Technology and Economics 2021 - Fake Exam

1) Suppose that two firms are in a patent race. They decide whether to undertake R&D investments in a new technology or not. The surplus from this particular new technology is $S = 100$. The cost of R&D is 10. The probability of successful R&D is $a = 9/10$. If both of them are successful in R&D, then they equally split S.

a) Show that both of the firms invest in R&D in the equilibrium.

b) Show that the socially optimal case is a single firm investing in R&D.

c) Solve the same question assuming each firm gets zero (due to competition) if they both innovate the same technology.

2) Assume that the demand for a particular medicine is
$$Q = 18 - 3P.$$

The cost of producing a single dose of medicine is 5. The medicine is initially produced by competitive firms. However, a scientist finds a new technology that reduces the cost of production to 1. Would a firm buy this new technology if the scientist sells its patent for 10?

3) The graphs below show the logarithm of capital (K) and population (L) in the US. The dotted lines are the linear trend-lines

a) Compute the slopes of the trend lines.

b) What are the growth rates of K and L?

c) Find the long-run growth rate of GDP per capita according to the Solow's model.

d) The actual growth of the GDP per capita in the US is around 2% (give or take). Is this figure consistent with the Solow's growth model?

In(K) in the US

In(L) in the US
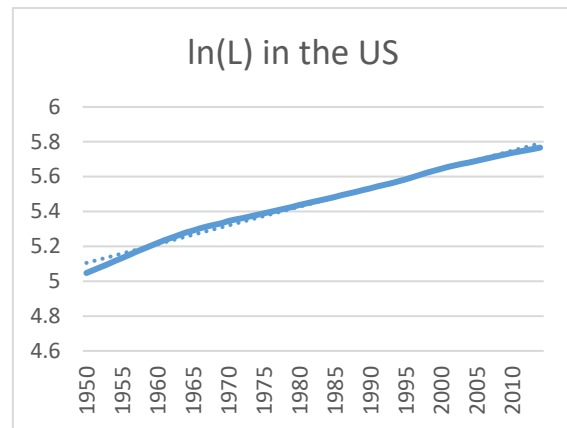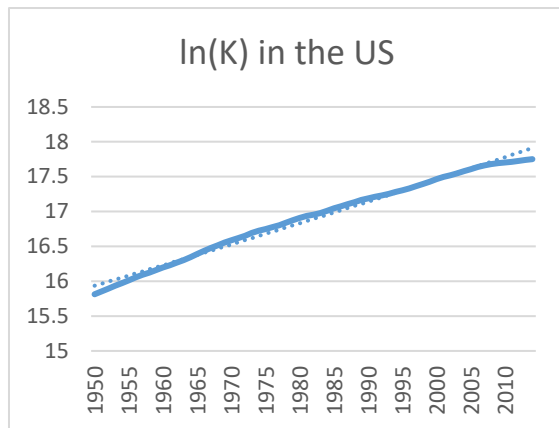
4) Suppose that you provide consultancy service to a certain firm. When you visit the production plant, you ask the manager whether the technology that they use exhibits increasing, constant , or decreasing returns to scale. If the production technology is given by

find the range of the the parameter a according to the answers of the manager below:

a) "We have DRS because our revenues are less than doubled if we would double our output".

b) "We have DRS, because the unit cost of production would decrease if we would double our output".

c) "Our progress ratio is less than %100 so we have IRS".