21BDS0340

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# Digital Lab Assignment 3

## Problem 1

Locate and classify all critical points for f (x, y) = x3 − 2y2 − 2y4 + 3x2y.

### Code:

syms x y

equation(x, y) = x^3 - 2\*y^2 - 2\*y^4 + 3\*x^2\*y;

fx = diff(equation, x);

fy = diff(equation, y);

fxx = diff(fx, x);

fyy = diff(fy, y);

fxy = diff(fy, x);

[ax, ay] = solve(fx, fy);

ax = double(ax);

ay = double(ay);

S = size(ax);

S = S(1) \* S(2);

subplot(1,2,1)

fsurf(equation)

subplot(1,2,2)

fsurf(equation)

leg = ['Function Plot'];

hold on

for i = 1:S

xval = ax(i);

yval = ay(i);

zval = equation(xval, yval);

m = subs(subs(fxx \* fyy - fxy \* fxy, x, xval), y, yval);

r = subs(subs(fxx, x, xval), y, yval);

if isreal(m) && isreal(r)

if m > 0 && r < 0

msg = sprintf('Maxima at x = %f and y = %f', xval, yval);

leg = [leg, {'Maxima'}];

mkr = 'g+';

elseif m > 0 && r > 0

msg = sprintf('Minima at x = %f and y = %f', xval, yval);

leg = [leg, {'Minima'}];

mkr = 'r\*';

elseif m < 0

msg = sprintf('Saddle point at x = %f and y = %f', xval, yval);

leg = [leg, {'Saddle Point'}];

mkr = 'ko';

elseif m == 0

msg = sprintf('Not known at x = %f and y = %f', xval, yval);

leg = [leg, {'Case of Further Investigation'}];

mkr = 'bv';

end

plot3(xval, yval, zval, mkr, "Linewidth", 4)

disp(msg)

end

end

legend(leg, 'Location', 'best');

xlabel('x')

ylabel('y')

zlabel('z')

### Chart, surface chart Description automatically generatedText, letter Description automatically generatedOutput:

## Problem 2

Let x2 + y2 represent the utility function or customer satisfaction derived by a consumer from the consumption of a certain amount of product x and certain amount of product y. Maximize the utility function subject to the constraint 2x + 4y = 40

### Code:

syms x y L

f(x, y) = x^2 + y^2;

g(x, y) = 2\*x + 4\*y - 40;

F = f + L \* g;

Fx = diff(F, x);

Fy = diff(F, y);

S = solve(g, Fx, Fy, 'Real', true);

points = [S.x, S.y];

points = double(points);

value = double(f(S.x, S.y))

X = double(linspace(min(S.x) - 3, max(S.x) + 3, 25));

Y = double(linspace(min(S.y) - 3, max(S.y) + 3, 25));

[X, Y] = meshgrid(X, Y);

Z = double(f(X, Y));

surf(X, Y, Z)

hold on

xlabel('x');

ylabel('y');

zlabel('f(x,y)');

gv = fimplicit(g, 'b');

xv = get(gv, 'XData');

yv = get(gv, 'YData');

fv = double(f(xv, yv));

plot3(xv, yv, fv, '-r')

### Output:

Chart, surface chart

Description automatically generatedChart

Description automatically generated with low confidence