Lecture 1 - 08/22

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office hours: Friday 4pm - 6pm

First homework: due Monday Aug 29th, 11:59 pm

Course load: 13 weekly HWs

2 midterm exam: Oct 3rd, Nov 7th, 8:45pm - 10pm

1 final exam

Grading policy: 15% HW + 25% EX1 + 25 EX2 + 35% Final

15% HW + 15% EX1 + 30% EX2 + 40% Final

15% HW + 30% EX1 + 15 EX2 + 40% Final

Website: courses.grainger.illinois.edu/EC313/fa2022

For today: ① Why probability.

② Set Operations.

③ Axioms of probability.

1.1: Life is full of uncertainties, and probability plays an important role in our everyday life:

① Will you wake-up in the morning using only one alarm?

1. Will you wake-up in the morning using only one alarm?
2. Should you wait for your advisor if you knock on his door and he did not responded?

Or more in engineering:

1. How many lamps should you test in quality assurance facility?
2. What is the best treatment for a patient?

There is a need for a mathematical model for these uncertain events.

1. a universal and precise language to share knowledge in face of uncertainty
2. a guidance for decision making, estimation, inference
3. modeling tools that will add new insights

Probability is life, probability is love.

An experiment: rolling a fair six-sided die

possible outcomes: $\{1,2,3,4,5,6\} \rightarrow$ Sample space Ω

probability of each observation: $1/6 \rightarrow$ probability function P

$A = \{1,3,5\}$. Probability of $A = 3/6 \rightarrow$ an event, subset of Ω.

Let $B = \{4,5\}$:

Probability of A or B = Prob of $\{1,3,4,5\} = 4/6$

→ $A \cup B$ = union of elements of A and B

Probability of A and B = Prob of $\{5\} = 1/6$

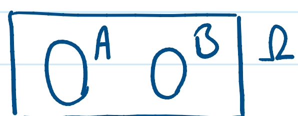
→ $A \cap B = AB$ = elements that are both in A and B

Probability of not A = Prob $\{2,4,6\} = 3/6$

→ A^c = elements that are in Ω but not in A

and any combination.

Some easy observations: $A \cap A^c = \emptyset$ and $A \cup A^c = \Omega$

We say A excludes B if $AB = \emptyset$. 

We say $A_1, \dots, A_n$ are mutually exclusive if $A_i \cap A_j = \emptyset$, $\forall i \neq j$.

We say $A_1, \dots, A_n$ partitions Ω if $\Omega = A_1 \cup \dots \cup A_n$

Demorgan's law:

$$(A \cup B)^c = A^c B^c \quad \text{and} \quad (AB)^c = A^c \cup B^c$$

Karnaugh map:

	B^c	B
A^c	$A^c B^c$	$A^c B$
A	AB^c	AB

Axioms of probability:

- An experiment is modeled with $(\Omega, \mathcal{F}, P)$
  - each element of Ω is called an outcome

- Ω is called sample space
- $\mathcal{F}$ set of subsets of Ω, called events
- P probability space. $P: \mathcal{F} \to [0,1]$
- $(\Omega, \mathcal{F}, P)$ prob. space

. Axioms of events:

1. $\Omega \in \mathcal{F}$
2. If $A \in \mathcal{F}$ then $A^c \in \mathcal{F}$
3. If $A_1, \dots, A_n, \dots \in \mathcal{F}$ then $A_1 \cup A_2 \cup \dots \in \mathcal{F}$.