Math 112
Integration by Parts

Integration by parts is the *product rule in integral form*:

$$\int u\,dv = uv - \int v\,du$$

This formula expresses one integral, $\int u\,dv$, in terms of another integral, $\int v\,du$. With a proper choice of u and v, the second integral may be easier to evaluate than the first. In general, use the LIPET rule when choosing u. We want u to be something that *simplifies when differentiated*, and we want dv to be something that we will be *able to integrate*.

Examples.

1. $\int x\cos x\,dx$

2. $\int_0^3 xe^{-x}\,dx$

3. $\int \ln x\,dx$

4. $\int x^2 e^x \, dx$

5. $\int e^x \cos x \, dx$

6. $\int x^3 e^{x^2}\, dx$

7. Use integration by parts to establish the following *reduction formula*:

$$\int (\sin x)^n\, dx = -\frac{1}{n}\cos x(\sin x)^{n-1} + \frac{n-1}{n}\int (\sin x)^{n-2}\, dx$$