Proportional Sampling → prob. sampling

$$d = \begin{array}{cccccc} d_1 & d_2 & d_3 & d_4 & \dots & d_n \\ \hline 2.0 & 6.0 & 1.2 & 5.8 & \dots & 20.0 \\ \hline 1 & 2 & 3 & 4 & \dots & n \end{array}$$

Let, $n = 5$

Task :- Pick an element amongst the n-elements such that the prob. of picking an element is proportional to values (d_i's)

randomly pick → each are equiprobable (do not want that)

→ prob. of picking ele d_3 → must be smallest

Step 1 (a) $S = \sum_{i=1}^{n} d_i = 35$ (compute the sum)

(b) $d_i' = d_i / S$ → d_1', d_2', d_3' --- d_5' → Normalizing using the sum.

$$\underbrace{\underset{0.0571}{d_1'},\ \underset{0.171428}{d_2'},\ \underset{0.0343}{d_3'}\ \cdots\ \underset{0.5714}{d_5'}}_{0 \text{ to } 1}$$

sum of all $= \sum d_i' = \sum \frac{d_i}{S} = 1$

(c) Cummolative normalization sum

$d_1' = 0.0571$	$\tilde{d}_1 = d_1' = 0.0571$
$d_2' = 0.171428$	$\tilde{d}_2 = d_1' + d_2' = 0.228528$
$d_3' = \dots$	$\tilde{d}_3 = d_1' + d_2' + d_3' = 0.262828$
$d_4' = \dots$	$\vdots$
$d_5' = 0.5714$	$\tilde{d}_5 = d_1' + d_2' + \dots + d_5' = 1$

$\tilde{d}_i$ = Cummolative-normalized-value

Step 2 :-

Sample one Value unif. (0.0 , 1.0)

$\underline{r}$ = numpy.random.uniform $(\underbrace{0.0,\ 1.0}_{\text{range}},\ 1)$ → How many no. you want

Let,

$r = 0.6$

Step 3 :- proportional - sampling.

```
if r ≤ d̃1
    return 1
elif r ≤ d̃2
    return 2
  ⋮
else
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$\tilde{d}_1$ r range: 0.0 — 1.0

$\tilde{d}_2$

$\tilde{d}_3$

$= d_4' \leftarrow r$ } → The prob. of 'r' lying b/w these two is d_4'.

$\tilde{d}_4$

$\tilde{d}_5$

prob. of picking up 'y'

The prob. of r lying b/w $\tilde{d}_3$ + $\tilde{d}_4$ $= d_4' \propto d_4$ $\left[d_4' = \dfrac{d_4}{S} \right]$