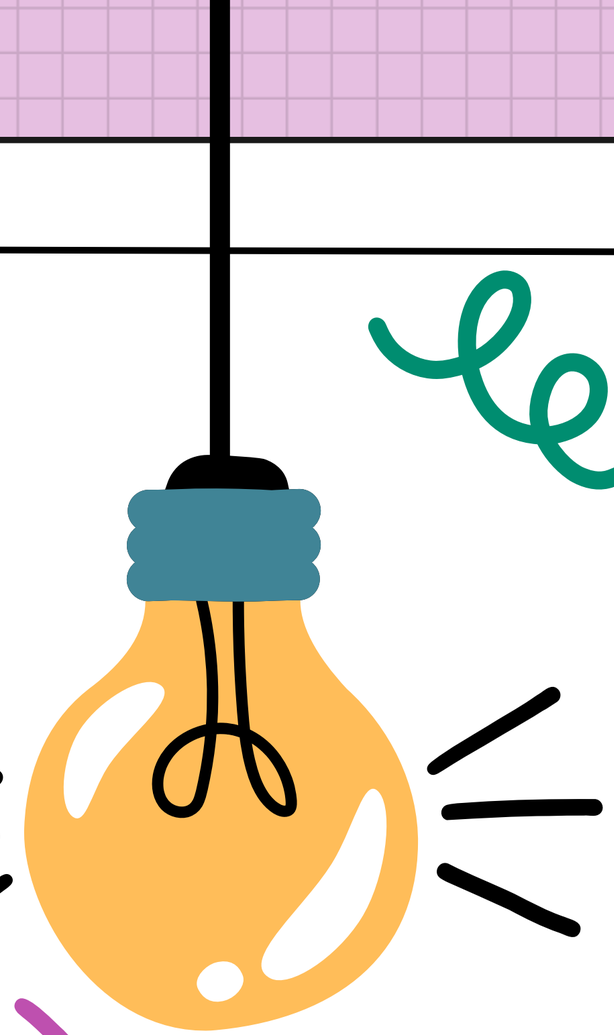
MODEL LINEAR

FINAL PROJECT



Group E

Analisis Regresi Terkait Harga Penjualan Rumah Menggunakan Model Regresi Linear Berganda

presented by :

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PENDAHULUAN

Rincian Data

Akan digunakan dataset House Price. Dataset ini memuat harga rumah beserta spesifikasinya masing masing. Dataset ini memuat 4600 baris data dengan 18 kolom. Deskripsi kolom-kolom tersebut adalah sebagia berikut:

Date (String)	: Tanggal diuploadnya data	Sqft_above (Numerik)	: Luas lantai atas
Bedrooms (Numerik)	: Banyak kamar tidur	Sqft_basement (Numerik)	: Luas basement
Bathrooms (Numerik)	: Banyak kamar mandi	Yr_built (Numerik)	: Tahun dibuat
Sqft_Living (Numerik)	: Luas rumah	Yr_renovated (Numerik)	: Tahun terakhir rumah direnovasi
Sqft_lot (Numerik)	: Luas tanah	Street (String)	: Jalan rumah
Floors (Numerik)	: Jumlah lantai	City (String)	: Kota rumah
Waterfront (Categorical)	: Daerah dengan air	StateZip (String)	: Kode pos rumah
View (Numerik)	: Pemandangan dari rumah	Country (String)	: Negara rumah
Condition (Ordinal)	: Kondisi rumah	Price (Numerik)	: Harga rumah

PRE-PROCESSING DAN ANALISIS DESKRIPTIF

- Pemilihan kolom

Akan dilakukan penghapusan kolom berikut :

1. Date: Tanggal upload tidak akan dibutuhkan
2. Street: Nama jalan rumah terlalu beragam sehingga tidak dapat dijadikan categorical variable
3. City: Nama kota rumah terlalu beragam sehingga tidak dapat dijadikan categorical variable
4. StateZip: Kode pos rumah tidak akan dibutuhkan
5. Country: Hanya terdapat 1 nilai pada variable rumah sehingga dapat dihapus

- Missing Values

```
> data %>%
+   summarise(count = sum(is.na(data)))
  count
1     0
```

PRE-PROCESSING DAN ANALISIS DESKRIPTIF

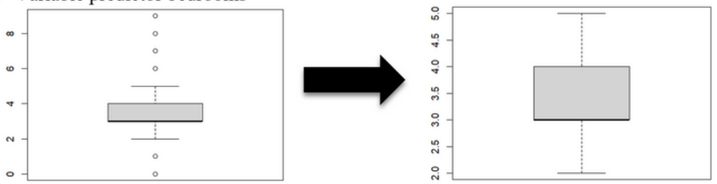
- **Outliers**

```
#Outliers
boxplot(data$bedrooms)
data = droplevels(data[-which(data$bedrooms>5),])
data = droplevels(data[-which(data$bedrooms<2),])
boxplot(data$bedrooms)

boxplot(data$bathrooms)
data = droplevels(data[-which(data$bathrooms>3.5),])
boxplot(data$bathrooms)

boxplot(data$sqft_living)
data = droplevels(data[-which(data$sqft_living>4050),])
boxplot(data$sqft_living)

boxplot(data$sqft_lot)
data = droplevels(data[-which(data$sqft_lot>15500),])
boxplot(data$sqft_lot)

boxplot(data$sqft_above)
data = droplevels(data[-which(data$sqft_above>3250),])
boxplot(data$sqft_above)

boxplot(data$sqft_basement)
data = droplevels(data[-which(data$sqft_basement>1350),])
boxplot(data$sqft_basement)
```

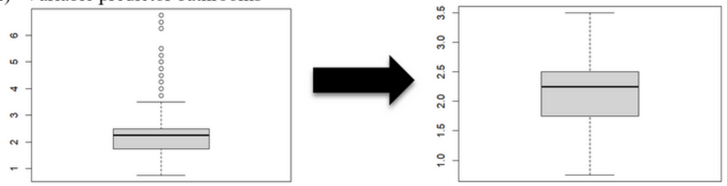
PRE-PROCESSING DAN ANALISIS DESKRIPTIF

Hasil dari penghapusan outliers:

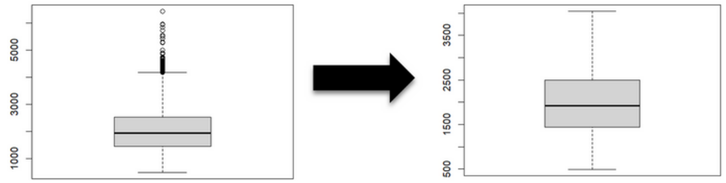
1) Variable predictor bedrooms



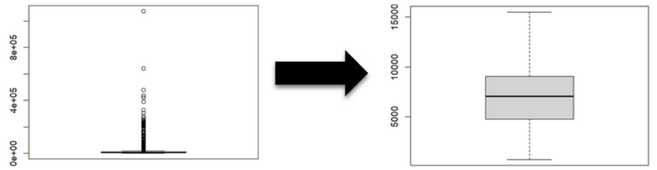
2) Variable predictor bathrooms



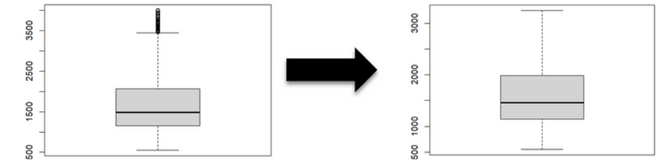
3) Variable predictor sqft_living



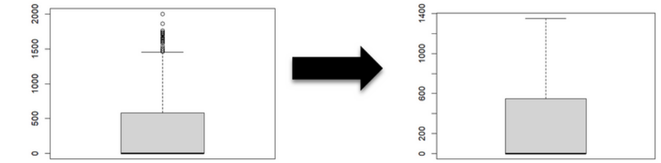
4) Variable predictor sqft_lot



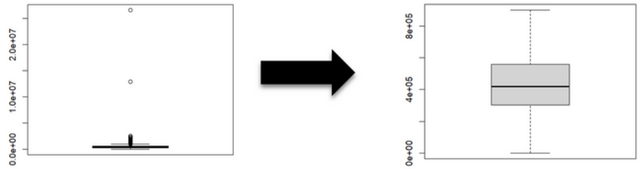
5) Variable predictor sqft_above



6) Variable predictor sqft_basement

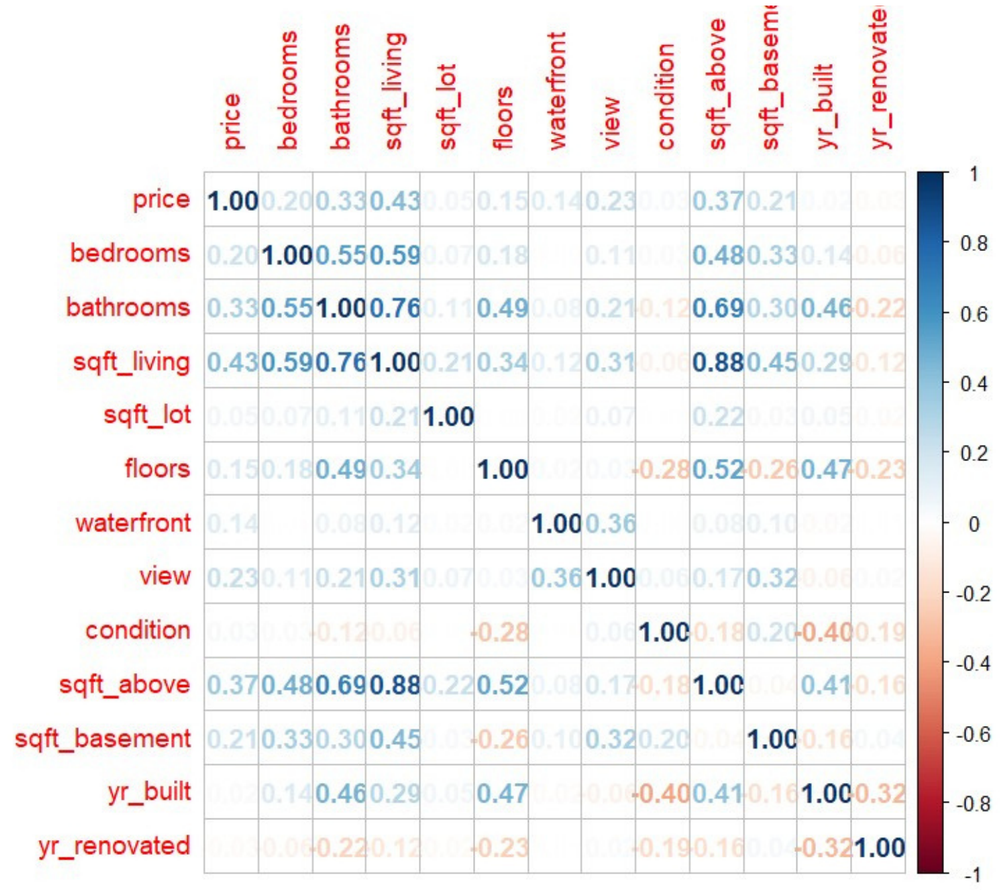


7) Variable respon price



PRE-PROCESSING DAN ANALISIS DESKRIPTIF

Analisis Deskriptif

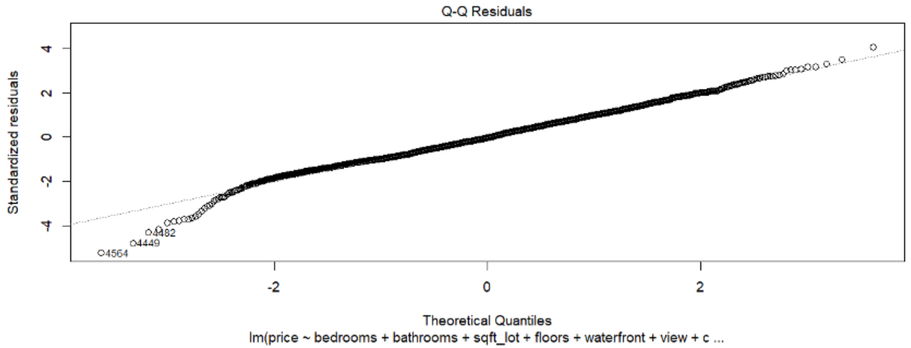


PEMODELAN

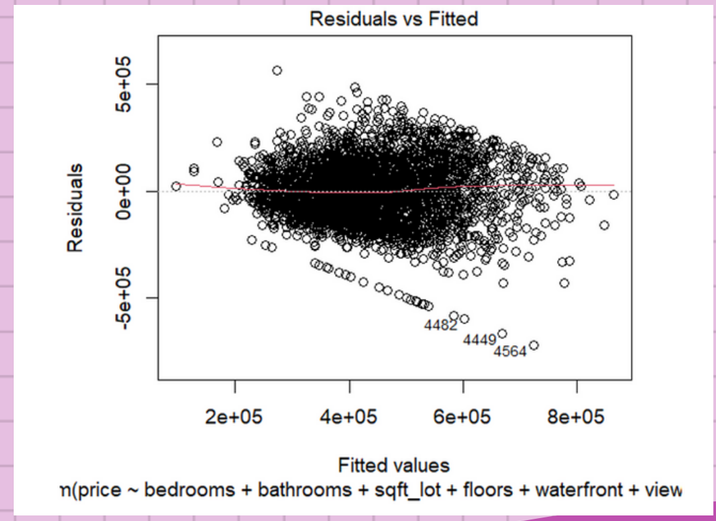
MODEL PERTAMA

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10} + \beta_{11} X_{11}$$

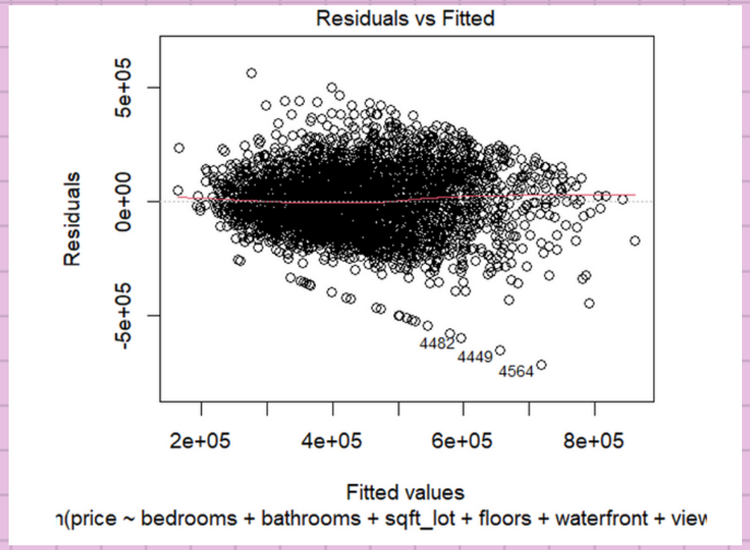
```
Call:
lm(formula = price ~ bedrooms + bathrooms + sqft_lot + floors +
    waterfront + view + condition + sqft_above + sqft_basement +
    yr_built + yr_renovated, data = data)

Residuals:
    Min      1Q  Median      3Q     Max
-723811  -95002   -4560   93867  565740

Coefficients:
               Estimate Std. Error t value Pr(>|t|)
(Intercept)   3.623e+06  2.466e+05  14.692  < 2e-16 ***
bedrooms     -3.740e+04  4.027e+03  -9.288  < 2e-16 ***
bathrooms     4.134e+04  6.397e+03   6.461 1.19e-10 ***
sqft_lot     -7.162e+00  9.684e-01  -7.396 1.76e-13 ***
floors        2.953e+04  7.195e+03   4.104 4.16e-05 ***
waterfront    4.470e+04  1.011e+05   0.442    0.659
view          2.609e+04  5.043e+03   5.174 2.43e-07 ***
condition2   -5.736e+04  1.053e+05  -0.545    0.586
condition3    6.966e+04  9.924e+04   0.702    0.483
condition4    8.269e+04  9.911e+04   0.834    0.404
condition5    1.038e+05  9.927e+04   1.045    0.296
sqft_above    1.826e+02  6.760e+00  27.017  < 2e-16 ***
sqft_basement 1.607e+02  9.001e+00  17.853  < 2e-16 ***
yr_built     -1.800e+03  1.197e+02 -15.043  < 2e-16 ***
yr_renovated  2.339e+00  2.931e+00   0.798    0.425
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 139700 on 3349 degrees of freedom
Multiple R-squared:  0.3894,    Adjusted R-squared:  0.3868
F-statistic: 152.5 on 14 and 3349 DF,  p-value: < 2.2e-16
```




```
> vif(model_1)
                   GVIF Df GVIF^(1/(2*Df))
bedrooms       1.657165  1        1.287309
bathrooms      2.945910  1        1.716365
sqft_lot       1.614989  1        1.270822
floors         2.639248  1        1.624576
waterfront     1.047234  1        1.023345
view           1.087780  1        1.042967
condition      1.710180  4        1.069376
sqft_above     2.757410  1        1.660545
sqft_basement  1.908012  1        1.381308
yr_built       2.259076  1        1.503022
yr_renovated   1.428604  1        1.195242
```

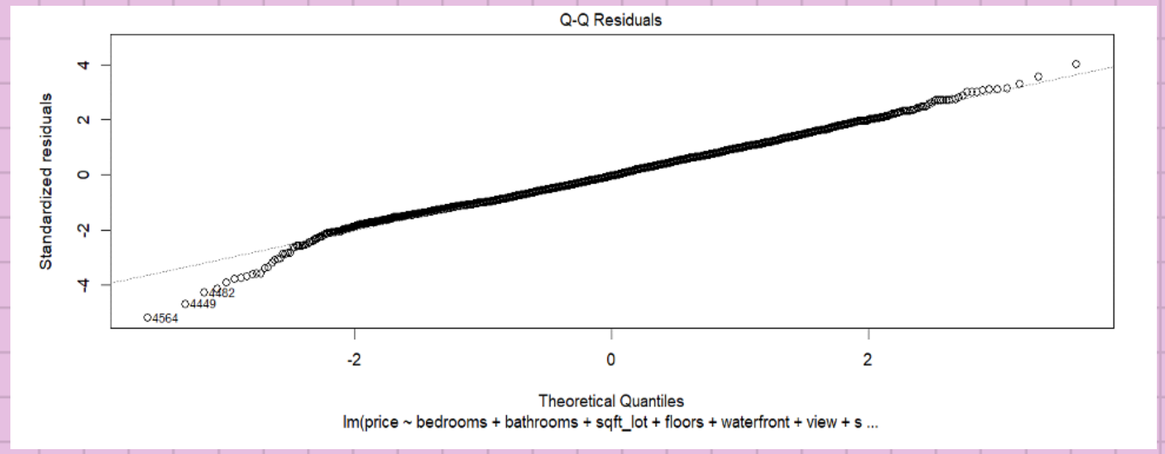


MODEL KEDUA



$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10}$$

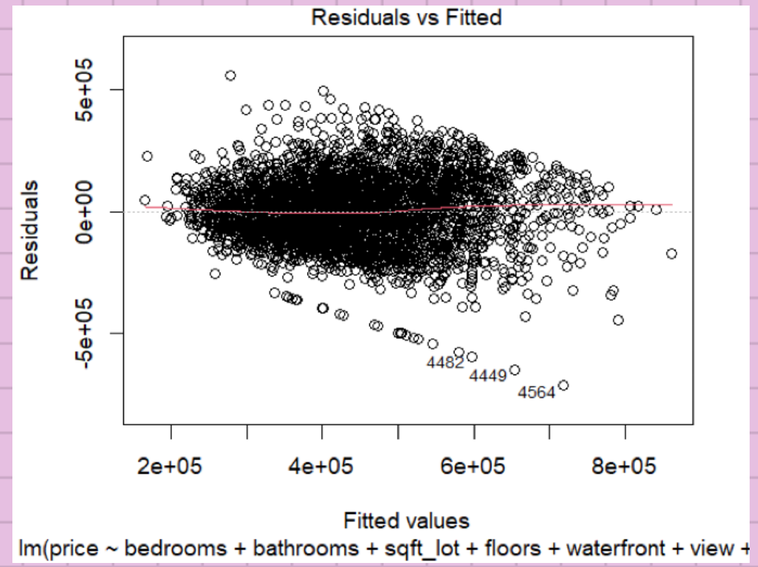
```
Call:
lm(formula = price ~ bedrooms + bathrooms + sqft_lot + floors +
    waterfront + view + sqft_above + sqft_basement + yr_built +
    yr_renovated, data = data)

Residuals:
    Min      1Q  Median      3Q     Max
-717200  -96533   -3409   93128  561556

Coefficients:
               Estimate Std. Error t value Pr(>|t|)
(Intercept)   4.012e+06  2.086e+05  19.229  < 2e-16 ***
bedrooms     -3.708e+04  4.036e+03  -9.187  < 2e-16 ***
bathrooms     4.370e+04  6.380e+03   6.850 8.77e-12 ***
sqft_lot     -6.956e+00  9.608e-01  -7.240 5.55e-13 ***
floors        2.764e+04  7.183e+03   3.848 0.000121 ***
waterfront    5.642e+04  1.014e+05   0.556 0.578162
view          2.586e+04  5.058e+03   5.113 3.35e-07 ***
sqft_above    1.814e+02  6.768e+00  26.804  < 2e-16 ***
sqft_basement 1.626e+02  9.021e+00  18.025  < 2e-16 ***
yr_built     -1.959e+03  1.086e+02 -18.046  < 2e-16 ***
yr_renovated -9.341e-01  2.637e+00  -0.354 0.723164
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 140200 on 3353 degrees of freedom
Multiple R-squared:  0.3843,    Adjusted R-squared:  0.3824
F-statistic: 209.3 on 10 and 3353 DF,  p-value: < 2.2e-16
```

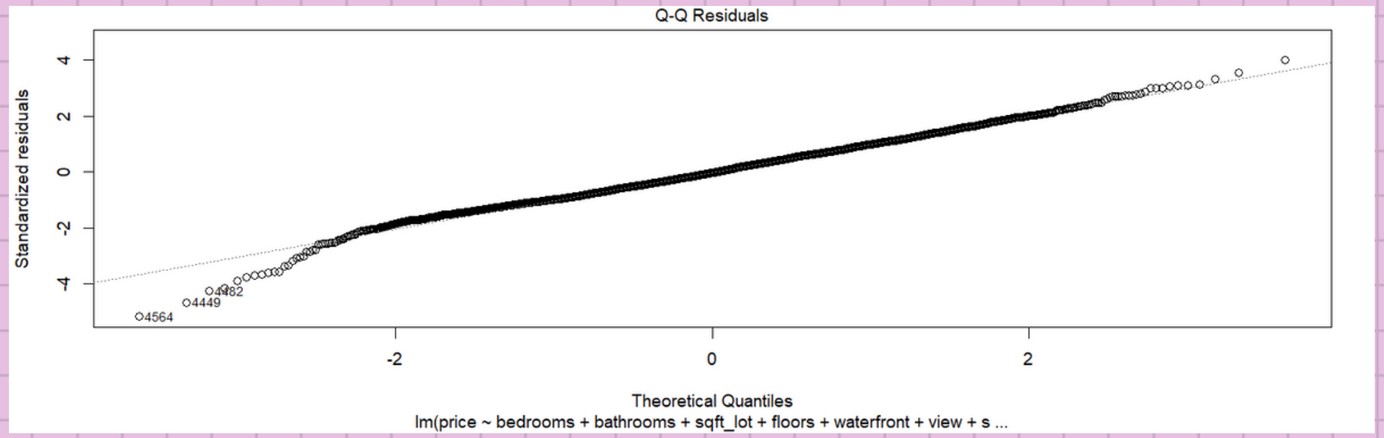



```
> vif(model_2)
    bedrooms    bathrooms     sqft_lot       floors   waterfront         view
    1.652931     2.908853     1.578371     2.611843     1.046174     1.086661
  sqft_above sqft_basement     yr_built yr_renovated
    2.744805     1.903051     1.846063     1.148146
```

MODEL KETIGA

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9$$



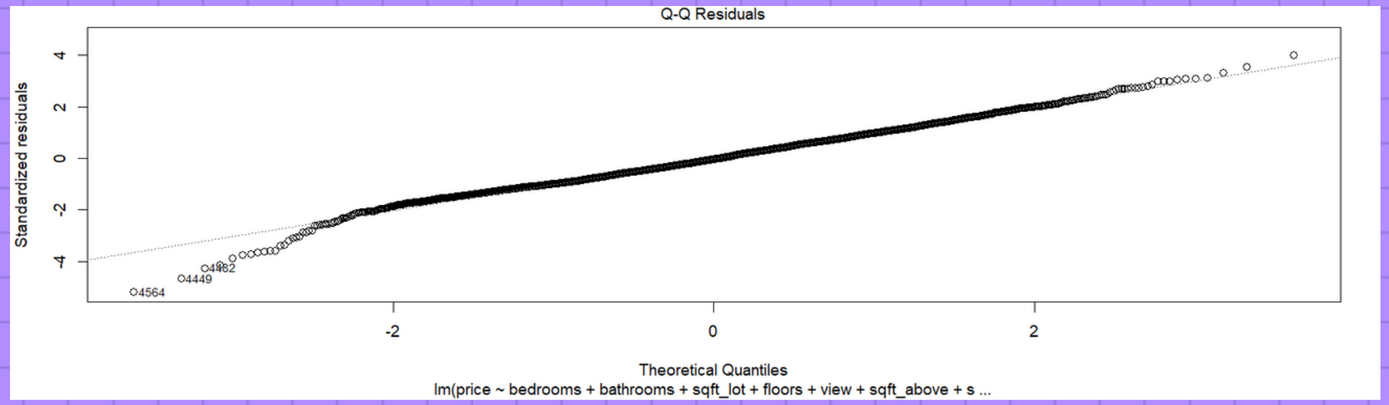



```
> vif(model_3)
    bedrooms    bathrooms     sqft_lot       floors   waterfront         view
    1.652450     2.884413     1.576125     2.605645     1.045278     1.085944
    yr_built   sqft_above sqft_basement
    1.795456     2.744477     1.903050
```

```
Call:
lm(formula = price ~ bedrooms + bathrooms + sqft_lot + floors +
    waterfront + view + sqft_above + sqft_basement + yr_built,
    data = data)

Residuals:
    Min      1Q  Median      3Q     Max
-718044  -97019   -3595   93437  560877

Coefficients:
               Estimate Std. Error t value Pr(>|t|)
(Intercept)   3.998e+06  2.050e+05  19.504  < 2e-16 ***
bedrooms     -3.711e+04  4.035e+03  -9.195  < 2e-16 ***
bathrooms     4.390e+04  6.352e+03   6.912 5.69e-12 ***
sqft_lot     -6.968e+00  9.600e-01  -7.259 4.82e-13 ***
floors        2.776e+04  7.173e+03   3.870 0.000111 ***
waterfront    5.747e+04  1.014e+05   0.567 0.570878
view          2.582e+04  5.056e+03   5.106 3.47e-07 ***
sqft_above    1.814e+02  6.767e+00  26.805  < 2e-16 ***
sqft_basement 1.626e+02  9.020e+00  18.028  < 2e-16 ***
yr_built     -1.953e+03  1.070e+02 -18.241  < 2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 140200 on 3354 degrees of freedom
Multiple R-squared:  0.3843,    Adjusted R-squared:  0.3826
F-statistic: 232.6 on 9 and 3354 DF,  p-value: < 2.2e-16
```

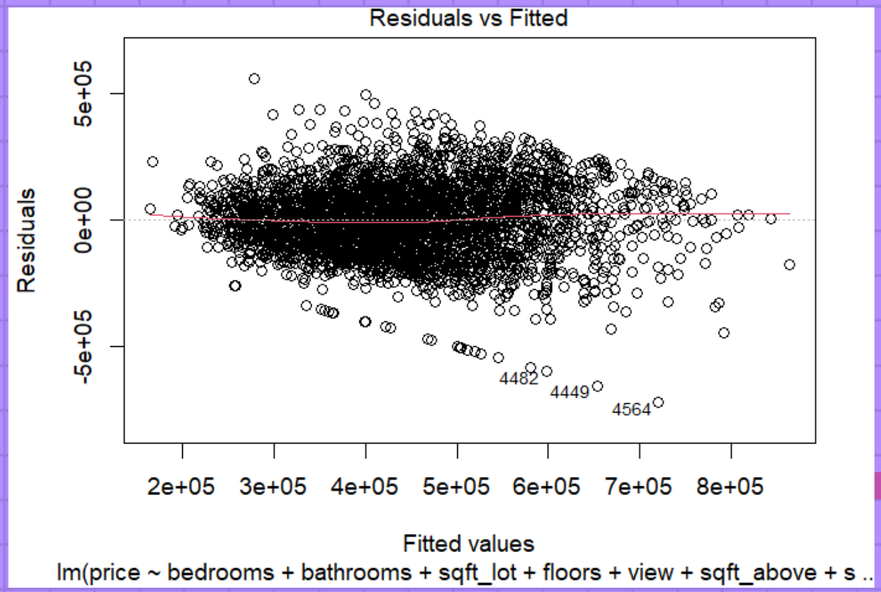
MODEL KEEMPAT

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8$$



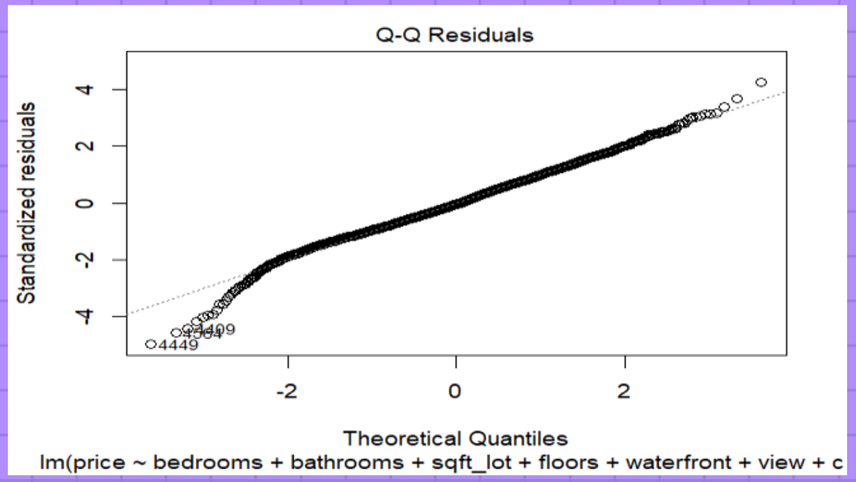

```
> vif(model_4)
    bedrooms    bathrooms      sqft_lot       floors
    1.649972     2.883137     1.568961     2.598151
        view   sqft_above sqft_basement     yr_built
    1.050604     2.744065     1.899141     1.795086
```

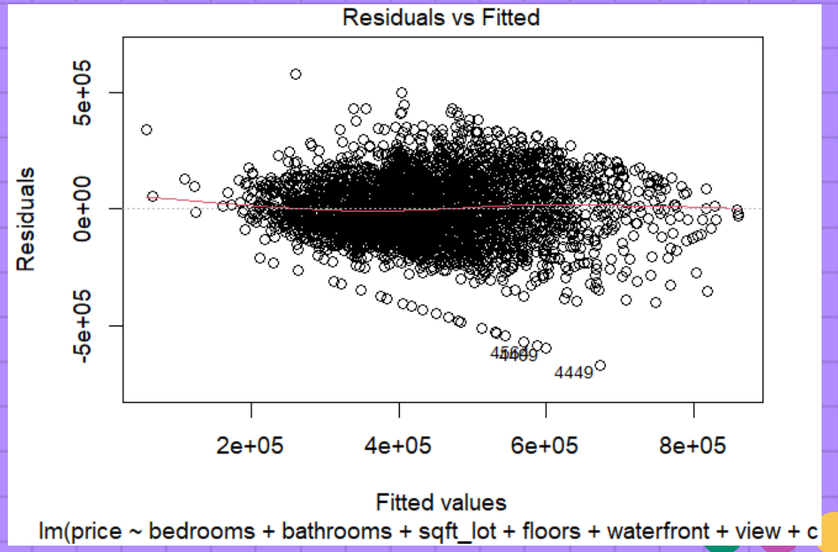
```
Call:
lm(formula = price ~ bedrooms + bathrooms + sqft_lot + floors +
    view + sqft_above + sqft_basement + yr_built, data = data)

Residuals:
    Min      1Q  Median      3Q     Max
-720171  -96914   -3565   93465  560763

Coefficients:
               Estimate Std. Error t value Pr(>|t|)
(Intercept)    3.996e+06  2.049e+05  19.499  < 2e-16 ***
bedrooms      -3.719e+04  4.032e+03  -9.225  < 2e-16 ***
bathrooms      4.383e+04  6.350e+03   6.902 6.09e-12 ***
sqft_lot      -6.932e+00  9.577e-01  -7.238 5.61e-13 ***
floors         2.798e+04  7.162e+03   3.907 9.54e-05 ***
view           2.633e+04  4.972e+03   5.296 1.26e-07 ***
sqft_above     1.813e+02  6.766e+00  26.803  < 2e-16 ***
sqft_basement  1.628e+02  9.010e+00  18.074  < 2e-16 ***
yr_built      -1.952e+03  1.070e+02 -18.237  < 2e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 140200 on 3355 degrees of freedom
Multiple R-squared:  0.3842,    Adjusted R-squared:  0.3827
F-statistic: 261.6 on 8 and 3355 DF,  p-value: < 2.2e-16
```



MODEL KELIMA

```
Call:
lm(formula = price ~ bedrooms + bathrooms + sqft_lot + floors +
    waterfront + view + condition + sqft_above + sqft_basement +
    yr_built + yr_renovated + bedrooms:sqft_lot + bedrooms:floors +
    bedrooms:view + bedrooms:sqft_above + bedrooms:yr_built +
    bathrooms:floors + bathrooms:view + sqft_lot:floors + sqft_lot:condition +
    sqft_lot:sqft_above + sqft_lot:sqft_basement + sqft_lot:yr_built +
    floors:condition + floors:sqft_above + floors:yr_built +
    view:yr_built + condition:yr_built + condition:yr_renovated +
    sqft_above:sqft_basement + sqft_basement:yr_built, data = data)

Residuals:
    Min      1Q  Median      3Q     Max
-673256  -91539   -5430   92448  577786

Coefficients: (4 not defined because of singularities)
                          Estimate Std. Error t value Pr(>|t|)
(Intercept)               3.841e+06  1.371e+06   2.802 0.005114 **
bedrooms                  9.033e+05  2.559e+05   3.529 0.000422 ***
bathrooms                 8.825e+04  1.776e+04   4.968 7.09e-07 ***
sqft_lot                 -3.105e+02  9.914e+01  -3.132 0.001752 **
floors                   -1.524e+06  5.317e+05  -2.867 0.004168 **
waterfront                1.761e+05  1.028e+05   1.712 0.086991 .
view                     -6.383e+05  3.654e+05  -1.747 0.080766 .
condition2                5.190e+06  5.573e+06   0.931 0.351797
condition3                1.295e+06  9.427e+05   1.374 0.169492
condition4                2.867e+06  1.003e+06   2.859 0.004275 **
condition5                2.374e+05  3.947e+05   0.602 0.547502
sqft_above                1.438e+02  3.931e+01   3.657 0.000259 ***
sqft_basement            -1.125e+03  5.987e+02  -1.879 0.060376 .
yr_built                 -1.968e+03  6.930e+02  -2.840 0.004532 **
yr_renovated              3.175e+01  1.131e+01   2.807 0.005029 **
bedrooms:sqft_lot         3.091e+00  1.480e+00   2.088 0.036886 *
bedrooms:floors           3.444e+04  1.090e+04   3.158 0.001601 **
bedrooms:view             1.598e+04  7.254e+03   2.203 0.027662 *
bedrooms:sqft_above      -2.701e+01  8.193e+00  -3.297 0.000988 ***
bedrooms:yr_built        -4.919e+02  1.336e+02  -3.683 0.000234 ***
bathrooms:floors         -3.155e+04  1.100e+04  -2.868 0.004156 **
bathrooms:view           -1.724e+04  9.467e+03  -1.821 0.068649 .
sqft_lot:floors          -1.395e+01  2.210e+00  -6.314 3.08e-10 ***
sqft_lot:condition2       -2.513e+01  6.281e+01  -0.400 0.689094
sqft_lot:condition3       -3.101e+01  6.008e+01  -0.516 0.605789
sqft_lot:condition4       -2.146e+01  6.008e+01  -0.357 0.720996
sqft_lot:condition5       -2.568e+01  5.999e+01  -0.428 0.668687
sqft_lot:sqft_above        1.126e-02  2.114e-03   5.324 1.08e-07 ***
sqft_lot:sqft_basement    -7.090e-03  2.674e-03  -2.652 0.008049 **
sqft_lot:yr_built          1.652e-01  4.230e-02   3.906 9.58e-05 ***
floors:condition2        -1.380e+05  2.033e+05  -0.679 0.497383
floors:condition3        -5.338e+04  2.500e+04  -2.135 0.032802 *
floors:condition4        -1.260e+04  2.592e+04  -0.486 0.626847
floors:condition5                NA         NA      NA       NA
floors:sqft_above         3.728e+01  1.632e+01   2.285 0.022404 *
floors:yr_built           7.885e+02  2.737e+02   2.881 0.003991 **
view:yr_built             3.304e+02  1.909e+02   1.731 0.083527 .
condition2:yr_built      -2.540e+03  2.803e+03  -0.906 0.364942
condition3:yr_built      -5.031e+02  4.561e+02  -1.103 0.270110
condition4:yr_built      -1.366e+03  4.889e+02  -2.795 0.005221 **
condition5:yr_built              NA         NA      NA       NA
condition2:yr_renovated          NA         NA      NA       NA
condition3:yr_renovated  -3.175e+01  1.190e+01  -2.668 0.007674 **
condition4:yr_renovated  -2.645e+01  1.237e+01  -2.138 0.032587 *
condition5:yr_renovated          NA         NA      NA       NA
sqft_above:sqft_basement  4.103e-02  1.818e-02   2.257 0.024068 *
sqft_basement:yr_built    6.473e-01  3.124e-01   2.072 0.038341 *
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 136700 on 3321 degrees of freedom
Multiple R-squared:  0.4206,    Adjusted R-squared:  0.4132
F-statistic: 57.39 on 42 and 3321 DF,  p-value: < 2.2e-16
```





THANK YOU

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