Optimization with Constraints on Resources

Examples:

1. **How should Hillary Clinton spend $10,000,000 on political advertising to maximize her chances of being elected president?**
2. **How should I invest $1000 to maximize my expected return in 3 years?**
3. **How should I invest $1000 to maximize the chances that I will have $5000 in 3 years?**
4. **How often should I replace my car?**
5. **How should I choose food at a salad bar to meet my nutritional needs for the minimum amount of money?**
6. **Where should the government store emergency supplies to help out in a natural disaster?**
7. **How does an oil company decide where to drill wells?**
8. **How should an auto factory be set up to maximize the number of cars made per day?**
9. **Where should Amazon build a warehouse to decrease the average time to deliver a book to a customer? How should it stock that warehouse?**
10. **Where should a cell phone company locate its towers to maximize coverage area?**

11. **Can the U.S. Department of Energy safely decomission a particular particular set of nuclear weapons in a month? If not, how many more people do they need to hire to do so?**
12. **How does a UPS driver visit 87 customers in one day and still get home in time to watch the Mets game on TV?**
13. **Should I buy skis?**
14. **How can the registrar schedule the classes to rooms so that every student has a seat?**
15. **How do I get to Carnegie Hall?**

Topics

See syllabus

Q. Why study this stuff?

A. It's a success.

Some examples

1. ***Police Patrol Officer Scheduling in San Francisco.*** **Using linear programming, goal programming and integer programming, the department saves $11 million per year, improved response times by 20% and increased revenue from traffic citations by $3 million per year.**
2. ***Reduction of Fuel Costs in Electric Power Industry*** **Using dynamic programming, 79 electric utilities saved $125 million per year.**
3. ***Gasoline Blending at Texaco.*** **Using blending models, Texaco saves $30 million annually**
4. ***Scheduling Trucks at North American Van Lines.*** **Using network models and dynamic programming to assign loads to North American Van Line drivers reduced costs by $2.5 million per year and improved service.**
5. ***Linear programming to determine bond portfolios.***
6. ***Linear programming to plan Creamery Production***

Why is mathematical programming a success

- **Real Life Models**
- **Mathematical Insight**
- **Efficient Algorithms**
- **Fast Computers**

All four exist in a synergistic fashion.

Goals of the course

- **Learn how to model real-life problems mathematically**
- **Understand the mathematics behind optimization**
- **Understand different types of problems/solutions/methods/algorithms**
- **Learn how to interpret the solutions to the models**