Plugging in rational ansätze into the linearised symmetry condition for the phase plane

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1 LV-model

The LV-model in the phase plane is given by:

$$\frac{\mathrm{d}v}{\mathrm{d}u} = \frac{av\,(u-1)}{u\,(1-v)} \tag{1}$$

The monomials are:

$$M = \begin{bmatrix} 1 \\ v \\ v^2 \\ u \\ uv \\ u^2 \end{bmatrix}. \tag{2}$$

The unknown coefficient in our polynomial ansatze are:

$$\mathbf{c} = \begin{bmatrix} c_0 \\ c_1 \\ c_2 \\ c_3 \\ c_4 \\ c_5 \\ c_6 \\ c_7 \\ c_8 \\ c_9 \\ c_{10} \\ c_{11} \\ c_{12} \\ c_{13} \\ c_{14} \\ c_{15} \\ c_{16} \\ c_{17} \\ c_{18} \\ c_{19} \\ c_{20} \\ c_{21} \\ c_{22} \\ c_{23} \end{bmatrix}. \tag{3}$$

Now, we use rational ansatze of the type $\eta_1 = P_1/P_2$ and $\eta_2 = P_3/P_4$. Our four polynomials are:

$$
\begin{aligned}
P_1 &= c_0 + c_1 v + c_2 v^2 + c_3 u + c_4 uv + c_5 u^2,\\
P_2 &= c_{10} uv + c_{11} u^2 + c_6 + c_7 v + c_8 v^2 + c_9 u,\\
P_3 &= c_{12} + c_{13} v + c_{14} v^2 + c_{15} u + c_{16} uv + c_{17} u^2,\\
P_4 &= c_{18} + c_{19} v + c_{20} v^2 + c_{21} u + c_{22} uv + c_{23} u^2.
\end{aligned}
$$

The system of equations resulting from plugging in these ansatze into the linearised symmetry condition contains 73 equations.