

The Fundamental Theorem and u-Substitution

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Objective

To illustrate how to evaluate integrals in Maple using u -substitution.

Narrative

If we wanted to substitute $u(x)$ for u in the expression $f(u)$ then we could do this using Maple's `subs` command:

`subs(u=<u(x)>,f(u))` Substitute $u(x)$ for u in the expression $f(u)$.

There is, however, more than just using this command to evaluating an integral by u -substitution. In this project we illustrate the following command (which is in Maple's `student` package) for performing u -substitution:

`changevar(u=<u(x)>,MyInt,u)` Perform the u -substitution $u = u(x)$ in the integral $MyInt$.

Task

1. Type the command lines in the left-hand column below into Maple in the order in which they are listed. These commands are aimed at using a u -substitution to evaluate a definite integral and an indefinite integral.

> # Your name, today's date	
> # The Fundamental Theorem and u-Substitution	
> restart;	Clear Maple's memory.
> MyInt := Int(x^3*cos(x^4+2),x=0..1);	Let $MyInt = \int_{x=0}^1 x^3 \cos(x^4 + 2) dx$.
> with(Student):	Using the <i>Student</i> package ...
> changevar(u=x^4+2,MyInt,u);	make the u -substitution $u = x^4 + 2$ in $MyInt$.
> value(%);	Evaluate the resulting integral.
> evalf(%);	Write $MyInt$ as a floating point real number.
> MyInt := Int(x^3*cos(x^4+2),x);	Let $MyInt = \int x^3 \cos(x^4 + 2) dx$.
> changevar(u=x^4+2,MyInt,u);	Make the u -substitution $u = x^4 + 2$ in $MyInt$.
> value(%);	Evaluate the resulting integral.
> subs(u=x^4+2,%);	Get the solution back in terms of x .
> diff(%,x);	Check our answer by differentiating.

2. Use Maple to evaluate $\int_1^3 (2x + 1)(x^2 + x)^5 dx$ and $\int (2x + 1)(x^2 + x)^5 dx$ using a u -substitution.

Your lab report will be a hard-copy of your typed input and Maple's responses.

Comments

Note that since `MyInt` is an expression (as opposed to a function), we differentiate it using the operator `diff` which applies to expressions (as opposed to the operator `D` which applies to functions).