# Forensic Genetics

Module 15 – Section 3 & 4 Exercises

# Section 3 Group Work

Allelic Independence

# Bayesian Exercise

A rapid test for covid-19 is set up outside a supermarket and is available to anyone who wishes. The test has a false-positive rate of 5% and a false-negative rate of 30%.

If the disease has a prevalence in that population of 20%. What is the probability a person who tests positive does actually have the disease? i.e. calculate $\Pr(B|A)$ if $A$ is the event that a test is positive, and $B$ is the event that a person has the disease. Use Bayes' Theorem.

# NIST Data

Go to https://strbase.nist.gov/NISTpop.htm

and look at "Excel file of revised allele frequencies."

How many loci appear not to be in Hardy-Weinberg Equilibrium?

# Section 4 Group Work

LR Calculations

# 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).