**Question 1**

1. Let be the amount of investments in fund i, where i = A, B.

**Objective:**

**Subject to:**

The maximum rate of return is 11.4% and the risk is 0.46. The investments in fund A and fund B are 40000 and 10000 respectively.

1. Let be the amount of investments in fund i, where i = A, B.

**Objective:**

**Subject to:**

The minimum risk is 0.38 and the return is 10.2%. The investments in fund A and fund B are 20000 and 30000 respectively.

1. Let be the amount of investments in fund i, where i = A, B.

Let be the percentage deviation variable.

**Objective:** Minimize Q

**Subject to:**

The investments in fund A and fund B are 26666.7 and 23333.3 respectively. The risk is 0.41 and the return is 10.6%. The percentage deviation from the best possible solution for each objective is 7.02%.

**Question 2**

0

0

+100

0

0

0

-100

55

15

30

10

25

20

Let be the network flow between nodes I and j, where

Objective:

Subject to:

**Question 3**

1. AON

b.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Activity** | **Duration** | **ES** | **EF** | **LS** | **LF** | **Slack** | **Critical** |
| A | 10 | 0 | 10 | 4 | 14 | 4 | no |
| B | 20 | 0 | 20 | 0 | 20 | 0 | yes |
| C | 15 | 0 | 15 | 4 | 19 | 4 | no |
| D | 5 | 0 | 5 | 9 | 14 | 9 | no |
| E | 5 | 10 | 15 | 14 | 19 | 4 | no |
| F | 3 | 20 | 23 | 20 | 23 | 0 | yes |
| G | 4 | 15 | 19 | 19 | 23 | 4 | no |
| H | 2 | 23 | 25 | 23 | 25 | 0 | yes |
| I | 2 | 25 | 27 | 25 | 27 | 0 | yes |

c. The duration of project is 27 days. The critical path is B-F-H-I.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Path** | **Duration** | I (300) | H (450) | F \*2(600\*2) | B\*2 (5000\*2) |
| AEFHI | 22 | 21 | 20 | 18 | 18 |
| AEGHI | 23 | 22 | 21 | 21 | 21 |
| BFHI | 27 | 26 | 25 | 23 | 21 |
| CGHI | 23 | 22 | 21 | 21 | 21 |
| DEFHI | 17 | 16 | 15 | 13 | 13 |
| DEGHI | 18 | 17 | 16 | 16 | 16 |
| **Crashing cost** | | 300 | 450 | 1200 | 10000.0 |

The earliest completion is 21 days and the corresponding crashing cost is $11950 while the total cost is $35250. Therefore it is no possible to complete the project within 20 days.

**Question 4**

1. Let be the number of large, medium and small buses used, where i = 1 (Large), 2 (Medium), 3 (Small).

Objective:

Subject to:

8 large buses, 44 medium buses and 28 small buses are used. The minimum cost is $34480 with a mean pollution rating of 6 and a mean safety rating of 7.4.

1. Let be the number of large, medium and small buses used, where i = 1 (Large), 2 (Medium), 3 (Small).

Objective:

Subject to:

8 large buses and 72 medium buses are used. The minimum mean pollution rating is 5.3 and the mean safety rating is 8.1 at a cost of $35600.

1. Let be the number of large, medium and small buses used, where i = 1 (Large), 2 (Medium), 3 (Small).

Objective:

Subject to:

All of the 80 buses are large buses. The maximum mean safety rating is 9 with a mean pollution rating of 8 at a cost of $39200.

1. Let be the number of large, medium and small buses used, where i = 1 (Large), 2 (Medium), 3 (Small).

Let Q be the percentage deviation of the three goals.

73 large buses and 7 small buses are used. The value of Q is 0.12. The mean pollution rating is 7.9 and the mean safety rating is 8.7 at a cost of $38570.