EC Inspector: A Visual Analytics Application for Exploring and Analyzing Executive Condominium Prices in Singapore

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Abstract - There are little to no applications to allow residents in Singapore to explore the EC trends and prices that could potentially help them make decisions when purchasing ECs. With the increasing amount of data about ECs purchases that are left unused, can be used to aid them in making such decisions. Hence, EC Inspector was developed through a series of steps and design considerations. This pocket size application can derive insights and can be built on with some future enhancements mentioned to better decision making process.

1 INTRODUCTION

Executive Condominium (EC) is a special type of housing in Singapore and just like private condominiums, it also has common facilities like swimming pool, gym, gaming rooms etc. EC was first introduced in Q2 1996 and there is an increasing popularity of residents in Singapore buying EC units over the years. Despite the many general analysis of housing prices in Singapore (refer to [1] for an example of analysis), there were hardly any people providing visualization about EC specifically for residents to utilize.

Currently, there are a large dataset available about the transactions of buying and selling EC units which can be a new sale or a resale unit. These dataset captures the price and year of purchasing the EC unit, type of sale when purchasing, planning area of the unit sold and other various data about the transaction. However, there is little to no visual analytics targeted on finding out EC sale patterns, trends and prices.

Hence, we specifically designed and developed a visual analytics application, EC Inspector, targeted towards this area that has yet to be discovered. Our aim is to provide buyers and sellers a visual analytics tools for them to analyze and discover the patterns and trends. This allows them to better plan and decide the location of the EC units to purchase while having zero or more benefits in the future if they plan to sell their units.

This paper reports on our research and development effort to design and implement EC Inspector tool for supporting the analysis and visualisation to benefit EC buyers in Singapore. It consists of 11 sections. Section 1 provides an introduction of the paper. Section 2 gives an overview of the motivation and objectives of EC Inspector. Section 3 mentioned about some existing visual analytics application techniques which can be applied to our application. Section 4, 5 and 6 will talk about how and why the application was designed and implemented, and talk about the process. Section 7, 8 and 9 will show what EC Inspector would be like while highlighting the findings from it. Thereafter, we will end off with future enhancements and conclusion in Section 10 and 11.

2 MOTIVATION AND OBJECTIVES

This project is motivated by lack of detailed visual analysis on EC prices over the past two decades in Singapore. By converting spreadsheet reports into informative graphs, this project aims to provide buyers and sellers a visual analytics tools for them to analyze and discover the patterns and trends. This allows them to better plan and decide the location of the EC units to purchase while having zero or more benefits in the future if they plan to sell their units.

However, there would be inflation of money over the years and the value of the EC would also change. Without taking this issue into account, people might perceive that selling at a higher price than what they buy for would mean earning money. However, in actual fact, they would not know whether they are gaining or losing money from the sale of their EC units. Hence, we attempt to support the following analysis requirements:

1. To be able to analyze the purchase price change over the years;

2. To create a visualization that provides different perspectives of the same dataset;

3. To provide an interface to show the real price value of what they gain or lose from the sale of their units;

4. To visualize the distribution of the prices that ECs are generally sold at;

3 APPROACH

After the path for our visualization application is defined, we followed 6 main steps: (1) data collection, (2) research on related works, (3) data exploration and preparation, (4) brainstorming and prototyping, (5) repeat steps 3 & 4 until substantial insights are derived and then (6) implement the visualization.

4 RELATED WORK ANALYSIS

During the process of developing EC Inspector from the start to the end, we also researched on some related works from related analysis of articles. Below is an example taken from an online article[1].
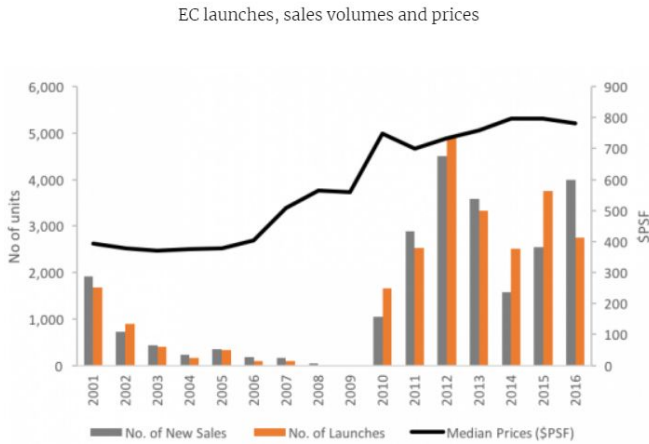

Fig. 4.1 EC launches, sales volume and prices

From Fig. 4.1, you can see the number of ECs are launched, number of people buying ECs and the average price it was sold at. These insights can give an overview of the trend and price of buying ECs over the year. However, we felt that there is no reason for adding number of launches in our case because our objective is to really analyze ECs in the 2 dimensions of new sale and resale prices and not just to tell users that there is an increase in new sales and its price of ECs.
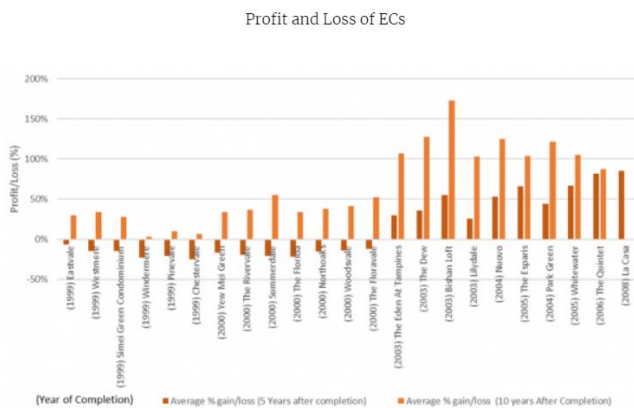

Fig. 4.2 Profits and losses of ECs

From Fig. 4.2, it tells us the profitability of each project in general, which is not something that we need. However, we can learn from its mistakes. if there are more and more projects, the list on the x-axis will keep increasing. This makes the chart more cluttered. A way to improve it could be adding filters to filter by planning areas.
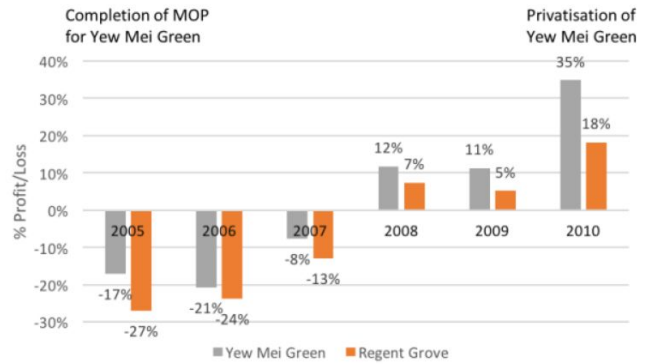

Fig. 4.3 Comparison of profit and loss of first-hand owners

In the article referenced[1], it has a chart that shows the profit and loss of first hand owners for the next 5 years after purchasing (refer to Fig. 4.3). This chart also analyzes between 2 specific projects of 2 types of housing which includes, normal condominium and EC. We think that this chart usage is a good way to compare between different types of housing. However, this chart is subjected to only 2 projects. It would be difficult to see when there are more than 10 projects for example, and would not be as easy to detect patterns.

After researching and analyzing related work, we can see that there are limited visualization that fits into what we intent to develop. However, this could help us develop EC Inspector while attempting to avoid pitfalls mentioned above.

5 DATA EXPLORATION & PREPARATION

It is important to gather the necessary data to aid us in the visualization process. We obtained data regarding the "Transactions Records of Executive Condominium since 1996" from Singapore's Real Estate Information System (data obtained from EALIS). We also required the data related to the Consumer Price Index[3] which was used to determine the real value of the transacted prices. For proof of concept, we used Tableau to visualize our ideas and explore the different graph types. We also calculated the real price of the transactions using the CPI data so that we could visualize the average gain or loss from selling the EC per year per planning area. Finally, we capped our time slider from 1996 to 2019 as ECs were established in 1996.

6 DESIGN PROCESS AND RATIONALE

With a better understanding of the dataset in our data exploration process, the team choose suitable types of graphs to achieve the goals of this project based on knowledge learnt in this course and extra research. The look of the visualizations is designed first using paper prototype before the charts are actually implemented.

Done in 11-2019

Prototype charts designed for each objective and the design rationale are as follows:

Objective 1: To be able to analyze the purchase price change over the years
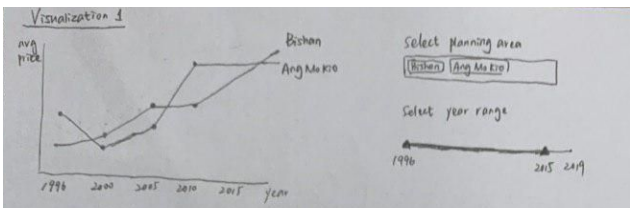

Fig. 6.1 Purchase price trend with filters

The team decide to use a line chart to visualize transaction price change since it is good for showing data over time and easy for viewers to see the trend of the price. To represent the average price level of EC for each year, mean value of all transaction price records for that year is used. The viewer should be able to select the region(s) and time range they want to check on the user interface.

Objective 2: To create a visualization that provides different perspectives of the same dataset
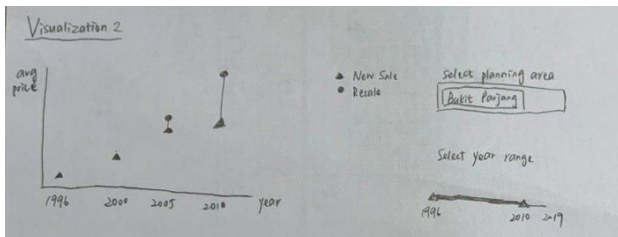

Fig. 6.2 Compare prices between new sale and resale

In this dataset, there are two types of sales: new sale and resale. The team designed a lollipop chart so that the average price of new sale and resale price differences can be easily compared over the years.

Objective 3: To provide an interface to show the real price value of what they gain or lose from the sale of their units
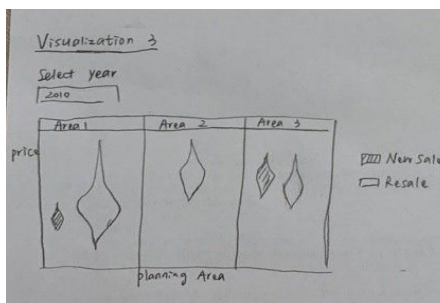

Fig. 6.3 Price distribution for new sale and resale

In order to visualize the distribution of the transaction price records, the team designed a violin chart, which shows ranges and variabilities effectively [2]. New

sale and resale are displayed separately for each planning area to enable viewers to see the difference.

Objective 4: To visualize the distribution of the gains or losses for selling ECs
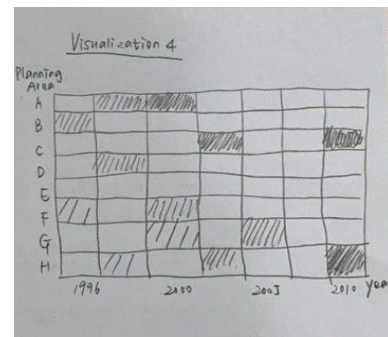

Fig. 6.4 Gain or loss from selling ECs

A calendar heatmap (in years) is used to illustrate the real value change over the years. The color shade of the blocks representing the gain or loss makes it more intuitive for viewers to identify the patterns.

7 DATA VISUALIZATION WALKTHROUGH

To use our dashboard, the user must first select the planning areas to compare along with the year range which is shown in figure 6.4.

Fig. 7.1 Selection of Filters

After selecting the filters, the user will be shown three graphs different aspects of the EC pricing data:

1. the user will be able to see the trends in the average EC prices based on the planning areas and the year range selected on the slider. Which can be seen in figure 6.5. The user can add planning areas to compare the trends. This visualization is aimed at showing the pricing trends to give insights on changing prices of the ECs over time.
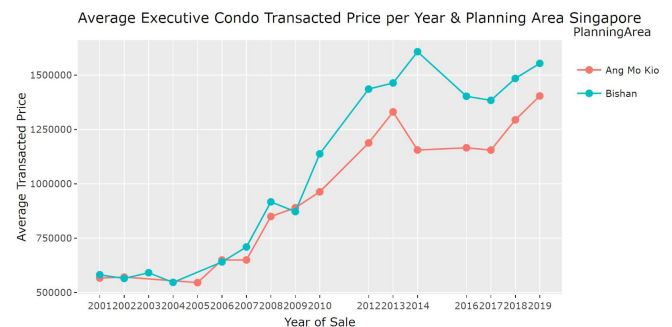

Fig 7.2 Comparison between Ang Mo Kio and Bishan

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2. The graph above shows the average transacted price trend, whereas the next visualization shows the comparison between the types of sales which are resales and new sales. The pie chart is interactive, so the user can click on a particular point on the graph described above to get a breakup of the type of sales. If a point is not clicked, the pie chart shows the comparison between the types of sales over all the data points which can be seen below in figure 6.6.
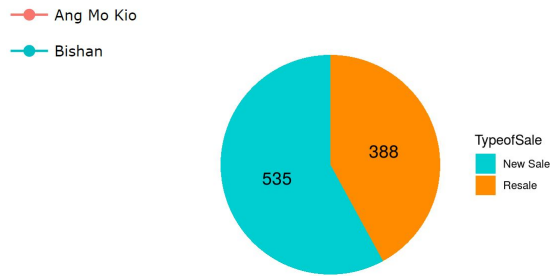

Fig 7.3 Comparison between New Sale and Resale

3. Our last graph based on the selected filters is the lollipop graph. The objective of this graph is to show the difference in transacted prices of resales and the newsales. As it can be seen in figure 6.7, for the planning area Cho Chu Kang, the new sale prices were higher than the resale prices between 2003-2007. The opposite trend was seen between 2012-2018.

Fig 7.4 Comparison between new sale and resale prices

The next part of our visualization requires our users to select a year which is shown in Figure 6.8.

Select Year to compare

2017

Fig 7.5 Showing the year filter

After selecting the year, the violin graph will give the distribution of Resale and New Sale prices of all the planning areas. This visualization is created to help gauge the price distributions of the ECs. The visualization is

interactive so the user can hover over the graph to get the specific point values. Fig 6.8 shows the distribution EC transacted price per year, planning area & type of sale.
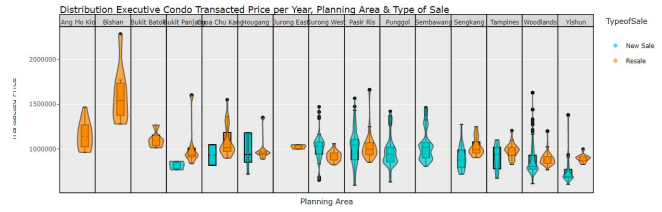

Fig 7.6 Distribution of Prices per year, Planning Area, and Type of Sales

Finally, our last visualization shows the average profit or loss obtained from reselling the ECs. This is shown through a heatmap showing a comparison of profit or loss over the planning areas. This can be seen in Figure 7.0.
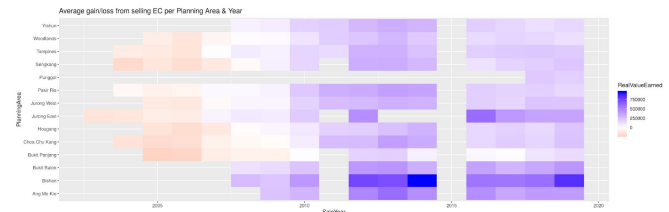

Fig 7.7 Comparison of the Average profit or loss obtained from resales per planning area.

8 KEY FINDINGS & OBSERVATIONS

Through the visualizations, the team summarize the following findings **in general** (for all areas):

1. Increasing EC price over 20 years

   From the first visualization (Fig. 7.2), there is an overall increasing trend of the price since EC was first introduced, with a peak of price in around 2013. Specifically, ECs in Bishan have the highest price while those in Yishun have the lowest.

2. Higher price of resale than new sale

   From the second chart (Fig. 7.4) we can tell that generally, resale prices of EC are higher than new sale prices. Upon research, this is due to the restriction of buying a new EC: 'a prescribed monthly household income ceiling of $14,000', which keeps the price of new ECs being too high [1]. However, after the EC has become private property when being re-sold, it enters the free market, which subsequently causes the rise of its price. However, it can also be noticed that in the year 2019, the average price of new sales increases dramatically to be much higher than that of resales, which results from the cancellation of this policy.

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Another observation is that there is no resales before the year 2000, since a new EC is only allowed to be sold after 5 years according to the regulations.

Also, it can be observed that from 2008 to 2010, there are almost no new sales of EC, meaning very few new constructions in these years.

3. Wider range of price for new sale than resale

From Fig. 7.6, it can be observed that generally, the variety of the price distribution for new sales is larger than that of resale.

4. Increasing gains of selling EC

From Fig. 7.7, the color shade is getting darker in time order, which means the actual gain from selling an EC is generally rising. Therefore, EC has been worth investing in over the years.

9   TOOLS & LIBRARIES USED

In the initial data exploration process, the team used excel tableau prep and tableau to view and conduct preliminary analysis of data. The final application is built mainly using R. R tidyverse is used to clean up the data for actual use and R shiny and plotly are used to implement the charts.

10   FUTURE ENHANCEMENTS

There are potential enhancements that can be done to the current design of the EC Inspector application. Below are some of the improvements:

1. Include data of other housing types in Singapore

By doing so will require the dashboard to have tabs for each housing type e.g. landed property so as to give users the flexibility to switch between the housing types to analyze its patterns and trends. This would broaden the coverage of the application.

2. Introduce comparison analysis between different housing types

This would require a separate tab for comparison of the housing types selected in the filter by the users. This would help users get a clearer view of the differences and discover better insights.

3. Predictive model for future sale prices

Having this feature in place would help users predict future sales price and make better decisions when purchasing houses for investment or other reasons.

4. Explore geospatial visualizations

Using choropleth, maps or even symbol maps expose patterns and insights that are location-based that our existing design does not cover.

11   CONCLUSION

With all the explanation of the current EC Inspector application design, it has potential insights that can be retrieved about the trend of the price, distribution, amount gain or loss based on real value of the EC units sold over the years. Furthermore, as discussed in Section 10, EC Inspector can be enhanced with various features and related datasets that can potentially add value to residents in their journey of buying and selling houses in Singapore.

ACKNOWLEDGMENT

REFERENCES

[1] Orange Tee Research. (2017, July 18). *The real value of Executive Condominiums: This is why Hundred Palms EC sold out in 7 hours.* Retrieved from https://zuuonline.sg/property/local-properties/executive-condominiums-still-a-value-buy-in-the-current-market/

[2] *5 reasons you should use a violin graph* - BioTuring's Blog. (2019). Retrieved 20 November 2019, from https://blog.bioturing.com/2018/05/16/5-reasons-you-should-use-a-violin-graph/

[3] https://www.tablebuilder.singstat.gov.sg/publicfacing/createDataTable.action?refId=12005

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