Introduction	Mechanics	Chapter 70 Aid	Hedging Bets

Math 466: Advanced Applied Analysis First Lecture

Steven J Miller Williams College

sjm1@williams.edu

http://www.williams.edu/Mathematics/sjmiller/public_html/466Fa17

Williams College

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Introduction and Objectives

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Introduction / Objectives

Objectives

- Obviously learn advanced topics in analysis.
- Emphasize techniques / asking the right questions.
- Prepare for grad school / industry.
- Gain expertise in proofs / applications.
- Seeing applications of earlier courses.



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Types of Problems

- Benford's Law of Digit Bias.
- Random Matrix Theory.
- Probability: Central Limit Theorem.

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My experiences			

- Consulting / Advising: Financial, Medical, Policy, Sabermetrics.
- Theory: Mathematics (especially number theory and probability), Physics.

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Course Mechanics



- Move at fast pace, class participation: 5%. HW: 15%. Midterm: 40%. Final exam: 40%. You may also do a project and have the percentages adjusted.
- Pre-reqs: Real Analysis.

Office hours / feedback

- TBD and when I'm in my office (schedule online).
- Feedback ephsmath@gmail.com (password 1793williams).



- Webpage: numerous handouts, additional comments each day (mix of review and optional advanced material).
- PREPARE FOR CLASS! Must do readings before each class.
- Option to influence topics, present to class.



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Other: Advice from	n Jeff Miller		

• Party less than the person next to you.

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- Party less than the person next to you.
- Take advantage of office hours / mentoring.

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- Party less than the person next to you.
- Take advantage of office hours / mentoring.
- Learn to manage your time: no one else wants to.

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Happy to do practice interviews, adjust deadlines....

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First Application: Chapter 70 Aid



Real World Challenge: Need to assign \$3,500,000 to three schools (LES, WES, MtG).

 Pre-regionalization know how much state gives each; post regionalization only know sum.

• State has formula, lots of variables, secret.

What is the goal? How do we accomplish it?

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Objectives			

- Fair formula that predicts well.
- Transparent, seems fair.
- Can be explained.

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Solution			

Solution: Method of Least Squares / Linear Regression.

Inputs: Population of Schools (LES(pop), WES(pop), MtG(pop)), Assessment of Towns (EQV(L), EQV(W)).

Formula: If $\overrightarrow{y} = \mathbf{X}\overrightarrow{\beta}$ then

$$\overrightarrow{\beta} = \left(\mathbf{X}^{\mathrm{T}}\mathbf{X}\right)^{-1}\mathbf{X}^{\mathrm{T}}\overrightarrow{\mathbf{y}}$$

What properties do we want the solution to have?

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Properties of Solu	tion		

- Want solution to exist will it?
- Want values to be between 0 and 1 will it?
- Want values to be stable under small changes will it?
- Want the sum of the three percentages to add to 1 will it?

HW: Due Friday, September 15th: address these conditions as well as you can.

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Theory vs Reality			

Predicted, Actual and Errors for Schools: LES: 21.7826 22.0248 -0.242194 WES: 27.8397 27.8767 -0.0369861 MtG: 50.3776 50.0984 0.279181 Sum of three predictions is 100%

Total chapter 70 funds in 2018: 3,489,437. 1% of total is 34,894.40. .3% of total is 10,468.31.

School budgets (roughly): LES \$2.7 million, WES \$6.6 million, MtG \$11 million.

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Second Application: Hedging Bets

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Hedging Bets			

A win by the Cleveland Indians on Thursday night will result in a local company rebating customers who spent \$1.7 million on window installation, siding, doors and other services. Universal Windows Direct offered a promotion for all of July that any customer who did business with the company would receive a full rebate if the Indians went on a 15-game winning streak any time between Aug. 1 and the end of the season. With the Indians at 14 straight wins, Universal CEO William Barr will be with the most interested customers at the stadium on Thursday night for a watch party as the Indians take on the White Sox in Chicago. Barr said the idea came to him thanks to the fact that the company was celebrating its 15th anniversary. It would also beat the record for the most consecutive wins by the Indians, who won 14 straight games last season. Barr said he paid \$75,000 for insurance to cover the \$1.7 million in sales. "I already paid for the policy," he said. "I just hope they win now." - Darren Rovell, ESPN Senior Writer, 9/7/17. http://www.espn.com/mlb/story/ /id/20623379/

local-window-company-give-17-million-customer-rebates-cleveland-indians-win-streak-reaches-

Homework: Due Friday, September 15, 2017: Was this a good price for the insurance?