A Dynamic Model of Fishing Cruise Duration

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Abstract

In many fisheries, particularly high seas fisheries, effort is controlled primarily by scaling estimated fleet capacity to available biomass. Capacity is traditionally estimated by relating inputs to outputs, with gaps between maximum harvest and actual harvest ascribed to technical inefficiency; precaution often dictates managing for maximum technical efficiency. I demonstrate that cruise-level production is determined not by use of quasi-fixed inputs, but rather by dynamic consideration of the rate at which fish is caught, balancing the quantity and quality of fish to maximize their cruise level revenue or profit. This response is modeled as a daily optimal stopping problem, with the state variables representing the decreasing freshness of fish caught on each previous day of the cruise. I estimate cruise duration decisions based on unusually detailed daily logbook data on a Japanese longline fleet. The dynamic discrete choice problem is modeled with a two-step conditional choice probability (CCP) estimator. The large space of state variables is narrowed and overfitting is avoided in the first step with a machine learning method, elastic-net logit estimation. The results show that harvesters are more likely to terminate their fishing cruises when they have more of 20-days or older fish, reflecting that they respond to timing of catch during a cruise as well as cumulative catch itself. This suggests that catching power is constrained by a dynamic factor during a cruise, as well as quasi-fixed inputs, and that a management strategy based solely on technical efficiency will systematically overestimate actual catches.