

# BioSIM' Survival Models

## Standardized Parameters

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General Parameters	$k, k_0, k_1, k_2, k_4, kk, kk_1, kk_2$
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Temperature	$T \text{ }^{\circ}\text{C}$
Lower	$T_L \text{ }^{\circ}\text{C}$
Optimum	$T_o \text{ }^{\circ}\text{C}$
Upper	$T_H \text{ }^{\circ}\text{C}$

Temperature scale	$\Delta_T, \Delta_{T_L}, \Delta_{T_H}$
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01• Survival\_01

$$\frac{1}{1 + e^{k_0 + k_1 T + k_2 T^2}}$$

02• Survival\_02

$$\frac{1}{1 + e^{k_0 + k_1 T + k_2 T^{kk}}}$$

03• Survival\_03

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

04• Survival\_04

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

05• Survival\_05

$$k_0 + k_1 e^{-kk \left( \frac{T - T_o}{\Delta T} \right)^2}$$

06• Survival\_06

$$k_0 + k_1 e^{-kk \left( \frac{\ln \left| \frac{T}{T_o} \right|}{\Delta T} \right)^2}$$

07• Survival\_07

$$k_0 + k_1 T + k_2 T^{kk}$$

08• Survival\_08

$$k_0 + k_1 e^{kk_1 T} + k_2 e^{kk_2 T}$$

09• Survival\_09

$$1 - e^{k_0 + k_1 T + k_2 T^{-kk}}$$

10• Survival\_10

$$\frac{k_0}{1 + k_1 e^{k_2 + k_3 T + k_4 T^{kk}}}$$

11• Survival\_11

$$\frac{1}{e^{kk} \left( 1 + e^{-\frac{T - T_0}{\Delta T_L}} \right) \left( 1 + e^{-\frac{T_0 - T}{\Delta T_H}} \right)}$$

12• Survival\_12

$$\frac{k}{e^{\left( 1 + e^{-\frac{T - T_0}{\Delta T_L}} \right)} \left( 1 + e^{-\frac{T_0 - T}{\Delta T_H}} \right)}$$

13• Survival\_13

$$\frac{k}{e^{\left(1+e^{-\frac{T-T_L}{\Delta T_L}}\right)}\left(1+e^{-\frac{T_H-T}{\Delta T_H}}\right)}$$

14• Survival\_14

$$k\left(1-e^{-\frac{T-T_L}{\Delta T}}\right)\left(1-e^{-\frac{T_H-T}{\Delta T}}\right)$$

15• Survival\_15

$$1-e^{kk\left(1-e^{-\frac{T-T_L}{\Delta T_L}}\right)\left(1-e^{-\frac{T_H-T}{\Delta T_H}}\right)}$$

16• Survival\_16

$$\frac{1}{e^{kk\left(1+e^{-\frac{T-T_L}{\Delta T_L}}\right)\left(1+e^{-\frac{T_H-T}{\Delta T_H}}\right)}}$$

## Reference

Sporleder M, Tonnang HEZ, Carhuapoma P, Gonzales JC, Juarez H, Kroschel J. 2013. Insect Life Cycle Modeling (ILCYM) software a new tool for Regional and Global Insect Pest Risk Assessments under Current and Future Climate Change Scenarios. In: Peña JE, ed. Potential invasive pests of agricultural crops. Wallingford: CABI <https://doi.org/10.1079/9781845938291.0412>