

Calculus Refresher: Integration by Substitution

The following guideline summarizes the steps involved in u-substitution method:

Integration by substitution

Choose a new variable u . Usually try choosing u to be some complicated part of the integrand whose derivative is also in the integrand.

Compute du .

Replace all terms in the original integrand with expressions involving u and du .

Evaluate the resulting u integrand. (If you can't, you may need to try a different u or a different method of integration.)

Replace u with the corresponding expression in x .

Example: Evaluate $\int \frac{x}{x^2+2} dx$

We would choose $u = x^2 + 2$ since its derivative is $2x$ and we can write the entire expression in terms of u and du .

$$u = x^2 + 2$$
$$du = 2x dx \rightarrow \frac{du}{2} = x dx$$

When substituting we should get the entire expression in terms of u and du .

$$\int \frac{x}{x^2+2} dx = \int \frac{du}{u}$$
$$= \frac{1}{2} \int \frac{du}{u}$$
$$= \frac{1}{2} \ln |u| + C$$
$$= \frac{1}{2} \ln(x^2+2) + C$$

Now you try it!

Evaluate:

$$\int x^3 \sqrt{x^4+5} dx$$

Answer: $\frac{(x^4+5)^{3/2}}{6} + C$

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