Project 7.3 Maximizing profit

Part 4 of this project assumes that you have read Section 7.6.

Suppose you are opening a new coffee bar, and need to decide how to price each shot of espresso. If you price your espresso too high, no customers will buy from you. On the other hand, if you price your espresso too low, you will not make enough money to sustain your business.

Part 1: Poll customers

To determine the most profitable price for espresso, you poll 1,000 potential daily customers, asking for the maximum price they would be willing to pay for a shot of espresso at your coffee bar. To simulate these potential customers, write a function

```
randCustomers(n)
```

that returns a list of `n` normally distributed prices with mean $4.00 and standard deviation $1.50. Use this function to generate a list of maximum prices for your 1,000 potential customers, and display of histogram of these maximum prices.

Part 2: Compute sales

Next, based on this information, you want to know how many customers would buy espresso from you at any given price. Write a function

```
sales(customers, price)
```

that returns the number of customers willing to buy espresso if it were priced at the given `price`. The first parameter `customers` is a list containing the maximum price that each customer is willing to pay. Then write another function

```
plotDemand(customers, lowPrice, highPrice, step)
```

that uses your `sales` function to plot a *demand curve*. A demand curve has price on the x-axis and the quantity of sales on the y-axis. The prices on the x-axis should run from `lowPrice` to `highPrice` in increments of `step`. Use this function to draw a demand curve for prices from free to $8.00, in increments of a quarter.

Part 3: Compute profits

Suppose one pound (454 g) of roasted coffee beans costs you $10.00 and you use 8 g of coffee per shot of espresso. Each "to go" cup costs you $0.05 and you estimate that half of your customers will need "to go" cups. You also estimate that you have about $500 of fixed costs (wages, utilities, etc.) for each day you are open. Write a function

```
profits(customers, lowPrice, highPrice, step, perCost, fixedCost)
```

that plots your profit at each price. Your function should return the maximum profit, the price at which the maximum profit is attained, and the number of customers who buy espresso at that price. Do not use the built-in `min` and `max` functions.

Question 7.3.1 *How should you price a shot of espresso to maximize your profit? At this*

price, how much profit do you expect each day? How many customers should you expect each day?

*Part 4: Find the demand function

If you have not already done so, implement the linear regression function discussed in Section 7.6. (See Exercise 7.6.1.) Then use linear regression on the data in your demand plot in Part 2 to find the linear function that best approximates the demand. This is called the *demand* function. Linear demand functions usually have the form

$$Q = b - m \cdot P,$$

where Q is the quantity sold and P is the price. Modify your `plotDemand` function so that it computes the regression line and plots it with the demand curve.

Question 7.3.2 *What is the linear demand function that best approximates your demand curve?*