



## Sheep breeding: Generation interval

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The generation interval is the average age of parents when their offspring are born. For example, if the average age of ewes in the flock is five years, and the average age of rams is three years, then the generation interval is four years.

### Importance of generation interval

Response to selection (R) per year is:

$R/\text{year} = \text{heritability} \times \text{selection differential} \div \text{generation interval}$

The higher the generation interval, the lower will be the annual rate of genetic improvement.

### Calculating generation interval

Take the following factors into account when calculating the generation interval:

- the age structure of the flock;
- the survival rate from age to age; and
- differential reproduction rates with age.

Replacement rates are easily produced from these calculations.

#### Example

In a flock of 1000 ewes, 95 per cent survive from year to year. They are culled after their fifth lambing. Rams are used at the rate of 2 per cent and culled after three years.

Effective reproduction rates, which relate to the number reaching selection age at 18 months, increase from 60 per cent for maiden ewes to 70 per cent for ewes having second births and 80 per cent for older ewes. The survival rate for rams is 90 per cent.

From these assumptions, the following can be calculated:

#### Number of maiden ewes

Maiden ewes have not undergone a cycle of survival since selection, so their survival rate is 100 per cent. Each year thereafter, their numbers are decreased by 5 per cent (Table 1).

The proportion of the flock that are maidens is:

$$P_2 = 1 \div (1.00 + 0.95 + 0.95^2 + 0.95^3 + 0.95^4) = 0.221$$

Therefore, there are 221 maiden ewes.

**Table 1. Cumulative proportions of ewes surviving with annual survival of 95 per cent**

Ages of ewes at lambing	Proportion surviving
2	1.00
3	0.95
4	0.95 <sup>2</sup>
5	0.95 <sup>3</sup>
6	0.95 <sup>4</sup>

#### Age structure of ewe flock

Table 2 shows the numbers of ewes of each age.

**Table 2. Number of ewes surviving with 95 per cent annual survival rate**

Age of ewes at lambing	Number surviving
2	221
3	210
4	199
5	190
6	180

#### Female generation interval

If there were no difference in effective lambing, the female generation ( $G_E$ ) interval would be calculated as:

$$G_E = [\text{sum of (age} \times \text{number)}] \div \text{total ewes} \\ = [(2 \times 221) + (3 \times 210) + (4 \times 199) + (5 \times 190) + (6 \times 180)] \div 1000 = 3.90$$

With different reproduction rates, the procedure is a little more complex (Table 3).

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**Table 3. Calculation of generation interval**

Age at lambing	Number of ewes	Lambs per ewe	Number of lambs	Lambs by age
2	221	0.60	133	266
3	210	0.70	147	441
4	199	0.80	159	636
5	190	0.80	152	760
6	180	0.80	144	864
Totals			735	2967

$$G_E = [\text{sum of (age x number x number of lambs per ewe)}] \div \text{total lambs}$$

$$= [(2 \times 221 \times 0.60) + (3 \times 210 \times 0.70) + (4 \times 199 \times 0.8) + (5 \times 190 \times 0.80) + (6 \times 180 \times 0.80)] \div 735$$

$$= 2967 \div 735 = 4.04$$

### Number of two-year rams

$$\text{Proportion of two year old rams} = 1 \div (1 + 0.90 + 0.810) = 0.37$$

$$\text{Total number of rams required} = 1000 \times 0.02 = 20$$

$$\text{Number of two-year rams} = 20 \times 0.37 = 7$$

### Ram age structure

Using the figures in Table 4, the male generation interval ( $G_R$ ) is calculated as:

**Table 4. Age structure for ram flock**

Age	Number
2	7
3	7
4	6

$$G_R = [\text{sum of (age x number)}] \div \text{total rams}$$

$$= [(2 \times 7) + (3 \times 7) + (4 \times 6)] \div 20 = 2.95$$

## Flock generation interval

The flock generation interval ( $G_F$ ) is the average of the male and female generation intervals:

$$G_F = [G_E + G_R] \div 2$$

$$= (4.04 + 2.95) \div 2 = 3.50$$

## Adding more age groups

If the age structure of one sex is extended, the flock generation interval will increase by about 0.5 years, depending upon survival and reproduction.

## Further reading

- Farmnote No. 73/2003 'Genetic nomenclature and animal breeding terms' (Agdex 400/30).
- Farmnote No. 52/93 'Sheep breeding: Heritability' (Agdex 430/30).

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