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http://www.nslij-genetics.org/microarray/
HD
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http://www.ncbi.nlm.nih.gov/geo/
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`affy`
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`affyPLM`
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`car`
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`limma`
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`qvalue`
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`rmeta`
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`affyPLM`
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http://affycomp.biostat.jhsph.edu/
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?
$\log_2$
$\log_2 b(PM_{ij})$
$\log_2 b(PM_{ij}) = \mu_i + \alpha_j + \epsilon_{ij},$
(1)
μ_i
i
α_j
ϵ_{ij}
?
$\sum_j \alpha_j =$
0
?
μ_i
i
`affy`
?
$M \log_2$
M
M
M
M
t
t
?
?
?
?
g
Y_g
$Y_g = X\beta_g + \epsilon_g,$

X
β_g
ϵ_g
X
t
j
g

$$\mathrm{mod}t_{gj} = \frac{\hat{\beta}_{gj}}{\tilde{s}_g \sqrt{v_{gj}}},$$

$\hat{\beta}_{gj}$
j
g
$\tilde{s}_g$
v_{gj}
$\mathrm{mod}t$
M
g
t
?
$\mathrm{mod}t$
p
p
?
?
p
q
?
?
q
$\mathrm{mod}t$
p
q
`qvalue`
?
q
g
g
I
$y =$
$\beta_0 +$
$\beta_{HD} I_{\{HD=1\}} +$
ϵ
$y =$
$\beta_0 +$
$\beta_{HD} I_{\{HD=1\}} +$

$\beta_{batch} I_{\{batch=1\}}+$
ϵ
$y =$
β_0+
$\beta_{HD} I_{\{HD=1\}}+$
$\beta_{batch} I_{\{batch=I\}}+$
$\beta_{HD\times batch} I_{\{HD\times batch=1\}}+$
ϵ
`limma`
mod$t$
p
q
p
`rmeta`
?
t
p
q
?
g
β_i
k
g
$H_0\colon\ \beta_1 = \beta_2 = \cdots = \beta_k$
β_i
Q

$$Q = \sum_{i=1}^{k} w_i(\hat{\beta}_i - \bar{\beta}_.)^2, \tag{2}$$

$\hat{\beta}_i$
i
w_i
i
$\bar{\beta}_.$

$$\bar{\beta}_. = \frac{\sum_i w_i \hat{\beta}_i}{\sum_i w_i}. \tag{3}$$

Q
χ^2_{k-1}
?
??
w_i
$\bar{\beta}_.$
?
$1/\sum_{i=1}^{k} w_i$
$\bar{\beta}_.$
p
q
p
$\bar{\beta}_.$
p

$$w_i^* = \frac{1}{(1/w_i) + \hat{\tau}^2},$$

$\hat{\tau}$
?
??
w_i^*
w_i
$1/\sum_{i=1}^{k} w_i^*$
p
q
p
p
p
p
p
?
p
?
p
p_i
$U(0,1)$

$$S = -2\sum_{i=1}^{k} \log(p_i). \tag{4}$$

S
p
S
χ^2_{2k}
$2k$
p
p
S
χ^2_4
?
p
$U(0,1)$
p
p
??
S^R
S^R
p
S
S_i^R
S
p
S
p
??
??
?
MA
??
$\log_2$
?
?
??
C
p
q
C
B
p
q
??
p
q
C
B
??
q
$<$
q
$<$
p
q
A
q
B
??
q
B
q
A
B
B
A
q
mod$t$
p
q
B
Q
??
$\hat{\tau}$
??
p
$p <$
0.05
$p <$
0.10
??
q
p
q
Q
Q
χ^2_1
$\hat{\tau} <$
$\sqrt{.05}$
??
χ^2_1
χ^2_1
χ^2
$\hat{\tau}$
$\hat{\tau} <$
0.01
??
$\hat{\tau}$
??
$\hat{\tau} \approx$
0.1
$\hat{\tau} \approx$
0.1
τ
??
??
q
??
q
$-\log_{10}$
q
Q
$-\log_{10}$
q
$-\log_{10}$
q
q
Q
??
??
q
$-\log_{10}$
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q
??
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