**Genotype effect (G) simulation:**

For n subjects and m SNPs, the genotype matrix can be given as:

For the genotype of the ith SNP and jth subject, .

The effect sizes of the genotypes are written as

The frequency of the ith genotype can be calculated using:

And the portion of phenotypic variation explainable by genetics of the jth subject can be written as:

where is the weight of each genotype and each subject, calculated using:

**Residual (e) simulation:**

Define the overall variance of the phenotype simulated as:

where is the variance of the genetically explained portion of the variance of the phenotype, is the portion of phenotypic variance explained by the environment, and is the variance of the error term.

Given the heritability of a phenotype:

The variance of the error term can be written as:

Since the variance of the error term should be greater than or equal to zero, the variance explainable by the environment is bounded by: