Algebra (basic rules)

E=evidence

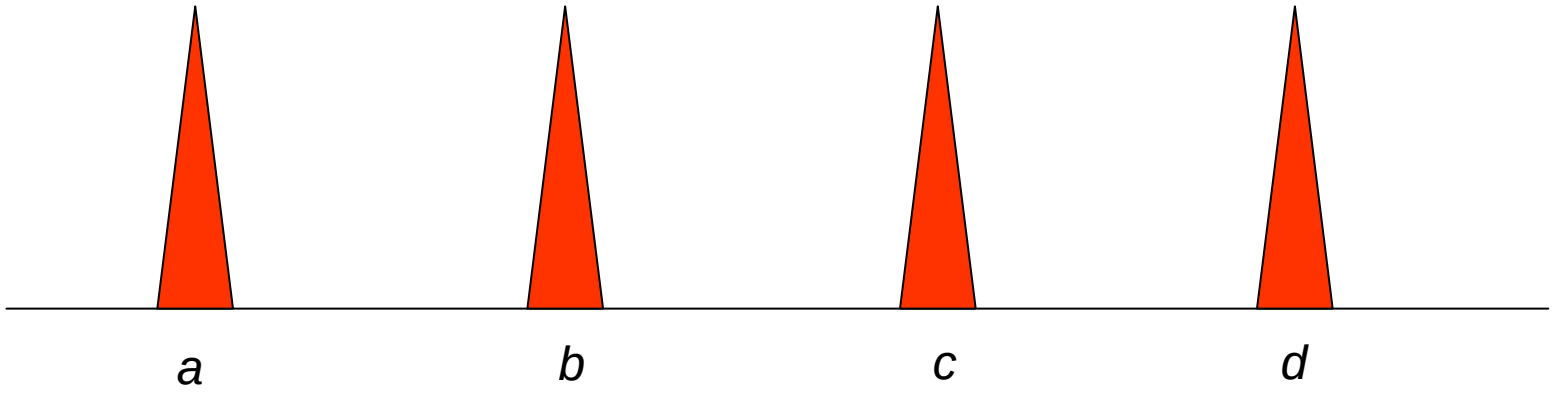
Hd= defence hypothesis

Hp=prosecution hypothesis

S=suspect

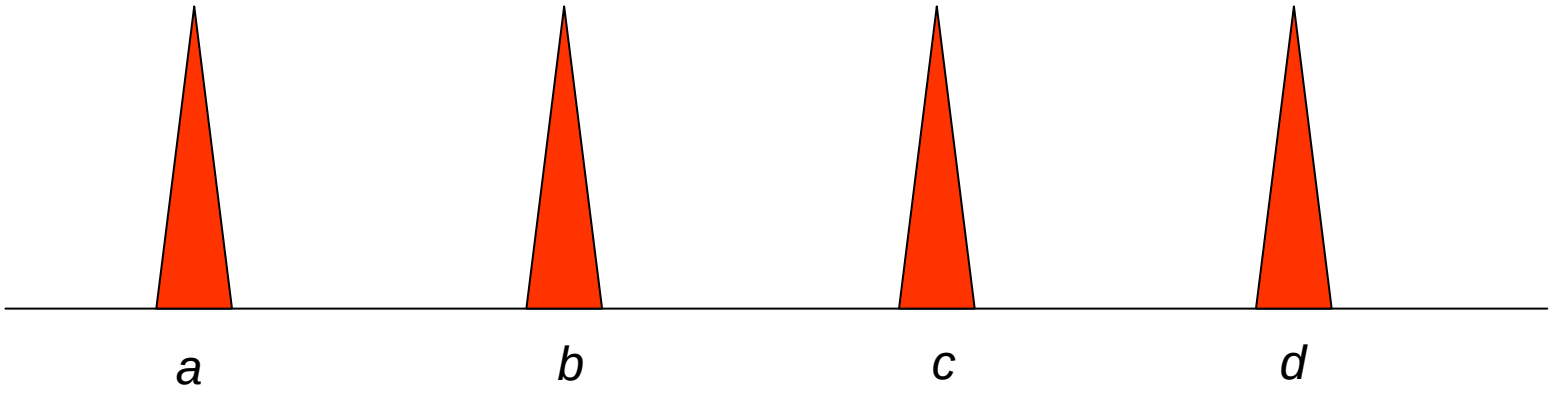
V=victim

The numerator (forget peak area for the time being)



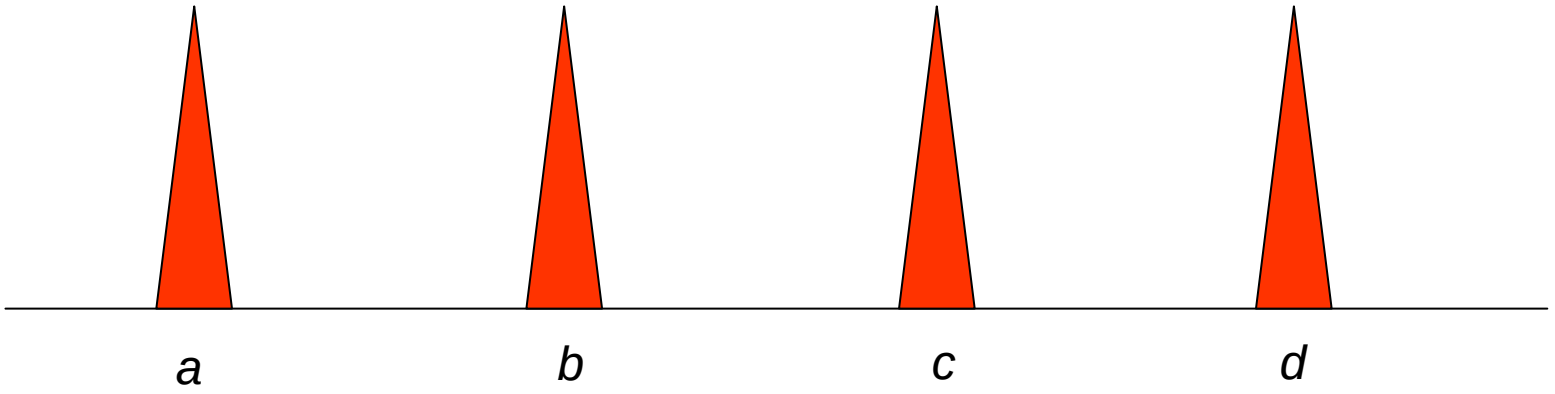
- Consider a simple 2 person mixture – 1 locus only consisting of 2 heterozygotes
- The suspect is *ab*
- There must be another (unknown person) who is *cd*

The numerator (forget peak area for the time being)



- The prosecution say: the DNA has come from the suspect and one unknown person
- The defence say: The DNA has come from 2 unknown people
- How do we evaluate this evidence?

The numerator (forget peak area for the time being)



- The prosecution say: the DNA has come from the suspect and one unknown person
  - IF this is true then we would expect *ab* to be present with probability
  - Pr=1. The chance of seeing an unknown person of type *cd* is $2p_cp_d$
  - *Pr(E|S,U)=2pcpd*

The denominator

- The defence say: this could have come from any two random individuals
- Work out all pairwise combinations from *abcd* and their probabilities

Individual 1	Individual 2	products
ab	*cd*	*4abcd*
ac	*bd*	*4abcd*
ad	*bc*	*4abcd*
cd	*ab*	*4abcd*
bd	*ac*	*4abcd*
bc	*ad*	*4abcd*
	Sum of products	*24abcd*

These are the reverse combations

Now we form the LR

$$LR = \frac{\Pr(E \mid S, U)}{\Pr(E \mid U_1, U_2)}$$

$$= \frac{\cancel{2}cd}{\cancel{24}abc\cancel{d}}$$

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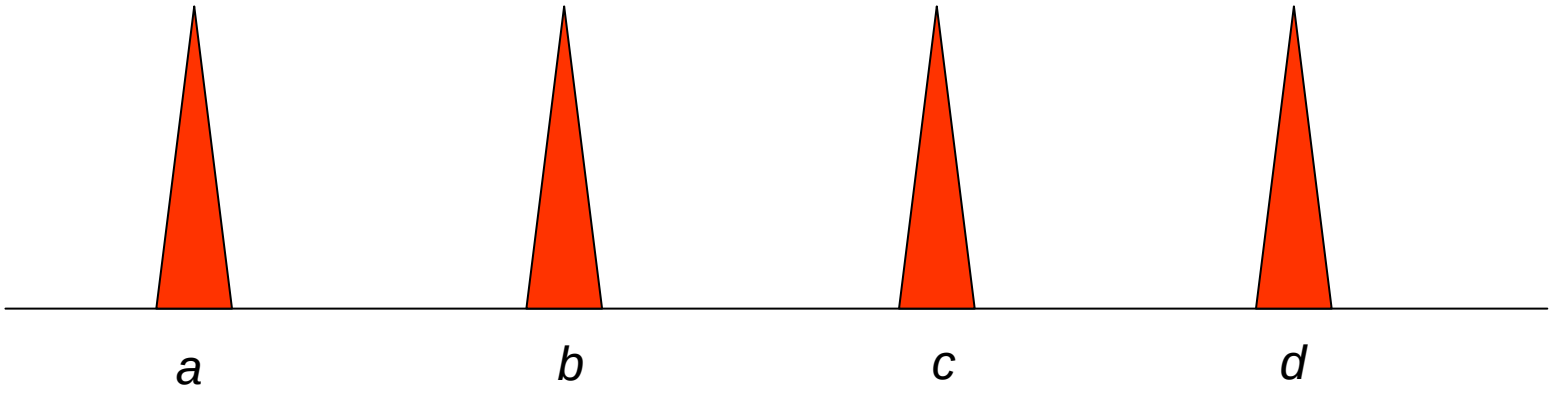
$$= \frac{1}{12ab}$$

All Calculations follow the same basic rules as described

- Different hypotheses?
- More on conditioning
- The top bit of the equation belongs to the prosecution
- The bottom bit of the equation belongs to the defence.
- Lets change the hypotheses

The numerator (forget peak area for the time being)



- The profile is from a semen contaminated vaginal swab
- The suspect is ab and the victim is cd
- Because it is reasonable to suppose that alleles from the victim are on the swab we can condition on this

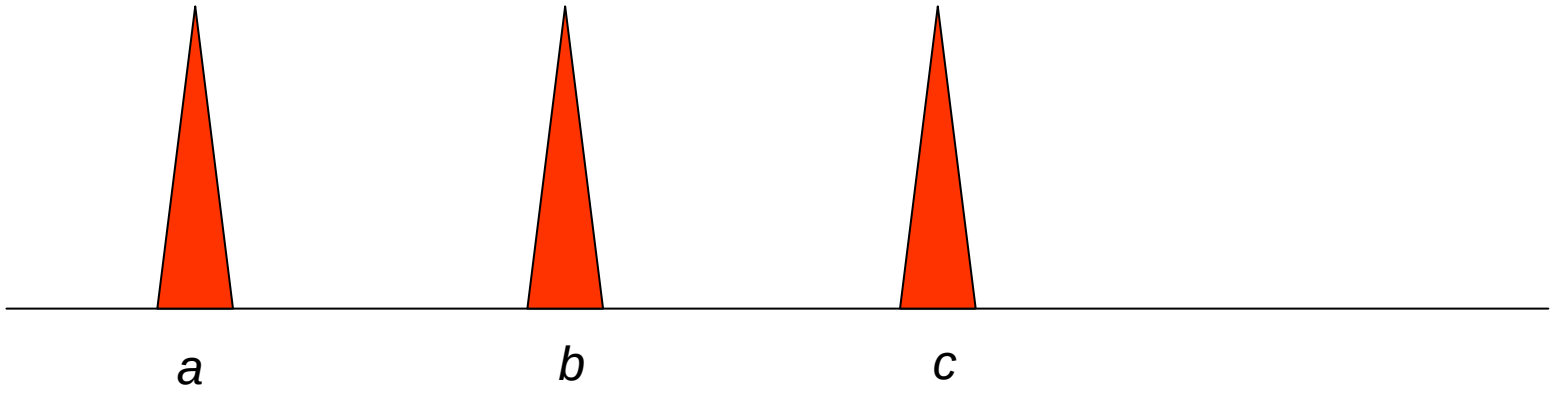
Conditioning on a victim

- The prosecution hypothesis (S+V) is completely explained hence the probability of the evidence is Pr=1.
- The defence hypothesis is U (still) + V.
- The LR is therefore:

$$\frac{1}{2ab}$$

- This is the same as for a non-mixed sample comprising the suspect alone.
- An illustration of simplification by ‘subtraction’
- Subtraction is an important part of reporting mixtures but care must always be taken to ensure that we do not remove alleles simply because they are ‘inconvenient’.
- Later we will discuss the use of ‘thresholds’ to assist with the interpretation process

Moving onto more complex examples (the three allele locus)

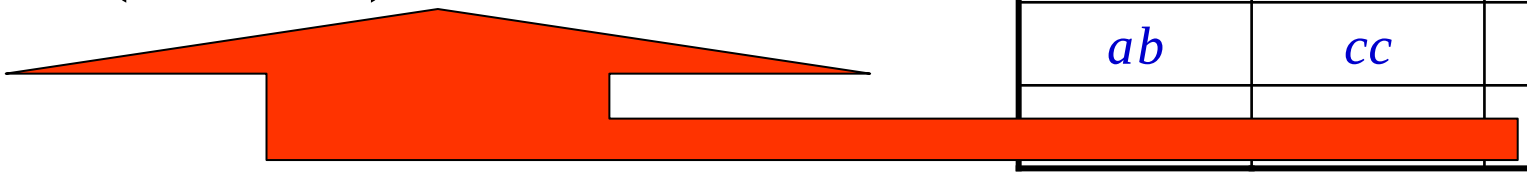


There are four alleles present given a two person mixture
So one person must be homozygous.
Lets work with Hp: S+U and Hd: U + U
IF S=ab then U=cc under Hp then $Pr(E|Hp)=c^2$
What is Pr(E|Hd) if the suspect is ab?

Denominator

1	2	Pr
aa	bc	$2a^2bc$
ab	ac	$4a^2bc$
ab	bc	$4ab^2c$
bc	ab	$4abc^2$
bb	ac	$2ab^2c$
cc	ab	$2abc^2$

$$\Pr(E \mid Hd) = 2(6a^2bc + 6ab^2c + 6abc^2)$$
$$= 12abc(a+b+c)$$



bc	aa	$2a^2bc$
ac	ab	$4a^2bc$
bc	ab	$4ab^2c$
ab	bc	$4abc^2$
ac	bb	$2ab^2c$
ab	cc	$2abc^2$
		sum

The LR (three alleles)

- Hp: S+U
- Hd:U+U

- IF S=ab, $\Pr(E|Hp)=c^2$

$$\Pr(E \mid Hd) = 2(6a^2bc + 6ab^2c + 6abc^2)$$

$$LR = \frac{c^2}{12abc(a+b+c)}$$

$$= \frac{c}{12ab(a+b+c)}$$

- IF S=aa, $\Pr(E|Hp)=2bc$

$$\Pr(E \mid Hd) = 2(6a^2bc + 6ab^2c + 6abc^2)$$

$$LR = \frac{2bc}{12abc(a+b+c)}$$

$$= \frac{1}{6a(a+b+c)}$$

For homework try 2 alleles

- Calculations are quite time consuming
- But easily programmed
- The rules are just the same as described for any mixture and can be expanded for complex mixtures (3-person or more)