

Forensic genetics conference - Zakopane 2022

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Solutions for exercise set I

Note: In some cases the answers are given in the exercises and therefore omitted here.

Exercise I-1 (Building pedigrees)

Answer omitted.

Exercise I-2 (Marker genotypes. Plot options)

Answer omitted.

Exercise I-3 (Pedigree likelihoods)

```
a) x = nuclearPed(3)
x = addMarker(x, geno = c("A/A", NA, "A/B", "A/B", "A/B"))
afreq(x, marker = 1)

##    A    B
## 0.5 0.5

b) x = setAfreq(x, marker = 1, afreq = c(A = 0.9, B = 0.1))
likelihood(x, marker = 1)

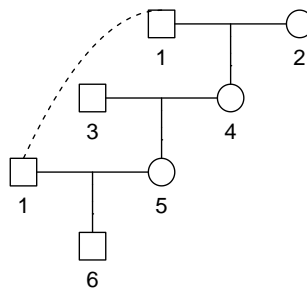
## [1] 0.026325
```

Exercise I-4 (Creating and loading a pedigree file)

Answer omitted.

Exercise I-5 (Inbred pedigree)

```
a) x = linearPed(2, sex = 2)
x = addChildren(x, father = 1, mother = 5, nch = 1)
plot(x)
```



```
b) inbreeding(x, 6)

## [1] 0.125
```

Exercise I-6 (A double relationship)

- a) Adrian and Belinda are simultaneous half siblings and half first cousins. They are not inbred.
b) The plot may be produced with the commands below.

```
ids = c("Adrian", "Belinda")
x = halfSibStack(2)
x = swapSex(x, 8)
x = relabel(x, old = c(7,8), new = ids)
plot(x, labs = ids, hatched = ids)
```

c) `kinship(x, ids)`

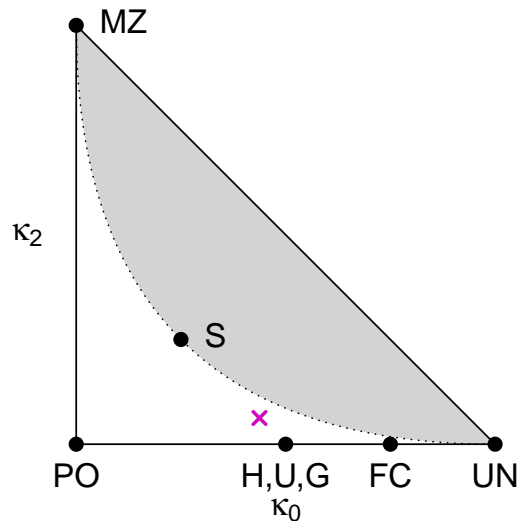
```
## [1] 0.15625
```

d) `k = kappaIBD(x, ids)`

```
k
```

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

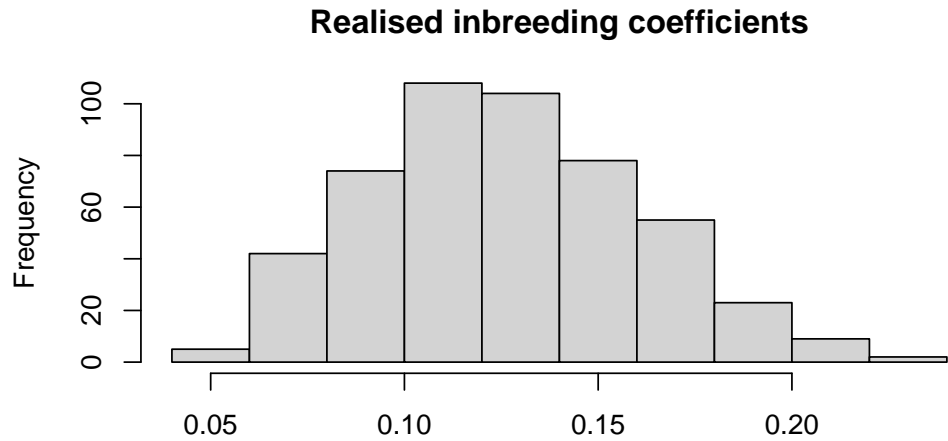
e) `showInTriangle(k)`



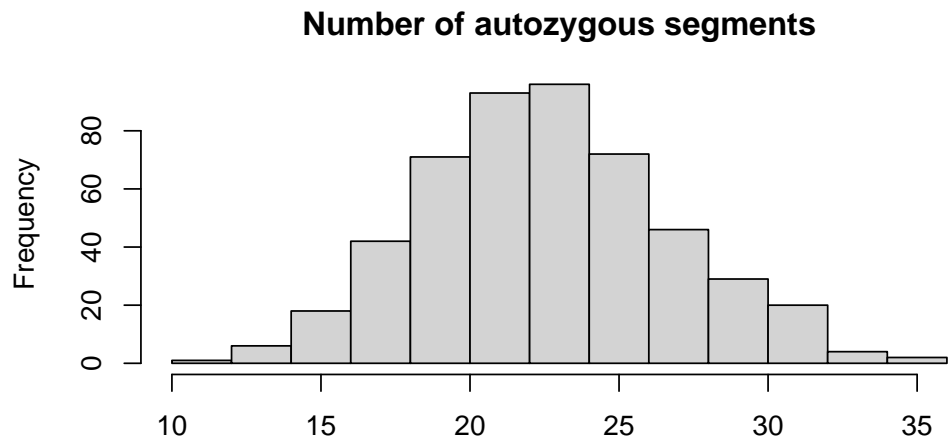
Exercise I-7 (Realised inbreeding)

- a) `x = cousinPed(deg = 0, removal = 1, child = TRUE)`
`sims = ibdsim(x, N = 500, ids = 7)`
`real = realisedInbreeding(sims)`

```
hist(real$perSimulation$fReal, xlab = NULL, main = "Realised inbreeding coefficients")
```



b) `hist(real$perSimulation$nSeg, xlab = NULL, main = "Number of autozygous segments")`



Exercise I-8 (Zero IBD)

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

```
## $zeroprob
## [1] 0.614
##
## $stErr
## [1] 0.02177172
```

These simulations estimate a probability of 0.61 that none of Napoleon's DNA survived down to you. *Comment.* Your answer may differ slightly because of the random number generation. To ensure reproducible results, you may set a random number seed in the simulation command, e.g., `ibdsim(..., seed = 1234)`.

- b) To simulate a female line, we add `sex = 2` to the `linearPed()` call. Note also that we use the female founder (2) instead of the male (1) in the `ids` argument.

```
x = linearPed(10, sex = 2)
sims = ibdsim(x, N = 500, ids = c(2, 21))
z2 = zeroIBD(sims)
z2
```

```
## $zeroprob
## [1] 0.452
##
## $stErr
## [1] 0.0222574
```

The simulations estimate a probability of 0.45 of no sharing in the female case. The probability is lower in this case because of the higher recombination rate in females.