

Notes on Math Tutorials, week 1  
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Overview: I'm lecturing on numerical methods for integration, interpolation, and differentiation.

Because there is a tutorial on Monday, we'll have to base week 1 tutorials mainly on the first lecture.

I'd like you to get them more used to the idea of numerical computations & error bounds.

suggestions: Consider

$$I = \int_0^2 e^{-t} \sin^2(20t) dt.$$

[Can be done analytically, see E. below].

This type of integral comes up in root mean squared current computations.

- A) Show them a graph of the function. Get them to estimate the number of subintervals needed to get a reasonable estimate of  $I$  with numerical integration.

B) Get some estimates for  $I$  using Trapezoidal rule (if they have laptops or computer access, get them using MATLAB or excel).

c)  $f(t) = e^{-t} \sin^2(20t)$

compute  $f''$  and find a bound for it on  $[0, 2]$ . Discuss the idea of bounding and not just finding the exact maximum of  $|f''|$ . Estimate errors in B).

D) Use Simpson's rule for  $I$ .

E) Evaluate  $I$  exactly using trig identities & integration by parts.

F) compare  $T_N$  &  $S_N$  to exact  $I$ , see that the bound in C) was pessimistic, but still a bound.

Be prepared to give some hints on the suggested problems for this week.