

## Notation (*e* is cool)

- In this course  $\log$  or  $\log_e$  means the *natural* logarithm (written *ln* in the textbooks)
  - If I mean  $\log_{10}$ , I will say so
- $\exp()$  is a synonym for “*e* to the power of”

## Logarithms

- Multiplying on the original scale is equivalent to adding on the log scale
  - $\log(ab) = \log(a) + \log(b)$
- Division is the opposite of multiplication and subtraction is the opposite of addition:
  - $\log(a/b) \equiv \log\left(\frac{a}{b}\right) = \log(a) - \log(b)$
- Exponentiation is to multiplication like multiplication is to addition:
  - $\log(\lambda^k) = k \log(\lambda)$

## Complementarity

- $\log_e$  and  $\exp$  are complementary functions
  - $\exp(\log_e(x)) \equiv e^{\log_e(x)} = x$
  - $\log_e(\exp(x)) \equiv \log_e(e^x) = x$

## Exponentiation

- The rules for  $\exp$  are exactly complementary to those for  $\log$ 
  - $\exp(a + b) = \exp(a) \cdot \exp(b)$
  - $\exp(a - b) = \exp(a) / \exp(b)$
  - $\exp(k \log_e(\lambda)) = \lambda^k$
- Remember: you can't take the log or exponent of something with units

## Problems

- You should be able to use these rules to solve simple problems, algebraically, or on your calculator
  - If  $\lambda^{20} = 0.1$ , what is  $\lambda$ ?
- Also, word problems
  - If a population declines by 90% in 20 generations, what is its reproductive number per generation?

## Algebra

- If  $\lambda^{20} = 0.1$ , what is  $\lambda$ ?

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- If  $\exp(rt) = 5$ , and  $r = 0.1/\text{yr}$ , what is  $t$ ?

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## Units are our friends

- Keep track of units at all times
- Use units to confirm that your answers make sense
  - Or to find quick ways of getting the answer
- Get used to manipulating and cancelling units
- $36 \text{ mpg} = ?? \text{ L}/100\text{km}$

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