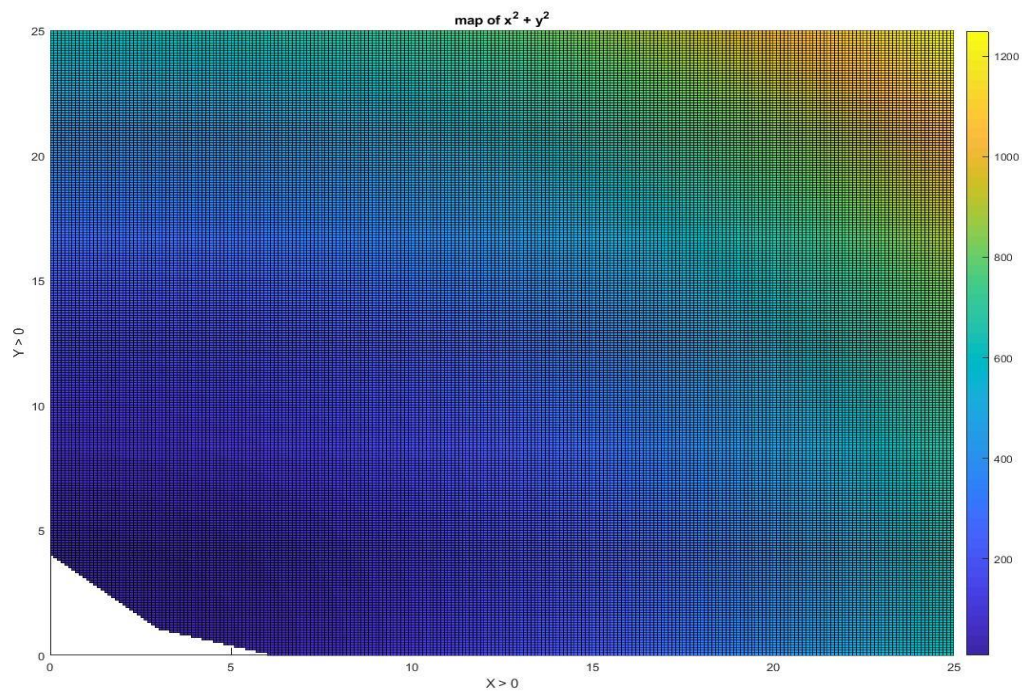
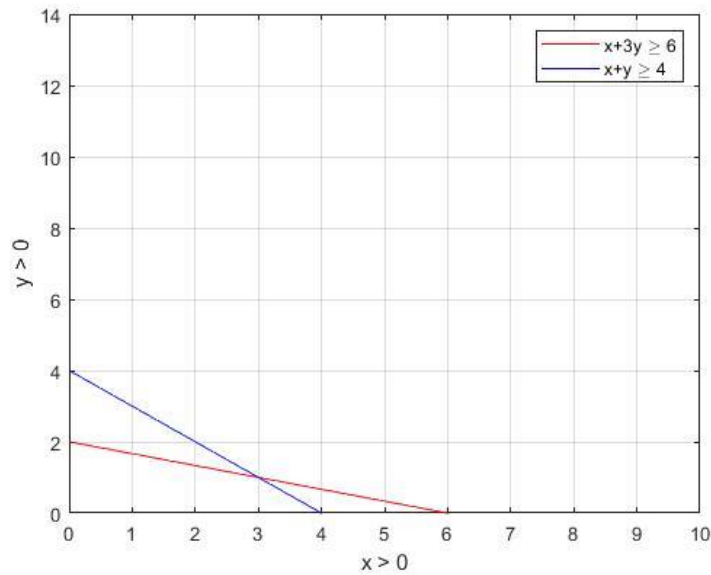


ABHISHEK KASHYAP (Week 1)

Question 1:

$$\min\{x^2 + y^2 : x + 3y \geq 6, \quad x + y \geq 4, \quad x \geq 0, \quad y \geq 0\}$$

Shown below are the inequalities, with the region of interest for both plots more clearly illustrated in the lower figure with a colormap. MATLAB was used to plot the figures. The colormap can be interpreted as a heat map created using the objective function $x^2 + y^2$.



MATLAB codes:

```
v = -10:0.1:25;
[X,Y] = meshgrid(v);

conditions = (X + 3*Y >= 6) & (X + Y >= 4) ...
            & (X >= 0) & (Y >= 0);    % contains logical 0's and 1's

conditions = double(conditions);
conditions(conditions == 0) = NaN;

X = X .* conditions;
Y = Y .* conditions;

objective_function = X.^2 + Y.^2;

[app.min_val, Idx] = min(objective_function(:));
[app.min_row, app.min_col] = ind2sub(size(objective_function), Idx);

app.min_val_x = X(app.min_row, app.min_col);
app.min_val_y = Y(app.min_row, app.min_col);

figure, surf(X, Y, objective_function), colorbar, view(0,90)
xlabel('X > 0'), ylabel('Y > 0'), zlabel('X^2 + Y^2'), title('map of x^2 + y^2')
```

The values that satisfy the optimization are

$$x = 2, \quad y = 2, \quad x^2 + y^2 = 8$$

Question 2:

$$\max\{x(1-2x)^2 : 0 \leq x \leq 1/2\}$$

Using basic calculus, let $f = x(1-2x)^2$

Taking its derivative and equating it to zero: $\dot{f} = 12x^2 - 8x + 1 = 0$

$$x = 1/2, 1/6$$

For determining maxima, double derivate should be negative: $\ddot{f} = 24x - 8$

Plugging in 1/2 and 1/6 for x in \ddot{f} , the optimal objective value is $x = 1/6$ and the optimal solution is $2/27$.

Question 3:

Closing stock prices were downloaded from Yahoo finance for the last 24 months 2016-18. Using the code provided in the lesson, the following results were obtained:

Data from lesson	New data 2016-18
----- MSFT: Exp ret = 0.024611, Risk = 0.058040 V: Exp ret = 0.018237, Risk = 0.042807 WMT: Exp ret = 0.009066, Risk = 0.044461 ----- Optimal portfolio ----- x[MSFT] = 0.582818 x[V] = 0.204324 x[WMT] = 0.212858 ----- Exp ret = 0.020000 risk = 0.038256 -----	----- MSFT: Exp ret = 0.029252, Risk = 0.036801 V: Exp ret = 0.025350, Risk = 0.034881 WMT: Exp ret = 0.014360, Risk = 0.061106 ----- Optimal portfolio ----- x[MSFT] = 0.430991 x[V] = 0.552723 x[WMT] = 0.016286 ----- Exp ret = 0.026853 risk = 0.031653 -----

Based on new data and the optimal investment derived from it, the maximum amount invested should be in Visa stocks = \$552.7

Expected monthly return is \$26.85 with a standard deviation of \$31.65. Based on the $\pm 3\sigma$ range, end of the month wealth will most likely be in the range \$930-\$1122.