Kinship and pedigree analysis: Methods and applications

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Solutions for exercise set II

Note: For most of these exercises QuickPed gives the quickest solution. Alternative R code is given here.

```
library(pedsuite)
```

Exercise II-1

a) $\varphi = \frac{1}{8} = 0.125$.
b) $\varphi = \frac{1}{32} = 0.03125$.

Exercise II-2

The inbreeding coefficient is $f = \frac{1}{8} = 0.125$, which can be computed in R as follows:

```
x = linearPed(2, sex = 2)
x = addSon(x, parents = c(1, 5))
plot(x)
inbreeding(x, id = 6)
```

[1] 0.125

Exercise II-3

a) Maternal half siblings, and also first cousins through the fathers. The children are not inbred.

b) Solution in R:

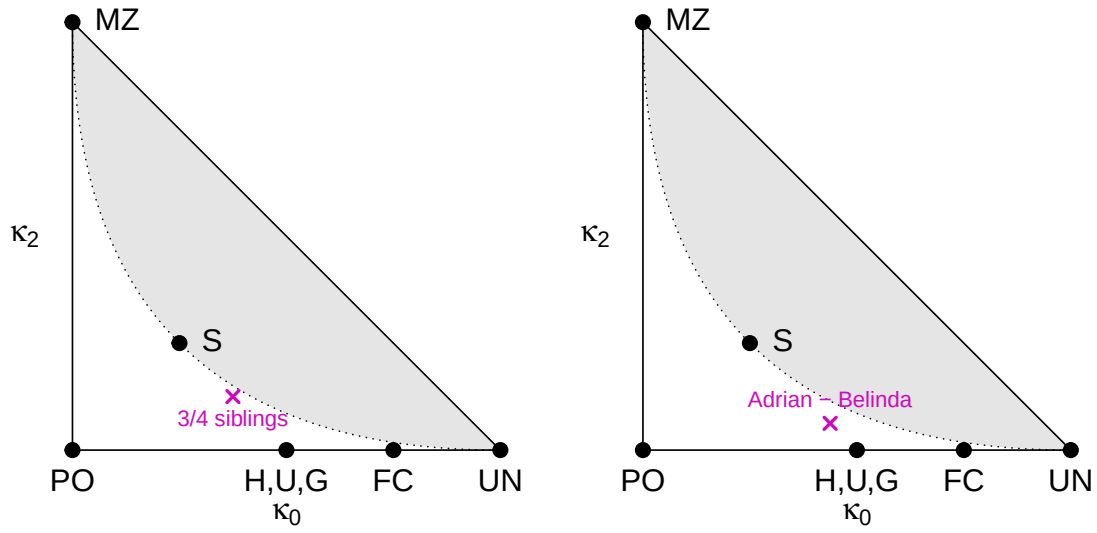
```
x = nuclearPed(2) |> addSon(c(3,5)) |> addSon(c(4,5))
k = kappaIBD(x, 6:7)
k
```

[1] 0.375 0.500 0.125

c) The point is shown in the left-most triangle below. R code:

```
showInTriangle(k, label = "3/4 siblings")
```

d) The point is exactly halfway between half and full siblings. And $\frac{3}{4}$ is halfway between $\frac{1}{2}$ and 1.



Exercise II-4

a) The kinship coefficient is $\frac{5}{32} = 0.15625$:

```
x = halfSibStack(2) |> swapSex(8)
plot(x, hatched = leaves)
kinship(x, 7:8)
```

```
[1] 0.15625
```

b) $(\frac{7}{16}, \frac{1}{2}, \frac{1}{16}) = (0.4375, 0.5, 0.0625)$, as found by

```
k = kappaIBD(x, c(7,8))
k
```

```
[1] 0.4375 0.5000 0.0625
```

c) The point is shown in the right-most triangle above. R code:

```
showInTriangle(k, label = "Adrian - Belinda", pos = 3)
```

d) The point can be written as $\frac{3}{4}H + \frac{1}{4}S$, where H and S corresponds to half and full siblings, respectively. Thus, arithmetically speaking, their "fraction of siblingship" is $\frac{3}{4} \cdot \frac{1}{2} + \frac{1}{4} \cdot 1 = \frac{5}{8}$

Exercise II-5

a) Outbred monozygotic twins have kinship coefficient $\varphi = 0.5$.
b) A kinship coefficient of $\varphi = 1$ is possible only asymptotically, for example after infinitely many generations of full-sib mating. The *realised* kinship coefficient may be 1 in a finite pedigree, however. More about this later in the course!

Exercise II-6

a) Possible R code:

```
x = fullSibMating(1)
plot(x)
identityCoefs(x, ids = 5:6)
```

[1] 0.06250 0.03125 0.12500 0.03125 0.12500 0.03125 0.21875 0.31250 0.06250

b) $\Delta_9 = 0.0625$ is much smaller than $\kappa_0 = 0.25$ for outbred siblings. This quantifies the intuitive fact that the inbreeding increases the overall probability of *some* IBD sharing.