In [1]:
```
import pandas as pd
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.model_selection import train_test_split
```

```
/usr/local/lib/python3.6/dist-packages/statsmodels/tools/_testing.py:19: FutureWarning: pandas.util.testing is deprecat
ed. Use the functions in the public API at pandas.testing instead.
  import pandas.util.testing as tm
```

In [2]:
```
from google.colab import files
uploaded = files.upload()
```

Choose Files No file chosen

Upload widget is only available when the cell has been executed in the current browser session. Please rerun this cell to enable.

```
Saving melb_data.csv to melb_data.csv
```

In [3]:
```
df = pd.read_csv("melb_data.csv")
d = pd.read_csv("melb_data.csv")
```

In [4]:
```
df.head()
```

Out[4]:

	Suburb	Address	Rooms	Type	Price	Method	SellerG	Date	Distance	Postcode	Bedroom2	Bathroom	Car	Landsize	Building
0	Abbotsford	85 Turner St	2	h	1480000.0	S	Biggin	3/12/2016	2.5	3067.0	2.0	1.0	1.0	202.0	I
1	Abbotsford	25 Bloomburg St	2	h	1035000.0	S	Biggin	4/02/2016	2.5	3067.0	2.0	1.0	0.0	156.0	
2	Abbotsford	5 Charles St	3	h	1465000.0	SP	Biggin	4/03/2017	2.5	3067.0	3.0	2.0	0.0	134.0	1
3	Abbotsford	40 Federation La	3	h	850000.0	PI	Biggin	4/03/2017	2.5	3067.0	3.0	2.0	1.0	94.0	I
4	Abbotsford	55a Park St	4	h	1600000.0	VB	Nelson	4/06/2016	2.5	3067.0	3.0	1.0	2.0	120.0	1

In [5]:
```
df.tail()
```

Out[5]:

	Suburb	Address	Rooms	Type	Price	Method	SellerG	Date	Distance	Postcode	Bedroom2	Bathroom	Car	Landsize	B
13575	Wheelers Hill	12 Strada Cr	4	h	1245000.0	S	Barry	26/08/2017	16.7	3150.0	4.0	2.0	2.0	652.0	
13576	Williamstown	77 Merrett Dr	3	h	1031000.0	SP	Williams	26/08/2017	6.8	3016.0	3.0	2.0	2.0	333.0	
13577	Williamstown	83 Power St	3	h	1170000.0	S	Raine	26/08/2017	6.8	3016.0	3.0	2.0	4.0	436.0	
13578	Williamstown	96 Verdon St	4	h	2500000.0	PI	Sweeney	26/08/2017	6.8	3016.0	4.0	1.0	5.0	866.0	
13579	Yarraville	6 Agnes St	4	h	1285000.0	SP	Village	26/08/2017	6.3	3013.0	4.0	1.0	1.0	362.0	

In [6]:
```
#Data Given :
#Rooms  Number of rooms
#Type   Property type
#Price  Price in dollars
#Method Property status
#SellerG    Real Estate Agent
#Distance   Distance from CBD
#Postcode   Code of the area
#Bathroom   Number of Bathrooms
#Car    Number of carspots
#Landsize   Land Size
#BuildingArea   Building Size
#YearBuilt  The year in which home was built
#CouncilArea    Governing council for the area
#Longtitude The angular distance of a place east or west
#Regionname General Region (West, North West, North, Northeast …etc)
#PropertyCount  Number of properties that exist in the suburb
```

In [7]:
```
df.isnull().sum()
```

Out[7]:
```
Suburb              0
Address             0
Rooms               0
Type                0
Price               0
Method              0
SellerG             0
Date                0
Distance            0
Postcode            0
Bedroom2            0
Bathroom            0
Car                62
Landsize            0
BuildingArea     6450
YearBuilt        5375
CouncilArea      1369
Lattitude           0
Longtitude          0
Regionname          0
Propertycount       0
dtype: int64
```

In [8]:
```
# dropping column with building area as almost half of the data is missing.
# df.drop(['BuildingArea','Address'],axis=1)
```

In [9]:
```
#Replaced the nan value in the BuildingArea with mean
df['BuildingArea'].replace({np.nan:df['BuildingArea'].mean()},inplace=True)

df['CouncilArea']=df['CouncilArea'].replace(np.NaN,0)

#Replaced the nan value in the car with YearBuilt
df['YearBuilt'].replace({np.NaN:df['YearBuilt'].mean()},inplace=True)

#Replaced the nan value in the car with mode value ie,2
df.Car.replace({np.nan:2},inplace=True)
```

In [10]:
```
df.isnull().sum()
```

Out[10]:
```
Suburb           0
Address          0
Rooms            0
Type             0
Price            0
Method           0
SellerG          0
Date             0
Distance         0
Postcode         0
Bedroom2         0
Bathroom         0
Car              0
Landsize         0
BuildingArea     0
YearBuilt        0
CouncilArea      0
Lattitude        0
Longtitude       0
Regionname       0
Propertycount    0
dtype: int64
```

In [12]:
```
df.describe()
```

Out[12]:

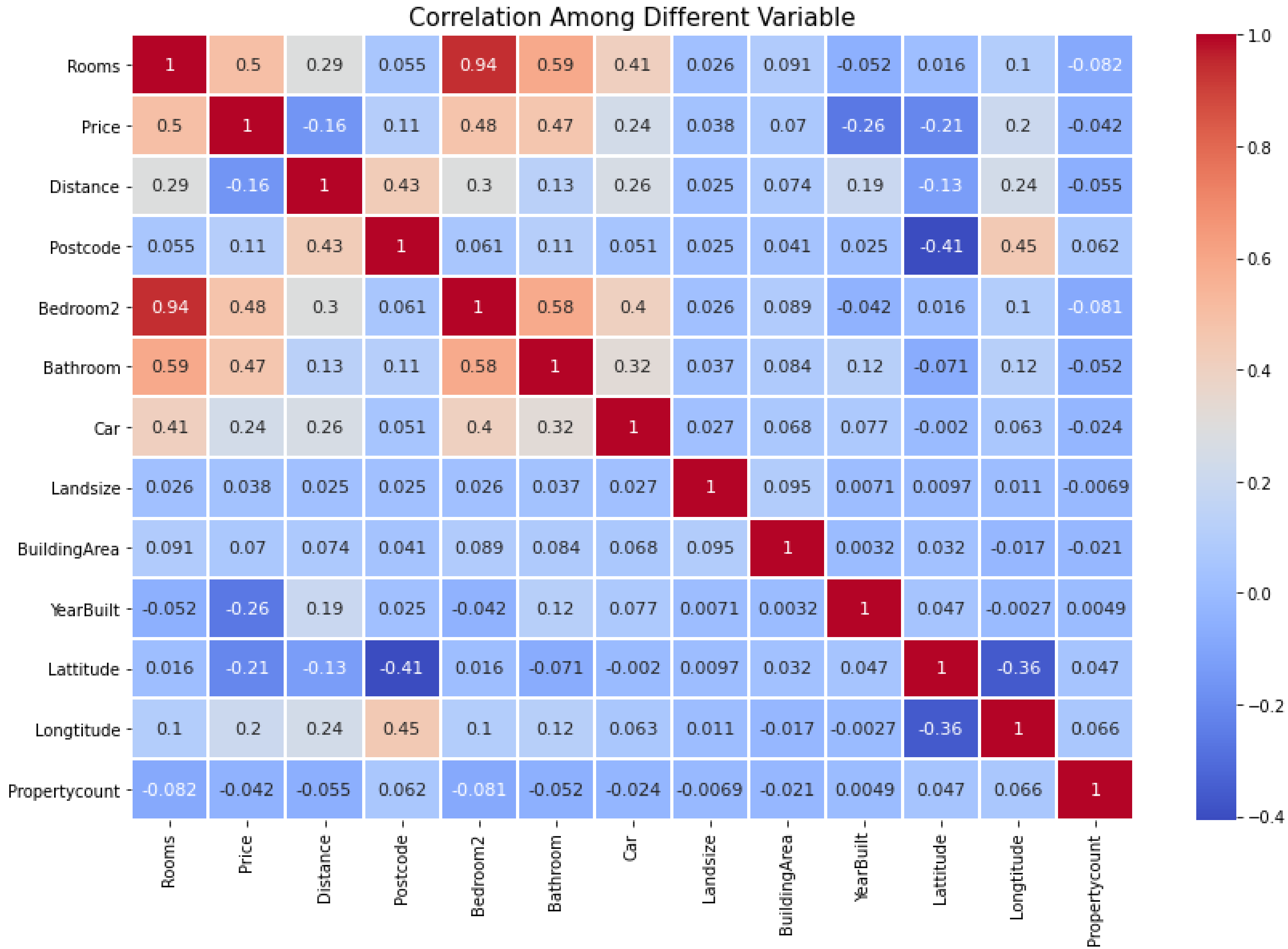
	Rooms	Price	Distance	Postcode	Bedroom2	Bathroom	Car	Landsize	BuildingArea	YearBu
count	13580.000000	1.358000e+04	13580.000000	13580.000000	13580.000000	13580.000000	13580.000000	13580.000000	13580.000000	13580.0000
mean	2.937997	1.075684e+06	10.137776	3105.301915	2.914728	1.534242	1.611856	558.416127	151.967650	1964.6842
std	0.955748	6.393107e+05	5.868725	90.676964	0.965921	0.691712	0.960793	3990.669241	392.002962	28.9722
min	1.000000	8.500000e+04	0.000000	3000.000000	0.000000	0.000000	0.000000	0.000000	0.000000	1196.0000
25%	2.000000	6.500000e+05	6.100000	3044.000000	2.000000	1.000000	1.000000	177.000000	122.000000	1960.0000
50%	3.000000	9.030000e+05	9.200000	3084.000000	3.000000	1.000000	2.000000	440.000000	151.967650	1964.6842
75%	3.000000	1.330000e+06	13.000000	3148.000000	3.000000	2.000000	2.000000	651.000000	151.967650	1975.0000
max	10.000000	9.000000e+06	48.100000	3977.000000	20.000000	8.000000	10.000000	433014.000000	44515.000000	2018.0000

In [13]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 13580 entries, 0 to 13579
Data columns (total 21 columns):
 #   Column         Non-Null Count  Dtype  
---  ------         --------------  -----  
 0   Suburb         13580 non-null  object 
 1   Address        13580 non-null  object 
 2   Rooms          13580 non-null  int64  
 3   Type           13580 non-null  object 
 4   Price          13580 non-null  float64
 5   Method         13580 non-null  object 
 6   SellerG        13580 non-null  object 
 7   Date           13580 non-null  object 
 8   Distance       13580 non-null  float64
 9   Postcode       13580 non-null  float64
 10  Bedroom2       13580 non-null  float64
 11  Bathroom       13580 non-null  float64
 12  Car            13580 non-null  float64
 13  Landsize       13580 non-null  float64
 14  BuildingArea   13580 non-null  float64
 15  YearBuilt      13580 non-null  float64
 16  CouncilArea    13580 non-null  object 
 17  Lattitude      13580 non-null  float64
 18  Longtitude     13580 non-null  float64
 19  Regionname     13580 non-null  object 
 20  Propertycount  13580 non-null  float64
dtypes: float64(12), int64(1), object(8)
memory usage: 2.2+ MB
```

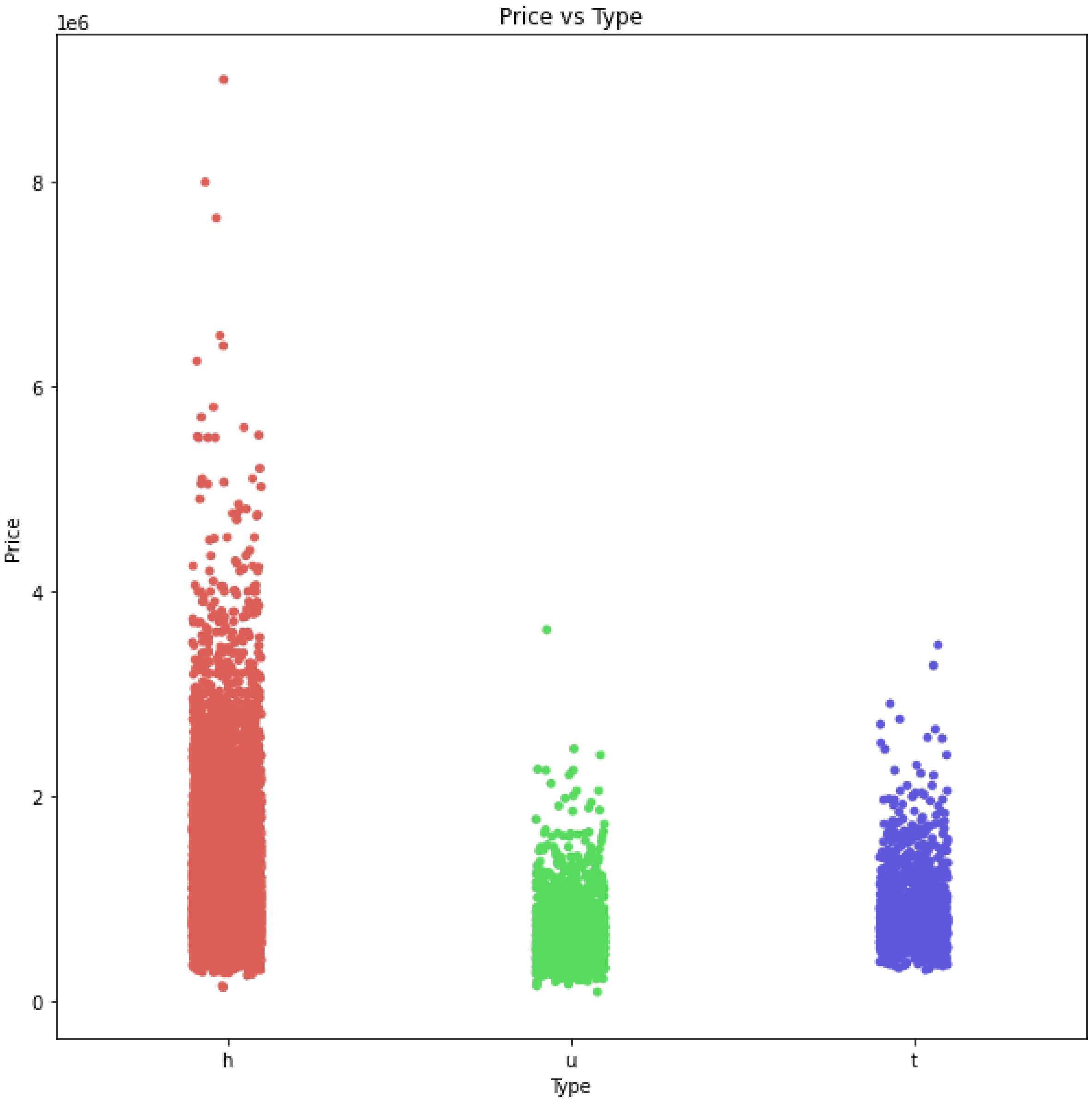
In [14]:
```
# Prepare the data for correlation
corr=df.corr()

# Relation between different variable
fig,ax=plt.subplots(figsize=(14,9))
sns.heatmap(corr,annot=True,cmap = 'coolwarm',linewidth = 1,annot_kws={"size": 11})
plt.title("Correlation Among Different Variable",size=15);
```

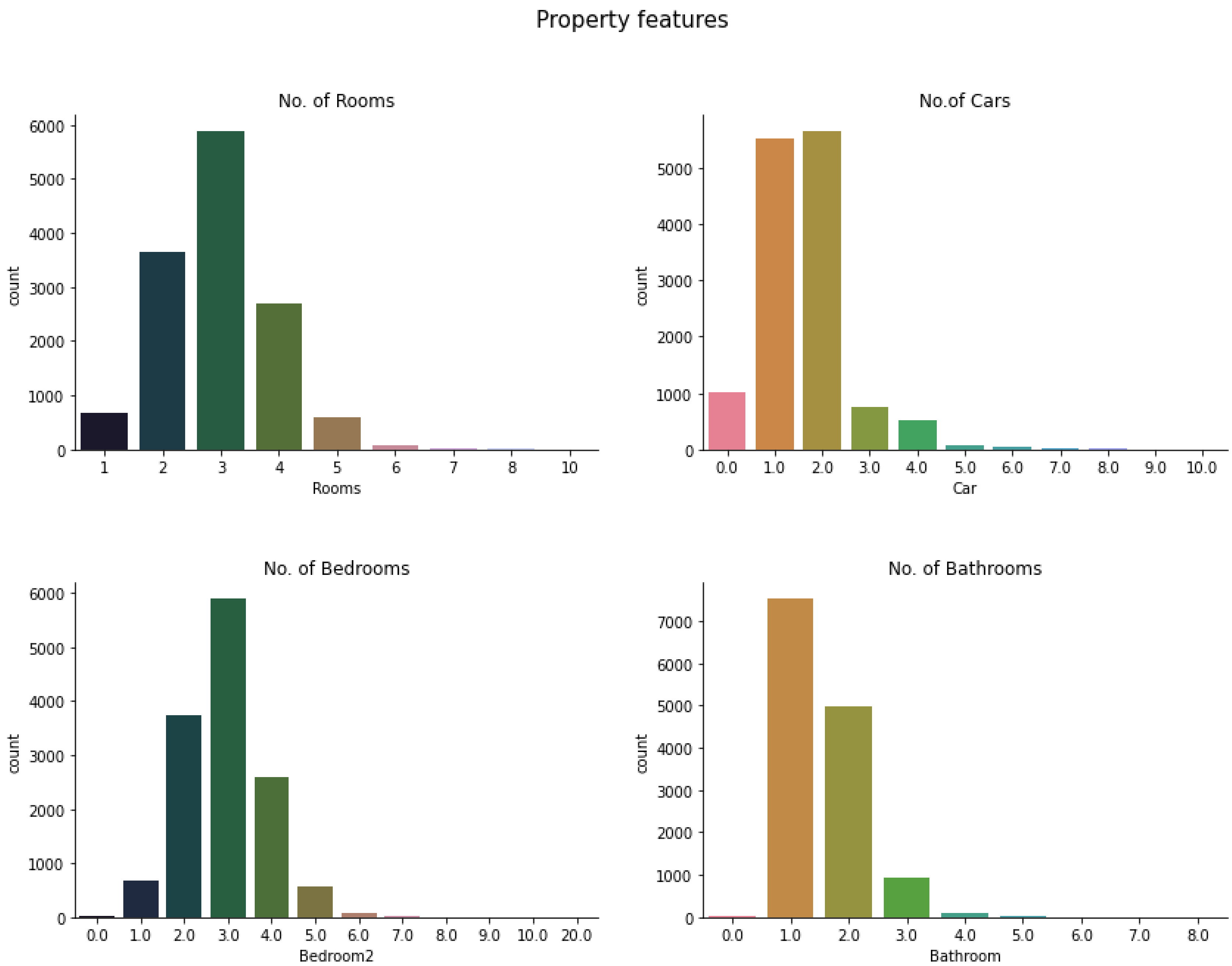

Correlation Among Different Variable
Rooms 1 0.5 0.29 0.055 0.94 0.59 0.41 0.026 0.091 -0.052 0.016 0.1 -0.082
Price 0.5 1 -0.16 0.11 0.48 0.47 0.24 0.038 0.07 -0.26 -0.21 0.2 -0.042
Distance 0.29 -0.16 1 0.43 0.3 0.13 0.26 0.025 0.074 0.19 -0.13 0.24 -0.055
Postcode 0.055 0.11 0.43 1 0.061 0.11 0.051 0.025 0.041 0.025 -0.41 0.45 0.062
Bedroom2 0.94 0.48 0.3 0.061 1 0.58 0.4 0.026 0.089 -0.042 0.016 0.1 -0.081
Bathroom 0.59 0.47 0.13 0.11 0.58 1 0.32 0.037 0.084 0.12 -0.071 0.12 -0.052
Car 0.41 0.24 0.26 0.051 0.4 0.32 1 0.027 0.068 0.077 -0.002 0.063 -0.024
Landsize 0.026 0.038 0.025 0.025 0.026 0.037 0.027 1 0.095 0.0071 0.0097 0.011 -0.0069
BuildingArea 0.091 0.07 0.074 0.041 0.089 0.084 0.068 0.095 1 0.0032 0.032 -0.017 -0.021
YearBuilt -0.052 -0.26 0.19 0.025 -0.042 0.12 0.077 0.0071 0.0032 1 0.047 -0.0027 0.0049
Lattitude 0.016 -0.21 -0.13 -0.41 0.016 -0.071 -0.002 0.0097 0.032 0.047 1 -0.36 0.047
Longtitude 0.1 0.2 0.24 0.45 0.1 0.12 0.063 0.011 -0.017 -0.0027 -0.36 1 0.066
Propertycount -0.082 -0.042 -0.055 0.062 -0.081 -0.052 -0.024 -0.0069 -0.021 0.0049 0.047 0.066 1
Rooms
Price
Distance
Postcode
Bedroom2
Bathroom
Car
Landsize
BuildingArea
YearBuilt
Lattitude
Longtitude
Propertycount
1.0
0.8
0.6
0.4
0.2
0.0
−0.2
−0.4

In [15]:
```
plt.figure(figsize=(10,10))
sns.stripplot(x=df['Type'],y=df['Price'],palette='hls').set_title('Price vs Type')
```

Out[15]:
```
Text(0.5, 1.0, 'Price vs Type')
```



In [16]:
```
fig, axarr = plt.subplots(2, 2, figsize=(14,10))
fig.suptitle('Property features',fontsize=15)
sns.countplot(df['Rooms'],ax=axarr[0][0],palette='cubehelix').set_title('No. of Rooms')
sns.countplot(df['Bedroom2'],ax=axarr[1][0],palette='cubehelix').set_title('No. of Bedrooms')
sns.countplot(df['Bathroom'],ax=axarr[1][1],palette='husl').set_title('No. of Bathrooms')
sns.countplot(df['Car'],ax=axarr[0][1],palette='husl').set_title('No.of Cars')
plt.subplots_adjust(hspace=.4)
sns.set_style('darkgrid')
sns.despine()
```


Property features
No. of Rooms
count
Rooms
No.of Cars
Car
No. of Bedrooms
Bedroom2
No. of Bathrooms
Bathroom

In [17]:
```
df['CouncilArea'].unique()
```

Out[17]:
```
array(['Yarra', 'Moonee Valley', 'Port Phillip', 'Darebin', 'Hobsons Bay',
       'Stonnington', 'Boroondara', 'Monash', 'Glen Eira', 'Whitehorse',
       'Maribyrnong', 'Bayside', 'Moreland', 'Manningham', 'Banyule',
       'Melbourne', 'Kingston', 'Brimbank', 'Hume', 0, 'Knox',
       'Maroondah', 'Casey', 'Melton', 'Greater Dandenong', 'Nillumbik',
       'Whittlesea', 'Frankston', 'Macedon Ranges', 'Yarra Ranges',
       'Wyndham', 'Cardinia', 'Unavailable', 'Moorabool'], dtype=object)
```

In [18]:
```
def clean_price(x):
  x = str(x)
  x = x.replace("0","zero")
  return str(x)
```

In [19]:
```
df["CouncilArea"] = df["CouncilArea"].map(clean_price)
```

In [20]:
```
df.drop(['Address','Date'], axis = 1, inplace = True)
```

In [23]:
```
df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 13580 entries, 0 to 13579
Data columns (total 19 columns):
 #   Column         Non-Null Count  Dtype  
---  ------         --------------  -----  
 0   Suburb         13580 non-null  object 
 1   Rooms          13580 non-null  int64  
 2   Type           13580 non-null  object 
 3   Price          13580 non-null  float64
 4   Method         13580 non-null  object 
 5   SellerG        13580 non-null  object 
 6   Distance       13580 non-null  float64
 7   Postcode       13580 non-null  float64
 8   Bedroom2       13580 non-null  float64
 9   Bathroom       13580 non-null  float64
 10  Car            13580 non-null  float64
 11  Landsize       13580 non-null  float64
 12  BuildingArea   13580 non-null  float64
 13  YearBuilt      13580 non-null  float64
 14  CouncilArea    13580 non-null  object 
 15  Lattitude      13580 non-null  float64
 16  Longtitude     13580 non-null  float64
 17  Regionname     13580 non-null  object 
 18  Propertycount  13580 non-null  float64
dtypes: float64(12), int64(1), object(6)
memory usage: 2.0+ MB
```

In [21]:
```
df_num = df.select_dtypes(["int64","float64"])
df_cat = df.select_dtypes("object")
```

In [22]:
```
df_num.head()
```

Out[22]:

	Rooms	Price	Distance	Postcode	Bedroom2	Bathroom	Car	Landsize	BuildingArea	YearBuilt	Lattitude	Longtitude	Propertycount
0	2	1480000.0	2.5	3067.0	2.0	1.0	1.0	202.0	151.96765	1964.684217	-37.7996	144.9984	4019.0
1	2	1035000.0	2.5	3067.0	2.0	1.0	0.0	156.0	79.00000	1900.000000	-37.8079	144.9934	4019.0
2	3	1465000.0	2.5	3067.0	3.0	2.0	0.0	134.0	150.00000	1900.000000	-37.8093	144.9944	4019.0
3	3	850000.0	2.5	3067.0	3.0	2.0	1.0	94.0	151.96765	1964.684217	-37.7969	144.9969	4019.0
4	4	1600000.0	2.5	3067.0	3.0	1.0	2.0	120.0	142.00000	2014.000000	-37.8072	144.9941	4019.0

In [24]:
```
df_cat.head()
```

Out[24]:

	Suburb	Type	Method	SellerG	CouncilArea	Regionname
0	Abbotsford	h	S	Biggin	Yarra	Northern Metropolitan
1	Abbotsford	h	S	Biggin	Yarra	Northern Metropolitan
2	Abbotsford	h	SP	Biggin	Yarra	Northern Metropolitan
3	Abbotsford	h	PI	Biggin	Yarra	Northern Metropolitan
4	Abbotsford	h	VB	Nelson	Yarra	Northern Metropolitan

In [25]:
```
from sklearn.preprocessing import LabelEncoder
```

In [26]:
```
for col in df_cat:
  le = LabelEncoder()
  df_cat[col] = le.fit_transform(df_cat[col])
```

```
/usr/local/lib/python3.6/dist-packages/ipykernel_launcher.py:3: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a
-view-versus-a-copy (https://pandas.pydata.org/pandas-docs/stable/user_guide/indexing.html#returning-a-view-versus-a-co
py)
  This is separate from the ipykernel package so we can avoid doing imports until
```

In [27]:
```
df_cat.head()
```

Out[27]:

	Suburb	Type	Method	SellerG	CouncilArea	Regionname
0	0	0	1	23	31	2
1	0	0	1	23	31	2
2	0	0	3	23	31	2
3	0	0	0	23	31	2
4	0	0	4	155	31	2

In [28]:
```
df_new = pd.concat([df_num,df_cat],axis=1)
```

In [29]:
```
df_new.head()
```

Out[29]:

	Rooms	Price	Distance	Postcode	Bedroom2	Bathroom	Car	Landsize	BuildingArea	YearBuilt	Lattitude	Longtitude	Propertycount	S
0	2	1480000.0	2.5	3067.0	2.0	1.0	1.0	202.0	151.96765	1964.684217	-37.7996	144.9984	4019.0	
1	2	1035000.0	2.5	3067.0	2.0	1.0	0.0	156.0	79.00000	1900.000000	-37.8079	144.9934	4019.0	
2	3	1465000.0	2.5	3067.0	3.0	2.0	0.0	134.0	150.00000	1900.000000	-37.8093	144.9944	4019.0	
3	3	850000.0	2.5	3067.0	3.0	2.0	1.0	94.0	151.96765	1964.684217	-37.7969	144.9969	4019.0	
4	4	1600000.0	2.5	3067.0	3.0	1.0	2.0	120.0	142.00000	2014.000000	-37.8072	144.9941	4019.0	

In [30]:
```
from sklearn.model_selection import train_test_split
from sklearn.linear_model import LinearRegression
```

In [31]:
```
X = df_new.drop("Price",axis=1)
y = df["Price"]
```

In [32]:
```
X_train,X_test,y_train,y_test = train_test_split(X,y,test_size=0.3,random_state=1)
```

In [33]:
```
lr = LinearRegression()
lr.fit(X_train,y_train)
```

Out[33]:
```
LinearRegression(copy_X=True, fit_intercept=True, n_jobs=None, normalize=False)
```

In [34]:
```
# Train score
lr.score(X_train,y_train)
```

Out[34]:
```
0.5819003970611216
```

In [35]:
```
#Test score
lr.score(X_test,y_test)
```

Out[35]:
```
0.2901404271527054
```

In [36]:
```
lr.coef_
```

Out[36]:
```
array([ 1.45607186e+05, -4.81954674e+04,  9.32695765e+02,  1.56696664e+04,
        2.17728520e+05,  4.58445848e+04,  1.59831856e+01,  5.14378193e+02,
       -2.83734591e+03, -9.26729631e+05,  1.12471725e+06,  4.12494561e-01,
       -3.78679627e+02, -2.17300292e+05, -7.77233634e+03, -1.82523291e+02,
       -2.13385373e+03,  3.34244843e+04])
```

In [38]:
```
from sklearn.linear_model import Lasso
from sklearn.linear_model import Ridge
```

In [39]:
```
# Ridge Regularization
l2 = Ridge(100)
l2.fit(X_train,y_train)
l2.coef_
```

Out[39]:
```
array([ 1.38910141e+05, -4.80175470e+04,  1.43996159e+03,  2.80776522e+04,
        2.20728955e+05,  4.86815545e+04,  1.39036890e+01,  5.37393743e+02,
       -3.15083327e+03, -3.75269570e+05,  4.85539625e+05, -8.73845325e-02,
       -5.01171553e+02, -1.99404754e+05, -8.64631793e+03, -1.96819255e+02,
       -3.10986135e+03,  2.32382390e+04])
```

In [40]:
```
# Lasso helps in feature selection
l1 = Lasso(500)
l1.fit(X_train,y_train)
l1.coef_
```

Out[40]:
```
array([ 1.45839670e+05, -4.81063126e+04,  9.86528294e+02,  1.57140999e+04,
        2.17872861e+05,  4.57000316e+04,  1.57313160e+01,  5.18433987e+02,
       -2.87655372e+03, -8.40852544e+05,  1.07401808e+06,  3.42357102e-01,
       -3.92325507e+02, -2.15047659e+05, -7.45852879e+03, -1.82498882e+02,
       -2.22465471e+03,  3.29897248e+04])
```

In [41]:
```
for i in range(50):
  l2 = Ridge(alpha=i)
  l2.fit(X_train,y_train)
  print(i,":",l2.score(X_test,y_test))
```

```
0 : 0.29014042715263444
1 : 0.2893549722324765
2 : 0.2885702152285111
3 : 0.2877869282879334
4 : 0.28700578290959
5 : 0.28622736360232337
6 : 0.2854521792910384
7 : 0.2846806729245398
8 : 0.2839132296314678
9 : 0.28315018369161105
10 : 0.2823918245317347
11 : 0.2816384019109034
12 : 0.28089013042717814
13 : 0.28014719345191597
14 : 0.27940974657814
15 : 0.2786779206538149
16 : 0.2779518244585636
17 : 0.27723154707275954
18 : 0.27651715997972215
19 : 0.27580871893557635
20 : 0.2751062656359916
21 : 0.27440982920480317
22 : 0.27371942752578604
23 : 0.27303506843609393
24 : 0.27235675079721167
25 : 0.2716844654572568
26 : 0.27101819611665856
27 : 0.27035792010770066
28 : 0.26970360909721836
29 : 0.2690552297204727
30 : 0.26841274415343963
31 : 0.26777611062974427
32 : 0.26714528390792824
33 : 0.266520215693959
34 : 0.26590085502342886
35 : 0.2652871486073971
```

```
36 : 0.2646790411453883
37 : 0.26407647560870673
38 : 0.2634793934968649
39 : 0.2628877350697162
40 : 0.2623014395575053
41 : 0.26172044535093675
42 : 0.26114469017307473
43 : 0.26057411123476204
44 : 0.26000864537504265
45 : 0.2594482291879786
46 : 0.25889279913704255
47 : 0.25834229165825806
48 : 0.2577966432530414
49 : 0.25725579057171555
```

In [42]:

```
for i in range(200,500,50):
  l1 = Lasso(alpha=i)
  l1.fit(X_train,y_train)
  print(i,":",l1.score(X_test,y_test))
```

```
200 : 0.28763143845585437
250 : 0.2869933831906637
300 : 0.2863511052465231
350 : 0.28570449624002947
400 : 0.2850535537824771
450 : 0.28439847296740617
```

In [43]:

```
# Final models
l2 = Ridge(alpha=2)
l2.fit(X_train,y_train)
print(l2.score(X_test,y_test))
```

```
0.2885702152285111
```

In [44]:
```
l2.coef_
```

Out[44]:
```
array([ 1.45469095e+05, -4.81880176e+04,  9.56079268e+02,  1.59747792e+04,
        2.18047550e+05,  4.59577610e+04,  1.58805333e+01,  5.15182886e+02,
       -2.85166749e+03, -8.98628885e+05,  1.09714540e+06,  3.89807255e-01,
       -3.84328601e+02, -2.16575632e+05, -7.80999991e+03, -1.83018669e+02,
       -2.17769491e+03,  3.30358511e+04])
```

In [45]:
```
l1 = Lasso(alpha=2000)
l1.fit(X_train,y_train)
print(l1.score(X_test,y_test))
```

```
0.26194963250029557
```

In [46]:
```
l1.coef_
```

Out[46]:
```
array([ 1.46555247e+05, -4.78387771e+04,  1.14802773e+03,  1.58326523e+04,
        2.18303920e+05,  4.52660393e+04,  1.49756378e+01,  5.30598724e+02,
       -2.99417874e+03, -5.83222253e+05,  9.21917456e+05,  1.31956788e-01,
       -4.33262825e+02, -2.08287787e+05, -6.51705386e+03, -1.82424639e+02,
       -2.49704254e+03,  3.16853558e+04])
```

In [47]:
```
# Cross Validation
```

In [48]:
```
from sklearn.model_selection import cross_val_score
```

In [49]:
```
l1_cross = cross_val_score(l1,X,y,cv=4)
```

In [50]:
```
l1_cross
```

Out[50]:
```
array([0.60869205, 0.57486712, 0.5734602 , 0.09129809])
```

In [51]:
```
l2_cross = cross_val_score(l2,X,y,cv=4)
```

In [52]:
```
l2_cross
```

Out[52]:
```
array([0.61336893, 0.57979532, 0.57636251, 0.14783038])
```

In [53]:
```
np.mean(l1_cross)
```

Out[53]:
```
0.462079364972721
```

In [54]:
```
np.mean(l2_cross)
```

Out[54]:
```
0.47933928588151975
```