MAT1575 Module 1 – Inequalities, Restrictions, and the FTC.

Objectives: Learn how to graph inequalities, apply domain/range restrictions, and the FTC.

1. Inequalities: Desmos will shade the area of the plane that satisfies a given inequality in terms of `x` and `y`. For example, try the following inequalities:

```
x < 2
x^2 + y^2 <= 36
y > 3
1-x^2 <= y <= x^2
```

2. Restrictions: You can restrict the domain or range of a function by using `{}`. For example, try the following restrictions:

```
f(x) = x^2-1{x < 2}
g(x) = sin(x){0 <= x <= pi}
y = x^3 {y < 3}
```

   Note that if you want to restrict the range, your function must be set equal to `y`, not `f(x)`.

3. Use Desmos to do the following:

   (a) Graph the area of the plane that satisfies the inequality $y < e^x$.

   (b) Graph the set of points that satisfy the equation $y^2 = x^3 - x$ with $x < 2$ and $-1 < y < 1$. (Hint: You can restrict both the domain and range by using two sets of `{}` next to each other.)

   (c) Graph the area under the curve for $f(x) = x^3 - x^2 - 1$ on the interval $[0, 2]$. (Hints: The area should be above $f(x)$ if the function is negative and below $f(x)$ if the function is positive. Try graphing `min(0,f(x))`, the minimum of `0` and `f(x)`, and `max(0,f(x))`, the maximum of `0` and `f(x)`).

   (d) Graph the function $S(x) = \int_0^x \sin(t^2)\, dt$ for $x \geq 0$. This integral is important in optics: `https://en.wikipedia.org/wiki/Fresnel_integral`.

      i. Compute (by hand) the derivative of $S(x)$.

      ii. On the interval $[0, \pi]$, estimate the following:

         A. the intervals where $S(x)$ is increasing/decreasing,

         B. the intervals where $S(x)$ is concave up/down,

         C. and the location of local maximums/minimums.