

The background features a dark grey gradient with vibrant, abstract wavy shapes in shades of purple, blue, and green. Scattered throughout are several circles of different sizes and colors, including pink, orange, and light blue.

Introduction to Survival Analysis

Understanding Time-to-Event Data







Presented by:

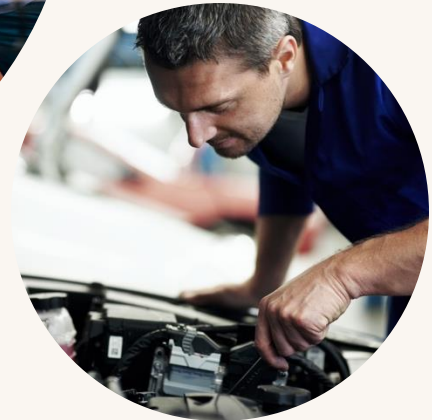
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What is Survival Analysis?

- Study of **time until an event occurs**
- Crucial in **medicine, engineering, business, insurance**, and beyond
- Events include:
 -  **Death**
 -  **System failure**
 -  **Relapse**
 -  **Customer churn**
 -  **Morbidity**
 -  **Retirement**



Key Variables

Event Time (T):

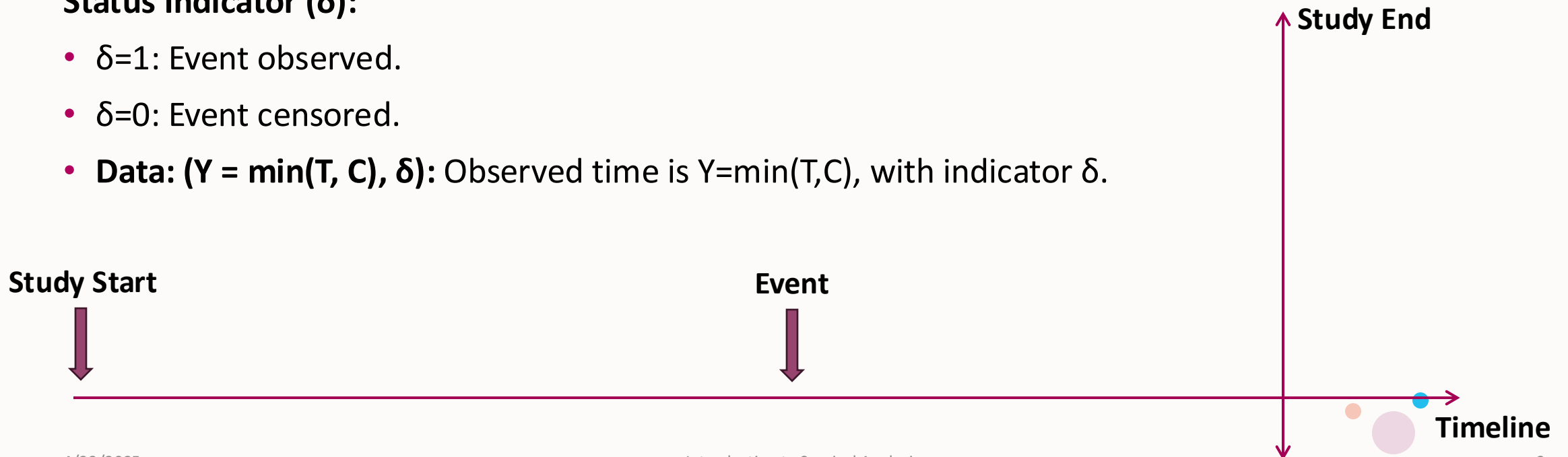
Time until the event occurs.

Censoring (C):

Occurs when the event is not observed by the end of the observation period.

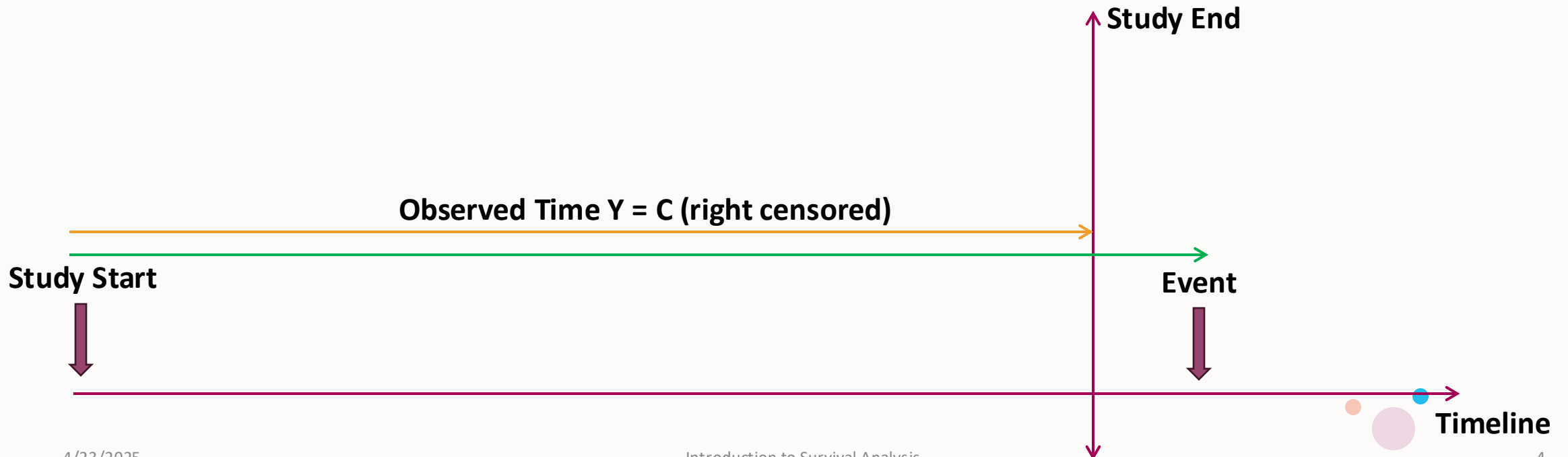
Status Indicator (δ):

- $\delta=1$: Event observed.
- $\delta=0$: Event censored.
- **Data: ($Y = \min(T, C), \delta$):** Observed time is $Y=\min(T,C)$, with indicator δ .



Types of Censoring

- **Right censoring** (most common): event has not occurred *yet*
- **Left censoring**: event occurred before observation
- **Interval censoring**: event occurred in a time interval



Survival & Hazard Functions

- Definition:

$$S(t) = P(T > t) = 1 - F(t)$$

- $F(t)$ is the CDF.
- The probability an individual survives past time t .
- Starts at 1, decreases over time
- If $f(t)$ is the PDF:

$$S(t) = \int_t^{\infty} f(u) du = 1 - F(t)$$

- Or:

$$f(t) = -\frac{dS(t)}{dt}$$

Survival & Hazard Functions

- Hazard Function:

$$\lambda(t) = \frac{f(t)}{S(t)}$$

- Think of it as: *"If you're alive at time t , what's the risk you die instantly?"*
- *Cumulative Hazard function:*

$$\Lambda(t) = \int_0^t \lambda(u) du$$

- Relation to survival:

$$S(t) = \exp(-\Lambda(t))$$

- It is the total accumulated risk of experiencing the event up to time t .
- Think it as the “exposure to danger” that builds up over time.
- The longer you “survive,” the more risk you've accumulated — but not necessarily experienced yet.

The slide features decorative elements in the corners consisting of various colored circles. In the top-left corner, there are circles in shades of pink, orange, and blue. In the top-right corner, there are circles in shades of pink, orange, and blue. In the bottom-right corner, there are circles in shades of pink, orange, and blue. The text "Thank you!" is centered on the slide in a dark blue font.

Thank you!