Table 1a

In[ ]:= **1**

In[ ]:=

In[ ]:= $\alpha = 0.05$;
$\beta = 0.01$;
$\gamma = 0.05$;
$\delta = 0.02$;
$\epsilon = 0.03$;
$\zeta = 0.01$;
$\eta = 0.05$;
$\theta = 1.0$;
$\psi = -0.1$;

FindRoot$\left[\{\alpha\,x - \beta\,y - \gamma\,z + \psi\,x^2 - \delta\,y\,z, -\alpha\,x + \beta\,y + \gamma\,z + \theta\,y^2 - \epsilon\,x\,\text{Abs}[z],\right.$
$\left. \zeta - \alpha\,x + \beta\,y + \gamma\,z - \eta\,\text{Abs}[y]\,x\}, \{\{x, -1\}, \{y, -1\}, \{z, -1\}\}\right]$

Out[ ]=
$\{x \to -0.322945, y \to -0.0781141, z \to -0.532549\}$

In[ ]:= FindRoot$\left[\{\alpha\,x - \beta\,y - \gamma\,z + \psi\,x^2 - \delta\,y\,z, -\alpha\,x + \beta\,y + \gamma\,z + \theta\,y^2 - \epsilon\,x\,\text{Abs}[z],\right.$
$\left. \zeta - \alpha\,x + \beta\,y + \gamma\,z - \eta\,\text{Abs}[y]\,x\}, \{\{x, -100\}, \{y, 100\}, \{z, -100\}\}\right]$

Out[ ]=
$\{x \to 0.289824, y \to 0.0972025, z \to 0.0985556\}$

In[ ]:= FindRoot$\left[\{\alpha\,x - \beta\,y - \gamma\,z + \psi\,x^2 - \delta\,y\,z, -\alpha\,x + \beta\,y + \gamma\,z + \theta\,y^2 - \epsilon\,x\,\text{Abs}[z],\right.$
$\left. \zeta - \alpha\,x + \beta\,y + \gamma\,z - \eta\,\text{Abs}[y]\,x\}, \{\{x, 1\}, \{y, 1\}, \{z, 1\}\}\right]$
Out[ ]=
$\{x \to 0.289824, y \to 0.0972025, z \to 0.0985556\}$

In[ ]:= FindRoot$\left[\{\alpha\,x - \beta\,y - \gamma\,z + \psi\,x^2 - \delta\,y\,z, -\alpha\,x + \beta\,y + \gamma\,z + \theta\,y^2 - \epsilon\,x\,\text{Abs}[z],\right.$
$\left. \zeta - \alpha\,x + \beta\,y + \gamma\,z - \eta\,\text{Abs}[y]\,x\}, \{\{x, 1000\}, \{y, 1000\}, \{z, 1000\}\}\right]$
Out[ ]=
$\{x \to 0.289824, y \to 0.0972025, z \to 0.0985556\}$

In[ ]:= FindRoot$\left[\{\alpha\,x - \beta\,y - \gamma\,z + \psi\,x^2 - \delta\,y\,z, -\alpha\,x + \beta\,y + \gamma\,z + \theta\,y^2 - \epsilon\,x\,\text{Abs}[z],\right.$
$\left. \zeta - \alpha\,x + \beta\,y + \gamma\,z - \eta\,\text{Abs}[y]\,x\}, \{\{x, -1000\}, \{y, -1000\}, \{z, -1000\}\}\right]$
Out[ ]=
$\{x \to -0.322945, y \to -0.0781141, z \to -0.532549\}$

In[ ]:= $\{x \to -0.322945, y \to -0.0781141, z \to -0.532549\}$ /. Rule $\to$ List

In[ ]:= `{{x, -0.3229448286411948`}, {y, -0.07811410406784347`}, {z, -0.5325485537802762`}}`

FindRoot$\left[\left\{\alpha x - \beta y - \gamma z + \psi x^2 - \delta y z, -\alpha x + \beta y + \gamma z + \theta y^2 - \epsilon x \, \text{Abs}[z],\right.\right.$
$\left.\left. \xi - \alpha x + \beta y + \gamma z - \eta \, \text{Abs}[y] \, x \right\}, \{\{x, 1000\}, \{y, -1000\}, \{z, 1000\}\}\right]$

Out[ ]=
{{x, -0.322945}, {y, -0.0781141}, {z, -0.532549}}

Out[ ]=
{x → 0.296949, y → -0.0991488, z → 0.14622}

In[ ]:=

This is for the 1a data, find the range for x,y,z (

Table1b

In[ ]:= `x = 3;`
`y = 4;`
`x + y`

Out[ ]=
7

In[ ]:= $\alpha = 0.05$;
$\beta = 0.01$;
$\gamma = 0.05$;
$\delta = 0.02$;
$\epsilon = 0.03$;
$\xi = 0.1$;
$\eta = 0.04$;
$\theta = 1.0$;
$\psi = -0.01$;

In[ ]:= FindRoot$\left[\left\{\alpha x - \beta y - \gamma z + \psi x^2 - \delta y z, -\alpha x + \beta y + \gamma z + \theta y^2 - \epsilon x \, \text{Abs}[z],\right.\right.$
$\left.\left. \xi - \alpha x + \beta y + \gamma z - \eta \, \text{Abs}[y] \, x \right\}, \{\{x, -1\}, \{y, -1\}, \{z, -1\}\}\right]$

⋯ FindRoot: 无法在 100 次迭代中收敛到要求的准确度或者精度. ⓘ

Out[ ]=
{3 → -1.47085, 4 → -0.000202617, 10 → -1.90559}

In[•]:= `FindRoot[{α x - β y - γ z + ψ x² - δ y z, -α x + β y + γ z + θ y² - ε x Abs[z],`
`ξ - α x + β y + γ z - η Abs[y] x }, {{x, 1}, {y, 1}, {z, 1}}]`

Out[•]=
{3 → 2.3871, 4 → 0.371111, 10 → 1.02158}

In[•]:= `FindRoot[{α x - β y - γ z + ψ x² - δ y z, -α x + β y + γ z + θ y² - ε x Abs[z],`
`ξ - α x + β y + γ z - η Abs[y] x }, {{x, -100}, {y, 100}, {z, -100}}]`

{3 → 2.387099818745504`, 4 → 0.371110898375896`, 10 → 1.0215806456683911`}
`FindRoot[{α x - β y - γ z + ψ x² - δ y z, -α x + β y + γ z + θ y² - ε x Abs[z],`
`ξ - α x + β y + γ z - η Abs[y] x }, {{x, -100}, {y, -100}, {z, -100}}]`

Out[•]=
{3 → 2.3871, 4 → 0.371111, 10 → 1.02158}

⋯ FindRoot: 无法在 100 次迭代中收敛到要求的准确度或者精度. ⓘ

Out[•]=
{3 → -1.50074, 4 → -0.0226223, 10 → -1.95918}

In[•]:= `FindRoot[{α x - β y - γ z + ψ x² - δ y z, -α x + β y + γ z + θ y² - ε x Abs[z],`
`ξ - α x + β y + γ z - η Abs[y] x }, {{x, 100}, {y, 100}, {z, 100}}]`

Out[•]=
{3 → 2.3871, 4 → 0.371110 Abs[y] x }, {{x, -1}, {y, -1}, {z, -1}}]

In[•]:= `FindRoot[{α x - β y - γ z + ψ x² - δ y z, -α x + β y + γ z + θ y² - ε x Abs[z],`
`ξ - α x + β y + γ z - η Abs[y] x }, {{x, 1}, {y, -1}, {z, -1}}]`

Out[•]=
{3 → 2.62537, 4 → -0.426286, 10 → 1.60595}

In[•]:= `FindRoot[{α x - β y - γ z + ψ x² - δ y z, -α x + β y + γ z + θ y² - ε x Abs[z],`
`ξ - α x + β y + γ z - η Abs[y] x }, {{x, -1}, {y, 1}, {z, 1}}]`

Out[•]=
{3 → 2.3871, 4 → 0.371111, 10 → 1.02158}

In[•]:= `FindRoot[{α x - β y - γ z + ψ x² - δ y z, -α x + β y + γ z + θ y² - ε x Abs[z],`
`ξ - α x + β y + γ z - η Abs[y] x }, {{x, 1}, {y, 1}, {z, -1}}]`

Out[•]=
{3 → 2.3871, 4 → 0.371111, 10 → 1.02158}

In[•]:= `FindRoot[{α x - β y - γ z + ψ x² - δ y z, -α x + β y + γ z + θ y² - ε x Abs[z],`
`ξ - α x + β y + γ z - η Abs[y] x }, {{x, -1}, {y, -1}, {z, 1}}]`

⋯ FindRoot: 无法在 100 次迭代中收敛到要求的准确度或者精度. ⓘ

Out[•]=
{3 → -1.50137, 4 → 0.0000806973, 10 → -1.96074}

In[ ]:= `FindRoot[{`α` x - `β` y - `γ` z + `ψ` x`^{2}` - `δ` y z, -`α` x + `β` y + `γ` z + `θ` y`^{2}` - `ϵ` x Abs[z],`
`    `ζ` - `α` x + `β` y + `γ` z - `η` Abs[y] x }, {{x, -100}, {y, -100}, {z, 100}}]`

Out[ ]=
`{3 → 2.62537, 4 → -0.426286, 10 → 1.60595}`

In[ ]:= `FindRoot[{`α` x - `β` y - `γ` z + `ψ` x`^{2}` - `δ` y z, -`α` x + `β` y + `γ` z + `θ` y`^{2}` - `ϵ` x Abs[z],`
`    `ζ` - `α` x + `β` y + `γ` z - `η` Abs[y] x }, {{x, 100}, {y, -100}, {z, -100}}]`

⚫⚫⚫ FindRoot: 无法在 100 次迭代中收敛到要求的准确度或者精度. ℹ

Out[ ]=
`{3 → -1.53169, 4 → -0.00316276, 10 → -1.99131}`

In[ ]:= `FindRoot[{`α` x - `β` y - `γ` z + `ψ` x`^{2}` - `δ` y z, -`α` x + `β` y + `γ` z + `θ` y`^{2}` - `ϵ` x Abs[z],`
`    `ζ` - `α` x + `β` y + `γ` z - `η` Abs[y] x }, {{x, -001}, {y, -100}, {z, 100}}]`

Out[ ]=
`{3 → 2.62537, 4 → -0.426286, 10 → 1.60595}`

In[ ]:= `x = 1;`
`y = 10;`
`x / y`

Out[ ]=
$$\frac{1}{10}$$

Table 1c

In[ ]:= `x = x;`
`y = y;`

In[ ]:= α` = 0.05 ;`
β` = 0.01 ;`
γ` = 0.05 ;`
δ` = 0.02 ;`
ϵ` = 0.01 ;`
ζ` = 0.1 ;`
η` = 0.05 ;`
θ` = 1.0 ;`
ψ` = -0.01;`
`FindRoot[{`α` x - `β` y - `γ` z + `ψ` x`^{2}` - `δ` y z, -`α` x + `β` y + `γ` z + `θ` y`^{2}` - `ϵ` x Abs[z],`
`    `ζ` - `α` x + `β` y + `γ` z - `η` Abs[y] x }, {{x, 1}, {y, 1}, {z, 1}}]`

$\{x \to 2.4022047405798954`, y \to 0.2992484893010768`, 10 \to 1.061211182330099`\}$

In[ ]:= FindRoot$\Big[\{\alpha\, x - \beta\, y - \gamma\, z + \psi\, x^2 - \delta\, y\, z, -\alpha\, x + \beta\, y + \gamma\, z + \theta\, y^2 - \epsilon\, x\, \text{Abs}[z],$
$\zeta - \alpha\, x + \beta\, y + \gamma\, z - \eta\, \text{Abs}[y]\, x\,\}, \{\{x, -1\}, \{y, -1\}, \{z, -1\}\}\Big]$

⚫⚫⚫ FindRoot: 线搜索把步长降低到由 AccuracyGoal 和 PrecisionGoal
指定的容差范围内，但是无法使优化目标函数的值减小得足够多. 您可能需要多于 MachinePrecision
位的工作精度以满足这些容差. ⓘ

Out[ ]=

$\{4 \to -2.70536, 4 \to -0.000394684, 10 \to -4.11817\}$

In[ ]:= FindRoot$\Big[\{\alpha\, x - \beta\, y - \gamma\, z + \psi\, x^2 - \delta\, y\, z, -\alpha\, x + \beta\, y + \gamma\, z + \theta\, y^2 - \epsilon\, x\, \text{Abs}[z],$
$\zeta - \alpha\, x + \beta\, y + \gamma\, z - \eta\, \text{Abs}[y]\, x\,\}, \{\{x, 100\}, \{y, 100\}, \{z, 100\}\}\Big]$

Out[ ]=

$\{4 \to 2.4022, 4 \to 0.299248, 10 \to 1.06121\}$

In[ ]:= FindRoot$\Big[\{\alpha\, x - \beta\, y - \gamma\, z + \psi\, x^2 - \delta\, y\, z, -\alpha\, x + \beta\, y + \gamma\, z + \theta\, y^2 - \epsilon\, x\, \text{Abs}[z],$
$\zeta - \alpha\, x + \beta\, y + \gamma\, z - \eta\, \text{Abs}[y]\, x\,\}, \{\{x, -100\}, \{y, -100\}, \{z, -100\}\}\Big]$

⚫⚫⚫ FindRoot: 线搜索把步长降低到由 AccuracyGoal 和 PrecisionGoal
指定的容差范围内，但是无法使优化目标函数的值减小得足够多. 您可能需要多于 MachinePrecision
位的工作精度以满足这些容差. ⓘ

Out[ ]=

$\{4 \to -2.67228, 4 \to -0.000313835, 10 \to -3.99985\}$

In[ ]:= FindRoot$\Big[\{\alpha\, x - \beta\, y - \gamma\, z + \psi\, x^2 - \delta\, y\, z, -\alpha\, x + \beta\, y + \gamma\, z + \theta\, y^2 - \epsilon\, x\, \text{Abs}[z],$
$\zeta - \alpha\, x + \beta\, y + \gamma\, z - \eta\, \text{Abs}[y]\, x\,\}, \{\{x, 100\}, \{y, -100\}, \{z, 100\}\}\Big]$

Out[ ]=

$\{4 \to 2.61548, 4 \to -0.313359, 10 \to 1.49774\}$

In[ ]:= FindRoot$\Big[\{\alpha\, x - \beta\, y - \gamma\, z + \psi\, x^2 - \delta\, y\, z, -\alpha\, x + \beta\, y + \gamma\, z + \theta\, y^2 - \epsilon\, x\, \text{Abs}[z],$
$\zeta - \alpha\, x + \beta\, y + \gamma\, z - \eta\, \text{Abs}[y]\, x\,\}, \{\{x, 1\}, \{y, -1\}, \{z, 1\}\}\Big]$

Out[ ]=

$\{4 \to 2.61548, 4 \to -0.313359, 10 \to 1.49774\}$

In[ ]:= FindRoot$\Big[\{\alpha\, x - \beta\, y - \gamma\, z + \psi\, x^2 - \delta\, y\, z, -\alpha\, x + \beta\, y + \gamma\, z + \theta\, y^2 - \epsilon\, x\, \text{Abs}[z],$
$\zeta - \alpha\, x + \beta\, y + \gamma\, z - \eta\, \text{Abs}[y]\, x\,\}, \{\{x, 100\}, \{y, 100\}, \{z, -100\}\}\Big]$

Out[ ]=

$\{4 \to 2.4022, 4 \to 0.299248, 10 \to 1.06121\}$

In[ ]:= FindRoot$\Big[\{\alpha\, x - \beta\, y - \gamma\, z + \psi\, x^2 - \delta\, y\, z, -\alpha\, x + \beta\, y + \gamma\, z + \theta\, y^2 - \epsilon\, x\, \text{Abs}[z],$
$\zeta - \alpha\, x + \beta\, y + \gamma\, z - \eta\, \text{Abs}[y]\, x\,\}, \{\{x, 100\}, \{y, -100\}, \{z, -100\}\}\Big]$

⚫⚫⚫ FindRoot: 无法在 100 次迭代中收敛到要求的准确度或者精度. ⓘ

Out[ ]=

$\{4 \to -2.69, 4 \to -0.0000756739, 10 \to -4.02688\}$

In[ ]:=
```
x = 6;
y = 5;
x * y
```

Out[ ]=

30

Table2

```
x = 7;
y = 9;
```

In[ ]:=
```
α = 0.07 ;
β = 0.01 ;
γ = 0.05 ;
δ = 0.02 ;
ϵ = 0.04 ;
ζ = 0.03 ;
η = 0.03 ;
θ = 5.0 ;
ψ = -0.1;
```

$$\text{FindRoot}\left[\left\{\alpha x - \beta y - \gamma z + \psi x^2 - \delta y z, -\alpha x + \beta y + \gamma z + \theta y^2 - \epsilon x \text{ Abs}[z],\right.\right.$$
$$\left.\left. \zeta - \alpha x + \beta y + \gamma z - \eta \text{ Abs}[y] x \right\}, \{\{x, 1\}, \{y, 1\}, \{z, 1\}\}\right]$$

Out[ ]=

{7 → 0.533549, 9 → 0.0800752, 10 → 0.156589}

In[ ]:=
$$\text{FindRoot}\left[\left\{\alpha x - \beta y - \gamma z + \psi x^2 - \delta y z, -\alpha x + \beta y + \gamma z + \theta y^2 - \epsilon x \text{ Abs}[z],\right.\right.$$
$$\left.\left. \zeta - \alpha x + \beta y + \gamma z - \eta \text{ Abs}[y] x \right\}, \{\{x, 1\}, \{y, -1\}, \{z, 1\}\}\right]$$

Out[ ]=

{7 → 0.538589, 9 → -0.0811439, 10 → 0.196475}

In[ ]:=
$$\text{FindRoot}\left[\left\{\alpha x - \beta y - \gamma z + \psi x^2 - \delta y z, -\alpha x + \beta y + \gamma z + \theta y^2 - \epsilon x \text{ Abs}[z],\right.\right.$$
$$\left.\left. \zeta - \alpha x + \beta y + \gamma z - \eta \text{ Abs}[y] x \right\}, \{\{x, 100\}, \{y, 100\}, \{z, 100\}\}\right]$$

Out[ ]=

{7 → 0.533549, 9 → 0.0800752, 10 → 0.156589}

Table3

```
α = 0.07 ;
β = 0.01 ;
γ = 0.05 ;
δ = 0.01 ;
ϵ = 0.01 ;
ξ = 0.05 ;
η = 0.05 ;
θ = 0.1;
ψ = -0.01;
```