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# Numerical Analysis Homework #7

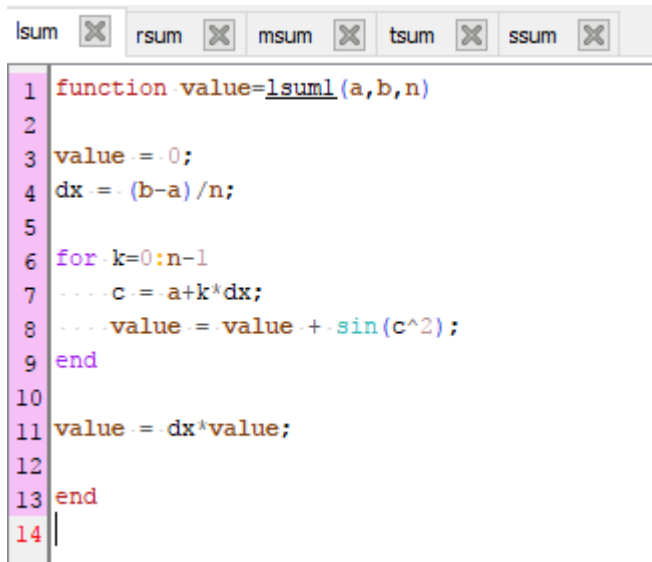
Numerical Integration

# Assignments

Evaluate the following definite integral of  $\sin(x^2)$  for  $x$  from 1 to 4. Use 15 digits after the decimal point.

1. **(10 points)** Evaluate the integral using the Left-End-Point Rule with  $n = 20$ .

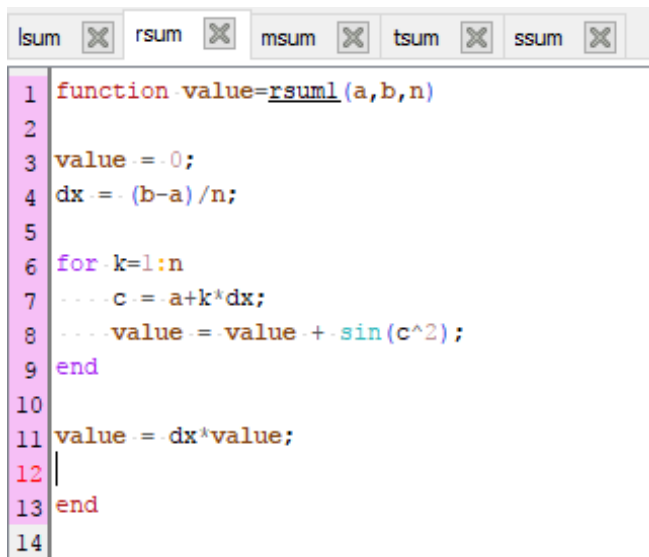
Left:



```
lsum  x rsum  x msum  x tsum  x ssum  x
1 function value=lsum1(a,b,n)
2
3 value = 0;
4 dx = (b-a)/n;
5
6 for k=0:n-1
7     c = a+k*dx;
8     value = value + sin(c^2);
9 end
10
11 value = dx*value;
12
13 end
14
```

Sum = 0.50479970592451096

Right:



```
lsum  x rsum  x msum  x tsum  x ssum  x
1 function value=rsum1(a,b,n)
2
3 value = 0;
4 dx = (b-a)/n;
5
6 for k=1:n
7     c = a+k*dx;
8     value = value + sin(c^2);
9 end
10
11 value = dx*value;
12
13 end
14
```

Sum = 0.33539356070356663

2. (10 points) Evaluate the integral using the Mid-Point Rule with  $n = 20$ .

```
lsum [X] rsum [X] msum [X] tsum [X] ssum [X]
1 function value=msuml(a,b,n)
2
3 value = 0;
4 dx = (b-a)/n;
5
6 for k=1:n
7     c = a + (2*k-1)/2*dx;
8     value = value + sin(c^2);
9 end
10
11 value = dx*value;
12
13 end
14
```

Sum = 0.44539295958999503

3. (10 points) Evaluate the integral using the Trapezoidal Rule with  $n = 20$ .

```
lsum [X] rsum [X] msum [X] tsum [X] ssum [X]
1 function value=tsuml(a,b,n)
2
3 value = 0;
4 dx = (b-a)/n;
5
6 for k=0:n
7     if (k == 0) || (k == n)
8         d = 1;
9     else
10        d = 2;
11    end
12    c = a + k*dx;
13    value = value + d*sin(c^2);
14 end
15
16 value = dx*value/2;
17
18 end
19
```

Sum = 0.42009663331403874

4. (10 points) Evaluate the integral using the Simpson's Rule with  $n = 20$ .

```
lsum x rsum x msum x tsum x ssum x
1 function value=ssuml(a,b,n)
2
3 value = 0;
4 dx = (b-a)/n;
5
6 for k=0:n
7     if (k==0) || (k==n)
8         d = 1;
9     elseif (modulo(k,2) == 1 & k<>0 & k<>n)
10        d = 4;
11    elseif (modulo(k,2) == 0 & k<>0 & k<>n)
12        d = -2;
13    end
14
15    c = a+k*dx;
16    value = value + d*sin(c^2);
17 end
18
19 value = dx*value/3;
20 end
```

Sum = 0.43862419431767519

5. (10 points) Evaluate the integral using the 5-point Gaussian-Legendre Quadrature Rule.

```
--> x = [-sqrt(5 + 2*sqrt(10/7))/3, -sqrt(5 - 2*sqrt(10/7))/3, 0, sqrt(5 - 2*sqrt(10/7))/3, sqrt(5 + 2*sqrt(10/7))/3]
x =
```

```
column 1 to 4
```

```
-0.90617984593866396 -0.53846931010568311 0. 0.53846931010568311
```

```
column 5
```

```
0.90617984593866396
```

```
--> w = 2./ (5* ((35*x.^4-30*x.^2+3)/8) .* ((63*5*x.^4 -70*3*x.^2+15)/8))
w =
```

```
column 1 to 3
```

```
0.23692688505618950 0.4786286704993664 0.56888888888888889
```

```
column 4 to 5
```

```
0.4786286704993664 0.23692688505618950
```

```
--> (4-1)/2*sum(w.*sin((4-1)/2*x.^2+(4+1)/2))
ans =
```

```
0.40980180281383155
```