(1) Shannon – Fano coding.

1. List the source symbol in order of decreasing probability.
2. Partition the set into two set that are close to equiprobable as possible.
3. assign 0 to the upper set and 1 to the lower set.
4. Continue this process, each time partioning the set with as nearly equal probabilities as possible until further partioning is not possible.

Example

x_1	x_2	x_3	x_4	x_5	x_6
0.30	0.25	0.12	0.20	0.08	0.05

x_i	P_i	step 1	step 2			Code	n_i
x_1	0.30	0	0			00	2
x_2	0.25	0	1			01	2
x_4	0.20	1	0			10	2
x_3	0.12	1	1	0		110	3
x_5	0.08	1	1	1	0	1110	4
x_6	0.05	1	1	1	1	1111	4

$$H(X) = -\sum_{j=1}^{m} P_j \log_2 P_j$$

$$= 2.36 \text{ b/sym}.$$

$$L = \sum_{j=1}^{m} P_j \cdot n_j$$

$$= 2.38$$

$$\eta = \frac{H}{L} \times 100 = 0.99 \times 100 = 99\%.$$