```
clear
```

Part A

```
syms f(x1,x2) x1 x2 g(x1,x2) lambda
f(x1,x2) = 4*x1 - 3*x2 + 2*x1^2 - 3*x1*x2 + 4*x2^2;
df1 = diff(f,x1);
df2 = diff(f,x2);

g(x1,x2) = 2*x1 - 1.5*x2 - 5;
dg1 = diff(g,x1);
dg2 = diff(g,x2);

solution = solve(df1 - lambda*dg1 == 0, df2 - lambda*dg2 == 0, g ==
 0);
lambda1 = double(solution.lambda)
x1_a = double(solution.x1)
x2_a = double(solution.x2)
minimum_value_a = double(f(x1_a,x2_a))

% The optimum agrees with the graphical optimum.
```

```
lambda1 =

     7


x1_a =

    2.5000


x2_a =

     0


minimum_value_a =

   22.5000
```

Part B

```
syms f(x1,x2) x1 x2 g(x1,x2) lambda
f(x1,x2) = 4*x1 - 3*x2 + 2*x1^2 - 3*x1*x2 + 4*x2^2;
df1 = diff(f,x1);
df2 = diff(f,x2);

g(x1,x2) = 2*x1 - 1.5*x2 - 5.1;
```

```
dg1 = diff(g,x1);
dg2 = diff(g,x2);

solution = solve(df1 - lambda*dg1 == 0, df2 - lambda*dg2 == 0, g ==
 0);
lambda = double(solution.lambda);
x1_b = double(solution.x1)
x2_b = double(solution.x2)
minimum_value_b = double(f(x1_b,x2_b))

real_change_f = minimum_value_b-minimum_value_a
approximated_change_f = lambda1*(5.1-5)
difference = real_change_f-approximated_change_f

% The lagrange multiplier predicts the change in objective pretty
% accurately, there is only a difference of 0.005 in the approximation
 to
% the real.
```

```
x1_b =

    2.5500


x2_b =

     0


minimum_value_b =

   23.2050


real_change_f =

    0.7050


approximated_change_f =

    0.7000


difference =

    0.0050
```

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