Ross Fischer | Comp Meth | ch.9 3, 5, 7, 10, 14, 16

96

(3) est surface area + volume, radius measured @ different heights

$S = 2\pi \int_0^L r\,dz$ $V = \pi \int_0^L r^2\,dz$

z	0	2	4	6	8	10	12	14	16	18	20	22	24	26
r	10	11	11.9	12.4	13	13.5	13.8	14.1	13.6	12.1	8.9	4.7	4.1	3.5

z	28	30	32	34	36
r	3	2.4	1.9	1.2	1.0

Matlab File submitted to calculate a) composite rectangle

Surface Area = 1961.6 cm^2 X

Volume = 10,929 cm^3 X

16/18

b) trapezoidal method

Surface Area = 1892.5 cm^2

Volume = 10,612 cm^3

c) simpson's 3/8

surface Area = 1892 cm^2

Volume = 10610 cm^3

COMET

3-0235 — 50 SHEETS — 5 SQUARES
3-0236 — 100 SHEETS — 5 SQUARES
3-0237 — 200 SHEETS — 5 SQUARES
3-0137 — 200 SHEETS — FILLER

(5) Head Severity index $HSI = \int_0^t [a(t)]^{2.5} dt$

where $a(t)$ is normalized accel in m/s^2 (divided by 9.81) and t is time(s) during crash

t (ms)	0	5	10	15	20	25	30	35	40	45	50
a	0	3	8	20	33	42	40	48	60	12	8

t(ms)	55	60
a	4	3

matlab file used to calc HSI using

a) composite trapezoidal

$HSI = 1.234$

b) composite simp. 1/3

$HSI = 1.151$

c) composite simp. 3/8

$HSI = 1.311$

15

(7) Evaluate $I = \int_0^{2.4} \frac{2x}{1+x^2} dx$

w/ $\frac{1}{3}$ + $\frac{3}{8}$ simp.

- Divide whole interval into 6

- exact answer is $\ln\left(\frac{169}{25}\right)$. compare + discuss

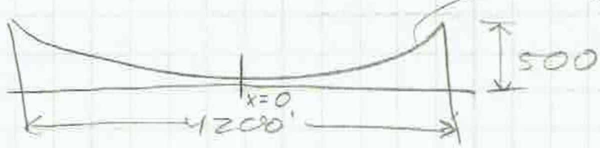
Matlab File used → $\boxed{\begin{array}{l}\text{Simpon's } \frac{1}{3} \text{ method estimates} \\ I = 1.9136 \\ \text{simpsons } \frac{3}{8} \text{ method estimates} \\ I = 1.9155\end{array}}$

While $\ln\left(\frac{169}{25}\right) = 1.911$

Both methods provide a very close estimate. Relative Errors?
Interestingly, the 1/3 method provides a closer estimate.

$\frac{13}{15}$

10



$$f(x) = c\left(\frac{e^{x/c} + e^{-x/c}}{2} - 1\right)$$

$c = 4491$

Using eq. $L = \int_a^b \sqrt{1 + f'(x)^2}\, dx$, est length of main cable

$$f'(x) = \frac{c}{2}\left(\frac{e^{x/c}}{c} - \frac{e^{-x/c}}{c}\right)$$

$$f'(x) = \frac{e^{x/c} - e^{-x/c}}{2}$$

Matlab File used

$\boxed{\begin{array}{l} \text{a) simpson's 1/3 method} \\ \quad \hookrightarrow L = 4354.742 \text{ Ft} \\ \text{b) simpson's 3/8 method} \\ \quad \hookrightarrow L = 4354.744 \text{ Ft} \end{array}}$

20

c) 3pt. Gauss Quad

$$\int_{-2100}^{2100} c\left(\frac{e^{x/c} + e^{-x/c}}{2} - 1\right) dx \qquad \int_{-1}^{1} f\left(\frac{(b-a)t + a + b}{2}\right)\left(\frac{b-a}{2}\right) dt$$

$$x = \left(\frac{4200t \cancel{+2100 - 2100}}{2}\right) \qquad dx = 2100\, dt$$

$$F'(t) = \frac{e^{\frac{2100t}{c}} - e^{-\frac{2100t}{c}}}{2} \rightarrow L = \int_{-1}^{1} \underbrace{2100\sqrt{1 + \frac{e^{2100t/c} - e^{-2100t/c}}{2}}}_{F}\, dt$$

$\rightarrow C_1 F(t_1) + C_2 F(t_2) + C_3 F(t_3) \rightarrow$

$\rightarrow (.5\overline{5}) F(-.774596) + (.8\overline{8}) F(0) + (.5\overline{5}) F(.774596) \rightarrow$

$\rightarrow$ $\boxed{\text{3pt Gauss quad. estimates } L = 4354.7}$

(14) $\pi = \frac{1}{2}\int_{-1}^{1} \frac{4}{1+x^2}\,dx$

approx. pie using comp trapezoid w/ six intervals

Matlab File used

a) Composite Trapezoidal method estimates $\pi \approx 3.1231$

b) Composite Simpson's $\frac{1}{3}$ estimates $\pi \approx 3.1419$

16

(16) $\operatorname{erf}(x) = \frac{2}{\sqrt{\pi}} \int_0^x e^{-t^2}\, dt$ @ $x = 2$

using 4 pt quad

$$\int_0^x e^{-t^2}\, dt \qquad \int_{-1}^{1} f\left(\frac{(b-a)x + a + b}{2}\right)\left(\frac{b-a}{2}\right) dx$$

$$t = \frac{2x + 2}{2} = x + 1 \qquad dt = \left(\frac{b-a}{2}\right) dx = dx$$

$$I = \int_{-1}^{1} e^{-(x+1)^2}\, dx$$

$$I = (.34785)f(-.86113) + (.65214)f(-.33998) + (.65214)f(.33998) + (.34785)f(.86113)$$

16

$$\boxed{\operatorname{erf}(2) = I \cdot \frac{2}{\sqrt{\pi}} = .9955}$$