**Text S2 : Orthogonality of the Stat-POE model before transformation**

In the Stat-POE model, from formulation A7, we could decompose the variance of the phenotypic value as

, (B1)

As

, (B2)

and similarly,

. (B3)

Moreover, . Therefore, we could express the additive and dominant variance components as

. (B4)

. (B5)

To show the additive variance, could be decomposed to be two parts which are only dependent on two additive effects (and), respectively,  needs to be satisfied. And as we know,which indeed equals to 0 if the locus is in HWE. In this way,

, (B6)

. (B7)

The two additive variance components  and are related only to the additive effects and , respectively, with one due to maternal alleles and the other due to paternal alleles. The dominant variance component  is only related with the dominant effect , This property of the variance component to be divided into two independent additive components and one dominant component supports the notion that the POE statistical model before transformation is orthogonal.