



ACTIVITY REPORTING FORM
FOR CDC GRANTS PROGRAM
IMU Simons African Fellowship Program

Name of grantee: **Dr Patrick Yawadu Ali**

Home institution and country of grantee: **Chancellor College, University of Malawi, Zomba, Malawi**

Name of the host: **Professor Ravindra B Bapat**

Name of the host institution and country: **Indian Statistical Institute, New Delhi, India**

Topic of the research activity: **Identities for the minors of the Laplacian, resistance and distance matrices using outer inverses**

Dates spend at the center/ host institution: **01/03/2017-31/03/2017**

1. Summary statement of major outcome of your visit:

I found out that the Jacobi identities for submatrices can be used to prove some identities for minors of Laplacian, resistance and distance matrices. These results are stronger because they are valid even when the distance matrix and resistance matrix are singular.

2. Brief description of your research activities during your research visit:

During my visit, I surveyed research that has been done on the Laplacian, resistance and distance matrices and outer inverses. Also I had several discussions with my host on these known research results. I observed that results of the paper titled 'Identities for minors of the Laplacian, resistance and distance matrices' by Bapat and Sivasubramanian [Linear Algebra and its Applications 435 (2011)] largely depended on the inverse. I therefore used the Jacobi identities for submatrices which depend on the outer inverse to prove the same results. The results turned out to be spectacular because they worked even for singular matrices. Further, I attended two seminars on Number Theory at the institute.

3. Students and post-doctoral fellows advised:

I did not have an opportunity to advise students and post-doctoral fellows.

4. Joint activities with your host:

We had one research seminar for five people. My host, his PhD student from a different institution, a visiting researcher from Iran and me presented. I shared my research work.

5. Research in progress (as a result from the visit):

I am now writing a paper on the work that we have done for possible submission to a journal.

6. Papers published or in preprint form as a result from the research visit:

There is no published paper yet.

7. Planned future activities as a result of your research visit:

I will continue to work with my host on new research topics through correspondences. If funds permit, I intend to visit him periodically. On the other hand, I am going to invite him to visit my institution.

Date: **30/05/2017**

Signature Grantee: