MATLAB之高等数学

董波
数学科学学院
大连理工大学

多元函数微分学

1. 偏导数与全微分；

2. 曲面的切平面与法线并绘制图形；

3. 多元函数的梯度；

4. 多元函数的极值；

diff函数

1. 求函数f(x,y)关于x的导数

```
>> syms x y
>> diff(f(x,y), x)
```

2. 求函数f(x,y)关于x的n阶导数

```
>> diff(f(x,y), x, n)
```

3. 求函数f(x,y)关于x和y的2阶混合偏导数

```
>> diff(f(x,y), x, y)
```

4. 求函数f(x,y)的全微分

```
>> syms dx dy
>> dz = diff(f(x,y), x)*dx+ diff(f(x,y), y)*dy
```

$$z=\frac{2xy}{x^2+y^2},求\frac{\partial z}{\partial x},\frac{\partial^2 z}{\partial x^2},\frac{\partial^3 z}{\partial x^2\partial y}$$

$>> syms\ \ x\ \ y;$

$>> z=2*x*y/(x\wedge 2+y\wedge 2);$

$>> dzx=diff(z,x)$

$>> dzxx=diff(z,x,2)$

$>> dzxxy=diff(dzxx,y)$

命令行窗口

```
>> syms x y;
>> z=2*x*y/(x^2+y^2);
>> dzx=diff(z,x)

dzx =

(2*y)/(x^2 + y^2) - (4*x^2*y)/(x^2 + y^2)^2

>> dzxx=diff(z,x,2)

dzxx =

(16*x^3*y)/(x^2 + y^2)^3 - (12*x*y)/(x^2 + y^2)^2

>> dzxxy=diff(dzxx,y)

dzxxy =

(16*x^3)/(x^2 + y^2)^3 - (12*x)/(x^2 + y^2)^2 + (48*x*y^2)/(x^2 + y^2)^3 - (96*x^3*y^2)/(x^2 + y^2)^4

>>
```

$u = xy^2z^3$,求du

```
>> syms x y z dx dy dz;
>> u = x * y ^ 2 * z ^ 3;
>> dux = diff(u,x);
>> duy = diff(u,y);
>> duz = diff(u,z);
>> du = dux * dx + duy * dy + duz * dz
```

命令行窗口

```
>> syms x y z dx dy dz;
>> dux=diff(u,x);
>> duy=diff(u,y);
>> duz=diff(u,z);
>> du=dux*dx+duy*dy+duz*dz

du =

dx*((32*x^3*y^5)/(x^2 + y^2)^3 - (48*x^5*y^5)/(x^2 + y^2)^4) + dy*((40*x^4*y^4)/(x^2 + y^2)^3 - (48*x^4*y^6)/(x^2 + y^2)^4)
```

求 $z = 2x^2 + y^2$ 在点(1,1)处的切平面、法线方程，并画出他们的图形。

```
>> syms x y z
>> f = 2*x^2+y^2-z;
>> fx = diff(f,x); fy = diff(f,y);
>> x = 1; y = 1; z = 3;
>> fxv = eval(fx), fyv = eval(fy)

fxv =

     4


fyv =

     2
```

切平面方程

$$f_x(x_0,y_0)(x-x_0)+f_y(x_0,y_0)(y-y_0)=z-z_0$$

法线方程

$$\frac{x-x_0}{f_x(x_0,y_0)}=\frac{y-y_0}{f_y(x_0,y_0)}=\frac{z-z_0}{-1}$$

```
>> [x,y] = meshgrid(-2:0.1:3);
z1 = 2*x.^2+y.^2;
z2 = fxv*(x-1)+fyv*(y-1)+3;
t = -1:0.1:1;
x3 = fxv*t+1; y3 = fyv*t+1; z3 = -t+3;
hold on
mesh(x,y,z1)
mesh(x,y,z2)
plot3(x3,y3,z3)
hold off
```