STAT40180 — Stochastic Models

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Week 1

Motivating Examples

Crime Statistics

- Suppose you work in the police station of a city.
- Suppose that a certain number of crimes are reported per week.
- However, you don't know how many crimes happen.
- You also don't know what percentage of crimes are reported.
- You get data of the number of crimes that are reported for the last ten weeks:
  38 34 32 34 32 27 28 36 37 33
- Can you estimate the number of crimes that happen per week?
- Can you estimate the percentage of crimes reported?

Taxi Cab Problem

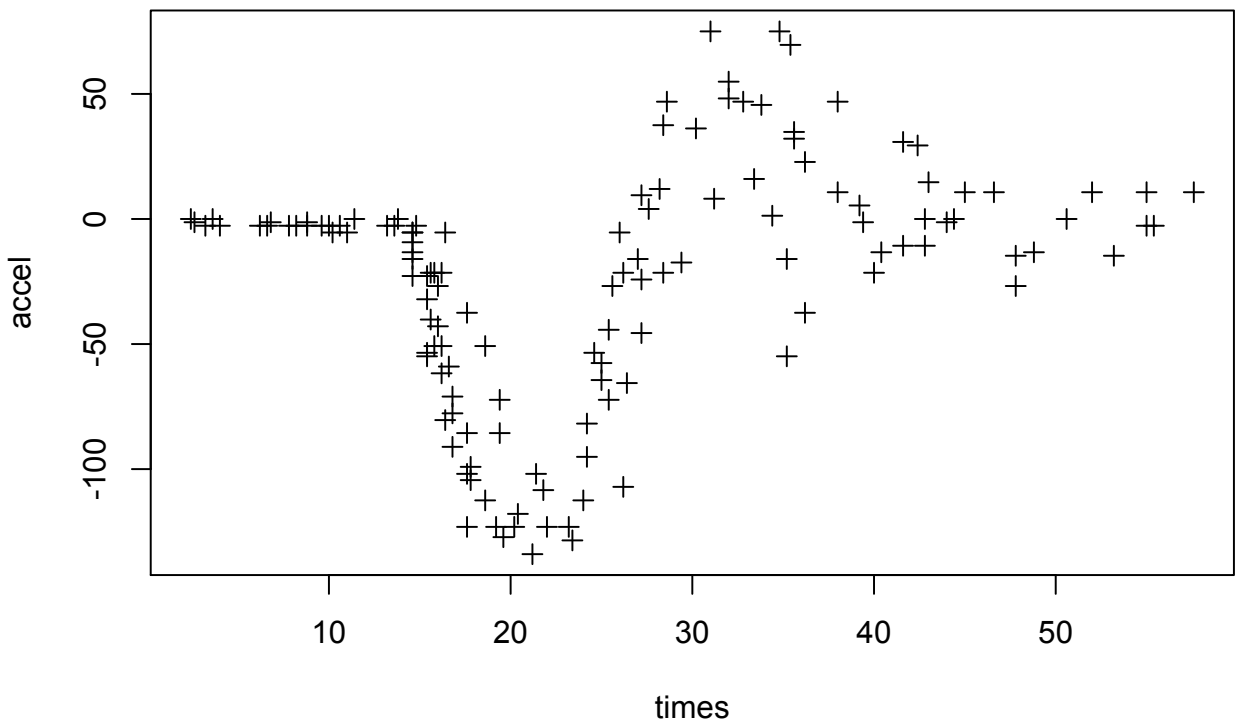
- Suppose you land into a new city that you've never been to before.
- You walk out of the airport and you see that some taxis.
- You are wondering how many taxis there are in the city.
- You see eight taxis parked outside the airport.
  You notice that they are numbered and their numbers are:
  `127 469 404 148 315 170 271 131`
- Can you estimate how many taxis there are in the city?

Employee Retention

- You are working for a company where they are concerned about employee retention.
- The company has collected sample data on a number of employees (former and current) and how long they worked in the company.
- The following data were recorded (the time units are weeks):
  40* 94 83 88 13 70* 49 130* 55 100*
  31 79 17 162 76 2* 11 97 30* 77
  Employees marked with a * are still with the firm.
- How long do employees stay working with the company?
- Suppose we had other covariates about the employees.
  How could we use this in studying retention?

Motorcycle Crash

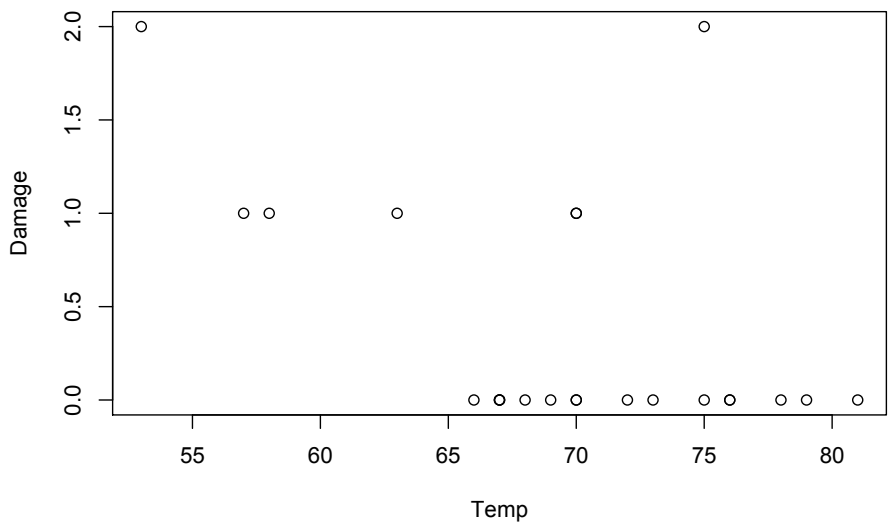
- The head acceleration of a motorcyclist was recorded in a simulated crash.
- A plot of acceleration versus time is given as follows:



- How do we model the relationship between time and acceleration?

Space Shuttle

- On January 20th, 1986 the space shuttle Challenger exploded shortly after it was launched.
- The root cause of the explosion was the failure of rubber O-rings on the fuel tanks (there were six O-rings).
- Data on launch temperature (in degrees Fahrenheit) and the number of failed O-rings are given below:



- The temperature on January 20th, 1986 was 32 degrees. What was the probability of O-ring failure on that day?

Summary

- For each of the above problems, we have:
  - Scenario
  - Data
  - Question
- We need to:
  - Develop a model
  - Infer the model unknowns
  - Use the model to answer the question of interest.