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## A class of bijective Lotka-Volterra operators and its application

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### MATHEMATICAL METHODS IN THE APPLIED SCIENCES

**DOI:** 10.1002/mma.9088

**Early Access:** JAN 2023

**Indexed:** 2023-02-12

**Document Type:** Article; Early Access

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### Abstract:

It is well known that any classical Lotka-Volterra (LV) operator (associated with quadratic stochastic operator) defined on the simplex is a homeomorphism. On the other hand, more general LV systems have important applications in the time evolution of conflicting species in biology. It is natural to study the bijectivity of such kind of LV operators. There is an example of a LV operator which is not injective. In this paper, we introduce a class of LV operators that are bijective. As an application of our result, the existence and uniqueness of solution of a class of Hammerstein integral equations is proved.

### Keywords

**Author Keywords:** bijective; integral equation; Lotka-Volterra operator; stochastic

**Keywords Plus:** QUADRATIC STOCHASTIC OPERATORS; NONLINEAR MARKOV OPERATORS; MODELS; STABILITY

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## Categories/ Classification

**Research Areas:** Mathematics

**Citation Topics:** 9 Mathematics > 9.28 Pure Maths > 9.28.1639 Prime Ring

**Web of Science Categories:** Mathematics, Applied

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## Journal information

**MATHEMATICAL METHODS IN THE APPLIED SCIENCES**

**ISSN:** 0170-4214

**eISSN:** 1099-1476

**Current Publisher:** WILEY, 111 RIVER ST, HOBOKEN 07030-5774, NJ

**Journal Impact Factor:** Journal Citation Reports™

**Research Areas:** Mathematics

**Web of Science Categories:** Mathematics, Applied

**3.007**

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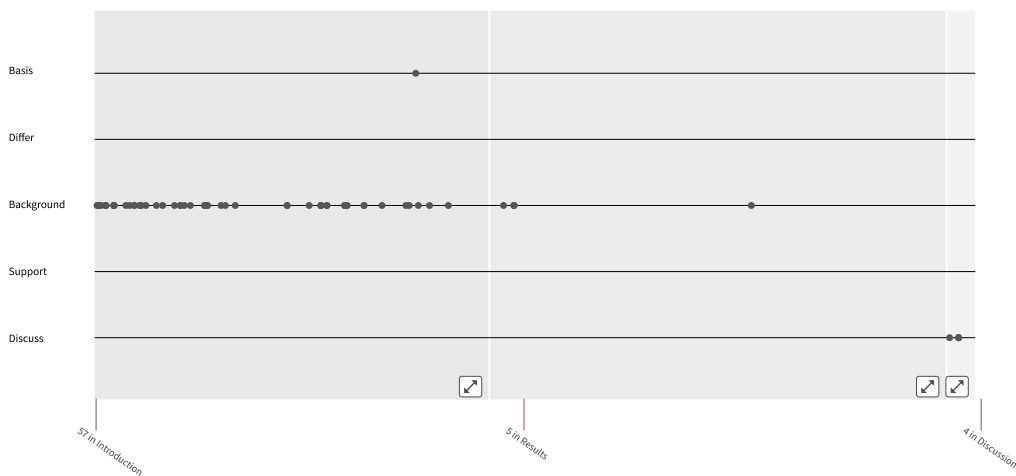
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Lotka, AJ  
Jul-dec 1920 |  
JOURNAL OF THE AMERICAN CHEMICAL SOCIETY 42

567  
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0  
References

, pp.1595-1599  
AMER CHEMICAL SOC, 1155 16TH ST, NW,  
WASHINGTON, DC 20036 USA

Cited in Article: 2

2 [Not available]

Volterra, V.  
1931 |  
Lecons sur theorie math de la lutte pour la vie 214  
Gauthier-villars VI, Paris

Cited in Article: 1

1

Citation

---

0

References

3 SOLUTION OF A MATHEMATICAL  
PROBLEM IN THEORY OF HEREDITY

BERNSHTEIN, SN  
1976 |  
SOCIAL SCIENCE INFORMATION SUR LES SCIENCES  
SOCIALES  
15 (4-5) , pp.797-821

[Full Text at Publisher](#) ...

Cited in Article: 1

2

Citations

---

2

References

---

[Related records](#)

4 Lois de fluctuation de la population de  
plusieurs especes coexistant dans le  
meme milieu

Volterra, V.  
1926 | Association Franc , pp.96-98

Cited in Article: 1

1

Citation

---

0

References

5 COEXISTENCE FOR SYSTEMS GOVERNED  
BY DIFFERENCE-EQUATIONS OF LOTKA-

142

Citations

---

## VOLTERRA TYPE

[HOFBAUER, J](#); [HUTSON, V](#) and [JANSEN, W](#)  
1987 | JOURNAL OF MATHEMATICAL BIOLOGY 25 (5)  
, pp.553-570

[Full Text at Publisher](#) ...

Cited in Article: 2

25

References

---

[Related records](#)

6

## Mathematical Biology. I

[Murray, J. D.](#)  
2002 | Interdisciplinary Applied Mathematics 17  
Springer-Verlag, New York

Cited in Article: 1

614

Citations

0

References

7

## SOME REMARKS ON ANIMAL POPULATION DYNAMICS

[MORAN, PAP](#)  
1950 | BIOMETRICS 6 (3) , pp.250-258  
WILEY, 111 RIVER ST, HOBOKEN 07030-5774, NJ  
USA

Cited in Article: 1

121

Citations

0

References

8

## Harvesting in discrete-time predator- prey systems

[Basson, M](#) and [Fogarty, MJ](#)  
Apr 1 1997 | MATHEMATICAL BIOSCIENCES 141 (1) ,  
pp.41-74

[Full Text at Publisher](#) ...

Cited in Article: 1

32

Citations

51

References

---

[Related records](#)

9

OCCURRENCE OF CHAOS IN HIGHER-DIMENSIONAL DISCRETE-TIME-SYSTEMS

DOHTANI, A

Dec 1992 |

SIAM JOURNAL ON APPLIED MATHEMATICS 52 (6) ,

pp.1707-1721  
[Full Text at Publisher](#) ...

Cited in Article: 1

40

16<sup>tions</sup>

References

[Related records](#)

10

STABILITY IN A CLASS OF DISCRETE-TIME MODELS OF INTERACTING POPULATIONS

FISHER, ME and GOH, BS

1977 | JOURNAL OF MATHEMATICAL BIOLOGY 4 (3) ,

pp.265-274

[Full Text at Publisher](#) ...

Cited in Article: 1

18

Citations

12

References

[Related records](#)

11

VOLTERRA AND OTHER NONLINEAR MODELS OF INTERACTING POPULATIONS

GOEL, NS; MAITRA, SC and MONTROLL, EW

1971 | REVIEWS OF MODERN PHYSICS 43 (2) , pp.231-

+

[Full Text at Publisher](#) ...

Cited in Article: 3

480

Citations

92

References

[Related records](#)

12

Permanence and global attractivity for Lotka-Volterra difference systems

Lu, ZY and Wang, WD

Sep 1999 | JOURNAL OF MATHEMATICAL BIOLOGY

39 (3) , pp.269-282

[Full Text at Publisher](#) ...

Cited in Article: 1

57

Citations

12

References

[Related records](#)

13 Two dimensional Explodators. Global analysis of the Lotka-Volterra-Brusselator (LVB) model

[Farkas, H.](#); [Noszticzius, Z.](#); (...); [Schelly, Z.A.](#)  
1989 | Acta Physica Hungarica 66 (1-4) , pp.203-20

Cited in Article: 1

5  
Citations

---

0  
References

14 LIMIT-CYCLES IN RANDOM ENVIRONMENTS

[LIN, J](#) and [KAHN, PB](#)  
1977 | SIAM JOURNAL ON APPLIED MATHEMATICS  
32 (1) , pp.260-291

[Full Text at Publisher](#) ...

Cited in Article: 1

13  
Citations

---

25  
References

---

[Related records](#)

15 On a Volterra Cubic Stochastic Operator

[Jamilov, UU](#); [Khamraev, AY](#) and [Ladra, M](#)  
Feb 2018 | BULLETIN OF MATHEMATICAL BIOLOGY  
80 (2) , pp.319-334

[Full Text at Publisher](#) ...

Cited in Article: 1

15  
Citations

---

27  
References

---

[Related records](#)

16 ORTHOGONAL-PRESERVING AND SURJECTIVE CUBIC STOCHASTIC OPERATORS

[Mukhamedov, F](#); [Embong, AF](#) and [Rosli, A](#)  
Nov 2017 | ANNALS OF FUNCTIONAL ANALYSIS 8 (4) ,  
pp.490-501

[Free Full Text From Publisher](#) ...

12  
Citations

---

16  
References

---

[Related records](#)

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[Related records](#)

17 **Impacts of Biotic Resource Enrichment on a Predator-Prey Population**

[Safuan, HM](#); [Sidhu, HS](#); (...); [Towers, IN](#)  
Oct 2013 | BULLETIN OF MATHEMATICAL BIOLOGY  
75 (10) , pp.1798-1812

[Full Text at Publisher](#) ...

Cited in Article: 1

19  
[Citations](#)

31  
[References](#)

[Related records](#)

18 **Stability and Monotonicity of Lotka-Volterra Type Operators**

[Mukhamedov, F](#) and [Saburov, M](#)  
Jul 2017 |  
QUALITATIVE THEORY OF DYNAMICAL SYSTEMS 16  
(2) , pp.249-267

[Free Submitted Article From Repository](#)

[Full Text at Publisher](#)

...

Cited in Article: 9

12  
[Citations](#)

45  
[References](#)

[Related records](#)

19 **QUADRATIC STOCHASTIC OPERATORS, LYAPUNOV FUNCTIONS, AND TOURNAMENTS**

[GANIKHODZHAEV, RN](#)  
1993 |  
RUSSIAN ACADEMY OF SCIENCES SBORNIK  
MATHEMATICS  
76 (2) , pp.489-506

[Full Text at Publisher](#) ...

Cited in Article: 4

98  
[Citations](#)

12  
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20 **On non-linear Markov operators: surjectivity vs orthogonal preserving**

7  
[Citations](#)



property

14

References

[Mukhamedov, F](#) and [Embong, AF](#)

2018 | LINEAR & MULTILINEAR ALGEBRA 66 (11) ,  
pp.2183-2190

[Free Submitted Article From Repository](#)

[Full Text at Publisher](#)

•••

Cited in Article: 1

---

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21 On surjective second order non-linear  
Markov operators and associated  
nonlinear integral equations

8

Citations

[Mukhamedov, F](#); [Khakimov, O](#) and [Embong, AF](#)

Nov 2018 | POSITIVITY 22 (5) , pp.1445-1459

[Free Published Article From Repository](#)

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Cited in Article: 1

17

References

---

[Related records](#)

22 Solvability of nonlinear integral  
equations and surjectivity of nonlinear  
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2

Citations

[Mukhamedov, F](#); [Khakimov, O](#) and [Embong, AF](#)

Oct 2020 | Jun 2020 (Early Access) |

MATHEMATICAL METHODS IN THE APPLIED  
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43 (15) , pp.9102-9118

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31

References

---

[Related records](#)

23 On omega limiting sets of infinite  
dimensional Volterra operators

5

Citations

[Mukhamedov, F](#); [Khakimov, O](#) and [Embong, AF](#)

Nov 2020 | NONLINEARITY 33 (11) , pp.5875-5904

34

References

 [Enriched Cited References](#)

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---

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**8**  
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---

[Saburov, M](#)

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44 (1) , pp.813-819

**29**  
References

 [Enriched Cited References](#)

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---

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25      **[Not available]**

**112**  
Citations

---

[Beverton, R.J.H. and Holt, S.J.](#)

1993 |

On the Dynamics of Exploited Fish Populations

Springer, Berlin/Heidelberg, Germany

**0**  
References

Cited in Article: 2

26      **DENSITY-DEPENDENCE IN SINGLE-  
SPECIES POPULATIONS**

**525**  
Citations

---

[HASSELL, MP](#)

1975 | JOURNAL OF ANIMAL ECOLOGY 44 (1) ,  
pp.283-295

**24**  
References

[Free Submitted Article From Repository](#)

[Full Text at Publisher](#)

...

---

[Related records](#)

Cited in Article: 2

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27 STABILITY OF PREDATOR-PREY SYSTEMS

303

Citations

[SMITH, JM](#) and [SLATKIN, M](#)  
1973 | *ECOLOGY* 54 (2) , pp.384-391

17

References

[Full Text at Publisher](#) ...

Cited in Article: 2

[Related records](#)

28 Stock and recruitment

2,333

Citations

[RICKER, W. E.](#)  
1954 | *JOUR FISH RES BD CANADA* 11 ((5)) , pp.559-623

0

References

Cited in Article: 1

29 A Class of Lotka-Volterra Operators with Historical Behavior

3

Citations

[Jamilov, U](#) and [Mukhamedov, F](#)  
Aug 2022 | *RESULTS IN MATHEMATICS* 77 (4)

31

References

 Enriched Cited References

[Full Text at Publisher](#) ...

Cited in Article: 1

[Related records](#)

30 QUADRATIC STOCHASTIC OPERATORS AND PROCESSES: RESULTS AND OPEN PROBLEMS

147

Citations

[Ganikhodzhaev, R](#); [Mukhamedov, F](#) and [Rozikov, U](#)

110

References

Jun 2011 |  
INFINITE DIMENSIONAL ANALYSIS QUANTUM  
PROBABILITY AND RELATED TOPICS  
[Full Text at Publisher](#)  
14 (2) , pp.279-335  
Cited in Article: 1

[Related records](#)

31 [Not available]

[Rozikov, UA.](#)  
2020 | POPULATION DYNAMICS  
World Sci. Publ., Singapore

Cited in Article: 1

12  
Citations

0  
References

32 A Lotka-Volterra three-species food chain

[Chauvet, E.](#); [Paullet, J.E.](#); (...); [Walls, Z.](#)  
2002 | Math. Mag 75 (4) , pp.243-255

Cited in Article: 1

45  
Citations

0  
References

33 MATHEMATICAL-ANALYSIS OF SOME 3-SPECIES FOOD-CHAIN MODELS

[FREEDMAN, HI](#) and [WALTMAN, P](#)  
1977 | MATHEMATICAL BIOSCIENCES 33 (3-4) ,  
pp.257-276

[Full Text at Publisher](#) ...

Cited in Article: 1

166  
Citations

29  
References

[Related records](#)

34 Mathematical Models in Biology

[Edelstein-Keshet, L](#)

65  
Citations

2005 |  
Society for Industrial and Applied Mathematics

Cited in Article: 1

0  
References

35 PERSISTENCE IN MODELS OF 3  
INTERACTING PREDATOR-PREY  
POPULATIONS

FREEDMAN, HI and WALTMAN, P  
1984 | MATHEMATICAL BIOSCIENCES 68 (2) , pp.213-  
231

[Full Text at Publisher](#) ...

Cited in Article: 1

339  
Citations

62  
References

[Related records](#)

36 **Preprint**  
Extending the Monod Model of  
Microbial Growth with Memory (From:  
Preprint Citation Index)

Amirian, MM; Irwin, AJ and Finkel, ZV  
Jul 01 2022 | Arxiv

[View Full Text At Repository](#) ...

Cited in Article: 1

2  
Citations

46  
References

[Related records](#)

37 Phytoplankton functional types: a trait  
perspective

Finkel, ZV and Irwin, AJ.  
2017 | bioRxiv

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4  
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38

15  
Citations

Memory and mutualism in species sustainability: A time-fractional Lotka-Volterra model with harvesting

[Amirian, MM; Towers, JN; \(...\); Irwin, AJ](#)  
[Free Full Text from Publisher](#) ...  
Sep 2020 | HELIYON 6 (9)  
Cited in Article: 1

47  
References

[Related records](#)

39 Modelling hiding behaviour in a predator-prey system by both integer order and fractional order derivatives

[Barman, D; Roy, J and Alam, S](#)  
Mar 2022 | Nov 2021 (Early Access) |  
ECOLOGICAL INFORMATICS 67

[View full text](#) ...

Cited in Article: 2

6  
Citations

75  
References

[Related records](#)

40 On Dynamics of Lotka-Volterra Type Operators

[Mukhamedov, F and Saburov, M](#)  
2014 |  
BULLETIN OF THE MALAYSIAN MATHEMATICAL  
SCIENCES SOCIETY  
37 (1) , pp.59-64

...

Cited in Article: 1

23  
Citations

16  
References

[Related records](#)

41 On Nonergodic Uniform Lotka-Volterra Operators

[Mukhamedov, FM; Jamilov, UU and Pirnapasov, AT](#)  
Jan 2019 | MATHEMATICAL NOTES 105 (1-2) , pp.258-  
264

[Full Text at Publisher](#) ...

Cited in Article: 1

13  
Citations

13  
References

[Related records](#)

42 On Non-ergodic Volterra Cubic Stochastic Operators

[Mukhamedov, F](#); [Pah, CH](#) and [Rosli, A](#)  
Dec 2019 |  
QUALITATIVE THEORY OF DYNAMICAL SYSTEMS 18  
(3) , pp.1225-1235

[Free Accepted Article From Repository](#)

[Full Text at Publisher](#)

...

Cited in Article: 1

12  
Citations

22  
References

[Related records](#)

43 Uniformly historic behaviour in compact dynamical systems

[Saburov, M](#)  
Jul 3 2021 | Jul 2021 (Early Access) |  
JOURNAL OF DIFFERENCE EQUATIONS AND  
APPLICATIONS  
27 (7) , pp.1006-1023

[Full Text at Publisher](#) ...

Cited in Article: 1

5  
Citations

50  
References

[Related records](#)

44 A Family of Volterra Cubic Stochastic Operators

[Jamilov, U](#) and [Reinfelds, A](#)  
2021 | JOURNAL OF CONVEX ANALYSIS 28 (1) , pp.19-30

...

Cited in Article: 1

8  
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26  
References

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