

# GAMS

## Solving systems of linear and nonlinear equations

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### 1. Examples:

**Example 1:** Use GAMS to find the roots of the following function:

$$f(x) = x^2 + 5x + 1$$

**Solution:** The following GAMS code finds the roots of the given function. Since finding the roots is done numerically, different starting values may provide different roots.

```
variable x independent variable
          z objective function;

* Specify the initial value of x
  x.l=0;

Equations fx the given function f(x)
          obj dummy objective function to be used;

fx.. power(x,2)+5*x+1=e=0;
obj.. z=e=0;

model roots /all/
solve roots using NLP minimizing z;

display x.l;
```

The roots are: -0.209 and -4.791.

**Example 2:** Use GAMS to solve the following set of equations:

$$2xy + y + z = 10$$

$$2x - y^2 + 3z = 0$$

$$x + y + z = 3$$

**Solution:** The following GAMS code finds the solution for the given set of equations.

```
variables x,y,z
          obj objective function value;

Equations eq1 the first equation
          eq2 the second equation
          eq3 the third equation
          objective dummy objective function;

eq1.. 2*x*y+y+z=e=10;
eq2.. 2*x-power(y,2)+3*z=e=0;
eq3.. x+y+z=e=3;
objective.. obj=e=10;

model EquSet /all/;
solve EquSet using NLP minimizing obj;
display x.l,y.l,z.l;
```

The solution of the set of equations is:

VARIABLE x.L	=	3.880
VARIABLE y.L	=	1.215
VARIABLE z.L	=	-2.095

## 2. Exercises:

**Problem 1:** Write a GAMS model that finds the zeros of the following function:

$$f(x) = 5x^3 - 2x + 5$$

**Problem 2:** Write a GAMS model to solve the following set of equations:

$$\begin{aligned} 5x - 2y &= 3 \\ 10x + y &= 11 \end{aligned}$$

**Problem 3:** Write a GAMS model to solve the following set of equations:

$$\begin{aligned}3x^2 - y^2 &= 0 \\ 3xy^2 - x^3 &= 1\end{aligned}$$