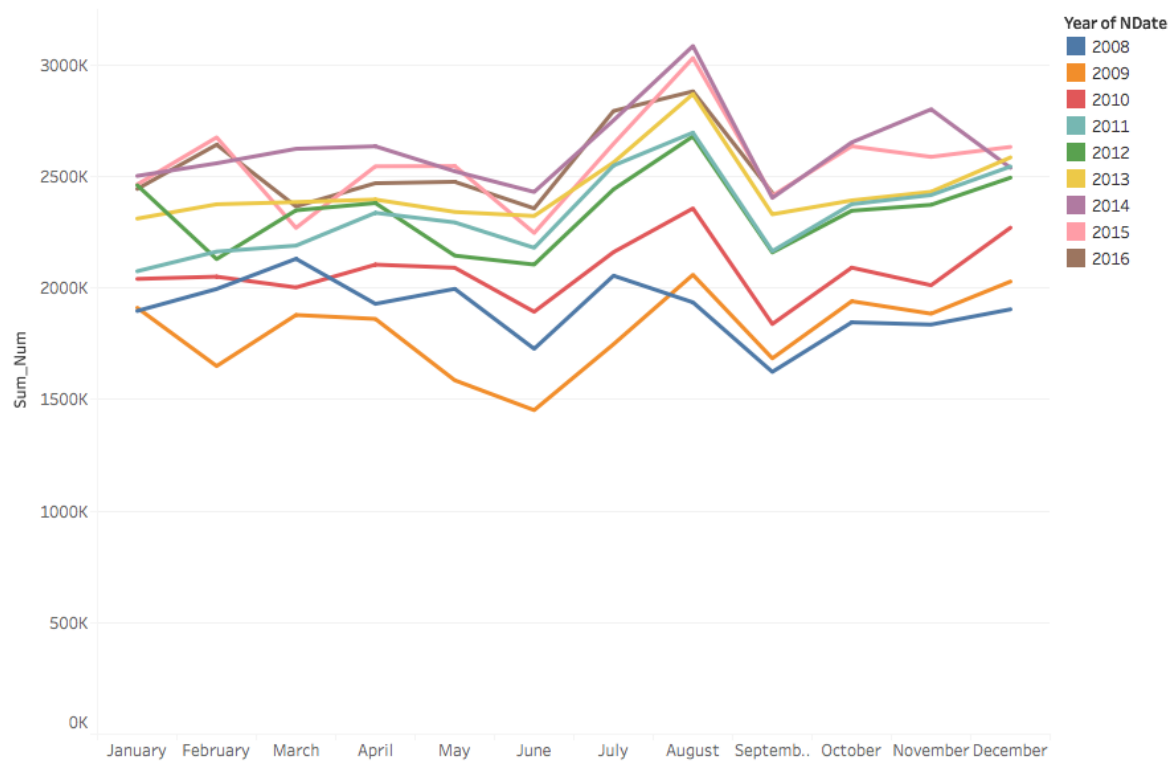
Number of Vistors from China - 2016



The other part is actually calculated by subtraction of total mainland visitors and recorded visitors and grouped by the unnamed areas, which are most in western China. In all, the top 3 friendly provinces from mainland to Macau are Guangdong, Fujian, Hunan. The biggest gap could be over 800K for just a month.

Ø Which is the most favorite month for people from same region to come?

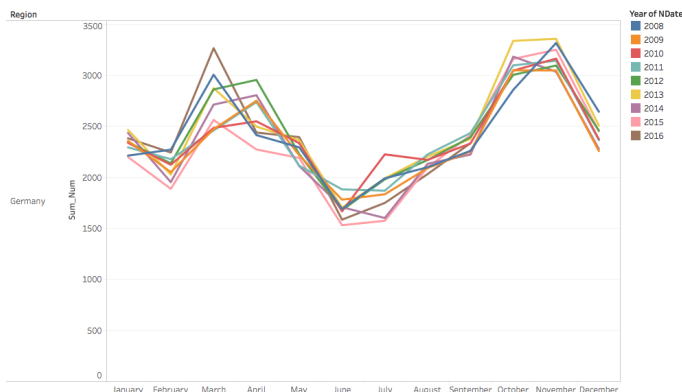
2008-2016 Monthly Changes for All



The trend of Sum_Num for NDate Month. Color shows details about NDate Year. The data is filtered on Region and Action (YEAR(NDate),Region). The Region filter keeps 27 of 27 members. The Action (YEAR(NDate),Region) filter keeps 243 members.

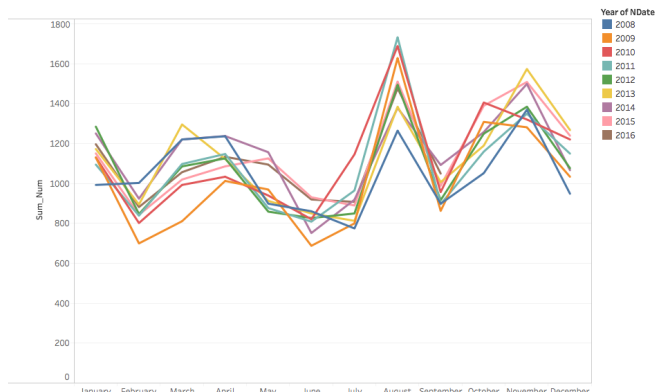
With the line chart above there is an obvious favor for visitors in different regions to choose to visit Macau - autumn is best! but we know that China plays an essential part in affecting the result. After identify each region separately, there lies typical monthly changing pattern in most regions :

2008-2016 Monthly Changes for Germany



The trend of Sum_Num for NDate Month broken down by Region. Color shows details about NDate Year. The data is filtered on Action (YEAR(NDate),Region), which keeps 243 members. The view is filtered on Region, which keeps Germany.

-2016 Monthly Changes for Italy



l of Sum_Num for NDate Month broken down by Region. Color shows details about NDate Year. The data is filtered on Action (YEAR(NDate),Region), which keeps 243 members. The view is filtered on Region, which keeps Italy.

Based on the past data , a forecast indicator is calculated and shown in graph, for the remaining 3 month in 2016 and monthly tendency in 2017 as a reference for public , government need .

So it becomes very easy to model the number of visitors for each region, more work could be done and prepared to attract and guide the tourists.

The Favorite Season for some region :

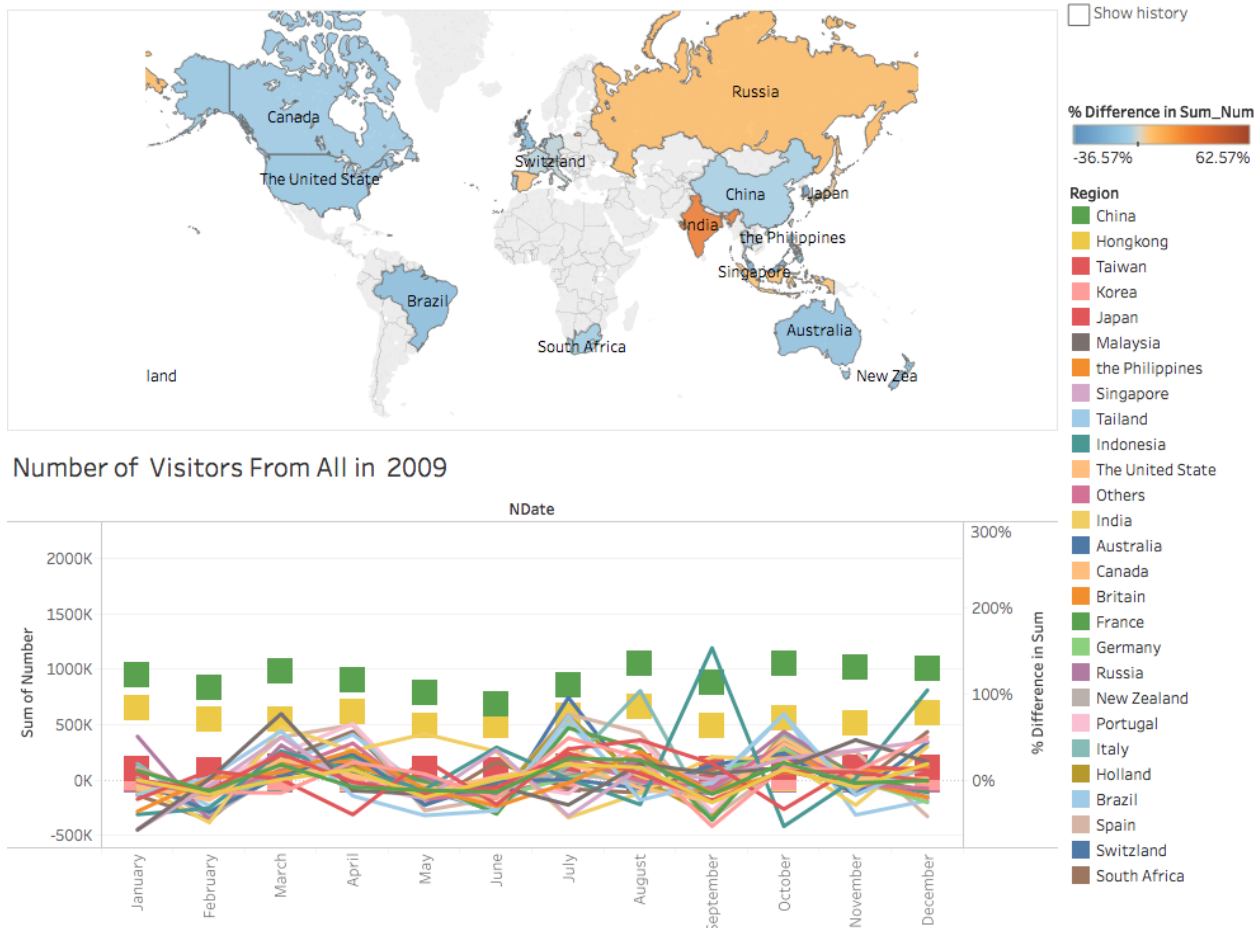
Austria , Russia – January Canada – March

Brazil -- April India – May China ,France,Italy – August

Indonesia – Autumn Holland – Autumn

To sum up, one more visualization is made to show most features:

Global Gerographic Distribution Of Vistors Entering Macau



The world map shows the global distribution of the number of visitors among 26 regions/countries from January 2008 to September 2016. The colour varies from

blue to red , which presents the year over year growth of that area . Grey is near 0% , which indicates the total number of visitors does not vary much in this year while red means increasing and blue - decreasing .

The 6-years data are inside pages that could be view independently via the year selection;

To have a better idea of the changes throughout a year, the dual axis graph contains one square chart and line chart. Regions are marked in colour, the square means simply the total number of visitors had come to Macau, while the line amplifies the changing trends of each month.

Conclusion:

- 1) Only mainland china and Hong Kong are able in to manage OVER 500K people visiting Macau in one month time, Taiwan could arrive a entering number 50K
- 2) Look outside China, all other Asian countries(that are inside the dataset) including Korea , Japan, Malaysia ,The Philippines, Thailand , Singapore Indonesia , India follows with Australia and United State that could reach a number of over 10K visiting Macau per month . At the same time, there are only hundreds visitors coming from areas that rank the bottom: Spain, Switzerland , South Africa. Certainly those areas that are not included in the dataset would have less number, which also means Macau is full of potential in those places.
- 3) Attention! The number of visitors from Japan, Malaysia, Singapore, Thailand decreases rapidly and a lot ! They used to like visiting Macau! Reasons should be investigated and attentions should be raised.
- 4) In 2009 and 2015, with most area in blue , large percent of countries decrease , - 5.47% and -4.04% respectively .While the changes in small areas would not be noticed easily in the global map , in my opinion I still consider the colour changing meaningful as more larger countries would have more influence and worth be paying more attention , at the same time , it's a overall perspective , specific detail could be learnt from the other sheet.
- 5) From a whole perspective, there is an obvious increase every Autumn, and Winter could be considered as the off-season. But it has a strong connection with Chinese visitors, part of the reason might be that it's summer holiday for students. In fact,

there is favorite month for every region and connected with this feature, relevant suitable cultural activities could be arranged to attract or suit their flavor.

- 6) As the graph indicates a super huge gap in number, More image-building, propaganda activities, welcome policies could be arranged towards south Africa\Russia\Europe , so does the south American as there lies historical connections behind .

Part2 Visitors entering from Different Entry Sites

Problem Statement

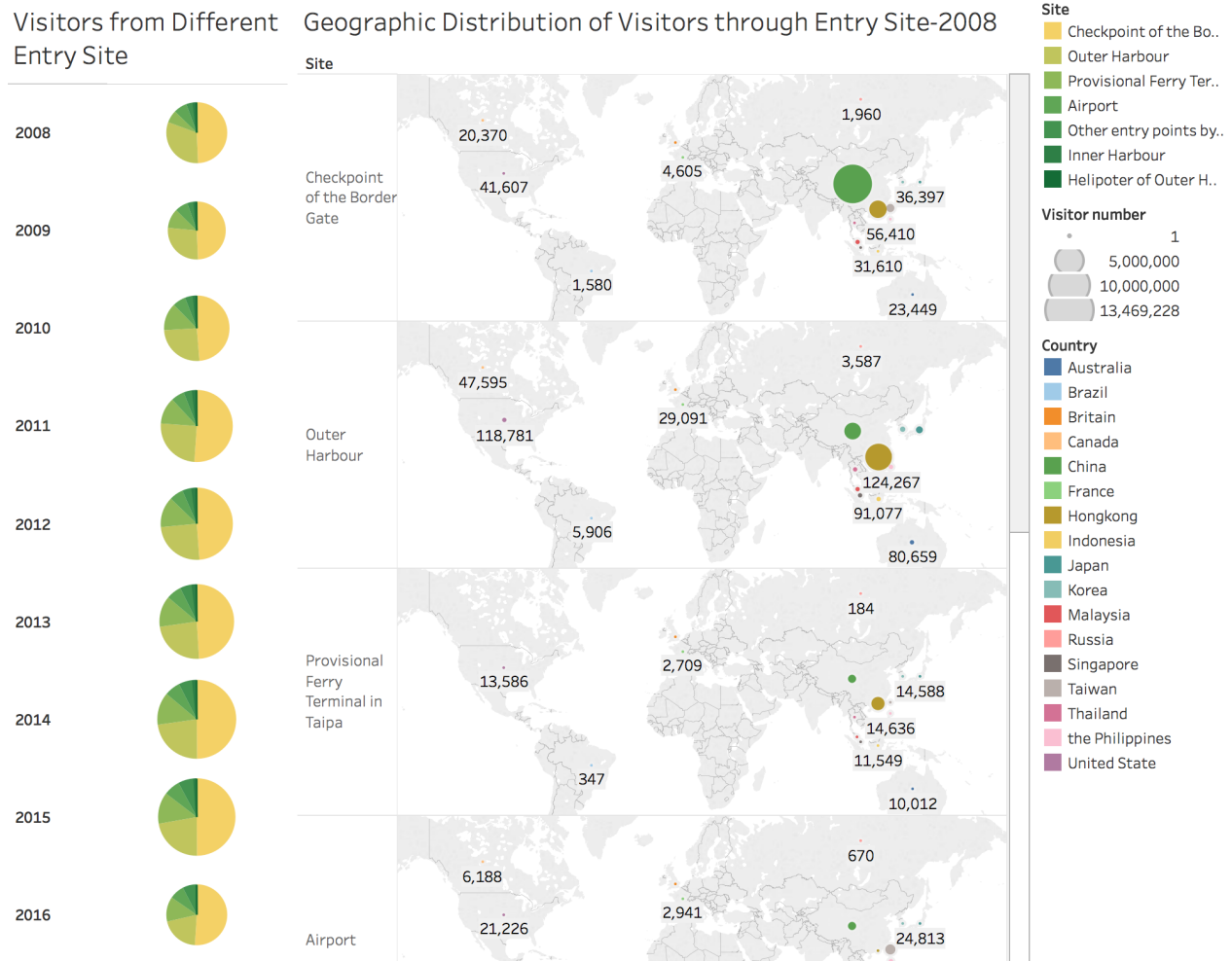
Like the former part, in this part we still focus on numbers of visitors, but analyze from a different angle, entry site. Here, we are going to answer the following questions:

- Ø How do visitors enter Macau? Through which entry site?
- Ø Are there any structure changes in the proportion distribution of numbers from different entry site?
- Ø For visitors from different entry site, what is any geographical distribution characteristics?

Method and Tools

To answer these question, we choose pie chart and global map to visualize our data. As for the tools, we use tableau to draw graph and its dashboard function to

link this two graphs:



The series of pie charts in the left show proportion distribution of visitors through different entry sites since 2008, while the right part illustrates more detailed geographic distribution of visitors entering through different sites.

In pie chart, each slice represents an entry site and its angle is determined by the proportion it takes up in total visitor's number. Size of each pie chart is determined by number of visitors in that years. The right part aims to explore geographical distribution of visitors from each entry site, and the size of each dot represents the number of visitors

It is worthy to point out that the whole picture is an interactive graph allowing website viewers to easily explore data by themselves. If a user wants to see one specific year's data, he or she can click that year in left part, then the right global

map will display data in the year chosen correspondingly. Further demand of deep diving can be meted easily. For example, by clicking a particular slice in the pie chart, the right part will jump to geographic distribution details. In this way, users can easily explore geographical distribution of visitors through one particular entry site in one particular year.

Results and Findings

1.Static perspective

From cross-section study perspective, the proportion distribution of visitor number from different entry site appear to be similar in recent seven years. It is easy to find out that every year approximately 50% visitors enter Macau through “Checkpoint of the Border Gate”, and the second biggest entry site is “Outer Harbor”, taking up nearly one quarter. Usually, “Provisional Ferry Terminal in Taipa” is the third biggest entry point, followed by airport.

As shown in map, majority of visitors entering from “Outer Harbor” comes from mainland China. Hongkong is the second biggest source of visitors through “Checkpoint of Border Gate”, and Taiwan is the third biggest one. There are still a few visitors from other countries, such as Japan, South Korea, Philippines, Thailand, Singapore, Malaysia and Indonesia choose “Checkpoint of Border Gate” as their entry gate. Visitors entering through “Outer Harbor” are mostly from Hong Kong, and the second biggest Mainland China. Japan, South Korea, Philippines, Thailand, Singapore, Malaysia and Indonesia also contribute to number of visitors entering through “Outer Harbor”. As for geographical distribution of visitors entering through “Provisional Ferry Terminal in Taipa”, similar with “Outer harbor”, majority of visitors comes from Hong Kong and mainland China. Tourism from Taiwan account for a relatively high proportion of visitors entering by airplane.

2.Dynamic Perspective

From longitude study perspective, we pay more attention on the changes of proportion in different years. By interactive exploration, a signal of visitor decrease in Outer Harbor need to notice: the proportion of arrivals from Outer Harbor decreases year by year, from over one quarter, 31% in 2008 to 22% in 2015. Not

only the relative ratio decrease, the actual data of arrivals from Outer Harbor also reduce from in approximate 7.1 million in 2008 to 6.8 million in 2015 even in the scenario of growing visitor population in total. This is a phenomenon worth of attention by authorities and the Outer Harbor. Why do visitors no longer prefer to enter Macau through Outer Harbor? Does that mean Outer Harbor lack of competition compared with other entry sites? What kind of measure can be taken? All related questions need to be seriously considered.

At the same time, the number and the proportion of visitors entering through the Provisional Ferry Terminal in Taipa is increasing as well, from 1.5 million to 3.0 million, and from 6% to 13% respectively. Further exploration reveals that among visitors entering through the Provisional Ferry Terminal in Taipa, Mainland visitors population rise up rapidly, from 0.4 million in 2008 to 1.7 million in 2015. This is a relatively interesting finding contradicted with our common sense! Reason behind this growth is worthy of further exploration with more data and information. Our speculation about the growth is that in recent years, mainland tourists may first visit Hong Kong and then enter Macau directly from Hong Kong by cruise. This finding may act as reference for cruise industry in Macau. Our suggestion is that cruise industry can take some measures to adopt the shift and provide more convenient and qualified service. For example, they may adjust their shuttle times, create new routes and use new cruises. If they can get more detailed consuming profiles of visitors, they can not only serve visitors well, but also improve their own revenue.

Another concern is the decline in number of visitors entering by helicopters(shown as bellow). From 2008 to 2014, the number of visitors entering through “Helicopter Land of Outer Harbor” remains relatively stable, keeping above 20,000 people. However, in 2015, the number of helicopters visitors dramatically dropped to 11,169. The 2016 data appears to be continue the decline trend: up to September, visitors entering by helicopters is only 4939.

Visitors from each Entry Site by Year



The trend of sum of Visitor number for Time Year broken down by Site.

*Note: the figure in 2016 is up to September

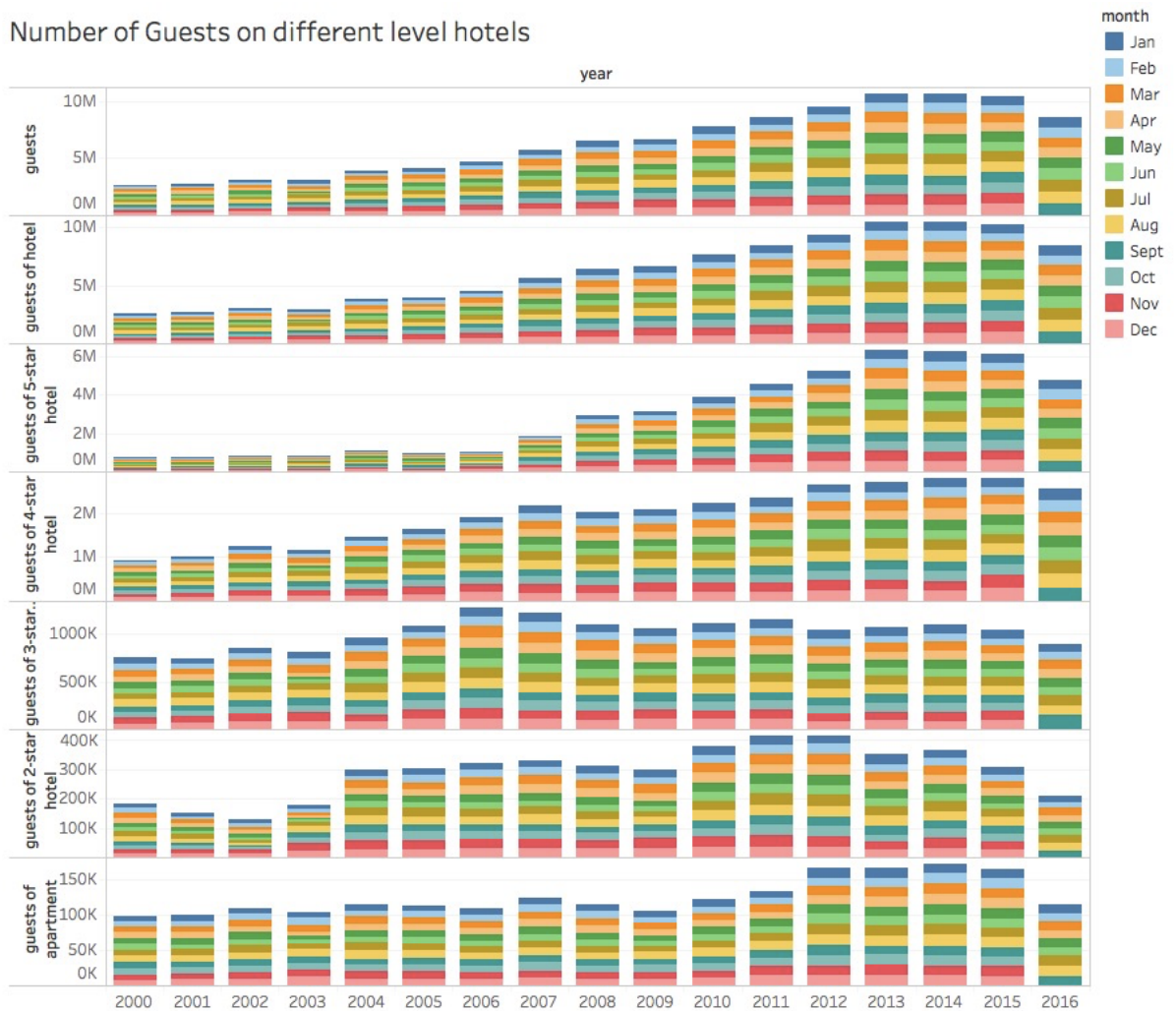
Part3 Tourism

Problem Statement:

This part is about the tourism in Macau, which is one of the most important part of the income source. Here we solved the problems as below.

- 1.Is Macau still a hot place to visit?
- 2.How many hotels are there in Macau? Is it still worth opening new hotels?
- 3.Which month is the most popular for tourism?

Number of Guests on different level hotels



From the data on hotels in Macau, we can see that the number of the guests grows up stably from 2000 to 2013 and maintain stability recently. There are two choices of accommodation, hotels and apartments and most visitors tends to choose hotels as their accommodation. Among them, there is a strongly positive correlation between the quantity of 5-star hotel guests and the quantity of total guests with an average growing rate of 11% before 2013, while other kind of accomodations not being such strongly positive correlated. Because of this trend, more and more hotels opened these year as we can see from the line chart Number of Hotels below.

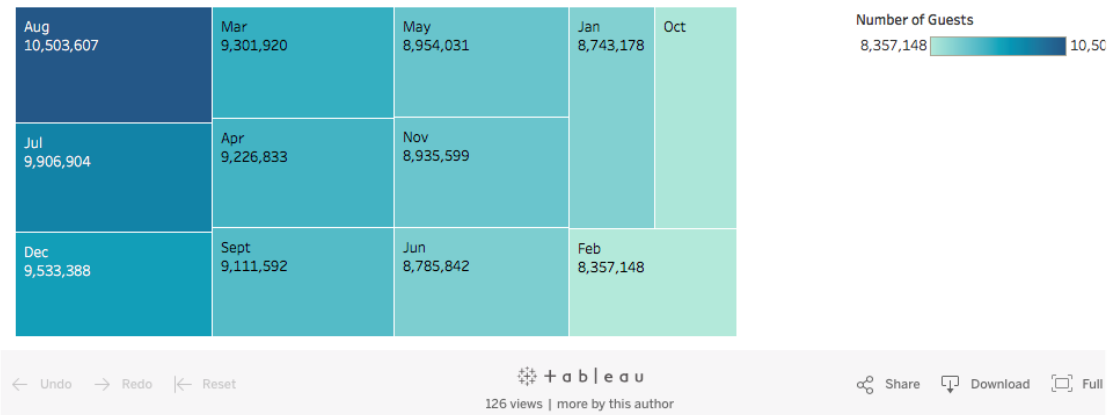
The chart displays the growth of accommodation in London over a 16-year period. The y-axis for each facet represents the count of properties, with scales varying by category: 2-star hotels (0-10), 3-star hotels (0-10), 4-star hotels (0-15), 5-star hotels (0-30), and apartments (0-30). The x-axis represents the year from 2000 to 2016. The '2-star hotels' series (orange) shows a slight decline from approximately 12 to 11. The '3-star hotels' series (yellow) shows a steady increase from about 9 to 13. The '4-star hotels' series (green) increases from around 8 to 17. The '5-star hotels' series (teal) shows a significant rise from about 7 to 32. The 'apartments' series (blue) remains relatively stable, starting around 35 and ending around 32.

Year	2-star hotels	3-star hotels	4-star hotels	5-star hotels	apartments
2000	12	9	8	7	35
2001	11	8	9	7	34
2002	10	8	9	7	34
2003	10	8	9	7	34
2004	11	8	9	8	33
2005	12	11	10	8	32
2006	12	13	12	9	31
2007	12	14	12	12	31
2008	11	12	12	16	29
2009	12	12	13	20	31
2010	11	12	13	23	31
2011	12	12	13	25	31
2012	13	12	14	27	33
2013	13	12	14	27	33
2014	13	13	14	27	33
2015	13	13	15	29	32
2016	12	13	17	32	32

[illegible]

From the heat map, we can figure out that the occupancy rate is up to 80% in recent years, increasing more than 10% in the last decade. Except for the spring of the 2003 which the SARS had a severe hit in the tourism in Macau, the rate increases stably. In August it even reached peak at 90%, which suggests great prospect in high-level hotels opening.

Number of Guests



For further information we can see the tree map below which indicates when there are most visitors. August and July which stands for summer vacation are the most hot months for tourism, followed by December which is the Christmas vacation. On the other hand, there are only 8 million guests in February, the least in number of all months.

Conclusion

Before the year 2013, the consisting increase in tourists led the fast pace development of the top-rating hotels. However, the ceiling of the tourist quantity has been reached in recent years while the construction of the new luxury hotels are still in progress. This is a dangerous signal: the accommodation market in Macau is saturated now. Precise market positioning should be done by those who are preparing for the new 5-star hotel programmes, or else they will face a critical loss.

Part 4 Gaming Industry

Problem Statement:

When heard about Macau, the first thing jumping into our minds is usually the gaming industry ,fancy casino and money on the game board.We know that gaming industry contribute a lot to Macau's economy. The tax revenue from gaming accounts for nearly 80% in the public revenue of Macau these years. So it's important and meaningful for us to study the gaming industry.

In this part, we will discuss revenue of gaming industry and its relationship with number of visitors. More specifically, here we focus on the following questions:

How much profits does the gaming industry create?

Which kind of game contributes the most gaming revenue?

Is there any relationship between visitors and the revenue of the gaming?

Tentative to explore the role of Mainland visitors play in the gaming industry

dataset

respective revenue of six main games in casino from 2002 to 2015 and the change of number of visitors and total profit in gaming industry from 2008 to 2015

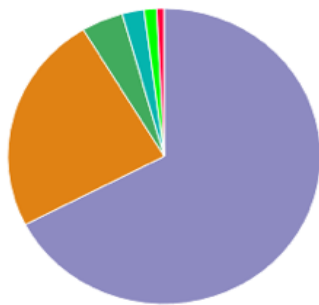
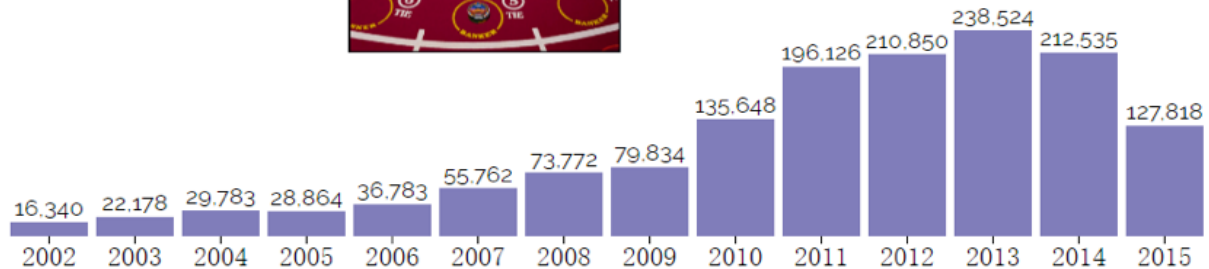
Method and Tools

as there are two kinds of comparison between 6 games and yearly revenue, d3 is chosen to present one pie chart to show the percentage of each game's profit out of total and one histogram to show the yearly change.And tableau is used when identify the relationship between visitors' number and revenue.

From following graph, we can see the total revenue of gaming from 2002 to 2015. In the histogram, it's obviously the revenue increases so rapidly that it grows from 23496 million MOP in 2002 to the climax 361866 million MOP in 2013.

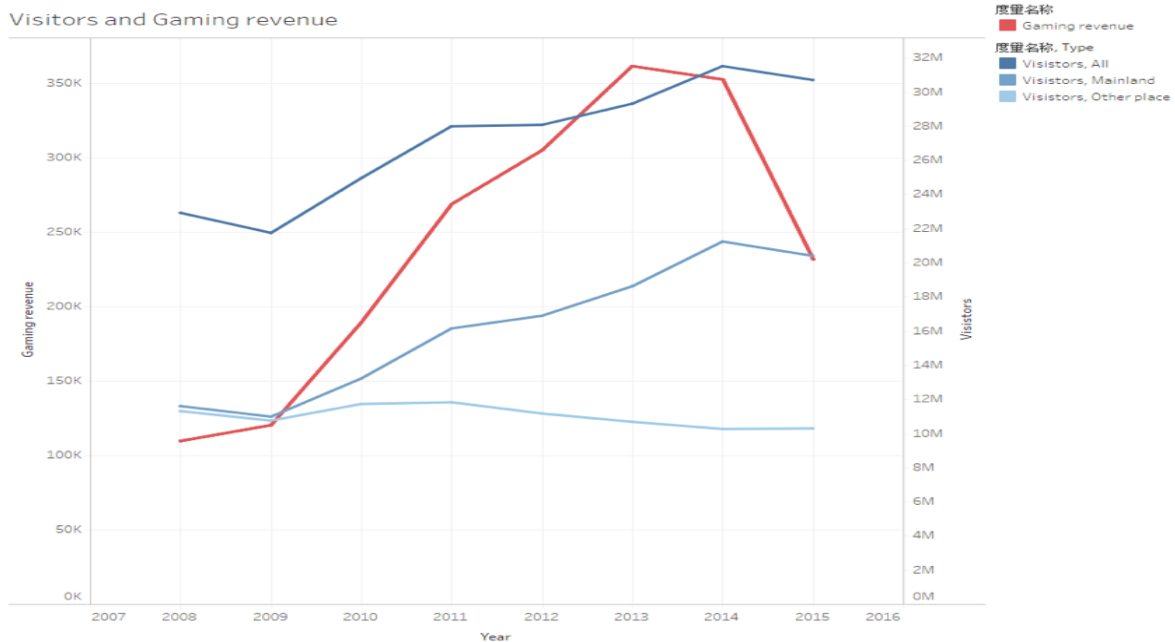
It's nearly 15 times in 2013 than in 2002. So we can see the growth is very obvious. However, in 2014 and 2015, the revenue declines, especially in 2015, the revenue declines more than 120 billion MOP than 2014, the amount is more than 31% of 2014. It's a big loss to Macau's economy.

vipBaccarat



vipBaccarat	1,464,817	67%
Baccarat	521,610	24%
SlotMachine	94,029	4%
Cussec	49,169	2%
Blackjack	27,874	1%
LotteryBetting	16,785	1%

And the pie chart is composed of different kinds of games in the gaming. There are VIP Baccarat, Baccarat, Slot Machine, Cussec, Blackjack and Lottery Betting. From the chart we can see that VIP Baccarat and Baccarat account for more than 90% to the revenue. When you put the mouse on the VIP Baccarat part in the pie chart, you can find that the revenue trend of VIP Baccarat is nearly the same as the total revenue, and it declines nearly 39.8% year-on-year in 2015, and it loss more than 84 billion MOP. So we can conclude that gaming industry is deeply relies on VIP Baccarat.



In this graph, there are four lines including the number of total visitors, visitors from Mainland China and visitors from other places and the gaming revenue. We notice that the trend visitors' number is growing from 2008 to 2014, only declines in 2009 and 2015. The number of visitors in 2008 is nearly 23 million and more than 31.5 million in 2014. It grows more than 8.5 million in six years. There are still two lines, one is visitors from Mainland China and the other is visitors from other place. We can find that the number of visitors from other place is stable and rarely changes. So the number of tourists is great depends on tourists from Mainland China. Visitors from Mainland account for more than 50% of the total visitors. The trend of total visitors and visitors from Mainland is nearly the same.

In the gaming revenue line, there is a sharply decline in 2015. It declines about 31% year-on-year, however, the number of visitors only declines 2.57%, about 0.811 million. And we find that the number of visitors from Mainland decreases 0.841 million, it's even more than the total loss. So the loss of visitors is caused by the decline of visitors from Mainland. And the casinos loss 120 billion MOP because of losing 0.841 million visitors from Mainland. So we can draw the conclusion that visitors from Mainland is very important to the gaming industry.