

## Riemannian Integration Tests by James Pate Williams, Jr., BA, BS, MSWE, PhD

The first indefinite integral is:

$$\int x^3 e^x dx = ?$$

Create the following tableau:

$$x^3 \quad e^x$$

$$3x^2 \quad e^x$$

$$6x \quad e^x$$

$$6 \quad e^x$$

$$e^x$$

$$\int x^3 e^x dx = (x^3 - 3x^2 + 6x - 6)e^x$$

$$\int x^3 \sin x dx = ?$$

$$x^3 \quad + \sin x$$

$$3x^2 \quad - \cos x$$

$$6x \quad - \sin x$$

$$6 \quad + \cos x$$

$$+ \sin x$$

$$\int x^3 \sin x dx = -x^3 \cos x + 3x^2 \sin x + 6x \cos x - 6 \sin x$$

We compute the following definite integrals:

$$\int_0^1 x^3 e^x dx = (1 - 3 + 6 - 6)e + 6 = -2e + 6$$

$$\int_0^\pi x^3 \sin x dx = -\pi^3 \cos \pi + 6\pi \cos \pi$$

Functions are:

$f1(x) = x^3 * \exp(x)$

$f2(x) = x^3 * \sin(x)$

Trapezoidal and Simpson Use 1024 Steps

|         | Value           | % Error        |
|---------|-----------------|----------------|
| trap1 = | 0.563437207200  | 0.000153365757 |
| simp1 = | 0.563436343082  | 0.000000000077 |
| true1 = | 0.563436343082  |                |
| trap2 = | 12.156696438505 | 0.000200056056 |
| simp2 = | 12.156720758748 | 0.000000000106 |
| true2 = | 12.156720758761 |                |