

Trend Identification & Sales Forecasting of Recreational Vehicles in Australia

IS Project at Carnegie Mellon University

Developed by

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I. Background

1. Introduction

According to the latest domestic tourism snapshot, Australians spent a total of 54.5 million nights caravan and camping in the year ending March 2019, marking a 6.5% increase from the previous year.¹ Caravanning and camping, as a lifestyle to recharge in nature and connect with loved ones, are gaining popularity among Australian families. As exciting as the number revealed, stakeholders in the caravan industry still ponder the future. Will the upward momentum last amid all the economic uncertainties, and for how long?

Caravan Industry Association of Australia is certainly the one organization share the concern. The association is the peak national body for caravanning and camping industry in Australia. As a not-for-profit organisation with individual state caravanning and camping associations working collaboratively, the organization work on matters concerning the caravanning and camping industry in Australia². It plays a role as a communicator between business and consumers, and as an advocate for the industry.

2. Objectives

In general, caravan industry is subject to volatility in operating results due primarily to economic conditions, because the purchase of recreational vehicle products is often viewed as a consumer discretionary purchase. Demand for such goods can fluctuate with economic growth rates, consumer confidence, etc³. Seasonal factors, over which companies have no control, also have an effect on the demand for caravan products. There is the possibility of a degree of reflexivity between recreational vehicles sales and all the factors, as the past markets have already demonstrated responsiveness to economic and seasonal factors.

In this study, we analysed recreational vehicle registration data from the database of Caravan Industry Association of Australia. Combining with open data source, we explored the correlations between recreational vehicles registrations and influencing factors. Specifically, the factors we analyzed are:

- Employment Rate
- Consumer Price Index
- Gross State Productivity
- Home Loan Interest Rate
- Temperature
- Population

¹ New figures reveal domestic caravan and camping trips increase in popularity, Available at: <https://www.caravanindustry.com.au/new-figures-reveal-domestic-caravan-and-camping-trips-increase-in-popularity>

² <https://www.caravanindustry.com.au/who-is-caravanindustry>

³ Winnebago Industries_10K_20181018

Following exploratory data analysis, we tested and implemented GRU Neural Network, a deep learning model to predict the sales/registration with and without impacting factors. The purpose of this analysis is to provide recreational vehicle dealers and associations with insights into market share and trends influencing the purchase of vehicles in their market.

II. Data Warehousing

1. Data Extraction

In general, 7 datasets are selected and downloaded from several open and authoritative websites for the considerations from economic, demographic, and meteorologic perspectives. Each dataset describe a possible factor influencing the registration of recreational vehicles in Australia. All of the data sources are maintained and updated in a recurring manner, which is accessible for repetitive analysis processes.

Table 1 - List of Data Sources

Factors	Source Websites	Source Links
Employment Rate	.id community	Employment Rate - Data Source Page
Consumer Price Index	Australian Bureau of Statistics	CPI - Data Source Page
Gross State Productivity	Australian Bureau of Statistics	GSP - Data Source Page
Home Loan Interest Rate	Reserve Bank of Australia	Home Loan Interest Rate - Data Source Page
Temperature	Australian Bureau of Meteorology	Temperature - Data Source Page
Population	Australian Bureau of Statistics	Population - Data Source Page

To clarify, home loan rate is used here instead of car loan or national cash rate based on two reasons: (1) no published standard car loan rate was found from open data source; (2) car loan rate is closely related to home loan, and both car/home loan rate manifest the move of national cash rate published by RBA.

The temperature value of each instance in the temperature dataste is the monthly mean maximum temperature with the unit as °C, and assume to use the temperature of the nearest Bureau station to the central business district in each state to represent the temperature in the whole state (see selected bureau stations of meteorology in [Appendix 1](#)).

2. Data Transforming

For importing the datasets into an integrated data warehouse and the use of visualization and modelling, the data has been transformed by the following steps:

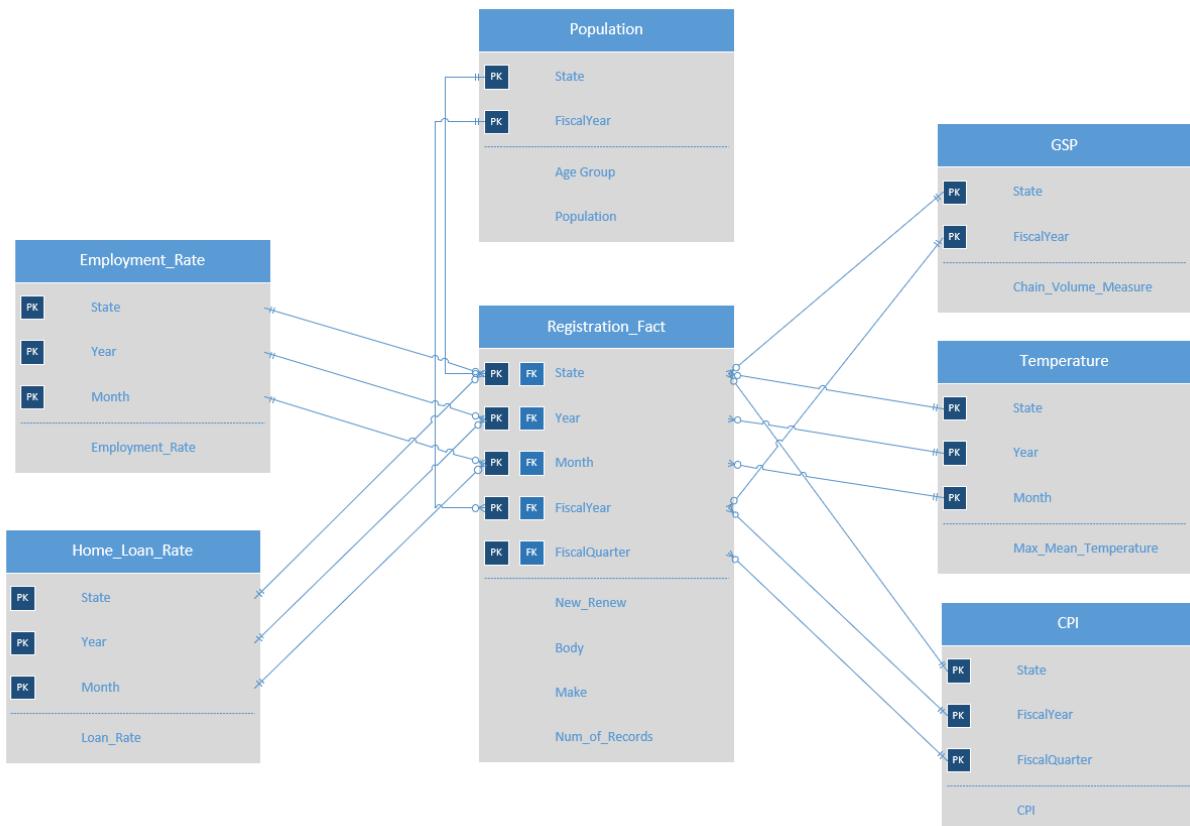
- For the caravan dataset
 - 1) Add fiscal year identifier, fiscal quarter identifier.
 - 2) Aggregate the caravan sales (registration) in the minimum granularity as month.
 - 3) Replace the null value in makes with 'Unknown'.

- 4) Combine the ‘makes’ from the same stakeholder. (See details of combination in [Appendix 2](#))
- For the open datasets: Add state identifier, year identifier, fiscal year identifier, and month identifier (if accessible) for each open dataset.
 - For CPI dataset: add fiscal quarter identifier.
 - For Home Loan Interest dataset: extract calendar month and year from the ‘date’ filed before adding identifiers.
 - For Population dataset:
 - Filter the data to include the years from 2013 to 2018
 - Create the categories for age ranges (0-6), (7-17), (18-30), (30-65), (65~) and store the sum of all underlying ages in respective categories (see the definition of each age group in [Appendix 3](#)).
 - Repeat the process for all states
 - Store final fields as State, Year, Population count, Age group.

3. Data Loading

To build a data warehouse, all the transformed datasets are loaded on the server. The data in the data warehouse can be accessed in multiple analysis tools such as MySQL, Tableau and Jupyter Notebook, connecting by the server address, port number, username, and password (see the presentation of connection with multiple tools in [Appendix 4](#)). The schema of the data warehouse is designed based on the analysis purposes and the demand of repetitive importing in the future.

Figure 1 - Schema of Data Warehouse



III. Trend Analysis

Key Findings

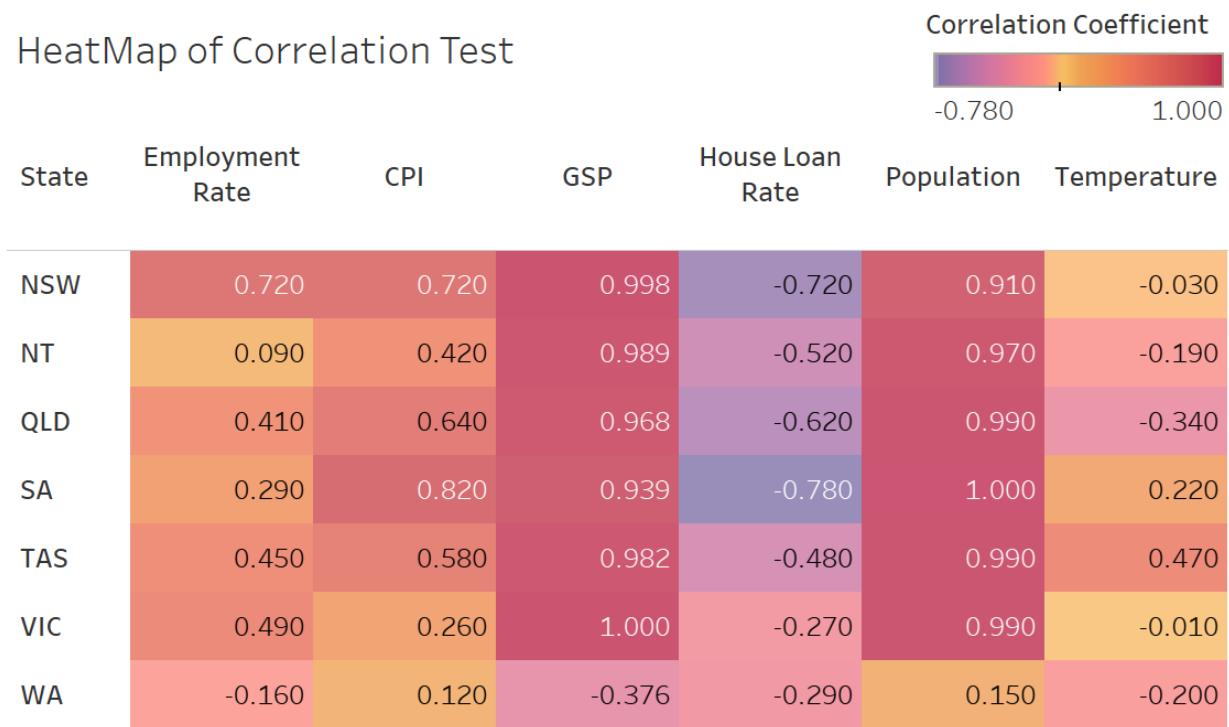
1. Total number of registrations of recreational vehicles in FY2018 is 784,483 , consisting of 18.44% camper trailers, 69.04% caravans, and 12.52% motorhomes. New registrations occupy 6.88%, and the rest are renew registrations.
2. There is obvious seasonality in the national caravan registration. The number of registrations reaches peak in December and drops to the bottom in January.
3. In national market, Jayco is the most popular Camper Trailer make with a market share of 9.23% in new registrations and a market share of 13.37% in renew registrations. Jayco is also the dominant caravan make with almost one third of the market share. Toyota, with a market share of over 30% in both new and renew registrations, is the most popular motorhome make.
4. Based on the results of time series decomposition, Victoria shows the most fluctuating seasonal trend in registration (Seasonality Range = 0.91) while South Australia achieves a slight leading in trend growth rate (32.7%).
5. Based on the result of correlation test, among all of the states, the registration in South Australia shows the highest correlation with CPI (82%), and house loan rate (-78%) while New South Wales has the highest correlation with employment rate (72%), Tasmania has the highest correlation with temperature (47%).
6. The trend of employment rate and registrations are highly synchronized. The reason can be the underlying seasonality of both trends are highly coincident.
7. The trend of temperature and registrations are correlated but with an obvious lag phenomenon, where the number of registrations goes up right before the temperature goes up. So, the temperature should be the proxy of school holiday that has positive impact on RV registration.
8. The population in Australia is largely consisting of the 'settled workforce' age group (31-65). This age group can be the main customer group for the Australia recreational vehicle market as well. The population in the age-range of 65 years old or more have been the highest growing population segment (annual growth rate 3%), which indicates that the retirement group can be a potential customer group of recreational vehicles.
9. South Australia, Tasmania, and Queensland are the top 3 states in terms of registration to population ratios.

General Correlation Test

Correlation Test is a commonly-used statistical method to evaluate the association between two or more variables. The calculated correlation coefficient in a correlation test presents the strength of the association (The correlation coefficient ranges from -1 to 1. A value of 1 implies a perfect positive relationship between two variables while a value of -1 implies that a perfect negative relationship. A value of 0 implies that there is no linear correlation between variables).

Before visualizing the registration trend with possible influencing factors, the correlations between registration volume and each possible influencing factor are tested for each state. All data are normalized to (0,1) before correlation test. Generally, the yearly datasets, GSP and population, show a higher correlation, since the fluctuation of sales during months is curved in those dataset. For the other factors, the registration in South Australia shows the highest correlation with CPI and house loan rate; the registration in New South Wales shows the highest correlation with employment rate; the registration in Tasmania shows the highest correlation with temperature. This result of correlation test becomes a good complement to the visual effects obtained from the charts.

Figure 2 -HeatMap of Correlation Test with Registration and Driver Data for Multiple States



For all the visualizations below, fiscal years are presented instead of physical years, following the standard of Australian fiscal year and quarter.

1. Caravan Registration Trend

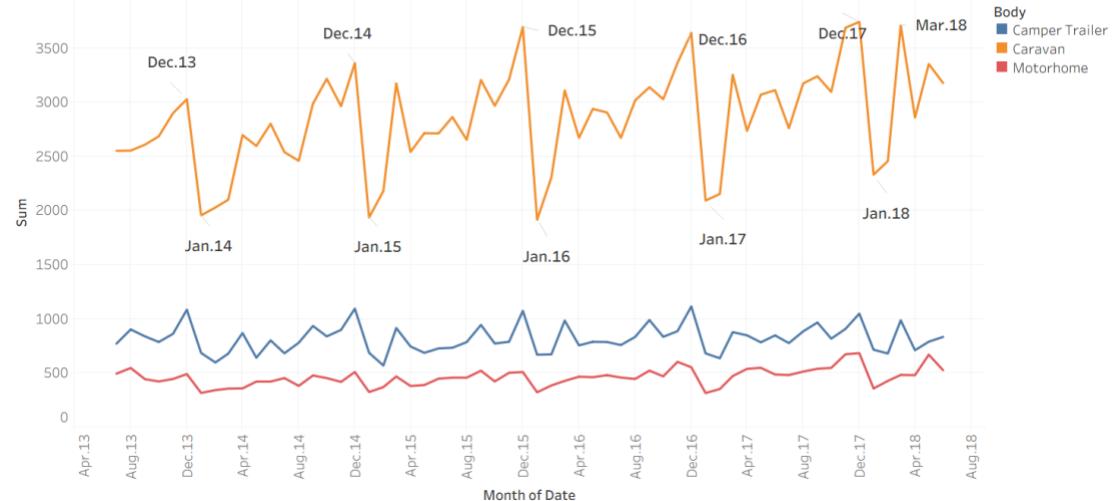
- Registration trend analysis by type

In this section, the registration trend is analyzed by body type (Caravan\Camper Trailer\Motorhome) and registration type (New\Renew). Overall (nationally), the general trend of the registration of caravans keeps increasing. In the fiscal year 2018, the new registration of caravans in Australia increases 6.55%, the new registration of camper trailers in Australia increases 0.25%, and the new registration of motorhomes in Australia increases 10.74%. The number of registrations is at the lowest point in January and the highest in December each year. The caravan is the most popular body type, occupying 69.04% of total registrations. The national

trend for renew registration is similar to the trend of new registration. But there is one unusual point that in FY2018 the yearly growth rate is quite low compared to previous years. The yearly growth rate of camper trailers is even negative. (In general, registrations trends in states are similar to the national trend, you can see the details in [Appendix 6](#))

Figure 3 - National Registration Trend by Body

National Registration Trend by Body (New)



National Registration Trend by Body (Renew)

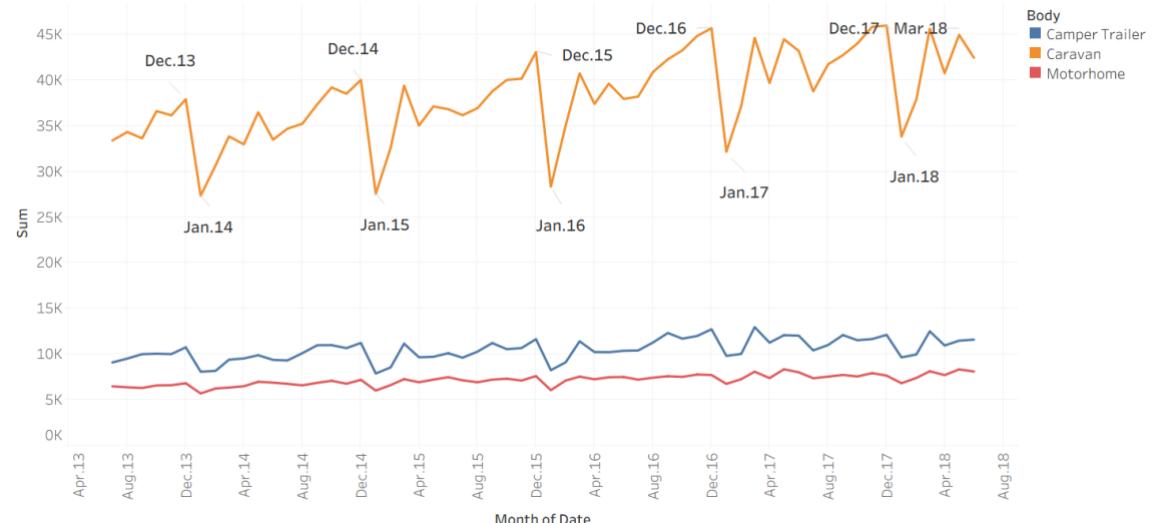
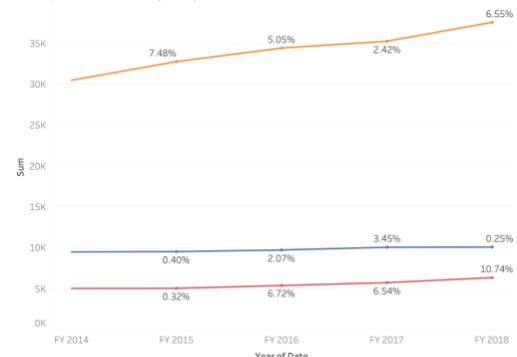
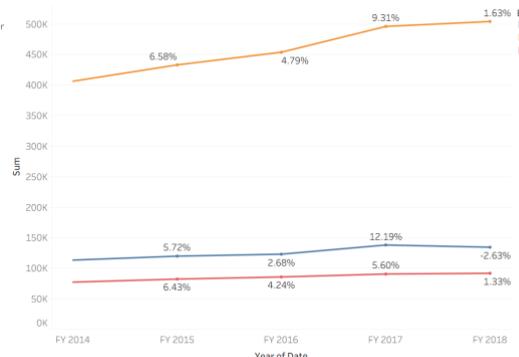


Figure 4 - Yearly Growth Rate of New and Renew Registration

Yearly Growth Rate (New)



Yearly Growth Rate (Renew)



The trend of sum of Sum for Date Year. Color shows details about Body. The marks are labeled by % Difference in Sum. The data is filtered on Date, which ranges from 7/1/2013 to 6/30/2018.

The trend of sum of Sum for Date Year. Color shows details about Body. The marks are labeled by % Difference in Sum. The data is filtered on Date, which ranges from 7/1/2013 to 6/30/2018.

- Comparison of Trend and Seasonality across States

In this section, a statistical task, time series decomposition is adopted to deconstructs the time series of recreational vehicles registration in multiple states into 4 components. Each component represents one of the underlying categories of patterns, which help further explore the underlying number change of recreational vehicles registration.

Components obtained from time series decomposition:

- 1) Observed: the actual value of registration number
- 2) Trend (T_t): the trend component at time t, which reflects the long-term progression of the registration series
- 3) Seasonal (S_t): the seasonal component at time t, which depicts the repeatable yearly pattern for the registration series
- 4) Residual (R_t): the remainder of the series, which is unexplained by any trend or seasonality patterns

A multiplicative model is appropriately used here since the registration trend of recreational vehicles is proportional to the level of the time series.

Formula 1 - Multiplicative Time Series Decomposition

$$y_t = S_t \times T_t \times R_t$$

After the time series decomposition, the growth rate of trend and the range of seasonality are calculated for each state to measure the increasing trend of registration and the fluctuation intensity impacted by seasonal factors. Excluding the measures of North Territory w(widely-different magnitude of registration compared to other states may lead to a high occasionality of analysis result), Victoria shows an extremely fluctuating seasonal trend (Seasonality Range = 0.91) while South Australia shows the most promising trend with a slight leading in trend growth rate (32.7%).

Figure 5 - Trend Growth Rate and Seasonality Range in Multiple States
(* See calculation process in [Appendix 5](#))

State	NSW	NT	QLD	SA	TAS	VIC	WA
Trend Growth Rate	30.00%	35.40%	29.50%	32.70%	21.80%	17.70%	30.80%
Seasonality Range	0.26	0.64	0.36	0.22	0.38	0.91	0.17

* Trend is recorded based on the actual number, which is close to the observed registration number.

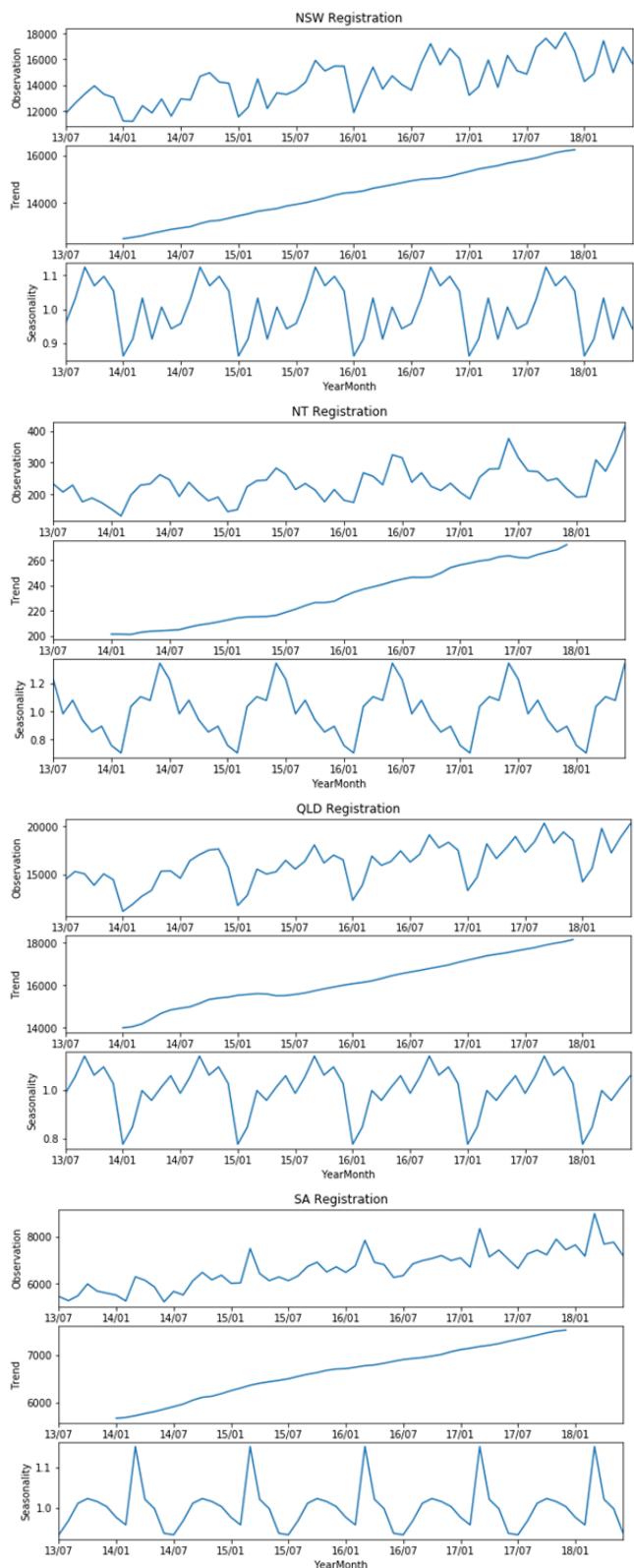
* Seasonality is recorded as an index. Above 1 reflects a positive seasonality while below 1 presents a negative seasonality. 1 refers to no seasonality.

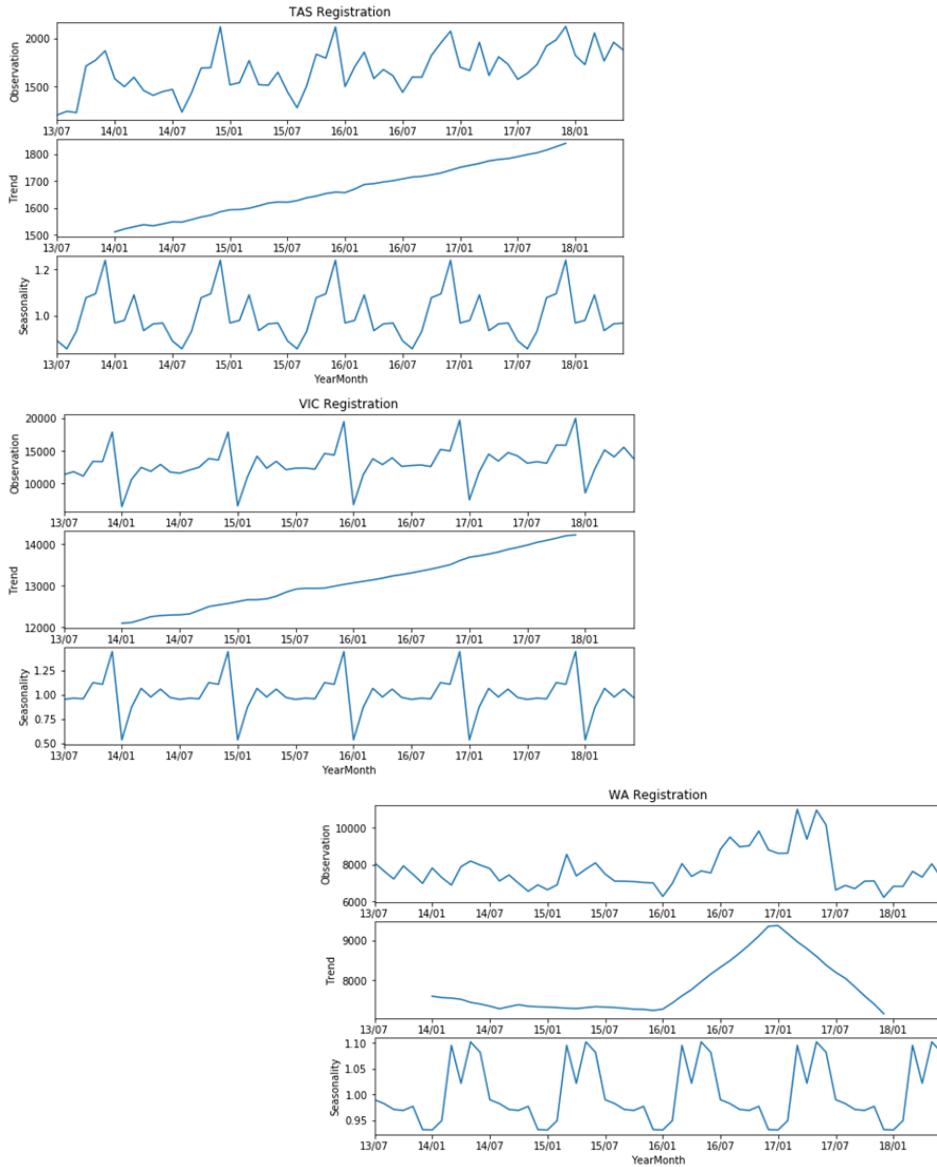
* In a series, the seasonality range and trend growth rate are calculated as:

$$\text{Seasonality Range} = \text{Max Seasonality} - \text{Min Seasonality}$$

$$\text{Trend Growth Rate} = (\text{End of Trend} - \text{Start of Trend}) / \text{Start of Trend} * 100\%$$

Figure 6 - Time Series Decomposition Plots for Multiple States
*(*omitting the residual component)*

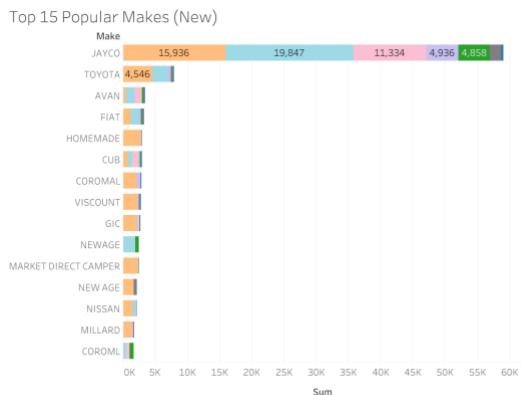




● Popular Makes

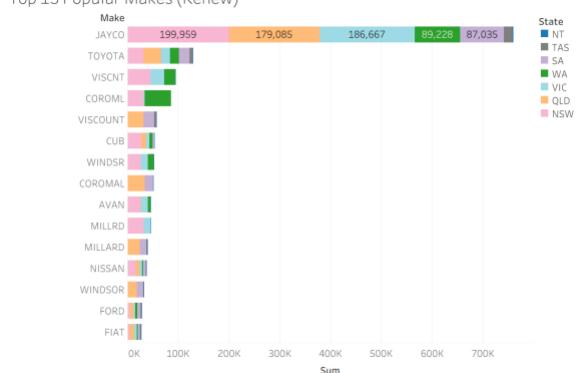
Jayco is the most popular make for both new and renew registrations, and the number of Jayco is much larger than other makes. People in Queensland prefer to buy popular makes. (The fraction of Queensland is large in most of the top 15 makes.) People in New South Wales register more renew popular makes because the fraction of NSW is large in 9 out of top 15 popular makes. (You could also refer to [Appendix 6](#) for information about popular makes by states)

Figure 7 - Top 15 Popular Makes of New and Renew Registration



Sum of Sum for each Make. Color shows details about State. The marks are labeled by sum of Sum. The view is filtered on Make, which keeps 15 members.

Top 15 Popular Makes (Renew)



Sum of Sum for each Make. Color shows details about State. The marks are labeled by sum of Sum. The view is filtered on Make, which keeps 15 members.

● Market shares of Top 5 popular makes

All registrations data miss make information in FY2014, so we only drew market shares from FY2015 to FY2018. For the whole country and most states, the market share of popular makes does not change much (usually less than 1%) in the recent four fiscal years. Take FY2018 as an example, Jayco is the most popular camper trailer make with a market share of 9.23% in new registrations and a market share of 13.37% in renew registrations. For caravans, Jayco occupies a dominant percentage of the market. Its market share is almost one third in both new and renew registrations. For motorhome, Toyota, with a market share of over 30% in both new and renew registrations is the most popular make. (You could also refer to [Appendix 6](#) for information about the details of market shares of top 5 popular makes in each year and each state)

Figure 8 - Market Shares of Top 5 Camper Trailer Makes (National)

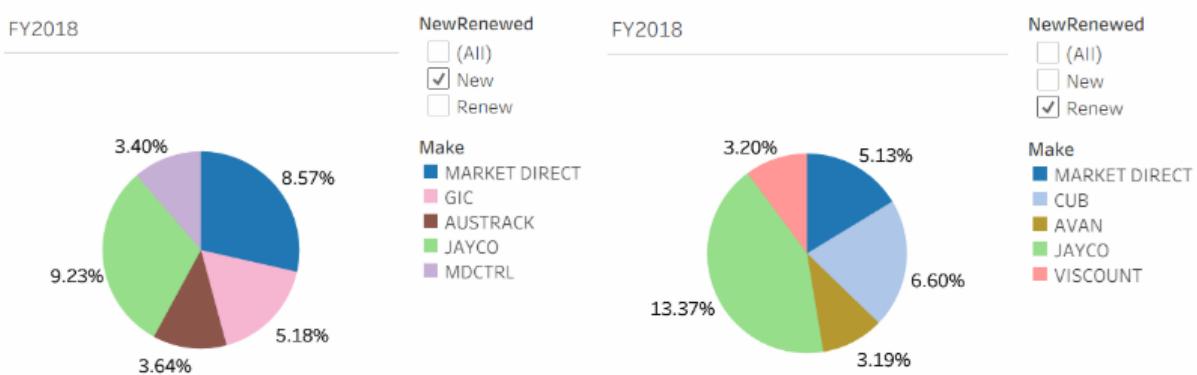


Figure 9 - Market Shares of Top 5 Caravan Makes (National)

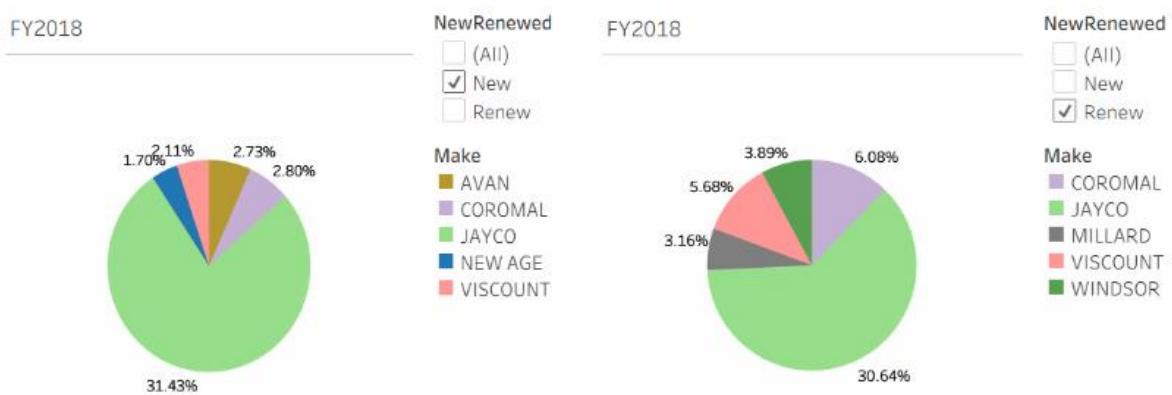
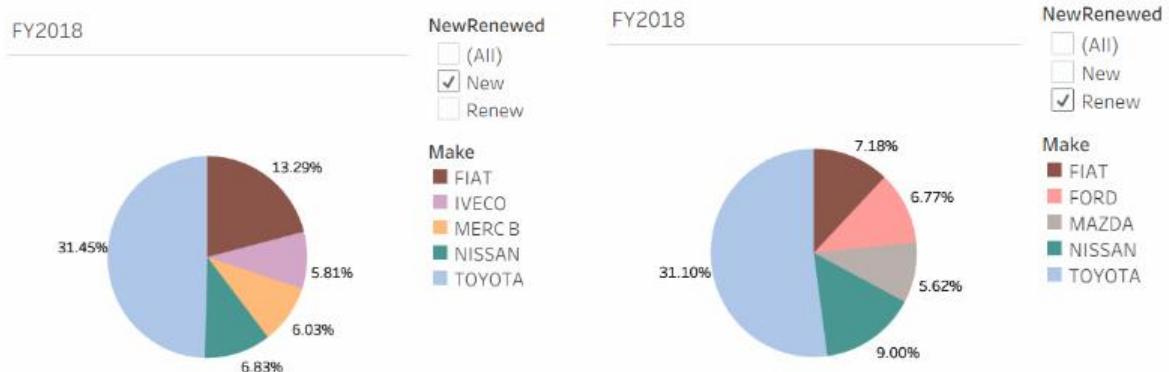
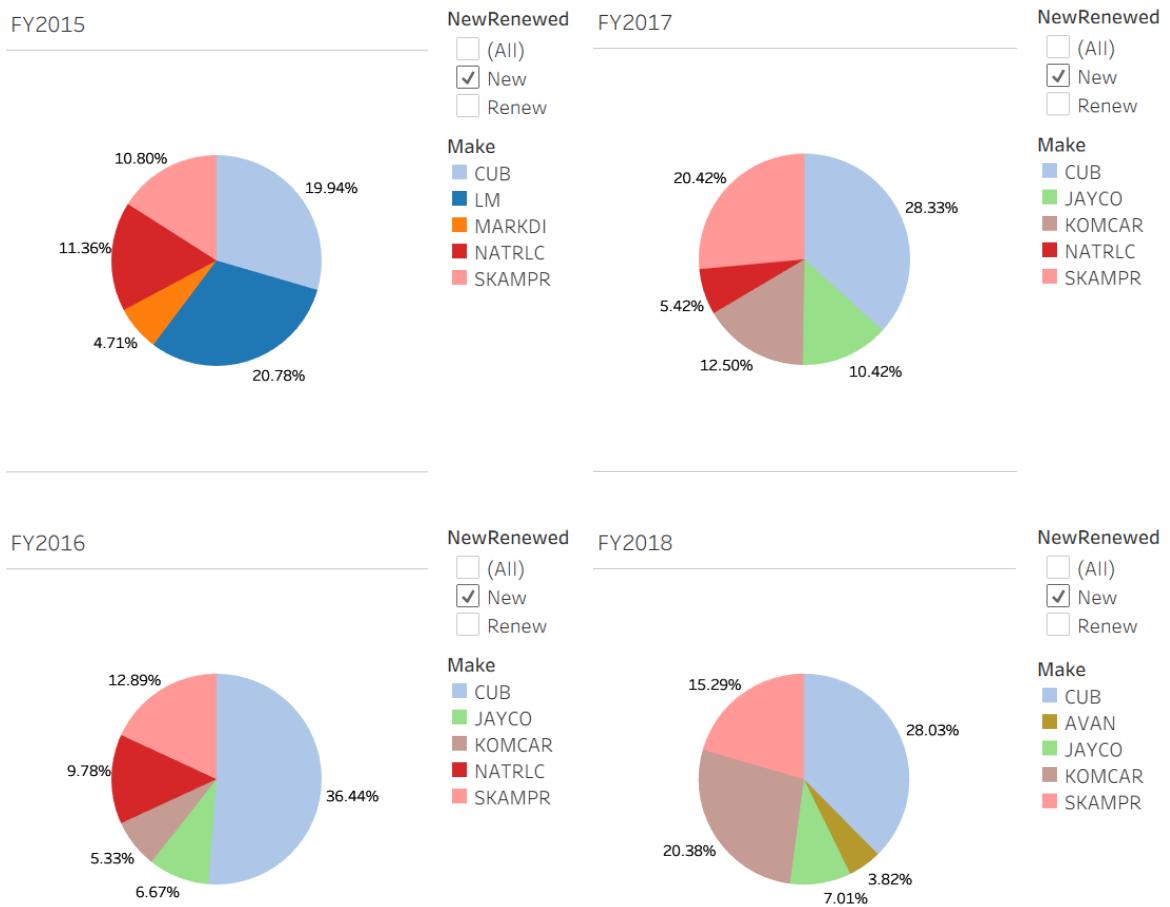


Figure 10 - Market Shares of Top 5 Motorhome Makes (National)



One interesting insight is that, in New South Wales, the market share of KOMCAR in new registrations of camper trailers grew very fast. It was not in the top 5 makes in FY2015, but became the second most popular make and occupied 20.38% market share in FY2018.

Figure 11 - Market Shares of Top 5 Camper Trailer Makes (NSW)



2. Caravan Registration Trend with Economic Driver

- Employment rate vs. Registration

Since employment rates are all between 92% and 98%, in order to see changes more clearly, the following employment rate is calculated by $(\text{actual employment rate} - 0.9) * 300$.

The following graph shows the trend of the employment rate and the number of registrations.

(1) National trend

Generally, the employment rate is fluctuating around the same level, and it doesn't show an obvious increase over the years. The general trend of registrations shows us a slowly increasing trend with some seasonal fluctuations. We can see that both lines have some peaks and troughs. For fiscal year from 2014 to 2018, the troughs of registration all happen in January, while the troughs of employment rate happen in January or February. Comparing the two lines, we can easily find the two trends are quite similar. The reasons why they are similar could be related to school holidays and part-time employees. The longest school holiday in Australia is summer holiday which starts in late December around Christmas and ends in early February. Caravans are usually bought by families with kids, as caravans are useful for them to take kids out for trips. In order to take kids out in summer holiday, parents need to buy caravans in advance. Therefore, registrations reach peaks in December, and reach troughs in January. 36% of Australian citizens are part-time employees. They usually finish work before Christmas and takes a holiday, then

start finding jobs after summer holiday. Therefore, employment rate reaches troughs in January or February, and starts increasing then.

Figure 12 - Monthly Registration Trend vs Employment Rate in Nation

Employment Rate vs Registration in all states



(2) State trend

In this section, we picked some typical states which can best show the correlation between registration trend and employment rate trend. We selected Queensland and Victoria to discuss in detail. More detailed figures of all states and years can be found in [appendix](#).

For Queensland, the trends of 3 types of body and trend of employment rate are shown in the figure below. For caravan, the peaks happen in November and troughs happen in January. For camper trailer and motorhome, the trends are smoother. We cannot tell the commons in troughs and peaks. The trend of the employment rate is more similar to the trend of caravan.

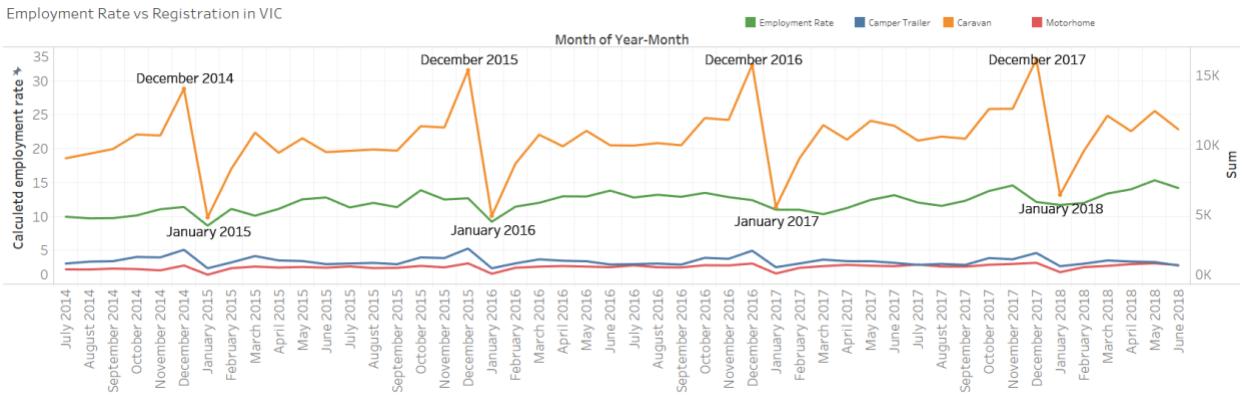
Figure 13 - Monthly Registration Trend vs Employment Rate in Queensland

Employment Rate vs Registration in QLD



For Victoria, the trends of 3 types of body and trend of employment rate are shown in the figure below. For caravan, the peaks happen in December and troughs happen in January, which is almost the same as the national trend. For camper trailer and motorhome, the trends are smoother, but the peaks and troughs are quite clear. In the following figure, we can see that the peaks and troughs of all four lines are similar, and a strong seasonality exists in the trends.

Figure 14 - Monthly Registration Trend vs Employment Rate in Victoria



- Other Economic Factors vs. Registration

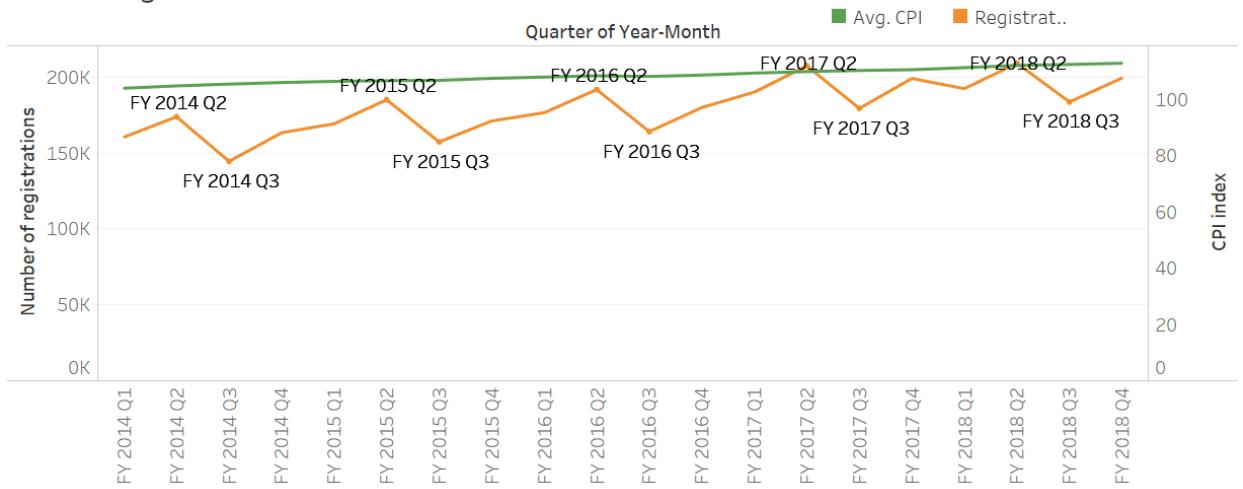
- Consumer Price Index vs. Registration

National trend

The following graph shows the trend of CPI and number of registrations. The Green line shows CPI. The color legend of 3 body types is shown in the graph. We can see that CPI keeps increasing over time, and the number of registrations also have a trend of increase. CPI's trend and trends of registration in 3 types are all similar. Caravan's trend has more peaks and troughs, while others' trends are smoother. The trend by states are shown in [appendix](#).

Figure 15 - Quarterly Registration Trend vs CPI Index in all states

CPI vs Registration in all states



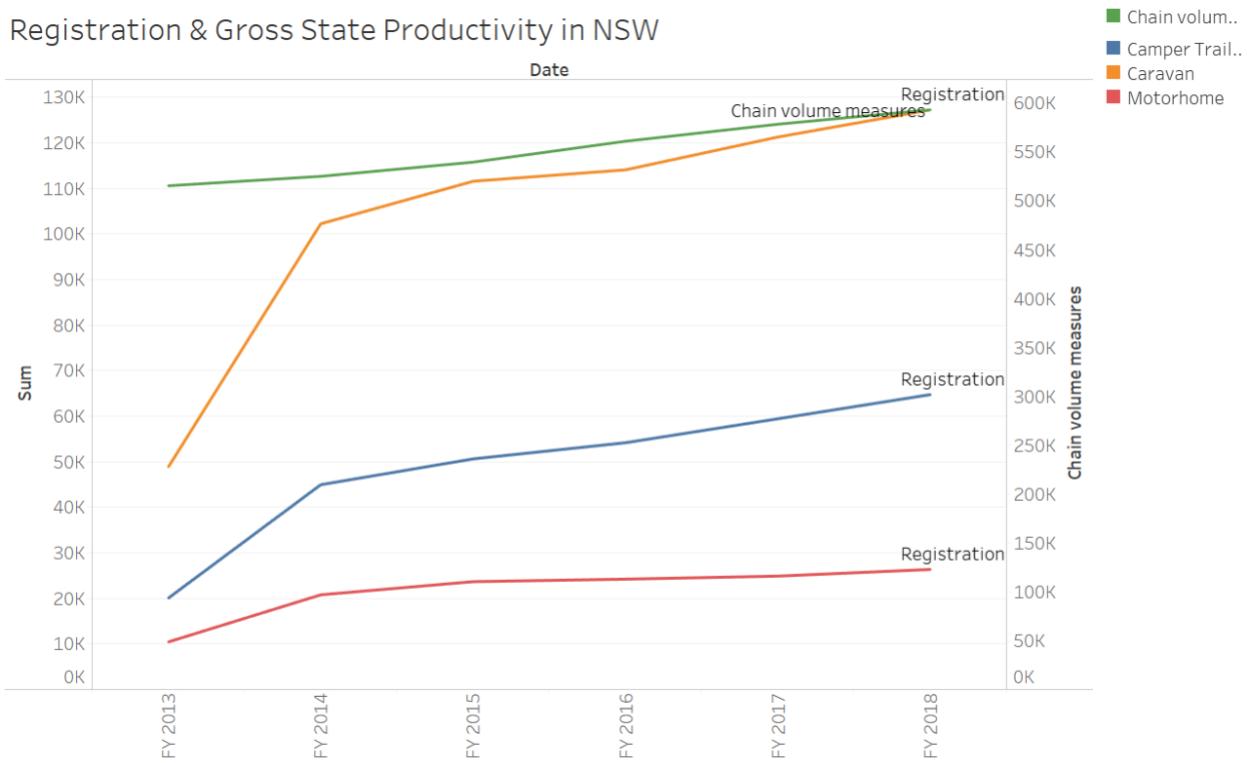
- Gross State Productivity vs. Registration

Since there are only yearly GSP data, I showed trend of GSP and registrations both based on yearly data. Since the trend is similar, I only showed total trend and two states trend as the following:

- (1) Registrations Trend by States

Figure 16 - Total number of registrations vs mean GSP in NSW (yearly)

Registration & Gross State Productivity in NSW

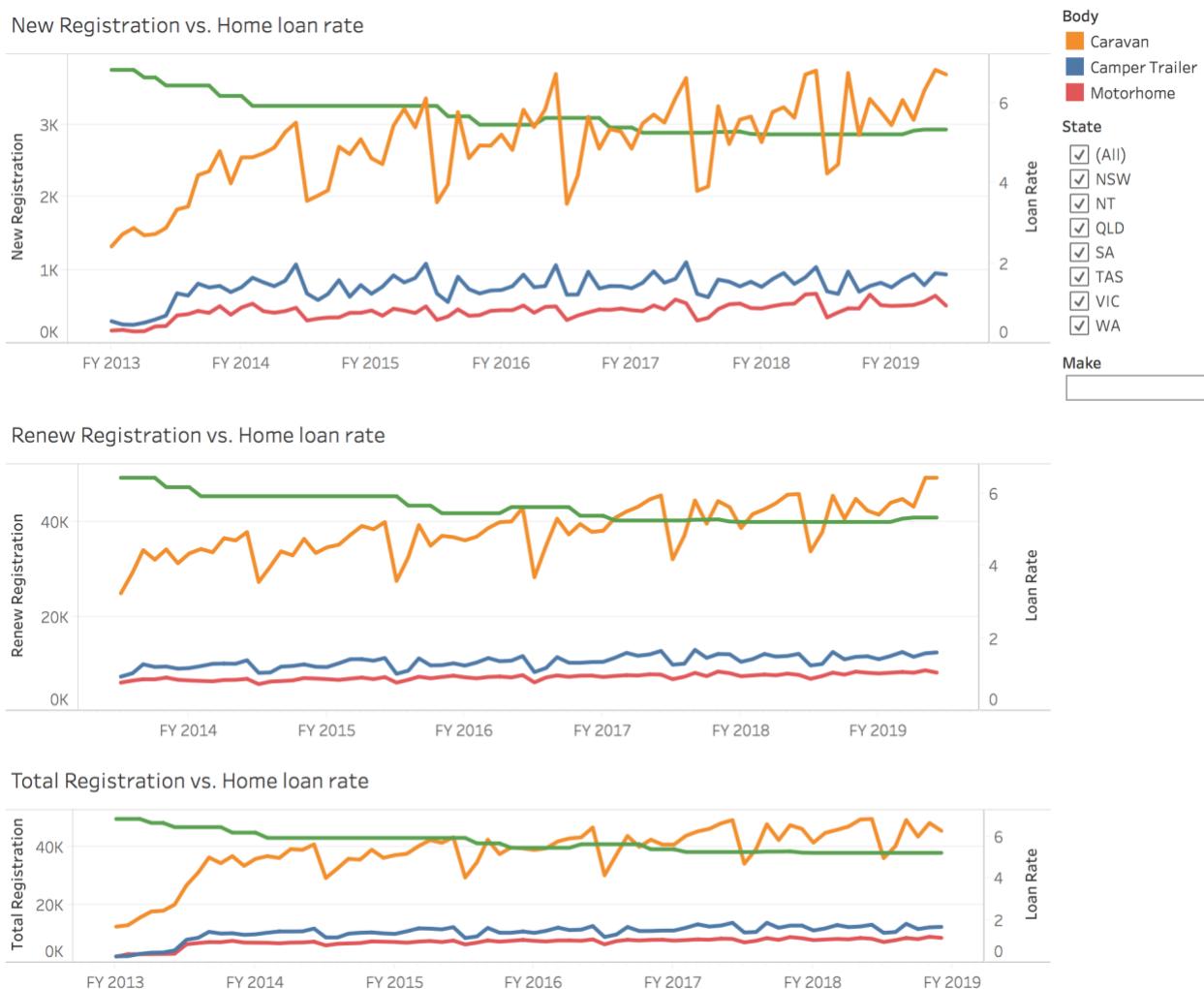


As we can see above, the trend of GSP is increasing from 2013 to 2018, while total registration numbers for all bodies of vehicles are increasing as well. Although the trend of registration from 2013 to 2014 went up faster, the relationship of these two variables should be positive related.

- Home Loan Interest Rate vs. Registration
 - (1) National trend

The general trend is clear from visualization. Looking at national level of registration, as housing loan rate falls over time from 2013, the number of new and renew registration rises.

Figure 17 - Total number of registrations vs. Loan Interest Rate in Nation



(2) Registrations Trend by States

State wise, we are seeing the same general trend across all body types, as shown in the following visualizations of the top 3 states (**VIC**, **NSW**, **QLD**) with most registration records. It makes logical sense that the lower borrowing rate could stimulate people's major purchasing, such as houses or vehicles. For detailed state level visualization, refer to [Appendix](#).

3. Caravan Registration Trend with Meteorologic Driver

- Temperature vs. registrations

We used monthly data for every fiscal year to compare the trend of temperature and registration number. Monthly temperature is calculated by the mean value of the highest temperature for every day in that month, while the monthly registration number is the sum of that for everyday registrations. In every chart, we showed the trend of temperature and trend of registration for every state from financial year 2014 to 2018 for different bodies, including Camper Trailer, Caravan and Motorhome that are shown in the legend.

Registrations Trend by States

For every state, the trends for new and renewed registration are similar every year. We can see that right before the temperature goes up or down, the number of registration goes up significantly. Besides, the number of registration goes down during the winter and summer when the temperature is at the lowest and highest point respectively. To some extent, we think the temperature fluctuation goes along with school holidays since schools have summer and winter holidays during these seasons. Before those holidays, families will consider to purchase recreational vehicles so that they can take children for travel. Hence, temperature could be considered as a proxy for holidays that have positive impact on recreational vehicles purchasing. Only for NT among all the states, it is hard to find some meaningful insight due to low population along with low sales. In the following section, I will present the trend for number of registrations and mean temperature in TAS, due to the high correlation coefficient between the two variables, and in NSW. As for the chart of these two trends for other states every year, you can find them in [appendix_Tem](#).

Figure 18 - Total number of registrations vs Temperature in TAS

- Camper Trailer
- Caravan
- Motorhome
- Temperature



Monthly registration & Temperature in TAS

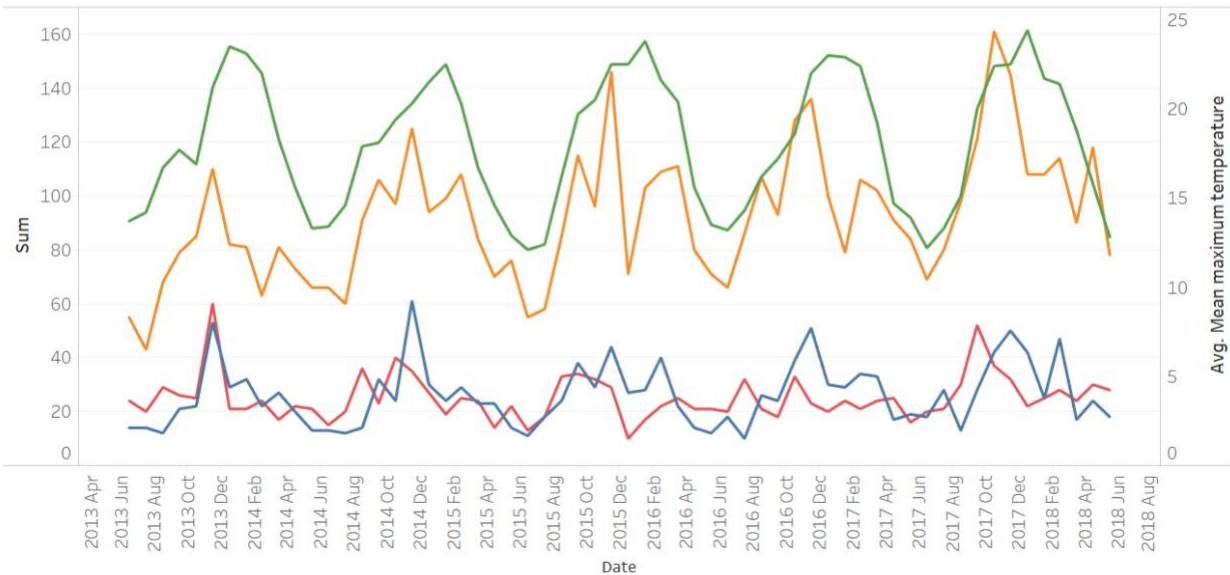
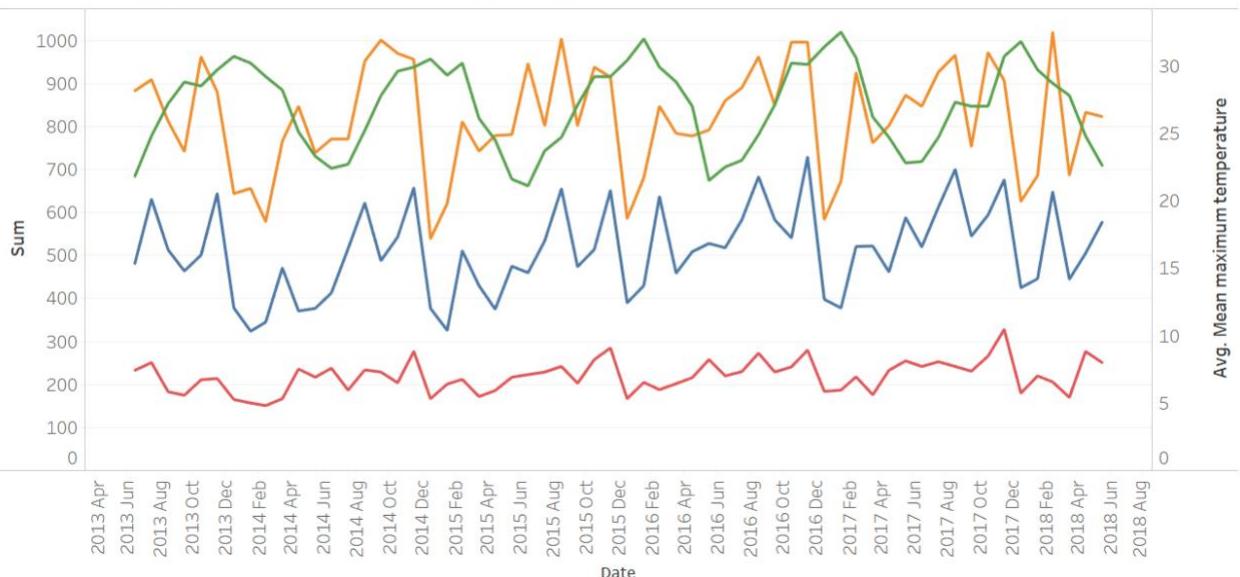


Figure 19 - Total number of registrations vs Temperature in NSW

- Camper Trailer
- Caravan
- Motorhome
- Temperature



Monthly registration & Temperature in NSW



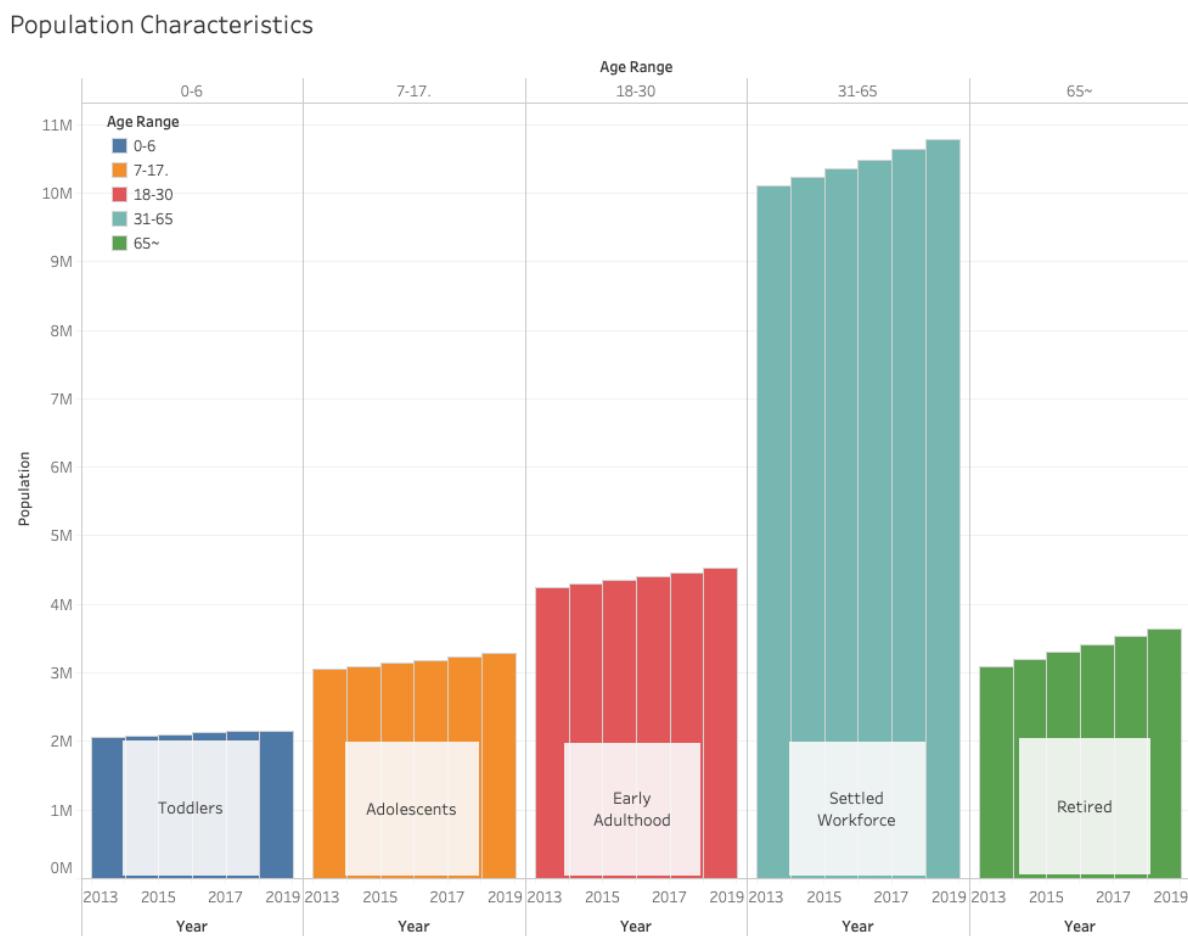
4. Caravan Registration Trend with Demographic Driver

- Population

National Trend

By grouping the population in Australia into different age range, we can see that the demographic is largely consisting of a settled workforce over the recent fiscal years. People in this group mostly have stable incomes and lives and are probably parents as well, who can become the main customer group for the Australia recreational vehicle market.

Figure 20 - Population Characteristics in Different Age Group

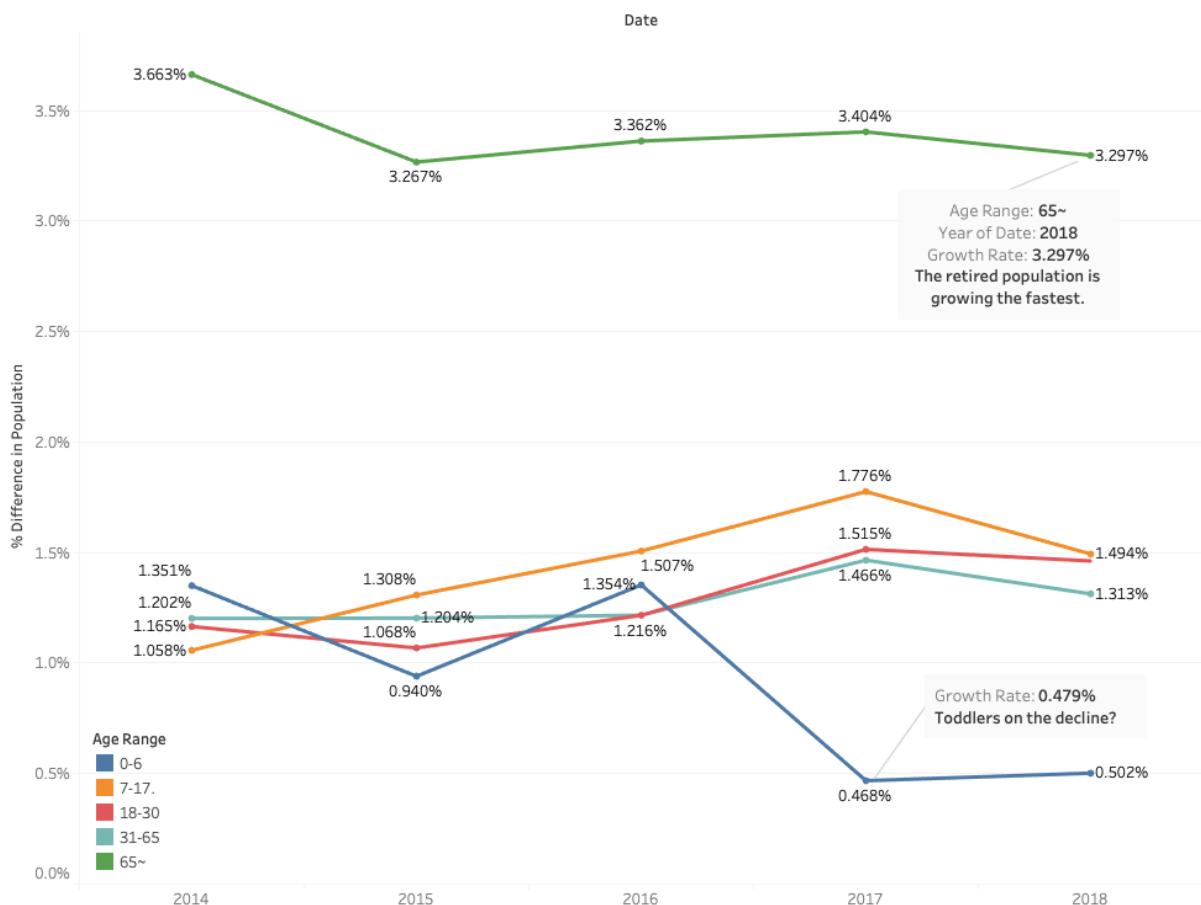


National Growth Rate

Australia has shown steady population growth in the last 5 years with a mean growth rate of 1.5%. Its age groups vary in the growth rate. The standout group was the retired group with GR above 3% every year. The highest growth rate indicates that the retirement group can be a potential customer group of recreational vehicles. The rest of the age groups GR is hovering between 1-2%. The toddler group has reported declining growth in the previous 2 years.

Figure 21 - National Population Trend in Age Groups

National Trend in Age GR (Age group Wise)



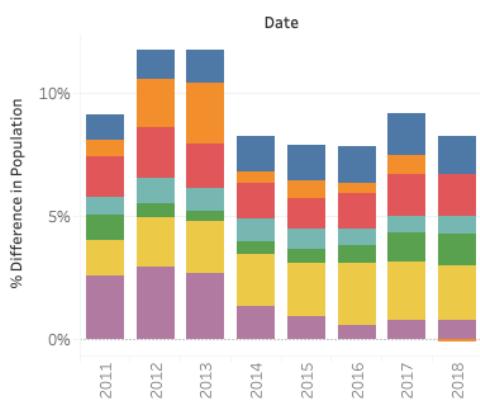
State Trend

Australia has 7 primary states and the population of these states is hugely a function of urban areas, development, climate, urban areas, etc. NSW is the largest while NT is the smallest in terms of population.

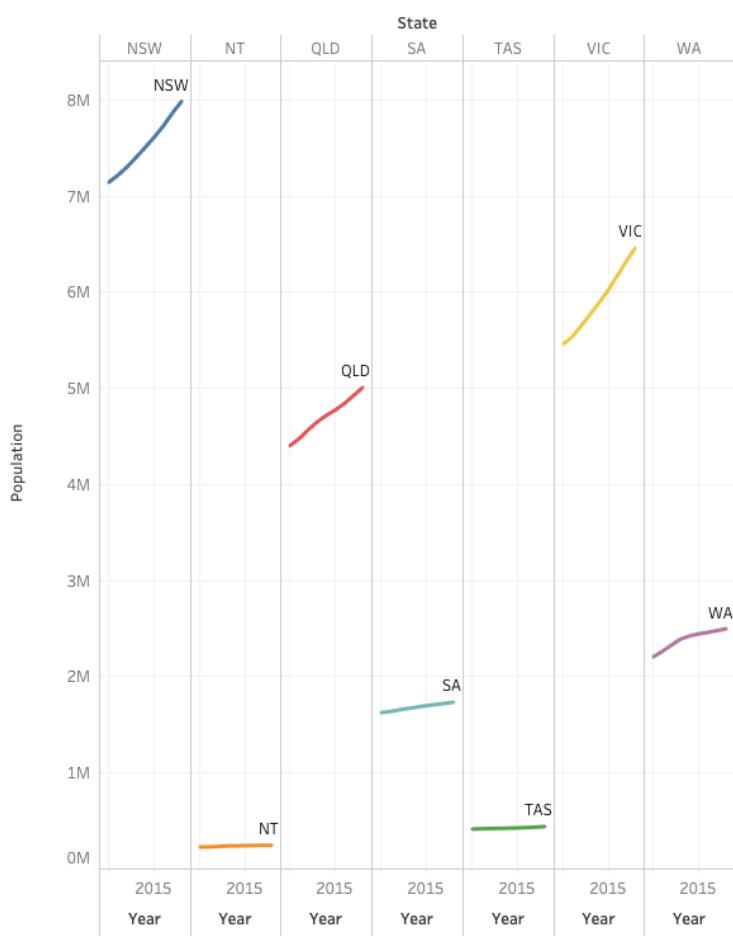
The top 3 populated states (NSW, VIC and QLD) show the highest growth rate too. This may be assumed as an effect of urbanization, where people migrate to urban areas for better opportunities.

Figure 22 - State Population Characteristics

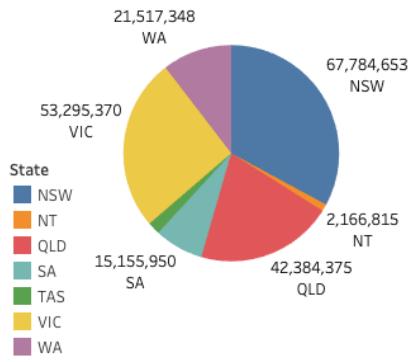
Statewise yearly % change in Population



State Yearly Population Trends



Population Distribution Pie Chart



Registration to Population Ratio (Conversion Ratio)

To figure out the role of the population in a state plays in registration, the Registration to Population Ratio is calculated here.

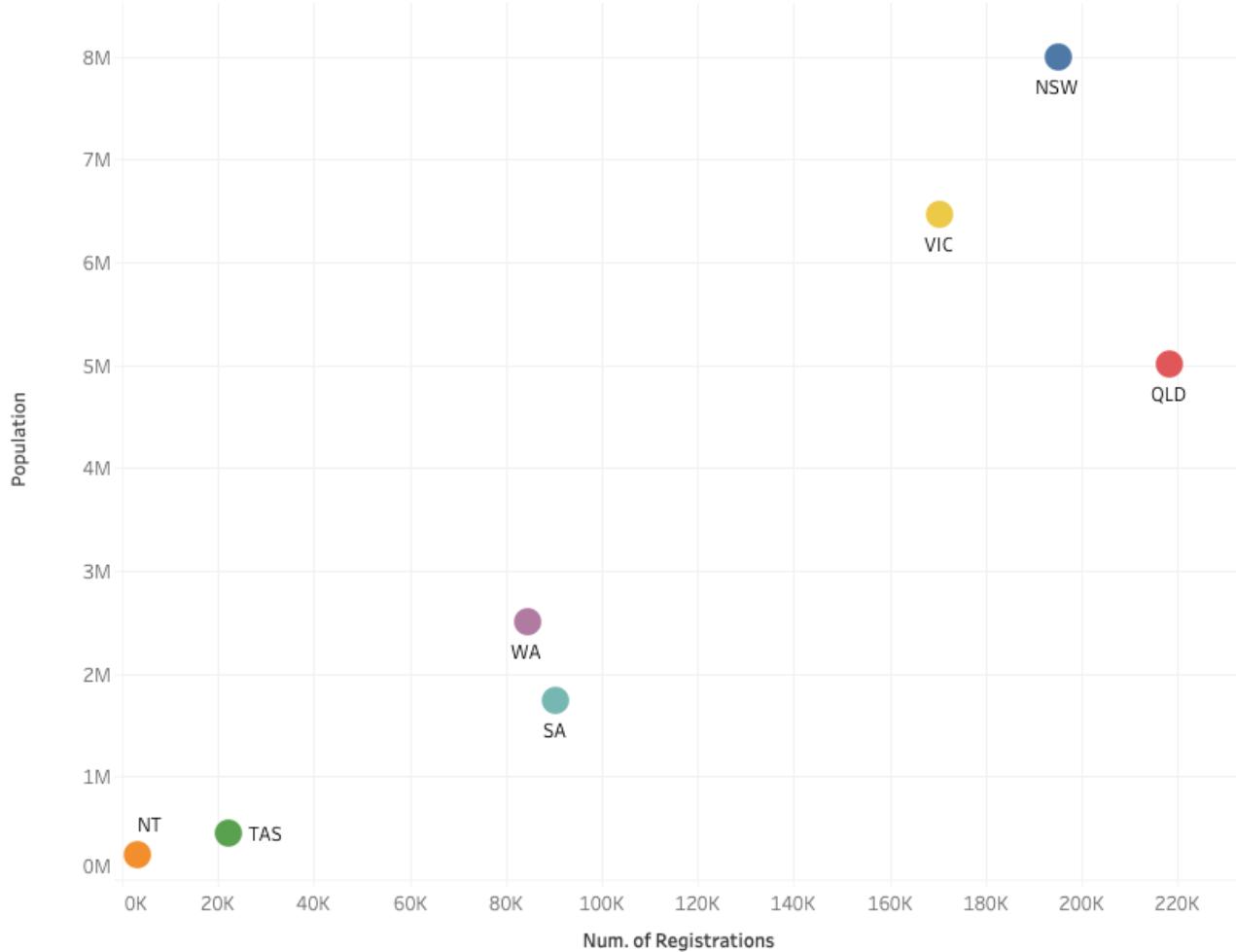
$$\text{Conversion Ratio} = \frac{\text{Total number of Vehicle Registrations}}{\text{Population of the territory in a particular time frame}}$$

The new ratio devised to depict a relationship between population as a driver to sales.

Using the above equation, we could find out that the top 3 states for which the population drove the most registrations were **SA (5.2%)**, **TAS (5%)** and **QLD(4.35%)**.

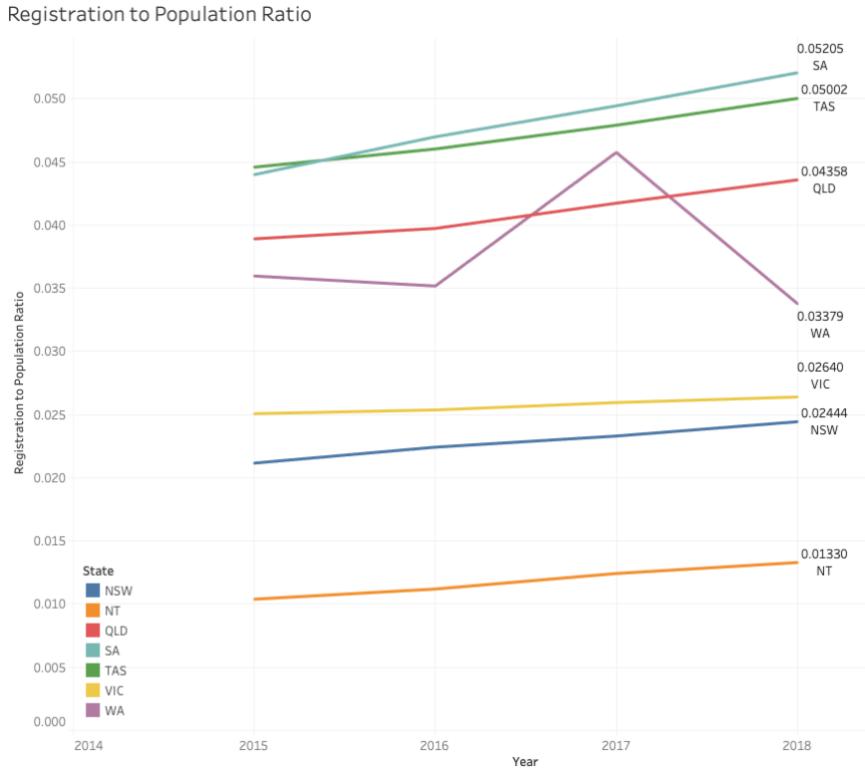
Figure 23 - Conversion Matrix of Registration to Population in FY2018

Registration to Population Matrix



In the above figure, the population (y-axis) and registration (x-axis) for each state is depicted. Such a distinct difference points out to the tourist friendliness of a state, i.e a larger proportion of the population is buying recreational vehicles. SA, TAS, and QLD present relatively large difference between the registration and the population. This highlights the significance and potential of these states for the registrations of recreational vehicles.

Figure 24 - Conversion Ratio over the years for all the states



IV. Registration Forecasting with Gated Recurrent Unit Model

In this part, we are trying to explore the correlation between sales and other time series based open data sources using some nontraditional ways such as deep neural network.

1. Introduction to GRU

GRU, which stands for gated recurrent units, is a relatively new type of recurrent neural network which was firstly introduced in 2014 by Kyunghyun Cho et al. It's a revised version of the well-known long short term memory (LSTM) model, however, despite the similarity, GRU has fewer parameters and does not contain an output gate, which let it have better performance on smaller datasets.

The basic matrix calculation behind a single GRU unit is like the following:

$$z_t = \sigma_g(W_z x_t + U_z h_{t-1} + b_z)$$

$$r_t = \sigma_g(W_r x_t + U_r h_{t-1} + b_r)$$

$$h_t = (1 - z_t) \circ h_{t-1} + z_t \circ \sigma_h(W_h x_t + U_h(r_t \circ h_{t-1}) + b_h)$$

The variables are:

x_t : input vector

h_t : output vector

z_t : update gate vector

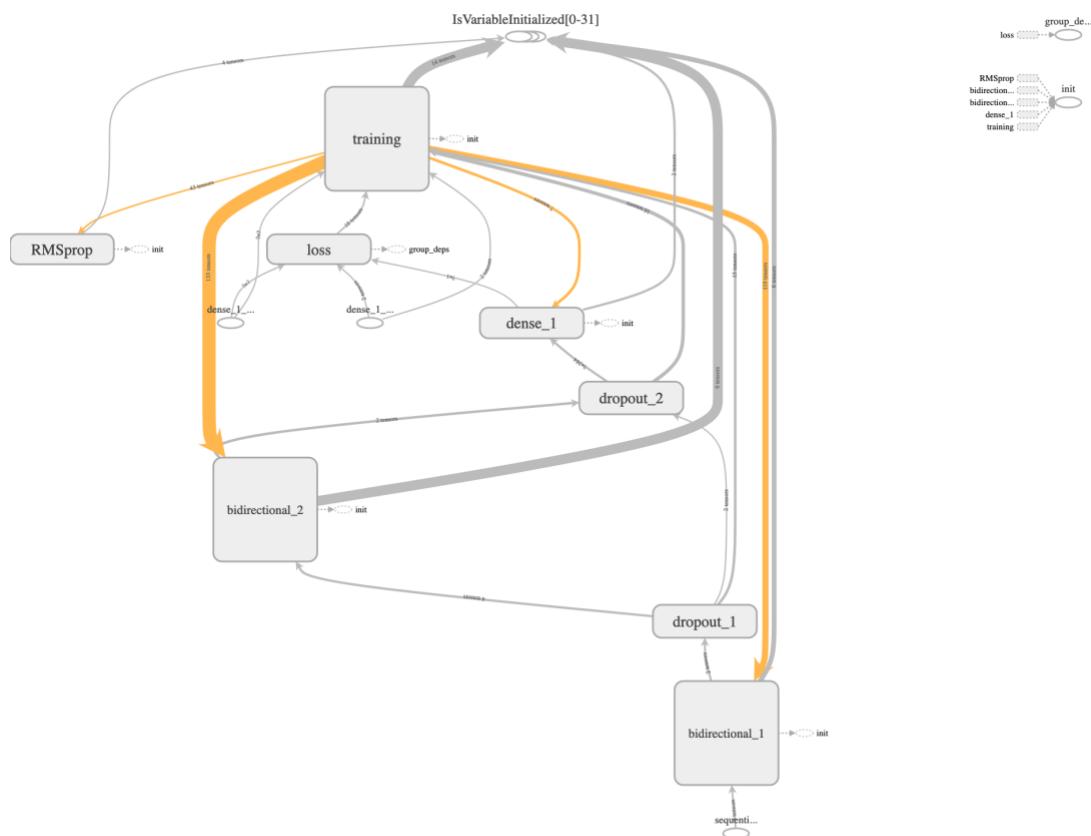
r_t : reset gate vector

W , U and b : parameter matrices and vector

Besides GRU, we also adopt the most famous deep learning algorithms such as Dropout and Dense. We are not going to dive into these topics deeply in this report. The thing that matters is with the usage of all these functions, we can get a better prediction results.

We have also tried with arima, lstm, finally decided to adopt GRU because of its best performance)

2. GRU Model with Single Input

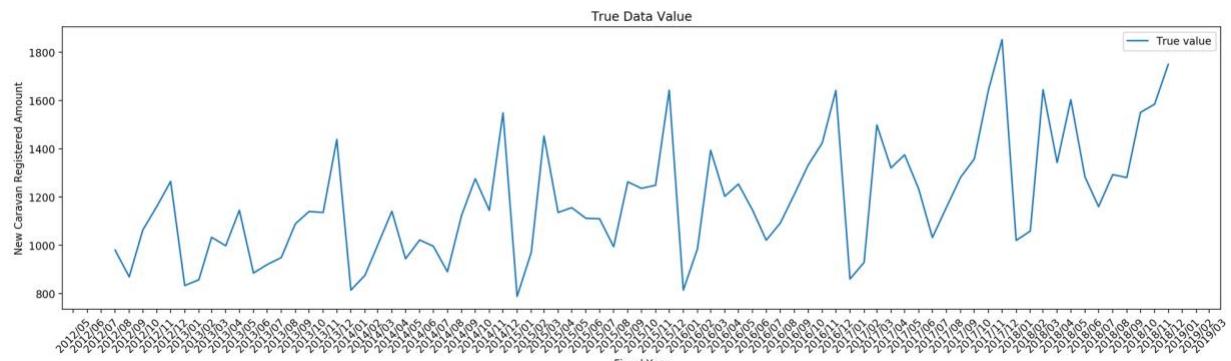


We first build a model based only on historical sales. The main idea of the model is basically predicting the sales of the current month using its previous twelve months' sales data.

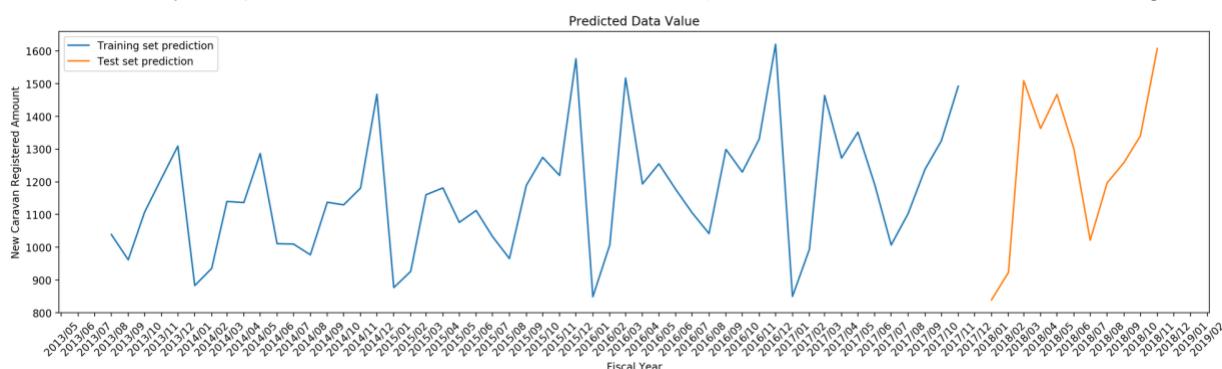
Layer (type)	Output Shape	Param #
<hr/>		
bidirectional_1 (Bidirection (None, 1, 96)		17568
dropout_1 (Dropout)	(None, 1, 96)	0
bidirectional_2 (Bidirection (None, 384)		332928
dropout_2 (Dropout)	(None, 384)	0
dense_1 (Dense)	(None, 1)	385
<hr/>		
Total params:	350,881	
Trainable params:	350,881	
Non-trainable params:	0	

The structure of the model is a sequential model which has two bidirectional gru layers and each one followed by a dropout layer. It's hard to explain why we set the parameters like this, but this is the best model we can get after tuning and training it for a lot of times.

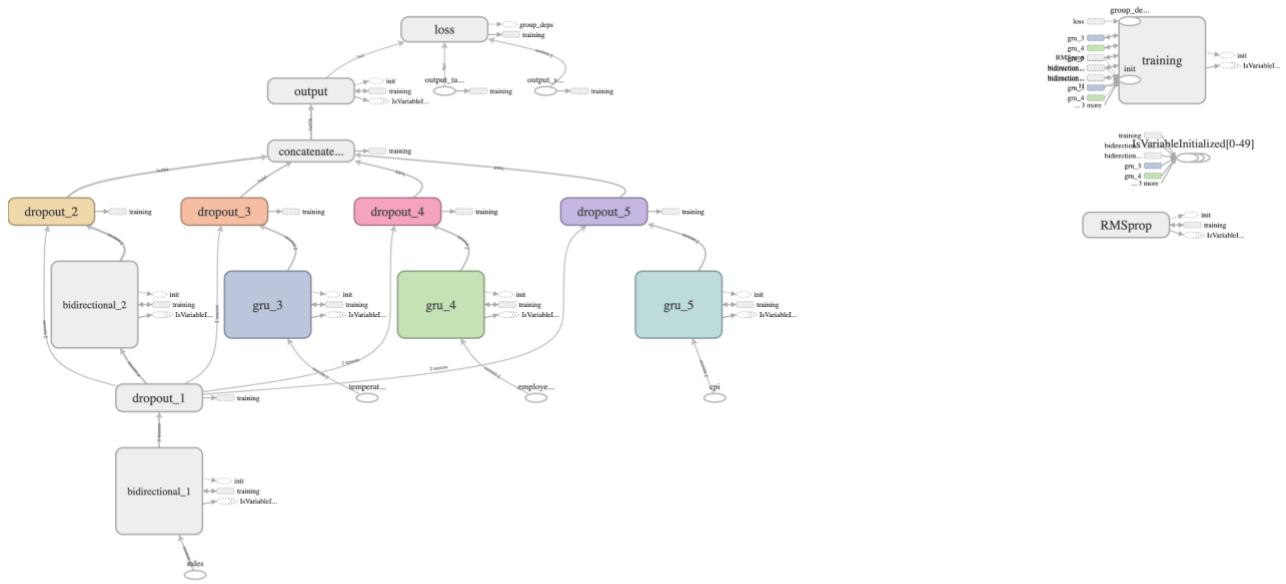
We take the new vehicles' sales from Victoria State's data, the original sales looks like the following.



Then we use the first five years to train the model and use the trained model to predict the last 1 year (also includes some months in 2019). The result looks like the following.



3. GRU Model with Multiple Inputs

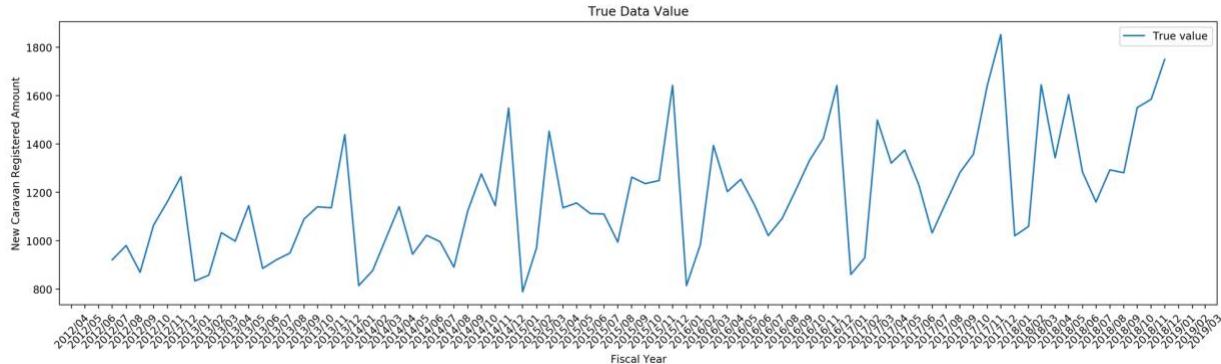


We add employee rate, temperature, and cpi data together with the original sales data to redesign the model. After several tries, we have built the final model like the following.

Layer (type)	Output Shape	Param #	Connected to
sales (InputLayer)	(None, 1, 12)	0	
bidirectional_1 (Bidirectional)	(None, 1, 96)	17568	sales[0][0]
dropout_1 (Dropout)	(None, 1, 96)	0	bidirectional_1[0][0]
cpi (InputLayer)	(None, 1, 1)	0	
bidirectional_2 (Bidirectional)	(None, 384)	332928	dropout_1[0][0]
temperature (InputLayer)	(None, 1, 1)	0	
employee_rate (InputLayer)	(None, 1, 1)	0	
gru_5 (GRU)	(None, 64)	12672	cpi[0][0]
dropout_2 (Dropout)	(None, 384)	0	bidirectional_2[0][0]
gru_3 (GRU)	(None, 64)	12672	temperature[0][0]
gru_4 (GRU)	(None, 64)	12672	employee_rate[0][0]
dropout_5 (Dropout)	(None, 64)	0	gru_5[0][0]
concatenate_1 (Concatenate)	(None, 576)	0	dropout_2[0][0] gru_3[0][0] gru_4[0][0] dropout_5[0][0]
output (Dense)	(None, 1)	577	concatenate_1[0][0]

Total params: 389,089
Trainable params: 389,089
Non-trainable params: 0

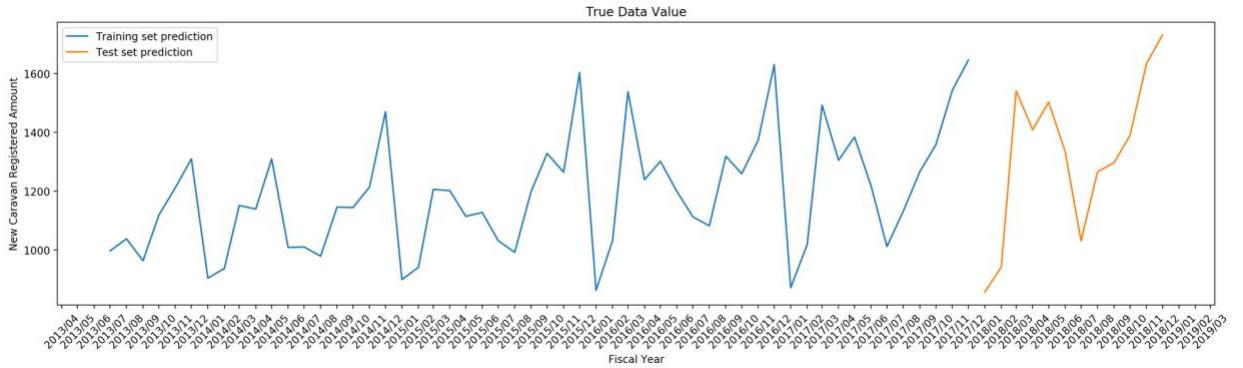
It takes over 380,000 parameters to train the final model. The model concatenates four layers into one dense layer to predict the monthly sales value.



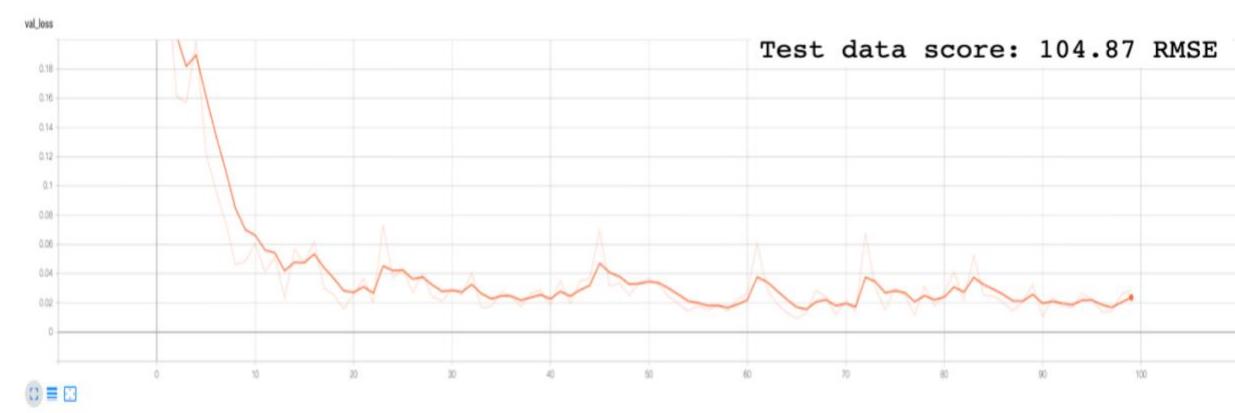
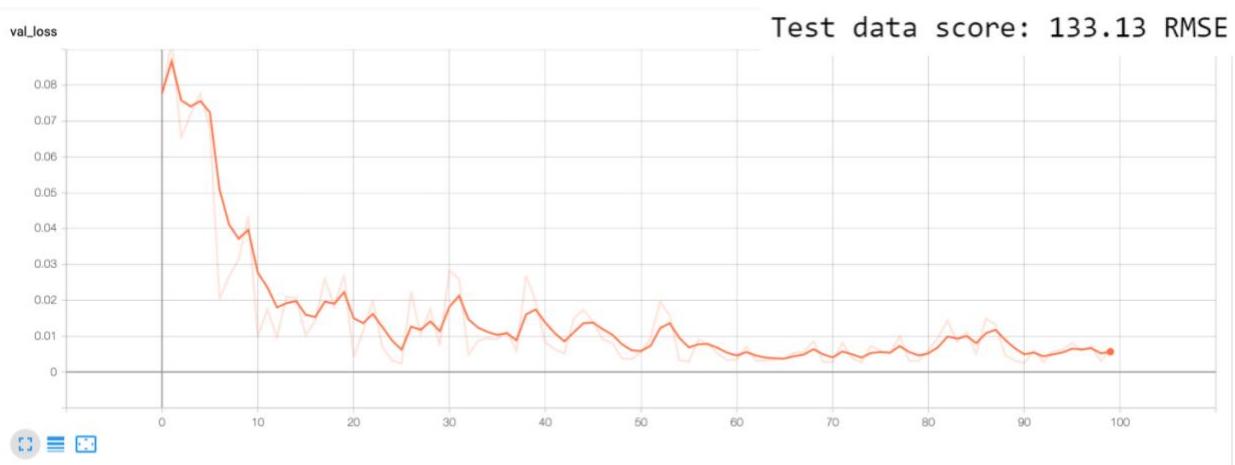
We take the new vehicles' sales from Victoria State's data. Then we use the first five years to train

the model and use the trained model to predict the last 1 year (also includes some months in 2019).

The result looks like the following.



4. Loss Comparison



By evaluating the first single input model, we use root mean squared error, the training data score is

111.83 and the test data score is 133.13. The result is not good, so we start to use our open data to calibrate the model.

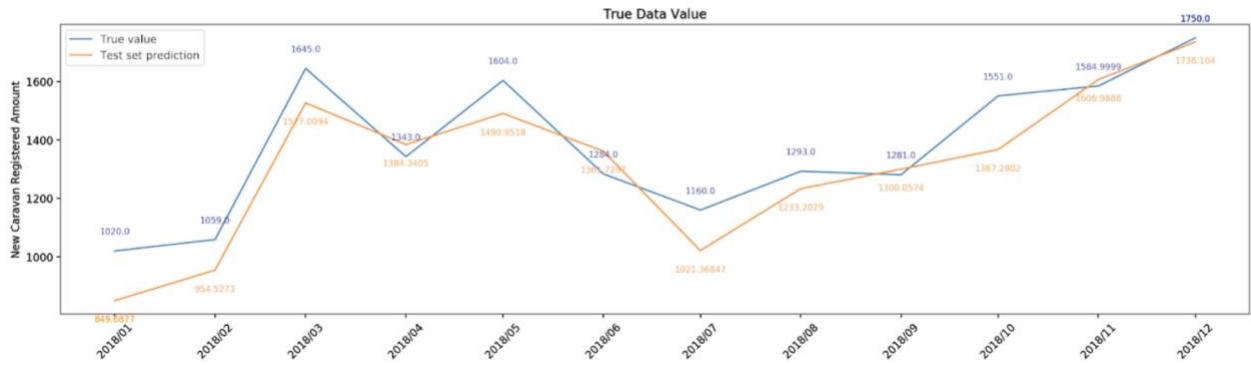
By evaluating the second model with multiple inputs, we can see that the RMSE of training data

goes down to 94.37, and RMSE of the test data goes down to 104.87, it's a 30% decline in the

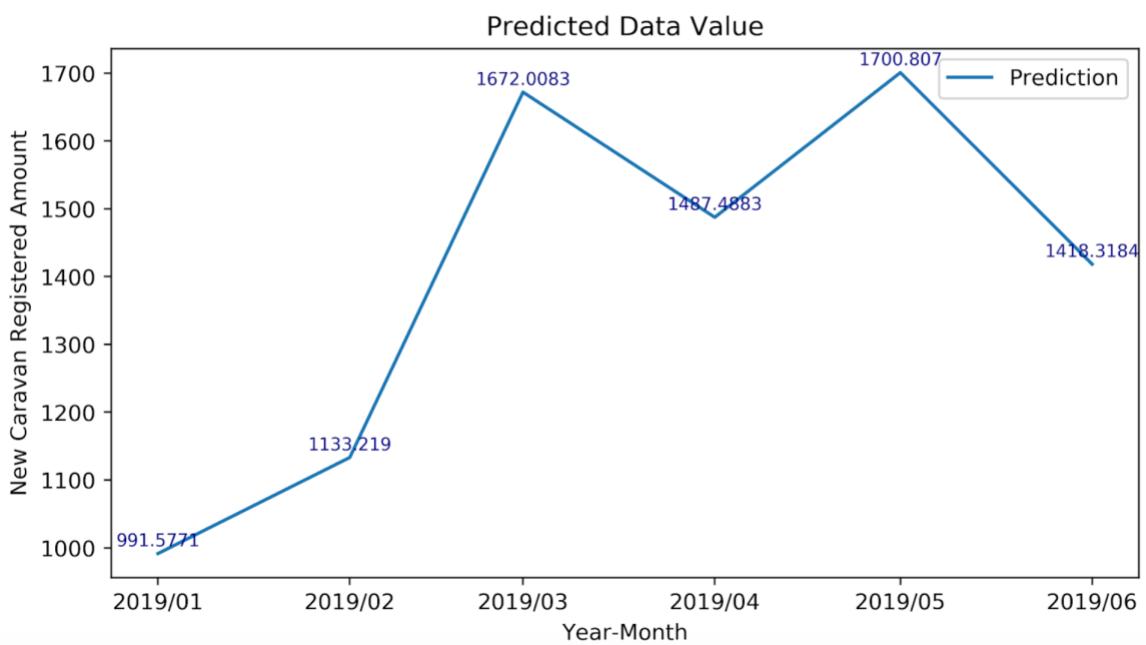
average deviation between true values and prediction values.

5. Further Prediction

First we predict the sales of Caravan in Victoria in year 2018, as we already know the true sales value, we can easily do a comparison between them. The following plot shows the result:



Although the result is still not perfect, we can somehow get some insights of the trend of the change of monthly sales by predicting the sales in the future. The following plot shows the likely sales in Victoria in the first six months in 2019.



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1. List of Selected Bureau Stations of Meteorology

State	Nearest Bureau Station to CBD
Victoria (VIC)	Melbourne (Olympic Park)
Sydney (NSW)	Sydney (Observatory Hill)
Western Australia (WA)	Perth Metro
South Australia (SA)	Adelaide (Kent Town)
Queensland (QLD)	Brisbane
Tasmania (TAS)	Hobart (Ellerslie Road)
Northern Territory (NT)	Darwin NTC AWS

2. Makes combination

{'JAYCOM', 'JAYCOO', 'JAYCO/BAGARA', 'JAYCOCARAVAN', 'JAYCON', 'JAYCOR', 'JAYCO1', 'JAYCO TRAILERS', 'JAYCOP', 'JAYCOTRAILERS', 'JAYCO', 'JAYCOF', 'JAYCO ', 'JAYCOA', 'JAYCOB', 'JAYCOS', '3JAYCO', 'JAYCO ', 'JAYCO CARAVAN', 'JAYCO', 'JAYCO AL-KO', 'JAYCO STIRLING', 'JAYCOCARAVANS', 'JAYCO CARAVANS', 'JAYCOC', 'JAYCOI', 'JJAYCO', 'JAYCOV'}
-> JAYCO

{'COROMC', 'COROMAL CARAVANS', 'COROMEL', 'COROMO', 'COROMAL 615', 'COROMAL CARAVAN', 'COROMI', 'COROMAL', 'COROMB', 'COROMP', 'COROMA', 'COROM', 'COROML', 'COROME', 'COROM '}
-> CORMAL

{'FRONTLINE TOYOTA', 'TALVOR TOYOTA', 'TOYOTA FRONTLINE', 'TOYOTA', 'THL TOYOTA', 'TOYOTA ', 'TOYOTA THL'}
-> TOYOTA

{'VISCN ', 'VISC', 'VISCUT', 'VISCOUNT', 'VISCT ', 'VISCO ', 'VISCON', 'VISCOU', 'VISCOO', 'VISCO', 'VISCOUNT CARAVANS', 'VISCTN', 'VISCT', 'VISCNT', 'VISCOT', 'VISCUN'}
-> VISCOUNT

{"WINDSO", "WINDSOR", "WINDSOR CARAVAN", "WINDSOR CARAVANS", "WINDSP", "WINDSR"}
-> WINDSOR

{"MILLRD", "MILLAD", "MILLAR", "MILLARD", "MILLARD CARAVAN"}
-> MILLARD

{"NISSEN", "NISSAN"}
-> NISSAN

{"CUB", "CUB O ", "CUB KAMPAROO", "CUB CA", "CUB CAMPER", "CUB C ", "CUB SU", "CUB TR", "CUB DR", "CUB O", "CUB CAMPERS", "CUB TRAILERS", }
-> CUB

{"AVAN A", "AVAN CAMPERS", "AVAN CARAVAN", "AVAN FIAT", "AVAN CARAVAN", "AVAN CAMPERS (A'VA)", "AVAN CARAVANS", "AVAN C", "AVAN CARAVANS", "AVAN ", "AVAN", "AVAN CAMPERS", "AVAN ", "AVAN CAMPER"}
-> AVAN

{"HOMEMADE", "HOME-M", "HOME MADE", "HOME-B", "HOME M", "HOME-BUILT", "HOME-MADE", "HOME B"}
-> HOMEMADE

{'FORD', 'FORDS ', 'FORDSO', 'FORDSON', 'KMC FORD', 'SUNLINER FORD', 'TALVOR FORD'}
-> FORD

{'ADRIA FIAT', 'AVAN FIAT', 'AVIDA FIAT', 'FIAT', 'FIATAG', 'ROLLERTEAM FIAT', 'WINNEBAGO FIAT'}
-> FIAT

{'ROMA', 'ROMA C', 'ROMA CARAVAN', 'ROMA CARAVANS', 'ROMAD', 'ROMAD '}
-> ROMA

{'REGENT', 'REGENT CARAVAN', 'REGENT CARAVANS'}
-> REGENT

Delete 'CAMPER' 'CARAVAN' in make names. For example, replace "TOYOTA CARAVAN" with "TOYOTA".

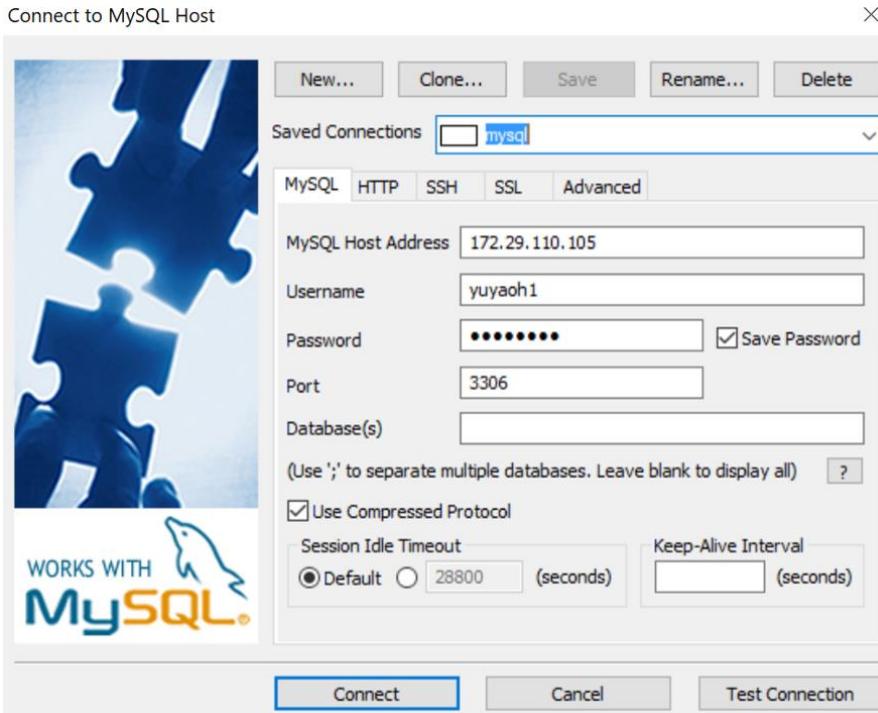
3. Definition of Age Groups in Population

The population of Australia shows a steady rise in the last 5 years. The age groups in the population dataset are defined with the following assumptions to fit the analysis purpose in this report:

- Toddlers: The population that is between the age range 0 to 6 years old. These age ranges include newborns and children that are enrolled in pre-school.
- Adolescents: The population that is between the age range 7 to 17 years old. People in this age group are teenagers who are legally dependent on their parents. Most of the population can be characterized as school-going.
- Early Adulthood: The population that is between the age range 18 to 30 years old. Age 18 years marks the legal age to drive in Australia. This age group is characterized by young professionals and University students who are starting out their careers, so they may also be looked upon as a price-sensitive customer group.
- Settled Workforce: The population that is between the age range 31 to 65 years old. This age group starts from people who may have started settling down. In Australia, the mean age for people to marry is 32 (Males) and 30.5 (Females).
- Retired: The population that is beyond the age of 65 years. This population is slowly retiring from their workforce. The segment is supported by the pension, insurance schemes, and usually support themselves through retirement funds and savings.

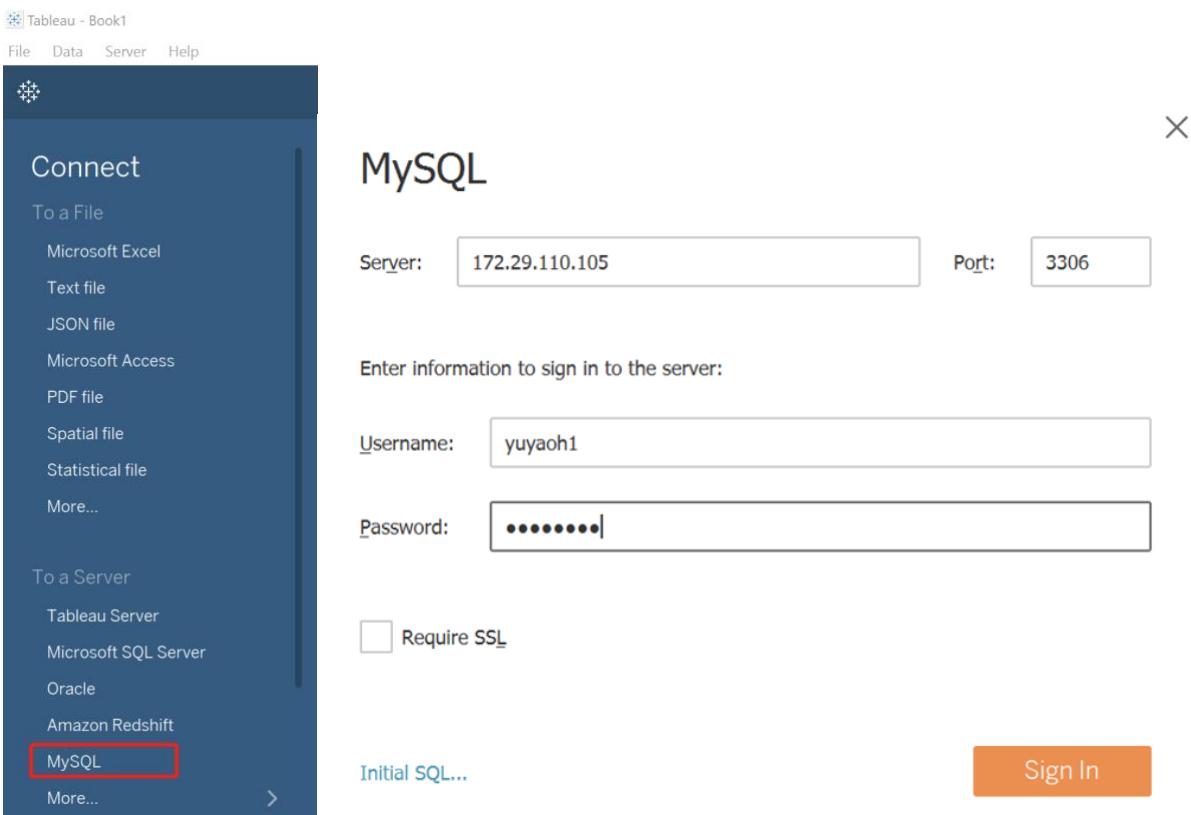
4. Presentation of Connecting Data Warehouse with Multiple Tools

- **MySQL Host**



- **Tableau**

To load the data source, go to the ‘connect’ menu, choose MySQL in the list of ‘To a Server’.



- **Jupyter Notebook**

```

import mysql.connector
conn = mysql.connector.connect(host = "172.29.110.105", port = "3306", user = "yuyaoh1",
                                password = "Password", database = "Caravan Industry Association of Australia")

```

5. Calculation of Seasonality Range & Trend Growth Rate

Seasonality Range in Multiple States

State	Min Seasonality	Max Seasonality	Seasonality Range
NSW	1.12	0.86	0.26
NT	1.34	0.70	0.64
QLD	1.14	0.78	0.36
SA	1.15	0.93	0.22
TAS	1.24	0.86	0.38
VIC	1.44	0.53	0.91
WA	1.10	0.93	0.17

Trend Growth Rate in Multiple States

State	Start of Trend	End of Trend	Growth Rate
NSW	12,500	16,246	30.0%
NT	201	272	35.4%
QLD	14,008	18,143	29.5%
SA	5,671	7,526	32.7%
TAS	1,511	1,840	21.8%
VIC	12,092	14,228	17.7%
WA	7,160	9,369	30.8%

6. Caravan Registration Trend

Registration Trend



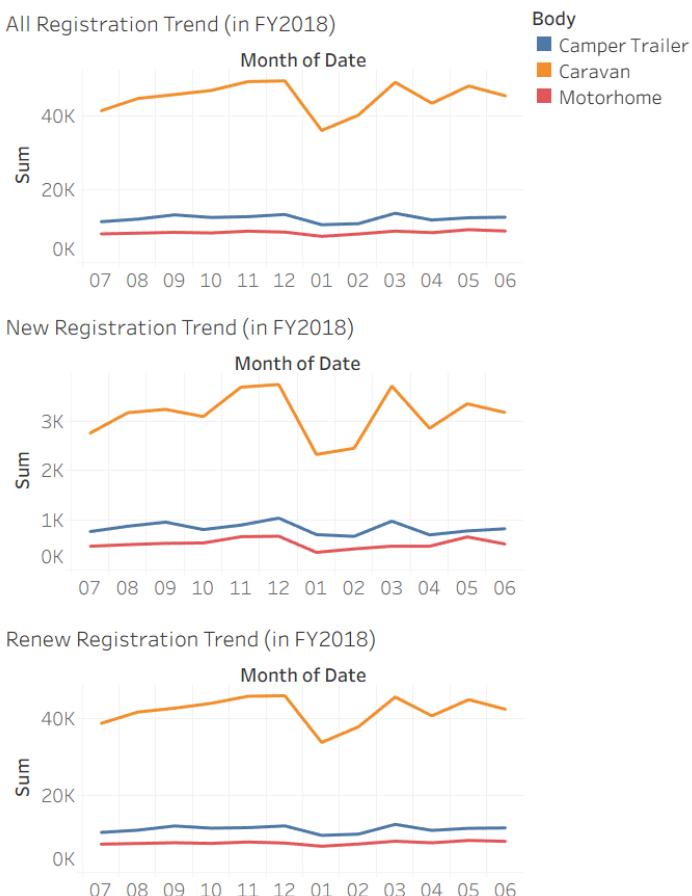
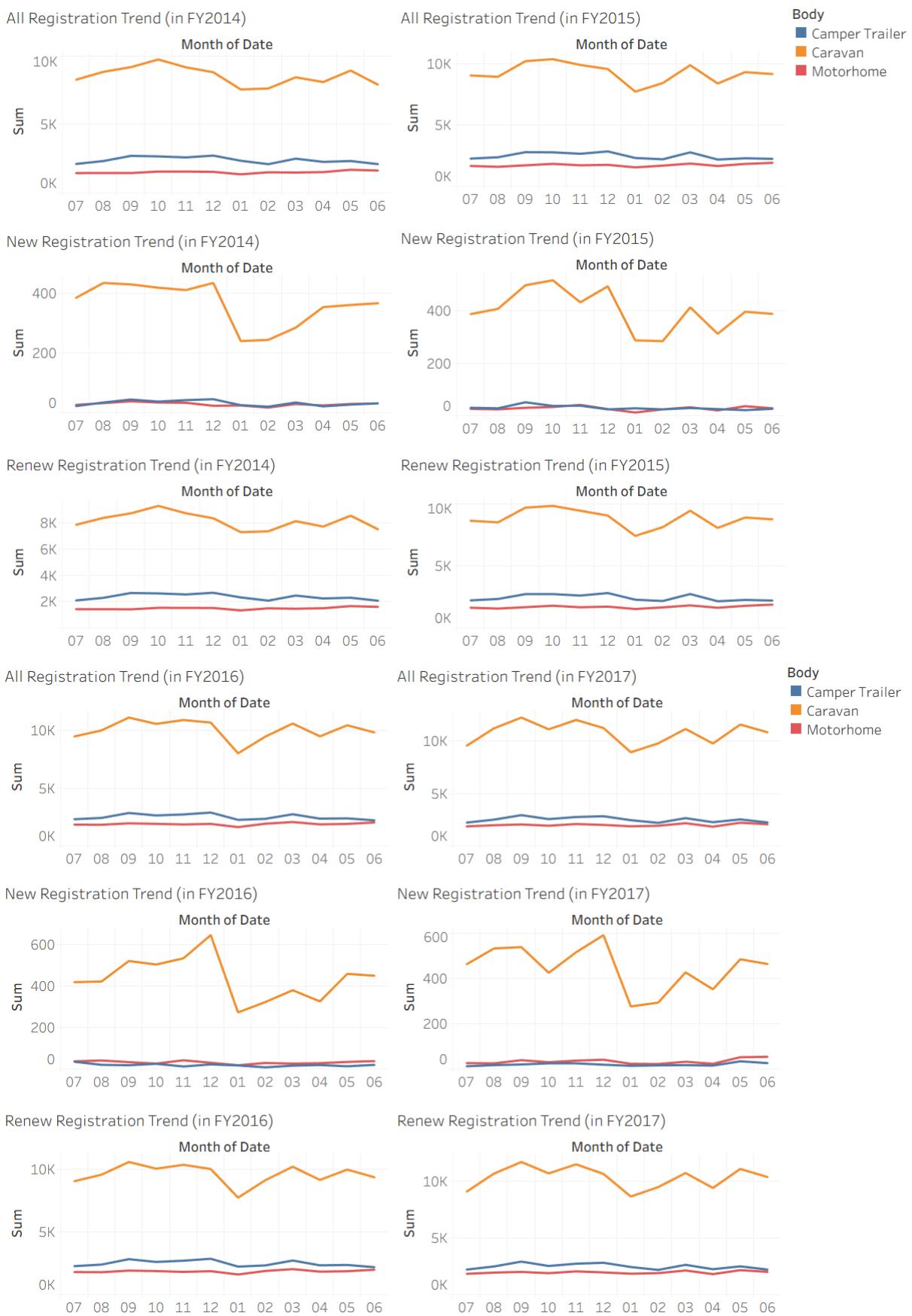
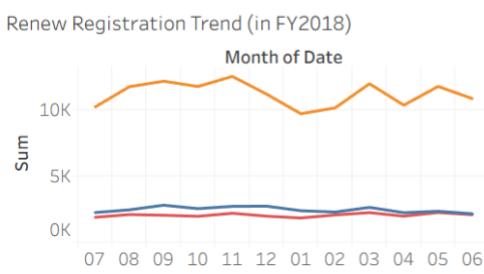
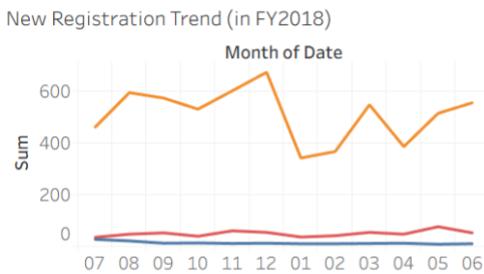
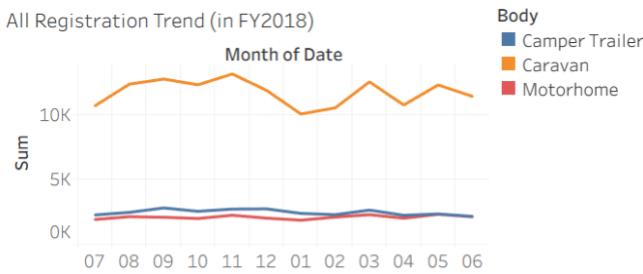


Figure - National Registration Trend by Body

For **NSW**, the number of new registrations for the caravan is low in Jan. and Feb, and high in Nov. and Dec. The trend of the motorhome is increasing slowly. The trend of camper trailer is decreasing slowly. The trend of renewing registration is similar to the trend of new registration.

Figure - Registration Trend by Body in NSW

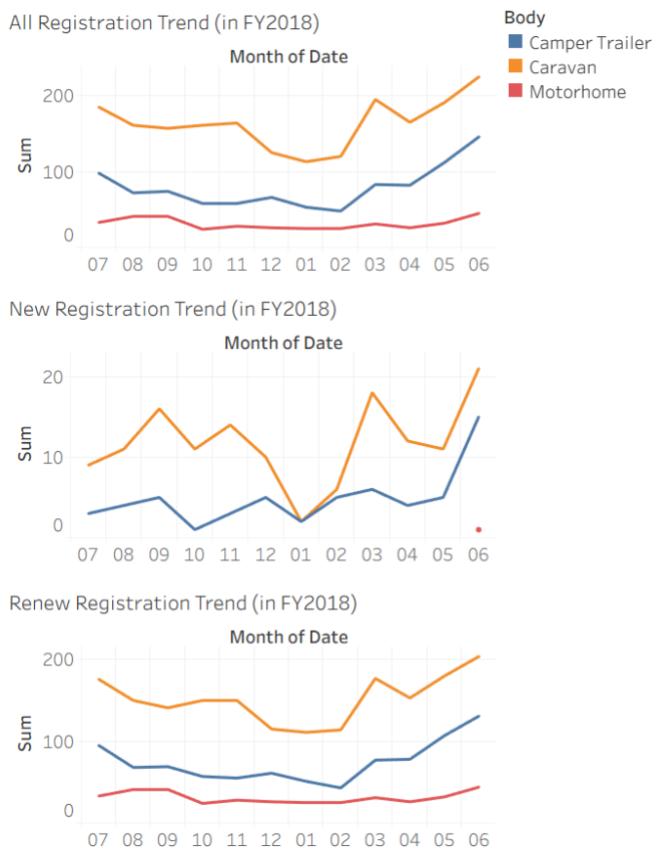




For NT, the sample size of new registrations is too small and there is no significant trend. As for renew registrations, the peak is in June, and the bottom is in January and February for both caravan and camper trailer. For motorhome, the peak is in September.

Figure - Registration Trend by Body in NT

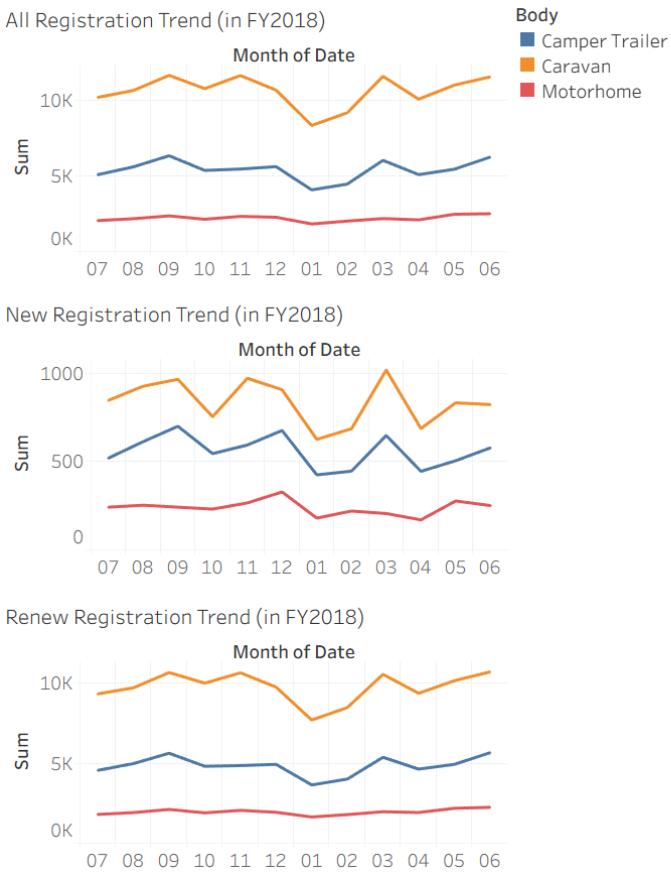




For QLD: The number of new registrations is low in Jan. and Feb, high in Nov. and Dec. There are four peaks (Mar., June, Sep., and Nov.) for renew registrations of caravan. There are three peaks (March, June, and September) for renew registrations of camper trailer. Renew registrations of motorhome did not change much.

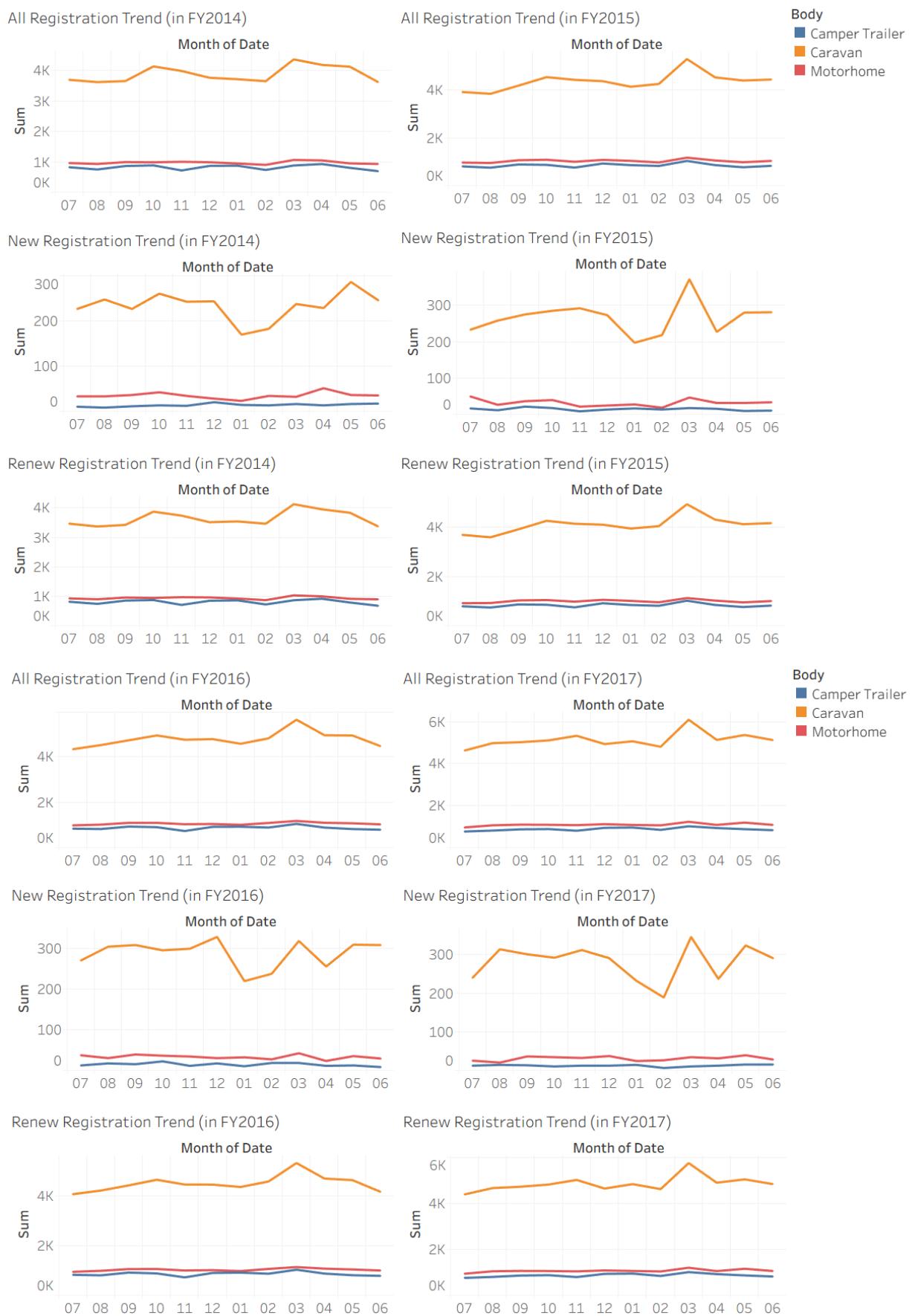
Figure - Registration Trend by Body in QLD

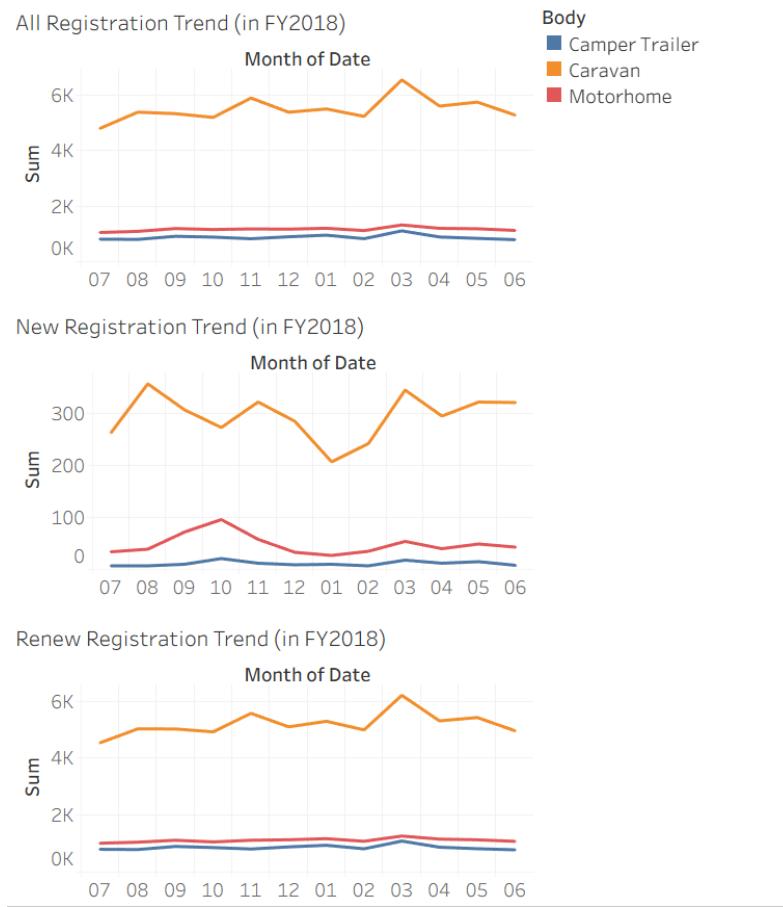




For **SA**, there is no significant trend for new registrations. The registration number is always fluctuating. There is a peak in October 2017 for the motorhome. For renew registrations, the peak is in March, and the bottom is in June. TAS and SA are the only states where the number of registrations of motorhome exceeds the number of registrations of camper trailer.

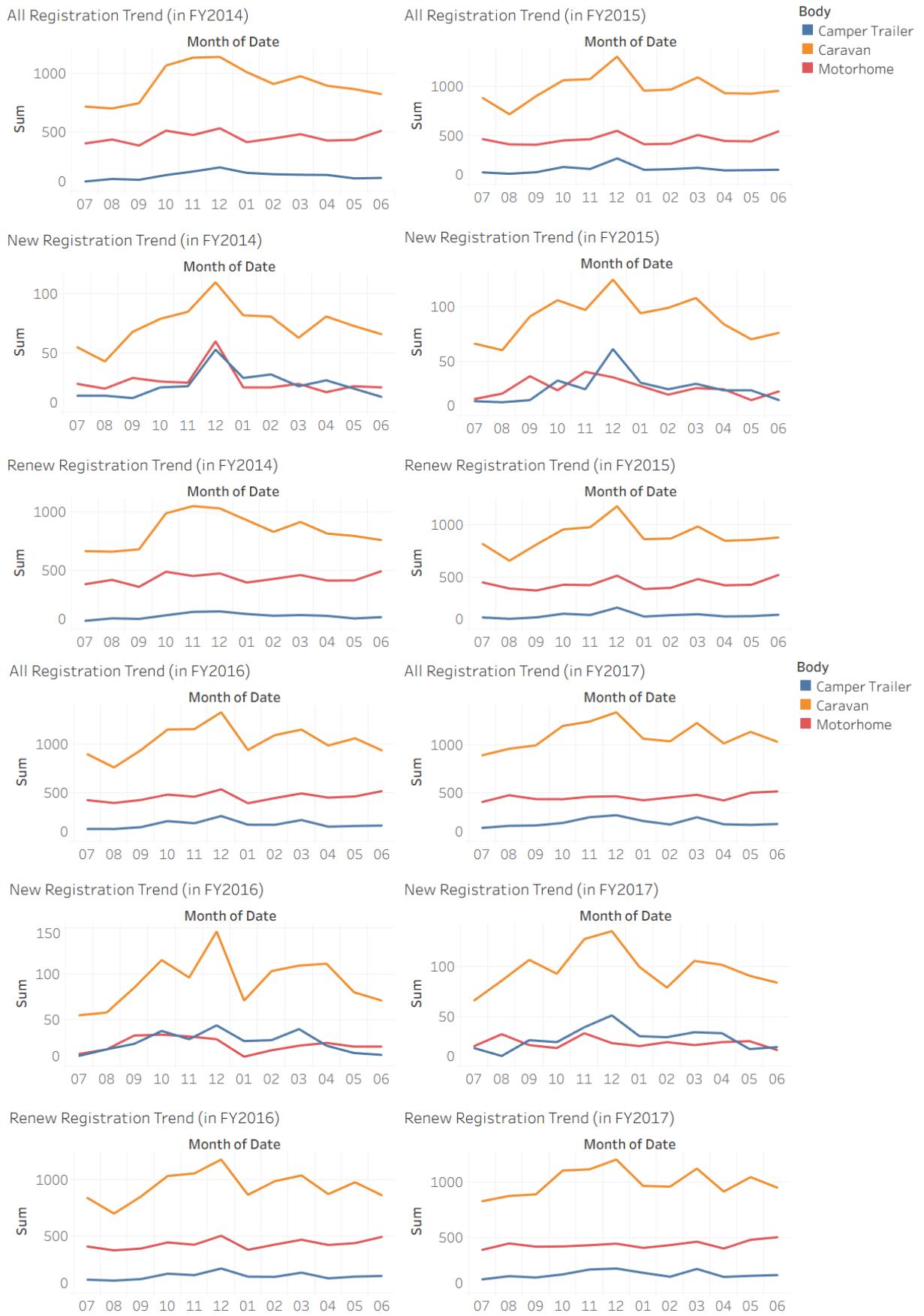
Figure - Registration Trend by Body in SA

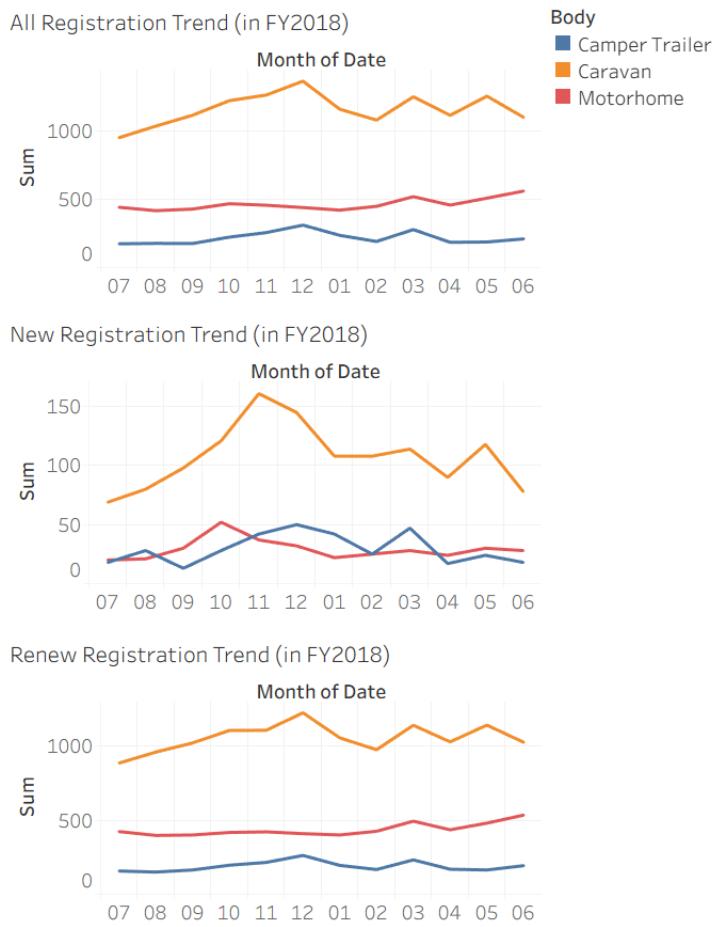




For TAS, the peak of new registrations is in December in each year, and the bottom is in August in each year. The trend is similar for the three body types. The peaks of caravan renew registrations are at December, March, and May. The peaks of motorhome renew registrations are in March and June. The peaks of camper trailer renew registrations are in March and December. TAS and SA are the only states where the number of registrations of motorhome exceeds the number of registrations of camper trailer.

Figure - Registration Trend by Body in TAS





For **VIC**, the number of new registrations of caravan is low in Jan and Aug., and high in Dec. For motorhome, the peak is in April and November, and the bottom is from June to August. Camper trailer registrations do not change much. For renew registrations, the peak is in December, and the bottom is in January. Other months the number of renewing registrations does not change much.

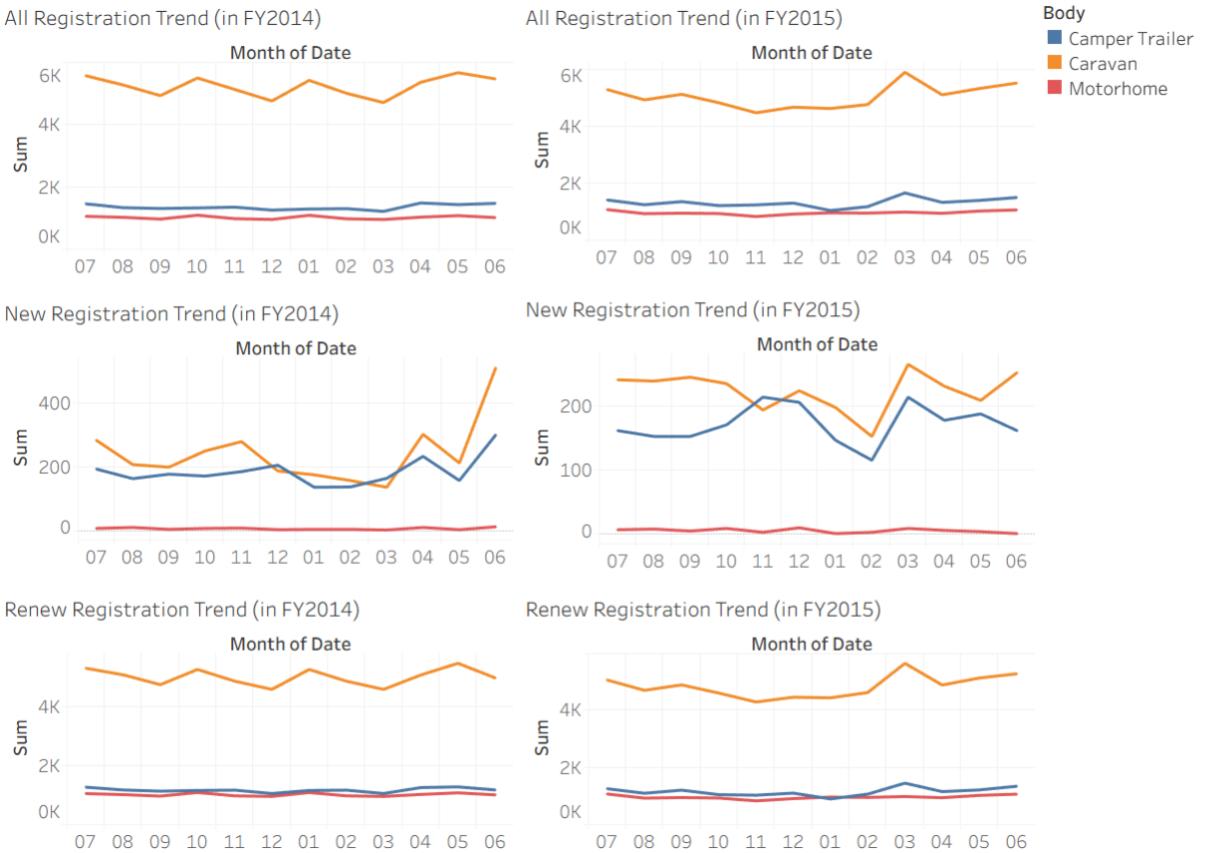
Figure - Registration Trend by Body in VIC

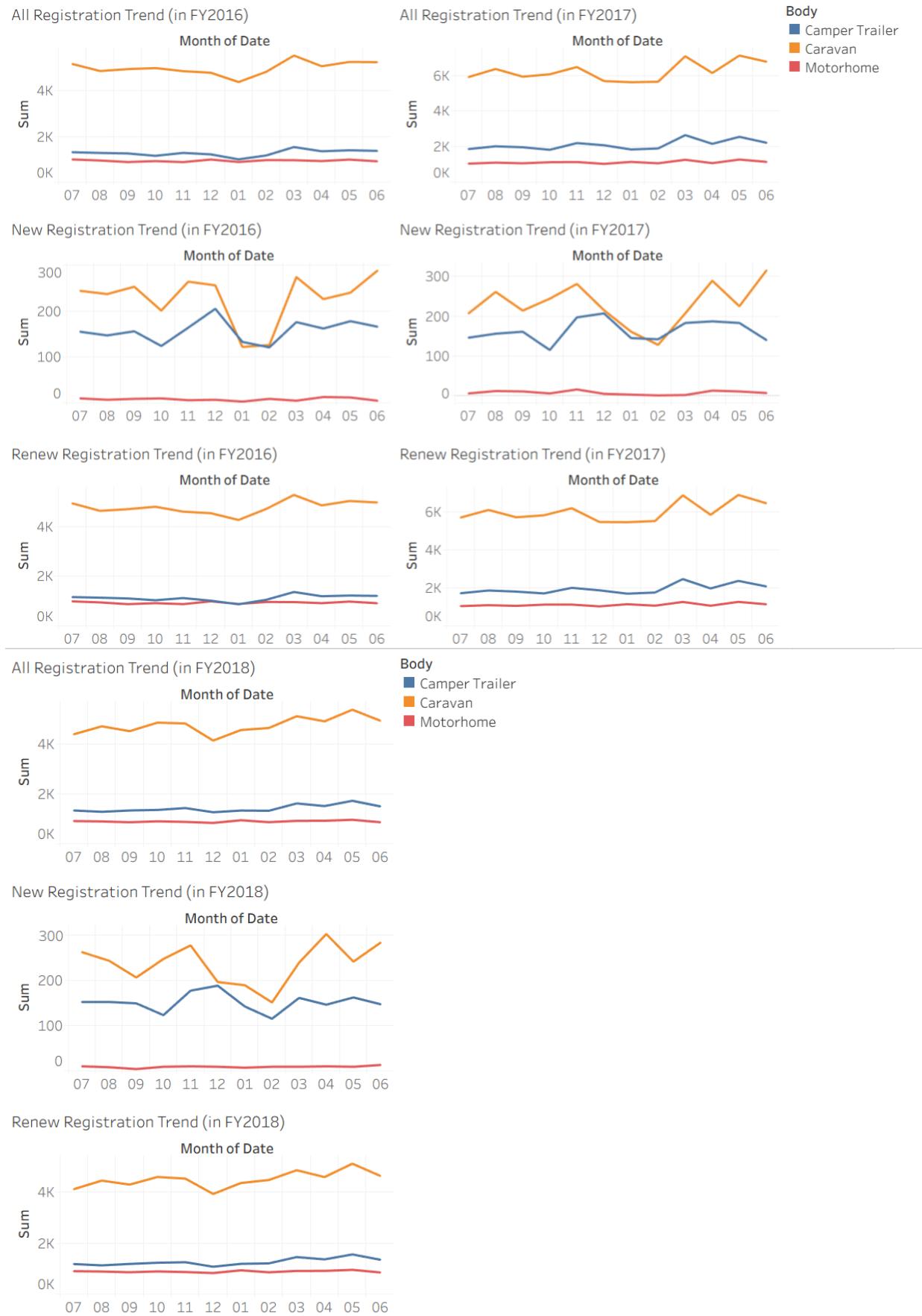




For WA, there is an extreme value in June 2014 of new registrations. For caravan, the bottom of new registrations is around March, and in other times the number of registrations is larger. Camper trailer's trend is similar to the caravan, but there is another bottom in October. The registration number of Motorhome does not change much. For renew registrations, the number of registrations dropped sharply from June to July in 2017.(For example, there are 6k caravan renew registrations in June and only 4k caravan registrations in July.)

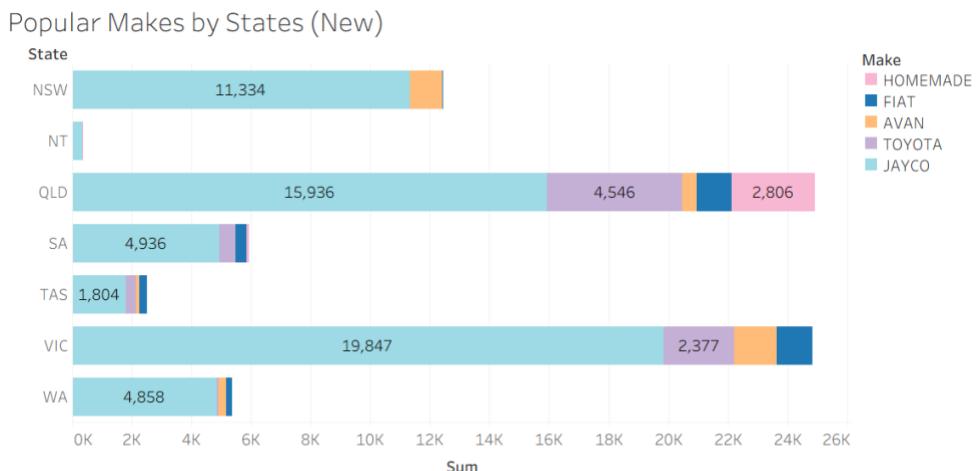
Figure - Registration Trend by Body in WA





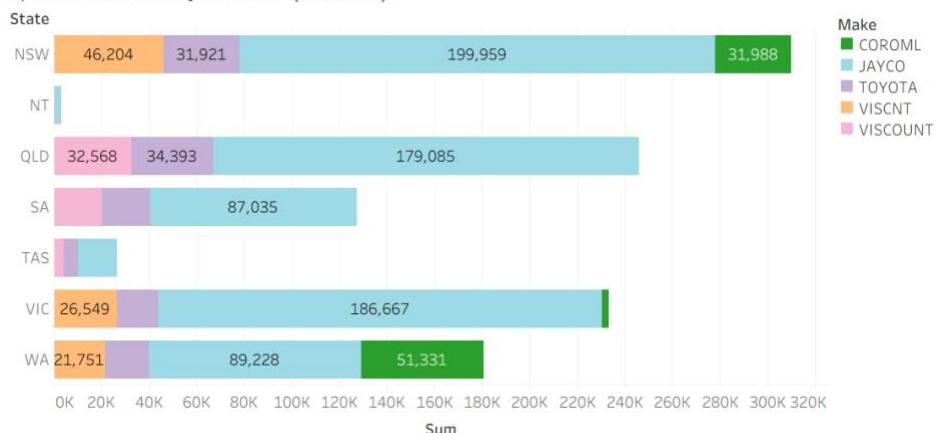
Popular Makes by States

Figure - Popular Makes by States



Sum of Sum for each State. Color shows details about Make. The marks are labeled by sum of Sum. The view is filtered on Make, which has multiple members selected.

Popular Makes by States (Renew)

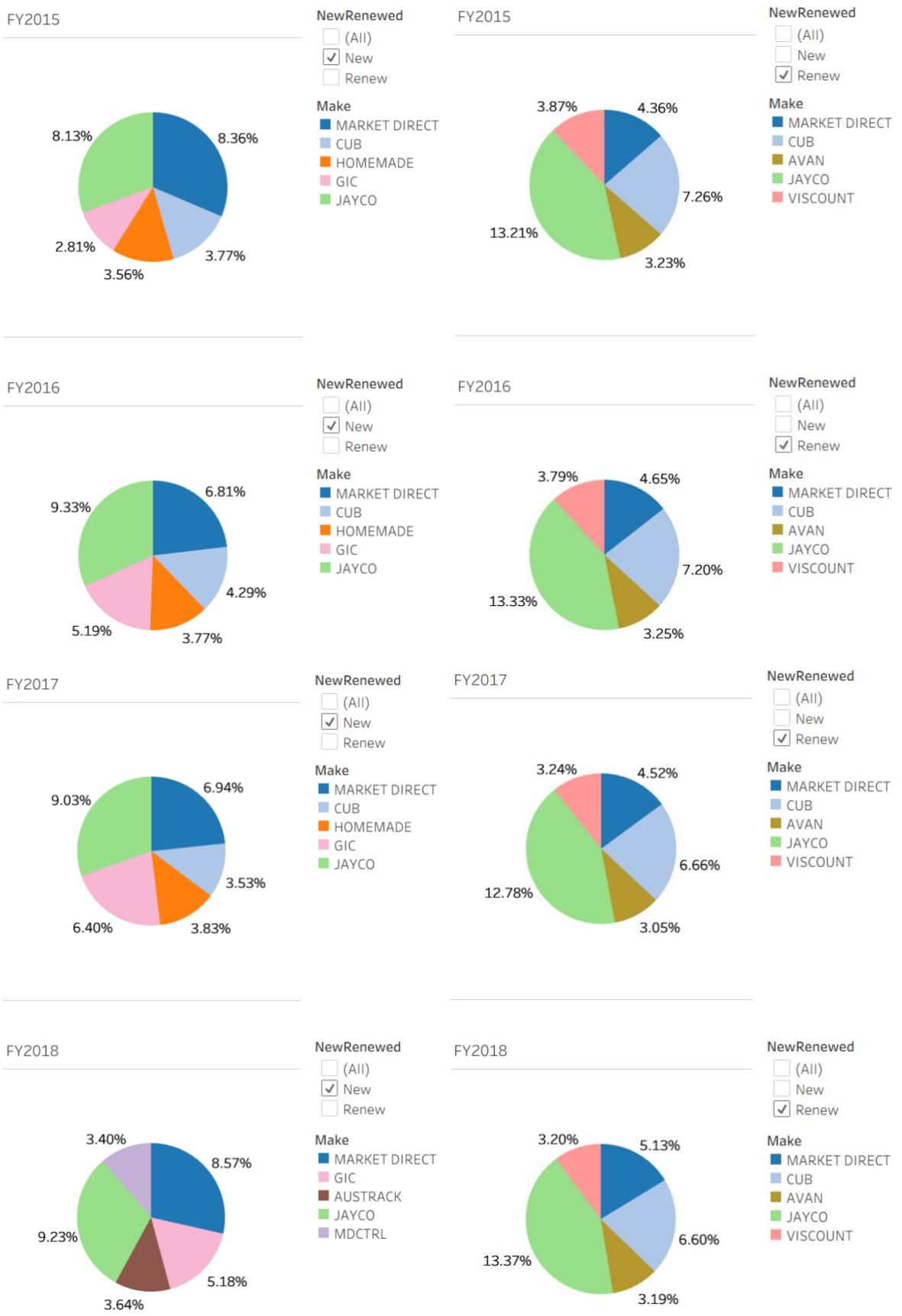


Sum of Sum for each State. Color shows details about Make. The marks are labeled by sum of Sum. The view is filtered on Make, which has multiple members selected.

Market Share of Popular Makes

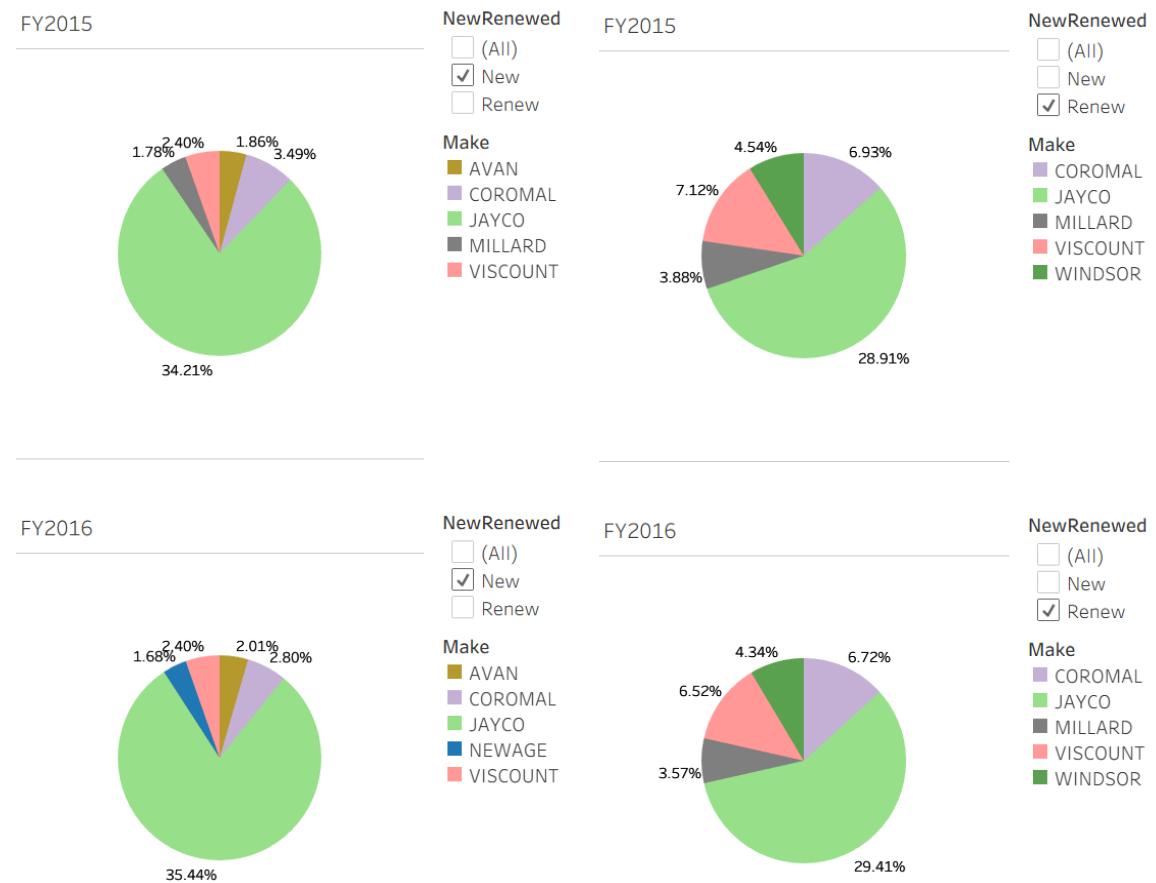
For **National**, top 5 popular makes for new registrations of camper trailers were same from FY2015 to FY2017, but AUSTRACK and MDCTRL replaced HOMEMADE and CUB in FY2018. Top 5 popular makes for renew registrations of camper trailers did not change during the four fiscal years.

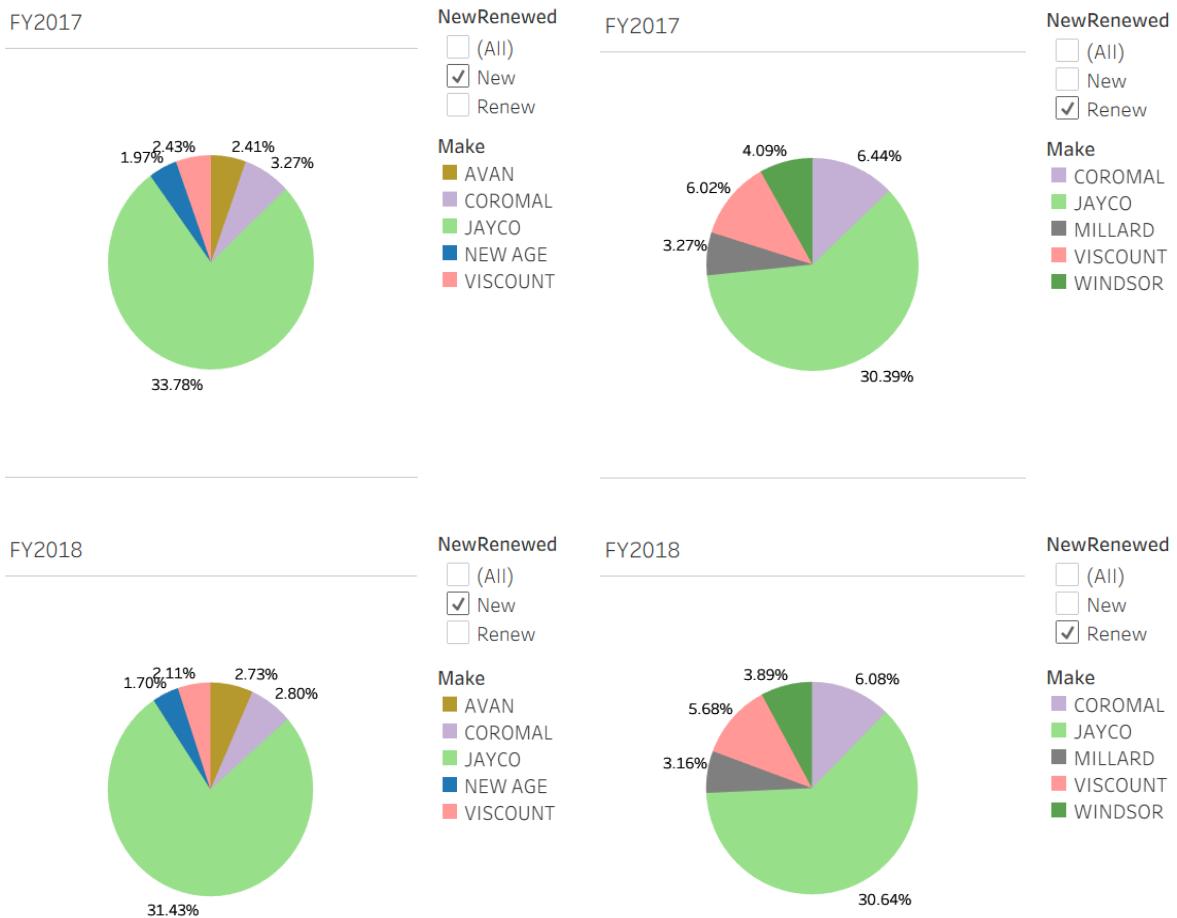
Figure - Market Shares of Top 5 Camper Trailer Makes (National)



JAYCO is the most popular make for caravans and the number of registrations is much larger than other makes. Top 5 popular makes for new registrations of caravans were same from FY2016 to FY2018. MILLARD was replaced by NEW AGE in FY2016. Top 5 popular makes for renew registrations of caravans did not change during the four fiscal years.

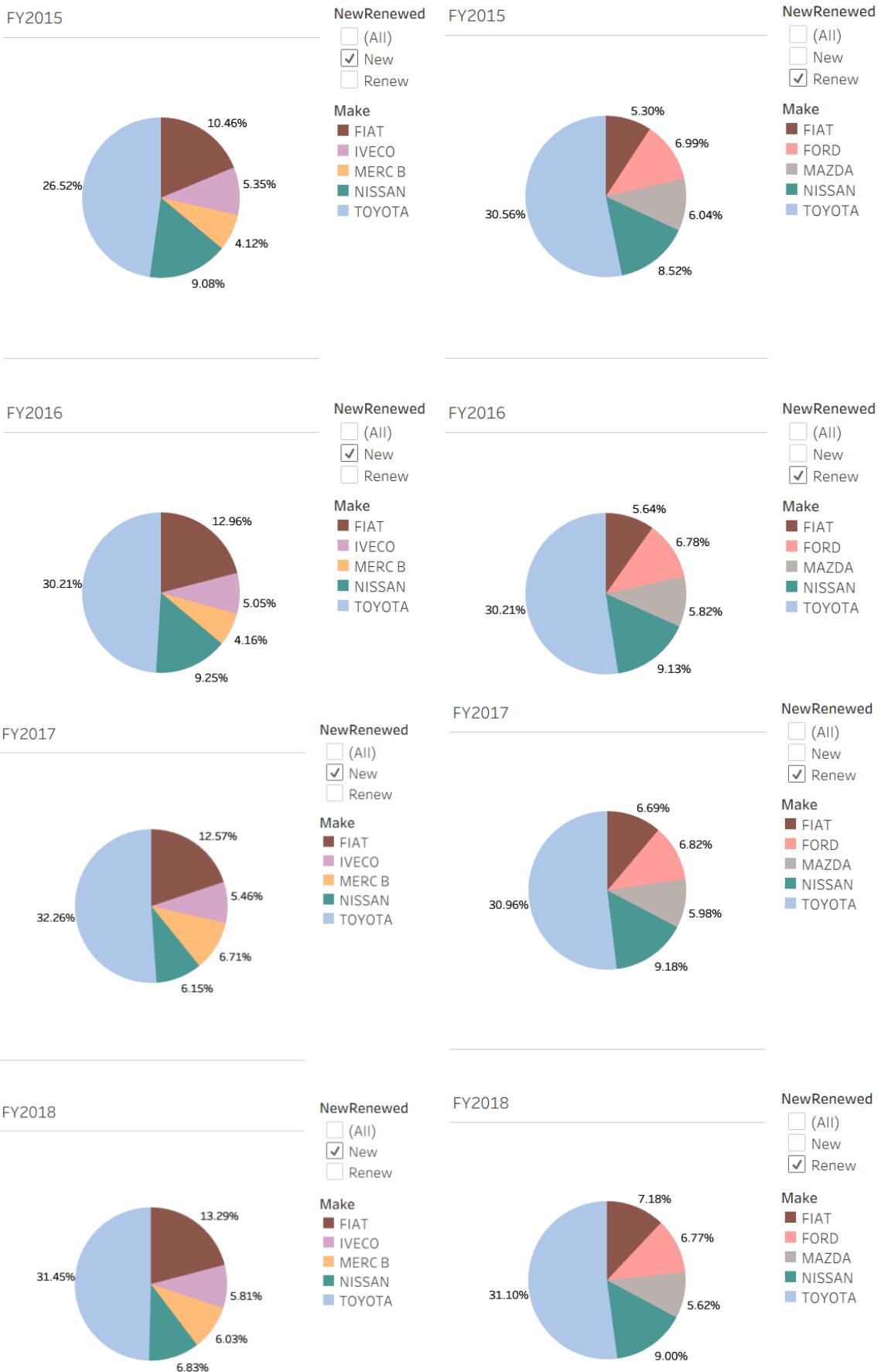
Figure - Market Shares of Top 5 Caravan Makes (National)





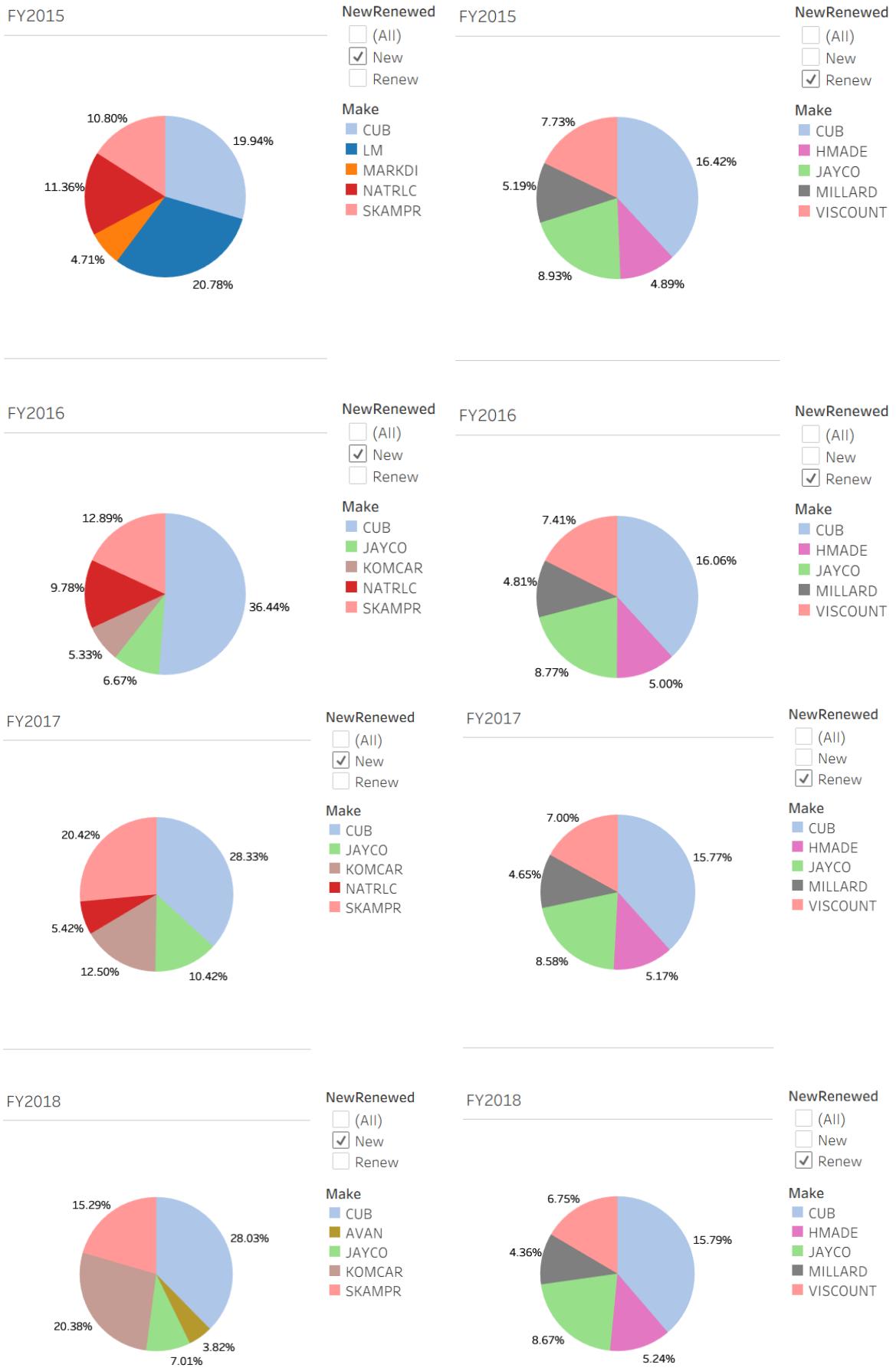
TOYOTA is the most popular make for motorhomes and the number of registrations is much larger than other makes. Top 5 popular makes for new and renew registrations of motorhomes were almost the same. MERC B was replaced by FORD in renew registrations. Top 5 popular makes for new and renew registrations of motorhomes did not change during the four fiscal years.

Figure - Market Shares of Top 5 Motorhome Makes (National)



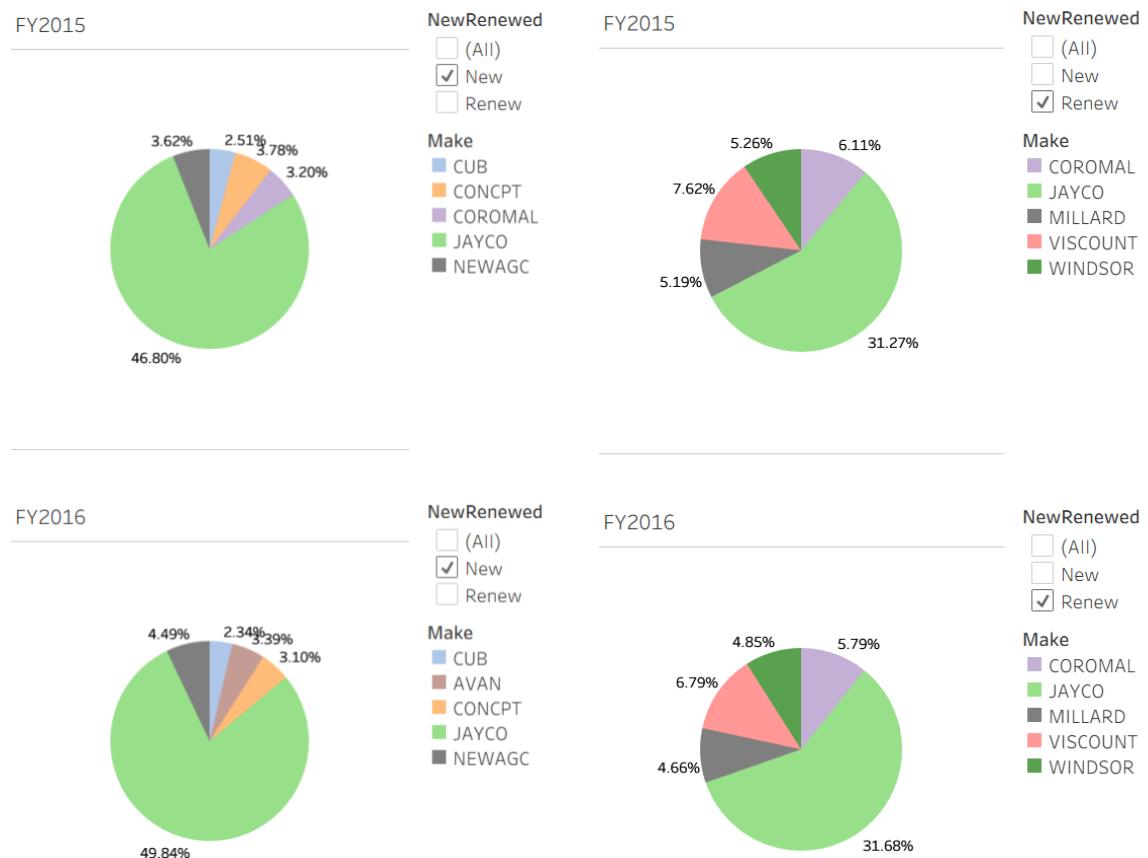
For **NSW**, the market share of KOMCAR in new registrations of camper trailers grew very fast. It was not in the top 5 makes in FY2015, but became the second most popular make and occupied 20.38% market share in FY2018. Top 5 popular makes for renew registrations of camper trailers in NSW did not change much.

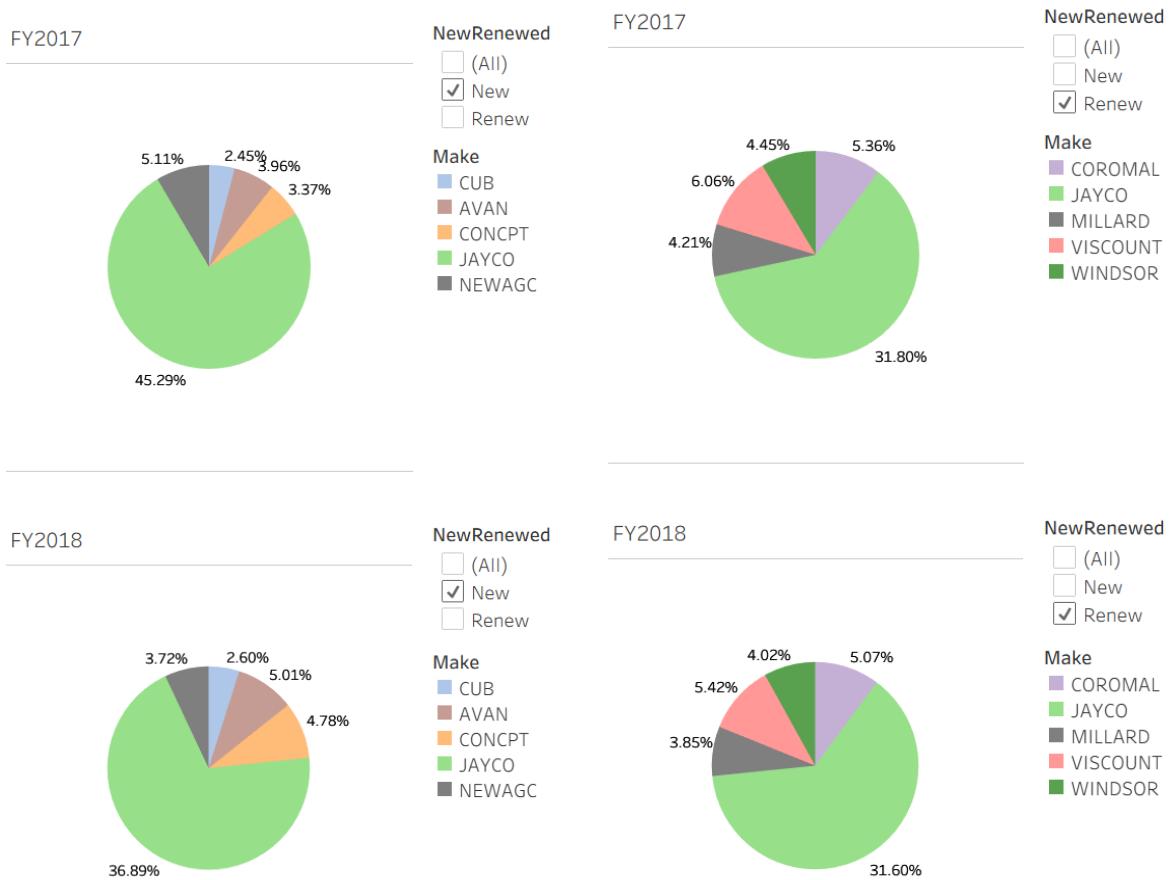
Figure - Market Shares of Top 5 Camper Trailer Makes (NSW)



Top 5 popular makes for new and renew registrations of caravans in NSW did not change much.

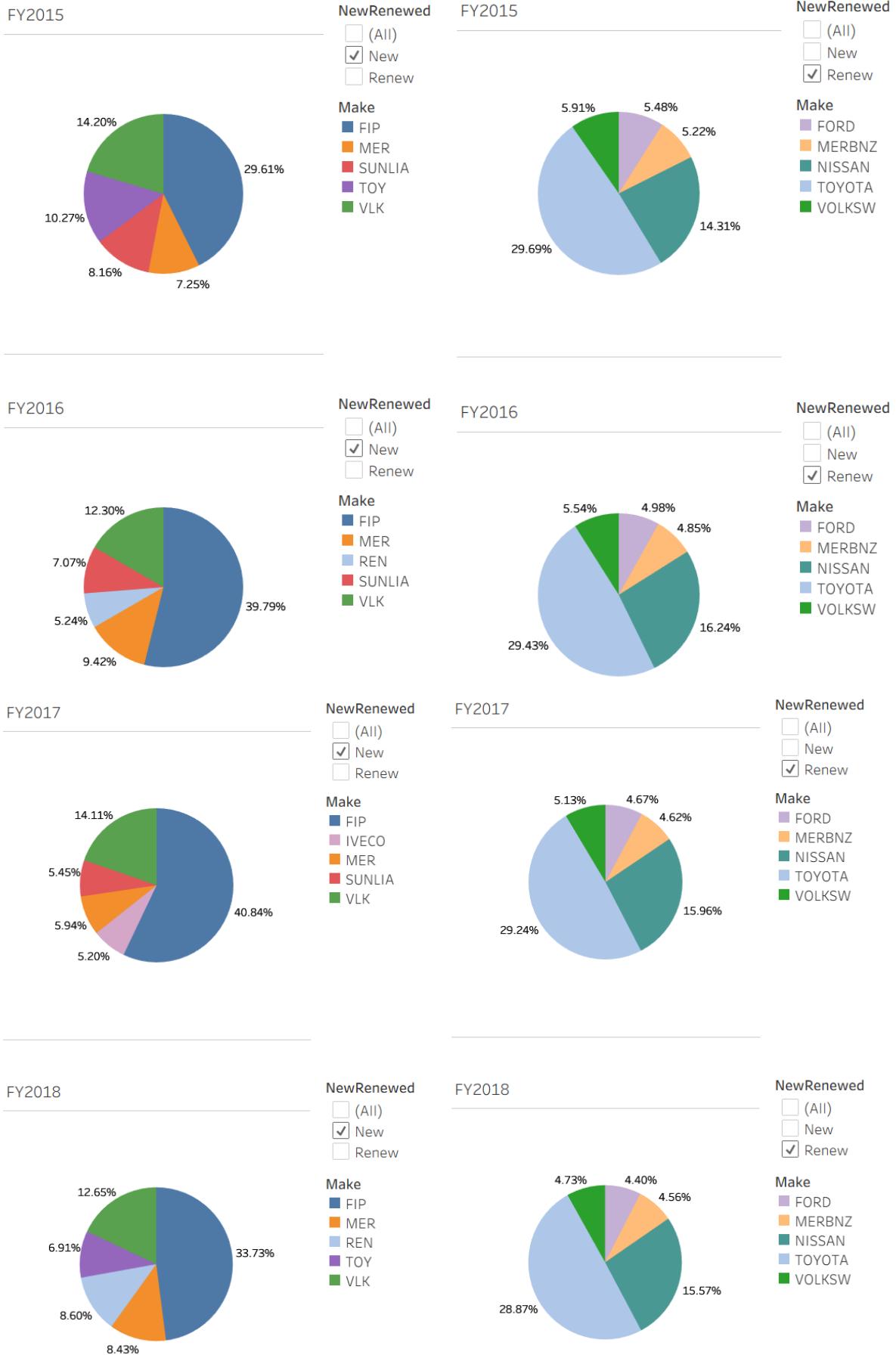
Figure - Market Shares of Top 5 Caravan Makes (NSW)





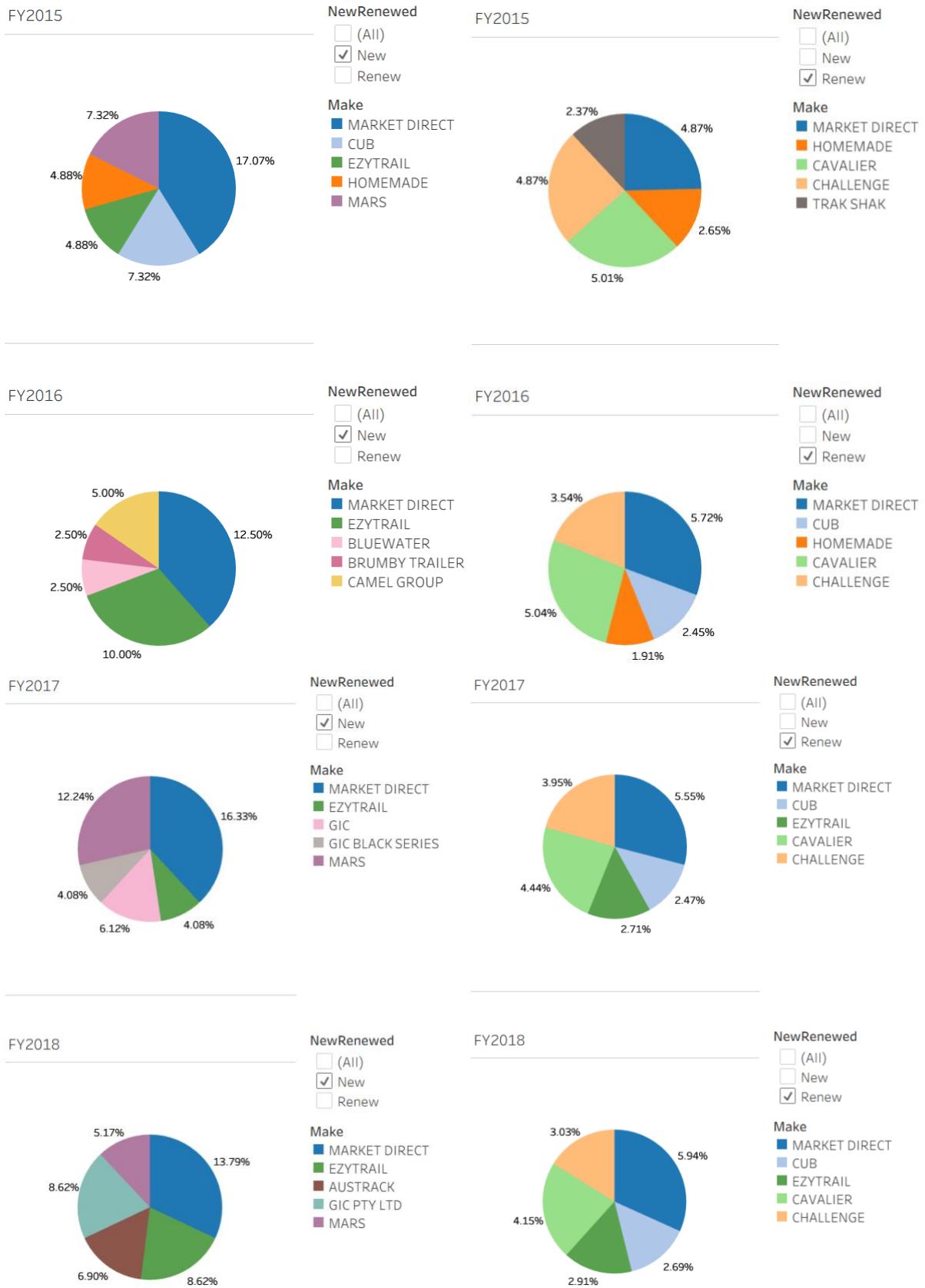
Top 5 popular makes for new and renew registrations of motorhomes in NSW did not change much. FIP is the most popular make for new registrations, and TOYOTA is the most popular make for renew registrations.

Figure - Market Shares of Top 5 Motorhome Makes (NSW)



For **NT**, the new registration number of top 5 popular makes of camper trailers are smaller than 10. Top 5 makes changed every fiscal year, but it does not make much sense because the number is too small. Top 5 popular makes for renew registrations of camper trailers in NT did not change much.

Figure - Market Shares of Top 5 Camper Trailer Makes (NT)



The most popular make for new and renew registrations of caravans is JAYCO in NT. The market share of other makes is also quite small.

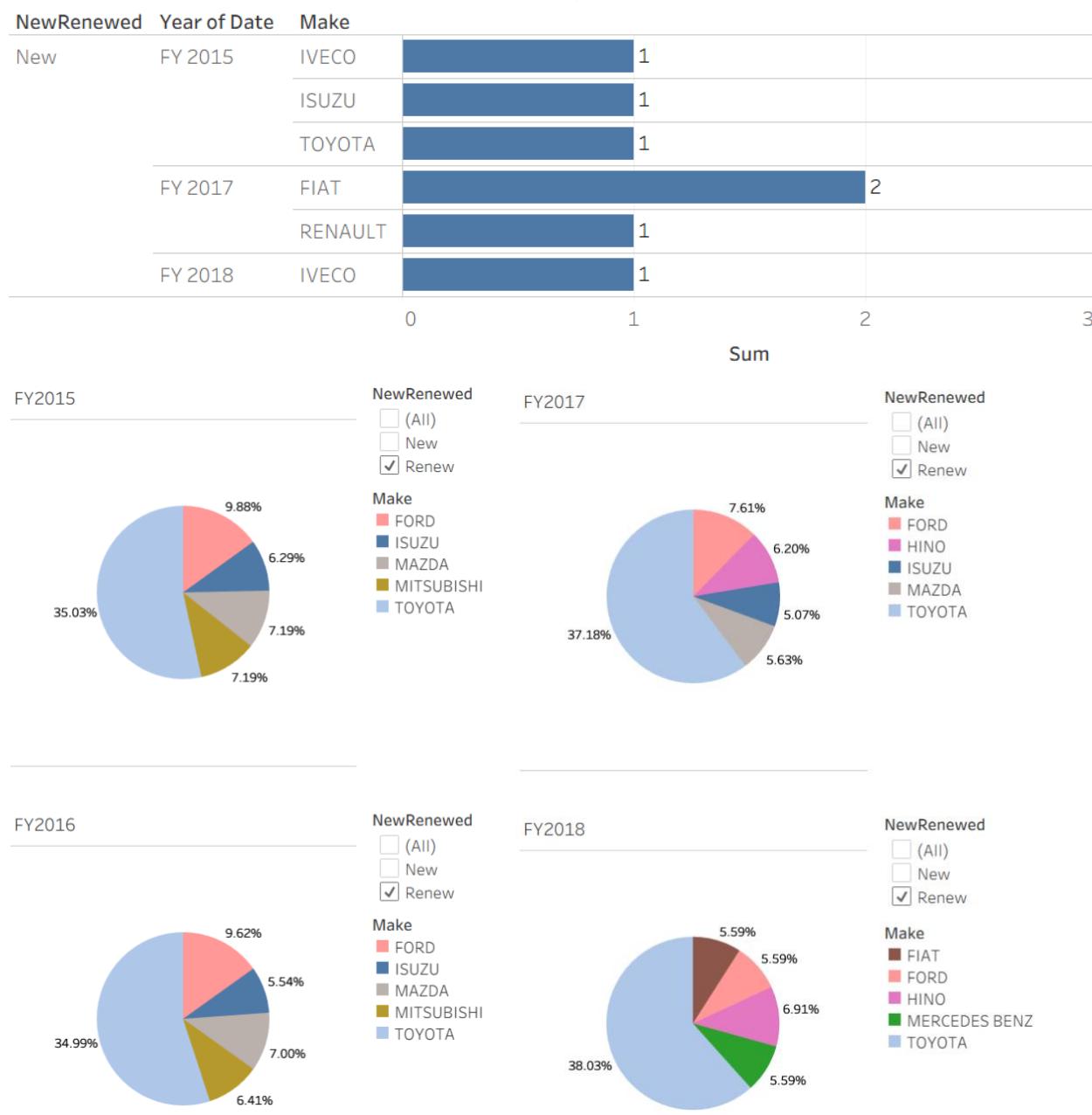
Figure - Market Shares of Top 5 Caravan Makes (NT)



The number of new registrations of motorhomes in NT was too small. It does not make much sense to draw pie charts to show market shares, so we drew a bar chart instead. For renew registrations, TOYOTA is the most popular make.

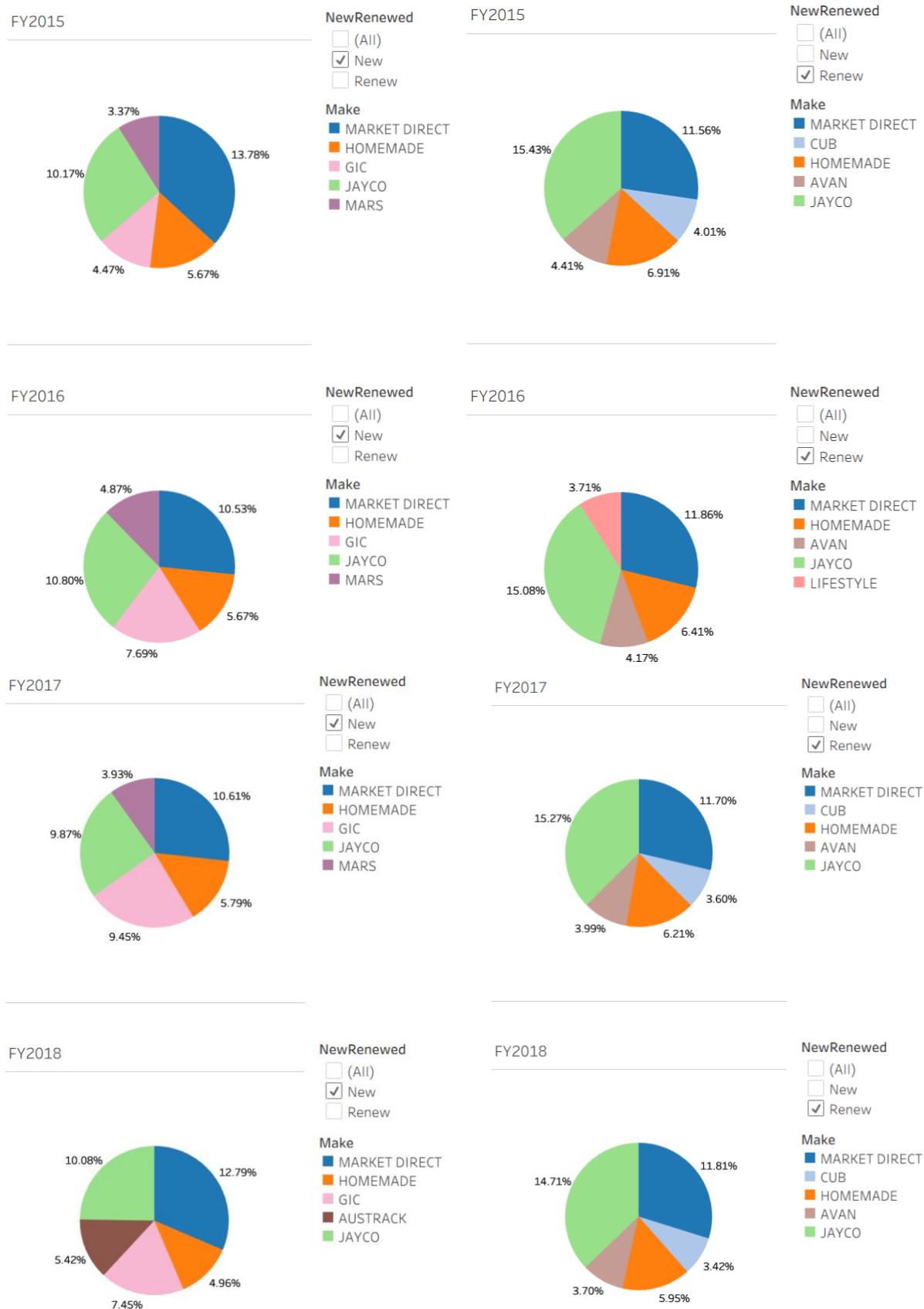
Figure - Market Shares of Top 5 Motorhome Makes (NT)

New Registrations of Motorhomes by Make in NT



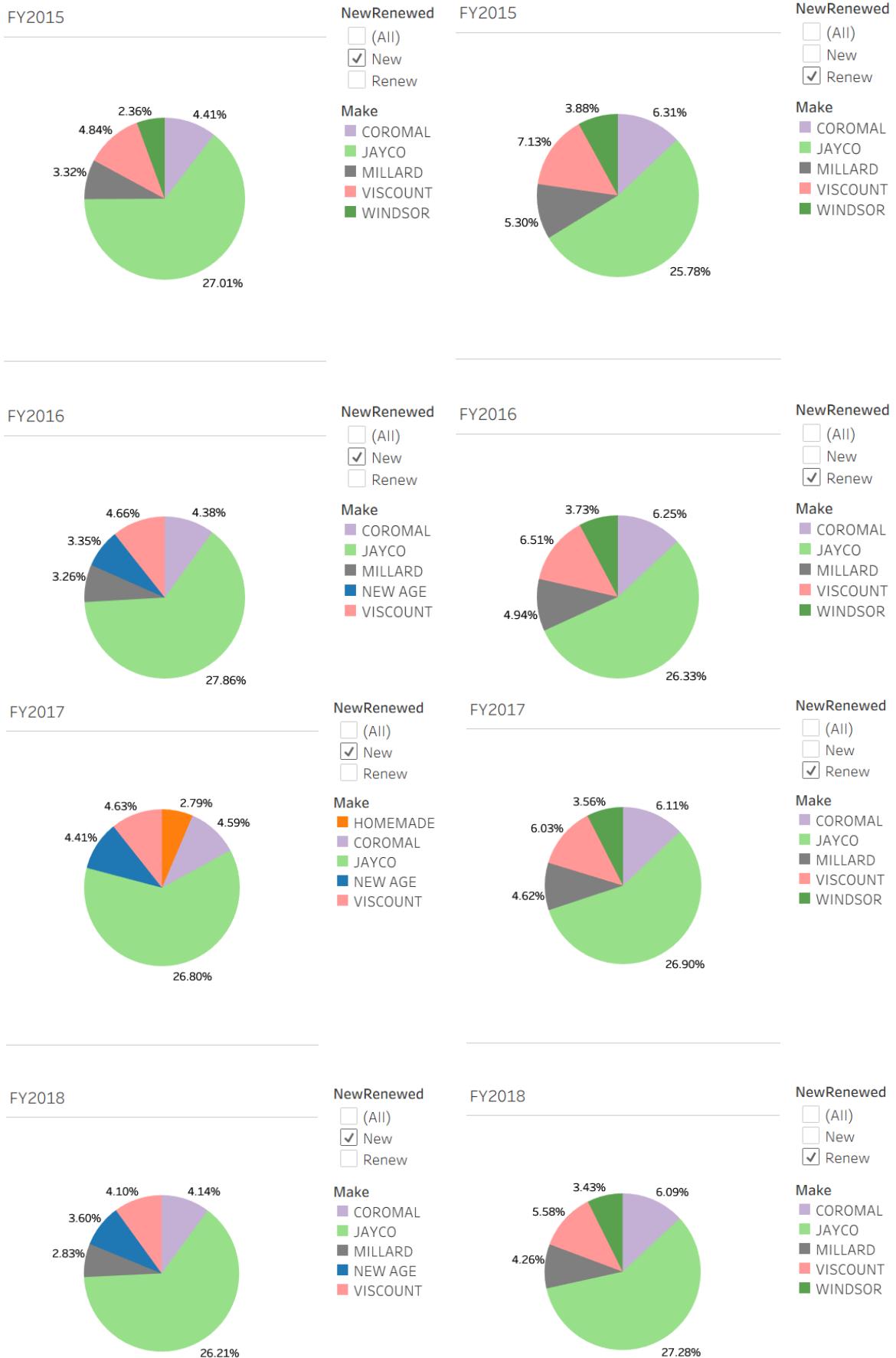
For QLD, the most popular make of new registrations of camper trailers alternate between JAYCO and MARKET DIRECT. For renew registrations, LIFESTYLE occurred in top 5 makes in FY2016 and did not appear in the other three fiscal years.

Figure - Market Shares of Top 5 Camper Trailer Makes (QLD)



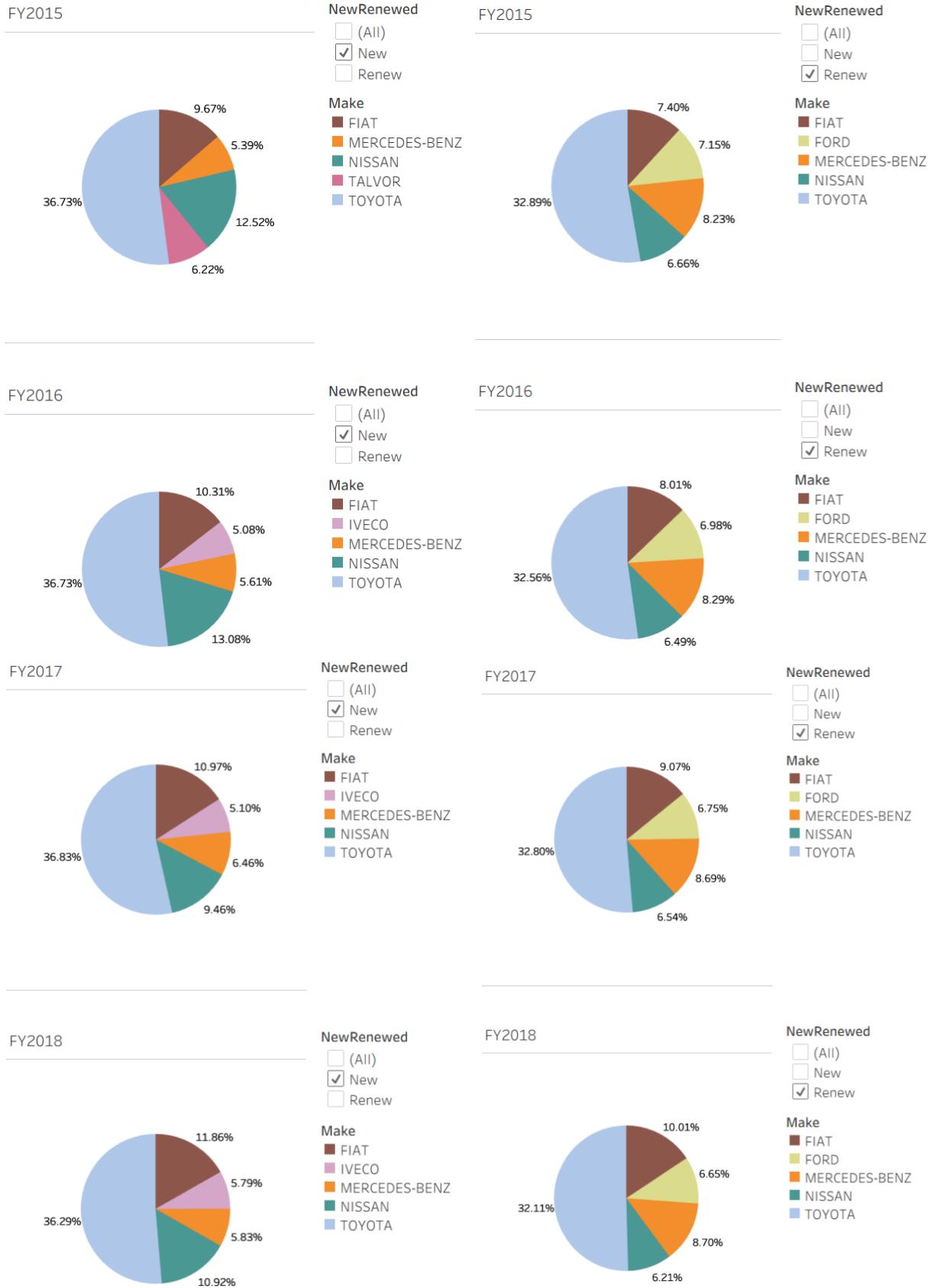
Top 5 popular makes for new and renew registrations of caravans in QLD did not change much. JAYCO is the most popular make.

Figure - Market Shares of Top 5 Caravan Makes (QLD)



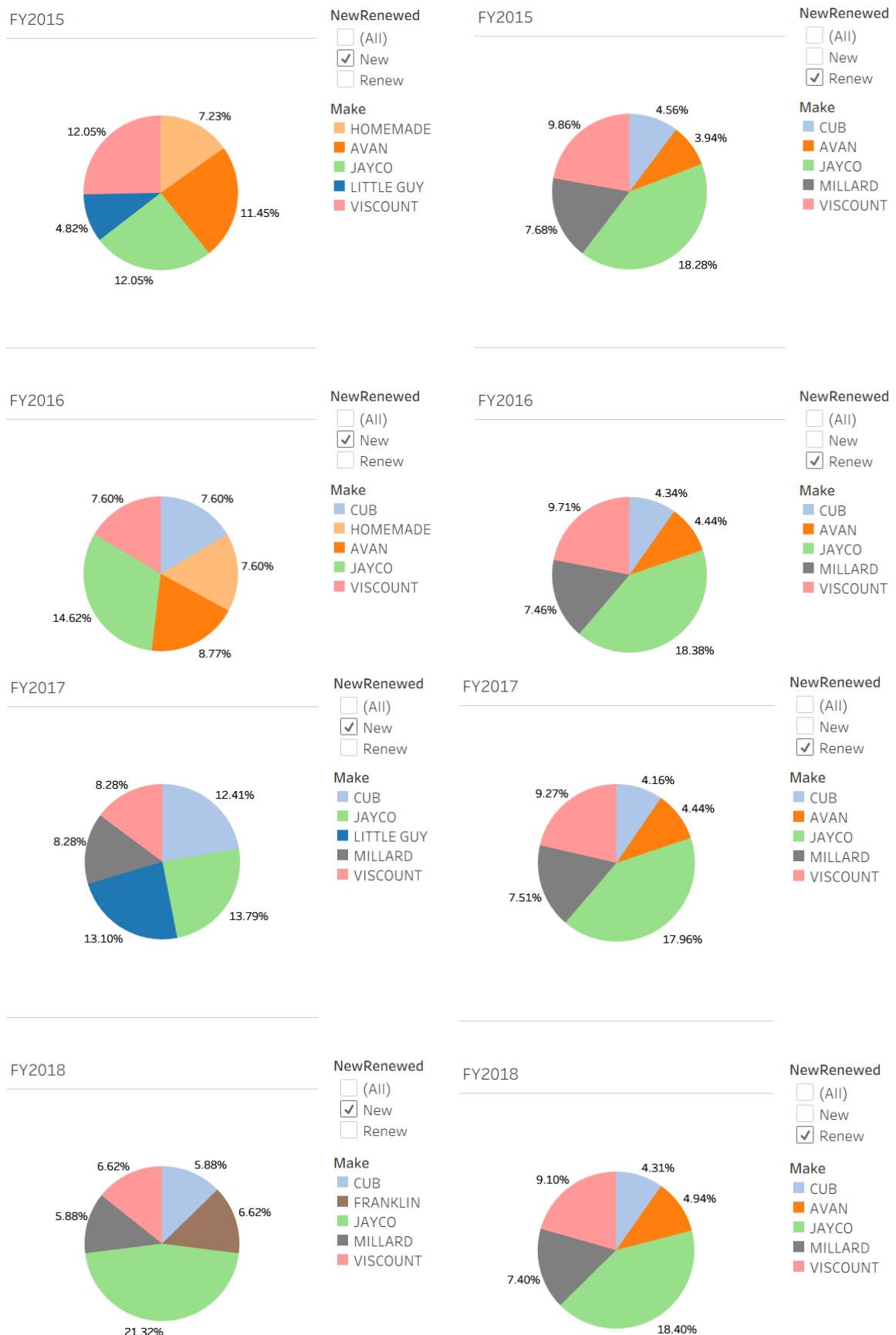
Top 5 popular makes for new and renew registrations of motorhomes in QLD did not change much. TOYOTA is the most popular make.

Figure - Market Shares of Top 5 Motorhomes Makes (QLD)



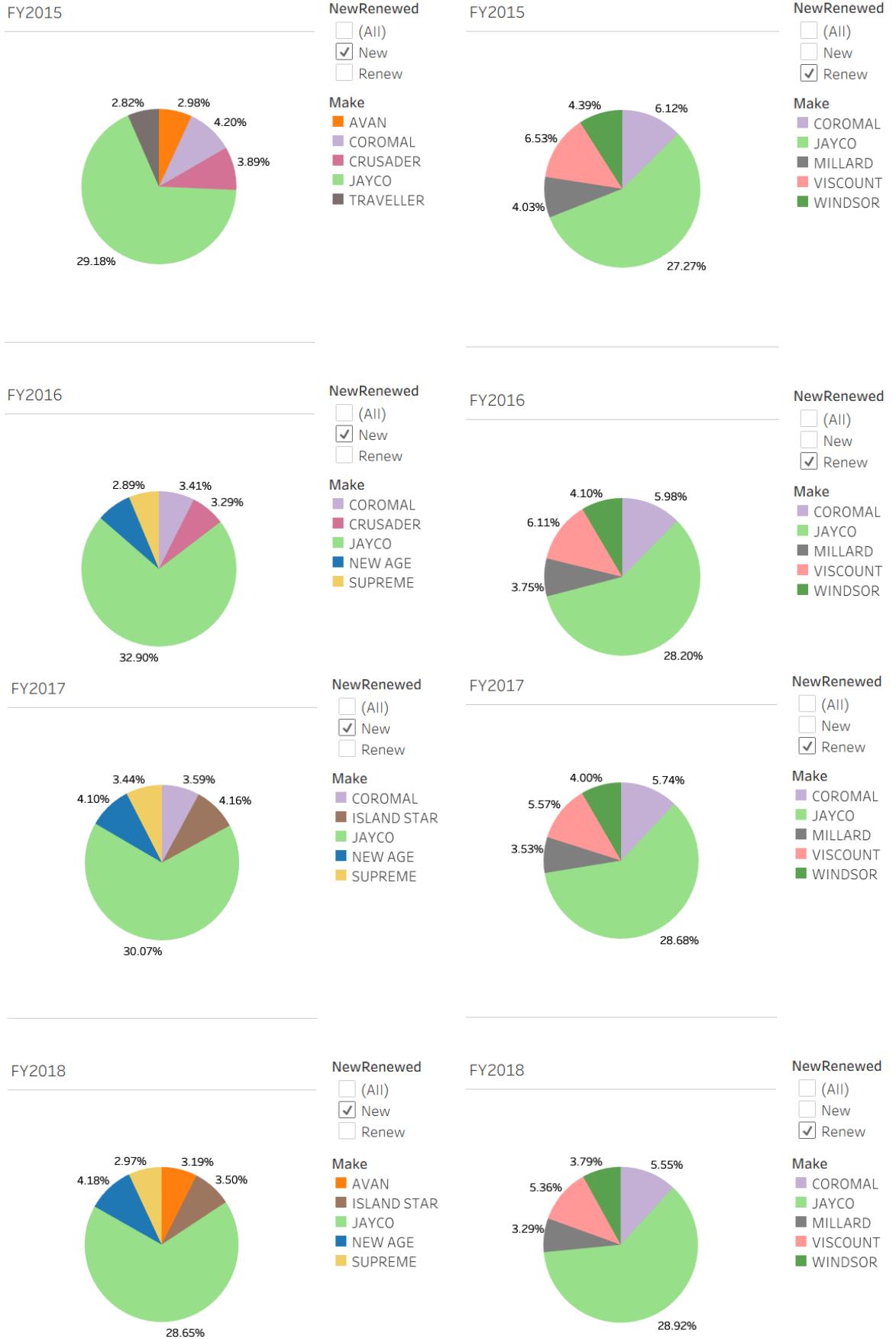
For SA, top 5 popular makes for new registrations of camper trailers changed from year to year. Top 5 popular makes for renew registrations of camper trailers did not change much.

Figure - Market Shares of Top 5 Camper Trailers Makes (SA)



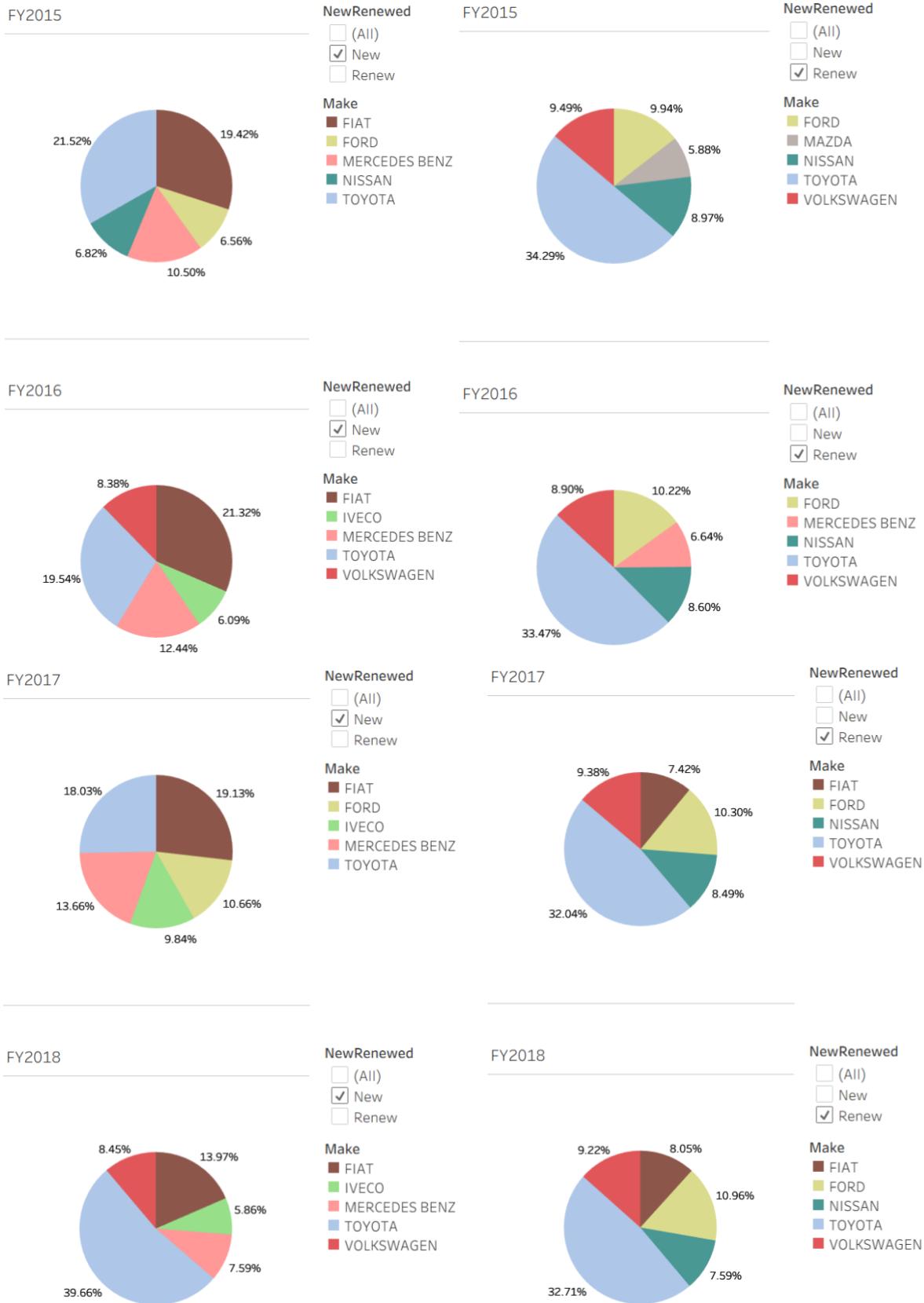
JAYCO is the most popular make for caravan registrations.

Figure - Market Shares of Top 5 Caravan Makes (SA)



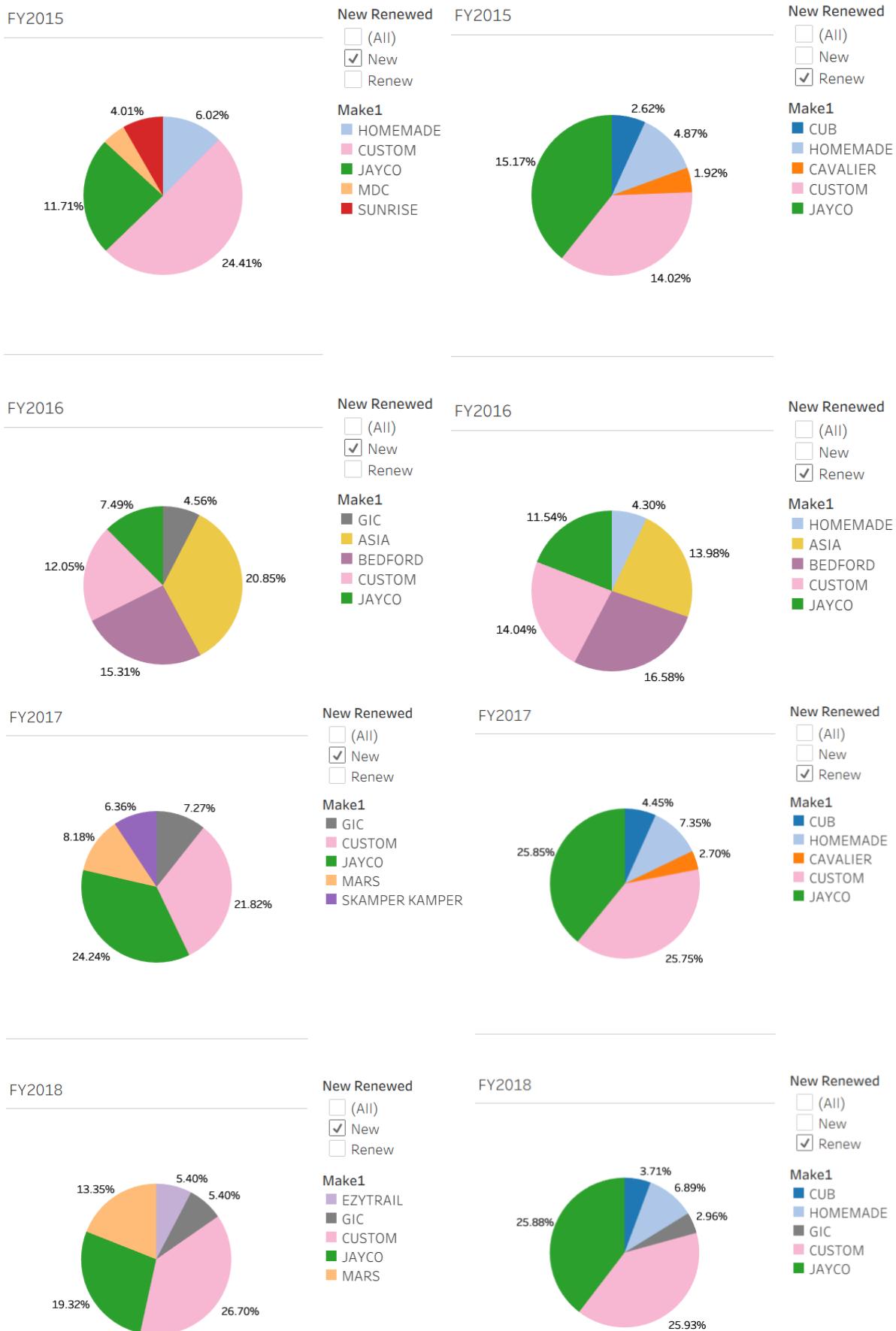
The market share of TOYOTA in new motorhome registrations increased from around 20% in the previous three fiscal years to 39.66% in FY2018. Top 5 popular makes in renew registrations did not change much.

Figure - Market Shares of Top 5 Motorhomes Makes (SA)



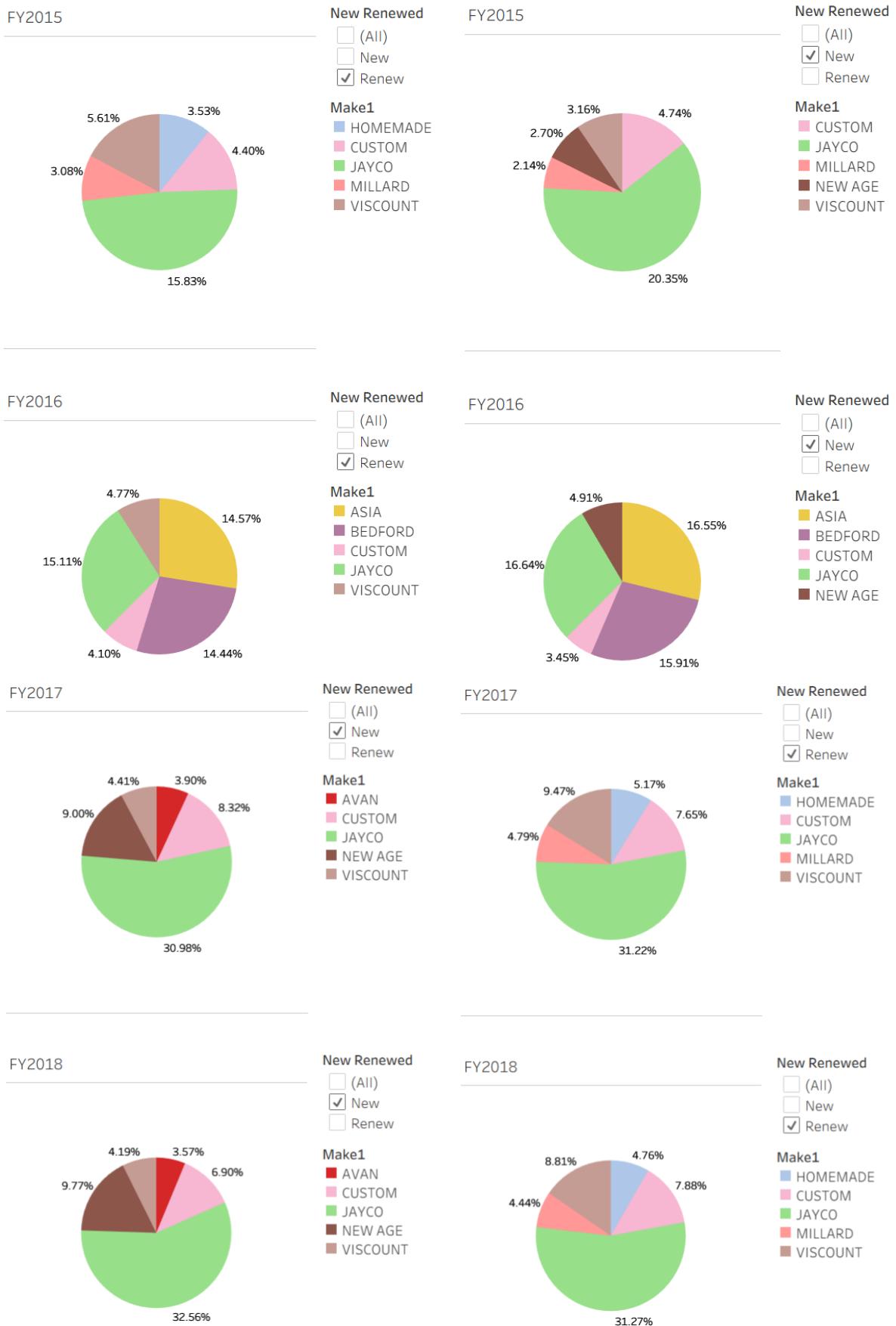
For TAS, CUSTOM camper trailers are popular for both new and renew registrations.

Figure - Market Shares of Top 5 Camper Trailer Makes (TAS)



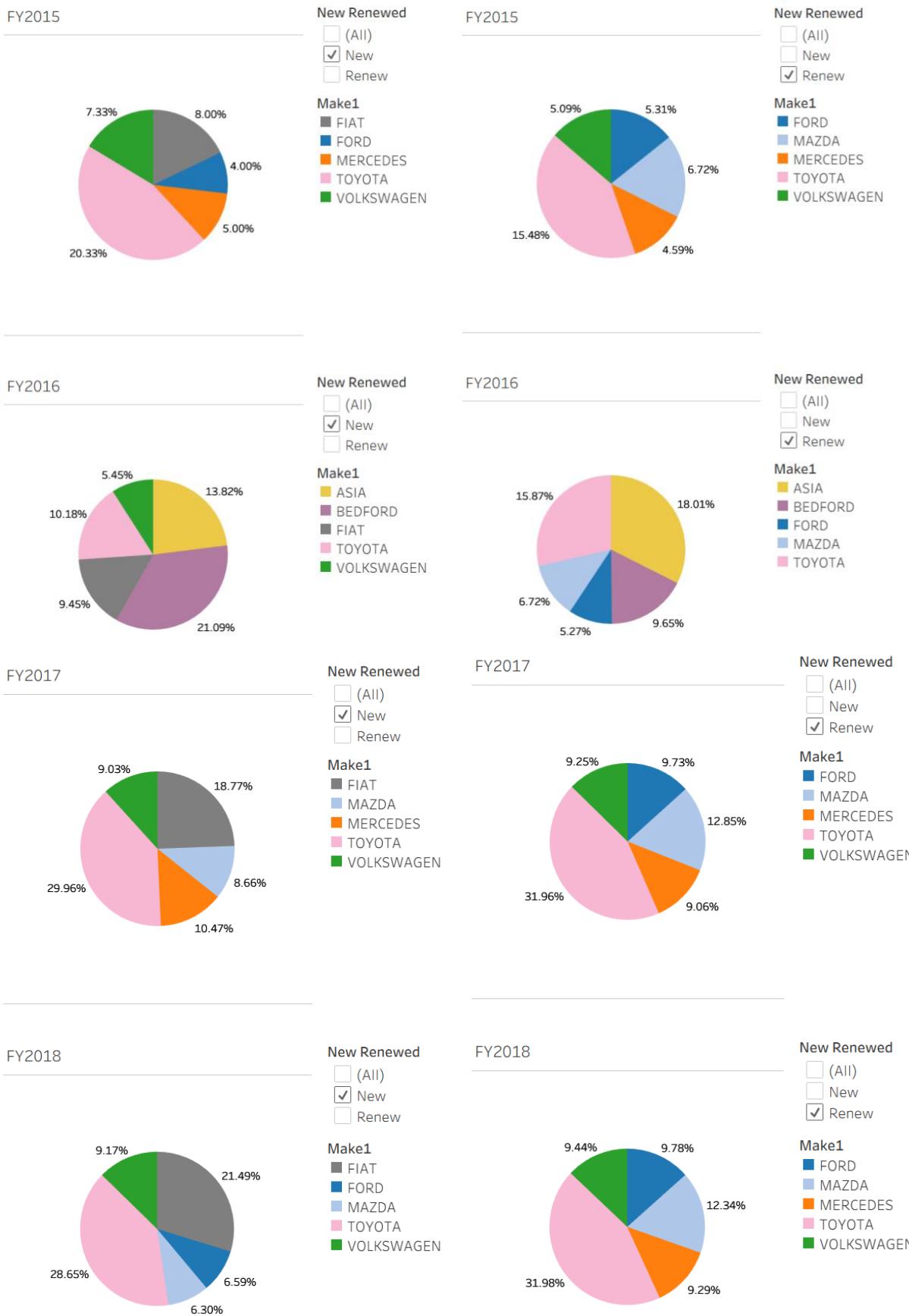
CUSTOM is still one of the top 5 makes for caravans, but its market share is less than its market share of camper trailers.

Figure - Market Shares of Top 5 Caravan Makes (TAS)



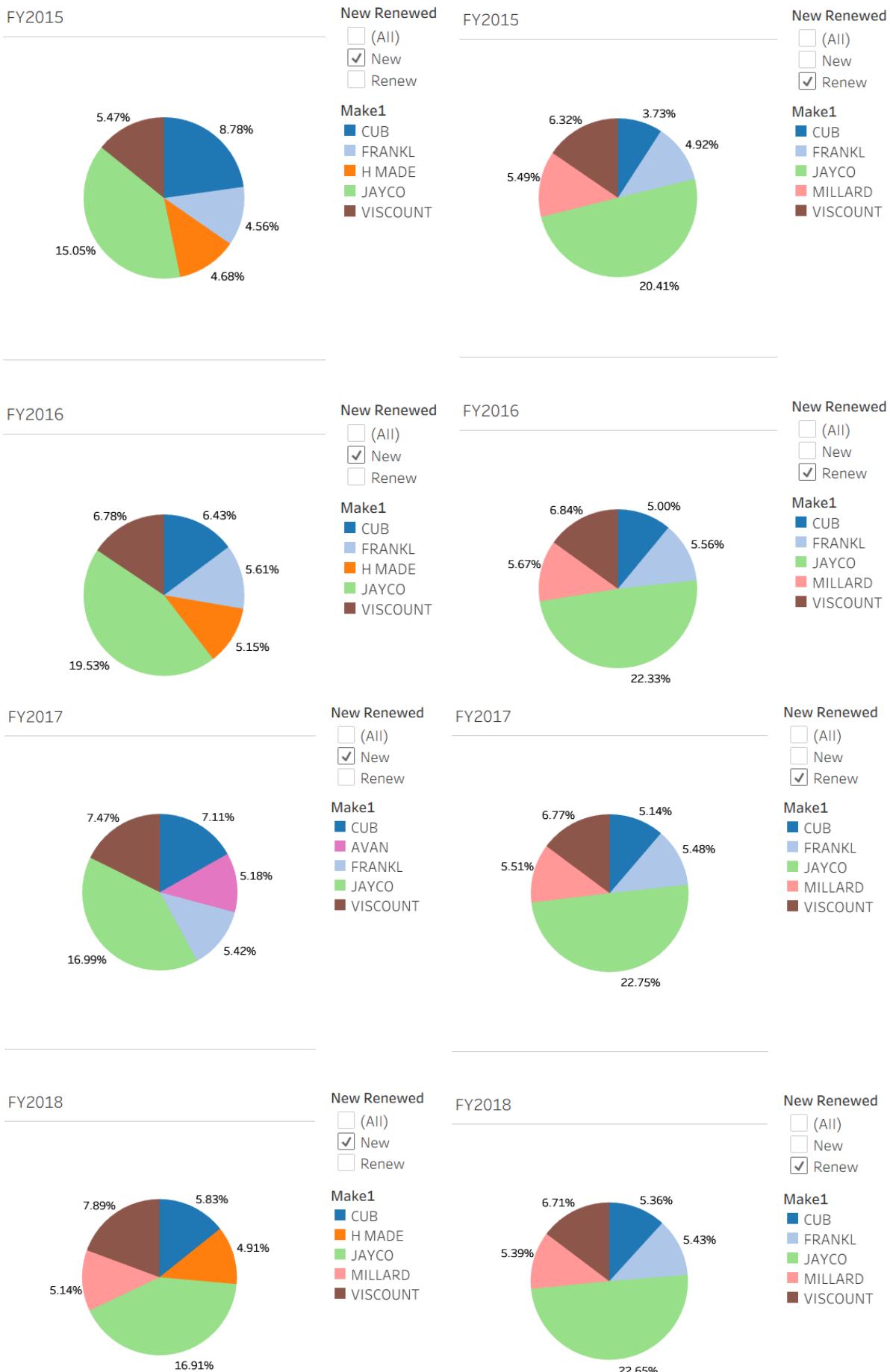
For motorhome registrations, TOYOTA is the most popular make for most times.

Figure - Market Shares of Top 5 Motorhome Makes (TAS)



For **VIC**, JAYCO is the most popular camper trailer make. The market shares of top 5 makes for both new and renew registrations of camper trailer did not change much during the four fiscal years.

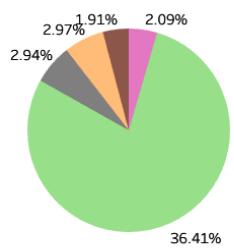
Figure - Market Shares of Top 5 Camper Trailer Makes (VIC)



JAYCO is the most popular caravan make. Top 5 makes for caravans did not change much in the recent four fiscal years.

Figure - Market Shares of Top 5 Caravan Makes (VIC)

FY2015



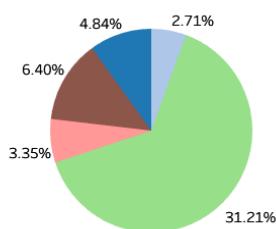
New Renewed

- (All)
- New
- Renew

Make1

- AVAN
- JAYCO
- NEWAGE
- SUPREM
- VISCOUNT

FY2015



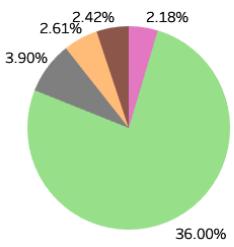
New Renewed

- (All)
- New
- Renew

Make1

- COROMAL
- JAYCO
- MILLARD
- VISCOUNT
- WINDSOR

FY2016



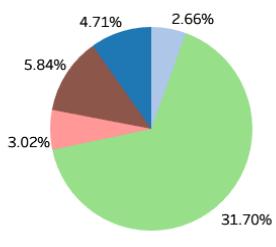
New Renewed

- (All)
- New
- Renew

Make1

- AVAN
- JAYCO
- NEWAGE
- SUPREM
- VISCOUNT

FY2016



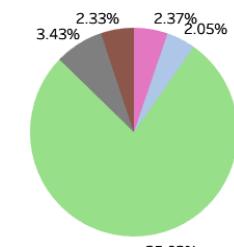
New Renewed

- (All)
- New
- Renew

Make1

- COROMAL
- JAYCO
- MILLARD
- VISCOUNT
- WINDSOR

FY2017



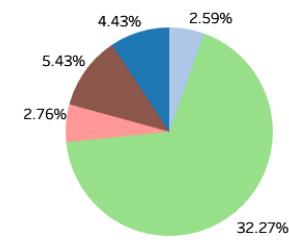
New Renewed

- (All)
- New
- Renew

Make1

- AVAN
- COROMAL
- JAYCO
- NEWAGE
- VISCOUNT

FY2017



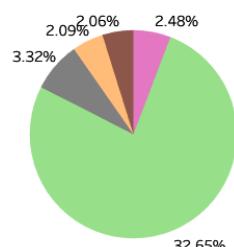
New Renewed

- (All)
- New
- Renew

Make1

- COROMAL
- JAYCO
- MILLARD
- VISCOUNT
- WINDSOR

FY2018



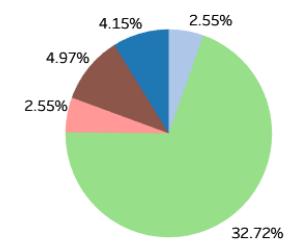
New Renewed

- (All)
- New
- Renew

Make1

- AVAN
- COROMAL
- JAYCO
- NEWAGE
- SUPRME
- VISCOUNT

FY2018



New Renewed

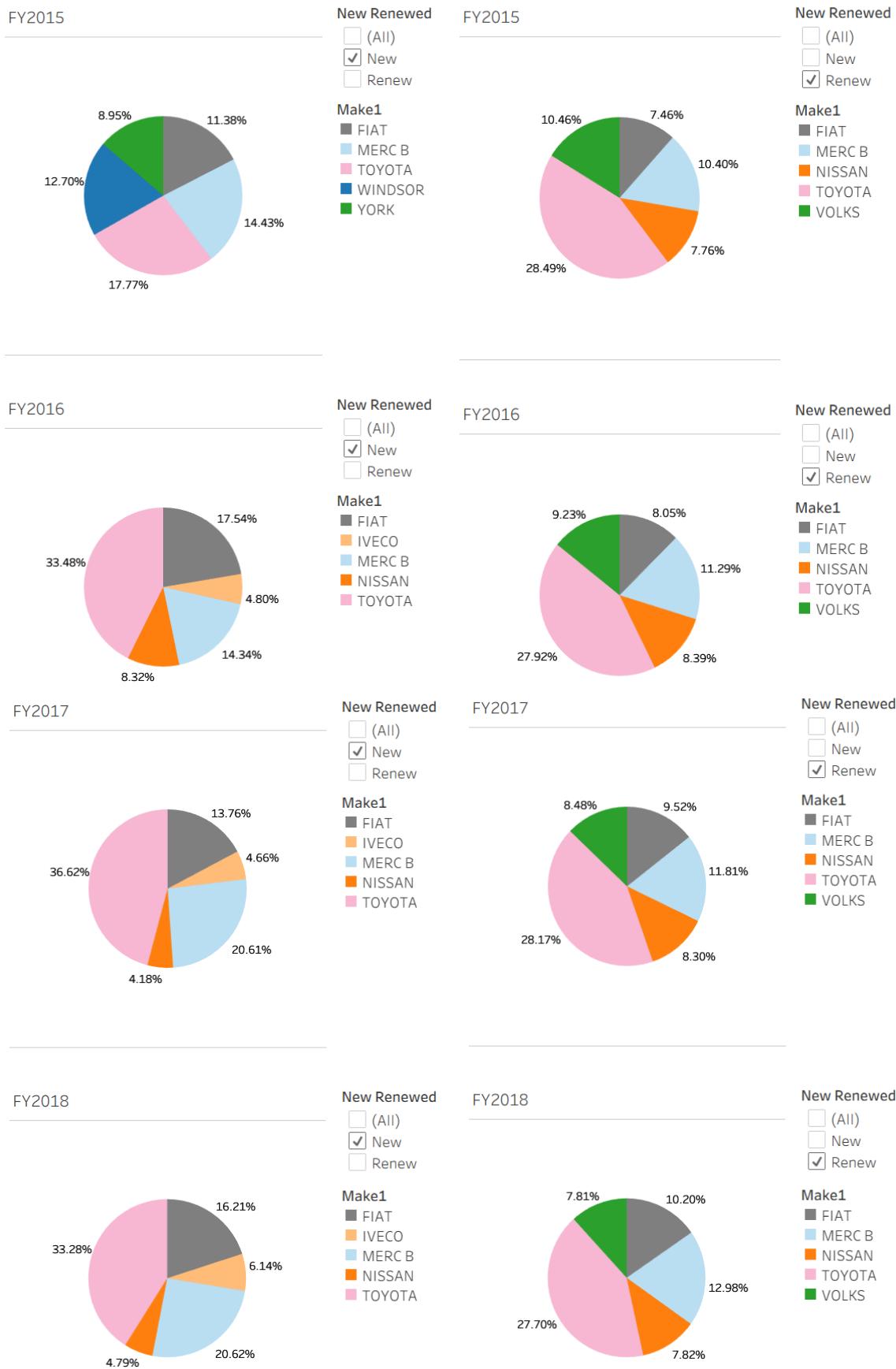
- (All)
- New
- Renew

Make1

- COROMAL
- JAYCO
- MILLARD
- VISCOUNT
- WINDSOR

For motorhomes, popular makes did not change much. The most popular make for both new and renew registration is TOYOTA.

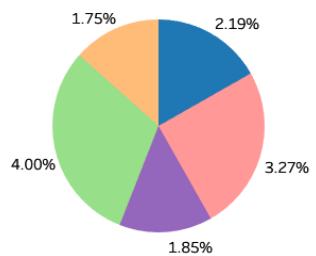
Figure - Market Shares of Top 5 Motorhome Makes (VIC)



For **WA**, 75% new registrations of camper trailers' makes are unknown in FY2015, so the market shares of top 5 makes are all small. Renew registrations' popular makes did not change much.

Figure - Market Shares of Top 5 Camper Trailer Makes (WA)

FY2015



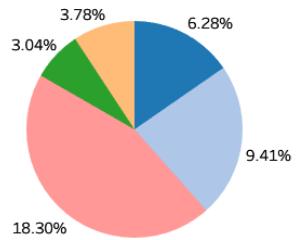
New Renewed

- (All)
- New
- Renew

Make1

- CUB
- CMADE
- FOLCAM
- MDCTRL
- OUTBKC

FY2015



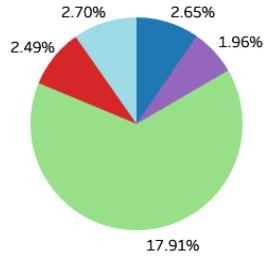
New Renewed

- (All)
- New
- Renew

Make1

- CUB
- CAVALR
- CMADE
- JPAPAS
- OUTBKC

FY2016



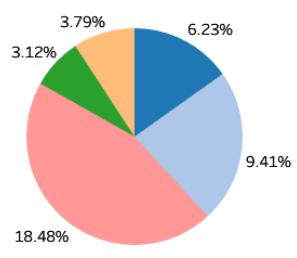
New Renewed

- (All)
- New
- Renew

Make1

- CUB
- FOLCAM
- MDCTRL
- PIONER
- STHCRS

FY2016



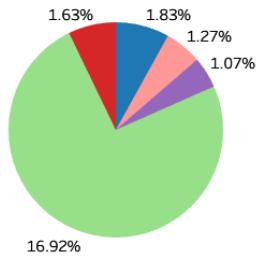
New Renewed

- (All)
- New
- Renew

Make1

- CUB
- CAVALR
- CMADE
- JPAPAS
- OUTBKC

FY2017



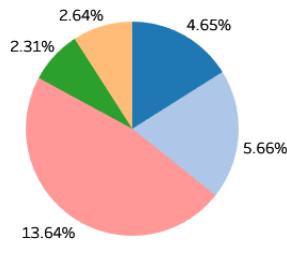
New Renewed

- (All)
- New
- Renew

Make1

- CUB
- CMADE
- FOLCAM
- MDCTRL
- PIONER

FY2017



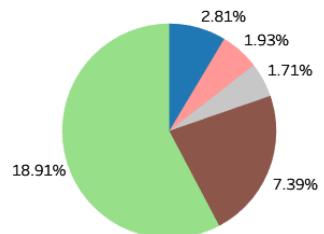
New Renewed

- (All)
- New
- Renew

Make1

- CUB
- CAVALR
- CMADE
- MDCTRL
- OUTBKC

FY2018



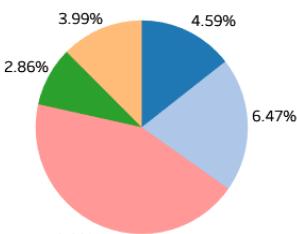
New Renewed

- (All)
- New
- Renew

Make1

- CUB
- CMADE
- EAGLE
- LEISUR
- MDCTRL

FY2018



New Renewed

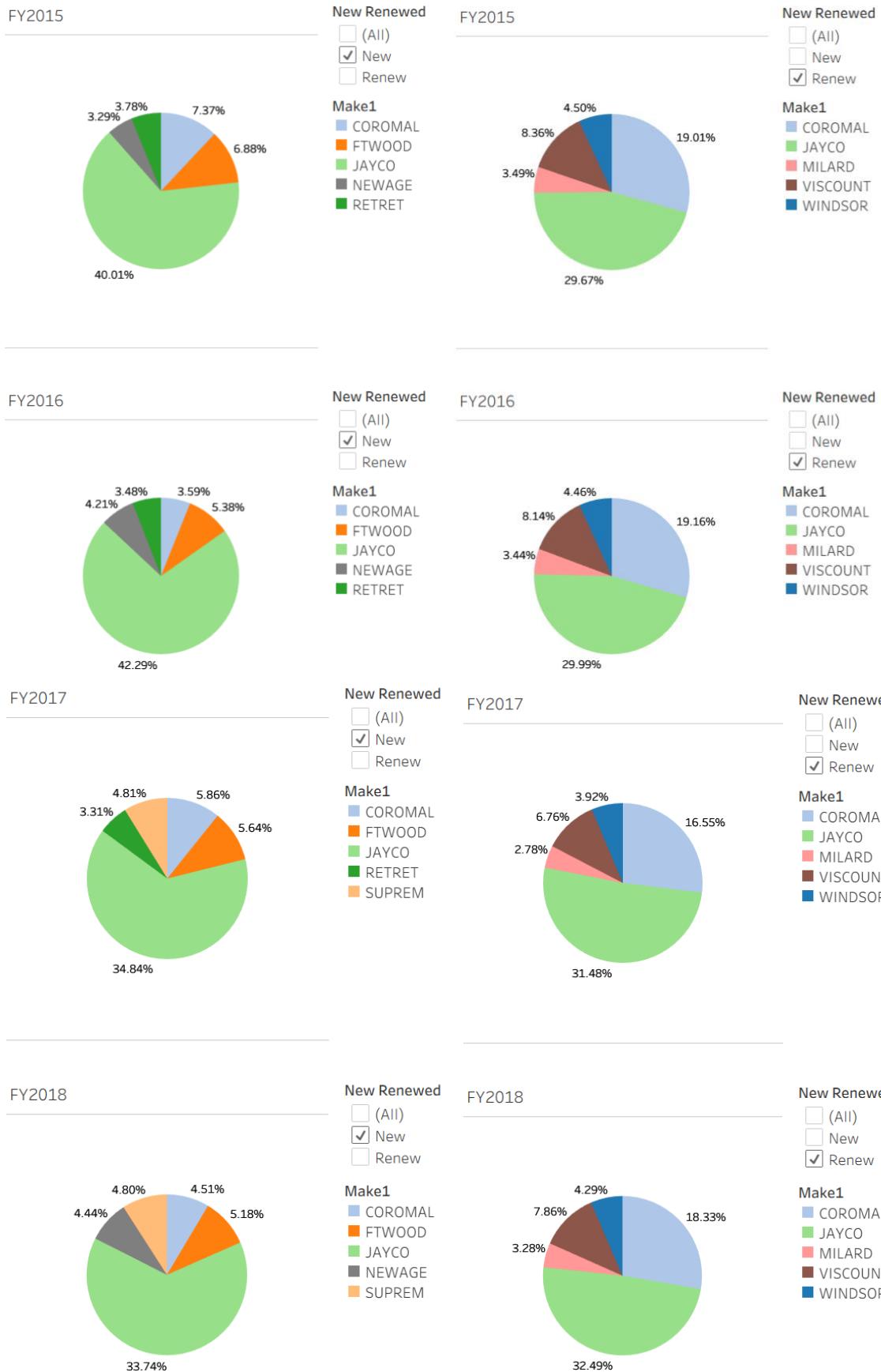
- (All)
- New
- Renew

Make1

- CUB
- CAVALR
- CMADE
- JPAPAS
- OUTBKC

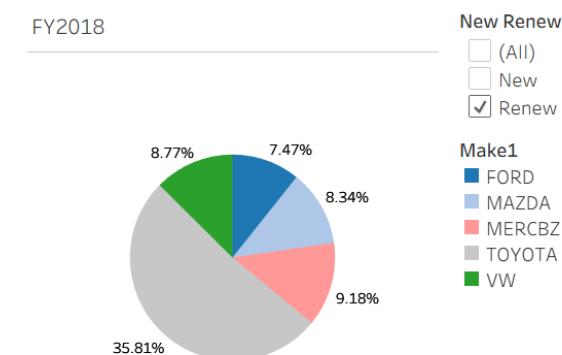
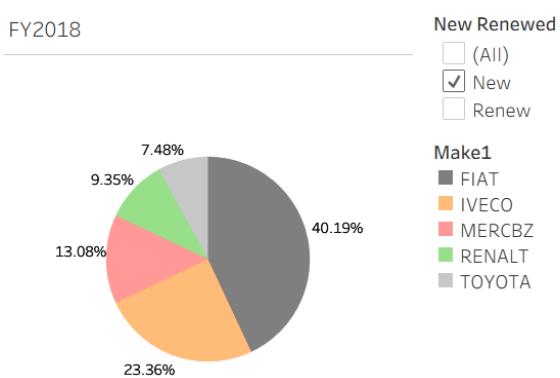
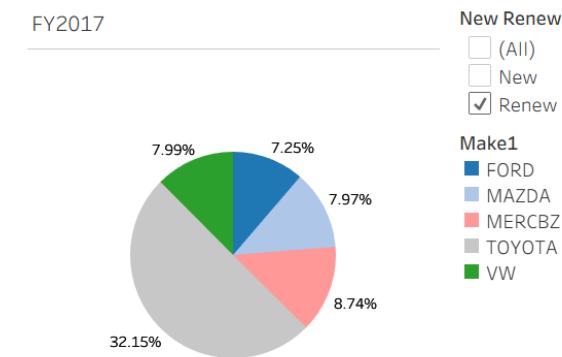
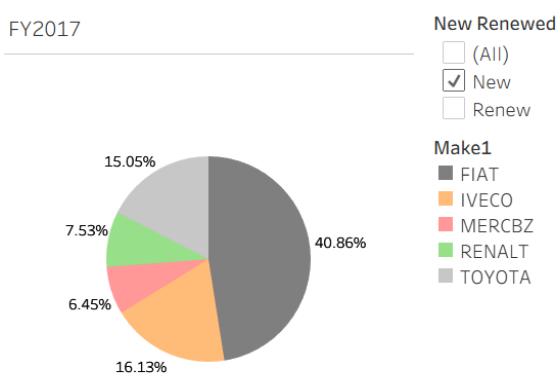
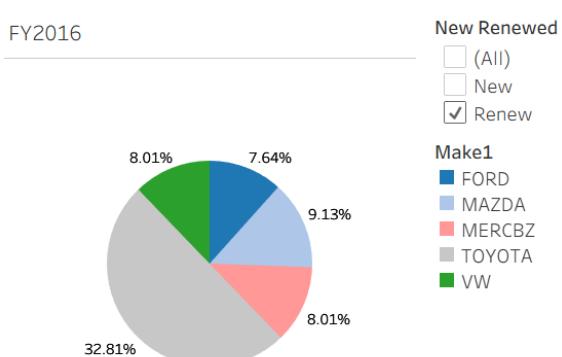
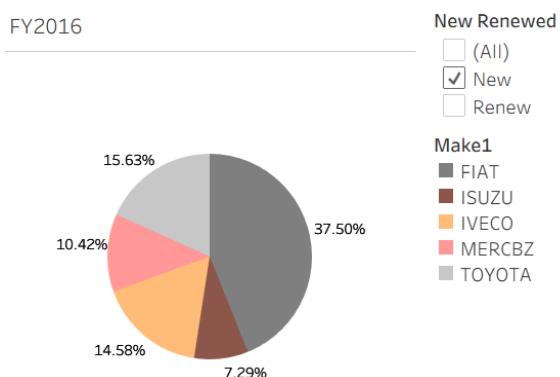
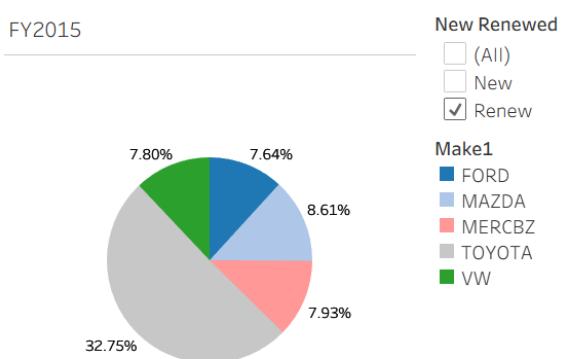
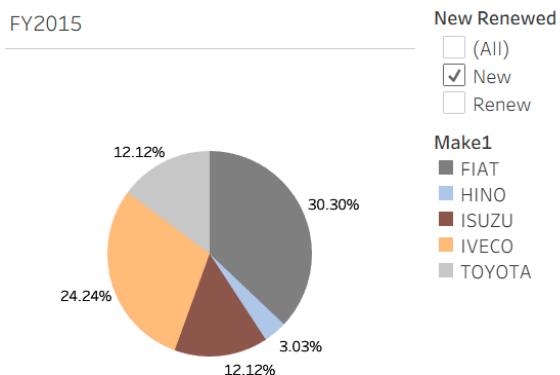
JAYCO is the most popular caravan make in WA for both new and renew registrations.

Figure - Market Shares of Top 5 Caravan Makes (WA)



FIAT is the most popular caravan make in WA for new registrations. TOYOTA is the most popular caravan make in WA for renew registrations.

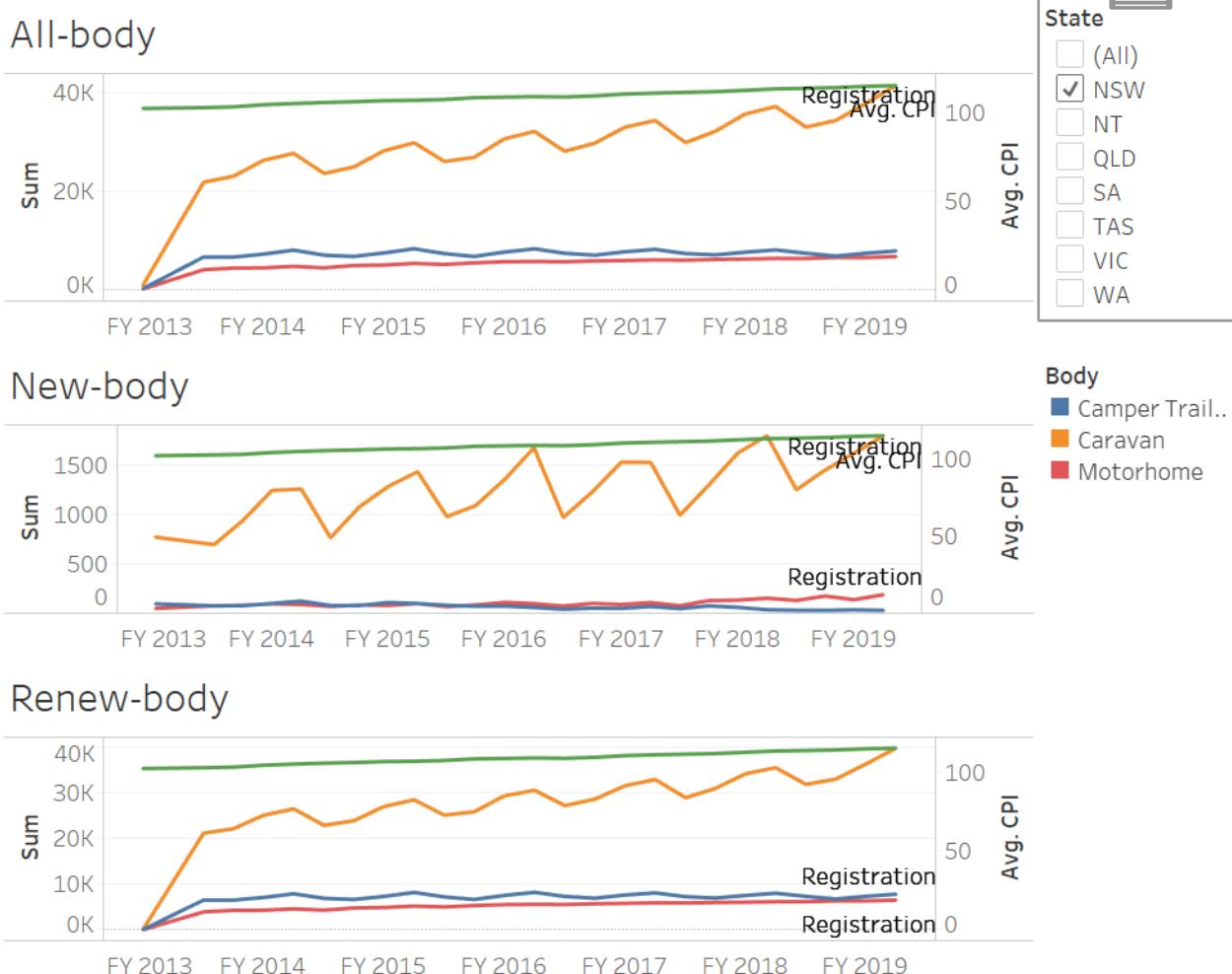
Figure - Market Shares of Top 5 Motorhome Makes (WA)



7. Registrations Trend by States with CPI

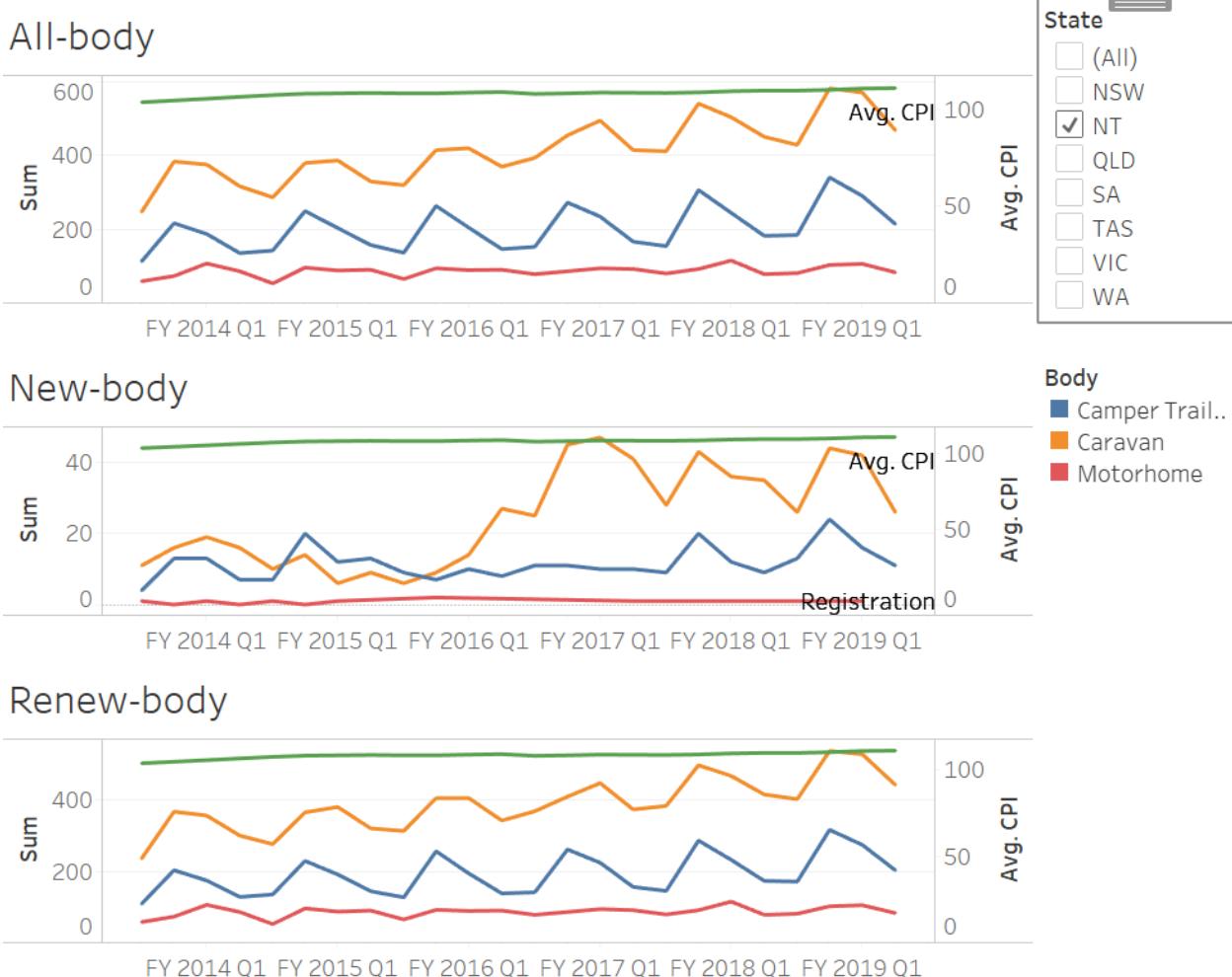
The following graph shows the trend of CPI and the number of registrations of 3 body types for **New South Wales**. The Green line shows CPI. The color legend of 3 body types is shown in the graph.

CPI's trend and trends of registration in 3 types are all similar. Caravan's trend has more peaks and troughs, while others' trends are smoother.



The following graph shows the trend of CPI and the number of registrations of 3 body types for **Northern Territory**. The Green line shows CPI. The color legend of 3 body types is shown in the graph.

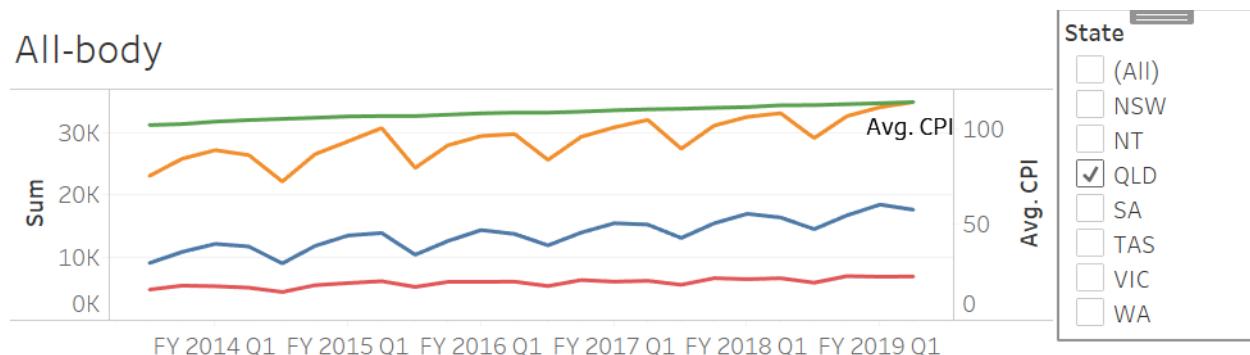
The CPI of Northern Territory hasn't changed much. We can't tell the similarity here.



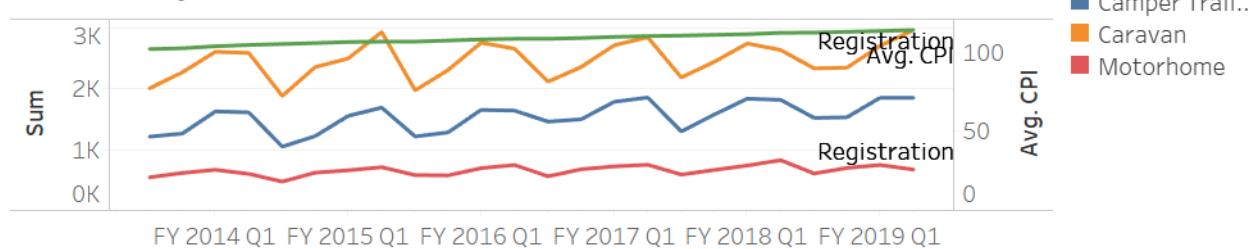
The following graph shows the trend of CPI and the number of registrations of 3 body types for **Queensland**. The Green line shows CPI. The color legend of 3 body types is shown in the graph.

CPI's trend and trends of registration in 3 types are all similar.

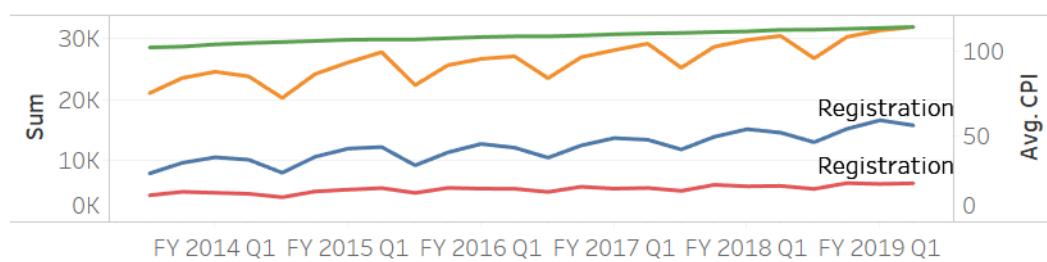
All-body



New-body

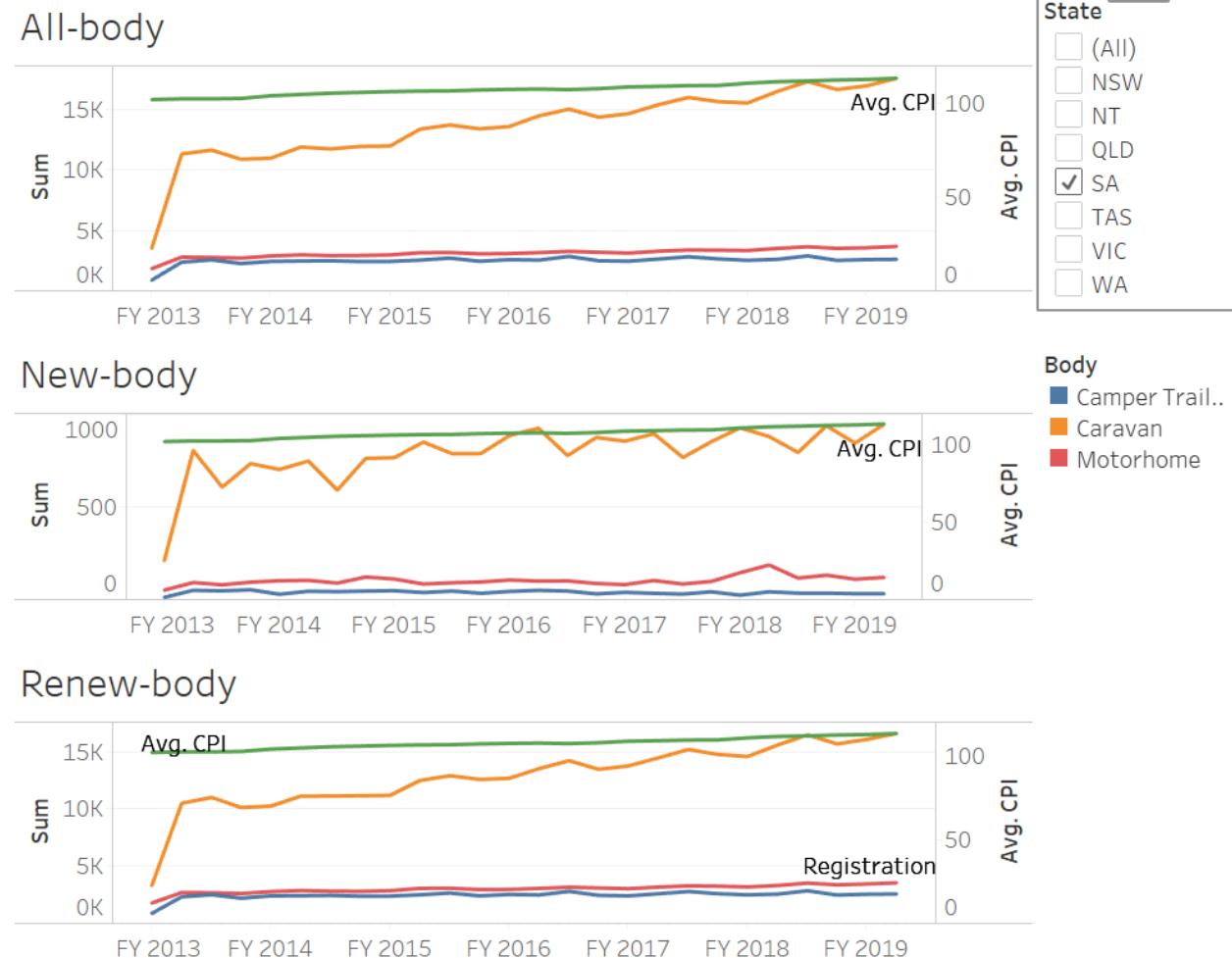


Renew-body



The following graph shows the trend of CPI and the number of registrations of 3 body types for South Australia. The Green line shows CPI. The color legend of 3 body types is shown in the graph.

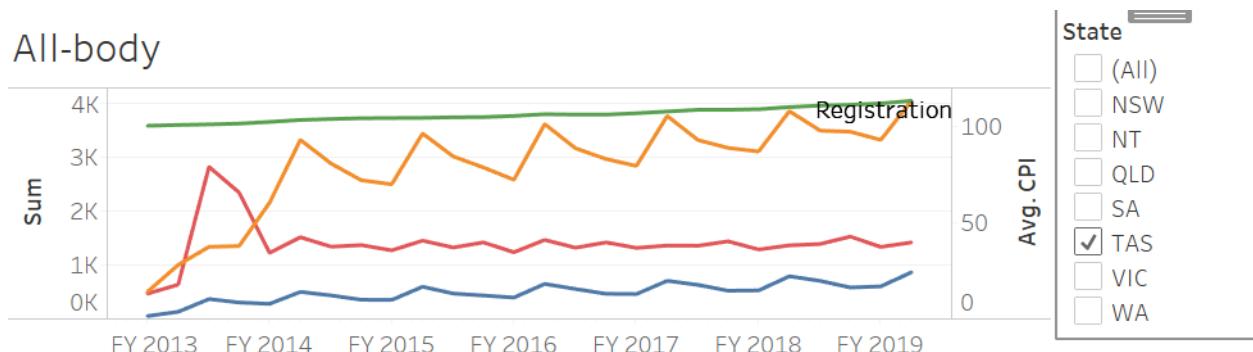
The trends of Camper Trailer and Motorhome are more similar to the CPI trend from Q2 of FY 2013, while new Caravan registrations are increasing more rapidly.



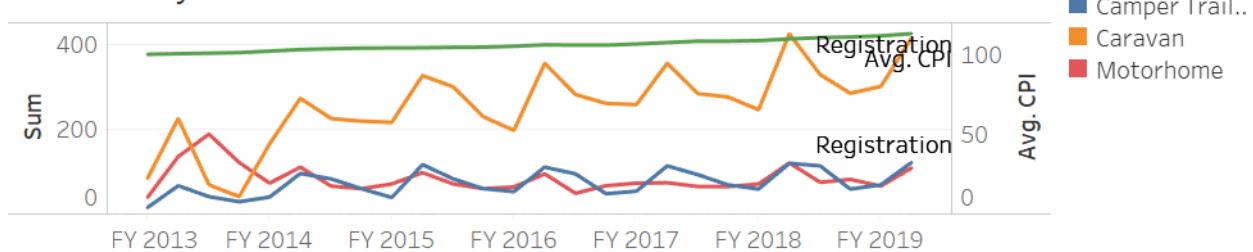
The following graph shows the trend of CPI and the number of registrations of 3 body types for **Tasmania**. The Green line shows CPI. The color legend of 3 body types is shown in the graph.

The trends start to look similar to the CPI trend from Q2 of FY 2014

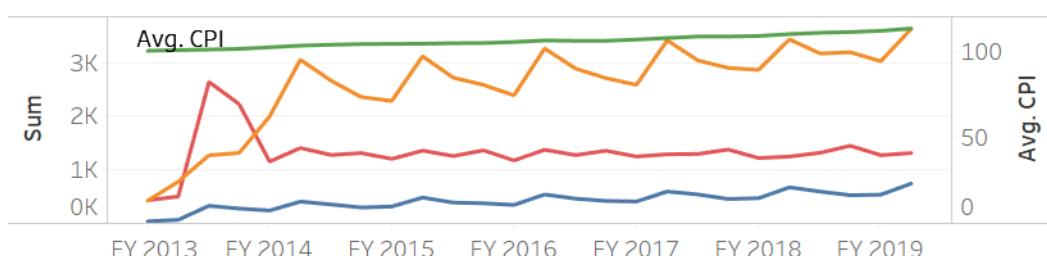
All-body



New-body



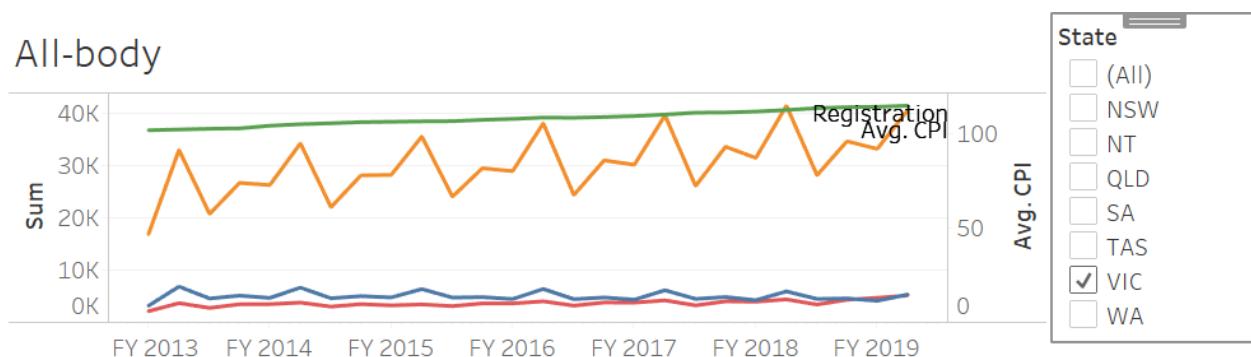
Renew-body



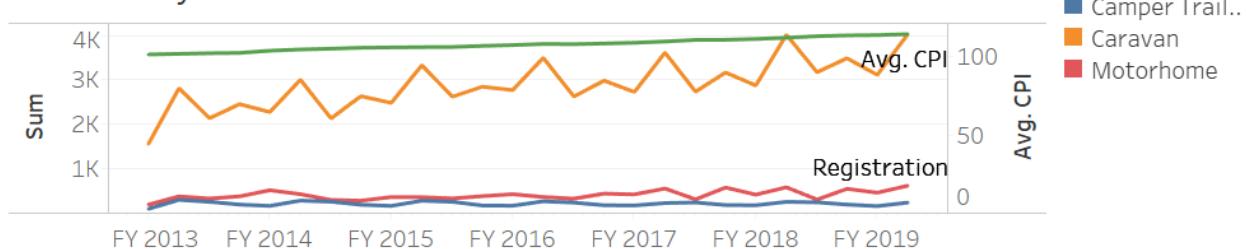
The following graph shows the trend of CPI and the number of registrations of 3 body types for **Victoria**. The Green line shows CPI. The color legend of 3 body types is shown in the graph.

CPI's trend and trends of registration in 3 types are all similar. Caravan's trend has more peaks and troughs, while others' trends are smoother.

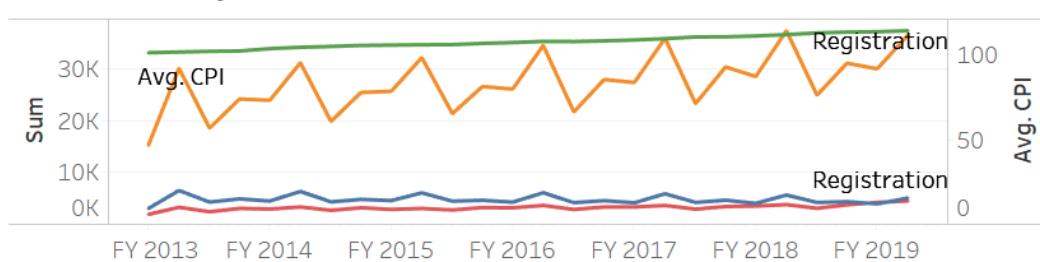
All-body



New-body



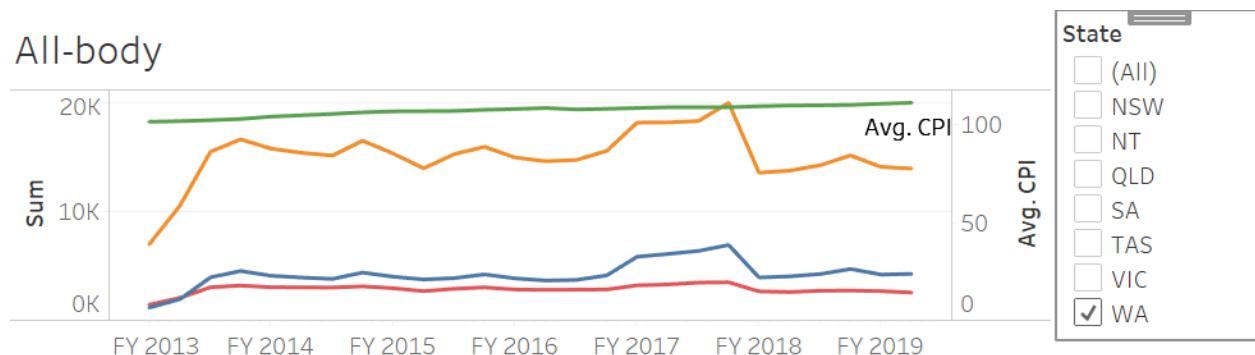
Renew-body



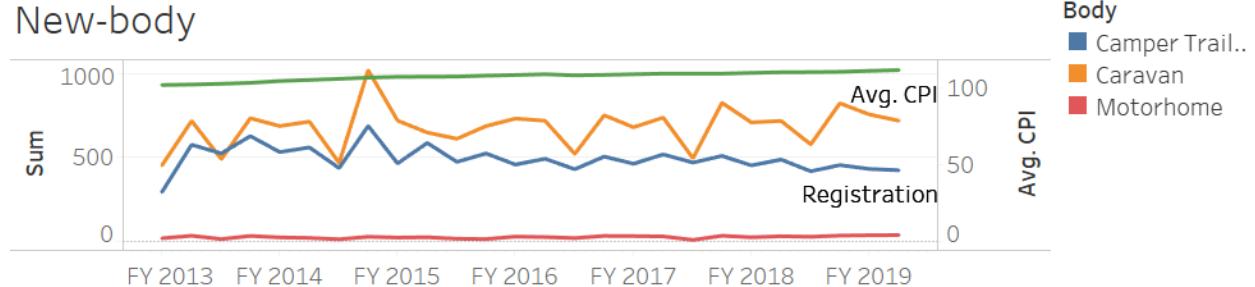
The following graph shows the trend of CPI and the number of registrations of 3 body types for **West Australia**. The Green line shows CPI. The color legend of 3 body types is shown in the graph.

I think we cannot see a clear similarity between the CPI trend and registration trend here.

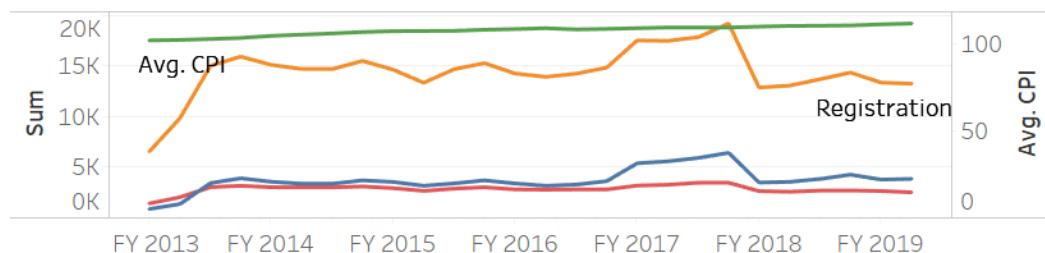
All-body



New-body



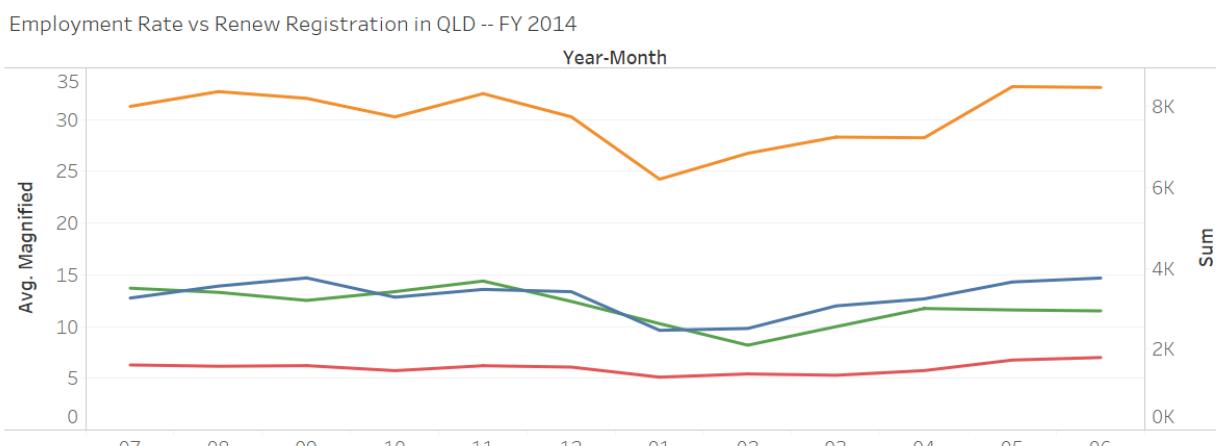
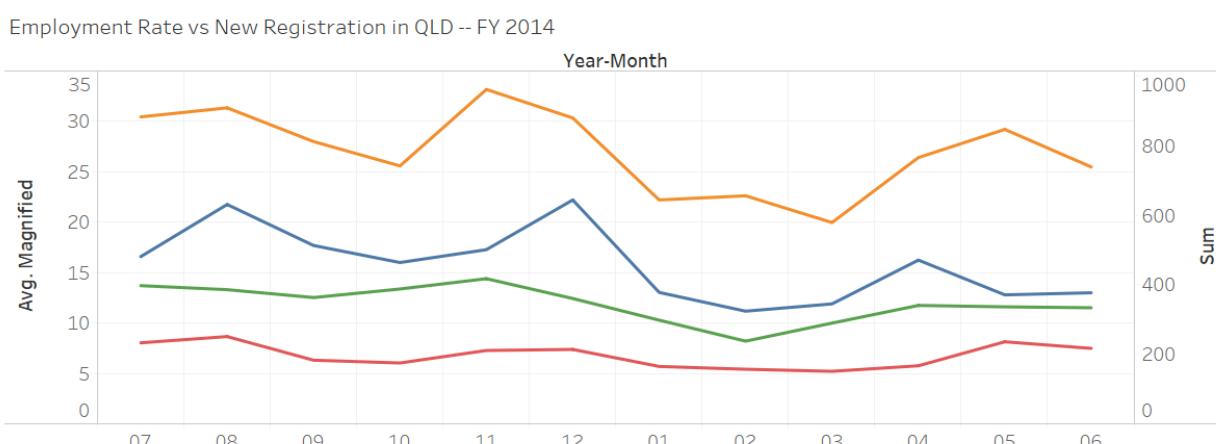
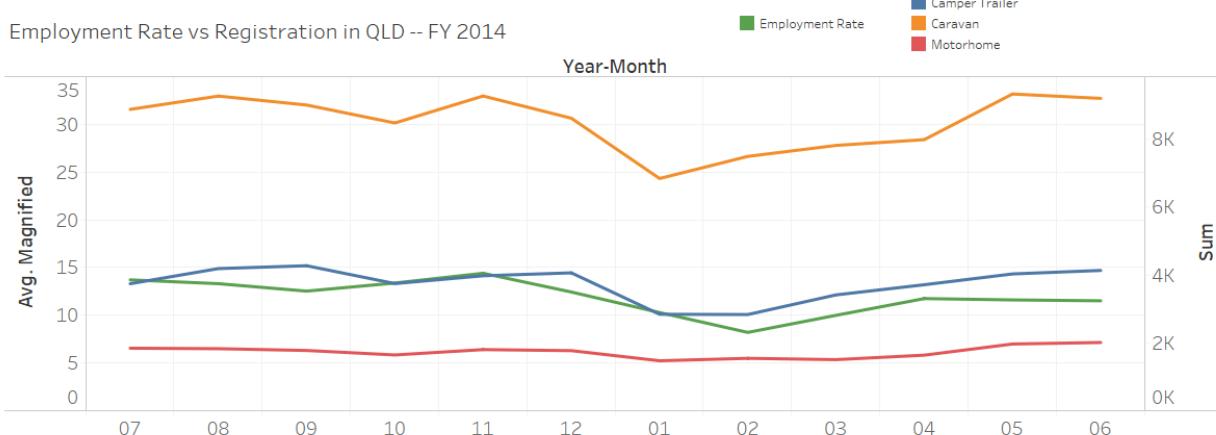
Renew-body

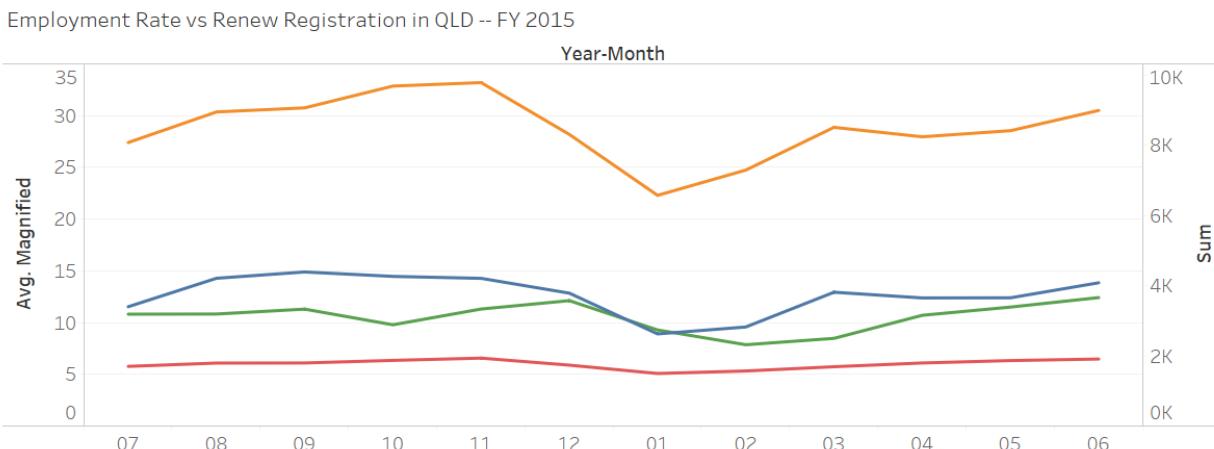
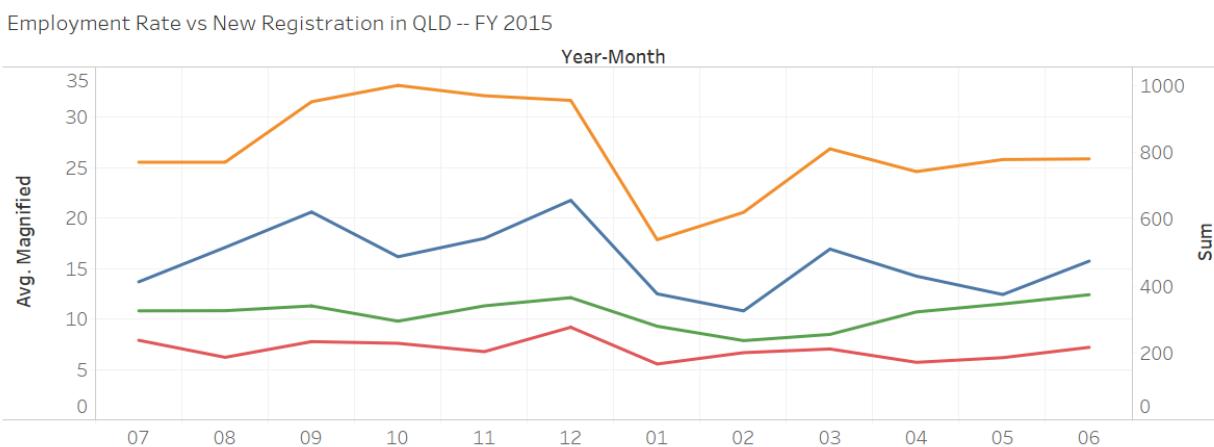
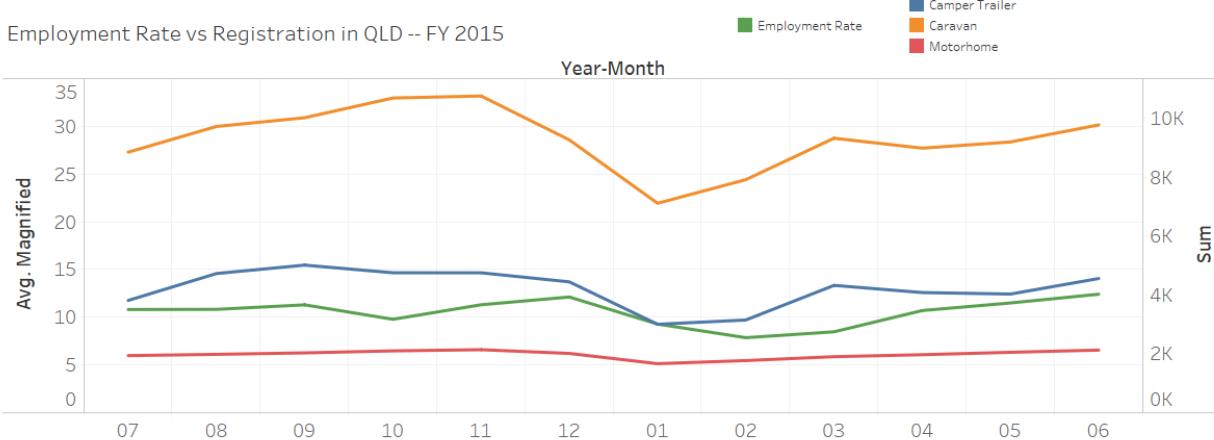


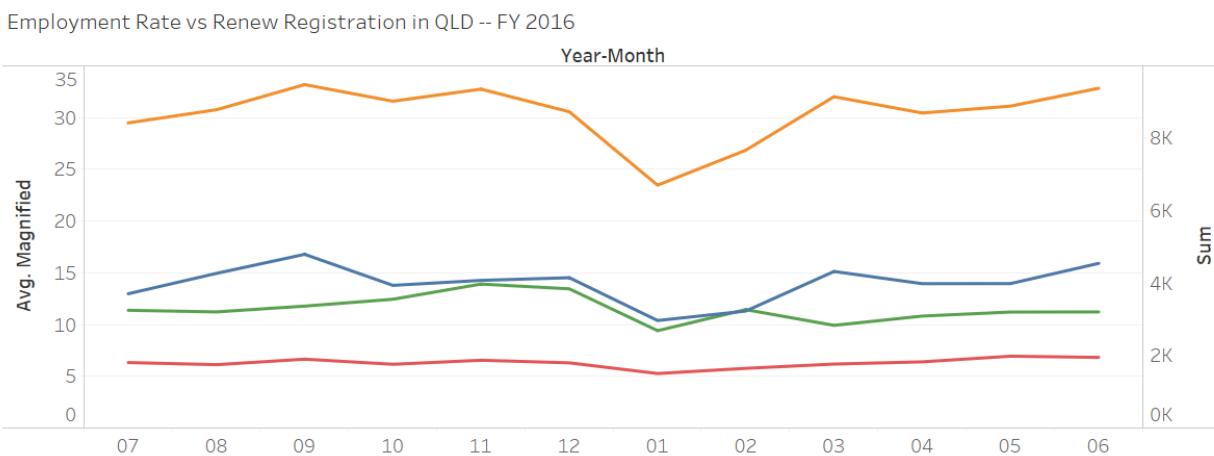
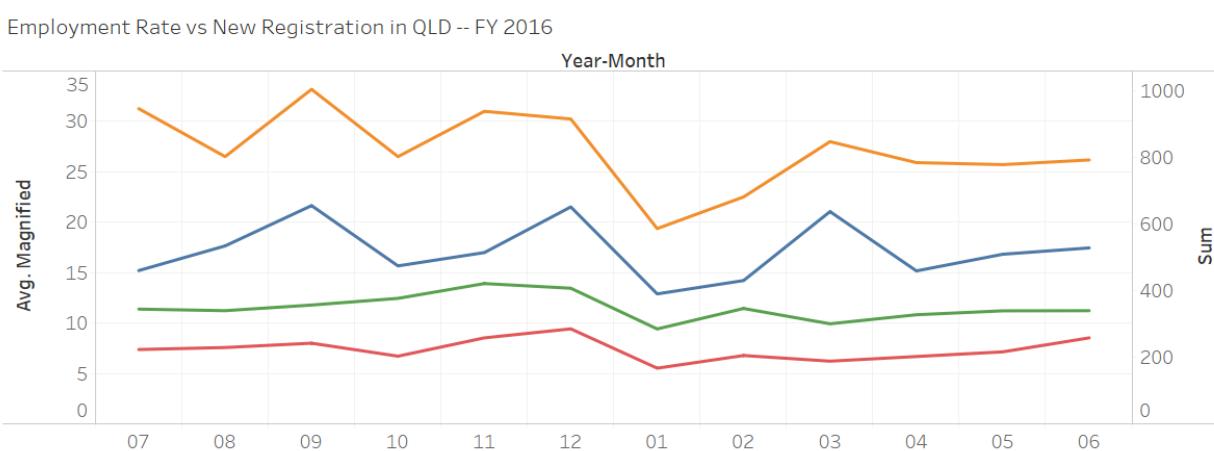
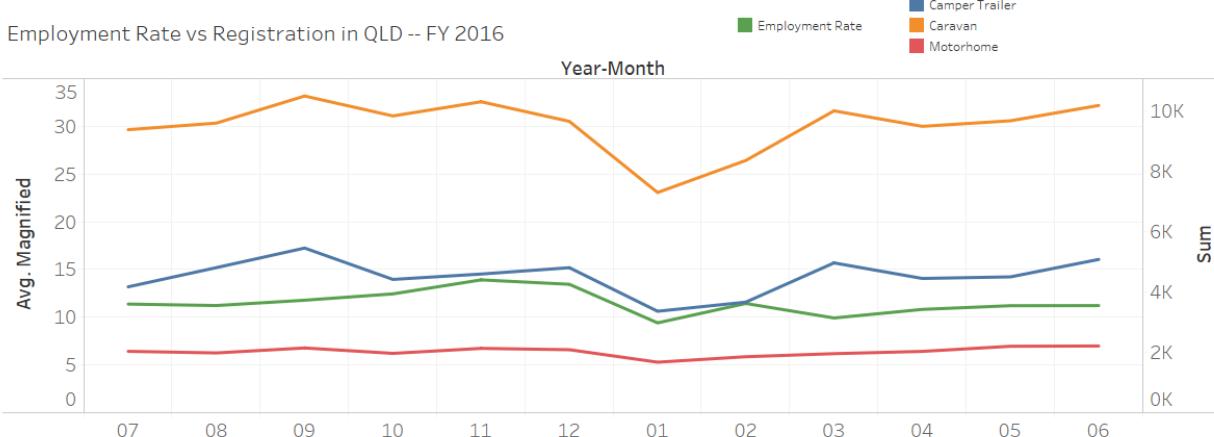
Registration Trends by States and Year with Employment Rate

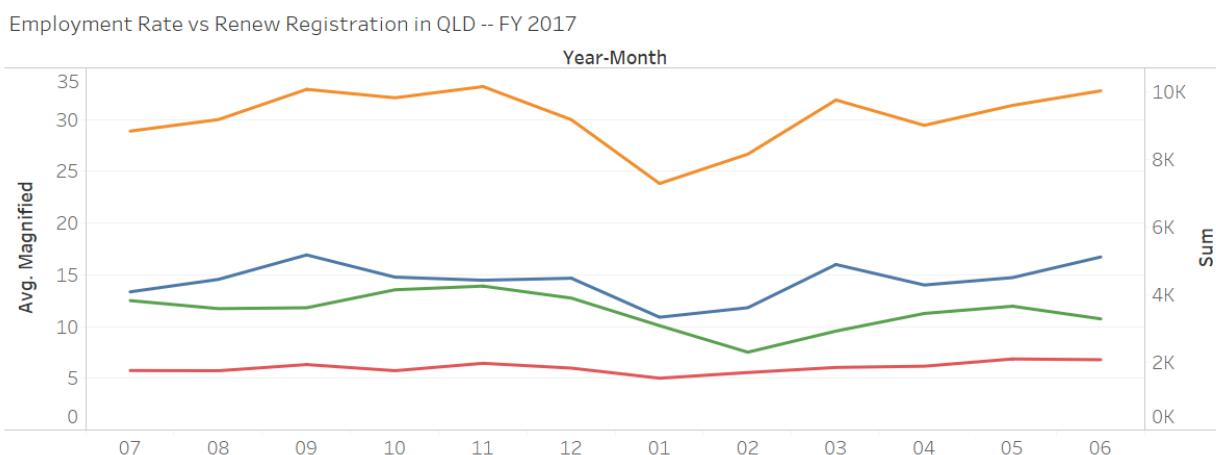
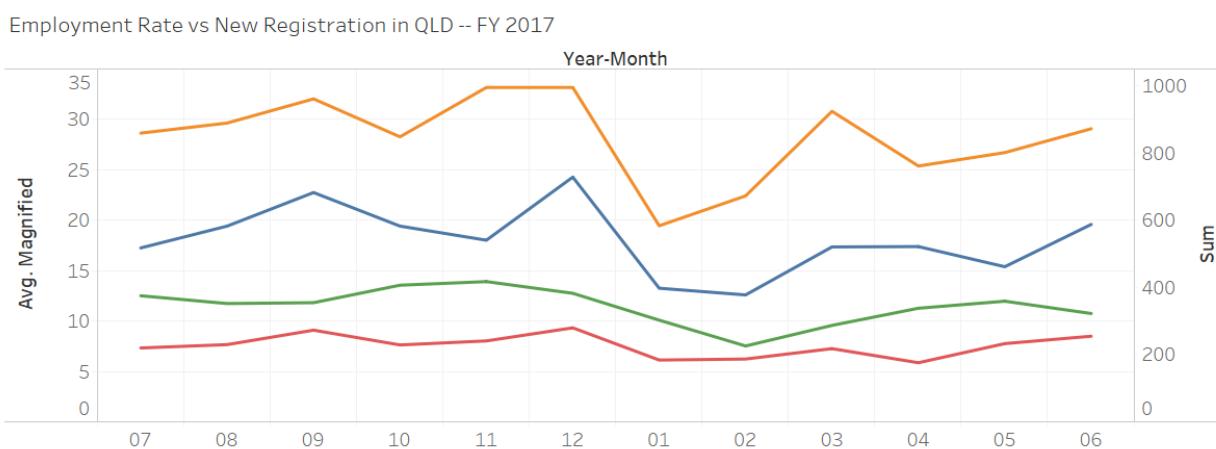
- Queensland

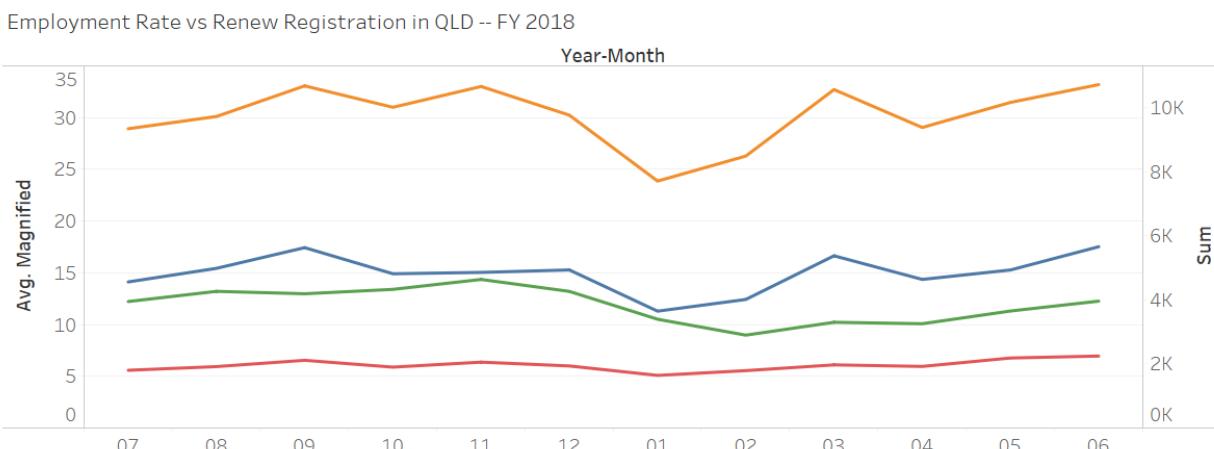
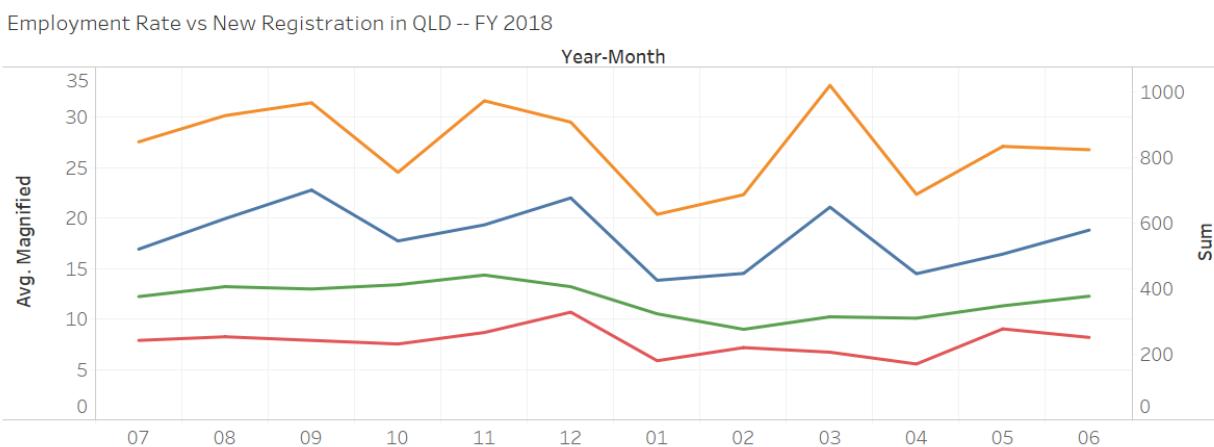
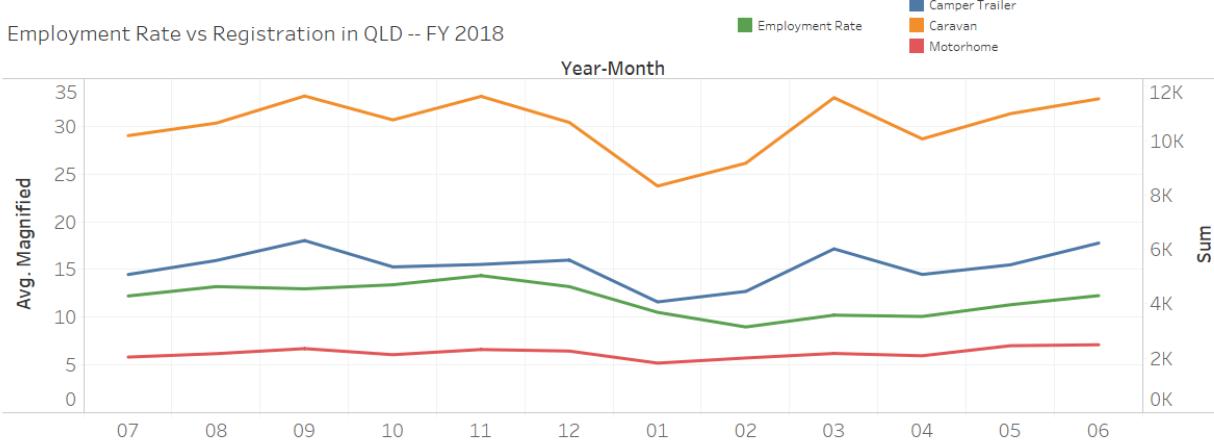
The following graph shows the trend of the employment rate and the number of registrations of 3 body types for **Queensland**. The Green line shows the employment rate. The color legend of 3 body types is shown in the graph. Caravan, Camper Trailer and Motorhome's trends are very similar to the employment rate trend.







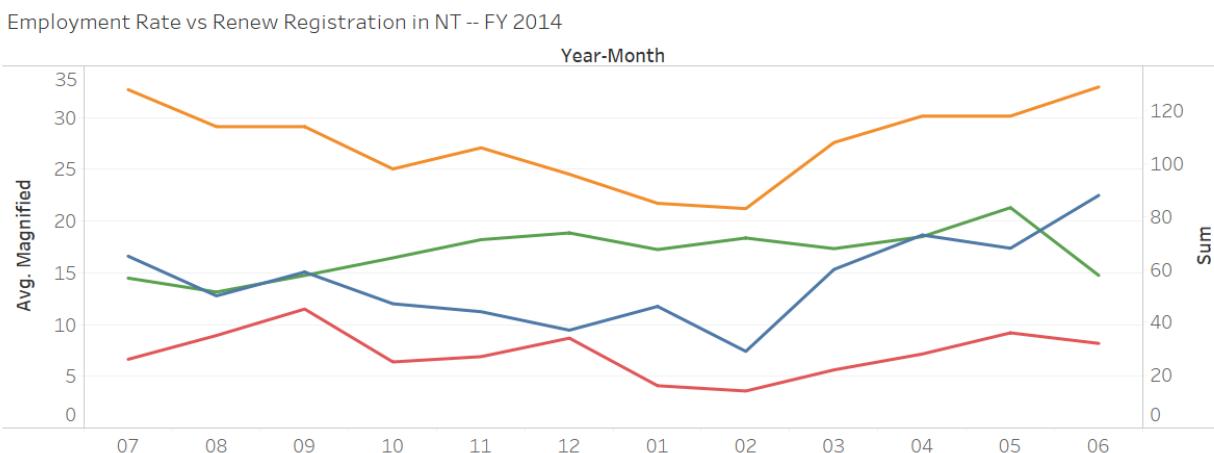
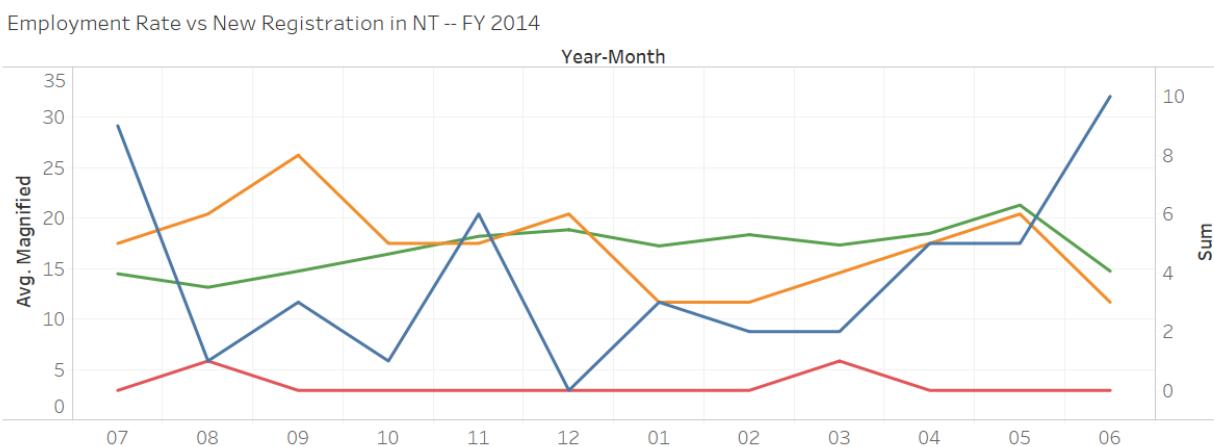
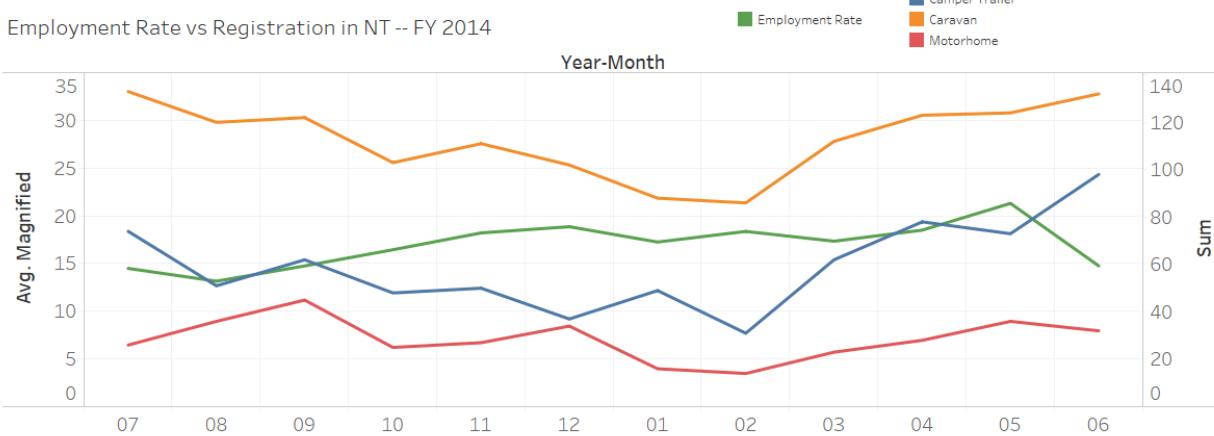


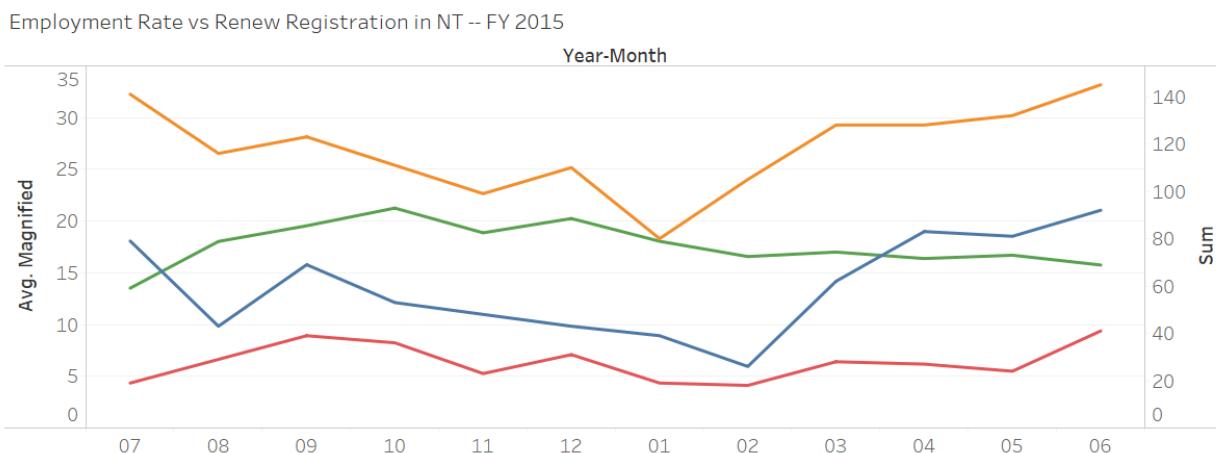
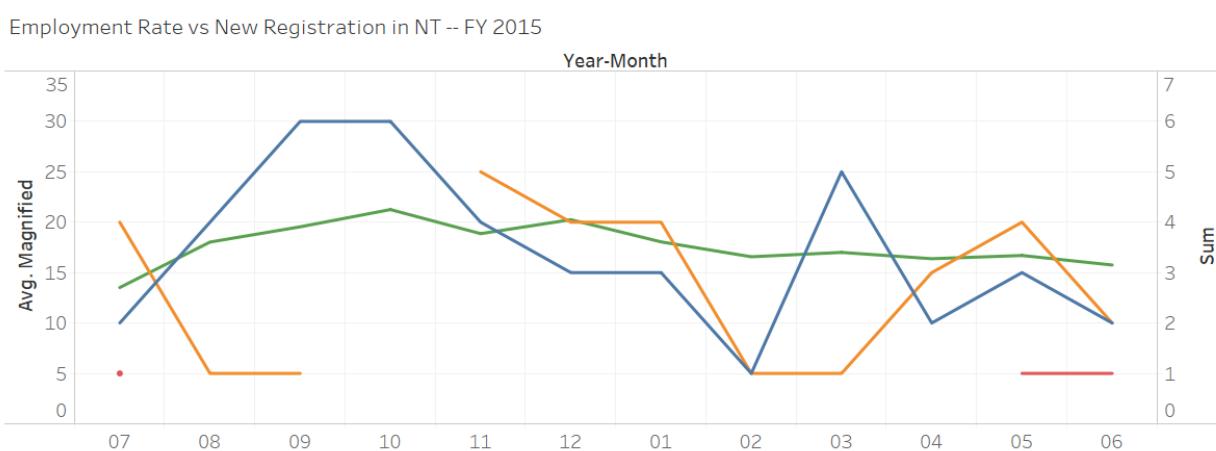
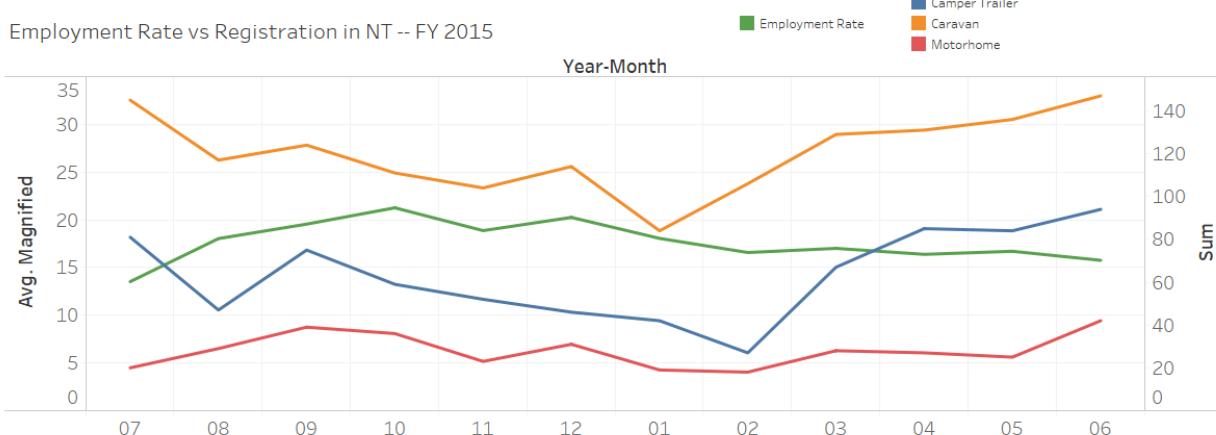


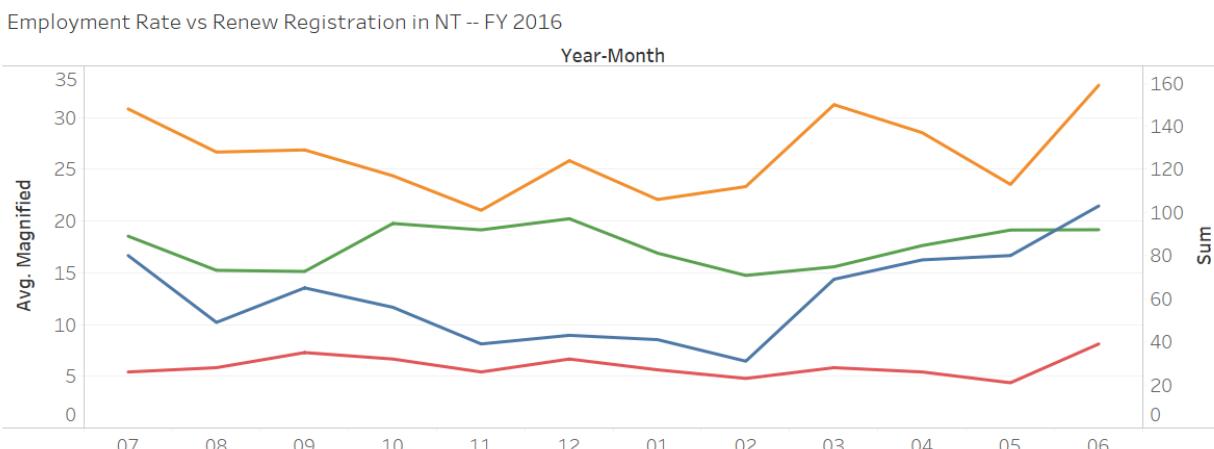
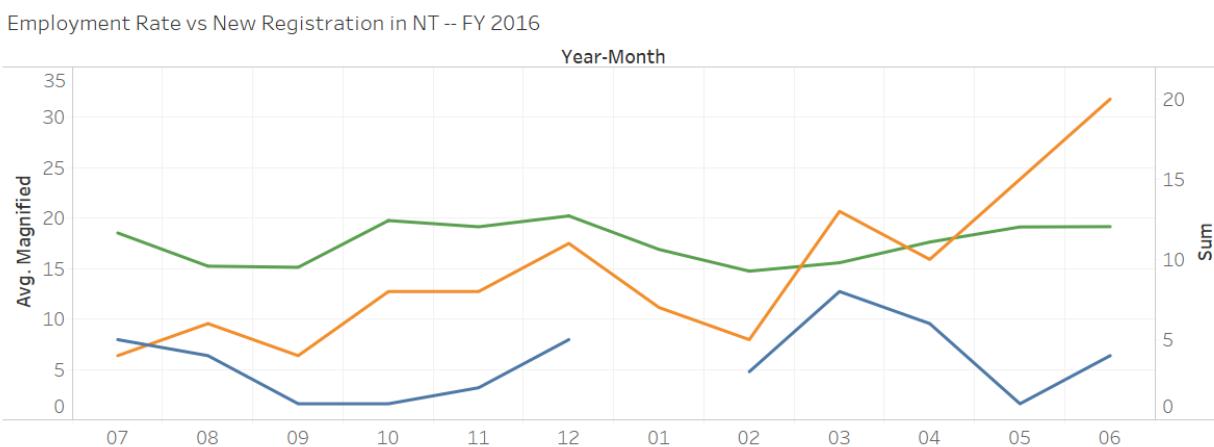
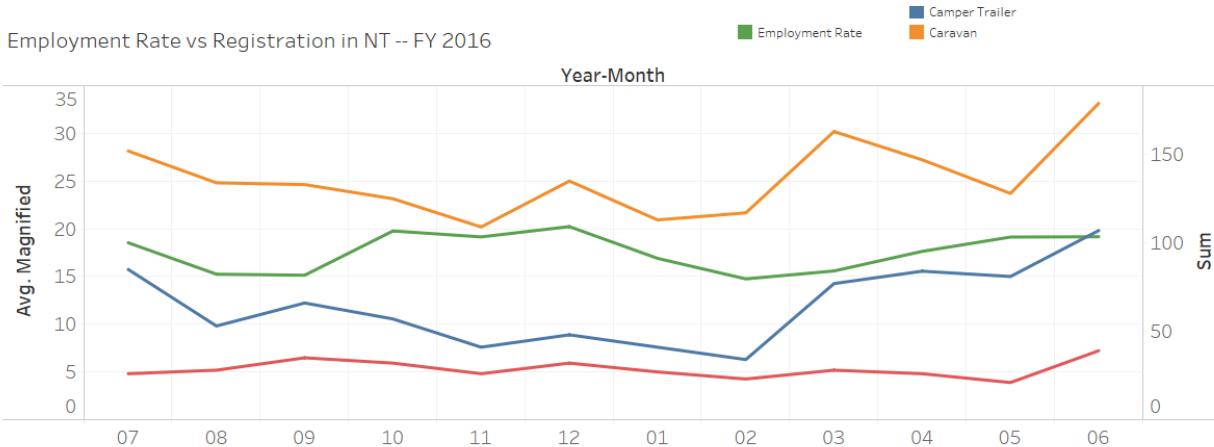
- Northern Territory

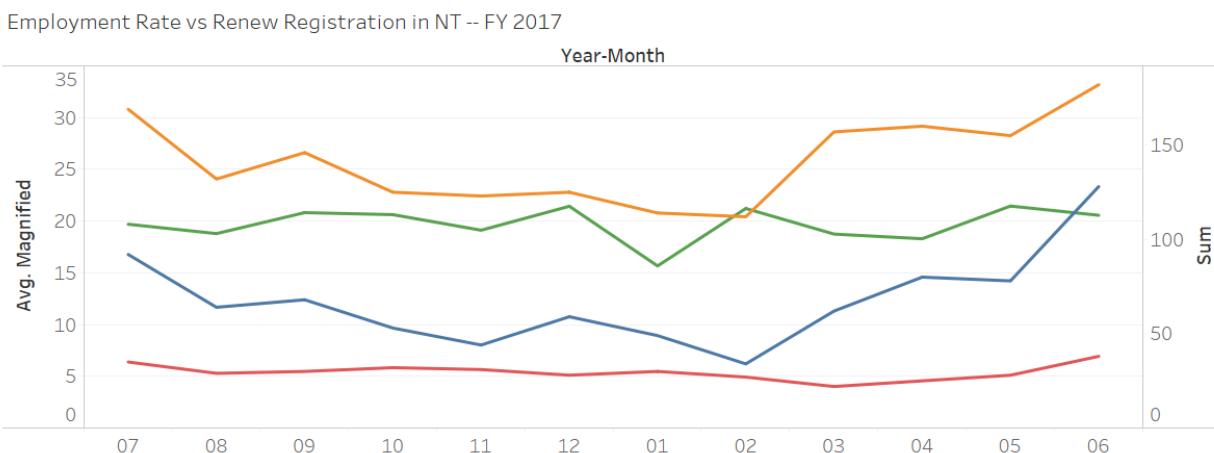
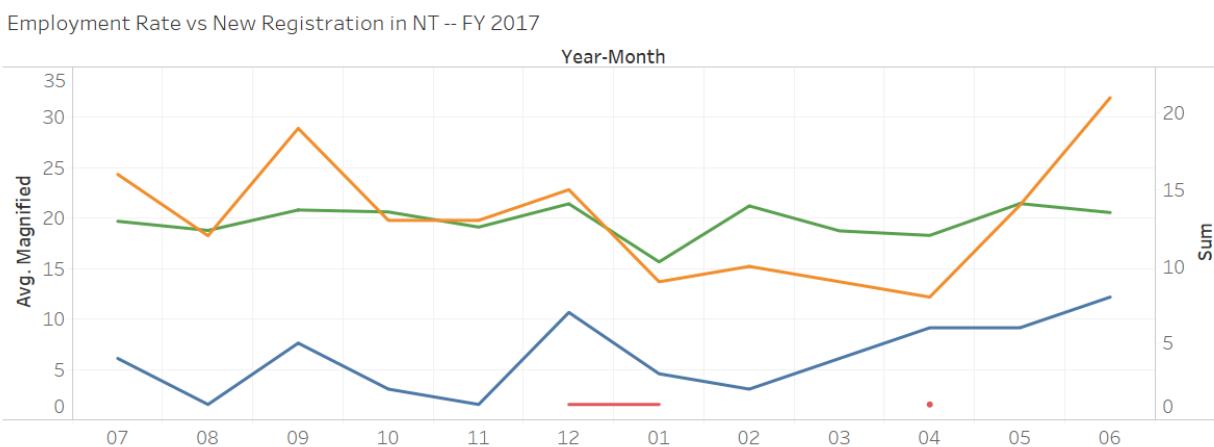
The following graph shows the trend of the employment rate and the number of registrations of 3 body types for **Northern Territory**. The Green line shows the employment rate. The color legend of 3 body types is shown in the graph.

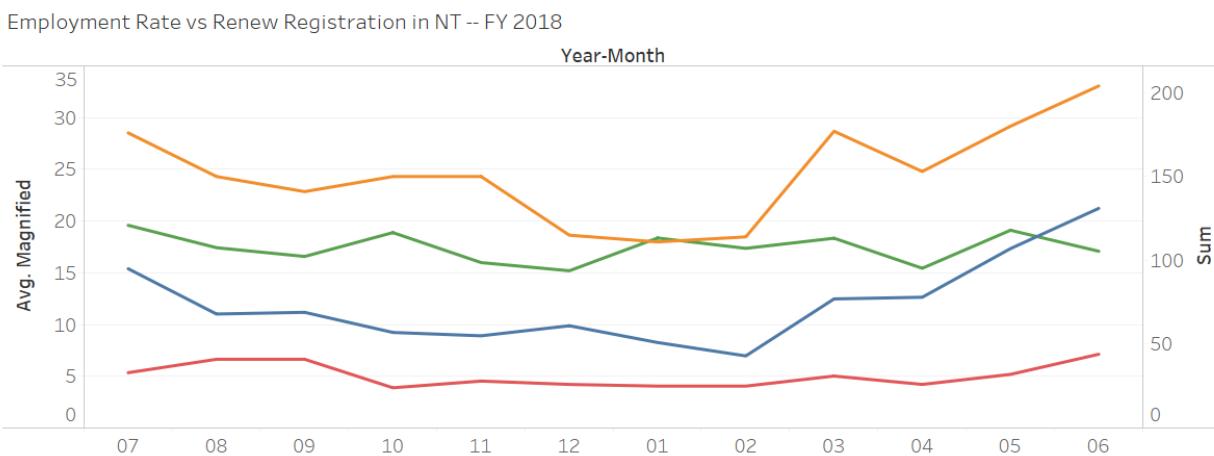
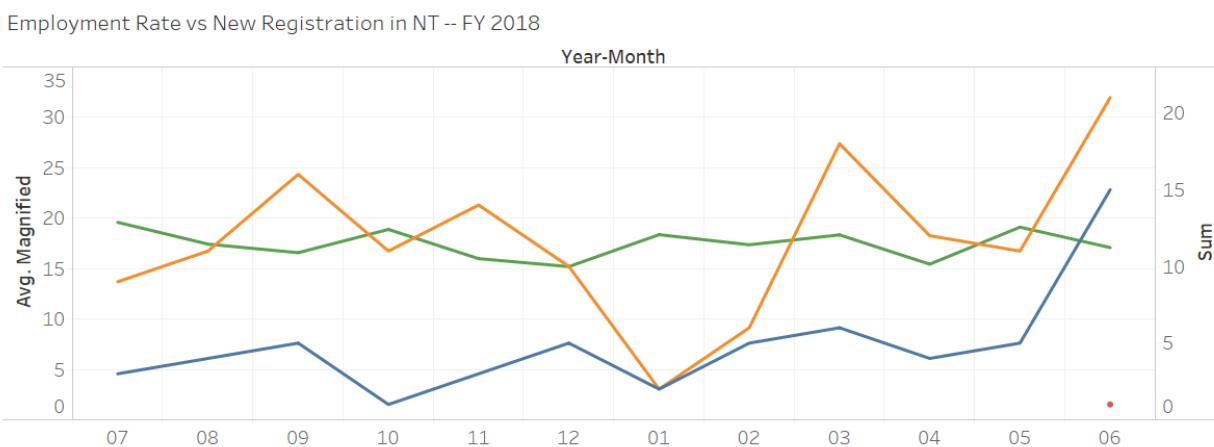
There's no obvious relationship between the employment rate and the number of registrations in Northern Territory.









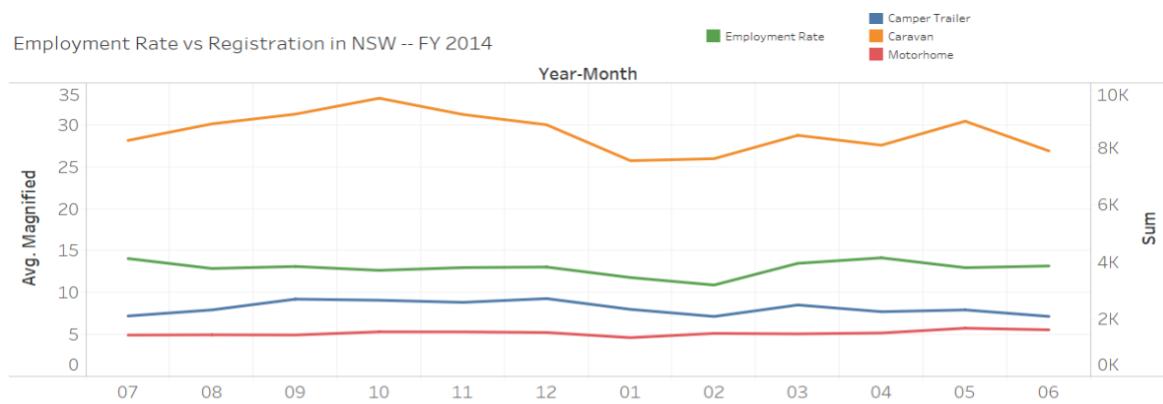


- New South Wales

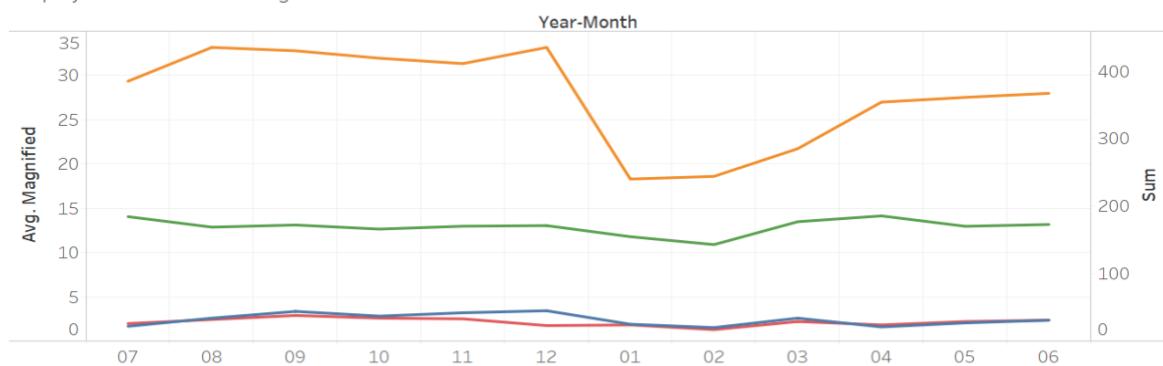
The following graph shows the trend of the employment rate and the number of registrations of 3 body types for **New South Wales**. The Green line shows the employment rate. The color legend of 3 body types is shown in the graph.

Caravan, Camper Trailer and Motorhome's trend are all very similar to the employment rate trend, while Caravan's trend is more fluctuated than Camper Trailer and Motorhome's trends.

Employment Rate vs Registration in NSW -- FY 2014



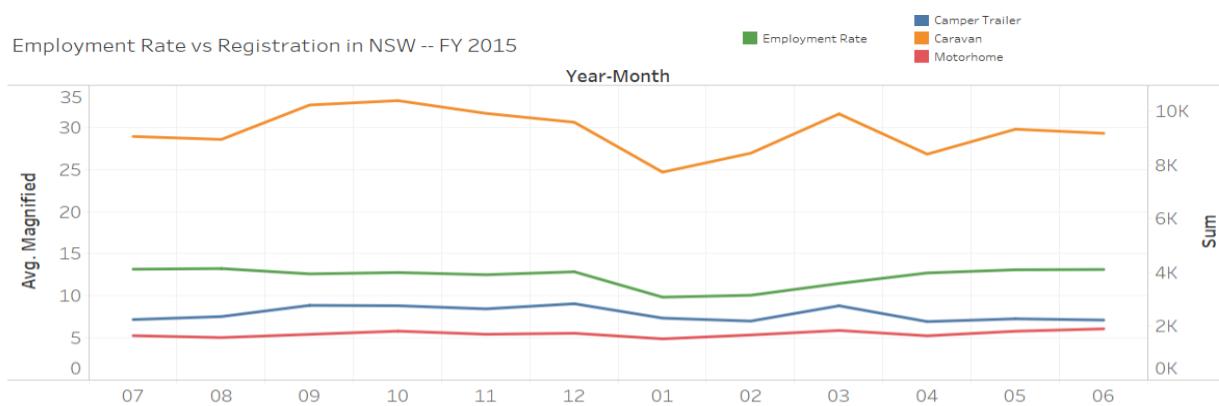
Employment Rate vs New Registration in NSW -- FY 2014



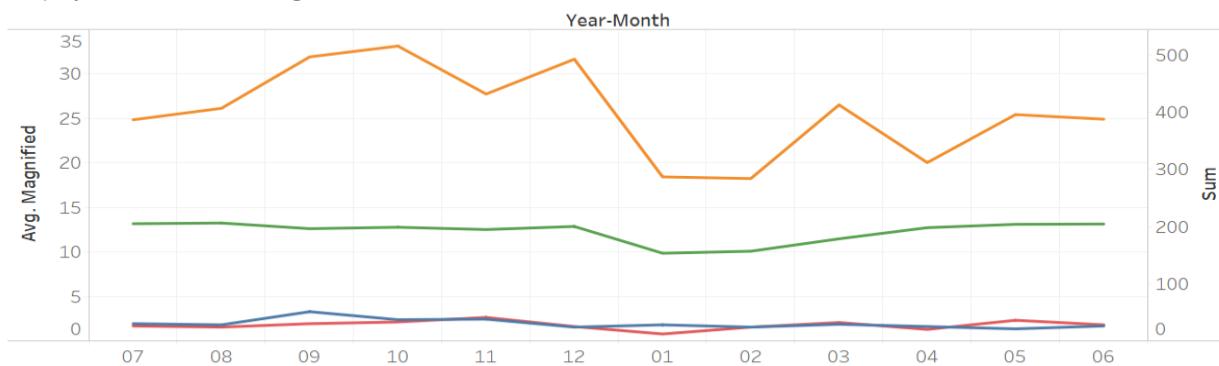
Employment Rate vs Renew Registration in NSW -- FY 2014



Employment Rate vs Registration in NSW -- FY 2015

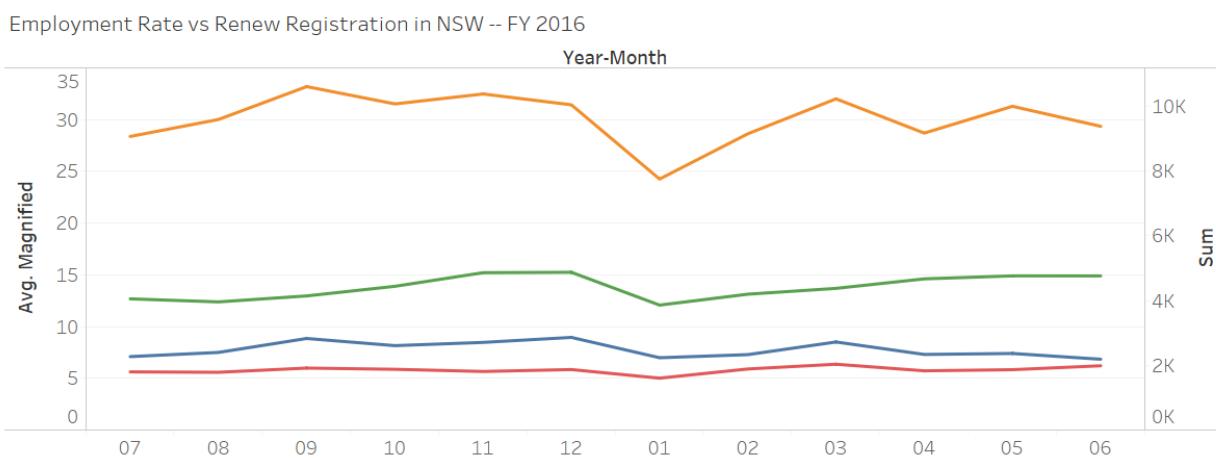
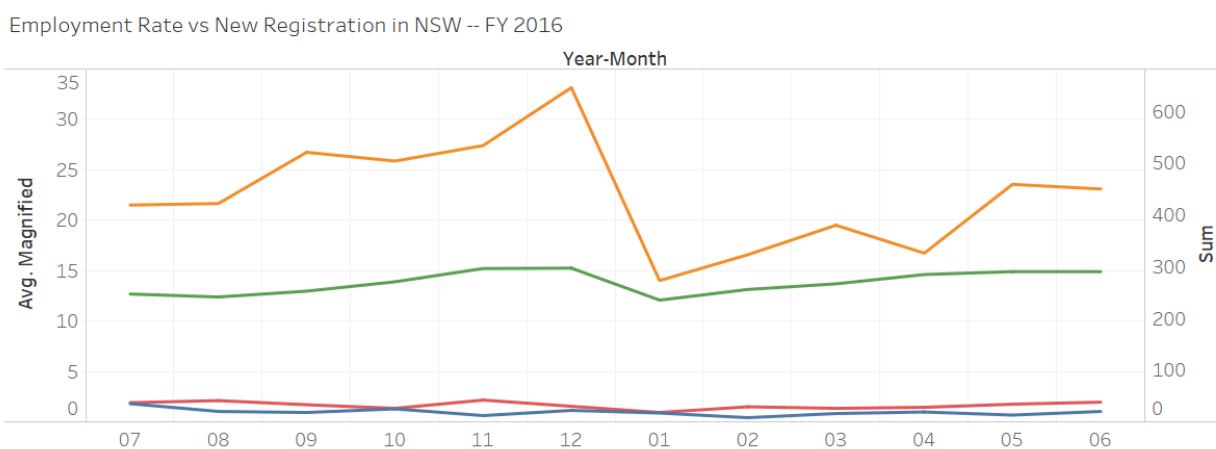
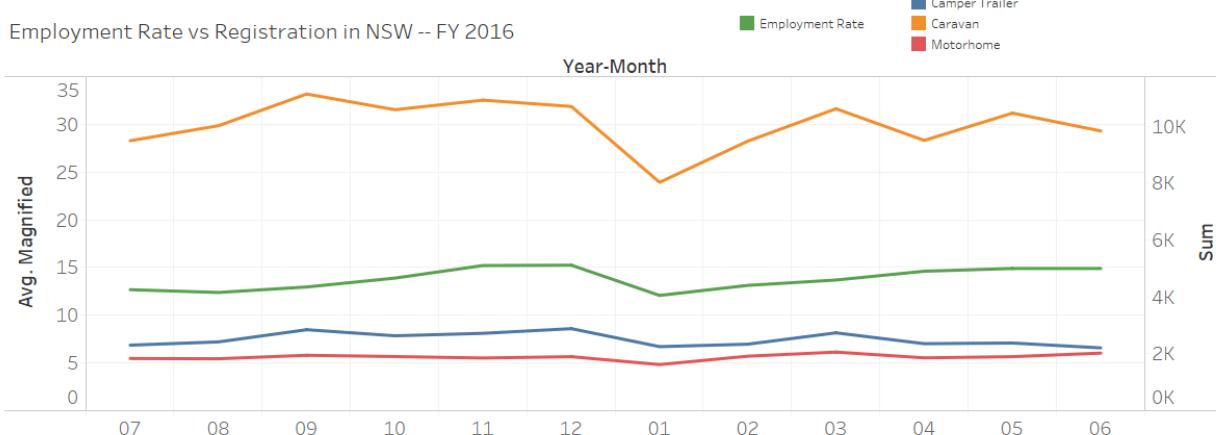


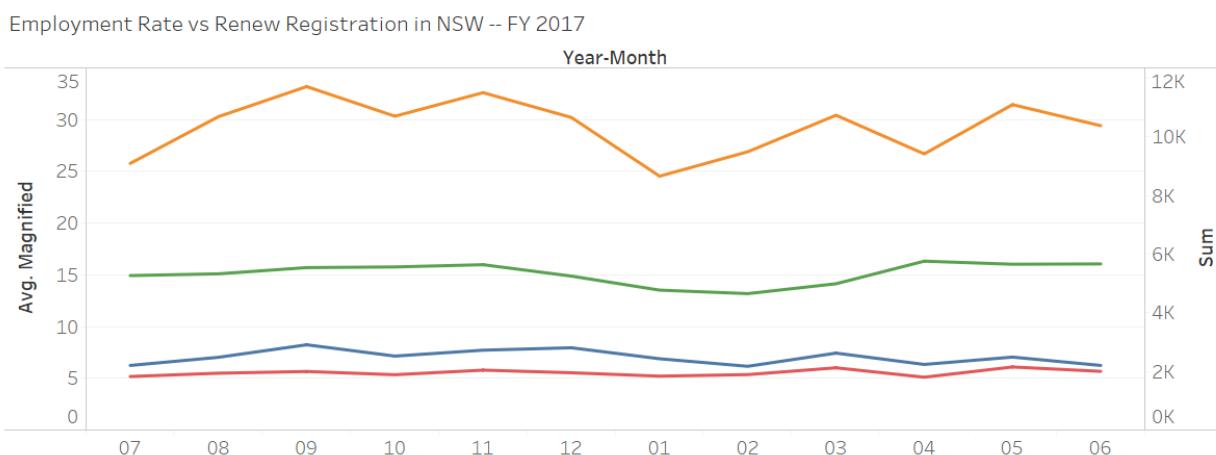
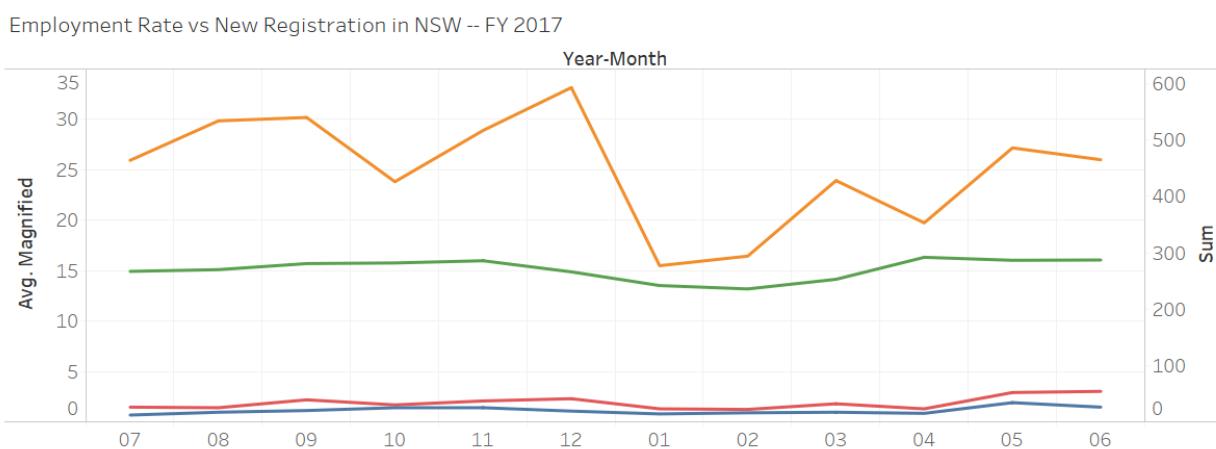
Employment Rate vs New Registration in NSW -- FY 2015

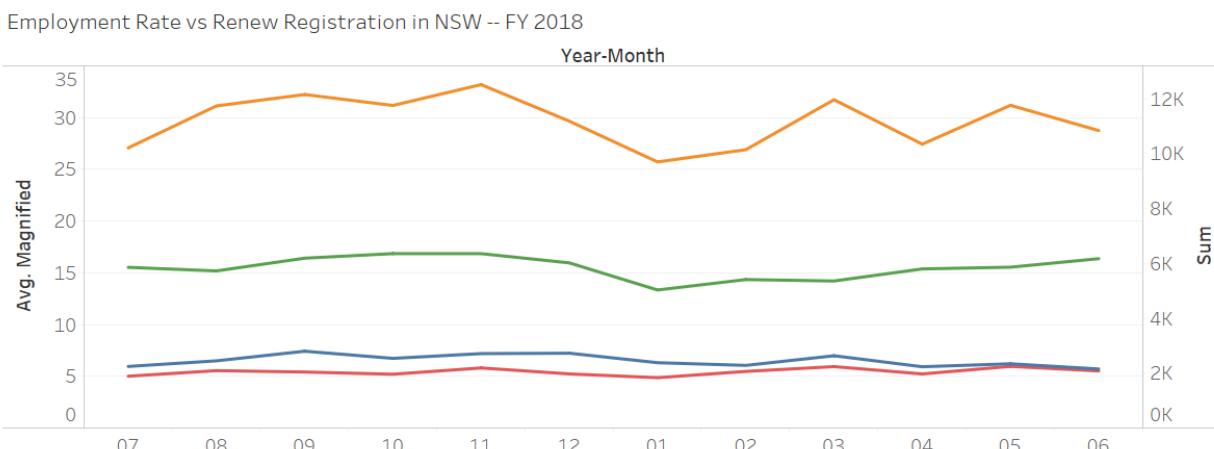
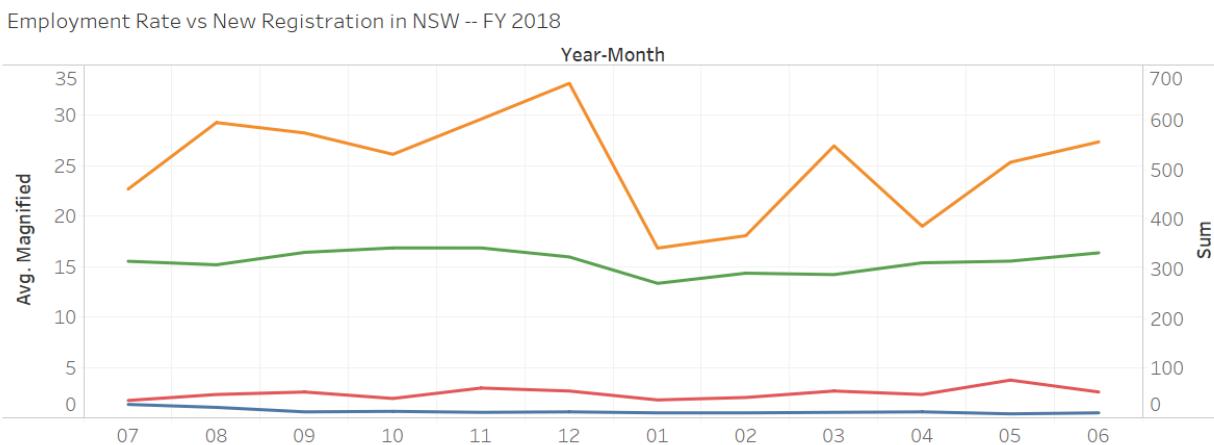
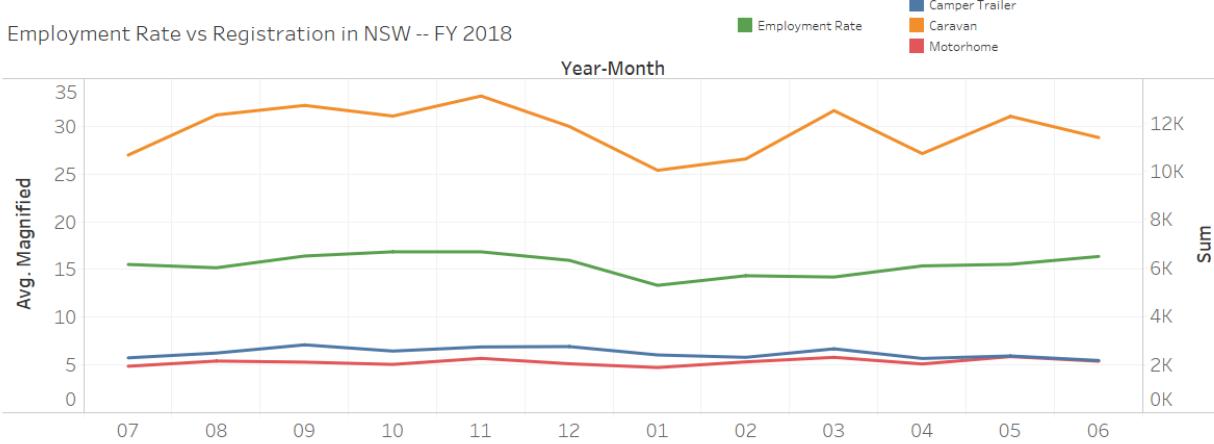


Employment Rate vs Renew Registration in NSW -- FY 2015



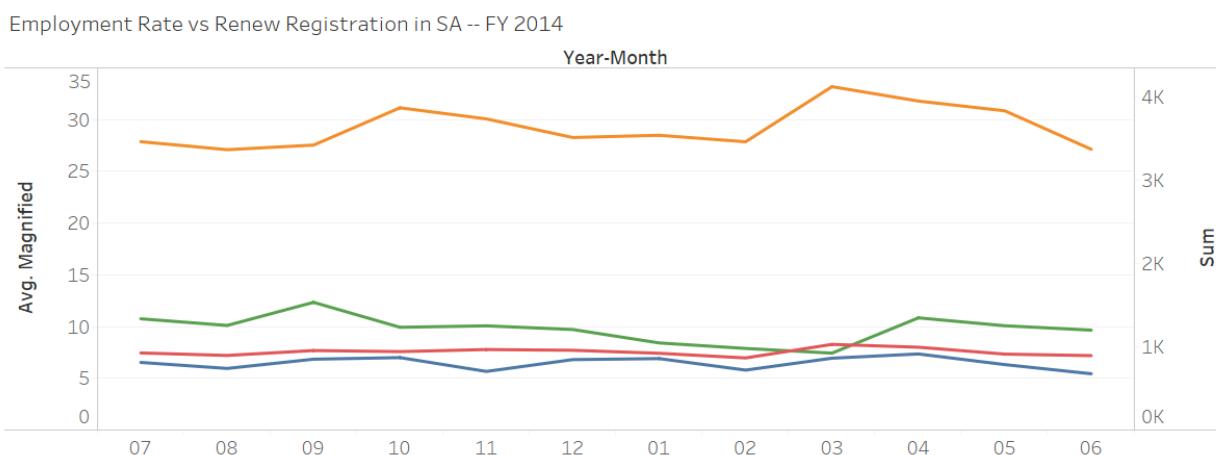
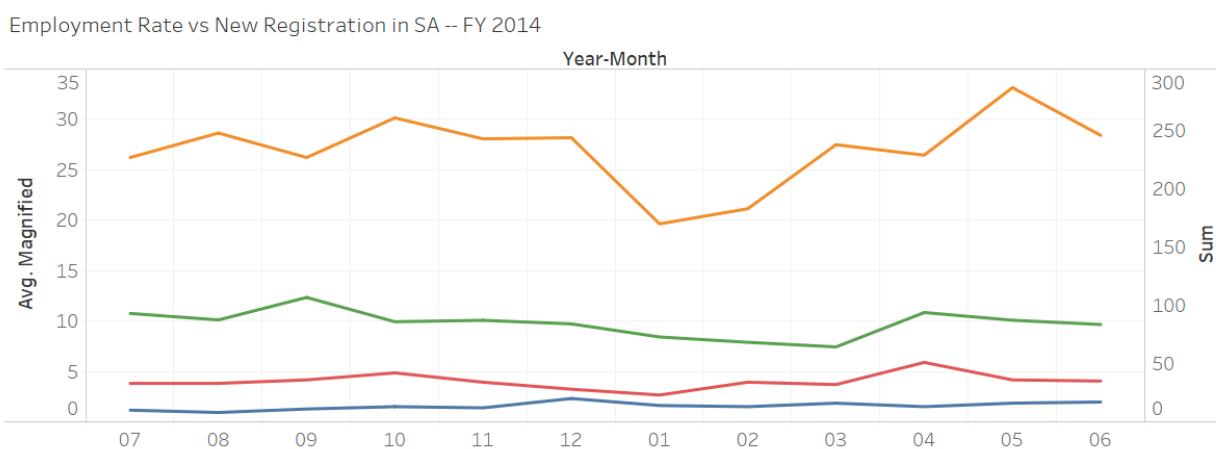
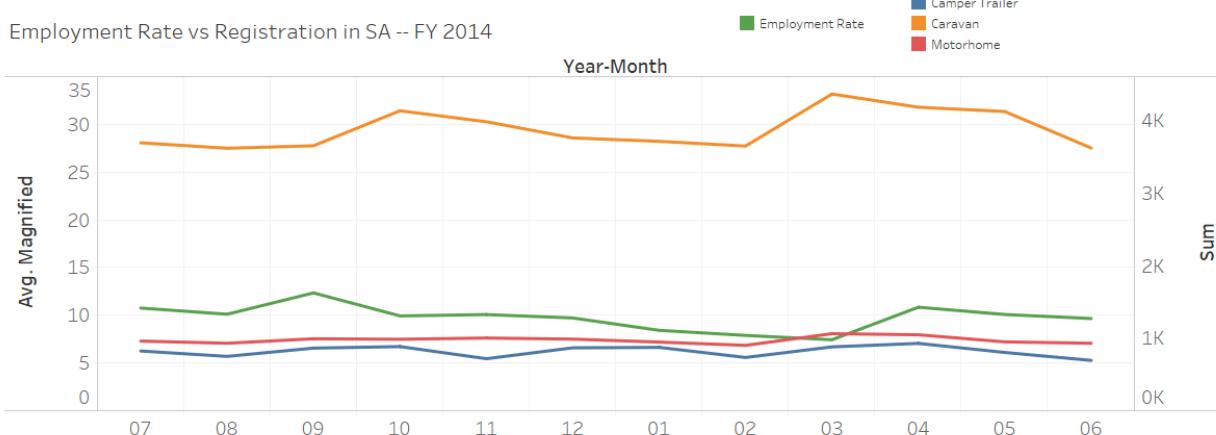


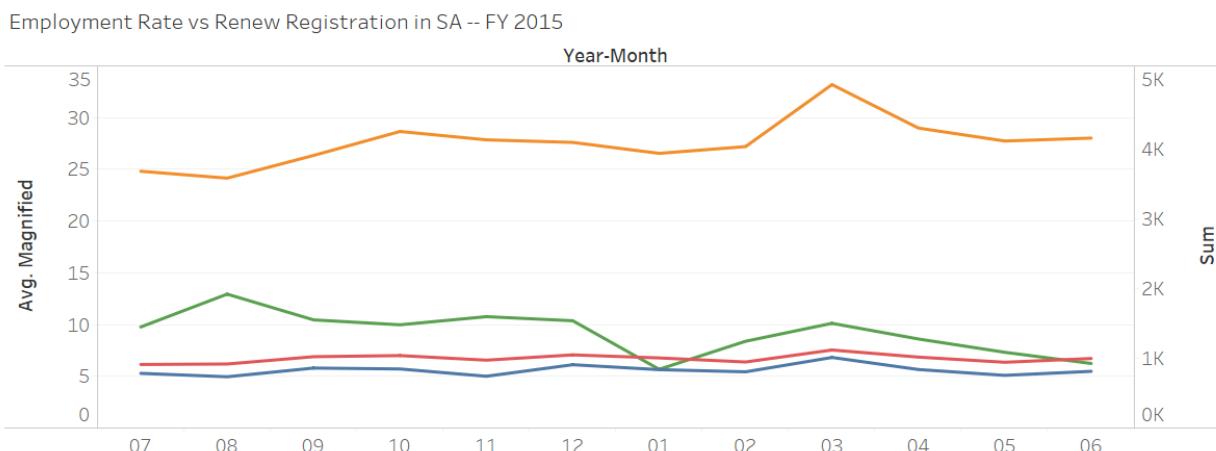
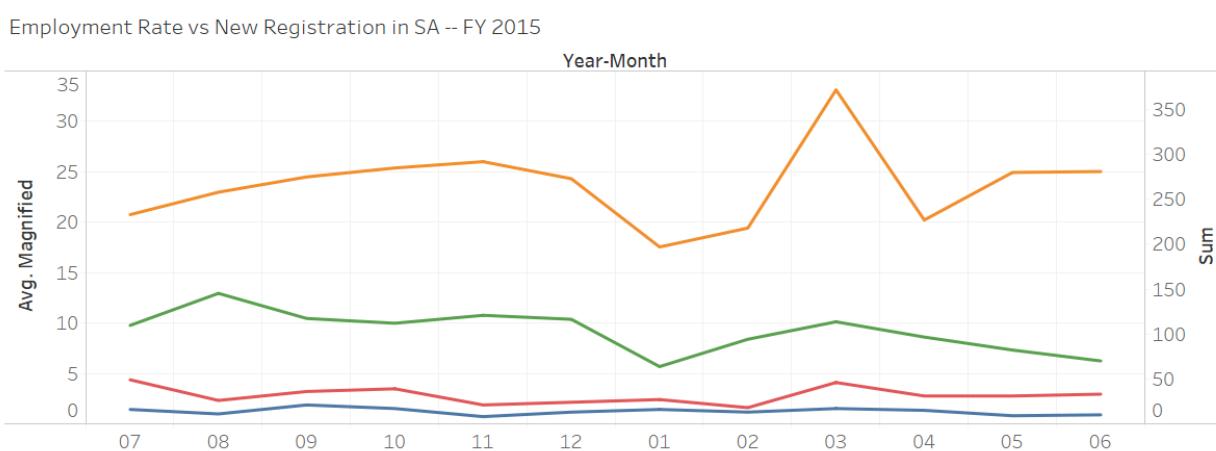
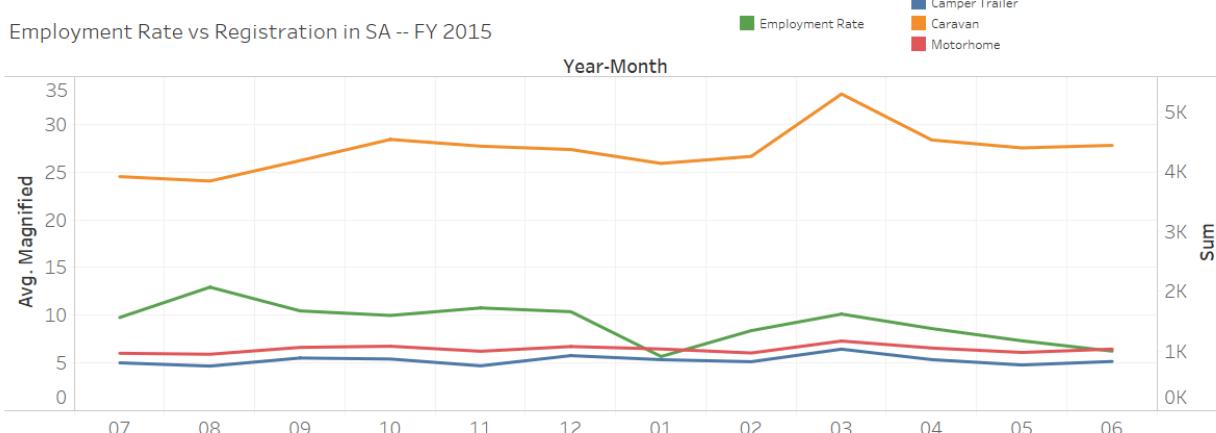


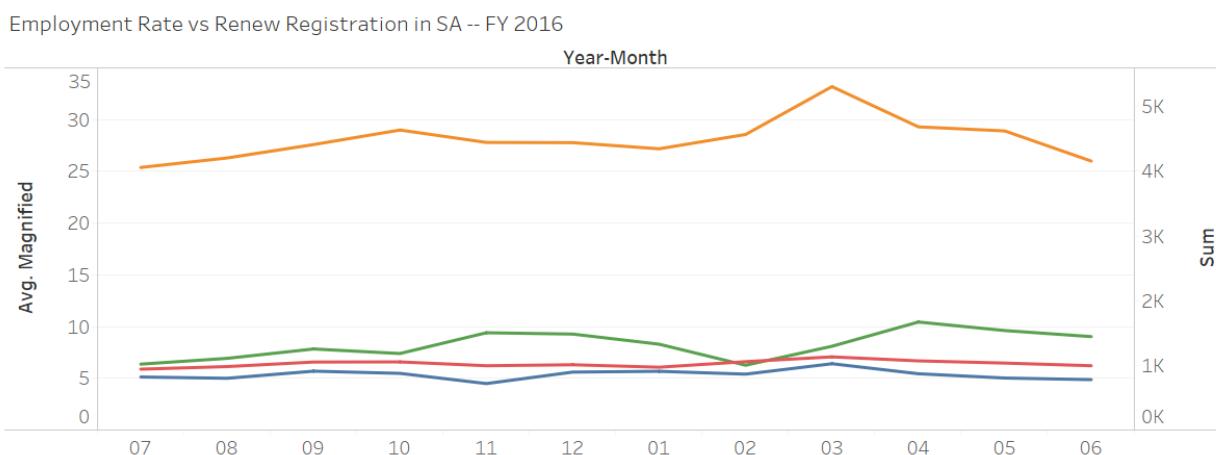
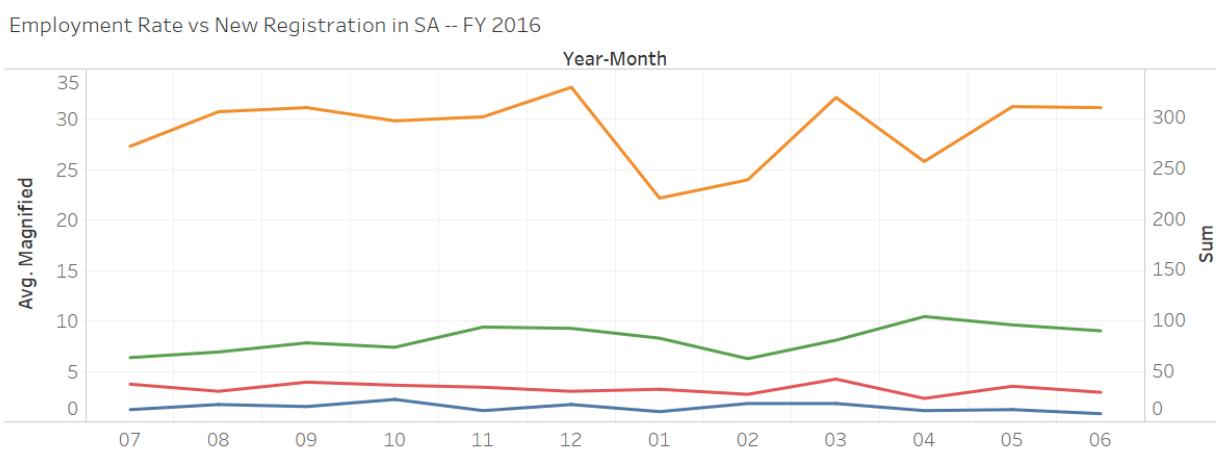
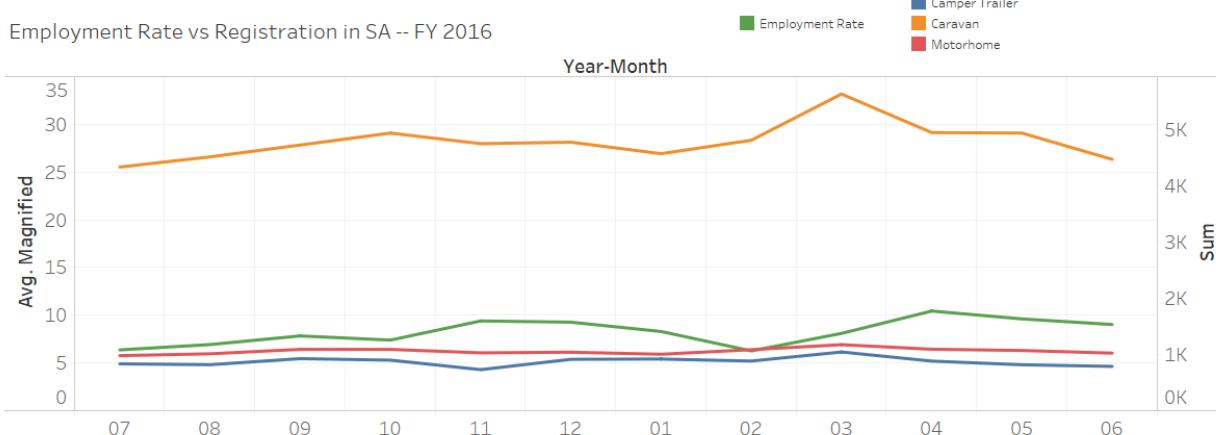


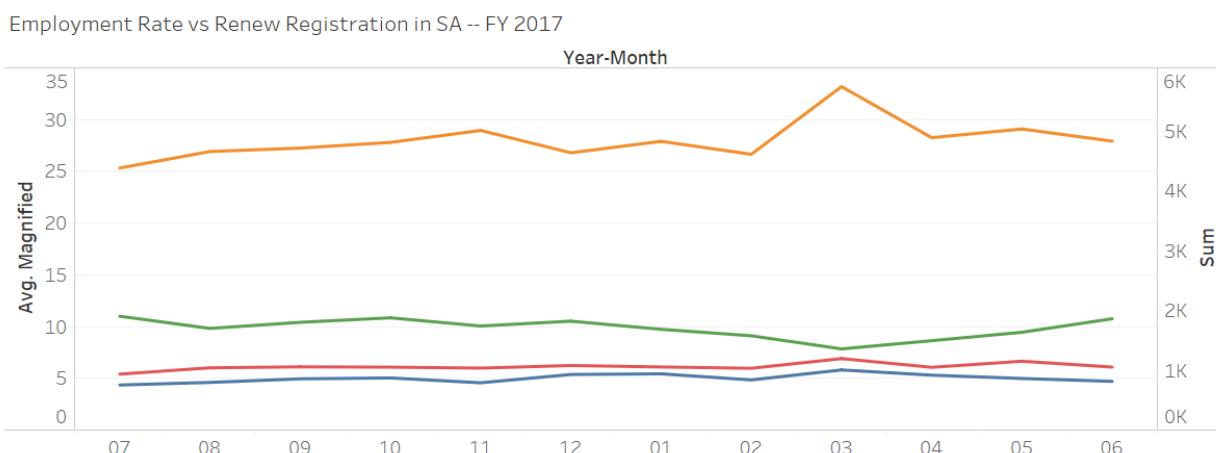
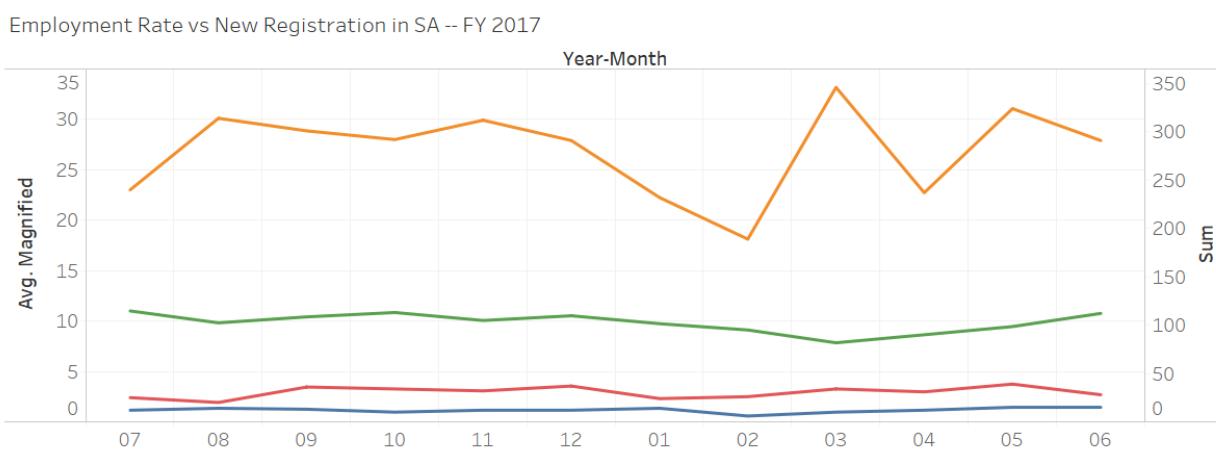
- South Australia

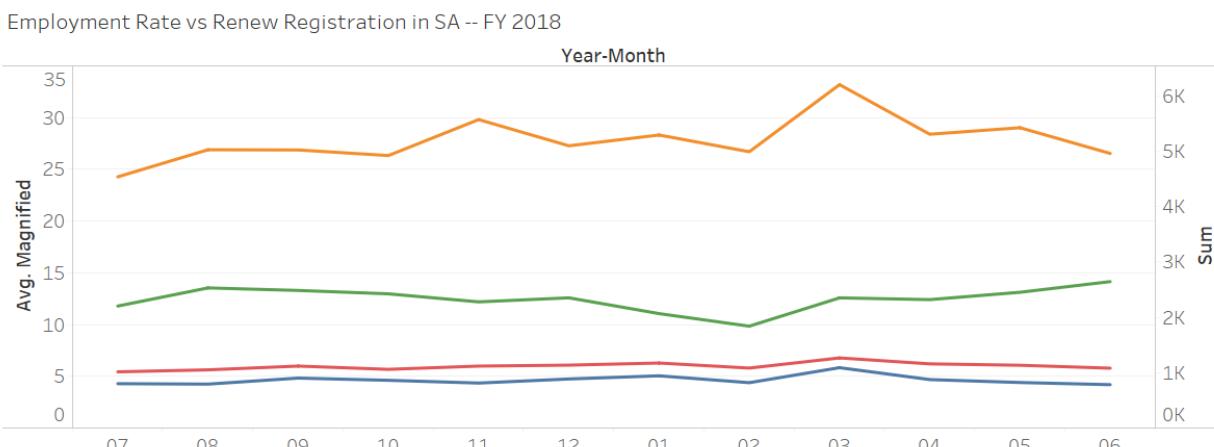
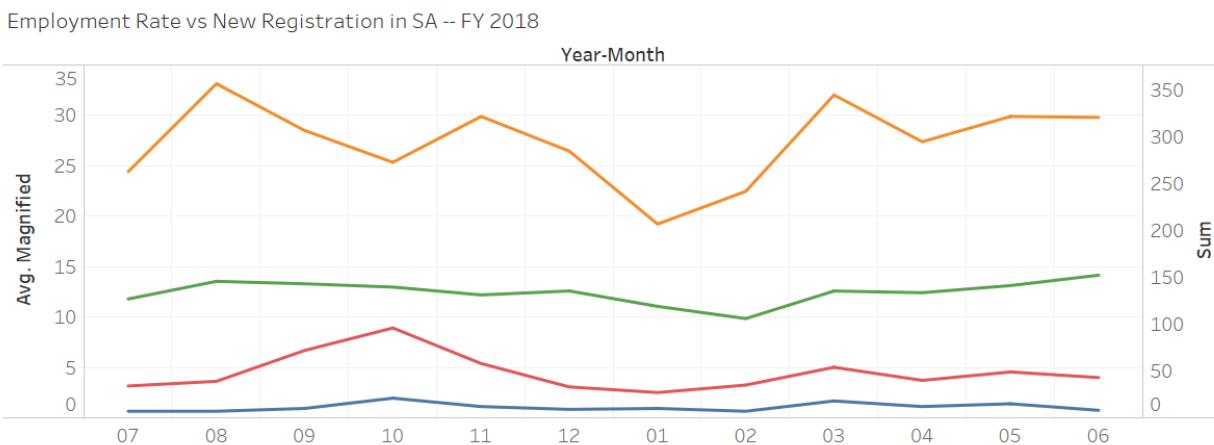
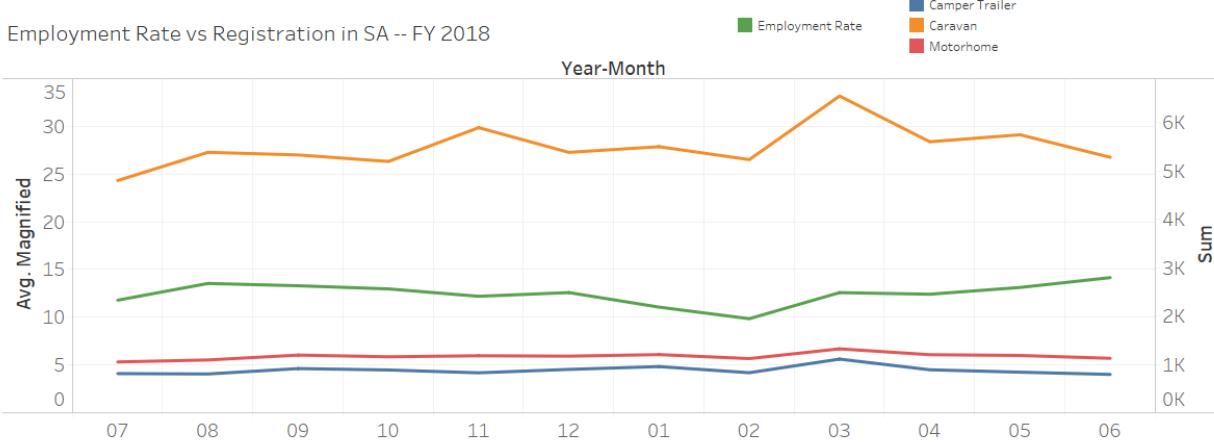
The following graph shows the trend of the employment rate and the number of registrations of 3 body types for **South Australia**. The Green line shows the employment rate. The color legend of 3 body types is shown in the graph. There's no obvious relationship between the employment rate and the number of registrations in South Australia.





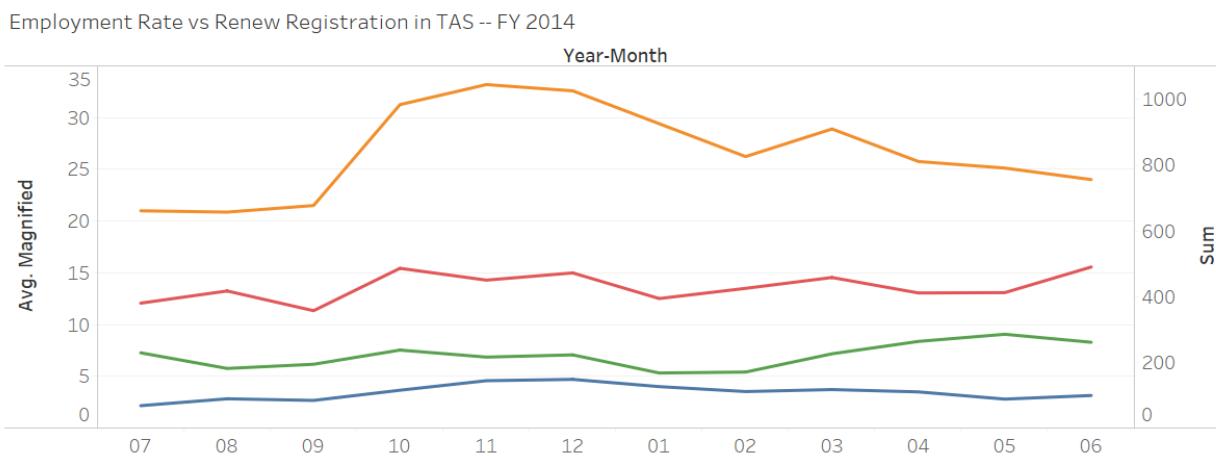
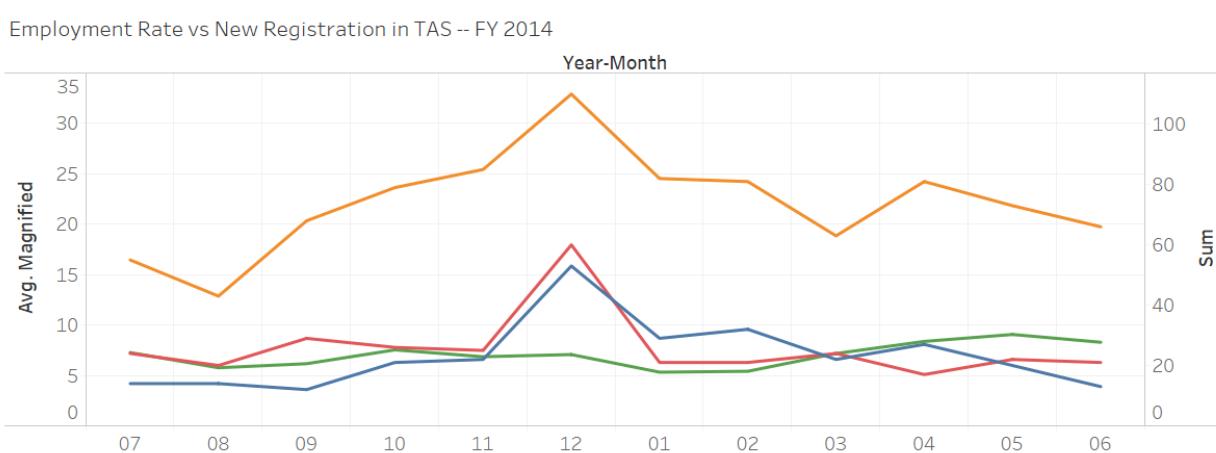
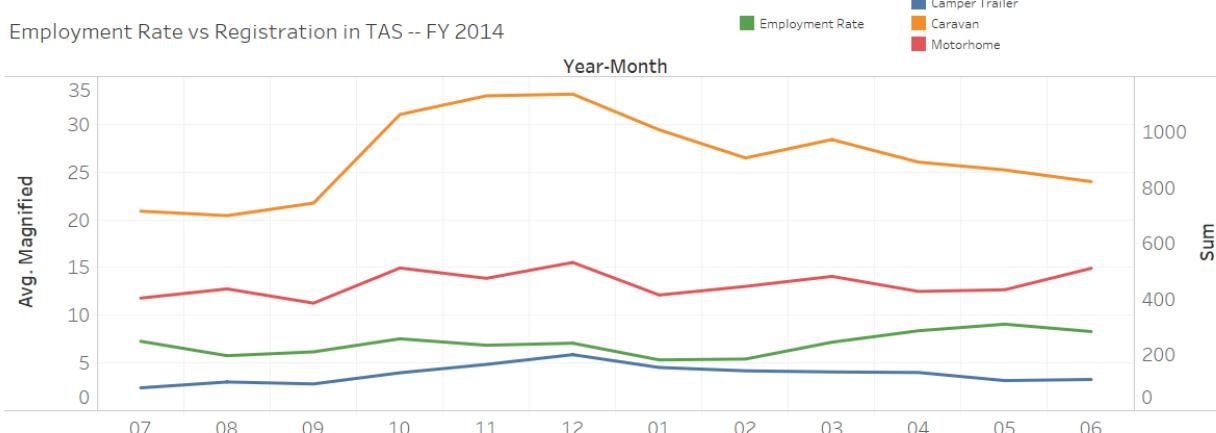


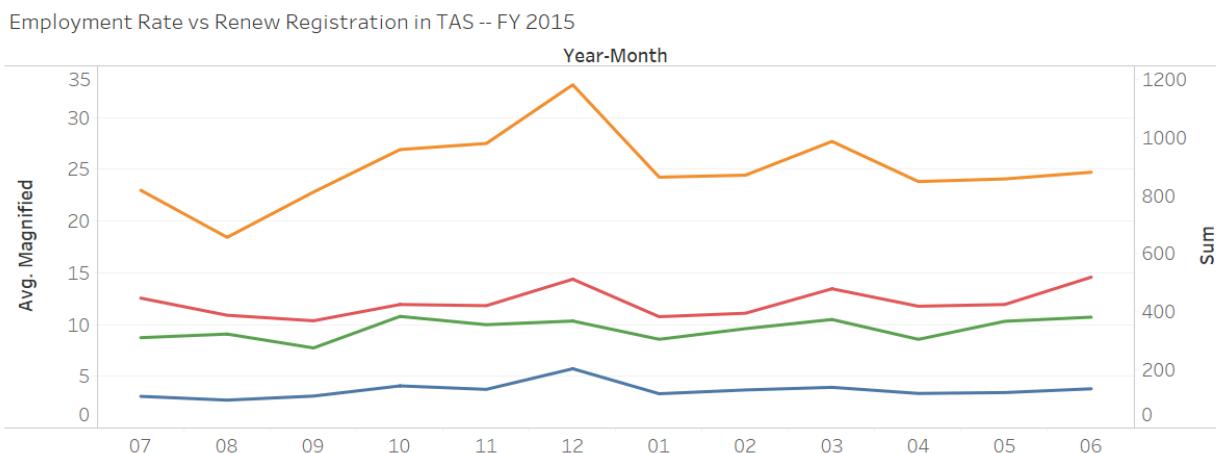
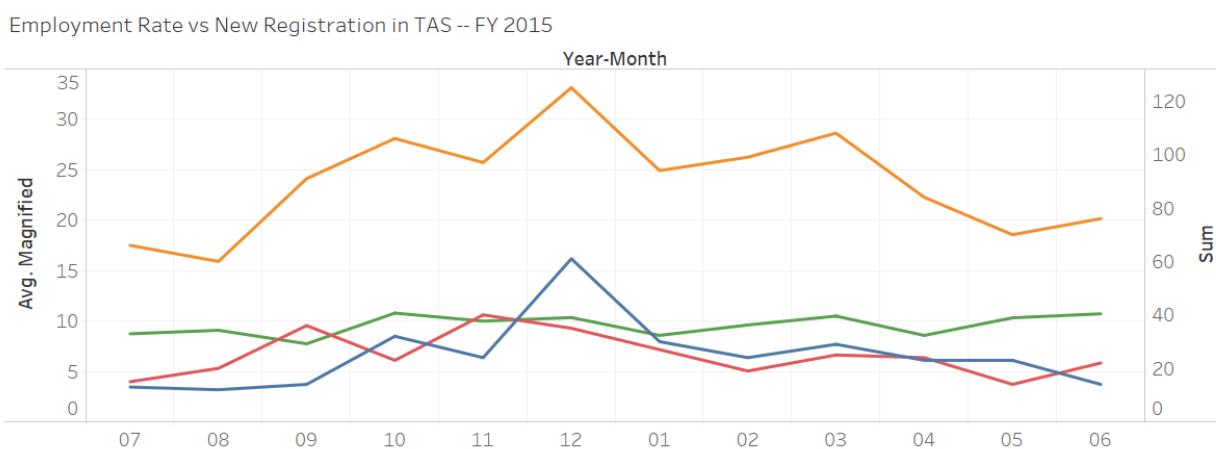
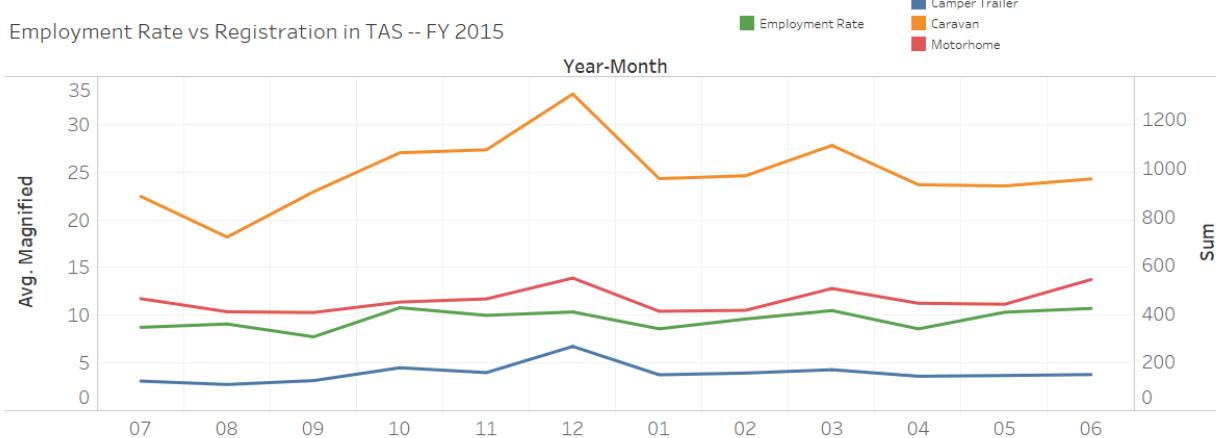


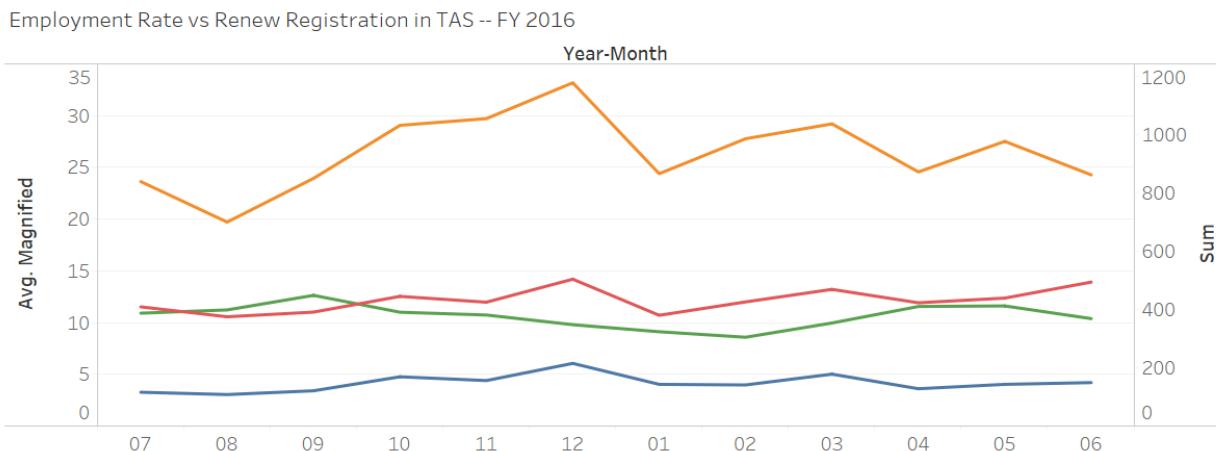
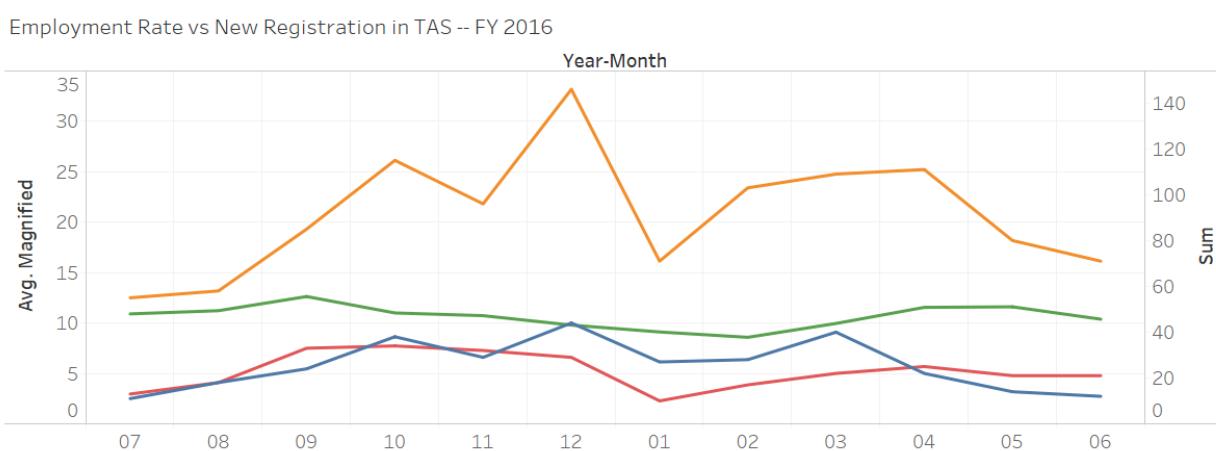
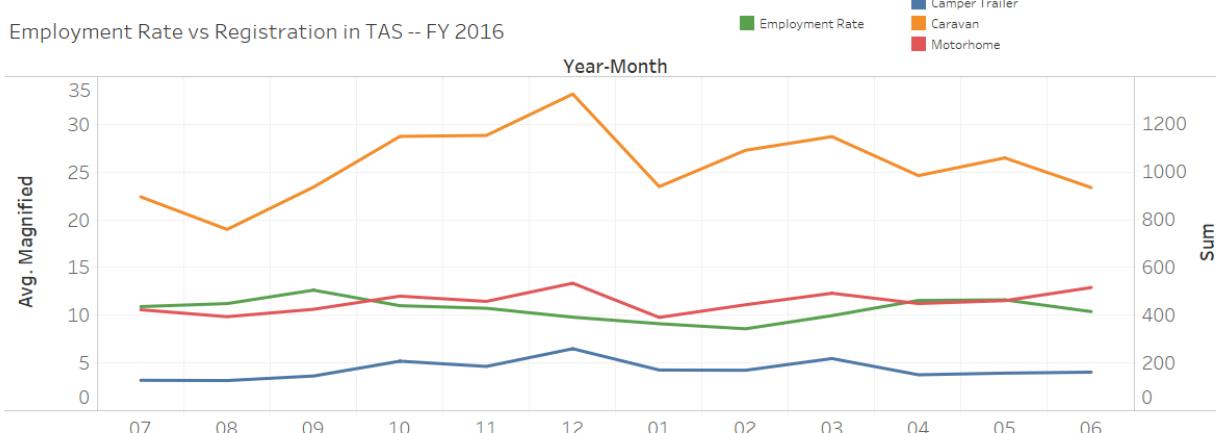


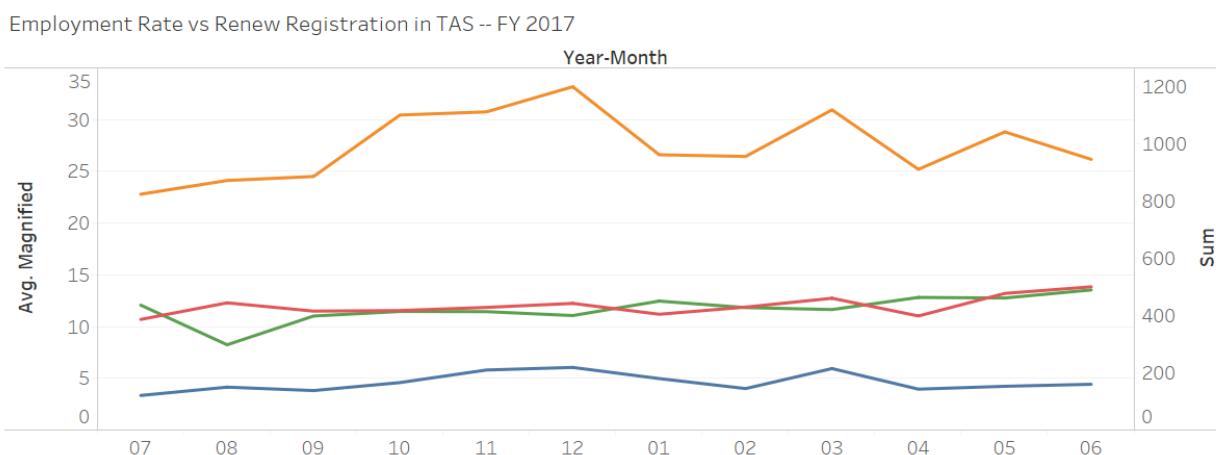
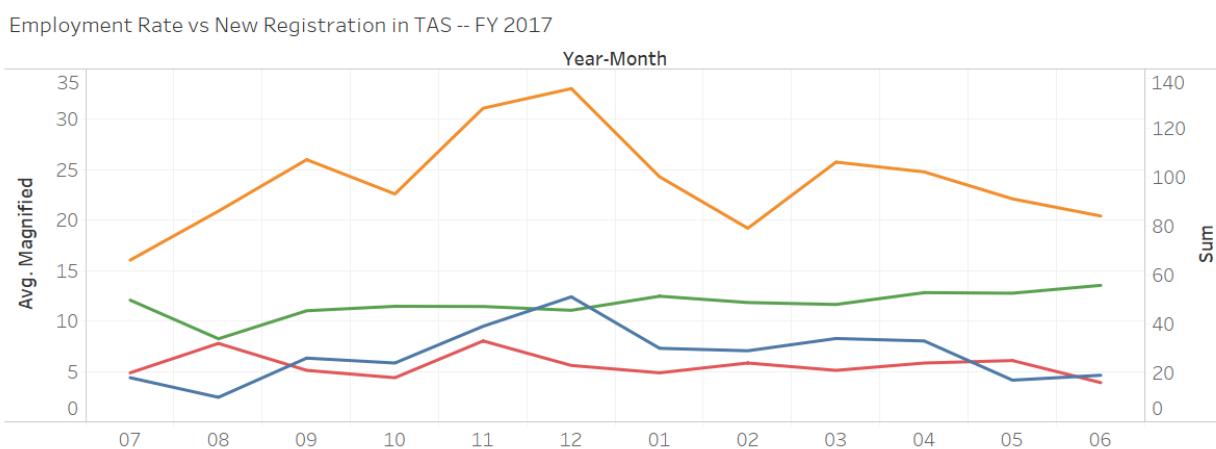
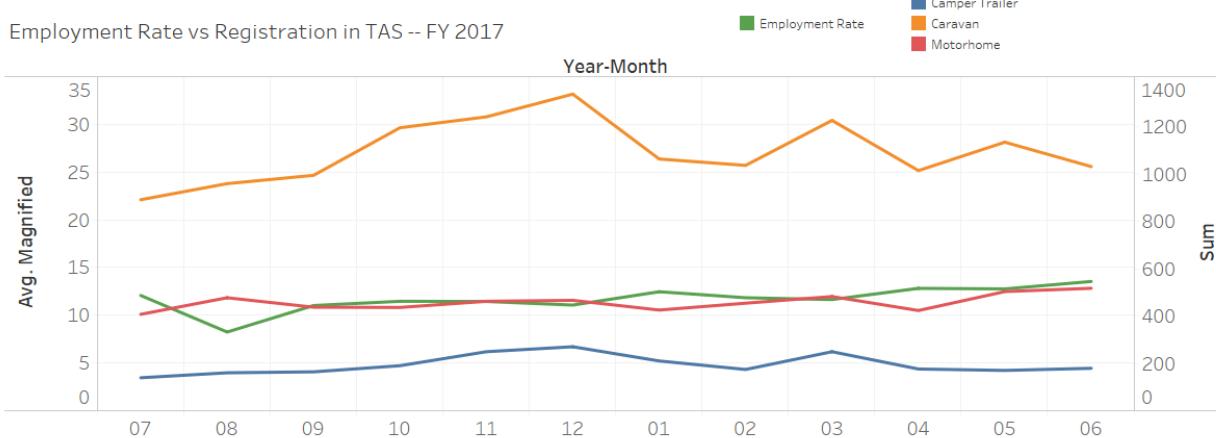
- Tasmania

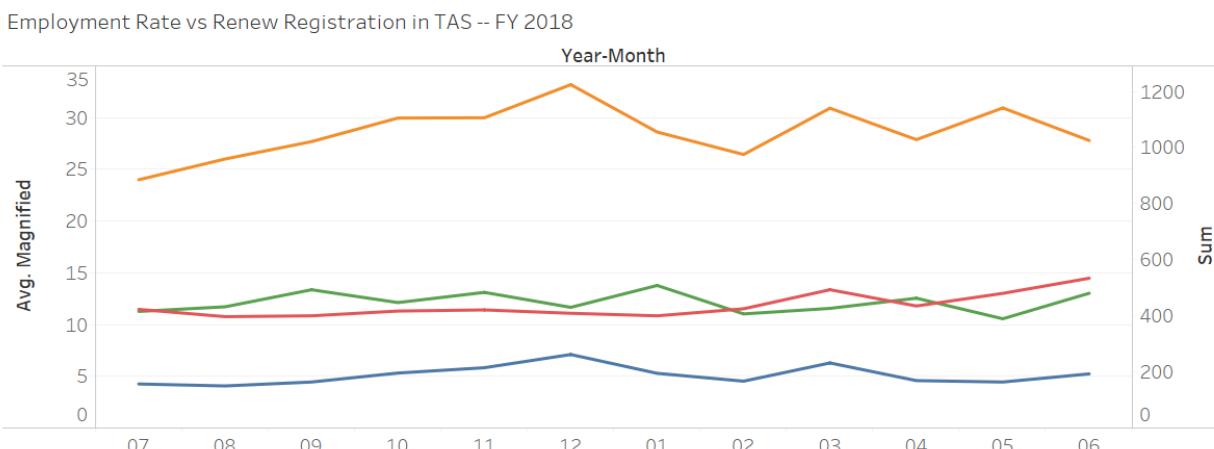
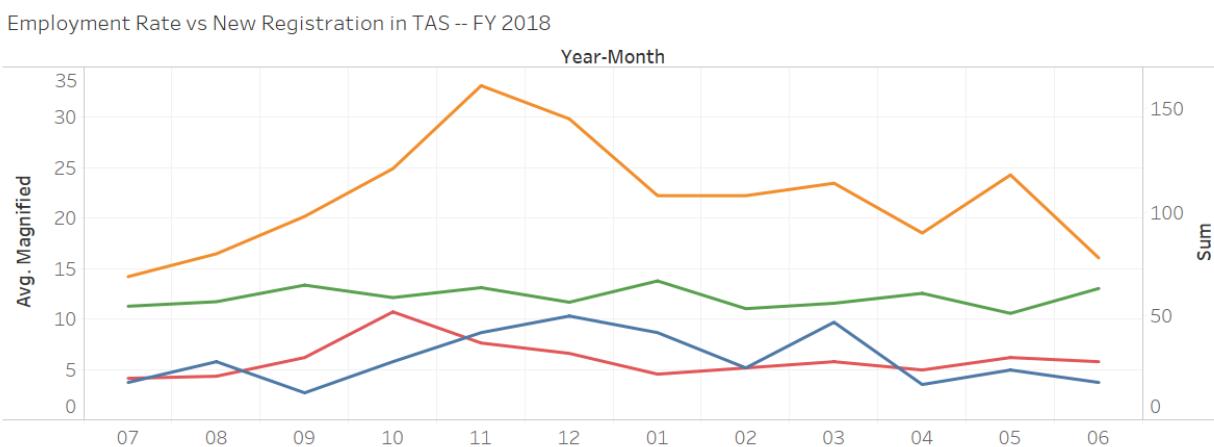
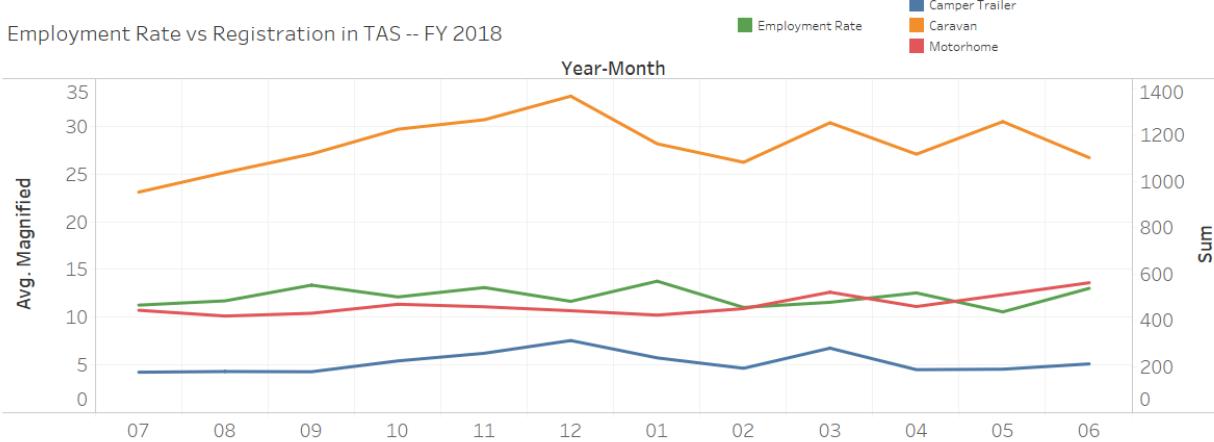
The following graph shows the trend of the employment rate and the number of registrations of 3 body types for **Tasmania**. The Green line shows the employment rate. The color legend of 3 body types is shown in the graph. There's no obvious relationship between the employment rate and the number of registrations in Tasmania.







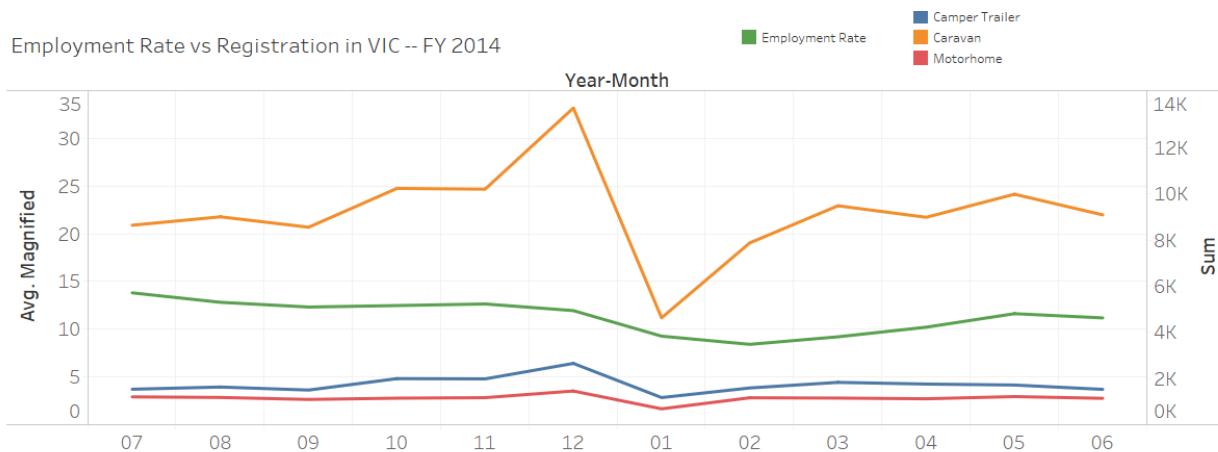




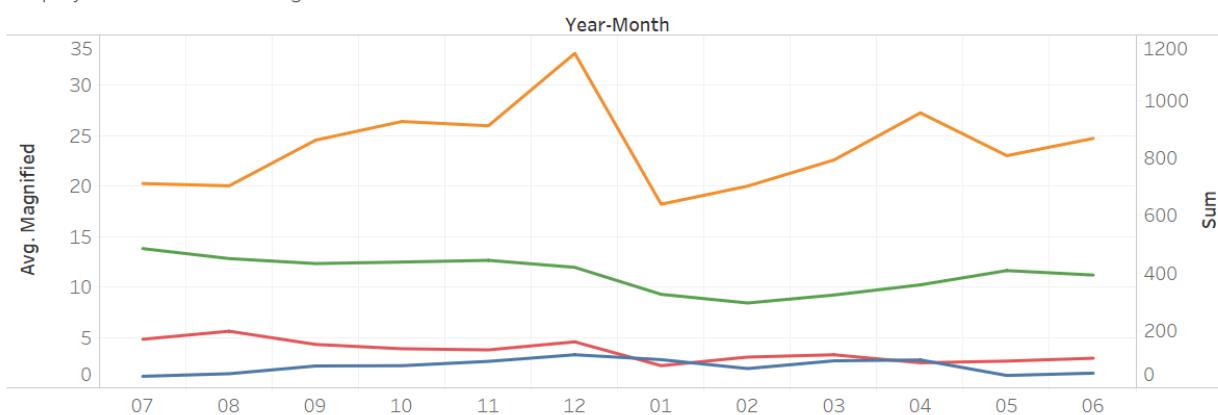
- Victoria

The following graph shows the trend of the employment rate and the number of registrations of 3 body types for **Victoria**. The Green line shows the employment rate. The color legend of 3 body types is shown in the graph. Caravan, Camper Trailer and Motorhome's trend are all very similar to the employment rate trend in all registration and renew the registration, and not similar in the new registration.

Employment Rate vs Registration in VIC -- FY 2014



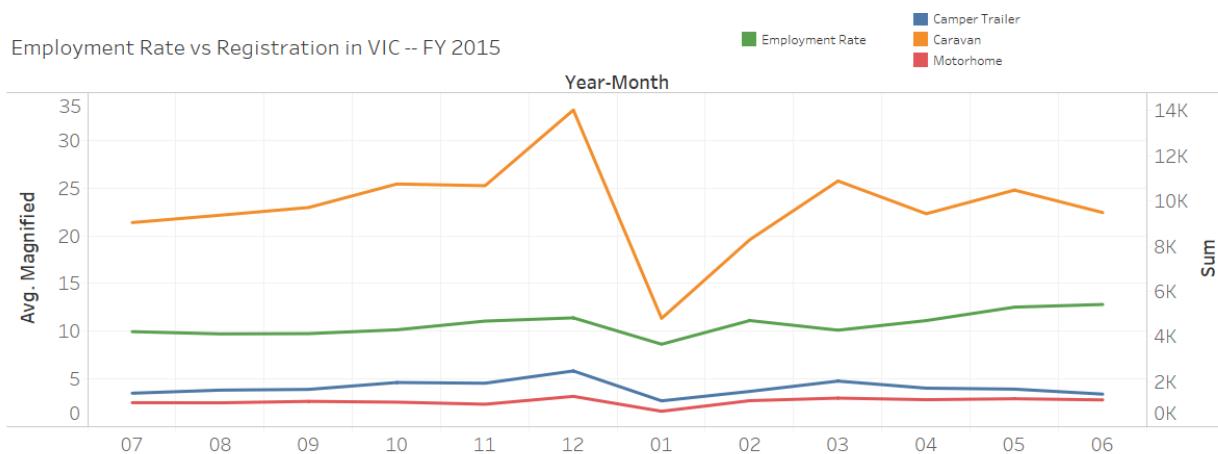
Employment Rate vs New Registration in VIC -- FY 2014



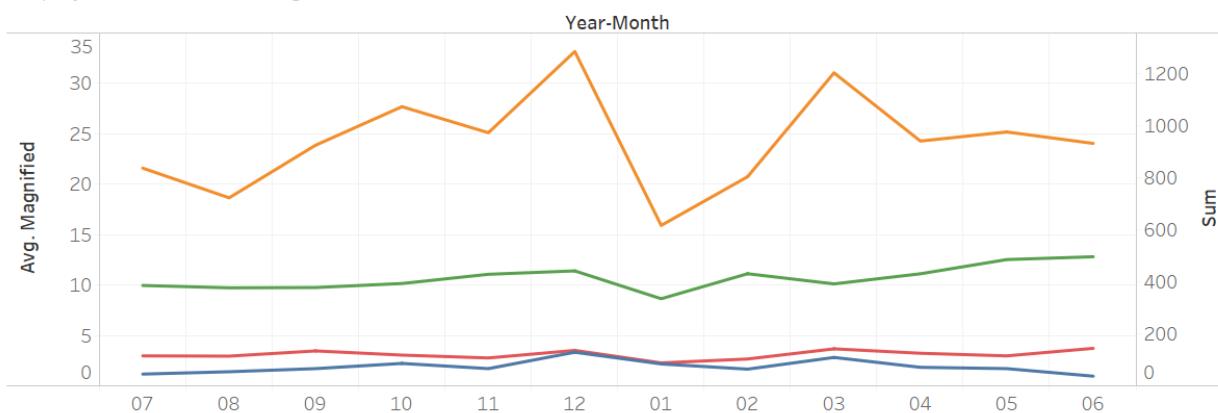
Employment Rate vs Renew Registration in VIC -- FY 2014



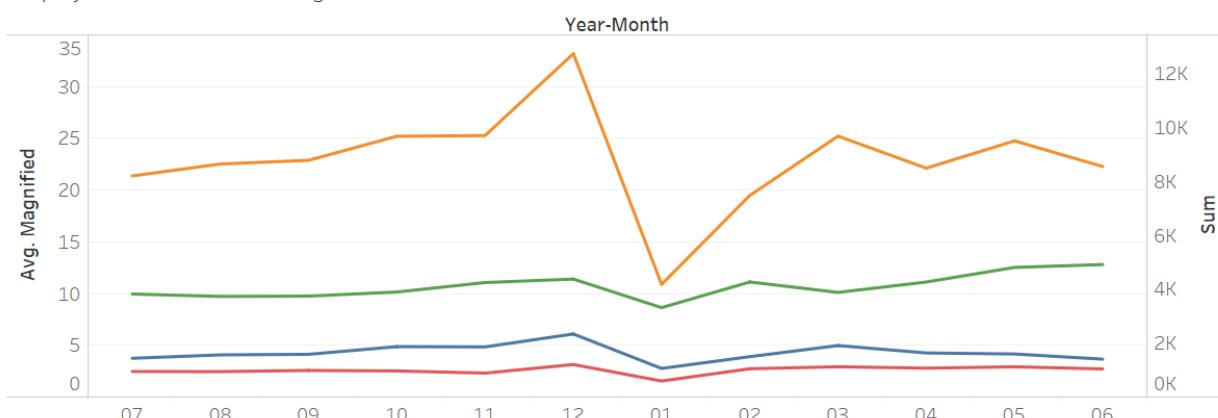
Employment Rate vs Registration in VIC -- FY 2015



Employment Rate vs New Registration in VIC -- FY 2015



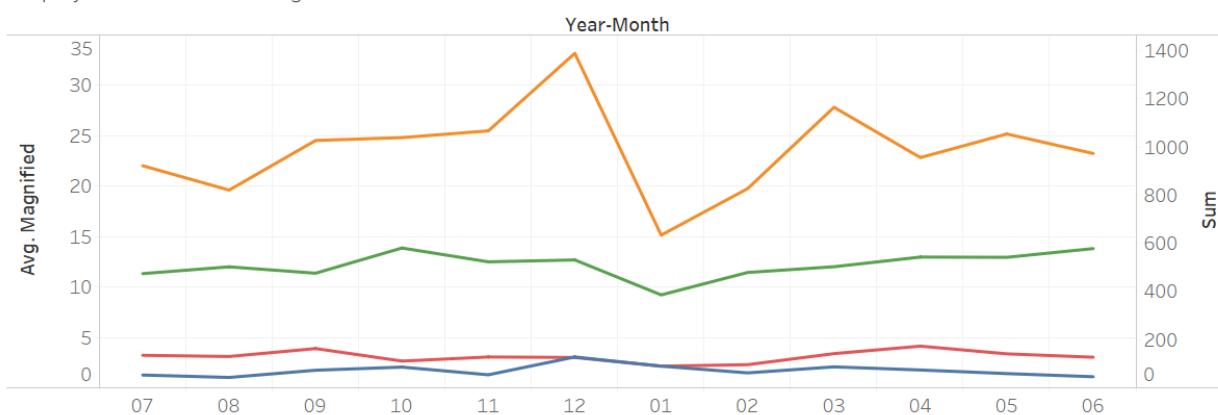
Employment Rate vs Renew Registration in VIC -- FY 2015



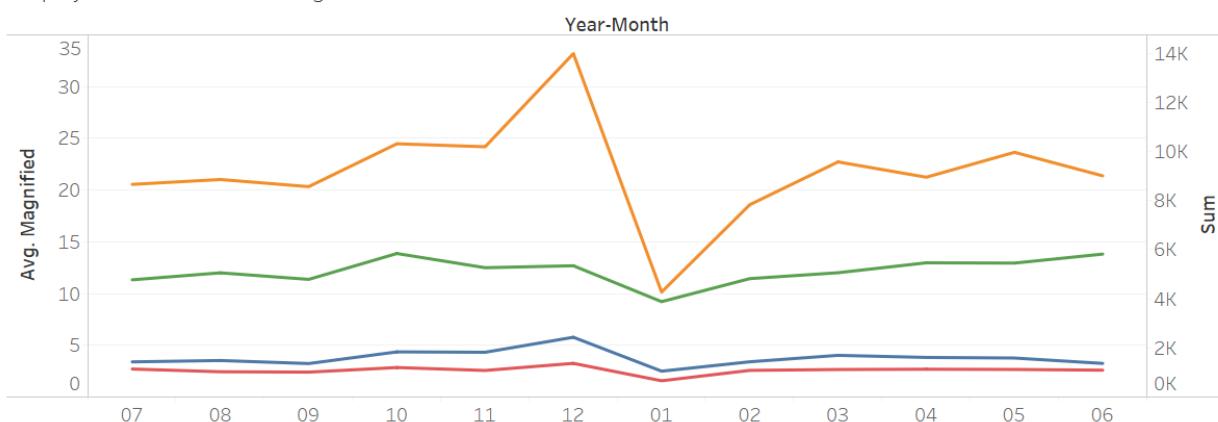
Employment Rate vs Registration in VIC -- FY 2016

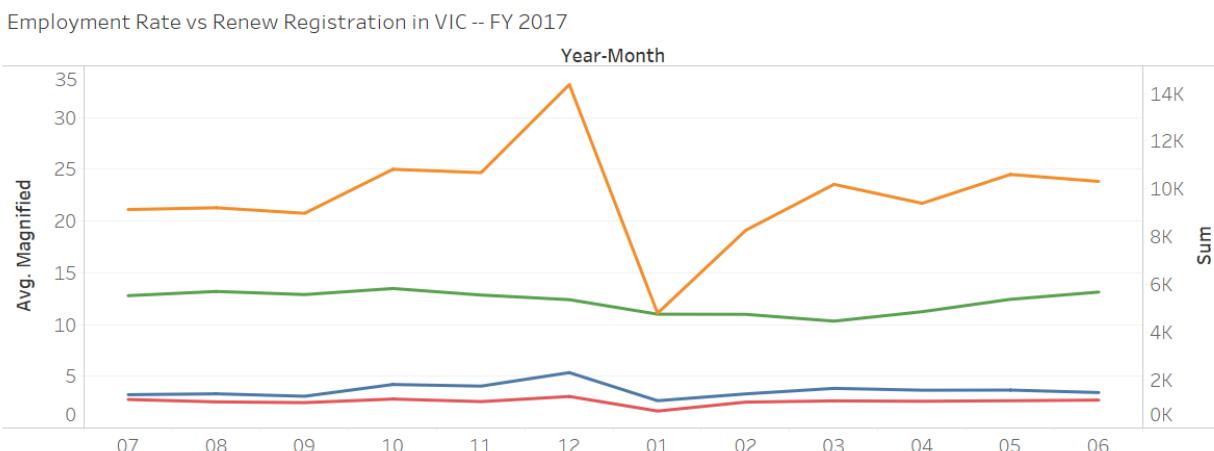
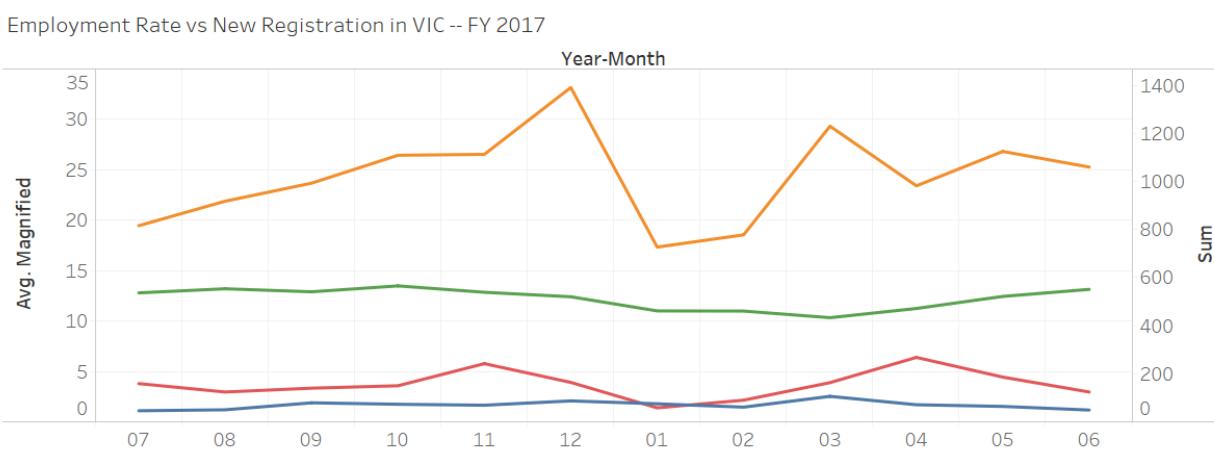


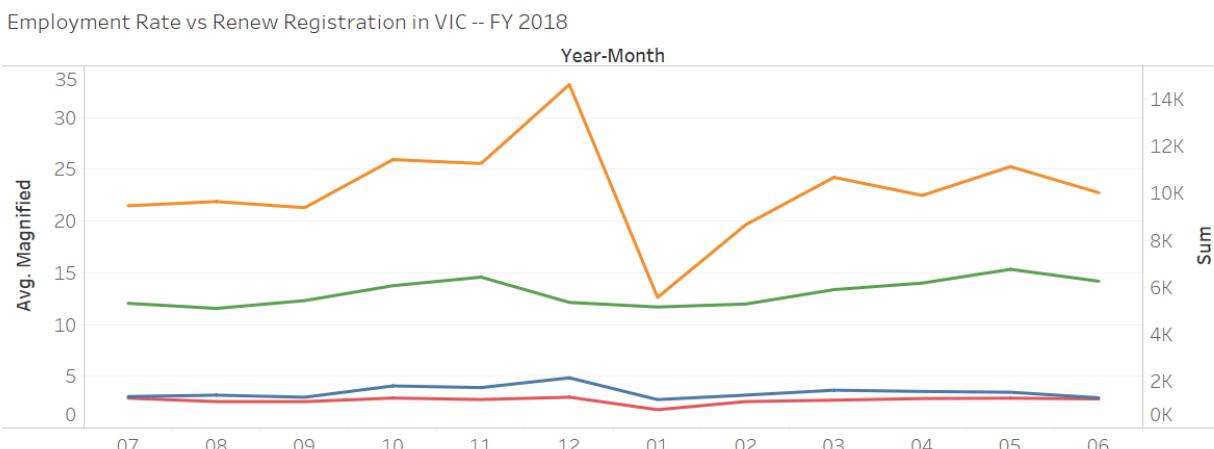
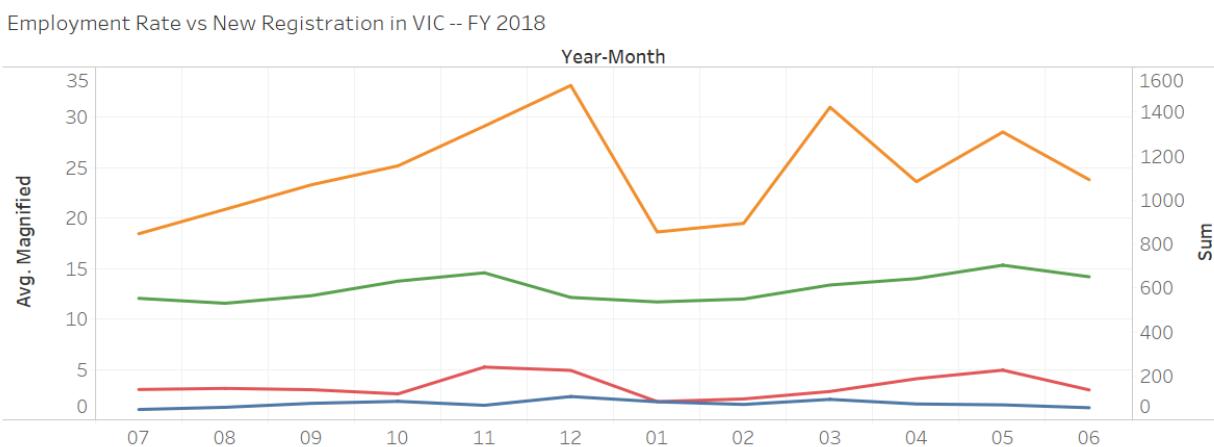
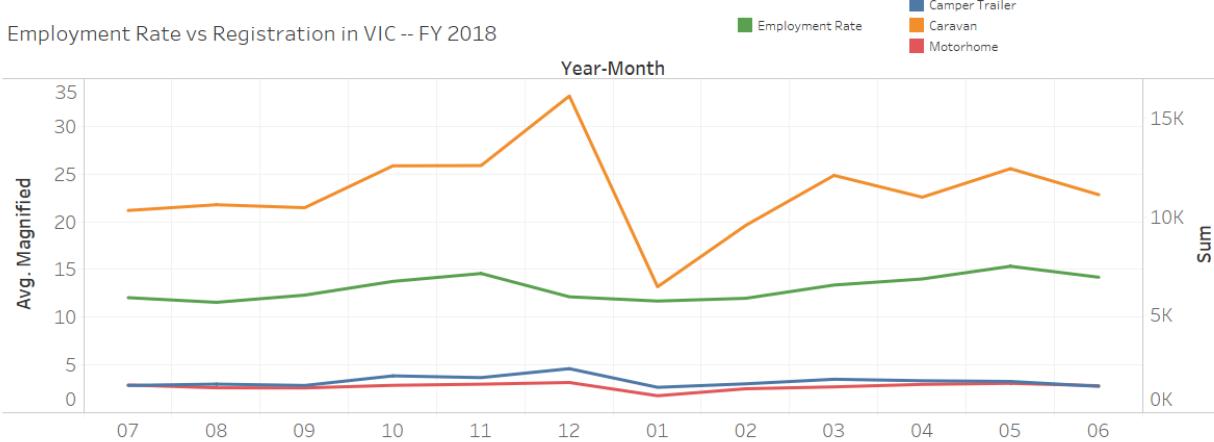
Employment Rate vs New Registration in VIC -- FY 2016



Employment Rate vs Renew Registration in VIC -- FY 2016

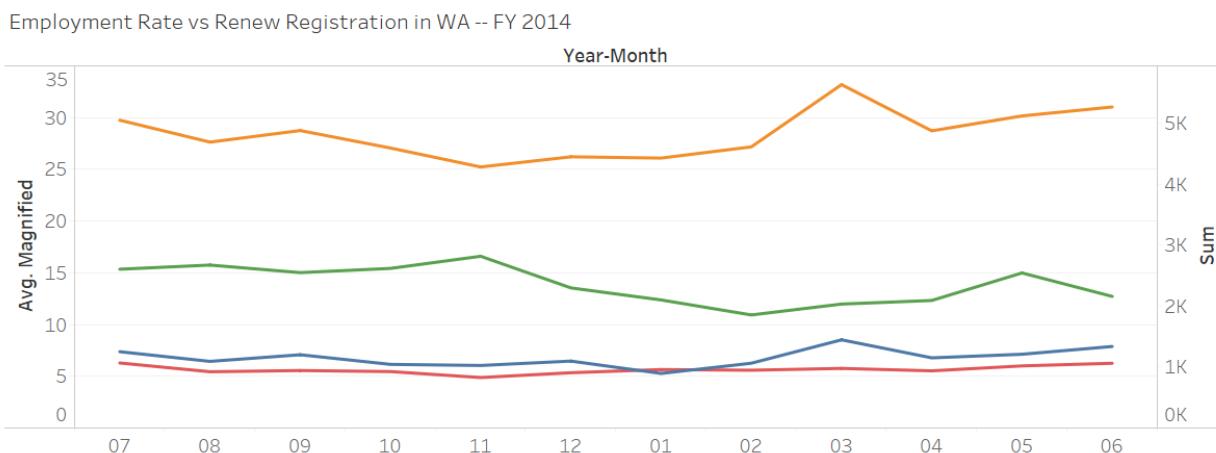
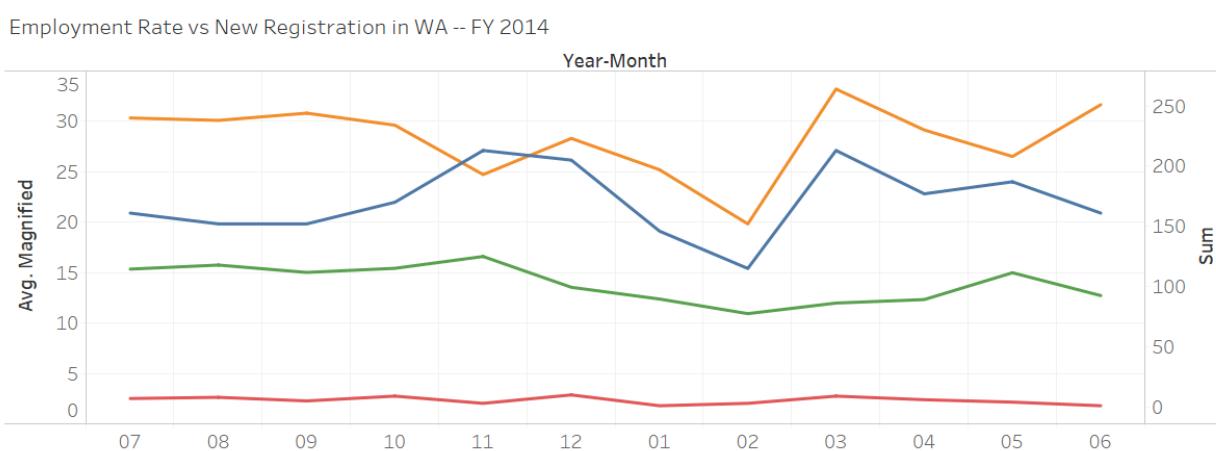
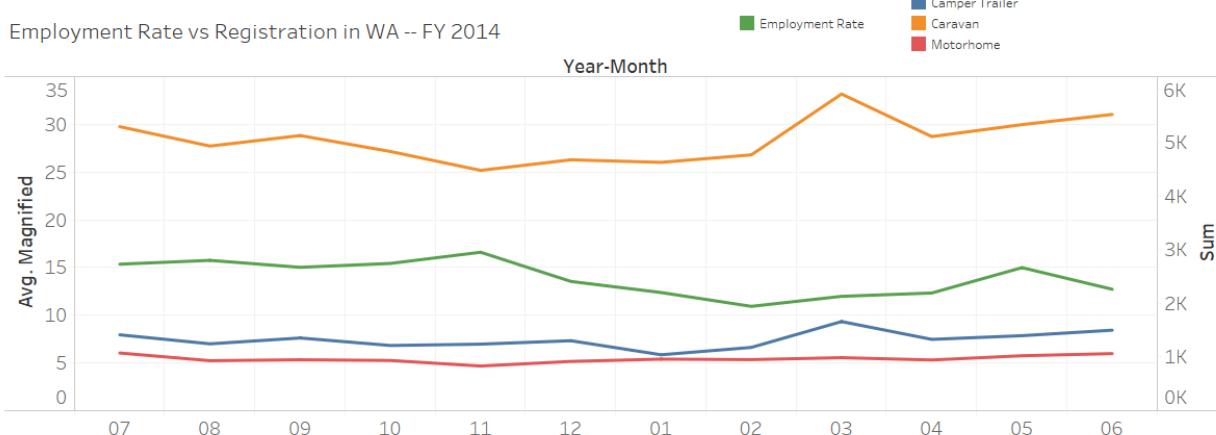


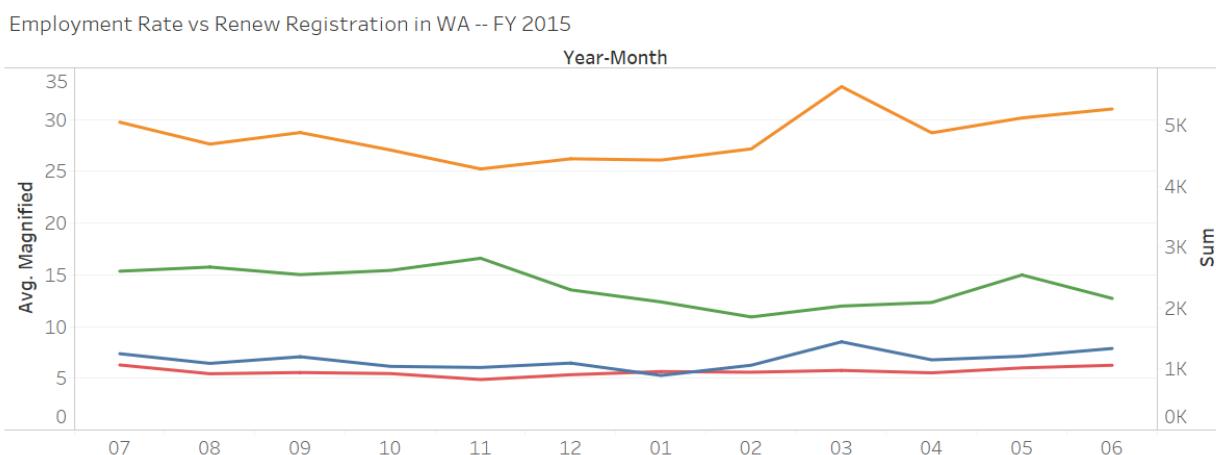
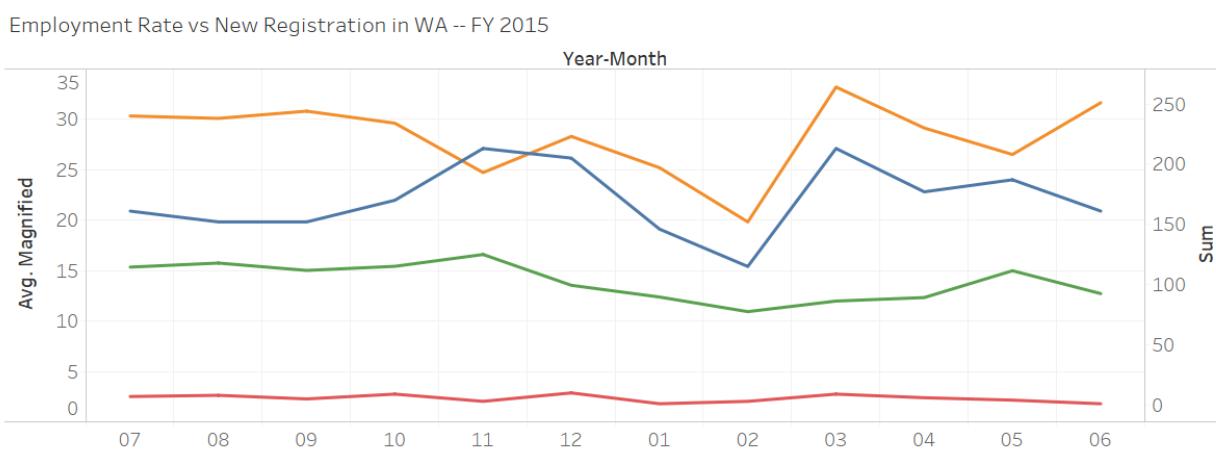
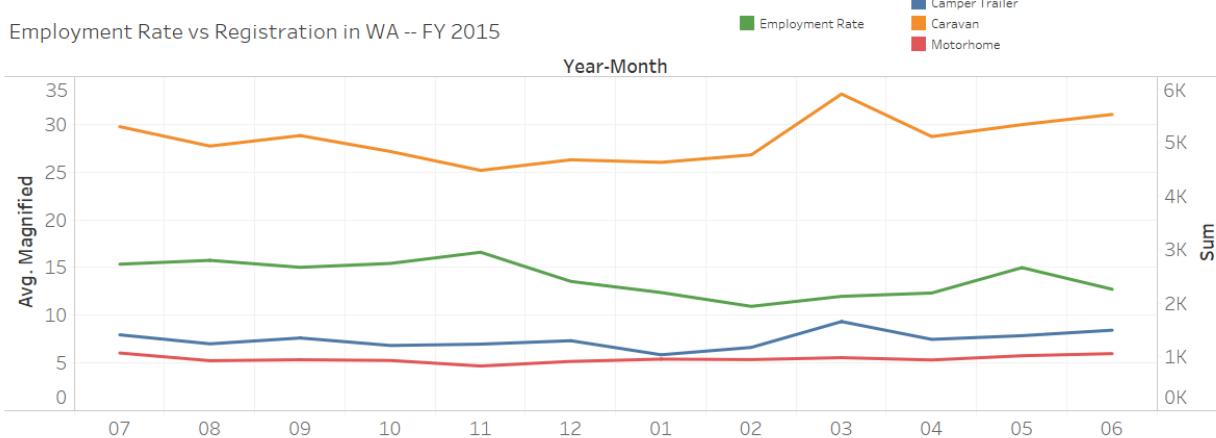


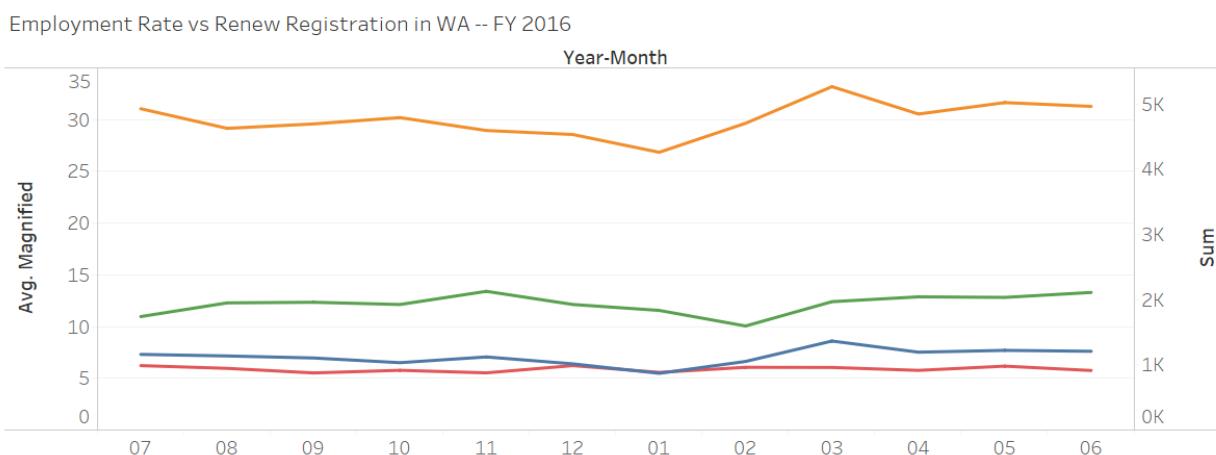
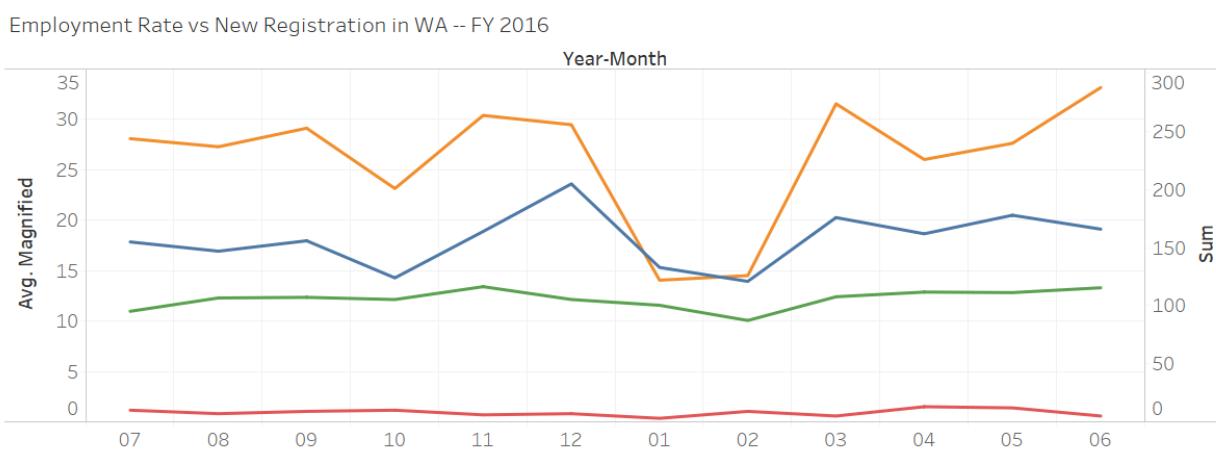
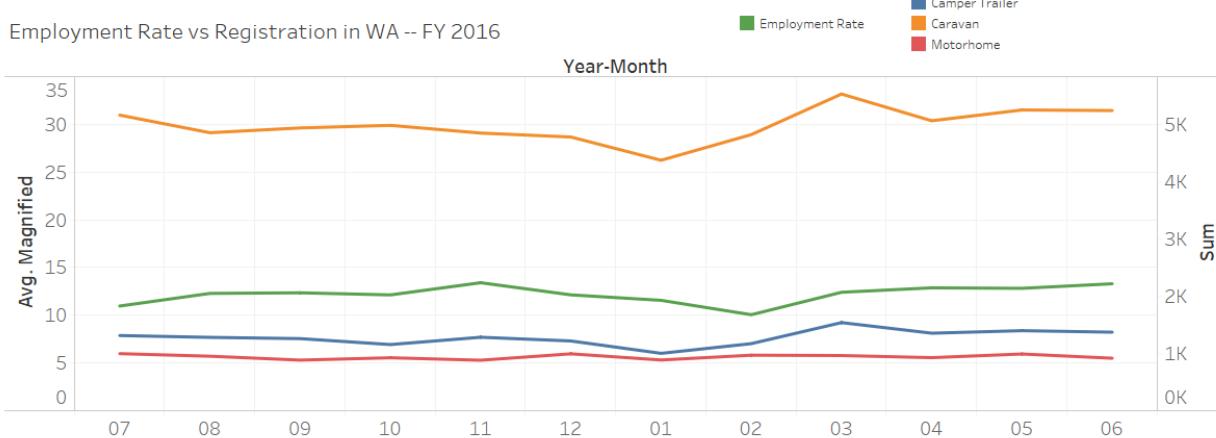


- West Australia

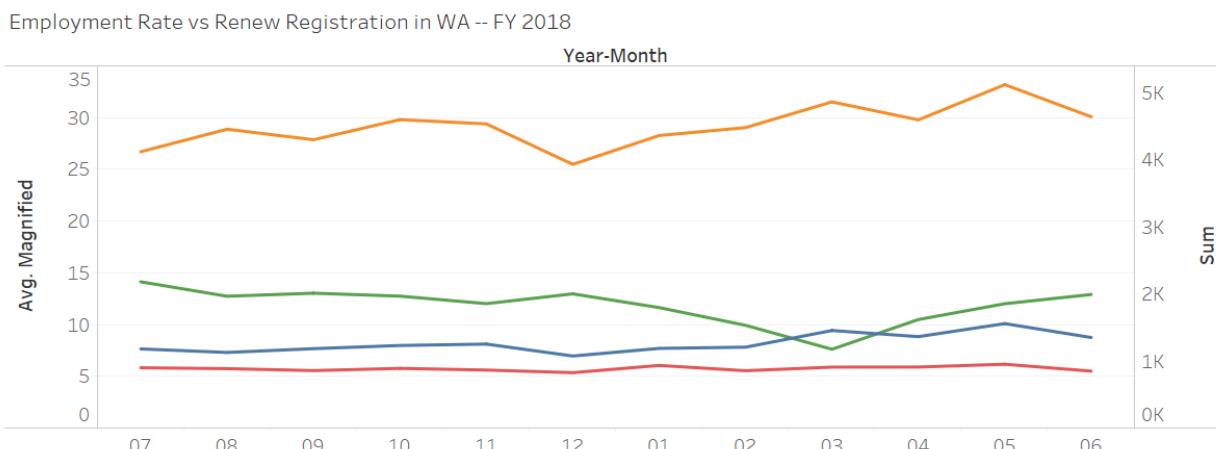
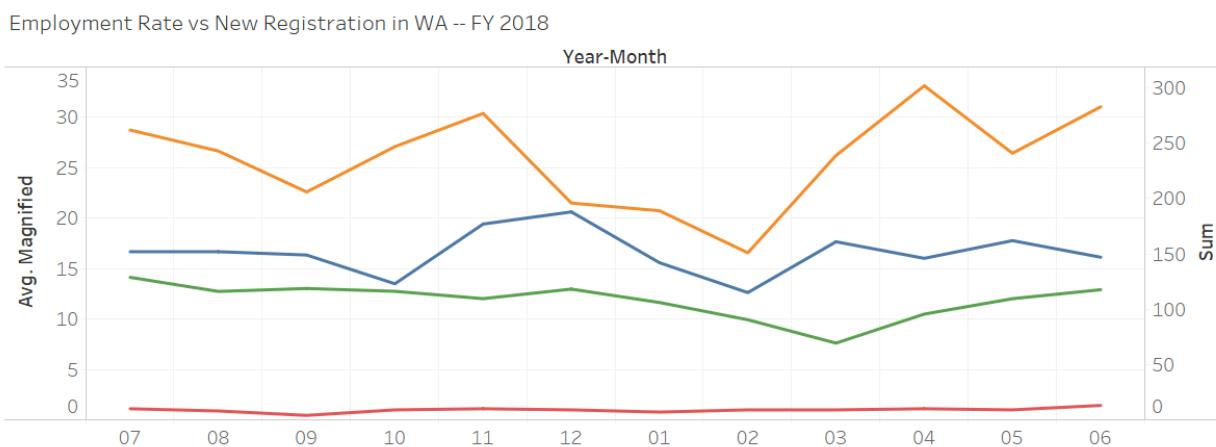
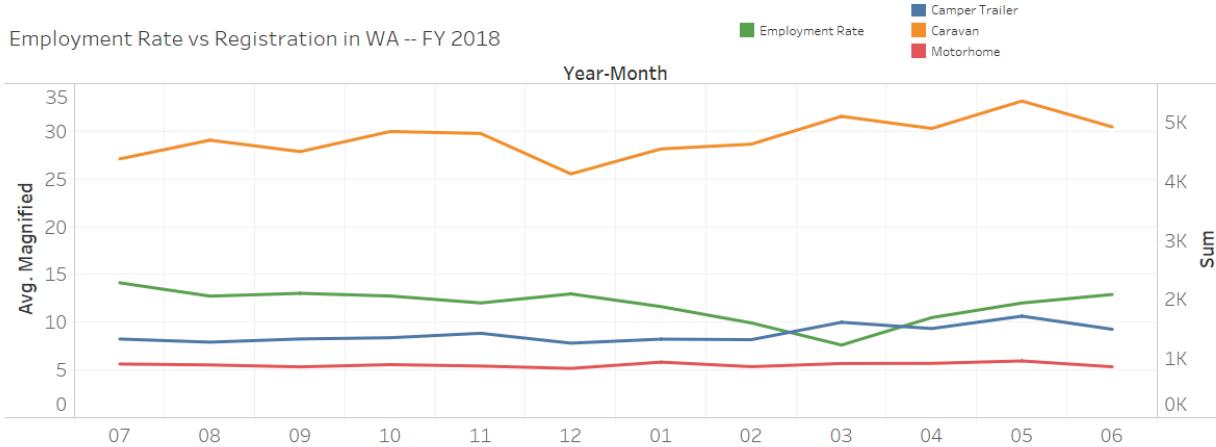
The following graph shows the trend of the employment rate and the number of registrations of 3 body types for **West Australia**. The Green line shows the employment rate. The color legend of 3 body types is shown in the graph. There's no obvious relationship between the employment rate and the number of registrations in West Australia.







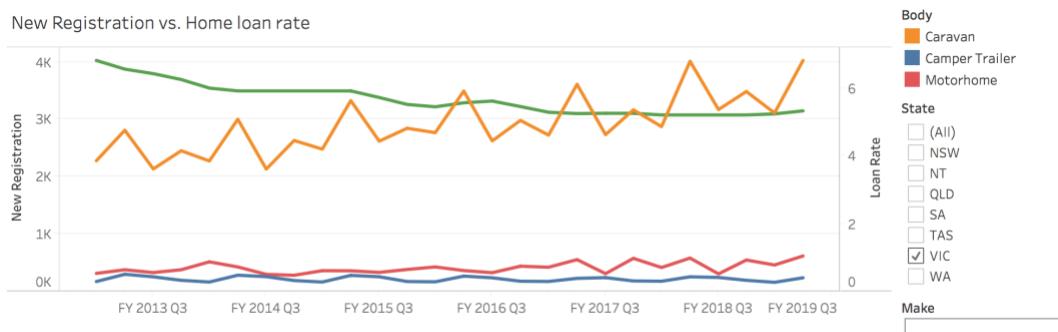




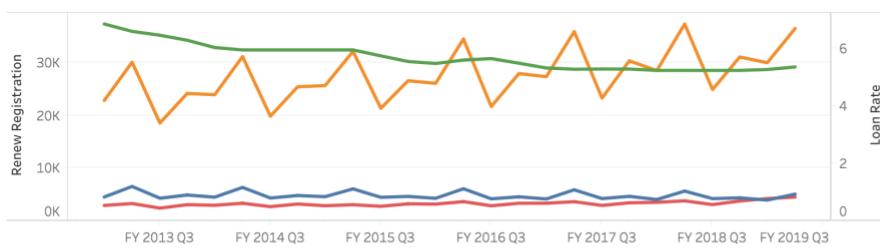
Registration Trends by States and Year with Home Loan Rate

- VIC

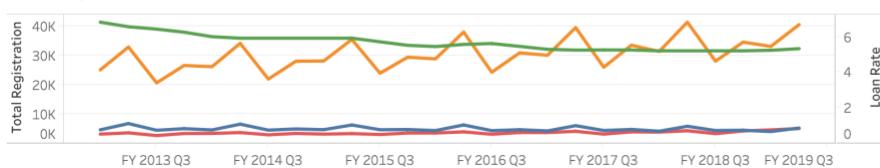
New Registration vs. Home loan rate



Renew Registration vs. Home loan rate

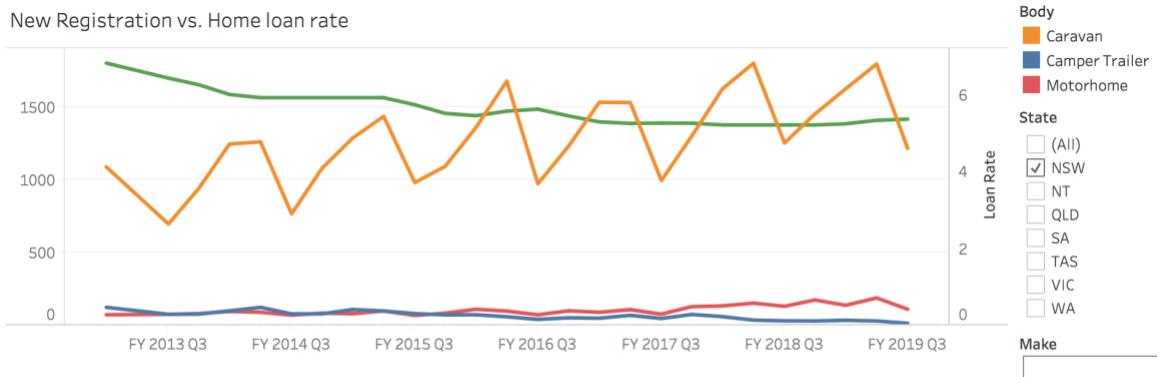


Total Registration vs. Home loan rate

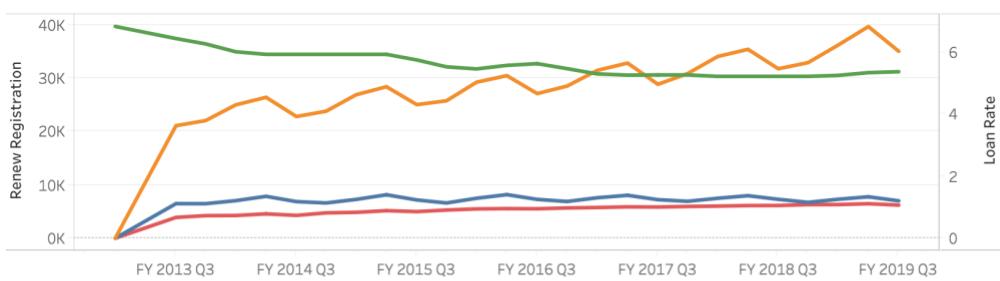


- NSW

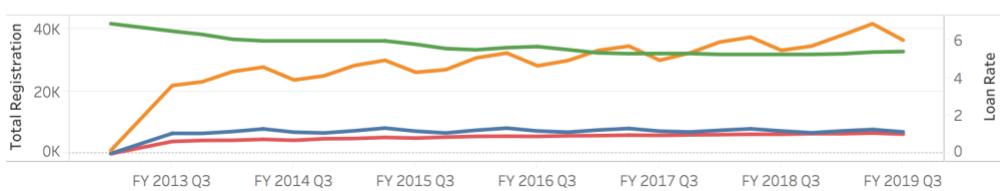
New Registration vs. Home loan rate



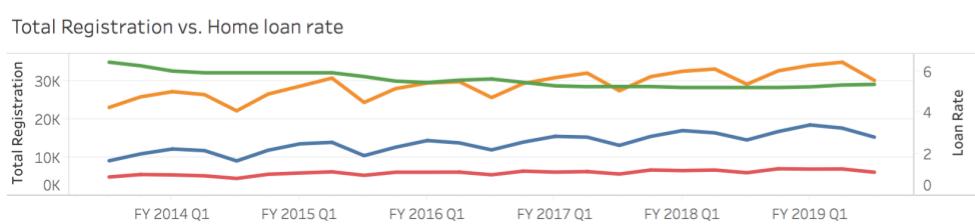
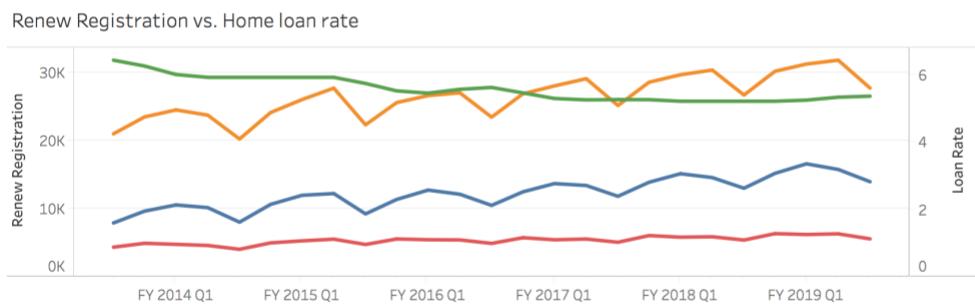
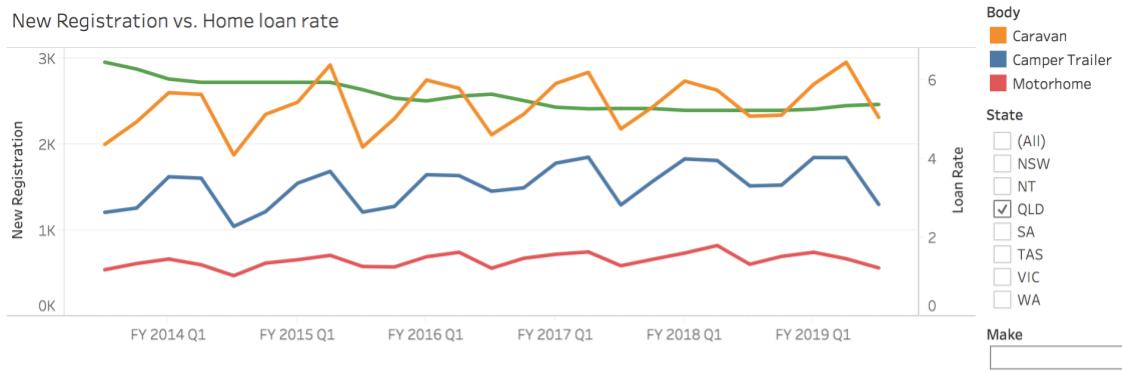
Renew Registration vs. Home loan rate



Total Registration vs. Home loan rate

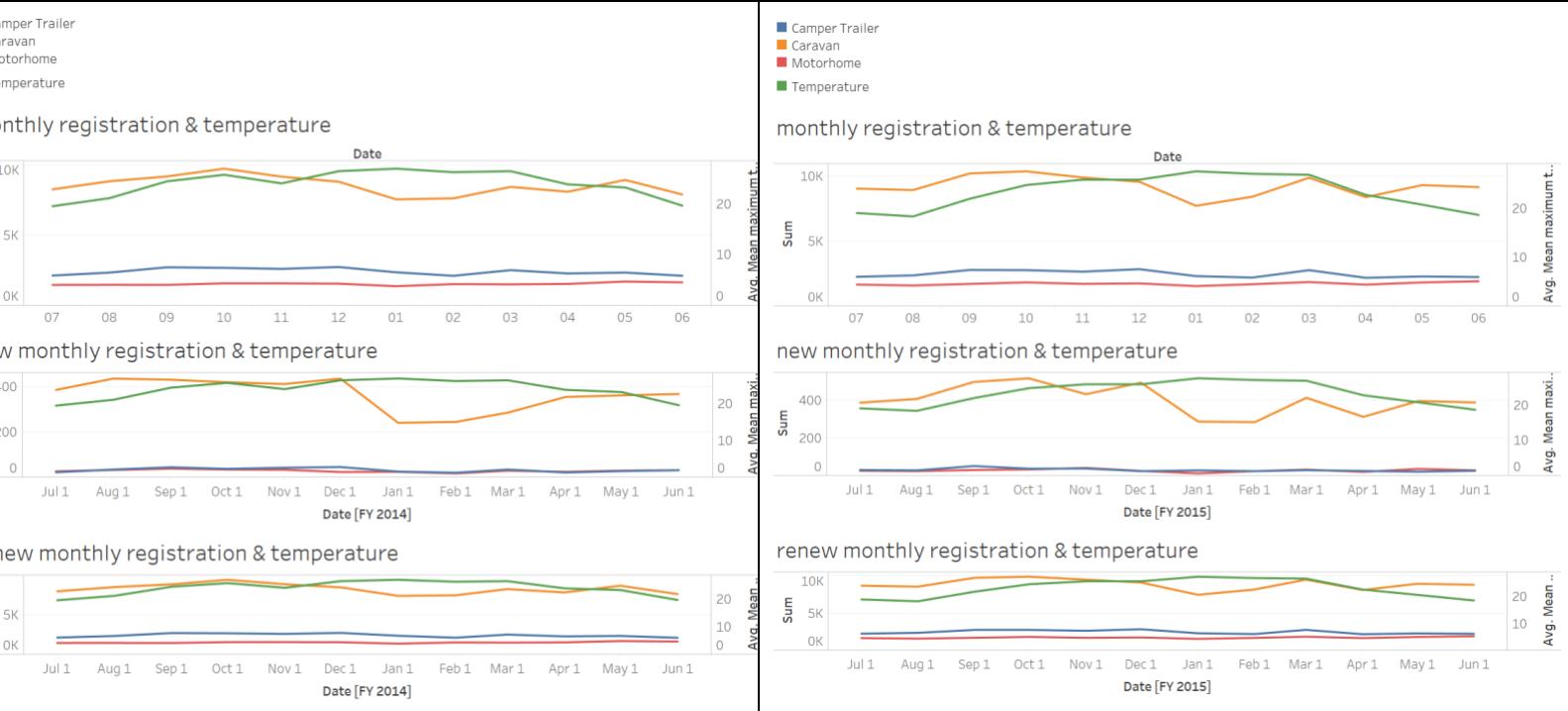


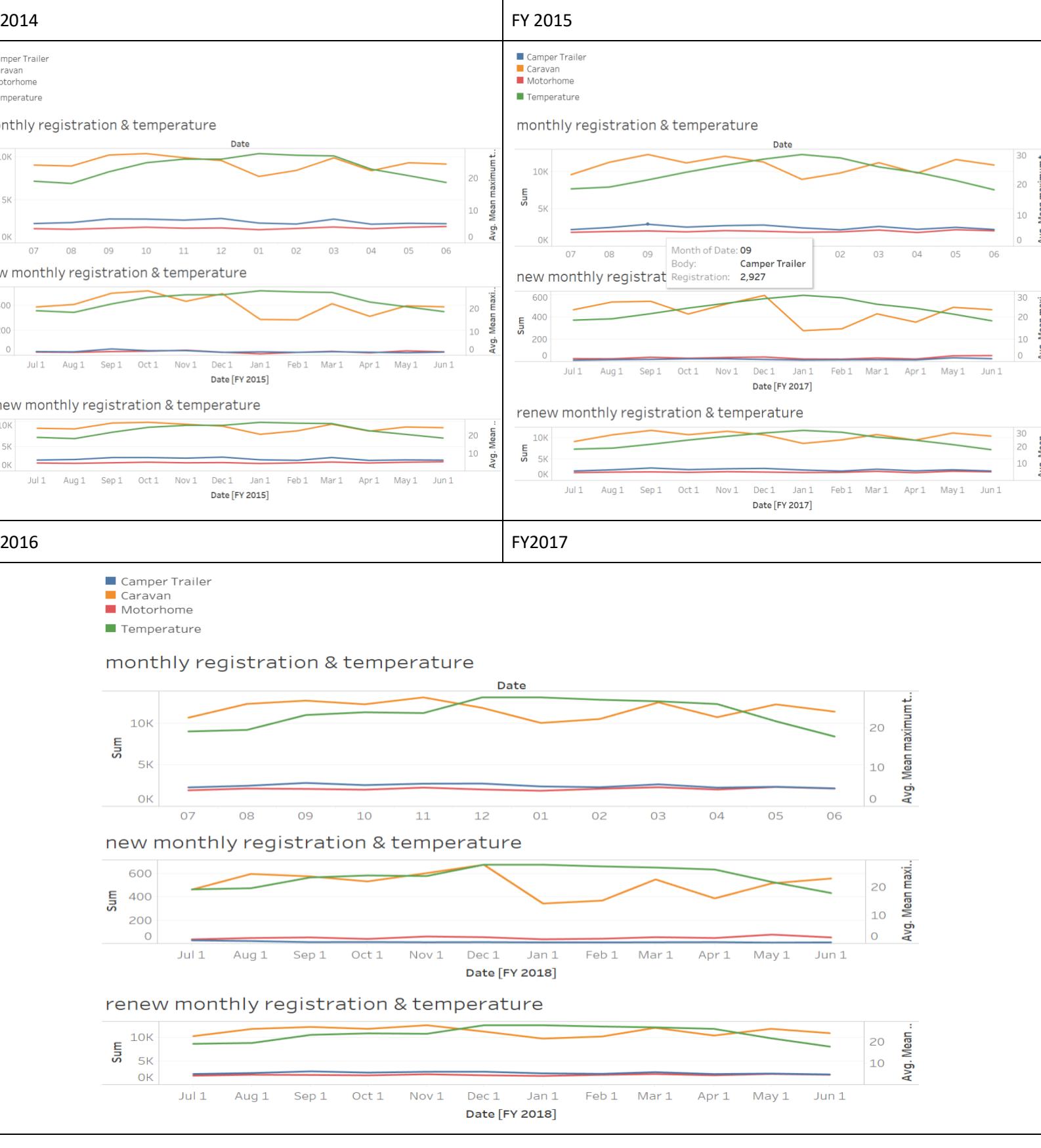
- QLD



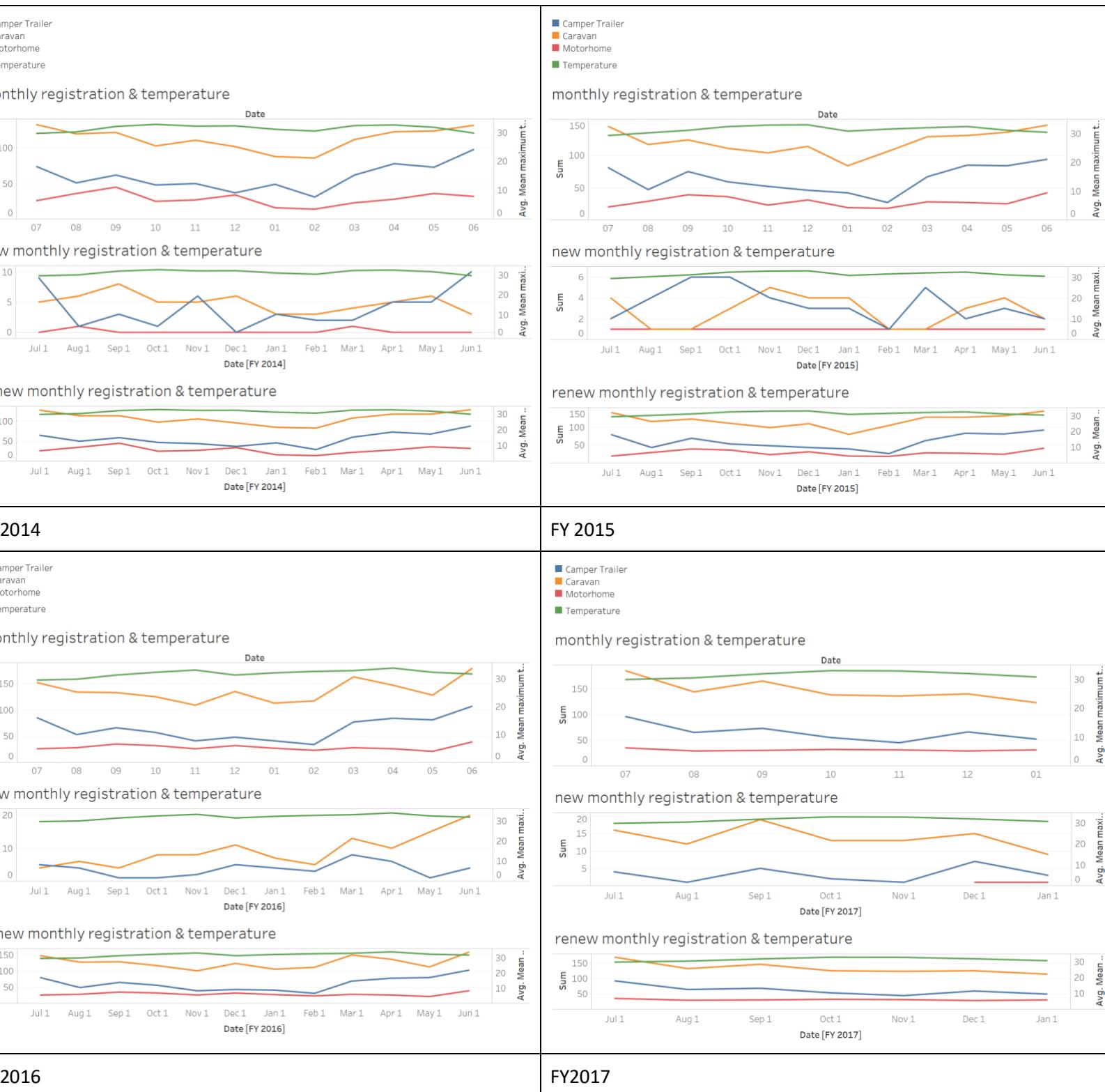
Registrations Trend by States and with Temperature

Total number of registrations & mean temperature in NSW

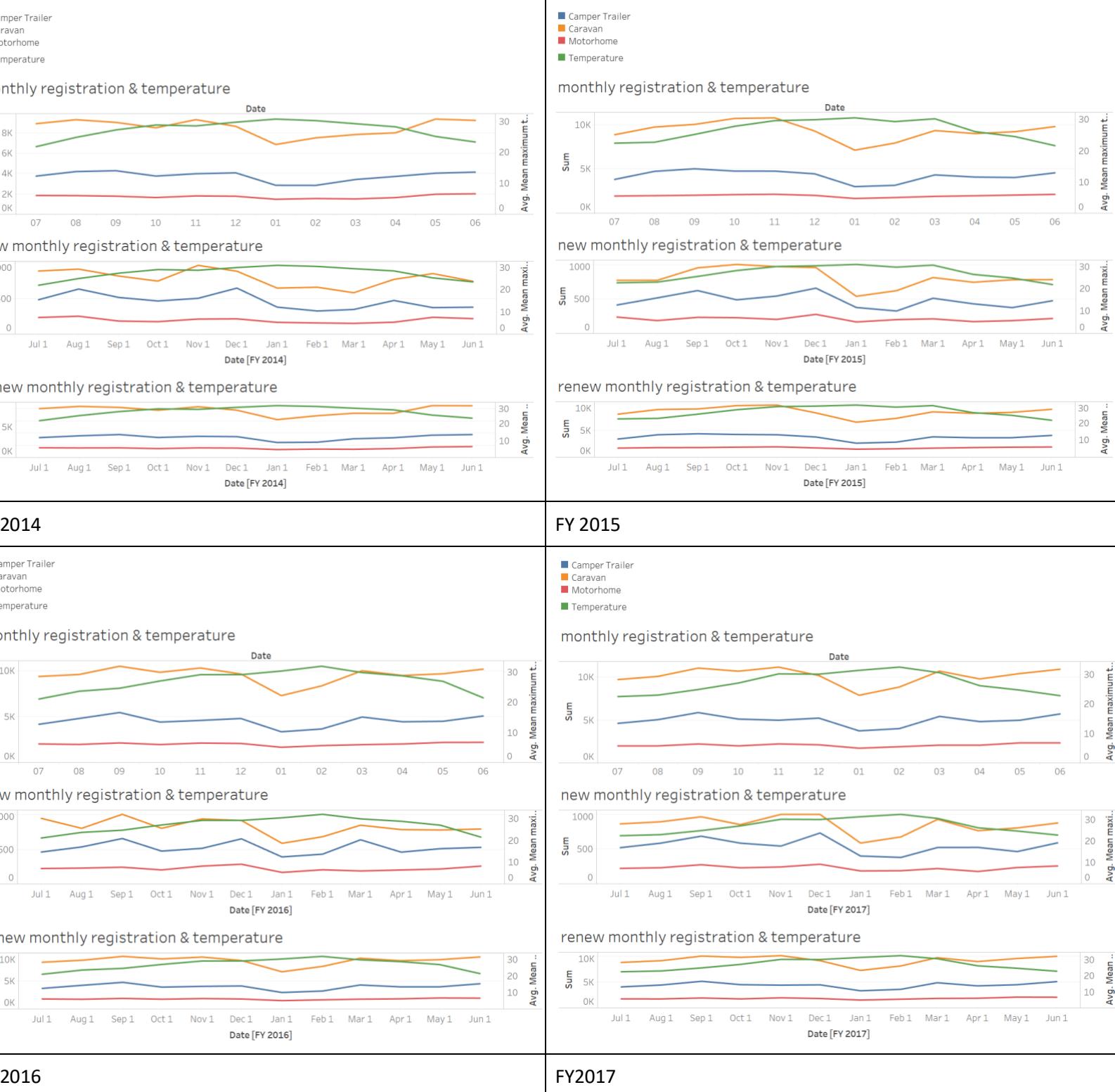




Total number of registrations & mean temperature in NT

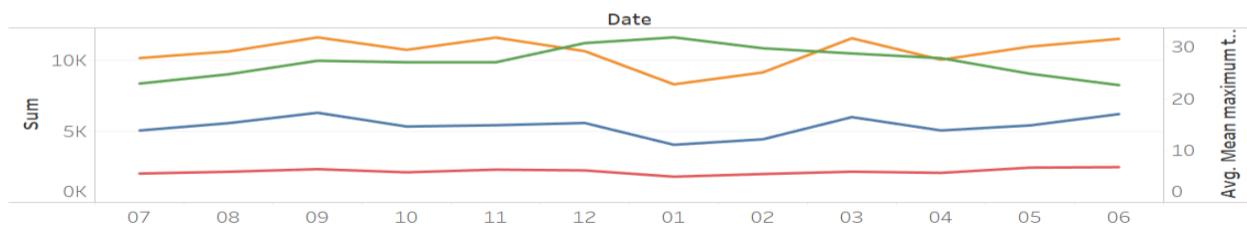


Total number of registrations & mean temperature in QLD



- █ Camper Trailer
- █ Caravan
- █ Motorhome
- █ Temperature

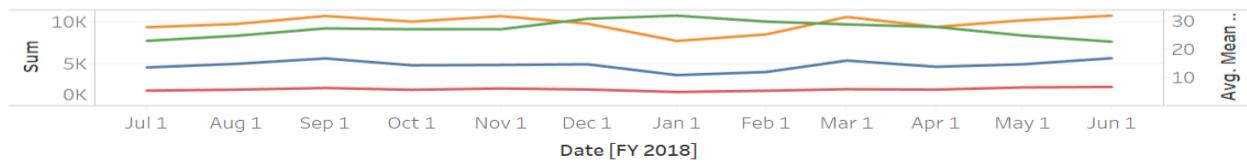
monthly registration & temperature



new monthly registration & temperature

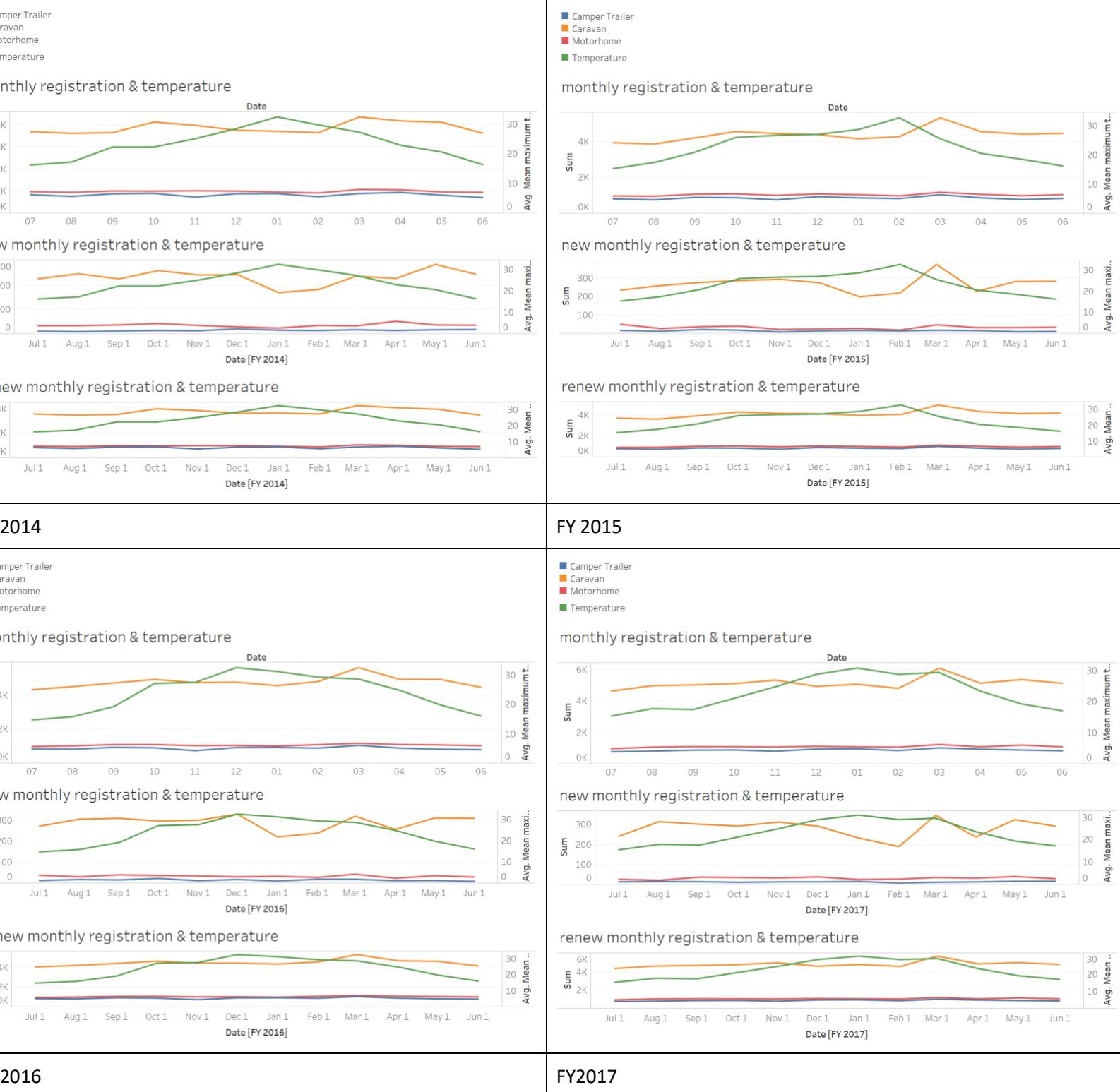


renew monthly registration & temperature



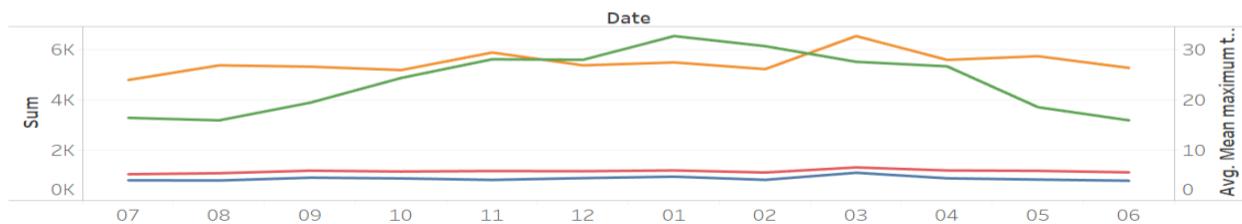
2018

Total number of registrations & mean temperature in SA

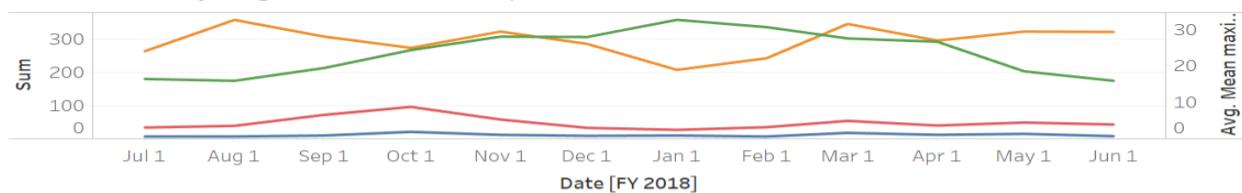


- Camper Trailer
- Caravan
- Motorhome
- Temperature

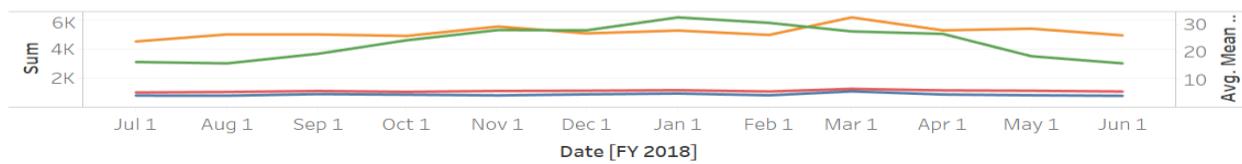
monthly registration & temperature



new monthly registration & temperature

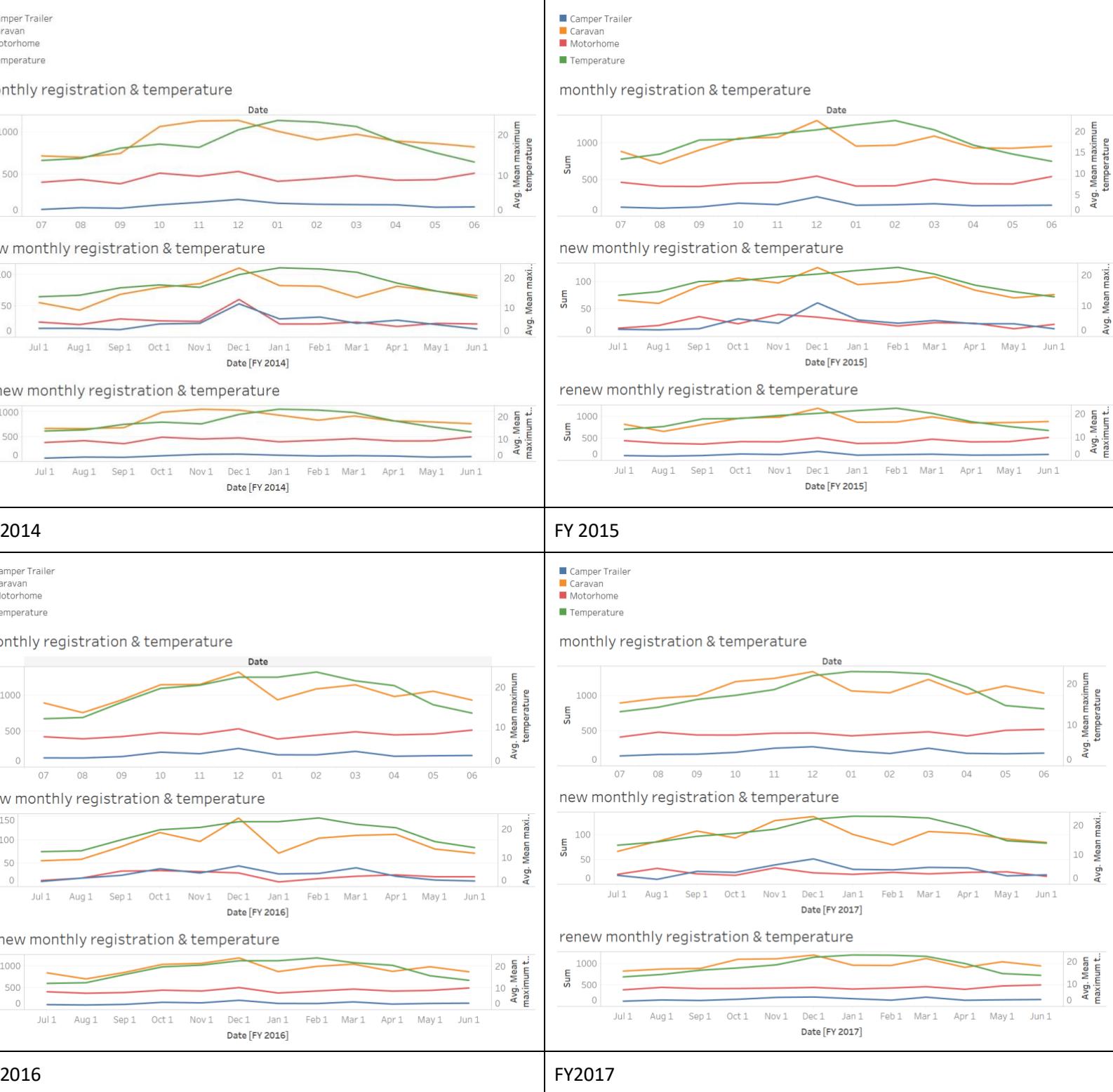


renew monthly registration & temperature



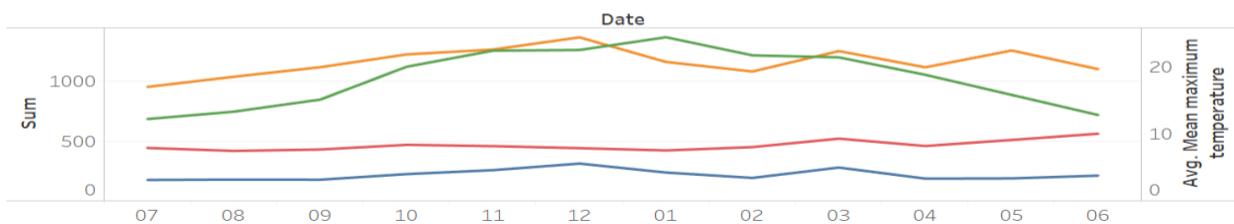
2018

Total number of registrations & mean temperature in TAS

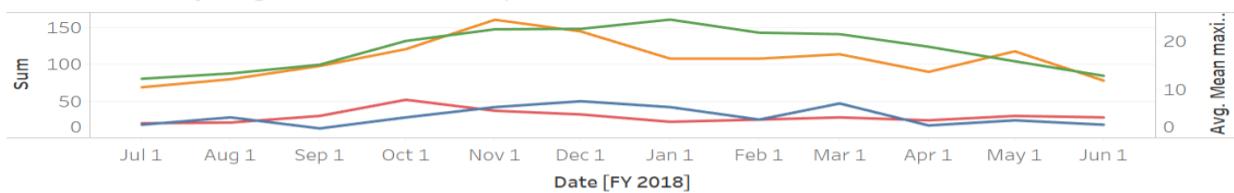


- Camper Trailer
- Caravan
- Motorhome
- Temperature

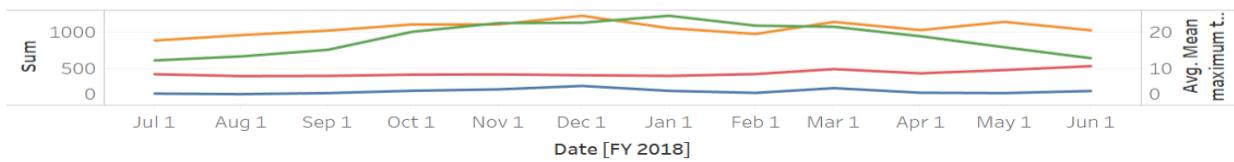
monthly registration & temperature



new monthly registration & temperature

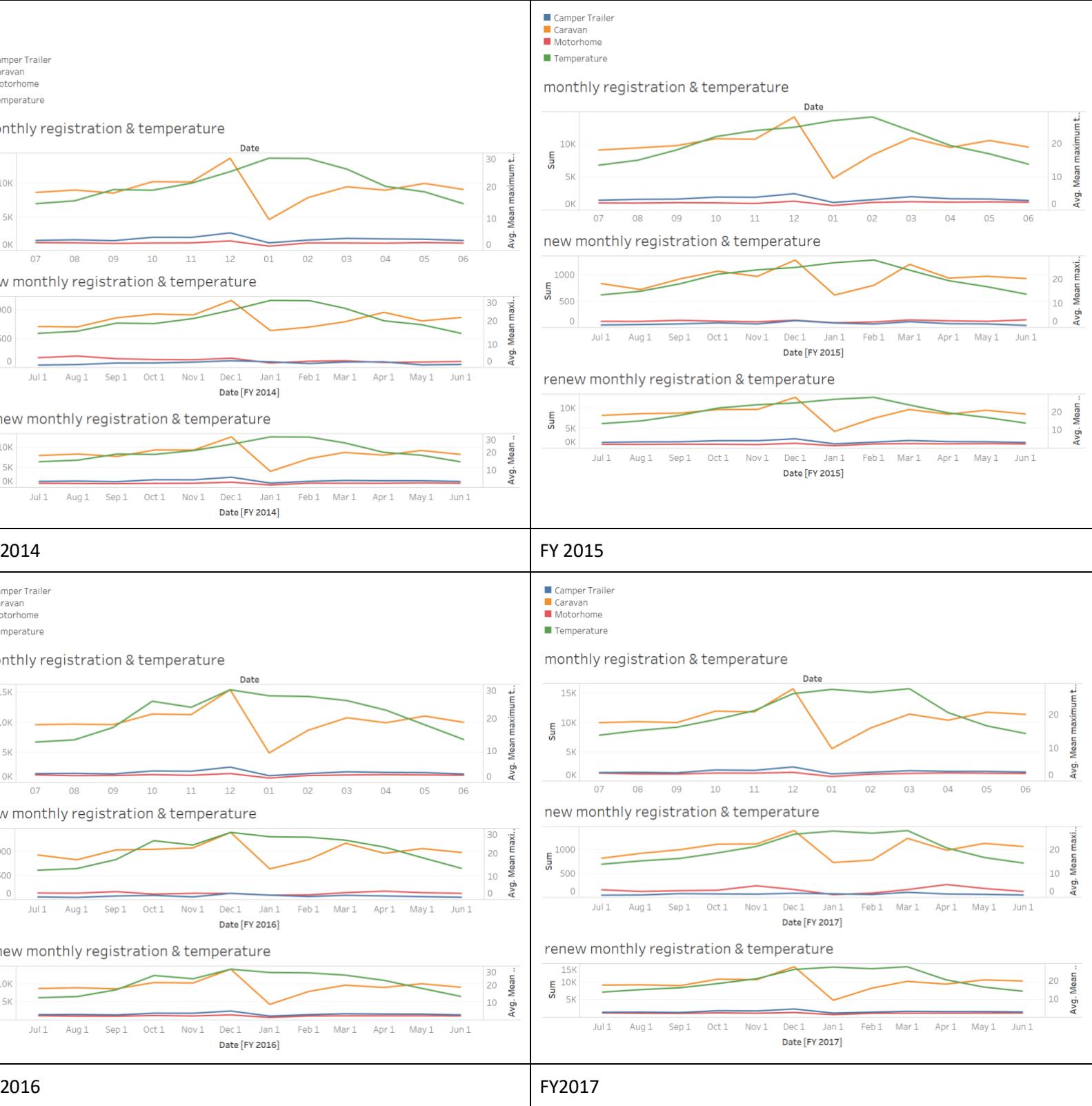


renew monthly registration & temperature



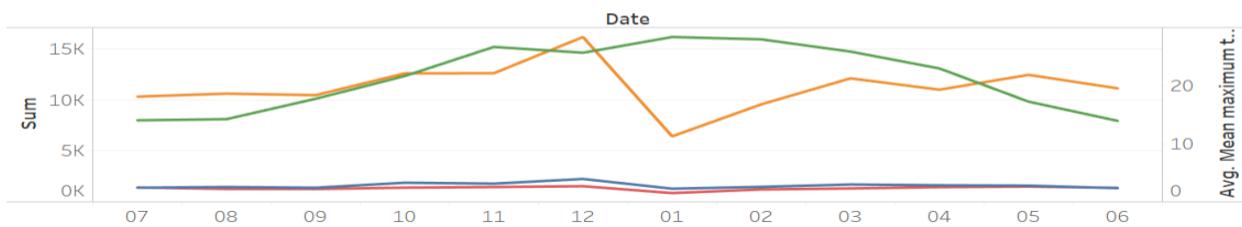
2018

Total number of registrations & mean temperature in VIC

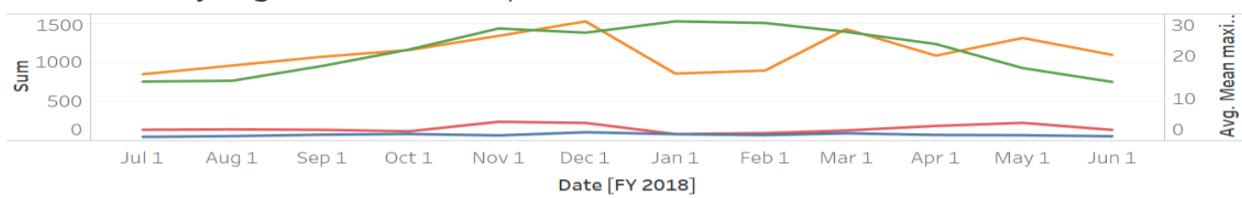


- Camper Trailer
- Caravan
- Motorhome
- Temperature

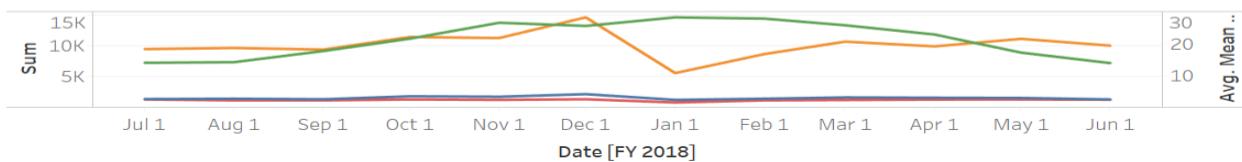
monthly registration & temperature



new monthly registration & temperature

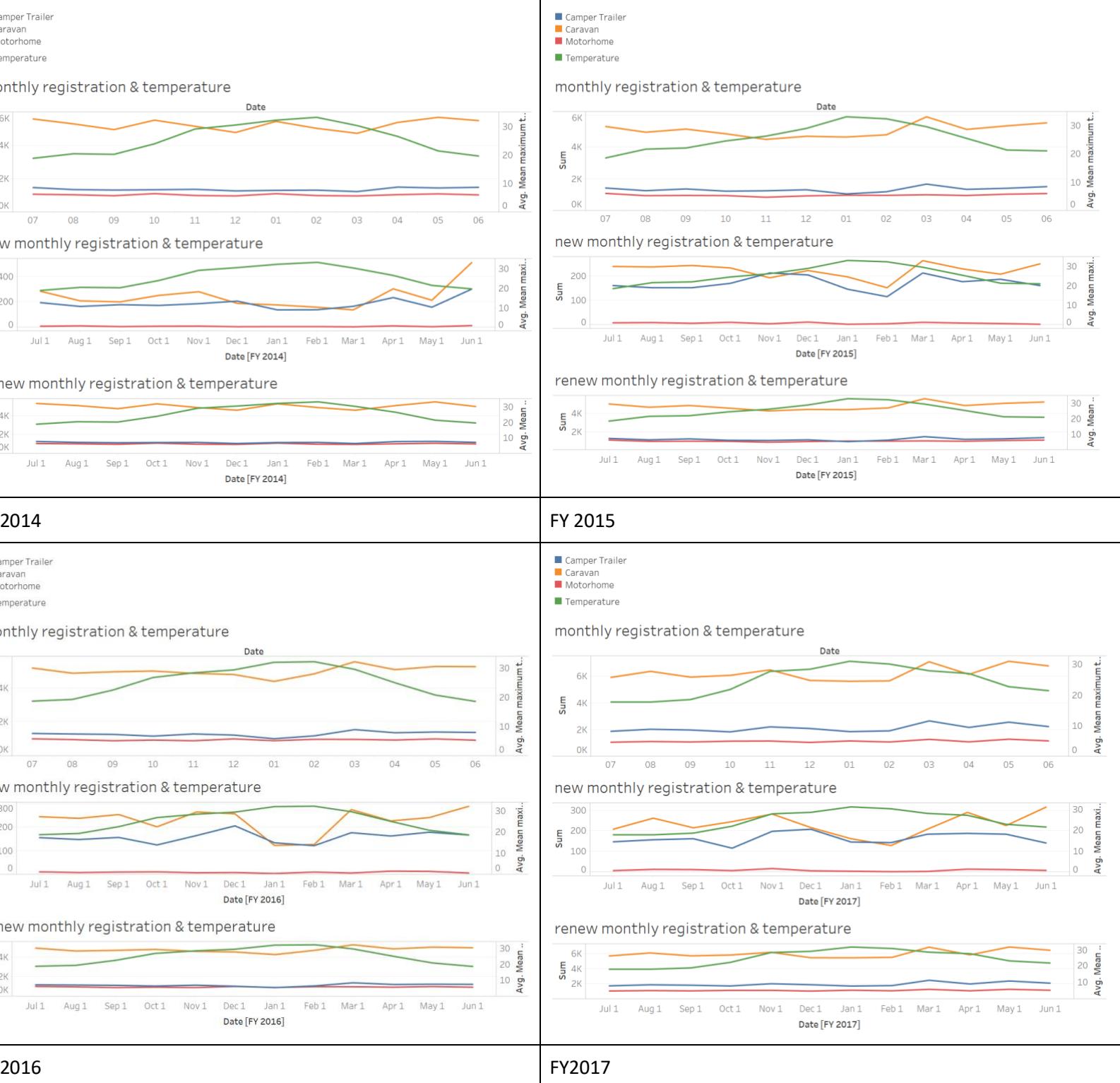


renew monthly registration & temperature



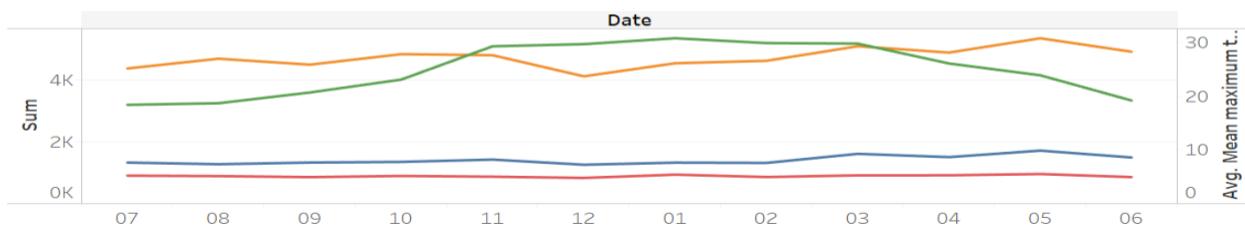
2018

Total number of registrations & mean temperature in WA

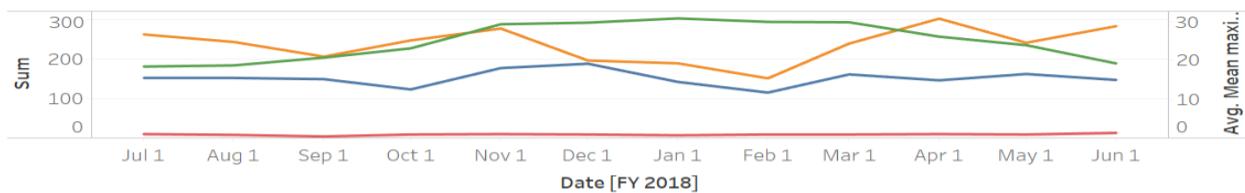


█ Camper Trailer
█ Caravan
█ Motorhome
█ Temperature

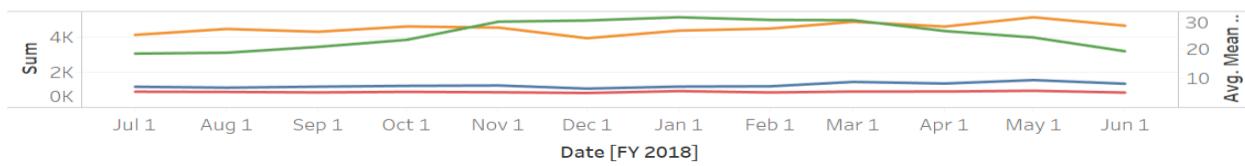
monthly registration & temperature



new monthly registration & temperature



renew monthly registration & temperature

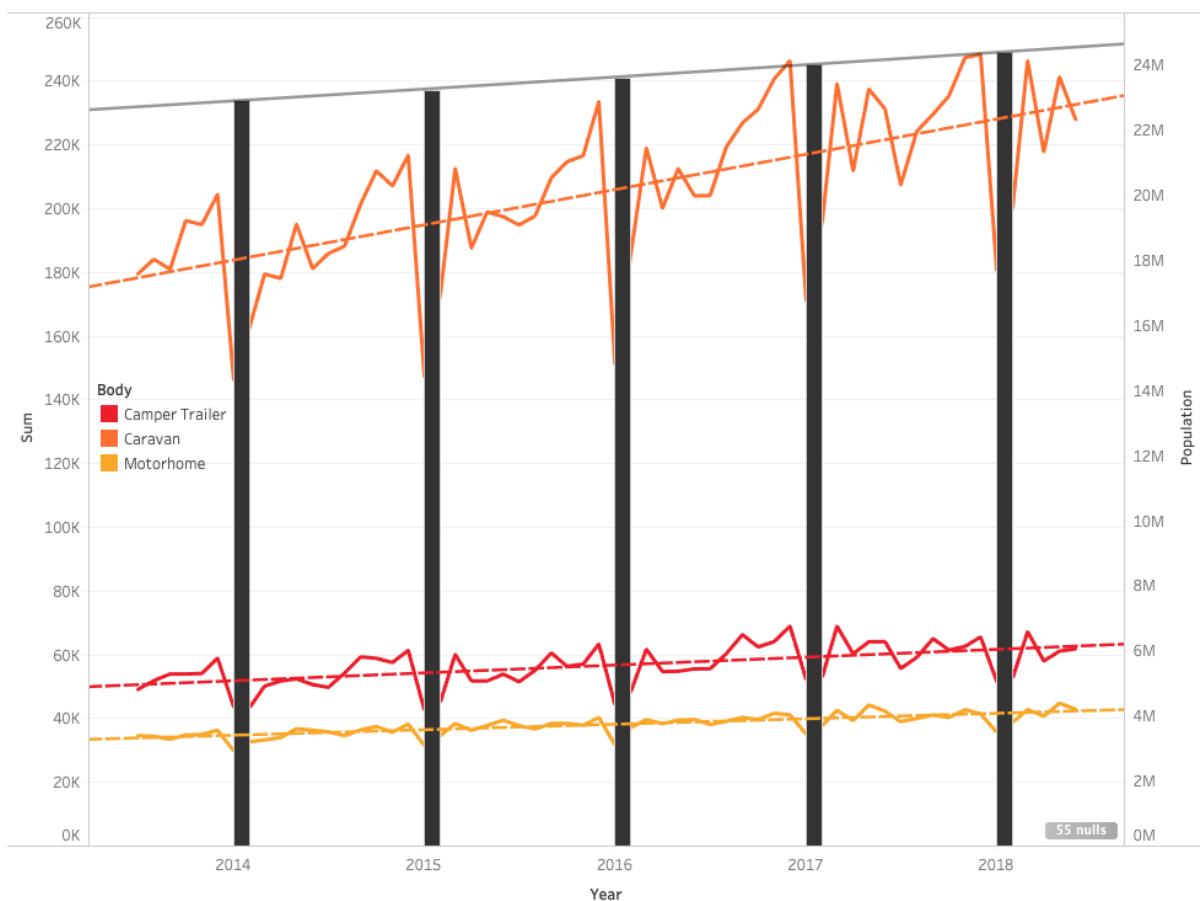


2018

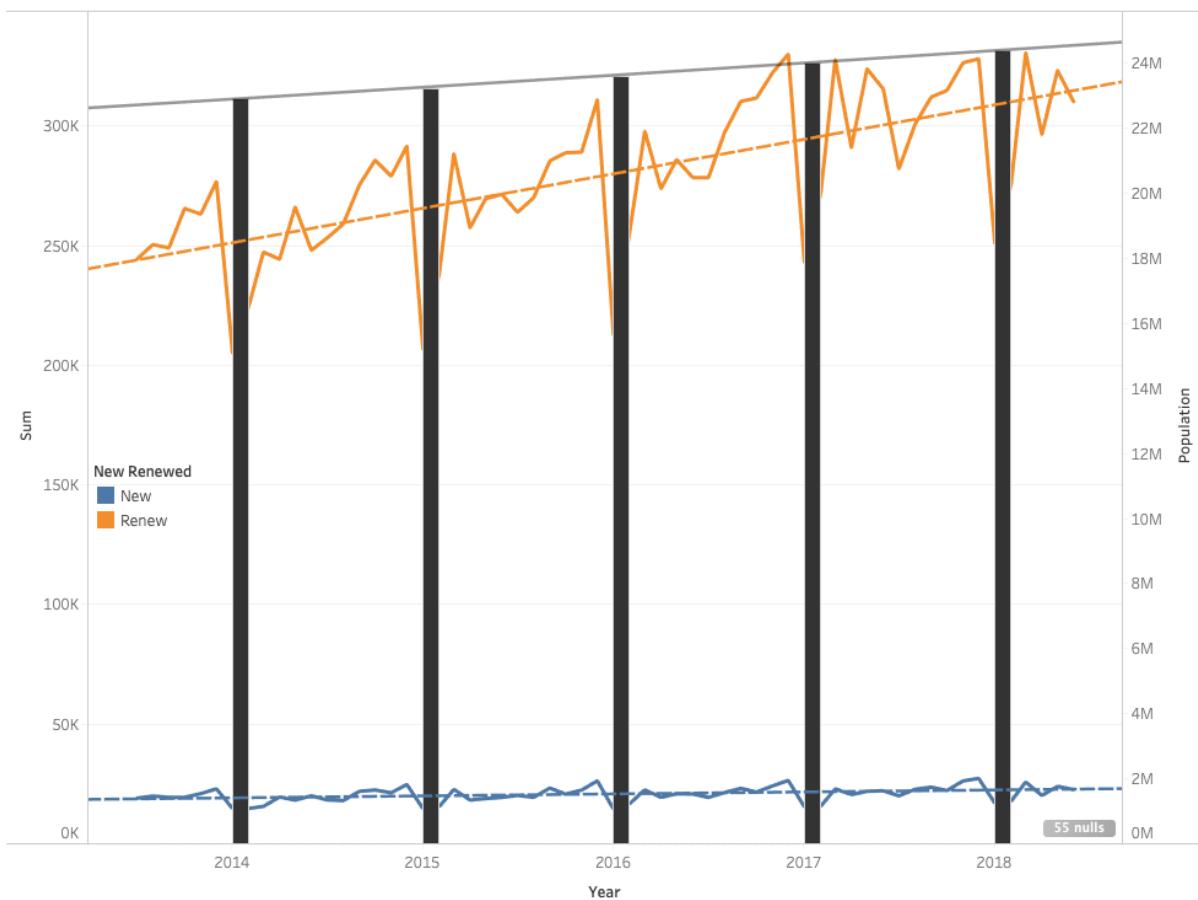
8. Population Trends

National Level

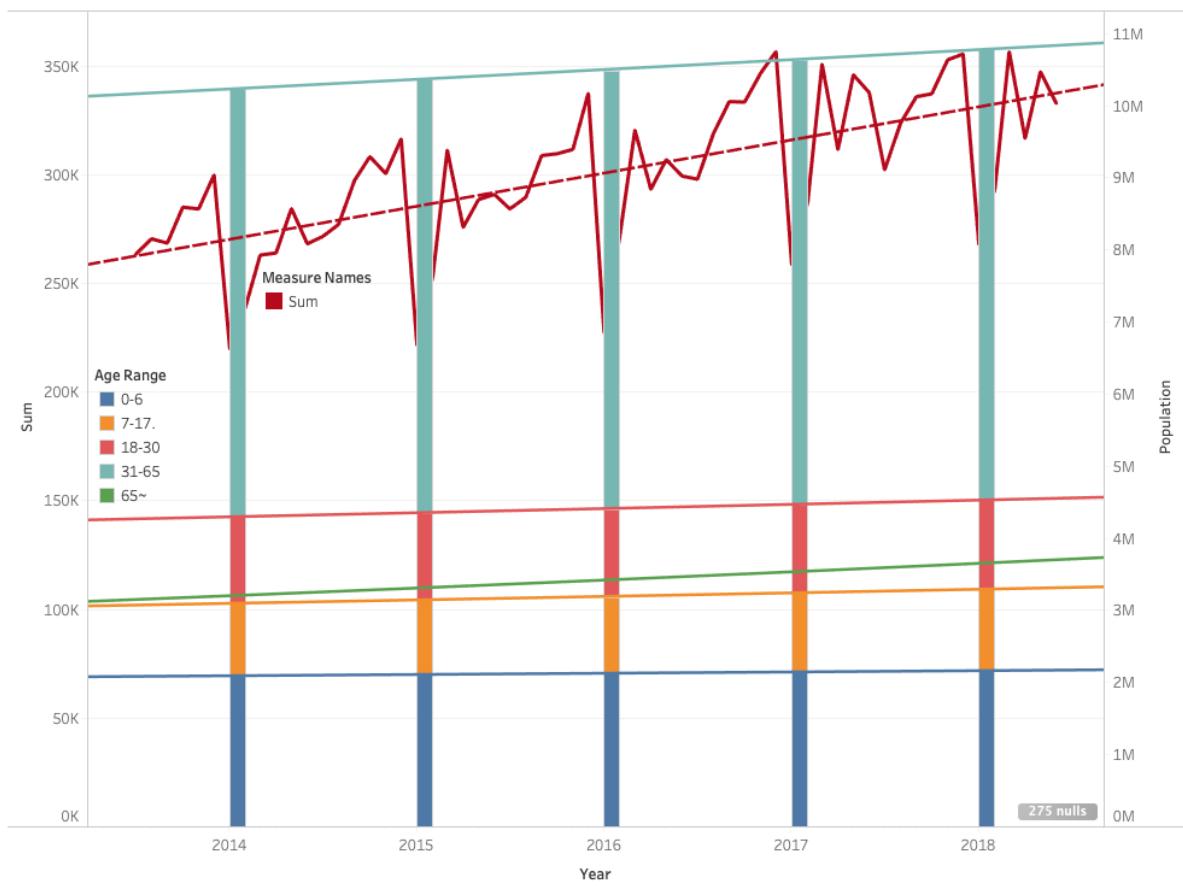
Trends - Registration Type & Population (Body type)



Trends - Registration Type & Population (Registration Type)

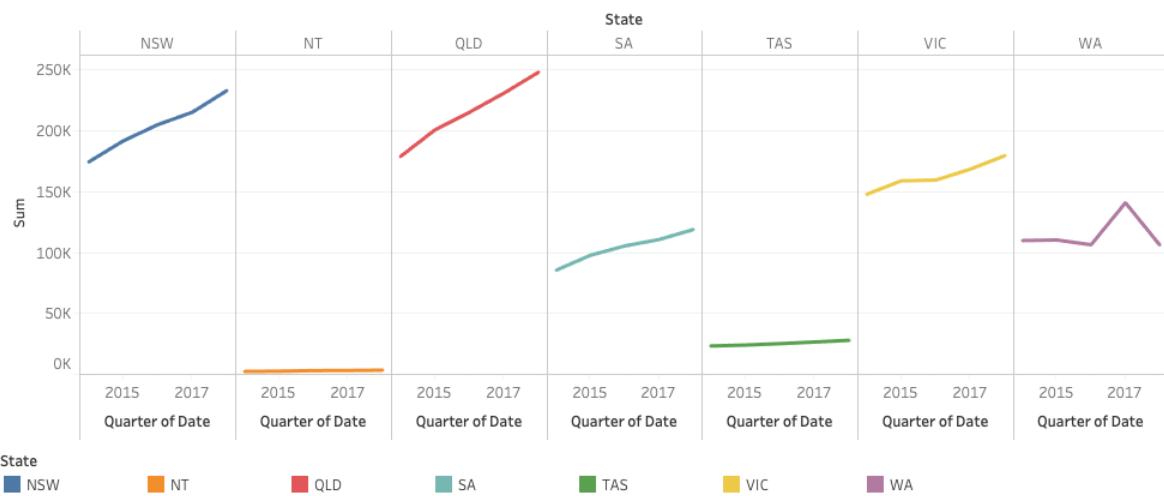


Trends - Registrations with Population (Age Range)



State Level

Absolute Increase in Sales



GR Increase in Sales

