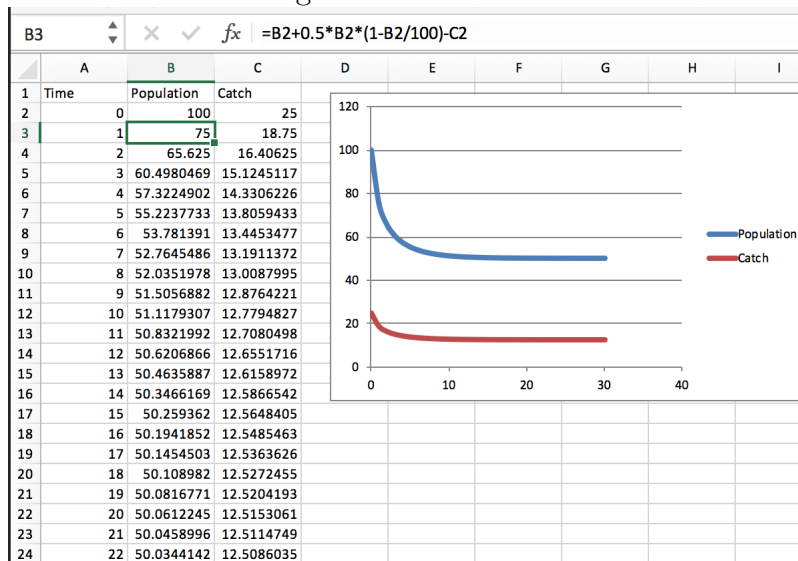


Problem Set #3 – Economics 409 & 639 - Due Friday October 9th by 4pm

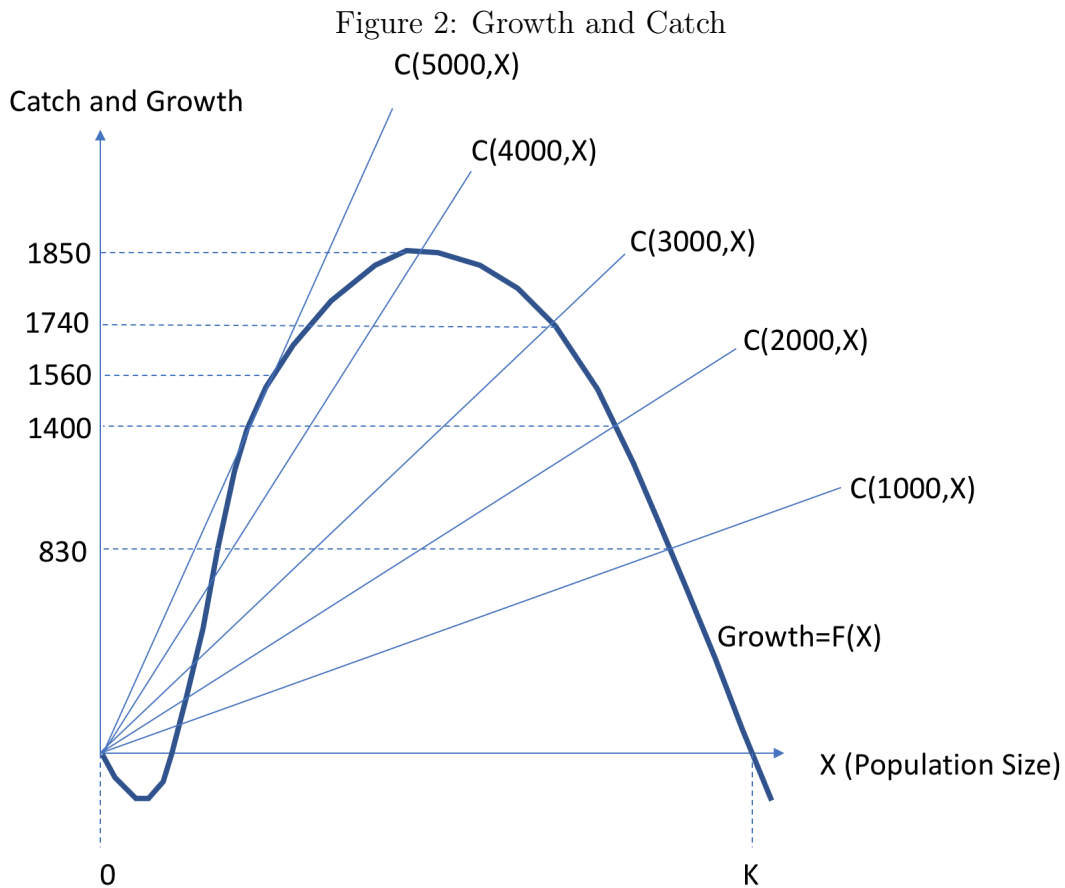
Email to le20@hawaii.edu.

Figure 1: Screenshot



1. Open up your answer to Problem Set #2 Question #3. Set the starting population size in cell B2 (X_0) equal to carrying capacity: 100. So your graph of population over time should initially just look like a horizontal line since the population starts out at carrying capacity. Now create a new column in Column C in your spreadsheet by labelling it “Catch”. Let’s start out by assuming that fishing effort is such that boats always catch 25% of the population. So, in cell C2, enter the following code: “=B2*0.25”. Autofill this code into cells C3-C32. Now here’s the tricky part. In time

period 1, we need to add the growth to the population like before but now we also need to subtract the catch. In cell B3, type in the following code without the quotation marks: `"=B2+0.5*B2*(1-B2/100)-C2"`. This adds growth and subtracts catch from the last time period. Auto fill this code to cells B4 to B32. Make a graph showing both population and catch over time. Your screen should look a little something like Figure 1. Now let's increase fishing effort so that the boats always catch 50% of the population. Before you do this, write down as your answer to this question what you expect to happen and why? Do you expect catch to be higher or lower initially? What about in the long-term (or steady state)? Change the code in cell C2 to `"=B2*0.5"` and then autofill to cells C3-C32 to see what happens. Write down what you observe. Submit pictures of the two graphs (one for 25% catch and one for 50% catch) as part of your answer.



2. The diagram in Figure 2 shows two relationships that apply to a fishery. $F(X)$ is the relationship between total growth F in the fish population and the fish stock X . $C(E, X)$ is the relationship between the catch C , the level of effort E (here given integer values), and the fish stock X .
- Why does the Catch function pivot up with increases in Effort (E)?
 - For any effort level less than 5000, there are three points of intersection (including the origin) between the C and F functions. What do those three points signify? Which of the three is locally stable? Why? *[Hint: imagine the population is slightly above or below one of these three points, will it move towards or away from the point of intersection (see the lecture notes)]*
 - Suppose the price of fish is \$2.50. Derive and plot 5 points on the Total Revenue curve associated with each level of effort shown and with zero effort. You can use Excel, similar software or draw it by hand.
 - Suppose the cost of a unit of effort is \$1. On the same graph as your Total Revenue plot, graph the Total Cost curve. What (approximately, based on labeling and eyeballing these points on a graph) is OA , the level of aggregate effort under open access? What (approximately) is SO , the efficient level of effort? What is the social "waste" under unregulated, open access? Why must SO always be less than MSY , the level of effort that leads to the maximum sustainable yield?
 - Suppose that the fishery manager wants to control the total catch through equal catch licenses. Suppose each license entitles the owner to a certain level of catch, and that there are 20 licensees. If each license allows the same maximum catch, approximately what catch level should this be to (i) maximize total profits (ii) maximize catch? What types of fishers will be better off, and who might be worse off, under (i) and (ii)?
3. Open the "Hawaii Longline Data – NO CPUE" file on your computer. The data for

billfishes, sharks, tunas, Other Pelagic Management Unit Species (wahoo, mahimahi, etc.), and Total Catch are in numbers of fish caught per year.

- (a) Make a graph of Total Catch over time. Is Total Catch increasing or decreasing?
 - (b) Make a graph of Total Catch per Boat over time. Is it increasing or decreasing?
 - (c) Make a graph of Total Catch per trip over time. Is it increasing or decreasing?
 - (d) Make a graph of Total Catch per set over time. Is it increasing or decreasing?
 - (e) Make a graph of Total Catch per 1000 hooks over time. Is it increasing or decreasing?
 - (f) Which of the CPUE measures do you think is the most accurate indicator of biomass? Why?
 - (g) Based on your analysis, biomass in 2014 is what % of 1991 biomass? Use the same approach to compare the average biomass in 2011-2014 to the average biomass in 1991-1994.
4. Explain, in your own words, the three arguments that Watson and Pauly (2001) give for their suspicions regarding China's official catch statistics.
5. **Stock Assessment.** Use the data below on the famous Mānoafish fishery to answer the following questions.

Year	Catch (tons)	Effort (boats)
2004	100	50
2005	96	45
2006	75	30
2007	45	20
2008	52	15
2009	32	8
2010	20	5
2011	9	2
2012	8	1.5
2013	7	1

- (a) Make a plot of catch over time using Excel or similar software. Copy and paste the graph into the document you are writing to answer the other questions. Based purely on catch statistics, would you conclude that this stock is increasing or decreasing over time?
 - (b) In which years would this fishery be categorized as “collapsed” (according to the definition in Worm et al. (2006))?
 - (c) Now make a plot of Catch Per Unit Effort over time. Based on CPUE, would you conclude that this stock is increasing or decreasing over time?
 - (d) A group of fisheries scientists has concluded that the catchability coefficient, q , of the Mānoafish is 0.00001 (if catch is measured in tons and effort is measured in boats). How many Mānoafish were in the ocean in 2013?
6. Think about a Tragedy of the Commons situation in your daily life (this could be anything from your roommates not cleaning the dishes to traffic to too many people at the beach/in the surf). For each of Ostrom’s seven principles (see pg. 90 of the Governing the Commons reading), explain whether or not the principle applies to your

particular common property resource. Does this help you understand whether resource users will be able to solve the tragedy themselves or do they need outside help?

Here's an example I've started using traffic in Honolulu...

Principle	Does it apply?	Why/Why not?
Clearly defined boundaries (place and people)	Not really	The place is clear (where the roads are) but the users are hard to define, technically anyone in the world with a driver's license can drive on the roads in Honolulu
Consistency between extraction and contribution (those who give the most get to take the most)	No	If I drive a little or avoid rush-hour, I don't get any special rewards from other drivers. People who drive a lot do not also spend a lot of time trying to reduce traffic.
Democratic	Yes, sort of	All adult road users in Hawaii get to vote for politicians and laws that determine the rules of the road and traffic policies (e.g. the Rail vote)