pHandDyingRoughDraft

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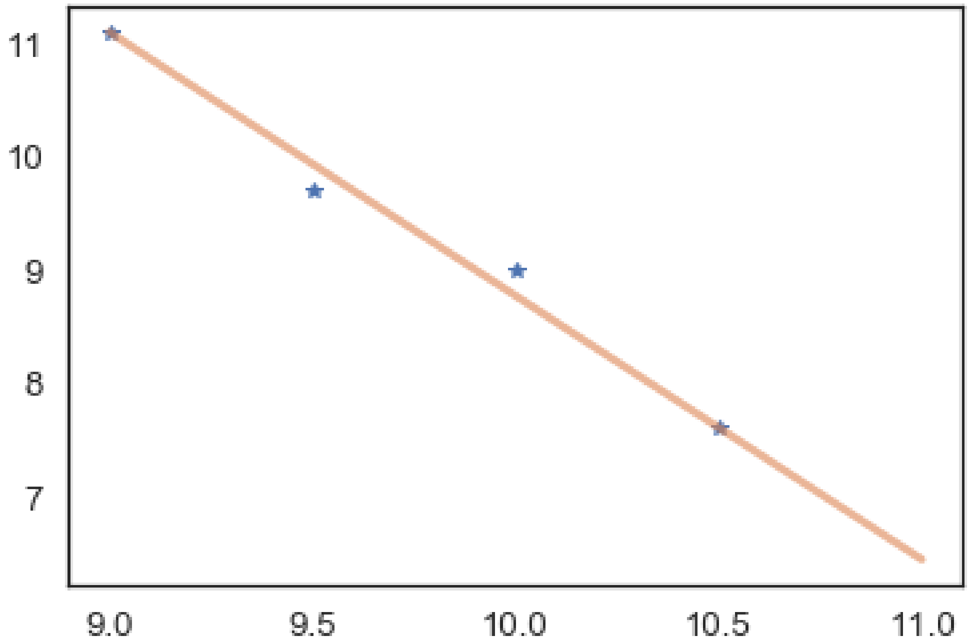
1 pH and Dying

Meagan Rittmanic & Dieter Brehm - Project 1 - Fall 2018
A project examining how to model an assumed relation between crustaceans and pH levels

In [2]:
```
# Configure Jupyter so figures appear in the noebook
%matplotlib inline

# import functions from the modsim.py module
from modsim import *
import random
import matplotlib.pyplot as plt
```

In [8]:
```
# Plot our data points for pH levels and crustacean birth rates
plt.plot([9,9.5,10,10.5], [11.1, 9.7, 9, 7.6], '*')

# Create a best-fit line
def run_match():
    match = TimeSeries()
    match[9] = 11.1
    for p in linrange(9, 11, 1):
        match [p+1] = match[p] - 2.33
    return match

# overlay the fit line with our data
p2 = run_match()
plot (p2)
plt.show()
```




```
In [5]: def run_match2():
            match = TimeSeries()
            match[9] = 11.1
            for p in linrange(9, 11, 1):
                match [p+1] = match[p] - 2.33
            return match[11]
        run_match2()
```

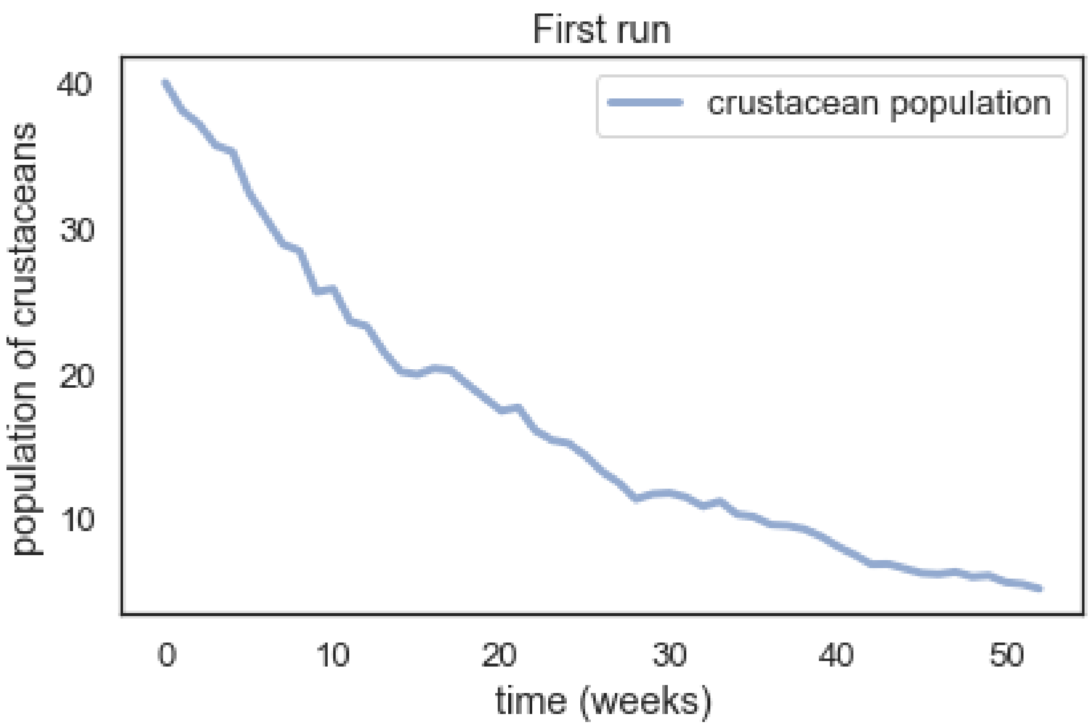
```
Out[5]: 6.4399999999999995
```

```
In [80]: # set our constants
         birth_rate_normal = 0.12
         birth = run_match2()
         birth1 = birth_rate_normal*(birth/11.1)
         values = System(death=0.1, birth_lb = birth1-0.07, birth_ub = birth1+0.07, pop_0 = 40
```

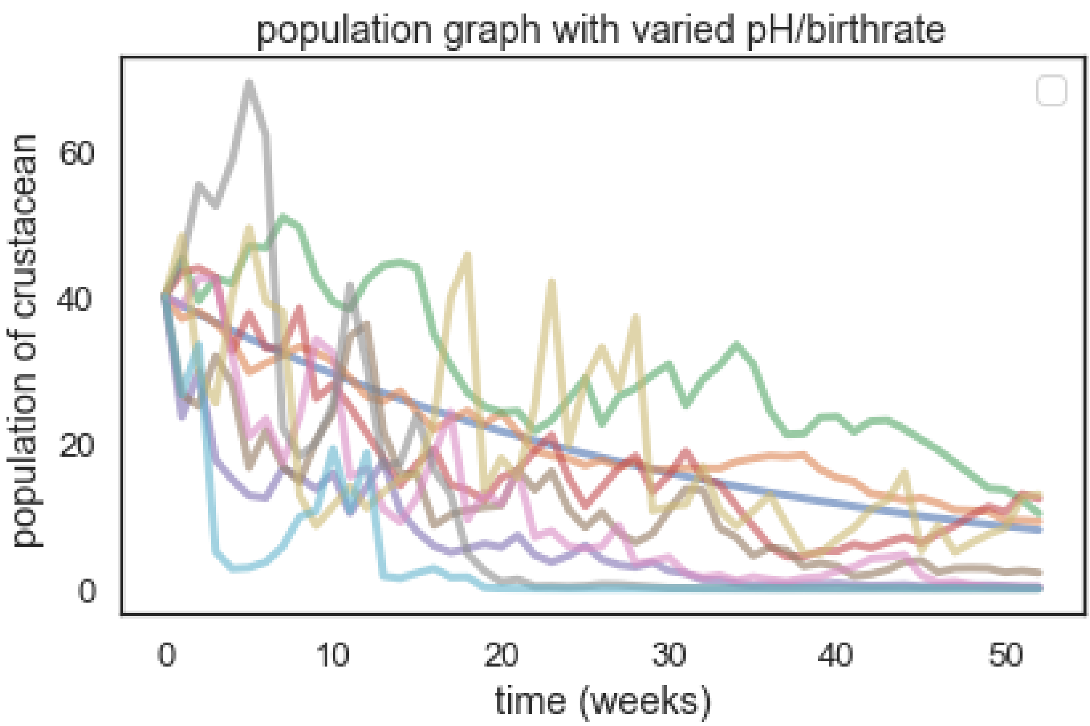
```
In [81]: def run_ph_sim(system):
             """
             Runs the simulation

             system: a System object with our initial constants, relies on:
                     - pop_0: initial population
                     - birthi: lower range deviation of birthrate due to pH
                     - birthii: upper range deviation of birthrate due to pH
                     - death: death rate
```

```
                - time period: how many weeks to run the simulation for

            Return TimeSeries with results
            """
            run = TimeSeries()
            run[0] = system.pop_0
            for t in linrange (0, values.time_period, 1):
                for x in range(1):
                    b = random.uniform(system.birth_lb, system.birth_ub)
                run[t+1] = run[t] + run[t]*(b)-run[t]*(system.death)
            return run

        def plot_rps(variable, title):
            """
            Plots data

            variable: the data we want to graph
            title: the title of the graph

            directly plots data with no return statement
            """
            plot (variable, label = 'crustacean population')
            decorate(xlabel = 'time (weeks)',
                    ylabel = 'population of crustaceans',
                    title = title)
```

```
In [82]: x = run_ph_sim(values)
         plot_rps(x, 'First run')
```




```
In [112]: # sweep for a few different birthrate / pH ranges
          birth_ub_array = linspace(0, 0.9, 10);

          for rate in birth_ub_array:
              # for now, let's keep the upper and lower limits absolute value the same
              values.birth_lb = birth1 - rate
              values.birth_ub = birth1 + rate
              x = run_ph_sim(values)
              plot(x)

          decorate(xlabel = 'time (weeks)',
                   ylabel = 'population of crustacean',
                   title = "population graph with varied pH/birthrate")
```




```
In [113]: def run_ph_sim2(system):
              """
              Runs the simulation

              system: a System object with our initial constants, relies on:
                      - pop_0: initial population
                      - birthi: lower range deviation of birthrate due to pH
                      - birthii: upper range deviation of birthrate due to pH
                      - death: death rate
                      - time period: how many weeks to run the simulation for

              Return TimeSeries with 52nd result
              """
              run = TimeSeries()
              run[0] = system.pop_0

              for t in linrange (0, values.time_period, 1):
                  for x in range(1):
                      # randomly select a decimal number between
                      # the lower and upper birth rate(pH) bounds
                      b = random.uniform(system.birth_lb, system.birth_ub)
                  run[t+1] = run[t] + run[t]*(b)-run[t]*(system.death)
              return run[52]
```

In [114]:
```
def run_program(number_of_runs, system, state):
    """
    Runs the simulation multiple times

    number_of_runs: how many times we want to run the simulation
    system: a System object with our initial constants, relies on:
            - extinct: tracks number of runs in which the population went extinct
    state: a State object with the number of extinctions that have occured

    """
    for i in range (number_of_runs):
        x = run_ph_sim2(system)
        if x<=8:
            extinct.extinct +=1
    return extinct.extinct
```

In [115]:
```
# run the simulation 100 times
extinct = State(extinct = 0)
extinctions = run_program(12, values, extinct)
print(extinctions)
```

```
12
```