Load Stretching Algorithm

The motivation for this is that given a load forecast shape, $X\_{t}$, we want a linear transformation, $aX\_{t}+ b= Y\_{t}$ such that $\max\_{t}Y\_{t}=q$ and $mean\_{t} Y\_{t}=p$. That is, we can pick the average and peak and get a load shape based on the original $X\_{t}$ with a given energy (mean) and peak (max) value.

I’ll give you the answer first and offer a more detailed explanation after. If you take the peak for the original load forecast to be $\max\_{t}X\_{t}=s$ and the energy to be $mean\_{t} X\_{t}=r$, then

$a=\frac{q-p}{s-r}$ and $b=\frac{ps-qr}{s-r}$

This comes from some basic substitution:

$$\max\_{t}Y\_{t}=q⟹\max\_{t}\left(aX\_{t}+ b\right)=q⇒a=\frac{q-b}{\max\_{t}X\_{t}}=\frac{q-b}{s}$$

And

$$mean\_{t} Y\_{t}=p⇒mean\_{t}\left(aX\_{t}+ b\right) =p⟹b=p-a(mean\_{t}X\_{t})⟹b=p-ar$$

Substitute for $a$ in the second equation gives the answer for $b$:

$$b=p-\left(\frac{q-b}{s}\right)r ⇒b- \frac{br}{s}=b\left(1- \frac{r}{s}\right)=b\left(\frac{s-r}{s}\right)= \frac{ps-qr}{s}⇒b=\frac{ps-qr}{s}\left(\frac{s}{s-r}\right)=\frac{ps-qr}{s-r}$$

Substituting for $b$ in the first equation gives the answer for $a$:

$$a=\frac{q- \frac{ps-qr}{s-r}}{s}=\frac{\frac{qs-qr-ps+qr}{s-r}}{s}=\frac{qs-ps}{s\left(s-r\right)}=\frac{q-p}{s-r}$$

I’m sure this is a basic result from somewhere, but we’ve reproved it for you. Basically this gives you a function that transforms using the energy and peak from the existing forecast and the targeted energy and peak in a linear transformation.

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