Probability distribution of interest is $\{p_i\} = \Pr\{X = i\}$. Assume there are N values i for which $p_i > 0$. Let $i \in S$ if $p_i > 0$. Each alias table entry of the form (v_j, u_j, s_j), where $v_j, u_j \in S$ and s_j is the probability of selecting v_j when this table entry is choosen.

1. **Initialization** Set $q_i = Np_i$, for all $i \in S$. Define $G = \{i | i \in S \text{ and } q_i \geq 1\}$, and $H = \{i | i \in S \text{ and } q_i < 1\}$.

2. **Build Table**

   For $j = 1$ to N
   if($H \neq \emptyset$) {
   REMOVE any $i \in H$
   set $v_j = i$
   set $s_j = q_i$
   REMOVE any $k \in G$
   set $u_j = k$
   set $q_k = q_k - (1 - s_j)$
   put k in G if $q_k > 1$ else put k in H
   } else {
   REMOVE any $k \in G$, assign $v_j = k$, $s_j = 1$
   }

To sample a value from this distribution

1. Choose cell index $i \in [1, N]$ uniformly at random.

2. With probability s_i select value v_i, otherwise select u_i.

Example : $p_2 = 0.4, p_6 = 0.1, p_8 = 0.2, p_9 = 0.3$.

The table below illustrates the state of the algorithm after each step. The initial state is

value	probability	q	Set	index	v	u	s
2	0.4	1.6	G	0	-	-	-
6	0.1	0.4	H	1	-	-	-
8	0.2	0.8	H	2	-	-	-
9	0.3	1.2	G	3	-	-	-

For $j = 1$ we choose $2 \in G$ and $6 \in H$. Assign $v_1 = 6$, $u_1 = 2$, $s_1 = 0.4$, reassign $q_2 = 1.6 - (1 - 0.4) = 1.0$, return 2 to G:

value	probability	q	Set	index	v	u	s
2	0.4	1.0	G	1	6	2	0.4
6	0.1	—	—	2	-	-	-
8	0.2	0.8	H	3	-	-	-
9	0.3	1.2	G	4	-	-	-

For $j = 2$ we choose $8 \in H$ and $9 \in G$. Assign $v_2 = 8$, $u_2 = 9$, $s_2 = 0.8$, reassign $q_9 = 1.2 - (1 - 0.8) = 1.0$, return 9 to G:

value	probability	q	Set	index	v	u	s
2	0.4	1.0	G	1	6	2	0.4
6	0.1	—	—	2	8	9	0.8
8	0.2	—	—	3	-	-	-
9	0.3	1.0	G	4	-	-	-

H is empty so we choose $2 \in G$, assign $v_3 = 2$, $s_3 = 1.0$.

H is empty so we choose $9 \in G$, assign $v_4 = 9$, $s_4 = 1.0$.

value	probability	q	Set	index	v	u	s
2	0.4	—	—	1	6	2	0.4
6	0.1	—	—	2	8	9	0.8
8	0.2	– -	—	3	2	-	1.0
9	0.3	—	—	4	9	-	1.0

Reconstructing the probabilities, if X samples from this distribution, then

- $X = 2$ if EITHER cell 1 is selected and then u_1 is selected OR cell 3 selected and then v_3 is selected. This happens with probability $(1/4) * (1 - 0.4) + (1/4) * 1 = 0.4$.
- $X = 6$ if cell 1 is selected and then v_1 is selected. This happens with probability $(1/4) * 0.4 = 0.1$.
- $X = 8$ if cell 2 is selected and then v_2 is selected. This happens with probability $(1/4) * 0.8 = 0.2$.
- $X = 9$ if EITHER cell 2 is selected and then u_2 is selected OR cell 4 selected and then v_4 is selected. This happens with probability $(1/4) * (1 - 0.8) + (1/4) * 1 = 0.3$.