Math 694 Professional Tools Seminar - Matlab

Spring 2014, Tuesday 4:00-4:50, Room 215 Armstrong Hall

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Class 1 & 2 (Jan 14 & 21)

Calculus and Plot

Example 1. Find the value of the following function. $\sin(3.1\pi)$, $\sin^{-1}(0.2)$, e^2.

```
sin(3.1*pi)

asin(0.2)

exp(2)
```

Example 2. Explore the command 'help'.

```
help exp
help asin
```

Example 3. Plot the function e^x.

```
x=[-1:0.2:1]

plot(x,exp(x))

plot(x,exp(x), '*')
```

Example 4. Let f(x)= $\cos x\left[0.5+\frac{3\sin x}{1+x^2}\right]$. Find $f(-0.5)$, $f(0.7)$. Plot the function in $x=[0,2\pi]$. (.^, ./, .*, subs, eval and format long)

```
syms x

y=cos(x)*(0.5+3*sin(x)/(1+x^2));

subs(y,x,-0.5)

eval(subs(y,x,0.7))
```

Or

```
subs(y,x,[-0.5,0.7])

format long

help format

plot([0:2*pi/100:2*pi],subs(y,x, [0:2*pi/100:2*pi]))
```

Exercise 1. Let f(x)= $\sin\frac{1}{x}$. Find $f(0.05)$, $f(0.007)$. Plot the function in $x=[0,\pi]$.

Example 5. Find the derivative of the function $xy^4+\sin(xy)=\sin(\tan x)$ with respect to x and y.

```
syms x y
```

```
z=x*y^4+sin(x*y)-sin(tan(x))
diff(z,x)
```

Verify the answer by

```
int(ans,x)
```

Example 6. Let $y = \sin^4 x + \cos^4 x$. Then find the derivative $y^{(18)}$.

```
syms x
y=(sin(x))^4+(cos(x))^4
diff(y,18)
```

Exercise 2. Let $z = y^4 \sin^4 x + x^4 \cos^4 y$. Then find $\frac{\partial z}{\partial x}$.

Exercise 3. Let $y = xe^{2x}$. Then find the derivative $y^{(20)}$.

Example 7. Find $\int \frac{\sin(\ln t)}{t} dt$, $\int \frac{1}{(x^2+1)(x^2-1)}$ and $\int_0^1 \frac{t^2+1}{t^2-1} dt$.

```
int(sin(log(t))/t,t)
int((t^2+1)/(t^2-1),t,0,1)
```

Exercise 4. Find $\int \frac{1}{(x^2+1)(x^2-1)}$

Exercise 8. Graph the curve of the polar equation $r = \sin\theta + (\sin\frac{5\theta}{2})^3$. (Calculus P502)

```
t= [0:0.01*pi:10*pi]
polar(t,sin(t)+(sin(5*t/2))^3)
```

Exercise 5. Graph the curve of the polar equation $r = \sin\frac{8\theta}{5}$. (Calculus P502)

Example 9. 3D plot. Plot the function $f(x,y) = -xye^{-x^2-y^2}$. (Calculus p597)

```
x=[-2:0.1:2]
y=[-2:0.2:2]
[xx,yy]=meshgrid(x,y)
zz=-xx.*yy.*exp(-xx.^2-yy.^2)
surf(xx,yy,zz)
```

Exercise 6. 3D plot. Plot the function $f(x,y) = \frac{\sin x \cdot \sin y}{xy}$. (Calculus p594)

Class 3 (Jan 28)

Linear Algebra, Curve Fitting and Interpolation

Example 1. Solve the following linear system.

$$\begin{cases} 2y - z = 3 \\ x + y + 2z = 1 \\ x + y + z = -1 \end{cases}$$

```
A= [0 1 -1; 1 1 2; 1 1 1]

b=[3 1 -1]

Solution=b\A
```

Example 2. Let $A = \begin{bmatrix} 1 & 0 \\ 0 & a \\ b & 1 \end{bmatrix}$, $B = \begin{bmatrix} 1 & 0 & 1 \\ a & 1 & 0 \end{bmatrix}$. Then find A^T. Let C=AB and k be the row 2 column 3 element in AB. Let d be the 3rd column vector. Find kd.

```
syms a b

A=[1 2; 3 5; a b]

B=[1 0 1; a 1 0]

A'

C=A*B

k=C(2,3)

d=C(3,:)

k*d
```

Example 3. Let A be a random matrix with size 10*10. Let the diagonal elements be 0.

```
A=rand(10)

for i=1:10

A(i,i)=0;

End

A
```

Exercise 7. Let A be a random matrix with size 5*5. Let the antidiagonal elements be 1.

Example 4. Fit the over time temperature and return a linear function, and a polynomial. Plot the 2 resulting function together with the original data.

```
hours=1:12; % time

temps=[5   8   9   15   25   29   31   30   22   25   27   24];

hours=[1:12]'
```

```
temps=[5   8   9   15   25   29   31   30   22   25   27   24]'
fl=fit(hours, temps, 'poly1')
fq=fit(hours, temps, 'poly2')
plot(hours,temps, '*')
hold on
x=[1:0.2:12]
plot(x,fl(x))
hold on
plot(x,fq(x), 'r-')
%Option: use built in curve fitting apps.
```

Example 5. Interpolate the temperature using linear and polynomial interpolates and estimate temperature at hour=9.3 and 4.7. Plot the result and compare.

```
interpl(hours',temps',9.3, 'spline')
interpl(hours',temps',4.7, 'spline')
y=interpl(hours',temps',x,'spline')
hold on
plot(x,y,'g-')
```

Exercise 8. Generate two 6×8 matrices, one with random distribution, and one with normal distribution. Find the mean and variance of each row. For the normal distribution data, sort it and then make a plot.

Class 4 (Feb 4)

Scripts

Example 1. Find square root of the sum over all the primes in [1, 100].

```
ps=0; %Initial value for the summation
for i=1:100
   if isprime(i) %isprime returns 0 if i is not a prime, returns 1 if i is a
prime.
      ps=ps+I; % This statement is executed if the expression after 'if'
returns 1
   end
end
```

```
ps %Display the result: ps
```

Or

```
ps=0; %Initial value for the summation
for i=1:100
    Index=1; %To record if i is a prime
    for j=2:sqrt(i) %Check if j divides i
        if mod(i,j)==0
            Index=0; %If yes, then i is not a prime and let Index=0. If not, do
nothing and check next j.
        end
    end
    ps=ps+Index*i; %If Index=0, add nothing to ps because it is not a prime.
If Index=1, then add i to ps.
end
ps  %Display the result: ps
```

Example 2. Creat an m file with the following function. Input the password from the keyboard. If it is 123, display 'Your password is correct. Your lucky number is 765', otherwise, display 'Your password is incorrect' and input the password again.

```
Password=input('Enter your password:')
k=0;
while k~=1
    if Password==123
        display('Your lucky number is 765')
        k=1;
    else

        display('Your password is incorrect')
        Password=input('Enter your password:');
    end
end
```

Or define a function

```
function f=check
Password=input('Enter your password:')
if Password==123
    display('Your lucky number is 765')
else
    check
end
```

Example 3. Assuming an aunt is walking on the xy-plane starting from the origin. In each step, it can only walk NSEW, the direction of its walk is random. Display the trajectory of the aunt for 20 steps.

```
Steps=50; %Number of steps you are going to record.
Location=zeros(2,Steps+1); %Location of each step. Use a spare column to save
the origin.
Dir = [[1 0]', [-1 0]', [0 1]', [0 -1]']; % 4 directions,WENS.
for i=1:Steps
    k=randsample(4,1) %pick a direction randomly
    Location(:,i+1)=Location(:,i)+Dir(:,k) %Change the direction
end
figure(100)
clf;
plot(Location(1,:),Location(2,:),'r-')
xlim([-10,10])
ylim([-10,10])
```

Exercise 9. Input the numbers one by one from keyboard until you enter the number 0. Find the mean and variance.