جامعة المستقبل
AL MUSTAQBAL UNIVERSITY

College of Science
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Lecture_Lab#4

Sample Space and Events in Medical Probability

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1. What is Probability in Medicine?

Probability helps us **predict outcomes** when we deal with uncertainty—like test results, disease detection, or treatment responses.

In medical systems, probability helps answer questions like:

- What is the chance a patient tests positive?
- What are all possible outcomes for a group of patients?

2. Random Experiment (تجربة عشوائية)

A **random experiment** is something we do where the outcome is not known in advance.

Example:
A COVID test on one patient
→ Possible results: Positive (P), Negative (N)

3. Sample Space (الفضاء العيني)

This is the list of **all possible outcomes**.

Example: 2 Patients Getting Tested

Each patient can be Positive (P) or Negative (N)

```
Sample Space S = {
    ('P', 'P'),  # both positive
    ('P', 'N'),  # patient 1 positive, patient 2 negative
    ('N', 'P'),  # patient 1 negative, patient 2 positive
    ('N', 'N')   # both negative
}
```

. Events (الحدث)

An **event** is just a subset (جزء) of the sample space.
We define events based on what we're interested in.

```
Event A = {
    ('P', 'P'),
    ('P', 'N'),
    ('N', 'P')
}
```

---

5. Complement of an Event (A')

This means: all outcomes that are **not** in Event A.

```
A' = {
    ('N', 'N')  # both negative
}
```

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6. Another Event: Patients with the Same Result

```
Event B = {
    ('P', 'P'),
    ('N', 'N')
}
```

🔹 7. Set Operations in Medical Terms

Operation	Meaning	Result
A ∩ B	Both events happen	{('P', 'P')}
A ∪ B	Either or both happen	{('P', 'P'), ('P', 'N'), ('N', 'P'), ('N', 'N')} (full space)
A'	Not A	{('N', 'N')}

Event Outcomes Analysis

```python
import itertools

# Outcomes: Positive (P), Negative (N)
outcomes = ['P', 'N']
sample_space = list(itertools.product(outcomes, repeat=2))

print("Sample Space (2 Patients):", sample_space)

# Event A: At least one patient tests Positive
event_A = [outcome for outcome in sample_space if 'P' in outcome]

# Event B: Both patients test Negative
event_B = [outcome for outcome in sample_space if outcome == ('N', 'N')]

# Complement of A
event_A_complement = [o for o in sample_space if o not in event_A]

print("\nEvent A (At least one Positive):", event_A)
print("Event B (Both Negative):", event_B)
print("Complement of A:", event_A_complement)
```