# Fall 2014 Welcome

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# Jacques Hadamard (1902) Well-Posed Problems

# Talking Points

Grade Distributions
Email
Accommodations

# Jacques Hadamard 1902 notion of a well-posed problem

Context: Solutions to a PDE modeling a physical process.

1. The equation has a solution
2. The solution is unique
3. The solutions's behavior changes continuously with the initial conditions.

If it is not well-posed, it is *ill-posed*. It can be well-posed but be *ill-conditioned* (small changes in initial conditional have much bigger changes in solutions).

# Existence and Email

Advisors (other than Pamela) are not your friend

- Do not reply to email from students wanting to add your class, just forward them to advisor@math.fsu.edu

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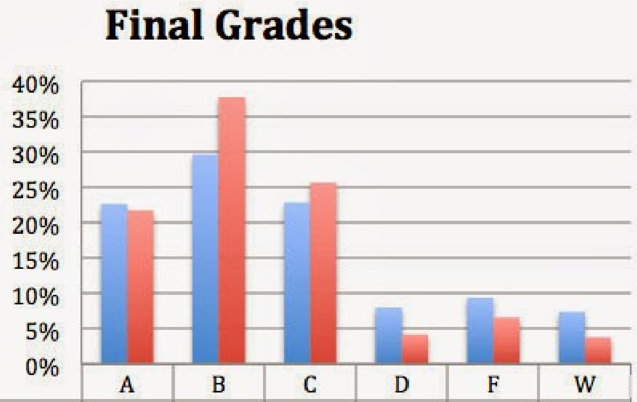
http://www.maa.org/CSPCC




| | A | B | C | D | F | W |
|---|---|---|---|---|---|---|
| all PhD universities | 22.7% | 29.7% | 22.9% | 8.0% | 9.4% | 7.4% |
| 5 case study sites | 21.8% | 37.8% | 25.7% | 4.2% | 6.6% | 3.8% |

Figure 1: Instructor reported final grades.

# An ill-posed problem, the backwards heat equation

Let $u(x,t)$ be a solution to $u_{xx} = u_t$, $u(x,0) = 0$ and look at $u(x,-1)$, this is not continuous with respect to the initial condition.
Alternately, look at forward solutions ($t > 0$) to $u_{xx} = -u_t$ with $u(x,0) = 0$ and look at $u(x,1)$

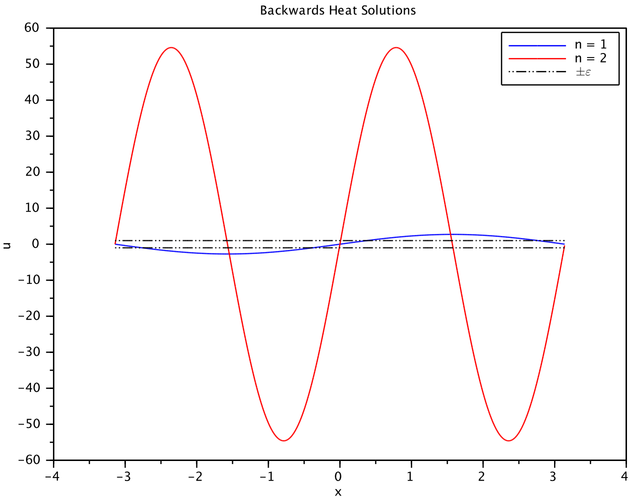
# An ill-posed problem

$$u(x,t) = \varepsilon \sin(nx) \exp(-n^2 t)$$

solves $u_{xx} = u_t$ and has $\sup |u(x,0)| \le \varepsilon$. But for $t = -1$

$$|u(x,-1)| = \varepsilon |\sin(nx)| \exp(n^2) \sim \varepsilon \exp(n^2) \to \infty$$

# An ill-posed problem



# Finally

You have a lot of support, if you need help, ask.
You are the math department.