20181020a applications of matrices and linear equations

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October 20, 2018

### Worked example

supply function qs(p) == a*p^2 + b*p + c

when p == 1, qs == 5  
when p == 2, qs == 12  
when p == 3, qs == 23

We can therefore transform it into a system of equations:

a + b + c == 5  
4*a + 2*b + c == 12  
9*a + 3*b + c == 23

#### LHS

library(Ryacas)  
library(mosaic)

# LHS  
a = Sym('a'); b = Sym('b'); c = Sym('c')  
Solve(List(a + b + c == 5, 4\*a + 2\*b + c == 12, 9\*a + 3\*b + c == 23),  
 List(a,b,c))

## expression(list(list(a == 2, b == 1, c == 2)))

#### RHS

# RHS  
A = matrix(c(1,4,9,1,2,3,1,1,1,5,12,23),ncol = 4); A

## [,1] [,2] [,3] [,4]  
## [1,] 1 1 1 5  
## [2,] 4 2 1 12  
## [3,] 9 3 1 23

# R2 = R2 - 4\*R1  
A[2,] = A[2,] - A[1,]\*4; A

## [,1] [,2] [,3] [,4]  
## [1,] 1 1 1 5  
## [2,] 0 -2 -3 -8  
## [3,] 9 3 1 23

# R2 = R2/-2  
A[2,] = A[2,] / -2; A

## [,1] [,2] [,3] [,4]  
## [1,] 1 1 1.0 5  
## [2,] 0 1 1.5 4  
## [3,] 9 3 1.0 23

# R3 = R3 - 9\*R1  
A[3,] = A[3,] - 9\*A[1,]; A

## [,1] [,2] [,3] [,4]  
## [1,] 1 1 1.0 5  
## [2,] 0 1 1.5 4  
## [3,] 0 -6 -8.0 -22

# R3 = R3 + 6\*R2  
A[3,] = A[3,] + 6\*A[2,]; A

## [,1] [,2] [,3] [,4]  
## [1,] 1 1 1.0 5  
## [2,] 0 1 1.5 4  
## [3,] 0 0 1.0 2

c == 2;  
b + (3/2)(2) == 4 => b == 1;  
a + 1 + 2 == 5 => a == 2

#### Plotting the supply curve

p = Sym('p')  
plotFun(2\*p^2 + p + 2 ~ p, xlim = c(1,5))

