Linear populations unit (5)

1. A population of dandelions is growing exponentially. If 50 dandelions are observed in Year 0, and 150 are observed in Year 2, how many would you expect to see in Year 6?

A. 250
B. 350
C. 450
D. **1350**
E. 4050

2. If we are comparing a 1 kg rat, a 60 kg person, and a 600 kg buffalo, the _____ is most different on the linear scale, and the _____ is most different on the log scale

A. rat; rat
B. rat; buffalo
C. **buffalo; rat**
D. buffalo; buffalo

3. Plotting how population changes through time on a log scale reflects a(n) _____ perspective, because _____ changes through time reflect _____ rates of birth and death

A. individual; additive; per capita
B. **individual; multiplicative; per capita**
C. population; additive; total
D. population; multiplicative; total

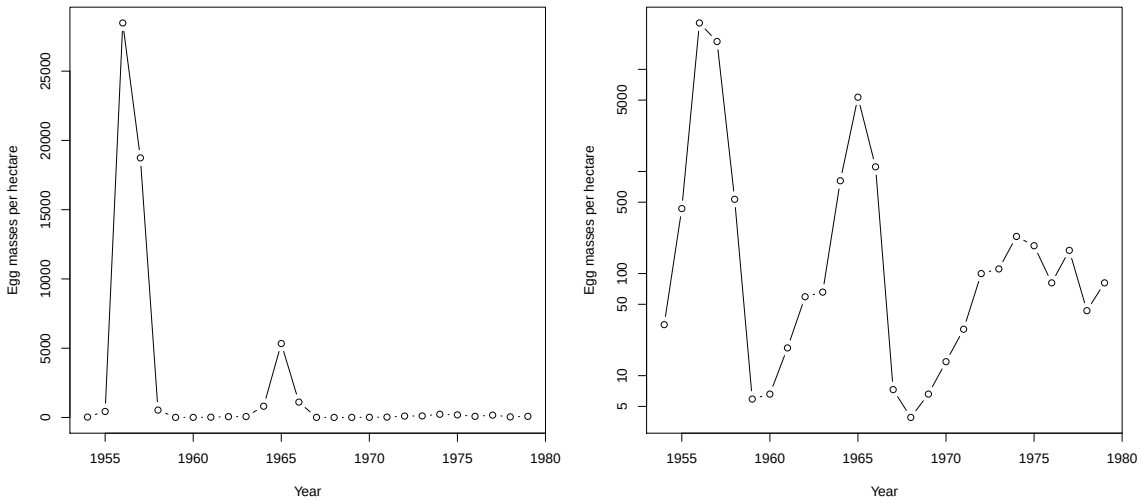
4. A population of shrubs is growing exponentially with a chararacteristic time of 4 yr. Its doubling time will be approximately

A. 0.17 yr
B. 0.36 yr
C. 1 yr
D. **2.8 yr**
E. 5.8 yr

Nonlinear populations unit (6)

5. In this class, the professor argued that populations cannot increase or decline exponentially for long, and that high population densities must:

A. have direct positive effects on their own growth rate
B. have either indirect or direct positive effects on their own growth rate
C. have direct negative effects on their own growth rate
D. **have either indirect or direct negative effects on their own growth rate**



6. The picture above on the _____ shows population on a log scale. Compared to the other picture, it shows _____.

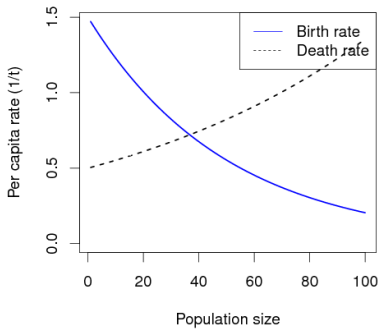
A. left; individual density instead of total density
B. left; the same numbers, but from a different perspective
C. right; individual density instead of total density
D. **right; the same numbers, but from a different perspective**

7. A population is regulated with a time delay, following the equation:

$$\frac{dN(t)}{dt} = (b(N(t-\tau)) - d(N(t-\tau)))N(t)$$

We expect it to show _____ oscillations when the unitless delay (τ/t_c) is short, and _____ oscillations when the unitless delay is long

A. no; damped
B. no; persistent
C. damped; damped
D. **damped; persistent**

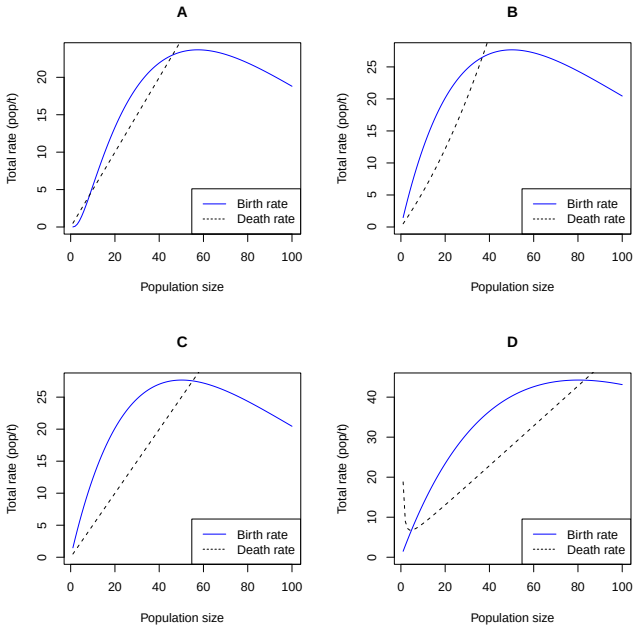


Use the picture above for the next 3 questions.

8. The figure shows _____ in the birth rate and _____ in the death rate:

A. **density dependence; density dependence**
B. density dependence; Allee effects
C. Allee effects; density dependence
D. Allee effects; Allee effects

9. Which of the four pictures below was generated by the same model as the picture above?



ANS: B

10. This population has a(n) _____ equilibrium at 0 individuals and a(n) _____ equilibrium at 37 individuals

A. stable; stable
B. stable; unstable
C. **unstable; stable**
D. unstable; unstable

Structured populations (5)

x	f_x	p_x
1	0	0.8
2	3	0.5
3	4	0

Use the life table above for the following three questions.

11. What is ℓ_2 for this population?

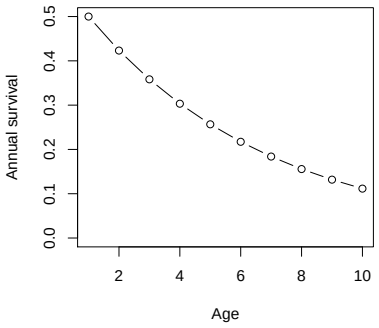
A. 0.4
B. 0.5
C. **0.8**
D. 1
E. 1.3

12. What is R for the population described above?

A. 1.2
B. 2.2
C. 3.2
D. 3.6
E. **4.0**

13. What can you say about the instantaneous growth rate λ for the population described above?

A. $\lambda < 1$
B. $\lambda = 1$
C. $1 < \lambda < \mathcal{R}$
D. $\lambda = \mathcal{R}$
E. $\lambda > \mathcal{R}$
ANS: C

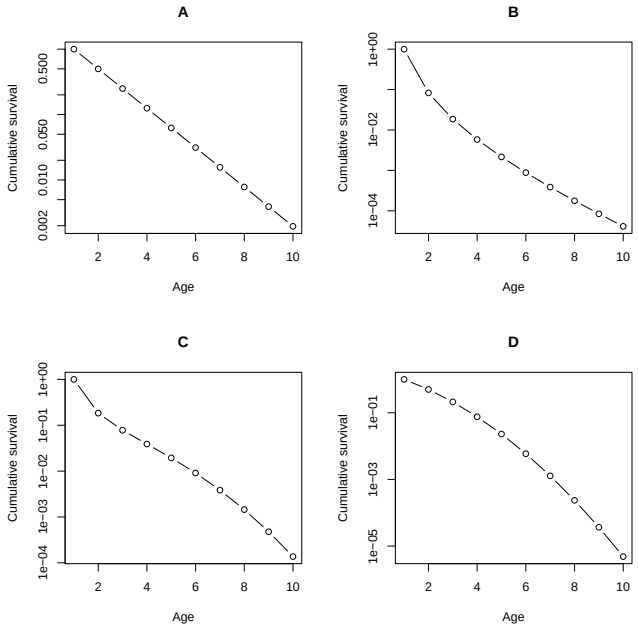


Use the picture above for the following 2 questions.

14. What does this picture of survivorship in an idealized age-structured population indicate about *mortality* in this population?

A. Mortality is constant
B. **Mortality is elevated in older individuals**
C. Mortality is elevated in younger individuals
D. Mortality is elevated in both older and younger individuals

15. The pictures below show *cumulative* survival. Which one corresponds to the picture shown above?



ANS: D

Life history (5)

Use this information for the next two questions. In a population of beetles, all reproduction is sexual. Females in this population produce many more female than male offspring.

16. What can you say about the relative fitness at birth of females and males in this population?

A. Females have higher lifetime fitness per individual
B. **Males have higher lifetime fitness per individual**
C. Both sexes have equal lifetime fitness per individual
D. There is not enough information to tell

If all reproduction is sexual, the total male fitness is the same as the total female fitness. If there are fewer males, their average fitness per individual must be higher.

17. The balance argument would predict that in this beetle population:

A. Females use more total resources producing male offspring than female offspring
B. Females use more total resources producing female offspring than male offspring
C. **Females use more resources for each individual male offspring than female offspring**
D. Females use more resources for each individual female offspring than male offspring

18. Cole pointed out that producing one more offspring increases an organism's $\lambda = f + p$ by 1 – the same amount it increases if the organism changes from not surviving at all after reproduction to being immortal. He asked why in that case any organisms would evolve to be long-lived. Which of the following does *not* help to answer this question?

A. Closing the loop: it is not so easy to produce one more offspring who will survive to where you are now
B. **Tradeoffs: organisms tend to evolve to a point where they are not able to increase survivorship without reducing fecundity**
C. Population regulation: if the long term average value of λ is 1, it can't be easy to increase f by 1.
D. Bet hedging: long-lived organisms can deal better with variation in offspring success

19. Which of these is *most* characteristic of a K competitor?

A. Has a low individual density at equilibrium
B. Has a high individual density at equilibrium
C. Competes poorly in crowded conditions
D. **Competes well in crowded conditions**

20. Which of the following arguments for the importance of "bet-hedging" strategies is correct?

A. Averaging within generations is better than averaging between generations, because the geometric mean is larger than the arithmetic mean
B. **Averaging within generations is better than averaging between generations, because the arithmetic mean is larger than the geometric mean**
C. Averaging between generations is better than averaging within generations, because the geometric mean is larger than the arithmetic mean
D. Averaging between generations is better than averaging within generations, because the arithmetic mean is larger than the geometric mean

Competition (8)

21. An ecologist wants to know what will happen in the short term if an invasive species (species 1) is accidentally introduced into a community where its competitor (species 2) is in equilibrium. The most important quantity to examine is:

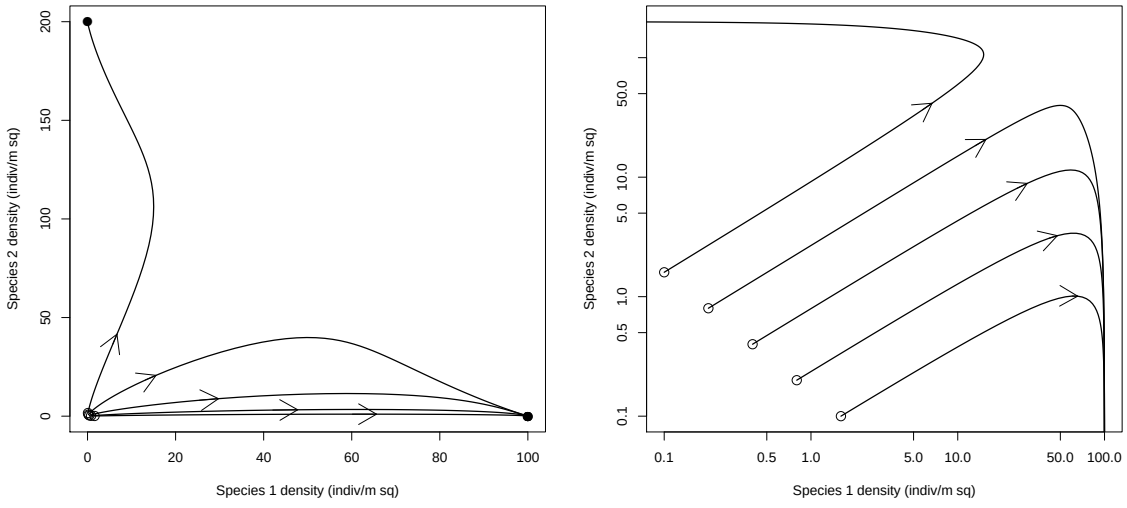
A. The individual-level competitive effect of species 1 on species 2 (α_{12})
B. The individual-level competitive effect of species 2 on species 1 (α_{21})
C. **The population-level competitive effect of species 1 on species 2 (E_{12})**
D. The population-level competitive effect of species 2 on species 1 (E_{21})

22. If K_1 is measured in units of indiv_1, and K_2 is measured in units of indiv_2, what are the units of α_{21}? (see Formulas section if necessary.)

A. indiv_1
B. indiv_2
C. $\text{indiv}_1/\,\text{indiv}_2$
D. $\text{indiv}_2/\,\text{indiv}_1$
ANS: C

23. In competition between a grass species and a tree species, what is a reason that *interspecific* competion (between different species) might be stronger than *intraspecific* competition?

A. **If the grasses encourage frequent, low-intensity fires, which hurt the trees more than they hurt the grasses**
B. If trees require high soil nitrogen, but the grasses have nitrogen-fixing bacteria and don't depend on soil nitrogen
C. If grass uses water in shallow soil layers while trees use water in deep soil layers
D. If the two species both compete for light
E. If individuals of both species use water in proportion to their biomass



Use the phase plot above (shown on two different scales) for the next two questions.

24. The figures show

A. Balanced competition
B. Equal competition
C. **Founder control**
D. Dominance
E. Coexistence

25. Species _____ has a larger value of K, and species _____ has a larger value of $r_{\max}$.

A. 1; 1
B. 1; 2
C. **2; 1**
D. 2; 2

26. On our planet (Earth), we observe a large diversity of competing species, despite the principle of competitive exclusion, which states that two species should not be able to co-exist in the same niche. Which of the following is *not* a possible explanation?

A. Species dynamics may be stabilized by non-competitive factors (like natural enemies)

B. **Some species have specialized mechanisms to suppress competition (like allelopathy, where plants release chemicals that can kill other species of plants)**

C. Environmental variation may create situations where some species do better under some conditions, and others do better under other conditions

D. Competing species may use resources differently – for example, one species may be more efficient at gathering light, and another may be more efficient at using nitrogen

Use this information for the next two questions. Two competing species of vulture use more or less exactly the same food resources. Species A is more efficient at finding food resources, and outcompetes Species B in favorable environments. Species B is more efficient at using water, and outcompetes Species A in drier environments. In intermediate environments, the two species co-exist.

27. In this case, we expect:

A. **Species A and B both have larger fundamental than realized niches**

B. Species A and B both have larger realized than fundamental niches

C. Species A has a larger fundamental than realized niche; while Species B has a larger realized than fundamental niche

D. Species B has a larger fundamental than realized niche; while Species A has a larger realized than fundamental niche

28. When these vultures are in intermediate environments, we _____ that both of the individual-level competition coefficients (α) < 1, and _____ that both of the population-level competition coefficients (E) < 1.

A. know; know
B. know; don't know
C. **don't know; know**
D. don't know; don't know

Predation (9)

29. Which of the following is the most accurate explanation for the reciprocal control theory of why cod densities apparently went up in the early days of mass fishing?

A. Reduced cod density dependence due to people catching cod
B. Reduced cod density dependence due to people catching sharks
C. Increased cod needed to regain equilibrium and balance the effect of people catching cod
D. **Increased cod needed to regain equilibrium and balance the effect of people catching sharks**

30. Why do we usually add density dependence in the resource species in a model of exploitation, but less often add it for the exploiter species?

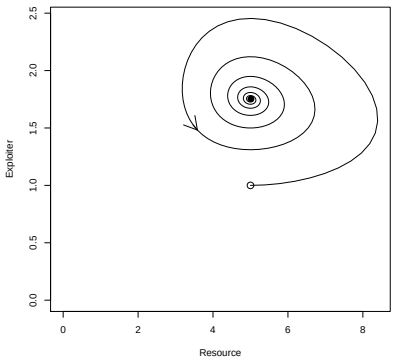
A. Because exploiters are not likely to experience density dependence
B. **Because explicitly modeling the resource species already provides a form of density dependence for the exploiter**
C. Because density dependence for the resource species is stabilizing, while density dependence for the exploiter species is destabilizing
D. Because density dependence for the resource species is destabilizing, while density dependence for the exploiter species is stabilizing

31. Resource-exploiter systems have an intrinsic tendency to oscillate because:

A. Each species has a direct, positive effect on its own growth rate
B. Each species has an indirect, positive effect on its own growth rate
C. Each species has a direct, negative effect on its own growth rate
D. **Each species has an indirect, negative effect on its own growth rate**

32. Which of the following effects tends to damp oscillations in a predator-prey interaction model?

A. Density dependence in the predator
B. Density dependence in the prey
C. Predator satiation
D. **Either A or B**
E. Either B or C



Use the figure above for the next three questions. It shows a simple model of an interaction between an exploiter and a resource species.

33. The figure above shows:

A. Unstable oscillations
B. Neutral oscillations
C. Persistent oscillations
D. **Damped oscillations**

34. This figure is consistent with a simple model that has:

A. No density dependence and weak predator satiation
B. No density dependence and strong predator satiation
C. **Prey density dependence and weak predator satiation**
D. Prey density dependence and strong predator satiation

35. If we were to add *predator density dependence* to the model discussed above, we would expect to see:

A. Unstable oscillations
B. Neutral oscillations
C. Persistent oscillations
D. **Damped oscillations**

Use the following information for the next two questions. A large lake has big fish and small fish at equilibrium under reciprocal control – ie., the small fish are controlled by predation from large fish, and the large fish are controlled by the food supply of small fish. Fishing has been prohibited in this lake for many years, but now will be allowed at a relatively low level that is not expected to change the fact that the two kinds of fish are the main factors controlling each others' population growth. Both big and small fish will be caught and taken.

36. What effect would you expect to see in the *short term*?

A. Populations of both small and large fish increase
B. Populations of small fish decline, while populations of large fish increase
C. Populations of large fish decline, while populations of small fish increase
D. **Populations of both small and large fish decline**

37. What effect would you expect to see in the *long term*?

A. Populations of both small and large fish increase
B. Populations of small fish decline, while populations of large fish increase
C. **Populations of large fish decline, while populations of small fish increase**
D. Populations of both small and large fish decline

Disease (3)

38. What does β represent in the equation

$$dI/dt = \beta SI/N - \gamma I?$$

A. **The rate at which individuals make potentially infectious contacts**
B. The average amount of time it takes an individual to make a potentially infectious contact
C. The rate at which individuals leave the infectious class
D. The average amount of time it takes an individual to leave the infectious class

39. If a new disease is introduced to a susceptible population, and $\mathcal{R}_0 > 1$, we expect it to:

A. grow linearly until equilibrium is reached
B. grow exponentially until everyone is infected
C. **grow exponentially at first and then grow less than exponentially as susceptibles are depleted**
D. grow less than exponentially at first and then exponentially as it becomes established in the population

40. Early investigations of disease models suggested that malaria could be eliminated from the Panama Canal zone if _____ could be reduced below _____.

A. $\mathcal{R}_0$; 0
B. $\mathcal{R}_0$**; 1**
C. $\mathcal{R}_{\text{eff}}$; 0
D. $\mathcal{R}_{\text{eff}}$; 1