Math 1432 DAY 13
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If you email me, please mention the course (1432) in the subject line.

Bubble in PS ID and Popper Number very carefully. If you make a bubbling mistake, your scantron can’t be saved in the system. In that case, you will not get credit for the popper even if you turned it in.

Check your CASA account for Quiz due dates. Don’t miss any online quizzes!

Be considerate of others in class. Respect your friends and do not distract anyone during the lecture.

Chapter 8 - Techniques of Integration

Example: \( \int xe^{x^2+1} dx \)

Example: \( \int xe^{x} dx \)
Section 8.1 - Integration by Parts

Let’s start with the product rule:

\[
\frac{d}{dx}(uv) = u \frac{d}{dx}v + v \frac{d}{dx}u
\]

So, the integration by parts formula is:

\[
\int u \, dv = uv - \int v \, du
\]

We use it to “undo” the product rule.

1. **Reduction to integrate**
   \[x^n \sin(ax), x^n \cos(ax), x^n e^{ax},\]
   
   polynomial \cdot \sin(ax), \text{ polynomial} \cdot \cos(ax), \text{ polynomial} \cdot e^{ax}

2. **Cycling to integrate**
   \[
   \cos(ax)\sin(bx), \cos(ax)e^{bx}, \sin(ax)e^{bx}
   \]

3. **Change of Form to integrate**
   \[
   \ln(x)\, f(x), \text{ arctan}(x)\, f(x), \text{ arcsin}(x)\, f(x)
   \]
   (where \( f(x) \) has a simple antiderivative)
How do you know what to pick for $u$ and for $dv$?

“Shortcut”: ILATE

<table>
<thead>
<tr>
<th>Type of function</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>I – Inverse trigonometric functions</td>
<td>arcsin($x$), arctan($x$), etc.</td>
</tr>
<tr>
<td>L – Logarithmic functions</td>
<td>ln($x$), log$_{2}$(x), etc.</td>
</tr>
<tr>
<td>A – Algebraic functions</td>
<td>$x^{3}$, $5x^{2}$, etc.</td>
</tr>
<tr>
<td>T – Trigonometric functions</td>
<td>sin($x$), tan($x$), etc.</td>
</tr>
<tr>
<td>E – Exponential functions</td>
<td>$e^{x}$, $2^{x}$, etc.</td>
</tr>
</tbody>
</table>

Functions which are higher on the list are more likely to be selected for $u$ and functions lower on the list are more likely to be used as $dv$ (don’t forget to include $dx$ in this term!).

Example 1: $\int xe^{x} \, dx$
Example 2: $\int x \sin(x) \, dx$

Example 3: $\int x^2 \cos(x) \, dx$
Example 4: \( \int x^2 \ln(5x) \, dx \)

Example 5: \( \int e^x \cos(x) \, dx \)
(*) Example 6: \( \int \ln(x) \, dx \)

Example 7: \( \int \arctan(x) \, dx \)

Exercise: \( \int \arcsin(x) \, dx \)

Exercise: \( \int x^2 \arctan(x) \, dx \)
POPPER 

Question# \[ \int_{0}^{1} xe^x \, dx = \]

A) \( e \) \hspace{1cm} B) 1 \hspace{1cm} C) (e-1) \hspace{1cm} D) (e+1) \hspace{1cm} E) None of these

Question# \[ \int \ln x \, dx = \]

A) \( x \ln(x) + C \)

B) \( \frac{1}{x} + C \)

C) \( x \ln(x) - x + C \)

D) \( x \ln(x) + x + C \)

E) None of these