COMPUTER SCIENCE 349A
Handout Number 29

USE OF NEWTON-COTES CLOSED QUADRATURE FORMULAS ON DISCRETE DATA AT UNEQUALLY SPACED POINTS

(Section 21.3)

Consider the data given in Table 21.3 on page 622 of the 6^{th} ed. or page 624 of the 7^{th} ed.

x	$f(x)$	x	$f(x)$
0.0	0.200000	0.44	2.842985
0.12	1.309729	0.54	3.507297
0.22	1.305241	0.64	3.181929
0.32	1.743393	0.70	2.363000
0.36	2.074903	0.80	0.232000
0.40	2.456000		

As the data is not specified at equally-spaced points *x*, no fixed Newton-Cotes formula for a small value of *n* can be used to approximate the integral of the continuous, but unknown, function $f(x)$ that is represented by this data. This data could be interpolated by a polynomial of degree 10, but such high order Newton-Cotes formulas should be avoided.

Instead, for example, you could do the following:

- use the Trapezoidal rule with $h = 0.12$ on [0.0, 0.12]
- use Simpson's rule with $h = 0.10$ on [0.12, 0.32]
- use Simpson's 3/8 rule with $h = 0.04$ on [0.32, 0.44]
- use Simpson's rule with $h = 0.10$ on [0.44, 0.64]
- use the Trapezoidal rule with $h = 0.06$ on [0.64, 0.70]
- use the Trapezoidal rule with $h = 0.10$ on [0.70, 0.80]

This is done in Example 21.8 on page 623 of the 6^{th} ed. or page 625 of the 7^{th} ed., and yields a computed approximation to $\int_{0.0}^{0.80} f(x)\,dx$ of 1.603641 . In this case, the given data was obtained by sampling a known function, and the correct value of the integral is 1.640533 .