# Question 1: Supply and Demand

The supply of ethanol (billions of gallons) is given by where is the price ethanol in $/gallon, and is the price of corn in $/bushel. Producing one gallon of ethanol requires 0.4 bushels of corn. The feedlot demand for corn (billions of bushels) is given by . The supply of corn is 15 billion bushels.

1. Let denote the demand for corn used in ethanol production and the total demand for corn. Use substitution to calculate the equilibrium price of corn as a function of the price of ethanol.
2. Set the price of ethanol, , to $2.25/gallon. There are now four variables in the system: , , and . There are also four equation: (1) the supply of ethanol; (2) the conversion equation, ; (3) corn demand for feed; and (4) market clearing in the corn market: . Write this system as a matrix where contains the four variables. Use the matrix tools in Excel or R to solve the system. Report the equilibrium corn price, and the fraction of the 15 billion bushels of corn which is used in the production of ethanol.

## Solution to (1)

Begin by creating an expression for the demand for corn used in ethanol production: . Create an expression for the total demand for corn: . Tee market clearing condition is that the total supply of corn, 15 billion bushels, is equal to total demand:

Solve this equation for as a function of :

## Solution to (2)

The system of equations can be written as

This system can be written as where

The solution values for the four variables are given by:

Create the X and Y matrices in R (note use %\*% for matrix multiplication)

x <- cbind(c(1,-0.4,0,0),c(0,1,0,1),c(0,0,1,1),c(1.5,0,2,0))  
y <- cbind(c(17.75,0,17.5,15))  
x\_inv <- solve(x)  
beta <- x\_inv %\*% y  
beta

## [,1]  
## [1,] 12.211538  
## [2,] 4.884615  
## [3,] 10.115385  
## [4,] 3.692308