ECON-A4000 - Economics of Global Challenges

Instructor: Matti Liski

TA: Max Toikka

Return method: through mycourses by the deadline (March 16, submission link to appear)

Problem Set I: Question 1

I begin this question with a quote: "*In 2014, the World Bank conducted an analysis of Mauritania's existing capital stock to assess the country's produced, intangible, and natural capital — both renewable and nonrenewable. The study results showed that the country's stock of natural capital amounts to approximately US$30–35 billion, or roughly US$9,000 per capita, and represents 44 percent of the total capital. More than half of the country's natural wealth is concentrated in renewable resources, which, given effective sustainability-focused policies, could theoretically support a continuous income flow over the long term. Such sustainable management is not a given, however, and unsustainable management of renewable resources can lead to permanent depletion of capital stocks in much the same way as the finite extraction of nonrenewable resources.*" World Bank, 2017 (Link).

1. Follow the directions in this *video* to produce a logistic growth function $F(x) = rx(1 - \frac{x}{K})$. In the video, I use $r = .3$ and $K = 50$, with the same interpretation of the parameters as in the lectures (the decimal separator in the video is comma while here it is dot).

    - Draw a figure where the horizontal axis depicts x (first column) and the vertical shows growth $F(x)$ (second column). In the absence of any harvesting (e.g., fishing), what is the "biological" equilibrium? That is, at what level should we expect the resource stock to settle?

- During the class we discussed the growth of the resource over time. Can you use your spreadsheet to show how the resource grows over time if we start with relatively low initial level, e.g., $x = 1$ in the beginning? That is, this would be graph where time is on the horizontal axis and x on the vertical axis. If you find it difficult to calculate the development using the spreadsheet, you may draw the figure by hand. In this case, you may draw first a graph for $K = \infty$. Then, you can add a finite carrying capacity to explain its impact on the resource development.
- At what resource level we can achieve the highest growth of the resource? You can see this from your first graph for $F(x)$, or you can also find this analytically.
- Assume now that the harvested amount depends on the effort and level of the stock, $H = Ex$. This is exactly as in the lecture. Let us assume that effort is fixed at $E = .2$. What is now the equilibrium harvest and resource stock level? Hint: You can take the gross growth $F(x)$ as above and deduct harvest at each resource level to obtain the net growth $F(x) - H$. In equilibrium, this net growth is zero. You can find this level by drawing a figure or analytically.
- Consider the equilibrium resource stock from the previous item where $E = .2$. In the class we learned that by allowing the stock to recover, the fishermen could get the same harvest with less effort. Can you find the effort level and recovered stock level that give the same harvest as above? You can find this recovered resource stock level by drawing a figure or analytically.
- It is possible use your spreadsheet to discuss how long it would take for the stock to recover if the effort was reduced as described in the previous item. This is a bonus item for those who get excited :>)