Identification of Individuals

- Identity by Descent
- Probability of Identity
- Human DNA fingerprinting

Probability of Individual Matching an Observed Individual

$$A_i A_i \qquad\qquad A_i A_j$$

$$P_{random} = p_i^2 \qquad\qquad P_{random} = 2p_i p_j$$

$$P_{parent\text{-}offspring} = p_i \qquad P_{parent\text{-}offspring} = \frac{(p_i + p_j)}{2}$$

$$P_{sibling} = \frac{\left(1 + 2p_i + p_i^2\right)}{4} \qquad P_{sibling} = \frac{\left(1 + p_i + p_j + 2p_i p_j\right)}{4}$$

Probability of a Random Individual having a Genotype

- Locus A

Allele	Freq
102	0.05
104	0.20
106	0.15
108	0.40
110	0.20

- Locus A

Allele	Freq
140	0.20
142	0.00
144	0.35
146	0.10
148	0.15
150	0.05
152	0.25

Probability of Identity

$$\text{Prob of Identity} = \sum_{i=1}^{n} \left(p_i^2\right)^2 + \sum_{i=1}^{n} \sum_{j=1+1}^{n} \left(2 p_i p_j\right)^2$$

- The probability that two randomly chosen individuals in a population have identical genotypes

Probability of Identity

$$P_{(ID)sib} = 0.25 + \left(0.5\sum p_i^2\right) + \left[0.5\left(\sum p_i^2\right)\right] - \left(0.25\sum p_i^4\right)$$

• Probability that two siblings share the same multilocus genotype

Probability of Identity

• Probability that a random individual matches the observed individual

$$P_{(ID)match} = \prod p_i^2 \prod 2p_i p_j$$

• Probability that a full sibling matches the observed individual

$$P_{(ID)match} = \prod \frac{\left(1 + 2p_i p_i^2\right)}{4} \prod \frac{\left(1 + p_i + p_j + 2p_i p_j\right)}{4}$$

Human Microsats Used

Locus	Repeat	# Alleles
CSFF1P0	AGAT	10
D5S818	AGAT	9
D72820	AGAT	9
D13S317	AGAT	9
D16S539	GAAA	9
F13A01	AAAT	7
F13B	AAAT	7
FESFPS	AAAT	8
HPRTB	AGAT	12
UPL	AAAT	8
TH01	AATG	8
TPOX	AATG	8
VWA	AGAT	10

Human Microsats Used

Population	$P_{(ID)}$ - Random	$P_{(ID)}$ - Full siblings
Jamaican	1 in 9.50×10^{-14}	1 in 6.80×10^{-4}
African-American	1 in 1.32×10^{-15}	1 in 8.24×10^{-4}
European-American	1 in 8.23×10^{-14}	1 in 7.78×10^{-4}
Italian	1 in 8.22×10^{-14}	1 in 7.05×10^{-4}
Apache	1 in 1.88×10^{-12}	1 in 2.63×10^{-4}

Allele Frequencies

CSF1P0

Allele	Frequency
122	0.09
126	0.21
130	0.11
134	0.04

F13A01

Allele	Frequency
159	0.07
163	0.13
167	0.13
171	0.06
175	0.31
179	0.01

VWA

Allele	Frequency
153	0.14
157	0.02
161	0.10
165	0.20

D13S317

Allele	Frequency
195	0.16
199	0.07
203	0.24

$$P_{(ID)sib} = 0.25 + \left(0.5\sum p_i^2\right) + \left[0.5\left(\sum p_i^2\right)\right] - \left(0.25\sum p_i^4\right)$$

$$P_{(ID)sib} = 02.5 + \left\{0.5\left[(0.16)^2 + (0.07)^2 + (0.24)^2\right]\right\} +$$
$$\left[0.5\left\{(0.16)^2 + (0.07)^2 + 0.24^2\right\}\right] - \left\{0.25\left[(0.16)^4 + (0.07)^4 + (0.24)^4\right]\right\}$$
$$= 0.3371$$

Allele	Frequency
201	0.16
203	0.07
205	0.24