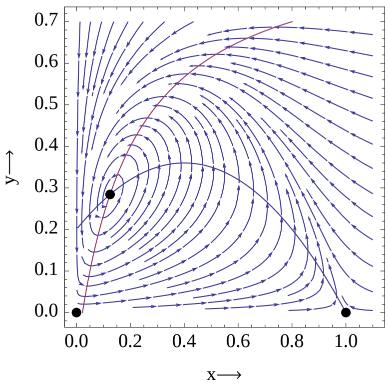
```
dx[x_, y_] := f[x] - g[x] y;
dy[x_, y_] := γ g[x] y - δ y - ϵ y^2;

f[x_] := x (1 - x);
g[x_] := β x (1 + β T x)^-1;

β = 5; γ = 1; δ = .1; ϵ = 1; T = 1;

{x, y} /. Solve[{dx[x, y] == 0, dy[x, y] == 0}, {x, y}] // N
```

$\{\{0., -0.1\}, \{0., 0.\}, \{1., -5.32907\times10^{-16}\}, \{0.124821, 0.284277\},$
$\{0.237589 - 0.651336\, i, 0.757862 - 0.211568\, i\}, \{0.237589 + 0.651336\, i, 0.757862 + 0.211568\, i\}\}$

```
{xEq, yEq} = {0.1248211895843873`, 0.2842766222982483`}
```

```
{0.124821, 0.284277}
```

```
Show[
 {
  StreamPlot[{dx[x, y], dy[x, y]}, {x, 0, 1.1}, {y, 0, .7}],
  ContourPlot[{dx[x, y], dy[x, y]}, {x, 0, 1.1}, {y, 0, .7}, PlotPoints → 100],
  Graphics[{PointSize[Medium], Point[{{0, 0}, {1, 0}, {xEq, yEq}}]}]
 },
 FrameLabel → {"x⟶", "y⟶"}, ImageSize → Small]
```




```
A = {{a11, a12}, {a21, a22}} = D[{dx[x, y], dy[x, y]}, {{x, y}}] /. {x → xEq, y → yEq};

MatrixForm[A]
```

$$\begin{pmatrix} 0.21149 & -0.384277 \\ 0.538868 & -0.284277 \end{pmatrix}$$

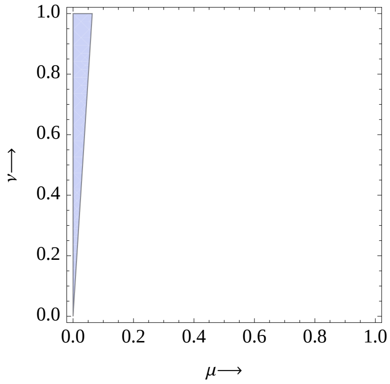
```
Det[A]
```

```
0.146953
```

```
Tr[A]
```

```
-0.0727871
```

```
RegionPlot[μ a22 + ν a11 > 2 Sqrt[μ ν Det[A]], {μ, 0, 1},
 {ν, 0, 1}, FrameLabel → {"μ⟶", "ν⟶"}, ImageSize → Small]
```




```
Id = {{1, 0}, {0, 1}};
Di = {{μ, 0}, {0, ν}};
```

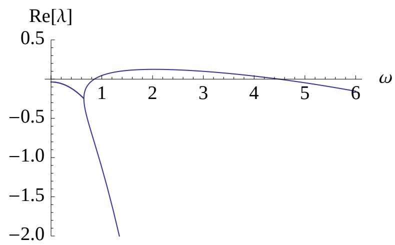
```
CharEq = Det[λ Id - A + ω^2 Di] == 0
```

$$0.146953 + 0.0727871\,\lambda + \lambda^2 + 0.284277\,\mu\,\omega^2 + \lambda\,\mu\,\omega^2 - 0.21149\,\nu\,\omega^2 + \lambda\,\nu\,\omega^2 + \mu\,\nu\,\omega^4 == 0$$

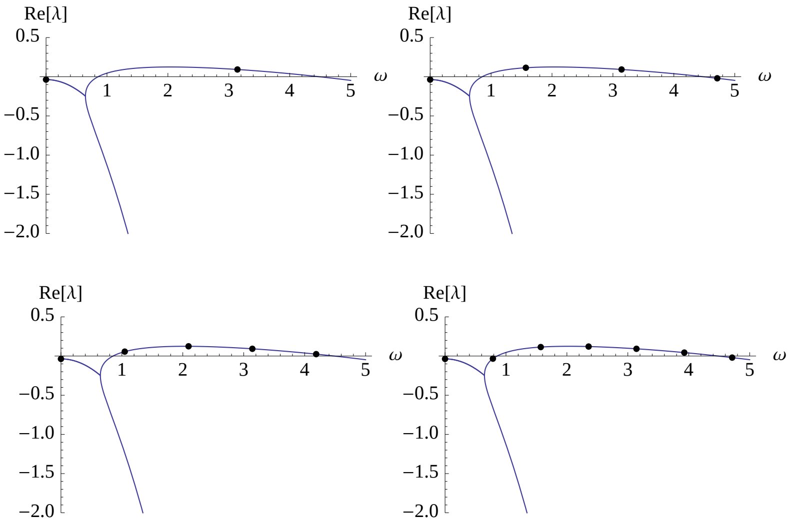
```
{λ1, λ2} = λ /. Solve[CharEq, λ] // Simplify
```

$$\Big\{-0.0363935 - 0.5\,\mu\,\omega^2 - 0.5\,\nu\,\omega^2 - 0.5\sqrt{\left(-0.582513 - 0.991532\,\mu\,\omega^2 + 0.991532\,\nu\,\omega^2 + 1.\,\mu^2\,\omega^4 - 2.\,\mu\,\nu\,\omega^4 + 1.\,\nu^2\,\omega^4\right)},\ -0.0363935 - 0.5\,\mu\,\omega^2 - 0.5\,\nu\,\omega^2 + 0.5\sqrt{\left(-0.582513 - 0.991532\,\mu\,\omega^2 + 0.991532\,\nu\,\omega^2 + 1.\,\mu^2\,\omega^4 - 2.\,\mu\,\nu\,\omega^4 + 1.\,\nu^2\,\omega^4\right)}\Big\}$$

```
Plot[Re[{λ1, λ2} /. {μ → .01, ν → 1}], {ω, 0, 6},
 PlotRange → {-2, .5}, AxesLabel → {"ω", "Re[λ]"}, ImageSize → Small]
```

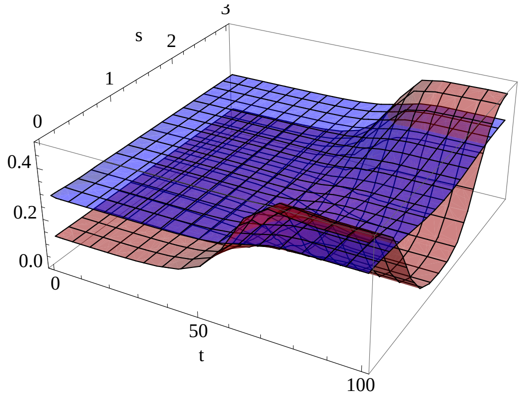


```
μ = .01; ν = 1; ωMax = 6;
Row[
 Table[
  Show[{
    Plot[Re[{λ1, λ2}], {ω, 0, 5}, PlotRange → {-2, .5}],
    Graphics[
     Point[Table[{k π / L, Max[Re[{λ1, λ2} /. {ω → k π / L}]]}, {k, 0, ωMax L / π, 1}]]]
   }, AxesLabel → {"ω", "Re[λ]"}, ImageSize → Small],
  {L, 1, 4}]
]
```

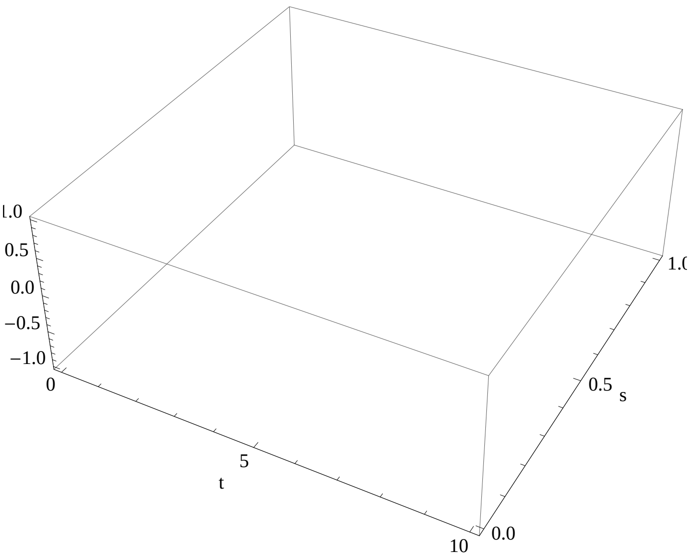



```
L = 3;
equations = {
   x^(1,0)[t, s] == f[x[t, s]] - g[x[t, s]] y[t, s] + μ x^(0,2)[t, s],
   y^(1,0)[t, s] == γ g[x[t, s]] y[t, s] - δ y[t, s] - ϵ y[t, s]^2 + ν y^(0,2)[t, s],
   x^(0,1)[t, 0] == 0,
   x^(0,1)[t, L] == 0,
   y^(0,1)[t, 0] == 0,
   y^(0,1)[t, L] == 0,
   x[0, s] == xEq (1 + .01 (Random[] - .5) Sum[Cos[k π s / L], {k, 1, 10}]),
   y[0, s] == yEq (1 + .01 (Random[] - .5) Sum[Cos[k π s / L], {k, 1, 10}])
  };
```

```
NDSolve[equations, {x, y}, {t, 0, 100}, {s, 0, L}]

Plot3D[Evaluate[{x[t, s], y[t, s]} /. %], {t, 0, 100}, {s, 0, L}, PlotRange → {0, .5},
 PlotStyle → {Directive[Opacity[0.7], Red], Directive[Opacity[0.7], Blue]},
 AxesLabel → {"t", "s", ""}]

{{x → InterpolatingFunction[{{0., 100.}, {0., 3.}}, <>],
  y → InterpolatingFunction[{{0., 100.}, {0., 3.}}, <>]}}
```




```
Plot3D[Evaluate[{x[t, s], y[t, s]} /. %], {t, 0, 10}, {s, 0, 1},
 PlotStyle → {Directive[Opacity[0.7], Red], Directive[Opacity[0.7], Blue]},
 AxesLabel → {"t", "s", ""}]
```




```
yEq

0.284277
```