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## Lampiran 1. Titik kesetimbangan bebas penyakit dan endemik model penyebaran COVID-19

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> restart:
> with(linalg):
> P1 := mu + gamma - (1 - rho1) * (1 - rho2) * beta * s * (c + u) - mu * s
P1 := mu + gamma - (1 - rho1) * (1 - rho2) * beta * s * (c + u) - mu * s
> P2 := (1 - rho1) * (1 - rho2) * beta * s * (c + u) - (delta + sigma + mu) * c
P2 := (1 - rho1) * (1 - rho2) * beta * s * (c + u) - (delta + sigma + mu) * c
> P3 := delta_1 * c - (q * alpha + (1 - q) * omega + mu) * p
P3 := delta_1 * c - (q * alpha + (1 - q) * omega + mu) * p
> P4 := (1 - rho1) * delta_2 * c - (omega + mu) * u
P4 := (1 - rho1) * delta_2 * c - (omega + mu) * u
> P5 := sigma * c + q * alpha * p - (mu + gamma) * r
P5 := sigma * c + q * alpha * p - (mu + gamma) * r

:
> fixedpoint := solve({P1, P2, P3, P4, P5}, {s, c, p, u, r})
fixedpoint := (c = 0, p = 0, r = 0, s = 1, u = 0), [c = (mu * (-alpha * beta * gamma * rho1^2 * rho2 * delta_2 - alpha * beta * mu * q * rho1^2 * rho2 * delta_2 + beta * gamma * q * rho1^2 * rho2 * delta_2 + beta * mu * q * rho1^2 * rho2 * delta_2 + alpha * beta * gamma * q * rho1 * rho2 + alpha * beta * gamma * rho1^2 * delta_2
+ 2 * alpha * beta * gamma * rho1 * rho2 * delta_2 + alpha * beta * omega * q * rho1 * rho2 + alpha * beta * mu * q * rho1^2 * delta_2 + 2 * alpha * beta * mu * q * rho1 * rho2 * delta_2 - beta * gamma^2 * q * rho1 * rho2 - beta * gamma * q * rho1^2 * delta_2 - 2 * beta * gamma * q * rho1 * rho2 - beta * gamma * rho1^2 * rho2 * delta_2 - beta * mu * omega * q * rho1 * rho2
- beta * mu * omega * rho1^2 * delta_2 - 2 * beta * mu * omega * rho1 * rho2 * delta_2 - beta * mu * omega * rho1^2 * rho2 * delta_2 - alpha * beta * gamma * q * rho1 - alpha * beta * gamma * q * rho2 - 2 * alpha * beta * gamma * rho1 * delta_2 - alpha * beta * gamma * rho2 * delta_2 - alpha * beta * omega * q * rho1 - alpha * beta * omega * q * rho2 - 2 * alpha * beta * mu * q * rho1 * delta_2
- alpha * beta * mu * q * rho2 * delta_2 + beta * gamma^2 * q * rho1 + beta * gamma^2 * q * rho2 + beta * gamma^2 * rho1 * rho2 + 2 * beta * gamma * q * rho1 * delta_2 + beta * gamma * q * rho2 * delta_2 + beta * gamma * rho1^2 * delta_2 + 2 * beta * gamma * rho1 * rho2 * delta_2 + beta * mu * omega^2 * q * rho1 + beta * mu * omega^2 * q * rho2 + beta * mu * omega^2 * rho1 * rho2
+ 2 * beta * mu * omega * q * rho1 * delta_2 + beta * mu * omega * q * rho2 * delta_2 + beta * mu * omega * rho1^2 * delta_2 + 2 * beta * mu * omega * rho1 * rho2 * delta_2 + alpha * beta * gamma * q + alpha * beta * gamma * delta_2 + alpha * beta * mu * omega * q + alpha * beta * mu * delta_2 - alpha * delta * gamma * q - alpha * delta * omega * q - alpha * gamma * omega * q - alpha * gamma * sigma
- alpha * mu^2 * omega * q - alpha * mu * omega * q - beta * gamma^2 * q - beta * gamma^2 * rho1 - beta * gamma^2 * rho2 - beta * gamma * q * delta_2 - 2 * beta * gamma * rho1 * delta_2 - beta * gamma * rho2 * delta_2 - beta * mu * omega^2 * q - beta * mu * omega^2 * rho1 - beta * mu * omega^2 * rho2 - beta * mu * omega * delta_2 - 2 * beta * mu * omega * rho1 * delta_2
- beta * mu * omega * rho2 * delta_2 + delta * gamma^2 * q + delta * mu * omega^2 * q + gamma * mu^2 * q + gamma^2 * q * sigma + mu^2 * omega^2 * q + mu^2 * omega * q * sigma + beta * gamma^2 + beta * gamma * delta_2 + beta * mu * omega^2 + beta * mu * delta_2 - delta * gamma^2 - delta * mu * omega^2 - gamma * mu^2 - gamma^2 * sigma - mu^2 * omega^2
- mu * omega^2 * sigma) / (beta * (-alpha * delta * gamma * rho1^2 * rho2 * delta_2 - alpha * delta * mu * q * rho1^2 * rho2 * delta_2 - alpha * gamma * mu * q * rho1^2 * rho2 * delta_2 + alpha * gamma * rho1^2 * rho2 * delta_1 * delta_2 - alpha * mu^2 * q * rho1^2 * rho2 * delta_2 - alpha * mu * q * rho1^2 * rho2 * sigma * delta_2 + delta * gamma * q * rho1^2 * rho2 * delta_2
+ delta * mu * omega * q * rho1^2 * rho2 * delta_2 + gamma * mu * q * rho1^2 * rho2 * delta_2 + mu^2 * omega * q * rho1^2 * rho2 * delta_2 + mu * omega * q * rho1^2 * rho2 * sigma * delta_2 + alpha * delta * gamma * q * rho1 * rho2 + alpha * delta * gamma * rho1^2 * delta_2 + 2 * alpha * delta * gamma * rho1 * rho2 * delta_2 + alpha * delta * mu * omega * q * rho1 * rho2
+ alpha * delta * mu * q * rho1^2 * delta_2 + 2 * alpha * delta * mu * q * rho1 * rho2 * delta_2 + alpha * gamma * mu * omega * q * rho1 * rho2 + alpha * gamma * mu * rho1^2 * delta_2 + 2 * alpha * gamma * mu * rho1 * rho2 * delta_2 - alpha * gamma * omega * rho1 * rho2 * delta_1 - alpha * gamma * rho1^2 * delta_1 * delta_2 - 2 * alpha * gamma * rho1 * rho2 * delta_1 * delta_2
+ alpha * mu^2 * omega * q * rho1 * rho2 + alpha * mu^2 * q * rho1^2 * delta_2 + 2 * alpha * mu^2 * q * rho1 * rho2 * delta_2 + alpha * mu * omega * q * rho1 * rho2 * sigma + alpha * mu * q * rho1^2 * sigma * delta_2 + 2 * alpha * mu * q * rho1 * rho2 * sigma * delta_2 - delta * gamma^2 * q * rho1 * rho2 - delta * gamma * q * rho1^2 * delta_2 - 2 * delta * gamma * q * rho1 * rho2 * delta_2
- delta * gamma * rho1^2 * rho2 * delta_2 - delta * mu * omega^2 * q * rho1 * rho2 - delta * mu * omega * q * rho1^2 * delta_2 - 2 * delta * mu * omega * q * rho1 * rho2 * delta_2 - delta * mu * rho1^2 * rho2 * delta_2 - gamma * mu * omega^2 * q * rho1 * rho2 - gamma * mu * omega * q * rho1^2 * delta_2 - 2 * gamma * mu * omega * rho1 * rho2 * delta_2 - gamma * mu * rho1^2 * rho2 * delta_2
- mu^2 * omega^2 * q * rho1 * rho2 - mu^2 * omega * q * rho1^2 * delta_2 - 2 * mu^2 * omega * q * rho1 * rho2 * delta_2 - mu^2 * omega * rho1^2 * rho2 * delta_2 - mu^2 * omega * q * rho1 * rho2 * sigma - mu * omega * q * rho1^2 * sigma * delta_2 - 2 * mu * omega * q * rho1 * rho2 * sigma * delta_2 - mu * omega * rho1^2 * rho2 * sigma * delta_2 - alpha * delta * gamma * q

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$$\begin{aligned}
& -\alpha\delta\gamma\omega q\rho 2-2\alpha\delta\gamma q\rho 1\delta_2-\alpha\delta\gamma q\rho 2\delta_2-\alpha\delta\mu\omega q\rho 1-\alpha\delta\mu\omega q\rho 2-2\alpha\delta\mu q\rho 1\delta_2-\alpha\delta\mu q\rho 2\delta_2-\alpha\gamma\mu\omega q\rho 1-\alpha\gamma\mu\omega q\rho 2-2\alpha\gamma\mu q\rho 1\delta_2 \\
& -\alpha\gamma\mu q\rho 2\delta_2+\alpha\gamma\omega q\rho 1\delta_1+\alpha\gamma\omega q\rho 2\delta_1+2\alpha\gamma q\rho 1\delta_1\delta_2+\alpha\gamma q\rho 2\delta_1\delta_2-\alpha\mu^2\omega q\rho 1-\alpha\mu^2\omega q\rho 2-2\alpha\mu^2 q\rho 1\delta_2-\alpha\mu^2 q\rho 2\delta_2-\alpha\mu\omega q\rho 1\sigma \\
& -\alpha\mu\omega q\rho 2\sigma-2\alpha\mu q\rho 1\sigma\delta_2-\alpha\mu q\rho 2\sigma\delta_2+\delta\gamma\omega^2 q\rho 1+\delta\gamma\omega^2 q\rho 2+\delta\gamma\omega^2\rho 1\rho 2+2\delta\gamma\omega q\rho 1\delta_2+\delta\gamma\omega q\rho 2\delta_2+\delta\gamma\omega\rho 1^2\delta_2+2\delta\gamma\omega\rho 1\rho 2\delta_2 \\
& +\delta\mu\omega^2 q\rho 1+\delta\mu\omega^2 q\rho 2+\delta\mu\omega^2\rho 1\rho 2+2\delta\mu\omega q\rho 1\delta_2+\delta\mu\omega q\rho 2\delta_2+\delta\mu\omega\rho 1^2\delta_2+2\delta\mu\omega\rho 1\rho 2\delta_2+\gamma\mu\omega^2 q\rho 1+\gamma\mu\omega^2 q\rho 2+\gamma\mu\omega^2\rho 1\rho 2 \\
& +2\gamma\mu\omega q\rho 1\delta_2+\gamma\mu\omega q\rho 2\delta_2+\gamma\mu\omega\rho 1^2\delta_2+2\gamma\mu\omega\rho 1\rho 2\delta_2+\mu^2\omega^2 q\rho 1+\mu^2\omega^2 q\rho 2+\mu^2\omega^2\rho 1\rho 2+2\mu^2\omega q\rho 1\delta_2+\mu^2\omega q\rho 2\delta_2+\mu^2\omega\rho 1^2\delta_2 \\
& +2\mu^2\omega\rho 1\rho 2\delta_2+\mu^2 q\rho 1\sigma+\mu^2 q\rho 2\sigma+\mu^2\rho 1\rho 2\sigma+2\mu\omega q\rho 1\delta_2+\mu\omega q\rho 2\delta_2+\mu\omega\rho 1^2\sigma\delta_2+2\mu\omega\rho 1\rho 2\sigma\delta_2+\alpha\delta\gamma\omega q+\alpha\delta\gamma q\delta_2+\alpha\delta\mu\omega q \\
& +\alpha\delta\mu q\delta_2+\alpha\gamma\mu\omega q+\alpha\gamma\mu q\delta_2-\alpha\gamma\omega q\delta_1-\alpha\gamma q\delta_1\delta_2+\alpha\mu^2\omega q+\alpha\mu^2 q\delta_2+\alpha\mu\omega q\sigma+\alpha\mu q\sigma\delta_2-\delta\gamma\omega^2 q-\delta\gamma\omega^2\rho 1-\delta\gamma\omega^2\rho 2-\delta\gamma\omega q\delta_2 \\
& -2\delta\gamma\omega\rho 1\delta_2-\delta\gamma\omega\rho 2\delta_2-\delta\mu\omega^2 q-\delta\mu\omega^2\rho 1-\delta\mu\omega^2\rho 2-\delta\mu\omega q\delta_2-2\delta\mu\omega\rho 1\delta_2-\delta\mu\omega\rho 2\delta_2-\gamma\mu\omega^2 q-\gamma\mu\omega^2\rho 1-\gamma\mu\omega^2\rho 2-\gamma\mu\omega q\delta_2 \\
& -2\gamma\mu\omega\rho 1\delta_2-\gamma\mu\omega\rho 2\delta_2-\mu^2\omega^2 q-\mu^2\omega^2\rho 1-\mu^2\omega^2\rho 2-\mu^2\omega q\delta_2-2\mu^2\omega\rho 1\delta_2-\mu^2\omega\rho 2\delta_2-\mu^2 q\sigma-\mu^2\rho 1\sigma-\mu^2\rho 2\sigma-\mu\omega q\sigma\delta_2 \\
& -2\mu\omega\rho 1\sigma\delta_2-\mu\omega\rho 2\sigma\delta_2+\delta\gamma\omega^2+\delta\gamma\omega\delta_2+\delta\mu\omega^2+\delta\mu\omega\delta_2+\gamma\mu\omega^2+\gamma\mu\omega\delta_2+\mu^2\omega^2+\mu^2\omega\delta_2+\mu\omega^2\sigma+\mu\omega\sigma\delta_2),p=((-\beta\gamma\rho 1^2\rho 2\delta_2 \\
& -\beta\mu\rho 1^2\rho 2\delta_2+\beta\gamma\omega\rho 1\rho 2+\beta\gamma\rho 1^2\delta_2+2\beta\gamma\rho 1\rho 2\delta_2+\beta\mu\omega\rho 1\rho 2+\beta\mu\rho 1^2\delta_2+2\beta\mu\rho 1\rho 2\delta_2-\beta\gamma\omega\rho 1-\beta\gamma\omega\rho 2-2\beta\gamma\rho 1\delta_2-\beta\gamma\rho 2\delta_2-\beta\mu\omega\rho 1 \\
& -\beta\mu\omega\rho 2-2\beta\mu\rho 1\delta_2-\beta\mu\rho 2\delta_2+\beta\gamma\omega+\beta\gamma\delta_2+\beta\mu\omega+\beta\mu\delta_2-\delta\gamma\omega-\delta\mu\omega-\gamma\mu\omega-\gamma\omega\sigma-\mu^2\omega-\mu\omega\sigma)\delta_1\mu)/((- \rho 1^2\rho 2\delta_2+\omega\rho 1\rho 2+\rho 1^2\delta_2 \\
& +2\rho 1\rho 2\delta_2-\omega\rho 1-\omega\rho 2-2\rho 1\delta_2-\rho 2\delta_2+\omega+\delta_2)(\alpha\delta\gamma q+\alpha\delta\mu q+\alpha\gamma\mu q-\alpha\gamma q\delta_1+\alpha\mu^2 q+\alpha\mu q\sigma-\delta\gamma\omega q-\delta\mu\omega q-\gamma\mu\omega q-\mu^2\omega q-\mu\omega q\sigma \\
& +\delta\gamma\omega+\delta\mu\omega+\gamma\mu\omega+\mu^2\omega+\mu\omega\sigma)\beta),r=((-\alpha\beta q\rho 1^2\rho 2\sigma\delta_2-\alpha\beta q\rho 1^2\rho 2\delta_1\delta_2+\beta\omega q\rho 1^2\rho 2\sigma\delta_2+\alpha\beta\omega q\rho 1\rho 2\sigma+\alpha\beta\omega q\rho 1\rho 2\delta_1 \\
& +\alpha\beta q\rho 1^2\sigma\delta_2+\alpha\beta q\rho 1^2\delta_1\delta_2+2\alpha\beta q\rho 1\rho 2\sigma\delta_2+2\alpha\beta q\rho 1\rho 2\delta_1\delta_2-\beta\omega^2 q\rho 1\rho 2\sigma-\beta\omega q\rho 1^2\sigma\delta_2-2\beta\omega q\rho 1\rho 2\sigma\delta_2-\beta\omega\rho 1^2\rho 2\sigma\delta_2 \\
& -\alpha\beta\omega q\rho 1\sigma-\alpha\beta\omega q\rho 1\delta_1-\alpha\beta\omega q\rho 2\sigma-\alpha\beta\omega q\rho 2\delta_1-2\alpha\beta q\rho 1\sigma\delta_2-2\alpha\beta q\rho 1\delta_1\delta_2-\alpha\beta q\rho 2\sigma\delta_2-\alpha\beta q\rho 2\delta_1\delta_2+\beta\omega^2 q\rho 1\sigma+\beta\omega^2 q\rho 2\sigma \\
& +\beta\omega^2\rho 1\rho 2\sigma+2\beta\omega q\rho 1\sigma\delta_2+\beta\omega q\rho 2\sigma\delta_2+\beta\omega\rho 1^2\sigma\delta_2+2\beta\omega\rho 1\rho 2\sigma\delta_2+\alpha\beta\omega q\sigma+\alpha\beta\omega q\delta_1+\alpha\beta q\sigma\delta_2+\alpha\beta q\delta_1\delta_2-\alpha\delta\omega q\sigma-\alpha\delta\omega q\delta_1 \\
& -\alpha\mu\omega q\sigma-\alpha\mu\omega q\delta_1-\alpha\omega q\sigma^2-\alpha\omega q\sigma\delta_1-\beta\omega^2 q\sigma-\beta\omega^2\rho 1\sigma-\beta\omega^2\rho 2\sigma-\beta\omega q\sigma\delta_2-2\beta\omega\rho 1\sigma\delta_2-\beta\omega\rho 2\sigma\delta_2+\delta\omega^2 q\sigma+\mu\omega^2 q\sigma+\omega^2 q\sigma^2
\end{aligned}$$



$$\begin{aligned}
& + \beta \omega^2 \sigma + \beta \omega \sigma \delta_2 - \delta \omega^2 \sigma - \mu \omega^2 \sigma - \omega^2 \sigma^2) \mu) / ((- \rho^2 \rho_2 \delta_2 + \omega \rho_1 \rho_2 + \rho^2 \delta_2 + 2 \rho_1 \rho_2 \delta_2 - \omega \rho_1 - \omega \rho_2 - 2 \rho_1 \delta_2 - \rho_2 \delta_2 + \omega + \delta_2) (\alpha \delta \gamma q \\
& + \alpha \delta \mu q + \alpha \gamma \mu q - \alpha \gamma q \delta_1 + \alpha \mu^2 q + \alpha \mu q \sigma - \delta \gamma \omega q - \delta \mu \omega q - \gamma \mu \omega q - \mu^2 \omega q - \mu \omega q \sigma + \delta \gamma \omega + \delta \mu \omega + \gamma \mu \omega + \mu^2 \omega + \mu \omega \sigma) \beta), s \\
& = \frac{\omega(\delta + \sigma + \mu)}{\beta(-\rho^2 \rho_2 \delta_2 + \omega \rho_1 \rho_2 + \rho^2 \delta_2 + 2 \rho_1 \rho_2 \delta_2 - \omega \rho_1 - \omega \rho_2 - 2 \rho_1 \delta_2 - \rho_2 \delta_2 + \omega + \delta_2)}, u = -((-\alpha \beta \gamma q \rho^2 \rho_2 \delta_2 - \alpha \beta \mu q \rho^2 \rho_2 \delta_2 \\
& + \beta \gamma \omega q \rho^2 \rho_2 \delta_2 + \beta \mu \omega q \rho^2 \rho_2 \delta_2 + \alpha \beta \gamma \omega q \rho_1 \rho_2 + \alpha \beta \gamma q \rho^2 \delta_2 + 2 \alpha \beta \gamma q \rho_1 \rho_2 \delta_2 + \alpha \beta \mu \omega q \rho_1 \rho_2 + \alpha \beta \mu q \rho^2 \delta_2 + 2 \alpha \beta \mu q \rho_1 \rho_2 \delta_2 - \beta \gamma \omega^2 q \rho_1 \rho_2 \\
& - \beta \gamma \omega q \rho^2 \delta_2 - 2 \beta \gamma \omega q \rho_1 \rho_2 \delta_2 - \beta \gamma \omega \rho^2 \rho_2 \delta_2 - \beta \mu \omega^2 q \rho_1 \rho_2 - \beta \mu \omega q \rho^2 \delta_2 - 2 \beta \mu \omega q \rho_1 \rho_2 \delta_2 - \beta \mu \omega \rho^2 \rho_2 \delta_2 - \alpha \beta \gamma \omega q \rho_1 - \alpha \beta \gamma \omega q \rho_2 \\
& - 2 \alpha \beta \gamma q \rho_1 \delta_2 - \alpha \beta \gamma q \rho_2 \delta_2 - \alpha \beta \mu \omega q \rho_1 - \alpha \beta \mu \omega q \rho_2 - 2 \alpha \beta \mu q \rho_1 \delta_2 - \alpha \beta \mu q \rho_2 \delta_2 + \beta \gamma \omega^2 q \rho_1 + \beta \gamma \omega^2 q \rho_2 + \beta \gamma \omega^2 \rho_1 \rho_2 + 2 \beta \gamma \omega q \rho_1 \delta_2 \\
& + \beta \gamma \omega q \rho_2 \delta_2 + \beta \gamma \omega \rho^2 \delta_2 + 2 \beta \gamma \omega \rho_1 \rho_2 \delta_2 + \beta \mu \omega^2 q \rho_1 + \beta \mu \omega^2 q \rho_2 + \beta \mu \omega^2 \rho_1 \rho_2 + 2 \beta \mu \omega q \rho_1 \delta_2 + \beta \mu \omega q \rho_2 \delta_2 + \beta \mu \omega \rho^2 \delta_2 + 2 \beta \mu \omega \rho_1 \rho_2 \delta_2 \\
& + \alpha \beta \gamma \omega q + \alpha \beta \gamma q \delta_2 + \alpha \beta \mu \omega q + \alpha \beta \mu q \delta_2 - \alpha \delta \gamma \omega q - \alpha \delta \mu \omega q - \alpha \gamma \mu \omega q - \alpha \gamma \omega q \sigma - \alpha \mu^2 \omega q - \alpha \mu \omega q \sigma - \beta \gamma \omega^2 q - \beta \gamma \omega^2 \rho_1 - \beta \gamma \omega^2 \rho_2 - \beta \gamma \omega q \delta_2 \\
& - 2 \beta \gamma \omega \rho_1 \delta_2 - \beta \gamma \omega \rho_2 \delta_2 - \beta \mu \omega^2 q - \beta \mu \omega^2 \rho_1 - \beta \mu \omega^2 \rho_2 - \beta \mu \omega q \delta_2 - 2 \beta \mu \omega \rho_1 \delta_2 - \beta \mu \omega \rho_2 \delta_2 + \delta \gamma \omega^2 q + \delta \mu \omega^2 q + \gamma \mu \omega^2 q + \gamma \omega^2 q \sigma + \mu^2 \omega^2 q \\
& + \mu \omega^2 q \sigma + \beta \gamma \omega^2 + \beta \gamma \omega \delta_2 + \beta \mu \omega^2 + \beta \mu \omega \delta_2 - \delta \gamma \omega^2 - \delta \mu \omega^2 - \gamma \mu \omega^2 - \gamma \omega^2 \sigma - \mu^2 \omega^2 - \mu \omega^2 \sigma) \mu \delta_2) / (\omega(-\alpha \delta \gamma q \rho_1 \rho_2 \delta_2 - \alpha \delta \mu q \rho_1 \rho_2 \delta_2 \\
& - \alpha \gamma \mu q \rho_1 \rho_2 \delta_2 + \alpha \gamma q \rho_1 \rho_2 \delta_1 \delta_2 - \alpha \mu^2 q \rho_1 \rho_2 \delta_2 - \alpha \mu q \rho_1 \rho_2 \delta_2 + \delta \gamma \omega q \rho_1 \rho_2 \delta_2 + \delta \mu \omega q \rho_1 \rho_2 \delta_2 + \gamma \mu \omega q \rho_1 \rho_2 \delta_2 + \mu^2 \omega q \rho_1 \rho_2 \delta_2 \\
& + \mu \omega q \rho_1 \rho_2 \sigma \delta_2 + \alpha \delta \gamma \omega q \rho_2 + \alpha \delta \gamma q \rho_1 \delta_2 + \alpha \delta \gamma q \rho_2 \delta_2 + \alpha \delta \mu \omega q \rho_2 + \alpha \delta \mu q \rho_1 \delta_2 + \alpha \delta \mu q \rho_2 \delta_2 + \alpha \gamma \mu \omega q \rho_2 + \alpha \gamma \mu q \rho_1 \delta_2 + \alpha \gamma \mu q \rho_2 \delta_2 \\
& - \alpha \gamma \omega q \rho_2 \delta_1 - \alpha \gamma q \rho_1 \delta_1 \delta_2 - \alpha \gamma q \rho_2 \delta_1 \delta_2 + \alpha \mu^2 \omega q \rho_2 + \alpha \mu^2 q \rho_1 \delta_2 + \alpha \mu^2 q \rho_2 \delta_2 + \alpha \mu \omega q \rho_2 \sigma + \alpha \mu q \rho_1 \sigma \delta_2 + \alpha \mu q \rho_2 \sigma \delta_2 - \delta \gamma \omega^2 q \rho_2 \\
& - \delta \gamma \omega q \rho_1 \delta_2 - \delta \gamma \omega q \rho_2 \delta_2 - \delta \gamma \omega \rho_1 \rho_2 \delta_2 - \delta \mu \omega^2 q \rho_2 - \delta \mu \omega q \rho_1 \delta_2 - \delta \mu \omega q \rho_2 \delta_2 - \delta \mu \omega \rho_1 \rho_2 \delta_2 - \gamma \mu \omega^2 q \rho_2 - \gamma \mu \omega q \rho_1 \delta_2 - \gamma \mu \omega q \rho_2 \delta_2 \\
& - \gamma \mu \omega \rho_1 \rho_2 \delta_2 - \mu^2 \omega^2 q \rho_2 - \mu^2 \omega q \rho_1 \delta_2 - \mu^2 \omega q \rho_2 \delta_2 - \mu^2 \omega \rho_1 \rho_2 \delta_2 - \mu \omega^2 q \rho_2 \sigma - \mu \omega q \rho_1 \sigma \delta_2 - \mu \omega q \rho_2 \sigma \delta_2 - \mu \omega \rho_1 \rho_2 \sigma \delta_2 - \alpha \delta \gamma \omega q - \alpha \delta \gamma q \delta_2 \\
& - \alpha \delta \mu \omega q - \alpha \delta \mu q \delta_2 - \alpha \gamma \mu \omega q - \alpha \gamma \mu q \delta_2 + \alpha \gamma \omega q \delta_1 + \alpha \gamma q \delta_1 \delta_2 - \alpha \mu^2 \omega q - \alpha \mu^2 q \delta_2 - \alpha \mu \omega q \sigma - \alpha \mu q \sigma \delta_2 + \delta \gamma \omega^2 q + \delta \gamma \omega^2 \rho_2 + \delta \gamma \omega q \delta_2 \\
& + \delta \gamma \omega \rho_1 \delta_2 + \delta \gamma \omega \rho_2 \delta_2 + \delta \mu \omega^2 q + \delta \mu \omega^2 \rho_2 + \delta \mu \omega q \delta_2 + \delta \mu \omega \rho_1 \delta_2 + \delta \mu \omega \rho_2 \delta_2 + \gamma \mu \omega^2 q + \gamma \mu \omega^2 \rho_2 + \gamma \mu \omega q \delta_2 + \gamma \mu \omega \rho_1 \delta_2 + \gamma \mu \omega \rho_2 \delta_2 \\
& + \mu^2 \omega^2 q + \mu^2 \omega^2 \rho_2 + \mu^2 \omega q \delta_2 + \mu^2 \omega \rho_1 \delta_2 + \mu^2 \omega \rho_2 \delta_2 + \mu \omega^2 q \sigma + \mu \omega^2 \rho_2 \sigma + \mu \omega q \sigma \delta_2 + \mu \omega \rho_1 \sigma \delta_2 + \mu \omega \rho_2 \sigma \delta_2 - \delta \gamma \omega^2 - \delta \gamma \omega \delta_2 - \delta \mu \omega^2 \\
& - \delta \mu \omega \delta_2 - \gamma \mu \omega^2 - \gamma \mu \omega \delta_2 - \mu^2 \omega^2 - \mu^2 \omega \delta_2 - \mu \omega^2 \sigma - \mu \omega \sigma \delta_2) \beta) \}
\end{aligned}$$

**Lampiran 2. Sintax simulasi untuk grafik populasi dengan nilai parameter pemberlakuan PSBB yang berbeda yaitu 0.08, 0.2, 0.3423, 0.6**

**(0,08)**

> restart :

> with(linalg) : with(plots) : with(DEtools) :

>

$\rho1 := 0.3; \rho2 := 0.08; \beta := 0.75; \delta2 := 0.04; \omega := 0.5; \mu := 0.00322; \sigma := 0.17; \delta := 0.2;$   
 $\delta1 := 0.16; q := 0.96; \gamma1 := 0.01; \alpha := 0.1; R0 := \frac{(1 - \rho1) \cdot (1 - \rho2) \cdot \beta \cdot (\omega + \mu + \delta2)}{(\delta + \mu + \sigma) \cdot (\omega + \mu)}$

>  $T11 := \frac{d}{dt}s(t) = \mu + \gamma1 \cdot r(t) - (1 - \rho1) \cdot (1 - \rho2) \cdot \beta \cdot s(t) \cdot (c(t) + u(t)) - \mu \cdot s(t)$

>  $T21 := \frac{d}{dt}c(t) = (1 - \rho1) \cdot (1 - \rho2) \cdot \beta \cdot s(t) \cdot (c(t) + u(t)) - (\delta + \sigma + \mu) \cdot c(t)$

>  $T3 := \frac{d}{dt}p(t) = \delta1 \cdot c(t) - (q \cdot \alpha + (1 - q) \cdot \omega + \mu) \cdot p(t)$

>  $T4 := \frac{d}{dt}u(t) = (1 - \rho1) \cdot \delta2 \cdot c(t) - (\omega + \mu) \cdot u(t)$

>  $T5 := \frac{d}{dt}r(t) = \sigma \cdot c(t) + q \cdot \alpha \cdot p(t) - (\mu + \gamma1) \cdot r(t)$

>

>

#c=0.006015391641,p=0.007913687408,r=0.1348207693,s=0.734730511,u=0.000272143490

>

DEplot([T11, T21, T3, T4, T5], [s(t), c(t), p(t), u(t), r(t)], t=0..900, [[s(0)=0.8, c(0)=0.005, p(0)=0.008, u(0)=0.0005, r(0)=0.2], [s(0)=0.7, c(0)=0.005, p(0)=0.008, u(0)=0.0005, r(0)=0.2]], linecolor=[blue, green], arrows=medium, scene=[t, s(t)], method=rosenbrock, stepsize=0.5);

>

#c=0.006015391641,p=0.007913687408,r=0.1348207693,s=0.734730511,u=0.000272143490

&gt;

```
DEplot([T11, T21, T3, T4, T5], [s(t), c(t), p(t), u(t), r(t)], t=0..900, [[s(0)=0.8, c(0)=0.012,
p(0)=0.008, u(0)=0.0005, r(0)=0.2], [s(0)=0.8, c(0)=0.005, p(0)=0.008, u(0)
=0.0005, r(0)=0.2]], linecolor=[blue, green], arrows=medium, scene=[t, c(t)], method
=rosenbrock, stepsize=0.5);
```

```
> #c=0.006015391641, p=0.007913687408, r=0.1348207693, s=0.734730511, u=0.000272143490
```

&gt;

```
DEplot([T11, T21, T3, T4, T5], [s(t), c(t), p(t), u(t), r(t)], t=0..900, [[s(0)=0.8, c(0)
=0.015, p(0)=0.008, u(0)=0.0005, r(0)=0.2], [s(0)=0.8, c(0)=0.005, p(0)=0.006,
u(0)=0.0005, r(0)=0.2]], linecolor=[blue, green], arrows=medium, scene=[t, p(t)],
method=rosenbrock, stepsize=0.5);
```

&gt;

```
#c=0.006015391641, p=0.007913687408, r=0.1348207693, s=0.734730511, u=0.000272143490
```

&gt;

```
DEplot([T11, T21, T3, T4, T5], [s(t), c(t), p(t), u(t), r(t)], t=0..900, [[s(0)=0.8, c(0)
=0.007, p(0)=0.0002, u(0)=0.0004, r(0)=0.004], [s(0)=0.8, c(0)=0.0001, p(0)
=0.0002, u(0)=0.0001, r(0)=0.004]], linecolor=[blue, green], arrows=medium, scene
=[t, u(t)], method=rosenbrock, stepsize=0.5);
```

```
> #c=0.006015391641, p=0.007913687408, r=0.1348207693, s=0.734730511, u=0.000272143490
```

&gt;

```
DEplot([T11, T21, T3, T4, T5], [s(t), c(t), p(t), u(t), r(t)], t=0..800, [[s(0)=0.8, c(0)
=0.007, p(0)=0.0002, u(0)=0.00001, r(0)=0.18], [s(0)=0.8, c(0)=0.007, p(0)
=0.0002, u(0)=0.00001, r(0)=0.12]], linecolor=[blue, green], arrows=medium, scene
=[t, r(t)], method=rosenbrock, stepsize=0.5);
```

**(0,2)**

&gt; restart :

&gt; with(linalg) : with(plots) : with(DEtools) :

&gt;

```
 $\rho_1 := 0.3; \rho_2 := 0.2; \beta := 0.75; \delta_2 := 0.04; \omega := 0.5; \mu := 0.00322; \sigma := 0.17; \delta := 0.2; \delta_1$   

 $:= 0.16; q := 0.96; \gamma_1 := 0.01; \alpha := 0.1; R_0 := \frac{(1 - \rho_1) \cdot (1 - \rho_2) \cdot \beta \cdot (\omega + \mu + \delta_2)}{(\delta + \mu + \sigma) \cdot (\omega + \mu)}$ 
```

```
>  $T_{11} := \frac{d}{dt}s(t) = \mu + \gamma_1 \cdot r(t) - (1 - \rho_1) \cdot (1 - \rho_2) \cdot \beta \cdot s(t) \cdot (c(t) + u(t)) - \mu \cdot s(t)$ 
```

&gt;

```
>  $T_{21} := \frac{d}{dt}c(t) = (1 - \rho_1) \cdot (1 - \rho_2) \cdot \beta \cdot s(t) \cdot (c(t) + u(t)) - (\delta + \sigma + \mu) \cdot c(t)$ 
```

&gt;

```

> T3 :=  $\frac{d}{dt}p(t) = \delta l \cdot c(t) - (q \cdot \alpha + (1 - q) \cdot \omega + \mu) \cdot p(t)$ 
> T4 :=  $\frac{d}{dt}u(t) = (1 - \rho l) \cdot \delta 2 \cdot c(t) - (\omega + \mu) \cdot u(t)$ 
> T5 :=  $\frac{d}{dt}r(t) = \sigma \cdot c(t) + q \cdot \alpha \cdot p(t) - (\mu + \gamma l) \cdot r(t)$ 
>
#c=0.003678126085,p=0.004838843722,r=0.07243649257,s=0.8496940088,u=
0.0001612212695
>
DEplot([T11, T21, T3, T4, T5], [s(t), c(t), p(t), u(t), r(t)], t=0..900, [[s(0)=0.9, c(0)
=0.005, p(0)=0.008, u(0)=0.0005, r(0)=0.2], [s(0)=0.8, c(0)=0.005, p(0)=0.008,
u(0)=0.0005, r(0)=0.2]], linecolor=[blue, green], arrows=medium, scene=[t, s(t)],
method=rosenbrock, stepsize=0.5);
>
#c=0.003678126085,p=0.004838843722,r=0.07243649257,s=0.8496940088,u=
0.0001612212695
>
DEplot([T11, T21, T3, T4, T5], [s(t), c(t), p(t), u(t), r(t)], t=0..900, [[s(0)=1, c(0)=0.006,
p(0)=0.008, u(0)=0.00008, r(0)=0.02], [s(0)=1, c(0)=0.002, p(0)=0.008, u(0)
=0.00008, r(0)=0.02]], linecolor=[blue, green], arrows=medium, scene=[t, c(t)],
method=rosenbrock, stepsize=0.5);
>
#c=0.003678126085,p=0.004838843722,r=0.07243649257,s=0.8496940088,u=
0.0001612212695
>
DEplot([T11, T21, T3, T4, T5], [s(t), c(t), p(t), u(t), r(t)], t=0..900, [[s(0)=1, c(0)=0.006,
p(0)=0.005, u(0)=0.00008, r(0)=0.02], [s(0)=1, c(0)=0.002, p(0)=0.001, u(0)
=0.00008, r(0)=0.02]], linecolor=[blue, green], arrows=medium, scene=[t, p(t)],
method=rosenbrock, stepsize=0.5);
>
#c=0.003678126085,p=0.004838843722,r=0.07243649257,s=0.8496940088,u=
0.0001612212695
>
DEplot([T11, T21, T3, T4, T5], [s(t), c(t), p(t), u(t), r(t)], t=0..900, [[s(0)=1, c(0)=0.006,
p(0)=0.005, u(0)=0.00008, r(0)=0.02], [s(0)=1, c(0)=0.002, p(0)=0.001, u(0)
=0.00008, r(0)=0.02]], linecolor=[blue, green], arrows=medium, scene=[t, u(t)],
method=rosenbrock, stepsize=0.5);
>
#c=0.003678126085,p=0.004838843722,r=0.07243649257,s=0.8496940088,u=
0.0001612212695

```

&gt;

```
DEplot([T11, T21, T3, T4, T5], [s(t), c(t), p(t), u(t), r(t)], t=0..900, [[s(0)=0.8, c(0)
=0.007, p(0)=0.0002, u(0)=0.0002, r(0)=0.07], [s(0)=0.8, c(0)=0.007, p(0)=0.0002,
u(0)=0.0002, r(0)=0.05]], linecolor=[blue, green], arrows=medium, scene=[t, r(t)],
method=rosenbrock, stepsize=0.5);
```

**(0,3423)**

&gt; restart :

&gt; with(linalg) : with(plots) : with(DEtools) :

&gt;

```
ρ1 := 0.3; ρ2 := 0.3423; β := 0.75; δ2 := 0.04; ω := 0.5; μ := 0.00322; σ := 0.17; δ
:= 0.2; δ1 := 0.16; q := 0.96; γ1 := 0.01; α := 0.1; R0
:= 
$$\frac{(1 - \rho1) \cdot (1 - \rho2) \cdot \beta \cdot (\omega + \mu + \delta2)}{(\delta + \mu + \sigma) \cdot (\omega + \mu)}$$

```

```
> T11 := 
$$\frac{d}{dt}s(t) = \mu + \gamma1 \cdot r(t) - (1 - \rho1) \cdot (1 - \rho2) \cdot \beta \cdot s(t) \cdot (c(t) + u(t)) - \mu \cdot s(t)$$

```

&gt;

```
> T21 := 
$$\frac{d}{dt}c(t) = (1 - \rho1) \cdot (1 - \rho2) \cdot \beta \cdot s(t) \cdot (c(t) + u(t)) - (\delta + \sigma + \mu) \cdot c(t)$$

```

&gt;

```
> T3 := 
$$\frac{d}{dt}p(t) = \delta1 \cdot c(t) - (q \cdot \alpha + (1 - q) \cdot \omega + \mu) \cdot p(t)$$

```

```
> T4 := 
$$\frac{d}{dt}u(t) = (1 - \rho1) \cdot \delta2 \cdot c(t) - (\omega + \mu) \cdot u(t)$$

```

```
> T5 := 
$$\frac{d}{dt}r(t) = \sigma \cdot c(t) + q \cdot \alpha \cdot p(t) - (\mu + \gamma1) \cdot r(t)$$

```

&gt;

```
DEplot([T11, T21, T3, T4, T5], [s(t), c(t), p(t), u(t), r(t)], t=0..900, [[s(0)=1.1, c(0)
=0.005, p(0)=0.008, u(0)=0.0005, r(0)=0.2], [s(0)=0.9, c(0)=0.005, p(0)=0.008,
u(0)=0.0005, r(0)=0.2]], linecolor=[blue, green], arrows=medium, scene=[t, s(t)],
method=rosenbrock, stepsize=0.5);
```

&gt;

```
DEplot([T11, T21, T3, T4, T5], [s(t), c(t), p(t), u(t), r(t)], t=0..300, [[s(0)=0.8, c(0)=0.009,
p(0)=0.008, u(0)=0.0005, r(0)=0.2], [s(0)=0.8, c(0)=0.005, p(0)=0.008, u(0)
=0.0005, r(0)=0.2]], linecolor=[blue, green], arrows=medium, scene=[t, c(t)], method
=rosenbrock, stepsize=0.5);
```

&gt;

&gt;

```
DEplot([T11, T21, T3, T4, T5], [s(t), c(t), p(t), u(t), r(t)], t=0..350, [[s(0)=0.8, c(0)
=0.015, p(0)=0.008, u(0)=0.0005, r(0)=0.2], [s(0)=0.8, c(0)=0.005, p(0)=0.006,
u(0)=0.0005, r(0)=0.2]], linecolor=[blue, green], arrows=medium, scene=[t, p(t)],
method=rosenbrock, stepsize=0.5);
```

&gt;

```
DEplot([T11, T21, T3, T4, T5], [s(t), c(t), p(t), u(t), r(t)], t=0..150, [[s(0)=0.8, c(0)=0.007, p(0)=0.0002, u(0)=0.0005, r(0)=0.004], [s(0)=0.8, c(0)=0.007, p(0)=0.0002, u(0)=0.00009, r(0)=0.004]], linecolor=[blue, green], arrows=medium, scene=[t, u(t)], method=rosenbrock, stepsize=0.5);
```

&gt;

```
DEplot([T11, T21, T3, T4, T5], [s(t), c(t), p(t), u(t), r(t)], t=0..700, [[s(0)=0.8, c(0)=0.007, p(0)=0.0002, u(0)=0.00001, r(0)=0.2], [s(0)=0.8, c(0)=0.007, p(0)=0.0002, u(0)=0.00001, r(0)=0.09]], linecolor=[blue, green], arrows=medium, scene=[t, r(t)], method=rosenbrock, stepsize=0.5);
```

**(0,6)**

&gt; restart :

&gt; with(linalg) : with(plots) : with(DEtools) :

&gt;

```
 $\rho1 := 0.3; \rho2 := 0.6; \beta := 0.75; \delta2 := 0.04; \omega := 0.5; \mu := 0.00322; \sigma := 0.17; \delta := 0.2; \delta l := 0.16; q := 0.96; \gamma l := 0.01; \alpha := 0.1; R0 := \frac{(1 - \rho1) \cdot (1 - \rho2) \cdot \beta \cdot (\omega + \mu + \delta2)}{(\delta + \mu + \sigma) \cdot (\omega + \mu)}$ 
```

```
> T11 :=  $\frac{d}{dt}s(t) = \mu + \gamma l \cdot r(t) - (1 - \rho1) \cdot (1 - \rho2) \cdot \beta \cdot s(t) \cdot (c(t) + u(t)) - \mu \cdot s(t)$ 
```

&gt;

```
> T21 :=  $\frac{d}{dt}c(t) = (1 - \rho1) \cdot (1 - \rho2) \cdot \beta \cdot s(t) \cdot (c(t) + u(t)) - (\delta + \sigma + \mu) \cdot c(t)$ 
```

&gt;

```
> T3 :=  $\frac{d}{dt}p(t) = \delta l \cdot c(t) - (q \cdot \alpha + (1 - q) \cdot \omega + \mu) \cdot p(t)$ 
```

```
> T4 :=  $\frac{d}{dt}u(t) = (1 - \rho1) \cdot \delta2 \cdot c(t) - (\omega + \mu) \cdot u(t)$ 
```

```
> T5 :=  $\frac{d}{dt}r(t) = \sigma \cdot c(t) + q \cdot \alpha \cdot p(t) - (\mu + \gamma l) \cdot r(t)$ 
```

&gt;

```
DEplot([T11, T21, T3, T4, T5], [s(t), c(t), p(t), u(t), r(t)], t=0..2000, [[s(0)=1.3, c(0)=0.005, p(0)=0.008, u(0)=0.0005, r(0)=0.2], [s(0)=0.7, c(0)=0.005, p(0)=0.008, u(0)=0.0005, r(0)=0.2]], linecolor=[blue, green], arrows=medium, scene=[t, s(t)], method=rosenbrock, stepsize=0.5);
```

&gt;

```
DEplot([T11, T21, T3, T4, T5], [s(t), c(t), p(t), u(t), r(t)], t=0..60, [[s(0)=0.8, c(0)=0.00009, p(0)=0.008, u(0)=0.0005, r(0)=0.2], [s(0)=0.8, c(0)=0.00005, p(0)=0.008, u(0)=0.0005, r(0)=0.2]], linecolor=[blue, green], arrows=medium, scene=[t, c(t)], method=rosenbrock, stepsize=0.5);
```

&gt;

&gt;

```
DEplot([T11, T21, T3, T4, T5], [s(t), c(t), p(t), u(t), r(t)], t=0..100, [[s(0)=0.8, c(0)
=0.015, p(0)=0.008, u(0)=0.0005, r(0)=0.2], [s(0)=0.8, c(0)=0.005, p(0)=0.006,
u(0)=0.0005, r(0)=0.2]], linecolor=[blue, green], arrows=medium, scene=[t, p(t)],
method=rosenbrock, stepsize=0.5);
```

&gt;

```
DEplot([T11, T21, T3, T4, T5], [s(t), c(t), p(t), u(t), r(t)], t=0..50, [[s(0)=0.8, c(0)=0.007,
p(0)=0.0002, u(0)=0.0004, r(0)=0.004], [s(0)=0.8, c(0)=0.007, p(0)=0.0002, u(0)
=0.0001, r(0)=0.004]], linecolor=[blue, green], arrows=medium, scene=[t, u(t)],
method=rosenbrock, stepsize=0.5);
```

&gt;

```
DEplot([T11, T21, T3, T4, T5], [s(t), c(t), p(t), u(t), r(t)], t=0..700, [[s(0)=0.8, c(0)
=0.007, p(0)=0.0002, u(0)=0.00001, r(0)=0.2], [s(0)=0.8, c(0)=0.007, p(0)=0.0002,
u(0)=0.00001, r(0)=0.09]], linecolor=[blue, green], arrows=medium, scene=[t, r(t)],
method=rosenbrock, stepsize=0.5);
```

**Lampiran 3. Sintax simulasi untuk grafik populasi dengan nilai parameter interaksi antar individu yang berbeda yaitu 0.75, 0.65, 0.536, 0.3.**

**(0,75)**

```

> restart :
> with(linalg) : with(plots) : with(DEtools) :
>
ρ1 := 0.3; ρ2 := 0.08; β := 0.75; δ2 := 0.04; ω := 0.5; μ := 0.00322; σ := 0.17; δ := 0.2;
    δl := 0.16; q := 0.96; γl := 0.01; α := 0.1; R0 :=  $\frac{(1 - \rho1) \cdot (1 - \rho2) \cdot \beta \cdot (\omega + \mu + \delta2)}{(\delta + \mu + \sigma) \cdot (\omega + \mu)}$ 
>
T11 :=  $\frac{d}{dt}s(t) = \mu + \gamma l \cdot r(t) - (1 - \rho1) \cdot (1 - \rho2) \cdot \beta \cdot s(t) \cdot (c(t) + u(t)) - \mu \cdot s(t)$ 
>
T21 :=  $\frac{d}{dt}c(t) = (1 - \rho1) \cdot (1 - \rho2) \cdot \beta \cdot s(t) \cdot (c(t) + u(t)) - (\delta + \sigma + \mu) \cdot c(t)$ 
>
T3 :=  $\frac{d}{dt}p(t) = \delta l \cdot c(t) - (q \cdot \alpha + (1 - q) \cdot \omega + \mu) \cdot p(t)$ 
>
T4 :=  $\frac{d}{dt}u(t) = (1 - \rho1) \cdot \delta2 \cdot c(t) - (\omega + \mu) \cdot u(t)$ 
>
T5 :=  $\frac{d}{dt}r(t) = \sigma \cdot c(t) + q \cdot \alpha \cdot p(t) - (\mu + \gamma l) \cdot r(t)$ 
>
#c=0.006015391641,p=0.007913687408,r=0.1348207693,s=0.734730511,u=0.000272143490
>
DEplot([T11, T21, T3, T4, T5], [s(t), c(t), p(t), u(t), r(t)], t=0..900, [[s(0)=0.8, c(0)
=0.005, p(0)=0.008, u(0)=0.0005, r(0)=0.2], [s(0)=0.7, c(0)=0.005, p(0)=0.008,
u(0)=0.0005, r(0)=0.2]], linecolor=[blue, green], arrows=medium, scene=[t, s(t)],
method=rosenbrock, stepsize=0.5);
>
DEplot([T11, T21, T3, T4, T5], [s(t), c(t), p(t), u(t), r(t)], t=0..900, [[s(0)=0.8, c(0)=0.012,
p(0)=0.008, u(0)=0.0005, r(0)=0.2], [s(0)=0.8, c(0)=0.005, p(0)=0.008, u(0)
=0.0005, r(0)=0.2]], linecolor=[blue, green], arrows=medium, scene=[t, c(t)], method
=rosenbrock, stepsize=0.5);
>
#c=0.006015391641,p=0.007913687408,r=0.1348207693,s=0.734730511,u=0.000272143490
>
DEplot([T11, T21, T3, T4, T5], [s(t), c(t), p(t), u(t), r(t)], t=0..900, [[s(0)=0.8, c(0)
=0.015, p(0)=0.008, u(0)=0.0005, r(0)=0.2], [s(0)=0.8, c(0)=0.005, p(0)=0.006,
u(0)=0.0005, r(0)=0.2]], linecolor=[blue, green], arrows=medium, scene=[t, p(t)],
method=rosenbrock, stepsize=0.5);

```



>  
 #c=0.006015391641,p=0.007913687408,r=0.1348207693,s=0.734730511,u=0.000272143490

>  
 DEplot([T11, T21, T3, T4, T5], [s(t), c(t), p(t), u(t), r(t)], t=0..900, [[s(0)=0.8, c(0)=0.007, p(0)=0.0002, u(0)=0.0004, r(0)=0.004], [s(0)=0.8, c(0)=0.0001, p(0)=0.0002, u(0)=0.00001, r(0)=0.004]], linecolor=[blue, green], arrows=medium, scene=[t, u(t)], method=rosenbrock, stepsize=0.5);

>  
 >  
 #c=0.006015391641,p=0.007913687408,r=0.1348207693,s=0.734730511,u=0.000272143490

>  
 DEplot([T11, T21, T3, T4, T5], [s(t), c(t), p(t), u(t), r(t)], t=0..900, [[s(0)=0.8, c(0)=0.007, p(0)=0.0002, u(0)=0.00001, r(0)=0.16], [s(0)=0.8, c(0)=0.007, p(0)=0.0002, u(0)=0.00001, r(0)=0.09]], linecolor=[blue, green], arrows=medium, scene=[t, r(t)], method=rosenbrock, stepsize=0.5);

### (0,65)

> restart :  
 > with(linalg) : with(plots) : with(DEtools) :  
 >

$\rho1 := 0.3; \rho2 := 0.08; \beta := 0.65; \delta2 := 0.04; \omega := 0.5; \mu := 0.00322; \sigma := 0.17; \delta := 0.2;$   
 $\delta1 := 0.16; q := 0.96; \gamma1 := 0.01; \alpha := 0.1; R0 := \frac{(1 - \rho1) \cdot (1 - \rho2) \cdot \beta \cdot (\omega + \mu + \delta2)}{(\delta + \mu + \sigma) \cdot (\omega + \mu)}$

>  $T11 := \frac{d}{dt}s(t) = \mu + \gamma1 \cdot r(t) - (1 - \rho1) \cdot (1 - \rho2) \cdot \beta \cdot s(t) \cdot (c(t) + u(t)) - \mu \cdot s(t)$

>  
 >  $T21 := \frac{d}{dt}c(t) = (1 - \rho1) \cdot (1 - \rho2) \cdot \beta \cdot s(t) \cdot (c(t) + u(t)) - (\delta + \sigma + \mu) \cdot c(t)$

>  
 >  $T3 := \frac{d}{dt}p(t) = \delta1 \cdot c(t) - (q \cdot \alpha + (1 - q) \cdot \omega + \mu) \cdot p(t)$

>  $T4 := \frac{d}{dt}u(t) = (1 - \rho1) \cdot \delta2 \cdot c(t) - (\omega + \mu) \cdot u(t)$

>  $T5 := \frac{d}{dt}r(t) = \sigma \cdot c(t) + q \cdot \alpha \cdot p(t) - (\mu + \gamma1) \cdot r(t)$

>  
 #c=0.003618196198,p=0.004760001577,r=0.07109330598,s=0.8324689052,u=0.00021569650366

>  
 DEplot([T11, T21, T3, T4, T5], [s(t), c(t), p(t), u(t), r(t)], t=0..900, [[s(0)=1, c(0)=0.005, p(0)=0.008, u(0)=0.0005, r(0)=0.2], [s(0)=0.7, c(0)=0.005, p(0)=0.008, u(0)=0.0005, r(0)=0.2]], linecolor=[blue, green], arrows=medium, scene=[t, s(t)], method=rosenbrock, stepsize=0.5);

&gt;

```
#c=0.003618196198,p=0.004760001577,r=0.07109330598,s=0.8324689052,u=
0.00021569650366
```

&gt;

```
DEplot([T11,T21,T3,T4,T5],[s(t),c(t),p(t),u(t),r(t)],t=0..900,[[s(0)=1,c(0)=0.006,
p(0)=0.008,u(0)=0.00008,r(0)=0.02],[s(0)=1,c(0)=0.0002,p(0)=0.008,u(0)
=0.00008,r(0)=0.02]],linecolor=[blue,green],arrows=medium,scene=[t,c(t)],
method=rosenbrock,stepsize=0.5);
```

&gt;

&gt;

```
DEplot([T11,T21,T3,T4,T5],[s(t),c(t),p(t),u(t),r(t)],t=0..900,[[s(0)=1,c(0)=0.006,
p(0)=0.005,u(0)=0.00008,r(0)=0.02],[s(0)=1,c(0)=0.002,p(0)=0.003,u(0)
=0.00008,r(0)=0.02]],linecolor=[blue,green],arrows=medium,scene=[t,p(t)],
method=rosenbrock,stepsize=0.5);
```

&gt;

```
#c=0.003618196198,p=0.004760001577,r=0.07109330598,s=0.8324689052,u=
0.00021569650366
```

&gt;

```
DEplot([T11,T21,T3,T4,T5],[s(t),c(t),p(t),u(t),r(t)],t=0..900,[[s(0)=1,c(0)=0.006,
p(0)=0.005,u(0)=0.00008,r(0)=0.02],[s(0)=1,c(0)=0.002,p(0)=0.001,u(0)
=0.00008,r(0)=0.02]],linecolor=[blue,green],arrows=medium,scene=[t,u(t)],
method=rosenbrock,stepsize=0.5);
```

&gt;

```
#c=0.003618196198,p=0.004760001577,r=0.07109330598,s=0.8324689052,u=
0.00021569650366
```

&gt;

```
DEplot([T11,T21,T3,T4,T5],[s(t),c(t),p(t),u(t),r(t)],t=0..900,[[s(0)=0.8,c(0)
=0.007,p(0)=0.0002,u(0)=0.0002,r(0)=0.08],[s(0)=0.8,c(0)=0.007,p(0)=0.0002,
u(0)=0.0002,r(0)=0.05]],linecolor=[blue,green],arrows=medium,scene=[t,r(t)],
method=rosenbrock,stepsize=0.5);
```

**(0,536)**

&gt; restart :

&gt; with(linalg) : with(plots) : with(DEtools) :

&gt;

```
 $\rho1 := 0.3; \rho2 := 0.08; \beta := 0.536; \delta2 := 0.04; \omega := 0.5; \mu := 0.00322; \sigma := 0.17; \delta := 0.2;$ 
 $\delta1 := 0.16; q := 0.96; \gamma1 := 0.01; \alpha := 0.1; R0 := \frac{(1 - \rho1) \cdot (1 - \rho2) \cdot \beta \cdot (\omega + \mu + \delta2)}{(\delta + \mu + \sigma) \cdot (\omega + \mu)}$ 
```

```
> T11 :=  $\frac{d}{dt}s(t) = \mu + \gamma1 \cdot r(t) - (1 - \rho1) \cdot (1 - \rho2) \cdot \beta \cdot s(t) \cdot (c(t) + u(t)) - \mu \cdot s(t)$ 
```

&gt;

$$> T21 := \frac{d}{dt}c(t) = (1 - \rho1) \cdot (1 - \rho2) \cdot \beta \cdot s(t) \cdot (c(t) + u(t)) - (\delta + \sigma + \mu) \cdot c(t)$$

>

$$> T3 := \frac{d}{dt}p(t) = \delta1 \cdot c(t) - (q \cdot \alpha + (1 - q) \cdot \omega + \mu) \cdot p(t)$$

$$> T4 := \frac{d}{dt}u(t) = (1 - \rho1) \cdot \delta2 \cdot c(t) - (\omega + \mu) \cdot u(t)$$

$$> T5 := \frac{d}{dt}r(t) = \sigma \cdot c(t) + q \cdot \alpha \cdot p(t) - (\mu + \gamma1) \cdot r(t)$$

>

*DEplot*([T11, T21, T3, T4, T5], [s(t), c(t), p(t), u(t), r(t)], t=0..800, [[s(0)=1.1, c(0)=0.005, p(0)=0.008, u(0)=0.0005, r(0)=0.2], [s(0)=0.9, c(0)=0.005, p(0)=0.008, u(0)=0.0005, r(0)=0.2]], *linecolor*=[blue, green], *arrows*=medium, *scene*=[t, s(t)], *method*=rosenbrock, *stepsize*=0.5);

>

*DEplot*([T11, T21, T3, T4, T5], [s(t), c(t), p(t), u(t), r(t)], t=0..300, [[s(0)=0.8, c(0)=0.009, p(0)=0.008, u(0)=0.0005, r(0)=0.2], [s(0)=0.8, c(0)=0.005, p(0)=0.008, u(0)=0.0005, r(0)=0.2]], *linecolor*=[blue, green], *arrows*=medium, *scene*=[t, c(t)], *method*=rosenbrock, *stepsize*=0.5);

>

*DEplot*([T11, T21, T3, T4, T5], [s(t), c(t), p(t), u(t), r(t)], t=0..350, [[s(0)=0.8, c(0)=0.015, p(0)=0.008, u(0)=0.0005, r(0)=0.2], [s(0)=0.8, c(0)=0.005, p(0)=0.006, u(0)=0.0005, r(0)=0.2]], *linecolor*=[blue, green], *arrows*=medium, *scene*=[t, p(t)], *method*=rosenbrock, *stepsize*=0.5);

>

*DEplot*([T11, T21, T3, T4, T5], [s(t), c(t), p(t), u(t), r(t)], t=0..150, [[s(0)=0.8, c(0)=0.007, p(0)=0.0002, u(0)=0.0005, r(0)=0.004], [s(0)=0.8, c(0)=0.007, p(0)=0.0002, u(0)=0.00009, r(0)=0.004]], *linecolor*=[blue, green], *arrows*=medium, *scene*=[t, u(t)], *method*=rosenbrock, *stepsize*=0.5);

>

*DEplot*([T11, T21, T3, T4, T5], [s(t), c(t), p(t), u(t), r(t)], t=0..700, [[s(0)=0.8, c(0)=0.007, p(0)=0.0002, u(0)=0.00001, r(0)=0.2], [s(0)=0.8, c(0)=0.007, p(0)=0.0002, u(0)=0.00001, r(0)=0.09]], *linecolor*=[blue, green], *arrows*=medium, *scene*=[t, r(t)], *method*=rosenbrock, *stepsize*=0.5);

### (0,3)

> *restart* :

> *with(linalg)* : *with(plots)* : *with(DEtools)* :

>

$\rho1 := 0.3; \rho2 := 0.08; \beta := 0.3; \delta2 := 0.04; \omega := 0.5; \mu := 0.00322; \sigma := 0.17; \delta := 0.2; \delta1$   
 $:= 0.16; q := 0.96; \gamma1 := 0.01; \alpha := 0.1; R0 := \frac{(1 - \rho1) \cdot (1 - \rho2) \cdot \beta \cdot (\omega + \mu + \delta2)}{(\delta + \mu + \sigma) \cdot (\omega + \mu)}$

$$> T11 := \frac{d}{dt}s(t) = \mu + \gamma l \cdot r(t) - (1 - \rho l) \cdot (1 - \rho 2) \cdot \beta \cdot s(t) \cdot (c(t) + u(t)) - \mu \cdot s(t)$$

>

$$> T21 := \frac{d}{dt}c(t) = (1 - \rho l) \cdot (1 - \rho 2) \cdot \beta \cdot s(t) \cdot (c(t) + u(t)) - (\delta + \sigma + \mu) \cdot c(t)$$

>

$$> T3 := \frac{d}{dt}p(t) = \delta l \cdot c(t) - (q \cdot \alpha + (1 - q) \cdot \omega + \mu) \cdot p(t)$$

$$> T4 := \frac{d}{dt}u(t) = (1 - \rho l) \cdot \delta 2 \cdot c(t) - (\omega + \mu) \cdot u(t)$$

$$> T5 := \frac{d}{dt}r(t) = \sigma \cdot c(t) + q \cdot \alpha \cdot p(t) - (\mu + \gamma l) \cdot r(t)$$

>

*DEplot*([*T11, T21, T3, T4, T5*], [*s(t), c(t), p(t), u(t), r(t)*], *t=0..2000*, [[*s(0)=1.3, c(0)=0.005, p(0)=0.008, u(0)=0.0005, r(0)=0.2*], [*s(0)=0.7, c(0)=0.005, p(0)=0.008, u(0)=0.0005, r(0)=0.2*]], *linecolor=[blue, green]*, *arrows=medium*, *scene=[t, s(t)]*, *method=rosenbrock*, *stepsize=0.5*);

>

*DEplot*([*T11, T21, T3, T4, T5*], [*s(t), c(t), p(t), u(t), r(t)*], *t=0..60*, [[*s(0)=0.8, c(0)=0.00009, p(0)=0.008, u(0)=0.0005, r(0)=0.2*], [*s(0)=0.8, c(0)=0.00005, p(0)=0.008, u(0)=0.0005, r(0)=0.2*]], *linecolor=[blue, green]*, *arrows=medium*, *scene=[t, c(t)]*, *method=rosenbrock*, *stepsize=0.5*);

>

*DEplot*([*T11, T21, T3, T4, T5*], [*s(t), c(t), p(t), u(t), r(t)*], *t=0..80*, [[*s(0)=0.8, c(0)=0.015, p(0)=0.008, u(0)=0.0005, r(0)=0.2*], [*s(0)=0.8, c(0)=0.005, p(0)=0.006, u(0)=0.0005, r(0)=0.2*]], *linecolor=[blue, green]*, *arrows=medium*, *scene=[t, p(t)]*, *method=rosenbrock*, *stepsize=0.5*);

>

*DEplot*([*T11, T21, T3, T4, T5*], [*s(t), c(t), p(t), u(t), r(t)*], *t=0..50*, [[*s(0)=0.8, c(0)=0.007, p(0)=0.0002, u(0)=0.0005, r(0)=0.004*], [*s(0)=0.8, c(0)=0.007, p(0)=0.0002, u(0)=0.00009, r(0)=0.004*]], *linecolor=[blue, green]*, *arrows=medium*, *scene=[t, u(t)]*, *method=rosenbrock*, *stepsize=0.5*);

>

*DEplot*([*T11, T21, T3, T4, T5*], [*s(t), c(t), p(t), u(t), r(t)*], *t=0..700*, [[*s(0)=0.8, c(0)=0.007, p(0)=0.0002, u(0)=0.00001, r(0)=0.2*], [*s(0)=0.8, c(0)=0.007, p(0)=0.0002, u(0)=0.00001, r(0)=0.09*]], *linecolor=[blue, green]*, *arrows=medium*, *scene=[t, r(t)]*, *method=rosenbrock*, *stepsize=0.5*);

**Lampiran 4. Sintax grafik perbandingan antara parameter pemberlakuan PSBB dan interaksi antar individu pada saat  $R_0 = 1$**

```

> restart :
> with(linalg) : with(plots) : with(DEtools) : with(plots, implicitplot)
  [implicitplot]
>  $\rho_1 := 0.3; \rho_2 := \rho_2; \beta := \beta; \delta_2 := 0.04; \omega := 0.5; \mu := 0.00322; \sigma := 0.17; \delta := 0.2;$ 

>  $R0 := \frac{(1 - \rho_1) \cdot (1 - \rho_2) \cdot \beta \cdot (\omega + \mu + \delta_2)}{(\delta + \mu + \sigma) \cdot (\omega + \mu)}$ 
> R0
>
> implicitplot(R0 = 1,  $\rho_2 = 0..1, \beta = 0..1$ )
>  $\rho_2 := 0.3; \beta := 0.6;$ 

> R0

```