CALCULATION OF THE EXACT INTEGRAL BY THE MONTE CARLO METHOD

Tajiyev Tahirjon Halimovich
Fergana State University
Associate Professor of the Department of Applied Mathematics
Khusanov Azizjon Abdurashidovich
Fergana State University
2nd year master's student in applied mathematics (by fields).
Samijonov is the son of Azizbek Ismailjon
Fergana State University
2nd year master's student in applied mathematics (by fields).

Abstract: The most important aspect of constructing Monte Carlo methods is to reduce the problem to the calculation of mathematical expectations. Since mathematical expectations are often simple integrals, the central place in the theory of the Monte Carlo method is occupied by methods of calculating integrals.

Key words : Definite integral, random variable, mathematical expectation, Chebyshev's theorem, statistics of experiments, surface bounded by lines, unit square, uniformly distributed, curved trapezoidal surface, random points.

1 . In solving many problems in nature, it is difficult or impossible to obtain an exact solution. The Monte Carlo method is a numerical method for studying many problems and obtaining results. The essence of this method is as follows: the process is described by a mathematical model using a generator of random variables, the model is calculated many times, and based on the obtained data, the probability characteristics of the considered process are calculated.

The Monte Carlo method is used to solve problems related to various fields of physics, chemistry, mathematics, economics, optimization, control theory, etc.

$\int_0^1 \varphi(t)dt$ we use the Monte Carlo method to calculate the exact integral. Here $t$is a uniformly distributed random variable whose density function is $P(t)$:

$$P(t)=\begin{cases}0, & t<0\\ 1, & 0<t\le 1\\ 0, & t>1\end{cases}$$

let it be The mathematical expectation of a random $\varphi(t)$function is defined as:

$$M(\varphi(t))=\int_0^1 \varphi(t)\cdot P(t)\,dt$$

$P(t)$based $0\le t\le 1$on the value of

$$M(\varphi(t))=\int_0^1 \varphi(t)\,dt \tag{1.1}$$

We calculate the approximate value of the mathematical expectation. Let N experiments have tN random variables t_1 , t 2 , ... , t_N values. These values can be obtained from the table of random numbers [10]. In this case, the $M(\varphi(t))$mathematical expectation value is found from the following equation based on Chebyshev's theorem.

$$M(\varphi(t) \approx \frac{1}{N}\sum_{i=1}^{N}\varphi(t_i) \tag{1.2 }$$

ISSN 2277-3630 (online), Published by International journal of Social Sciences & Interdisciplinary Research., under Volume: 11 Issue: 12 in December-2022
https://www.gejournal.net/index.php/IJSSIR

(1.2) and (1.2) on the basis of equations

$$\int_0^1 \varphi(t)dt \approx \frac{1}{N}\sum_{i=1}^{N}\varphi(t_i) \quad (1.3)$$

2 . Let's see the general case. $\int_a^b f(x)dx$ be required to calculate an integer. $x = a + (b - a)t$ with equality t we pass to the variable. In this case

$$\int_a^b f(x)dx = (b-a)\int_0^1 \varphi(t)dt \quad (1.4)$$

here $\varphi(t) = f(a + (b - a)t)$. Based on the formula (1.3), we calculate the right side of the formula (1.4).

$$\int_a^b f(x)dx \approx \frac{b-a}{N}\sum_{i=1}^{N}\varphi(t_i) \text{ or } \quad \int_a^b f(x)dx \approx \frac{b-a}{N}\sum_{i=1}^{N} f(x_i) \quad (1.5)$$

here

$$x_i = a + (b - a)t_i, (i = 1, 2, \dots, n).$$

We make a table for calculating the intergal.

Table 1

i	t_i	$x_i = a + (b-a)t_i$	$f(x_i)$
1	T_1	x_1	$f(x_1)$
2	t_2	x_2	$f(x_2)$
…	…	…	…
N	t_N	x_N	$f(x_N)$

In this method, calculation of the exact integral based on the formula (1.5) by **the Monte Carlo method** is calculated in simple methods of statistics of experiments.

We will see how to calculate the exact integral based on the Monte Carlo method:

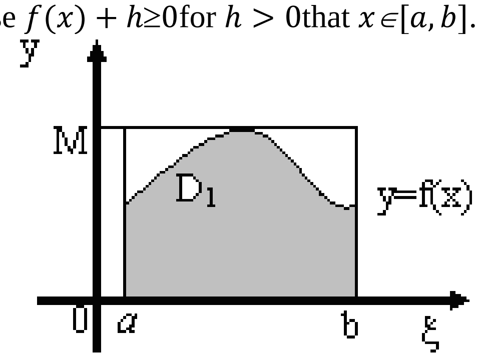
$$I = \int_a^b f(x)dx$$

The geometric meaning of the definite integral: is $x = a, x = b, y = 0, y = f(x)$equal to the surface bounded by the lines, if $f(x)$the function $[a, b]$is continuous and positive.

Now $x = a, x = b, y = 0, y = M$ $(M \geq max\ f(x), [a, b])$let's see the quadrilateral, (Fig. 1). If the $f(x) \geq 0$inequality $[a, b]$does not hold at all points of , we use the following expression:

$$\int_a^b f(x)dx = \int_a^b [f(x) + h]dx - h(b-a)$$

's choose $f(x) + h \geq 0$for $h > 0$that $x \in [a, b]$.



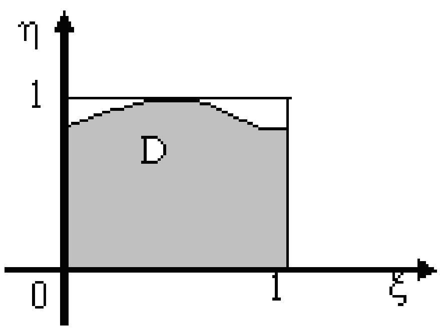


Figure 1 Figure 2

ISSN 2277-3630 (online), Published by International journal of Social Sciences & Interdisciplinary Research., under Volume: 11 Issue: 12 in December-2022
https://www.gejournal.net/index.php/IJSSIR

This method is [0,1]based on a table of random numbers, which also belongs to the cross section. Therefore, it is necessary to switch from variables *x*, *y* to variables such ξ*that the unit* ηarea $0\le\xi\le1, 0\le\eta\le1$D $_1$ is replaced by area D, which is a square (Fig. 2). for this

$$x = a + (b - a)\xi, \; y = M\eta$$

we will exchange. Where dx = $(b - a)d\xi$and $x \in (a, b)$ is $\xi \in (0, 1)$. The given integral is:

$$I = (b-a)M\int_a^b \varphi(\xi)d\xi \qquad (1.6)$$

in this

$$\varphi(\xi) = \frac{1}{M} f[a + (b-a)\xi] \qquad (1.7)$$

From equation (1.7) $f(x) = M\varphi(\xi)$.

$_1$, ξ_1), (ξ_2 , ξ_2), ..., (ξ_N , ξ_N) with unit square uniform distribution ξ. Suppose that n points fall into the sphere D. Since the random points are uniformly distributed

$$\frac{n}{N} \xrightarrow{\text{ehtimollik}} \frac{\int_0^1 \varphi(\xi)d\xi}{1}$$

where the value of 1 unit square area. In this case

$$\int_0^1 \varphi(\xi)d\xi \approx \frac{n}{N} \qquad (1.8)$$

Based on equations (1.7) and (1.8):

$$\int_0^1 f(x)dx \approx \frac{(b-a)nM}{N} \qquad (1.9)$$

This is the formula for calculating the exact integral using the Monte Carlo method.

From the formula (1.9) we can write the following:

$$\frac{\int_0^1 f(x)dx}{M(b-a)} \approx \frac{n}{N}$$

the curved trapezoid D $_1$ to the surface of the rectangle (Fig. 1) is approximately equal to the ratio of the number of random points falling on the area D $_1$ to the number of random points falling on the four corners.

We write the table of approximate calculation of the definite integral with the formula (1.9).

Table 2

I	ξ_i	η_I	$x_i = a + (b - a)\xi_i$	$y_i = M\eta_i$	$U_i = f(x_i)$
1	ξ_1	η_1	X_1	y_1	$f(x_1)$
2	ξ_2	η_2	x_2	y_2	$f(x_2)$
.	.	.	.	.	.
.	.	.	.	.	.
n	ξ_N	η_N	x_N	y_N	$f(x_N)$

From Y_i (I =1, 2, …, *N*) it is necessary to choose those that satisfy the condition $y_i < Y_i$. The number of these will be n.

1 : $I = \int_2^3 (x^2 + x^3)dx$ **we calculate the integral by formula (1.9).**

ISSN 2277-3630 (online), Published by International journal of Social Sciences & Interdisciplinary Research., under Volume: 11 Issue: 12 in December-2022
https://www.gejournal.net/index.php/IJSSIR

Here a =2 , b =3 , $\max\limits_{2\le x\le 3}(x^2+x^3)=36$will be From this 2 $\le x \le$3 x=2+ ξ, y =36 η. From the table of random numbers (ξ, η) we get 20 (N =20). The calculation table will be as follows.

I	ξ_i		η_i	$x_i = 2+\xi_I$	y_i =36 η_i	x_i^2	x_i^3	$Y_i = x_i^2 + x_i^3$
1	0.857		0.457	2,857	16,452	8,162	23,319	31,481
2	0.499		0.762	2,499	27,432	6,245	15,606	21,851
3	0.431		0.608	2,431	25,128	5,910	14,367	20,727
4	0.038		0.558	2,038	20,088	4,153	8,464	12,617
5	0.651		0.573	2,653	20,628	7,038	18,672	25,710
6	0.609		0.179	2,609	6,444	6,807	17,759	24,566
7	0.974		0.011	2,974	0.396	8,845	26,305	35,150
8	0.098		0.805	2,098	28,980	4,402	9,235	13,637
9	0.316		0.296	2,516	10,656	6,330	15,926	22,256
10	0.149		0.815	2,140	29,340	4,618	9,924	14,542
11	0.070		0.692	2,070	24,912	4,285	8,870	13,155
12	0.696		0.203	2,696	7,308	7,266	15,595	26,863
13	0.350		0.900	2,350	32,400	5,523	12,979	18,502
14	0.451		0.318	0.451	11,448	6,007	14,723	20,730
15	0.798		0.111	2,798	3,906	7,829	21,906	20,736
16	0.933		0.199	2,933	7,164	8,602	25,230	33,832
17	0.183		0.421	2,183	15,155	4,765	10,402	15,167
18	0.338		0.104	2,338	3,744	5,466	12,780	18,246
19	0.190		0.150	2,190	5,400	4,706	10,503	15,299
20	0.449		0.320	2,449	11,520	5,998	14,689	20687

We see from the table that the number of values (points) satisfying the condition $y_i < Y_i$ *is equal to n=13.* (1.9) according to the formula:

$$I \approx \frac{36\cdot 13}{20} = 23{,}4$$

One of the first ways to use random numbers was to calculate the integral. Let us generate uniformly distributed random numbers $x_1, \ldots, x_n$ in the interval a and b , then the approximation of the solution is found as follows:

$$\int_a^b f(x)dx = \frac{b-a}{n}\sum_{i=1}^{n} f(x_i) \qquad (1.10)$$

This method is usually called Monte Carlo integration. We can express the expression (1.10) as a subroutine:

```
import random as random_number

def MCint (f, a, b, n):
s = 0
```


ISSN 2277-3630 (online), Published by International journal of Social Sciences & Interdisciplinary Research., under Volume: 11 Issue: 12 in December-2022
https://www.gejournal.net/index.php/IJSSIR

```
    for i in range (n):
x = random_number . uniform(a, b)
s += f(x)
I = ( float (b - a) / n) * s
    return I
```

Usually, n is given with a large number so that the method achieves sufficient accuracy, so the vectorized version is more convenient:

```
from numpy import *

def MCint_vec ( f , a _ b , n ):
    x = random . uniform ( a , b , n )
    s = sum ( f ( x ))
    I = ( float ( b - a ) / n ) * s
    return I
```

Let's consider Monte Carlo integration on the example of a simple linear function f(x)=2x+3, we take the limits of integration from 1 to 2. It is more interesting to see how the method can solve the problem for different n. We see the evaluation in the following MCint method, slightly modified:

```
def MCint2 ( f , a _ b , n ):
    s = 0

    I = zeros ( n )
    for k in range ( 1 , n + 1 ):
        x = random_number . uniform ( a , b )
        s += f ( x )
        I [ k - 1 ] = ( float ( b - a ) / k ) * s
    return I
```

It appears that k' varies from 1 to n. Given that n can be very large, the array I can occupy or fill memory. Therefore, only every Nth approximation value should be recorded. This can be solved using the familiar residue detection function:

```
for k in range ( 1 , n + 1 ):
    ...
    if k % N == 0 :
        # store
```

Thus, every time k is divided by N without a remainder, we write the value (in our case from each hundred). The corresponding function is shown below.

```
def MCint3 ( f , a _ b , n _ N = 100 ):
    '''Stores every Nth approximation of the integral in array I
and k
writes the corresponding value of
    s = 0
```


ISSN 2277-3630 (online), Published by International journal of Social Sciences & Interdisciplinary Research., under Volume: 11 Issue: 12 in December-2022
https://www.gejournal.net/index.php/IJSSIR

```
    I_values = []
    k_values = []
    for k in range ( 1 , n + 1 ):
        x = random_number . uniform ( a , b )
        s += f ( x )
        if k % N == 0 :
            I = ( float ( b - a ) / k ) * s
            I_values . append ( I )
            k_values . append ( k )
    return k_values , I_values
```

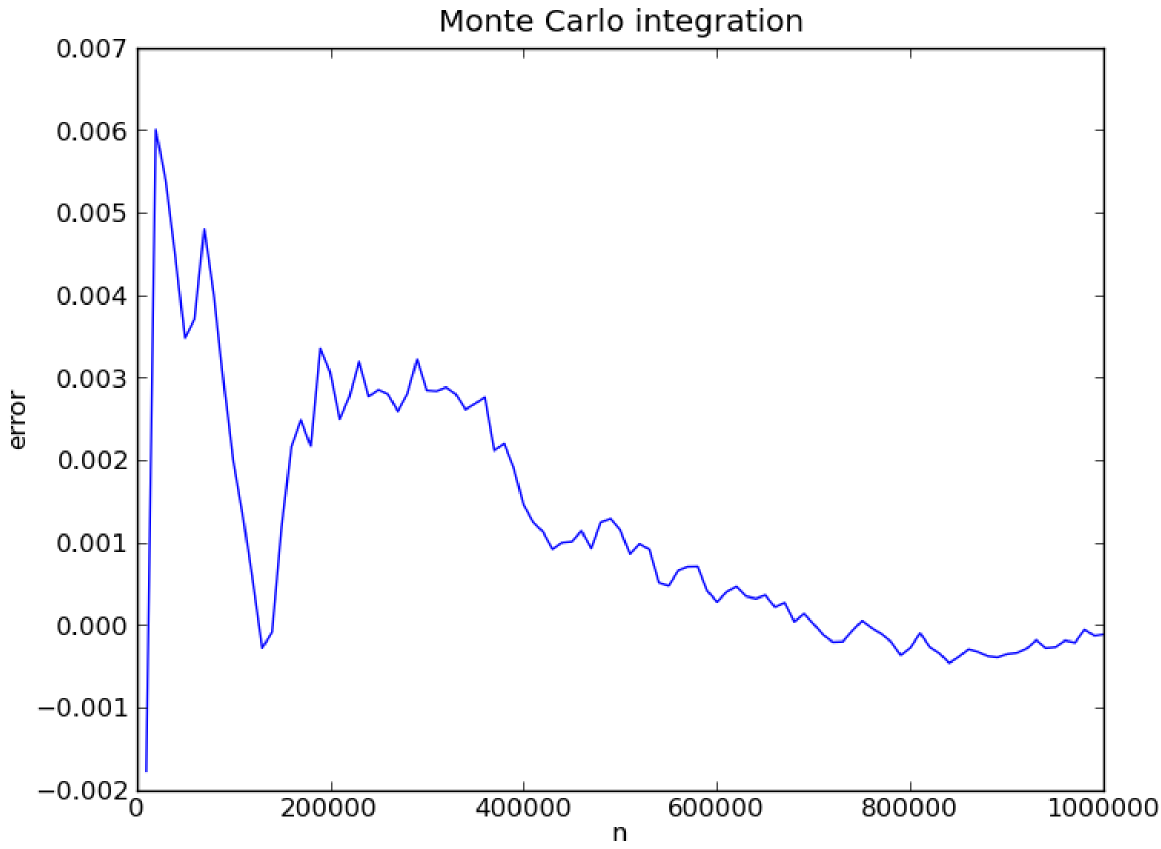
We now have a tool to see how the Monte Carlo integration error changes as n increases. The finished program looks like this, the output of the program (randomness may vary slightly) is shown below:

```
import random as random_number
import matplotlib.pyplot as plt
from numpy import array


def MCint3 ( f , a _ b , n _ N = 100 ):
    '''Stores every Nth approximation of the integral in array I
and k
writes the corresponding value of
    s = 0

    I_values = []
    k_values = []
    for k in range ( 1 , n + 1 ):
        x = random_number . uniform ( a , b )
        s += f ( x )
        if k % N == 0 :
            I = ( float ( b - a ) / k ) * s
            I_values . append ( I )
            k_values . append ( k )
    return k_values , I_values

def f1 ( x ):
    return 2 + 3 * x

k , I = MCint3 ( f1 , 1 , 2 , 1000000 , N = 10000 )
error = 6.5 - array ( I )

plt . title ( 'Monte Carlo integration' )
plt . xlabel ( 'n' )
plt . ylabel ( 'error' )
plt . plot ( k , error )
```


ISSN 2277-3630 (online), Published by International journal of Social Sciences & Interdisciplinary Research., under Volume: 11 Issue: 12 in December-2022
https://www.gejournal.net/index.php/IJSSIR

```
plt . show ()
```

The result:



References:

1. S. M. Ermakov. Method Monte-Carlo i smezhnye voprosy, izd. 2-e, Glavnaya redaktsiya fiziko-mathematicheskoy literatury izd-va "Nauka", 1975.
2. S. M. Ermakov. Statistical modeling. Chast II . Integrally. Integral equations. Saint Petersburg, 2004
3. ru . wikiversity . org / wiki /Programmirovanie_i_nauchnye_vychislenie_na_yazyke_ Python /§18
4. Jurayev VT PEDAGOGICAL SOFTWARE IN THE PREPARATION OF FUTURE TEACHERS OF INFORMATICS IN AN INNOVATIVE ENVIRONMENT //Theoretical & Applied Science. - 2020. - No. 4. - S. 182-185.
5. Jorayev VT The Role And Advantages Of Distance Courses In The Innovative Educational System //The American Journal of Social Science and Education Innovations. - 2020. - T. 2. – no. 10. – S. 434-439.
6. Mashrabovich, Mullaev Bakhtior. "The role of digital technologies in improving the quality of higher education." ACADEMICIA: An International Multidisciplinary Research Journal 12.9 (2022): 23-26.
7. Iqboljan S. USE OF INFORMATION TECHNOLOGIES IN THE EDUCATIONAL PROCESS OF PRIMARY CLASS //CREATIVE TEACHER. - 2022. - T. 2. – no. 20. - S. 137-140.

ISSN 2277-3630 (online), Published by International journal of Social Sciences & Interdisciplinary Research., under Volume: 11 Issue: 12 in December-2022
https://www.gejournal.net/index.php/IJSSIR

8. Aldashev I. ISPOLZOVAT SPETsIFIChESKIE SVOYSTVA KOMPUTERA, POZVOLYaYushchIE INDIVIDUALIZIROVAT UChEBNYY PROTsESS I OBRATITSya K PRINTsIPIALNO NOVYM POZNAVATELNYM SREDSTVAM //Ekonomika i sotsium. - 2020. - No. 6. - S. 337-340.
9. Aldashev I. Use the specific properties of the computer, allowing you to individualize the educational process and turn to fundamentally new cognitive means //Economy And Society. - 2020. - No. 6 (73).
10. Karimov ST, Shishkina EL Some methods of solution to the Cauchy problem for an inhomogeneous equation of hyperbolic type with a Bessel operator //Journal of Physics: Conference Series. - IOP Publishing, 2019. - T. 1203. - no. 1. – S. 012096.
11. FARMONOV Sh. R., MURATOV N. A. OPREDELENIE INTEGRIRUYushchEGO MNOJITELYa POLNOGO DIFFERENTsIALA VTOROGO PORYADKA //Aktualnye issledovaniya. - 2021. - S. 6.
12. FARMONOV Sh. R., JALOLKHUJAEV M. A. SRAVNITELNYY ANALYZ ANALITIChESKOGO I CHISLENNOGO RESHENIya ZADACHI DLYa URAVNENIya TEPLOPROVODNOSTI //Aktualnye issledovaniya. - 2021. - S. 6.
13. Tojiyev TK, Tashboltayev FU METHODOLOGY OF TEACHING INFORMATION TECHNOLOGIES WITH INNOVATIVE TECHNOLOGIES // Economics i society _ – 2021. – no. 4-1. - S. 414-416.
14. Tojiev T., Otakhanov A. Stochasticheskie metody approximatsii reshenia smeshannoi zadachi dlya obobshchennogo uravneniya neizotropicnoe diffuzii //Sovremennye nauchnye issledovaniya i razrabotki. - 2018. - T. 1. – no. 5. - S. 634-636.
15. Tojiev T., Ulikov Sh. Postroenie nesmeshchennaya i e-meshchyonnaya otsenki dlya reshenia zadachi Cauchy dlya obobshchennogo uravneniya neizotropicnoi diffuzii //Sovremennye nauchnye issledovaniya i razrabotki. - 2018. - T. 1. – no. 5. - S. 636-639.
16. Tojiev T., IBRAGIMOV Sh. STOKHASTICHESKIE METHODY APPROKSIMATsII DLYa RESHENIYA DIFFUZIONNYX ZADACh //Fundamentalnye i prikladnye nauchnye issledovaniya: aktualnye voprosy, dostizheniya i innovatsii. - 2018. - S. 13-15.
17. Tojiev T I. Sh., Rakhimov K. METODY POSTROENIya TsEPEY MARKOVA APPROXIMIRUYushchIE DIFFUZIONNYX ZADACh //TURIN POLYTECHNIC UNIVERSITY IN THE CITY OF TASHKENT. - 2017. - S. 156.
18. Otajonov U. A., Tojiev T. X. Широкополостные услуги TRIPLE PLAY (Internet, IPTV AND IP-telephony) //Obrazovanie i nauka v Rossii i za rubejom. – 2015. – no. 2. - S. 74-80.
19. Urinov AK, Khaydarov IU On a problem for parabolic-hyperbolic type equation with non-smooth line of type change //Abstracts, 6th international ISAAC congress, Ankara, Turkey. - 2007. - S. 105.
20. Khaydarov IU, Salakhitdinov MS, Urinov AK An Extremum Principle for a Class of Hyperbolic Type Equations and for Operators Connected with Them //Modern Aspects of the Theory of Partial Differential Equations. - Springer, Basel, 2011. - S. 211-231.
21. Zunnunov R. T., Khaidarov I. U. Kraevaya zadacha so smeshcheniem dlya obobshchennogo uravneniya Trikomi so spectralnym parametrom v neogranichennoy oblasti //Vestnik KRAUNTs. Physical and mathematical science. - 2020. - T. 32. - no. 3. - S. 55-64.
22. Khaydarov IU A problem with non-local conditions for a mixed parabolic-hyperbolic equation with two lines of changing type //INTERNATIONAL JOURNAL OF RESEARCH IN COMMERCE, IT, ENGINEERING AND SOCIAL SCIENCES ISSN: 2349-7793 Impact Factor: 6.876. - 2022. - T. 16. – no. 10. – S. 22-30.

ISSN 2277-3630 (online), Published by International journal of Social Sciences & Interdisciplinary Research., under Volume: 11 Issue: 12 in December-2022
https://www.gejournal.net/index.php/IJSSIR

23. Ismailov A. THE DARBOUX PROBLEM FOR THE NONHOMOGENEOUS GENERALIZED EULER-POISSONDARBOUX EQUATION //Norwegian Journal of Development of the International Science. – 2022. – no. 91. - S. 24-33.
24. Urinov AK, Ismailov AI, Mamanazarov AO A Cauchy-Goursat problem for the generalized Euler-Poisson-Darboux equation //Contemp. Anal. Appl. Math. - 2016. - T. 4.
25. Urinov A. _ K. , Ismailov A. _ I. _ OB ODNOM ANALOGUE ZADACHI IF DLYa OBOBshchENNOGO Uravnenia EULERA – POISSONA – DARBU ON AN ANALOGUE OF THE GOURSAT PROBLEM FOR THE GENERALIZED // BBK B16+ B192 D 503. – S . 274.
26. Urinov A. K., Ismailov A. I. Zadacha s boundary conditions and parallel characteristics for the general Euler-Poisson-Darbou equation //UZBEKISTAN MATHEMATICS JOURNAL. - S. 132.
27. Ismailov AI, Mamanazarov AO, Urinov AK Darboux problem for the generalized Euler–Poisson–Darboux equation //Ukrains' kyi Matematychnyi Zhurnal. - 2017. - T. 69. - no. 1. – S. 52-70.
28. Usmanov B., Rakhimov Q., Akhmedov A. The problem of takeoff and landing of a hereditarily deformable aircraft in a turbulent atmosphere // Construction Mechanics, Hydraulics & Water Resources Engineering, CONMECHYDRO 2021 AS, 7 - 9 September 2021.
29. 16. Usmanov B.Sh., Rakhimov K. O., Modeling and analysis of numerical research problems of linear and nonlinear successive-deformation systems in the Matlab environment // Problemy vychislitelnoy i praktanoy matematiki. - 2021. - No. 4(34). - p. 50-59.
30. 17. Karimov, Sh. T. "New Properties of Generalized Erdélyi–Kober Operator With Application", Dokl. Acad. Nauk Uzbek Republic, No. **5** , 11–13 (2014) [in Russian].
31. 18. Karimov, Sh. T. "Multidimensional Generalized Erdélyi–Kober Operator and its Application to Solving Cauchy Problems for Differential Equations With Singular Coefficients", Fract. Calc. Appl. Anal. **18** , No. 4, 845–861 (2015).
32. 19. Sh.T. Karimov, Solution of a Cauchy problem for multidimensional hyperbolic equations with singular coefficients by the method of fractional integrals (in Russian). Doc. Acad. Nauk R. Uz. No. 1 (2013), 11-13.
33. 20. Sh.T. Karimov, On a method of solution of Cauchy problem for the generalized Euler-Poisson-Darboux equation (in Russian). Uzbek Mathematical Journal No. 3 (2013), 57-69.
34. 21. AK Urinov, ST Karimov, Solution of the Cauchy Problem for generalized Euler-Poisson-Darboux equation by the method of fractional integrals. In: Progress in Partial Differential Equations, Springer International Publishing (2013), 321-337.
35. 22. Karimov Sh.T. The Erdei-Kobera multivariate operator and its application to the Cauchy solution for three-dimensional hyperbolic equations with singular coefficients //Uzb. sorry journal. 2013. No. 1. -C.70-80.
36. 23. Karimov K.T. Zadacha Dirichle for three-dimensional elliptic equations with two singular coefficients. Uzbek mathematical journal. -Tashkent, 2017. -#1. -S.96- 105.
37. 24. Sh.T. Karimov, Solution of a Cauchy problem for multidimensional hyperbolic equations with singular coefficients by the method of fractional integrals, Dokl. Acad. Nauk R. Uz. 1 (2013) 11–13 (in Russian).
38. 25. Karimov Sh.T, Yulbarsov Kha.A. Gursa's analog problem for one pseudoparabolic equation of the third order // Material scientific conference "Actual problems of stochastic analysis". Tashkent. 2021. S. 309–311
39. 26. Karimov Sh.T. Solving the problem of Cauchy for multidimensional hyperbolic equations with singular coefficients by the method of small integrals. // Doklady AN RUz, 2013, No. 1, p. 11-13.

ISSN 2277-3630 (online), Published by International journal of Social Sciences & Interdisciplinary Research., under Volume: 11 Issue: 12 in December-2022
https://www.gejournal.net/index.php/IJSSIR

40. 27. Karimov Sh.T. Ob odnom methode sheniya kraevyx zadach dlya mongomernyx parabolicheskikh euravneniy s operatorami Besselya. // Trudy mejd. Nauch. conf. Differential equations and intermediate problems, t.1, -Ufa, RITs BashGU, 2013, p. 54-59.
41. 28. Sh. T. Karimov, ``On some generalizations of properties of the Lowndes operator and their applications to partial differential equations of higher order," Philomat **32** , 873–883 (2018).
42. Abdunabiyevna K. D., Mansur B. SOLVING ALGEBRAIC PROBLEMS USING THE VECTOR CONCEPT //INTERNATIONAL JOURNAL OF RESEARCH IN COMMERCE, IT, ENGINEERING AND SOCIAL SCIENCES ISSN: 2349-7793 Impact Factor: 6.876. – 2022. – T. 16. – №. 10. – C. 49-59.

ISSN 2277-3630 (online), Published by International journal of Social Sciences & Interdisciplinary Research., under Volume: 11 Issue: 12 in December-2022
https://www.gejournal.net/index.php/IJSSIR