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(* Δεύτερη παραλλαγή του βασικού μοντέλου Lotka-
 Volterra (θηρευτών-θηραμάτων) *)
a = 30;
b = 1;
c = 15;
d = 1;
k1 = 10;
k2 = 20.2;
tend = 10;
x0 = 16; y0 = 2;
x =.;
y =.;
```
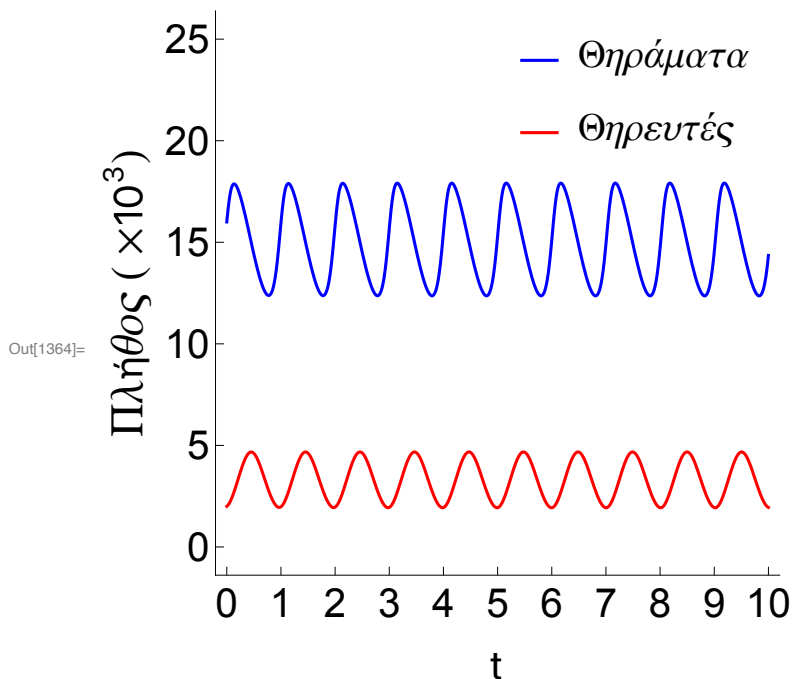
```
In[1361]:= Sol = NDSolve[{D[x[t], t] == -a * x[t] * (1 - x[t] / k1) * (1 - x[t] / k2) - b * x[t] * y[t],
        D[y[t], t] == -c * y[t] + d * x[t] * y[t],
        x[0] == x0, y[0] == y0}, {x, y}, {t, 0, tend}];
    Plot1 = Plot[Evaluate[x[t] /. First[Sol]], {t, 0, tend}, PlotPoints → 200,
        Mesh → False, AxesLabel → {t, x}, PlotRange → All, PlotStyle → Blue,
        FrameLabel → {Style["t", FontFamily → "MS Serif", FontSize → 21],
          Style["Πλήθος ( ×10³)", FontFamily → "MS Serif", FontSize → 21]},
        RotateLabel → True, Frame → {{Automatic, False}, {Automatic, False}}];
    Plot2 = Plot[Evaluate[y[t] /. First[Sol]], {t, 0, tend}, PlotPoints → 200,
        Mesh → False, AxesLabel → {t, y}, PlotRange → All, PlotStyle → Red];

    MP0 = Show[Plot1, Plot2, PlotRange → {{0, tend}, {0, 25}}, Epilog →
        Inset[Column[{LineLegend[{Blue, Red}, {"Θηράματα", "Θηρευτές"}, LabelStyle →
            {FontFamily → "Times New Roman", FontSize → 21, FontSlant → Italic}]}],
          Scaled[{0.75, 0.85}]], MaxRecursion → 0, PlotPoints → {200, 100},
        AspectRatio → 1, AxesOrigin → {0, 0}, RotateLabel → True,
        LabelStyle → {21, GrayLevel[0]}, FrameTicks →
        {{{0, 5, 10, 15, 20, 25}, None}, {{0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10}, None}}]
```

Out[1364]=


```
In[1365]:= Sol1 = NDSolve[{D[x[t], t] == -a * x[t] * (1 - x[t] / k1) * (1 - x[t] / k2) - b * x[t] * y[t],
        D[y[t], t] == -c * y[t] + d * x[t] * y[t],
        x[0] == x0, y[0] == y0}, {x, y}, {t, 0, tend}];
```

In[1366]:=
```
P1 =
  ParametricPlot[{Evaluate[x[t] /. First[Sol1]], Evaluate[y[t] /. First[Sol1]]},
    {t, 0, tend}, PlotPoints → 200, Mesh → False, PlotRange → All, PlotStyle → Black,
    FrameLabel → {Style["Πλήθος θηραμάτων( ×10³)", FontFamily → "MS Serif",
        FontSize → 21, FontColor → Black], Style["Πλήθος θηρευτών( ×10³)",
        FontFamily → "MS Serif", FontSize → 21, FontColor → Black]},
    RotateLabel → True, Frame → {{Automatic, False}, {Automatic, False}},
    Epilog →
      {Inset[Graphics[{Black, Text[Style["Αρχικές συνθήκες", 21]]}], {17, 8}],
       Inset[Graphics[{Blue, Text[Style["x₀=16, y₀=2", 21]]}], {17.5, 1}]}];
  G0 = Graphics[{PointSize[0.02], Blue, Point[{7.5, 8}]}];
  G1 = Graphics[{PointSize[0.02], Blue, Point[{x0, y0}]}];
```
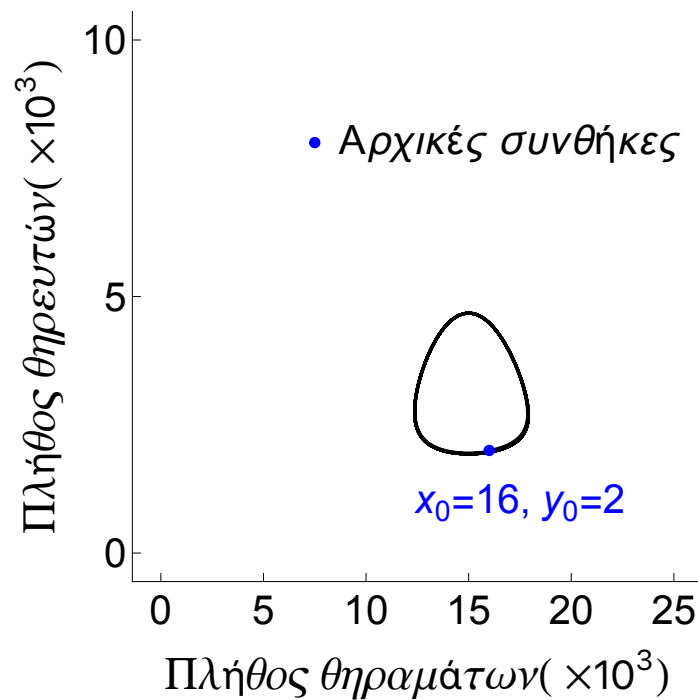
In[1369]:=
```
MP0 = Show[P1, G0, G1, PlotRange → {{0, 25}, {0, 10}},
    MaxRecursion → 0, PlotPoints → {200, 100}, AspectRatio → 1,
    AxesOrigin → {0, 0}, RotateLabel → True, LabelStyle → {21, GrayLevel[0]},
    FrameTicks → {{{0, 5, 10}, None}, {{0, 5, 10, 15, 20, 25}, None}}]
```

Out[1369]=

In[1370]:= `(*Phase plane *)`
`StreamPlot[{-a * x * (1 - x / k1) * (1 - x / k2) - b * x * y, -c * y + d * x * y},`
`{x, 0, 25}, {y, 0, 25}, StreamPoints → 2000, StreamScale → Full]`

Out[1370]=