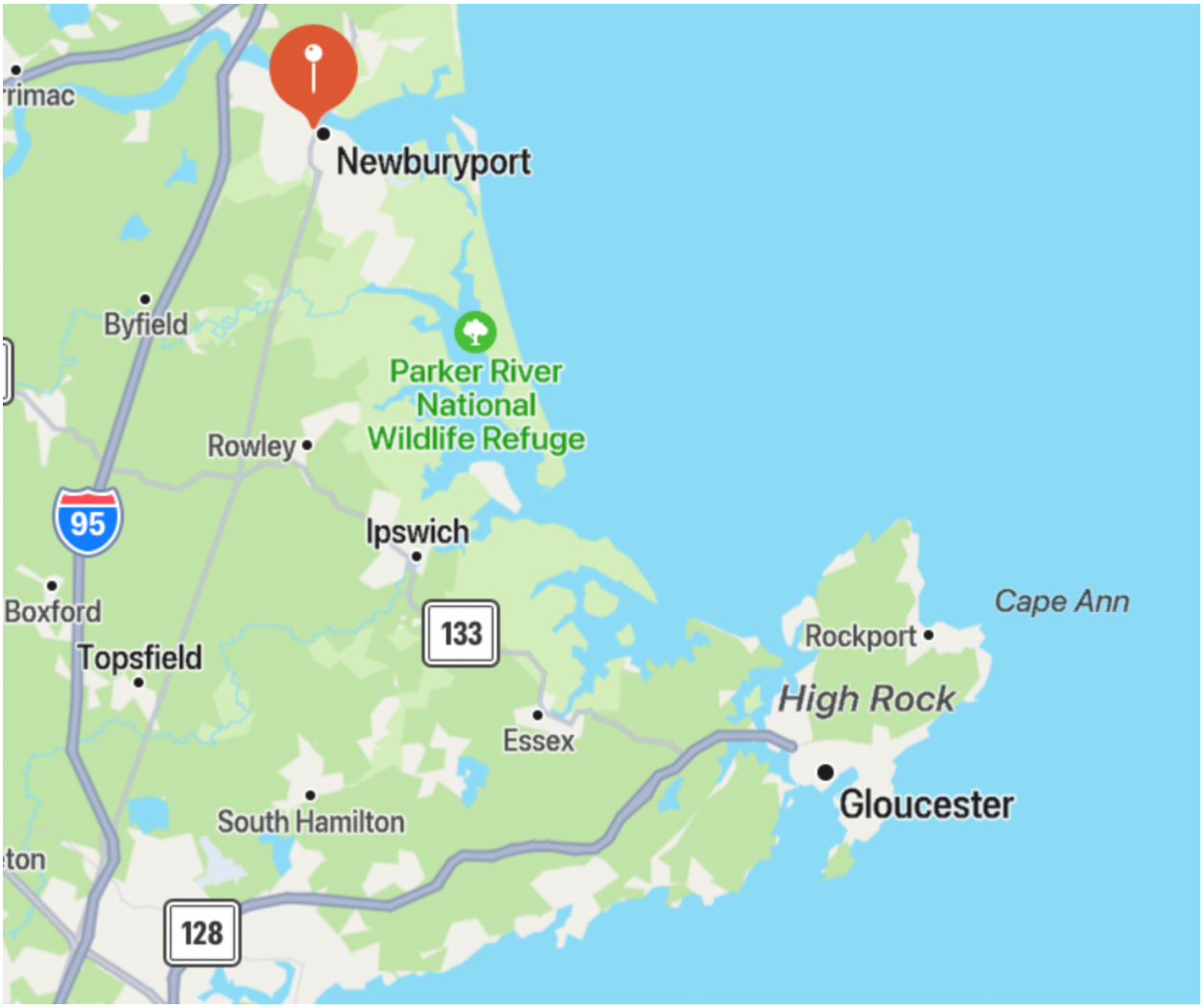
## Conley Fisheries Case Description:

Mr. Clint Conley, president of Conley fisheries Inc., operates a fleet of 50 cod fishing boats out of Newburyport, Massachusetts, which is about an hour's drive north of Boston. Clint's father started the company 40 years ago but has recently turned the business over to Clint, who has been working for the family business after earning his MBA 10 years ago. Every weekday of the year each Conley Fisheries boat leaves early in the morning, fishes for most of the day, and completes its catch of codfish (3500 pounds) by mid afternoon. The boat then has a number of ports where it can sell its daily catch. The price of codfish at some ports is very uncertain and can change quite a bit even on a daily basis. Also, the price of codfish tends to be different at different ports. Furthermore, some ports have only limited demand for codfish, so if a boat arrives relatively later than other fishing boats at that port, the catch of fish cannot be sold and must be disposed of in ocean waters. This makes it difficult for a boat captain to decide where to sell the day's catch because demand at certain ports is not known until arrival, at which point it is too late to go elsewhere.

To keep this problem simple enough to analyze with ease, assume that the daily operating expenses of a boat is $10,000 per day. Also, assume that a boat is always able to catch all the fish that it can hold (3500 pounds). Assume also that the Conley Fisheries' boat can bring its catch to port in Gloucester (pronounced “glouster”) or to the port in Rockport, Massachusetts. Here is a map of Newburyport in relation to Gloucester and Rockport:



Gloucester is a major port for codfish with a well-established market. The price of codfish in Gloucester is $3.25 per pound. This price has been stable for quite some time. The price of codfish in Rockport tends to be a bit higher than Gloucester but has a lot of variability. Clint has estimated that the daily price of codfish in Rockport is normally distributed with the mean of $\mu\mu$ = $3.65 and a standard deviation of $\sigma\sigma$ = .2 per pound.
The port in Gloucester has a very large market for codfish, so Conley Fisheries never has a problem selling the codfish there. In contrast the port in Rockport is much smaller and sometimes the boat is unable to sell part or all of its daily catch. Based on past history, Clint has estimated that the demand for codfish that he faces when his boat arrives at port in Rockport obeys the discrete probability distribution summarized below:

| Demand | Probability |
|---|---|
| 0 | 0.02 |
| 1000 | 0.03 |
| 2000 | 0.05 |
| 3000 | 0.08 |
| 4000 | 0.33 |
| 5000 | 0.29 |
| 6000 | 0.2 |

It is assumed that the price of codfish in Rockport and the demand for codfish in Rockport faced by Conley Fisheries are independent of one another. Therefore, there is no correlation between the daily price of codfish and the daily demand in Rockport faced by Conley Fisheries.

At the start of any given day, the decision Clint Conley faces is which port to use for selling his daily catch. The price of codfish that the catch might command in Rockport is only known if and when the the boat docks at the port and Clint negotiates with buyers. After the boat has docked at one of the two ports, it must sell its catch at the port or not at all since it takes too much time to pilot the boat out of one port and power it all the way to the other port.

Clint Conley is just as anxious as any other business person to earn a profit. For this reason he wonders if the smart strategy might be to sell all of his daily catch in Rockport. After all, the expected price of codfish is higher in Rockport, and although the standard deviation of the price is high, and hence there is greater risk with the strategy, Clint is not averse to taking chances when they make good sense. However, it also might be true that the smart strategy could be to sell the codfish in Gloucester, since in Gloucester there is ample demand for his daily catch, whereas in Rockport there is the possibility that he might not sell all of his catch (and so potentially lose valuable revenue). It is not clear to him which strategy is best.

One can start to analyze this problem by computing the daily earnings if Clint chooses to sell his daily catch of codfish in Gloucester. The earnings from using Gloucester, denoted by G, is simply:

$G = 3.25 * 3500 - 10000 = 1375$
which is the revenue of \$3.25 per pound times the number of pounds of codfish minus the daily operating expenses of \$10,000.

The computation of daily earnings if Clint chooses Rockport is not as straightforward, since both price and demand in Rockport are uncertain. Therefore, the daily earnings from choosing Rockport is an uncertain quantity, i.e., a random variable.

Let's start by defining two random variables:

- $PR$ = price of codfish in Rockport in \$/lb.
- $D$ = demand faced by Conley Fisheries in Rockport

Now we will define a new random variable, $F$, representing daily earnings if the boat docks in Rockport to sell it catch:
$F = PR * 3500 - 10000, \text{if } D \geq 3500$ $F = PR * 3500 - 10000, \text{if } D \geq 3500$ and $F = PR * D - 10000, \text{if } D < 3500$ $F = PR * D - 10000, \text{if } D < 3500$
In other words, $F$ is simply the price times the quantity of codfish that can be sold (total sales revenue) minus the cost of daily operations. However, in this case, the quantity of the catch that can be sold is the minimum of the quantity of the catch for each boat (3500 lbs.) and the demand for codfish at the dock in Rockport. Thus the above expression can be alternatively written as:
$F = PR * \min(3500, D) - 10000$
where the expression $\min(a, b)$ stands for the minimum of the two quantities $a$ and $b$.
This formula is a concise way of stating the problem in terms of the underlying random variables.

Note: This case is borrowed from Bertsimas, Dimitris, and Robert Freund. *Data, Models, and Decisions: The Fundamentals of Management Science*. Dynamic Ideas, 2004.