

# Likelihood ratio test

2020-07-28

## Parameter setting

### If GEM model is true

The outcome is generated following

$$Y_k = S(\beta_k + b_k + \Gamma_k(\alpha'_k x)) + \epsilon_k, k = \{1, 2\} \text{ presents drug group and placebo group.} \quad (1)$$

The parameter settings are:

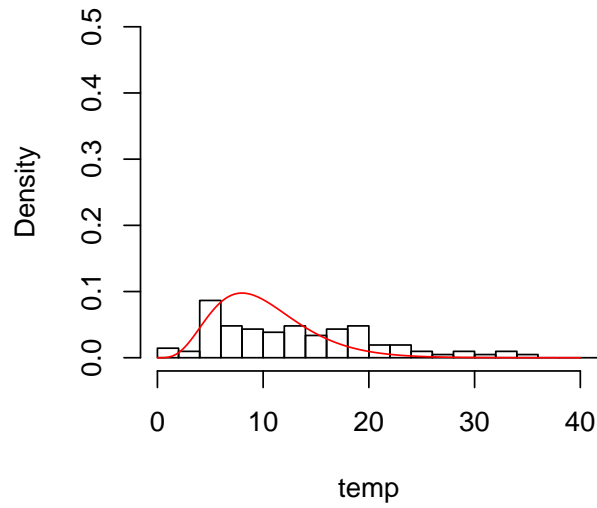
- dimension of the predictors  $p = 3, 10, 20$
- $\beta_{drg} = (1, -0.5, -0.2)'; \beta_{pbo} = (1, -0.5, -0.2)'$
- $\Gamma_{drg} = (0, 0.1, 0)$
- $\Gamma_{pbo} = (0, 0, 0.1)$
- $S = [1, t, t^2]$ ,  $t = [0, 1, 2, 3, 4, 6, 8]$  is the design matrix for fixed effect and random effect
- $x \sim MVN(\mu_x, \Sigma_x)$ ,  $\mu_x = \mathbf{0}_p$ ,  $\Sigma_x$  has diagonal equals to 1 and 0.5 everywhere else.
- $D_{drg} = \begin{pmatrix} 0.1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 0.3 \end{pmatrix}$ ,  $D_{pbo} = \begin{pmatrix} 0.1 & 0 & 0 \\ 0 & 0.3 & 0 \\ 0 & 0 & 1 \end{pmatrix}$
- $\epsilon_{drg}, \epsilon_{pbo} \sim N(0, 1^2)$
- $\alpha_{drg} = \alpha_{pbo} = (1, \dots, p)'$

### If the GEM model is not true

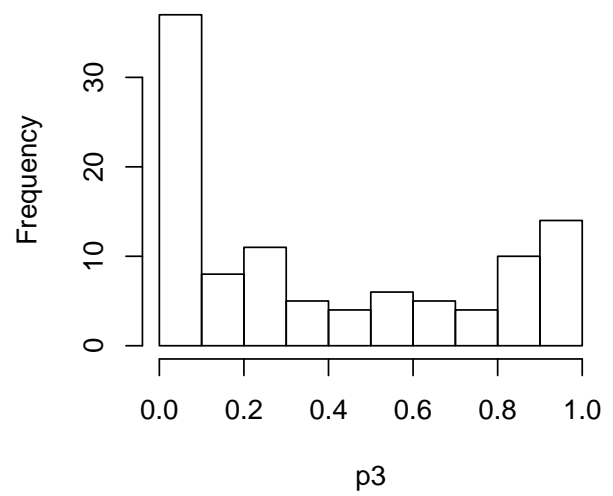
$$\text{The } \gamma_{drg} = \begin{pmatrix} -0.056 & 0.056 \\ -0.023 & 0.033 \\ 0.156 & -0.156 \end{pmatrix}, \gamma_{pbo} = \begin{pmatrix} 0.17 & 0.17 \\ -0.071 & 0.076 \\ -0.028 & 0.036 \end{pmatrix}$$

### When the GEM is true

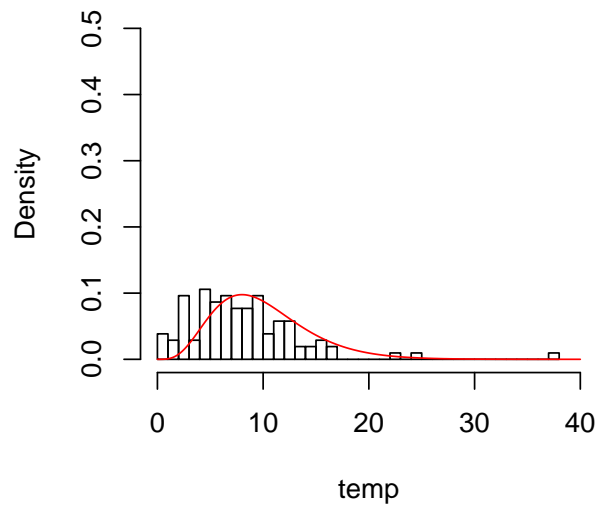
**Purity: Test statistics,  $p = 3$**



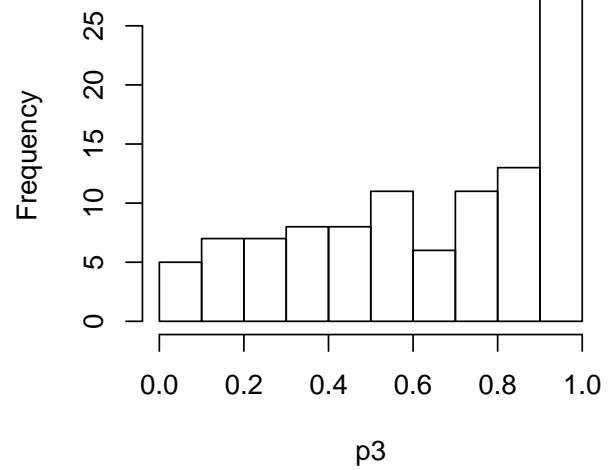
**$p = 3$ ;  $df = 10$**



**Likelihood: Test statistics,  $p = 3$**

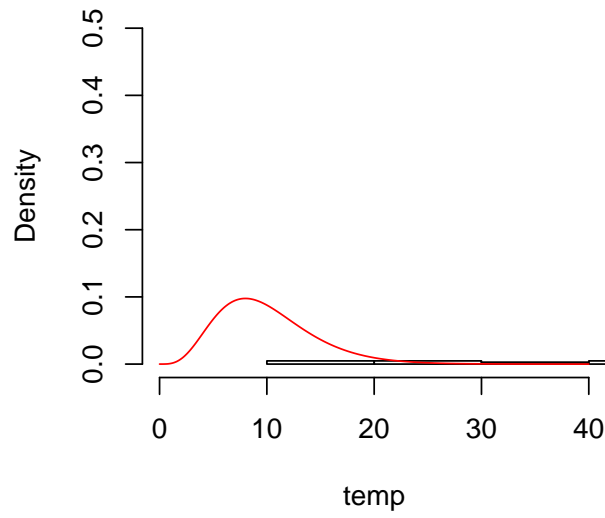


**$p = 3$ ;  $df = 10$**

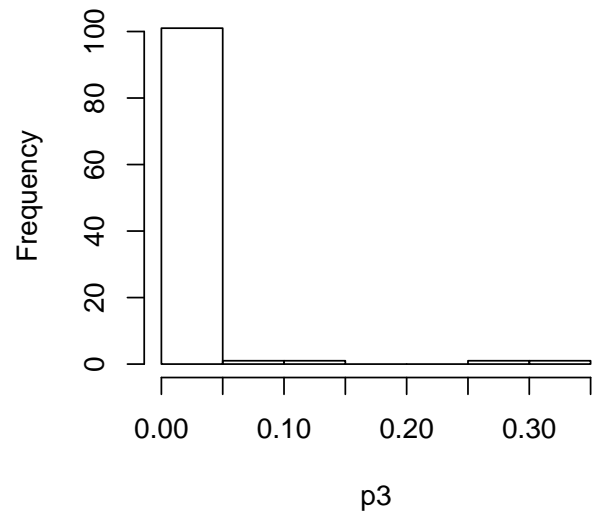


When the unrestricted model is true

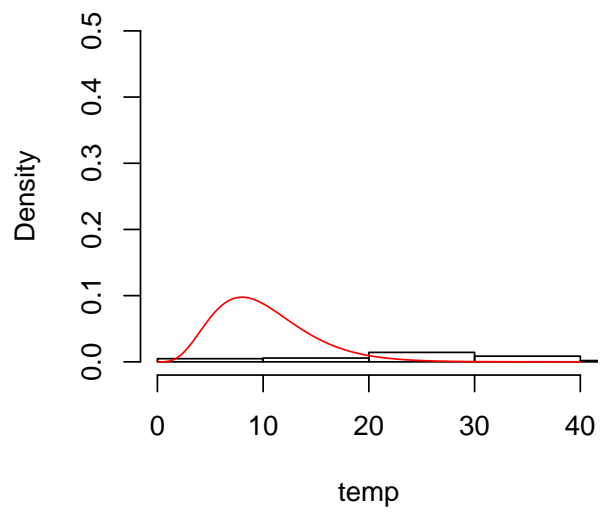
**Purity: Test statistics,  $p = 3$**



**$p = 3$ ;  $df = 10$**



**Likelihood: Test statistics,  $p = 3$**



**$p = 3$ ;  $df = 10$**

