So let me summarize what the steps that we've taken are to do this differential analysis.

So when you're trying to analyze a continuous mass distribution, the first step is to pick some arbitrary mass element, a small but finite size mass element somewhere in the middle of the mass distribution.

You don't want to pick one of the endpoints, because the endpoints are special.

You want to pick an arbitrary point somewhere in the middle and then pick a small mass element at that point, so a small but finite size.

Analyze the forces acting on that mass element.

So write down Newton's second law, the equation of motion, for that mass element.

That will give you what the forces are on that element.

Then go to the limit of an infinitesimally small element.

That will give you a differential equation.

You can then separate the differential equation and integrate both sides to solve the differential equation.

And then finally, you can apply a boundary condition, something you know about one or the other of the endpoints.

And that will allow you to solve for the function of interest at any point along your distribution.