**Math 10A**
**Worksheet, Discussion** #30; **Friday, 7/27/2018**
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# 1 Logistic Growth

## 1.1 Problems

1. **TRUE** False A semistable equilibrium occurs in the differential equation $\frac{dP}{dt} = P(K-P) - h$ when the quadratic polynomial $P(K-P) - h$ has a double root.

2. **TRUE** False It is not possible for there to be no unstable equilibria and two stable equilibria.

3. The percentage of wolves in a population is modeled by the differential equation $\frac{dy}{dt} = y(1-y)(1-3y)$. Sketch some solutions and classify all the equilibria. What will the percentage of wolves be if initially there are an equal amount of wolves and bunny.

   **Solution:** The equilibria are $0, 1, 1/3$. If we draw it out, we see that $0, 1$ are unstable and $1/3$ is stable. If we start with $1/2$ wolves, then we will end up $1/3$ wolves in the future.

4. Draw some solutions and classify the equilibria of $\frac{dy}{dt} = y(2-y) - 1$.

   **Solution:** We have $y(2-y) - 1 = -y^2 + 2y - 1 = -(y-1)^2$ so theres only one equilibria of $y = 1$ which is semistable.

5. Sketch some solutions and classify the equilibria of $\frac{dy}{dt} = 4 - y^2$.

   **Solution:** The equilibria are $y = \pm 2$. $y = -2$ is unstable and $y = 2$ is stable.

6. Sketch some solutions and classify the equilibria of $\frac{dy}{dt} = y^2(2-y)(4-y)$.

   **Solution:** The equilibria are $y = 0, 2, 4$. Drawing solutions, we see that $y = 0$ is semistable, $y = 2$ is stable, $y = 4$ is unstable.

7. Sketch some solutions and classify the equilibria of $\frac{dy}{dt} = y(1+y)(y-1)(3-y)$.

**Solution:** The equilibria are $y = -1, 0, 1, 3$. In order, they are unstable, stable, unstable, stable respectively.