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Course: Quantitative Methods I

Assignment . Exercise -5.24

Reference: Principle of Econometrics 5th Edition

(A)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Dependent Variable: PRICE | | |  |  |
| Method: Least Squares | | |  |  |
| Date: 12/14/24 Time: 15:11 | | |  |  |
| Sample: 1 500 | |  |  |  |
| Included observations: 500 | | |  |  |
|  |  |  |  |  |
|  |  |  |  |  |
| Variable | Coefficient | Std. Error | t-Statistic | Prob. |
|  |  |  |  |  |
|  |  |  |  |  |
| C | -105.2613 | 13.35759 | -7.880261 | 0.0000 |
| SQFT | 14.91562 | 0.651346 | 22.89969 | 0.0000 |
| SQFT\_AGE | -0.233562 | 0.073423 | -3.181034 | 0.0016 |
|  |  |  |  |  |
|  |  |  |  |  |
| R-squared | 0.648474 | Mean dependent var | | 250.2369 |
| Adjusted R-squared | 0.647059 | S.D. dependent var | | 171.4765 |
| S.E. of regression | 101.8721 | Akaike info criterion | | 12.09130 |
| Sum squared resid | 5157833. | Schwarz criterion | | 12.11658 |
| Log likelihood | -3019.824 | Hannan-Quinn criter. | | 12.10122 |
| F-statistic | 458.4175 | Durbin-Watson stat | | 0.942106 |
| Prob(F-statistic) | 0.000000 |  |  |  |

1**. Constant Term** (C):

- Coefficient: -105.2613

- t-Statistic: -7.880261

- p-value: 0.0000

- Interpretation: The constant term is significantly different from zero at the 1% significance level (p-value < 0.01).

2. **SQFT:**

- Coefficient: 14.91562

- t-Statistic: 22.89969

- p-value: 0.0000

- Interpretation: The coefficient for SQFT is significantly different from zero at the 1% significance level (p-value < 0.01). This indicates a strong positive relationship between SQFT and PRICE.

3. **SQFT\_AGE**:

**Coefficient**: -0.233562

**t-Statistic**: -3.181034

**p-value**: 0.0016

- Interpretation: The coefficient for SQFT\_AGE is significantly different from zero at the 1% significance level (p-value < 0.01). This suggests a negative interaction effect between SQFT and AGE on PRICE.

**Overall Model Fit:**

R-squared: 0.648474

This indicates that approximately 64.85% of the variation in PRICE is explained by the model.

F-statistic: 458.4175 with a Prob(F-statistic) of 0.000000

The overall model is statistically significant.

In summary, all the estimated coefficients are significantly different from zero, indicating that SQFT and the interaction term SQFT\_AGE have a significant impact on PRICE

(B)

The regression model is given by: PRICE = β1 +β2SQFT+β3(SQFT × AGE) + e

Marginal Effect of SQFT :

The marginal effect of SQFT on the price depends on the value of age. For each additional unit increase in SQFT, the expected change in price is

Marginal Effect of AGE::

The marginal effect of AGE on price depends on the value of SQFT. For each additional unit increase in age, the expected change in price is

Assumptions with Categorical AGE

**Linearity**: The model assumes a linear relationship between PRICE and the interaction term SQFT × AGE.

**Homogeneity**: The effect of SQFT on PRICE is assumed to change linearly with AGE.

**Ordinal Nature**: AGE is treated as an ordinal variable, assuming a consistent effect across its levels.

( C ) To calculate the marginal effect of SQFT, we use the formula :

(Please refer to table above)

Where = 14.91562

= -0.233562

To evaluate for different ages

1. 5 years : = 14.91562+(-0.233562)\*5= **13.74781**
2. 20 years : =14.91562+(-0.233562)\*20= **10.24438**
3. 40 years : : = 14.91562+(-0.233562)\*40 = **5.57314**

As AGE increases, the marginal effect of SQFT on PRICE decreases, indicating that the value added by additional square footage is less for older houses.

(D )

( i) for 1500 sqft

Ho = -6000

H1≠ 6000

The expected price decline for a house with 1500 square feet is given by the interaction term:

∆price = \*sqft = -0.233562\*1500

∆price = -350.343

Se( = 0.073423

T o calculate the Test Statistic: :

Determine the Critical Value for a 5% significance level, the critical value for a two-tailed at ±1.96

t- =

t= 51.50

Since this value is much greater than the critical value of1.96 for a 5% significance level, you would reject the null hypothesis. This suggests that the expected price decline is significantly different from $6000 for a house with 1500 square feet.

( ii) for 3000 sqft

Ho = -6000

H1≠ 6000

Expected price decline

\*sqft = -0.233562\*3000

Se( = 0.073423=3000.0.073423

t- =

t 24.05

The t-statistic is approximately 24.05, which is much greater than 1.96. Reject the null hypothesis. The expected price decline is significantly different from $6000 for a house with 3000 square feet

( iii) for 4500 sqft

Ho = -6000

H1≠ 6000

Expected price decline

\*sqft = -0.233562\*4500

Se( = 0.073423=4500\*.0.073423

t- =

t 14.98

The t-statistic is approximately 14.98, which is much greater than 1.96. Reject the null hypothesis. The expected price decline is significantly different from $6000 for a house with 4500 square feet

( E )   
Using the regression equation:  
PRICE=β1+β2⋅SQFT+β3⋅(SQFT×AGE)

 Substitute the Values:  
 AGE = 60  
SQFT = 2500  
Interaction Term: SQFT\_AGE=2500×60

 β1=−105.2613  
 β2=14.91562  
 β3=−0.233562

 Predicted Price:  
Predicted PRICE=−105.2613+14.91562⋅2500+(−0.233562)⋅(2500×60)

Predicted PRICE= $2149.4887

Standard Error of Prediction:

Se(prediction) =

Prediction Interval:  
PI=Predicted PRICE±tα/2,n−2×SE(prediction)

- tα/2,n−2 is the critical value from the t-distribution for a 95% confidence level.

 the Interval:  
SE(prediction) is approximately the standard error of the regression for simplicity. - PI=2149.4887±1.96×101.8721  
 PI=2149.4887±199.6733  
  
 Prediction Interval:  
- Lower Bound: 2149.4887−199.6733=1949.8154  
- Upper Bound: 2149.4887+199.6733=2349.162