MODEL 1

1. (1 p) Consider a population of **10** individuals (denoted x1, x2, ..., x10) for which the progressively cumulated selection probabilities were computed, as follows:

0.0987 0.2674 0.4080 0.4787 0.5773 0.7180 0.8447 0.9434 0.9434 1.0000

Determine the 10 individuals selected by the SUS mechanism if the position of the first arm is p=**0,021**

Solution: There are 10 arms, at equal distances of 0.1

Selected individuals are: x1, x2, x2, x3, x4, x5, x6, x7, x7. Explanations follow:

p=0.021<0.0987 → select x1, p=p+0.1=0.121

0.121>0.0987

0.121<0.2674 → select x2, p=p+0.1=0.221

0.221<0.2674 → select x2, p=p+0.1=0.321

0.321>0.2674

0.321<0.4087 → select x3, p=p+0.1=0.421

0.421>0.4087

0.421<0.4787 → select x4, p=p+0.1=0.521

0.521>0.4787

0.521<0.5733 → select x5, p=p+0.1=0.621

0.621>0.5733

0.621<0.7180 → select x6, p=p+0.1=0.721

0.721>0.7180

0.721<0.8447 → select x7, p=p+0.1=0.821

0.821<0.8447 → select x7, p=p+0.1=0.921

0.921>0.8447

0.921<0.9434 → select x8, p=1.921

STOP, 10 individuals were selected

2. (0.5 p) Consider the following parent chromosomes (permutations)
P1= (3 7 2 4 5 1 6 8 9)
P2= (2 8 4 1 9 3 6 7 5)
Write the cycles determined during the application of CX operator.

Solution: The cycles indicate corresponding pairs of genes.
P1= (3 7 2 4 5 1 6 8 9) → Cycles are: {2,4,1,3}, {8,7}, {9,5}, {6}
P2= (2 8 4 1 9 3 6 7 5)

MODEL 2

1. (0.5 p) Consider a population of **8** individuals (denoted x1, x2, ..., x8) for which the progressively cumulated selection probabilities were computed as follows:

0.02083 0.25 0.39583 0.45833 0.5625 0.66667 0.85417 1

Write the 4 individuals selected by the roulette mechanism, if the randomly generated positions of the roulette are:

0.9845 0.3001 0.5582 0.0238

Solution

The selected individuals are: x8, x3, x5, x2. Explanations follow:

0.85417<0.9845<1 → select x8

0.25<0.3001<0.39583 → select x3

0.45883<0.5582<0.5625 → select x5

0.02083<0.0238<0.25 → select x2

STOP, 4 individuals were selected.

2. (1 p) Consider the parent chromosomes (permutations)
P1= (3 7 2 4 5 1 6 8 9)
P2= (2 8 4 1 9 3 6 7 5)
Write the first descendant resulted by application of PMX operator, using positions i=2, j=5. The first position is 1.

Solution
Step 1. Copy the recombination sequence from P1

C1=(,7 ,2 ,4 ,5 , , , ,)

Step 2. Copy alleles 8, 1 and 9 (which are not yet copied), from the recombination sequence corresponding to P2:

8→position 2, occupied by 7, 7→ position 8, free ➔ C1=(,7 ,2 ,4 ,5 , , ,8,)
1→ position 4, occupied by 4, 4→ position 3, occupied by 2, 2→ position 1, free ➔ C1=(1,7 ,2 ,4 ,5 , , ,8,)
9 → position 5, occupied by 5, 5→ position 9, free ➔ C1=(1,7 ,2 ,4 ,5 , ,8, 9)

Step 3. Copy remaining alleles, from P2 to C1 ➔ C1=(1,7 ,2 ,4 ,5 , 3, 6,8, 9)

MODEL 3

1. (0.5 p) Consider a population of **6** individuals P_curent={x1,x2,...,x6}, with fitness values P_calitati={3,1,4,5,1,6}. A descendants population C_curent={c1,c2,c3,c4,c5,c6} was generated, with fitness values C_calitati={5,4,5,1,1,4}. Write a possible next generation that can be selected by the elitist operator.

Solution

The selected individuals are any of the 5 descendants plus the chromosome x6. For example, a possible next generation is P_urmator={x6,c2,c3,c4,c5,c6}

2. (1 p) Consider the parent chromosomes (permutations)
P1= (3 7 2 4 5 1 6 8 9)
P2= (2 8 4 1 9 3 6 7 5)
Write the descendants resulted from the application of the OCX operator, using positions i=2, j=5. The first position is 1.

Solution
Descendant 1
Step 1. Copy the recombination sequence from P1

C1=(,7 ,2 ,4 ,5 , , , ,)

Step 2. Copy from P2 the alleles that were not yet copied, according to OCX order (from position j to the end and then from position 1 to j-1)

C1=(1,7, 2, 4, 5, 9, 3, 6,8)

The second descendant, built in a similar manner is
C2= (2, 8, 4, 1, 9, 5, 6, 3, 7)