11 Mar 2011

- Ideas from AusLAB to stand by you is on the Web site

- Review Seminar
  Monday 14 March in class
  Monday 14 March, 7-9 pm in BE 330

- Office hours on Tues 15 March
  12-2 in BE 160
  2-3 in BE 145

- Historical Friday: The economies of the California SeaHine Fishery
The problem: sustaining fish stocks and fisheries

Sardine biomass trajectory
Using economic thinking to understand what happened

\[ B(t) = \text{biomass (water) of Calmar sardine in year } t \]

\[ \frac{dB}{dt} = rB \left( 1 - \frac{B}{K} \right) \]

[Graph showing population growth with unlisted level carrying capacity]
No fishing
\[
\frac{dB}{dt} = rB \left(1 - \frac{B}{K}\right)
\]

Add fishing
Assume that the rate of harvest is
\[
\frac{g}{t}EB
\]
"catchability coefficient"
fishing effort (boat-days)
(boat-days * time)
\[
\frac{dB}{dt} = rB \left(1 - \frac{B}{K}\right) - gEB
\]
↑
growth
↑
harvest
Steady state: \( \frac{dB}{dt} = 0 \)

No fishing

\[ B = K \]

Fishing

\[ rB \left( 1 - \frac{B}{K} \right) = gE \]

\[ r \left( 1 - \frac{B}{K} \right) = gE \]

\[ \frac{B}{K} = 1 - \frac{gE}{r} \]

\[ B = K \left( 1 - \frac{gE}{r} \right) \]
\[ B = K \left( 1 - \frac{qE}{r} \right) \]

Steady state biomass when constant effort \( E \) is applied

What is the steady state yield (harvest)?

\[ \bar{Y} = qE \bar{B} = qE K \left( 1 - \frac{qE}{r} \right) \]

Steady state yield

Now we add assumptions:

\[ p = \text{price paid per unit harvested} \]

\[ c = \text{cost of a unit of effort} \]
\[ \Pi = \bar{y} - cE \]

\[ \Pi(E) = pgE(K) \left(1 - \frac{qE}{r}\right) - cE \]

Two policies

\[ \Pi(E) = pgE(K) \left(1 - \frac{qE}{r}\right) - cE \]

\[ \Pi(E) = pgE - pg^2\frac{K}{r}E^2 - cE \]
one policy: pick the effort that maximizes profit

Open Access

$\Pi(E_{OA}) = 0$

$\Pi(E) = q_p E K (1 - \frac{E}{K}) - CE$

In open access

$q_p E_{OA} K (1 - \frac{E_{OA}}{K}) = CE_{OA}$
Optimal Level of Effort

\[ \Pi(E) = \phi E K (1 - \frac{E}{K}) - cE \]

We set \( \frac{d\Pi(E)}{dE} = 0 \)

\[ \frac{d}{dE} \left[ \phi E K (1 - \frac{E}{K}) \right] - c = 0 \]

At the optimal effort, the line tangent to the \( Py \) has slope \( c \)
Two observations

- Optimal effort < open access effort
- Open access is economically inefficient - with a smaller effort we could get the same net profit