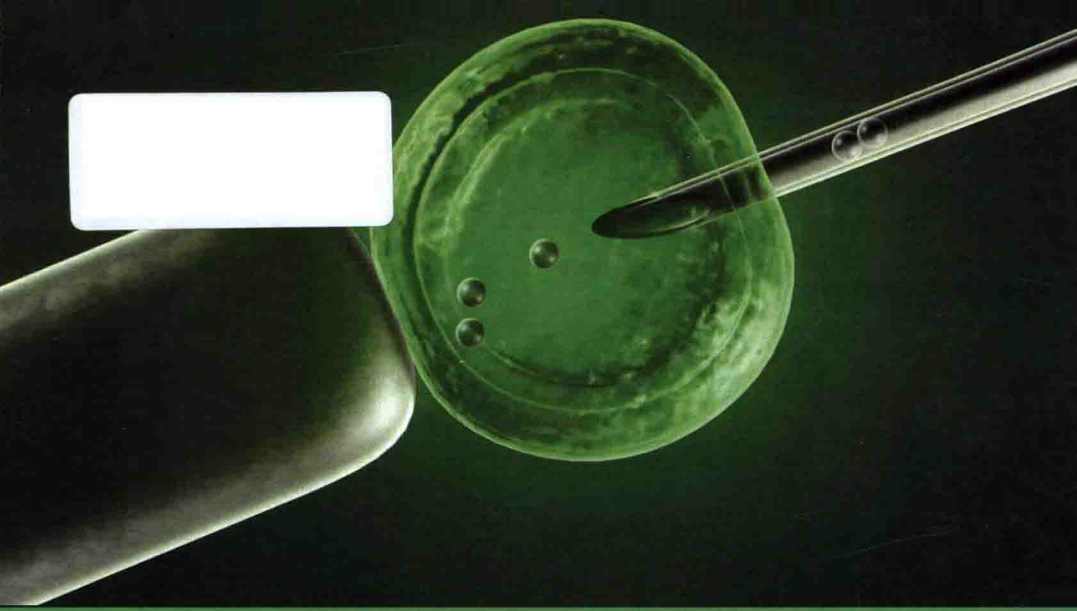

Shuo Jiao

MICROARRAY DATA ANALYSIS

DETECTING DIFFERENTIALLY EXPRESSED GENES WHILE CONTROLLING THE FALSE DISCOVERY RATE

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DETECTING DIFFERENTIALLY EXPRESSED GENES WHILE CONTROLLING THE FALSE DISCOVERY RATE FOR MICROARRAY DATA

by

Shuo Jiao

A DISSERTATION

Presented to the Faculty of

The Graduate College at the University of Nebraska

In Partial Fulfillment of Requirements

For the Degree of Doctor of Philosophy

Major: Statistics

Under the Supervision of Professors Shunpu Zhang and Stephen D. Kachman

Lincoln, Nebraska

December, 2009

DETECTING DIFFERENTIALLY EXPRESSED GENES WHILE CONTROLLING THE FALSE DISCOVERY RATE FOR MICROARRAY DATA

Shuo Jiao, Ph.D.

University of Nebraska, 2009

Advisers: Shunpu Zhang and Stephen D. Kachman

Microarray is an important technology which enables people to investigate the expression levels of thousands of genes at the same time. One common goal of microarray data analysis is to detect differentially expressed genes while controlling the false discovery rate. This dissertation consists with four papers written to address this goal. The dissertation is organized as follows: In Chapter 1, a brief introduction of the Affymetrix GeneChip microarray technology is provided. The concept of differentially expressed genes and the definition of the false discovery rate are also introduced. In Chapter 2, a literature review of the related works on this matter is provided. In Chapter 3, a t-mixture model based method is proposed to detect differentially expressed genes. In Chapter 4, a t-mixture model based false discovery rate estimator is proposed to overcome several problems of the current empirical false discovery rate estimators. In Chapter 5, a two-step false discovery rate estimation procedure is proposed to correct the overestimation of the false discovery rate caused by differentially expressed genes. In Chapter 6, a novel estimator is developed to estimate the proportion of equivalently expressed genes, which is an important component of the false discovery rate estimators. In Chapter 7, a summary of the dissertation will be given along with some possible directions for the future work.

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I dedicate this work to my parents, my fiancee, and our family who have been supportive all the time.

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