System S_1 (Components in ~~Serial~~ Series)

for each A_i $P(A_i \text{ fail}) = q_i$. then:

$$P(\text{System } S_1 \text{ fails}) = P\left(\bigcup_{i=1}^{n} A_i\right)$$

$$\left(= P(A_1 \cup A_2 \cdots \cup A_n)\right)$$

$$= 1 - P\left(\bigcap_{i=1}^{n} A_i^c\right)$$

$$= 1 - \prod_{i=1}^{n} P(A_i^c) \quad \text{(independency)}$$

$$= 1 - \prod_{i=1}^{n} (1 - P(A_i))$$

$$= 1 - \prod_{i=1}^{n} (1 - q_i) \qquad (*)$$

If $q_1 = q_2 = \cdots = q_n = q$

$$(*) = 1 - (1-q)^n$$

OR: when $q_1 = q_2 = \cdots = q_n = q$

$$\binom{n}{1} q (1-q)^{n-1} + \binom{n}{2} q^2 (1-q)^{n-2} + \cdots + \binom{n}{n} q^n$$