Variable

TERM	DESCRIPTION
C	consumer who own e-car
T	elctronic capatior for an e-car
X	SOC: the electrocity that already used
t	time(0~24)
E	energy consumption

Model

model 1: the distribution for initial SOC:

$$f_{\mathrm{c}}(x) = \frac{1}{\sqrt{2\pi}\times 0.1772}\mathrm{e}^{-\frac{(x-0.5137)^2}{2\times 0.1772^2}}$$

model 2: the distribution for charing demand probability

$$p_{\mathrm{c-shop}}(x) = 0.01272\mathrm{e}^{2.474x} + 1.528\times 10^{-5}\mathrm{e}^{10.95x}$$

model 3: the distribution for consumer popular time

Assume it adapt the normal distribution, then:

$$C(t,\mu,\sigma) = \frac{1}{\sigma\sqrt{2\pi}}e^{-\frac{(t-\mu)^2}{2\sigma^2}}$$

for the variable μ and σ, it depend on each shop's real situation, which can be easily calculated. Later, we will show a DEMO.

model 4: the energy demand function:

For: $\mathrm{P}_{\text{(the SOC for car owner is x)}} \cup$ P(the E-car owner want to charge), we can briefly describe as:

$$f_c(x) \times p_{x-shop}(x)$$

and for the number of people, it is:

$$f_c(x) \times p_{x-shop}(x) times C$$

then, for the energy consumption for a singer car, it can be describe as:

$$E_{total} = T \times X$$

Finally, considering the time distribution which shows in *model 3* and for the e-car owner with different SOC, we can build the *energy consumption model by*:

$$E = \sum_{t=0}^{24}\int_0^1 f_c(x) \times p_{x-shop}(x) \times C(t) \times X \times T$$

or it can also be write as:

$$E = \sum_{t=0}^{24} \int_{0}^{1} \frac{1}{\sqrt{2\pi}\times 0.1772} \mathrm{e}^{-\frac{(x-0.5137)^2}{2\times 0.1772^2}} \times (0.01272\mathrm{e}^{2.474x} + 1.528\times 10^{-5}\mathrm{e}^{10.95x}) \times \frac{1}{\sigma\sqrt{2\pi}} e^{-\frac{(t-\mu)^2}{2\sigma^2}} \times X \times T$$

however, to simplify as model solving procedural, we can consider the *consumer popular time* as a single variable. That is, we turn $C(t)$ to a constant P which describe the total consumers in a shop in a single day. Subsequently, we can rewrite our model like:

$$E = \int_{0}^{1} \frac{1}{\sqrt{2\pi}\times 0.1772} \mathrm{e}^{-\frac{(x-0.5137)^2}{2\times 0.1772^2}} \times (0.01272\mathrm{e}^{2.474x} + 1.528\times 10^{-5}\mathrm{e}^{10.95x}) \times X \times T$$