Chapter 11

Other Monte Carlo Likelihoods in Genetics

11.1 Improving pedigree samplers

The ways in which MCMC samplers can be extended, combined, and improved, are almost limitless. One method has been discussed in section 10.6. Where the pedigree is not too complex, so that the L-sampler is feasible (and practical), combining the L-sampler and M-sampler on extended pedigrees can achieve more robust and reliable results with higher Monte Carlo precision (Heath and Thompson, 1997). The M-sampler (section 8.4) does not suffer poor mixing due to tightly linked loci, but can mix poorly where there are extended ancestral paths of descent in a pedigree. Additionally, the M-sampler may not be irreducible. Since the L-sampler is irreducible (section 8.3), combination of the L-sampler and M-sampler can ensure irreducibility, as well as improve mixing. Whereas the L-sampler is often the more computationally intensive, and seems to take longer to achieve stable probability estimates, the M-sampler may simply fail to sample the part of the space containing the majority of the probability mass (Table 11.1). The examples of section 10.6 all combined L and M steps with the same probability (20%) that any given step is an L-step. Obviously, there is scope for other patterns of systematic or random resampling.

There are ways to improve the meiosis sampling itself. Updating all indicators at a meiosis jointly shows much improved performance over single-site updating (Thompson and Heath, 1999). Moreover, updating by meiosis avoids problems of poor mixing due to tight linkage. However, clearly there would be greater improvement if the vectors $S_{i,\bullet}$ for several meioses i were to be updated jointly. Likewise the L-sampler can be improved. For very tightly linked loci, single-locus updates are ineffective. However, where feasible, the L-sampler might update jointly $S_{\bullet,j}$ for several loci j. For the L-sampler, on a complex pedigree, usually no more than two or three loci can be updated jointly.

One case where updating several meioses jointly is effective and easily done is