BG Pulse Journal USA
ISSN:1947-2536 http://www.bgpulseusa.com/index.php/bg

QUADRATIC STOCHASTIC OPERATORS CONSTRUCTED USING THE BERNOULLI DISTRIBUTION

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https://doi.org/10.5281/zenodo.20338932

Abstract: In the article, the trajectories of quadratic stochastic operators built using a new construction are studied, and their fixed points and asymptotic fixed points are found. it is shown that quadratic stochastic operators are surjective quadratic stochastic operators and not.

Keywords: Population, diversity, simplex, reflection, Quadratic operators, Generation to generation, Voltero, density, cell, surjective, stochastic, original, frequency, genotype frequency, type, probability, hypothesis, allele, coefficient, construction, measurement, specialty

What kind of biological population? That is, we look at the closed relationship of organisms with each other. Let's assume that each specialty included in the population lies in one of the unique n varieties 1,2,3,...,n. ***i*** and ***j*** at the first step in the transition from the next generation to the next generation, let diversity k be determined with a single-valued probability. This probability (transition coefficient) $p_{ij,k}$ we define through It goes without saying that in this case the following conditions are fulfilled:

$p_{ij,k}$ 0, $\sum_{k=1}^{n} p_{ij,k} = 1$ all natural i, j, k for s.

The larger the population, the more likely it is to get the frequency. Then his condition $x = (x_1, x_2, ..., x_n)$ can be obtained as the probability of diversity, that is, the fraction of diversity i in the population xi. Then each appointed $x = (x_1, x_2, ..., x_n)$ for case parents pair i and j $x_i x_j$ is formed with probability, therefore, at the next stage in the transition from generation to generation, the full probability

$$x_k' = \sum_{i,j=1}^{n} p_{ij,k} x_i x_j \qquad (1)$$

is represented by a fotmula.

$S^{n-1} = \{x = (x_1, x_2, ..., x_n) : x_i$ 0, i=1,2,...,n, $\sum_{i=1}^{n} x_i = 1\}$ full $n-1$ - it is called a simplex with an ochovy. It goes without saying $\sum_{k=1}^{n} x_k' = 1$ va x_k' 0 will be. Then (1) reflection S^{n-1} is called a self-reflecting quadratic stochastic operator of a simplex. Let's assume (Λ, L) be a periodic finite graph without multiple edges. Here Λ - the set of vertices of the graph, and L- edges are spherical.

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Φ - and let there be a finite set of alleles. Reflection $\sigma:\Lambda\to\Phi$ and let there be a finite set of alleles. Reflection $S(\Lambda,\Phi)$ Ω the set of all probability distributions defined in a finite set. $S(\Lambda,\Phi)$ A quadratic stochastic operator that is self-reflexive of a simplex is defined in the form below. Λ_i - s (Λ,L) - is the set of all connected pieces of a graph, i=1,2,3,…,n. For optional two cells σ_1,σ_2 Ω for s

$$A(\sigma_1,\sigma_2)=\{x \quad \Lambda:\ \sigma_1(x)=\sigma_2(x)\}$$

and $\widehat{A}(\sigma_1,\sigma_2)=\bigcup_{j:A(\sigma_1,\sigma_2)\cap\Lambda_j\neq\varnothing}\Lambda_j$

If $\tilde{A}(\sigma_1,\sigma_2)$ if so, then

$$\Omega\left(\Lambda,\widehat{A}(\sigma_1,\sigma_2)\right)=\left\{\sigma\in\Omega:\sigma_{\widehat{A}(\sigma_1,\sigma_2)}=\sigma 1_{\widehat{A}(\sigma_1,\sigma_2)}\ yoki\ \sigma_{\widehat{A}(\sigma_1,\sigma_2)}=\sigma 2_{\widehat{A}(\sigma_1,\sigma_2)}\right\},$$

$\widehat{A}(\sigma_1,\sigma_2)=\varnothing$ just in case

$$\Omega\left(\Lambda,\widehat{A}(\sigma_1,\sigma_2)\right)=\left\{\sigma\in\Omega:\sigma_{\Lambda_j}=\sigma 1_{\Lambda_j}\ yoki\ \sigma_{\Lambda_j}=\sigma 2_{\Lambda_j},\quad j=1,2,3\ldots,n.\right\},$$

Let's assume μ $S(\Lambda,\Phi)$ - Ω defined in $\mu(\sigma)>0$ defined in σ Ω defined in $P_{\sigma_1\sigma_2,\sigma}$ we define as follows:

$$p_{\sigma_1\sigma_2,\sigma}=\begin{Bmatrix}\dfrac{\mu(\sigma)}{\mu\left(\Omega\left(\Lambda,\widehat{A}(\sigma_1,\sigma_2)\right)\right)} & If\ \sigma\in\Omega\left(\Lambda,\widehat{A}(\sigma_1,\sigma_2)\right)\\ 0 & for\ the\ remaining\ cases\end{Bmatrix}\ (2)$$

$S(\Lambda,\Phi)$ quadratic stochastic operator V built using the coefficient of transition from generation to generation (2) acting in a simplex is as follows defined: optional λ $S(\Lambda,\Phi)$ for measurement $V\lambda=\lambda'$ $S(\Lambda,\Phi)$ dimension is an optional cell σ Ω for

$$\lambda'(\sigma)=\sum_{\sigma_1,\sigma_2\ \Omega}P_{\sigma_1\sigma_2,\sigma}\lambda(\sigma_1)\lambda(\sigma_2)\qquad(3)$$

It can easily be seen that the intergenerational transmission coefficient satisfies the following conditions:

$P_{\sigma_1\sigma_2,\sigma}$ o, $\sum_{\sigma\ \Omega}P_{\sigma_1\sigma_2,\sigma}=1$ и $P_{\sigma_1\sigma_2,\sigma}=P_{\sigma_2\sigma_1,\sigma}$ everyone σ_1,σ_2,σ Ω that's it.

$\sigma(x)$ possible values of and [2] from the problem of static mechanics Φ the appearance of the space can be codified or darkened as much as possible. [1] it is known from the biological literature that arbitrary gene alleles can exist in different forms. In the population, we expand the A allele to the so-called "normal" or "safer" type, and the remaining forms are mutant α considered as alleles.

Affecting mutant alleles $\Phi=\{A,\alpha\}$ we consider the case consisting of two points.

Let's assume $|\Lambda|=n$ and $\Phi=\{A,\alpha\}$ let it be Optional check box σ Ω for σ in the cell (i.e. the number of "wins") A the number of alleles $n_A(\sigma)$ - we denote by and μ_α do not measure Ω in the same way as the binomial distribution:

$$\mu_\alpha(\sigma)=p^{n_A(\sigma)}q^{n-n_A(\sigma)}$$

Here $p \quad 0$, $q \quad 0$ $p+q=1$ and $p/q=\alpha$ is If $p=q$ when, that is $\alpha=1$ measure μ_1 Ω becomes a normal distribution at Let's assume (Λ,L) - let the set of edges of the graph be the empty set, that is, Λ do not keep the connecting lines.. In this case $n_A(\sigma_1)=n_A(\sigma_2)$ do not keep the connecting lines.. In this case $\Omega=\{\breve{\alpha}_1, \breve{\alpha}_2,\breve{\alpha}_3\ldots,\breve{\alpha}_k,$ here $\alpha_i-n_A(.)=i$ a set of cells satisfying the condition} we create a cell space. Here, the distribution is defined as follows:

$\mu_\alpha(\breve{\alpha}_i)=C_n^i p^i q^{n-i}$ (4)

Let's assume $\tilde{V}_\alpha$ - (4) constructed using a distribution $S(\Omega)=\{x=(x_1,x_2,...,x_n): x_i \quad 0, \ i=\overline{0,n}, \ \sum_{i=1}^{n} x_i=1\}$ be a quadratic stochastic operator acting in a simplex. If the rules of transmission from generation to generation satisfy Mendel's rules, the quadratic operators built using these rules are called Mendelian quadratic operators [1]. We consider models built using several quadratic operators.

In all the examples shown $p=q=1/2$ is the edge of the graph corresponding to it $|\Lambda|$=n is a graph.

1.n=1 models of transition from generation to generation were proposed by Elston and Stewart in 1971 [1].

$p_{Aa,A}$ - Aa is the probability of passing the A allele from a father with genotype to his child

And so on $p_{...,a}=1-p_{...,A}$.

Let's assume x_1 and x_2 – frequencies respectively A and α be the frequencies of Then it's optional (x_1,x_2) S^1 be the frequencies of Then it's optional:

$$x_1' = p_{AA,A}x_1^2 + 2p_{Aa,A}x_1x_2 + p_{aa,A}x_2^2$$
$$x_2' = p_{AA,a}x_1^2 + 2p_{Aa,a}x_1x_2 + p_{aa,a}x_2^2 \quad (5)$$

The Mendelian-type probability of passing from one generation to the next with the help of compatible hypotheses is found in the following form:

$p_{AA,A}=1$	$p_{Aa,A}=1/2$	$p_{aa,A}=0$
$p_{AA,a}=0$	$p_{Aa,a}=1/2$	$p_{aa,a}=1$

(6)

We generate .

(6) by pouring the values into (5).

$$x_1' = x_1^2 + x_1x_2$$
$$x_2' = x_2^2 + x_1x_2$$

we generate $x_1+x_2=1$ at the end if we take into account

$$x_1' = x_1$$
$$x_2' = x_2 \quad (7)$$

will be. That is, as the frequency of alleles does not change from generation to generation, this confirms the first law of Hardy-Weinberg.

Confirmation1. Hardy-Weinberg's law of invariance of allele frequency during the transition from the first generation to the next generation is appropriate for the Mendelian type of transmission from generation to generation. Proof. We introduce the following notations: $p_{AA,A} = a$, $p_{Aa,A} = b$, $p_{aa,A}$=c , then the Hardy-Weinberg proof is written in the following form:

$$x = ax^2 + 2bx(1-x) + c(1-x)^2 ,$$

Or after some simplification

$x = (a-2b+c)x^2 + 2(b-c)x + c$ we get

In that case, for the frequency to be constant

$$a - 2b + c = 0$$

$2(b-c) = 1$ must be.

$$c = 0$$

solving this system of equations $a = 1$, b=1/2, c=0 we get Hence the proof of assertion 1 follows. (7) from the relationship $V(S^1) = S^1$ it follows that quadratic stochastic operators are surjective.

2. n=2 as it is. Let's assume x_1, x_2 and x_3 frequencies $x = (x_1, x_2, x_3)$ S^2 - frequencies AA, Aa, aa be the frequencies of genotypes.

$P_{Aaaa,AA}$-A α α α genotypic parent to child AA genotypic parent to child $P_{\ldots,aa}$-1$-P_{\ldots,AA}$, $P_{\ldots,aA}$-1$-P_{\ldots,Aa}$

genotypic parent to child $\{p_{ij,k}\}_{i,j,k=1}^{3}$ will look like this:

1	1/4	0	1/2	0	0
0	1/2	0	1/2	1	1/2
0	1/4	1	0	0	1/2

If we put the values in this table into (5).

$$x_1' = x_1^2 + x_1x_2 + 1/4x_2^2$$

$$x_2' = x_1x_2 + 1/2x_2^2 + 2x_1x_3 + x_2x_3$$

$$x_3' = 1/4x_2^2 + x_2x_3 + x_3^2$$

and simplifying it

$$x_1' = (x_1 + 1/2x_2)^2$$

$$x_2' = 2(x_1 + 1/2x_2)(x_3 + 1/2x_2) \qquad (8)$$

$$x_3' = (x_3 + 1/2x_2)^2$$

we generate . To determine the frequency of transmission from generation to generation (5) to $x_1,\ x_2,\ x_3$ respectively instead of $x_1^{'},\ x_2^{'},\ x_3^{'}$, that is, we get the following equation

$$x_1^{''} = (x_1^{'} + 1/2x_2^{''})^2$$
$$x_2^{''} = 2(x_1^{'} + 1/2x_2^{'})(x_3^{'} + 1/2x_2^{'}) \qquad (9)$$
$$x_3^{''} = (x_3^{'} + 1/2x_2^{'})^2$$

or (9) by putting expression (8) at the end

$$x_1^{''} = (x_1 + 1/2x_2)^2$$
$$x_2^{''} = 2(x_1 + 1/2x_2)(x_3 + 1/2x_2)$$
$$x_3^{''} = (x_3 + 1/2x_2)^2$$

we will have

it can be seen from here that the genotype frequencies in the next stages of the transition from generation to generation are the same as in the first stage. We write this property in the form of an assertion.

Confirmation. 2. The frequency of the genotype does not change from one generation to the next.

invariance of frequencies is the third confirmation of Hardy-Weinberg's law. (8) munosabatdan ko'rinadiki (0;1;0) no'qtaning asli bush to'plamdir, bundan kelib chiqadiki bu kvadratik stoxastik operator suyr'ektiv akslantirish emas.

Thus, we proved the following theorems.

Theorem 2. Defined above $\tilde{V}_\alpha$ - quadratic stochastic operator $\alpha = 1$ va $n = 1$ or $n = 2$ becomes a Mendelian quadratic stochastic operator.

$x^{(k+1)}$ becomes a Mendelian quadratic stochastic operator.

Theorem 3. $\tilde{V}_\alpha$ - quadratic stochastic operator $\alpha = 1$ and $n = 1$ is a surjective quadratic stochastic operator when $n = 2$ is not a surjective quadratic stochastic operator.

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