



SMU

SINGAPORE MANAGEMENT
UNIVERSITY

DSA211 Statistical Learning with R – G1

Group Project Part 1 - Punggol

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1 Introduction

1.1 Objective

Given the averted rise in public housing (HDB) BTO prices in the recent year 2022, greater emphasis is placed on housing alternatives such as resale flats (Ng, 2022).

Thus, our team aims to analyse the resale prices of HDBs in the Punggol region, one of the fastest growing housing estates in Singapore, with multiple projects (BTO) developing in the area. Using the most recent transaction data for the previous year 2022, we will analyze the variables (Date, Type, Block, Street, Story, Area, Model, Leasebegin, Lease remaining) affecting Resale Prices. Thereby, concocting a model that could be used to best explain the Resaleprices in the dataset.

1.2 Best Linear Model

To select the Best Linear Model to explain ResalePrice, the decision criterion was to achieve the lowest BIC of the model while ensuring the simplicity and goodness of fit of the model.

After considering the effects of interactions and polynomials and making comparative analysis based on the decision criteria, the best model was also tested with residual analysis and various other statistical tests to ensure that the model chosen was the best fit for the given data in Punggol2023P.csv.

The Best Fit Linear Model Regression:

lm(ResalePrice~Date+Type+Block+Story+Area+Model+LeaseBegin+LeaseRemaining.in.months.+Area(Date+Type+Block+Story+Model+LeaseBegin+LeaseRemaining.in.months.)+LeaseRemaining.in.months.*(Date+Type+Block+Story+Model+LeaseBegin),data=Punggol)*

BIC criterion: 45337.12

This paper will go further to explain and justify the derivation of the best fitted model to explain the HDB resale price with the given independent variables. Furthermore, we evaluate the shortcomings of the existing model and provide recommendations to improve the model.

2 Data Cleaning

A multiple regression linear model on all the independent variables in the raw dataset, Punggol2023P.csv was run to investigate the relationship between other explanatory variables and Resale Price, the dependent variable.

2.1 Clustering of Blocks

Running a linear regression on Block, it is observed that the number of blocks in the data set accumulate to 1936 distinct blocks which amount to a high volume of regressors to work with. As a result, if every block is to be regressed, the model would have 1936 dummy variables on top of the existing variables.

Furthermore, this model is inefficient and complex for evaluating the impact of the geographical positioning on resale prices, due to its large number of regressors.

Hence, clustering of Blocks based on their geographical location was done as shown in Figure 1.

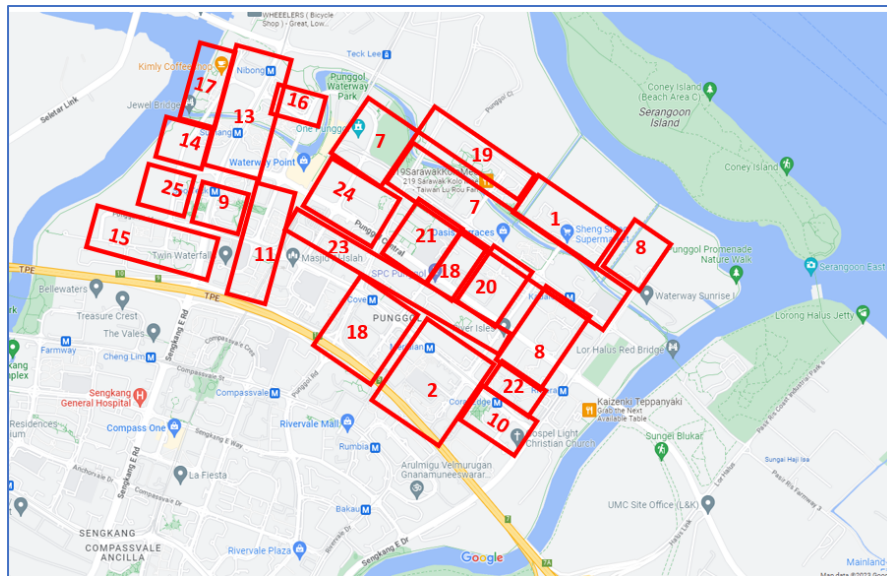


Figure 1: Clustering of Blocks on Google Maps

Indexing of the following clusters from 1 to 25 has been done as shown in Table A in the Annex.

2.2 Removal of Entries

Under the variable “Model”, the category of Premium Apartment Loft (PAL) was removed. With only one entry, there was insufficient data points in the category, and hence was unable to draw a linear regression model with PAL as a regressor.

Furthermore, the Resale Price of a PAL is exceptionally high compared to the other models as it is estimated to be around \$900k or even more than a million (PropertyGuru, 2021).

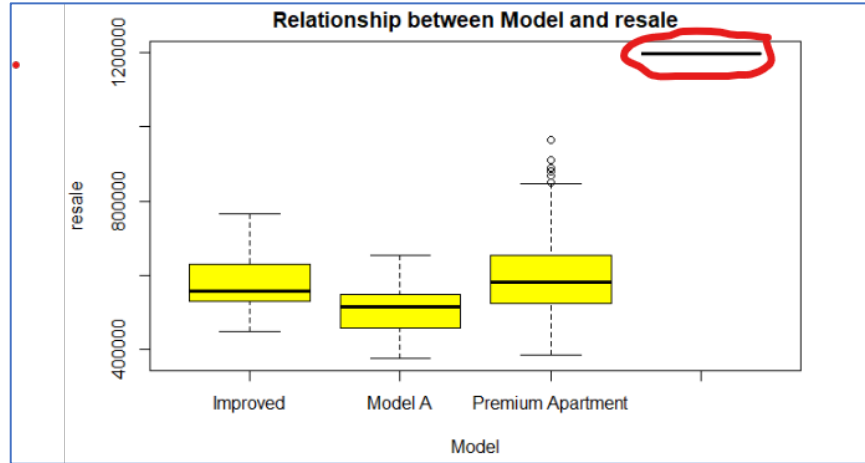


Figure 2: Boxplot of Relationship between Model and Resale Price

Figure 2 indicates that the dataset only contains one data point for Premium Apartment Loft, which is significantly higher than the other 3 models with their respective datasets.

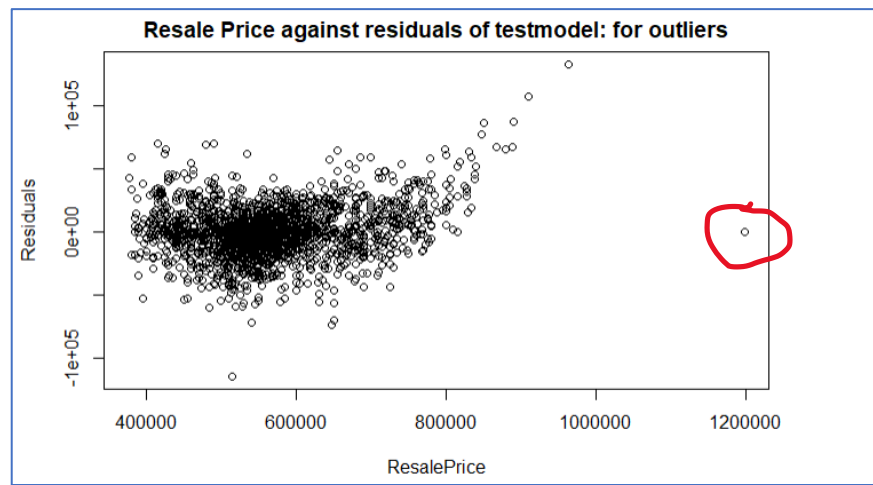


Figure 3: Residual Plot between Residuals and Resale Price

Figure 3 further explains the severity of the outlier. It is observed that the PAL representative data point is distant away from the other residual plots, therefore distorting linear regression model and impose higher variance. Hence, it would be safe and recommended to remove it from the analysis.

2.3 Computation of Lease Remaining

In order to improve computational efficiency, LeaseRemaining has been re-calculated into total number of months expressed numerically instead of the “original years and months” format (i.e. 1 year = 12 months).

3 Model Parameters

Variable Name	Type of Variable	Meaning of Variable
Date	Categorical	Transaction Month
Type	Categorical	HDB Types (3 -, 4-or 5- room flats)
Block	Categorical	Indexed Categories based on Block Geographical Location
Street	Categorical	Flat's Street Location
Story	Categorical	Flat's Storey
Area	Numerical	Size in Squared Meters
Model	Categorical	Flat's Model
LeaseBegin	Categorical	Year of Lease Start
LeaseRemaining(in months)	Numerical	Period of Lease Remaining (in months)
ResalePrice (Independent Variable)	Numerical	Resale Price of flat

For Block and LeaseBegin, RStudio recognized the variables as numerical variables instead of categorical variables. Hence, the classes of Block and LeaseBegin were reassigned as a factor, to run a more comprehensive and inferential model.

4 Optimal Regression Model

The criterion provided for the project to select the best linear model is determined by the model's BIC value. Alongside the BIC criterion, the Adjusted R-squared was considered to ensure a more accurate selection of the best model.

Overall Summary of Models Tested:

Model	Model Regressors	BIC	Adjusted R-squared
reg1	ALL independent	45625.41	0.9039
reg2	ALL independent – Street	45619.3	0.9038
reg3	ALL independent – Street + Area*(Date + Type + Block + Story + Model + LeaseBegin + LeaseRemaining.in.months.) + LeaseRemaining.in.months*(Date + Type + Block + Story + Model + LeaseBegin)	45337.12	0.9422
reg6	ALL independent – Street + Area*(Date + Type + Block + Story + Model + LeaseBegin + Area+ LeaseRemaining.in.months.) + LeaseRemaining.in.months*(Date + Type + Block + Story + Model + LeaseBegin + LeaseRemaining.in.months) ** with polynomials	45337.12	0.9422

Table 1: Comparison between model BIC and Adjusted R-squared

4.1 Removal of Independent Variables (Street)

After the reclassification of variables in the dataset, a base linear regression model (reg1) was run with the inclusion of all independent variables against Resale Price.

The decision criteria was set at the 0.05 significance level as a general threshold to filter out variables that were not significant. Street was proven to be not significant at the 5% significance level as seen in Figure 4 as its p-value yielded “NA” fields in a consistent manner.

StreetEDGEFIELD PLAINS	NA	NA	NA	NA
StreetPUNGGOL CTRL	NA	NA	NA	NA
StreetPUNGGOL DR	6708.6	5629.1	1.192	0.233507
StreetPUNGGOL EAST	NA	NA	NA	NA
StreetPUNGGOL FIELD	NA	NA	NA	NA
StreetPUNGGOL FIELD WALK	NA	NA	NA	NA
StreetPUNGGOL PL	NA	NA	NA	NA
StreetPUNGGOL RD	NA	NA	NA	NA
StreetPUNGGOL WALK	NA	NA	NA	NA
StreetPUNGGOL WAY	NA	NA	NA	NA
StreetSUMANG LANE	NA	NA	NA	NA
StreetSUMANG LINK	NA	NA	NA	NA
StreetSUMANG WALK	NA	NA	NA	NA

Figure 4: Output of Street regressors on reg1

Correlation between Street/Block & Linear Regression of Street / Block on ResalePrice

The presence of NA p values and the clustering of the Block variable earlier based on their geographical indicate a possible high correlation between the Street and Block variables.

Pearson's Chi-squared test	
data: Punggol\$Block and Punggol\$Street	
X-squared = 23220, df = 260, p-value < 2.2e-16	

Figure 5: Pearson’s Chi-squared test

Pearson’s Chi-squared test was performed to test if the relevant assumptions that the samples are independent are true. The test provides a p value of $2.2e^{-16}$, which is less than 0.05 at the 5% significance level, thereby rejecting the null hypothesis that there is no relationship between variables Block and Street.

Model Regressors	Adjusted R-squared
Street	0.07745
Block (after clustering)	0.1197

Table 2: Comparison of model’s Adjusted R-squared

To understand which regression model would be a better representation, a comparison between the Adjusted R-squared was made. As seen in Table 2, it can be observed that Block produced a higher Adjusted R- squared value and can be concluded that Block would be a better geographical regressor than Street to explain ResalePrice . Thus, it is safe to remove Street as an independent variable.

Linear regression with ALL variables excluding Street on ResalePrice (reg2)

Based on Table 1, it can be inferred that removing Street from the regression would not cause a significant change in the Adjusted R-Square (0.9038) and it would result in a decrease in BIC (45619.3). Hence, reg2 is a better linear regression model as compared to reg1.

4.2 Accounting for Interaction Effects

As all the regressors are within the scope of decision analysis when it comes to purchasing a Resale block in Punggol, we have gone on to investigate the effects of interaction between the independent variables due to the possibility of dependency of various independent variables.

With Area and LeaseRemaining.in.months. being the only numerical variables, a linear regression (reg3) including interaction effects between these two variables and the rest of the categorical variables was simulated.

The results have shown that including interaction terms in the linear regression greatly reduced BIC (45337.12) and greatly increased Adjusted R-squared (0.9422) as seen in Table 1. Hence, reg3 will make a better linear regression model than reg2. It is important to note that though the associated main effects might have relatively high p values, we have still included the main effects in reg3 due to the hierarchy principle, failing which, it would be hard to interpret the interaction effects in the model.

4.3 Measuring for Polynomial effects

Furthermore, the effects of polynomial (up to power of 2) regression were also explored. With Area and LeaseRemaining.in.months. being the only numerical variables, only the polynomial effects of these two variables were evaluated.

From Table 1, the linear regression with polynomials (up to power of 2) (reg6) had an Adjusted R-squared and BIC that does not differ from that of reg3. Hence, for the simplicity of the model with less regressors, reg3 is a better model than reg6.

5 Residual Analysis

5.1 Linear relationship Assumption

To ensure that the recommended model (reg3) is a good fit to explain the Resale Prices in Punggol, there is a need to ensure that the regression assumptions are not violated. Such regression assumptions include:

1. Linear relationship
2. Normality of error
3. Homoscedasticity: probability distribution of errors has constant variance
4. Independence of errors

As such, it is important to examine the residuals and a scatter plot of the residuals against the predicted values was run.

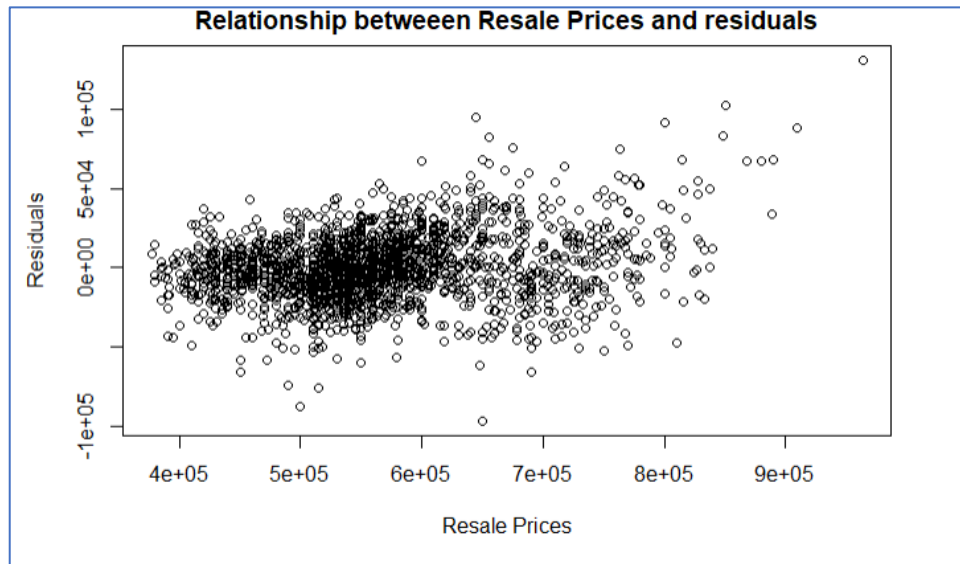


Figure 7: Scatterplot between ResalePrice and Residuals

Figure 7 indicates that there is largely no violation of a linear relationship between the residuals and resale price. It can be observed that the errors largely have a constant variance.

5.2 Checking of Q-Q / P-P plot

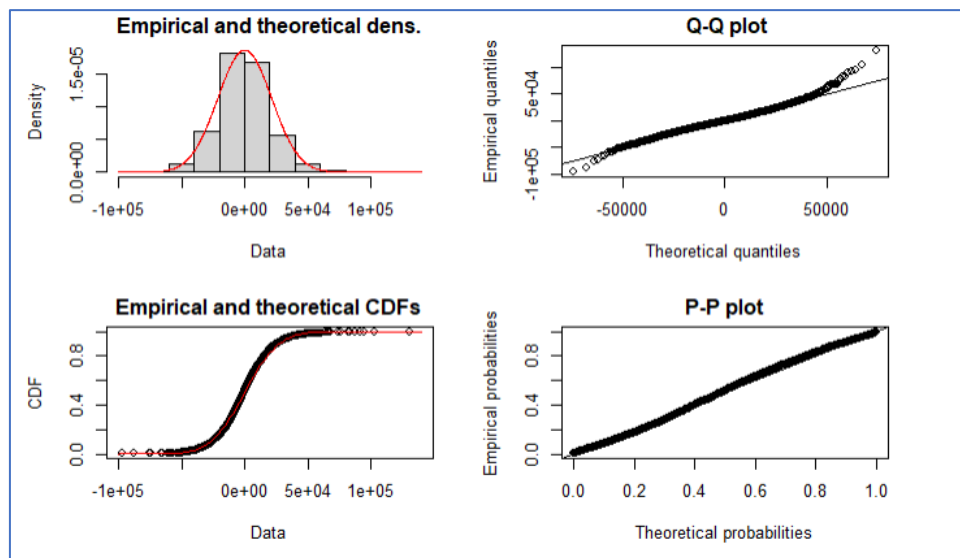


Figure 8: Q – Q / P – P plot for ResalePrices

As seen in Figure 8, a residual normal fit analysis was conducted, and it can be concluded that the P-P / Q-Q plots show no deviations from normal assumptions.

Furthermore, the Shapiro-Wilk test indicates that the residuals are normally distributed given a relatively strong goodness of fit of the model against a normal distribution. Therefore, it can be concluded that the normal assumption of the model is not violated.

Based on the residual analysis, it is safe to deduce that the assumptions of normality and homoskedasticity are valid for the statistical model, further implying that the model provides a good fit for the given estimates for Resale Price.

However, it is essential to note that residual analysis is only one aspect of model validation, and other tests should be conducted to assess the model's overall performance.

5.3 Kolmogorov – Smirnov Test Statistic

To further validate the goodness of fit of the recommended model, the KS statistic was calculated. As seen in Figure 9 below, the calculated KS statistic (0.03857706) is lower than the KS critical value of 0.3771961 at the 0.05 significance level. It is safe to conclude that there is sufficient evidence to reject the null hypothesis that residuals are not normally distributed at the 0.05 significance level.

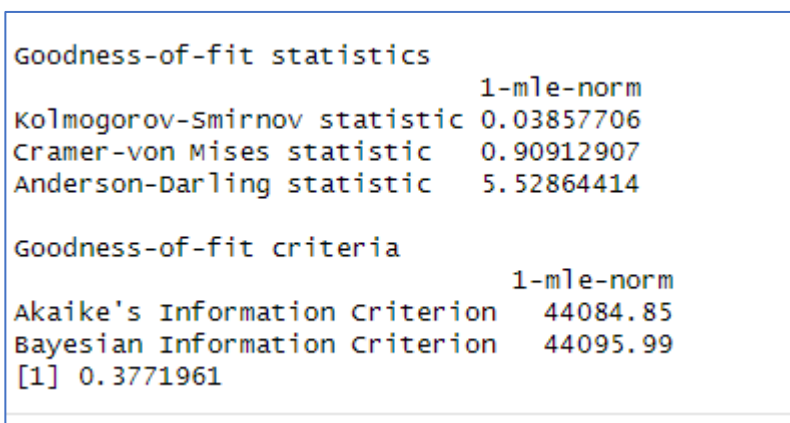


Figure 9: Kolmogorov – Smirnov Test Statistic

6 Evaluations

6.1 Removing Interaction Terms

Model	Model Regressors	BIC	Adjusted R-squared
reg3	ALL independent – Street + Area*(Date + Type + Block + Story + Model + LeaseBegin + LeaseRemaining.in.months.) + LeaseRemaining.in.months*(Date + Type + Block + Story + Model + LeaseBegin)	45337.12	0.9422
reg4	ALL independent – Street + Area*(Date + Type + Block + Story + Model + LeaseBegin + LeaseRemaining.in.months.) + LeaseRemaining.in.months*(Date + Type + Block + Story + Model) *removed Area*LeaseBegin	45333.64	0.9397
reg5	ALL independent – Street + Area*(Date + Type + Block + Story + Model + LeaseRemaining.in.months.) + LeaseRemaining.in.months*(Date + Type + Block + Story + Model + LeaseBegin) * removed LeaseRemaining.in.months*LeaseBegin	45311.25	0.9404

Table 3: Comparison between model BIC and Adjusted R-squared

In view of tendency of the BIC criterion to penalize models with more independent variables, more focus was placed on the higher Adjusted R-Squared, which acts as a stronger and more justified indicator in the decision of removing certain interaction terms.

Despite the higher BIC as shown in Figure 3, reg3 model was preferred over reg4 and reg5 due to its higher Adjusted R-squared, which implied that its regressors explained the model better relatively.

6.2 Other Findings/Improvements

Removal of PAL

As previously mentioned, one of the model fields (“Premium Apartment Loft”) was excluded from the dataset due to the lack of entries. As such, the recommended model may not be ideal in explaining datasets that may contain more entries for PALs.

Inference vs Predictive Model

As the purpose of the project is to create an inference model, the recommended model was evaluated based on the ability to best explain the given dataset using statistics such as BIC and Adjusted R-squared. However, it is key to note that if the recommended model was to be used for predictive purposes, the results may not be as accurate.

7 Conclusions

To summarize the various steps undertaken to recommend the best fit housing model, they are:

1. Data Cleaning (Clustering of blocks, Removal of data entries & Computation of LeaseRemaining)
2. Classification of Model Parameters (Numerical vs Categorical)
3. Building of best fit model through BIC & Adjusted R squared (Removal of Insignificant Independent Variables, Accounting for Interaction Effects & Measuring of Polynomial Effects)
4. Testing of Best Fit Model against Regression Assumptions (Linearity, Normality & Homoscedasticity)
5. Evaluation and Other Findings/Improvements

Based on the above steps, we recommend the **best fit model** (*BIC: 45337.12 & Adjusted R-squared: 0.9422*) to be as such:

Date + Type + Block + Area + Story + Model + LeaseBegin + LeaseRemaining.in.months

+

Area(Date + Type + Block + Story + Model + LeaseBegin + LeaseRemaining.in.months.)*

+

LeaseRemaining.in.months(Date + Type + Block + Story + Model + LeaseBegin)*

8 References

Ng, M. (2022, November 9). *Average price psf for BTO flats in mature estates rising faster than in non-mature estates*. The Straits Times. <https://www.straitstimes.com/singapore/average-psf-for-bto-flats-in-mature-estates-increased-faster-than-in-non-mature-estates-price-gap-widened>

PropertyGuru.(2021, November 15). *HDB Loft Units in Singapore: What Are They and Where to Find HDB Lofts for Sale*. <https://www.propertyguru.com.sg/property-guides/hdb-loft-units-2-35594>

9 Annex

9.1 Tables

Index	Blocks	Street
1	109; 120 – 122; 126; 130 – 135; 138; 171 – 174	Edgedale Plains
2	659 – 662; 682 – 684	Edgedale Plains
6	160 – 166; 643	Punggol Central
7	645 – 652	Punggol Drive
8	167 – 168	Punggol East
9	101, 102; 106; 110; 173, 175; 196 – 205; 258 – 259; 267 – 270	Punggol Field
10	128	Punggol Field Walk
11	207 – 210; 272 – 274; 288 – 306	Punggol Place
12	194 – 195; 303 – 306; 602 – 604; 612 – 619; 624; 632 – 638; 641 – 642; 662 – 667; 673; 676 – 679	Punggol Road
13	211 – 213; 270; 272; 306 – 310	Punggol Walk
14	313 – 316	Punggol Way
15	220 – 227; 231 – 234;	Sumang Lane
16	312 - 313	Sumang Link
17	217; 256; 316; 327	Sumang Walk
18	111; 114 – 118; 176 - 178; 183; 193 ; 103 – 107	EdgeField Plains
19	613 – 615; 667 – 673	EdgeField Plains
20	301 – 303; 622 – 624	Punggol Central
21	293 – 299; 601 – 602	Punggol Central
22	659	Punggol East
23	168 – 170	Punggol Field
24	288	Punggol Place
25	260 – 266	Punggol Way

Table A: Indexing of Block Areas

9.2 Codes and Outputs

Reading Revised Punggol2023P.csv

```
{r}
Punggol <- read.csv("Revised.csv", stringsAsFactors = TRUE)
summary(Punggol)
```

Converting Block and LeaseBegin into Categorical Variable

```
{r}
# convert year variable into a factor
Punggol$Block <- factor(Punggol$Block)
levels(Punggol$Block)

Punggol$LeaseBegin <- factor(Punggol$LeaseBegin)
levels(Punggol$LeaseBegin)

[1] "1" "2" "6" "8" "9" "10" "11" "12" "13" "14" "15" "16" "17" "18" "19" "20" "21" "22" "23" "24" "25"
[1] "2002" "2003" "2004" "2005" "2007" "2009" "2010" "2011" "2012" "2013" "2014" "2015" "2016" "2017" "2018"
```

9.2.1 Independent Variables Against Resale Price

```
{r}
# see which dummy variables are significant
date <- Punggol$date
type <- Punggol$type
block <- Punggol$Block
street <- Punggol$Street
area <- Punggol$Area
story <- Punggol$Story
model <- Punggol$Model
begin <- Punggol$LeaseBegin
resale <- Punggol$ResalePrice
remaining <- Punggol$LeaseRemaining
age <- Punggol$LeaseAge
years <- Punggol$Years
months <- Punggol$Months

boxplot(resale~date, main="Relationship between date and resale", xlab="date", ylab="resale", col="yellow")

boxplot(resale~type, main="Relationship between type and resale", xlab="type", ylab="resale", col="yellow")

boxplot(resale~block, main="Relationship between blk and resale", xlab="block", ylab="resale", col="yellow")

boxplot(resale~street, main="Relationship between street and resale", xlab="street", ylab="resale", col="yellow")

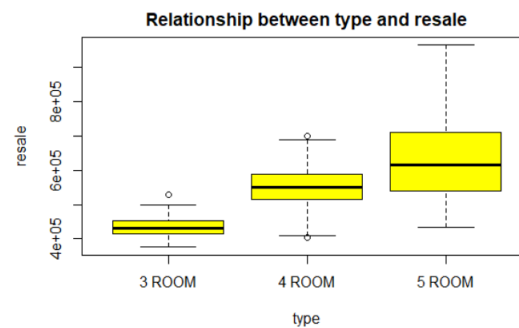
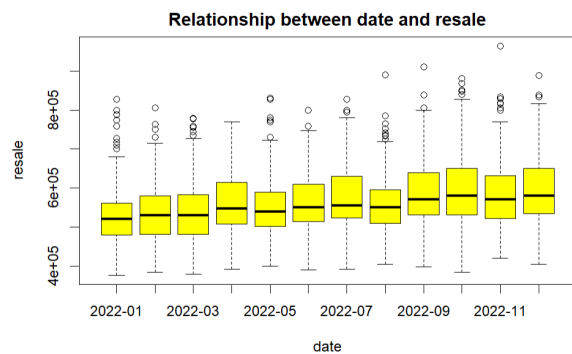
boxplot(resale~model, main="Relationship between Model and resale", xlab="Model", ylab="resale", col="yellow")

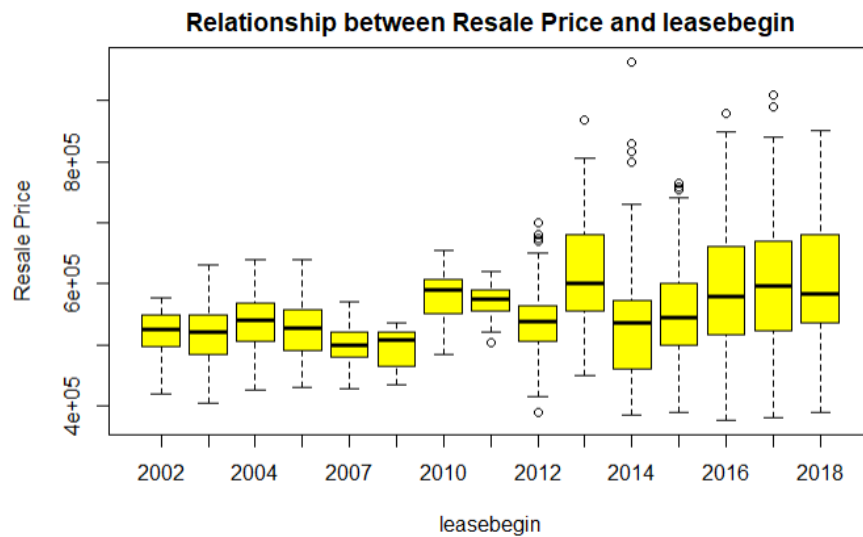
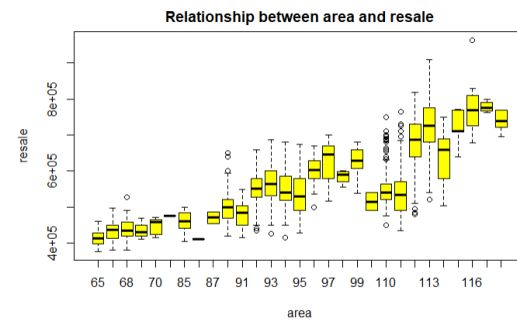
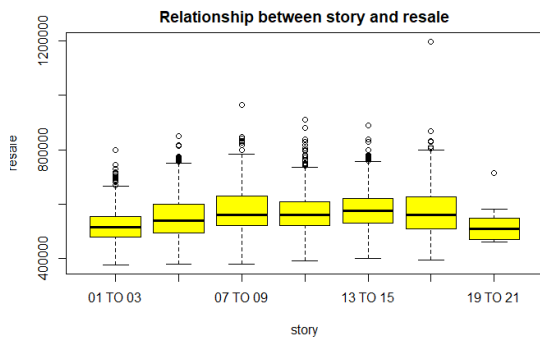
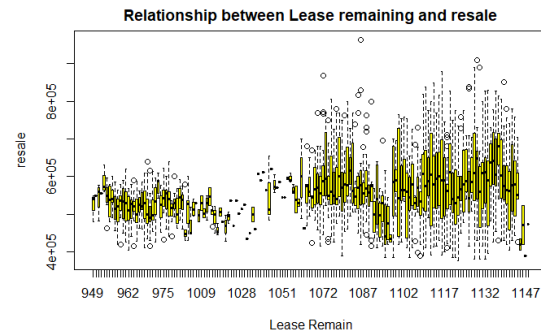
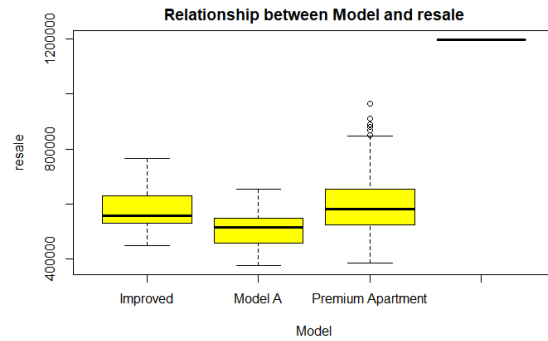
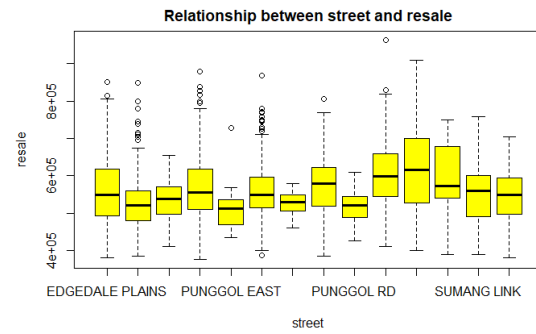
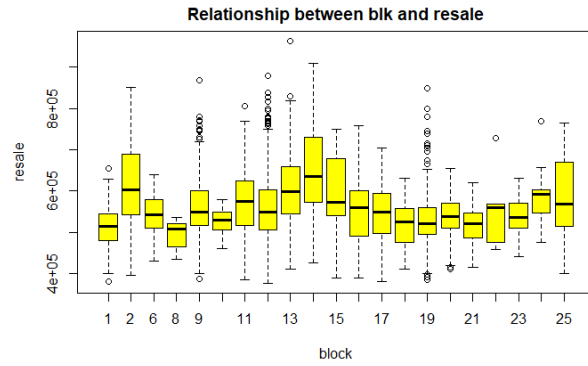
boxplot(resale~remaining, main="Relationship between Lease remaining and resale", xlab="Lease Remain", ylab="resale", col="yellow")

boxplot(resale~story, main="Relationship between story and resale", xlab="story", ylab="resale", col="yellow")

boxplot(resale~area, main="Relationship between area and resale", xlab="area", ylab="resale", col="yellow")

boxplot(resale~begin, main="Relationship between Resale Price and leasebegin", ylab="Resale Price", xlab="leasebegin", col="yellow")
```





9.2.2 Linear Model Regressions (reg1 → reg6)

Reg1 (Linear regression of all independent variables against resale price)

```
#see with all variables
options(max.print=999999)

reg1<-lm(ResalePrice~.,data=Punggol)
summary(reg1)
BIC(reg1)

#BIC: 45761.85
#adjusted = 0.8926
```

```
Call:
lm(formula = ResalePrice ~ ., data = Punggol)
```

Residuals:

Min	1Q	Median	3Q	Max
-96308	-18000	-1366	16124	205014

Coefficients: (13 not defined because of singularities)

	Estimate	Std. Error	t value	Pr(> t)	
(Intercept)	2430052.9	294077.6	8.263	2.64e-16	***
Date2022-02	3766.0	3302.9	1.140	0.254337	
Date2022-03	6387.1	3200.1	1.996	0.046091	*
Date2022-04	7662.6	3202.2	2.393	0.016812	*
Date2022-05	8918.3	3459.0	2.578	0.010006	*
Date2022-06	16240.3	3455.4	4.700	2.79e-06	***
Date2022-07	17328.8	3543.6	4.890	1.09e-06	***
Date2022-08	17613.1	3936.0	4.475	8.10e-06	***
Date2022-09	25151.9	3811.7	6.599	5.39e-11	***
Date2022-10	34842.5	4186.7	8.322	< 2e-16	***
Date2022-11	29425.2	4169.1	7.058	2.37e-12	***
Date2022-12	34774.8	4364.8	7.967	2.79e-15	***
Type4 ROOM	53515.1	15455.3	3.463	0.000547	***
Type5 ROOM	121241.2	27770.4	4.366	1.34e-05	***
Block2	27916.7	6006.8	4.648	3.59e-06	***
Block6	14365.3	5631.4	2.551	0.010822	*
Block8	272210.6	26388.7	10.315	< 2e-16	***
Block9	34157.4	3762.2	9.079	< 2e-16	***
Block10	42794.7	8402.7	5.093	3.88e-07	***
Block11	47151.1	5443.3	8.662	< 2e-16	***
Block12	28446.8	6930.4	4.105	4.22e-05	***
Block13	34158.3	5122.5	6.668	3.39e-11	***
Block14	99505.6	6137.4	16.213	< 2e-16	***
Block15	-5835.0	6704.3	-0.870	0.384225	
Block16	52312.2	7537.5	6.940	5.37e-12	***
Block17	36086.6	5588.8	6.457	1.36e-10	***
Block18	24043.1	4412.0	5.449	5.72e-08	***
Block19	25403.8	5557.0	4.572	5.16e-06	***
Block20	-866.6	7093.4	-0.122	0.902781	
Block21	36076.2	6029.8	5.983	2.62e-09	***
Block22	29445.0	14326.6	2.055	0.039992	*
Block23	-14587.4	8639.0	-1.689	0.091471	.
Block24	29103.6	9576.2	3.039	0.002405	**
Block25	40950.5	6153.9	6.654	3.72e-11	***
StreetEDGEFIELD PLAINS	NA	NA	NA	NA	
StreetPUNGGOL CTRL	NA	NA	NA	NA	
StreetPUNGGOL DR	6708.6	5629.1	1.192	0.233507	
StreetPUNGGOL EAST	NA	NA	NA	NA	
StreetPUNGGOL FIELD	NA	NA	NA	NA	
StreetPUNGGOL FIELD WALK	NA	NA	NA	NA	
StreetPUNGGOL PL	NA	NA	NA	NA	
StreetPUNGGOL RD	NA	NA	NA	NA	
StreetPUNGGOL WALK	NA	NA	NA	NA	

StreetPUNGGOL PL	NA	NA	NA	NA
StreetPUNGGOL RD	NA	NA	NA	NA
StreetPUNGGOL WALK	NA	NA	NA	NA
StreetPUNGGOL WAY	NA	NA	NA	NA
StreetSUMANG LANE	NA	NA	NA	NA
StreetSUMANG LINK	NA	NA	NA	NA
StreetSUMANG WALK	NA	NA	NA	NA
Story04 TO 06	23904.8	2510.4	9.522	< 2e-16 ***
Story07 TO 09	43785.7	2486.1	17.612	< 2e-16 ***
Story10 TO 12	52816.2	2480.4	21.294	< 2e-16 ***
Story13 TO 15	60818.1	2533.1	24.009	< 2e-16 ***
Story16 TO 18	66712.1	2795.3	23.866	< 2e-16 ***
Story19 TO 21	65102.3	11341.3	5.740	1.10e-08 ***
Area	3279.0	615.6	5.326	1.12e-07 ***
ModelModel A	22456.5	3221.5	6.971	4.35e-12 ***
ModelPremium Apartment	42470.4	3213.8	13.215	< 2e-16 ***
LeaseBegin2003	21052.2	8167.4	2.578	0.010025 *
LeaseBegin2004	72459.7	9772.5	7.415	1.84e-13 ***
LeaseBegin2005	67290.0	11467.3	5.868	5.20e-09 ***
LeaseBegin2007	206180.1	20075.9	10.270	< 2e-16 ***
LeaseBegin2009	NA	NA	NA	NA
LeaseBegin2010	384390.8	31706.5	12.123	< 2e-16 ***
LeaseBegin2011	364490.4	31896.4	11.427	< 2e-16 ***
LeaseBegin2012	414503.1	36198.4	11.451	< 2e-16 ***
LeaseBegin2013	443809.6	38991.9	11.382	< 2e-16 ***
LeaseBegin2014	483717.2	42899.3	11.276	< 2e-16 ***
LeaseBegin2015	505338.6	46588.8	10.847	< 2e-16 ***
LeaseBegin2016	546395.7	49771.0	10.978	< 2e-16 ***
LeaseBegin2017	560530.0	53442.3	10.489	< 2e-16 ***
LeaseBegin2018	617088.2	58006.8	10.638	< 2e-16 ***
LeaseRemaining.in.months.	-2584.2	305.7	-8.454	< 2e-16 ***

 signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 28870 on 1877 degrees of freedom
 Multiple R-squared: 0.9067, Adjusted R-squared: 0.9039
 F-statistic: 320 on 57 and 1877 DF, p-value: < 2.2e-16

[1] 45625.41

Reg 2 (All Independent Variables – Street)

```
##{r}
#remove street
reg2<-lm(ResalePrice~.-Street,data=Punggol)
summary(reg2)
BIC(reg2)

#BIC: 45619.3
#adjusted r^2 = 0.9038
##
```

```
Call:
lm(formula = ResalePrice ~ . - Street, data = Punggol)
```

```
Residuals:
    Min       1Q   Median       3Q      Max
-96573 -17953  -1362   16168  205076
```

```
Coefficients: (1 not defined because of singularities)
```

	Estimate	Std. Error	t value	Pr(> t)	
(Intercept)	2376655.1	290676.7	8.176	5.33e-16	***
Date2022-02	3848.8	3302.5	1.165	0.244007	
Date2022-03	6354.0	3200.4	1.985	0.047244	*
Date2022-04	7820.1	3199.8	2.444	0.014621	*
Date2022-05	9091.5	3456.4	2.630	0.008600	**
Date2022-06	16370.8	3454.1	4.740	2.30e-06	***
Date2022-07	17524.6	3540.2	4.950	8.08e-07	***
Date2022-08	17882.3	3929.9	4.550	5.70e-06	***
Date2022-09	25515.7	3799.9	6.715	2.49e-11	***
Date2022-10	35329.2	4167.2	8.478	< 2e-16	***
Date2022-11	29745.0	4160.9	7.149	1.25e-12	***
Date2022-12	35227.0	4348.8	8.100	9.76e-16	***
Type4 ROOM	51804.3	15390.3	3.366	0.000778	***
Type5 ROOM	118009.9	27640.9	4.269	2.06e-05	***
Block2	27833.3	6007.0	4.633	3.84e-06	***
Block6	13989.2	5623.2	2.488	0.012941	*
Block8	268126.0	26168.1	10.246	< 2e-16	***
Block9	34077.8	3762.0	9.058	< 2e-16	***
Block10	42890.6	8403.3	5.104	3.66e-07	***
Block11	47182.6	5443.8	8.667	< 2e-16	***
Block12	34637.8	4587.9	7.550	6.76e-14	***
Block13	34050.4	5122.2	6.648	3.89e-11	***
Block14	99165.7	6131.5	16.173	< 2e-16	***
Block15	-5816.3	6705.0	-0.867	0.385802	
Block16	52259.2	7538.2	6.933	5.66e-12	***
Block17	35744.4	5582.0	6.404	1.91e-10	***
Block18	24122.4	4412.0	5.467	5.18e-08	***
Block19	25366.0	5557.5	4.564	5.34e-06	***
Block20	-880.7	7094.2	-0.124	0.901211	
Block21	36537.6	6018.0	6.071	1.53e-09	***
Block22	29313.2	14327.8	2.046	0.040905	*
Block23	-14502.9	8639.7	-1.679	0.093388	.
Block24	28818.6	9574.2	3.010	0.002647	**
Block25	40743.2	6152.2	6.623	4.59e-11	***
Story04 TO 06	23882.2	2510.6	9.512	< 2e-16	***
Story07 TO 09	43719.9	2485.8	17.588	< 2e-16	***
Story10 TO 12	52728.7	2479.6	21.265	< 2e-16	***
Story13 TO 15	60741.3	2532.6	23.984	< 2e-16	***
Story16 TO 18	66696.6	2795.6	23.858	< 2e-16	***
Story19 TO 21	65192.0	11342.3	5.748	1.05e-08	***
Area	3352.3	612.6	5.472	5.04e-08	***
ModelModel A	22265.5	3217.9	6.919	6.21e-12	***

ModelPremium Apartment	42329.8	3212.0	13.179	< 2e-16	***
LeaseBegin2003	20492.3	8154.8	2.513	0.012057	*
LeaseBegin2004	71510.8	9741.1	7.341	3.14e-13	***
LeaseBegin2005	66355.7	11441.8	5.799	7.79e-09	***
LeaseBegin2007	200502.1	19504.6	10.280	< 2e-16	***
LeaseBegin2009	NA	NA	NA	NA	
LeaseBegin2010	379439.0	31436.6	12.070	< 2e-16	***
LeaseBegin2011	359077.9	31575.0	11.372	< 2e-16	***
LeaseBegin2012	407324.6	35697.7	11.410	< 2e-16	***
LeaseBegin2013	437216.5	38601.8	11.326	< 2e-16	***
LeaseBegin2014	476475.5	42471.6	11.219	< 2e-16	***
LeaseBegin2015	497529.6	46130.9	10.785	< 2e-16	***
LeaseBegin2016	538179.4	49296.7	10.917	< 2e-16	***
LeaseBegin2017	551560.0	52915.5	10.423	< 2e-16	***
LeaseBegin2018	607334.1	57432.9	10.575	< 2e-16	***
LeaseRemaining.in.months.	-2533.3	302.7	-8.368	< 2e-16	***

signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 28870 on 1878 degrees of freedom
Multiple R-squared: 0.9066, Adjusted R-squared: 0.9038
F-statistic: 325.6 on 56 and 1878 DF, p-value: < 2.2e-16

[1] 45619.3

Reg3 (All Independent – Street and Interaction Variables)

```
#include all the interaction variables
reg3<-lm(ResalePrice~Date+Type+Block+Story+Area+Model+LeaseBegin+LeaseRemaining.in.months.+Area*(Date + Type + Block + Story + Model
+ LeaseBegin + LeaseRemaining.in.months.) +LeaseRemaining.in.months*(Date + Type + Block + Story + Model + LeaseBegin),data=Punggol)
summary(reg3)
BIC(reg3)
#BIC: 45337.12
#Adjusted R^2: 0.9422
...

Call:
lm(formula = ResalePrice ~ Date + Type + Block + Story + Area +
    Model + LeaseBegin + LeaseRemaining.in.months. + Area * (Date +
    Type + Block + Story + Area + Model + LeaseBegin + LeaseRemaining.in.months.) +
    LeaseRemaining.in.months. * (Date + Type + Block + Story +
    Area + Model + LeaseBegin + LeaseRemaining.in.months.),
    data = Punggol)

Residuals:
    Min       1Q   Median       3Q      Max
-96590 -12944   -600   12312  131349

Coefficients: (4 not defined because of singularities)
              Estimate Std. Error t value Pr(>|t|)
(Intercept)  1.073e+07  2.984e+06   3.594 0.000334 ***
Date2022-02 -1.104e+05  5.745e+04  -1.923 0.054692 .
Date2022-03 -1.082e+05  5.416e+04  -1.998 0.045878 *
Date2022-04 -1.219e+05  5.763e+04  -2.114 0.034620 *
Date2022-05 -2.241e+05  6.282e+04  -3.567 0.000370 ***
Date2022-06 -1.884e+05  6.080e+04  -3.099 0.001971 **
Date2022-07 -2.039e+05  6.258e+04  -3.259 0.001139 **
Date2022-08 -2.891e+05  6.979e+04  -4.142 3.60e-05 ***
Date2022-09 -3.335e+05  6.804e+04  -4.901 1.04e-06 ***
Date2022-10 -5.435e+05  7.861e+04  -6.914 6.57e-12 ***
Date2022-11 -4.779e+05  7.852e+04  -6.087 1.41e-09 ***
Date2022-12 -4.840e+05  8.043e+04  -6.017 2.15e-09 ***
Type4 ROOM  -8.352e+05  4.024e+05  -2.076 0.038064 *
Type5 ROOM  -1.093e+06  6.026e+05  -1.813 0.069925 .
Block2      -6.150e+04  1.385e+06  -0.044 0.964598
Block6      -3.920e+05  1.008e+06  -0.389 0.697279
Block8      -3.579e+06  2.483e+06  -1.441 0.149658
Block9      1.188e+04  1.000e+05  0.119 0.905512
Block10     -6.498e+04  2.277e+06  -0.029 0.977234
Block11     -2.004e+06  5.039e+05  -3.978 7.23e-05 ***
Block12     -2.429e+05  1.336e+05  -1.819 0.069093 .
Block13     2.002e+06  3.864e+05  5.183 2.43e-07 ***
...

Block14      5.108e+05  1.350e+06  0.378 0.705256
Block15     -4.582e+06  2.187e+06  -2.096 0.036258 *
Block16      4.121e+06  1.369e+06  3.011 0.002643 **
Block17      9.228e+04  1.246e+06  0.074 0.940957
Block18      6.020e+05  7.569e+05  0.795 0.426553
Block19      1.532e+05  2.104e+05  0.728 0.466659
Block20     -2.631e+05  2.234e+05  -1.178 0.238959
Block21      5.346e+05  1.658e+05  3.225 0.001284 **
Block22     -2.421e+07  2.939e+07  -0.824 0.410137
Block23      3.077e+05  1.702e+06  0.181 0.856529
Block24      7.719e+05  2.251e+06  0.343 0.731734
Block25      3.039e+06  7.079e+05  4.294 1.85e-05 ***
Story04 TO 06 -1.411e+05  4.458e+04  -3.165 0.001579 **
Story07 TO 09 -1.640e+05  4.429e+04  -3.704 0.000219 ***
Story10 TO 12 -2.288e+05  4.498e+04  -5.087 4.02e-07 ***
Story13 TO 15 -2.500e+05  4.562e+04  -5.481 4.85e-08 ***
Story16 TO 18 -1.979e+05  4.845e+04  -4.084 4.62e-05 ***
Story19 TO 21 -1.547e+05  1.789e+05  -0.865 0.387102
Area        -5.603e+04  2.590e+04  -2.163 0.030668 *
ModelModel A -7.865e+05  3.103e+05  -2.535 0.011327 *
ModelPremium Apartment -1.076e+06  3.167e+05  -3.398 0.000693 ***
LeaseBegin2003 -2.526e+05  1.620e+06  -0.156 0.876086
LeaseBegin2004 -3.298e+05  1.674e+06  -0.197 0.843774
LeaseBegin2005  6.636e+05  1.874e+06  0.354 0.723303
LeaseBegin2007 -6.232e+05  1.809e+06  -0.345 0.730435
LeaseBegin2009 NA NA NA NA
LeaseBegin2010  1.406e+06  4.067e+06  0.346 0.729633
LeaseBegin2011 -5.850e+05  2.761e+06  -0.212 0.832224
LeaseBegin2012 -7.102e+05  1.747e+06  -0.407 0.684386
LeaseBegin2013 -5.550e+05  1.718e+06  -0.323 0.746695
LeaseBegin2014 -4.740e+05  1.813e+06  -0.261 0.793831
```

LeaseBegin2014	-4.740e+05	1.813e+06	-0.261	0.793831	
LeaseBegin2015	-7.008e+06	1.812e+06	-3.868	0.000114	***
LeaseBegin2016	-3.092e+06	1.735e+06	-1.782	0.074901	.
LeaseBegin2017	-4.307e+06	2.037e+06	-2.114	0.034628	*
LeaseBegin2018	-5.025e+05	2.634e+06	-0.191	0.848699	
LeaseRemaining. in. months.	-1.018e+04	3.067e+03	-3.317	0.000927	***
Date2022-02:Area	1.073e+02	2.067e+02	0.519	0.603707	
Date2022-03:Area	2.284e+02	1.973e+02	1.157	0.247254	
Date2022-04:Area	2.267e+02	2.094e+02	1.082	0.279200	
Date2022-05:Area	7.760e+02	2.250e+02	3.449	0.000577	***
Date2022-06:Area	5.311e+02	2.267e+02	2.343	0.019247	*
Date2022-07:Area	6.317e+02	2.311e+02	2.733	0.006339	**
Date2022-08:Area	8.149e+02	2.519e+02	3.235	0.001238	**
Date2022-09:Area	1.117e+03	2.497e+02	4.474	8.16e-06	***
Date2022-10:Area	1.639e+03	2.845e+02	5.762	9.76e-09	***
Date2022-11:Area	1.552e+03	2.843e+02	5.458	5.50e-08	***
Date2022-12:Area	1.467e+03	2.990e+02	4.906	1.02e-06	***
Type4 ROOM:Area	1.311e+01	2.546e+03	0.005	0.995892	
Type5 ROOM:Area	-1.328e+03	2.853e+03	-0.465	0.641667	
Block2:Area	-1.585e+02	4.008e+02	-0.396	0.692521	
Block6:Area	2.159e+03	5.185e+02	4.165	3.27e-05	***
Block8:Area	NA	NA	NA	NA	
Block9:Area	-3.724e+00	3.459e+02	-0.011	0.991411	
Block10:Area	-4.472e+02	7.068e+02	-0.633	0.527021	
Block11:Area	-1.085e+03	4.701e+02	-2.308	0.021124	*
Block12:Area	3.206e+02	3.986e+02	0.804	0.421278	
Block13:Area	-4.943e+02	4.160e+02	-1.188	0.234878	
Block14:Area	7.683e+02	4.139e+02	1.856	0.063584	.
Block15:Area	-6.854e+02	4.047e+02	-1.694	0.090494	.
Block16:Area	1.621e+03	5.144e+02	3.151	0.001654	**
Block17:Area	5.995e+02	3.897e+02	1.538	0.124119	
Block18:Area	3.970e+02	4.151e+02	0.956	0.339023	
Block19:Area	-1.964e+02	4.608e+02	-0.426	0.670040	
Block20:Area	-3.607e+02	6.010e+02	-0.600	0.548513	
Block21:Area	3.110e+02	5.355e+02	0.581	0.561511	
Block22:Area	3.625e+02	7.010e+02	0.517	0.605121	
Block23:Area	-1.942e+03	1.287e+03	-1.509	0.131452	
Block24:Area	2.127e+02	8.992e+02	0.237	0.813059	
Block25:Area	2.082e+02	4.510e+02	0.462	0.644368	
Story04 TO 06:Area	5.596e+02	1.644e+02	3.404	0.000680	***
Story07 TO 09:Area	7.898e+02	1.638e+02	4.822	1.54e-06	***
Story10 TO 12:Area	8.755e+02	1.665e+02	5.259	1.62e-07	***
Story13 TO 15:Area	1.083e+03	1.698e+02	6.382	2.22e-10	***
Story16 TO 18:Area	9.595e+02	1.792e+02	5.354	9.72e-08	***
Story19 TO 21:Area	6.854e+02	6.244e+02	1.098	0.272512	
Area:ModelModel A	4.631e+03	3.067e+03	1.510	0.131223	
Area:ModelPremium Apartment	6.147e+03	3.061e+03	2.008	0.044757	*
Area:LeaseBegin2003	-9.053e+02	9.299e+02	-0.974	0.330418	
Area:LeaseBegin2004	-1.767e+03	1.020e+03	-1.733	0.083213	.
Area:LeaseBegin2005	-2.732e+03	1.144e+03	-2.388	0.017032	*
Area:LeaseBegin2007	2.736e+03	5.151e+03	0.531	0.595350	

Area:LeaseBegin2016	-7.389e+03	3.951e+03	-1.870	0.061619	.
Area:LeaseBegin2017	-8.803e+03	4.216e+03	-2.088	0.036943	*
Area:LeaseBegin2018	-9.670e+03	4.544e+03	-2.128	0.033467	*
Area:LeaseRemaining.in.months.	5.442e+01	2.598e+01	2.095	0.036321	*
Date2022-02:LeaseRemaining.in.months.	9.695e+01	4.441e+01	2.183	0.029176	*
Date2022-03:LeaseRemaining.in.months.	8.698e+01	4.270e+01	2.037	0.041783	*
Date2022-04:LeaseRemaining.in.months.	1.070e+02	4.346e+01	2.463	0.013874	*
Date2022-05:LeaseRemaining.in.months.	1.556e+02	4.732e+01	3.289	0.001025	**
Date2022-06:LeaseRemaining.in.months.	1.481e+02	4.640e+01	3.191	0.001445	**
Date2022-07:LeaseRemaining.in.months.	1.585e+02	4.826e+01	3.284	0.001043	**
Date2022-08:LeaseRemaining.in.months.	2.246e+02	5.366e+01	4.185	2.99e-05	***
Date2022-09:LeaseRemaining.in.months.	2.461e+02	5.217e+01	4.717	2.58e-06	***
Date2022-10:LeaseRemaining.in.months.	4.020e+02	6.119e+01	6.570	6.58e-11	***
Date2022-11:LeaseRemaining.in.months.	3.488e+02	5.996e+01	5.818	7.05e-09	***
Date2022-12:LeaseRemaining.in.months.	3.659e+02	6.231e+01	5.873	5.10e-09	***
Type4 ROOM:LeaserRemaining.in.months.	7.674e+02	3.603e+02	2.130	0.033296	*
Type5 ROOM:LeaserRemaining.in.months.	1.186e+03	5.443e+02	2.179	0.029449	*
Block2:LeaseRemaining.in.months.	7.037e+01	1.224e+03	0.057	0.954172	.
Block6:LeaseRemaining.in.months.	1.869e+02	1.026e+03	0.182	0.855536	.
Block8:LeaseRemaining.in.months.	3.794e+03	2.492e+03	1.522	0.128166	.
Block9:LeaseRemaining.in.months.	1.354e+01	8.462e+01	0.160	0.872946	.
Block10:LeaseRemaining.in.months.	1.428e+02	2.359e+03	0.061	0.951763	.
Block11:LeaseRemaining.in.months.	1.992e+03	4.616e+02	4.314	1.69e-05	***
Block12:LeaseRemaining.in.months.	2.113e+02	1.122e+02	1.884	0.059794	.
Block13:LeaseRemaining.in.months.	-1.733e+03	3.459e+02	-5.009	6.02e-07	***
Block14:LeaseRemaining.in.months.	-4.645e+02	1.196e+03	-0.388	0.697764	.
Block15:LeaseRemaining.in.months.	4.065e+03	1.920e+03	2.117	0.034393	*
Block16:LeaseRemaining.in.months.	-3.807e+03	1.235e+03	-3.082	0.002091	**
Block17:LeaseRemaining.in.months.	-1.045e+02	1.098e+03	-0.095	0.924135	.
Block18:LeaseRemaining.in.months.	-6.531e+02	7.818e+02	-0.835	0.403631	.
Block19:LeaseRemaining.in.months.	-1.156e+02	1.854e+02	-0.624	0.532963	.
Block20:LeaseRemaining.in.months.	3.164e+02	1.834e+02	1.726	0.084585	.
Block21:LeaseRemaining.in.months.	-5.320e+02	1.370e+02	-3.883	0.000107	***
Block22:LeaseRemaining.in.months.	2.122e+04	2.575e+04	0.824	0.410156	.
Block23:LeaseRemaining.in.months.	-8.433e+01	1.563e+03	-0.054	0.956968	.
Block24:LeaseRemaining.in.months.	-7.190e+02	2.070e+03	-0.347	0.728300	.
Block25:LeaseRemaining.in.months.	-2.712e+03	6.247e+02	-4.342	1.49e-05	***
Story04 TO 06:LeaseRemaining.in.months.	1.020e+02	3.421e+01	2.981	0.002915	**
Story07 TO 09:LeaseRemaining.in.months.	1.219e+02	3.376e+01	3.610	0.000315	***
Story10 TO 12:LeaseRemaining.in.months.	1.847e+02	3.406e+01	5.422	6.69e-08	***
Story13 TO 15:LeaseRemaining.in.months.	1.929e+02	3.463e+01	5.571	2.93e-08	***
Story16 TO 18:LeaseRemaining.in.months.	1.606e+02	3.696e+01	4.345	1.47e-05	***
Story19 TO 21:LeaseRemaining.in.months.	1.429e+02	1.400e+02	1.021	0.307401	.
ModelModel A:LeaseRemaining.in.months.	2.421e+02	7.080e+01	3.419	0.000642	***
ModelPremium Apartment:LeaserRemaining.in.months.	4.155e+02	6.014e+01	6.909	6.80e-12	***
LeaseBegin2003:LeaseRemaining.in.months.	3.916e+02	1.695e+03	0.231	0.817329	.
LeaseBegin2004:LeaseRemaining.in.months.	6.130e+02	1.747e+03	0.351	0.725752	.
LeaseBegin2005:LeaseRemaining.in.months.	-2.802e+02	1.945e+03	-0.144	0.885431	.
LeaseBegin2007:LeaseRemaining.in.months.	6.455e+02	1.927e+03	0.335	0.737685	.
LeaseBegin2009:LeaseRemaining.in.months.	NA	NA	NA	NA	.
LeaseBegin2010:LeaseRemaining.in.months.	1.266e+03	2.696e+03	0.470	0.638759	.
LeaseBegin2011:LeaseRemaining.in.months.	6.595e+02	2.270e+03	0.291	0.771401	.

Block10:LeaseRemaining.in.months.	1.428e+02	2.359e+03	0.061	0.951763	
Block11:LeaseRemaining.in.months.	1.992e+03	4.616e+02	4.314	1.69e-05	***
Block12:LeaseRemaining.in.months.	2.113e+02	1.122e+02	1.884	0.059794	.
Block13:LeaseRemaining.in.months.	-1.733e+03	3.459e+02	-5.009	6.02e-07	***
Block14:LeaseRemaining.in.months.	-4.645e+02	1.196e+03	-0.388	0.697764	
Block15:LeaseRemaining.in.months.	4.065e+03	1.920e+03	2.117	0.034393	*
Block16:LeaseRemaining.in.months.	-3.807e+03	1.235e+03	-3.082	0.002091	**
Block17:LeaseRemaining.in.months.	-1.045e+02	1.098e+03	-0.095	0.924135	
Block18:LeaseRemaining.in.months.	-6.531e+02	7.818e+02	-0.835	0.403631	
Block19:LeaseRemaining.in.months.	-1.156e+02	1.854e+02	-0.624	0.532963	
Block20:LeaseRemaining.in.months.	3.164e+02	1.834e+02	1.726	0.084585	.
Block21:LeaseRemaining.in.months.	-5.320e+02	1.370e+02	-3.883	0.000107	***
Block22:LeaseRemaining.in.months.	2.122e+04	2.575e+04	0.824	0.410156	
Block23:LeaseRemaining.in.months.	-8.433e+01	1.563e+03	-0.054	0.956968	
Block24:LeaseRemaining.in.months.	-7.190e+02	2.070e+03	-0.347	0.728300	
Block25:LeaseRemaining.in.months.	-2.712e+03	6.247e+02	-4.342	1.49e-05	***
Story04 TO 06:LeaseRemaining.in.months.	1.020e+02	3.421e+01	2.981	0.002915	**
Story07 TO 09:LeaseRemaining.in.months.	1.219e+02	3.376e+01	3.610	0.000315	***
Story10 TO 12:LeaseRemaining.in.months.	1.847e+02	3.406e+01	5.422	6.69e-08	***
Story13 TO 15:LeaseRemaining.in.months.	1.929e+02	3.463e+01	5.571	2.93e-08	***
Story16 TO 18:LeaseRemaining.in.months.	1.606e+02	3.696e+01	4.345	1.47e-05	***
Story19 TO 21:LeaseRemaining.in.months.	1.429e+02	1.400e+02	1.021	0.307401	
ModelModel A:LeaseRemaining.in.months.	2.421e+02	7.080e+01	3.419	0.000642	***
ModelPremium Apartment:LeaseRemaining.in.months.	4.155e+02	6.014e+01	6.909	6.80e-12	***
LeaseBegin2003:LeaseRemaining.in.months.	3.916e+02	1.695e+03	0.231	0.817329	
LeaseBegin2004:LeaseRemaining.in.months.	6.130e+02	1.747e+03	0.351	0.725752	
LeaseBegin2005:LeaseRemaining.in.months.	-2.802e+02	1.945e+03	-0.144	0.885431	
LeaseBegin2007:LeaseRemaining.in.months.	6.455e+02	1.927e+03	0.335	0.737685	
LeaseBegin2009:LeaseRemaining.in.months.	NA	NA	NA	NA	
LeaseBegin2010:LeaseRemaining.in.months.	1.266e+03	2.696e+03	0.470	0.638759	
LeaseBegin2011:LeaseRemaining.in.months.	6.595e+02	2.270e+03	0.291	0.771401	
LeaseBegin2012:LeaseRemaining.in.months.	1.505e+03	1.812e+03	0.831	0.406301	
LeaseBegin2013:LeaseRemaining.in.months.	1.411e+03	1.780e+03	0.792	0.428179	
LeaseBegin2014:LeaseRemaining.in.months.	1.313e+03	1.866e+03	0.703	0.481867	
LeaseBegin2015:LeaseRemaining.in.months.	7.473e+03	1.864e+03	4.009	6.35e-05	***
LeaseBegin2016:LeaseRemaining.in.months.	4.013e+03	1.797e+03	2.233	0.025688	*
LeaseBegin2017:LeaseRemaining.in.months.	5.196e+03	2.027e+03	2.564	0.010438	*
LeaseBegin2018:LeaseRemaining.in.months.	1.926e+03	2.488e+03	0.774	0.439050	

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 22380 on 1770 degrees of freedom
Multiple R-squared: 0.9471, Adjusted R-squared: 0.9422
F-statistic: 193.2 on 164 and 1770 DF, p-value: < 2.2e-16

[1] 45337.12

Reg4 (All Independent – Street and Interaction Variables – Area*LeaseBegin)

```
##{r}
#remove leasebegin
reg4<-lm(ResalePrice~Date+Type+Block+Story+Area+Model+LeaseBegin+LeaseRemaining.in.months.+Area*(Date + Type + Block + Story + Model
+ LeaseBegin +LeaseRemaining.in.months.) + LeaseRemaining.in.months.*(Date + Type + Block + Story + Model),data=Punggol)
summary(reg4)
BIC(reg4)
#BIC: 45333.64
#Adjusted R: 0.9397
##{r}

Call:
lm(formula = ResalePrice ~ Date + Type + Block + Story + Area +
    Model + LeaseBegin + LeaseRemaining.in.months. + Area * (Date +
    Type + Block + Story + Model + LeaseBegin + LeaseRemaining.in.months.) +
    LeaseRemaining.in.months. * (Date + Type + Block + Story +
    Model), data = Punggol)

Residuals:
    Min       1Q   Median       3Q      Max
-93056 -13004   -677   13305  141490

Coefficients: (3 not defined because of singularities)
            (Intercept)             Estimate Std. Error t value Pr(>|t|)
Date2022-02             3.784e+06  2.290e+06   1.653 0.098582 .
Date2022-03            -7.710e+04  5.828e+04  -1.323 0.186055
Date2022-04            -5.190e+04  5.427e+04  -0.956 0.338974
Date2022-05            -2.227e+04  5.608e+04  -0.397 0.691292
Date2022-06            -9.728e+04  6.011e+04  -1.618 0.105774
Date2022-07            -4.554e+04  5.621e+04  -0.810 0.417952
Date2022-08            -3.428e+04  5.558e+04  -0.617 0.537529
Date2022-09            -9.505e+04  6.141e+04  -1.548 0.121861
Date2022-10            -1.342e+05  5.621e+04  -2.387 0.017100 *
Date2022-11            -2.993e+05  6.631e+04  -4.514 6.78e-06 ***
Date2022-12            -2.353e+05  6.277e+04  -3.748 0.000184 ***
Date2022-12            -2.217e+05  6.271e+04  -3.536 0.000417 ***
Type4 ROOM              -9.483e+05  4.069e+05  -2.331 0.019878 *
Type5 ROOM             -1.474e+06  6.078e+05  -2.426 0.015380 *
Block2                 -3.340e+05  8.990e+05  -0.372 0.710306
Block6                  3.617e+05  8.534e+05  0.424 0.671700
Block8                 -1.968e+06  1.972e+06  -0.998 0.318465
Block9                  3.371e+04  1.006e+05  0.335 0.737723
Block10                -5.979e+04  2.299e+06  -0.026 0.979253
Block11                -1.218e+05  4.159e+05  -0.293 0.769633
Block12                -2.460e+05  1.311e+05  -1.876 0.060843 .
Block13                 6.968e+05  3.545e+05  1.966 0.049481 *
Block14                -1.077e+06  9.532e+05  -1.130 0.258821
Block15                -3.385e+06  9.942e+05  -3.405 0.000676 ***
Block16                -6.977e+05  1.202e+06  -0.581 0.561628
Block17                -1.024e+06  1.101e+06  -0.930 0.352316
Block18                 7.538e+05  7.230e+05  1.043 0.297296

Block19                -4.341e+04  2.100e+05  -0.207 0.836263
Block20                 2.390e+05  2.169e+05  1.102 0.270543
Block21                 5.324e+05  1.667e+05  3.194 0.001428 **
Block22                -2.408e+07  2.996e+07  -0.804 0.421725
Block23                 1.962e+06  1.578e+06  1.243 0.213931
Block24                 2.110e+06  2.247e+06  0.939 0.347974
Block25                 1.045e+06  6.623e+05  1.578 0.114811
Story04 TO 06          -1.318e+05  4.528e+04  -2.910 0.003654 **
Story07 TO 09          -1.654e+05  4.504e+04  -3.673 0.000247 ***
Story10 TO 12          -2.179e+05  4.573e+04  -4.764 2.05e-06 ***
Story13 TO 15          -2.365e+05  4.628e+04  -5.112 3.54e-07 ***
Story16 TO 18          -1.984e+05  4.939e+04  -4.016 6.16e-05 ***
Story19 TO 21          -1.730e+05  1.818e+05  -0.951 0.341553
Area                   -6.565e+03  2.474e+04  -0.265 0.790771
ModelModel A           -9.092e+05  3.134e+05  -2.901 0.003766 **
ModelPremium Apartment -1.251e+06  3.199e+05  -3.910 9.57e-05 ***
LeaseBegin2003         6.749e+04  1.017e+05  0.664 0.506988
LeaseBegin2004         1.469e+05  1.091e+05  1.347 0.178201
LeaseBegin2005         2.249e+05  1.209e+05  1.859 0.063125 .
LeaseBegin2007         6.608e+04  4.289e+05  0.154 0.877587
LeaseBegin2009         NA      NA      NA      NA
LeaseBegin2010         2.009e+06  2.261e+06  0.889 0.374202
LeaseBegin2011         -5.224e+05  1.385e+06  -0.377 0.705984
LeaseBegin2012         1.878e+05  2.923e+05  0.643 0.520609
LeaseBegin2013         1.771e+05  2.993e+05  0.592 0.554147
LeaseBegin2014         1.146e+05  3.276e+05  0.350 0.726473
LeaseBegin2015         3.263e+05  3.516e+05  0.928 0.353525
LeaseBegin2016         3.631e+05  3.758e+05  0.966 0.334081
LeaseBegin2017         4.245e+05  3.997e+05  1.062 0.288410
LeaseBegin2018         4.730e+05  4.295e+05  1.101 0.270901
LeaseRemaining.in.months.
Date2022-02:Area       -2.898e+03  2.329e+03  -1.244 0.213617
Date2022-03:Area       1.513e+01  2.098e+02  0.072 0.942515
Date2022-04:Area       9.878e+01  2.004e+02  0.493 0.622156
Date2022-05:Area       2.202e+01  2.113e+02  0.104 0.917039
Date2022-06:Area       5.647e+02  2.268e+02  2.490 0.012874 *
Date2022-07:Area       2.651e+02  2.272e+02  1.167 0.243539
Date2022-08:Area       3.609e+02  2.310e+02  1.563 0.118292
Date2022-09:Area       4.718e+02  2.509e+02  1.880 0.060249 .
Date2022-10:Area       8.379e+02  2.480e+02  3.379 0.000744 ***
Date2022-11:Area       1.193e+03  2.819e+02  4.230 2.45e-05 ***
Date2022-12:Area       1.168e+03  2.798e+02  4.176 3.11e-05 ***
Date2022-12:Area       1.035e+03  2.949e+02  3.511 0.000457 ***
Type4 ROOM:Area        -3.442e+02  2.594e+03  -0.133 0.894451
Type5 ROOM:Area        -1.251e+03  2.907e+03  -0.430 0.666886
Block2:Area            -2.361e+02  4.049e+02  -0.583 0.559944
Block6:Area            2.301e+03  5.248e+02  4.384 1.23e-05 ***
Block8:Area            NA      NA      NA      NA
Block9:Area            9.461e+01  3.503e+02  0.270 0.787118
Block10:Area           -4.906e+02  7.203e+02  -0.681 0.495832
Block11:Area           -8.691e+02  4.758e+02  -1.827 0.067903 .
```

Block10:Area	-4.906e+02	7.203e+02	-0.681	0.495832
Block11:Area	-8.691e+02	4.758e+02	-1.827	0.067903
Block12:Area	4.850e+02	4.034e+02	1.202	0.229463
Block13:Area	-3.730e+02	4.228e+02	-0.882	0.377797
Block14:Area	8.750e+02	4.158e+02	2.104	0.035488
Block15:Area	-8.886e+02	4.094e+02	-2.170	0.030116
Block16:Area	1.860e+03	5.226e+02	3.559	0.000382
Block17:Area	8.730e+02	3.878e+02	2.251	0.024478
Block18:Area	5.883e+02	4.198e+02	1.401	0.161271
Block19:Area	-1.069e+02	4.667e+02	-0.229	0.818914
Block20:Area	-6.450e+02	6.053e+02	-1.066	0.286754
Block21:Area	4.752e+02	5.432e+02	0.875	0.381749
Block22:Area	4.060e+02	7.131e+02	0.569	0.569218
Block23:Area	-1.776e+03	1.310e+03	-1.356	0.175363
Block24:Area	5.394e+01	9.141e+02	0.059	0.952957
Block25:Area	5.291e+02	4.564e+02	1.159	0.246428
Story04 TO 06:Area	5.497e+02	1.674e+02	3.283	0.001048
Story07 TO 09:Area	7.895e+02	1.667e+02	4.736	2.35e-06
Story10 TO 12:Area	8.169e+02	1.693e+02	4.824	1.53e-06
Story13 TO 15:Area	1.038e+03	1.725e+02	6.020	2.11e-09
Story16 TO 18:Area	9.522e+02	1.824e+02	5.220	2.00e-07
Story19 TO 21:Area	7.687e+02	6.325e+02	1.215	0.224443
Area:Model A	5.748e+03	3.100e+03	1.854	0.063900
Area:Model Premium Apartment	7.283e+03	3.091e+03	2.356	0.018580
Area:LeaseBegin2003	-5.447e+02	9.473e+02	-0.575	0.565340
Area:LeaseBegin2004	-1.021e+03	1.027e+03	-0.994	0.320406
Area:LeaseBegin2005	-1.602e+03	1.144e+03	-1.401	0.161392
Area:LeaseBegin2007	7.095e+02	4.679e+03	0.152	0.879495
Area:LeaseBegin2009	NA	NA	NA	NA
Area:LeaseBegin2010	-1.943e+04	2.426e+04	-0.801	0.423367
Area:LeaseBegin2011	7.818e+03	1.483e+04	0.527	0.598059
Area:LeaseBegin2012	5.949e+02	2.898e+03	0.205	0.837383
Area:LeaseBegin2013	6.296e+02	2.962e+03	0.213	0.831714
Area:LeaseBegin2014	1.527e+03	3.245e+03	0.471	0.638001
Area:LeaseBegin2015	-5.672e+02	3.482e+03	-0.163	0.870615
Area:LeaseBegin2016	-7.537e+02	3.732e+03	-0.202	0.839985
Area:LeaseBegin2017	-1.493e+03	3.979e+03	-0.375	0.707556
Area:LeaseBegin2018	-1.694e+03	4.286e+03	-0.395	0.692693
Area:LeaseRemaining.in.months.	2.908e+00	2.476e+01	0.117	0.906518
Date2022-02:LeaseRemaining.in.months.	7.300e+01	4.509e+01	1.619	0.105628
Date2022-03:LeaseRemaining.in.months.	4.576e+01	4.275e+01	1.070	0.284653
Date2022-04:LeaseRemaining.in.months.	3.182e+01	4.205e+01	0.757	0.449333
Date2022-05:LeaseRemaining.in.months.	5.542e+01	4.487e+01	1.235	0.216907
Date2022-06:LeaseRemaining.in.months.	3.775e+01	4.243e+01	0.890	0.373804
Date2022-07:LeaseRemaining.in.months.	2.306e+01	4.212e+01	0.547	0.584163
Date2022-08:LeaseRemaining.in.months.	7.275e+01	4.620e+01	1.574	0.115552
Date2022-09:LeaseRemaining.in.months.	8.324e+01	4.155e+01	2.004	0.045268
Date2022-10:LeaseRemaining.in.months.	2.133e+02	5.047e+01	4.226	2.50e-05
Date2022-11:LeaseRemaining.in.months.	1.556e+02	4.601e+01	3.382	0.000736
Date2022-12:LeaseRemaining.in.months.	1.591e+02	4.664e+01	3.411	0.000663
Type4 ROOM:LeaseRemaining.in.months.	9.093e+02	3.639e+02	2.499	0.012542
Type5 ROOM:LeaseRemaining.in.months.	1.537e+03	5.484e+02	2.803	0.005119

Block2:LeaseRemaining.in.months.	3.185e+02	7.931e+02	0.402	0.688041
Block6:LeaseRemaining.in.months.	-6.030e+02	8.682e+02	-0.695	0.487428
Block8:LeaseRemaining.in.months.	2.035e+03	1.917e+03	1.062	0.288524
Block9:LeaseRemaining.in.months.	-2.439e+01	8.495e+01	-0.287	0.774057
Block10:LeaseRemaining.in.months.	1.394e+02	2.382e+03	0.059	0.953331
Block11:LeaseRemaining.in.months.	2.131e+02	3.777e+02	0.564	0.572681
Block12:LeaseRemaining.in.months.	1.889e+02	1.099e+02	1.719	0.085734
Block13:LeaseRemaining.in.months.	-5.859e+02	3.185e+02	-1.840	0.065968
Block14:LeaseRemaining.in.months.	9.388e+02	8.421e+02	1.115	0.265100
Block15:LeaseRemaining.in.months.	3.031e+03	8.660e+02	3.500	0.000477
Block16:LeaseRemaining.in.months.	5.094e+02	1.086e+03	0.469	0.639003
Block17:LeaseRemaining.in.months.	8.626e+02	9.640e+02	0.895	0.371019
Block18:LeaseRemaining.in.months.	-8.328e+02	7.445e+02	-1.119	0.263432
Block19:LeaseRemaining.in.months.	4.687e+01	1.850e+02	0.253	0.800027
Block20:LeaseRemaining.in.months.	-1.596e+02	1.761e+02	-0.906	0.365133
Block21:LeaseRemaining.in.months.	-5.504e+02	1.371e+02	-4.015	6.20e-05
Block22:LeaseRemaining.in.months.	2.110e+04	2.626e+04	0.804	0.421738
Block23:LeaseRemaining.in.months.	-1.656e+03	1.451e+03	-1.141	0.254025
Block24:LeaseRemaining.in.months.	-1.955e+03	2.066e+03	-0.946	0.344114
Block25:LeaseRemaining.in.months.	-9.631e+02	5.844e+02	-1.648	0.099548
Story04 TO 06:LeaseRemaining.in.months.	9.398e+01	3.474e+01	2.705	0.006889
Story07 TO 09:LeaseRemaining.in.months.	1.235e+02	3.431e+01	3.599	0.000328
Story10 TO 12:LeaseRemaining.in.months.	1.799e+02	3.462e+01	5.195	2.28e-07
Story13 TO 15:LeaseRemaining.in.months.	1.845e+02	3.517e+01	5.245	1.74e-07
Story16 TO 18:LeaseRemaining.in.months.	1.616e+02	3.769e+01	4.287	1.91e-05
Story19 TO 21:LeaseRemaining.in.months.	1.521e+02	1.422e+02	1.070	0.284933
Model A:LeaseRemaining.in.months.	2.405e+02	7.204e+01	3.338	0.000860
Model Premium Apartment:LeaseRemaining.in.months.	4.581e+02	6.072e+01	7.546	7.14e-14

signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 22850 on 1783 degrees of freedom
Multiple R-squared: 0.9444, Adjusted R-squared: 0.9397
F-statistic: 200.7 on 151 and 1783 DF, p-value: < 2.2e-16

[1] 45333.64

Reg5 (All Independent – Street and Interaction Variables – LeaseRemaining.in.months.*LeaseBegin)

```
##[r]
#Remove Area:Lease Beginning, while adding leaseRemaining*leaseBegin back
reg5<-lm(ResalePrice~Date+Type+Block+Story+Area+Model+LeaseBegin+LeaseRemaining.in.months.+Area*(Date + Type + Block + Story + Model
+LeaseRemaining.in.months.) + LeaseRemaining.in.months.*(Date + Type + Block + Story + Model+LeaseBegin),data=Punggol)
summary(reg5)
BIC(reg5)
#BIC: 45311.25
#Adjusted R:0.9404
...
```

Call:

```
lm(formula = ResalePrice ~ Date + Type + Block + Story + Area +
    Model + LeaseBegin + LeaseRemaining.in.months. + Area * (Date +
    Type + Block + Story + Model + LeaseRemaining.in.months.) +
    LeaseRemaining.in.months. * (Date + Type + Block + Story +
    Model + LeaseBegin), data = Punggol)
```

Residuals:

Min	1Q	Median	3Q	Max
-99238	-13263	-345	12377	149652

Coefficients: (3 not defined because of singularities)

	Estimate	Std. Error	t value	Pr(> t)
(Intercept)	6.835e+06	1.869e+06	3.657	0.000263 ***
Date2022-02	-1.106e+05	5.810e+04	-1.904	0.057026 .
Date2022-03	-9.362e+04	5.428e+04	-1.725	0.084783 .
Date2022-04	-9.373e+04	5.682e+04	-1.685	0.092224 .
Date2022-05	-1.910e+05	6.120e+04	-3.120	0.001836 **
Date2022-06	-1.590e+05	5.871e+04	-2.709	0.006823 **
Date2022-07	-1.641e+05	5.931e+04	-2.767	0.005710 **
Date2022-08	-2.498e+05	6.521e+04	-3.831	0.000132 ***
Date2022-09	-2.883e+05	6.285e+04	-4.587	4.80e-06 ***
Date2022-10	-4.794e+05	7.217e+04	-6.642	4.10e-11 ***
Date2022-11	-4.251e+05	6.998e+04	-6.075	1.51e-09 ***
Date2022-12	-4.080e+05	7.180e+04	-5.682	1.56e-08 ***
Type4 ROOM	-5.148e+05	3.593e+05	-1.433	0.152068
Type5 ROOM	-1.324e+06	5.622e+05	-2.355	0.018655 *
Block2	4.772e+05	1.364e+06	0.350	0.726432
Block6	-2.594e+05	1.009e+06	-0.257	0.797096
Block8	-3.538e+06	2.517e+06	-1.406	0.159994
Block9	-1.397e+05	9.242e+04	-1.511	0.130869
Block10	4.187e+04	2.311e+06	0.018	0.985543
Block11	-2.331e+06	5.057e+05	-4.609	4.33e-06 ***
Block12	-4.296e+05	1.232e+05	-3.489	0.000498 ***
Block13	1.725e+06	3.861e+05	4.469	8.35e-06 ***
Block14	6.898e+05	1.367e+06	0.505	0.613859
Block15	-4.246e+06	2.179e+06	-1.949	0.051476 .
Block16	3.353e+06	1.382e+06	2.426	0.015361 *
Block17	-4.425e+05	1.242e+06	-0.356	0.721652
Block18	6.628e+05	7.666e+05	0.865	0.387410
Block19	-5.487e+04	2.052e+05	-0.267	0.789216

Block20	4.127e+05	1.678e+05	2.377	0.002208	
Block21	4.695e+05	1.624e+05	2.890	0.003899	**
Block22	-2.314e+07	2.978e+07	-0.777	0.437331	
Block23	-1.001e+06	1.714e+06	-0.584	0.559320	
Block24	6.304e+05	2.262e+06	0.279	0.780515	
Block25	2.365e+06	7.060e+05	3.350	0.000825	***
Story04 TO 06	-1.399e+05	4.503e+04	-3.106	0.001927	**
Story07 TO 09	-1.651e+05	4.478e+04	-3.687	0.000234	***
Story10 TO 12	-2.301e+05	4.536e+04	-5.073	4.32e-07	***
Story13 TO 15	-2.546e+05	4.599e+04	-5.536	3.55e-08	***
Story16 TO 18	-2.016e+05	4.901e+04	-4.113	4.08e-05	***
Story19 TO 21	-1.438e+05	1.789e+05	-0.804	0.421596	
Area	-2.455e+04	1.235e+04	-1.988	0.046992	*
ModelModel A	-1.492e+06	2.703e+05	-5.518	3.93e-08	***
ModelPremium Apartment	-1.756e+06	2.789e+05	-6.299	3.77e-10	***
LeaseBegin2003	-4.339e+05	1.641e+06	-0.264	0.791525	
LeaseBegin2004	-4.835e+05	1.696e+06	-0.285	0.775558	
LeaseBegin2005	1.155e+05	1.892e+06	0.061	0.951318	
LeaseBegin2007	-7.179e+05	1.832e+06	-0.392	0.695153	
LeaseBegin2009	NA	NA	NA	NA	
LeaseBegin2010	-1.288e+06	2.647e+06	-0.487	0.626645	
LeaseBegin2011	1.216e+05	2.292e+06	0.053	0.957680	
LeaseBegin2012	-6.328e+05	1.767e+06	-0.358	0.720268	
LeaseBegin2013	-7.703e+05	1.733e+06	-0.445	0.656692	
LeaseBegin2014	2.140e+05	1.830e+06	0.117	0.906907	
LeaseBegin2015	-6.796e+06	1.827e+06	-3.720	0.000206	***
LeaseBegin2016	-3.496e+06	1.749e+06	-1.998	0.045820	*
LeaseBegin2017	-5.013e+06	2.048e+06	-2.447	0.014489	*
LeaseBegin2018	-1.709e+06	2.620e+06	-0.652	0.514311	
LeaseRemaining.in.months.	-5.045e+03	1.888e+03	-2.672	0.007615	**
Date2022-02:Area	7.354e+01	2.083e+02	0.353	0.724117	
Date2022-03:Area	1.393e+02	1.943e+02	0.717	0.473607	
Date2022-04:Area	5.627e+01	1.999e+02	0.281	0.778377	
Date2022-05:Area	5.691e+02	2.064e+02	2.757	0.005887	**
Date2022-06:Area	3.535e+02	2.062e+02	1.714	0.086727	.
Date2022-07:Area	3.747e+02	1.938e+02	1.934	0.053325	.
Date2022-08:Area	5.258e+02	2.038e+02	2.581	0.009942	**
Date2022-09:Area	7.642e+02	1.920e+02	3.980	7.17e-05	***
Date2022-10:Area	1.225e+03	2.143e+02	5.716	1.28e-08	***
Date2022-11:Area	1.114e+03	1.951e+02	5.708	1.34e-08	***
Date2022-12:Area	9.510e+02	2.031e+02	4.682	3.06e-06	***
Type4 ROOM:Area	3.157e+03	2.298e+03	1.374	0.169625	
Type5 ROOM:Area	7.345e+03	2.435e+03	3.017	0.002590	**
Block2:Area	-4.115e+01	3.029e+02	-0.136	0.891958	
Block6:Area	1.673e+03	4.419e+02	3.785	0.000159	***
Block8:Area	NA	NA	NA	NA	
Block9:Area	7.961e+02	2.533e+02	3.143	0.001699	**
Block10:Area	5.252e+01	6.887e+02	0.076	0.939223	
Block11:Area	9.822e+02	3.176e+02	3.093	0.002013	**
Block12:Area	1.027e+03	2.623e+02	3.917	9.32e-05	***
Block13:Area	6.127e+02	2.666e+02	2.298	0.021675	*
Block14:Area	1.097e+03	3.161e+02	3.471	0.000531	***
Block15:Area	-1.153e+03	3.044e+02	-3.788	0.000157	***

Block15:Area	-1.153e+03	3.044e+02	-3.788	0.000157	***
Block16:Area	2.291e+03	3.460e+02	6.622	4.67e-11	***
Block17:Area	7.647e+02	3.740e+02	2.045	0.041046	*
Block18:Area	8.486e+02	3.684e+02	2.304	0.021359	*
Block19:Area	8.117e+02	3.152e+02	2.575	0.010103	*
Block20:Area	1.402e+03	4.700e+02	2.983	0.002895	**
Block21:Area	9.961e+02	5.014e+02	1.987	0.047121	*
Block22:Area	1.520e+02	6.631e+02	0.229	0.818704	
Block23:Area	9.473e+02	1.214e+03	0.780	0.435416	
Block24:Area	1.187e+03	8.004e+02	1.483	0.138192	
Block25:Area	9.274e+02	3.366e+02	2.755	0.005924	**
Story04 TO 06:Area	5.377e+02	1.659e+02	3.242	0.001209	**
Story07 TO 09:Area	8.017e+02	1.657e+02	4.840	1.41e-06	***
Story10 TO 12:Area	8.895e+02	1.675e+02	5.309	1.24e-07	***
Story13 TO 15:Area	1.103e+03	1.713e+02	6.439	1.54e-10	***
Story16 TO 18:Area	9.885e+02	1.811e+02	5.460	5.44e-08	***
Story19 TO 21:Area	7.620e+02	6.246e+02	1.220	0.222657	
Area:ModelModel A	1.215e+04	2.744e+03	4.428	1.01e-05	***
Area:ModelPremium Apartment	1.305e+04	2.735e+03	4.773	1.96e-06	***
Area:LeaseRemaining.in.months.	9.794e+00	1.087e+01	0.901	0.367588	
Date2022-02:LeaseRemaining.in.months.	1.008e+02	4.494e+01	2.242	0.025100	*
Date2022-03:LeaseRemaining.in.months.	8.156e+01	4.314e+01	1.891	0.058850	,
Date2022-04:LeaseRemaining.in.months.	9.872e+01	4.361e+01	2.264	0.023708	**
Date2022-05:LeaseRemaining.in.months.	1.445e+02	4.735e+01	3.052	0.002303	**
Date2022-06:LeaseRemaining.in.months.	1.372e+02	4.621e+01	2.970	0.003020	**
Date2022-07:LeaseRemaining.in.months.	1.453e+02	4.803e+01	3.025	0.002518	**
Date2022-08:LeaseRemaining.in.months.	2.143e+02	5.305e+01	4.039	5.60e-05	***
Date2022-09:LeaseRemaining.in.months.	2.370e+02	5.147e+01	4.604	4.43e-06	***
Date2022-10:LeaseRemaining.in.months.	3.806e+02	6.026e+01	6.316	3.37e-10	***
Date2022-11:LeaseRemaining.in.months.	3.407e+02	5.840e+01	5.834	6.42e-09	***
Date2022-12:LeaseRemaining.in.months.	3.427e+02	6.104e+01	5.615	2.28e-08	***
Type4 ROOM:LeaseRemaining.in.months.	2.939e+02	2.999e+02	0.980	0.327258	
Type5 ROOM:LeaseRemaining.in.months.	6.519e+02	5.000e+02	1.304	0.192489	
Block2:LeaseRemaining.in.months.	-4.212e+02	1.209e+03	-0.349	0.727502	
Block6:LeaseRemaining.in.months.	9.266e+01	1.030e+03	0.090	0.928351	
Block8:LeaseRemaining.in.months.	3.705e+03	2.526e+03	1.467	0.142582	
Block9:LeaseRemaining.in.months.	8.387e+01	8.416e+01	0.997	0.319101	
Block10:LeaseRemaining.in.months.	-2.270e+01	2.394e+03	-0.009	0.992438	
Block11:LeaseRemaining.in.months.	2.108e+03	4.652e+02	4.532	6.24e-06	***
Block12:LeaseRemaining.in.months.	3.163e+02	1.106e+02	2.859	0.004293	**
Block13:LeaseRemaining.in.months.	-1.581e+03	3.475e+02	-4.551	5.71e-06	***
Block14:LeaseRemaining.in.months.	-6.564e+02	1.210e+03	-0.542	0.587672	
Block15:LeaseRemaining.in.months.	3.800e+03	1.916e+03	1.983	0.047483	*
Block16:LeaseRemaining.in.months.	-3.173e+03	1.250e+03	-2.540	0.011180	*
Block17:LeaseRemaining.in.months.	3.527e+02	1.095e+03	0.322	0.747365	
Block18:LeaseRemaining.in.months.	-7.667e+02	7.909e+02	-0.969	0.332477	
Block19:LeaseRemaining.in.months.	-1.840e+01	1.859e+02	-0.099	0.921191	
Block20:LeaseRemaining.in.months.	4.856e+02	1.785e+02	2.720	0.006593	**
Block21:LeaseRemaining.in.months.	-5.370e+02	1.357e+02	-3.958	7.85e-05	***
Block22:LeaseRemaining.in.months.	2.029e+04	2.610e+04	0.777	0.437085	
Block23:LeaseRemaining.in.months.	8.626e+02	1.578e+03	0.547	0.584689	
Block24:LeaseRemaining.in.months.	-6.750e+02	2.083e+03	-0.324	0.745984	
Block25:LeaseRemaining.in.months.	-2.168e+03	6.241e+02	-3.473	0.000526	***
Story04 TO 06:LeaseRemaining.in.months.	1.032e+02	3.461e+01	2.981	0.002917	**
Story07 TO 09:LeaseRemaining.in.months.	1.225e+02	3.416e+01	3.586	0.000345	***
Story10 TO 12:LeaseRemaining.in.months.	1.849e+02	3.442e+01	5.372	8.81e-08	***
Story13 TO 15:LeaseRemaining.in.months.	1.958e+02	3.495e+01	5.603	2.44e-08	***
Story16 TO 18:LeaseRemaining.in.months.	1.620e+02	3.743e+01	4.330	1.58e-05	***
Story19 TO 21:LeaseRemaining.in.months.	1.283e+02	1.403e+02	0.914	0.360758	
ModelModel A:LeaseRemaining.in.months.	1.242e+02	6.547e+01	1.897	0.057955	,
ModelPremium Apartment:LeaseRemaining.in.months.	3.292e+02	5.688e+01	5.788	8.38e-09	***
LeaseBegin2003:LeaseRemaining.in.months.	4.812e+02	1.720e+03	0.280	0.779679	
LeaseBegin2004:LeaseRemaining.in.months.	5.813e+02	1.773e+03	0.328	0.743132	
LeaseBegin2005:LeaseRemaining.in.months.	3.252e+00	1.970e+03	0.002	0.998683	
LeaseBegin2007:LeaseRemaining.in.months.	9.528e+02	1.895e+03	0.503	0.615167	
LeaseBegin2009:LeaseRemaining.in.months.	NA	NA	NA	NA	
LeaseBegin2010:LeaseRemaining.in.months.	1.593e+03	2.626e+03	0.607	0.544175	
LeaseBegin2011:LeaseRemaining.in.months.	3.108e+02	2.289e+03	0.136	0.891999	
LeaseBegin2012:LeaseRemaining.in.months.	1.046e+03	1.825e+03	0.573	0.566706	
LeaseBegin2013:LeaseRemaining.in.months.	1.167e+03	1.797e+03	0.649	0.516262	
LeaseBegin2014:LeaseRemaining.in.months.	2.680e+02	1.874e+03	0.143	0.886320	
LeaseBegin2015:LeaseRemaining.in.months.	6.669e+03	1.870e+03	3.567	0.000371	***
LeaseBegin2016:LeaseRemaining.in.months.	3.690e+03	1.809e+03	2.040	0.041495	*
LeaseBegin2017:LeaseRemaining.in.months.	5.024e+03	2.042e+03	2.460	0.014004	*
LeaseBegin2018:LeaseRemaining.in.months.	2.122e+03	2.494e+03	0.851	0.395135	

 signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 22720 on 1783 degrees of freedom
 Multiple R-squared: 0.9451, Adjusted R-squared: 0.9404
 F-statistic: 203.2 on 151 and 1783 DF, p-value: < 2.2e-16

[1] 45311.25

Reg6 (All Independent – Street and Interaction Variables + Polynomials (up to power 2))

```
## [r]
#Polynomial
reg6<-lm(ResalePrice~date+Type+Block+Story+Area+Model+LeaseBegin+LeaseRemaining.in.months.+Area*(date + Type + Block + Story +
Model+Area + LeaseBegin + LeaseRemaining.in.months.) +LeaseRemaining.in.months.*(date + Type + Block + Story + Model +
LeaseBegin+LeaseRemaining.in.months.),data=Punggol)
summary(reg6)
BIC(reg6)

call:
lm(formula = ResalePrice ~ date + Type + Block + Story + Area +
    Model + LeaseBegin + LeaseRemaining.in.months. + Area * (date +
    Type + Block + Story + Model + Area + LeaseBegin + LeaseRemaining.in.months.) +
    LeaseRemaining.in.months. * (date + Type + Block + Story +
    Model + LeaseBegin + LeaseRemaining.in.months.), data = Punggol)

Residuals:
    min      1q  median      3q     max
-96590 -12944    -600  12312 131349

Coefficients: (4 not defined because of singularities)
              Estimate Std. Error t value Pr(>|t|)
(Intercept)    1.073e+07  2.984e+06   3.594  0.000334 ***
Date2022-02   -1.104e+05  5.745e+04  -1.923  0.054692 .
Date2022-03   -1.082e+05  5.416e+04  -1.998  0.045878 *
Date2022-04   -1.219e+05  5.763e+04  -2.114  0.034620 *
Date2022-05   -2.241e+05  6.282e+04  -3.567  0.000370 ***
Date2022-06   -1.884e+05  6.080e+04  -3.099  0.001971 **
Date2022-07   -2.039e+05  6.258e+04  -3.259  0.001139 **
Date2022-08   -2.891e+05  6.979e+04  -4.142  3.60e-05 ***
Date2022-09   -3.335e+05  6.804e+04  -4.901  1.04e-06 ***
Date2022-10   -5.435e+05  7.861e+04  -6.914  6.57e-12 ***
Date2022-11   -4.779e+05  7.852e+04  -6.087  1.41e-09 ***
Date2022-12   -4.840e+05  8.043e+04  -6.017  2.15e-09 ***
Type4 ROOM    -8.352e+05  4.024e+05  -2.076  0.038064 *
Type5 ROOM    -1.093e+06  6.026e+05  -1.813  0.069925 .
Block2        -6.150e+04  1.385e+06  -0.044  0.964598
Block6        -3.920e+05  1.008e+06  -0.389  0.697279
Block8        -3.579e+06  2.483e+06  -1.441  0.149658
Block9        1.188e+04  1.000e+05  0.119  0.905512
Block10       -6.498e+04  2.277e+06  -0.029  0.977234
Block11       -2.004e+06  5.039e+05  -3.978  7.23e-05 ***
Block12       -2.429e+05  1.336e+05  -1.819  0.069093 .
Block13       2.002e+06  3.864e+05  5.183  2.43e-07 ***
Block14       5.108e+05  1.350e+06  0.378  0.705256
Block15      -4.582e+06  2.187e+06  -2.096  0.036258 *
Block16       4.121e+06  1.369e+06  3.011  0.002643 **

Block17       9.228e+04  1.246e+06  0.074  0.940957
Block18       6.020e+05  7.569e+05  0.795  0.426553
Block19       1.532e+05  2.104e+05  0.728  0.466659
Block20      -2.631e+05  2.234e+05  -1.178  0.238959
Block21       5.346e+05  1.658e+05  3.225  0.001284 **
Block22      -2.421e+07  2.939e+07  -0.824  0.410137
Block23       3.077e+05  1.702e+06  0.181  0.856529
Block24       7.719e+05  2.251e+06  0.343  0.731734
Block25       3.039e+06  7.079e+05  4.294  1.85e-05 ***
Story04 TO 06 -1.411e+05  4.458e+04  -3.165  0.001579 **
Story07 TO 09 -1.640e+05  4.429e+04  -3.704  0.000219 ***
Story10 TO 12 -2.288e+05  4.498e+04  -5.087  4.02e-07 ***
Story13 TO 15 -2.500e+05  4.562e+04  -5.481  4.85e-08 ***
Story16 TO 18 -1.979e+05  4.845e+04  -4.084  4.62e-05 ***
Story19 TO 21 -1.547e+05  1.789e+05  -0.865  0.387102
Area          -5.603e+04  2.590e+04  -2.163  0.030668 *
ModelModel A  -7.865e+05  3.103e+05  -2.535  0.011327 *
ModelPremium Apartment -1.076e+06  3.167e+05  -3.398  0.000693 ***
LeaseBegin2003 -2.526e+05  1.620e+06  -0.156  0.876086
LeaseBegin2004 -3.298e+05  1.674e+06  -0.197  0.843774
LeaseBegin2005  6.636e+05  1.874e+06  0.354  0.723303
LeaseBegin2007 -6.232e+05  1.809e+06  -0.345  0.730435
LeaseBegin2009 NA NA NA NA
LeaseBegin2010 1.406e+06  4.067e+06  0.346  0.729633
LeaseBegin2011 -5.850e+05  2.761e+06  -0.212  0.832224
LeaseBegin2012 -7.102e+05  1.747e+06  -0.407  0.684386
LeaseBegin2013 -5.550e+05  1.718e+06  -0.323  0.746695
LeaseBegin2014 -4.740e+05  1.813e+06  -0.261  0.793831
LeaseBegin2015 -7.008e+06  1.812e+06  -3.868  0.000114 ***
LeaseBegin2016 -3.092e+06  1.735e+06  -1.782  0.074901 .
LeaseBegin2017 -4.307e+06  2.037e+06  -2.114  0.034628 *
LeaseBegin2018 -5.025e+05  2.634e+06  -0.191  0.848699
LeaseRemaining.in.months. -1.018e+04  3.067e+03  -3.317  0.000927 ***
Date2022-02:Area 1.073e+02  2.067e+02  0.519  0.603707
Date2022-03:Area 2.284e+02  1.973e+02  1.157  0.247254
Date2022-04:Area 2.267e+02  2.094e+02  1.082  0.279200
Date2022-05:Area 7.760e+02  2.250e+02  3.449  0.000577 ***
Date2022-06:Area 5.311e+02  2.267e+02  2.343  0.019247 *
Date2022-07:Area 6.317e+02  2.311e+02  2.733  0.006339 **
Date2022-08:Area 8.149e+02  2.519e+02  3.235  0.001238 ***
Date2022-09:Area 1.117e+03  2.497e+02  4.474  8.16e-06 ***
Date2022-10:Area 1.639e+03  2.845e+02  5.762  9.76e-09 ***
Date2022-11:Area 1.552e+03  2.843e+02  5.458  5.50e-08 ***
Date2022-12:Area 1.467e+03  2.990e+02  4.906  1.02e-06 ***
Type4 ROOM:Area 1.311e+01  2.546e+03  0.005  0.995892
Type5 ROOM:Area -1.328e+03  2.853e+03  -0.465  0.641667
Block2:Area     -1.585e+02  4.008e+02  -0.396  0.692521
Block6:Area     2.159e+03  5.185e+02  4.165  3.27e-05 ***
Block8:Area     NA NA NA NA
Block9:Area     -3.724e+00  3.459e+02  -0.011  0.991411
Block10:Area    -4.472e+02  7.068e+02  -0.633  0.527021
Block11:Area    -4.005e+03  4.701e+03  -0.852  0.399444 .
```


Block11:Area	-1.085e+03	4.701e+02	-2.308	0.021124	*
Block12:Area	3.206e+02	3.986e+02	0.804	0.421278	
Block13:Area	-4.943e+02	4.160e+02	-1.188	0.234878	
Block14:Area	7.683e+02	4.139e+02	1.856	0.063584	.
Block15:Area	-6.854e+02	4.047e+02	-1.694	0.090494	.
Block16:Area	1.621e+03	5.144e+02	3.151	0.001654	**
Block17:Area	5.995e+02	3.897e+02	1.538	0.124119	
Block18:Area	3.970e+02	4.151e+02	0.956	0.339023	
Block19:Area	-1.964e+02	4.608e+02	-0.426	0.670040	
Block20:Area	-3.607e+02	6.010e+02	-0.600	0.548513	
Block21:Area	3.110e+02	5.355e+02	0.581	0.561511	
Block22:Area	3.625e+02	7.010e+02	0.517	0.605121	
Block23:Area	-1.942e+03	1.287e+03	-1.509	0.131452	
Block24:Area	2.127e+02	8.992e+02	0.237	0.813059	
Block25:Area	2.082e+02	4.510e+02	0.462	0.644368	
Story04 TO 06:Area	5.596e+02	1.644e+02	3.404	0.000680	***
Story07 TO 09:Area	7.898e+02	1.638e+02	4.822	1.54e-06	***
Story10 TO 12:Area	8.755e+02	1.665e+02	5.259	1.62e-07	***
Story13 TO 15:Area	1.083e+03	1.698e+02	6.382	2.22e-10	***
Story16 TO 18:Area	9.595e+02	1.792e+02	5.354	9.72e-08	***
Story19 TO 21:Area	6.854e+02	6.244e+02	1.098	0.272512	
Area:ModelModel A	4.631e+03	3.067e+03	1.510	0.131223	
Area:ModelPremium Apartment	6.147e+03	3.061e+03	2.008	0.044757	*
Area:LeaseBegin2003	-9.053e+02	9.299e+02	-0.974	0.330418	
Area:LeaseBegin2004	-1.767e+03	1.020e+03	-1.733	0.083213	.
Area:LeaseBegin2005	-2.732e+03	1.144e+03	-2.388	0.017032	*
Area:LeaseBegin2007	2.736e+03	5.151e+03	0.531	0.595350	
Area:LeaseBegin2009	NA	NA	NA	NA	
Area:LeaseBegin2010	-2.484e+04	2.534e+04	-0.980	0.327074	
Area:LeaseBegin2011	4.107e+03	1.470e+04	0.279	0.779966	
Area:LeaseBegin2012	-3.893e+03	3.033e+03	-1.283	0.199559	
Area:LeaseBegin2013	-4.525e+03	3.124e+03	-1.448	0.147655	
Area:LeaseBegin2014	-4.192e+03	3.424e+03	-1.224	0.221047	
Area:LeaseBegin2015	-6.578e+03	3.676e+03	-1.789	0.073759	.
Area:LeaseBegin2016	-7.389e+03	3.951e+03	-1.870	0.061619	.
Area:LeaseBegin2017	-8.803e+03	4.216e+03	-2.088	0.036943	*
Area:LeaseBegin2018	-9.670e+03	4.544e+03	-2.128	0.033467	**
Area:LeaseRemaining.in.months.	5.442e+01	2.598e+01	2.095	0.036321	*
Date2022-02:LeaseRemaining.in.months.	9.695e+01	4.441e+01	2.183	0.029176	*
Date2022-03:LeaseRemaining.in.months.	8.698e+01	4.270e+01	2.037	0.041783	*
Date2022-04:LeaseRemaining.in.months.	1.070e+02	4.346e+01	2.463	0.013874	*
Date2022-05:LeaseRemaining.in.months.	1.556e+02	4.732e+01	3.289	0.001025	**
Date2022-06:LeaseRemaining.in.months.	1.481e+02	4.640e+01	3.191	0.001445	**
Date2022-07:LeaseRemaining.in.months.	1.585e+02	4.826e+01	3.284	0.001043	**
Date2022-08:LeaseRemaining.in.months.	2.246e+02	5.366e+01	4.185	2.99e-05	***
Date2022-09:LeaseRemaining.in.months.	2.461e+02	5.217e+01	4.717	2.58e-06	***
Date2022-10:LeaseRemaining.in.months.	4.020e+02	6.119e+01	6.570	6.58e-11	***
Date2022-11:LeaseRemaining.in.months.	3.488e+02	5.996e+01	5.818	7.05e-09	***
Date2022-12:LeaseRemaining.in.months.	3.659e+02	6.231e+01	5.873	5.10e-09	***
Type4 ROOM:LeaseRemaining.in.months.	7.674e+02	3.603e+02	2.130	0.033296	*
Type5 ROOM:LeaseRemaining.in.months.	4.604e+02	5.403e+02	2.470	0.022490	*

Type4 ROOM:LeaseRemaining.in.months.	7.674e+02	3.603e+02	2.130	0.033296	*
Type5 ROOM:LeaseRemaining.in.months.	1.186e+03	5.443e+02	2.179	0.029449	*
Block2:LeaseRemaining.in.months.	7.037e+01	1.224e+03	0.057	0.954172	
Block6:LeaseRemaining.in.months.	1.869e+02	1.026e+03	0.182	0.855536	
Block8:LeaseRemaining.in.months.	3.794e+03	2.492e+03	1.522	0.128166	
Block9:LeaseRemaining.in.months.	1.354e+01	8.462e+01	0.160	0.872946	
Block10:LeaseRemaining.in.months.	1.428e+02	2.359e+03	0.061	0.951763	
Block11:LeaseRemaining.in.months.	1.992e+03	4.616e+02	4.314	1.69e-05	***
Block12:LeaseRemaining.in.months.	2.113e+02	1.122e+02	1.884	0.059794	.
Block13:LeaseRemaining.in.months.	-1.733e+03	3.459e+02	-5.009	6.02e-07	***
Block14:LeaseRemaining.in.months.	-4.645e+02	1.196e+03	-0.388	0.697764	
Block15:LeaseRemaining.in.months.	4.065e+03	1.920e+03	2.117	0.034393	*
Block16:LeaseRemaining.in.months.	-3.807e+03	1.235e+03	-3.082	0.002091	**
Block17:LeaseRemaining.in.months.	-1.045e+02	1.098e+03	-0.095	0.924135	
Block18:LeaseRemaining.in.months.	-6.531e+02	7.818e+02	-0.835	0.403631	
Block19:LeaseRemaining.in.months.	-1.156e+02	1.854e+02	-0.624	0.532963	
Block20:LeaseRemaining.in.months.	3.164e+02	1.834e+02	1.726	0.084585	.
Block21:LeaseRemaining.in.months.	-5.320e+02	1.370e+02	-3.883	0.000107	***
Block22:LeaseRemaining.in.months.	2.122e+04	2.575e+04	0.824	0.410156	
Block23:LeaseRemaining.in.months.	-8.433e+01	1.563e+03	-0.054	0.956968	
Block24:LeaseRemaining.in.months.	-7.190e+02	2.070e+03	-0.347	0.728300	
Block25:LeaseRemaining.in.months.	-2.712e+03	6.247e+02	-4.342	1.49e-05	***
Story04 TO 06:LeaseRemaining.in.months.	1.020e+02	3.421e+01	2.981	0.002915	**
Story07 TO 09:LeaseRemaining.in.months.	1.219e+02	3.376e+01	3.610	0.000315	***
Story10 TO 12:LeaseRemaining.in.months.	1.847e+02	3.406e+01	5.422	6.69e-08	***
Story13 TO 15:LeaseRemaining.in.months.	1.929e+02	3.463e+01	5.571	2.93e-08	***
Story16 TO 18:LeaseRemaining.in.months.	1.606e+02	3.696e+01	4.345	1.47e-05	***
Story19 TO 21:LeaseRemaining.in.months.	1.429e+02	1.400e+02	1.021	0.307401	
ModelModel A:LeaseRemaining.in.months.	2.421e+02	7.080e+01	3.419	0.000642	***
ModelPremium Apartment:LeaseRemaining.in.months.	4.155e+02	6.014e+01	6.909	6.80e-12	***
LeaseBegin2003:LeaseRemaining.in.months.	3.916e+02	1.695e+03	0.231	0.817329	
LeaseBegin2004:LeaseRemaining.in.months.	6.130e+02	1.747e+03	0.351	0.725752	
LeaseBegin2005:LeaseRemaining.in.months.	-2.802e+02	1.945e+03	-0.144	0.885431	
LeaseBegin2007:LeaseRemaining.in.months.	6.455e+02	1.927e+03	0.335	0.737685	
LeaseBegin2009:LeaseRemaining.in.months.	NA	NA	NA	NA	
LeaseBegin2010:LeaseRemaining.in.months.	1.266e+03	2.696e+03	0.470	0.638759	
LeaseBegin2011:LeaseRemaining.in.months.	6.595e+02	2.270e+03	0.291	0.771401	
LeaseBegin2012:LeaseRemaining.in.months.	1.505e+03	1.812e+03	0.831	0.406301	
LeaseBegin2013:LeaseRemaining.in.months.	1.411e+03	1.780e+03	0.792	0.428179	
LeaseBegin2014:LeaseRemaining.in.months.	1.313e+03	1.866e+03	0.703	0.481867	
LeaseBegin2015:LeaseRemaining.in.months.	7.473e+03	1.864e+03	4.009	6.35e-05	***
LeaseBegin2016:LeaseRemaining.in.months.	4.013e+03	1.797e+03	2.233	0.025688	*
LeaseBegin2017:LeaseRemaining.in.months.	5.196e+03	2.027e+03	2.564	0.010438	*
LeaseBegin2018:LeaseRemaining.in.months.	1.926e+03	2.488e+03	0.774	0.439050	

signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 22380 on 1770 degrees of freedom
Multiple R-squared: 0.9471, Adjusted R-squared: 0.9422
F-statistic: 193.2 on 164 and 1770 DF, p-value: < 2.2e-16

[1] 45337.12

9.2.3 Regression of Block and Street against Resale Price respectively

```
test.block<- lm(ResalePrice~Block,data=Punggol)
summary(test.block)

test.street<- lm(ResalePrice~Street,data=Punggol)
summary(test.street)
```

```
lm(formula = ResalePrice ~ Block, data = Punggol)

Residuals:
    Min       1Q   Median       3Q      Max
-219340  -51001  -7269   44349  361531

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  513588      7356   69.816 < 2e-16 ***
Block2       93561       9990    9.365 < 2e-16 ***
Block6      27512      12834    2.144  0.0322 *
Block8     -18639      26267   -0.710  0.4780
Block9     55511       9432    5.886 4.67e-09 ***
Block10     11225      24477    0.459  0.6466
Block11     55951      10950    5.110 3.54e-07 ***
Block12     51673       8709    5.933 3.52e-09 ***
Block13     88681       9800    9.049 < 2e-16 ***
Block14    131640      12227   10.767 < 2e-16 ***
Block15     74285      10924    6.800 1.39e-11 ***
Block16     40045      16892    2.371  0.0179 *
Block17     35695      14273    2.501  0.0125 *
Block18      2063       11867    0.174  0.8620
Block19     18702      10898    1.716  0.0863 .
Block20     19347      14378    1.346  0.1786
Block21      1677       16312    0.103  0.9181
Block22     44412      39751    1.117  0.2640
Block23     22359      20872    1.071  0.2842
Block24     75893      26267    2.889  0.0039 **
Block25     67314      13979    4.815 1.58e-06 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 87350 on 1914 degrees of freedom
Multiple R-squared:  0.1288,    Adjusted R-squared:  0.1197
F-statistic: 14.15 on 20 and 1914 DF, p-value: < 2.2e-16

> summary(test.street)

Call:
lm(formula = ResalePrice ~ Street, data = Punggol)

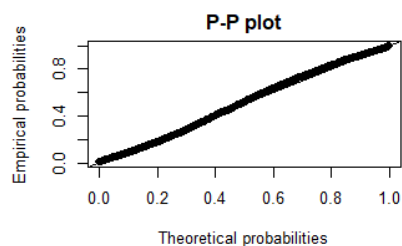
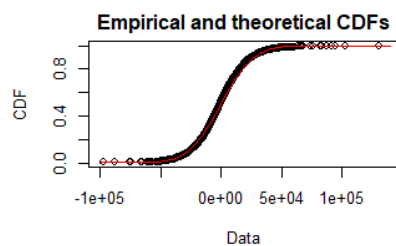
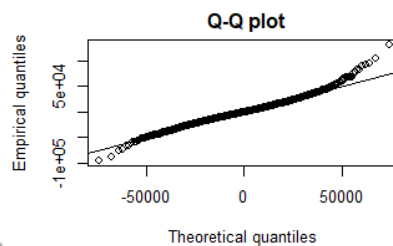
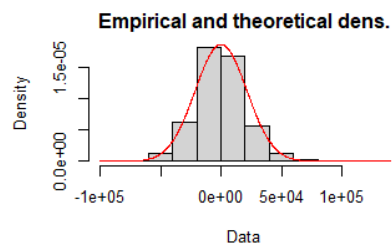
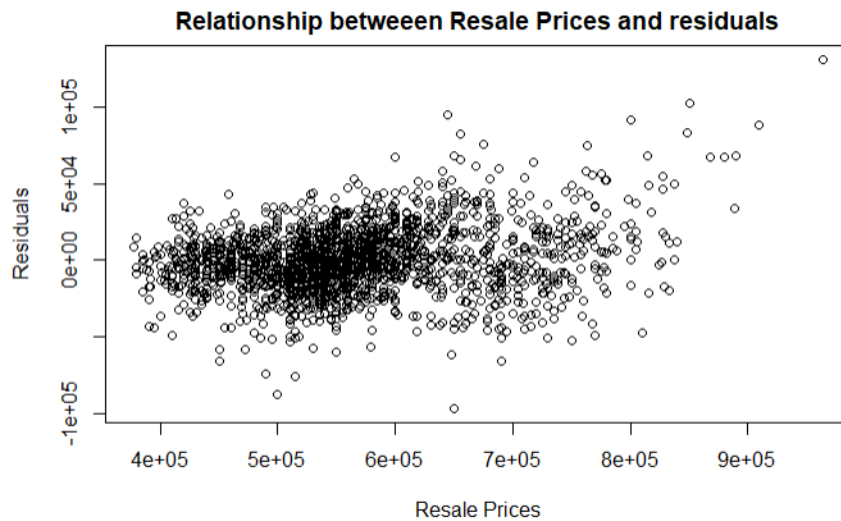
Residuals:
    Min       1Q   Median       3Q      Max
-219306  -55182  -7306   44592  361531

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  564317      5095  110.751 < 2e-16 ***
StreetEDGEFIELD PLAINS -39135      8049  -4.862 1.25e-06 ***
StreetPUNGGOL CTRL -31852      8806  -3.617 0.000306 ***
StreetPUNGGOL DR 7402       7188   1.030 0.303307
StreetPUNGGOL EAST -50824     22279  -2.281 0.022642 *
StreetPUNGGOL FIELD 2007       7708   0.260 0.794608
StreetPUNGGOL FIELD WALK -39504    24437  -1.617 0.106130
StreetPUNGGOL PL 7092       9404   0.754 0.450876
StreetPUNGGOL RD -49267     15029  -3.278 0.001064 **
StreetPUNGGOL WALK 37952      8361   4.539 5.99e-06 ***
StreetPUNGGOL WAY 54988      9254   5.942 3.33e-09 ***
StreetSUMANG LANE 23556      9711   2.426 0.015375 *
StreetSUMANG LINK -10684     16379  -0.652 0.514280
StreetSUMANG WALK -15034     13519  -1.112 0.266243
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 89420 on 1921 degrees of freedom
Multiple R-squared:  0.08365,    Adjusted R-squared:  0.07745
F-statistic: 13.49 on 13 and 1921 DF, p-value: < 2.2e-16
```

9.2.4 Residual Analysis Plots

```
##[r]
#Residual assumptions for reg 4
resid <- residuals(reg3)
plot(mungoli$ResalePrice, residuals(reg3), main="Relationship between Resale Prices and residuals", xlab="Resale Prices",
     ylab="Residuals")
library(fitdistrplus)
fnorm<- fitdistr(resid,"norm")
plot(Fnorm)
```



9.2.5 KS Statistic

```
##{r}

result<- gofstat(fnorm, discrete = FALSE)
result

kscritvalue<- 1.36/sqrt(length(reg4))
kscritvalue
|

##
```

```
Goodness-of-fit statistics
                                1-mle-norm
Kolmogorov-Smirnov statistic 0.03857706
Cramer-von Mises statistic  0.90912907
Anderson-Darling statistic  5.52864414

Goodness-of-fit criteria
                                1-mle-norm
Akaike's Information Criterion  44084.85
Bayesian Information Criterion  44095.99
[1] 0.3771961
```