Ty Spangler

1. It's easier to demonstrate that a theory is incorrect because you only need to show that that theory does not hold up in one situation. Conversely, if you demonstrate that a theory is true in one situation, it doesn't prove that the theory would be true in every situation. It would be impossible to prove that a theory is true in every situation so theory must be accepted based on reasonable testing and observation over time, which is much more difficult than simply refuting a theory.

2. The world's human population size is expected to double in size in approximately 50 years. Assuming continuous exponential population growth, calculate r for the human population. If the population size in 2009 was 6.9 billion, what is the projected population size for the year 2050?

$$1.38\times10^{10} = 6.9\times10^{9} \bullet e^{50r}$$

$$ln1.38\times10^{10} = ln6.9\times10^{9} \bullet 50r$$

$$1.03 = 50r$$

$$r = 0.021$$

$$N(50) = 6.9\times10^{9}e^{.021\bullet41}$$

$$N(50) = 1.63\times10^{10} \text{ people}$$

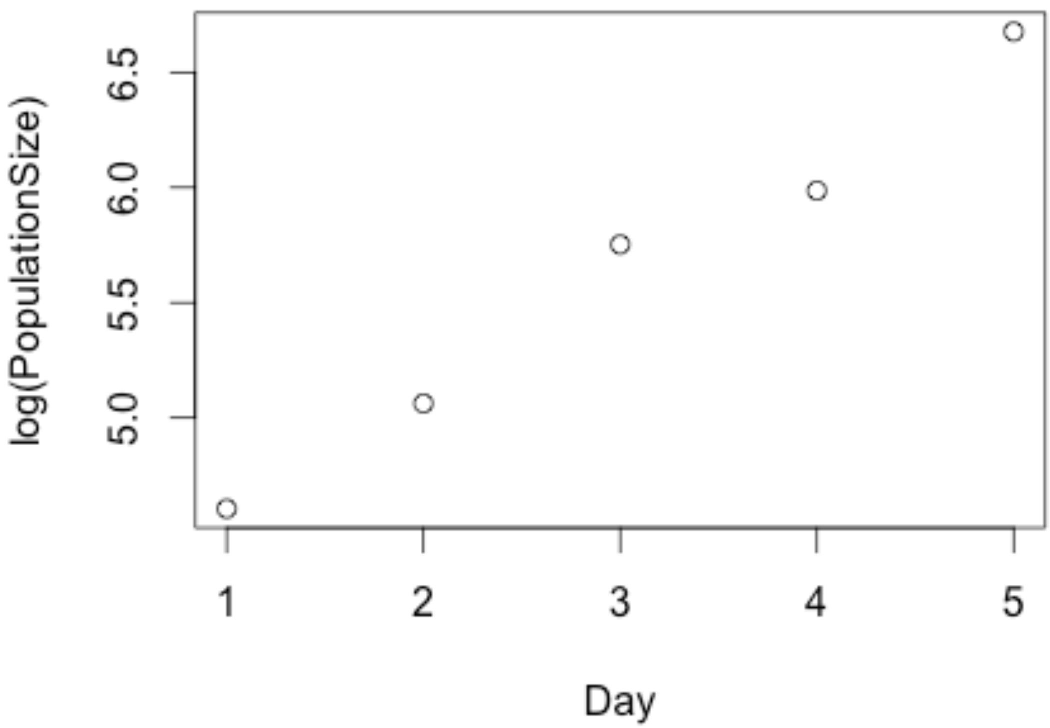
3. A population of annual grasses increases by 12% every year. What is the approximate doubling time?

   For the population to double it would need to increase by 100%. 100/12 = 8.33. Therefore, the approximate doubling time is 8 years and 4 months.

4. I think that the human death rate isn't significantly density dependent, however, density does have an effect on death rate. One major cause of death is traffic accidents. This can be thought of as density dependent because, the higher the density, the higher the likelihood of a fatal accident. Density will also affect supply and demand dynamics and high density can drive prices up, which could negatively impact the fitness of certain individuals. Higher density could also increase the number of violent interactions leading to more deaths.

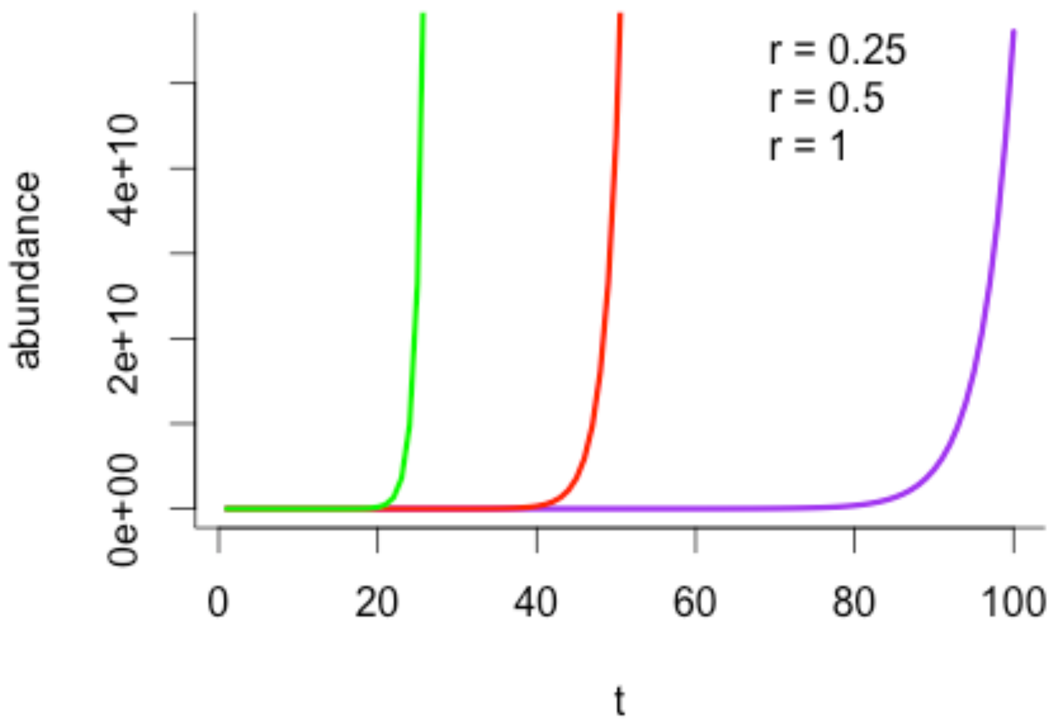
5. Dungeness crab should be modeled using a discrete rather than continuous framework because they reproduce at around the same time every year and grow at a predictable rate. Due to commercial catches, the male population is almost completely caught, allowing us to know the population size of individuals that age, typically 4 years old. Additionally, estimations of populations can be made by capturing larval stages of the crab. Their future populations can then be accurately predicted on a yearly basis by the timing of the spring transition.

6.
```
# Population vector
PopulationSize <- c(100,158,315,398,794)

# Time vector
Day <- 1:5

# log base e plot with population size as y axis and day as x axis
plot(log(PopulationSize) ~ Day)

## slope of this line
lm(log(PopulationSize) ~ Day)$coefficients[2]
r=.507
```



7.
```
install.packages('deSolve')
library(deSolve)
p <- c('r' = 0.25)
y0 <- c('N' = 1)
t <- 1:100

exp.growth <- function(t, y, p)
 {N <- y[1]
 with(as.list(p), {
  dN.dt <- r * N
  return(list(dN.dt))
 })}

sim <- ode(y = y0, times = t, func = exp.growth, parms = p, method = 'lsoda')
head(sim)
class(sim)
sim.frame <- as.data.frame(sim)

names(sim.frame)
names(sim.frame) <- c('t', 'abundance')
```

```
sim.frame$t
sim.frame$abundance

## plot the first simulation here
plot(abundance ~ t, data = sim.frame, type = 'l', lwd = 3, col = 'purple', bty
='l')
 ?points

## now let's simulate the model with other r's
p.2 <- c('r' = 0.5)
sim.2 <- ode(y = y0, times = t, func = exp.growth, parms = p.2, method
='lsoda')
sm.frame.2 <- as.data.frame(sim.2)

names(sim.frame.2) <- c('t', 'abundance')
# sim.frame$t
# sim.frame$abundance

## add to plot
points(abundance ~ t, data = sim.frame.2, type = 'l', lwd = 3, col = 'red', bty
='l')

p.3 <- c('r' = 1)
sim.3 <- ode(y = y0, times = t, func = exp.growth, parms = p.3, method =
'lsoda')
sim.frame.3 <- as.data.frame(sim.3)

names(sim.frame.3) <- c('t', 'abundance')
# sim.frame$t
# sim.frame$abundance

## add to plot
points(abundance ~ t, data = sim.frame.3, type = 'l', lwd = 3, col = 'green', bty
= 'l')

## add a simple legend
legend(x = 60, y = 6e10, c('r = 0.25', 'r = 0.5', 'r = 1'), col = c('purple', 'red',
'green'), bty = 'n')
```


r = 0.25
r = 0.5
r = 1
abundance
0e+00
2e+10
4e+10
0
20
40
60
80
100
t