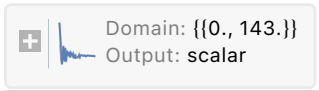
```
(*This is for special cases and to
 look what will happend. Stable or Unstable.*)
(*This is for page 29 figure 9*)
```

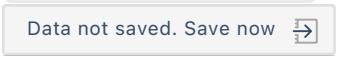
In[ ]:=
```
α = .01;
β = .07;
γ = .07;
δ = .07;
ϵ = .03;
ξ = .07;
η = .0;
θ = 0.1;
ψ = -0.01;
```

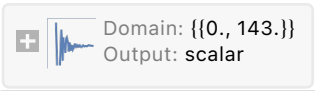
In[ ]:=
```
s = NDSolve[{x'[t] == α x[t] - β y[t] - γ z[t] + ψ x[t]^2 - δ z[t] × y[t],
   y'[t] == β y[t] - α x[t] + γ z[t] + θ y[t]^2 - ϵ Abs[z[t]] × x[t],
   z'[t] == ξ + γ z[t] - α x[t] + β y[t] - η x[t] × Abs[y[t]],
   x[0] == 6.4828, y[0] == 2.2467, z[0] == -2.2706}, {x, y, z}, {t, 400}]
```

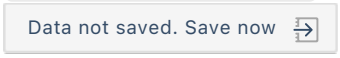
NDSolve: 在点 t == 143.4123054174886` 处达到了最大步数 103453.

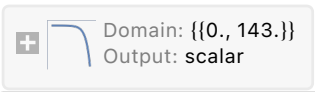
Out[ ]=

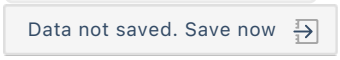
{{x → InterpolatingFunction[]



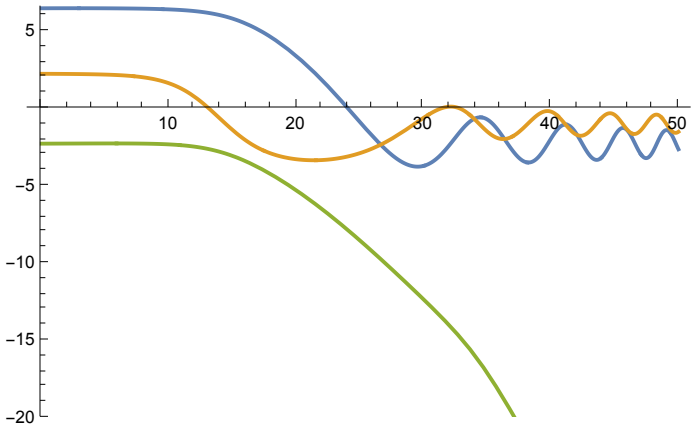
, y → InterpolatingFunction[]



, z → InterpolatingFunction[]}}



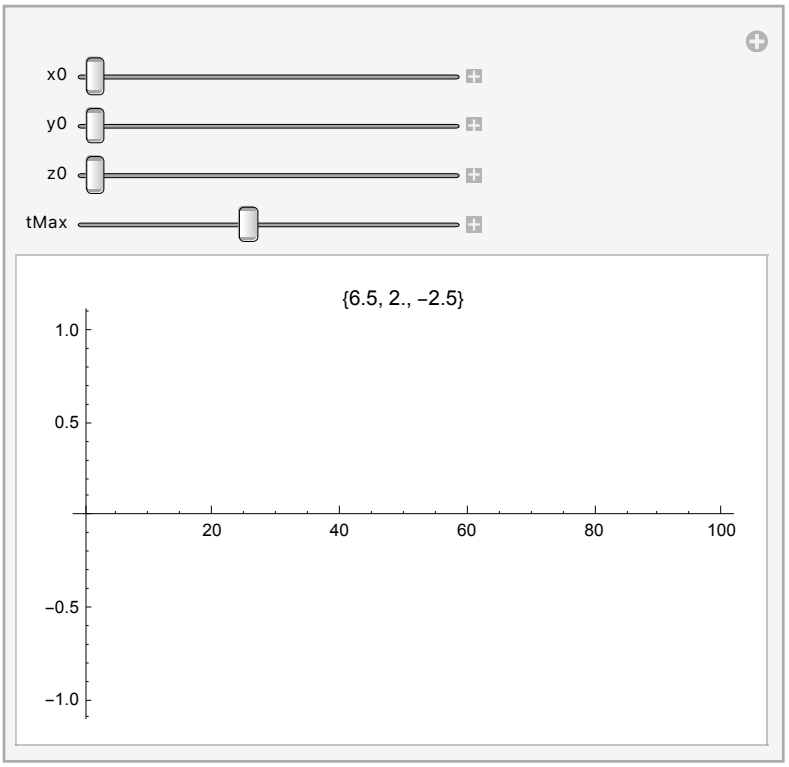
In[•]:=
```
Plot[Evaluate[{x[t], y[t], z[t]} /. s], {t, 0, 50}, PlotRange → {-20, 6.5}]
```



In[•]:=
```
Manipulate[Plot [Evaluate[ {x[t], y[t], z[t]} /.
    NDSolve[{x'[t] == α x[t] - β y[t] - γ z[t] + ψ x[t]^2 - δ z[t] × y[t],
      y'[t] == β y[t] - α x[t] + γ z[t] + Θ y[t]^2 - ϵ Abs[z[t]] × x[t],
      z'[t] == ξ + γ z[t] - α x[t] + β y[t] - η x[t] × Abs[y[t]], x[0] == x0, y[0] == y0,
      z[0] == z0}, {x, y, z}, {t, 500} ]], {t, 0, tMax}, PlotLabel → {x0, y0, z0}],
 {x0, 6.5, 10}, {y0, 2.0, 2.5}, {z0, -2.5, -3}, {tMax, 20, 200}]

(*Evaluate[
  {x[t],y[t],z[t]}/.NDSolve[{x'[t]==α x[t]-β y[t]-γ z[t]+ψ x[t]^2-δ z[t]y[t],
     y'[t]==β y[t]-α x[t]+γ z[t]+Θ y[t]^2-ϵ Abs[z[t]]x[t],
     z'[t]==ξ+γ z[t]-α x[t]+β y[t]-η x[t]Abs[y[t]],x[0]==x0,y[0]==y0,z[0]==z0},
    {x,y,z},{t,500} ]]/.t→100*)
```

Out[ ]=



NDSolve::ndnum: Encountered non−numerical value for a derivative at t == 0..

ReplaceAll::reps:
{NDSolve[{x'[t] == α x[t] + ψ x[t]^2 − β y[t] − γ z[t] − δ y[t] z[t],
y'[t] == −(α x[t]) − ϵ Abs[z[t]] x[t] + β y[t] + θ y[t]^2 + γ z[t],
<<3>>, z[0] == −2.5}, {x, y, z}, {t, 500}]} is neither a list of replacement rules nor a valid dispatch table, and so cannot be used for replacing.

NDSolve::dsvar: 0.00204286 cannot be used as a variable.

ReplaceAll::reps:
{NDSolve[{x'[0.00204286] == α x[0.00204286] + ψ x[0.00204286]^2 −
β y[0.00204286] − γ z[0.00204286] − δ y[0.00204286] z[0.00204286],
<<4>>, z[0] == −2.5}, {x, y, z}, {0.00204286, 500}]} is neither a list of replacement rules nor a valid dispatch table, and so cannot be used for replacing.

NDSolve::dsvar: 0.00204286 cannot be used as a variable.

ReplaceAll::reps:
{NDSolve[{x'[0.00204286] == α x[0.00204286] + ψ x[0.00204286]^2 −
1. β y[0.00204286] − 1. γ z[0.00204286] −
1. δ y[0.00204286] z[0.00204286], <<4>>, z[0.] == −2.5}, {<<3>>},
{<<10>>, 500.}]} is neither a list of replacement rules nor a valid dispatch table, and so cannot be used for replacing.

General::stop: Further output of ReplaceAll::reps will be suppressed during this calculation.

NDSolve::dsvar: 2.04286 cannot be used as a variable.

General::stop: Further output of NDSolve::dsvar will be suppressed during this calculation.

In[•]:=
```
x[20]
```

Out[•]=
```
x[20]
```

```
(* For this case,
we can change the range to know it became more and more stable*)
```

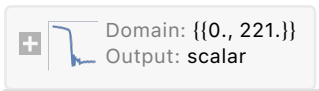
In[•]:=
```
ClearAll
```

Out[•]=
```
ClearAll
```

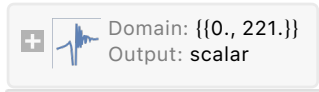
In[•]:=
```
α = .01;
β = .07;
γ = .07;
δ = .07;
ϵ = .03;
ξ = .07;
η = .0;
θ = 0.1;
ψ = -0.01;
```

In[•]:=
```
s = NDSolve[{x'[t] == α x[t] - β y[t] - γ z[t] + ψ x[t]^2 - δ z[t] × y[t],
   y'[t] == β y[t] - α x[t] + γ z[t] + θ y[t]^2 - ϵ Abs[z[t]] × x[t],
   z'[t] == ξ + γ z[t] - α x[t] + β y[t] - η x[t] × Abs[y[t]],
   x[0] == 3.9544, y[0] == -1.3335, z[0] == 0.8484 }, {x, y, z}, {t, 400}]
```

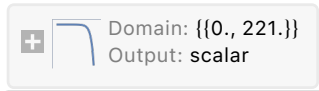
NDSolve: 在点 t == 220.81572730801324` 处达到了最大步数 113314.

Out[•]=
```
{{x → InterpolatingFunction[  ],
```
Domain: {{0., 221.}}
Output: scalar

Data not saved. Save now

```
 y → InterpolatingFunction[  ],
```
Domain: {{0., 221.}}
Output: scalar

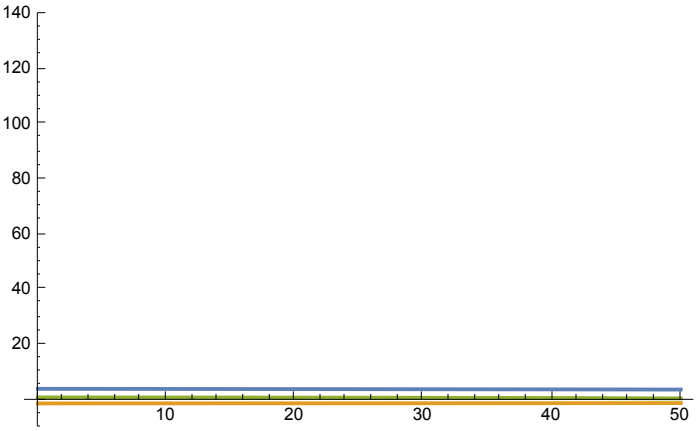
Data not saved. Save now

```
 z → InterpolatingFunction[  ]}}
```
Domain: {{0., 221.}}
Output: scalar

Data not saved. Save now

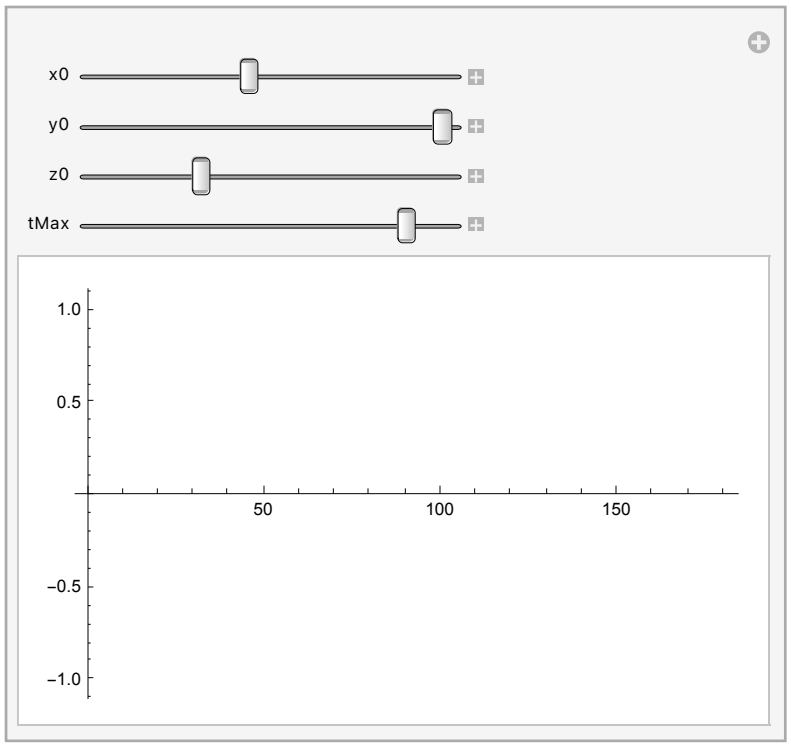
In[ ]:=
```
Plot[Evaluate[{x[t], y[t], z[t]} /. s], {t, 0, 50}, PlotRange → {140, -10}]
```

Out[ ]=



In[ ]:=
```
Manipulate[Plot [Evaluate[ {x[t], y[t], z[t]} /.
    NDSolve[{x'[t] == α x[t] - β y[t] - γ z[t] + ψ x[t]^2 - δ z[t] × y[t],
      y'[t] == β y[t] - α x[t] + γ z[t] + Θ y[t]^2 - ϵ Abs[z[t]] × x[t],
      z'[t] == ξ + γ z[t] - α x[t] + β y[t] - η x[t] × Abs[y[t]],
      x[0] == x0, y[0] == y0, z[0] == z0}, {x, y, z}, {t, 500} ]], {t, 0, tMax}],
 {x0, 3.5, 6}, {y0, -2.0, -1.0}, {z0, 0.5, 1.5}, {tMax, 20, 200}]
```

Out[ ]=



NDSolve: 在点 t == 207.15413655874616` 处达到了最大步数 2411328.

NDSolve: 在点 t == 207.15413655874616` 处达到了最大步数 2411328.

NDSolve: 在点 t == 204.86164730459691` 处达到了最大步数 2335046.

NDSolve: 在点 t == 190.92946341531982` 处达到了最大步数 590866.

NDSolve: 在点 t == 221.83183461662347` 处达到了最大步数 121343.

NDSolve: 在点 t == 221.83183461662347` 处达到了最大步数 121343.

NDSolve: 在点 t == 221.83183461662347` 处达到了最大步数 121343.

NDSolve: 在点 t == 221.83183461662347` 处达到了最大步数 121343.

NDSolve: 在点 t == 221.83183461662347` 处达到了最大步数 121343.

NDSolve: 在点 t == 205.32813396648237` 处达到了最大步数 285530.

NDSolve: 在点 t == 204.76793269160464` 处达到了最大步数 394256.

NDSolve: 在点 t == 263.21616759511073` 处达到了最大步数 1164120.

NDSolve: 在点 t == 236.93587181764377` 处达到了最大步数 1115495.

NDSolve::ndnum: Encountered non−numerical value for a derivative at t == 0..

ReplaceAll::reps:
{NDSolve[{x'[t] == α x[t] + ψ x[t]^2 − β y[t] − γ z[t] − δ y[t] z[t], y'[t] == −(α x[t]) − ϵ Abs[z[t]] x[t] + β y[t] + θ y[t]^2 + γ z[t], <<3>>, z[0] == 0.8}, {x, y, z}, {t, 500}]} is neither a list of replacement rules nor a valid dispatch table, and so cannot be used for replacing.

NDSolve::dsvar: 0.0036894 cannot be used as a variable.

ReplaceAll::reps:
{NDSolve[{x'[0.0036894] == α x[0.0036894] + ψ x[0.0036894]^2 − β y[0.0036894] − γ z[0.0036894] − δ y[0.0036894] z[0.0036894], y'[0.0036894] == −<<1>> + <<4>>, <<3>>, z[0] == 0.8}, <<2>>]} is neither a list of replacement rules nor a valid dispatch table, and so cannot be used for replacing.

NDSolve::dsvar: 0.0036894 cannot be used as a variable.

ReplaceAll::reps:
{NDSolve[{x'[0.0036894] == α x[0.0036894] + ψ x[0.0036894]^2 − 1. β y[0.0036894] − 1. γ z[0.0036894] − 1. δ y[0.0036894] z[0.0036894], <<4>>, z[0.] == 0.8}, {x, y, z}, {0.0036894, 500.}]} is neither a list of replacement rules nor a valid dispatch table, and so cannot be used for replacing.

General::stop: Further output of ReplaceAll::reps will be suppressed during this calculation.

NDSolve::dsvar: 3.6894 cannot be used as a variable.

General::stop: Further output of NDSolve::dsvar will be suppressed during this calculation.

```
(* This case is still unstable *)
```