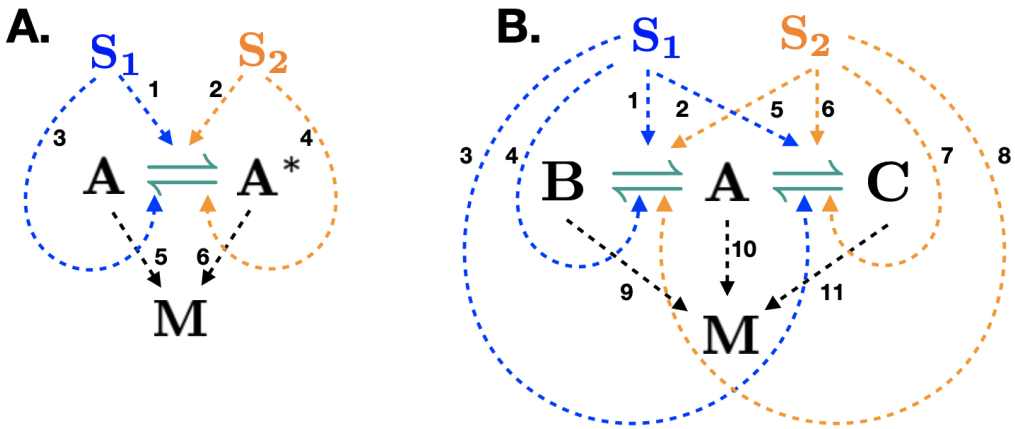
Minimal conversion network for value antagonism

Here we analyze the following general networks using conversion mechanism-



For the derivations we use the math –

$$\begin{array}{c} S \\ \downarrow \\ A_1 \rightleftharpoons A_2 \end{array}$$

$$\dot{a_2} = k_1 s a_1 - k_2 a_2$$

$$a_1 + a_2 = k_0$$

This analysis will be similar to analysis in Appendix C for binding networks where P_i determines the presence or absence of an edge-

Network A - five nodes

Dynamics-

```
In[•]:= dadt = (k_B + P_3 * k_3 * s_1 + P_4 * k_4 * s_2) * (a0 - a) - (k_F + P_1 * k_1 * s_1 + P_2 * k_2 * s_2) * a;
        dmdt = k_m0 + P_5 * k_5 * a + P_6 * k_6 * (a0 - a) - k_dm * m;
        Solve[{dadt == 0, dmdt == 0}, {a, m}]
```

$$\text{Out[•]= } \left\{\left\{a \to \frac{a0\,(k_B + k_3\,P_3\,s_1 + k_4\,P_4\,s_2)}{k_B + k_F + k_1\,P_1\,s_1 + k_3\,P_3\,s_1 + k_2\,P_2\,s_2 + k_4\,P_4\,s_2},\right.\right.$$
$$\left.\left. m \to -\left(\left(-k_B\,k_{m0} - k_F\,k_{m0} - a0\,k_5\,k_B\,P_5 - a0\,k_6\,k_F\,P_6 - k_1\,k_{m0}\,P_1\,s_1 - k_3\,k_{m0}\,P_3\,s_1 - a0\,k_3\,k_5\,P_3\,P_5\,s_1 - a0\,k_1\,k_6\,P_1\,P_6\,s_1 - k_2\,k_{m0}\,P_2\,s_2 - k_4\,k_{m0}\,P_4\,s_2 - a0\,k_4\,k_5\,P_4\,P_5\,s_2 - a0\,k_2\,k_6\,P_2\,P_6\,s_2\right) / \left(k_{dm}\,(k_B + k_F + k_1\,P_1\,s_1 + k_3\,P_3\,s_1 + k_2\,P_2\,s_2 + k_4\,P_4\,s_2)\right)\right)\right\}\right\}$$

Steady state expressions when both signals are present-

```
In[•]:= mP = FullSimplify[
          -((-k_B k_m0 - k_F k_m0 - a0 k_5 k_B P_5 - a0 k_6 k_F P_6 - k_1 k_m0 P_1 s_1 - k_3 k_m0 P_3 s_1 - a0 k_3 k_5 P_3 P_5 s_1 -
              a0 k_1 k_6 P_1 P_6 s_1 - k_2 k_m0 P_2 s_2 - k_4 k_m0 P_4 s_2 - a0 k_4 k_5 P_4 P_5 s_2 - a0 k_2 k_6 P_2 P_6 s_2) /
            (k_dm (k_B + k_F + k_1 P_1 s_1 + k_3 P_3 s_1 + k_2 P_2 s_2 + k_4 P_4 s_2)))]
```

$$\text{Out[•]= } (k_F\,k_{m0} + k_B\,(k_{m0} + a0\,k_5\,P_5) + a0\,k_6\,k_F\,P_6 + k_1\,k_{m0}\,P_1\,s_1 + k_3\,k_{m0}\,P_3\,s_1 + a0\,k_3\,k_5\,P_3\,P_5\,s_1 + a0\,k_1\,k_6\,P_1\,P_6\,s_1 + (k_4\,P_4\,(k_{m0} + a0\,k_5\,P_5) + k_2\,P_2\,(k_{m0} + a0\,k_6\,P_6))\,s_2) / (k_{dm}\,(k_B + k_F + (k_1\,P_1 + k_3\,P_3)\,s_1 + (k_2\,P_2 + k_4\,P_4)\,s_2))$$

Steady state expressions when only one signal is present -

```
In[•]:= mP1 = FullSimplify[mP /. s_2 → 0]
```

$$\text{Out[•]= } \frac{k_B\,(k_{m0} + a0\,k_5\,P_5) + k_F\,(k_{m0} + a0\,k_6\,P_6) + (k_3\,P_3\,(k_{m0} + a0\,k_5\,P_5) + k_1\,P_1\,(k_{m0} + a0\,k_6\,P_6))\,s_1}{k_{dm}\,(k_B + k_F + (k_1\,P_1 + k_3\,P_3)\,s_1)}$$

```
In[•]:= mP2 = FullSimplify[mP /. s_1 → 0]
```

$$\text{Out[•]= } \frac{k_B\,(k_{m0} + a0\,k_5\,P_5) + k_F\,(k_{m0} + a0\,k_6\,P_6) + (k_4\,P_4\,(k_{m0} + a0\,k_5\,P_5) + k_2\,P_2\,(k_{m0} + a0\,k_6\,P_6))\,s_2}{k_{dm}\,(k_B + k_F + (k_2\,P_2 + k_4\,P_4)\,s_2)}$$

Plotting some surface maps-

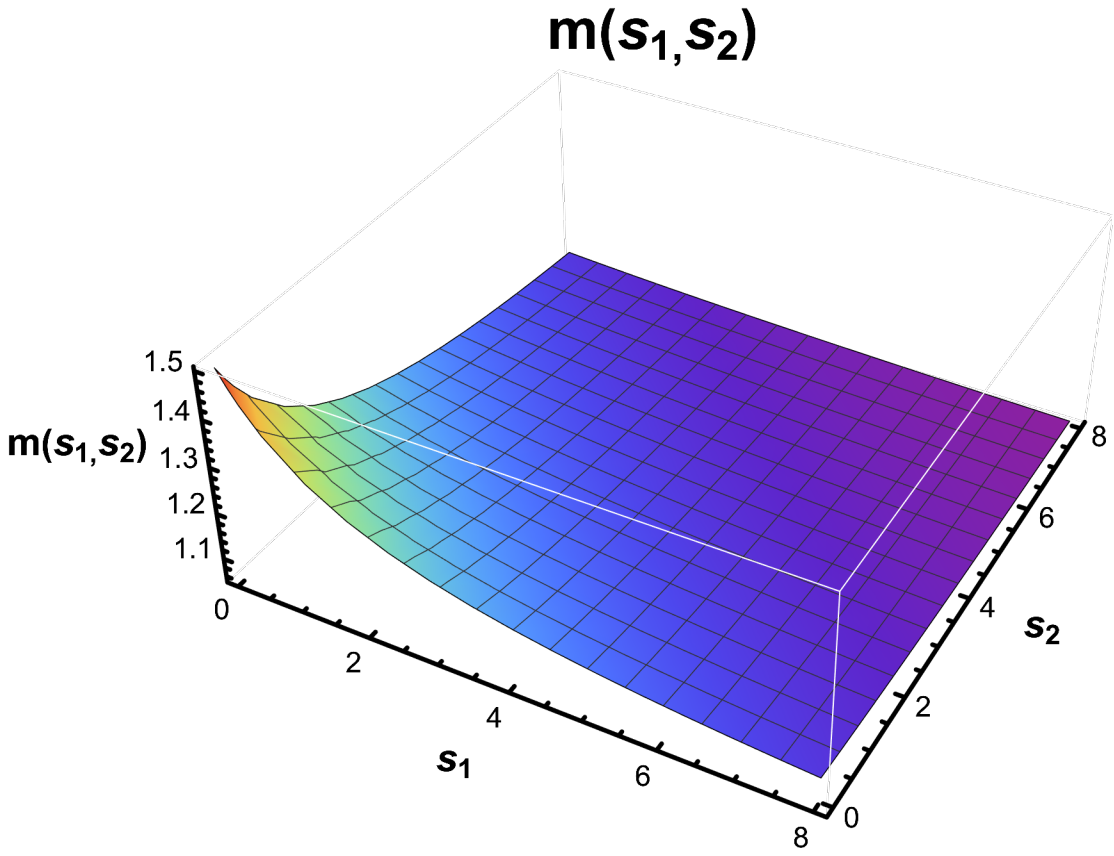
```
In[1]:= dadt = (1 + P_3 * 1 * s_1 + P_4 * 1 * s_2) * (1 - a) - (1 + P_1 * 1 * s_1 + P_2 * 1 * s_2) * a;
        dmdt = 1 + P_5 * 1 * a + P_6 * 1 * (1 - a) - 1 * m;
        Solve[{dadt == 0, dmdt == 0}, {a, m}]
```

$$\text{Out[3]= } \left\{\left\{a \to -\frac{-1 - P_3\,s_1 - P_4\,s_2}{2 + P_1\,s_1 + P_3\,s_1 + P_2\,s_2 + P_4\,s_2},\right.\right.$$
$$\left.\left. m \to -\frac{-2 - P_5 - P_6 - P_1\,s_1 - P_3\,s_1 - P_3\,P_5\,s_1 - P_1\,P_6\,s_1 - P_2\,s_2 - P_4\,s_2 - P_4\,P_5\,s_2 - P_2\,P_6\,s_2}{2 + P_1\,s_1 + P_3\,s_1 + P_2\,s_2 + P_4\,s_2}\right\}\right\}$$

Surface plot 1

In[20]:=
```
P1 = 0;
P2 = 0;
P3 = 1;
P4 = 1;
P5 = 0;
P6 = 1;
mP = -(-2 - P5 - P6 - P1 s1 - P3 s1 - P3 P5 s1 - P1 P6 s1 - P2 s2 - P4 s2 - P4 P5 s2 - P2 P6 s2) / (2 + P1 s1 + P3 s1 + P2 s2 + P4 s2);
Plot3D[mP, {s1, 0, 8}, {s2, 0, 8}, AxesLabel →
  {Style["s1", Bold, 20, FontColor → Black], Style["s2", Bold, 20, FontColor → Black],
   Style["m(s1,s2)", Bold, 20, FontColor → Black]},
 PlotLabel → Style["m(s1,s2)", Bold, 30, FontColor → Black],
 ColorFunction → "Rainbow", AxesStyle → Thickness[0.005], BoxStyle → GrayLevel[2],
 TicksStyle → Directive[Black, 15], ImageSize → Large, PlotRange → Full]
```

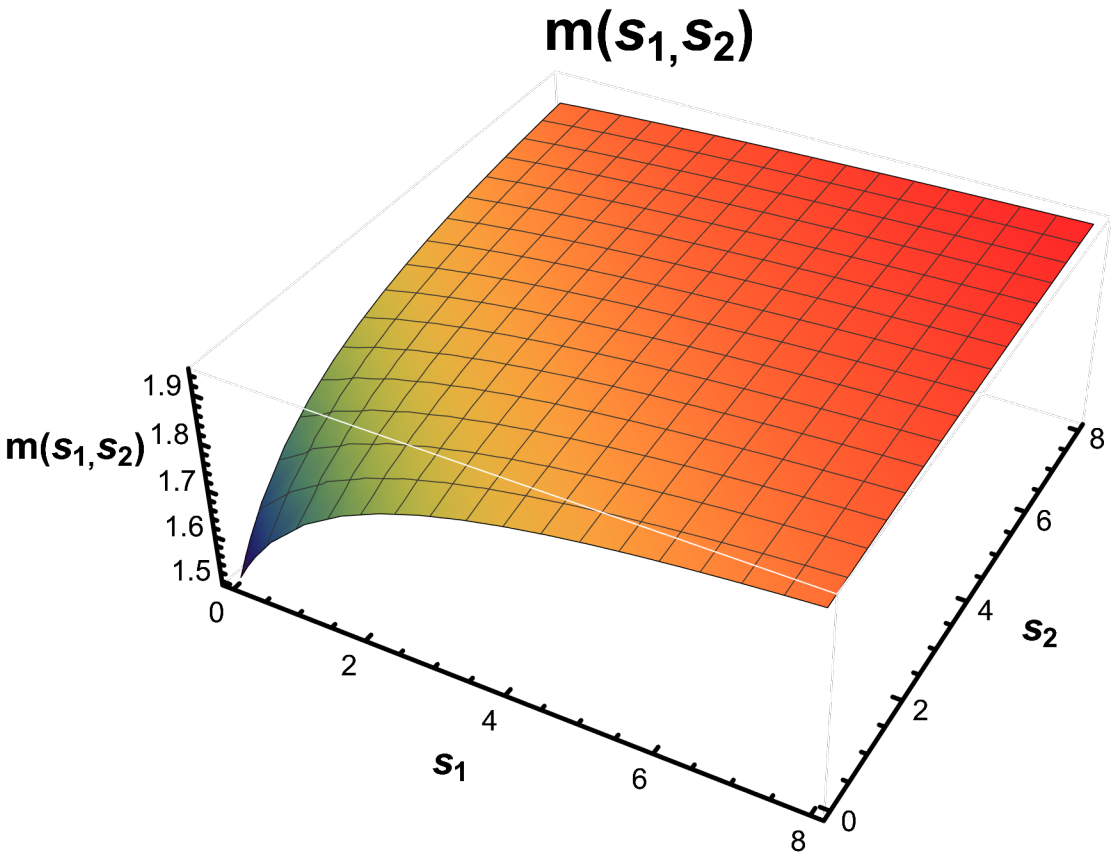
Out[27]=



Surface plot 2

In[28]:=
```
P1 = 0;
P2 = 0;
P3 = 1;
P4 = 1;
P5 = 1;
P6 = 0;
mP = -(-2 - P5 - P6 - P1 s1 - P3 s1 - P3 P5 s1 - P1 P6 s1 - P2 s2 - P4 s2 - P4 P5 s2 - P2 P6 s2) / (2 + P1 s1 + P3 s1 + P2 s2 + P4 s2);
Plot3D[mP, {s1, 0, 8}, {s2, 0, 8}, AxesLabel →
  {Style["s1", Bold, 20, FontColor → Black], Style["s2", Bold, 20, FontColor → Black],
   Style["m(s1,s2)", Bold, 20, FontColor → Black]},
 PlotLabel → Style["m(s1,s2)", Bold, 30, FontColor → Black],
 ColorFunction → "Rainbow", AxesStyle → Thickness[0.005], BoxStyle → GrayLevel[2],
 TicksStyle → Directive[Black, 15], ImageSize → Large, PlotRange → Full]
```

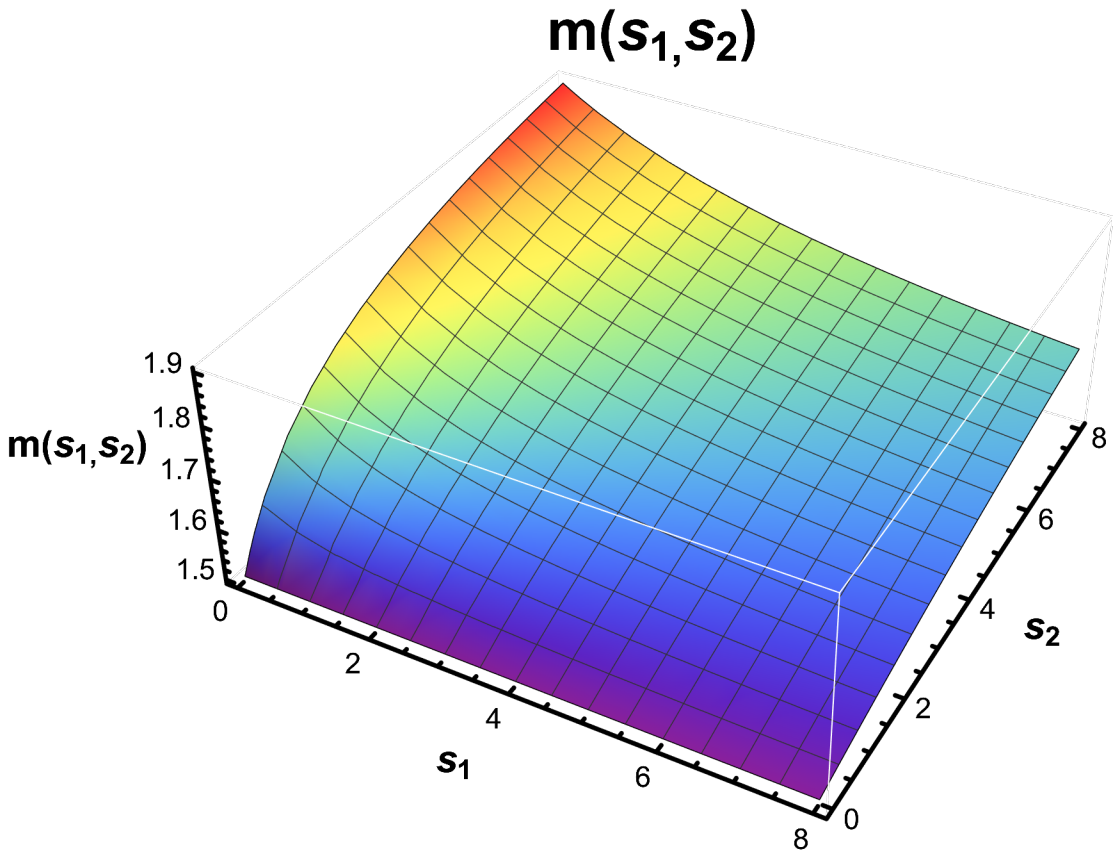
Out[35]=



Surface plot 3

In[36]:=
```
P1 = 1;
P2 = 0;
P3 = 1;
P4 = 1;
P5 = 1;
P6 = 0;
mP = -(-2 - P5 - P6 - P1 s1 - P3 s1 - P3 P5 s1 - P1 P6 s1 - P2 s2 - P4 s2 - P4 P5 s2 - P2 P6 s2) / (2 + P1 s1 + P3 s1 + P2 s2 + P4 s2);
Plot3D[mP, {s1, 0, 8}, {s2, 0, 8}, AxesLabel →
  {Style["s1", Bold, 20, FontColor → Black], Style["s2", Bold, 20, FontColor → Black],
   Style["m(s1,s2)", Bold, 20, FontColor → Black]},
 PlotLabel → Style["m(s1,s2)", Bold, 30, FontColor → Black],
 ColorFunction → "Rainbow", AxesStyle → Thickness[0.005], BoxStyle → GrayLevel[2],
 TicksStyle → Directive[Black, 15], ImageSize → Large, PlotRange → Full]
```

Out[43]=



Network B - six nodes

Dynamics-

In[•]:=
```
dcdt = (k_CA + P_2 * k_2 * s_1 + P_6 * k_6 * s_2) * (a0 - c - b) - (k_FC + P_3 * k_3 * s_1 + P_7 * k_7 * s_2) * c;
dbdt = (k_BA + P_4 * k_4 * s_1 + P_8 * k_8 * s_2) * (a0 - c - b) - (k_FB + P_1 * k_1 * s_1 + P_5 * k_5 * s_2) * b;
dmdt = k_m0 + P_10 * k_10 * (a0 - c - b) + P_9 * k_9 * b + P_11 * k_11 * c - k_dm * m;
Solve[{dcdt == 0, dbdt == 0, dmdt == 0}, {b, c, m}]
```

Out[•]=

$$\left\{\left\{b \to -\frac{(a0\,(k_{CA}+k_2\,P_2\,s_1+k_6\,P_6\,s_2)\,(-k_{BA}-k_4\,P_4\,s_1-k_8\,P_8\,s_2)-a0\,(-k_{CA}-k_{FC}-k_2\,P_2\,s_1-k_3\,P_3\,s_1-k_6\,P_6\,s_2-k_7\,P_7\,s_2)\,(k_{BA}+k_4\,P_4\,s_1+k_8\,P_8\,s_2))}{((-k_{CA}-k_2\,P_2\,s_1-k_6\,P_6\,s_2)\,(-k_{BA}-k_4\,P_4\,s_1-k_8\,P_8\,s_2)-(-k_{CA}-k_{FC}-k_2\,P_2\,s_1-k_3\,P_3\,s_1-k_6\,P_6\,s_2-k_7\,P_7\,s_2)\,(-k_{BA}-k_{FB}-k_1\,P_1\,s_1-k_4\,P_4\,s_1-k_5\,P_5\,s_2-k_8\,P_8\,s_2))},\right.$$

$$c \to -\frac{\left(-a0\,k_{CA}\,k_{FB}-a0\,k_1\,k_{CA}\,P_1\,s_1-a0\,k_2\,k_{FB}\,P_2\,s_1-a0\,k_1\,k_2\,P_1\,P_2\,s_1^2-a0\,k_5\,k_{CA}\,P_5\,s_2-a0\,k_6\,k_{FB}\,P_6\,s_2-a0\,k_2\,k_5\,P_2\,P_5\,s_1\,s_2-a0\,k_1\,k_6\,P_1\,P_6\,s_1\,s_2-a0\,k_5\,k_6\,P_5\,P_6\,s_2^2\right)}{\left(k_{CA}\,k_{FB}+k_{BA}\,k_{FC}+k_{FB}\,k_{FC}+k_1\,k_{CA}\,P_1\,s_1+k_1\,k_{FC}\,P_1\,s_1+k_2\,k_{FB}\,P_2\,s_1+k_3\,k_{BA}\,P_3\,s_1+k_3\,k_{FB}\,P_3\,s_1+k_4\,k_{FC}\,P_4\,s_1+k_1\,k_2\,P_1\,P_2\,s_1^2+k_1\,k_3\,P_1\,P_3\,s_1^2+k_3\,k_4\,P_3\,P_4\,s_1^2+k_5\,k_{CA}\,P_5\,s_2+k_5\,k_{FC}\,P_5\,s_2+k_6\,k_{FB}\,P_6\,s_2+k_7\,k_{BA}\,P_7\,s_2+k_7\,k_{FB}\,P_7\,s_2+k_8\,k_{FC}\,P_8\,s_2+k_2\,k_5\,P_2\,P_5\,s_1\,s_2+k_3\,k_5\,P_3\,P_5\,s_1\,s_2+k_1\,k_6\,P_1\,P_6\,s_1\,s_2+k_1\,k_7\,P_1\,P_7\,s_1\,s_2+k_4\,k_7\,P_4\,P_7\,s_1\,s_2+k_3\,k_8\,P_3\,P_8\,s_1\,s_2+k_5\,k_6\,P_5\,P_6\,s_2^2+k_5\,k_7\,P_5\,P_7\,s_2^2+k_7\,k_8\,P_7\,P_8\,s_2^2\right)},$$

$$m \to -\frac{\left(-k_{CA}\,k_{FB}\,k_{m0}-k_{BA}\,k_{FC}\,k_{m0}-k_{FB}\,k_{FC}\,k_{m0}-a0\,k_9\,k_{BA}\,k_{FC}\,P_9-a0\,k_{10}\,k_{FB}\,k_{FC}\,P_{10}-a0\,k_{11}\,k_{CA}\,k_{FB}\,P_{11}-k_1\,k_{CA}\,k_{m0}\,P_1\,s_1-k_1\,k_{FC}\,k_{m0}\,P_1\,s_1-k_2\,k_{FB}\,k_{m0}\,P_2\,s_1-k_3\,k_{BA}\,k_{m0}\,P_3\,s_1-k_3\,k_{FB}\,k_{m0}\,P_3\,s_1-k_4\,k_{FC}\,k_{m0}\,P_4\,s_1-a0\,k_3\,k_9\,k_{BA}\,P_3\,P_9\,s_1-a0\,k_4\,k_9\,k_{FC}\,P_4\,P_9\,s_1-a0\,k_1\,k_{10}\,k_{FC}\,P_1\,P_{10}\,s_1-a0\,k_3\,k_{10}\,k_{FB}\,P_3\,P_{10}\,s_1-a0\,k_1\,k_{11}\,k_{CA}\,P_1\,P_{11}\,s_1-a0\,k_2\,k_{11}\,k_{FB}\,P_2\,P_{11}\,s_1-k_1\,k_2\,k_{m0}\,P_1\,P_2\,s_1^2-k_1\,k_3\,k_{m0}\,P_1\,P_3\,s_1^2-k_3\,k_4\,k_{m0}\,P_3\,P_4\,s_1^2-a0\,k_3\,k_4\,k_9\,P_3\,P_4\,P_9\,s_1^2-a0\,k_1\,k_3\,k_{10}\,P_1\,P_3\,P_{10}\,s_1^2-a0\,k_1\,k_2\,k_{11}\,P_1\,P_2\,P_{11}\,s_1^2-k_5\,k_{CA}\,k_{m0}\,P_5\,s_2-k_5\,k_{FC}\,k_{m0}\,P_5\,s_2-k_6\,k_{FB}\,k_{m0}\,P_6\,s_2-k_7\,k_{BA}\,k_{m0}\,P_7\,s_2-k_7\,k_{FB}\,k_{m0}\,P_7\,s_2-k_8\,k_{FC}\,k_{m0}\,P_8\,s_2-a0\,k_7\,k_9\,k_{BA}\,P_7\,P_9\,s_2-a0\,k_8\,k_9\,k_{FC}\,P_8\,P_9\,s_2-a0\,k_5\,k_{10}\,k_{FC}\,P_5\,P_{10}\,s_2-a0\,k_7\,k_{10}\,k_{FB}\,P_7\,P_{10}\,s_2-a0\,k_5\,k_{11}\,k_{CA}\,P_5\,P_{11}\,s_2-a0\,k_6\,k_{11}\,k_{FB}\,P_6\,P_{11}\,s_2-k_2\,k_5\,k_{m0}\,P_2\,P_5\,s_1\,s_2-k_3\,k_5\,k_{m0}\,P_3\,P_5\,s_1\,s_2-k_1\,k_6\,k_{m0}\,P_1\,P_6\,s_1\,s_2-k_1\,k_7\,k_{m0}\,P_1\,P_7\,s_1\,s_2-k_4\,k_7\,k_{m0}\,P_4\,P_7\,s_1\,s_2-k_3\,k_8\,k_{m0}\,P_3\,P_8\,s_1\,s_2-a0\,k_4\,k_7\,k_9\,P_4\,P_7\,P_9\,s_1\,s_2-a0\,k_3\,k_8\,k_9\,P_3\,P_8\,P_9\,s_1\,s_2-a0\,k_3\,k_5\,k_{10}\,P_3\,P_5\,P_{10}\,s_1\,s_2-a0\,k_1\,k_7\,k_{10}\,P_1\,P_7\,P_{10}\,s_1\,s_2-a0\,k_2\,k_5\,k_{11}\,P_2\,P_5\,P_{11}\,s_1\,s_2-a0\,k_1\,k_6\,k_{11}\,P_1\,P_6\,P_{11}\,s_1\,s_2-k_5\,k_6\,k_{m0}\,P_5\,P_6\,s_2^2-k_5\,k_7\,k_{m0}\,P_5\,P_7\,s_2^2-k_7\,k_8\,k_{m0}\,P_7\,P_8\,s_2^2-a0\,k_7\,k_8\,k_9\,P_7\,P_8\,P_9\,s_2^2-a0\,k_5\,k_7\,k_{10}\,P_5\,P_7\,P_{10}\,s_2^2-a0\,k_5\,k_6\,k_{11}\,P_5\,P_6\,P_{11}\,s_2^2\right)}{\left(k_{dm}\left(k_{CA}\,k_{FB}+k_{BA}\,k_{FC}+k_{FB}\,k_{FC}+k_1\,k_{CA}\,P_1\,s_1+k_1\,k_{FC}\,P_1\,s_1+k_2\,k_{FB}\,P_2\,s_1+k_3\,k_{BA}\,P_3\,s_1+k_3\,k_{FB}\,P_3\,s_1+k_4\,k_{FC}\,P_4\,s_1+k_1\,k_2\,P_1\,P_2\,s_1^2+k_1\,k_3\,P_1\,P_3\,s_1^2+k_3\,k_4\,P_3\,P_4\,s_1^2+k_5\,k_{CA}\,P_5\,s_2+k_5\,k_{FC}\,P_5\,s_2+k_6\,k_{FB}\,P_6\,s_2+k_7\,k_{BA}\,P_7\,s_2+k_7\,k_{FB}\,P_7\,s_2+k_8\,k_{FC}\,P_8\,s_2+k_2\,k_5\,P_2\,P_5\,s_1\,s_2+k_3\,k_5\,P_3\,P_5\,s_1\,s_2+k_1\,k_6\,P_1\,P_6\,s_1\,s_2+k_1\,k_7\,P_1\,P_7\,s_1\,s_2+k_4\,k_7\,P_4\,P_7\,s_1\,s_2+k_3\,k_8\,P_3\,P_8\,s_1\,s_2+k_5\,k_6\,P_5\,P_6\,s_2^2+k_5\,k_7\,P_5\,P_7\,s_2^2+k_7\,k_8\,P_7\,P_8\,s_2^2\right)\right)}\right\}\right\}$$

Steady state expressions when both signals are present-

In[•]:=
```
mP = FullSimplify[
 -((-kCA kFB km0 - kBA kFC km0 - kFB kFC km0 - a0 k9 kBA kFC P9 - a0 k10 kFB kFC P10 - a0 k11 kCA kFB P11 -
      k1 kCA km0 P1 s1 - k1 kFC km0 P1 s1 - k2 kFB km0 P2 s1 - k3 kBA km0 P3 s1 -
      k3 kFB km0 P3 s1 - k4 kFC km0 P4 s1 - a0 k3 k9 kBA P3 P9 s1 - a0 k4 k9 kFC P4 P9 s1 -
      a0 k1 k10 kFC P1 P10 s1 - a0 k3 k10 kFB P3 P10 s1 - a0 k1 k11 kCA P1 P11 s1 -
      a0 k2 k11 kFB P2 P11 s1 - k1 k2 km0 P1 P2 s1^2 - k1 k3 km0 P1 P3 s1^2 - k3 k4 km0 P3 P4 s1^2 -
      a0 k3 k4 k9 P3 P4 P9 s1^2 - a0 k1 k3 k10 P1 P3 P10 s1^2 - a0 k1 k2 k11 P1 P2 P11 s1^2 -
      k5 kCA km0 P5 s2 - k5 kFC km0 P5 s2 - k6 kFB km0 P6 s2 - k7 kBA km0 P7 s2 - k7 kFB km0 P7 s2 -
      k8 kFC km0 P8 s2 - a0 k7 k9 kBA P7 P9 s2 - a0 k8 k9 kFC P8 P9 s2 - a0 k5 k10 kFC P5 P10 s2 -
      a0 k7 k10 kFB P7 P10 s2 - a0 k5 k11 kCA P5 P11 s2 - a0 k6 k11 kFB P6 P11 s2 - k2 k5 km0 P2 P5 s1 s2 -
      k3 k5 km0 P3 P5 s1 s2 - k1 k6 km0 P1 P6 s1 s2 - k1 k7 km0 P1 P7 s1 s2 - k4 k7 km0 P4 P7 s1 s2 -
      k3 k8 km0 P3 P8 s1 s2 - a0 k4 k7 k9 P4 P7 P9 s1 s2 - a0 k3 k8 k9 P3 P8 P9 s1 s2 -
      a0 k3 k5 k10 P3 P5 P10 s1 s2 - a0 k1 k7 k10 P1 P7 P10 s1 s2 - a0 k2 k5 k11 P2 P5 P11 s1 s2 -
      a0 k1 k6 k11 P1 P6 P11 s1 s2 - k5 k6 km0 P5 P6 s2^2 - k5 k7 km0 P5 P7 s2^2 - k7 k8 km0 P7 P8 s2^2 -
      a0 k7 k8 k9 P7 P8 P9 s2^2 - a0 k5 k7 k10 P5 P7 P10 s2^2 - a0 k5 k6 k11 P5 P6 P11 s2^2) /
   (kdm (kCA kFB + kBA kFC + kFB kFC + k1 kCA P1 s1 + k1 kFC P1 s1 + k2 kFB P2 s1 + k3 kBA P3 s1 +
      k3 kFB P3 s1 + k4 kFC P4 s1 + k1 k2 P1 P2 s1^2 + k1 k3 P1 P3 s1^2 + k3 k4 P3 P4 s1^2 +
      k5 kCA P5 s2 + k5 kFC P5 s2 + k6 kFB P6 s2 + k7 kBA P7 s2 + k7 kFB P7 s2 + k8 kFC P8 s2 +
      k2 k5 P2 P5 s1 s2 + k3 k5 P3 P5 s1 s2 + k1 k6 P1 P6 s1 s2 + k1 k7 P1 P7 s1 s2 +
      k4 k7 P4 P7 s1 s2 + k3 k8 P3 P8 s1 s2 + k5 k6 P5 P6 s2^2 + k5 k7 P5 P7 s2^2 + k7 k8 P7 P8 s2^2)))]
```

Out[•]=
```
(kBA kFC km0 + kFB kFC km0 + a0 k9 kBA kFC P9 + a0 k10 kFB kFC P10 +
  k1 kFC km0 P1 s1 + k2 kFB km0 P2 s1 + k3 kBA km0 P3 s1 + k3 kFB km0 P3 s1 + k4 kFC km0 P4 s1 +
  a0 k3 k9 kBA P3 P9 s1 + a0 k4 k9 kFC P4 P9 s1 + a0 k1 k10 kFC P1 P10 s1 + a0 k3 k10 kFB P3 P10 s1 +
  a0 k2 k11 kFB P2 P11 s1 + k1 k2 km0 P1 P2 s1^2 + k1 k3 km0 P1 P3 s1^2 + k3 k4 km0 P3 P4 s1^2 +
  a0 k3 k4 k9 P3 P4 P9 s1^2 + a0 k1 k3 k10 P1 P3 P10 s1^2 + a0 k1 k2 k11 P1 P2 P11 s1^2 +
  (k6 kFB km0 P6 + k7 kBA km0 P7 + k7 kFB km0 P7 + k8 kFC km0 P8 + a0 k7 k9 kBA P7 P9 + a0 k8 k9 kFC P8 P9 +
    a0 k7 k10 kFB P7 P10 + a0 k6 k11 kFB P6 P11 + ((k4 k7 P4 P7 + k3 k8 P3 P8) (km0 + a0 k9 P9) +
      k1 P1 (k7 P7 (km0 + a0 k10 P10) + k6 P6 (km0 + a0 k11 P11))) s1 +
    k5 P5 (kFC (km0 + a0 k10 P10) + (k3 P3 (km0 + a0 k10 P10) + k2 P2 (km0 + a0 k11 P11)) s1)) s2 +
  (k7 k8 P7 P8 (km0 + a0 k9 P9) + k5 P5 (k7 P7 (km0 + a0 k10 P10) + k6 P6 (km0 + a0 k11 P11))) s2^2 +
  kCA (km0 + a0 k11 P11) (kFB + k1 P1 s1 + k5 P5 s2)) /
 (kdm (kBA kFC + s1 (k4 kFC P4 + k1 P1 (kFC + (k2 P2 + k3 P3) s1) + k3 P3 (kBA + k4 P4 s1)) +
    (k1 k6 P1 P6 s1 + k8 P8 (kFC + k3 P3 s1) + k5 P5 (kFC + (k2 P2 + k3 P3) s1) +
      k7 P7 (kBA + (k1 P1 + k4 P4) s1)) s2 + (k5 P5 (k6 P6 + k7 P7) + k7 k8 P7 P8) s2^2 +
   kCA (kFB + k1 P1 s1 + k5 P5 s2) + kFB (kFC + (k2 P2 + k3 P3) s1 + (k6 P6 + k7 P7) s2)))
```

Steady state expressions when only one signal is present -

In[•]:=
```
mP1 = FullSimplify[mP /. s2 → 0]
```

Out[•]=
$$\Big(k_{FC}\,(k_{BA}\,(k_{m0}+a0\,k_9\,P_9)+k_{FB}\,(k_{m0}+a0\,k_{10}\,P_{10}))+(k_3\,k_{BA}\,k_{m0}\,P_3+k_3\,k_{FB}\,k_{m0}\,P_3+k_4\,k_{FC}\,k_{m0}\,P_4+a0\,k_3\,k_9\,k_{BA}\,P_3\,P_9+a0\,k_4\,k_9\,k_{FC}\,P_4\,P_9+a0\,k_3\,k_{10}\,k_{FB}\,P_3\,P_{10}+k_1\,k_{FC}\,P_1\,(k_{m0}+a0\,k_{10}\,P_{10})+k_2\,k_{FB}\,P_2\,(k_{m0}+a0\,k_{11}\,P_{11}))\,s_1+(k_3\,k_4\,P_3\,P_4\,(k_{m0}+a0\,k_9\,P_9)+k_1\,P_1\,(k_3\,P_3\,(k_{m0}+a0\,k_{10}\,P_{10})+k_2\,P_2\,(k_{m0}+a0\,k_{11}\,P_{11})))\,s_1^2+k_{CA}\,(k_{m0}+a0\,k_{11}\,P_{11})\,(k_{FB}+k_1\,P_1\,s_1)\Big)\Big/\Big(k_{dm}\,\Big(k_{BA}\,k_{FC}+k_{FB}\,(k_{CA}+k_{FC})+(k_1\,(k_{CA}+k_{FC})\,P_1+k_2\,k_{FB}\,P_2+k_3\,(k_{BA}+k_{FB})\,P_3+k_4\,k_{FC}\,P_4)\,s_1+(k_1\,P_1\,(k_2\,P_2+k_3\,P_3)+k_3\,k_4\,P_3\,P_4)\,s_1^2\Big)\Big)$$

In[•]:=
```
mP2 = FullSimplify[mP /. s1 → 0]
```

Out[•]=
$$\Big(k_{FC}\,(k_{BA}\,(k_{m0}+a0\,k_9\,P_9)+k_{FB}\,(k_{m0}+a0\,k_{10}\,P_{10}))+(k_7\,k_{BA}\,k_{m0}\,P_7+k_7\,k_{FB}\,k_{m0}\,P_7+k_8\,k_{FC}\,k_{m0}\,P_8+a0\,k_7\,k_9\,k_{BA}\,P_7\,P_9+a0\,k_8\,k_9\,k_{FC}\,P_8\,P_9+a0\,k_7\,k_{10}\,k_{FB}\,P_7\,P_{10}+k_5\,k_{FC}\,P_5\,(k_{m0}+a0\,k_{10}\,P_{10})+k_6\,k_{FB}\,P_6\,(k_{m0}+a0\,k_{11}\,P_{11}))\,s_2+(k_7\,k_8\,P_7\,P_8\,(k_{m0}+a0\,k_9\,P_9)+k_5\,P_5\,(k_7\,P_7\,(k_{m0}+a0\,k_{10}\,P_{10})+k_6\,P_6\,(k_{m0}+a0\,k_{11}\,P_{11})))\,s_2^2+k_{CA}\,(k_{m0}+a0\,k_{11}\,P_{11})\,(k_{FB}+k_5\,P_5\,s_2)\Big)\Big/\Big(k_{dm}\,\Big(k_{BA}\,k_{FC}+k_{FB}\,(k_{CA}+k_{FC})+(k_5\,(k_{CA}+k_{FC})\,P_5+k_6\,k_{FB}\,P_6+k_7\,(k_{BA}+k_{FB})\,P_7+k_8\,k_{FC}\,P_8)\,s_2+(k_5\,P_5\,(k_6\,P_6+k_7\,P_7)+k_7\,k_8\,P_7\,P_8)\,s_2^2\Big)\Big)$$

Some surface plots for network B

In[•]:=
```
dcdt = (1 + P2 * 1 * s1 + P6 * 1 * s2) * (1 - c - b) - (1 + P3 * 1 * s1 + P7 * 1 * s2) * c;
dbdt = (1 + P4 * 1 * s1 + P8 * 1 * s2) * (1 - c - b) - (1 + P1 * 1 * s1 + P5 * 1 * s2) * b;
dmdt = 1 + P10 * 1 * (1 - c - b) + P9 * 1 * b + P11 * 1 * c - 1 * m;
Solve[{dcdt == 0, dbdt == 0, dmdt == 0}, {b, c, m}]
```

Out[•]=
$$\Big\{\Big\{b\to -\Big(((1+P_2\,s_1+P_6\,s_2)\times(-1-P_4\,s_1-P_8\,s_2)-(-2-P_2\,s_1-P_3\,s_1-P_6\,s_2-P_7\,s_2)\times(1+P_4\,s_1+P_8\,s_2))\Big/((-1-P_2\,s_1-P_6\,s_2)\times(-1-P_4\,s_1-P_8\,s_2)-(-2-P_2\,s_1-P_3\,s_1-P_6\,s_2-P_7\,s_2)\times(-2-P_1\,s_1-P_4\,s_1-P_5\,s_2-P_8\,s_2))\Big),$$
$$c\to -\Big(\Big(-1-P_1\,s_1-P_2\,s_1-P_1\,P_2\,s_1^2-P_5\,s_2-P_6\,s_2-P_2\,P_5\,s_1\,s_2-P_1\,P_6\,s_1\,s_2-P_5\,P_6\,s_2^2\Big)\Big/\Big(3+2\,P_1\,s_1+P_2\,s_1+2\,P_3\,s_1+P_4\,s_1+P_1\,P_2\,s_1^2+P_1\,P_3\,s_1^2+P_3\,P_4\,s_1^2+2\,P_5\,s_2+P_6\,s_2+2\,P_7\,s_2+P_8\,s_2+P_2\,P_5\,s_1\,s_2+P_3\,P_5\,s_1\,s_2+P_1\,P_6\,s_1\,s_2+P_1\,P_7\,s_1\,s_2+P_4\,P_7\,s_1\,s_2+P_3\,P_8\,s_1\,s_2+P_5\,P_6\,s_2^2+P_5\,P_7\,s_2^2+P_7\,P_8\,s_2^2\Big)\Big),$$
$$m\to -\Big(\Big(-3-P_9-P_{10}-P_{11}-2\,P_1\,s_1-P_2\,s_1-2\,P_3\,s_1-P_4\,s_1-P_3\,P_9\,s_1-P_4\,P_9\,s_1-P_1\,P_{10}\,s_1-P_3\,P_{10}\,s_1-P_1\,P_{11}\,s_1-P_2\,P_{11}\,s_1-P_1\,P_2\,s_1^2-P_1\,P_3\,s_1^2-P_3\,P_4\,s_1^2-P_3\,P_4\,P_9\,s_1^2-P_1\,P_3\,P_{10}\,s_1^2-P_1\,P_2\,P_{11}\,s_1^2-2\,P_5\,s_2-P_6\,s_2-2\,P_7\,s_2-P_8\,s_2-P_7\,P_9\,s_2-P_8\,P_9\,s_2-P_5\,P_{10}\,s_2-P_7\,P_{10}\,s_2-P_5\,P_{11}\,s_2-P_6\,P_{11}\,s_2-P_2\,P_5\,s_1\,s_2-P_3\,P_5\,s_1\,s_2-P_1\,P_6\,s_1\,s_2-P_1\,P_7\,s_1\,s_2-P_4\,P_7\,s_1\,s_2-P_3\,P_8\,s_1\,s_2-P_4\,P_7\,P_9\,s_1\,s_2-P_3\,P_8\,P_9\,s_1\,s_2-P_3\,P_5\,P_{10}\,s_1\,s_2-P_1\,P_7\,P_{10}\,s_1\,s_2-P_2\,P_5\,P_{11}\,s_1\,s_2-P_1\,P_6\,P_{11}\,s_1\,s_2-P_5\,P_6\,s_2^2-P_5\,P_7\,s_2^2-P_7\,P_8\,s_2^2-P_7\,P_8\,P_9\,s_2^2-P_5\,P_7\,P_{10}\,s_2^2-P_5\,P_6\,P_{11}\,s_2^2\Big)\Big/\Big(3+2\,P_1\,s_1+P_2\,s_1+2\,P_3\,s_1+P_4\,s_1+P_1\,P_2\,s_1^2+P_1\,P_3\,s_1^2+P_3\,P_4\,s_1^2+2\,P_5\,s_2+P_6\,s_2+2\,P_7\,s_2+P_8\,s_2+P_2\,P_5\,s_1\,s_2+P_3\,P_5\,s_1\,s_2+P_1\,P_6\,s_1\,s_2+P_1\,P_7\,s_1\,s_2+P_4\,P_7\,s_1\,s_2+P_3\,P_8\,s_1\,s_2+P_5\,P_6\,s_2^2+P_5\,P_7\,s_2^2+P_7\,P_8\,s_2^2\Big)\Big)\Big\}\Big\}$$

Out[•]=

$$\{\{b \to -(((1+P_2 s_1+P_6 s_2)\times(-1-P_4 s_1-P_8 s_2)-(-2-P_2 s_1-P_3 s_1-P_6 s_2-P_7 s_2)\times (1+P_4 s_1+P_8 s_2))/((-1-P_2 s_1-P_6 s_2)\times(-1-P_4 s_1-P_8 s_2)-(-2-P_2 s_1-P_3 s_1-P_6 s_2-P_7 s_2)\times(-2-P_1 s_1-P_4 s_1-P_5 s_2-P_8 s_2))),$$

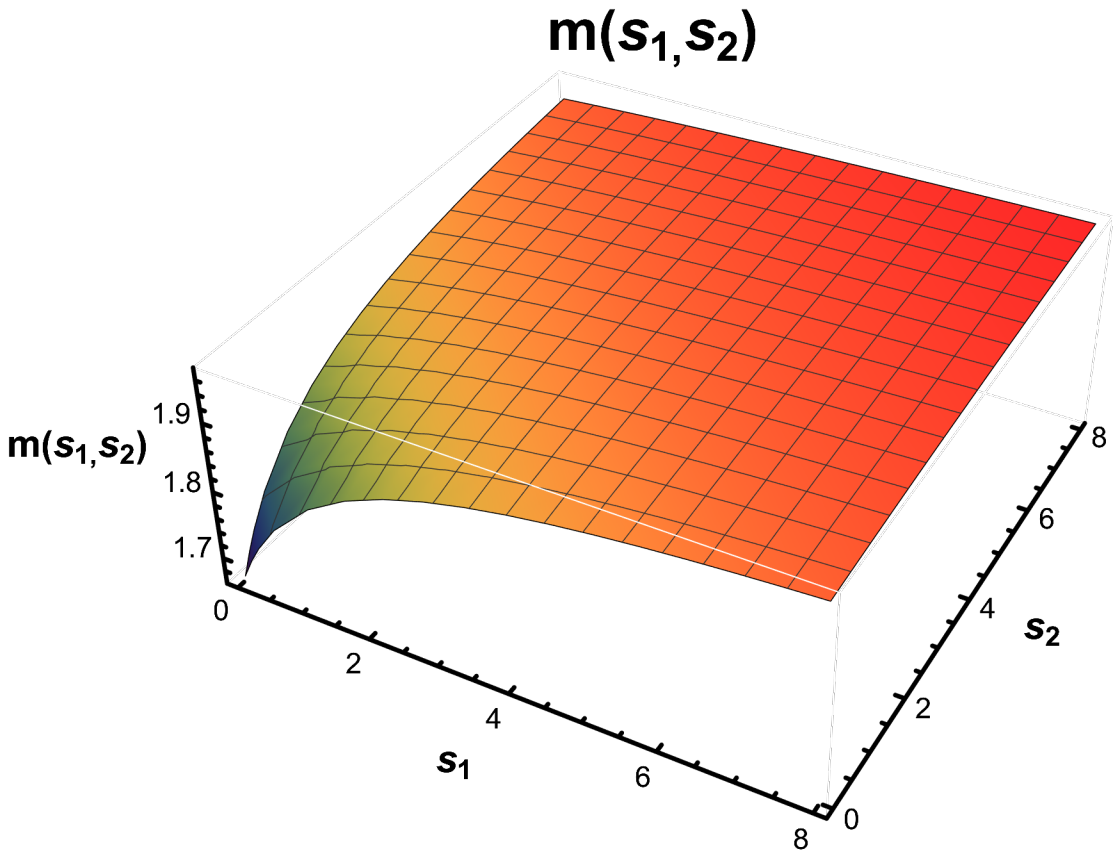
$$c \to -\left(\left(-1-P_1 s_1-P_2 s_1-P_1 P_2 s_1^2-P_5 s_2-P_6 s_2-P_2 P_5 s_1 s_2-P_1 P_6 s_1 s_2-P_5 P_6 s_2^2\right)/\left(3+2 P_1 s_1+P_2 s_1+2 P_3 s_1+P_4 s_1+P_1 P_2 s_1^2+P_1 P_3 s_1^2+P_3 P_4 s_1^2+2 P_5 s_2+P_6 s_2+2 P_7 s_2+P_8 s_2+P_2 P_5 s_1 s_2+P_3 P_5 s_1 s_2+P_1 P_6 s_1 s_2+P_1 P_7 s_1 s_2+P_4 P_7 s_1 s_2+P_3 P_8 s_1 s_2+P_5 P_6 s_2^2+P_5 P_7 s_2^2+P_7 P_8 s_2^2\right)\right),$$

$$m \to -\left(\left(-3-P_9-P_{10}-P_{11}-2 P_1 s_1-P_2 s_1-2 P_3 s_1-P_4 s_1-P_3 P_9 s_1-P_4 P_9 s_1-P_1 P_{10} s_1-P_3 P_{10} s_1-P_1 P_{11} s_1-P_2 P_{11} s_1-P_1 P_2 s_1^2-P_1 P_3 s_1^2-P_3 P_4 s_1^2-P_3 P_4 P_9 s_1^2-P_1 P_3 P_{10} s_1^2-P_1 P_2 P_{11} s_1^2-2 P_5 s_2-P_6 s_2-2 P_7 s_2-P_8 s_2-P_7 P_9 s_2-P_8 P_9 s_2-P_5 P_{10} s_2-P_7 P_{10} s_2-P_5 P_{11} s_2-P_6 P_{11} s_2-P_2 P_5 s_1 s_2-P_3 P_5 s_1 s_2-P_1 P_6 s_1 s_2-P_1 P_7 s_1 s_2-P_4 P_7 s_1 s_2-P_3 P_8 s_1 s_2-P_4 P_7 P_9 s_1 s_2-P_3 P_8 P_9 s_1 s_2-P_3 P_5 P_{10} s_1 s_2-P_1 P_7 P_{10} s_1 s_2-P_2 P_5 P_{11} s_1 s_2-P_1 P_6 P_{11} s_1 s_2-P_5 P_6 s_2^2-P_5 P_7 s_2^2-P_7 P_8 s_2^2-P_7 P_8 P_9 s_2^2-P_5 P_7 P_{10} s_2^2-P_5 P_6 P_{11} s_2^2\right)/\left(3+2 P_1 s_1+P_2 s_1+2 P_3 s_1+P_4 s_1+P_1 P_2 s_1^2+P_1 P_3 s_1^2+P_3 P_4 s_1^2+2 P_5 s_2+P_6 s_2+2 P_7 s_2+P_8 s_2+P_2 P_5 s_1 s_2+P_3 P_5 s_1 s_2+P_1 P_6 s_1 s_2+P_1 P_7 s_1 s_2+P_4 P_7 s_1 s_2+P_3 P_8 s_1 s_2+P_5 P_6 s_2^2+P_5 P_7 s_2^2+P_7 P_8 s_2^2\right)\right)\}\}$$

Surface plot 1

In[•]:=
```
P1 = 0;
P2 = 1;
P3 = 0;
P4 = 1;
P5 = 0;
P6 = 1;
P7 = 0;
P8 = 1;
P9 = 1;
P10 = 0;
P11 = 1;
mP =
  -((-3 - P9 - P10 - P11 - 2 P1 s1 - P2 s1 - 2 P3 s1 - P4 s1 - P3 P9 s1 - P4 P9 s1 - P1 P10 s1 - P3 P10 s1 -
        P1 P11 s1 - P2 P11 s1 - P1 P2 s1^2 - P1 P3 s1^2 - P3 P4 s1^2 - P3 P4 P9 s1^2 - P1 P3 P10 s1^2 - P1 P2 P11 s1^2 -
        2 P5 s2 - P6 s2 - 2 P7 s2 - P8 s2 - P7 P9 s2 - P8 P9 s2 - P5 P10 s2 - P7 P10 s2 - P5 P11 s2 -
        P6 P11 s2 - P2 P5 s1 s2 - P3 P5 s1 s2 - P1 P6 s1 s2 - P1 P7 s1 s2 - P4 P7 s1 s2 - P3 P8 s1 s2 -
        P4 P7 P9 s1 s2 - P3 P8 P9 s1 s2 - P3 P5 P10 s1 s2 - P1 P7 P10 s1 s2 - P2 P5 P11 s1 s2 -
        P1 P6 P11 s1 s2 - P5 P6 s2^2 - P5 P7 s2^2 - P7 P8 s2^2 - P7 P8 P9 s2^2 - P5 P7 P10 s2^2 - P5 P6 P11 s2^2) /
      (3 + 2 P1 s1 + P2 s1 + 2 P3 s1 + P4 s1 + P1 P2 s1^2 + P1 P3 s1^2 + P3 P4 s1^2 + 2 P5 s2 +
        P6 s2 + 2 P7 s2 + P8 s2 + P2 P5 s1 s2 + P3 P5 s1 s2 + P1 P6 s1 s2 +
        P1 P7 s1 s2 + P4 P7 s1 s2 + P3 P8 s1 s2 + P5 P6 s2^2 + P5 P7 s2^2 + P7 P8 s2^2));
Plot3D[mP, {s1, 0, 8}, {s2, 0, 8}, AxesLabel → {Style["s1", Bold, 20, FontColor → Black],
   Style["s2", Bold, 20, FontColor → Black],
   Style["m(s1,s2)", Bold, 20, FontColor → Black]},
 PlotLabel → Style["m(s1,s2)", Bold, 30, FontColor → Black],
 ColorFunction → "Rainbow", AxesStyle → Thickness[0.005], BoxStyle → GrayLevel[2],
 TicksStyle → Directive[Black, 15], ImageSize → Large, PlotRange → Full]
```

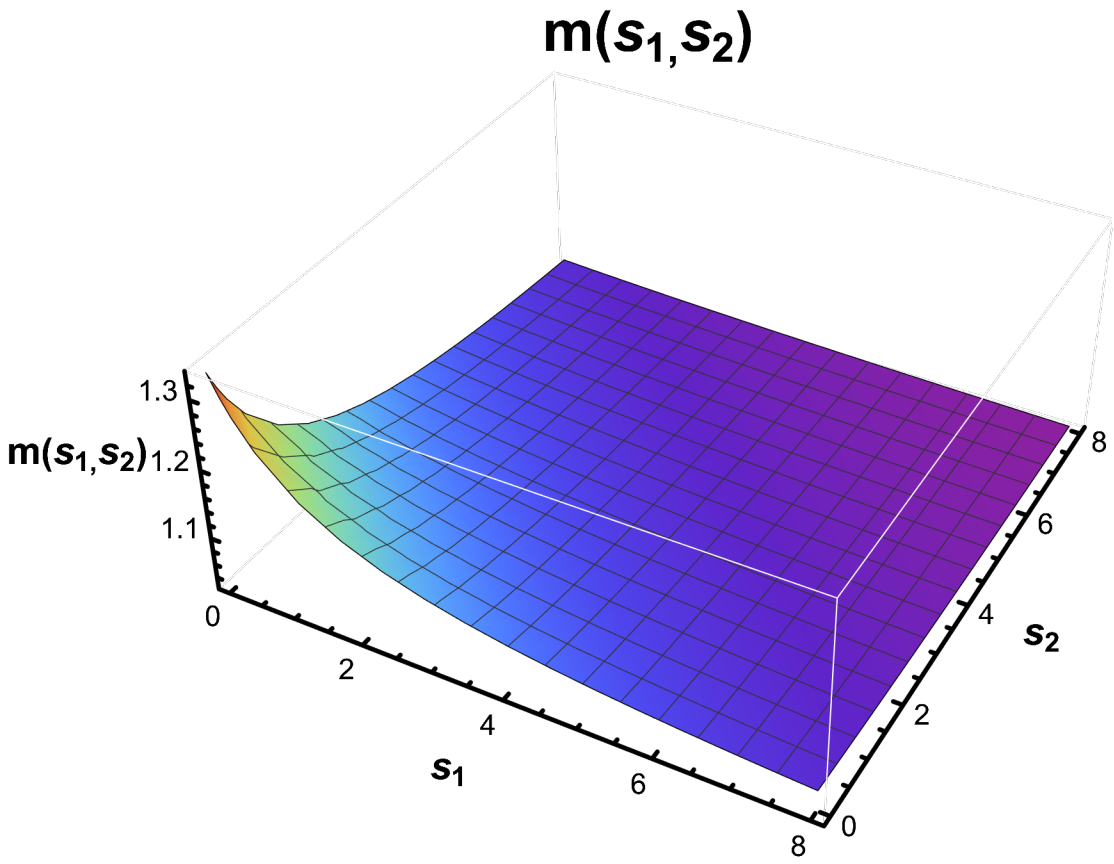
Out[•]=



Surface plot 2

In[ ]:=
```
P1 = 0;
P2 = 1;
P3 = 0;
P4 = 1;
P5 = 0;
P6 = 1;
P7 = 0;
P8 = 1;
P9 = 0;
P10 = 1;
P11 = 0;
mP =
  -((-3 - P9 - P10 - P11 - 2 P1 s1 - P2 s1 - 2 P3 s1 - P4 s1 - P3 P9 s1 - P4 P9 s1 - P1 P10 s1 - P3 P10 s1 -
        P1 P11 s1 - P2 P11 s1 - P1 P2 s1^2 - P1 P3 s1^2 - P3 P4 s1^2 - P3 P4 P9 s1^2 - P1 P3 P10 s1^2 - P1 P2 P11 s1^2 -
        2 P5 s2 - P6 s2 - 2 P7 s2 - P8 s2 - P7 P9 s2 - P8 P9 s2 - P5 P10 s2 - P7 P10 s2 - P5 P11 s2 -
        P6 P11 s2 - P2 P5 s1 s2 - P3 P5 s1 s2 - P1 P6 s1 s2 - P1 P7 s1 s2 - P4 P7 s1 s2 - P3 P8 s1 s2 -
        P4 P7 P9 s1 s2 - P3 P8 P9 s1 s2 - P3 P5 P10 s1 s2 - P1 P7 P10 s1 s2 - P2 P5 P11 s1 s2 -
        P1 P6 P11 s1 s2 - P5 P6 s2^2 - P5 P7 s2^2 - P7 P8 s2^2 - P7 P8 P9 s2^2 - P5 P7 P10 s2^2 - P5 P6 P11 s2^2) /
      (3 + 2 P1 s1 + P2 s1 + 2 P3 s1 + P4 s1 + P1 P2 s1^2 + P1 P3 s1^2 + P3 P4 s1^2 + 2 P5 s2 +
        P6 s2 + 2 P7 s2 + P8 s2 + P2 P5 s1 s2 + P3 P5 s1 s2 + P1 P6 s1 s2 +
        P1 P7 s1 s2 + P4 P7 s1 s2 + P3 P8 s1 s2 + P5 P6 s2^2 + P5 P7 s2^2 + P7 P8 s2^2));
Plot3D[mP, {s1, 0, 8}, {s2, 0, 8}, AxesLabel → {Style["s1", Bold, 20, FontColor → Black],
   Style["s2", Bold, 20, FontColor → Black],
   Style["m(s1,s2)", Bold, 20, FontColor → Black]},
 PlotLabel → Style["m(s1,s2)", Bold, 30, FontColor → Black],
 ColorFunction → "Rainbow", AxesStyle → Thickness[0.005], BoxStyle → GrayLevel[2],
 TicksStyle → Directive[Black, 15], ImageSize → Large, PlotRange → Full]
```

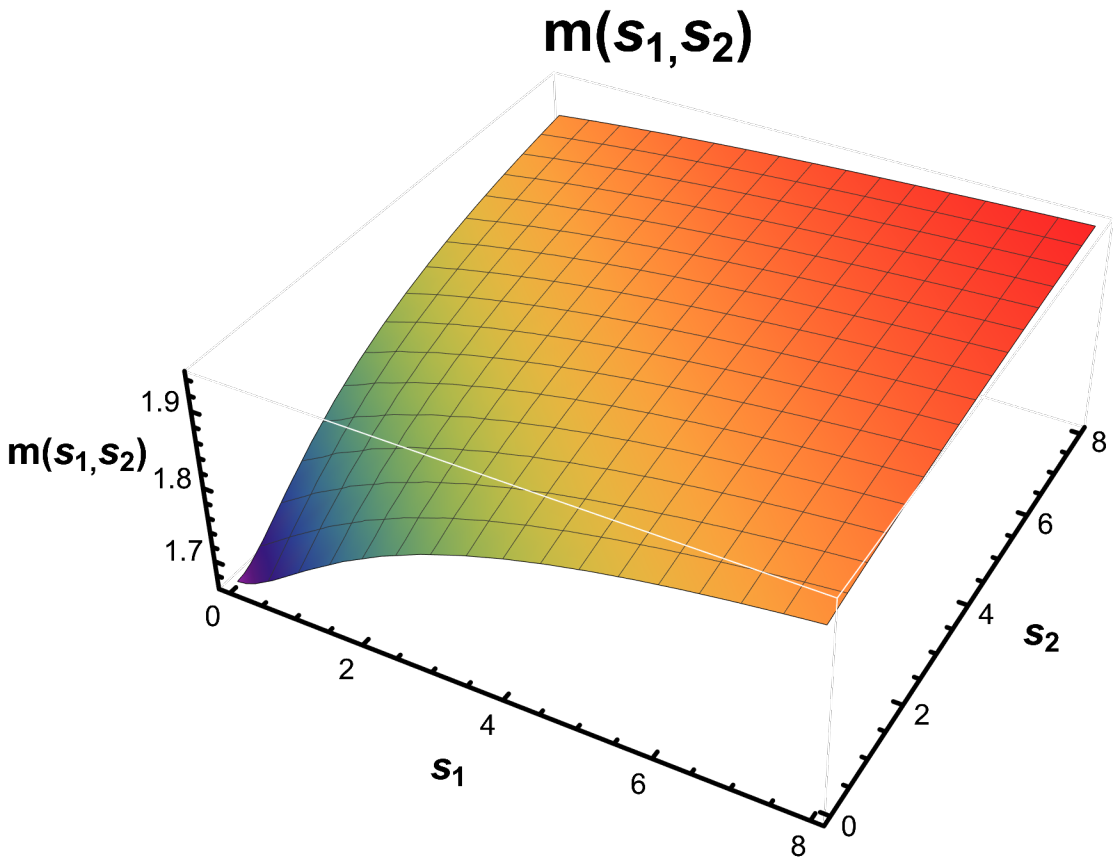
Out[ ]=



Surface plot 3

In[•]:=
```
P1 = 1;
P2 = 1;
P3 = 0;
P4 = 0;
P5 = 1;
P6 = 1;
P7 = 0;
P8 = 0;
P9 = 1;
P10 = 0;
P11 = 1;
mP =
  -((-3 - P9 - P10 - P11 - 2 P1 s1 - P2 s1 - 2 P3 s1 - P4 s1 - P3 P9 s1 - P4 P9 s1 - P1 P10 s1 - P3 P10 s1 -
        P1 P11 s1 - P2 P11 s1 - P1 P2 s1^2 - P1 P3 s1^2 - P3 P4 s1^2 - P3 P4 P9 s1^2 - P1 P3 P10 s1^2 - P1 P2 P11 s1^2 -
        2 P5 s2 - P6 s2 - 2 P7 s2 - P8 s2 - P7 P9 s2 - P8 P9 s2 - P5 P10 s2 - P7 P10 s2 - P5 P11 s2 -
        P6 P11 s2 - P2 P5 s1 s2 - P3 P5 s1 s2 - P1 P6 s1 s2 - P1 P7 s1 s2 - P4 P7 s1 s2 - P3 P8 s1 s2 -
        P4 P7 P9 s1 s2 - P3 P8 P9 s1 s2 - P3 P5 P10 s1 s2 - P1 P7 P10 s1 s2 - P2 P5 P11 s1 s2 -
        P1 P6 P11 s1 s2 - P5 P6 s2^2 - P5 P7 s2^2 - P7 P8 s2^2 - P7 P8 P9 s2^2 - P5 P7 P10 s2^2 - P5 P6 P11 s2^2) /
      (3 + 2 P1 s1 + P2 s1 + 2 P3 s1 + P4 s1 + P1 P2 s1^2 + P1 P3 s1^2 + P3 P4 s1^2 + 2 P5 s2 +
        P6 s2 + 2 P7 s2 + P8 s2 + P2 P5 s1 s2 + P3 P5 s1 s2 + P1 P6 s1 s2 +
        P1 P7 s1 s2 + P4 P7 s1 s2 + P3 P8 s1 s2 + P5 P6 s2^2 + P5 P7 s2^2 + P7 P8 s2^2));
Plot3D[mP, {s1, 0, 8}, {s2, 0, 8}, AxesLabel → {Style["s1", Bold, 20, FontColor → Black],
   Style["s2", Bold, 20, FontColor → Black],
   Style["m(s1,s2)", Bold, 20, FontColor → Black]},
 PlotLabel → Style["m(s1,s2)", Bold, 30, FontColor → Black],
 ColorFunction → "Rainbow", AxesStyle → Thickness[0.005], BoxStyle → GrayLevel[2],
 TicksStyle → Directive[Black, 15], ImageSize → Large, PlotRange → Full]
```

Out[ ]=



Surface plot 4 - One of the successful networks

In[•]:=
```
P1 = 1;
P2 = 1;
P3 = 0;
P4 = 0;
P5 = 0;
P6 = 0;
P7 = 1;
P8 = 1;
P9 = 1;
P10 = 0;
P11 = 1;
mP =
  -((-3 - P9 - P10 - P11 - 2 P1 s1 - P2 s1 - 2 P3 s1 - P4 s1 - P3 P9 s1 - P4 P9 s1 - P1 P10 s1 - P3 P10 s1 -
        P1 P11 s1 - P2 P11 s1 - P1 P2 s1^2 - P1 P3 s1^2 - P3 P4 s1^2 - P3 P4 P9 s1^2 - P1 P3 P10 s1^2 - P1 P2 P11 s1^2 -
        2 P5 s2 - P6 s2 - 2 P7 s2 - P8 s2 - P7 P9 s2 - P8 P9 s2 - P5 P10 s2 - P7 P10 s2 - P5 P11 s2 -
        P6 P11 s2 - P2 P5 s1 s2 - P3 P5 s1 s2 - P1 P6 s1 s2 - P1 P7 s1 s2 - P4 P7 s1 s2 - P3 P8 s1 s2 -
        P4 P7 P9 s1 s2 - P3 P8 P9 s1 s2 - P3 P5 P10 s1 s2 - P1 P7 P10 s1 s2 - P2 P5 P11 s1 s2 -
        P1 P6 P11 s1 s2 - P5 P6 s2^2 - P5 P7 s2^2 - P7 P8 s2^2 - P7 P8 P9 s2^2 - P5 P7 P10 s2^2 - P5 P6 P11 s2^2) /
      (3 + 2 P1 s1 + P2 s1 + 2 P3 s1 + P4 s1 + P1 P2 s1^2 + P1 P3 s1^2 + P3 P4 s1^2 + 2 P5 s2 +
        P6 s2 + 2 P7 s2 + P8 s2 + P2 P5 s1 s2 + P3 P5 s1 s2 + P1 P6 s1 s2 +
        P1 P7 s1 s2 + P4 P7 s1 s2 + P3 P8 s1 s2 + P5 P6 s2^2 + P5 P7 s2^2 + P7 P8 s2^2));
Plot3D[mP, {s1, 0, 8}, {s2, 0, 8}, AxesLabel → {Style["s1", Bold, 20, FontColor → Black],
   Style["s2", Bold, 20, FontColor → Black],
   Style["m(s1,s2)", Bold, 20, FontColor → Black]},
 PlotLabel → Style["m(s1,s2)", Bold, 30, FontColor → Black],
 ColorFunction → "Rainbow", AxesStyle → Thickness[0.005], BoxStyle → GrayLevel[2],
 TicksStyle → Directive[Black, 15], ImageSize → Large, PlotRange → Full]
```

Out[ ]=