Summary of symmetry calculations

November 3, 2021

Contents

Chapter 1

Lotka_Volterra

Run 10_32PM_03_November-2021

Degree in tangential ansätze: 2.
The system of ODEs is given by:

$$\frac{\mathrm{d}N}{\mathrm{d}t} = N\left(-Pb + a\right),$$
$$\frac{\mathrm{d}P}{\mathrm{d}t} = P\left(Nc - d\right).$$

The calculated generators are:

$$X_1 = (1)\,\partial t,$$

$$X_2 = (d - 1)\,\partial t$$

$$X_3 = \left(\frac{1}{c} + \mathrm{f}_1(t)\right)\partial t + \left(\frac{Na\,\mathrm{f}_1(t)}{c} - \frac{NPb\,\mathrm{f}_1(t)}{c}\right)\partial N + \left(NP\,\mathrm{f}_1(t) - \frac{Pd\,\mathrm{f}_1(t)}{c}\right)\partial P$$

Some of the generators might contain the following arbitrary functions:

$$\mathrm{f}_1$$

WARNING:
Some of the calculated generators did not satisfy the linearised symmetry conditions. Thus, the presented list here is not complete and consists exclusively of the calculated generators that satisfy the linearised symmetry conditions.

Equation:$-C_3 + \frac{C_6 b^2 e^{-2at}}{c^2} - \frac{C_6 b^2 d}{ac^2} + \frac{C_6 b^2 d e^{-2at}}{ac^2} = 0$ Basis functions:

$$\left[1.0,\ e^{-2at}\right]$$

$$C_3 = 0$$
$$C_6 = 0$$

Equation:$-\frac{C_{15} a c e^{2dt}}{2ad^2+4d^3} - \frac{C_{15} c d e^{2dt}}{2ad^2+4d^3} + \frac{C_{15} c}{a^2 e^{at}+2ade^{at}} + \frac{C_{15} c e^{dt}}{d^2} - \frac{C_{15} c}{2d^2} - \frac{C_{15} c}{2ad} + \frac{C_2 c e^{dt}}{d} - \frac{C_2 c}{d} - \frac{C_4 b}{a} + \frac{C_4 b e^{-at}}{a} - C_5 + \frac{C_7 abc^2 e^{2dt}}{2a^3d^2-2a^2d^3-8ad^4+8d^5} - \frac{C_7 abc^2 e^{at}}{2a^4d-6a^3d^2+4a^2d^3} + \frac{C_7 bc^2 d e^{2dt}}{2a^3d^2-2a^2d^3-8ad^4+8d^5} - \frac{C_7 bc^2 d e^{at}}{2a^4d-6a^3d^2+4a^2d^3} - \frac{C_7 bc^2}{4a^4e^{at}+10a^3de^{at}+4a^2d^2e^{at}} + \frac{C_7 bc^2 e^{at} e^{dt}}{2a^3d-a^2d^2-ad^3} - \frac{C_7 bc^2 e^{dt}}{a^2d^2-ad^3} + \frac{C_7 bc^2}{2a^2d^2} + \frac{C_8 ac^2 e^{2dt}}{2a^2d^2+2ad^3-4d^4} + \frac{C_8 c^2 d e^{2dt}}{2a^2d^2+2ad^3-4d^4} - \frac{C_8 c^2}{2a^3e^{at}+5a^2de^{at}+2ad^2e^{at}} - \frac{C_8 c^2 e^{at} e^{dt}}{2a^3-a^2d-ad^2} - \frac{C_8 c^2 e^{dt}}{ad^2} + \frac{C_8 c^2}{2ad^2} = 0$ Basis functions:

$$\left[1.0,\ e^{at},\ e^{dt},\ e^{at}e^{dt},\ e^{2dt},\ e^{-at}\right]$$

$$C_2 = 0$$
$$C_4 = 0$$
$$C_{15} = 0$$
$$C_7 = 0$$
$$C_5 = 0$$
$$C_8 = 0$$

Equation:$-C_9 = 0$ Basis functions:

$$[1.0]$$

$$C_9 = 0$$

Equation:$\frac{C_{10} bdt}{a} - \frac{C_{10} b}{a} + \frac{C_{10} b e^{-at}}{a} - \frac{C_{10} bd}{a^2} + \frac{C_{10} bde^{-at}}{a^2} - C_{11} + \frac{C_{13} a^2 b^2}{a^3de^{at}-a^2d^2e^{at}} + \frac{2C_{13} a^2 b^2}{a^3d+a^2d^2} - \frac{2C_{13} ab^2 c^2}{a^2c^2de^{dt}-ac^2d^2e^{dt}} + \frac{2C_{13} ab^2 d}{a^3de^{at}-a^2d^2e^{at}} + \frac{4C_{13} ab^2 d}{a^3d+a^2d^2} - \frac{C_{13} ab^2}{a^2de^{at}e^{dt}+ad^2e^{at}e^{dt}} - \frac{2C_{13} b^2 c^2 d}{a^2c^2de^{dt}-ac^2d^2e^{dt}} + \frac{C_{13} b^2 d^2}{a^3de^{at}-a^2d^2e^{at}} + \frac{C_{13} b^2 d^2}{a^3d+a^2d^2} - \frac{2C_{13} b^2 d}{a^2de^{at}e^{dt}+ad^2e^{at}e^{dt}} - \frac{C_{13} b^2 t}{a} + C_{14} bt + \frac{C_{16} ab^2}{acde^{at}e^{dt}+cd^2e^{at}e^{dt}} + \frac{2C_{16} b^2 d}{acde^{at}e^{dt}+cd^2e^{at}e^{dt}} + \frac{C_{16} b^2 d}{a^2c+acd} - \frac{C_{16} b^2 e^{-at}}{cd} - \frac{C_{16} b^2 e^{-at}}{ac} - \frac{C_{18} be^{-at}}{c} + \frac{C_{18} bd}{ac} - \frac{C_{18} bde^{-at}}{ac} = 0$ Basis functions:

$$\left[e^{-at}e^{-dt},\ 1.0,\ t,\ e^{-dt},\ e^{-at}\right]$$

$$C_{11} = \frac{C_{13}\left(a^3b^2e^{at}e^{dt} - 2a^3b^2e^{at} + a^3b^2e^{dt} - a^3b^2 + 2a^2b^2de^{at}e^{dt} - 4a^2b^2de^{at} + 3a^2b^2de^{dt} - a^2b^2d - 2ab^2d^2e^{at}e^{dt} - 2ab^2d^2e^{a}\right.}{a^4de^{at}e^{dt} - a^2d^3e^{at}e^{dt}}$$
$$C_{18} = \frac{C_{13}bc}{ad} - \frac{C_{14}c}{d} - \frac{C_{16}b}{d}$$
$$C_{10} = \frac{C_{13}b}{d} - \frac{C_{14}a}{d}$$

Equation:$-C_{12} + \frac{C_{13} bc}{a^2e^{at}e^{dt}+ade^{at}e^{dt}} + \frac{C_{13} bc}{ad+d^2} - \frac{C_{13} bce^{-dt}}{ad} - \frac{C_{16} b}{ae^{at}e^{dt}+de^{at}e^{dt}} + \frac{C_{16} b}{a+d} = 0$ Basis functions:

$$\left[e^{-at}e^{-dt},\ 1.0,\ e^{-dt}\right]$$

$$C_{16} = \frac{C_{12}\left(ae^{at}e^{dt} + de^{at}e^{dt}\right)}{be^{at}e^{dt} - b}$$
$$C_{13} = 0$$

Equation:$-\frac{C_{13}c^2}{a^2e^{at}e^{dt}+ade^{at}e^{dt}} - \frac{C_{13}c^2}{ad+d^2} + \frac{C_{13}c^2e^{-dt}}{ad} + \frac{C_{16}c}{ae^{at}e^{dt}+de^{at}e^{dt}} - \frac{C_{16}c}{a+d} - C_{17} = 0$ Basis functions:

$$\left[e^{-at}e^{-dt},\ 1.0,\ e^{-dt}\right]$$

$$C_{16} = \frac{C_{17}\left(a^2e^{2at}e^{2dt} + ade^{2at}e^{2dt} + ade^{at}e^{dt} + d^2e^{at}e^{dt}\right)}{-ace^{2at}e^{2dt} + ace^{at}e^{dt} - cde^{at}e^{dt} + cd}$$
$$C_{13} = 0$$

The execution time of the script was:

0 hours 1 minutes 37 seconds.