

10/19/09

250 Lecture

Announcements

- Lab II due today by 4:59
- Lab I grades/comments posted soon
- this week's HW is up

Goal: Provide a broad overview of where we have come to and where we are going from here [this lecture should serve as an 'anchor-point' for past + future]

- [1] student perceptions of what we have done so far (see incl. list on ~~two~~ next pg.)
- [2] front pg. of 10/16/09 NY Times, 'In Shift from '08, Holiday Airfare is Soaring Daily'

→ rate of change is the critical feature here!!

- [3] Methods to Handle ODEs we will develop the rest of 250A (and into 250B) that build off the foundation we have already developed:

[A] Exact analytic solutions → linear systems theory for linear eqns
~~linear~~ $\frac{dy}{dx} + f(x)y = g(x)$ [definition of a linear, first order ODE]

[B] Numerical approaches → e.g. Euler's Method, Runge-Kutta (Lab III)

[C] Approximating Solutions via Series Expansions (Taylor series, Fourier series)

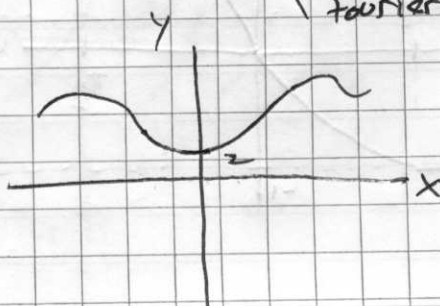
→ turn a complicated curve into a simpler combination of ones

Taylor series use polynomials:

0: $y = z$

1: $y = x + z$

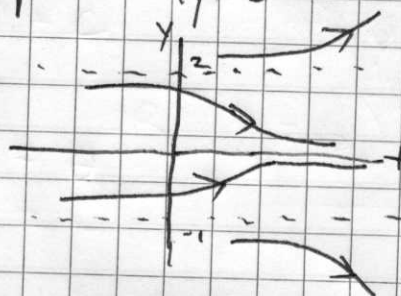
2: $y = x^2 + x + z$



[1]

[1] Graphical Approaches: slope fields, Finding equilib. + stability
phase plane analysis

eg. $\frac{dy}{dt} = y(y-2)(y+1)$



NOTE: can
solve explic.
via PFD +
integration

NOTE: when do solution curves cross?
→ Exist. + Uniqueness Theorem!

[4] Types of First order ODEs: $\frac{dy}{dx} = \begin{cases} f(x) & \text{(integrate)} \\ f(y) & \text{(autonomous)} \\ f(x)g(y) & \text{(sep. variables)} \\ h(x,y) \end{cases}$

* ⇒ 'methods' listed above provide a
general set of skills that allow you
to tackle whatever you are faced with

[5] Future Directions (that will build off the above foundation
going into 250B)

- systems of ODEs (coupled eqns.)
- higher order eqns. (e.g. $F = mA$)
- applications (incl. linear regression)
- linear vs. nonlinear eqns.
- bifurcations (how does the behavior of an ODE depend upon the 'parameters' given? ex. $\frac{dx}{dt} = ax(x-a)$)

→ how does solution behavior
change w/ a?

[6] Student-Voiced opinions as to what
we have covered so far:

- basics of ODEs, 'more complex' integration
- slope fields
- classifying/analyzing ODEs
- ODE = description of a way a system behaves w/ respect to some (independent/dependent) variable
- Riemann sums
- algebraic simplifications (e.g. PFD, long division, substit.)