

ISFG summer school - virtual edition 2021

Pedigree analysis in R

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Exercise set IV. Coefficients of relatedness

The packages **ribd** and **ibdsim2** are used in many of the following exercises, so we start by loading these. Note that each of these automatically loads **pedtools** as well.

```
library(ribd)
library(ibdsim2)
```

Exercise IV-1

Plot each relationship in R and use `kinship()` to compute the kinship coefficient.

- Half siblings.
- First cousins once removed.

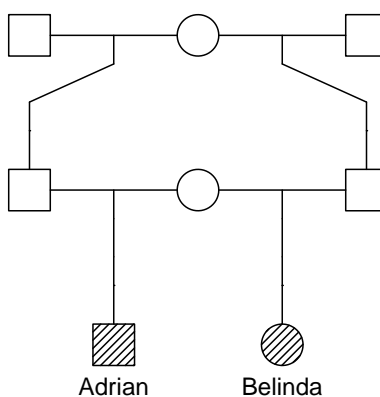
Exercise IV-2

In a case of incest a man had a child by his own granddaughter.

- Plot the pedigree in R.
- Compute the inbreeding coefficient of the child.

Exercise IV-3

Consider the relationship between Adrian and Belinda:



- Describe the relationship.
- Create and plot the pedigree in R. (Hint: `x = halfSibStack(2)`.)
- Compute the kinship coefficient between Adrian and Belinda.
- Compute the IBD coefficients ($\kappa_0, \kappa_1, \kappa_2$) of the relationship.
- Plot the corresponding point in the IBD triangle.

Exercise IV-4 (Realised inbreeding)

- a) Use the following code to estimate the distribution of the realised inbreeding coefficient in a child of uncle–niece parents.

```
x = cousinPed(deg = 0, removal = 1, child = TRUE)
sims = ibdsim(x, N = 500, ids = 7)
real = realisedInbreeding(sims)
hist(real$perSimulation$fReal)
```

Comment on the result.

- b) Make a similar histogram for the number of autozygous segments.
(Hint: Inspect the structure of `real$perSimulation`.)

Exercise IV-5 (Zero IBD)

Suppose that you are a 10th generation, male-line descendant of Napoleon Bonaparte.

- a) What is the probability that none of your (autosomal) DNA originates from Napoleon? Use the following code to give a realistic estimate:

```
x = linearPed(10)
sims = ibdsim(x, N = 500, ids = c(1, 21))
zeroIBD(sims)
```

Comment on the result.

- b) Repeat the analysis for a female line of 10 generations.

Exercise IV-6 (Bonus exercise if you have time: Double second cousins)

- a) Use `kappaIBD()` to compute the IBD coefficients of double second cousins.
(Hint: `x = doubleCousins(2, 2)`.)
- b) Plot the corresponding point in the IBD triangle.
- c) Prove that the point lies on the border of the inadmissible region. (Hint: Show that $\kappa_1^2 = 4\kappa_0\kappa_2$.)