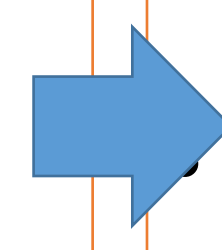


Experiences in estimation of metafounders ancestral relationships of dairy sheep

Incomplete pedigrees

- Widespread problem in ruminants and specially in sheep
- Dairy sheep 10-80% of missing father
- Typically dealt in with Genetic Groups
- Genetic Groups are unrelated and non inbred: incoherent



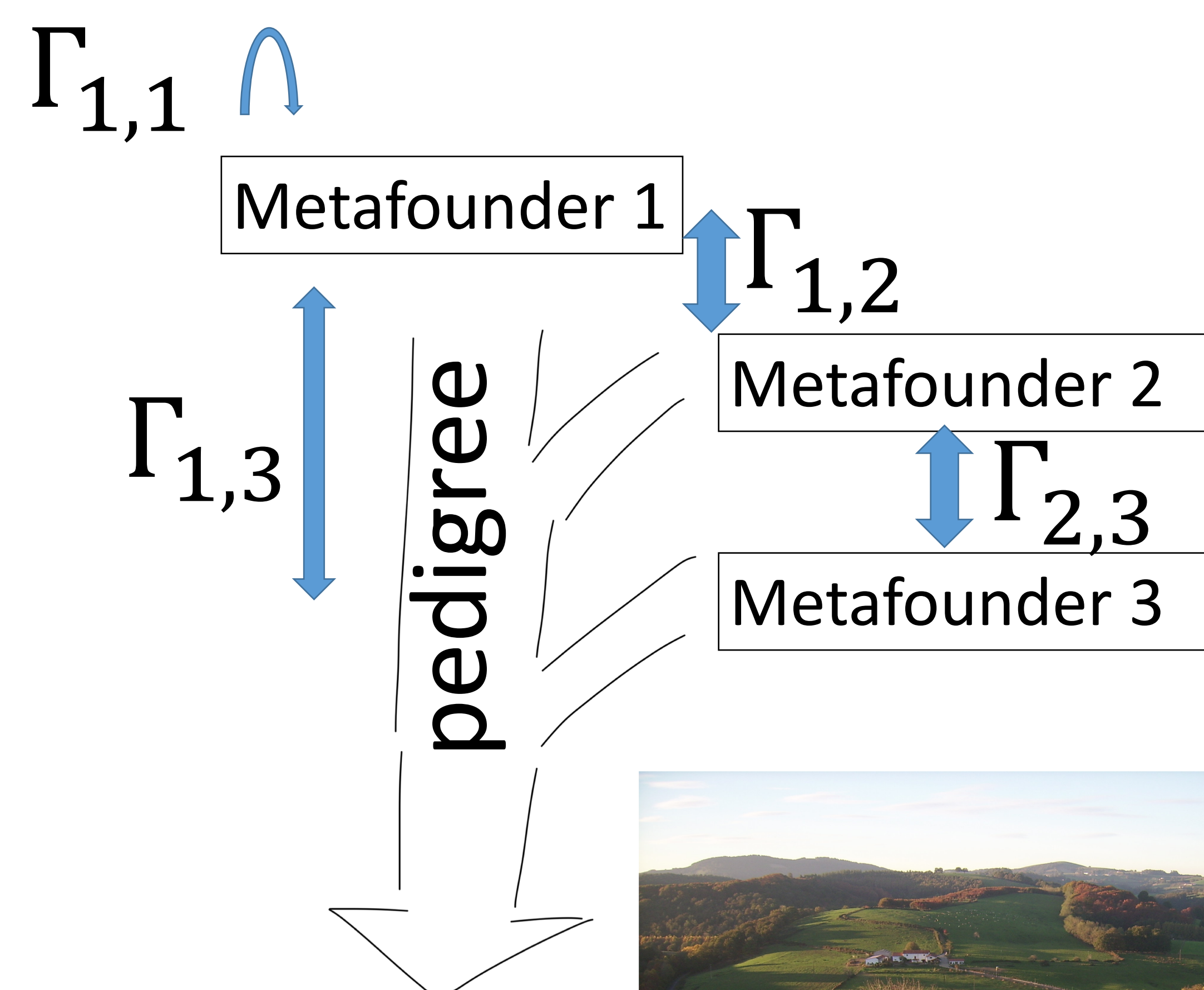
Metafounders

- Metafounders: related, partially inbred Genetic Groups
- Simple representation of "Pools of ancestral gametes"
- Relationships in Γ refer to an ideal population with $p = 0.5$

Pseudo-EM algorithm to estimate metafounders relationships in Γ

- Get pedigree, genotypes
- Model each marker as a quantitative trait
- Iterate on:
 - For each marker k
 1. Estimate p at each metafounder i using BLUP
 2. Compute $PEV(p_{ik})$
 - $\hat{\Gamma}_{ij} = 8Cov(\hat{p}_{ik}, \hat{p}_{jk}) + 8COPEV(\hat{p}_{ik}, \hat{p}_{jk})$
 - $\log L \approx const - \frac{pnz}{2} \log(s) - \frac{p}{2} \log(|A_{22}^{\Gamma}|) - \frac{p}{2s} \sum_{i=1}^{nsnp} z_i A_{22}^{\Gamma-1} z_i$

- p_{ik} : allele frequency of marker k in metafounder i
- Γ_{ii} = average relationship across ancestors *within* metafounder i
- $\Gamma_{ii} - 1$ = "inbreeding" (-1 if infinite population)
- Γ_{ij} = average relationship of ancestors in metafounder i and ancestors in metafounder j
- $\Gamma_{ij} = 8Cov(p_{ik}, p_{jk})$ across markers
- $\Gamma = 0$ is equal to regular Genetic Groups



Application to Manech Tete Rousse

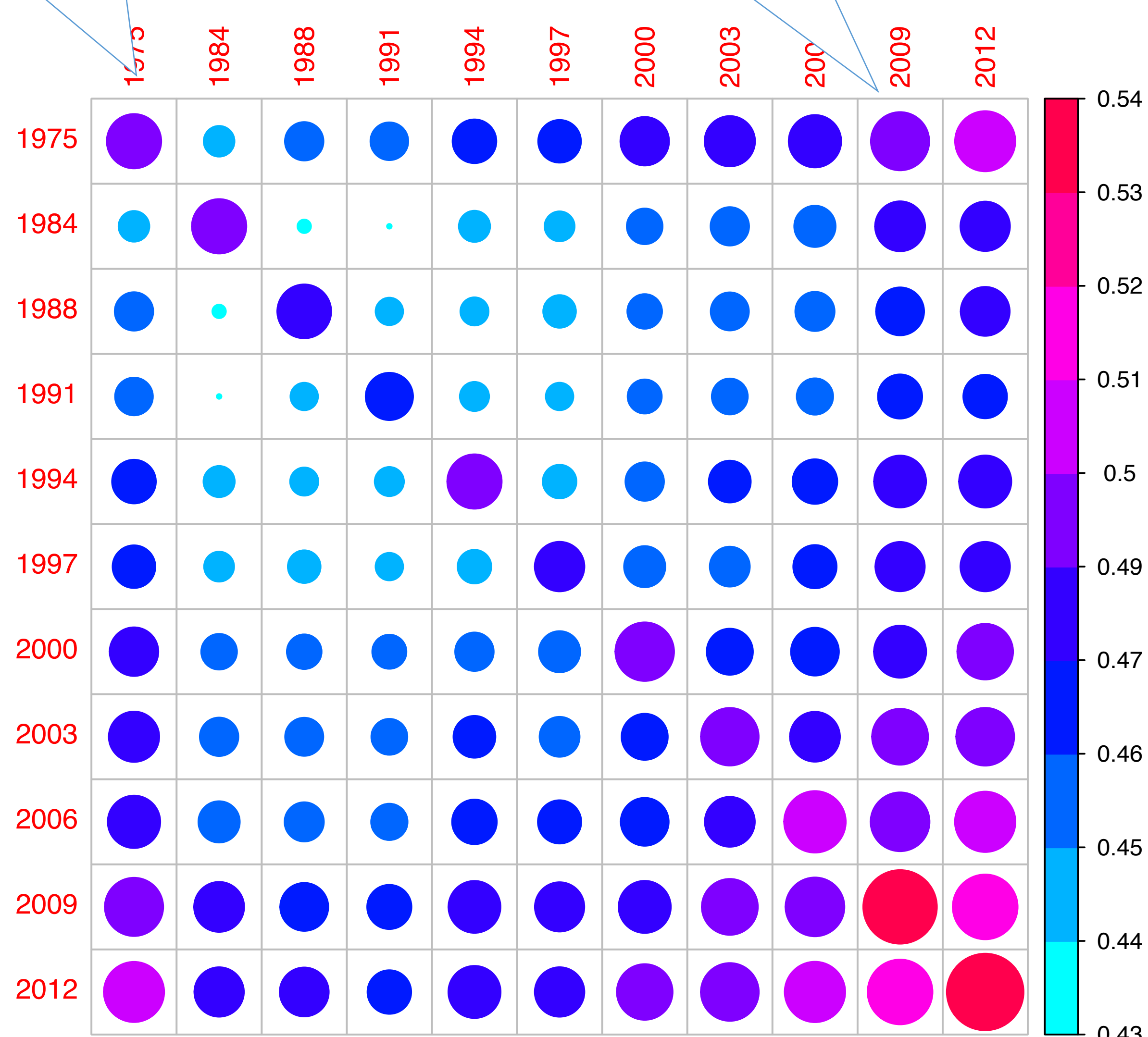
- 13 Genetic Groups from 1970 to 2005
- 2,000 animals with genotypes + 15,281 ancestors
- If genotyped rams are traced back, metafounders are found ~2-4 generations back
- All metafounders have enough information to estimate allele frequencies \hat{p}_{ik}
- Different starting values of $\Gamma_{ij, i \neq j} : \{0, 0.2, -0.2\}$



Final estimate of Γ

Average relationship across phantom parents of animals born in 1975

Average relationship across phantom parents of animals born in 1975 and in 2009



- 2-3 rounds are enough
- Likelihood always increases
- Final estimate of Γ robust to initial value

- Inbreeding increases with time
- Recent metafounders are more related
- Metafounder 1975 contains the great-great-great...sires of genotyped rams

Conclusions

- Estimation of Γ is feasible and robust
- Provided that allele frequencies \hat{p}_i can be estimated for each metafounder i