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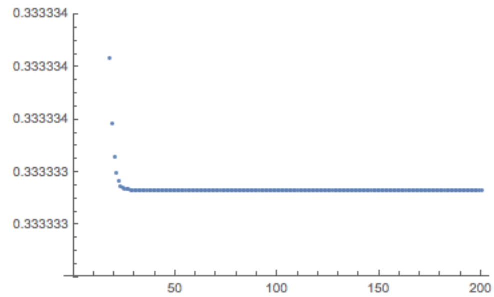
Homework

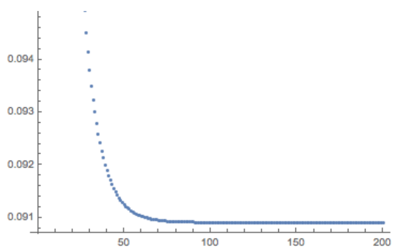
The logistic difference equation, governing population growth, is given by $x_{n+1} = rx_n(1 - x_n)$, in which r is the growth rate parameter. In the following exercises take the initial condition, x_1, to be 0.5.

1. Write a compute code (which utilizes either a for loop or a do loop) to analyze the behavior of the logistic equation for $r = 1.5$.

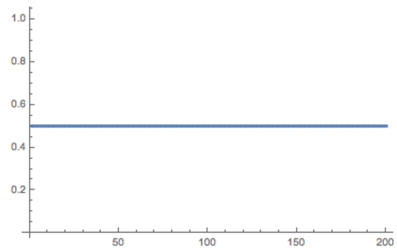
```
Population[r_, parg_: Automatic] :=
(
  x = Table[n, {n, 1, 200}];
  x[[1]] = 0.5;
  For[n = 2, n <= 200, n++,
   x[[n]] = r*x[[n - 1]]*(1 - x[[n - 1]])];
  ListPlot[x, PlotRange -> parg]
)
Population[1.5]
```



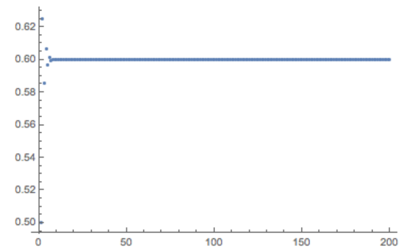
2. Try several other values of the growth rate parameter in the range $1 < r < 3$. Do your results support the conjecture that the limiting population always exists and is an increasing function or r?



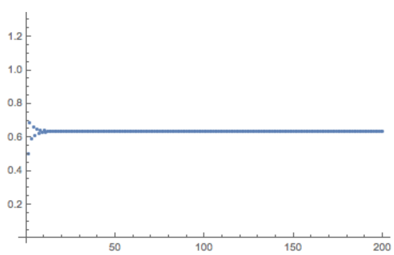
$r = 1.1$



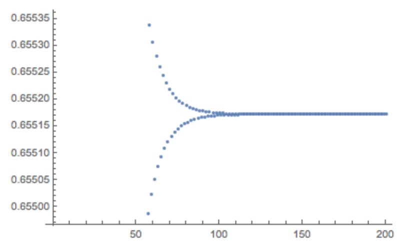
$r = 2.0$



$r = 2.5$



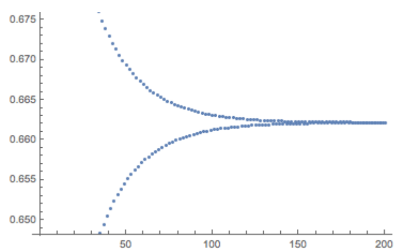
$r = 2.75$



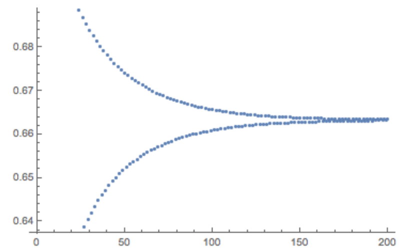
$r = 2.9$

It's not always increasing, but the limiting population does always exist.

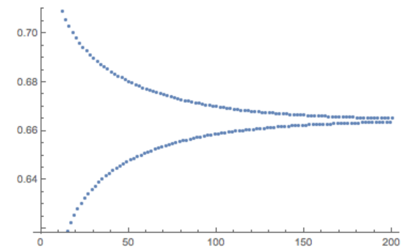
3. Try values of the growth rate parameter in the range $2.9 < r < 3.1$ to determine as closely as possible just where the single limiting population splits into a cycle of period 2.



$r = 2.96$



$r = 2.97$



$r = 2.98$

The population appears to begin to split around $2.97 < r < 2.98$.

4. Verify that a cycle with period 16 is obtained with the growth rate parameter $r = 3.565$.

```
Population[3.565]
```