

Dissertation Review Form **-for members of the Dissertation Commission-**

Please write a review of the dissertation taking the following criteria into account, where appropriate:

- General remarks
- The significance and status of the dissertation in the field
- The sufficiency and quality of the material
- The adequacy of the methods used
- The validity of results
- The logic of the dissertation's structure
- The knowledge and use of literature in the field
- The project's contribution to the research area
- The author's input into the achievement of the dissertation results
- Language
- The shortcomings of the manuscript

Name of the PhD Candidate : Mrs Sreelatha Chandragiri
Planned Date of Graduation : October, year: 2020

Title of the Dissertation: «The Cauchy problem for difference equations in lattice cones and generating functions for its solutions»

Would you please elaborate upon your review with reference to the above mentioned criteria in the box below. Please add extra pages if needed

While the theory of differential equations is a well-developed the theory of difference equations is much less developed, especially in the multidimensional case. The naive intuition says that the theory of difference equations should be a reflection of the theory of differential equation. But the reality is much more complicated than the picture suggested by naive intuition. For example the problem of "correct" formulation of an analog of the Cauchy problem for difference equations is non-trivial. One has to answer the questions: 1) what is the domain where the equation should be solved, 2) what is the initial condition.

Actually, there is no unique canonical formulation. There are several formulations of the Cauchy problem covering certain examples of difference equations arising in applications (the most important of them are difference equations arising in the enumerative combinatorics).

In Chapter 1 of the dissertation the author considers an example of formulation of the Cauchy problem in a cone arising from the problem of a calculation of a number of lattice paths. In this case the unique solvability of the mentioned problem is proved. Moreover, a formula expressing an arbitrary solution via a fundamental solution is given. But the most important result of the Chapter 1 for other Chapters of the dissertation is an identity satisfied by a generating function of a solution.

The idea of operating with generating functions and deriving identities for them is a key idea of the dissertation (of course this idea is common in combinatorics, but it is nontrivial if we try to use intuition coming from differential equations!).

The Chapter 2 of the dissertation seems at first to be independent from the results of the Chapter 1, but here again some sorts of generating functions are considered. In Chapter 2 vector partition functions are studied. The vector partition functions form some class of functions arising in enumerative combinatorics and having as a domain a cone considered before. The main result is an identity relating the vector partition function of a function φ and a generating function of φ . In this identity difference operators occur. This identity is a far going generalization of a discrete "Newton-Leibnitz formula".

Finally, in Chapter 3 results and ideas of the Chapters 1 and 2 are used to obtain new identities for generating functions of lattice paths. Formally it does not refer to the results of the previous Chapters but here the ideas of writing generating functions and deriving generalizations of discrete "Newton-Leibnitz formulas" are applied to certain situations. Using these ideas new results in this classical area of combinatorics are obtained.

Although the dissertation has some shortcomings. In the Introduction on the page 10 Lemma 1.2 is mentioned, but in contrast to other results it is not formulated in the Introduction. Also in the introduction on the page 11 the identity (2.2) is referred but in the Introduction all the formulas are indexed as (0.X). Finally in the statement of Theorem 2.5 in the Introduction the symbol $P_{\{A_j\}(\nu)}$ is not defined. Actually, all these questions are explained in the text of the dissertation, thus they are not essential.


The dissertation is good, results are valid, and the language is good. The author demonstrates knowledge of the literature. It is remarkable that the author develops both the general theory and obtains new results in combinatorics. I recommend to award the PhD degree to the author.

Name of the Dissertation Commission Member : Dmitry Artamonov

Chair / Function : Chair of the theory of functions

Date : 5.06.2020

Signature

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