**Optimisation Techniques and Algorithms Lab Assignment 4**

**Question 1:**

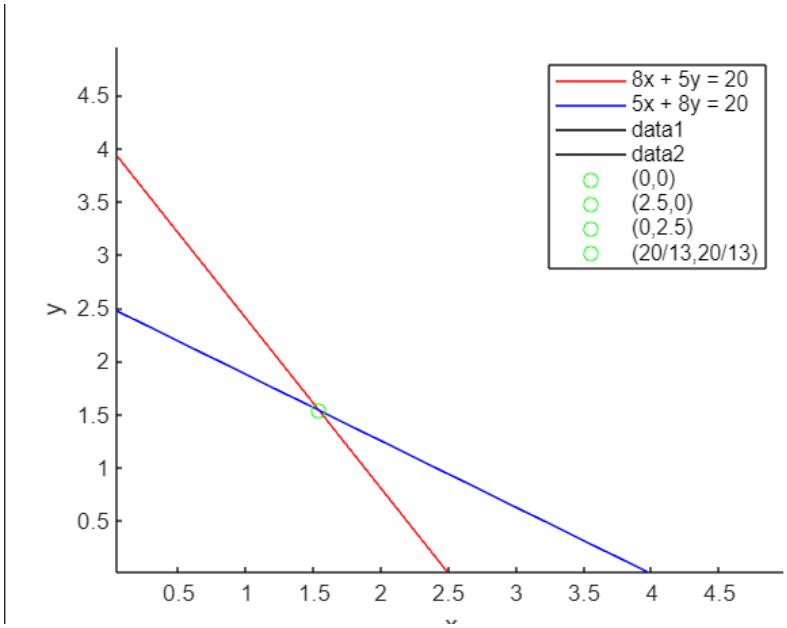
Maximize Z = 5x + 10y
Subject to:
8x + 5y <= 20
5x + 8y <= 20
x, y >= 0

**Code**:

```
% Question 1
x1 = linspace(0, 5);
y1 = (20 - 8*x1) / 5;
x2 = linspace(0, 5);
y2 = (20 - 5*x2) / 8;
hold on;
plot(x1, y1, 'r', 'DisplayName', '8x + 5y = 20');
plot(x2, y2, 'b', 'DisplayName', '5x + 8y = 20');
x = linspace(-1, 5);
y = linspace(0, 0);
plot(x, y, 'k');
plot(y, x, 'k');
xlabel('x');
ylabel('y');
axis([0 5 0 5]);
plot(0, 0, 'go', 'DisplayName', '(0,0)');
plot(2.5, 0, 'go', 'DisplayName', '(2.5,0)');
plot(0, 2.5, 'go', 'DisplayName', '(0,2.5)');
plot(20/13, 20/13, 'go', 'DisplayName', '(20/13,20/13)');
legend show;
hold off;


function z = func1(x, y)
```

```
    z = 5*x + 10*y;
end
val_1 = func1(0, 0);
val_2 = func1(2.5, 0);
val_3 = func1(0, 2.5);
val_4 = func1(20/13, 20/13);

values = [val_1, val_2, val_3, val_4];

[maxValue, maxIndex] = max(values);
[minValue, minIndex] = min(values);

disp(['The maximum value is ', num2str(maxValue), ' at index ', num2str(maxIndex)]);
disp(['The minimum value is ', num2str(minValue), ' at index ', num2str(minIndex)]);
```

**Output:**




```
>> Assignment4
The maximum value is 25 at index 3
The minimum value is 0 at index 1
```

**Result:**

Maximum Value is 25 at point (0, 2.5)

Minimum value is 0 at (0, 0)

**Question 2:**

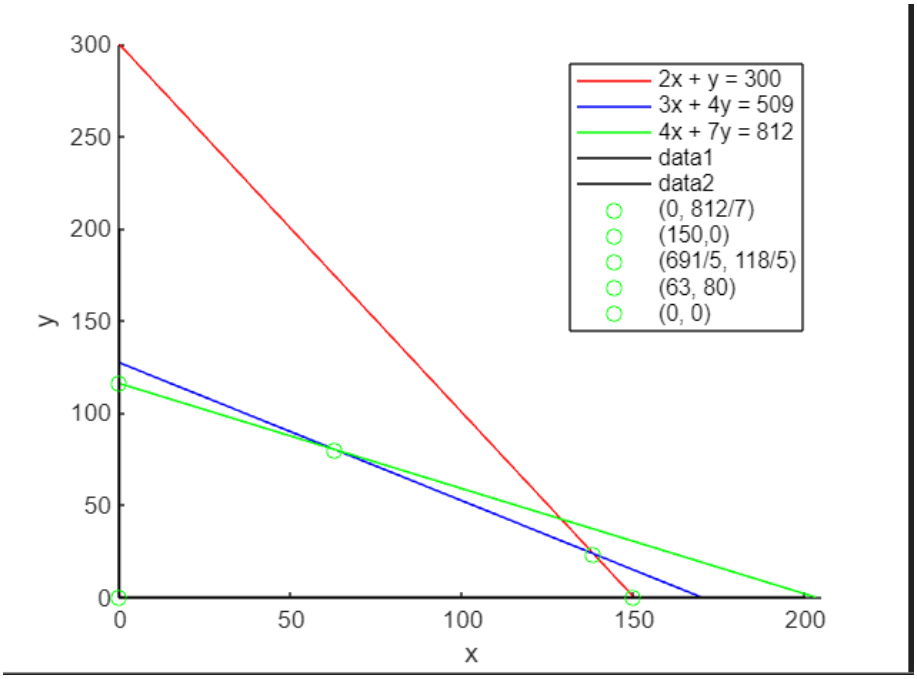
Maximize Z = 50x + 60y
Subject to:
2x + y <= 300
3x + 4y <= 509
4x + 7y <= 812
x, y >= 0

**Code:**

```
% Question 2
x1 = linspace(0, 150);
y1 = 300 - 2*x1;

x2 = linspace(0, 170);
y2 = (509 - 3*x2) / 4;

x3 = linspace(0, 203);
y3 = (812 - 4*x3) / 7;

hold on;
plot(x1, y1, 'r', 'DisplayName', '2x + y = 300');
plot(x2, y2, 'b', 'DisplayName', '3x + 4y = 509');
plot(x3, y3, 'g', 'DisplayName', '4x + 7y = 812');

x = linspace(-10, 200);
y = linspace(0, 0);
plot(x, y, 'k');
plot(y, x, 'k');
xlabel('x');
ylabel('y');
axis([0 205 0 300]);
```

```
plot(0, 812/7, 'go', 'DisplayName', '(0, 812/7)');
plot(150, 0, 'go', 'DisplayName', '(150,0)');
plot(691/5, 118/5, 'go', 'DisplayName', '(691/5, 118/5)');
plot(63, 80, 'go', 'DisplayName', '(63, 80)');
plot(0, 0, 'go', 'DisplayName', '(0, 0)');

legend show;
hold off;

function z = func2(x, y)
    z = 50*x + 60*y;
end

val_1 = func2(0, 812/7);
val_2 = func2(150, 0);
val_3 = func2(691/5, 118/5);
val_4 = func2(63, 80);
val_5 = func2(0, 0);

values = [val_1, val_2, val_3, val_4, val_5];

[maxValue, maxIndex] = max(values);
[minValue, minIndex] = min(values);

disp(['The maximum value is ', num2str(maxValue), ' at index ', num2str(maxIndex)]);
disp(['The minimum value is ', num2str(minValue), ' at index ', num2str(minIndex)]);
```

**Output:**




```
>> Assignment4
The maximum value is 8326 at index 3
The minimum value is 0 at index 5
```

**Result:**

The maximum value is 8326 at point (691/5, 118/5)

The minimum value is 0 at point (0, 0)

**Question 3:**

Maximize Z = 4x + 5y
Subject to:
x + y <= 20
3x + 4y <= 72
x, y >= 0

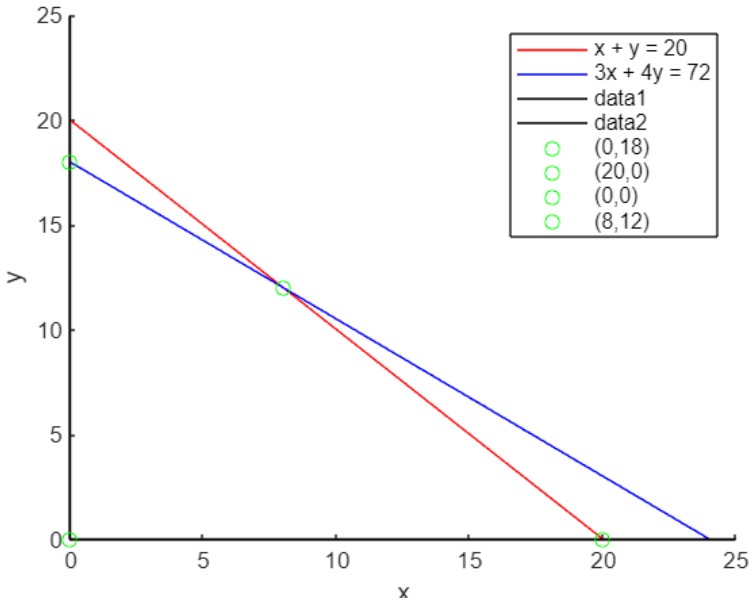
**Code:**

```
% Question 3

x1 = linspace(0, 20);

y1 = 20 - x1;


x2 = linspace(0, 24);

y2 = (72 - 3*x2) / 4;
```

```
hold on;
plot(x1, y1, 'r', 'DisplayName', 'x + y = 20');
plot(x2, y2, 'b', 'DisplayName', '3x + 4y = 72');

x = linspace(-5, 25);
y = linspace(0, 0);
plot(x, y, 'k');
plot(y, x, 'k');

xlabel('x');
ylabel('y');
axis([0 25 0 25]);

plot(0, 18, 'go', 'DisplayName', '(0,18)');
plot(20, 0, 'go', 'DisplayName', '(20,0)');
plot(0, 0, 'go', 'DisplayName', '(0,0)');
plot(8, 12, 'go', 'DisplayName', '(8,12)');
legend show;
hold off;

function z = func(x, y)
    z = 4*x + 5*y;
end

val_1 = func(0, 18);
val_2 = func(20, 0);
val_3 = func(0, 0);
val_4 = func(8, 12);
```

```
values = [val_1, val_2, val_3, val_4];


[maxValue, maxIndex] = max(values);
[minValue, minIndex] = min(values);


disp(['The maximum value is ', num2str(maxValue), ' at index ', num2str(maxIndex)]);
disp(['The minimum value is ', num2str(minValue), ' at index ', num2str(minIndex)]);
```

**Output:**




```
>> Assignment4
The maximum value is 92 at index 4
The minimum value is 0 at index 3
>>
```

**Result:**

The maximum value is 92 at point (8, 10)

The minimum value is 0 at point (0, 0)

**Question 4:**

Maximize Z = 100x + 40y
Subject to:
5x + 2y <= 1000

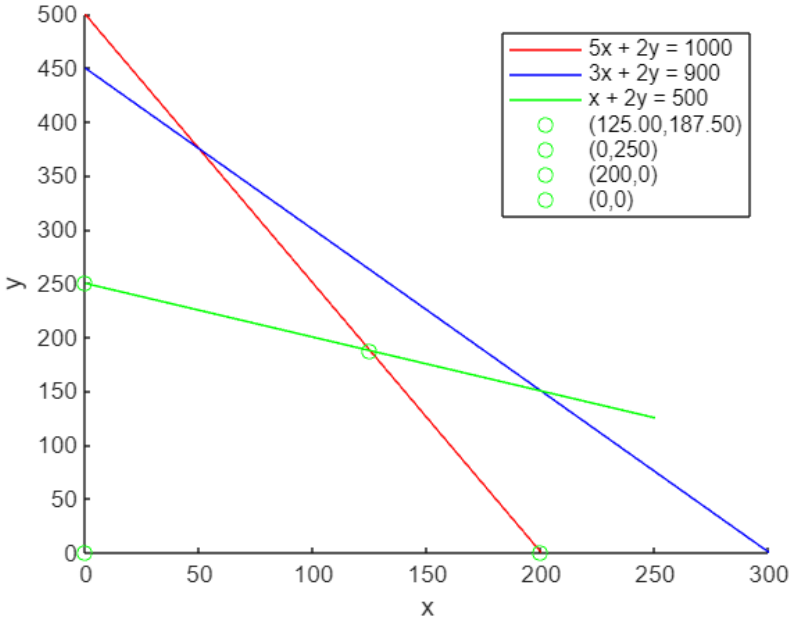
3x + 2y <= 900
x + 2y <= 500
x, y >= 0

**Code:**

```
% Question 4
x1 = linspace(0, 200);
y1 = (1000 - 5*x1) / 2;

x2 = linspace(0, 300);
y2 = (900 - 3*x2) / 2;

x3 = linspace(0, 250);
y3 = (500 - x3) / 2;

hold on;
plot(x1, y1, 'r', 'DisplayName', '5x + 2y = 1000');
plot(x2, y2, 'b', 'DisplayName', '3x + 2y = 900');
plot(x3, y3, 'g', 'DisplayName', 'x + 2y = 500');

xlabel('x');
ylabel('y');
axis([0 300 0 500]);



A = [5 2; 1 2];
b = [1000; 500];
intersection2 = A\b;
```

```
plot(intersection2(1), intersection2(2), 'go', 'DisplayName', sprintf('(%0.2f,%0.2f)', intersection2(1), intersection2(2)));
plot(0, 250, 'go', 'DisplayName', '(0,250)');
plot(200, 0, 'go', 'DisplayName', '(200,0)');
plot(0, 0, 'go', 'DisplayName', '(0,0)');

legend show;
hold off;

function z = func(x, y)
    z = 100*x + 40*y;
end

val_2 = func(intersection2(1), intersection2(2));
val_4 = func(0, 0);
val_5 = func(200, 0);
val_6 = func(0, 250);

values = [val_2, val_4, val_5, val_6];

[maxValue, maxIndex] = max(values);
[minValue, minIndex] = min(values);

disp(['The maximum value is ', num2str(maxValue), ' at index ', num2str(maxIndex)]);
disp(['The minimum value is ', num2str(minValue), ' at index ', num2str(minIndex)]);
```

**Output:**




```
>> Assignment4
The maximum value is 20000 at index 1
The minimum value is 0 at index 2
>>
```

**Result:**

x+2y=500 is redundant constraint

The maximum value is 20000 at point (128, 187.5)

The minimum value is 0 at point (0, 0)