Forecasts for the Ecology and Fisheries Economy of Scottish herring and mackerel

As the favorable food fbr Scotch, the herring and mackerel bring generous profits to fishing companies. Due to the hotter ocean, more fish move to the north to seek better habitats, laying a negative impact on the fishing industry. The aim of this report is to build a migratory prediction model to evaluate the influences on the income of fishing companies. We are expected to provide some strategies for fishing companies who can adapt to the migration of fish under the constraints of various objective conditions and prevent themselves from going bankrupt as much as possible. Three models are established: Model I: Seawater Temperature Prediction Model; Model II: Fish Migration Prediction Model; Model III: Fishing Company Earnings Evaluation Model.

For Model I, global ocean temperature date monthly from 1960 to 2019 is firstly collected. Then, based on the analysis of intrinsic trend of the data and the verification of the stationarity, the validation of using ARIMA model to predict temperature is proved. Next, historical data is used to fit the parameters of ARIMA, with introduction of krfbld cross validation to identify the final prediction model as ARIMA(l,l,0). Finally, according to ARIMA(l,l,0), bootstrap method is used to simulate 10000 possible prediction cases, which lays a great foundation to predict the migration of fish.

For Model II, firstly, according to the data of the migration speed and the ocean temperature, it is determined that the temperature gradient is the main factor affecting the migration speed and direction. And the corresponding empirical equation is established to determine the impact of temperature on fish migration. Then based on the 10000 temperature change samples generated by bootstrap method in Model I, migration situation of each sample is simulated to identify the most likely locations of the fish. It was finally shown that the fish are mainly distributed in the area between Iceland and the Faroe Islands 50 years later and the results are shown in figure 9.

For Model III, the profit evaluation equation of fishing companies is determined by the economic principle, and the parameters involved are estimated by introducing the actual management data, the results are shown in table 4; then based on the 10000 samples of fish migration from Model II, the profit change of fishing companies is simulated for each sample and the profit trend over time is shown in figure 10. Finally, it can be seen that the worst case is in 2030, fishing companies will go bankrupt due to fish migration with a probability of 0.02%, the best case is that they will not go bankrupt in 50 years with a probability of 5.27% and the most likely case is that in 2039, fishing companies will go bankrupt due to fish migration with a probability of 8.25%.

In addition, this report discusses the effective response to the fish migration for small fishing companies, together with effective response strategies. Without considering the policies and legal issues brought by the territorial sea, small fishing companies should transfer their ports to Iceland, which is closer to the fish. Finally, based on simulation of this strategys effect, 100.00% of companies can avoid bankruptcy. As fbr considering the policies and legal issues, small fishing companies should upgrade their fishing vessels to extend the shelf life of fish. After simulation, 62.68% of companies can avoid bankruptcy.

Eventually, robustness and sensitivity analysis of the model are tested. When the initial distribution of the fish is randomly generated from the uniform random distribution, the final convergence distribution of the model has little difference. As for the factors that affect the model, social profit rate and fishing boat navigation radius, it is found that the increase of these two factors will significantly reduce the bankruptcy probability of fishing companies.

Keywords: ARIMA; Fish Migration; Earnings Evaluation; Computer Simulation