Numerical Methods

**Assignment5: Curve Fitting and Interpolation**

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**Problem**

An experiment is conducted that measures the pressure of a gas by heating it in a closed chamber.

T = 0:10:100;

p = [0.94 0.96 1.0 1.05 1.07 1.09 1.14 1.17 1.21 1.24 1.28];

**Q1. Predict the pressure at T=150C**

**Q2. Estimate interpolated value P for T=0:5:100. What is the estimated value at T=75C**

**Part 1. Linear Least Square Regression**

Create a function for Linear least square regression to predict the pressure at T=150C.

z=linearFit(vector x, vector y)

Input: dataset xi,yi. vector or array.

Output: coefficient z=[a0, a1] of f(x)=a0+a1x

**Procedure**

● Write down a pseudocode for the function of z=linearFit(x,y)

**// 1. Error Checking**

If ( (x.rows != y.rows) || (x.rows<2) )

a1 = 0

a0 = 0

else

**// 2. initialize the values(Sx, Sxx, Sy, Sxy)**

Sx, Sxx, Sxy, Sy = 0

**// 3. Solve Sx, Sxx, Sy, Sxy, for k = 1 to m**

for (k = 0 to m-1)

Sx += x[k][0]

Sxx += x[k][0] \* x[k][0]

Sxy += x[k][0] \* y[k][0]

Sy += y[k][0]

end for

**// 4. Solve for a1 and a0**

a1 = (mx \* Sxy - Sx \* Sy) / (mx \* Sxx - Sx \* Sx)

a0 = (Sxx \* Sy - Sxy \* Sx) / (mx \* Sxx - Sx \* Sx)

end if

**// 5. Return z = [a1, a0]**

Z[0][0] = a1

Z[1][0] = a0

● Use MATLAB’s function command “polyfit()” to solve for the answer and plot the results.

MATLAB을 통해서 이번 과제에서 첫 번째로 물어보고 있는 질문에 대한 답을 미리 확인할 수 있었다.

Q1. Predict the pressure at T=150C

Ans) 1.44636atm

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| Figure 1.1 MATLAB Code for Part 1 | Figure 1.2 MATLAB Result for Part 1 |

● Create your own C/C++ function. Attach the code in the report.

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| Figure 1.3 C Code for Part 1 |

● Find the predicted value at T=100C. Compare your answer with MATLAB results

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| Figure 1.4 C Code Result for Part 1 |

MATLAB을 통해서 확인한 결과값 1.44636과 동일한 결과가 출력되었음을 확인할 수 있다.

**Reference**

**Part 2. Linear Spline Interpolation**

Estimate the interpolated value P when T=75 by using linear spline interpolation

**yq=linearInterp (x,y,xq)**

Input: dataset xi,y. vector or array.

Input: query input (xq), vector or array

Output: interpolated values for query xq. vector or array

**Procedure**

● Write down a pseudocode for the function of **yq=linearInterp (x,y,xq)**

**// 1. Error Checking**

If ( (x.rows != y.rows) || (x.rows<2) )

printf ("ERROR ")

else

for ( i = 0 to xq.rows-1)

for( j = 0 to x.rows-2)

**// 2. Find Each Coefficient a1 and a0**

a1 = (y[j][0] - y[j + 1][0]) / x[j][0] - x[j + 1][0]

a0 = (y[j + 1][0] \* x[j][0] - y[j][0] \* x[j + 1][0]) / x[j][0] - x[j + 1][0]

memory[0][j] = a1

memory[1][j] = a0

**// 3. Condition :: \_x.at[j][0] <= \_xq.at[i][0] <=\_x.at[j+1][0]**

if (x[j][0] <= xq[i][0] && xq[i][0] <= x[j + 1][0])

**// 4. make each functions :: 'f(x) = a1x + a0' form**

Z[i][0] = memory[0][j] \* xq[i][0] + memory [1][j]

End if

End for

End for

End if

return Z

● Create your own C/C++ function. Attach the code in the report.

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| Figure 2.1 C Code for Part 2 |

● Estimate interpolated value P for T=0:5:100

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| 텍스트이(가) 표시된 사진  자동 생성된 설명 |
| Figure 2.2 C Main Code for Part 2 |

arr2Mat 함수를 활용하여 측정 온도를 5 간격으로 세분화하여 데이터를 찾도록 Main문에서 설정해주었다.

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| Figure 2.3 C Code Result for Part 2 |

● What is the estimated value at T=75C?

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| Figure 2.4 C Code Result for Part 2 |

T=75℃ 에서는 1.19 atm임을 확인할 수 있다.

● Compare your answer with MATLAB results

MATLAB을 통해서 이번 과제에서 두 번째로 물어보고 있는 질문에 대한 답을 검토할 수 있었다.

Q2. Estimate interpolated value P for T=0:5:100. What is the estimated value at T=75C

Ans) 1.19atm

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| Figure 2.1 MATLAB Code for Part 2 | Figure 2.2 MATLAB Result for Part 2 |

MATLAB을 통해서 결과값이 1.19임을 확인하였고, C를 통해서 확인한 값과 동일한 출력이 나왔음을 확인하였다.

**Reference**