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Statistical Weights of Single Source DNA Profiles

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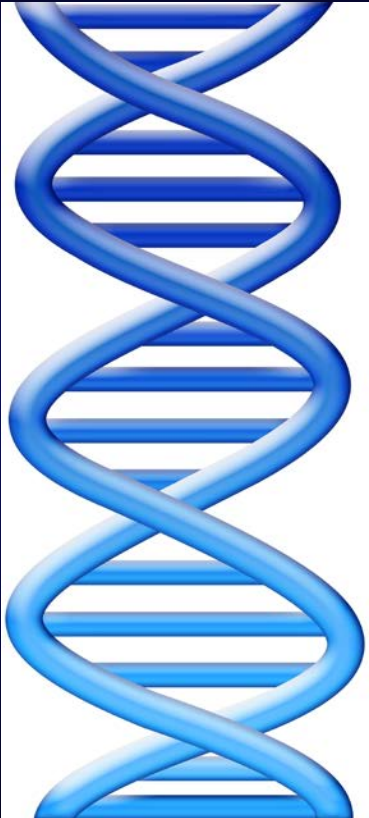
Statistical weights of single source DNA profiles

Dan E. Krane, Wright State University, Dayton, OH

Forensic DNA Profiling Video Series

Forensic Bioinformatics
(www.bioforensics.com)

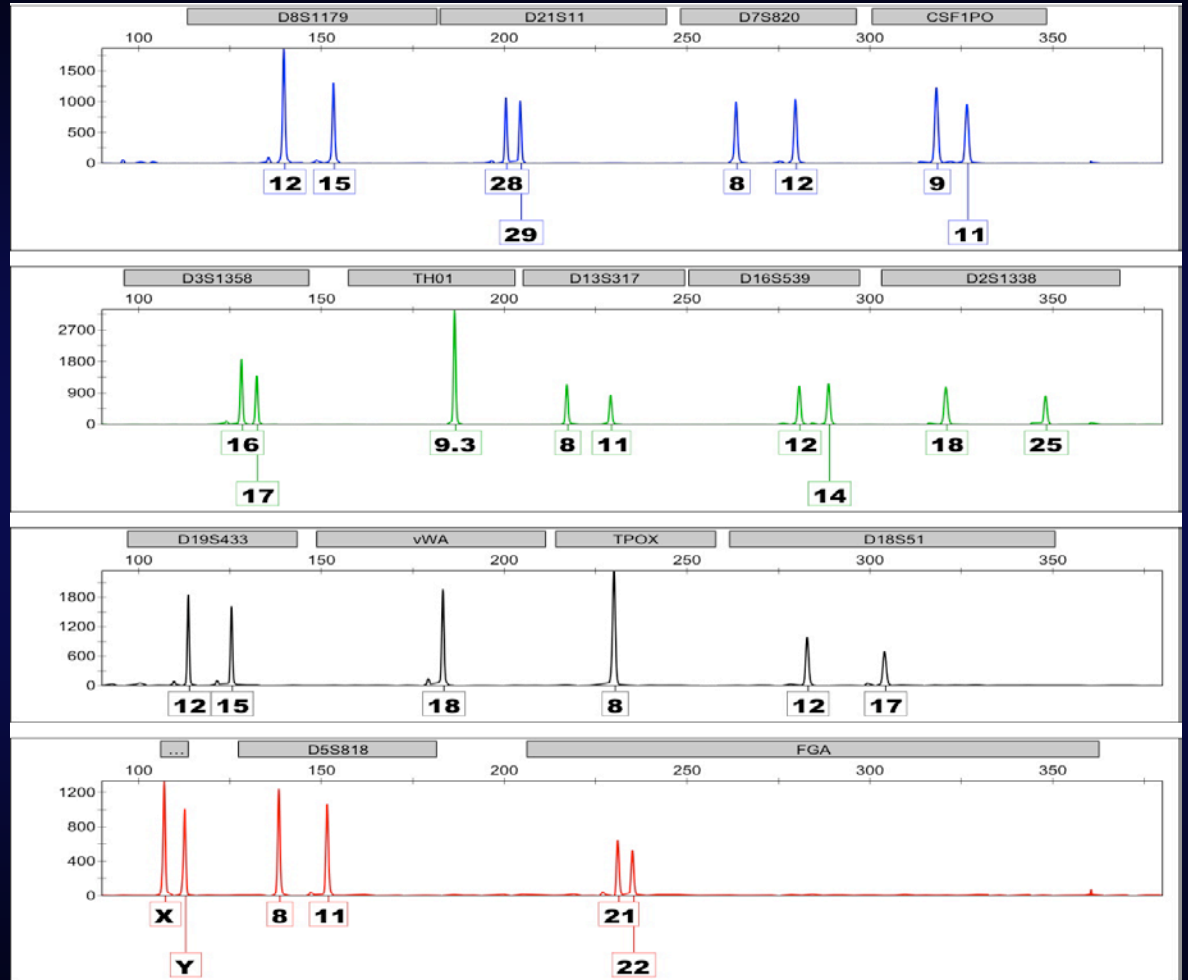
DNA statistics



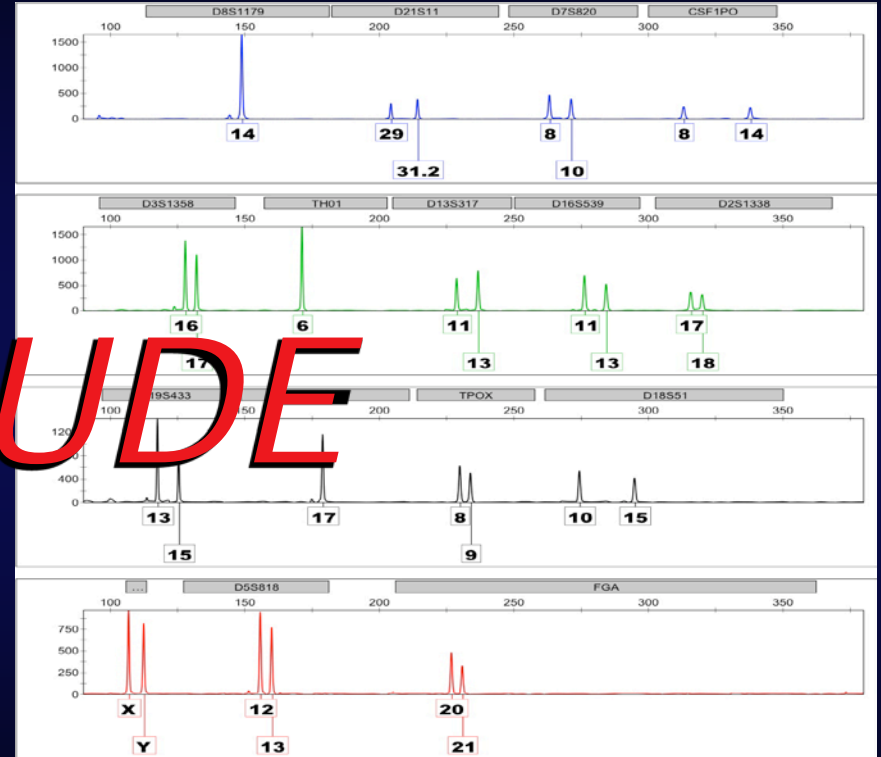
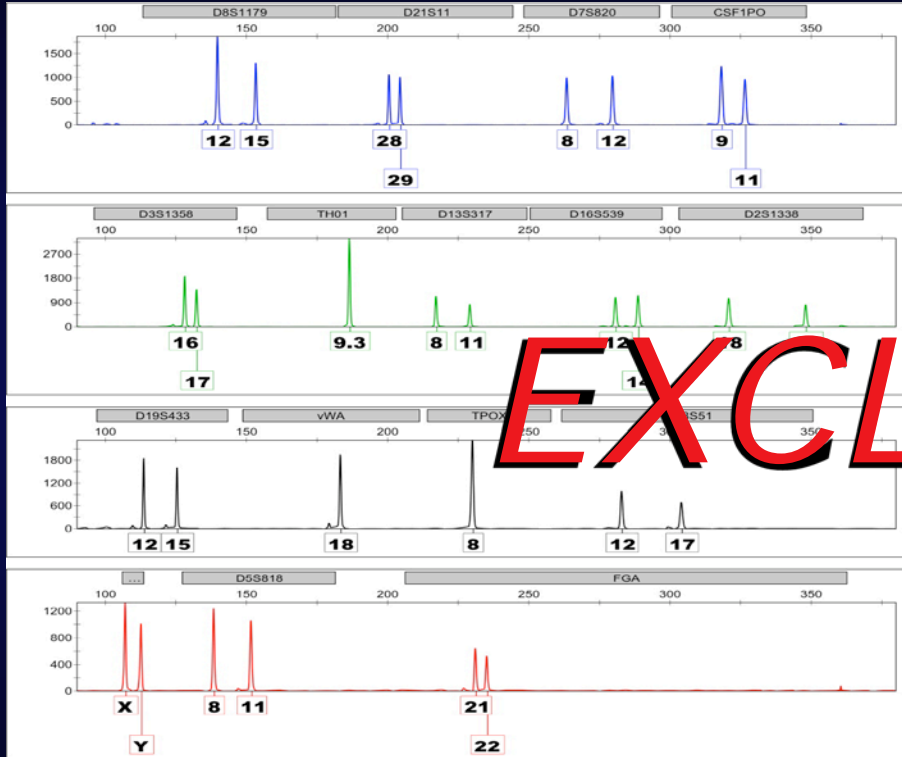
- Coincidental 13 locus DNA profile matches are exceedingly rare
- Several factors can make statistics less impressive
 - Mixtures
 - Incomplete information
 - Relatives

DNA profile

LOCUS	ALLELES
D8S1179	12, 15
D21S11	28, 29
D7S820	8, 12
CSF1PO	9, 11
D3S1358	16, 17
TH01	9.3
D13S317	8, 11
D16S539	12, 14
D2S1338	18, 25
D19S433	12, 15
vWA	18
TPOX	8
D18S51	12, 17
AMEL	X, Y
D5S818	8, 11
FGA	21, 22



Comparing electropherograms

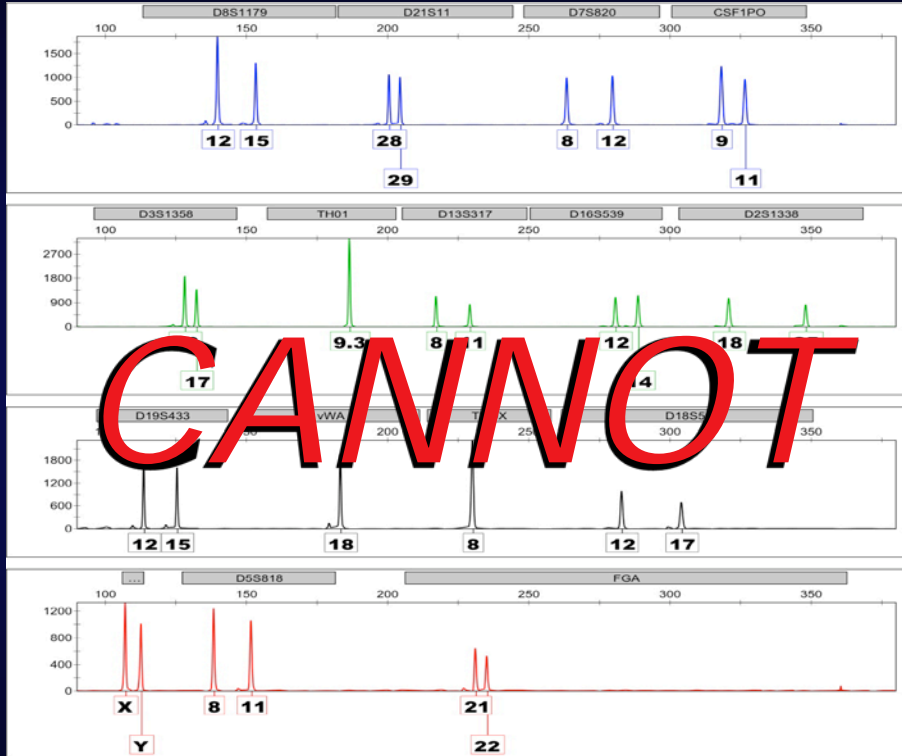


EXCLUDE

Evidence sample

Suspect #1's reference

Comparing electropherograms



Evidence sample



Suspect #2's reference

CANNOT

EXCLUDE

What weight should be given to DNA evidence?

Statistics do not lie.

But, you have to pay close attention to the questions they are addressing.

What weight should be given to DNA evidence?

Statistics do not lie.

But, you have to pay close attention to the questions they are addressing.

RMP: The chance that a randomly chosen, unrelated individual from a given population would have the same DNA profile observed in a sample.

Statistical estimates: the product rule

Single source samples

Formulae for RMP:

At a locus:

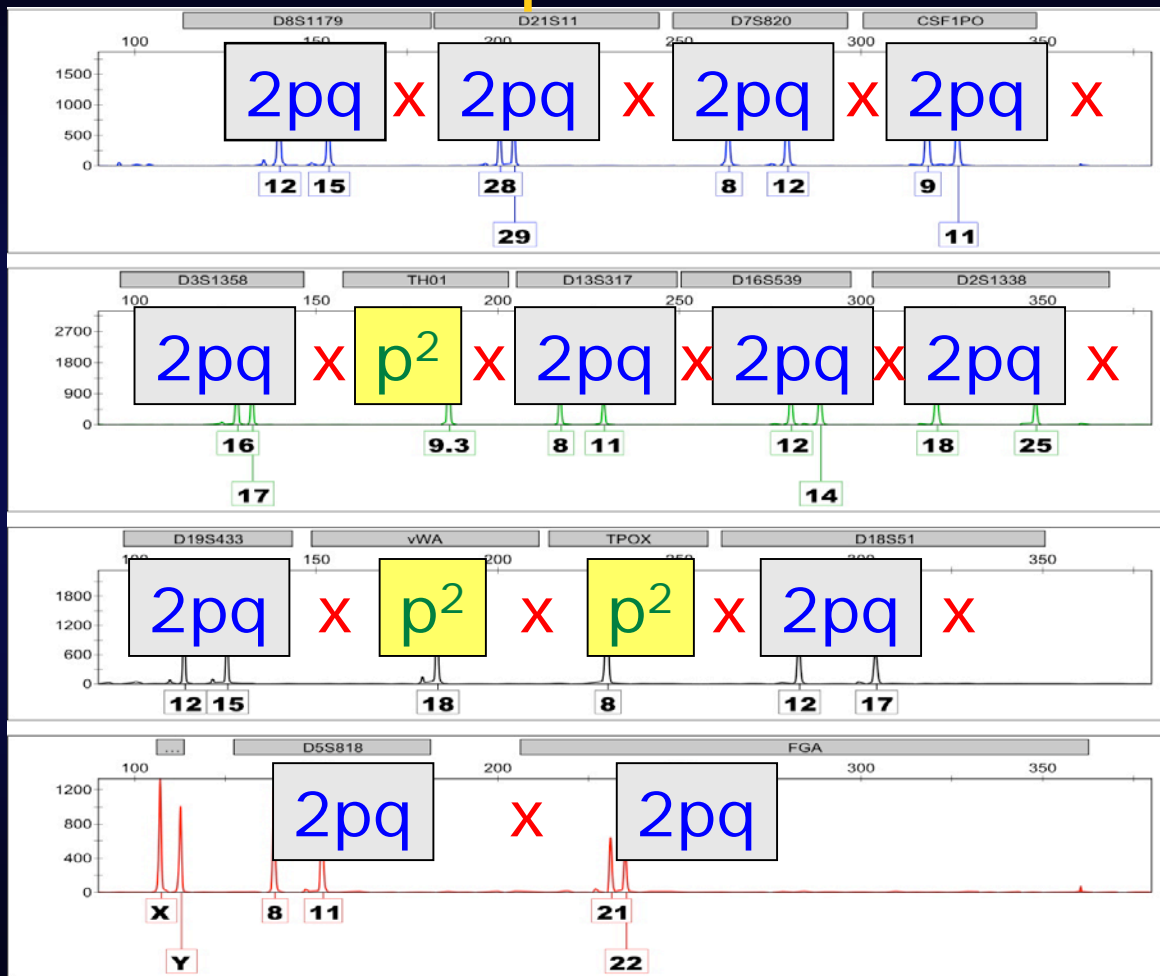
Heterozygotes:

$$2pq$$

Homozygotes:

$$p^2$$

Multiply across all loci



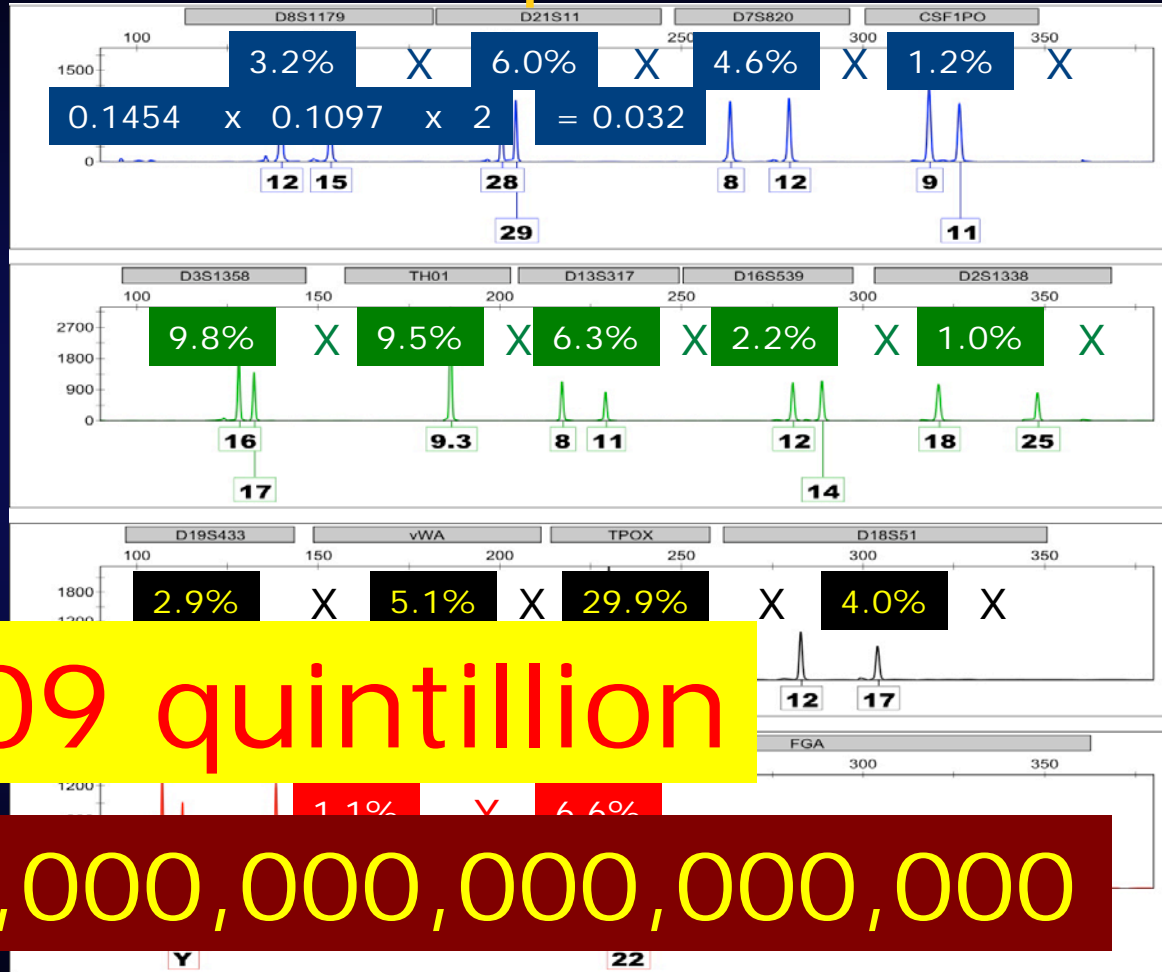
Statistical estimates: the product rule

D8S1179	Caucasian (N=196)
<9	1.786
9	1.020
10	10.204
11	5.867
12	14.541
13	33.929
14	20.153
15	10.969
16	1.276
17	0.255
18	0.000



Statistical estimates: the product rule

D8S1179	Caucasian (N=196)
<9	1.786
9	1.020
10	10.204
11	5.867
12	14.541
13	33.929
14	20.153
15	10.969
16	1.276
17	0.255
18	0.000



1 in 609,000,000,000,000,000,000,000,000,000

Two underlying assumptions of the product rule:

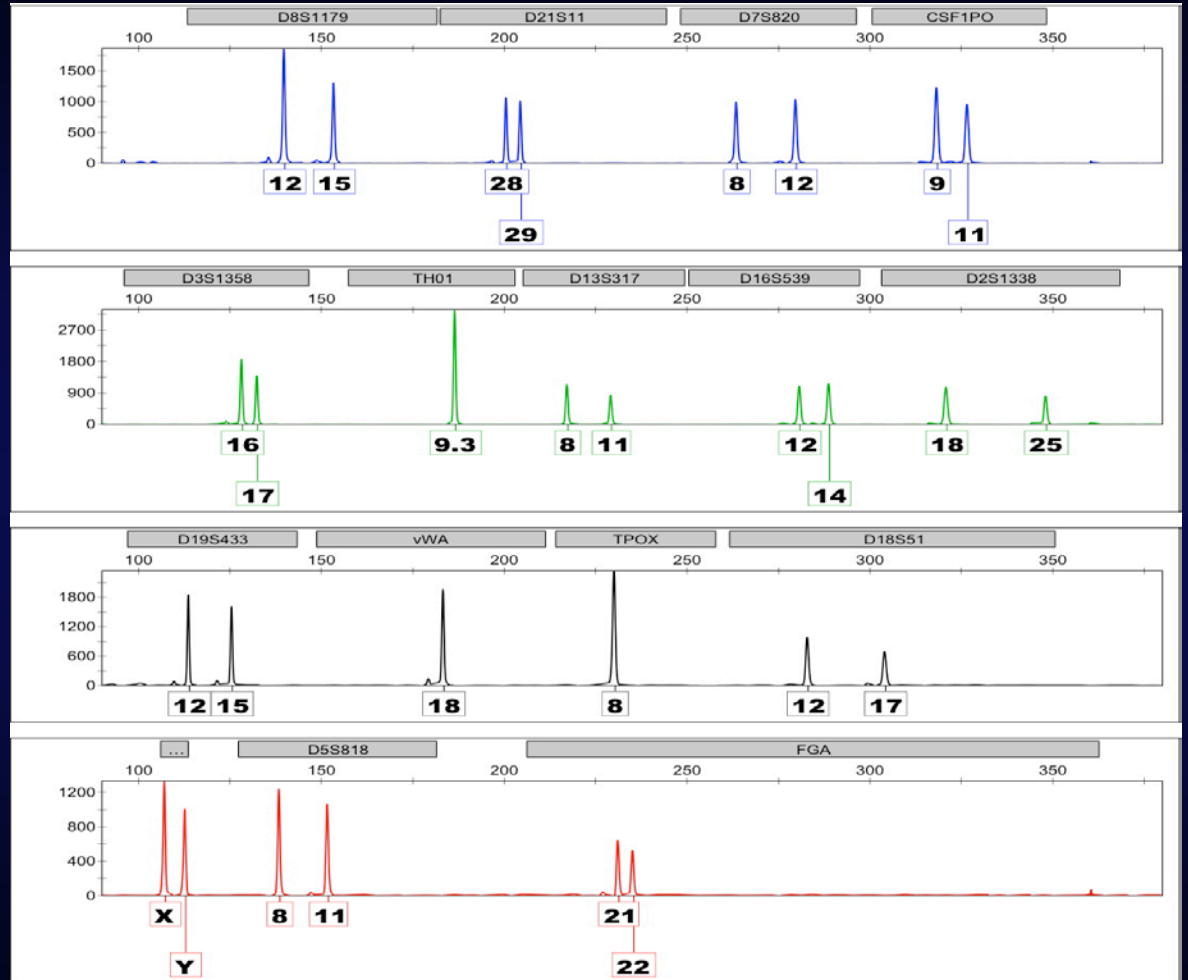
- The events being evaluated are independent
 - In this context, the events are the observation of specific alleles
- The frequencies of the events are known
 - In this context, at what frequency does each allele occur?

Population genetics: testing for independence

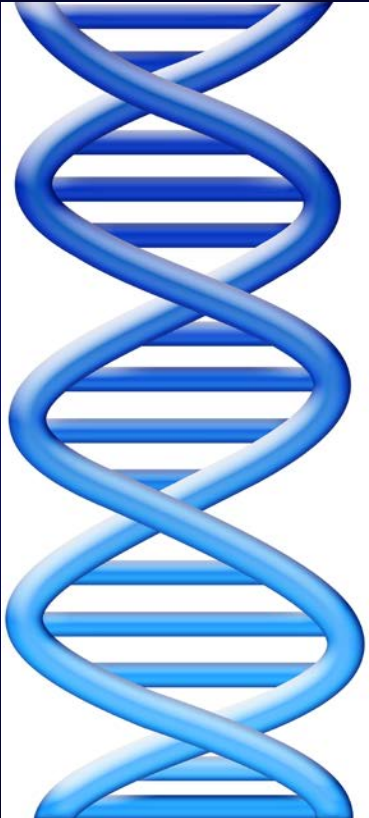
- Hardy-Weinberg equilibrium (HWE)
 - A test of the independence of alleles within a locus
- Linkage equilibrium
 - A test of the independence of alleles between loci

DNA profile

LOCUS	ALLELES
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FGA	21, 22



DNA statistics



- Coincidental 13 locus DNA profile matches are exceedingly rare
- Corrections can be made for population substructure
- RMP statistics described in terms of quintillions are common

Two underlying assumptions of the product rule:

- The events being evaluated are independent
 - In this context, the events are the observation of specific alleles
- The frequencies of the events are known
 - In this context, at what frequency does each allele occur?

What weight should be given to DNA evidence?

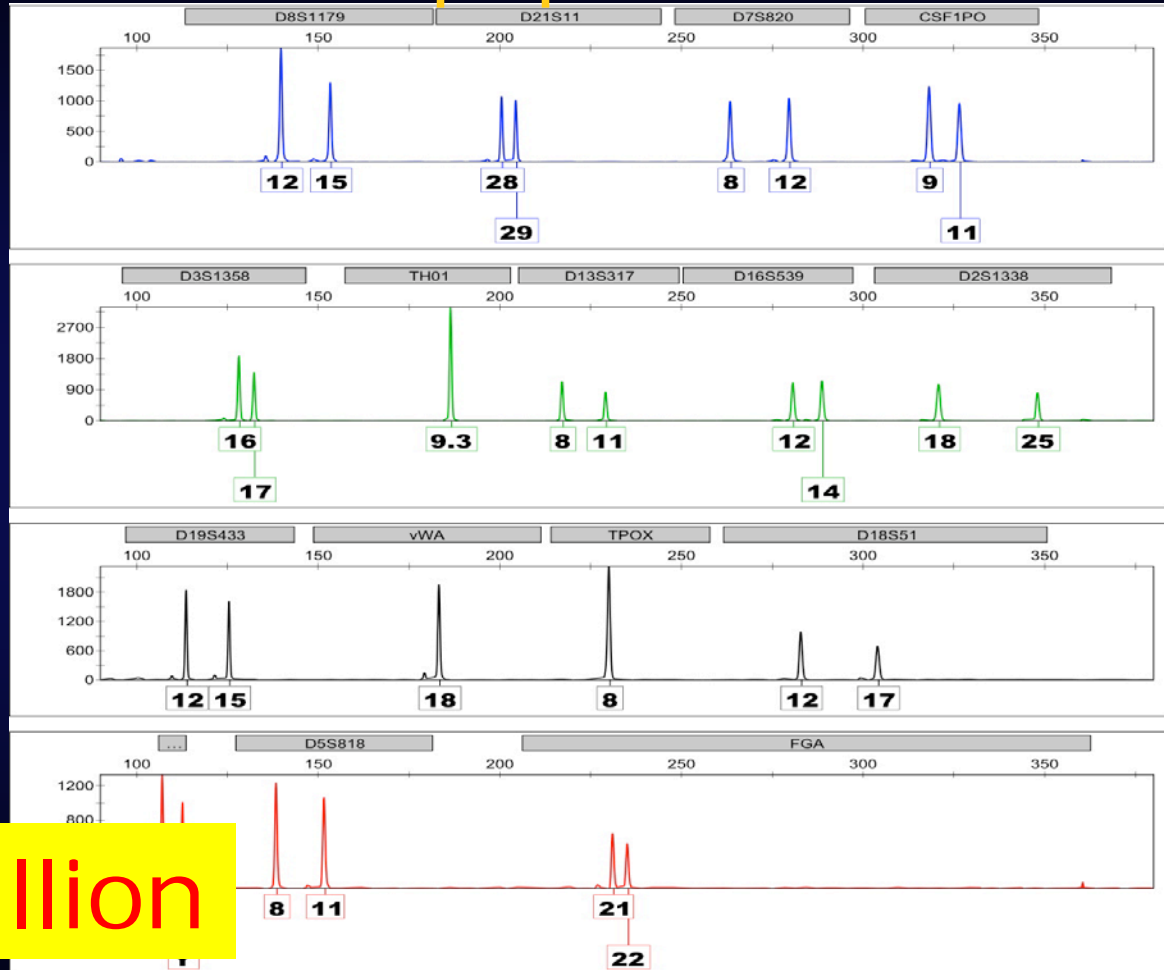
Statistics do not lie.

But, you have to pay close attention to the questions they are addressing.

RMP: The chance that a randomly chosen, unrelated individual from a given population would have the same DNA profile observed in a sample.

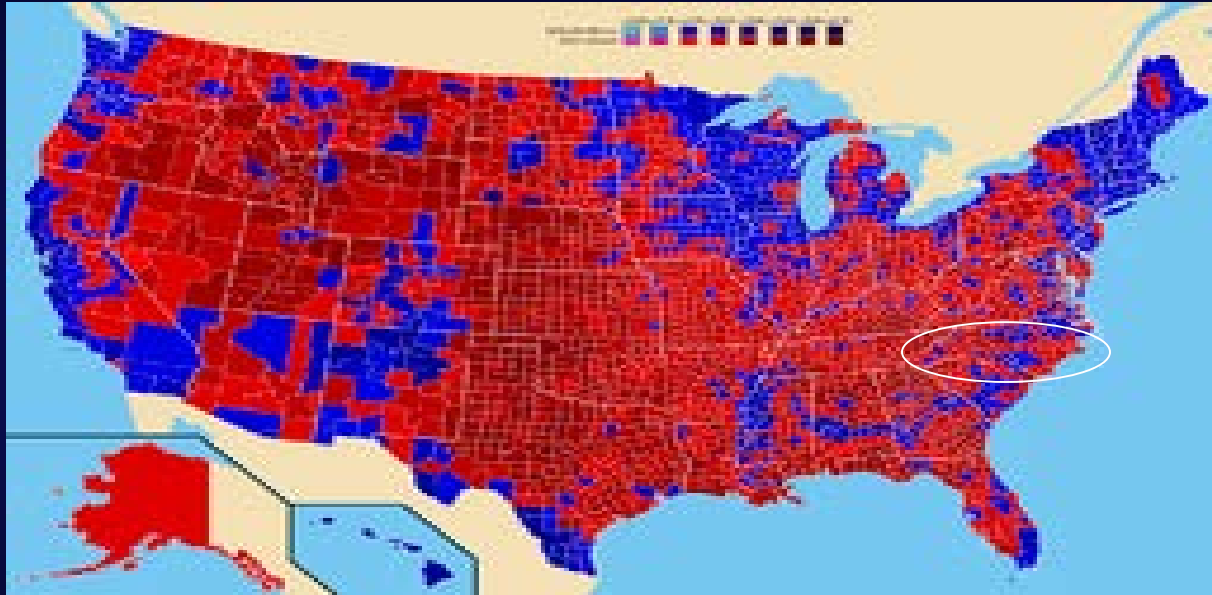
What is the relevant population?

D8S1179	Caucasian (N=196)
<9	1.786
9	1.020
10	10.204
11	5.867
12	14.541
13	33.929
14	20.153
15	10.969
16	1.276
17	0.255
18	0.000



1 in 609 quintillion

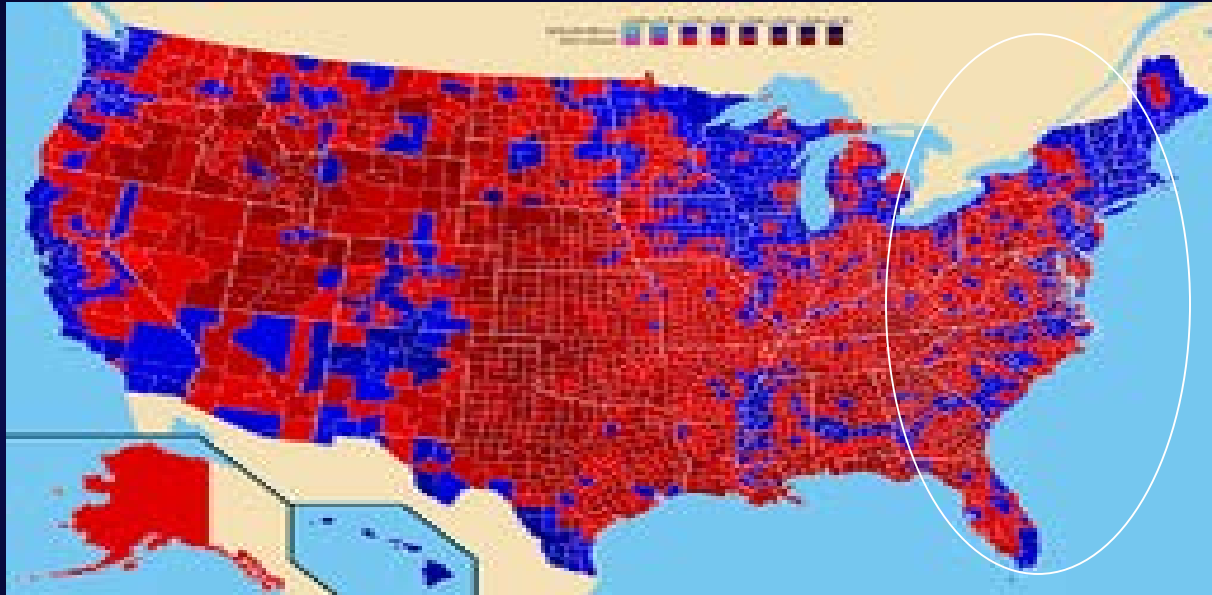
How would you determine the frequency of Obama supporters in North Carolina?



	<u>Obama</u>
N.C.	50.2%

Popular vote in 2008 by county. McCain won red counties, Obama won blue counties.

How would you determine the frequency of Obama supporters in North Carolina?



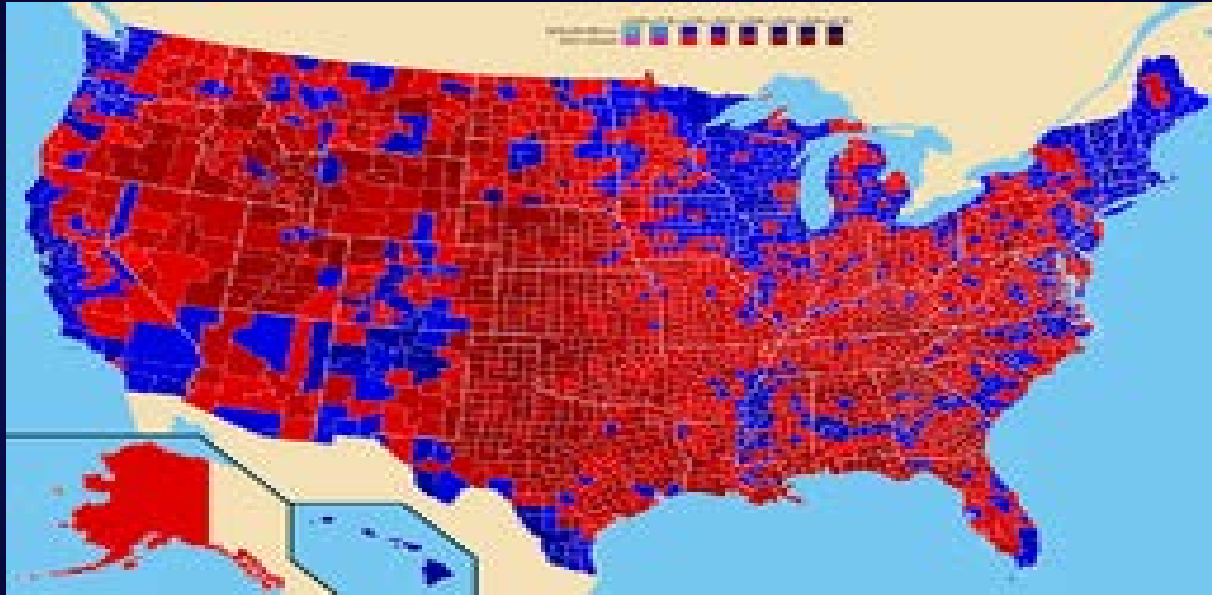
Obama

N.C. 50.2%

Region 59.6%

Popular vote in 2008 by county. McCain won red counties, Obama won blue counties.

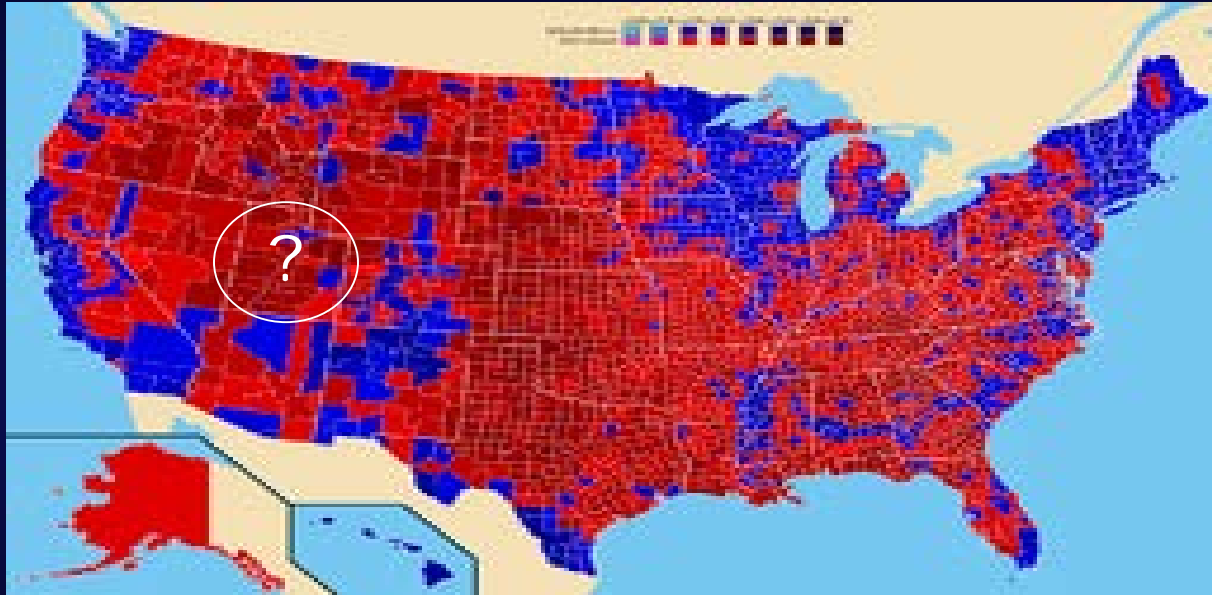
How would you determine the frequency of Obama supporters in North Carolina?



	<u>Obama</u>
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U.S.	52.9%

Popular vote in 2008 by county. McCain won red counties, Obama won blue counties.

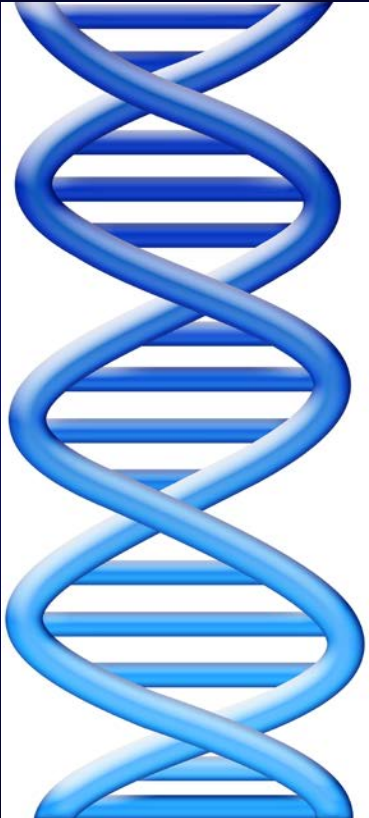
How would you determine the frequency of Obama supporters in North Carolina?



	<u>Obama</u>
N.C.	50.2%
Region	59.6%
U.S.	52.9%
Utah?	35.5%

Popular vote in 2008 by county. McCain won red counties, Obama won blue counties.

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