

Steady-state

```
In[1]:= sol = Solve[sourcep53 - dp53 * x1 - degbasal * x1 * x2 - kcop11 * x1 * x3 + kcop12 * x4 == 0 &&
f1 - dMdm2 * x2 == 0 && -kcop11 * x1 * x3 + kcop12 * x4 + kdegcop1 * x4 + f2 - dcop1 * x3 ==
0 && kcop11 * x1 * x3 - kcop12 * x4 - kdegcop1 * x4 == 0, {x1, x2, x3, x4}];

sol = Simplify[sol]

In[2]:= {x1 ->  $\frac{dcop1 \, dMdm2 \, (kcop12 + kdegcop1) \, sourcep53}{dMdm2 \, f2 \, kcop11 \, kdegcop1 + dcop1 \, (dMdm2 \, dp53 + degbasal \, f1) \, (kcop12 + kdegcop1)}$ ,
x2 ->  $\frac{f1}{dMdm2}$ , x3 ->  $\frac{f2}{dcop1}$ ,
x4 ->  $\frac{dMdm2 \, f2 \, kcop11 \, sourcep53}{dMdm2 \, f2 \, kcop11 \, kdegcop1 + dcop1 \, (dMdm2 \, dp53 + degbasal \, f1) \, (kcop12 + kdegcop1)}$ }

Out[2]:= {x1 ->  $\frac{dcop1 \, dMdm2 \, (kcop12 + kdegcop1) \, sourcep53}{dMdm2 \, f2 \, kcop11 \, kdegcop1 + dcop1 \, (dMdm2 \, dp53 + degbasal \, f1) \, (kcop12 + kdegcop1)}$ ,
x2 ->  $\frac{f1}{dMdm2}$ , x3 ->  $\frac{f2}{dcop1}$ ,
x4 ->  $\frac{dMdm2 \, f2 \, kcop11 \, sourcep53}{dMdm2 \, f2 \, kcop11 \, kdegcop1 + dcop1 \, (dMdm2 \, dp53 + degbasal \, f1) \, (kcop12 + kdegcop1)}$ }
```

Jacobian

```
In[3]:= y1 = sourcep53 - dp53 * x1 - degbasal * x1 * x2 - kcop11 * x1 * x3 + kcop12 * x4;
y2 = f1 - dMdm2 * x2 ;
y3 = -kcop11 * x1 * x3 + kcop12 * x4 + kdegcop1 * x4 + f2 - dcop1 * x3;
y4 = kcop11 * x1 * x3 - kcop12 * x4 - kdegcop1 * x4;
```

```
J = {{D[y1, x1], D[y1, x2], D[y1, x3], D[y1, x4]}, {D[y2, x1], D[y2, x2], D[y2, x3], D[y2, x4]}, {D[y3, x1], D[y3, x2], D[y3, x3], D[y3, x4]}, {D[y4, x1], D[y4, x2], D[y4, x3], D[y4, x4]}}

{{{-dp53 - degbasal x2 - kcop11 x3, -degbasal x1, -kcop11 x1, kcop12}, {0, -dMdm2, 0, 0}, {-kcop11 x3, 0, -dcop1 - kcop11 x1, kcop12 + kdegcop1}, {kcop11 x3, 0, kcop11 x1, -kcop12 - kdegcop1}}, {{-dp53 - degbasal x2 - kcop11 x3, -degbasal x1, -kcop11 x1, kcop12}, {0, -dMdm2, 0, 0}, {-kcop11 x3, 0, -dcop1 - kcop11 x1, kcop12 + kdegcop1}, {kcop11 x3, 0, kcop11 x1, -kcop12 - kdegcop1}}}
```

Evaluation at steady state

```
sourcep53 = 0.0073184;
dp53 = 0.0000034186;
f1 = 0.00000024471;
dMdm2 = 0.00073361;
f2 = 0.00068187;
dcop1 = 0.0013064;
kdegcop1 = 2.1436;
degbasal = 0.11435;
kcop11 = 0.1;
kcop12 = 0.0011;

{{x1 → 0.140266, x2 → 0.00033357, x3 → 0.521946, x4 → 0.0034136}}}

J2 = J /. sol
{{{ {-0.0522018, -0.0160395, -0.0140266, 0.0011}, {0, -0.00073361, 0, 0},
{-0.0521946, 0, -0.015333, 2.1447}, {0.0521946, 0, 0.0140266, -2.1447}}}}
```

EV = Eigenvalues[J2]

```
{-2.15911, -0.0518182, -0.00130662, -0.00073361}
```