# Primal and dual fisheries model

Reviderat efter bearbetningarna 2013-08-15 till 2013-08-16 i Lund

## Primal model

**Objective function**

Definition: maximize Revenues (p\*catch) minus VC (vc\*annual effort) minus FC (fc\*vessels)

Dimension: Scalar

**Catch**

Definition: Total catch as a function of effort and parameter values.

Dimension: f\*s matrix with annual catches of all species for all métier

Lagrange multiplier:

Equation:

Where is the distribution of catch of each species in each fishery , measured in metric tons per day of effort.

**Effort constraint per segment**

Definition: Effort constraint, total annual fishing days possible per segment (days per vessel and year)

Dimension: seg matrix of effort

Lagrange multiplier:

Equation:

**Effort constraint per fishery**

Definition: Effort constraint per fishery, limiting total number of days per vessel in each fishery (computed based on length of season and season overlap).

Dimension: f matrix of effort

Lagrange multiplier:

Equation:

**Catch (quota) constraint**

Definition: Catch constrained by quotas, defined over quotaArea and quotaSpecies

Dimension: Quotaspecies\*Quotaarea matrix

Lagrange multiplier:

Equation:

Check: ska I vara def över f och s??, räcker det inte med qs och qa?

**Positive effort**

Definition: Annual effort cannot be negative for any fishery

Dimension: f matrix

Lagrange multiplier:

Equation:

## The Lagrange equation

# First order conditions

With respect to annual effort (ea)

With respect to catch:

## Complementary slackness condition

**Effort constraint (inequality)**

**Effort constraint per fishery**

**Catch constraint (inequality)**

**Non-negative effort**

**Non-negative Lagrange multipliers**

### Sets

F = fisheries

S= species

Seg = segment

P = period

Seg\_fish = 1/0 if fishery performed by segment (yes=1)

Quotaspecies = Species with quotas

Quotaarea = areas over which quotas are defined (ex K, S, KS, etc.)

I = 1/0, equals one if the catch is in correct quotaspecies, quotaarea, fishery and species

### Parameters

P= price

Vc = variable costs

Fc = fixed cost

Ea = effort annual

E = effort

Vessels = vessels

Cd = Catch distribution (tons/day)

## Restrictions for documentation

Effort fixed to 0 for fisheries not in season. Not in Lagrange.