

Lab 3: Integrals via tables and computer symbolic math

You have learned a number of techniques for evaluating integrals. However, some integrals are very difficult or impossible to evaluate by hand. One way you can tackle the tough integrals is to refer to tables of integrals such as the one found inside the back cover of your textbook. Another method is to use symbolic mathematics tools such as the ones contained in MATLAB.

Example 3.1 Evaluate $\int \sin 3x \cos 7x dx$.

- (a) Using formula #81 from the tables in the back of the book with $a = 3$, $b = 7$ and $u = x$ and then simplifying gives

$$\int \sin 3x \cos 7x dx = \frac{\cos 4x}{8} - \frac{\cos 10x}{20} + C.$$



- (b) In MATLAB, enter the following:

```
>> syms x
>> int(sin(3*x)*cos(7*x),x)
ans =
-1/20*cos(10*x)+1/8*cos(4*x)
>> pretty(ans)           % If you want to pretty-print the answer.
- 1/20 cos(10 x) + 1/8 cos(4 x)
```

Exercise 3.1 Evaluate the following using both the tables and the computer:

$$\int \frac{1}{4x^2\sqrt{4x^2-9}} dx.$$

- (a) Use the table in the back of your textbook. Write the number of the formula you used, and state any substitutions for u or a that you used.
- (b) Use MATLAB to evaluate the integral. Note: The MATLAB function for \sqrt{x} is `sqrt(x)`.
- (c) How do your results compare? If they are not the same, figure out why not.

Exercise 3.2 Now do the following problems by hand. For each problem, write the formula number you used and identify any substitutions. Show all steps needed to complete the problem.

(a) $\int x^3 \arcsin(x^2) dx$

(b) $\int \frac{\sin \theta}{1 + 2 \cos \theta} d\theta$

(c) $\int \frac{x}{\sqrt{x^2 - 4x}} dx$

(d) $\int_0^1 x^4 e^{-x} dx$

Exercise 3.3 Check your answers in [Exercise 3.2](#) using MATLAB. Attach your MATLAB output. Note: In MATLAB, $\arcsin(x)$ is given by `acos(x)`, and e^x by `exp(x)`.

Exercise 3.4 Evaluate the following integrals using the tables from the back of the book. You may need your whole bag of integration tricks: substitution, integration by parts, partial fractions. Show all steps needed to complete the problem and identify the tools you use. Write the number of any formula that you use. (Do not use MATLAB for these problems!)

(a) Page 516, #6.

(b) Page 516, #12.

(c) Page 516, #14.

Exercise 3.5 Evaluate the following integrals using MATLAB. Attach your MATLAB output.

(a) Page 516, #36.

(b) Page 516, #38.

(c) Page 516, #40.

(d) Page 516, #41.