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

In[1127]:= Clear["Global`*"]

In[1128]:= type = "Cases_per_Million";
           policy = "C6_Policy";

In[1130]:= pD0 = 0.9640;
           pD1 = 0.0046;
           pD2 = 0.0268;
           pD3 = 0.0046;
           pD0 + pD1 + pD2 + pD3
Out[ ]= 1.

In[ ]:= (* COnditional Prob *)

In[1136]:= pD0C6l1 = 0.850239;
           pD1C6l1 = 0.9;
           pD2C6l1 = 0.9828;
           pD3C6l1 = 0.9;

In[1140]:= pD0C6l0 = 1 - pD0C6l1;
           pD1C6l0 = 1 - pD1C6l1;
           pD2C6l0 = 1 - pD2C6l1;
           pD3C6l0 = 1 - pD3C6l1;

In[ ]:= (* C6 - 1 *)

In[1145]:= prC6l0 = pD0 pD0C6l0 + pD1 pD1C6l0 + pD2 pD2C6l0 + pD3 pD3C6l0
Out[ ]= 0.145751

In[1146]:= prC6l1 = pD0 pD0C6l1 + pD1 pD1C6l1 + pD2 pD2C6l1 + pD3 pD3C6l1
Out[ ]= 0.854249

In[ ]:= (* Quantum Prob *)

In[1148]:= 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[1149]:= 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];

In[1150]:= qprC6l0 = prC6l0 + 2 interfC6l0;
```

In[1151]:=
```
qprC6l1 = prC6l1 + 2 interfC6l1;
```

In[1152]:=

In[1153]:=
```
qprC6l0Norm = FullSimplify[qprC6l0 / (qprC6l0 + qprC6l1)];
```

In[1154]:=
```
qprC6l1Norm = 1 - qprC6l0Norm;
(*FullSimplify[qprC6l1 / (qprC6l0+qprC6l1)]; *)
```

In[1155]:=
```
res = Minimize[{qprC6l0Norm, qprC6l0Norm + qprC6l1Norm == 1},
  {θ00, θ01, θ10, θ20, θ30, θ11, θ21, θ31}]
```

Out[•]=
```
{0.0650655, {θ00 → -1.26329, θ01 → 1.37013, θ10 → 1.8783, θ20 → 1.8783,
  θ30 → -4.40488, θ11 → 1.37013, θ21 → 1.37013, θ31 → 1.37013}}
```

In[•]:=
```
(* Params *)
```

In[1157]:=
```
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}
```

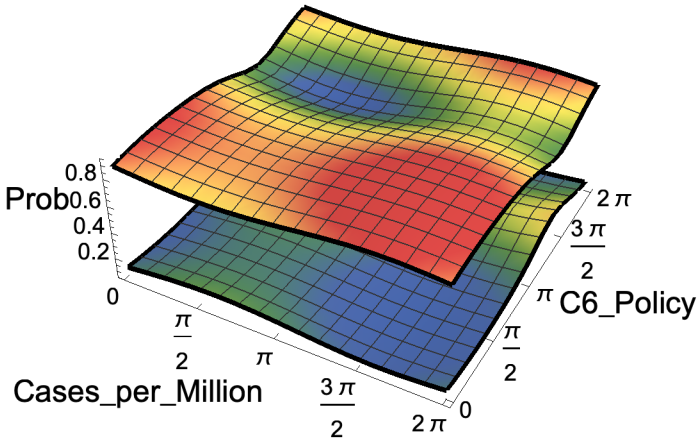
Out[•]=
```
{(4.55365 - 0.453944 Cos[θ00] + 1.42939 Sin[θ00]) / (32.281 + 1. Cos[1.8783 - θ00] +
    0.499739 Cos[4.40488 + θ00] + 16.1546 Cos[1.37013 - θ01]),
 1 - (4.55365 - 0.453944 Cos[θ00] + 1.42939 Sin[θ00]) / (32.281 +
    1. Cos[1.8783 - θ00] + 0.499739 Cos[4.40488 + θ00] + 16.1546 Cos[1.37013 - θ01])}
```

In[1168]:=
```
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[1169]:=
```
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]];
```

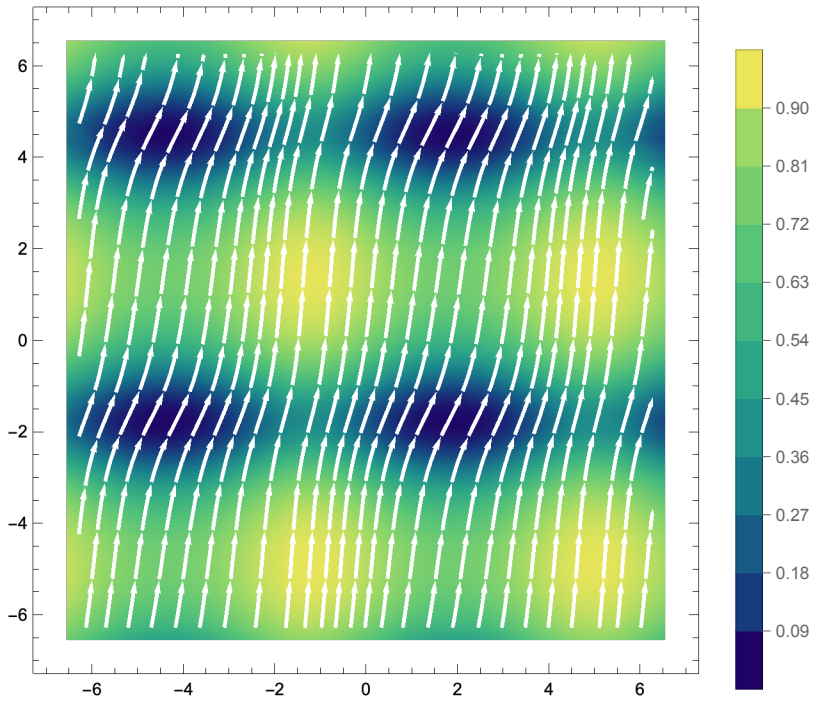
In[1170]:=
```
Show[p0, p1]
```

Out[•]=



In[•]:=

In[1172]:=
```
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}]
```



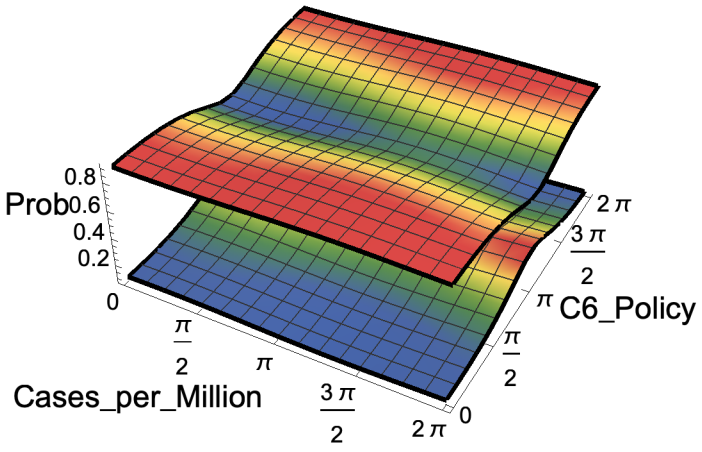
In[•]:=
```
Clear[θ10, θ20, θ30, θ11, θ21, θ31]
```

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

Out[•]=
```
{0.343433, {θ00 → 1.8783, θ01 → -1.77146, θ10 → 0.96554, θ20 → -1.49878,
  θ30 → 1.61366, θ11 → 0.495041, θ21 → 0.328515, θ31 → 0.159847}}
```

```
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[•]= {(8.88708 + 0.598153 Cos[θ00] + 0.82299 Sin[θ00]) /
          (64.3066 + 0.598153 Cos[θ00] + 30.4127 Cos[θ01] + 0.82299 Sin[θ00] + 10.3507 Sin[θ01]),
         1 - (8.88708 + 0.598153 Cos[θ00] + 0.82299 Sin[θ00]) / (64.3066 +
           0.598153 Cos[θ00] + 30.4127 Cos[θ01] + 0.82299 Sin[θ00] + 10.3507 Sin[θ01])}

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[•]=



```
In[•]:= 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}]
```