OPTIMIZATION HINTS

Suppose that you believe the stock price will follow the B-S model with mean μ and volatility σ.

You already know how to generate 10000 future stock prices.

- So you can write a functions to ~~price~~ compute the payoff of a portfolio of options.
- Represent the ~~vector~~ portfolio as ~~2~~ $2n$ dimensional vector, $\underline{v}$. Let the $(2i-1)^{th}$ entry of $\underline{v}$ be the quantity of option i that you have <u>bought</u> and let the $(2i)^{th}$ entry of $\underline{v}$ be the quantity of of option i that you have <u>sold</u>.
- Let $\underline{c}$ be a vector representing the initial cost. Its ~~(~~ $(2i-1)^{th}$ and $(i)^{th}$ entries are given by the ask and bid prices. So your initial cost is $\underline{c} \cdot \underline{v}$.

- You can compute a payoff matrix P such that the vector

$$P \underline{v}$$

consists of the payoffs for each of your 10 000 scenarios.

- Find the choice of v which optimizes the expected utility

$$\mathbb{E}(u(p))$$

for the utility function

$$u(p) = 1 - \exp(-p * \lambda)$$

where λ is a risk aversion parameter.

The constraints are:

$$v_j > 0$$

and $\underline{c} \cdot \underline{v} = 1$ (you have an initial budget of \$1)

- Compute v using real data for option and stock prices. You can choose your own values for μ, σ and λ. These represent your beliefs about the market and your risk appetite.

- When you've computed the optimal portfolio v, plot a scatter plot of its payoff against the final stock price.
- You should ~~include positions of on the "options"~~ allow the portfolio to include purchases of the stocks and ~~bon~~ zero coupon bonds too.
- You can see what happens if you add the additional constraint of disallowing short selling.

To perform optimization you will need to use the ~~fmin~~ fmincon function in MATLAB. I suggest you start by getting an understanding of this function.

One complexity is that fmincon takes a function as an argument.

You can define a function in the following way in MATLAB

```
myfunction = @(x) x^2 + 2x - 2;
minx = fmincon(myfunction, 0);
disp(minx);
```

This minimizes the function x^2+2x-2.

Good luck!