2. The formula for the parabola is $R = -\frac{0.7}{200^2}u^2 + 0.7$, so the discrete dynamical system is

$$u(n) = u(n-1) + \left(-\frac{0.7}{200^2}u^2(n-1) + 0.7\right) \cdot u(n-1)$$

The equilibrium values are -2000, 0, and 2000. You should be able to quickly find these without doing any algebra. The equilibrium value 2000 is stable and its maximum interval of stability is $\left(0, 2000\sqrt{17/7}\right) \approx (0, 3116.77)$. If we let $u(0)$ be a number in this interval other than 2000, we find that

$$\lim_{n\to\infty} \frac{u(n) - 2000}{u(n-1) - 2000} = -0.4$$

So for large enough n, $u(n)$ oscillates about its equilibrium value of 2000 and gets approximately 60% closer each time period.

6. (a) $a = -\frac{0.2}{100^4}$, $r = 0.2 - \frac{0.2}{100^4}u^4$, graph not shown.

   (b) $u(n) = u(n-1) + \left(0.2 - \frac{0.2}{100^4}u^4(n-1)\right) \cdot u(n-1)$ has equilibrium values -100, 0, and 100. You should be able to quickly find these without doing any algebra.

   (c) The equilibrium value 0 is unstable. The equilibrium value 100 is stable and its maximum interval of stability is $\left(0, 100\sqrt[4]{6}\right) \approx (0, 156.5)$. If we let $u(0)$ be a number in this interval other than 100, we find that

$$\lim_{n\to\infty} \frac{u(n) - 100}{u(n-1) - 100} = 0.2$$

   So for large enough n, $u(n)$ approaches its equilibrium value of 100 and gets approximately 80% closer each time period.

10. (a) $r = -\frac{0.3}{1000^2}(u - 1200)^2 + 0.3$. On the graph of this parabola one sees that the growth rate is negative for $u < 200$ or $u > 2200$.

   (b) $u(n) = u(n-1) + \left(-\frac{0.3}{1000^2}(u(n-1) - 1200)^2 + 0.3\right) \cdot u(n-1)$ has equilibrium values 0, 200, and 2200. You should be able to quickly find these without doing any algebra. The equilibrium value 0 is stable. The equilibrium value 200 is unstable. The equilibrium value 2200 is stable and its maximum interval of stability is $\left(200, 1100 + \frac{100}{3}\sqrt{4089}\right) \approx (200, 3231.5)$. If we let $u(0)$ be a number in this interval other than 2200, we find that

$$\lim_{n\to\infty} \frac{u(n) - 2200}{u(n-1) - 2200} \approx -0.32$$

   So for large enough n, $u(n)$ oscillates about its equilibrium value of 2200 and gets approximately 68% closer each time period.

   The minimum viable population is 200.