

**HACETTEPE UNIVERSITY**

**ENGINEERING FACULTY**

**ELECTRICAL AND ELECTRONICS**

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SPRING SEMESTER

ELE708

NUMERICAL METHODS IN ELECTRICAL ENGINEERING

HW7

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# Computer Problems

## 7.5

## An experiment has produced the following data:

**t 0.0 0.5 1.0 6.0 7.0 9.0**

**y 0.0 1.6 2.0 2.0 1.5 0.0**

**We wish to interpolate the data with a smooth curve in the hope of obtaining reasonable values of y for values of t between the points at which measurements were taken.**

**(a) Using any method you like, determine the polynomial of degree five that interpolates the given data, and make a smooth plot of it over the range 0 ≤ t ≤ 9.**

**(b) Similarly, determine a cubic spline that interpolates the given data, and make a smooth plot of it over the same range.**

**(c) Which interpolant seems to give more reasonable values between the given data points? Can you explain why each curve behaves the way it does?**

**(d) Might piecewise linear interpolation be a better choice for these particular data? Why?**

**a,b)**

diyagram, çizgi, öykü gelişim çizgisi; kumpas; grafiğini çıkarma, metin içeren bir resim

Açıklama otomatik olarak oluşturuldu

**c)** Cubic spline is better fit and smoother than monomial polynomial. Since we picked the degree of the polynomial as 5, it oscillates according to it, making the degree lower than 5 increase the overshoot and making the degree higher than 5 increase the ossification.

**d)** It may a better choice because itcreates reasonable values between the data points and the experiment may produce linear values.

metin, çizgi, ekran görüntüsü, dikdörtgen içeren bir resim

Açıklama otomatik olarak oluşturuldu

## 7.6

## Interpolating the data points

## t 0 1 4 9 16 25 36 49 64

**y 0 1 2 3 4 5 6 7 8**

**should give an approximation to the square root function.**

**(a) Compute the polynomial of degree eight that interpolates these nine data points. Plot the resulting polynomial as well as the corresponding values given by the built-in sqrt function over the domain [0, 64].**

**(b) Use a cubic spline routine to interpolate the same data and again plot the resulting curve along with the built-in sqrt function**

**(c) Which of the two interpolants is more accurate over most of the domain?**

**(d) Which of the two interpolants is more accurate between 0 and 1?**

**a)**

metin, çizgi, diyagram, öykü gelişim çizgisi; kumpas; grafiğini çıkarma içeren bir resim

Açıklama otomatik olarak oluşturuldu

**b)**

çizgi, metin, öykü gelişim çizgisi; kumpas; grafiğini çıkarma, diyagram içeren bir resim

Açıklama otomatik olarak oluşturuldu

**c)** Spline is definitely more accurate, polynomial is overshoots.

**d)** Both techniques is works fine

çizgi, metin, öykü gelişim çizgisi; kumpas; grafiğini çıkarma, diyagram içeren bir resim

Açıklama otomatik olarak oluşturuldu

## 7.8

## Consider the following population data for the United States

|  |  |
| --- | --- |
| **Year** | **Population** |
| 1900 | 76,212,168 |
| 1910 | 92,228,496 |
| 1920 | 106,021,537 |
| 1930 | 123,202,624 |
| 1940 | 132,164,569 |
| 1950 | 151,325,798 |
| 1960 | 179,323,175 |
| 1970 | 203,302,031 |
| 1980 | 226,542,199 |

**There is a unique polynomial of degree eight that interpolates these nine data points, but of course that polynomial can be represented in many different ways. Consider the following possible sets of basis functions φj(t), j = 1, . . . , 9: 1. φj(t) = tj−1**

**2. φj(t) = (t − 1900)j−1**

**3. φj(t) = (t − 1940)j−1**

**4. φj(t) = ((t − 1940)/40)j−1**

**(a) For each of these four sets of basis functions, generate the corresponding Vandermonde matrix and compute its condition number using a library routine for condition estimation. How do the condition numbers compare? Explain your results.**

**(b) Using the best-conditioned basis found in part a, compute the polynomial interpolant to the population data. Plot the resulting polynomial, using Horner’s nested evaluation scheme to evaluate the polynomial at one-year intervals to obtain a smooth curve. Also plot the original data points on the same graph.**

**(c) Use a routine for Hermite cubic interpolation, such as pchip from MATLAB or Netlib, to compute a monotone Hermite cubic interpolant to the population data and again plot the resulting curve on the same graph.**

**(d) Use a cubic spline routine to interpolate the population data and again plot the resulting curve on the same graph.**

**(e) Extrapolate the population to 1990 using each of the polynomial, Hermite cubic, and cubic spline interpolants and compare the values obtained. How close are these to the true value of 248,709,873 according to the 1990 census?**

**(f) Determine the Lagrange interpolant to the same nine data points and evaluate it at the same yearly intervals as in parts b and c. Compare the total execution time with those for Horner’s nested evaluation scheme and for evaluating the cubic spline.**

**(g) Determine the Newton form of the polynomial interpolating the same nine data points. Now determine the Newton polynomial of one degree higher that also interpolates the additional data point for 1990 given in part d, without starting over from scratch (i.e., use the Newton polynomial of degree eight already computed to determine the new Newton polynomial). Plot both of the resulting polynomials (of degree eight and nine) over the interval from 1900 to 1990.**

**(h) Round the population data for each year to the nearest million and compute the corresponding polynomial interpolant of degree eight using the same basis as in part b. Compare the resulting coefficients with those determined in part b. Explain your results.**

1. According to the answer, the last equation is more stable and less sensitive to small changes in the matrix.

metin, yazı tipi, ekran görüntüsü, makbuz içeren bir resim

Açıklama otomatik olarak oluşturuldu

metin, çizgi, öykü gelişim çizgisi; kumpas; grafiğini çıkarma, dikdörtgen içeren bir resim

Açıklama otomatik olarak oluşturuldu

metin, çizgi, öykü gelişim çizgisi; kumpas; grafiğini çıkarma, diyagram içeren bir resim

Açıklama otomatik olarak oluşturuldu

metin, çizgi, öykü gelişim çizgisi; kumpas; grafiğini çıkarma, ekran görüntüsü içeren bir resim

Açıklama otomatik olarak oluşturuldu

metin, çizgi, diyagram, öykü gelişim çizgisi; kumpas; grafiğini çıkarma içeren bir resim

Açıklama otomatik olarak oluşturuldu

metin, yazı tipi, beyaz, cebir içeren bir resim

Açıklama otomatik olarak oluşturuldu

metin, çizgi, diyagram, öykü gelişim çizgisi; kumpas; grafiğini çıkarma içeren bir resim

Açıklama otomatik olarak oluşturuldu

metin, çizgi, öykü gelişim çizgisi; kumpas; grafiğini çıkarma, diyagram içeren bir resim

Açıklama otomatik olarak oluşturuldu

1. All the coefficients is decreased.

metin, ekran görüntüsü, yazı tipi içeren bir resim

Açıklama otomatik olarak oluşturuldumetin, ekran görüntüsü, yazı tipi içeren bir resim

Açıklama otomatik olarak oluşturuldu