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> ## Assignment 11 , Mast 334/ Math 354 , Solutions

## Problems 1g,2g,3g,4g,5g,6g page 195
f:=x->x*sin(x);
exact_value:=evalf(int(f,0..Pi/4));
## Derivatives:
d1f:=D(f);d2f:=D(d1f);d3f:=D(d2f);d4f:=D(d3f);
```

$$f := x \rightarrow x \sin(x)$$

$$exact\_value := 0.1517464138$$

$$d1f := x \rightarrow \sin(x) + x \cos(x)$$

$$d2f := x \rightarrow 2 \cos(x) - x \sin(x)$$

$$d3f := x \rightarrow -3 \sin(x) - x \cos(x)$$

$$d4f := x \rightarrow -4 \cos(x) + x \sin(x)$$

```
> # Trapezoidal Rule:
x0:=0;x1:=Pi/4;h:=x1-x0;
Trapezoidal_value:=evalf((h/2)*(f(x0)+f(x1)));
```

$$x0 := 0$$

$$x1 := \frac{\pi}{4}$$

$$h := \frac{\pi}{4}$$

$$Trapezoidal\_value := 0.2180895062$$

```
> # Error estimate = -(h^3/12)* d2f(theta)
## Since 0<d2f<=2 we have
error_est:= evalf(-(h^3/12)* 2.0);
actual_error:=exact_value-Trapezoidal_value;
```

$$error\_est := -0.0807455122\dot{.}$$

$$actual\_error := -0.0663430924$$

```
> # Simpson's Rule:
x0:=0;x1:=Pi/8;x2:=Pi/4;h:=x1-x0;
Simpson_value:=evalf((h/3)*(f(x0)+4*f(x1)+f(x2)));
# Error estimate = -(h^5/90)* d4f(theta)
## Since -4<=d4f<=0 we have
error_est:= evalf((h^5/90)* 4.0);
actual_error:=exact_value-Simpson_value;
```

$$x0 := 0$$

$$x1 := \frac{\pi}{8}$$

$$x2 := \frac{\pi}{4}$$

$$h := \frac{\pi}{8}$$

$$Simpson\_value := 0.1513826289$$

$$error\_est := 0.0004150657618$$

$$actual\_error := 0.0003637849$$

```
> # Midpoint Rule:
x_1:=0;x0:=Pi/8;x1:=Pi/4;h:=x1-x0;
Midpoint_value:=evalf(2*h*f(x0));
# Error estimate = (h^3/3)* d2f(theta)
## Since 0<=d2f<=2 we have
error_est:= evalf((h^3/3)* 2.0);
actual_error:=exact_value-Midpoint_value;
```

$$x\_1 := 0$$

$$x0 := \frac{\pi}{8}$$

$$x1 := \frac{\pi}{4}$$

$$h := \frac{\pi}{8}$$

$$Midpoint\_value := 0.1180291903$$

$$error\_est := 0.04037275610$$

$$actual\_error := 0.0337172235$$