## ESWG PAPER CHALLENGE 2022

This year's paper challenge consists of a single exercise. In order to obtain the certificate, participants have to submit results. All data is given as files at https://familias.name/ESWG/ESWG2022 paperchallenge.zip in addition to some details given directly in the cases. Please fill out all answers in the supplied Excel questionnaire.

## Case - The Wheel of Time turns...

An excavation outside an ancient massive tower with an appearance of burnished steel, uncovers a mystical blue shawl. The shawl radiates power and bears the inscription 'Alys' which is a known pseudonym of the legendary Morraine Damodred. Using modern DNA techniques we are able to obtain STR profiles from personal items of known relatives of Morraine as well as from the shawl itself. The family tree is depicted below indicating the connection between Morraine and the relatives (samples with DNA data in green).


Figure 1. Illustration of the family tree for the individuals Galad, Gawyn and Elayne, related as half nieces/nephews of Morraine and additional data from a half brother of Galad, Rand.
a) State the theoretical IBD coefficients on the format [IBD0,IBD1,IBD2] for all pairs of individuals. For example, a pair of half siblings those are [0.5,0.5,0]. (Optional)
b) Using the DNA data provided below, calculate and report the pairwise LRs between the five individuals. Compute the LRs comparing half siblings versus unrelated and full siblings versus unrelated. Can we draw any conclusions from the results?

DNA data is given below and in the online files.

| Marker | Rand | Gawyn | Elayne | Galad | Shawl |
| :--- | :---: | :---: | :---: | :---: | :---: |
| CSF1PO | 13,12 | 10,12 | 10,12 | 10,13 | 10,10 |
| D13S317 | 11,10 | 12,12 | 11,12 | 11,9 | 11,13 |
| D16S539 | 8,12 | 12,11 | 12,11 | 12,8 | 12,9 |
| D18S51 | 16,15 | 13,16 | 13,16 | 17,16 | 15,15 |
| D19S433 | $13,16.2$ | 14,15 | $16.2,15$ | $16.2,18$ | 12,14 |
| D21S11 | $30,31.2$ | $31.2,30$ | $31.2,30$ | $31.2,30$ | 30,30 |
| D2S1338 | 23,18 | 18,19 | 27,19 | 18,23 | 18,20 |
| D3S1358 | 15,14 | 16,18 | 16,15 | 16,14 | 16,14 |
| D5S818 | 12,13 | 11,11 | 11,11 | 11,12 | 12,12 |
| D7S820 | 11,11 | 11,11 | 11,9 | 11,11 | 8,12 |
| D8S1179 | 12,11 | 13,11 | 13,13 | 13,12 | 13,14 |
| FGA | 23,24 | $22.2,20$ | $22.2,24$ | $22.2,23$ | $22.2,20$ |
| TH01 | $6,9.3$ | $9.3,6$ | $9.3,6$ | 8,6 | 6,7 |
| TPOX | 8,10 | 11,8 | 8,8 | 11,11 | 11,8 |
| D10S1248 | 16,13 | 14,13 | 16,13 | 16,16 | 13,17 |
| D12S391 | 18,17 | 26,17 | 26,17 | 24,18 | 26,21 |
| D1S1656 | 16,12 | 18,14 | 18,14 | 18,16 | 18,13 |
| D22S1045 | 11,15 | 16,16 | 16,11 | 17,17 | 15,16 |
| D2S441 | 14,11 | 10,10 | 10,10 | 10,14 | 14,14 |
| SE33 | $28.2,19$ | $26.2,14$ | $26.2,14$ | $26.2,26.2$ | $26.2,30.2$ |
| AMEL | $X, Y$ | $X, Y$ | $X, X$ | $X, Y$ | $X, X$ |

Allele frequencies are given as a file, no population substructure is assumed (i.e. theta=0). We can disregard mutations (i.e. mutation rate=0). Silent alleles and other complicating factors can also be disregarded.
c) Use the pedigree depicted above to compute a joint LR comparing the hypothesis that the shawl indeed belongs to Morraine versus the hypothesis that it belongs to someone unrelated to Elayne, Galad and Gawyn.

