(A)

LITTLE'S THEOREM — CALCULATING POPULATIONS FROM RATES AND LIFETIMES

student body population
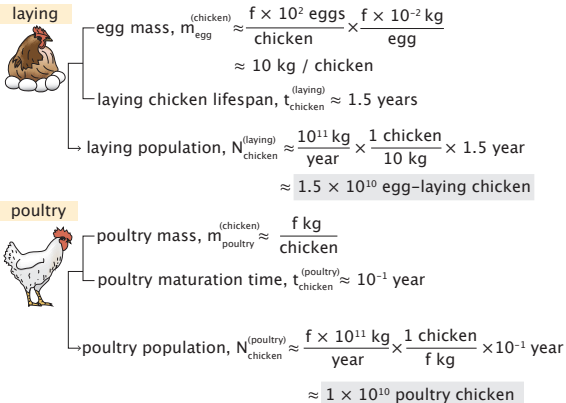
matriculation rate, r_{mat} → graduation rate, r_{grad}

residence time, t_{study}

assuming $r_{mat} \approx r_{grad}$

student body, $N_{student} \approx t_{study} \times r$
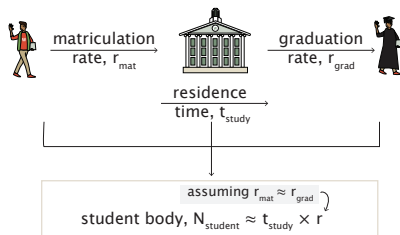
livestock standing population

hatch rate, r_{hatch} → slaughter rate, r_{death}

maturation time, t_{mature}

assuming $r_{birth} \approx r_{death}$

standing population, $N_{chicken} \approx t_{mature} \times r$
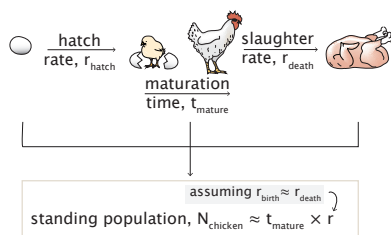
(B)

ESTIMATING STANDING CHICKEN POPULATION

laying

egg mass, $m_{egg}^{(chicken)} \approx \dfrac{f \times 10^2 \text{ eggs}}{chicken} \times \dfrac{f \times 10^{-2} \text{ kg}}{egg}$

≈ 10 kg / chicken

laying chicken lifespan, $t_{chicken}^{(laying)} \approx 1.5$ years

laying population, $N_{chicken}^{(laying)} \approx \dfrac{10^{11} \text{ kg}}{year} \times \dfrac{1 \text{ chicken}}{10 \text{ kg}} \times 1.5$ year

$\approx 1.5 \times 10^{10}$ egg–laying chicken

poultry

poultry mass, $m_{poultry}^{(chicken)} \approx \dfrac{f \text{ kg}}{chicken}$

poultry maturation time, $t_{chicken}^{(poultry)} \approx 10^{-1}$ year

poultry population, $N_{chicken}^{(poultry)} \approx \dfrac{f \times 10^{11} \text{ kg}}{year} \times \dfrac{1 \text{ chicken}}{f \text{ kg}} \times 10^{-1}$ year

$\approx 1 \times 10^{10}$ poultry chicken

(C)

total chicken population, $N_{chicken} \approx N_{chicken} + N_{chicken} \approx f \times 10^{10}$

data source: Food and Agricultural Organization (FAO) of the UN

- total population
- estimate

standing population [billions] vs. year