Linear Interpolation

Thomas Achia

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# Linear Interpolation

**Example** Find (using linear interpolation) the value of y at x=5 if y=10 when x=1 and y=17 when x=10. **Solution** Here

If we have 2 points, there only a single straight line that passes throught both points

# Polynomial interpolation

For data points, there is one and only one polynomial of order that passes through all the points.

Given n points

How do we find the polynomial that passes through all these points?

We substitute the into the polynomial as follows:

We want

**Example**

Fit a quadratic

to the following points

**Solution**

Using R to solve the matrix problem:

X<-matrix(c(90000,300,1,160000,400,1,250000,500,1),nrow=3,byrow = T)  
X

## [,1] [,2] [,3]  
## [1,] 90000 300 1  
## [2,] 160000 400 1  
## [3,] 250000 500 1

y<-c(0.616,0.525,0.457)  
y

## [1] 0.616 0.525 0.457

alpha=solve(X)%\*%y  
alpha

## [,1]  
## [1,] 1.150e-06  
## [2,] -1.715e-03  
## [3,] 1.027e+00

**Example**

Consider the following data

Use polynomial interpolation to determine the value of the function at x=2.7.

Using R to solve the matrix problem:

X<-matrix(c(1,1,1,4,2,1,9,3,1),nrow=3,byrow = T)  
X

## [,1] [,2] [,3]  
## [1,] 1 1 1  
## [2,] 4 2 1  
## [3,] 9 3 1

y<-c(7,23,100)  
y

## [1] 7 23 100

alpha=solve(X)%\*%y  
alpha

## [,1]  
## [1,] 30.5  
## [2,] -75.5  
## [3,] 52.0

**Example**

Consider the following data

Use polynomial interpolation to determine the value of the function at x=2.7.

Using R to solve the matrix problem:

X<-matrix(c(rep(1,4),3.375,2.25,1.5,1,27,9,3,1,125,25,5,1),nrow=4,byrow = T)  
X

## [,1] [,2] [,3] [,4]  
## [1,] 1.000 1.00 1.0 1  
## [2,] 3.375 2.25 1.5 1  
## [3,] 27.000 9.00 3.0 1  
## [4,] 125.000 25.00 5.0 1

y<-c(7,23,100,70)  
y

## [1] 7 23 100 70

alpha=solve(X)%\*%y  
alpha

## [,1]  
## [1,] -7.154762  
## [2,] 49.017857  
## [3,] -56.559524  
## [4,] 21.696429

**Example** Find the equation of the polynomial passing through the following

**Solution**

We want to solve the following:

X=matrix(c(1,1,1,4,2,1,9,3,1),nrow = 3,byrow = T)  
y<-c(1,3,-1)  
  
a<-solve(X)%\*%y

## Lagrangian polynomial (Interpolation)

**Example** Find the equation of the polynomial passing through the following

**Solution** The equation is

Jan(23) April(18) July(100) Oct(22)

Find approximate value in June.