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Warming up

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## Exercises: Overall Model Test

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### Computing the critical value

12/12 points (ungraded)

Assume we have have  $m$  observations in the vector  $\mathbf{y}$ , and  $n$  number of unknown parameters in the vector  $\mathbf{x}$ . The observables are normally distributed and the linear system of observation-equations has been given as

$$\mathbf{E}\{\underline{\mathbf{y}}\} = \mathbf{A}\mathbf{x}, \quad \mathbf{D}\{\underline{\mathbf{y}}\} = \mathbf{Q}_{yy}.$$

The BLU estimate of  $\mathbf{x}$  has been given as  $\hat{\mathbf{x}}$ , resulting in the BLU estimate of residual vector as

$$\hat{\mathbf{e}} = \mathbf{y} - \mathbf{A}\hat{\mathbf{x}}.$$

For each of the following situation, compute the critical value for the overall model test, and determine whether the test is accepted or not.

#### Case 1:

$m = 20$ ,  $n = 2$ ,  $\alpha = 0.05$ , and  $\hat{\mathbf{e}}^T \mathbf{Q}_{yy}^{-1} \hat{\mathbf{e}} = 30$ .


What is the OMT critical value  $K_\alpha$  (upto 2 decimal places)?

✓ Answer: 28.869

## 6.1. Overall Model Test (OMT)

### 6.2. OMT: Interpretation

#### Assessment

Graded Assignment due Feb 8, 2017 17:30 IST 

#### Q&A Forum

#### Feedback

#### Post-survey

- ▶ Pre-knowledge Mathematics
- ▶ MATLAB Learning Content

28.87

Is the OMT accepted or not?

☐ Accepted

☒ Rejected ✓

#### Answer

Correct:  $30 \nless k_{\alpha} = 28.869$ , so the test is rejected

Case 2:

$m = 82, n = 2, \alpha = 0.05$ , and  $\hat{e}^T Q_{yy}^{-1} \hat{e} = 100$ .

What is the OMT critical value  $K_{\alpha}$  (upto 2 decimal places)?

101.88

✓ Answer: 101.88

101.88

Is the OMT accepted or not?

☒ Accepted ✓

☐ Rejected

**Answer**

Correct:  $100 \leq k_\alpha = 101.88$ , so the test is accepted

**Case 3:**

$m = 20, n = 3, \alpha = 0.05$ , and  $\hat{e}^T Q_{yy}^{-1} \hat{e} = 25$ .

What is the OMT critical value  $K_\alpha$  (upto 2 decimal places)?

✓ Answer: 27.587

Is the OMT accepted or not?

☒ Accepted ✓

☐ Rejected

**Answer**

Correct:  $25 \leq k_\alpha = 27.587$ , so the test is accepted

**Case 4:**

$m = 20, n = 10, \alpha = 0.05$ , and  $\hat{e}^T Q_{yy}^{-1} \hat{e} = 15$ .

What is the OMT critical value  $K_\alpha$  (upto 2 decimal places)?

✓ Answer: 18.307

**18.31**

Is the OMT accepted or not?

☒ Accepted ✓

☐ Rejected

**Answer**

Correct:  $15 \leq k_\alpha = 18.31$ , so the test is accepted

**Case 5:**

$m = 20$ ,  $n = 2$ ,  $\alpha = 0.001$ , and  $\hat{e}^T Q_{yy}^{-1} \hat{e} = 44$ .

What is the OMT critical value  $K_\alpha$  (upto 2 decimal places)?

42.31

✓ Answer: 42.312

**42.31**

Is the OMT accepted or not?

☐ Accepted

☒ Rejected ✓

**Answer**

Correct:  $44 \neq k_\alpha = 42.31$ , so the test is rejected

**Case 6:**

$m = 20, n = 2, \alpha = 0.05, Q_{yy} = 4I_m$  ( $I_m$  is the identity matrix) and  $\hat{e}^T \hat{e} = 108$ .

What is the OMT critical value  $K_\alpha$  (upto 2 decimal places)?

✓ Answer: 28.869

Is the OMT accepted or not?

☒ Accepted ✓

☐ Rejected

**Answer**

Correct:  $T = \frac{108}{4} = 27$ , so  $T \leq k_\alpha = 28.87$ . The test is accepted

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✓ Correct (12/12 points)

## Properties of overall model test

4/4 points (ungraded)

For each of the following statements, determine whether it is true or false.

1. The overall model test statistics  $\underline{T} = \underline{\hat{e}}^T Q_{yy}^{-1} \underline{\hat{e}}$  follows the  $\chi^2$ -distribution, regardless of what the distribution of observations is.

☐ True

☒ False ✓

### Answer

Correct:

The OMT test statistics follows the  $\chi^2$ -distribution only when the observations are normally distributed.

2. The larger the value of the level of significance  $\alpha$ , the higher the chance to falsely accept the overall model test.

☐ True

☒ False ✓

### Answer

Correct:

$\alpha$  is the probability of false rejection of the test. The larger the  $\alpha$ , the higher the chance to falsely reject the test, and the lower the chance to falsely accept the test.

3. Assuming the same level of significance  $\alpha$  and the same functional model, a larger number of observations results in a smaller critical value.

☐ True

☒ False ✓

**Answer**

Correct: More observations result in more degrees of freedom, and so a larger critical value.

4. Assuming the same level of significance  $\alpha$  and the same number of observations  $m$ , a functional model with fewer unknowns has a lower chance to be falsely rejected with the overall model test.

☐ True

☒ False ✓

**Answer**

Correct: The probability of false rejection is  $\alpha$  which is constant in this case.

✓ Correct (4/4 points)

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