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# C1.

## Fitness Function

Optimum = Maximizing the equation = Maximum Y value

= Probability of Crossover

= Probability of Mutation

## Generation 0

### Population

1. Random weights are created between -100 to 100.

C10 = Weight = Gene of a chromosome

C10 = RANDBETWEEN(-100,100)

It is repeated for 6 genes ( 6 columns ) [ C10:H10 ]

and 8 chromosomes ( 8 rows ) [ C10:C17 ].



1. Fitness function is used to solve for ‘Y’.

C5, D5, E5, F5, G5, H5 = x values

C10, D10, E10, F10, G10, H10 = weights = genes of one chromosome

J10 = Y value for current chromosome

J10 = (C10\*POWER($C$5,2))+(D10\*POWER($D$5,3))+(E10\*$E$5)+(F10\*$F$5)+(G10\*$G$5)+(H10\*$H$5)

This is repeated for all 8 chromosomes [ J10:J17 ].

The values are also ranked.

K10 = RANK(J10,$J$10:$J$17,0)



### Crossing-Over

1. To create Roulette Wheel, the range is required. Since I have negative Y values, I would use the summation of the absolute values of Y as the full range of the wheel.

J10, J11, J12, J13, J14, J15, J16, J17 = Y values

J18 = Full range

J18 = ABS(J10)+ABS(J11)+ABS(J12)+ABS(J13)+ABS(J14)+ABS(J15)+ABS(J16)+ABS(J17)

1. The ranges for every chromosome are defined.

J10 = Y value of current chromosome

J18 = Full range

N10 = Range of current chromosome

N10 = ABS(J10)/$J$18

It is repeated for 8 chromosomes ( 8 rows ) [ N10:N17 ].

1. The sections for every chromosome are defined.

N10 = Range of current section

O10 = Ending point for previous section / Beginning point for current section

P10 = Ending point for current section

P10 = SUM(N10:O10)

It is repeated for 8 chromosomes ( 8 rows ) [ P10:P17 ].



1. A value for each chromosome is randomly determined between 0 and 1 [ S10:S17 ].

S10 = RAND()

Such value is considered as the roulette result for current chromosome.

Such result is used to determine the partner for crossover [ U10:U17 ].



1. The probability for crossover is defined as 0.8.

Pairs with values less than 0.8 will become parents.

A value for each pair is randomly determined between 0 and 1 [ W10:W17 ].

W10 = RAND()

7 pairs will become parents.

1. We would apply ‘Single point crossover’.

A crossover point for each pair is randomly determined between 1 and 5 [ Column Y ].



1. Parents are crossed over at crossover points to create children.

A pair of parents would create two children.



### Mutation

1. Both all parents and all children will be considered for mutation.



1. The probability for mutation is defined as 0.1.

Genes with values less than 0.1 will be mutated.

A value for each gene is randomly determined between 0 and 1 [ AT10:AY10:AT31:AY31 ].

AT10 = RAND()

1. The new population is created.

By mutation, the new gene will be randomized between -100 and 100.

BC10 = Gene of the chromosome

AT10 = Random probability for mutation of each gene

AM10 = Original gene of current chromosome

BC10 = IF(AT10<0.1,RANDBETWEEN(-100,100),AM10)

It is repeated for 6 genes ( 6 columns ) [ BC10:BH10 ]

and 22 chromosomes ( 22 rows ) [ BC10:BC31 ].



## Generation 1

### Population

1. The population from previous generation ( after bring crossed over and mutated ) will be carried over as the population.



1. Fitness function is used to solve for ‘Y’.

C5, D5, E5, F5, G5, H5 = x values

C10, D10, E10, F10, G10, H10 = weights = genes of one chromosome

J10 = Y value for current chromosome

J10 = (C10\*POWER($C$5,2))+(D10\*POWER($D$5,3))+(E10\*$E$5)+(F10\*$F$5)+(G10\*$G$5)+(H10\*$H$5)

This is repeated for all 22 chromosomes [ J10:J31 ].



1. Chromosomes with optimum ‘Y’ ( Maximum ‘Y’) values are considered best performers.

K10 = RANK(J10,$J$10:$J$31,0)

Best 8 chromosomes are selected.

The less performing chromosomes are eliminated.

These 8 chromosomes are the new population for this current generation.



1. Fitness function is used to solve for ‘Y’.

C5, D5, E5, F5, G5, H5 = x values

P10, Q10, R10, S10, T10, U10 = weights = genes of one chromosome

W10 = Y value for current chromosome

W10 = (P10\*POWER($C$5,2))+(Q10\*POWER($D$5,3))+(R10\*$E$5)+(S10\*$F$5)+(T10\*$G$5)+(U10\*$H$5)

This is repeated for all 8 chromosomes [ W10:W17 ].



### Crossing Over

Step 3 to 9 from Generation 0 is repeated.

1. Roulette Wheel



1. Determining partner



1. Probability of Crossover



### Mutation

Generation 10 to 12 from Generation 0 will be repeated.

1. Populations considered for mutation



1. Mutated Population



## Generation 2

### Population

Step 1 and 2 from Generation 1 will be repeated.

1. Previous population



1. Best performing population



### Crossing Over

Step 3 to 9 from Generation 0 is repeated.

1. Roulette Wheel



1. Determining Partner



1. Probability of crossover



### Mutation

Generation 10 to 12 from Generation 0 will be repeated.

1. Populations considered for mutation



1. Mutated Population



## Conclusion

The final population is used to solve for Y value. They are ranked and the best performing chromosome is chosen. The genes of the best performing chromosome are the best weights at Generation 2.





# C2.

Number of Chromosomes = 50

Number of Genes = 6

Number of Generations = 1000

C2A

The coding for C2A follows the step of C1.

Initial Weights – Randomized between -100 to 100

My coding took too long for me so, I only could finish until 100 for this type.

|  |  |
| --- | --- |
| Best Weights at Generation 100 | |
| w1 | 97 |
| w2 | -76 |
| w3 | 97 |
| w4 | -83 |
| w5 | 99 |
| w6 | 99 |
| Optimum Y score | 2822 |

C2B

Instead, this is for

Half the population with optimum fitness always become parents.

The chromosomes always crossover at halfway.

Number of genes mutating = The number of children chromosomes

Mutation = Increasing or decreasing a random value between 1 and. -1 from a gene

Initial Weights – Randomized between -150 to 150

|  |  |
| --- | --- |
| Best Weights at Generation 1000 | |
| w1 | 141 |
| w2 | -104 |
| w3 | 35 |
| w4 | -22 |
| w5 | 141 |
| w6 | 73 |
| Optimum Y score | 5067 |