Relationship and inbreeding coefficients

Relationship coefficient

$$Rxy = \frac{(\frac{1}{2})^{n+n'} \quad (1+FCA)}{\sqrt{(1+F_X)(1+F_Y)}}$$

Inbreeding coefficient

$$Fx = (1/2)^{ns+nd+1}(1+FCA)$$

Computing relationship and inbreeding using path coefficients

- **Wright** is responsible for the idea of tracing paths to establish the relationships among animals.

Step1: Convert the bracket pedigree to an arrow diagram in which each individual appears only once.

Step2: Locate common ancestors (CA)

For inbreeding coefficients: common ancestors are defined to be common to both the sire and the dam of inbred individuals (**X**).

For relationship coefficients: common ancestors are defined to be common to the two individuals of interest (**x** and **y**)

Relationship and inbreeding coefficients

Step 3: calculate the inbreeding coefficient for inbred common ancestors

Step 4: Full in the following table

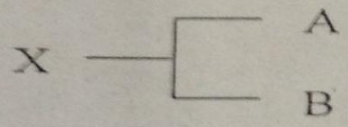
Common ancestor	Paths	$(1/2)^{n+n1}$ for R_{xy} or $(1/2)^{ns+nd+1}$ for F_x	1+FCA	Product of lost two columns

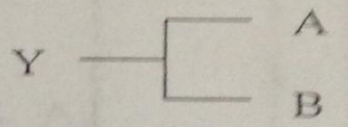
Step 5: Sum the last column to compute the numerator of R_{xy} or F_x

Step 6: Rxy calculations only: divided the sum by $\sqrt{1+F_X}\ \sqrt{1+F_Y}$

Relationship and inbreeding coefficients

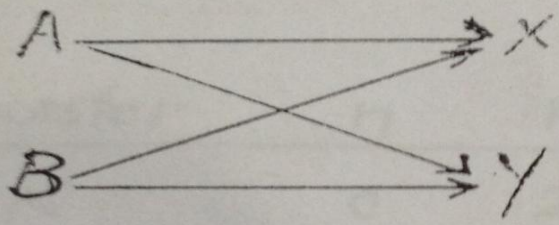
1. From the following bracket pedigree:





Compute R_{XY}

Solution :



R_{XY}

ancestor	n	n'	(1 + Fa)	
A	1	1	—	$= (\frac{1}{2})^2$
B	1	1	—	$= (\frac{1}{2})^2$

$R_{XY} = (\frac{1}{2})^2 + (\frac{1}{2})^2$

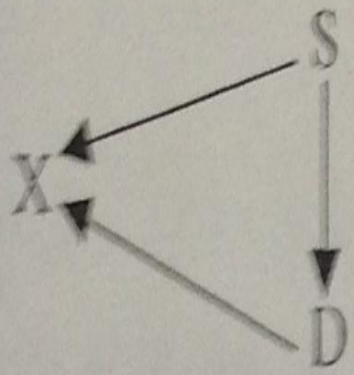
$= 0.25 + 0.25 = 0.50$

$= 50\%$ — Full sib.

Relationship and inbreeding coefficients

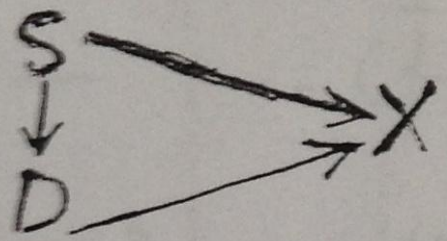
4. Calculate the inbreeding coefficient of individual X (F_X) and the relationship coefficient of the sire and dam (R_{SD}) in the following arrow diagrams of pedigrees.

(A)



Relationship and inbreeding coefficients

Solution :



(A)

F_X ancestor ns nd 1 $(1+F_A)$

S 0 1 1 — $= (\frac{1}{2})^2$

$F_X = (\frac{1}{2})^2 = 0.25$

R_{SD} ancestor n n' $(1+F_A)$

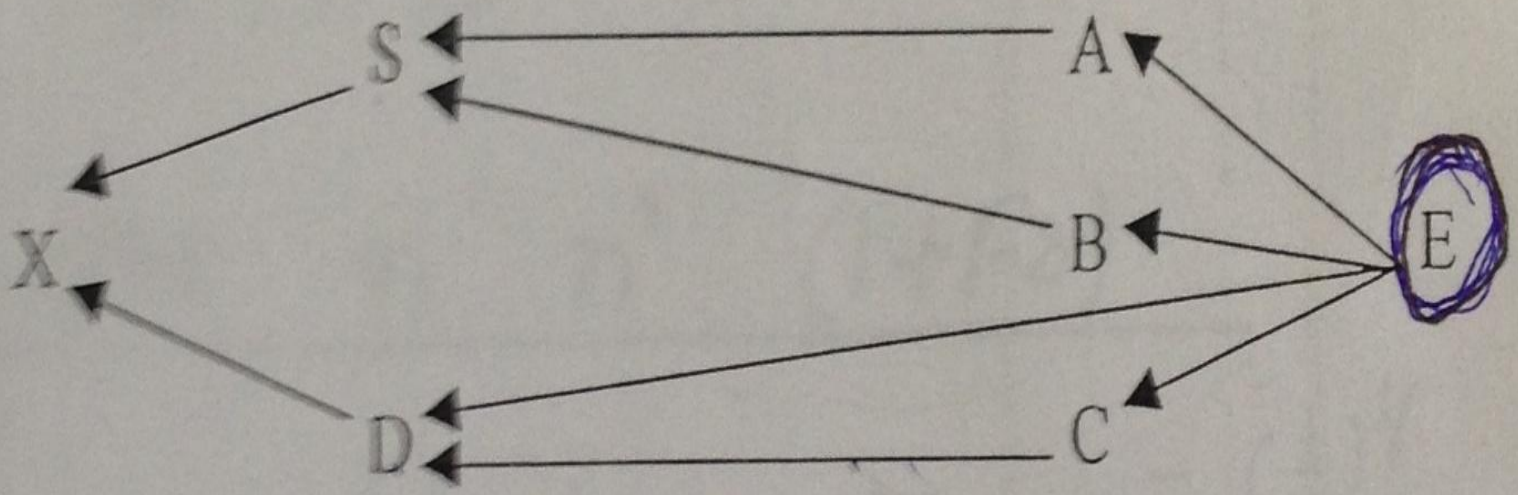
S 0 1 — $= (\frac{1}{2})^1$

$R_{SD} = (\frac{1}{2})^1 = 0.50$

Relationship and inbreeding coefficients

4. Calculate the inbreeding coefficient of individual X (F_X) and the relationship coefficient of the sire and dam (R_{SD}) in the following arrow diagrams of pedigrees.

(B)

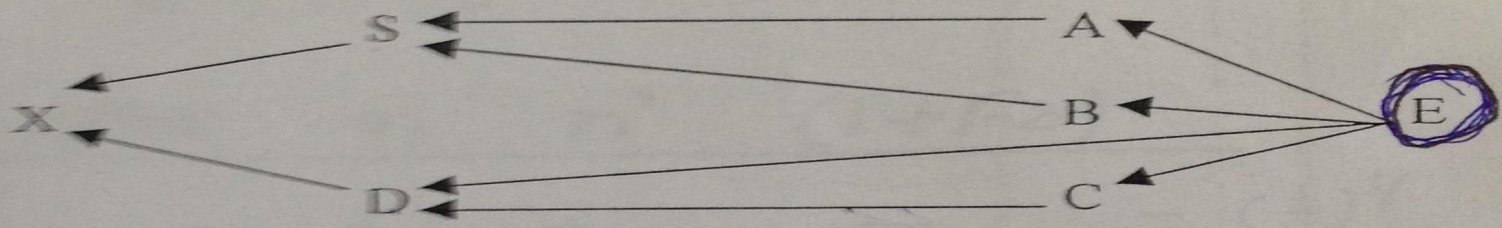


Also calculate R_{XE} for this pedigree.

Fx , RXE

Relationship and inbreeding coefficients

(B)



Also calculate R_{XE} for this pedigree.

F_X , R_{XE}

F_X

ancestor	ns	nd	1	(1+Fa)	
E	2	2	1	—	$= (\frac{1}{2})^5$
E	2	1	1	—	$= (\frac{1}{2})^4$
E	2	2	1	—	$= (\frac{1}{2})^5$
E	2	1	1	—	$= (\frac{1}{2})^4$

$$F_X = (\tfrac{1}{2})^5 + (\tfrac{1}{2})^4 + (\tfrac{1}{2})^5 + (\tfrac{1}{2})^4$$

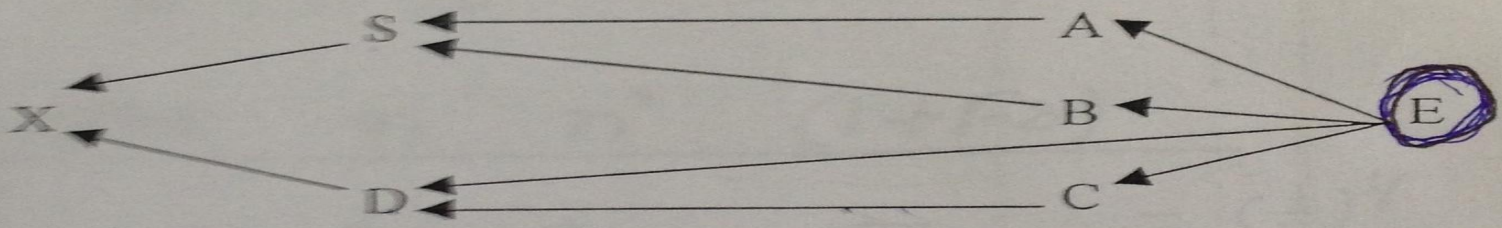
$$= 0.03125 + 0.0625 + 0.03125 + 0.0625$$

$$= 0.1875$$

$$= 18.75\ \%$$

Relationship and inbreeding coefficients

(B)



Also calculate R_{XE} for this pedigree.

F_X , R_{XE}

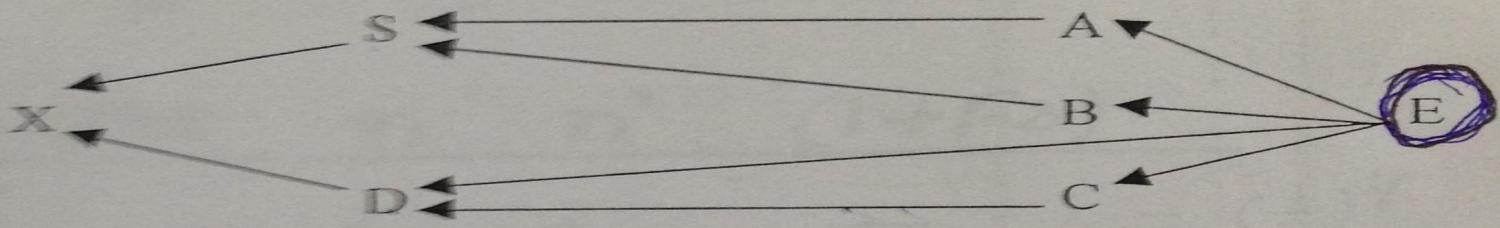
R_{SD}

ancestor	n	n'	(1+F_A)	
E	2	2	—	$= (\frac{1}{2})^4$
B	2	1	—	$= (\frac{1}{2})^3$
E	2	1	—	$= (\frac{1}{2})^3$
C	2	2	—	$= (\frac{1}{2})^4$

$$R_{SD} = (\tfrac{1}{2})^4 + (\tfrac{1}{2})^3 + (\tfrac{1}{2})^3 + (\tfrac{1}{2})^4$$
$$= 0.0625 + 0.125 + 0.125 + 0.0625$$
$$= 0.375$$

Relationship and inbreeding coefficients

(B)



Also calculate R_{XE} for this pedigree.

F_X , R_{XE}

F_S ancestor ns nd 1 (1+Fa)

E 1 1 1 — $= (\frac{1}{2})^3$

$F_S = (\frac{1}{2})^3 = 0.125$

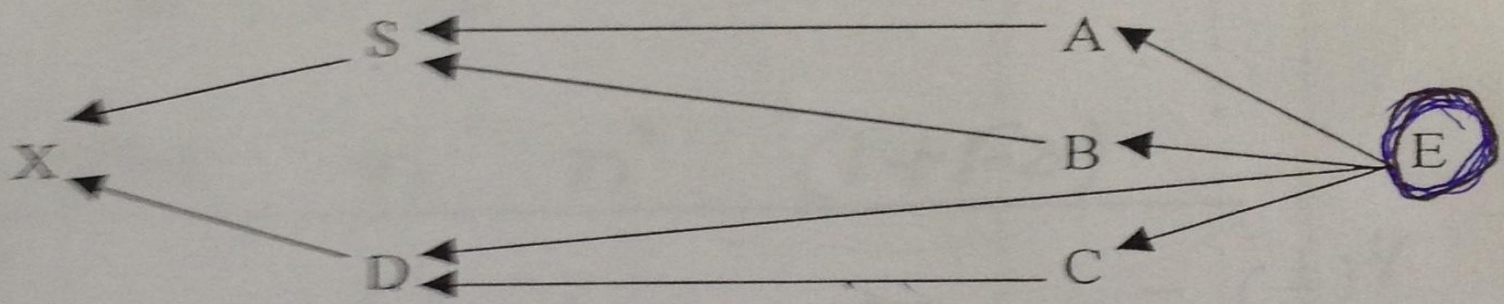
F_D ancestor ns nd 1 (1+Fa)

E 0 1 1 — $= (\frac{1}{2})^2$

$F_S = (\frac{1}{2})^2 = 0.25$

Relationship and inbreeding coefficients

(B)



Also calculate R_{XE} for this pedigree.

F_X , R_{XE}

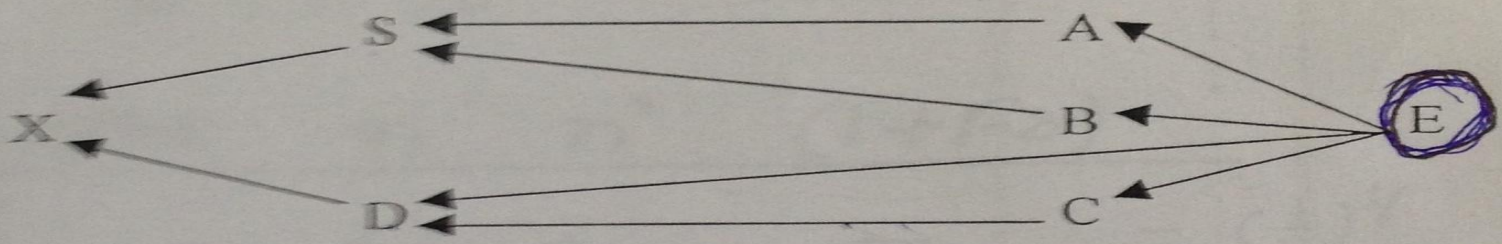
$$R_{SD} = \frac{0.375}{\sqrt{(1+0.125)(1+0.25)}}$$

$$= \frac{0.375}{\sqrt{(1.125)(1.25)}} = \frac{0.375}{1.186} = 0.3162$$

$$= 31.62\ \%$$

Relationship and inbreeding coefficients

(B)



Also calculate R_{XE} for this pedigree.

F_X , R_{XE}

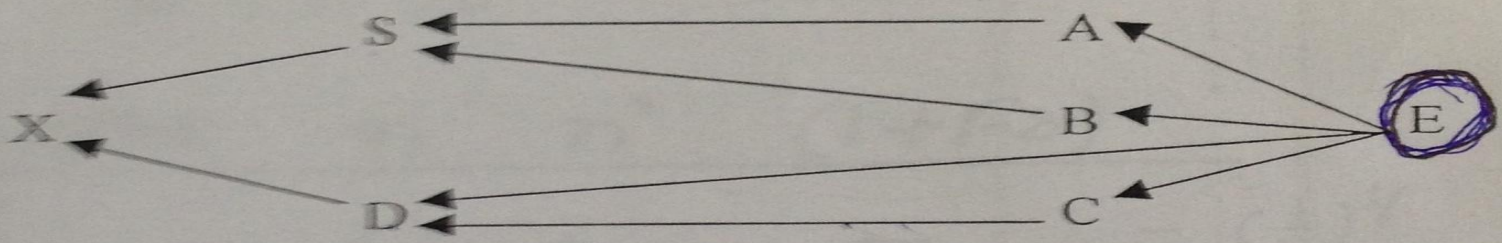
R_{XE}

ancestor	n	n'	(1+Fa)	
E	0	3	—	$= (\frac{1}{2})^3$
E	0	3	—	$= (\frac{1}{2})^3$
E	0	2	—	$= (\frac{1}{2})^2$
E	0	3	—	$= (\frac{1}{2})^3$

$$R_{XE} = (\tfrac{1}{2})^3 + (\tfrac{1}{2})^3 + (\tfrac{1}{2})^2 + (\tfrac{1}{2})^3$$
$$= 0.125 + 0.125 + 0.25 + 0.125$$
$$= 0.625$$

Relationship and inbreeding coefficients

(B)



Also calculate R_{XE} for this pedigree.

F_X , R_{XE}

$$R_{XE} = \frac{0.625}{\sqrt{(1+0)(1+0.1875)}}$$

$$= \frac{0.625}{\sqrt{1.1875}} = \frac{0.625}{1.0897} = 0.5736$$

$$= 57.36\ \%$$

Thanks for your attention