

Appendix I

Unconditional centile of EFW

For any given gestational age ($t=i$) in days, the mean log-transformed EFW (μ_{EFW}) is:

$$\mu_{EFW}(g) = \alpha + \beta \cdot t + \gamma \cdot \text{gender} \quad (\text{values given in table 2})$$

where t is the gestational age in days and $\text{gender}=1$ if female and $\text{gender}=0$ if male.

$$\mu_{EFW}(g) = 5.169 + 0.0108 \cdot t_i - 0.0177 \cdot \text{female}$$

And the variance (σ) is:

$$\sigma_{EFW}(g) = \sigma_\alpha^2 + 2 \cdot t_i \cdot \sigma_{\alpha\beta} + t_i^2 \cdot \sigma_\beta^2 + 2 \cdot \text{female} \cdot \sigma_{\alpha\gamma} + 2 \cdot t_i \cdot \text{female} \cdot \sigma_{\beta\gamma} + \sigma_e^2$$

$$\sigma_{EFW}(g) = 0.158 - 2 \cdot t_i \cdot 0.000651 + t_i^2 \cdot 2.809 \cdot 10^{-6} + 2 \cdot \text{female} \cdot 0.00234 - 2 \cdot t_i \cdot \text{female} \cdot 1.026 \cdot 10^{-5} + 0.00357$$

Then at 30.0 weeks (210 days) the mean and variance of the EFW of a female fetus with an estimated fetal weight of 1500 g would be:

$$\mu_{EFW}(g) = 5.16866 + 0.0108023 \cdot 210 - 0.0177182 = 7.41942 = \mu_1$$

$$\sigma_{EFW}(g) = 0.158224 - (2 \cdot 210 \cdot 0.000650569) + (210^2 \cdot 2.80935 \cdot 10^{-6}) + (2 \cdot 0.00234232) - (2 \cdot 210 \cdot 1.02609 \cdot 10^{-5}) + 0.0035721 = 0.012825 = \sigma_1^2$$

$$z\text{-value}_{(EFW)} = (\ln(1500) - 7.41942) / \sqrt{0.012825} = -0.94, \text{ that corresponds to a centile of 17.}$$

The same fetus at 37 weeks with an EFW of 2500 g would correspond to a z-value of -1.11 and a centile of 13 [$\mu_{EFW}(g) = 7.94874 = \mu_2$ and $\sigma_{EFW}(g) = 0.01262486 = \sigma_2^2$].

Conditional centile of EFW

The conditional mean ($\mu_{2/1}$) and variance ($\sigma_{2/1}^2$) of a second EFW measurement (Z_2) given a first EFW measurement (Z_1) is:

$$\mu_{2/1}(Z_2/Z_1) = \mu_2 + (Z_1 - \mu_1) \sigma_{12} / \sigma_1^2$$

$$\sigma_{2/1}^2(Z_2/Z_1) = \sigma_2^2 - \sigma_{12}^2 / \sigma_1^2$$

where σ_{12} (conditional covariance) is:

$$\sigma_{12} = \sigma_\alpha^2 + (t_1 \cdot t_2) \cdot \sigma_\beta^2 + (t_1 + t_2) \cdot \sigma_{\alpha\beta} + 2 \cdot \text{gender} \cdot \sigma_{\alpha\gamma} + ((t_1 \cdot \text{gender}) + (t_2 \cdot \text{gender})) \cdot \sigma_{\beta\gamma}$$

$$\sigma_{12} = 0.158224 + t_1 \cdot t_2 \cdot 2.80935 \cdot 10^{-6} - (t_1 + t_2) \cdot 0.000650569 + 2 \cdot \text{female} \cdot 0.00234232 - ((t_1 \cdot \text{female}) + (t_2 \cdot \text{female})) \cdot 1.02609 \cdot 10^{-5}$$

In the example above:

$$\mu_{2/1}(Z_2/Z_1) = 7.94874 + (\ln(1500) - 7.41942) \cdot 0.00578 / 0.012825 = 7.90087$$

$$\sigma_{12} = 0.158224 + (210 \cdot 259 \cdot 2.80935 \cdot 10^{-6}) - ((210 + 259) \cdot 0.000650569) + (2 \cdot 0.00234232) - ((210 + 259) \cdot 1.02609 \cdot 10^{-5}) = 0.00578$$

$$\text{Thus, } \sigma_{2/1}^2(Z_2/Z_1) = 0.01262486 - 0.00578^2 / 0.012825 = 0.0100199$$

Accordingly, the z-value would be: $(\ln(2500) - 7.90087) / \sqrt{0.0100199} = -0.768$ that corresponds to a conditional centile of 22.