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VOLUME 1

$$x' = 2xy$$
$$y' = 2xz$$

INVESTIGATIONS ON PURE MATHEMATICS, FINANCE MATHEMATICS AND OPTICS

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$$\varphi_1(x, y, z) = z$$

$$\pi_1 = \begin{pmatrix} x & y & z \\ y & z & x \end{pmatrix}$$

$$z' = x^2 + y^2 + z^2 + 2yz$$

$$\pi_1 V_1 \pi_1 = V_{17}$$

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ASSOCIATIVE ALGEBRA IN GENETIC INHERITANCE

Syahıra Mansur
Prof. Dr. Nasir Ganikhodjaev

Abstract. *As observed by Etherington, geneticists have already used basic algebraic notions without being aware of them. This paper examines the existence of associativity of algebraic structure that lies in genetic inheritance. By using the theory of Quadratic Stochastic Operators, we will determine the coefficients enabling the algebraic structure to be associative. We will use natural basis of* $\Re\{\boldsymbol{a}_1, \boldsymbol{a}_2, \boldsymbol{a}_3\}$ *in 2-dimensional simplex in* R^3 *and* $\{\boldsymbol{a}_1, \boldsymbol{a}_2, \boldsymbol{a}_3, \boldsymbol{a}_4\}$ *in 3-dimensional simplex in* R^4. *We will also observe the coefficients in three different cases: Volterra-Case when* $n = 3$, $n = 4$ *and General Case when* $n = 3$. *We will try to find all corresponding values so that the algebraic structure in genetic inheritance is associative.*

1 Introduction

This paper is written to discuss the associativity of genetic algebraic structure. In this paper, we will apply Quadratic Stochastic Operator to determine the existence or the lack of associative algebras in the genetic composition. Though generally, these algebraic structures are non-associative we will define the family of Quadratic Stochastic Operator so as to find the corresponding algebraic structures that are associative. With the popularity of biologically motivated mathematics are increasing, this paper is prepared such that it is another example of the breadth of mathematics that has biological significance.

Reed (1997) discussed the concepts of genetics that suggest the underlying algebraic structure of inheritance. In her paper, she gave a brief overview of the algebras which arise in genetics and some of their basic properties and relationships. She mentioned that multiplication of two such elements represents random mating between two populations for those elements of the gametic and zygotic algebras which represent populations. Therefore, plausibly the order in which populations mate is significant. For example, she considered population P that mates with population Q and subsequently the resulting population mates with population. However, the resulting population is not the same as the population resulting from P mating with the population obtained from mating Q and R originally. Hence, symbolically,

$$(P \times Q) \times R \neq P \times (Q \times R)$$

Mathematically, the algebras that arise in genetics are generally commutative but non-associative. However, they are not necessarily Lie, Jordan or alternative algebras. The most comprehensive reference for this subject is Worz-Busekros (1980). Our knowledge of the algebraic structure applies to real genetic situations. This was explained by Etherington (1941). He observed that geneticists had been using some of these basic notions without knowing them. So, he set out to formalize those algebraic notions and to advance the symbolism. Hopefully, it will get to a point where it could simplify the geneticists' methods of dealing with certain problems.

2 Quadratic Stochastic Operator (QSO)