



**University  
of Victoria**

Graduate Studies

Notice of the Final Oral Examination  
for the Degree of Master of Science

of

**MEIXIN LIU**

BSc (University of Victoria, 2017)

**“Graph Decompositions and Variance Balanced Block Designs of  
Experiments”**

Department of Mathematics and Statistics

Tuesday, August 6, 2019  
10:00 A.M.  
David Strong Building  
Room C128

Supervisory Committee:

Dr. Peter Dukes, Department of Mathematics and Statistics, University of Victoria (Co-Supervisor)  
Dr. Julie Zhou, Department of Mathematics and Statistics, UVic (Co-Supervisor)

External Examiner:

Dr. Hong-Chuan Yang, Department of Electrical and Computer Engineering, UVic

Chair of Oral Examination:

Dr. Charles Curry, School of Earth and Ocean Sciences, UVic

Dr. David Capson, Dean, Faculty of Graduate Studies

## **Abstract**

We study construction methods for variance balanced design (VBD) with both uncorrelated and correlated errors, where block designs are used to investigate several treatment effects. We begin with a review for the development of VBDs when the errors in the linear effects model are uncorrelated. There are several construction methods of VBDs for equal and unequal block sizes. When the errors are correlated, we introduce graph theory to study construction methods of VBDs. We develop new methods via graph decomposition. In addition, we construct block designs such that the covariance matrix of the least squares estimator of treatment effects is completely symmetric. Various applications are presented for certain specific error covariance matrices.