Pasadena City College

§7.5 & §7.6

Dr. Basilio

Outline

Guiding Questions

Strategies for $\int$

Using CAS

§7.5: Strategies for Integration & §7.6 Using Tables and CAS

Ch 7: Techniques of Integration
Math 5B: Calculus II

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Class #11 Notes

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Outline

1 Guiding Questions

2 Strategies for Integration

3 Using Integral Tables & CAS

Guiding Questions for §7.5 & 7.6

Guiding Question(s)

❶ Integration is hard. How can we organize our strategies for integration?

❷ When using a computer program, or Computer Algebra System to integrate what are some quirks to keep in mind?

Strategies for Integration

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Outline

Guiding Questions

Strategies for ∫

Using CAS

Integration Toolbox

When confronted with an integral, $\int f(x)\, dx$, the main tools in your integration toolbox are:

1. know a lot of derivative rules/anti-derivative rules!
2. u-substitution (corresponds to the chain rule)
3. integration by parts (corresponds to the product rule)
4. trigonometric substitution

Additional techniques:

1. Strategies for $\sin^n(x) \cdot \cos^m(x)$
2. Partial Fractions
3. Miscellaneous algebra manipulations Note: sometimes this is "step 0"

Strategies for Integration

Integration Toolbox

When confronted with an integral, $\int f(x)\,dx$, the main tools in your **integration toolbox** are:

➊ know a lot of derivative rules/anti-derivative rules! If you can recognize DRs, use the corresponding ADRs! MEMORIZE!!!!!

- General Theorems: sum/difference rule, even/odd tricks
- Power rule!
$$\int x^n\,dx = \begin{cases} \frac{x^{n+1}}{n+1} + C, & x \neq -1 \\ \ln|x| + C, & x = -1 \end{cases}$$
- Trig functions:
$$\int \sin(x)\,dx = -\cos(x) + C, \quad \int \cos(x)\,dx = \sin(x) + C,$$
$$\int \sec^2(x)\,dx = \tan(x) + C, \quad \int \sec(x)\tan(x)\,dx = \sec(x) + C,$$
$$\int \csc^2(x)\,dx = -\cot(x) + C, \quad \int \csc(x)\cot(x)\,dx = -\csc(x) + C,$$
$$\int \sec(x)\,dx = \ln|\sec(x) + \tan(x)|, \quad \int \tan(x)\,dx = \ln|\sec(x)|,$$

Strategies for Integration

Integration Toolbox

When confronted with an integral, $\int f(x)\, dx$, the main tools in your **integration toolbox** are:

❶ know a lot of derivative rules/anti-derivative rules! If you can recognize DRs, use the corresponding ADRs! MEMORIZE!!!!!

- Continued:
- Exponential functions: $\int e^x\, dx = e^x + C$ and $\int b^x\, dx = \dfrac{b^x}{\ln(b)} + C$
- *Logarithm functions: $\int \ln(x)\, dx = x\ln(x) - x + C$ (*or use IBP)
- Hyperbolic Trig functions:
  $$\int \sinh(x)\, dx = \cosh(x) + C, \int \cosh(x)\, dx = \sinh(x) + C,$$
  (straight-forward, look up the rest)

Strategies for Integration

Integration Toolbox

When confronted with an integral, $\int f(x)\,dx$, the main tools in your integration toolbox are:

❶ know a lot of derivative rules/anti-derivative rules! If you can recognize DRs, use the corresponding ADRs! MEMORIZE!!!!!

- Continued:
- Inverse Trig functions
$$\int \frac{1}{\sqrt{1-x^2}}\,dx = \sin^{-1}(x) + C, \int \frac{1}{1+x^2}\,dx = \tan^{-1}(x) + C,$$

Strategies for Integration

- PRACTICE
- PRACTICE
- PRACTICE
- !!!!!!!!!!

Using Integral Tables & CAS (computer algebra systems)

Some integrals, like

$$\int e^{x^2}\, dx,$$

cannot be expressed using any known "elementary functions" (functions we know of...). So no matter how hard we try there's no formula for the above integral. This means we must use technology to approximate a solution.

Using Computer Algebra Systems

❶ definitely use!

❷ Some examples: Symbolab, Wolfram Alpha, Desmos, GeoGebra, SAGE

❸ Do you know of any awesome programs I should know of?

❹ I'll have use do some labs soon using SAGE

Using Integral Tables & CAS (computer algebra systems)

§7.5 & §7.6

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Using Integral Tables

1. basically outdated, we can use technology.
2. Can still use it if you have your book at hand