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Counting subgraphs in F-free graphs

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University Grant Program 2015-2016, report

Name: Cory Palmer
Department: Mathematical Sciences
Grant number: M25364
Title: Counting subgraphs in F-free graphs

Objective

Investigate a generalization of the central theorem of extremal graph theory (Turan's theorem).

Summary of results

During the funded period I continued what had been a preliminary investigation into a generalization of the central theory of extremal graph theory. With the help of funding from the UGP grant I was able to cover the travel expenses for several very productive visits.

In April 2016 I presented my early findings at an AMS Special Session on Extremal Problems in Graph Theory in Salt Lake City, UT. At this conference I was fortunate to have the opportunity to discuss this research and future avenues of investigation with two of the top experts in this area.

Later in April 2016 I hosted my colleague Dr. Daniel Gerber of the Alfred Renyi Institute of Mathematics for a 10-day visit at UM. During his visit we worked on a number of the problems outlined in the scope of work for this project. We were able to prove several new theorems and begin work on a new manuscript titled ``Counting subgraphs in F-free graphs.'' We were also able to lay the groundwork for an approach to several of these problems using the so-called Flag Algebra technique; this was one of the goals of the proposal.

I was also able to use this support to help fund a visit to Budapest, Hungary in the summer where I continued working with Dr. Gerbner on our manuscript. During this time we dedicated a significant portion of our time to furthering our results from his visit to UM as well as doing the actual writing of the manuscript. We expect to submit our results to one of the top journals in combinatorics by the end of this year.

During the course of our research in April, we discovered an interesting link between our subgraph-counting problems and problems outlined in a paper by Keevash, Mubayi, Sudakov and Verstraete titled ``Rainbow Turan problems.'' In May 2016 I hosted Dr. Amites Sarkar of Western Washington University for a week at UM to work on some of the open problems posed in the paper of Keevash et al. This turned out to be a very productive collaboration. With Dr. Sarkar, myself and Dr. Dan Johnston of UM we were able to prove several new results in this area. This lead to a new manuscript titled ``Rainbow Turan problems for paths and forest of stars.'' This paper was submitted to a peer-reviewed journal in August and is currently under review.

Since receiving this award I submitted a related research proposal to the NSA Mathematical Sciences Program. Unfortunately, this proposal was not funded. I plan to submit an updated proposal next year.