

# hw\_house\_price\_india

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**This project will predict the price of Indian house using linear regression by R Programming**

Source : data.world  
type of source: xlsx

**Start with load library**

```
#load library
library(tidyverse)
library(caret)
library(mlbench)
library(readxl)
library(ggplot2)
```

**Load data file to dataframe("df1 = sheet1, df2 = sheet2")**

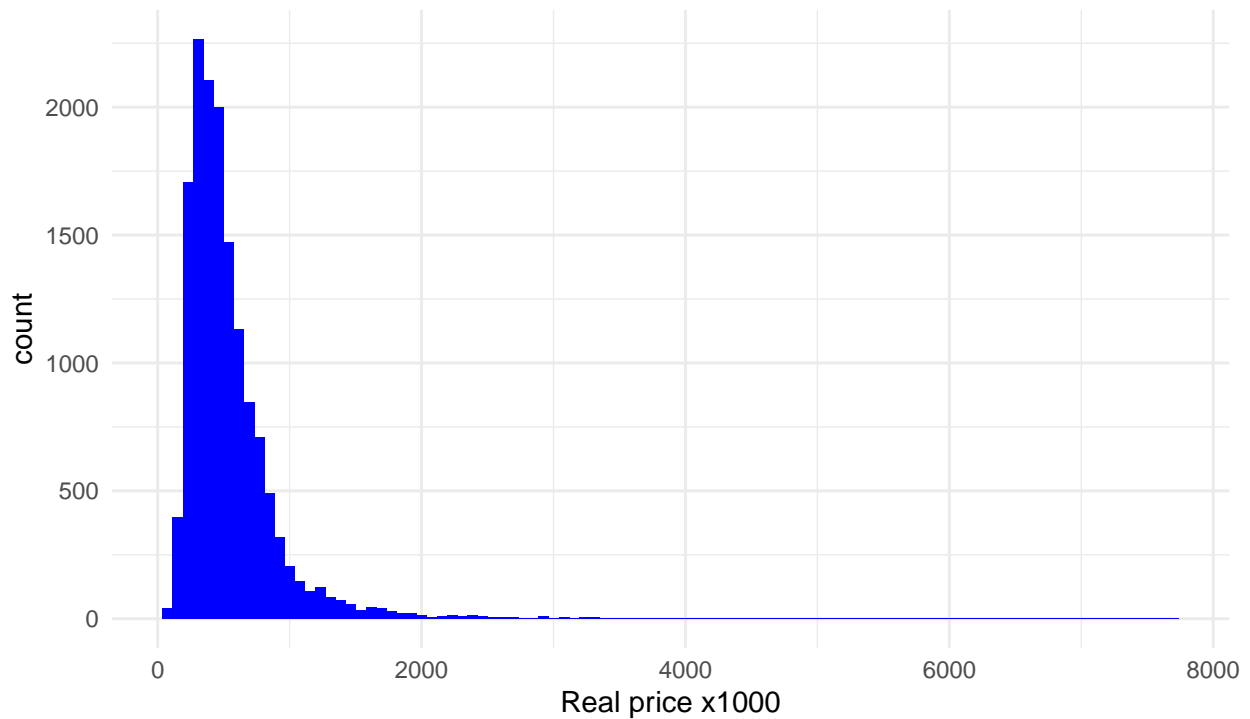
```
# Load data
df1<-read_excel("hpi.xlsx", sheet = 1)
df2<-read_excel("hpi.xlsx", sheet = 2)
```

**Visualized data(df1) ~ Price**

```
ggplot(df1, aes(Price/1000)) +
  geom_histogram(bins = 100, fill="blue") +
  theme_minimal() +
  labs(
    title = "Visualized Real price by histogram",
    subtitle = "Right skew",
    x = "Real price x1000",
    caption = "Source: data.world"
  )
```

## Visualized Real price by histogram

Right skew



Source: data.world

Note: Right skew distribution, not proper for build model but try it.

### Create function split\_data

```
split_data <- function(df) {  
  set.seed(42)  
  n <- nrow(df)  
  id <- sample(1:n, size = 0.8*n)  
  train_df <- df[id, ]  
  test_df <- df[-id, ]  
  list(train_df, test_df)  
}
```

## 1. Use full data and real price to build model

### 1.1 Split full df1 and real price

```
prep_data <- split_data(df1)  
train_data <- prep_data[[1]]  
test_data <- prep_data[[2]]
```

## 1.2 Train model full df1 and real price

### 1.2.1 Train

```
model <- train(Price ~ .,  
              data = train_data[ ,-c(1,2)], #remove id and date  
              method = "lm")
```

### 1.2.2 Show model and summary model

```
model ; summary(model)
```

```
## Linear Regression  
##  
## 11696 samples  
##    20 predictor  
##  
## No pre-processing  
## Resampling: Bootstrapped (25 reps)  
## Summary of sample sizes: 11696, 11696, 11696, 11696, 11696, 11696, ...  
## Resampling results:  
##  
##    RMSE      Rsquared   MAE  
## 192549.8  0.711037 123219.8  
##  
## Tuning parameter 'intercept' was held constant at a value of TRUE  
  
##  
## Call:  
## lm(formula = .outcome ~ ., data = dat)  
##  
## Residuals:  
##      Min       1Q   Median       3Q      Max  
## -1111112  -96339   -8097    75756  3896879  
##  
## Coefficients: (1 not defined because of singularities)  
##  
##              Estimate Std. Error t value  
## (Intercept)      -6.807e+07  1.241e+07  -5.485  
## '\\number of bedrooms\\'  
##      -3.545e+04  2.577e+03 -13.759  
## '\\number of bathrooms\\'  
##      4.235e+04  4.250e+03   9.966  
## '\\living area\\'  
##      1.409e+02  5.716e+00  24.652  
## '\\lot area\\'  
##     -5.479e-03  6.445e-02  -0.085  
## '\\number of floors\\'  
##      6.220e+03  4.677e+03   1.330  
## '\\waterfront present\\'  
##      6.331e+05  2.217e+04  28.558  
## '\\number of views\\'  
##      4.595e+04  2.800e+03  16.408  
## '\\condition of the house\\'  
##      3.138e+04  2.994e+03  10.479  
## '\\grade of the house\\'  
##      1.003e+05  2.814e+03  35.648  
## '\\Area of the house(excluding basement)\\'  
##      3.560e+01  5.671e+00   6.278  
## '\\Area of the basement\\'  
##              NA              NA              NA  
## '\\Built Year\\'  
##     -2.509e+03  9.334e+01 -26.879
```

```
## '\\Renovation Year\\' 2.295e+01 4.574e+00 5.016
## '\\Postal Code\\' 2.610e+02 1.006e+02 2.596
## Latitude 5.509e+05 1.429e+04 38.557
## Longitude -9.900e+04 1.566e+04 -6.323
## living_area_renov 2.529e+01 4.512e+00 5.606
## lot_area_renov -3.178e-01 9.726e-02 -3.268
## '\\Number of schools nearby\\' 3.513e+03 2.178e+03 1.613
## '\\Distance from the airport\\' 1.344e+01 1.993e+02 0.067
## Pr(>|t|)
## (Intercept) 4.22e-08 ***
## '\\number of bedrooms\\' < 2e-16 ***
## '\\number of bathrooms\\' < 2e-16 ***
## '\\living area\\' < 2e-16 ***
## '\\lot area\\' 0.93226
## '\\number of floors\\' 0.18359
## '\\waterfront present\\' < 2e-16 ***
## '\\number of views\\' < 2e-16 ***
## '\\condition of the house\\' < 2e-16 ***
## '\\grade of the house\\' < 2e-16 ***
## '\\Area of the house(excluding basement)\\' 3.56e-10 ***
## '\\Area of the basement\\' NA
## '\\Built Year\\' < 2e-16 ***
## '\\Renovation Year\\' 5.34e-07 ***
## '\\Postal Code\\' 0.00946 **
## Latitude < 2e-16 ***
## Longitude 2.67e-10 ***
## living_area_renov 2.12e-08 ***
## lot_area_renov 0.00109 **
## '\\Number of schools nearby\\' 0.10684
## '\\Distance from the airport\\' 0.94624
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
## Residual standard error: 192300 on 11676 degrees of freedom
## Multiple R-squared:  0.7136, Adjusted R-squared:  0.7131
## F-statistic: 1531 on 19 and 11676 DF, p-value: < 2.2e-16
```

### 1.3 score~predict model

```
p <- predict(model, newdata = test_data)
```

### 1.4 Evaluate model

Create function to calculate MAE, MSE, RMSE

```
cal_mae <- function(actual, predict) {
  error <- actual - predict
  mean(abs(error))
}
```

```

}

cal_mse <- function(actual, predict) {
  error <- actual - predict
  mean(error**2)
}

cal_rmse <- function(actual, predict) {
  error <- actual - predict
  sqrt(mean(error**2))
}

r_train <- function(A,P,M = model) {
  mae_log <- cal_mae(A$log_price, P)
  mse_log <- cal_mse(A$log_price, P)
  rmse_log <- cal_rmse(A$log_price, P)
  mae_expo <- cal_mae(exp(A$log_price), exp(P))
  mse_expo <- cal_mse(exp(A$log_price), exp(P))
  rmse_expo <- cal_rmse(exp(A$log_price), exp(P))
  print("--Evaulation of TRAIN--");
  print(paste("MAE_log_train : ",mae_log)) ;
  print(paste("MSE_log_train : ",mse_log)) ;
  print(paste("RMSE_log_train : ",rmse_log)) ;
  print(paste("MAE_expo_train : ",mae_expo)) ;
  print(paste("MSE_expo_train : ",mse_expo)) ;
  print(paste("RMSE_expo_train : ",rmse_expo)) ;
  print(paste("MAE_model : " , M[[4]][[4]])) ;
  print(paste("Rsquared_model : " , M[[4]][[3]])) ;
  print(paste("RMSE_model : " , M[[4]][[2]])) ;
  list(mae_log, mse_log, rmse_log, mae_expo, mse_expo, rmse_expo)
}

r_test <- function(A,P,M = model) {
  mae_log <- cal_mae(A$log_price, P)
  mse_log <- cal_mse(A$log_price, P)
  rmse_log <- cal_rmse(A$log_price, P)
  mae_expo <- cal_mae(exp(A$log_price), exp(P))
  mse_expo <- cal_mse(exp(A$log_price), exp(P))
  rmse_expo <- cal_rmse(exp(A$log_price), exp(P))
  print("--Evaulation of TEST--");
  print(paste("MAE_log_test : ",mae_log)) ;
  print(paste("MSE_log_test : ",mse_log)) ;
  print(paste("RMSE_log_test : ",rmse_log)) ;
  print(paste("MAE_expo_test : ",mae_expo)) ;
  print(paste("MSE_expo_test : ",mse_expo)) ;
  print(paste("RMSE_expo_test : ",rmse_expo)) ;
  print(paste("MAE_model : " , M[[4]][[4]])) ;
  print(paste("Rsquared_model : " , M[[4]][[3]])) ;
  print(paste("RMSE_model : " , M[[4]][[2]])) ;
  list(mae_log, mse_log, rmse_log, mae_expo, mse_expo, rmse_expo)
}

```

Create function to show error of model and save result to list, note: error in real price and logarithm price

### 1.5 Show error of model full df1 and real price

```
print(paste("MAE_test : " , cal_mae(test_data$Price, p)))
```

```
## [1] "MAE_test : 128122.818842742"
```

```
print(paste("MSE_test : " , cal_mse(test_data$Price, p)))
```

```
## [1] "MSE_test : 53518979494.8183"
```

```
print(paste("RMSE_test : " , cal_rmse(test_data$Price, p)))
```

```
## [1] "RMSE_test : 231341.694242128"
```

```
print(paste("MAE_model : " , model[[4]][[4]]))
```

```
## [1] "MAE_model : 123219.80420048"
```

```
print(paste("Rsquared_model : " , model[[4]][[3]]))
```

```
## [1] "Rsquared_model : 0.711036950308182"
```

```
print(paste("RMSE_model : " , model[[4]][[2]]))
```

```
## [1] "RMSE_model : 192549.824849158"
```

The model(full data, real price) : high error compare train and test, Rsquared\_model : 0.711036950308182

So correct the Right skew distribution by take logarithm price(log\_price)

## 2. Use full data and logarithm price to build model

### 2.1 Create log\_price and Split full df1 with log\_price to df1\_log

```
df1_log <- df1 %>%  
  mutate(log_price = log(Price))  
  
# Split full df1_log  
  
prep_data_log <- split_data(df1_log)  
train_data_log <- prep_data_log[[1]]  
test_data_log <- prep_data_log[[2]]
```

## 2.2 Train model dfl\_log and log\_price

### 2.2.1 Train

```
set.seed(42)
model_log <- train(log_price ~ .,
  data = train_data_log[, -c(1,2,23)], #remove price,id,date
  method = "lm")
```

### 2.2.2 calculate train error

#### 2.2.2.1 predict train model\_log

```
p_log_train <- predict(model_log, newdata = train_data_log)
```

#### 2.2.2.2 calculate train error from model\_log with logarithm price and real price\_exp(log)

```
model_log_r_train <- r_train(train_data_log, p_log_train, model_log)
```

```
## [1] "--Evaulation of TRAIN--"
## [1] "MAE_log_train : 0.186876611630186"
## [1] "MSE_log_train : 0.0592234337771878"
## [1] "RMSE_log_train : 0.243358652562813"
## [1] "MAE_expo_train : 106108.300922603"
## [1] "MSE_expo_train : 32179140733.112"
## [1] "RMSE_expo_train : 179385.45295846"
## [1] "MAE_model : 0.188182348161632"
## [1] "Rsquared_model : 0.783296783181617"
## [1] "RMSE_model : 0.245141773832881"
```

## 2.3 score~predict model(model\_log)

```
p_log_test <- predict(model_log, newdata = test_data_log)
```

## 2.4 Evaluate model(model\_log)

```
model_log_r_test <- r_test(test_data_log, p_log_test, model_log)
```

```
## [1] "--Evaulation of TEST--"
## [1] "MAE_log_test : 0.193446178197938"
## [1] "MSE_log_test : 0.0648345743548279"
## [1] "RMSE_log_test : 0.254626342617624"
## [1] "MAE_expo_test : 119667.914904593"
## [1] "MSE_expo_test : 125501870360.535"
```

```
## [1] "RMSE_expo_test : 354262.431483406"
## [1] "MAE_model : 0.188182348161632"
## [1] "Rsquared_model : 0.783296783181617"
## [1] "RMSE_model : 0.245141773832881"
```

After train model use real price vs logarithm price

find out the important variable for tuning the new model(model\_log\_s) for lower error or high accuracy

```
## [1] "variable importance of --> model"
```

```
## lm variable importance
##
## Overall
## Latitude 100.00000
## '\\grade of the house\\' 92.44341
## '\\waterfront present\\' 74.02204
## '\\Built Year\\' 69.66113
## '\\living area\\' 63.87331
## '\\number of views\\' 42.45423
## '\\number of bedrooms\\' 35.57289
## '\\condition of the house\\' 27.05106
## '\\number of bathrooms\\' 25.71746
## Longitude 16.25183
## '\\Area of the house(excluding basement)\\' 16.13526
## living_area_renov 14.38876
## '\\Renovation Year\\' 12.85816
## lot_area_renov 8.31543
## '\\Postal Code\\' 6.56831
## '\\Number of schools nearby\\' 4.01476
## '\\number of floors\\' 3.27998
## '\\lot area\\' 0.04566
## '\\Distance from the airport\\' 0.00000
```

```
## [1] "variable importance of --> model_log"
```

```
## lm variable importance
##
## Overall
## Latitude 100.00000
## '\\grade of the house\\' 63.49513
## '\\Built Year\\' 39.30658
## '\\living area\\' 30.85679
## '\\condition of the house\\' 25.85637
## living_area_renov 24.40844
## '\\number of views\\' 23.01281
## '\\waterfront present\\' 19.73784
## '\\number of bathrooms\\' 18.30983
## '\\Postal Code\\' 18.06680
## '\\number of floors\\' 16.05220
## '\\Renovation Year\\' 12.04673
```



## '\\lot area\\'	7.21650
## '\\number of bedrooms\\'	6.90855
## Longitude	4.33343
## '\\Area of the house(excluding basement)\\'	1.72684
## lot_area_renov	1.61028
## '\\Distance from the airport\\'	0.05296
## '\\Number of schools nearby\\'	0.00000