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(/ / : // :)

()

(REML)

DFREML

(h_m)

() / () /

() / () / (h_m)

() / (c) ()

h_m c () /

/ (r_{am}) / / /

REML

| | | | |
|---------------------------------|-------------------|------------------|---------|
| | () | | () |
| | | | () |
| | | | () |
| : | | | () |
| $y = Xb + Z_1a + e$ | (M1) | | |
| $y = Xb + Z_1a + Wc + e$ | (M2) | | |
| $y = Xb + Z_1a + Z_2m + e$ | (M3) | | |
| $Cov_{am} = 0$ | (M3) | | |
| $y = Xb + Z_1a + Z_2m + e$ | (M4) | | |
| $Cov_{am} \neq 0$ | (M4) | | |
| $y = Xb + Z_1a + Z_2m + Wc + e$ | (M7) | | |
| $Cov_{am} = 0$ | (M7) | | |
| $y = Xb + Z_1a + Z_2m + Wc + e$ | (M8) | | |
| $Cov_{am} \neq 0$ | (M8) | | |
| a | y | | |
| m | c | | |
| Z ₁ X | e | W Z ₂ | (BW8W) |
| () | | | (EW) |
| | | | (EN) |
| | | | (ASM) |
| | Cov _{am} | | () |
| (EN) | (EW) | (BW8W) | (DP) |
| (ASM) | (ASM) | (DP) | |
| ASM () | DP () | EN () | EW () |
| BW8W () | | | |
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| / (/) | / (/) | / (/) | / (/) |
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() /
) ()
 () (h_a^2)
) (h_m^2)
) (c^2)
) (r_{am})
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(REML)
 () DFREML
 () Simplex (LogL)^r
 ()

/ /
) ($p < / /$)
 (/ /)
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$$\chi^2 = -2(\text{LogL}_{M_i} - \text{LogL}_{M_j})$$

$$\chi^2$$

$$\text{LogL}_{M_j} \text{ LogL}_{M_i}$$

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 ()
) i j
) ($p > / /$)
) ($p < / /$)

/ / / $r_{am} c h_m^2 h_a^2$ ()
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() / /
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) ($p < / /$)
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) ($p < / /$)

1. Derivative Free Algorithm
 2. Log Likelihood

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$h_m c^2$ /

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($P < /$)

($P < /$)

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/ (/)

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/ $r_{am} c h_m h_a$ /

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| LogL | r_{am} | h_m^2 | c^2 | h_a^2 | σ_p^2 | σ_e^2 | σ_{am} | σ_m^2 | σ_c^2 | σ_a^2 |
|------|----------|-----------|-----------|-----------|--------------|--------------|---------------|--------------|--------------|--------------|
| / | | | | / \pm / | / | / | | | | / |
| / | | | / \pm / | / \pm / | / | / | | | / | / |
| / | | / \pm / | | / \pm / | / | / | | / | | / |
| / | / | / \pm / | | / \pm / | / | / | / | / | | / |
| / | | / \pm / | / \pm / | / \pm / | / | / | | / | / | / |
| / | / | / \pm / | / \pm / | / \pm / | / | / | / | / | / | / |

σ_{am}

σ_m^2

σ_c^2

σ_a^2 *

c^2

h_a^2

σ_p^2

σ_e^2

LogL

r_{am}

h_m^2

()

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| LogL | r_{am} | h_m^2 | c^2 | h_a^2 | σ_p^2 | σ_e^2 | σ_{am} | σ_m^2 | σ_c^2 | σ_a^2 |
|------|----------|-----------|-----------|-----------|--------------|--------------|---------------|--------------|--------------|--------------|
| / | | | | / \pm / | / | / | | | | / |
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| LogL | r_{am} | h_m^2 | c^2 | h_a^2 | σ_p^2 | σ_e^2 | σ_{am} | σ_m^2 | σ_c^2 | σ_a^2 |
|------|----------|---------|-------|---------|--------------|--------------|---------------|--------------|--------------|--------------|
| / | | | | / ± / | / | / | | | | / |
| / | | | / ± / | / ± / | / | / | | | / | / |
| / | | / ± / | | / ± / | / | / | | / | | / |
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(P< /)

/ / c h_a () ()

h_m h_a / /

/ /

/ / h_m c ()

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(P< /) (P< /) ()

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(r_{am} c h_m h_a / /

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| LogL | r_{am} | h_m^2 | c^2 | h_a^2 | σ_p^2 | σ_e^2 | σ_{am} | σ_m^2 | σ_c^2 | σ_a^2 |
|------|----------|---------|-------|---------|--------------|--------------|---------------|--------------|--------------|--------------|
| / | | | | / ± / | / | / | | | | / |
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| / | | / ± / | | / ± / | / | / | | / | | / |
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$c^2 h_m$

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