

**Table S2** Probability  $P(\mathbf{D}|\mathbf{Z}, \mathbf{O}, \epsilon_F)$  of the derived genotype  $\mathbf{D}$  given the true phased genotype  $\mathbf{Z}$ , the latent ancestral origin state  $\mathbf{O}$ , and the allelic typing error probability  $\epsilon_F$ . The  $\delta$  is an indicator of the latent IBD, and the question marks denote missing alleles derived from founders.

Derived genotype $\mathbf{D}$	True phased genotype $\mathbf{Z}$			
	(1, 1)	(1, 2)	(2, 1)	(2, 2)
(?, ?)	1	$1 - \delta$	$1 - \delta$	1
(?, 1)	$(1 - \delta)(1 - \epsilon_F)$	$(1 - \delta)\epsilon_F$	$(1 - \delta)(1 - \epsilon_F)$	$(1 - \delta)\epsilon_F$
(1, ?)	$(1 - \delta)(1 - \epsilon_F)$	$(1 - \delta)(1 - \epsilon_F)$	$(1 - \delta)\epsilon_F$	$(1 - \delta)\epsilon_F$
(2, ?)	$(1 - \delta)\epsilon_F$	$(1 - \delta)(1 - \epsilon_F)$	$(1 - \delta)\epsilon_F$	$(1 - \delta)(1 - \epsilon_F)$
(?, 2)	$(1 - \delta)\epsilon_F$	$(1 - \delta)\epsilon_F$	$(1 - \delta)(1 - \epsilon_F)$	$(1 - \delta)(1 - \epsilon_F)$
(1, 1)	$\delta(1 - \epsilon_F) + (1 - \delta)(1 - \epsilon_F)^2$	$(1 - \delta)\epsilon_F(1 - \epsilon_F)$	$(1 - \delta)\epsilon_F(1 - \epsilon_F)$	$\delta\epsilon_F + (1 - \delta)\epsilon_F^2$
(1, 2)	$(1 - \delta)\epsilon_F(1 - \epsilon_F)$	$(1 - \delta)(1 - \epsilon_F)^2$	$(1 - \delta)\epsilon_F^2$	$(1 - \delta)\epsilon_F(1 - \epsilon_F)$
(2, 1)	$(1 - \delta)\epsilon_F(1 - \epsilon_F)$	$(1 - \delta)\epsilon_F^2$	$(1 - \delta)(1 - \epsilon_F)^2$	$(1 - \delta)\epsilon_F(1 - \epsilon_F)$
(1, 2)	$\delta\epsilon_F + (1 - \delta)\epsilon_F^2$	$(1 - \delta)\epsilon_F(1 - \epsilon_F)$	$(1 - \delta)\epsilon_F(1 - \epsilon_F)$	$\delta(1 - \epsilon_F) + (1 - \delta)(1 - \epsilon_F)^2$