```
In[•]:= (* C3.AI COVID CHALLENGE *)

In[•]:= (* Sweden *)

In[1059]:= Clear["Global`*"]

In[•]:= type = "Cases_per_Million";
        policy = "H2_Policy";

In[1062]:= pD0 = 0.9640;
        pD1 = 0.0046;
        pD2 = 0.0268;
        pD3 = 0.0046;
        pD0 + pD1 + pD2 + pD3

Out[•]= 1.

In[•]:= (* COnditional Prob *)

In[1068]:= pD0C6l1 = 0.578469;
        pD1C6l1 = 0.9;
        pD2C6l1 = 0.9828;
        pD3C6l1 = 0.9;

In[1072]:= pD0C6l0 = 1 - pD0C6l1;
        pD1C6l0 = 1 - pD1C6l1;
        pD2C6l0 = 1 - pD2C6l1;
        pD3C6l0 = 1 - pD3C6l1;

In[•]:= (* C6 - 1 *)

In[1077]:= prC6l0 = pD0 pD0C6l0 + pD1 pD1C6l0 + pD2 pD2C6l0 + pD3 pD3C6l0

Out[•]= 0.407737

In[1078]:= prC6l1 = pD0 pD0C6l1 + pD1 pD1C6l1 + pD2 pD2C6l1 + pD3 pD3C6l1

Out[•]= 0.592263

In[•]:= (* Quantum Prob *)

In[1080]:= interfC6l0 = Sqrt[pD0 pD0C6l0 pD1 pD1C6l0] Cos[θ00 - θ10] +
            Sqrt[pD0 pD0C6l0 pD2 pD2C6l0] Cos[θ00 - θ20] +
            Sqrt[pD0 pD0C6l0 pD3 pD3C6l0] Cos[θ00 - θ30] +
            Sqrt[pD1 pD1C6l0 pD2 pD2C6l0 ] Cos[θ10 - θ20] +
            Sqrt[pD1 pD1C6l0 pD3 pD3C6l0] Cos[θ10 - θ30] +
            Sqrt[pD2 pD2C6l0 pD3 pD3C6l0] Cos[θ20 - θ30];


In[1081]:= interfC6l1 = Sqrt[pD0 pD0C6l1 pD1 pD1C6l1] Cos[θ01 - θ11] +
            Sqrt[pD0 pD0C6l1 pD2 pD2C6l1] Cos[θ01 - θ21] +
            Sqrt[pD0 pD0C6l1 pD3 pD3C6l1] Cos[θ01 - θ31] +
            Sqrt[pD1 pD1C6l1 pD2 pD2C6l1 ] Cos[θ11 - θ21] +
            Sqrt[pD1 pD1C6l1 pD3 pD3C6l1] Cos[θ11 - θ31] +
            Sqrt[pD2 pD2C6l1 pD3 pD3C6l1 ] Cos[θ21 - θ31];
```

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In[1082]:=
```
qprC6l0 = prC6l0 + 2 interfC6l0;
```

In[1083]:=
```
qprC6l1 = prC6l1 + 2 interfC6l1;
```

In[1084]:=

In[1085]:=
```
qprC6l0Norm = FullSimplify[qprC6l0 / (qprC6l0 + qprC6l1)];
```

In[1086]:=
```
qprC6l1Norm = 1 - qprC6l0Norm;
(*FullSimplify[qprC6l1 / (qprC6l0+qprC6l1)]; *)
```

In[1087]:=
```
res = Minimize[{qprC6l0Norm, qprC6l0Norm + qprC6l1Norm == 1},
  {θ00, θ01, θ10, θ20, θ30, θ11, θ21, θ31}]
```

Out[•]=
```
{0.233709, {θ00 → 3.01037, θ01 → -0.551924, θ10 → -0.131226, θ20 → -0.131226,
  θ30 → -0.131226, θ11 → -0.551924, θ21 → -0.551924, θ31 → -0.551924}}
```

In[•]:=
```
(* Params *)
```

In[1089]:=
```
θ10 = res[[2]][[3]][[2]];
θ20 = res[[2]][[4]][[2]];
θ30 = res[[2]][[5]][[2]];
θ11 = res[[2]][[6]][[2]];
θ21 = res[[2]][[7]][[2]];
θ31 = res[[2]][[8]][[2]];
```

In[•]:=

In[•]:=
```
qprC6l0Norm = FullSimplify[qprC6l0 / (qprC6l0 + qprC6l1)];
```

In[•]:=
```
qprC6l1Norm = 1 - qprC6l0Norm;
```

In[•]:=
```
(* Updated probabilities *)
```

In[•]:=
```
{qprC6l0Norm, qprC6l1Norm}
```

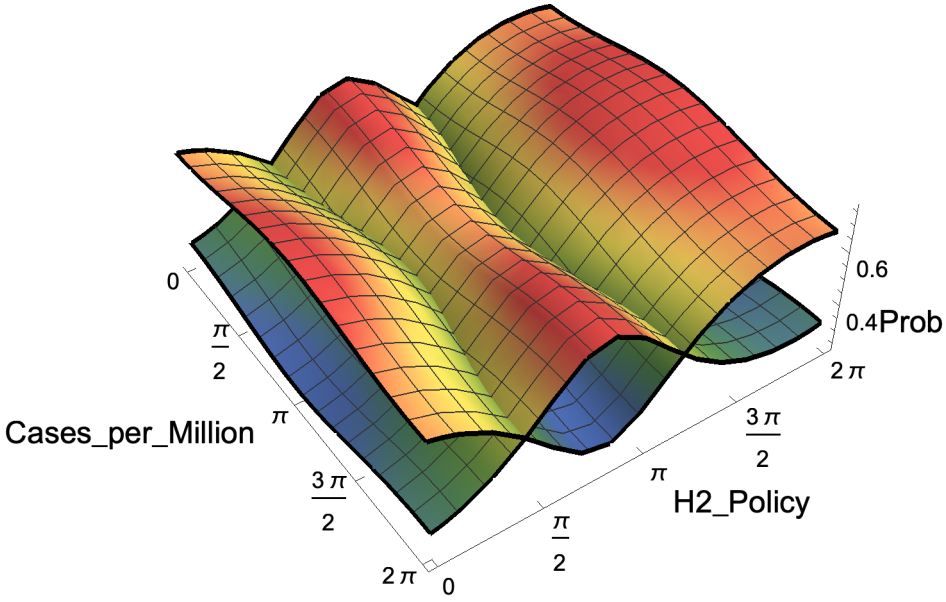
Out[•]=
```
{(15.0124 + 2.97524 Cos[θ00] - 0.392686 Sin[θ00]) /
  (38.5025 + 2.97524 Cos[θ00] + 13.5332 Cos[θ01] - 0.392686 Sin[θ00] - 8.33316 Sin[θ01]),
 1 - (15.0124 + 2.97524 Cos[θ00] - 0.392686 Sin[θ00]) / (38.5025 +
      2.97524 Cos[θ00] + 13.5332 Cos[θ01] - 0.392686 Sin[θ00] - 8.33316 Sin[θ01])}
```

In[1100]:=
```
p0 = Plot3D[qprC6l0Norm, {θ00, 0, 2 π},
   {θ01, 0, 2 π}, ColorFunction → (ColorData["DarkRainbow"][#3] &),
   AxesLabel → {Style[type, 16], Style[policy, 16], Style["Prob", 16]},
   BoundaryStyle → Thick, Boxed → False,
   Ticks → {{0, Pi/2, Pi, 3 Pi/2, 2 Pi}, {0, Pi/2, Pi, 3 Pi/2, 2 Pi}, Automatic},
   TicksStyle → Directive[Black, 12]];
```

In[1101]:=
```
p1 = Plot3D[qprC6l1Norm, {θ00, 0, 2 π},
    {θ01, 0, 2 π}, ColorFunction → (ColorData["DarkRainbow"][#3] &),
    AxesLabel → {Style[type, 16], Style[policy, 16], Style["Prob", 16]},
    BoundaryStyle → Thick, Boxed → False,
    Ticks → {{0, Pi/2, Pi, 3 Pi/2, 2 Pi}, {0, Pi/2, Pi, 3 Pi/2, 2 Pi}, Automatic},
    TicksStyle → Directive[Black, 12]];
```

In[1102]:=
```
Show[p0, p1]
```

Out[•]=




```
fig = StreamDensityPlot[{qprC6l0Norm, qprC6l1Norm},
  {θ00, -2 π, 2 π}, {θ01, -2 π, 2 π}, ColorFunction → "BlueGreenYellow",
  PlotLegends → BarLegend[{"BlueGreenYellow", {0, 1}}, 10],
  AxesLabel → Automatic, StreamStyle → {White, Thick}]
```

In[•]:=
```
Clear[θ10, θ20, θ30, θ11, θ21, θ31]
```

In[•]:=
```
res = Maximize[{qprC6l0Norm, qprC6l0Norm + qprC6l1Norm == 1},
  {θ00, θ01, θ10, θ20, θ30, θ11, θ21, θ31}]
```

Out[•]=
```
{0.703363, {θ00 → -0.131226, θ01 → 2.58967, θ10 → 1.00509, θ20 → 1.62333,
  θ30 → -0.879434, θ11 → 1.21861, θ21 → 1.51541, θ31 → 0.774528}}
```

In[•]:=
```
θ10 = res[[2]][[3]][[2]];
θ20 = res[[2]][[4]][[2]];
θ30 = res[[2]][[5]][[2]];
θ11 = res[[2]][[6]][[2]];
θ21 = res[[2]][[7]][[2]];
θ31 = res[[2]][[8]][[2]];
```

In[•]:=
```
qprC6l0Norm = FullSimplify[qprC6l0 / (qprC6l0 + qprC6l1)];
```

In[•]:=
```
qprC6l1Norm = 1 - qprC6l0Norm;
```

In[•]:=
```
(* Updated probabilities *)
```

In[•]:=
```
{qprC6l0Norm, qprC6l1Norm}
```

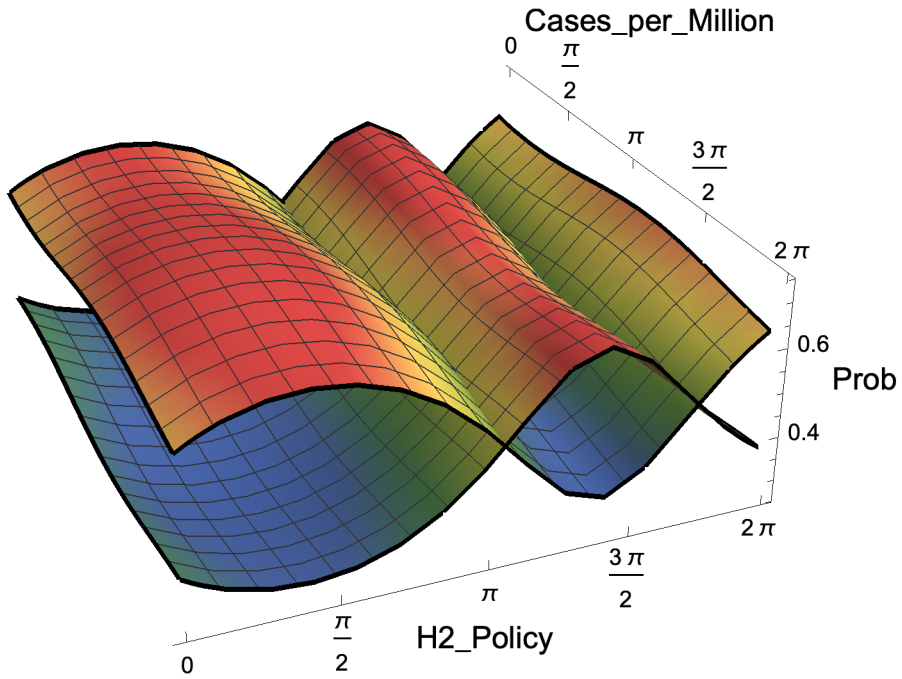
Out[•]=
$$\left\{\frac{14.9014 + 1.12104\,\text{Cos}[\theta 00] + 1.07349\,\text{Sin}[\theta 00]}{38.1285 + 1.12104\,\text{Cos}[\theta 00] + 4.21488\,\text{Cos}[\theta 01] + 1.07349\,\text{Sin}[\theta 00] + 14.6073\,\text{Sin}[\theta 01]},\right.$$
$$\left.1 - \frac{14.9014 + 1.12104\,\text{Cos}[\theta 00] + 1.07349\,\text{Sin}[\theta 00]}{38.1285 + 1.12104\,\text{Cos}[\theta 00] + 4.21488\,\text{Cos}[\theta 01] + 1.07349\,\text{Sin}[\theta 00] + 14.6073\,\text{Sin}[\theta 01]}\right\}$$

In[•]:=
```
p0 = Plot3D[qprC6l0Norm, {θ00, 0, 2 π},
    {θ01, 0, 2 π}, ColorFunction → (ColorData["DarkRainbow"][#3] &),
    AxesLabel → {Style[type, 16], Style[policy, 16], Style["Prob", 16]},
    BoundaryStyle → Thick, Boxed → False,
    Ticks → {{0, Pi/2, Pi, 3 Pi/2, 2 Pi}, {0, Pi/2, Pi, 3 Pi/2, 2 Pi}, Automatic},
    TicksStyle → Directive[Black, 12]];
```

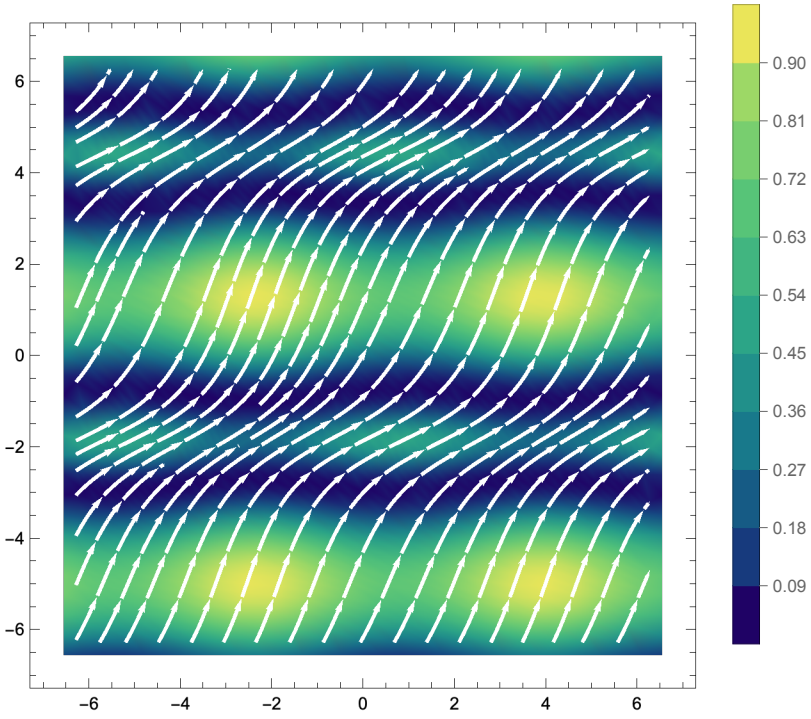
In[•]:=
```
p1 = Plot3D[qprC6l1Norm, {θ00, 0, 2 π},
    {θ01, 0, 2 π}, ColorFunction → (ColorData["DarkRainbow"][#3] &),
    AxesLabel → {Style[type, 16], Style[policy, 16], Style["Prob", 16]},
    BoundaryStyle → Thick, Boxed → False,
    Ticks → {{0, Pi/2, Pi, 3 Pi/2, 2 Pi}, {0, Pi/2, Pi, 3 Pi/2, 2 Pi}, Automatic},
    TicksStyle → Directive[Black, 12]];
```

In[•]:=
```
Show[p0, p1]
```

Out[•]=




```
fig = StreamDensityPlot[{qprC6l0Norm, qprC6l1Norm},
  {θ00, -2 π, 2 π}, {θ01, -2 π, 2 π}, ColorFunction → "BlueGreenYellow",
  PlotLegends → BarLegend[{"BlueGreenYellow", {0, 1}}, 10],
  AxesLabel → Automatic, StreamStyle → {White, Thick}]
```


6
4
2
0
−2
−4
−6
−6
−4
−2
0
2
4
6
0.90
0.81
0.72
0.63
0.54
0.45
0.36
0.27
0.18
0.09