# Math 23, Spring 2007

## Lecture 15

Scott Pauls [1]

[1] Department of Mathematics
Dartmouth College

4/30/07

# Outline

# Midterm results

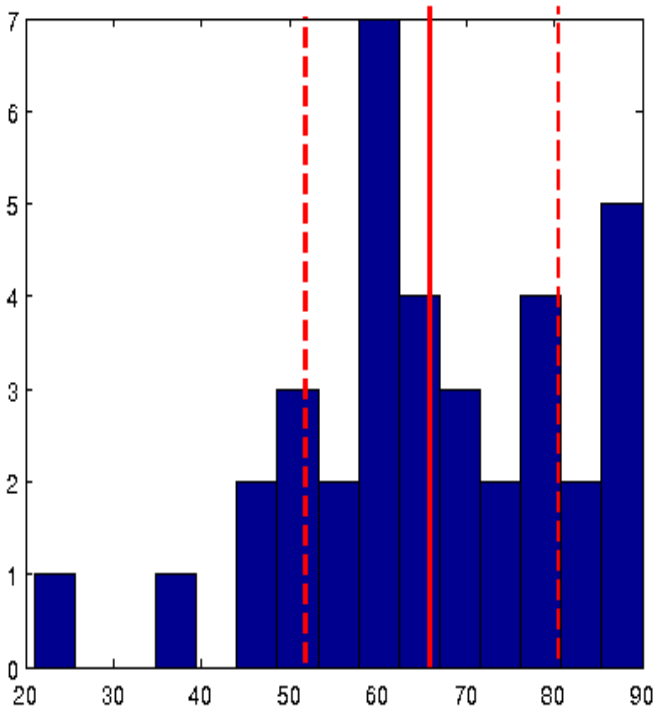


Figure: Histogram from total score

- In class: mean =31, std = 8
- Take home: mean =35, std=9
- Total: mean = 66, std = 15

# Material from last class

- Series solutions for second order linear ODE
- $$y = \sum_{n=0}^{\infty} a_n (t - t_0)^n$$
- Further examples

# Example from last class

Legendre's equation:

$$(1 - x^2)y'' - 2xy' + \alpha(\alpha + 1)y = 0$$

# Example from midterm

In the second problem on the take home midterm, you were asked to transform a second order equation

$$ay'' + by' + cy = g(t)$$

into two (coupled) first order equations:

$$L_1[y(t)] = u(t)$$

$$L_2[u(t)] = g(t)$$

Point: one can then solve two first order equations (often simple) rather than a single, potentially harder higher order equation.

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# Examples of systems

## Predator/Prey

The Lotka-Volterra model:

$$\frac{dH}{dt} = a_1 H - b_1 HP$$
$$\frac{dP}{dt} = -a_2 P + b_2 HP$$

where $H, P$ are the two populations, $a_1$ is the birth rate of $H$, $a_2$ is the death rate of $P$ and $b_1, b_2$ are the coefficients of the interaction between predator and prey $HP$.

# Transformation of second order systems

$$y'' + p(t)y' + q(t)y = g(t)$$

Let $u = y', v = y$. Then this system becomes

$$v' = u$$
$$u' = g(t) - p(t)u - q(t)v$$

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# Using matlab

Consider a difficult second order system:

$$y'' + \sin(y) = 0$$

Convert it to a first order system:

$$u = v', u' = -\sin(v)$$

We can using `ode45` to solve this system. See `linsys.m` on our website.

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# Work for next class

- Read: 7.1-5.4
- Homework 5 is due wednesday 5/1, Homework 6 is posted today and due Monday 5/7/07