Overall summary of the Thesis

Define two-phase experiments

Two-phase experiments are used when the responses of experimental units to treatments cannot be measured directly in a single experiment. Subsequent processing (Phase 2) of the initial (Phase 1) experiment is necessary in order for the measurements to be made. In the case of proteomics experiments, the Phase 1 experiment involves the organisms that are to be perturbed by the experimental conditions of interest. Since the abundance of proteins cannot be measured directly from the organisms, the Phase 2 experiment uses multiplexing techniques such as iTRAQ peptide labelling, coupled with liquid chromatography-mass spectrometry (LC-MS), to measure the abundance of proteins in samples extracted from the organisms in the Phase 1 experiment.

biological stuff

Two-phase experiment review.

Overview of the thesis

An R package enables the researcher to produce the theoretical ANOVA table of any two-phase experiments quickly. This theoretical ANOVA table consists of the degrees of freedom for each associated mean squares as well as the coefficients of the variance components in every stratum. In addition, the package can also generate the treatment average efficiency factors for every treatment effect to indicate the amount of information that is presented across strata. The theoretical ANOVA tables are used extensively in this thesis to examine the properties of the design given, especially for a complicated design such as two-phase experimental design.

For a given set of design parameters, there are often many ways to allocate the samples collected from the Phase 1 experiment to the iTRAQ labels of the Phase 2 experiment. The following two chapters show the developments in the method for finding the optimal two-phase experiments. The objective function defined can identify the best allocation in terms of allowing a valid test for the treatment effects with the highest average efficiency factor. An improved version of simulated annealing algorithm is then presented for optimising the objective function defined.

The method is focusing in find the optimal design for the two-phase MudPIT-iTRAQ experiment, where the Phase 1 experiment is arranged in completely randomised design and the Phase 2 experiment is arranged in randomised block design. The subsequent chapter will modify the objective function to accommodate for the cases where the Phase 1 experiment is either arranged in randomised block design or balanced incomplete block design.

Finally, the method in computing the variance component and the effective degrees of freedom is presented. The effective degrees of freedom will further help in comparing the design from knowing the variance component estimates, i.e. between runs or between animals.