

BioSIM' Development Rate Models

Standardized Parameters

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Scale factor	ψ
Sharpe&all parameters	$H_A, H_L, T_L, T_{k_L}, H_H, T_H, T_{k_H}, T_{k_o}$
Sharpe&all parameters scale factor $F = 10\,000$	
General parameters	$k, k_0, k_1, k_2, k_3, k_4$
Temperature	$T\text{ }^{\circ}\text{C}$ (or T_k in Kelvin)
Lower	$T_b\text{ }^{\circ}\text{C}$
Optimum	$T_o\text{ }^{\circ}\text{C}$
Upper	$T_m\text{ }^{\circ}\text{C}$
Others	T_{ω}
Temperature scale	$\Delta_T, \Delta_{T_b}, \Delta_{T_m}$
Intermediate computation	$\beta, \beta_1, \beta_2, \Omega$

- Allahyari (2005)

$$\psi \left(\beta^{k_1} \right) \left(1 - \beta^{k_2} \right), \quad \beta = \frac{T - T_b}{T_m - T_b}$$

- Analytis (1977)

$$\psi \left(T - T_b \right)^{k_1} \left(T_m - T \right)^{k_2}$$

- Angilletta (2006)

$$\psi e^{-\frac{1}{2} \left| \frac{T - T_o}{\Delta T} \right|^k}$$

- Bieri (1983)

$$\left[k_1 \left(T - T_b \right) \right] - \left[k_2 e^{T - T_\omega} \right]$$

- Boatman (2017)

$$\psi \sin \left[\pi \left(\frac{T - T_b}{T_m - T_b} \right)^{k_0} \right]^{k_1}$$

- Briere1 (1999)

$$\psi T \left(T - T_b \right) \left(T_m - T \right)^{\frac{1}{2}}$$

- Briere2 (1999)

$$\psi T \left(T - T_b \right) \left(T_m - T \right)^{\frac{1}{k}}$$

- Damos (2011)

$$\psi \left(\frac{1}{1 + k_1 T + k_2 T^2} \right)$$

- Deva&Higgs

$$\psi \left[10^{-\Omega} \left(1 - k_2 + k_2 \Omega \right) \right], \quad \Omega = \left(\frac{\beta_1 + e^{k_1 \beta_1}}{\beta_2} \right)^2, \quad \beta_1 = \left(\frac{T - T_o}{T_o - T_b} \right) - \left(\frac{1}{1 + 0.28 k_1 + 0.72 \ln(1 + k_1)} \right)$$

$$\beta_2 = \frac{1 + k_1}{1 + 1.5 k_1 + 0.39 k_1^2}$$

- Hansen (2011)

$$\psi \left\{ \left[e^{k(T - T_m)} - 1 \right] - \left[e^{k(T_m - T_b)} - 1 \right] e^{\left(\frac{T - T_m}{\Delta T} \right)} \right\}$$

- Hilbert&Logan (1983)

$$\psi \left[\frac{\left(T - T_b \right)^2}{\left(T - T_b \right)^{2 + k^2}} - e^{-\frac{T_o - (T - T_b)}{\Delta T}} \right]$$

- Hilbert&LoganIII

$$\psi \left[\frac{T^2}{T^2 + k^2} - e^{-\frac{T_m - T}{\Delta T}} \right]$$

- Huey&Stevenson (1979)

$$\psi \left(T - T_b \right) \left(1 - e^{k \left(T - T_m \right)} \right)$$

- Janisch1 (1932)

$$\frac{1}{\psi} \left(\frac{2}{e^{k \left(T - T_o \right)} + e^{-k \left(T - T_o \right)}} \right)$$

- Janisch2 (1932)

$$\frac{1}{\psi} \left(\frac{2}{k_1 \left(T - T_o \right) + k_2 \left(T_o - T \right)} \right)$$

- Johnson (1974)

$$\psi \left[\frac{\beta_1 T_k e^{-\frac{k_1}{T_k}}}{1 + e^{\left(\beta_2 - \frac{k_2}{T_k} \right)}} \right], \beta_1 = \frac{k_2}{(k_2 - k_1) T_{k_o} e^{-\frac{k_1}{T_{k_o}}}}, \beta_2 = \frac{k_2}{T_{k_o}} - \ln \left(\frac{k_2}{k_1} - 1 \right)$$

- Kontodimas (2004)

$$\psi \left(T - T_b \right)^2 \left(T_m - T \right)$$

- Lactin1 (1995)

$$e^{k T} - e^{\left(k T_m - \frac{T_m - T}{\Delta T} \right)}$$

- Lactin2 (1995)

$$k_1 + e^{k_2 T} - e^{\left(k_2 T_m - \frac{T_m - T}{\Delta T}\right)}$$

- Lamb (1992)

$$\psi e^{-\frac{1}{2}\left(\frac{T-T_o}{\Delta T_x}\right)^2}, \Delta T_x = \begin{cases} \Delta T_1 & T \leq T_o \\ \Delta T_2 & T > T_o \end{cases}$$

- Lobry&Rosso&Flandrois (1993)

$$\psi \frac{\left(T - T_m\right)\left(T - T_b\right)^2}{\left(T_o - T_b\right)\left[\left(T_o - T_b\right)\left(T - T_o\right) - \left(T_o - T_m\right)\left(T_o + T_b - 2 T\right)\right]}$$

- Logan10 (1976)

$$\psi \left(\frac{1}{1 + k_1 e^{-k_2 T}} - e^{-\frac{T_m - T}{\Delta T}} \right)$$

- Logan6 (1976)

$$\psi \left(e^{k T} - e^{\left(k T_m - \frac{T_m - T}{\Delta T}\right)} \right)$$

- LoganTb (1979)

$$\psi e^{\left(k\left(T - T_b\right) - e^{k \frac{T - T_b}{\Delta T}}\right)}$$

- ONeill (1972)

$$\psi \beta^k e^{k(1-\beta)}, \beta = \frac{T_m - T}{T_m - T_o}$$

- Poly1

$$k_0 + k_1 T$$

- Poly2

$$k_0 + k_1 T + k_2 T^2$$

- Poly3

$$k_0 + k_1 T + k_2 T^2 + k_3 T^3$$

- Ratkowsky (1983)

$$\psi^2 \left[(T - T_b) \left(1 - e^{k(T - T_m)} \right) \right]^2$$

- Regniere (1982)

$$\psi \left[e^{k\beta} - e^{\left(k - \frac{1-\beta}{\Delta T}\right)} \right], \quad \beta = \frac{T - T_{\omega b}}{T_m - T_{\omega b}}$$

- Regniere (1987)

$$\psi \left[\left(\frac{1}{1 + e^{(k_1 - k_2 \beta)}} \right) - e^{\left(\frac{\beta - 1}{\Delta T} \right)} \right], \quad \beta = \frac{T - T_{\omega b}}{T_m - T_{\omega b}}$$

- Regniere (2012)

$$\psi \left[e^{k(T - T_b)} - \left(\left(\frac{T_m - T}{T_m - T_b} \right) e^{-k \left(\frac{T - T_b}{\Delta T_b} \right)} \right) - \left(\frac{T - T_b}{T_m - T_b} \right) e^{k(T_m - T_b) - \left(\frac{T_m - T}{\Delta T_m} \right)} \right]$$

- Room (1986)

$$\psi e^{-k_x (T - T_o)^2}, \quad k_x = \begin{cases} k_1 & T \leq T_o \\ k_2 & T > T_o \end{cases}$$

- Saint-Amant (2021)

$$\psi e^{\left[-k_1 (T_{\omega o} - T)^2 + \left(\frac{1}{-k_2 (T_m - T)} \right) \right]}$$

- Saint-Amant (2022)

$$\psi \left[1 - e^{-k_1 (T - T_b)^{kk_1}} - e^{-k_2 (T_m - T)^{kk_2}} \right]$$

- Schoolfield (1981)

$$\frac{\rho_{25} \left[\frac{T_k}{298} \right] e^{\left(\frac{F_{HA}}{1.987} \right) \left(\frac{1}{298} - \frac{1}{T_k} \right)}}{1 + e^{\left(\frac{F_{HL}}{1.987} \right) \left(\frac{1}{T_{kL}} - \frac{1}{T_k} \right)} + e^{\left(\frac{F_{HH}}{1.987} \right) \left(\frac{1}{T_{kH}} - \frac{1}{T_k} \right)}}$$

- Sharpe&DeMichele (1977)

$$\frac{\rho_{25} \left[\frac{T_k}{T_{k0}} \right] e^{\left(\frac{F_{HA}}{1.987} \right) \left(\frac{1}{T_{k0}} - \frac{1}{T_k} \right)}}{1 + e^{\left(\frac{F_{HL}}{1.987} \right) \left(\frac{1}{T_{kL}} - \frac{1}{T_k} \right)} + e^{\left(\frac{F_{HH}}{1.987} \right) \left(\frac{1}{T_{kH}} - \frac{1}{T_k} \right)}}$$

- Shi (2011)

$$\psi \left(1 - e^{-k_1 (T - T_b)} \right) \left(1 - e^{k_2 (T - T_m)} \right)$$

- Shi (2016)

$$\psi \left(\frac{T_m - T}{T_m - T_o} \right) \left(\frac{T - T_b}{T_o - T_b} \right)^{\left(\frac{T_o - T_b}{T_m - T_o} \right)}$$

- Stinner (1974)

$$\begin{cases} \psi \frac{1}{1 + e^{k_1 + k_2 T}} & T < T_o \\ \psi \frac{1}{1 + e^{k_1 + k_2 (2 \cdot T_o - T)}} & T \geq T_o \end{cases}$$

- Taylor (1981)

$$\psi e^{-\frac{1}{2} \left(\frac{T - T_o}{\Delta T} \right)^2}$$

- Wagner (1988)

$$\frac{\rho_{25} \left(\frac{T_k}{298.15} \right) e^{\left(\frac{F_{HA}}{1.987} \right) \left(\frac{1}{298.15} - \frac{1}{T_k} \right)}}{1 + e^{\left(\frac{F_{HL}}{1.987} \right) \left(\frac{1}{T_{kL}} - \frac{1}{T_k} \right)}}$$

- Wang&Engel (1998)

$$\psi \left[\frac{2 \left(T - T_b \right)^\beta \left(T_o - T_b \right)^\beta - \left(T - T_b \right)^{2 \cdot \beta}}{\left(T_o - T_b \right)^{2 \cdot \beta}} \right], \quad \beta = \frac{\ln(2)}{\ln \left(\frac{T_m - T_b}{T_o - T_b} \right)}$$

- Wang&Lan&Ding (1982)

$$\psi \left(\frac{1}{1 + e^{-k \left(T - T_o \right)}} \right) \left(1 - e^{-\frac{T - T_b}{\Delta T}} \right) \left(1 - e^{-\frac{T_m - T}{\Delta T}} \right)$$

- Yan&Hunt (1999)

$$\psi \left(\frac{T_m - T}{T_m - T_o} \right) \left(\frac{T}{T_o} \right)^{\frac{T_o}{T_m - T_o}}$$

- Yin (1995)

$$e^{\psi \left(T - T_b \right)^{k_1} \left(T_m - T \right)^{k_2}}$$

Reference

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