



Statistical Methods for Analyzing X-Chromosome Data

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X-chromosome inactivation (XCI) is the process in which one of the two copies of the X-chromosome in females is randomly inactivated to achieve the dosage compensation of X-linked genes between males and females. That is, 50% of the cells have one allele inactive and the other 50% of the cells have the other allele inactive. However, studies have shown that skewness or non-random X-inactivation is a biological plausibility in which more than 75 or 80% of cells have the same allele inactive. Also, some of the X-chromosome genes escape the X-inactivation, i.e., both alleles are active in all cells. Because the true X-inactivation process is unknown and differs across different regions on X-chromosome, we proposed a unified approach of maximizing likelihood over all such biological possibilities. A permutation-based procedure was developed to assess the significance of the approach. The results showed that the proposed approach has higher powers in the scenarios when XCI is skewed while maintaining similar power in scenarios when XCI is random or XCI is escaped with well controlled type I errors.

Keywords: Genetic Association, X-chromosome inactivation, skewness, likelihood ratio test