Justice

- Distributive Justice (equal treatment of equals)
- Procedural Justice (just rules and processes)
- Retributive Justice (retribution)
- Restorative Justice (restoration compensation - Tort law)
- Commutative Justice (just deserts)

We are mostly interested in distributive justice and procedural justice and rules for achieving these and enabling environmental justice in fisheries.
Kolm, S. C. (2002). Modern theories of justice. MIT Press.

Distributive justice

What is fair division?

What is fair division?

- Fair division aims to divide contested objects in a manner that might be considered fair.
- The literature on fair division spans, philosophy, mathematics and economics.
- The literature on fair division has widespread applications to environmental and resource problems and represents one framework for thinking about questions of environmental justice.
- The first case is dividing up an available resource.

There have been a number of proposed procedures.
Let''s start with the example of two players who wish to divide a resource between them in a fair manner. An example here might be a the following. It is agreed to set a total allowable catch at the maximum economic yield level resulting in an efficient outcome. but different players in the fishery need a procedure to divide the fishery fairly between them. One approach might be to split it 50:50.

Exact or consensus divison

We wish to divide a resource up so that the value that each player (country) receives equals some weight. Hugo Steinhaus showed in 1949 that there is no exact finite algorithm that can achieve this. finite here means that the calculation involving dividing up the resource by determining a set of weights that all agree to can be achieved in a finite number of steps. As a result it implies that an exact division of resource using weights cannot achieve a consensus unless a continuous procedure, e.g. the moving knife procedure is used.

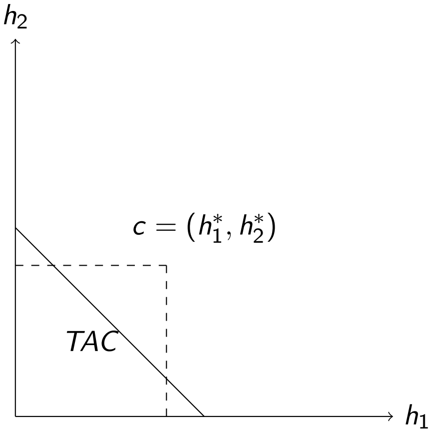
Steinhaus, H. (1948). The problem of fair division. Econometrica, 16, 101-104.

Steinhaus, H. (1949). Sur la division pragmatique.*Econometrica: Journal of the Econometric Society*, 315-319.

A nice popular article here on Steinhaus and his work `https://www.americanscientist.org/article/slicing-sandwiches-states-and-solar-systems`

There are a variety of approaches to fair division. the literature on cake cutting is based on the notion of entitlement whereas the literature on bankruptcy is based on the concept of a claim.
The literature on fair division is also divided into positive and normative approaches. Much of the mathematical literature is positive in nature and the economics literature is mostly normative in nature and might be considered a subfield of social choice and welfare economics.

Claims rules



Fisheries claims problems

A fisheries claims problem is a pair $(h, TAC) \in \mathcal{R}_+^N \times \mathcal{R}_+$ where $h = qX^*E^*$ and TAC is the total allowable catch, with $\sum_i h_i \geq TAC$. the latter is the situation where the sum of the demands for fish catch in equilibrium at the optimal license fees exceed the TAC.

Proportional rule

The proportional rule awards a catch share in proportion to the claim. So in a fisheries claims problem the rule would be

$$C(h, TAC) = \lambda h$$

where λ is chosen to achieve balance to so that $\sum h_i = TAC$. In other words we scale each claim by a multiplier so that summing the multiples equals the TAC. so $\lambda = \frac{TAC}{\sum h_i}$ satisfies this.

frametitleExample

Let;'s say the TAC is 200 and we have 3 countries who wish to split this proportionally the first claims 50, the second 100 and the third 150 summing thes ewe get 300.

So $\lambda = 200/300 = 2/3$

- $2/3$ of 50 is 33.33
- $2/3$ 100 is this 66.66
- $2/3$ of 150 is 100

These allocations all sum to 200 which is the TAC.

Proportional rule

Using the catch equation $h_i = qX^*E^*$and the demand for foreign and domestic licenses and the demand estimate for fishing on the high seas we obtain the following claims for fishing in each zone and the high seas.

$$h^*_{i,D} = qX^*e^*_{i,D}, \forall i$$
$$h^*_{i,F} = qX^*e^*_{i,F}, i = 1, \ldots, n$$

and the high seas catch

$$h^*_{n+1,F} = qX^*e^*_{n+1,F}$$

then substituting into the rule we get the following allocation

$$C(h, TAC) = \lambda h = \lambda[h^*_{i,D}, h^*_{i,F}, h^*_{n+1,F}]$$

$$[\lambda h^*_{i,D}, \lambda h^*_{i,F}, \lambda h^*_{n+1,F}]$$

λ and the claims in a fisheries allocation problem

where

$$\lambda = \frac{TAC}{\sum h^*_{i,D} + \sum h^*_{i,F} + h^*_{n+1,F}}$$

and

$$h^*_{i,D} = qX^* e^*_{i,D}, i = 1, \ldots, n$$

$$h^*_{i,F} = qX^* e^*_{i,F}, i = 1, \ldots, n$$

$$h^*_{n+1,F} = qX^* e^*_{n+1,F}$$

Constrained equal awards

Another rule that is frequently proposed and that has a number of desirable properties is the constrained equal awards rule

$$C(h, TAC) = (\min(h_i, \lambda), i \in N$$

with λ chosen to achieve balance (efficiency).
Both constrained equal awards and the proportional rule have been studies in the fisheries context.

Example

$$CEA(50, 100, 150; 100)$$

First observe that equally dividing 100 would allocate 33.33 to each claimant. Which they would obviously object to.However this is the fairest thing to do.
If the TAC were 150 then dividing equally would satisfy the first claimant, they only want 50, then give it to them. That leaves 100 left to be divided between the next two claimants in this case equally so all of them get 50.
If the TAC is 200 (CEA(50,100,150,200) then $200/3 = 66.66$ but the first claimant only wants 50, so give the first claimant 50, leaving 150 which should be divided equally between the last two claimants, so the allocation is 50, 75, 75.

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