# Integration by Parts

## Learning Goals

- Identify when an integral requires integration by parts

- Compute integrals using integration by parts

- Identify which factor of a product should be integrated and which should be differentiated

- Evaluate integrals that require "circular" or repeated integration by parts

## Contents

# 1    Basic Formula

The theme for this next chapter is integration techniques, more tricks to work towards evaluating integrals that aren't just derivatives of functions already known.

# Product Rule

Recall the product rule for differentiation.

# Integration by Parts

**Example:** Compute $\displaystyle\int xe^x \, dx$

# 2 Using Integration by Parts

What tricks can be used to analyze an integral to figure out how to apply integration by parts?

**Example:** Compute $\displaystyle\int x^2 \sin x \; dx$

# 3  Circular Integration by Parts

Some integration by parts problems make it hard to tell there is progress being made.

**Example:** Compute $\int x^2 \sin x \; dx$

**Example:** Compute $\int e^x \cos x \ dx$

# 4    Definite Integration By Parts

Everything discussed so far has been indefinite integrals. What happens if these are definite integrals?

**Example:** Compute $\displaystyle\int_2^5 t \ln t \; dt$

# 5   Other Integrations by Parts

This technique also allows for computing the integrals of some other functions that could not be done before.

**Example:** Find $\displaystyle\int \ln x \ dx$