

Math 426.2SY

Calculus II

University of New Hampshire

June 7, 2017

Outline

1 8.1 - Integration by parts

Introduction

Integration by parts

- Integration by parts is a technique for simplifying integrals of the form

$$\int f(x)g(x) dx$$

- For example:

$$\int x \sin x dx, \int x \cos x dx, \int e^x \sin x dx, \dots$$

Deriving the Integration by Parts formula

Integration by Parts Formula

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

- The difficult thing is that there is no general rule for choosing u and dv . But we'd like to choose them in such a way that:
- u can be easily differentiated
- dv can be easily integrated
- $\int v \, du$ is either a simpler integral or one we can evaluate right away

Integration by parts

Example

$$\int x \cos(x) dx$$

Integration by parts

Example

$$\int \ln(x) dx$$

Integration by parts

Example

$$\int e^x x^2 dx$$

Integration by parts

Example

$$\int e^x \cos(x) dx$$

Integration by parts

Example

$$\int x \sec^2(x) dx$$

Integration by parts

Example

$$\int \sin^{-1}(x) dx$$

Integration by parts

Example

Use the integration by parts to establish the reduction formula:

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

Integration by Parts

Integration by Parts Formula for Definite Integrals

$$\int_a^b u \, dv = (uv) \Big|_a^b - \int_a^b v \, du$$

Integration by Parts

Example

$$\int_0^4 x e^{-x} dx$$