DATA VISUALISATION AND VISUAL ANALYTICS
Assessment Task 1: Data Visualisation Foundations

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1. Brief report and data overview

1.1 Report overview

This report requires performing data collection and data visualisation techniques from which insights are extracted, providing recommendations to potential buyers or investors about real estate properties in Moorebank. Moorebank is one of the suburbs encompassing Sydney, located 27 kilometres to the southwest of Sydney CBD and in the local government area of the City of Liverpool ("Moorebank, New South Wales," 2023).

1.2 Data overview

The data are entirely collected from two sources: "Australian Bureau of Statistics (ABS) Census data" and "Pricefinder propertiy price". The collected data type is quantitative data, ratio-scale specifically, in numerical and percentage format. To facilitate further steps, the data are arrayed into a dataset in table form. The data are collected for a period of 20 years, ranging from 2001 to 2021, with intervals of 5 years, meaning there are 5 group: Y2001, Y2006, Y2011, Y2021. To have a comprehensive analytics in real estate property market moving trends and patterns and concerning, affecting factors thereof , various attributes have been gathered and arranged into seven categories with relevant as below:

- Property median price: including attributes "Median House Price", and "Median Unit Price" collected from "Pricefinder property price".
- Type of dwellings: including "Total private dwelling", "Occupied dwellings", "Unoccupied dwellings", "Separate House", "Semi-detached", "Flat unit/Apartment", "1 bedroom", "2 bedrooms", "3 bedrooms", "Average number of bedrooms per dwelling", "4 or more bedrooms", and "Average motor vehicles per dwelling" collected from "ABS Census data".
- Ownership status: including "Fully owned", "Owned with mortgage", "Rented", "Family household", "Single person household", "Group household", and "Average number of people per household" collected from "ABS Census data".
- Financial status of the household/personal and family: including "Median personal weekly income", "Median family weekly income", "Median

household weekly income", "Median mortgage weekly payment", "Median weekly rent", "Less than $650 total household weekly income", "More than $3000 total household weekly income", "Household rent payments < 30% income", "Household rent payments >30% income", "Household mortgage repayments < 30% income", and "Household mortgage >30 income" collected from "ABS Census data".

- Suburb population and marriage status: including "Population", "Median age", "Population equal or older than 15 years old", "Population younger than 15 years old", "Married", "Separated or Divorced", "Widowed", "Never married", and "Birth in Australia" collected from "ABS Census data".
- (Un)employment status: including "Labour force", "Worked full-time", "Worked part-time", "Unemployment", "People travelled to work by Public Transport", and "People travelled to work by car" collected from "ABS Census data".
- Family information: including "Families", "Couple family not children", "Couple family has children", "One parent family", and "Other family" collected from "ABS Census data".

To make data visualisation more feasible, related attributes are broken down into sheets. Additionally, some attributes are newly created in sheets to gain deeper insight, thus evaluating which option benefits buyers and investors. For instance, the attribute "Ratio of supply-demand" is calculated by dividing "Population" by "Total private dwelling". Another derivative, "Change Rate", is generated to measure how fast attributes change through the years.

Location	Moorebank	Moorebank	Moorebank	Moorebank	Moorebank
Time	Y2001	Y2006	Y2011	Y2016	Y2021
MedianHousePrice	$281,000	$397,500	$496,500	$878,350	$1,100,000
MedianUnitPrice	$252,250	$356,500	$358,500	$530,000	$665,000
MedianPersonalWeeklyIncome		$522	$630	$746	$843
MedianFamilyWeeklyIncome		$1,272	$1,542	$1,972	$2,340
MedianHouseholdWeeklyIncome		$1,166	$1,434	$1,889	$2,201
MedianMortgageWeeklyPayment		$399	$529	$557	$575
MedianWeeklyRent		$250	$351	$450	$500
Population	5,960	7,599	7,595	9,747	11,408
MedianAge	0	34	35	35	36
Families	1,711	2,107	2,118	2,702	3,092
TotalPrivateDwelling	2,170	2,741	2,656	3,291	3,804
Population>=15yo	4,961	6,016	5,959	7,367	8,645
Population<15yo	999	1,583	1,636	2,380	2,763
Married(%)	54.50%	56.20%	55.30%	58.20%	55.50%
Separated+Divorced(%)	8.90%	9.50%	10.00%	10.30%	10.20%
Widowed(%)	4.40%	4.50%	4.40%	4.20%	4.50%
NeverMarried(%)	32.40%	29.70%	30.30%	27.30%	29.90%
BirthInAustralia(%)	85.8%	65.9%	65.8%	63.8%	63.0%
LabourForce	3,309	3,951	3,781	4,768	5,169
Worked full-time(%)	66.1%	66.9%	65.8%	65.5%	54.9%
Worked part-time(%)	25.8%	22.3%	23.0%	24.5%	24.6%
Unemployment(%)	5.3%	4.3%	4.7%	5.0%	4.8%
PeopleTravelledToWorkByPublicTransport(%)			11.2%	15.0%	2.9%
PeopleTravelledToWorkByCar(%)			67.9%	76.1%	41.8%
AverageMotorVehiclesPerDwelling			1.9	1.9	2.0
CoupleFamilyNoChidren(%)	31.7%	31.5%	31.6%	29.2%	26.9%
CoupleFamilyHasChidren(%)	52.5%	52.5%	51.4%	55.0%	57.1%
OneParentFamily(%)	14.5%	14.9%	15.9%	14.5%	15.0%
OtherFamily(%)	1.2%	1.2%	1.1%	1.3%	1.2%
OccupiedDwellings(%)	95.4%	93.7%	95.2%	94.8%	96.0%
UnoccupiedDwelling(%)	4.6%	6.3%	4.8%	5.2%	4.2%
SeparateHouse(dwellings%)	85.7%	88.1%	87.7%	85.2%	82.1%
SemiDetached(dwellings%)	11.1%	9.7%	8.9%	12.4%	14.0%
FlatUnitApartment(dwellings%)	2.6%	1.9%	3.3%	2.0%	3.7%
0xBedroom(%)			0.2%	0.1%	0.1%
1xBedroom(%)			1.4%	1.5%	1.4%
2xBedroom(%)			6.0%	5.6%	7.4%
3xBedroom(%)			50.3%	40.1%	37.0%
4xBedroom+(%)			40.6%	50.6%	52.9%
AverageNumberBedroomsPerDwelling			3.4	3.6	3.6
AverageNumberPeoplePerHousehold		2.9	2.9	3.1	3.1
FullyOwned(%)	51.1%	36.3%	34.0%	29.5%	27.5%
OwnedWithMortgage(%)	24.5%	36.2%	44.2%	50.5%	48.6%
Rented(%)	18.0%	21.6%	19.4%	17.5%	22.6%
FamilyHouseHolds(%)	80.3%	79.3%	82.8%	84.4%	83.4%
SinglePersonHouseHolds(%)	14.4%	14.7%	15.5%	14.2%	14.5%
GroupHouseHold(%)	2.5%	2.0%	1.7%	1.3%	2.1%
LessThan$650WeeklyIncome(%)			17.5%	13.1%	11.6%
MoreThan$3000WeeklyIncome(%)			12.0%	22.0%	31.0%
HouseholdsRentPayments<30%Income (%)			93.7%	93.3%	51.8%
HouseholdsRentPayments>30%Income(%)			6.3%	6.7%	38.1%
HouseholdsMortgageRepayments<30%Income(%)			81.5%	91.6%	70.4%
HouseholdsMortgageRepayments>30%Income(%)			18.5%	8.4%	19.8%

2. Data visualisation and insight

2.1 Property price in Moorebank
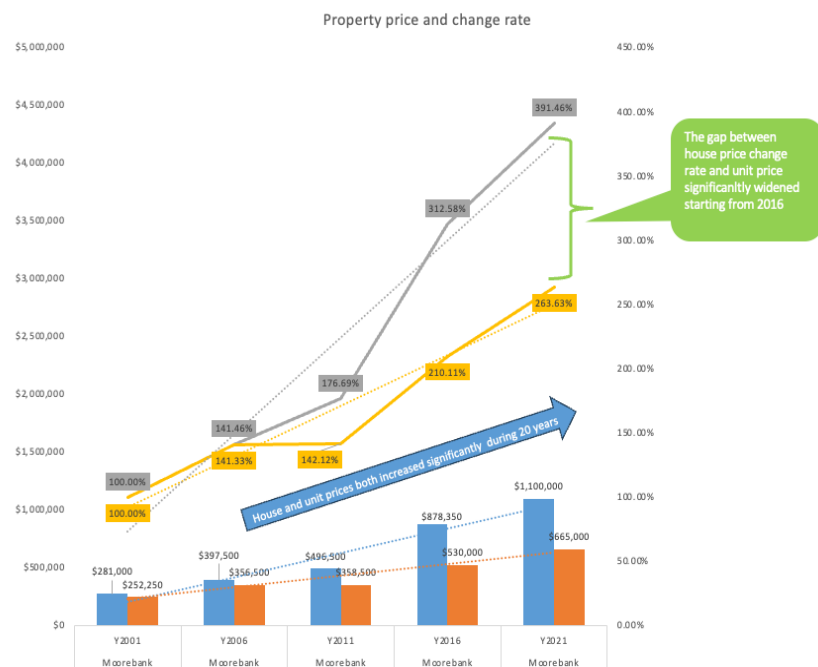
2.1.1 Visualisation techniques

Location	Moorebank	Moorebank	Moorebank	Moorebank	Moorebank	
Time	Y2001	Y2006	Y2011	Y2016	Y2021	
MedianHousePrice	⬇ $281,000	⬇ $397,500	⬇ $496,500	⬆ $878,350	⬆ $1,100,000	～
MedianUnitPrice	⬇ $252,250	⬇ $356,500	⬇ $358,500	⬆ $530,000	$665,000	～
MedianHousePriceChangeRate(%)	⬇ 100.00%	⬇ 141.46%	⬇ 176.69%	⬆ 312.58%	391.46%	～
MedianUnitriceChangeRate(%)	⬇ 100.00%	⬇ 141.33%	⬇ 142.12%	⬆ 210.11%	263.63%	～

In this category, "Median house price", "Median unit price" and two newly created attributes "Median house price change rate" and "Median unit price change rate" have been utilised for this segment visualisation.. Since these attributes are splitted into numerical and percentage formats, a combo chart with distinctive vertical axes should be most suitable for visualization. While the prices have been illustrated via column shape preferred for quantitative values, the change rates have been visualised in line form, which presents degrees of change with gradients. Colouring has been applied to distinguished attributes in similar forms. Data labelling was also used to alleviate tracking through the years. Trendlines have taken charge of showing general trends of attributes during 20 years, along with two notes highlighting differences in trends. The original combo chart come with an overlapping issue, leaving the chart cluttered. To deal with it, vertical axes have been rescaled to elevate lines on top and push columns in bottom.

2.1.2 Insight

Overall, properties prices soared after 20 years, despite different paces. From the beginning, in 2001, the median house price was only higher than the median unit one approximately $30,000, $282,000 versus $252,250. After five years, two attributes shared change rates, around 141.4%. But when it comes to the year 2011, they diverged. The median unit change rate was almost stationary at 142.12%, whereas one of

Property price and change rate

median house price was augmented with an amount of 35.23%, which ended up at 176.69% for the change rate and $496,500 for the median house price. Since then, the median house price have been keeping rocketing, even with higher rates in 2016 and 2021, 312.58% and 391.46% respectively. In 2021, the median house price was $1,100,000, 3.9 times higher than in 2001. For median unit price, it ceased levelling off, returning to the track. After ten years from 2011, the median unit price has increased 2.6 times, up to $665,000. For 20 years, the discrepancy between median and unit house prices has widened 14.5 times, from $30,000 to $435,000. In conclusion, owning a house is quite a good deal for long-term investment compared to buying a unit.

2.2 Assessing the supply-demand

2.2.1 Visualisation techniques

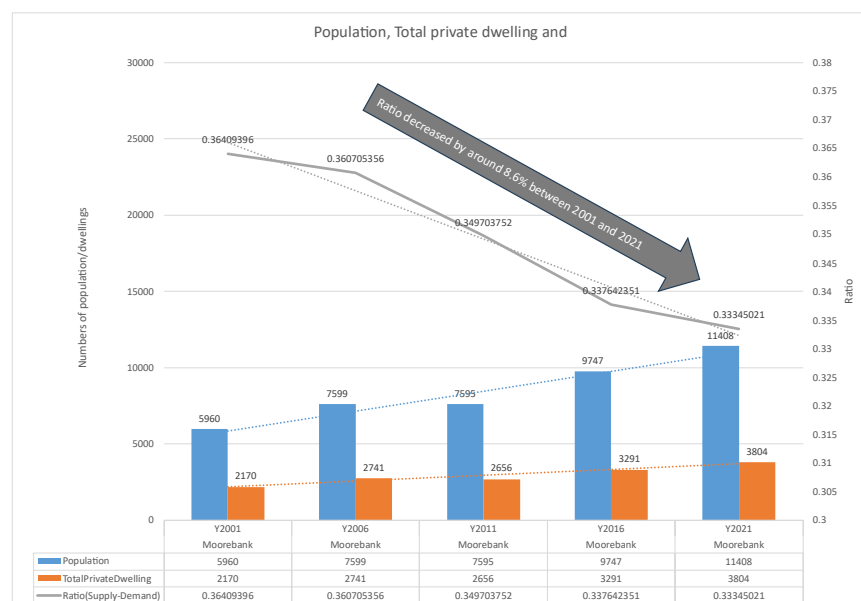| Location	Moorebank	Moorebank	Moorebank	Moorebank	Moorebank	
Time	Y2001	Y2006	Y2011	Y2016	Y2021	
Population	↓ 5960	↓ 7599	↓ 7595	↑ 9747	↑ 11408	▪
TotalPrivateDwelling	↓ 2170	⇨ 2741	↓ 2656	↑ 3291	↑ 3804	▪
Ratio(Supply-Demand)	↓ 0.364094	↓ 0.3607054	↓ 0.3497038	↓ 0.3376424	↓ 0.3334502	
Ratio(Supply-Demand)ChangeRate(%)	↑ 100.00%	↑ 99.07%	⇨ 96.05%	↓ 92.73%	↓ 91.58%	
PopulationchangeRate(%)	↑ 100.00%	↑ 127.50%	↓ 127.43%	↑ 163.54%	↑ 191.41%	
TotalPrivateDwellingChangeRate(%)	↓ 100.00%	⇨ 126.31%	↓ 122.40%	↑ 151.66%	↑ 175.30%	

For this aspect, attributes "Population" and "Total private dwelling" and three additional deduced attributes "Ratio change rate", "Population change rate", and "Total private dwelling change rate" have been scrutinised for interpretation. While attributes "Population" and "Total private dwelling" are in numerical format, the others are in percentage format. For this reason, combo chart has been used for the visualisation. "Population" and "Total private dwelling" have been displayed as columns. Despite being in similar numerical format, for better efficiency in visualisation, "Ratio" has been displayed in a line, showing the degree of change through the 20-year timeline. Colouring was also applied to distinguish attributes having the same visualisation form. The overlapping issue continued, and rescaling was applied again for both horizontal axes in the combo chart, lifting the ratio line on top and pushing columns into the bottom. Trendlines, data labels, and auxiliary data table, along with two arrow-shaped notes, have been added for further clarification. During visualisation, another issue arose. "Population change rate" and "total dwelling private change rate" have also been drawn in lines. To avoid confusion when putting these two lines with ratio line, another line chart has been created, with one note.

2.2.2 Insight

In 20 years, the ratio decreases over time, from 0.36409396 to 0.33345021, equivalent to a decrease by 8.6%. A statement that the population has increased faster than total private dwelling owing to the ratio formula. After 20 years, the population has roughly doubled, rising from 5960 in 2001 to 11,408 in 2021. Meanwhile, total private dwelling has risen only 1.75 times from 2170 in 2001 to 3804 in 2021. There is difference in change between two halves of the time period. While the population and the total private dwelling has risen by 27.43% and 22.4% respectively for the first half, the change rates have been augmented 63.98% and 52.9% for the latter. Observing closer to the change rate chart, while there was not much difference between the population and the total private dwelling change

Population, Total private dwelling and

rate for the first ten years, the change rate of population has commenced leaving the total private dwelling change rate far behind since 2011 and has reached the most significant gap in 2021, 191.41% compared to 175.30%. Coincidentally, the period 2011-2021 has also witnessed drastic increase in property price. Gathering all of these findings, it is justified to state that a lack of dwelling supply, resonated by an incredible population
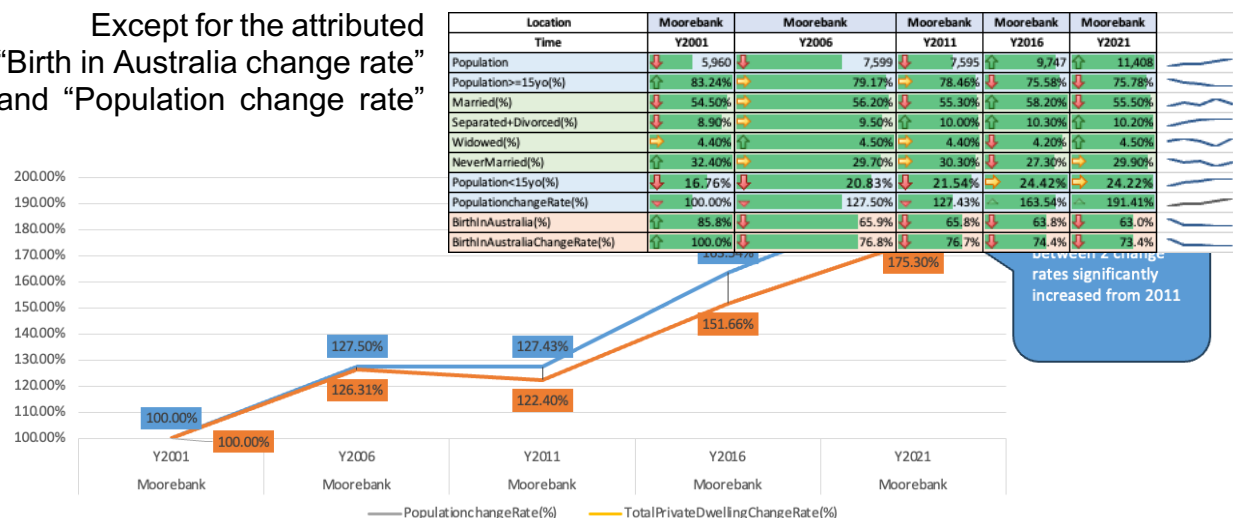
growth, resulted in a giant leap in dwelling price, in both terms of house and unit. Further justification for the booming population are going to be presented in the upcoming segments.

2.3   Population and marriage status in Moorebank
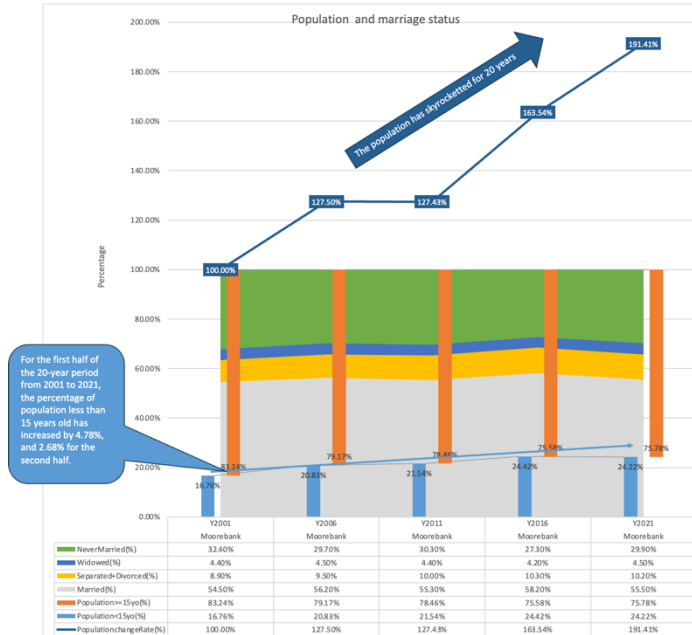
2.3.1   Visualisation techiniques

Except for the attributed "Birth in Australia change rate" and "Population change rate"

Location	Moorebank		Moorebank		Moorebank	Moorebank	Moorebank	
Time	Y2001		Y2006		Y2011	Y2016	Y2021	
Population	⬇ 5,960	⬇	7,599	⬇	7,595 ⬆	9,747 ⬆	11,408	〰
Population>=15yo(%)	⬆ 83.24%	➡	79.17%	➡	78.46% ⬇	75.58% ⬇	75.78%	〰
Married(%)	⬇ 54.50%	➡	56.20%	⬇	55.30% ⬆	58.20% ⬇	55.50%	〰
Separated+Divorced(%)	⬇ 8.90%	➡	9.50%	⬆	10.00% ⬆	10.30% ⬆	10.20%	〰
Widowed(%)	➡ 4.40%	⬆	4.50%	➡	4.40% ⬇	4.20% ⬆	4.50%	〰
NeverMarried(%)	⬆ 32.40%	➡	29.70%	➡	30.30% ⬇	27.30% ➡	29.90%	〰
Population<15yo(%)	⬇ 16.76%	⬇	20.83%	⬇	21.54% ➡	24.42% ➡	24.22%	〰
PopulationchangeRate(%)	🔽 100.00%	🔽	127.50%	🔽	127.43% 〰	163.54% 〰	191.41%	〰
BirthInAustralia(%)	⬆ 85.8%	⬇	65.9%	⬇	65.8% ⬇	63.8% ⬇	63.0%	〰
BirthInAustraliaChangeRate(%)	⬆ 100.0%	⬇	76.8%	⬇	76.7% ⬇	74.4% ⬇	73.4%	〰

that are derivative, the rest attributes "Population", "Population>=15yo", "Married", "Separated or Divorced", "Widowed", "Never married", "Population<15yo", and "Birth in Australia" are retrieved from the original dataset for analytics purpose. Since the sum of all attributes relating to marriage status and the sum of attributes relating to age are approximately 100%, 100% stacked combo chart seems ideal for visualisation. All attributes in the stacked combo chart are in percentage format, so only one vertical axis has been used. Data labelling and optional data tables have been added to the chart for clarification. Two notes have been inserted to express interpretation. In this category, there was a combination comprising "Time", "Population", and "Birth in Australia" correlating tightly to each other. Thus, a bubble chart has been applied to visualise these 3-dimensional data. This bubble chart also had a trendline showing "Birth in Australia" trend and an arrow-shaped note containing further information about the trend. The levels of the bubbles represented "Birth in Australia", the sizes of the bubbles illustrated the population values, and the order of the bubbles was identical to the timeline.

2.3.2   Insight

While the population has multiplied 1.9 times through 20 years, the marriage status and age composition have stayed almost stable or changed with a minor degree. The "widowed" and "married" proportions have remained unchanged for 20 years, 4.5% and 55.5% respectively in 2021. While the "never married" has decreased from 32.4% in 2001 to 29.9% in 2021, the "Separated or Divorced" has moved oppositely, 8.9% in 2001 to 10.2% in 2021. For the bubble chart, while the bubble has inflated 2 times for 20 years, meaning the population has increased considerably, it has decreased gradually from 85.8% to 63.0%. The significant drop happened in the first 5-year interval, from 85.8% in 2001 to 65.9% in 2001. The "Birth in Australi" then has almost levelled off for the rest 15 years, ranging from 65.9% to 63.0%. Surprisingly, from 2001 to 2006, the population has increased by 27.5%. This can be interpreted as a large amount of people have migrated to Moorebank and settled down.

Another finding is that from 2011 to 2021, the population has elevated with great gradient. Still, the percentage of the population born in Australia hasn't changed much, meaning it's likely to have the second migrant wave in this period. There is a hypothesis that more migrants coming results in more demand in dwelling, consequently the house and unit price rise. In fact, the price at this time has risen with the highest rate.
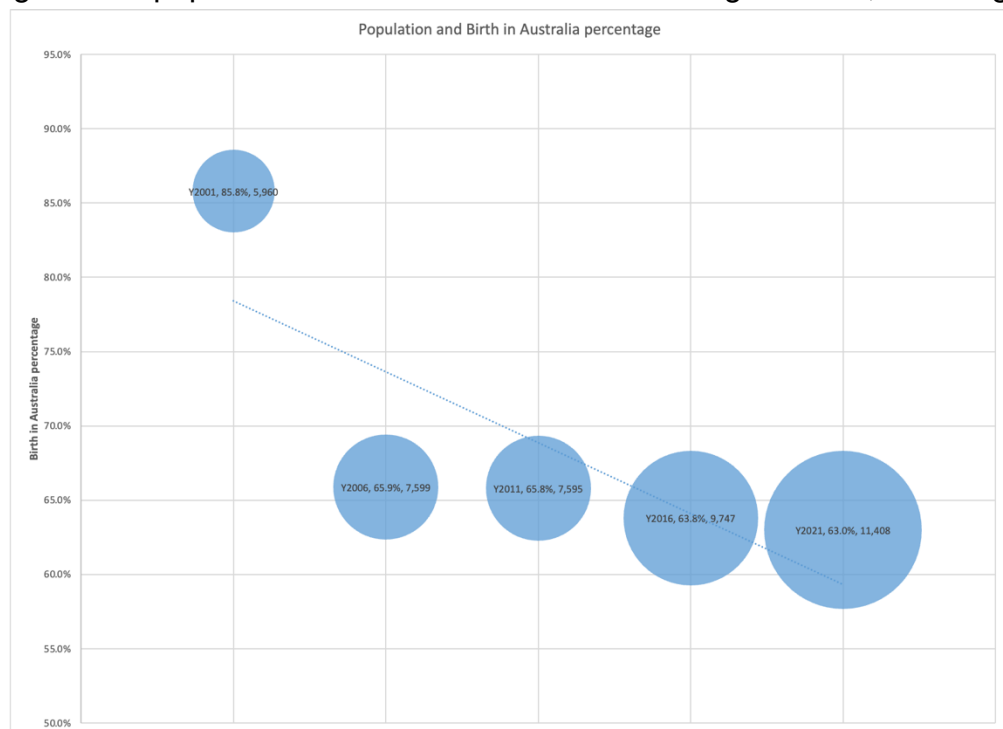
2.4   House Finance status in Moorebank

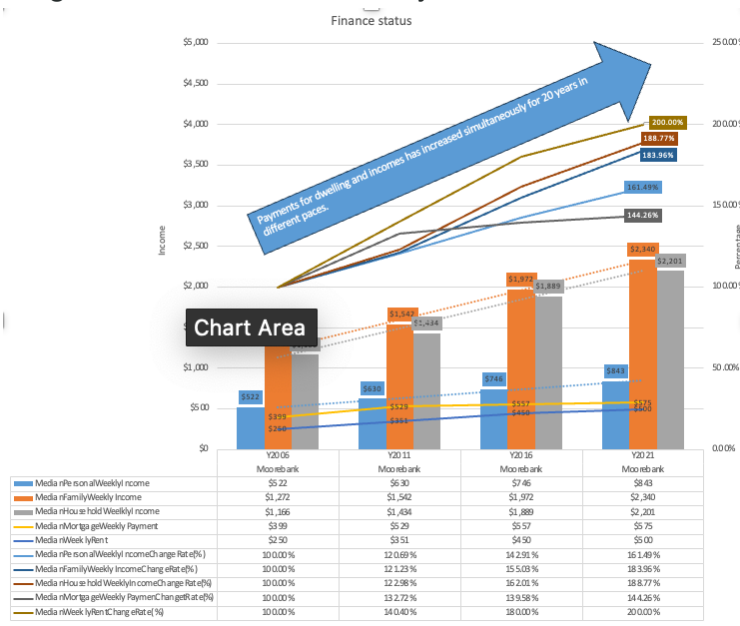### 2.4.1   Visualisation techniques

This segment is about comparing the median weekly income of three group "household", "family", and "personal", to the median weekly payment for the dwelling in terms of "mortgage repayment" and "Rent". Thus, five attributes has included in this segment

Location	Moorebank	Moorebank	Moorebank	Moorebank	Moorebank	
Time	Y2001	Y2006	Y2011	Y2016	Y2021	
MedianPersonalWeeklyIncome	$0 ⬇	$522 ➡	$630 ⬆	$746 ⬆	$843	▬ ▬ ▬
MedianFamilyWeeklyIncome	$0 ⬇	$1,272 ⬇	$1,542	$1,972 ⬆	$2,340	▬ ▬ ▬
MedianHouseholdWeelklyIncome	$0 ⬇	$1,166 ⬇	$1,434	$1,889 ⬆	$2,201	▬ ▬ ▬
MedianMortgageWeeklyPayment	$0 ⬇	$399 ⬆	$529 ⬆	$557 ⬆	$575	▬ ▬ ▬
MedianWeeklyRent	$0 ⬇	$250 ➡	$351 ⬆	$450 ⬆	$500	▬ ▬ ▬
MedianPersonalWeeklyIncomeChangeRate(%)		⬇ 100.00%	➡ 120.69%	⬆ 142.91%	⬆ 161.49%	〰
MedianFamilyWeeklyIncomeChangeRate(%)		⬇ 100.00%	⬇ 121.23%	➡ 155.03%	⬆ 183.96%	〰
MedianHouseholdWeeklyIncomeChangeRate(%)		⬇ 100.00%	⬇ 122.98%	⬆ 162.01%	⬆ 188.77%	〰
MedianMortgageWeeklyPaymenChangetRate(%)		⬇ 100.00%	⬆ 132.72%	⬆ 139.58%	⬆ 144.26%	〰
MedianWeeklyRentChangeRate(%)		⬇ 100.00%	➡ 140.40%	⬆ 180.00%	⬆ 200.00%	〰

accordingly. There were five other derivative change rate attributes calculated from 5 original attributes. These attributes have numerical and percentage format, and combo chart has been used for visualisation. The combo chart has two vertical axes, one for numerical values and the other for percentage values. As usual, numerical values have been illustrated in column shape, and line shape has been reserved for percentage values. There was one exception for using lines for numerical values in this segment. To draw median mortgage weekly payment and median weekly rent, lines have been used to have a perspective in how much of the incomes that the payments has taken up. Like other segments, trendlines, arrow-shaped note, and auxiliary data table have been inserted for clarification.

2.4.2   Insight

A remark is that all attributes have only been recorded and calculated for fifteen years instead of twenty years, starting from 2006. For fifteen years, all incomes and payments have increased with different rates. For the income part, the "Family" have occupied the highest values for the whole period, from $1,272 in 2006 to $2,340 in 2021. In contrast, the lowest values belonged to "Personal", with $522 in 2006 and $843 in 2021. When it comes to payment, although mortgage payment has always been higher than rent payment, the gap between the two payments has been reduced gradually from $149 in 2006 to $75 in 2021. Through 15 years, the incomes have improved significantly compared to payment. For

instance, the higher payment, mortgage payment, has taken up 76.43% of the lowest income, personal income in 2006 but only 68.2% in 2021. When looking at the change rate, it is evident that the rent payment has changed with the most excellent rate, doubling for 15 years, followed by family income with 1.88 times, household income with 1.83 times, personal income with 1.61 times and the lowest rate 1.44 times for the mortgage payment. There is a hypothesis that there might be an allurement in income, especially from 2011, letting people migrate to Moorebank, thus contributing in the rise of house and unit prices. While renting is getting harsher for individuals, buying a house seems more beneficial, especially for family.
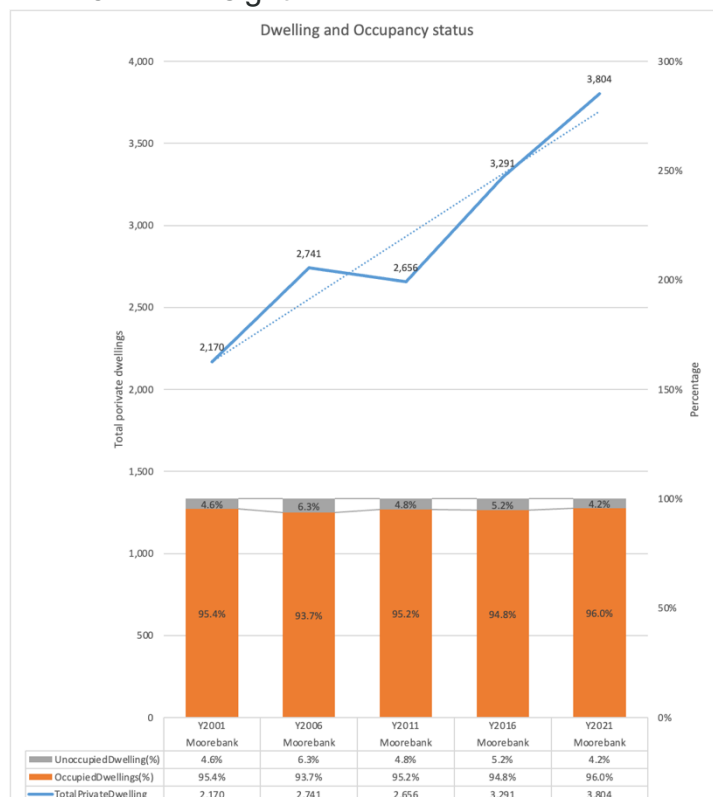
2.5 Dwelling status in Moorebank

2.5.1 Visualisation techniques

To analyse this category, it is more feasible to break it down into sub-categories, including Dwelling number with attribute Total private dwelling, Total private dwelling rate change, Occupation with Occupied dwelling and Unoccupied dwelling, Dwelling types with separate house,

Location	Moorebank	Moorebank	Moorebank	Moorebank	Moorebank	
Time	Y2001	Y2006	Y2011	Y2016	Y2021	
TotalPrivateDwelling	2,170	2,741	2,656	3,291	3,804	
OccupiedDwellings(%)	95.4%	93.7%	95.2%	94.8%	96.0%	
UnoccupiedDwelling(%)	4.6%	6.3%	4.8%	5.2%	4.2%	
SeparateHouse(dwellings%)	85.7%	88.1%	87.7%	85.2%	82.1%	
SemiDetached(dwellings%)	11.1%	9.7%	8.9%	12.4%	14.0%	
FlatUnitApartment(dwellings%)	2.6%	1.9%	3.3%	2.0%	3.7%	
0xBedroom(%)	0.0%	0.0%	0.2%	0.1%	0.1%	
1xBedroom(%)	0.0%	0.0%	1.4%	1.5%	1.4%	
2xBedroom(%)	0.0%	0.0%	6.0%	5.6%	7.4%	
3xBedroom(%)	0.0%	0.0%	50.3%	40.1%	37.0%	
4xBedroom+(%)	0.0%	0.0%	40.6%	50.6%	52.9%	
TotalPrivateDwellingChangeRate(%)	100.00%	126.31%	122.40%	151.66%	175.30%	

semi-detached and flat/unit, Number of bedroom with 1,2,3, 4+ bedrooms. The data is in numerical and percentage format. Combine charts have been used for this category; one has included dwelling number and occupation, and the other has had bedroom number and dwelling types. The dwelling number has been illustrated in line shape to explain how fast the number changed. Owning to the sum of occupation attributes is 100%, these attributes have been stacked to columns with different colours for each attribute. This combo chart has added trendline, data labels, and auxiliary data table. Regarding the other combo chart, the number of bedroom attributes has been piled into columns. At the same time, dwelling types have been presented in lines, with trendlines, data labels, auxiliary data table and note.

2.5.2 Insight

Despite the decrease in the period from 2006 to 2011, overall, the total dwelling number multiplied 1.75 times for 20 years, with 3,804 in 2021. The trend significantly has soared from 2011 to 2021. For occupation, most of the dwellings have been occupied for the whole time, and the proportion has stayed stable at around 95%. On the contrary, the percentage of the unoccupied has remained at 4.2%. In the sub-category number of bedrooms, all data have been recorded from 2011, not 2001. There has been an increase in the number of dwellings having two or more than four bedrooms, 6.0% to 7.4 % for two bedrooms and 40.6% to 52.9% for more than four bedrooms. The number of dwellings containing three bedrooms has decreased for twenty years, from 50.3% to 37%. Dwellings with one bedroom has remained unchanged. For occupation types, there is little change happening during the time. Separate houses take the most prominent part, around 83%, and the flat/unit counts least, around 2.7%. A hypothesis is that Moorebank has been having more couples, and couples having one child are having more children. The liquidity of the mortgage could be secured with a high percentage of occupied dwellings, letting investors feel more secure.

But when it comes to single person or couples with one child, it is getting harder to find an appropriate dwelling with the demand.

Bedroom number/Dwelling structure propotion of occupied dwellings

	Moorebank Y2001	Moorebank Y2006	Moorebank Y2011	Moorebank Y2016	Moorebank Y2021
4xBedroom+(%)	0.0%	0.0%	40.6%	50.6%	52.9%
3xBedroom(%)	0.0%	0.0%	50.3%	40.1%	37.0%
2xBedroom(%)	0.0%	0.0%	6.0%	5.6%	7.4%
1xBedroom(%)	0.0%	0.0%	1.4%	1.5%	1.4%
0xBedroom(%)	0.0%	0.0%	0.2%	0.1%	0.1%
SeparateHouse(dwellings%)	85.7%	88.1%	87.7%	85.2%	82.1%
SemiDetached(dwellings%)	11.1%	9.7%	8.9%	12.4%	14.0%
FlatUnitApartment(dwellings%)	2.6%	1.9%	3.3%	2.0%	3.7%

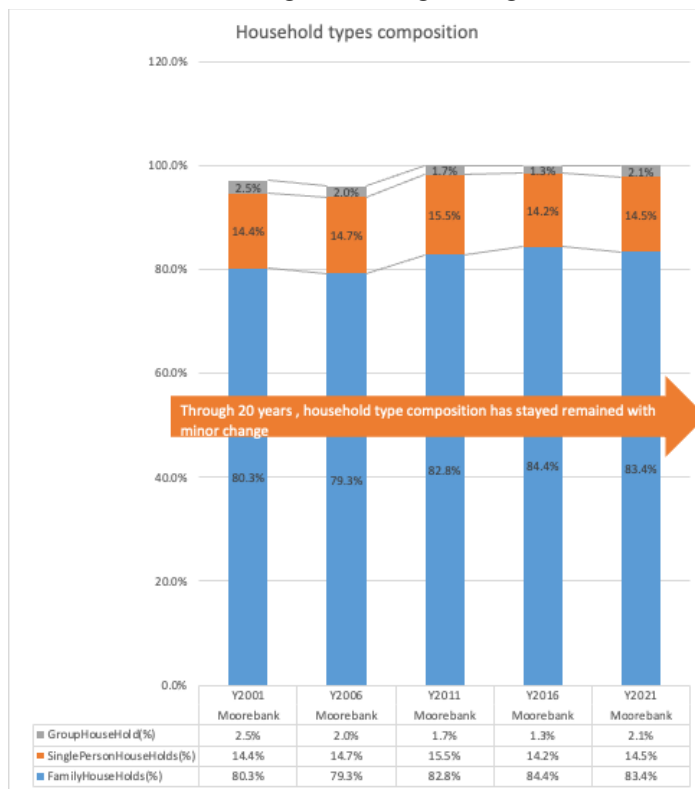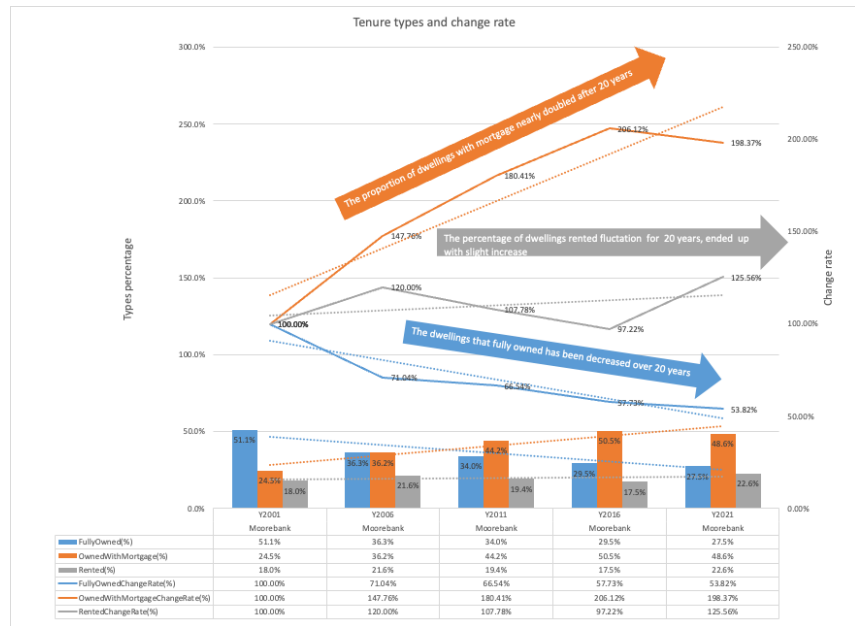## 2.6 Ownership status in Moorebank

2.6.1 Visualisation techniques

This segment is about ownership traits among dwellings and household types in Moorebank. Hence, attributes "Fully owned", "Owned with mortgage", "Rented", "Family household", "Single person household", "Group household", and three derivatives "Fully owned change rate", "owned with Mortgage change rate", "Rented change rate" have been selected for visualisation and insight

Location	Moorebank	Moorebank	Moorebank	Moorebank	Moorebank	
Time	Y2001	Y2006	Y2011	Y2016	Y2021	
FullyOwned(%)	⇑ 51.1%	⇨ 36.3%	⇩ 34.0%	⇩ 29.5%	⇩ 27.5%	
OwnedWithMortgage(%)	⇩ 24.5%	⇨ 36.2%	⇑ 44.2%	⇑ 50.5%	⇑ 48.6%	
Rented(%)	⇩ 18.0%	⇑ 21.6%	⇨ 19.4%	⇩ 17.5%	⇑ 22.6%	
FullyOwnedChangeRate(%)	⇑ 100.00%	⇨ 71.04%	⇩ 66.54%	⇩ 57.73%	⇩ 53.82%	
OwnedWithMortgageChangeRate(%)	⇩ 100.00%	⇨ 147.76%	⇑ 180.41%	⇑ 206.12%	⇑ 198.37%	
RentedChangeRate(%)	⇩ 100.00%	⇑ 120.00%	⇨ 107.78%	⇩ 97.22%	⇑ 125.56%	
FamilyHouseHolds(%)	⇩ 80.3%	⇩ 79.3%	⇑ 82.8%	⇑ 84.4%	⇩ 83.4%	
SinglePersonHouseHolds(%)	⇩ 14.4%	⇨ 14.7%	⇑ 15.5%	⇩ 14.2%	⇑ 14.5%	
GroupHouseHold(%)	⇑ 2.5%	⇨ 2.0%	⇨ 1.7%	⇩ 1.3%	⇨ 2.1%	

acquisition. Despite the fact that all attributes have been in percentage format, various shapes have been used for utilisation, specifically column shape for ownership traits, line shape for change rates, and stack column for household types. Owing to this, combo chart and stack chart have been used for visualisation. The combo chart has been drawn with two rescaled horizontal axes to avoid overlapping, pushing change rate lines on top and ownership traits columns down the bottom. Both charts contain auxiliary data table, data labels, and arrow-shaped notes. The stock chart additionally has trendlines. Colouring has also been applied for both charts for improved distinguishment.

2.6.2 Insight

When it comes to ownership characteristics, there have been three distinguished trends. The most stable attribute goes to "Rented". After twenty years, this attribute has only increased by 4.6%, meaning the change rate is 25.5%. The two other attributes have drastically changed. While dwellings with mortgages doubled for 20 years, to 48.6% of the dwellings, the wholly owned dwellings percentage halved, and ended up at 27.5% in 2021. This could be interpreted as a large number of migrants have come in families, generating a high demand for dwellings, but these acquisitions are mostly in instalments, not paid off. For attributes in household types, all of them are stable after 20 years. The group has considerably changed in 2016, dropped to 1.3%. But five years later, the percentage has recovered to the initial level, 14.5% in 2001. The single-person household percentage has fluctuated, reaching the peak at 15.5% in 2011 and returning to 14.5% in 2021. The attribute family household is the only attribute that merely increased after the period, augmented by 3.1%. In conclusion, most of migrants have come to Moorebank with their families, and they have tendency buying a house with instalments for their whole families.

Tenure types and change rate

	Y2001 Moorebank	Y2006 Moorebank	Y2011 Moorebank	Y2016 Moorebank	Y2021 Moorebank
FullyOwned(%)	51.1%	36.3%	34.0%	29.5%	27.5%
OwnedWithMortgage(%)	24.5%	36.2%	44.2%	50.5%	48.6%
Rented(%)	18.0%	21.6%	19.4%	17.5%	22.6%
FullyOwnedChangeRate(%)	100.00%	71.04%	66.54%	57.73%	53.82%
OwnedWithMortgageChangeRate(%)	100.00%	147.76%	180.41%	206.12%	198.37%
RentedChangeRate(%)	100.00%	120.00%	107.78%	97.22%	125.56%

Household types composition

|	Y2001 Moorebank	Y2006 Moorebank	Y2011 Moorebank	Y2016 Moorebank	Y2021 Moorebank
GroupHouseHold(%)	2.5%	2.0%	1.7%	1.3%	2.1%
SinglePersonHouseHolds(%)	14.4%	14.7%	15.5%	14.2%	14.5%
FamilyHouseHolds(%)	80.3%	79.3%	82.8%	84.4%	83.4%

2.7   Family Information
2.7.1   Visualisation techiques

Family information is about the number of families through the years, how many parents are in the family and whether that family has children. Hence, this part includes "Families", "Couple family has children", "Couple family with no children","One parent family", "Other family" and their

Location	Moorebank	Moorebank	Moorebank	Moorebank	Moorebank	
Time	Y2001	Y2006	Y2011	Y2016	Y2021	
Families	1,711	2,107	2,118	2,702	3,092	
CoupleFamilyNoChidren(%)	31.7%	31.5%	31.6%	29.2%	26.9%	
CoupleFamilyHasChildren(%)	52.5%	52.5%	51.4%	55.0%	57.1%	
OneParentFamily(%)	14.5%	14.9%	15.9%	14.5%	15.0%	
OtherFamily(%)	1.2%	1.2%	1.1%	1.3%	1.2%	
FamiliesChangeRate(%)	100.0%	123.1%	123.8%	157.9%	180.7%	
CoupleFamilyNoChidrenChangeRate(%)	100.0%	99.4%	99.7%	92.1%	84.9%	
CoupleFamilyHasChidrenChangeRate(%)	100.0%	100.0%	97.9%	104.8%	108.8%	
OneParentFamilyChangeRate(%)	100.0%	102.8%	109.7%	100.0%	103.4%	
OtherFamilyChangeRate(%)	100.0%	100.0%	91.7%	108.3%	100.0%	

derivative attributes for change rates. A combo chart has been used to combine attributes about family types, the number of families, and the change rate. Families number has been illustrated in columns, family types have been gathered into one stacked area chart, and line shape for the families change rate. This combo chart has two re-scaled vertical axes for families' numbers and percentages. Colouring, trendlines, data labels, note and auxiliary data table are included in this chart. Another line chart is drawn for change rate lines. This chart also included colouring, data labels, auxiliary data table, and mark along with text.

2.7.2 Insight

Except for the second 5-year interval, the family number increased for the rest of the period, 1381 in total. This augmentation is equivalent to 80.7% for 20 years— meanwhile, the proportion of 5 family types primarily unchanged. Only two types have changed: "Family with children" has increased by 4.6% and "Family with no children" decreased by a similar amount. The three other types have remained the percentages in 2021 similar to the ones in 2001. Taking closer to the change rate chart, couples with children change rate has changed most. This could be explained by waves of migrants with their families arrived Moorebank as presented in the previous part rather than individuals.
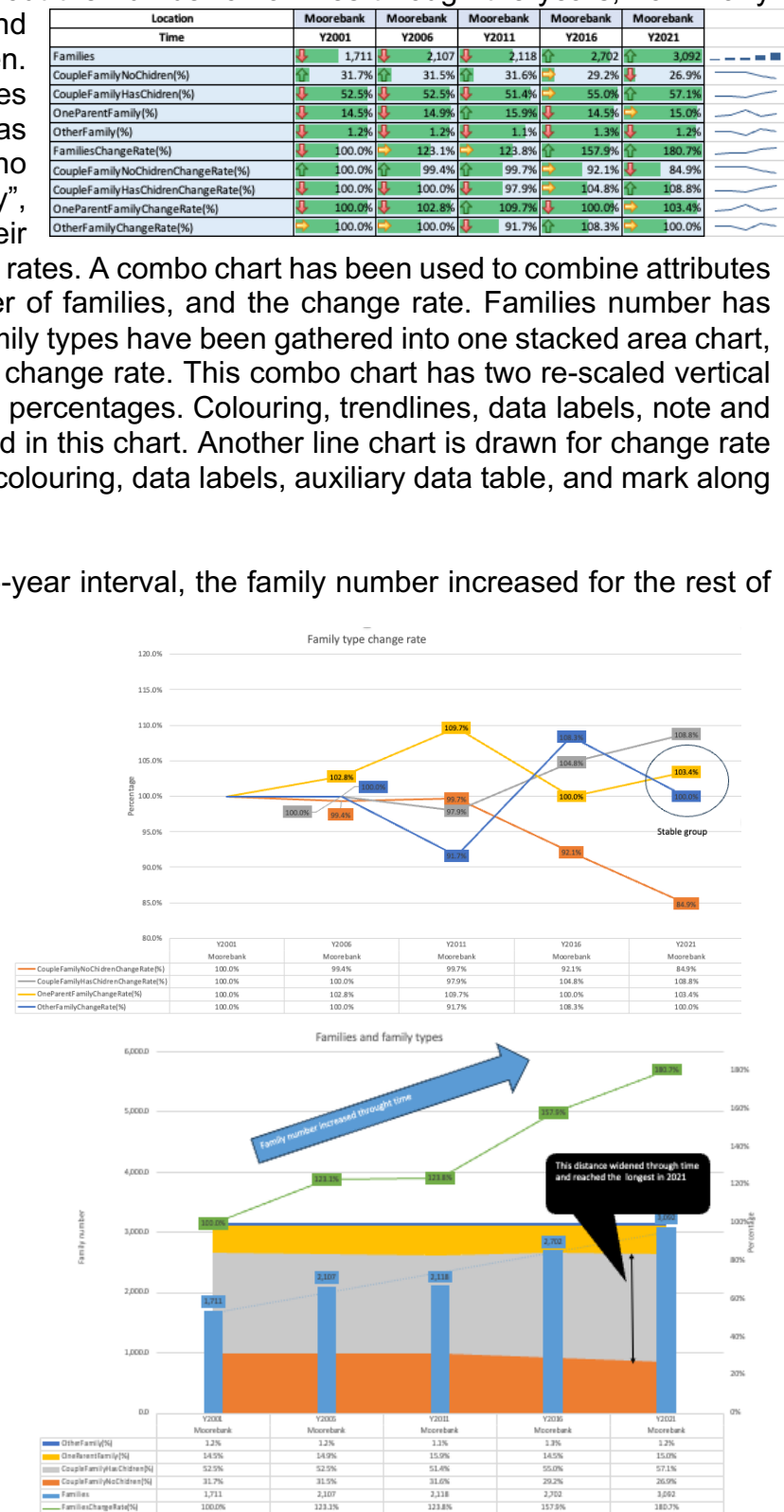
2.8 Workforce status
### 2.8.1 Visualisation techniques

To have a deep analytic in this category, attributes "Labour force", "Worked full-time", "Worked part-time", "Unemployment", and their derivative attributes have been

Location	Moorebank	Moorebank	Moorebank	Moorebank	Moorebank	
Time	Y2001	Y2006	Y2011	Y2016	Y2021	
LabourForce	⬇ 3309	➡ 3951	⬇ 3781	⬆ 4768	⬆ 5169	▬ ▬ ▬ ▪ ▪
Worked full-time(%)	⬆ 66.1%	⬆ 66.9%	⬆ 65.8%	⬆ 65.5%	⬇ 54.9%	▪ ▪ ▪ ▪ _
Worked part-time(%)	⬆ 25.8%	⬇ 22.3%	⬇ 23.0%	⬆ 24.5%	⬆ 24.6%	▪ _ ▬ ▪ ▪
Unemployment(%)	⬆ 5.3%	⬇ 4.3%	➡ 4.7%	⬆ 5.0%	⬇ 4.8%	▪ _ ▬ ▪ ▪
Worked full-timeChangeRate(%)	⬆ 100.00%	⬆ 101.21%	⬆ 99.55%	⬆ 99.09%	⬇ 83.06%	⌇
Worked part-timeChangeRate(%)	⬆ 100.00%	⬇ 86.43%	⬇ 89.15%	➡ 94.96%	➡ 95.35%	⌇
UnemploymentChangeRate(%)	⬆ 100.00%	⬇ 81.13%	➡ 88.68%	⬆ 94.34%	⬇ 90.57%	⌇
LabourForceChangeRate(%)	⬇ 100.00%	➡ 119.40%	⬇ 114.26%	⬆ 144.09%	⬆ 156.21%	⌇

utilised. Only one combo chart has been drawn to illustrate employment types in columns, change rate and labour force in lines. Two vertical axes have been rescaled to avoid overlapping by pushing lines on top and columns to bottom. Data labels, colouring, trendlines, and arrow-shaped note have been added to improve interpretation.

2.8.2 Insight

For twenty years, in general, the labour force has increased one and a half times, from 3309 counted in 2001 to 5169 in 2021. The labour force has only decreased in the second interval, dropping to 3781 in 2011. After that, it has witnessed the highest increase rate, 29.8%. Considering employment types, it can be seen that "worked full-time"
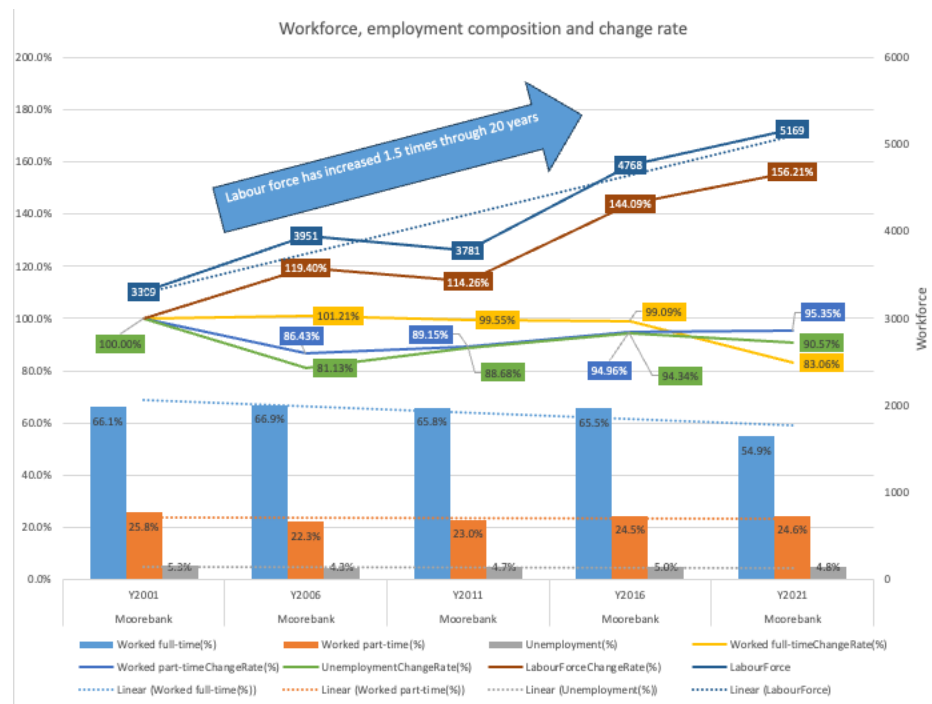
proportion has remained stable most of the time, except in the last interval when the percentage dropped to 54.9%. It can be justified that during the pandemic, the infected have been isolated; thus this is considered as "away from work" instead of "worked full-time". Two other attributes fluctuated through time. Both have undergone a decrease in the first interval, but the unemployment has had a more significant decrease rate, 18.87% compared to 13.57% of "worked part-time". For the last fifteen years, they has had increased slightly, ended up with 24.6% for "worked part-time" and 4.8% for "unemployment". A stability in employment types proportion and an increase in labour force will likely pose a dwelling demand. In fact, this hypothesis is verified with data in house price and employment status in the past.

3. Executive summary and conclusion

By collecting 53 attributes for a 20-year period from ABS Census and Pricefinder, and breaking them down into seven categories, it is stated that

property price in Moorebank moves proportionally with the population and the income. Migration could boost up the population number significantly in a short time. For the time being, the dwelling supply-demand ratio seems to be lowering, with the expansion of labour force and income improvement, it is likely to have upcoming property price hike. For those who want to invest in real estate in this area, it is more beneficial to have a house with four or more bedrooms than owning a flat/unit. If the investor prefers weekly income from renting, a flat/unit with multiple bedrooms will be the best option owing to high ren rate. It is more feasible for buyers who have family with children to acquire a big house with four or more bedrooms suitable to the demand than buyers who are individuals or newly married couples that are looking for a house or a flat/unit with two or less bedrooms. Additionally, if possible, it is recommended to acquire a house with instalments as soon as possible, rather than keep renting and saving up money.

4.   Reference

Moorebank, New South Wales. (2023, August 26). In *Wikipedia.* https://en.wikipedia.org/wiki/Moorebank,_New_South_Wales