Data visualization of labor market

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1 Abstract

Labor markets have recently been the most popular topic among graduates. Since too much information is provided at the same times, graduates could be confused about their career paths. To solve this problem, this research created 4 data visualization cases, which are a dynamic bubble chart, pie chart, dynamic radar chart, and a dynamic line chart. Information of 4 main industries: Financial industry, Law and Business, Logistics industry and Travelling industry in Hong Kong was analyzed and visualized in these 4 charts. According to the data found in the website of Hong Kong government, 5 hypotheses were constructed and then be proved by these 4 charts. The superiority of these 4 charts was analyzed and concluded by comparing with alternative visualization methods.

2 Introduction

The increasing number of unemployment rate has always been the severest problem for governments. Graduates are finding difficulties in searching for a suitable job opportunity provide that there are too many websites and advertisements for them to review. Besides, it is hard to get a general view of labor market with excessive and disordered information. This research attempted to construct clear and plain visualizations by utilizing data of labor market in Hong Kong. The aim of this research is find the underlying patterns of given data. For each chart created in this research, several hypotheses were obtained and eventually verified through observation and analysis of dynamic charts. The first hypothesis is that Hong Kong was severely influenced by financial crisis in 2008, and salary level dropped in 2008 and swiftly went back in2009. The second hypothesis is that there are possibilities that logistics industry is experiencing recessions. The third hypothesis is that the whole economy was recovering generally. The forth hypothesis is that female are growing to take a larger part of labor market; more specifically, number of women having high level of salaries are growing to be larger, but at the same time they are still dominating the workplace of lowest level of salaries. The last hypothesis is that financial industry, went through

fluctuations, is still the most energetic industry in Hong Kong; however, travelling industry is facing recessions. These 4 dynamic charts were also evaluated in terms of their efficiency, accuracy, and intuitiveness. Obviously these 4 charts are winners for numerous advantages they have. In this report, specific analysis of each chart would be given and validation of hypotheses would be given as well. In the last part of this research, conclusion would be given.

3 Related Work

Dynamic bubble charts are wildly used in data visualization, and it is very efficient and informational. In the case of visualization in Social Networks (JEREMY ASHKENAS, MATTHEW BLOCH, SHAN CARTER and AMANDA COX), each social network and searching machine is presented as bubbles with different areas, and those bubbles are changing with time. Large number of bubbles were presented in one picture, and through the movement of each of them, clear relationships and trends were shown intuitively.

http://www.nytimes.com/interactive/2012/05/17/business/dealbook/how-the-facebook-offering-compares.html

4 Visual Design

We propose to build four visualizations to analyze the industry development in Hong Kong. We handle with many different datasets from some official sources and according to the target of our project, we select some useful and reliable datasets. As our plan, the original structure of the four visualizations is bubble chart, pie chart, line chart and radar chart separately. The first 'animated bubble chart' has four dimensions (e.g., time, industry population, work time and salary/price level). The second 'sub aggregation pie chart' has two visualizations, complex pie chart and line chart, which has three dimensions and four dimensions separately. The last visualization is the radar chart, also three dimensions. These visualizations involve the information on employee treatment, gender difference and development change of industry, which can give us a many-sided sight on Hong Kong's industry development. The design rationale we obey and the concrete visualizations are introduced below.

4.1 Design Rationale

Rationale 1: Based on the change tendency to find the regulation.

Time is an important factor in our plan because it can show the change tendency of the variable and may help us to make reasonable estimation of the variable in the short future. Depend on this reason, we add the information about year in every visualization.

Rationale 2: Find the interactions between different information and combine the information reasonably.

There are plenty of information and it's unrealistic for us to put these information into our visualization one by one. Thus, we need to find the relation in different information and sometimes have the necessity to combine them together.

Rationale 3: Allow exploration when analyze the different industries.

Although we put each industry as independent variable, there are some potential interaction in the different industries in reality. When do analysis, we should consider this reason and make some exploration.

4.2 Animated Bubble Chart

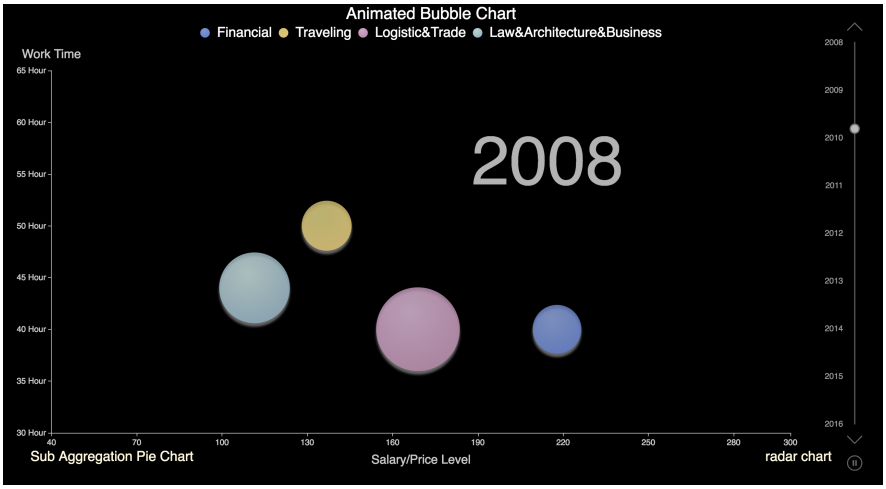

Figure 1: Animated Bubble Chart

This dynamic chart gives us an overview of the job market occupied by the four main industries from a time flowing view. It can be seen that there are four different colored bubbles in this chart represents different four main industries in Hong Kong. Different sizes indicate different populations in different industries. It can convey the information how popular the industry is and somebody may have the opportunity to get some idea from this popularity trend such as the larger or smaller number of the provided positions. We can see the changes of the four main industries clearly as the bubbles jump up and down, or left and right. There are three other dimensions in this chart. In terms of searching a job, we may consider the balance between work time and salary level. And this salary value should stand for the real value of your ability of consumption. So, price level in different years are added into consideration to help to account for the salary level. When we say the balance between work time and salary level, there may be four conditions come up into our minds. These four conditions illustrate the four directions the bubbles may go to. Someone wants a challenge in his or her life, he or she may enjoy the life in an industry whose bubble goes

right and up. For someone can't stand the overload in work time and desire not to pursue a high salary level, he or she may think the bubble goes left and down is better. While it's common view that most people have the opinions that it's better to have a job which has a higher salary level and less work time. On the contrary, on one wants a job which has lower salary level and need to work longer. So, it's happy to see the bubble goes right and down instead of going left and up. It's no doubt that in general condition, these bubbles stay in an approximately stable position with slightly changed sizes. If there is abnormal situation such as big jump or significant change of size, there must be an abnormal event happens which has a serious effect on the industry.

4.3 Sub Aggregation Pie Chart

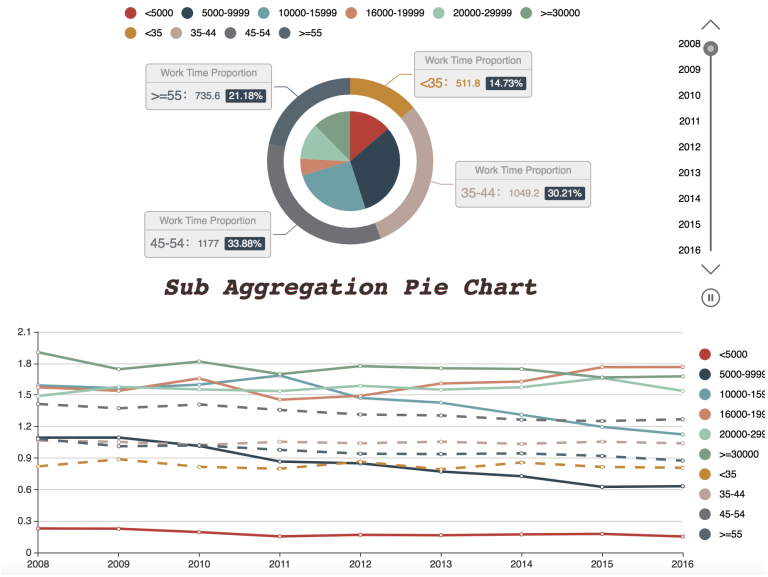

Figure 2: Sub Aggregation Pie Chart

The sub aggregation pie chart has two charts. We have considered that if we put two charts in one canvas, the volume of information will be too large to be accepted by others. However, the relation between these two charts is very tight, which both focus on the whole city employee. It may be better to put them together.

The upper pie chart has three dimensions, year, work time and salary. It can move by the year and then we can find the proportion change on the other two variables. The outside pie is about work time and the inner pie is about salary, where different color stands for different range. From this chart, we focus on whose salary is less than ten thousands and over thirty thousands per month and whose work time is less than 44 hours and over 54 hours per week. Not only

because these parts have large charge in the period, but also because they have special meaning in the society. The employee whose work time over 54 hours in a week is in situation that is overburden, whose proportion can reflect the pressure that the employer put on the employee in the society and the part whose work time less than 44 hours is in a reasonable workload and obey the rules to labor protection. What's more, the salary difference of employee can reflect the gap between the rich and the poor. Those salary less than ten thousands will have a difficult life in Hong Kong.

The line chart below the pie chart is added another attribute, the sexual ratio in the different level. The x axis stands for the time and the y axis is about the sexual ratio. The full lines contain the information of salary and the dotted line contain the information of work time in this chart. The attribute of salary and work time are still retained but in this chart we cannot know their proportion. This chart focuses on the gender difference in the labor market. The special range of the salary and the work time is the same as pie chart, although at this time we want to find that if there has different treatment between the female employee and the male employee.

4.4 Radar Chart

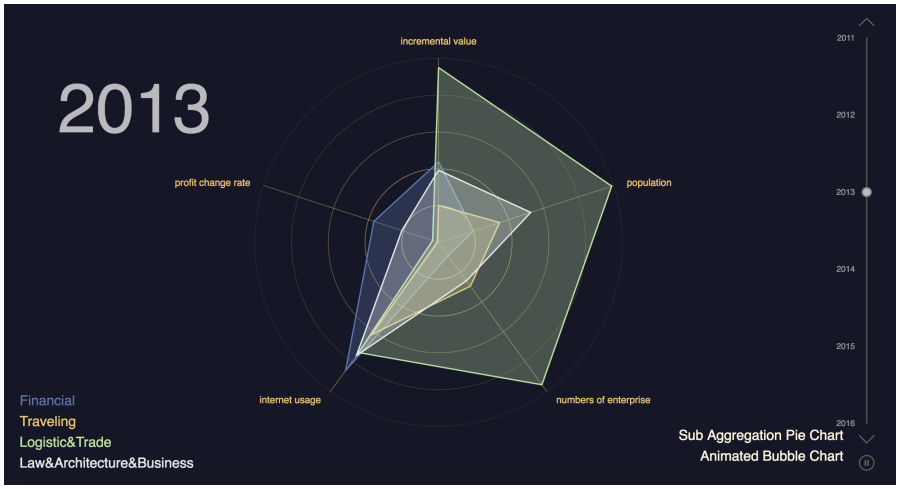

Figure 3: Radar Chart

This dynamic radar chart can give us a comprehensive view of a six-year change trend of these four industries and get some idea about how they perform in five different aspects during recent six years. This is to say there are two views of comparation which can give us information about the development trend for the same industry during different years and the comparation in five different aspects for different industries in the same year. When we search for the job opportunity, we may care about whether there is potential for an industry in

development and it's better for people to devote themselves and realize more value in an industry which is in the raising stage. The five aspects which we have considered are incremental value, population, number of new formed enterprise, internet usage and profit change rate. The incremental value means whether and how this industry gave contribution to economy development. The population concluded in an industry indicates the popularity of an industry. The number of new formed enterprise indicates the popularity as well and besides that it means more job opportunities and more vitality in an industry. Internet usage means the internet penetration in an industry which may contribute to a faster development in an industry. There is no doubt that profit change rate is an important index indicating the growing or recession of an industry in a certain extent. With scores assigned to all these five aspects, we can get different colored areas. The larger the area is, the more potential an industry has in development. In addition, in a view of the score change of each industry in different time, we can see the development extent is increasing or decreasing.

5 Case study

We collected the data of companies in smart cities. So we came up with the data of industries, salaries, working hours, the ratio of men and women, the number of people and so on. So we can see that the industry trends in Hong Kong We have mainly found the four industries, finance, tourism, law, architecture and other business , logistics trade. We wanted to visualize the trends of these major industries through data visualization. We designed four charts, the first is the bubble chart, a total of four-dimensional information, including the population in four industries, time, working hours, and salaries. Besides, bubble chart is a dynamic form so that we can see changes over time, on behalf of various industries, for example, the financial industry shows a marked drop in salary in 2008, which directly reflected the overall situation of the financial industry at the time.

From the center pie chart, we can see that the proportion of salary levels accounted for less than one million of the population fell by 20% within a decade, excluding nearly 50% of inflation due to ineffective wage growth, we can see that the average wage of workers is on the rise. The proportion of those with salaries exceeding 30,000 has increased by nearly 10%, boosting the income level of Hong Kong employees, but this has also brought a more serious gap between the rich and the poor.

From line chartthere is a big gap between the salaries of women. In the job market in Hong Kong in recent years, the proportion of females has risen below 15,999 and above 30,000, the stronger competitiveness of females and The weaken shows Matthew effect, but from the datathe total working hours are totally increased.

From the radar chartwe find the financial industry in Hong Kong is still showing a strong trend, especially in the insurance industry. In both 2015 and 2016, profits have been growing at a rate of 60% and nearly 100% in successive

yearsbesidesthe significant increase in employment has proved to be an important position in Hong Kong's financial industry on the one hand.

The profit change ratio and population of traveling increased firstly and decreasedIt also reflects the fact that the traveling is facing a transformationalthough it reached its peak in 2014 when major visitors to Hong Kong came from the mainland and from Asian countries. However, the free trade and transportation industry were affected by the changes in the Mainland.

6 Conclusion

We attempt to analysis the job market in HK, including the trend of four industries gender ratio, working hours and population of industries. Bubble chart shows the relationship between working hours, salaries, population of industry and timeline. From 2008 to 2009, there is a big jump. That may indicate HK was influenced by financial crisis in 2008. Salary level drop in 2008 and swiftly went back in 2009. logistic move left and down, which means both salary level and working hours are shrinking, from the center pie chart, we can see that the average wage of workers is on the rise. From the radar chart, we find the financial industry in Hong Kong is still showing a strong trend, especially in the insurance industry. From line chart the working environment in HK is not very nice to females. At the same time the integrated skills are also important for employees to find a job.

References

[1]Badoe, D. and Miller, E. 2000. Transportation-land use interaction: Empirical findings in North America, and their implications for modeling. Transportation Research D, 5: 235–263.

[2]Akiva, M., Walker, J., Bernardino, A, Gopinath, D. Morikawa,T. and Polydoropoulou, A. 1997. Integration of choice and latent variable models, Cambridge, MA: Massachusetts Institute of Technology. (Working paper)

[3]Bollerslev,T.1986,Generalized autoregressive conditional heteroscedasticity, Journal of Econometrics 31, 307-327.

[4]]Engle, R.F., D.M. Lilien and R.P. Robins, 1987, Estimating time varying risk premia in the term structure: The ARCH-M model, Econometrica 55, 391-407.

[5]R. Knight, J. Ahrens, and P. McCormick. Improving the scientific visualization process with multiple usage modalities. LAUR-001619. 2. C.

[6]Upson, T. Faulhaber, Jr., D. Kamins, D. H. Laidlaw, D. Schlegel, J. Vroom, R. Gurwitz, and A. van Dam. The application visualization system: a computational environment for scientific visualization. IEEE Computer Graphics and Applications, 9(4):30–42, 1989.