Tutorial 1: Introduction to LaTex

Yicheng Jan 21, 2021

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1 Install Your LaTex

1.1 Install a LaTex Compiler

Find it via `https://www.latex-project.org/get/`

1.2 Install a LaTex Editor

For Windows: WinEdt, TeXMaker, TeXstudio, etc;
For Mac: TeXShop, MacTex, etc.

2 Fonts Selection

2.1 Text-Mode Fonts

Text-mode: Given random samples ....
Given random samples .... Given random samples ....
Given random samples .... Given random samples ....

size size size size size size size size size size

2.2 Math-Mode Fonts

Math mode: $X_1, \cdots, X_n$ ...
ABC, $\mathbf{ABC}$, $\mathcal{ABC}$, $\mathbb{ABC}$

3 Format

3.1 Structure

Sections $\longrightarrow$ Subsections $\longrightarrow$ Subsubsections

3.1.1 subsubsection

NO "subsubsubsections"

3.2 New lines and paragraphs

Line1
Line2
Line3

Par1

Par2

Par3

Par4

Par5

4 Tables

A table through tabular environment.

A	B	C	D
a	b	c	d
1	2	3	4

5 Figures

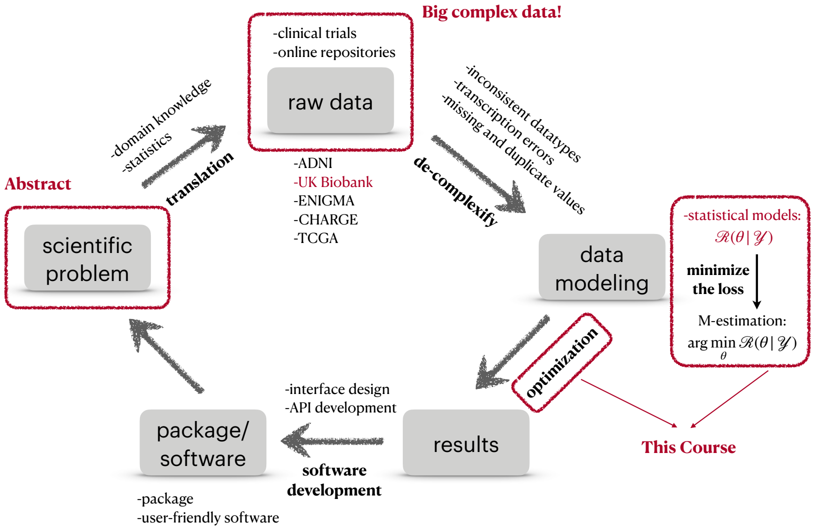

Figure 1: Big Data Science Loop

By Figure 1, we can ...

6 Some Frequently-Used Mathematical Notations

$$\alpha,\ \beta, \theta, \lambda,\ a_1, \cdots, a_n,\ b_1 \ldots b_n,\ \{x_i\}_{1\le i\le n},\ X \sim \mathcal{N}(0,1)$$
$$X_n \to X,\ X_n \xrightarrow{D} X,\ a \ge b,\ a \le b, a \ne b$$
$$\sum_{i=1}^n a_i,\ \prod_{i=1}^n a_i,\ \lim_{n\to\infty} a_n,\ \int_a^b f(x)dx$$

$$\alpha,\ \beta, \theta, \lambda,\ a_1, \cdots, a_n,\ b_1 \ldots b_n,\ \{x_i\}_{1\le i\le n},\ X \sim \mathcal{N}(0,1) \tag{6.1}$$
$$X_n \to X,\ X_n \xrightarrow{D} X,\ a \ge b,\ a \le b, a \ne b \tag{6.2}$$
$$\sum_{i=1}^n a_i,\ \prod_{i=1}^n a_i,\ \lim_{n\to\infty} a_n,\ \int_a^b f(x)dx \tag{6.3}$$

$$\alpha,\ \beta, \theta, \lambda,\ a_1, \cdots, a_n,\ b_1 \ldots b_n,\ \{x_i\}_{1\le i\le n},\ X \sim \mathcal{N}(0,1) \tag{6.4}$$
$$X_n \to X,\ X_n \xrightarrow{D} X,\ a \ge b,\ a \le b, a \ne b \tag{6.5}$$
$$\sum_{i=1}^n a_i,\ \prod_{i=1}^n a_i,\ \lim_{n\to\infty} a_n,\ \int_a^b f(x)dx \tag{6.6}$$

By the equation (6.1), we can get that ...

7 An Example

Question 1 (Maximum Likelihood Estiamtor (MLE) and Asymptotic Normality (20 points))**.** Maximum likelihood is one of the most fundamental principals in parameter estimation. Suppose we have n i.i.d. random samples $\{X_i\}_{i=1}^n$ that have probability density function $p_\theta(x)$. We are interested in estimating the parameter θ. Denote the correspondent MLE by $\widehat{\theta_n}$. In the lecture, we have known that under some regularity conditions, the MLE enjoys the asymptotic normality

$$\sqrt{n}(\widehat{\theta_n} - \theta) \xrightarrow{D} N(0, \frac{1}{I(\theta)}), \tag{7.1}$$

where

$$I(\theta) := \mathbb{E}\left(-\frac{\partial^2}{\partial\theta^2}\log p_\theta(X)\right) = -\int_{\mathcal{X}}\left(\frac{\partial^2}{\partial\theta^2}\log p_\theta(x)\right)p_\theta(x)dx$$

is the Fisher information and $\mathcal{X}$ is the range of X_i.