



## MATH 152 – PYTHON LAB 5

**Directions:** Use Python to solve each problem, unless the question states otherwise. ([Template link](#))

1. Given the integral

$$\int \frac{x^3 + x^2 - 12x + 1}{x^2 + x - 12} dx,$$

- (a) Use **sp.div** to break up the above fraction via long division. Here's the syntax:  
**q, r = sp.div(numerator, denominator)**

This gives  $q$ , the quotient, and  $r$ , the remainder, from the division.

Display the reduced function (it should have the form  $q + \frac{r}{\text{denominator}}$ ).

- (b) Write the form of the partial fraction decomposition for the remaining fraction (by hand). Use it to set up and solve a system of equations (in Python) to obtain the missing coefficients  $A$ ,  $B$ , etc.
- (c) Check your answer to part (B) by using the **sp.apart** command.
- (d) Use your decomposition from Parts (A) and (B) or use the output from Part (C) to evaluate the integral. Check your answer by integrating directly.

2. (a) Calculate the value of  $a$  so that  $\int_0^{\infty} \frac{x^4}{x^7 + a^2} dx = 0.1$ . (Note: When defining  $x$  and  $a$  as symbolic variables, include **positive = True** to clear up some issues when solving.)

(b) Find the value of  $a$  such that  $\int_2^a x^6 e^{-x^7} dx = \int_a^{\infty} x^6 e^{-x^7} dx$ .

- (c) Evaluate  $\int_2^{\infty} x^6 e^{-x^7} dx$  using the value found in part (b).

3. Let  $f(x) = \frac{\sin^2(x) + 2}{x}$  and  $g(x) = \frac{1}{x}$ .

(a) Show  $\int_1^{\infty} g(x) dx$  diverges using Python.

- (b) Plot  $f$  and  $g$  on the same axes with domain  $[1, 40]$  to show  $f(x) \geq g(x)$  on the given interval.

(c) Show  $\int_1^{\infty} f(x) dx$  diverges using Python.

(d) Using what you know from parts (a) and (b), how could you conclude that  $\int_1^{\infty} f(x)dx$  diverges WITHOUT using Python to evaluate the integral?