```
% ----------------------------------------
% Assignment for Numerical Integration
% LiXin
% 2022/3/25
% ----------------------------------------
```

Problem 1

```
clear; close; clc;
fun=@(x) (x+1./x).^2;
```

when n = 1

```
n1=linspace(1,2,2);
y1=fun(n1);
res1=trapz(n1,y1)
```

```
res1 = 5.1250
```

when n = 2

```
n2=linspace(1,2,3);
y2=fun(n2);
res2=trapz(n2,y2)
```

```
res2 = 4.9097
```

when n = 3

```
n3=linspace(1,2,4);
y3=fun(n3);
res3=trapz(n3,y3)
```

```
res3 = 4.8677
```

when n = 4

```
n4=linspace(1,2,5);
y4=fun(n4);
res4=trapz(n4,y4)
```

```
res4 = 4.8527
```

analytical solution

```
syms x
an_sol=int((x+1/x)^2,[1 2])
```

```
an_sol =
```

$$\frac{29}{6}$$

```
rel_err=([res1,res2,res3,res4]-an_sol)/an_sol
```

```
rel_err =
```

$$\left(\frac{7}{116}\quad\frac{11}{696}\quad\frac{371}{52200}\quad\frac{65562606820223}{16325548649218048}\right)$$

```
fprintf("relative errors are:\nn=1:%f n=2:%f n=3:%f n=4:%f",rel_err(1),rel_err(2),rel_err(3),re
```

```
relative errors are:
n=1:0.060345 n=2:0.015805 n=3:0.007107 n=4:0.004016
```

Problem 2

```
clear;close;clc;
fun=@(x)x.^2.*exp(x);
x=linspace(0,3,5);
```

使用 trapezoidal 方法

```
trap_sol=trapz(x,fun(x))
```

```
trap_sol = 112.2684
```

使用 Simpson's 1/3 方法

```
simp_y=fun(x);
simp_sol=1/3*(simp_y(1)+4*simp_y(2)+2*simp_y(3)+4*simp_y(4)+simp_y(5))*(x(2)-x(1))
```

```
simp_sol = 99.4568
```

使用 analytical 方法

```
syms x
ana_sol=int(x^2*exp(x),[0 3])
```

```
ana_sol =
```

$$5\,e^3-2$$

```
rel_err=([trap_sol, simp_sol]-ana_sol)/ana_sol
```

```
rel_err =
```

$$\left(-\frac{5\,e^3-\frac{8040923371442111}{70368744177664}}{5\,e^3-2}\quad-\frac{5\,e^3-\frac{7139389958978273}{70368744177664}}{5\,e^3-2}\right)$$

```
fprintf("relative errors\ntrapzezoidal:%f simpson's 1/3:%f",rel_err(1),rel_err(2))
```

```
relative errors
trapzezoidal:0.140618 simpson's 1/3:0.010456
```

Problem 3

```
clear;close;clc;
```

(a)

```
y=[0 1 3 5 7 8 9 10];
H=[0 1 1.5 3 3.5 3.2 2 0];
U=[0 0.1 0.12 0.2 0.25 0.3 0.15 0];
avg_depth=1/y(8)*trapz(y,H)
```

```
avg_depth = 2.0950
```

(b)

```
area=trapz(y,H)
```

```
area = 20.9500
```

(c)

```
avg_vel=1/y(8)*trapz(y,U)
```

```
avg_vel = 0.1615
```

(d)

```
Q=trapz(y,H.*U)
```

```
Q = 4.2825
```

Problem 4

```
clear;close;clc;
t=[0 1 5.5 10 12 14 16 18 20 24];
c=[1 1.5 2.3 2.1 4 5 5.5 5 3 1.2];
fun=@(x)20+10*sin(2*pi/24*(x-10));
denominator=integral(fun,0,24);
Q=fun(t);
numerator=trapz(t,c.*Q);
avg_con=numerator/denominator
```

```
avg_con = 3.4852
```

Problem 5

```
clear;close;clc;
```

(a)

```
t=[0 15 30 45 75 105];
rate4=[18 24 26 20 18 9];
rate=rate4/4;
total_cars=trapz(t,rate)
```

```
total_cars = 502.5000
```

(b)

```
avg_cars=total_cars/t(6)
```

```
avg_cars = 4.7857
```