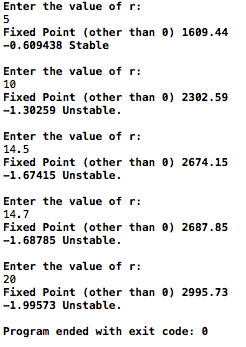
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**Mathematical Modeling Project #3**

a) 

|  |  |  |  |
| --- | --- | --- | --- |
| **r** | **Fixed Point** | **Stability Value** | **Stable/Unstable** |
| 5 | 0 | 5 | Unstable |
| 5 | 1609.438 | -0.609 | Stable |

b)

|  |  |  |  |
| --- | --- | --- | --- |
| 10 | 0 | 10 | Unstable |
| 10 | 2302.585 | -1.303 | Unstable |

At {3670.5744, 934.5958}, the iterations falls into a stable 2-cycle. With different initial values below 200,000, we see the values switch between 3670.5744 and 934.5958. The iterations show that the model is stable, and the value of the derivative evaluated at {a,b} is less than 1, therefore proving a stable 2-cycle.

This becomes less apparent when the initial value is above 200,000. Interestingly, when the initial value is above this value, the only thing that changes is the exponent’s power after iteration. For example, an initial value of 300,000 outputs some variation of 1.5445 E -120, but this falls into a 2-cycle later on, after hundreds of iterations. \

c)

|  |  |  |  |
| --- | --- | --- | --- |
| 14.5 | 0 | 14.5 | Unstable |
| 14.5 | 2674.149 | -1.674 | Unstable |

With r=14.5, the population model had was a 7-cycle.

The smaller the initial value, the sooner the m-cycle is apparent. The model falls into a stable pattern of 373.242, 3726.164, 1301.30, 5135.68, etc. The iterations showed that if the population began in the tens of thousands up until the 290,000s, the P100 would be a positive number. After that, the values became increasingly more negative, until, they fall into the stable 7-cycle.

d)

|  |  |  |  |
| --- | --- | --- | --- |
| 14.7 | 0 | 14.7 | Unstable |
| 14.7 | 2687.847 | -1.688 | Unstable |

With r=14.7, again, the value of P100 is only positive when the initial value is below 290,000. This model was a 16-Cycle, repeating 454.2845988, 4239.865247, 898.0888572,5377.762369, 365.0786372, 3725.221646, 1320.159021, etc.

At first glance, this value of r seems to reveal no pattern, but after graphing the points, it was clear that this was an m-cycle.

e)

|  |  |  |  |
| --- | --- | --- | --- |
| 20 | 0 | 20 | Unstable |
| 20 | 2995.732 | -1.996 | Unstable |

As the chart below shows, there does not seem to be a pattern even in the asymptotic dynamics. With a value of r= 20, the population model, with each point consistently positive because the initial value for this chart is 40,000, the data remains unstable. The graph reveals that there is some oscillation in the numbers, but it does not appear to be the smae set of values each time.