Forensic Genetics

Module 16 – Section 4 Exercises

Exercise 1a: LR – Binary Model

Consider a simple two-person mixture profile (e.g. contributors are unrelated, ignoring population structure, no drop-outs/drop-ins), where $G_C = ABCD$. Let K denote a known contributor with observed profile $G_K = CD$, and S the POI with profile $G_S = AB$.

- $G_S = AB$ and $G_K = CD$, with

  H_p : K + POI (S) and H_d : K + Unknown (U)

What are the LRs for $p_A = p_B = p_C = p_D = 0.1$?

Exercise 1b: LR – Binary Model

Consider a simple two-person mixture profile (e.g. contributors are unrelated, ignoring population structure, no drop-outs/drop-ins), where $G_C = ABCD$. Let K denote a known contributor with observed profile $G_K = CD$, and S the POI with profile $G_S = AB$.

- $G_S = AB$ and $G_K = CD$, with

  H_p : K + POI (S) and H_d : K + Unknown (U)

- $G_S = AB$ and $G_K = CD$, with

  H_p : K + S and H_d : 2U

What are the LRs for $p_A = p_B = p_C = p_D = 0.1$?

Exercise 1c: LR – Binary Model

Consider a simple two-person mixture profile (e.g. contributors are unrelated, ignoring population structure, no drop-outs/drop-ins), where $G_C = ABCD$. Let K denote a known contributor with observed profile $G_K = CD$, and S the POI with profile $G_S = AB$.

- $G_S = AB$ and $G_K = CD$, with

  H_p : K + POI (S) and H_d : K + Unknown (U)

- $G_S = AB$ and $G_K = CD$, with

  H_p : K + S and H_d : 2U

- $G_S = AB$ and the second contributor is unknown

  H_p : S + U and H_d : 2U

What are the LRs for $p_A = p_B = p_C = p_D = 0.1$?

Exercise 2: LR – Binary Model

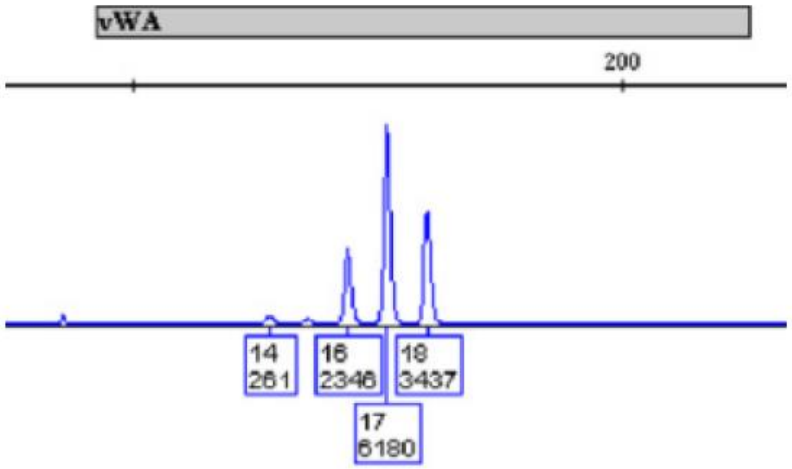
a) Considering the previous exercise, what do you expect to happen to the LRs if we use match probabilities instead of profile probabilities? *Increase, decrease or stay the same?*

b) Verify your answer by using the appropriate Balding-Nichols formula with $\theta = 0.03$ in Exercise 1a.

c) Ignoring a known contributor under H_d (but not under H_p) is *favorable/unfavorable/irrelevant* to the defendant? (Hint: compare your answers from 1a and 1b).

Exercise 3: LR – Continuous Model

The epg for a 3-person mixture at locus vWA is as follows:



We would like to assess the LR under the hypothesis that:

H_p : $G_S = 17, 18$ and 2U are the source of the sample.

H_d : 3U are the source of the sample.

Exercise 3: LR – Continuous Model

Suppose the following weights have been established for locus vWA:

Genotype Set	Donor 1	Donor 2	Donor 3	Weight
S_1	16, 18	17, 17	14, 14	0.00045
S_2	16, 18	17, 17	14, 15	0.00017
S_3	16, 18	17, 17	14, 16	0.00008
S_4	16, 18	17, 17	14, 17	0.00002
S_5	16, 18	17, 17	14, 18	0.00054
S_6	18, 18	17, 17	14, 16	0.00005
S_7	16, 16	17, 18	14, 14	0.00218
S_8	16, 16	17, 18	Q, 14	0.00010
S_9	16, 16	17, 18	14, 15	0.00207
S_{10}	16, 16	17, 18	14, 16	0.00511
S_{11}	16, 16	17, 18	14, 17	0.02030
S_{12}	16, 16	17, 18	14, 18	0.00279
S_{13}	16, 17	17, 18	14, 14	0.19300
S_{14}	16, 17	17, 18	Q, 14	0.00368
S_{15}	16, 17	17, 18	14, 15	0.15800
S_{16}	16, 17	17, 18	14, 16	0.28700
S_{17}	16, 17	17, 18	14, 17	0.21000
S_{18}	16, 17	17, 18	14, 18	0.11400
S_{19}	17, 17	17, 18	14, 16	0.00016

Exercise 3: LR – Continuous Model

The LR can now be assessed by writing the ratio in the form:

$$\mathrm{LR} = \frac{\Pr(G_C|G_S, H_p, I)}{\Pr(G_C|G_S, H_d, I)}$$

$$= \frac{\sum_j \Pr(G_C|S_j)\Pr(S_j|H_p)}{\sum_{j'} \Pr(G_C|S_{j'})\Pr(S_{j'}|H_d)}$$

$$= \frac{\sum_j w_j \Pr(S_j|H_p)}{\sum_{j'} w_{j'} \Pr(S_{j'}|H_d)}.$$

The two propositions each define sets of genotypes S, and the weights w describe how well these sets fit our observed data G_C. Under H_p all the genotype sets S_j usually include G_S.

Exercise 3: LR – Continuous Model

Use the following allele frequencies (and assume $\theta = 0$):

Allele	Frequency
14	0.1146
15	0.1071
16	0.2044
17	0.2726
18	0.2090

a) What is $\Pr(E|H_p)$?

b) What is $\Pr(E|H_d)$?

c) What is the LR for this locus?