

FORK 1002 Statistics
Exercise Set 3: Multiple Regression

1. Exercises on the F -distribution:

- (a) Let the numerator degrees of freedom be equal to 2 and let the denominator degrees of freedom be equal to 30. What is the critical value at, respectively, the 10%, 5% and 1% significance levels?
- (b) Let the numerator degrees of freedom be equal to 4 and let the denominator degrees of freedom be equal to 47. What is the critical value at, respectively, the 10%, 5% and 1% significance levels?
- (c) Let the numerator degrees of freedom be equal to 5 and let the denominator degrees of freedom be equal to 1592. What is the critical value at, respectively, the 10%, 5% and 1% significance levels?
- (d) The value of an F -distributed test expression with 7 numerator and 35 denominator degrees of freedom is equal to 1.896. What is the p -value?
- (e) The value of an F -distributed test expression with 2 numerator and 60 denominator degrees of freedom is equal to 4.977. What is the p -value?
- (f) The value of an F -distributed test expression with 3 numerator and 25 denominator degrees of freedom is equal to 5.175. What is the p -value?

2. Consider the model

$$\text{Salesprice}_i = B_0 + B_1 m2_i + B_2 \text{Rooms}_i + B_3 \text{Debt}_i + u_i.$$

How does the model look like with the following restrictions?:

- (a) $B_2 = 0$
- (b) $B_0 = 0, B_2 = 0$
- (c) $B_2 = 0, B_3 = 1$
- (d) $B_1 = 0, B_2 = 0, B_3 = 0$

3. Which of the following models are contained in the model in the previous exercise?:

- (a) $\text{Salesprice}_i = B_1 m2_i + u_i$
- (b) $\text{Salesprice}_i = B_0 + B_1 m2_i + B_2 \text{Rooms}_i - \text{Debt}_i + u_i$
- (c) $\text{Salesprice}_i = B_0 + B_1 m2_i + B_2 \text{Rooms}_i + B_3 \text{Debt}_i + B_4 \text{Yearofconstruction}_i + u_i$
- (d) $\text{Salesprice}_i / m2_i = B_0 + B_2 \text{Rooms}_i + B_3 \text{Debt}_i + u_i$

4. The dataset *houses_sample.xls* contains information about the sales of 20 houses and apartments in 2010 in an area of Oslo:

<i>m2</i> :	Size measured in square meters
<i>Rooms</i> :	Number of rooms
<i>Priceindication</i> :	Price indication (in thousands of NOK) before sale
<i>Salesprice</i> :	Sales price (in thousands of NOK)
<i>Salespriceincldebt</i> :	Sales price + debt of house/apartment
<i>Debt</i> :	<i>Salespriceincldebt</i> – <i>Salesprice</i>

The following models were estimated in an analysis of the relationship between *Salesprice*, *m2*, *Rooms* and *Debt* (the numbers in parentheses are the standard errors of the parameter estimates):

$$\widehat{Salesprice}_i = \underset{(222.95)}{335.37} + \underset{(6.17)}{28.55}m2_i + \underset{(112.96)}{41.40}Rooms_i - \underset{(0.20)}{1.20}Debt_i \quad (1)$$

$$R^2 = 0.8296 \quad RSS = 1006064$$

$$\widehat{Salesprice}_i = \underset{(217.06)}{338.23} + \underset{(3.83)}{30.30}m2_i - \underset{(0.20)}{1.19}Debt_i \quad (2)$$

$$R^2 = 0.8282 \quad RSS = 1014511$$

$$\widehat{Y}_i = \underset{(216.51)}{337.49} + \underset{(3.72)}{26.48}m2_i, \quad \text{where } Y_i = Salesprice_i + Debt_i \quad (3)$$

$$R^2 = 0.7770 \quad RSS = 1068704$$

$$\widehat{Salesprice}_i = \underset{(124.66)}{1745.75} \quad (4)$$

$$R^2 = 0.0000 \quad RSS = 5905314$$

- Interpret the estimated slope parameters in model (1).
- Test if the number of rooms matters for salesprice (use both a *t*-test and an *F*-test) in model (1) at the 10% significance level.
- Test the restrictions $B_2 = 0, B_3 = -1$ in model (1) by means of an *F*-test at the 5% significance level. Interpret the result with respect to B_3 .
- Test jointly if any of the explanatory variables in model (1) have an impact on salesprice at the 5% significance level.

5. Computer exercises:

- Load the data *houses_sample.xls*. [Hint for SPSS: File → Open → Data...]

- (b) Estimate model (1) [Hint for SPSS: Analyze → Regression → Linear..., put *Salesprice* into the “Dependent” box and *m2*, *Rooms* and *Debt* into the “Independent(s)” box, press “OK”]
- (c) Estimate model (3) [Hint for SPSS: First make the variable *Salesprice + Debt* calling it (for example) *SalespriceAndDebt*. Then proceed in a similar way to previous question: Analyze → Regression → Linear..., put *SalespriceAndDebt* in the “Dependent” box and *m2* in the “Independent(s)” box, press “OK”]
- (d) Estimate model (4) [Hint for SPSS: Analyze → Regression → Linear..., put *Salesprice* in the “Dependent” box, make sure “Include constant in equation” is ticked in “Options” before continuing, press “OK”]