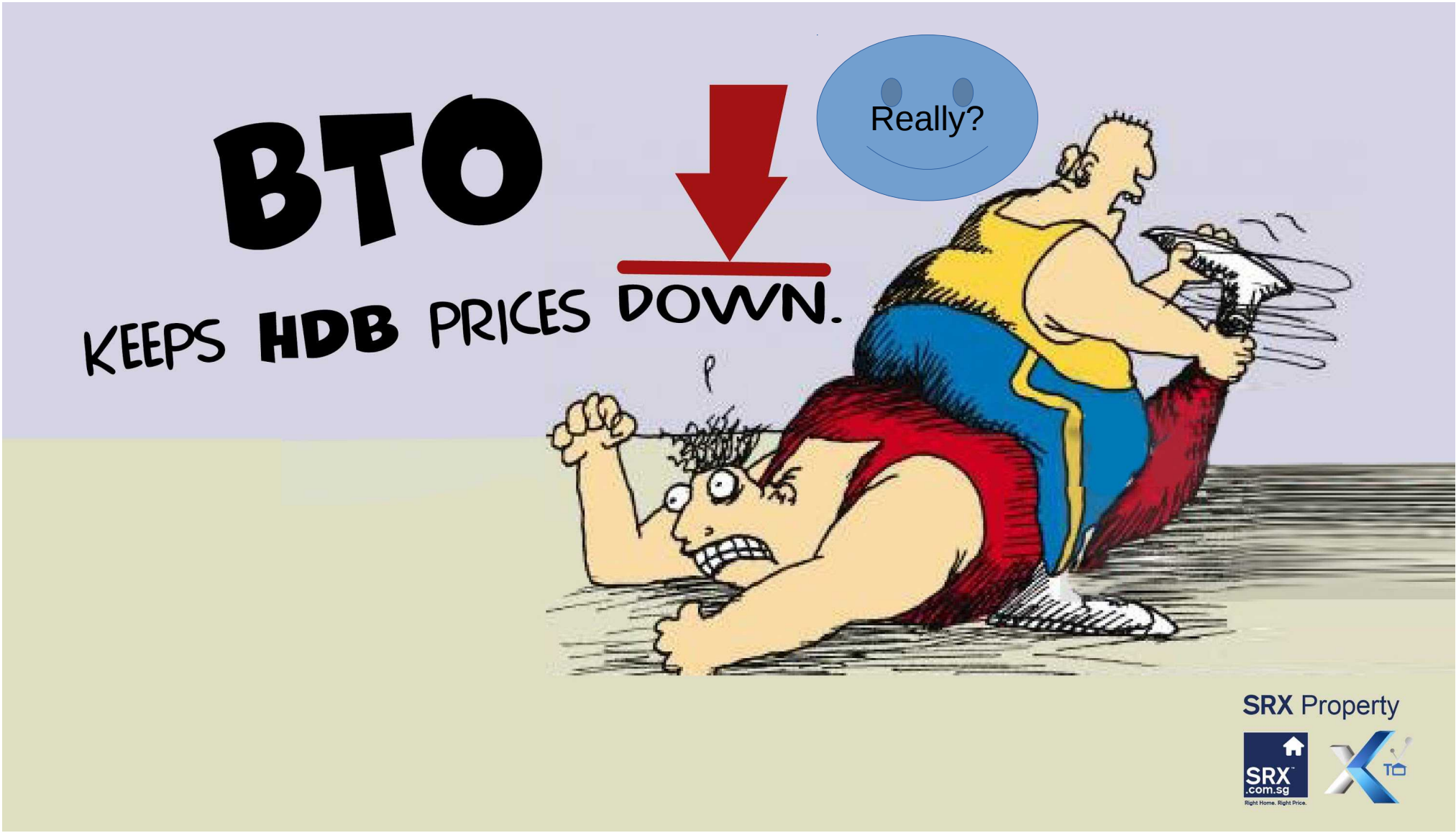
Resale HDB prices



Why study HDB prices

- HDB is the largest expense in many people's life
- Study how prices of HDB changes over time
- Learn about the overall trend of HDB prices over the past 40 years

File list

- Initial data file

  resale-flat-prices-based-on-approval-date*.csv
- MRT/Primary school location files

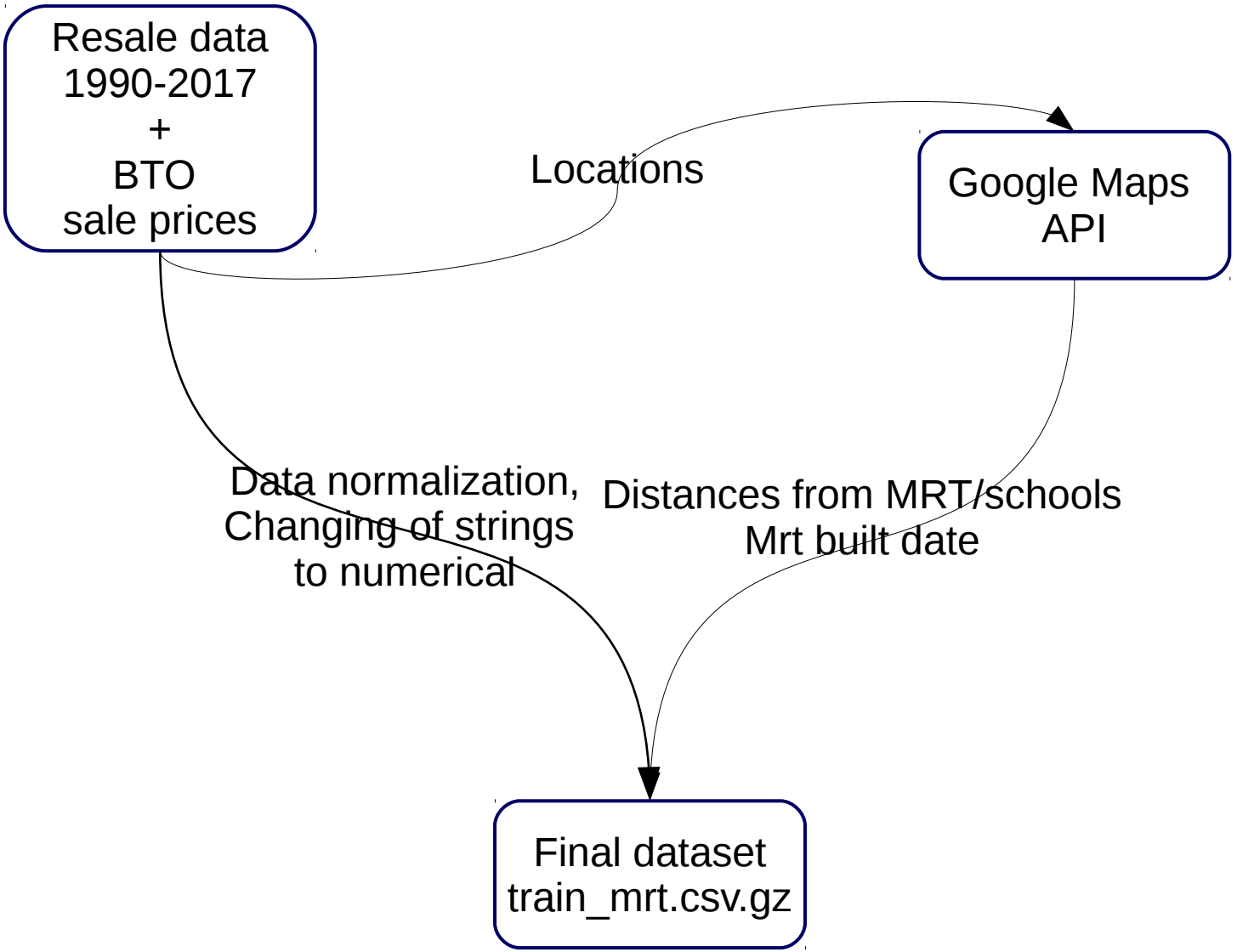
  Primary_school, mrt_date.csv, where.data_mrt
- Preprocessed files

  train_mrt.csv.gz
- Scripts

  notebook_preprocess.ipynb

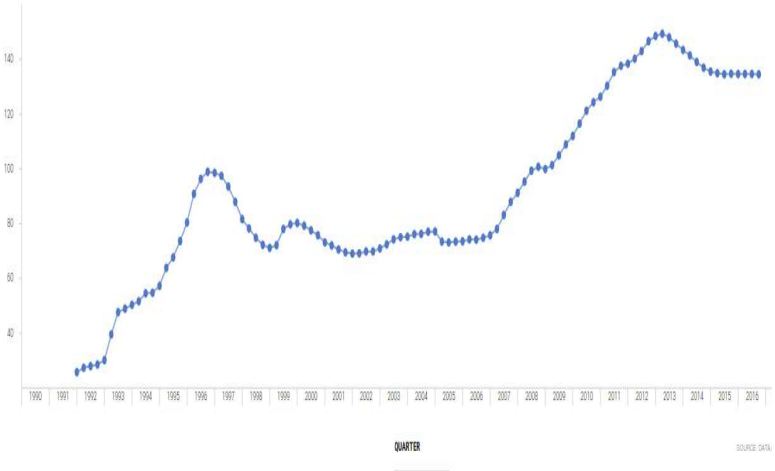
  notebook_analysis.ipynb

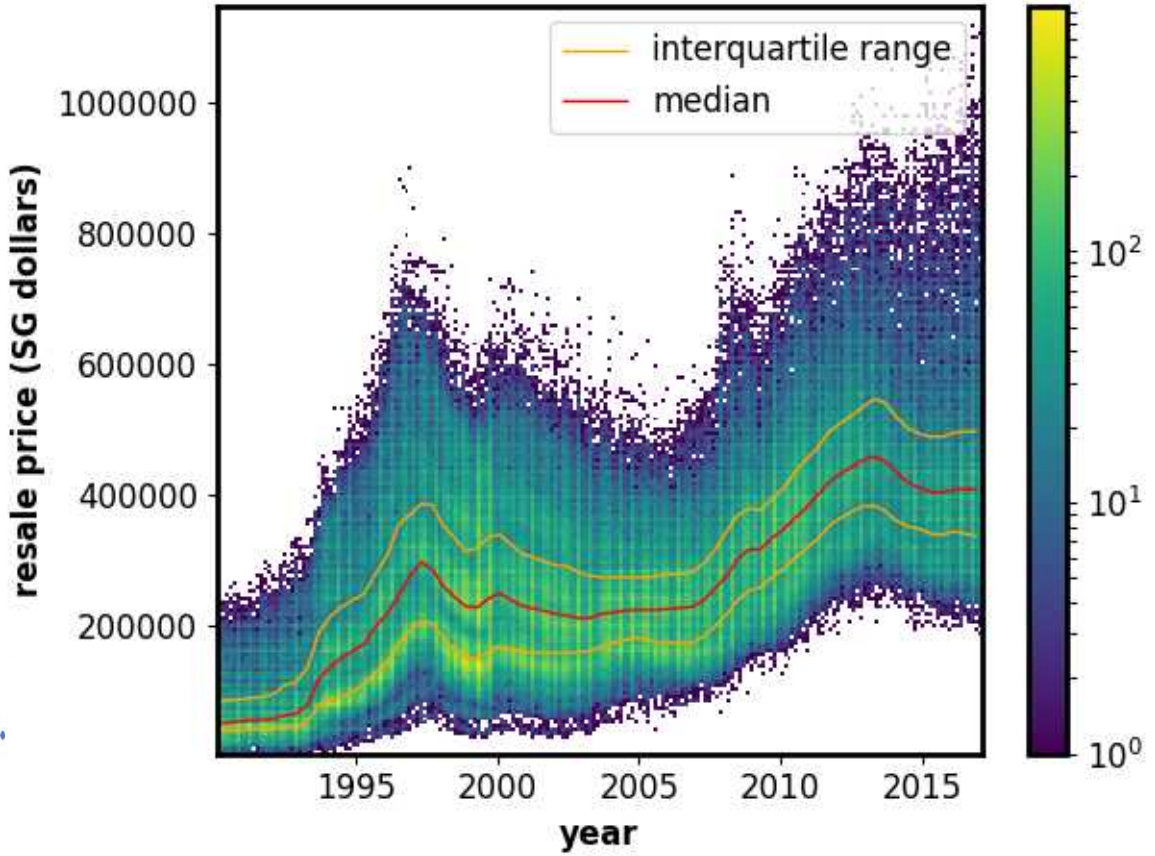
Data processing



General Prices of HDB

- General trend similar to one reported by gov.data.sg (below)





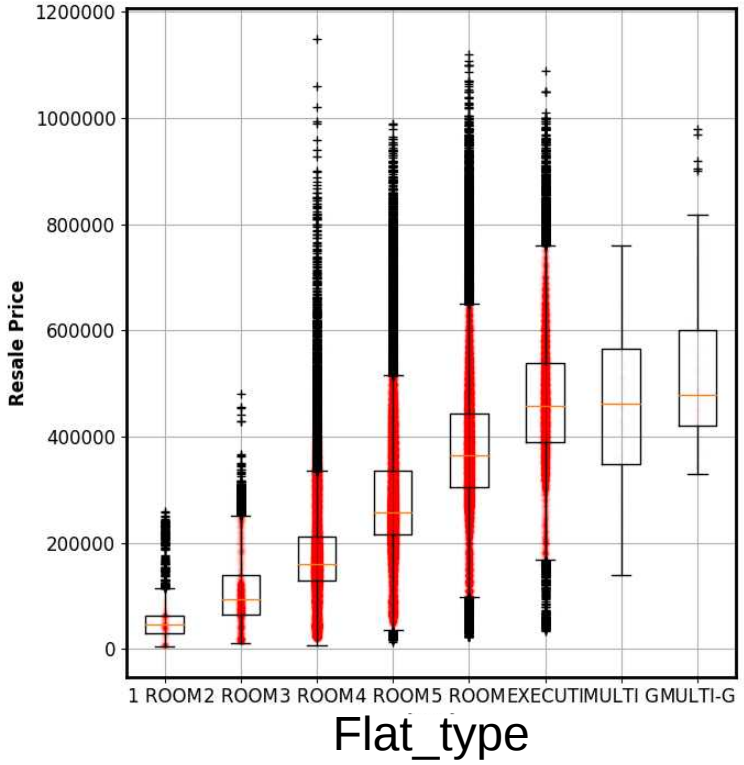
Main predictors of HDB flats

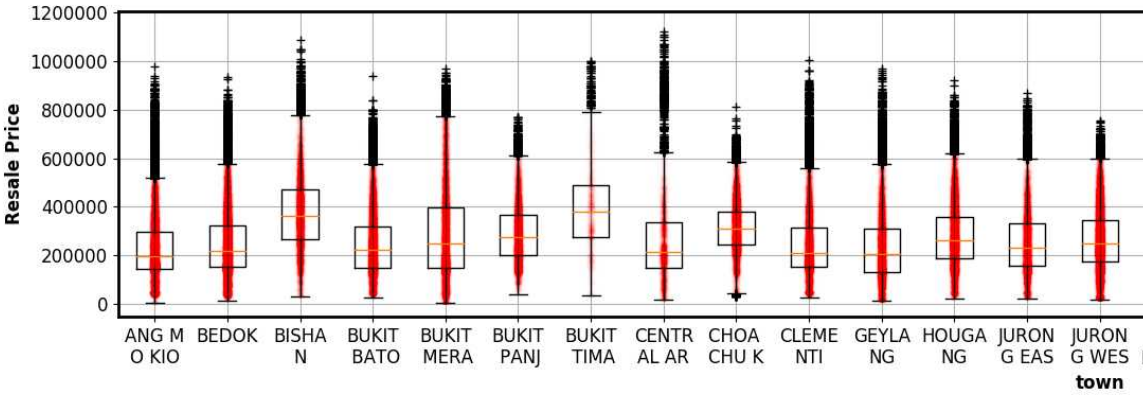
- Variables are month of sale, HDB town, flat type, bock, street name, level of flat, floor area, lease commence date, nearest MRT, consumed lease length, distance to MRT, area,
- Correlation of numerical variables show that floor area and month of sale are most important numerical factors with pearson coefficient of 0.65 and 0.58 respectively.

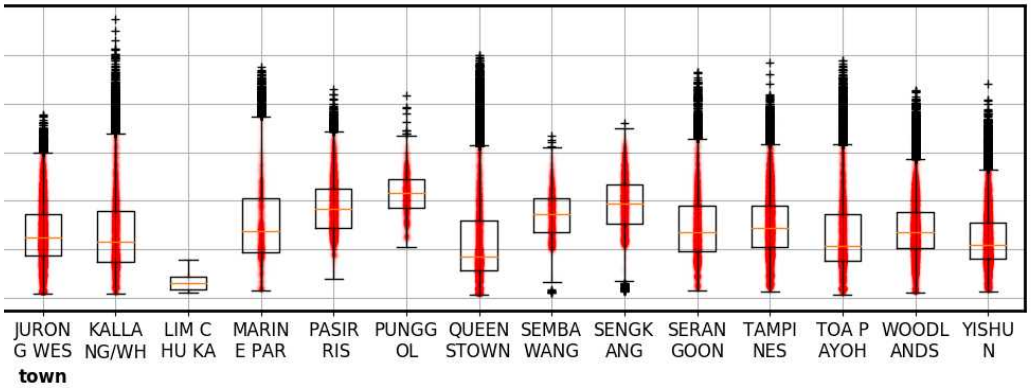
```
>>> train[['month','storey_range','floor_area_sqm','dist_nearestMRT','Time_since
MRTbuilt','lease_length','resale_price']].corr()['resale_price']
month                0.579766
storey_range         0.174023
floor_area_sqm       0.650346
dist_nearestMRT      0.021082
Time_sinceMRTbuilt   0.295540
lease_length        -0.033021
resale_price         1.000000
Name: resale_price, dtype: float64
```

Most important categorical variables

- Flat type and town were import variables
- I will ignore flat type for this study and focus on town

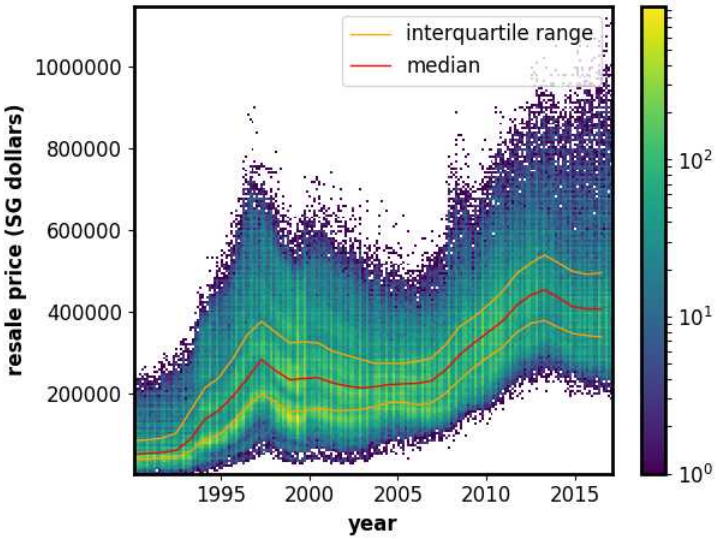


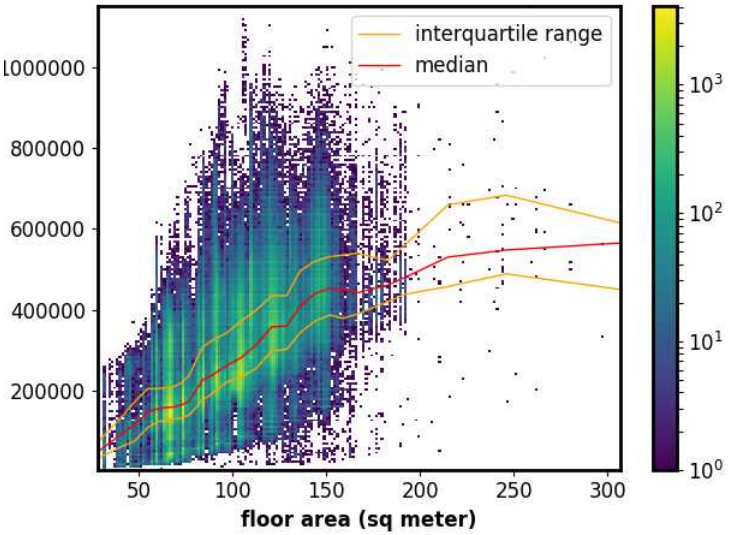




Normalizing the price across years and floor area

- Prices are dependent on inflation and economic climates, we need to normalize across different years.
- Normalized price by area and median resale price per month to get relative price across years



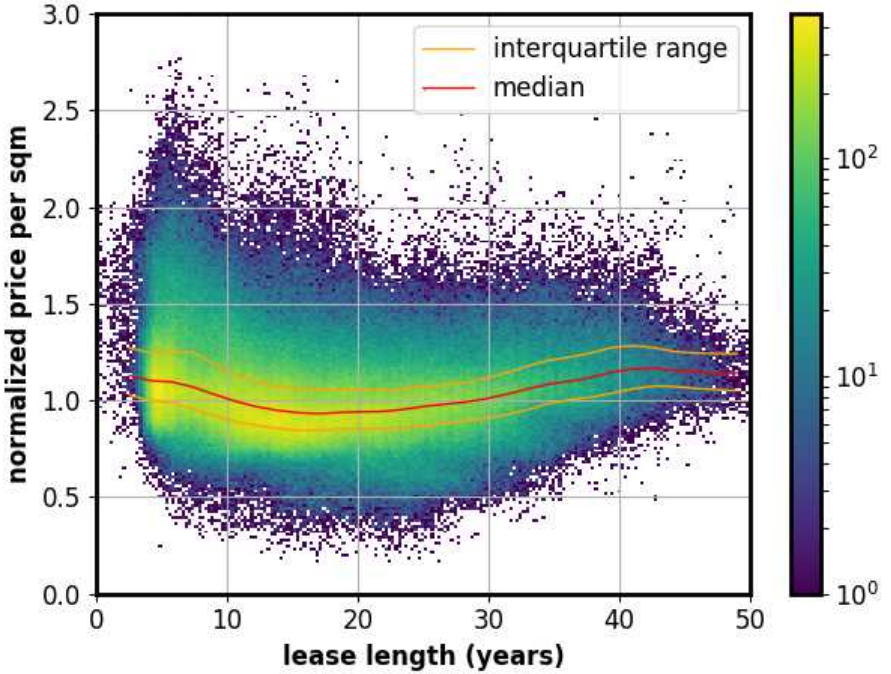


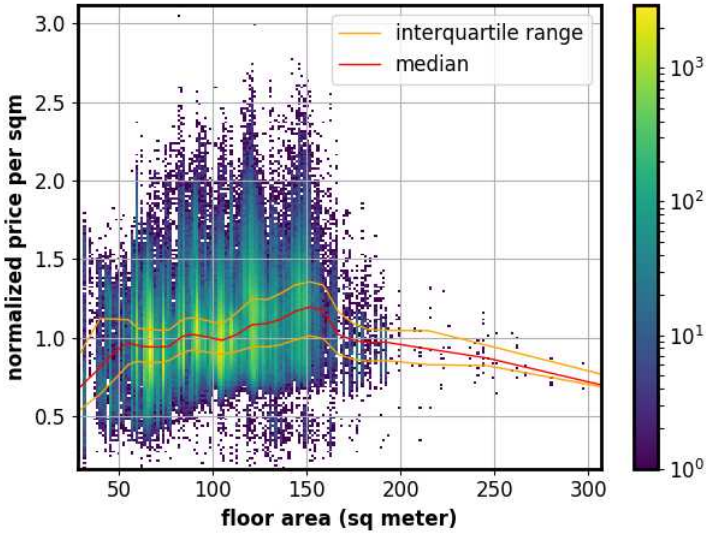
$$Normalized\ Price_{month}/sqm = \frac{resale\ value}{floor\ area * \sum_{month} resale\ value/n}$$

Average resale price for Month

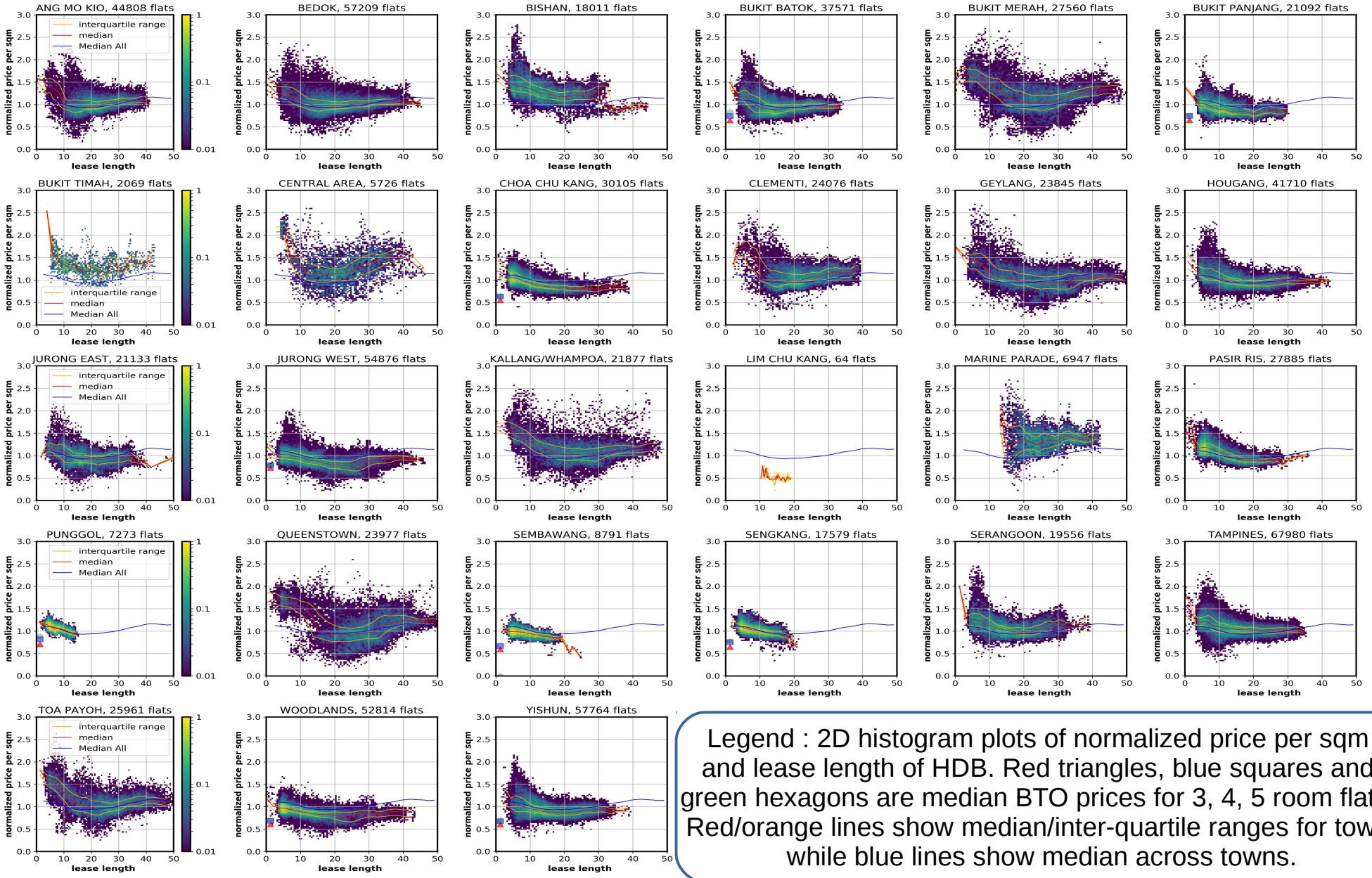
Normalized price per sqm over time

- Peak Prices at 5 year mark and lowest at 20 year mark accounting for inflation and floor area.
- Older flats above 40 years are sold for higher prices than new flats
- Larger flats are more expensive per sqm, but I have decided to concentrate on other factors instead.





Normalized price per sqm over time (by town)

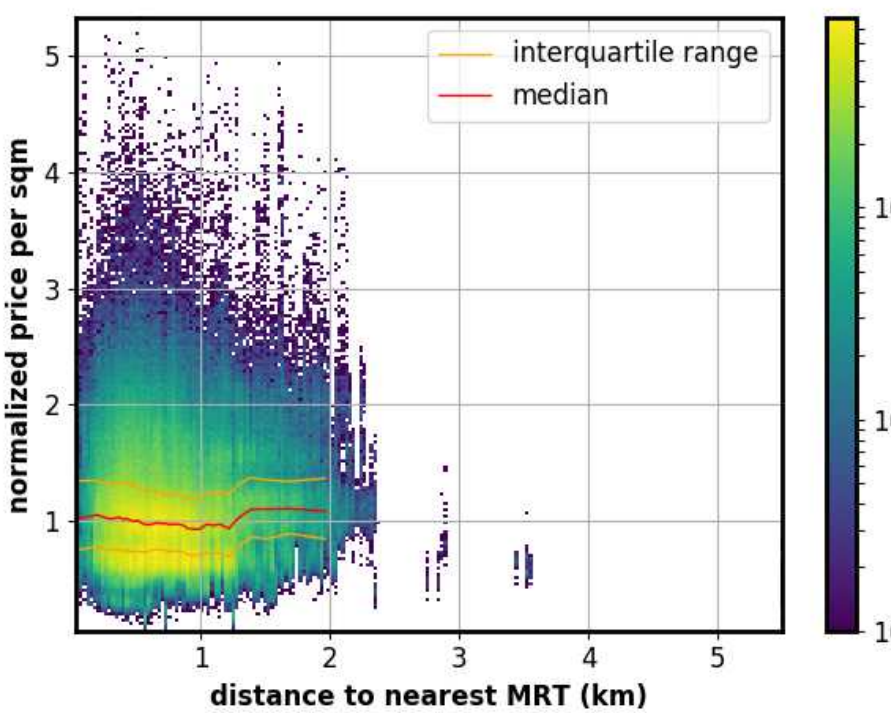


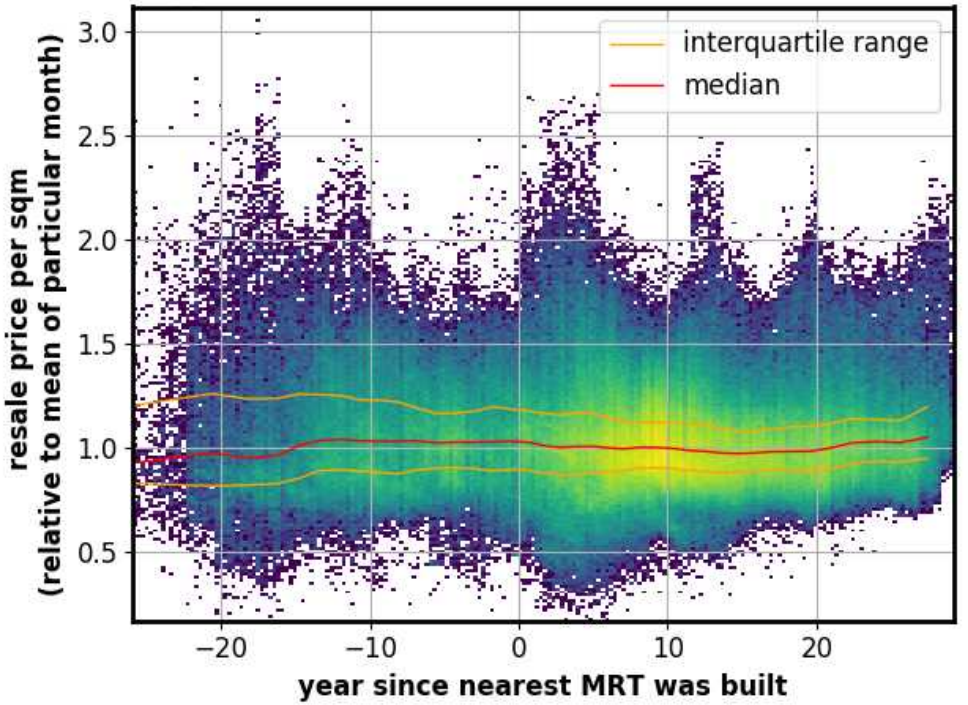
Legend : 2D histogram plots of normalized price per sqm and lease length of HDB. Red triangles, blue squares and green hexagons are median BTO prices for 3, 4, 5 room flats. Red/orange lines show median/inter-quartile ranges for town while blue lines show median across towns.

How do flats fare in pricing

- BTOs are lower than most resale flats even comparing with rock bottom prices at 20 year lease.
- Newer estates like Punggol and Sembawang Sengkang show much less variability compared to most mature estates like Ang Mo Kio, Toa Payoh and Queenstown.

MRT effect on HDB prices





- Building of MRT and distance to MRT does not impact prices per sqm.
- Houses further from MRT are generally a bit more expensive

Applications of Study

- Investigate trends of data using a normalized measure taking account inflation and floor area.
- This metric found that relative prices are lowest at twenty years and increases henceforth.
- Future resale prices can be forcasted by obtaining the unnormalized (formula below) price after getting an expert to estimate the mean resale price.

$$Normalized\ Price_{month}/sqm = \frac{resale\ value}{floor\ area * \sum_{month} resale\ value/n}$$

Average resale price of Month can be estimated by experts
This is affected by property market forces

Forecasting Data

- Previous slides give an intuition of prices, now for forecasting.

1)xgboost model

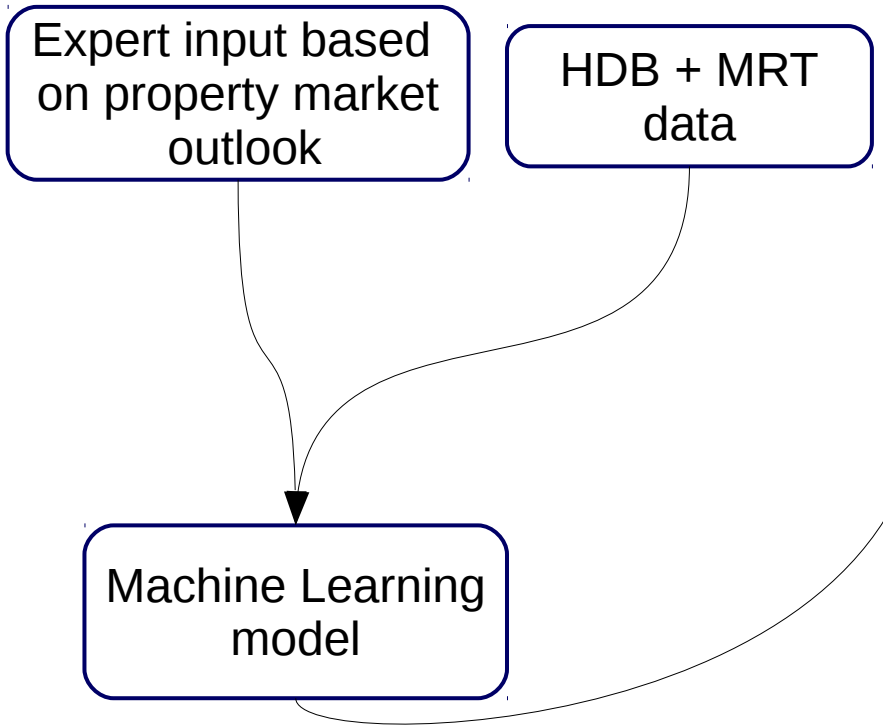
2)Train data :1990-2010

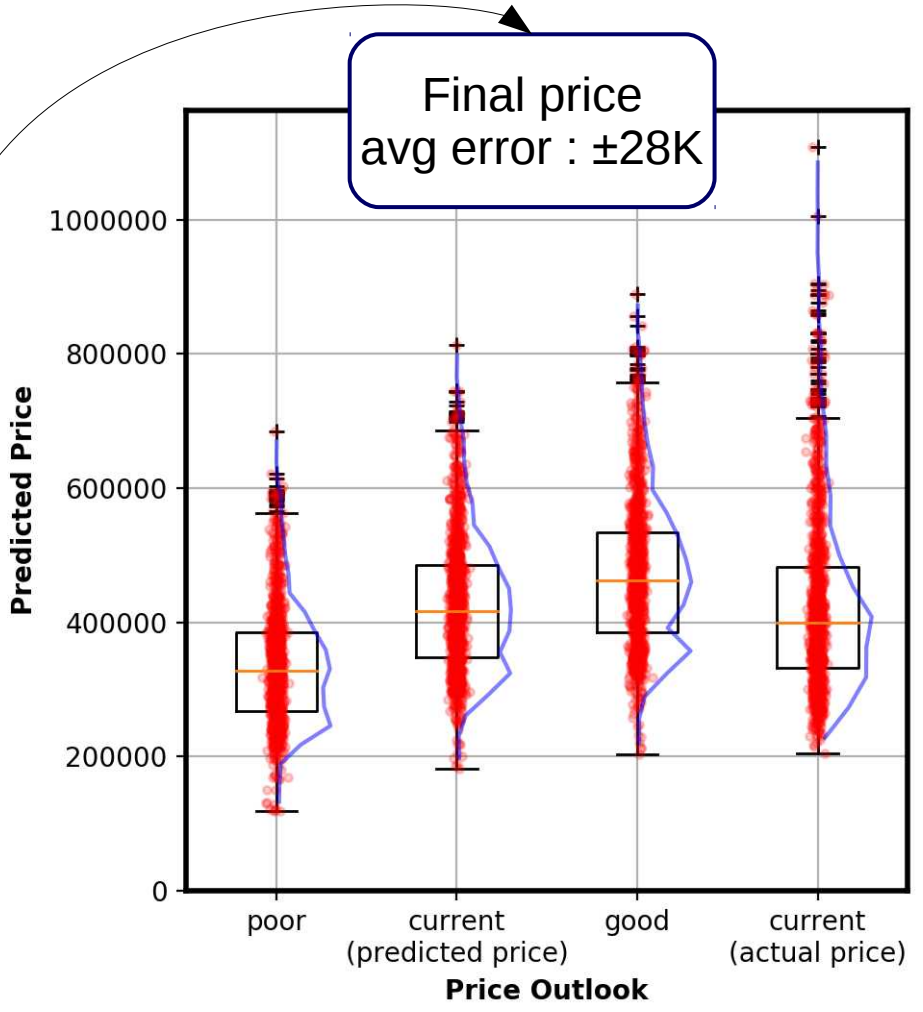
3)Test data :2010-2017

4)Features:

month_of_sale, town, flat_type, storey_range, floor_area_sqm,lease_commence_date, lat, lng, nearestMRT, dist_nearestMRT, MRTbuilt, Time_sinceMRTbuilt, month_mean, lease_length

Application: Forecasting with expert inputs





- We can forecast future prices after experts inputs on the *future median price*

Legend:
Red Dots : individual data-points
Blue line : histogram of prices

Conclusion

- Showed certain trends regarding property prices related to lease, town and MRTs.
- Prediction accuracy of machine learning model was in the error of ±28K.
- Our model facilitated expert inputs to help predict future prices

Limitations of data

- Current data is based on resale data, which is not truly representation of entire HDB data.
- Size of BTO flat was estimated using medians since it was not given. The prices per sqm meter are thus also estimates.
- It is known that larger HDB flats cost more per sqm meter, this was not taken into account when plotting the prices per sqm per town.
- Forecasting uses mean of all flats sold in the period, which might be better represented by a stratified means of different flats.

Appendix: Have HDB sizes shrank ?

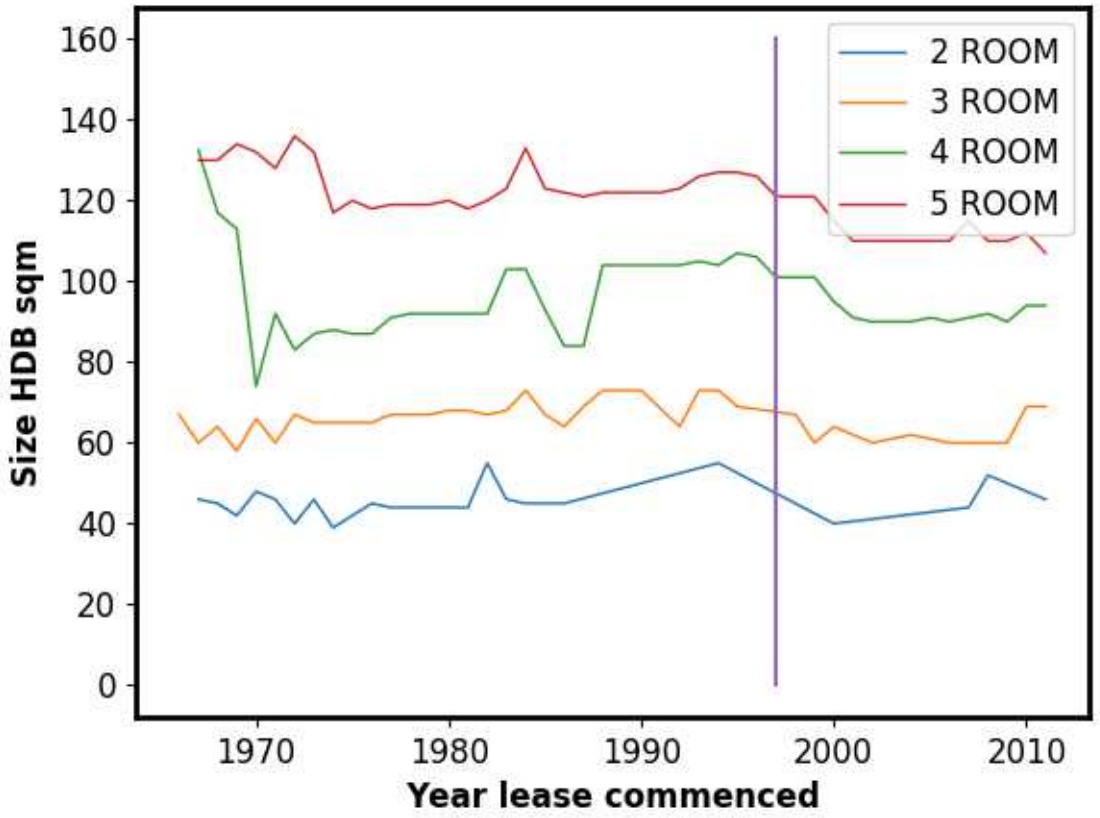
- HDB flat sizes not shrinking: Khaw Boon Wan

  “My comment at that dialogue was in response to a question. I was purely stating that HDB plans (flat sizes) based on certain design norms, and as far as I know, it has not changed for the past 15 years,”

  Posted by temasektimes on June 13, 2012

Appendix: HDB resale data

- Taking 15 years back, to 1998 (purple line)
- Flat sizes have been decreasing since 1998, with the decrease mainly from 1998 to 2001
- Flat sizes have not decreased for 10 years since 2001-2012



Appendix : Data sources

- https://data.gov.sg/dataset/resale-flat-prices
  from year 1990-2017
- Google maps API data for geospatial cordinates
- Wikipedia for MRT and primary school data