CS3081 Assignment 3

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Question 1 (Problem 4.26)

(i) (a) = 4, (b)= 7
(ii) (a)=2.2, (b)=7
(iii) (a)=4, (b)=2.2
(iv) (a)=7, (b)=4

Your Answer ((i)-(iv)): (i)

```
function N = MathsQ4_26(A)
    [n,m]= size(A);
    N = 0;
    rVal = 0;
    for i = 1:n
        for j = 1:n
            elem = abs(A(ij));
            rVal = elem + rVal;
        end
        if N< rVal
            N = rVal;
        end
    rVal = 0;
    end
end
A = [-2 1 0; 1 -2 1; 0 1 -1.5];
B = [4 -1 0 1 0; -1 4 -1 0 1; 0 -1 4 -1 0; 1 0 -1 4 -1; 0 1 0 -1 4];

N1 = MathsQ4_26(A);
N2 = MathsQ4_26(B);

disp(N1);
disp(N2);
```

```
>> Test
     4

     7
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Question 2 (Problem 6.13)

(i) 420W
(ii) 420KW
(iii) 530W
(iv) 580KW

Your Answer ((i)-(iv)): (iii)

$f(x)=\frac{(x-x2)(x-x3)(x-x4)(x-x5)}{(x1-x2)(x1-x3)(x1-x4)(x1-x5)}y1+\frac{(x-x1)(x-x3)(x-x4)(x-x5)}{(x2-x1)(x2-x3)(x2-x4)(x2-x5)}y2+\frac{(x-x1)(x-x2)(x-x4)(x-x5)}{(x3-x1)(x3-x2)(x3-x4)(x3-x5)}y3+\frac{(x-x1)(x-x2)(x-x3)(x-x5)}{(x4-x1)(x4-x2)(x4-x3)(x4-x5)}y4+\frac{(x-x1)(x-x2)(x-x3)(x-x4)}{(x5-x1)(x5-x2)(x5-x3)(x5-x4)}y5$

$f(26)=\frac{(26-22)(26-30)(26-38)(26-46)}{(14-22)(14-30)(14-38)(14-46)}(320)+\frac{(26-14)(26-30)(26-38)(26-46)}{(22-14)(22-30)(22-38)(22-46)}(490)+\frac{(26-14)(26-22)(26-38)(26-46)}{(30-14)(30-22)(30-38)(30-46)}(540)+\frac{(26-14)(26-22)(26-30)(26-46)}{(38-14)(38-22)(38-30)(38-46)}(500)+\frac{(26-14)(26-22)(26-30)(26-38)}{(46-14)(46-22)(46-30)(46-38)}(480)$

= -12.5+229.6875+379.6875-78.125+11.25
=530W

Question 3 (Problem 8.7)

The truncation error is:

(i) O(h)
(ii) O(h^2)
(iii) O(h^3)
(iv) O(h^4)

Your Answer ((i)-(iv)): (ii)

Taylor Series about $f(x_i)= f(x0)+f'(x0)(x-x0)\frac{f''(x0)}{2!}(x-x0)^2$

Taylor Series about $f(x_{i+1})= f(xi)+f'(xi)(xi+1-xi)\frac{f''(xi)}{2!}(xi+1-xi)^2$

Taylor Series about $f(x_{i-1})= f(xi)+f'(xi)(xi-xi-1)\frac{f''(xi)}{2!}(xi-xi-1)^2$

$f(x_{i+1})+f(x_{i-1})=(f(xi)+f'(xi)(xi+1-xi)\frac{f''(xi)}{2!}(xi+1-xi)^2)+(f(xi)+f'(xi)(xi-xi-1)\frac{f''(xi)}{2!}(xi-xi-1)^2)$

Sub in 2h and h and solve: $f(x_{i+1})+f(x_{i-1})=(f(xi)+f'(xi)(h)\frac{f''(xi)}{2!}(h)^2)+(f(xi)+f'(xi)(2h)\frac{f''(xi)}{2!}(2h)^2)$

$= 2f(x_i)-f'(x_i)(h)+\frac{5f''(xi)}{2!}(h)^2$

$f(x_{i+1})+f(x_{i-1})-2f(x_i)+f'(x_i)(h)=\frac{5f''(xi)}{2!}(h)^2$

$2(f(x_{i+1})+f(x_{i-1})-2f(x_i)+f'(x_i)(h)=5f''(x_i)(h)^2$

$\frac{2(f(xi+1)+f(xi-1)-2f(xi)+f'(xi)(h)}{5}=f''(x_i)(h)^2$

$$\frac{2(f(xi+1)+ f(xi-1)- 2f(xi)+f'(xi)(h)}{5}+O(h)^2=f''(x_i)$$

Question 4 (Problem 8.9)

(i) f'_male(2006)=4965;
f'_female(2006)=10681;
Predicted_Males(2008)=673601;
Error_Males=0.62%;
Predicted_Females(2008)=277990;
Error_Females=0.58%

(ii) f'_male(2006)=4940;
f'_female(2006)=10681;
Predicted_Males(2008)=673601;
Error_Males=0.62%;
Predicted_Females(2008)=277987;
Error_Females=0.57%

(iii) f'_male(2006)=4940;
f'_female(2006)=10681;
Predicted_Males(2008)=673601;
Error_Males=0.68%;
Predicted_Females(2008)=277987;
Error_Females=0.42%

(iv) f'_male(2006)=4965;
f'_female(2006)=10670;
Predicted_Males(2008)=673601;
Error_Males=0.68%;
Predicted_Females(2008)=277987;
Error_Females=0.52%

Your Answer ((i)-(iv)): (ii)

a)

$$f'(x_{i+2}) = \frac{x_{i+2}-x_{i+1}}{(x_i-x_{i+1})(x_i-x_{i+2})}\, y_i + \frac{x_{i+2}-x_i}{(x_{i+1}-x_i)(x_{i+1}-x_{i+2})}\, y_{i+1} + \frac{2x_{i+2}-x_i-x_{i+1}}{(x_{i+2}-x_i)(x_{i+2}-x_{i+1})}\, y_{i+2}$$

f'_male(2006)

$$f'(2006) = \frac{2006-2003}{(2002-2003)(2002-2006)}(638182) + \frac{2006-2002}{(2003-2002)(2003-2006)}(646493) + \frac{2(2006)-2002-2003}{(2006-2002)(2006-2003)}(665647)$$

=478636.5-861980.6+388294.0883

=4939.983

=4940

f'_female(2006)

$f'(2006) = \frac{2006-2003}{(2002-2003)(2002-2006)}(215005) + \frac{2006-2002}{(2003-2002)(2003-2006)}(225042) + \frac{2(2006)-2002-2003}{(2006-2002)(2006-2003)}(256257)$

=161253.75-300056+149403.25

=10681

b)

$$f'(x_{i+1}) = \frac{x_{i+1}-x_{i+2}}{(x_i-x_{i+1})(x_i-x_{i+2})}\,y_i + \frac{2x_{i+1}-x_i-x_{i+2}}{(x_{i+1}-x_i)(x_{i+1}-x_{i+2})}\,y_{i+1} + \frac{x_{i+1}-x_i}{(x_{i+2}-x_i)(x_{i+2}-x_{i+1})}\,y_{i+2}$$

2008 Male

$4940 = \frac{2006-2008}{(2003-2006)(2003-2008)}(646493) + \frac{2(2006)-2003-2008}{(2006-2003)(2006-2008)}(665647) + \frac{2006-2003}{(2008-2003)(2008-2006)}y_{i+2}$

$4940 = -86199.06-110941.16+0.3y_{i+2}$

$\frac{4940+86199.06+110941.16}{0.3} = y_{i+2}$

$y_{i+2} = 673600.7333$

$= 673601$

Error: $|1-\frac{677807}{673601}| = 0.0062$

2008 Female

$10681 = \frac{2006-2008}{(2003-2006)(2003-2008)}(225042) + \frac{2(2006)-2003-2008}{(2006-2003)(2006-2008)}(256257) + \frac{2006-2003}{(2008-2003)(2008-2006)}y_{i+2}$

$10681 = -30005.6-42709.5+0.3y_{i+2}$

$\frac{10681+30005.6+42709.5}{0.3} = y_{i+2}$

$3y_{i+2} = 187987$

Error: $|1-\frac{276417}{277987}| = 0.0057$