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شبكة المعلومات الجامعية

بالرسالة صفحات

لم ترد بالأصل

SALWA AKL

A GENERALIZED NUMERICAL METHOD FOR SOLVING MULTI- INTEGRAL PROBLEMS . NUMERICAL METHODS TO SOLVE INTEGRO-DIFFERENTIAL EQUATIONS

A THESIS
SUBMITTED FOR THE DEGREE OF MASTER OF SCIENCE
IN
PURE MATHEMATICS

PRESENTED
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CONTENTS

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I also would like to express my great thanks to Dr.A.Amer,Faculty of Science,Monofia University, for his constructive help.

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preface

This thesis treats several points . Firstly , the so-called Multi-Integrals . Begining from Double integrals passing through Triple integrals until we have arrived to Multiple integrals from Numerical Analysis viewpoint . For this purpose we have formulated a certain procedure and a well defined method based on an algorithm followed by certain soft ware computer programs , for different forms of integrals and according to the problem's nature (i.e the integration domain and also according to the integrand which we will integrate it) .The following results are obtained for determining the best dividing of the integration interval to be used in the following parts .

(1) The dividing method of the integration area gives us good or bad results for certain type to get results congurent to what we have obtained by exact methods .

(2) In most cases we obtain quick and accurate results.

(3) We have different results according to the different integration classes that is to see there is no general method to solve all types of integrations .

(4) The numerical approach for evaluating integrals is a principle and alternative way to the exact approach .

Secondly , we have used Laplace Transformations to solve certain type of Integro-differential equation problems .

Finally , we try to put our hands on a method to solve certain types of integral equation problems . From basic viewpoint through the three following methods Successive Approximations , Algebraic Methods and Collocation and Least Squares Methods . And from applied and technical viewpoint to another types, we have discussed Symmetric operators treatments and also we deal with some Miscellaneous methods which are appropriate to such different types . In different stages , sometimes we have used the extension concept to show how each method is an extension to the pervious one. And by applying the Integro-differential equation on the case study which is , population pyramid prediction , we found that it needs a lot of time and effort over that have been taken on this thesis . Henceforth we will redo this application widely at the Ph.D. research .

CHAPTER 1

A NUMERICAL METHOD FOR SOLVING MULTI-INTEGRAL PROBLEMS

1-1 Double integrals

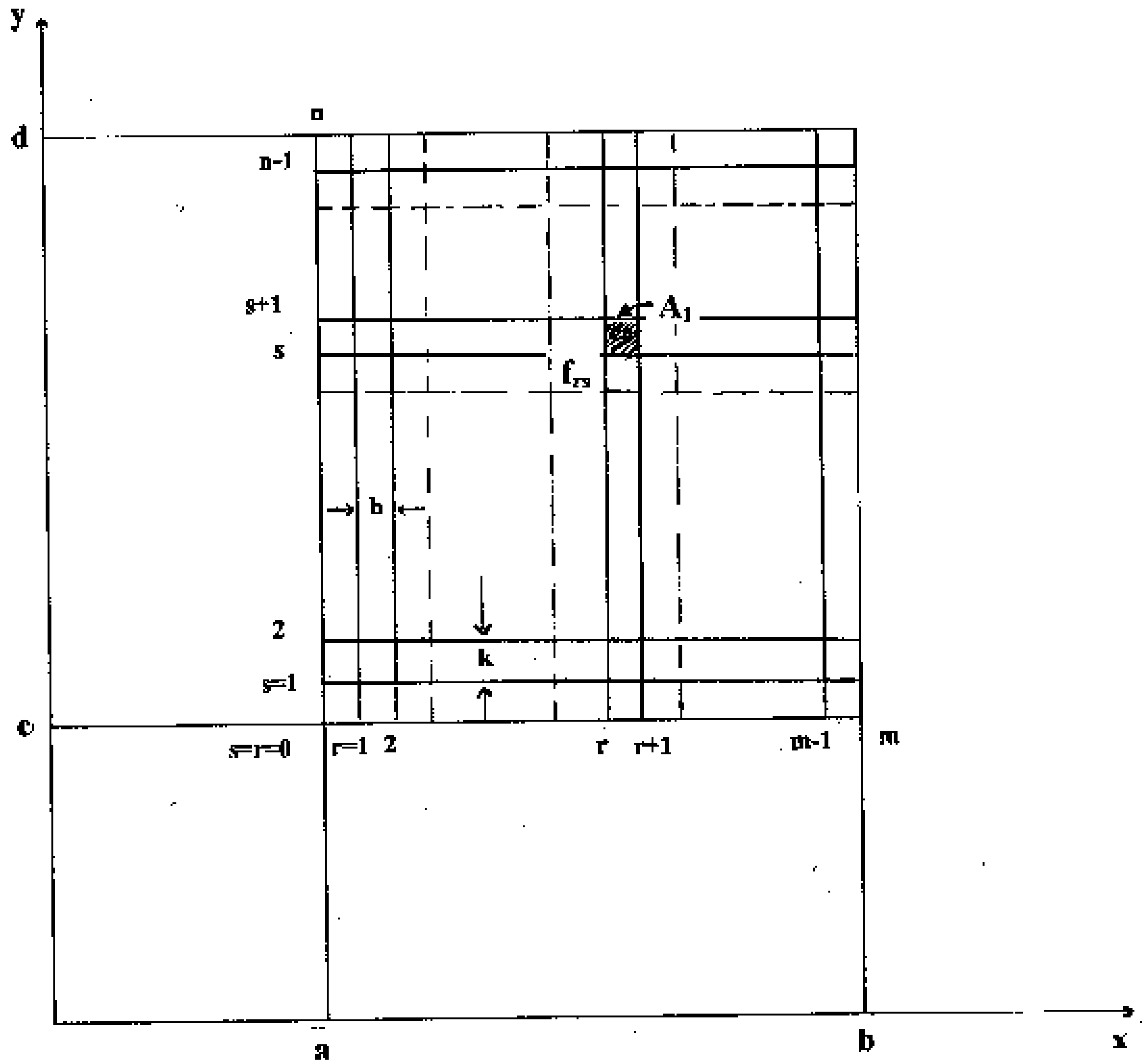
1-1-1 Rectangular regions of integration

The double integral $v = \int_a^b \int_c^d f(x,y)\,dx\,dy$,

extended to a rectangle x=a , x=b ,y=c , y=d , can be evaluated numerically by two successive integrations in the x and y directions , using the Simpson's rule .

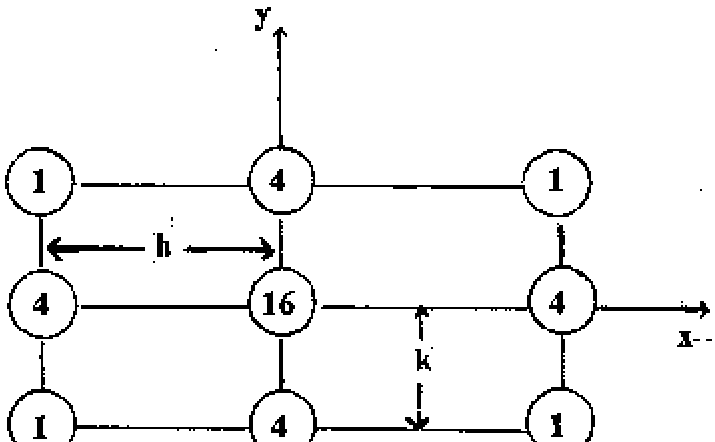
For this purpose , divide the rectangle (a,b) , (c,d) into a number m . n of rectangles of sides h=(b-a)/m , k=(d-c)/n , and consider the values f_{rs} at the pivotal points

$x_r=a+rh$ (r=0,1,2,...,m) ; $y_s=c+sk$ (s=0,1,2,...,n)



the value B_4 of the double integral extended to four adjacent rectangles of sides h ,k meeting at(x_r,y_s)becomes by the Simpson's rule .

$$(9/hk) \int_{-h}^{h} \int_{-k}^{k} f(x,y)\, dx\, dy =$$



$$+ 1/h^2\, O(h^4)$$

$$B_4 = \int_{y_{s-1}}^{y_{s+1}} dy \int_{x_{r-1}}^{x_{r+1}} f(x,y)\, dx$$

$$= \int_{y_{s-1}}^{y_{s+1}} (h/3) [\; f_{r-1}(y) + 4\, f_r(y) + f_{r+1}(y)]\, dy$$

$$= (h/3) [\; \int_{y_{s-1}}^{y_{s+1}} f_{r-1}(y)\, dy + 4 \int_{y_{s-1}}^{y_{s+1}} f_r(y)\, dy + \int_{y_{s-1}}^{y_{s+1}} f_{r+1}(y)\, dy\,]$$

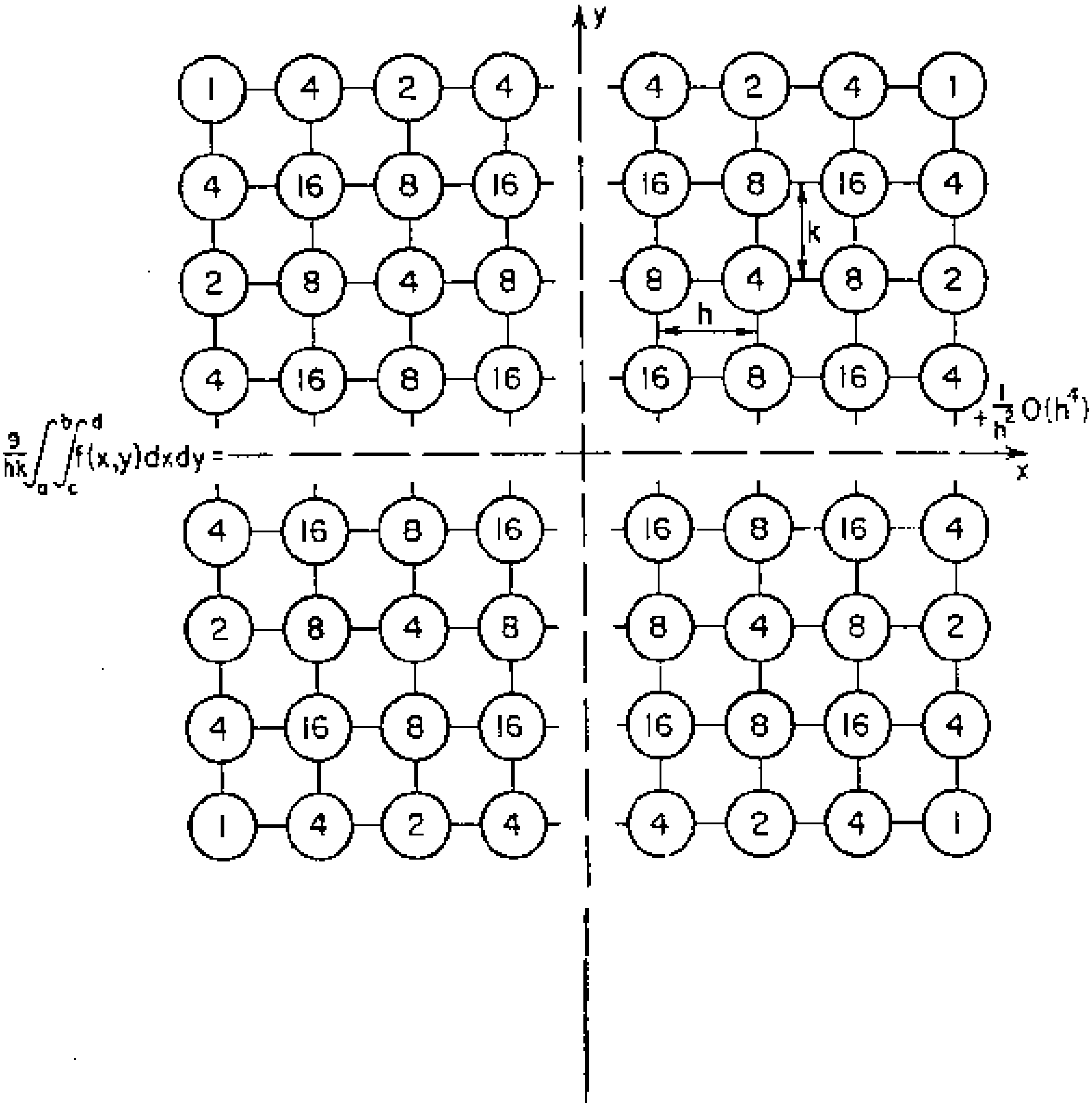
$$= (h/3)\{ (k/3)[\; f_{r-1,s-1} + 4\, f_{r-1,s} + f_{r-1,s+1}] + (4k/3)\, [[\; f_{r,s-1} + 4\, f_{r,s} + f_{r,s-1}] + (k/3)$$

$$[\; f_{r+1,s-1} + 4\, f_{r+1,s} + f_{r+1,s+1}]\}$$

$$= (hk/9)[\; f_{r-1,s-1} + f_{r-1,s+1} + f_{r+1,s-1} + f_{r+1,s+1}] + 4[\; f_{r-1,s} + f_{r,s-1} + f_{r,s+1} +$$

$$f_{r+1,s}] + 16\, f_{rs}\,] \qquad (1-1)$$

Adding the values B_4 corresponding to each rectangle of the domain we obtain the operator or " molecle " of Figure .



It is easy to prove that the error in Simpson's rule for double integration is of order h^4 and that therefore h^4- extrapolations may be used in connection with the two -dimensional Simpson's rule .

Example (1.1.1)

Simpson's rule will be now applied to evaluate the integral

$$v = \int_{1}^{2} \int_{1}^{2} [1/(x+y)]\,dy\,dx \qquad \text{for} \quad n=2$$

solution

a) Manual , by using equation (1-1)

(1)	(4)	(1)
0.333333	0.285714	0.25
(4)	(16)	(4)
0.4	0.333333	0.285714
(1)	(4)	(1)
0.5	0.4	0.333333

$V_{S,2}$ = [(0.5)(0.5)]/9{0.5+0.333333+0.25+0.333333+4(0.4+0.4+0.285714+0.285714)+16(0.333333)}

=0.3391881 , with an error of -0.0024 percent .

b) Applying the computer program (1.1.1) (Appendex)

$$\int_{1}^{2.0} \int_{1}^{2.0} \frac{dydx}{(x+y)} = 0.339798073 \qquad \text{exact}$$

two dimensional integration using simpson's rule

no-of divisions of interval required ? 7

enter ratio of intervals in x/intrevals in y ? 1

enter upper limit for y ? 2