Input 10

Gender Weight Height

0 0 0

0 0 0

0 1 0

1 0 1

0 0 0

0 0 1

- 0 0

1 1 1

0 0 1

0 0 1

0 0 0

0 0 0

- 0 1

0 1 0

1 1 1

0 0 1

0 0 0

1 0 1

1 0 1

0 0 0

**//The first times:**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Initial**  **probability** | Male | **0.7** | Weight>130 for male | **0.8** | Weight>130 for female | **0.4** | Height>55 for male | **0.7** | Height>55 for female | **0.3** |
| **Final**  **probability** | Male | **0.726** | Weight>130 for male | **0.862** | Weight>130 for female | **0.634** | Height>55 for male | **0.688** | Height>55 for female | **0.000** |
| **Iteration** | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| Likelihood | **-32.137** | **-29.554** | **-29.478** | **-29.472** | **-29.472** |  |  |  |  |  |

**//The second times:**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Initial**  **probability** | Male | **0.1** | Weight>130 for male | **0.5** | Weight>130 for female | **0.1** | Height>55 for male | **0.5** | Height>55 for female | **0.1** |
| **Final**  **probability** | Male | **0.726** | Weight>130 for male | **0.862** | Weight>130 for female | **0.634** | Height>55 for male | **0.688** | Height>55 for female | **0.000** |
| **Iteration** | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| **Likelihood** | **-61.753** | **-29.749** | **-29.492** | **-29.474** | **-29.472** | **-29.472** |  |  |  |  |

**//The third times:**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Initial**  **probability** | Male | **0.7** | Weight>130 for male | **0.1** | Weight>130 for female | **0.1** | Height>55 for male | **0.1** | Height>55 for female | **0.1** |
| **Final**  **probability** | Male | **0.726** | Weight>130 for male | **0.862** | Weight>130 for female | **0.634** | Height>55 for male | **0.688** | Height>55 for female | **0.000** |
| **Iteration** | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| **Likelihood** | **-71.999** | **-29.760** | **-29.493** | **-29.474** | **-29.472** | **-29.472** |  |  |  |  |

**//The fourth times:**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Initial**  **probability** | Male | **0.1** | Weight>130 for male | **0.9** | Weight>130 for female | **0.9** | Height>55 for male | **0.9** | Height>55 for female | **0.9** |
| **Final**  **probability** | Male | **0.726** | Weight>130 for male | **0.862** | Weight>130 for female | **0.634** | Height>55 for male | **0.688** | Height>55 for female | **0.000** |
| **Iteration** | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| **Likelihood** | **-65.436** | **-30.439** | **-29.545** | **-29.477** | **-29.472** | **-29.472** |  |  |  |  |

Input 30

**//The original dataset:**

Gender Weight Height

1 1 1

1 1 1

1 1 0

0 0 0

1 0 0

1 1 1

0 0 0

0 0 1

0 0 1

- 0 0

1 1 1

0 0 1

- 1 1

0 1 0

0 0 0

0 0 0

1 0 1

- 1 1

0 0 1

0 0 1

**//The first times:**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Initial**  **probability** | Male | **0.7** | Weight>130 for male | **0.8** | Weight>130 for female | **0.4** | Height>55 for male | **0.7** | Height>55 for female | **0.3** |
| **Final**  **probability** | Male | **0.556** | Weight>130 for male | **0.892** | Weight>130 for female | **0.235** | Height>55 for male | **0.532** | Height>55 for female | **0.235** |
| **Iteration** | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| Likelihood | **-36.41** | **-34.002** | **-33.966** | **-33.965** | **-33.965** |  |  |  |  |  |

**//The second times:**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Initial**  **probability** | Male | **0.1** | Weight>130 for male | **0.5** | Weight>130 for female | **0.1** | Height>55 for male | **0.5** | Height>55 for female | **0.1** |
| **Final**  **probability** | Male | **0.555** | Weight>130 for male | **0.893** | Weight>130 for female | **0.235** | Height>55 for male | **0.533** | Height>55 for female | **0.235** |
| **Iteration** | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| **Likelihood** | **-51.836** | **-33.983** | **-33.965** | **-33.965** |  |  |  |  |  |  |

**//The third times:**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Initial**  **probability** | Male | **0.7** | Weight>130 for male | **0.1** | Weight>130 for female | **0.1** | Height>55 for male | **0.1** | Height>55 for female | **0.1** |
| **Final**  **probability** | Male | **0.555** | Weight>  130 for male | **0.893** | Weight>130 for female | **0.235** | Height>55 for male | **0.533** | Height>55 for female | **0.235** |
| **Iteration** | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| **Likelihood** | **-60.153** | **-34.479** | **-33.966** | **-33.966** | **-33.965** |  |  |  |  |  |

**//The fourth times:**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Initial**  **probability** | Male | **0.1** | Weight>130 for male | **0.9** | Weight>130 for female | **0.9** | Height>55 for male | **0.9** | Height>55 for female | **0.9** |
| **Final**  **probability** | Male | **0.555** | Weight>  130 for male | **0.892** | Weight>130 for female | **0.235** | Height>55 for male | **0.532** | Height>55 for female | **0.235** |
| **Iteration** | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| **Likelihood** | **-71.992** | **-34.223** | **-33.968** | **-33.965** | **-33.965** |  |  |  |  |  |

**Input 50**

Gender Weight Height

- 0 0

1 1 1

- 0 0

- 1 0

0 0 0

1 1 1

- 1 0

- 1 1

0 0 0

- 0 0

- 1 1

- 0 1

- 0 1

1 0 1

0 1 1

- 0 0

0 0 0

- 0 0

- 0 0

- 1 0

**//The first times:**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Initial**  **probability** | Male | **0.7** | Weight>130 for male | **0.8** | Weight>130 for female | **0.4** | Height>55 for male | **0.7** | Height>55 for female | **0.3** |
| **Final**  **probability** | Male | **0.704** | Weight>  130 for male | **0.696** | Weight>130 for female | **0.373** | Height>55 for male | **0.852** | Height>55 for female | **0.003** |
| **Iteration** | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| **Likelihood** | **-29.667** | **-28.907** | **-28.756** | **-28.674** | **-28.618** | **-28.578** | **-28.547** | **-28.524** | **-28.506** | **-28.492** |
| **Iteration** | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| **Likelihood** | **-28.473** | **-28.466** | **-28.461** | **-28.457** | **-28.454** | **-28.451** | **-28.449** | **-28.448** | **-28.447** | **-28.446** |

**//The second times:**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Initial**  **probability** | Male | **0.1** | Weight>130 for male | **0.5** | Weight>130 for female | **0.1** | Height>55 for male | **0.5** | Height>55 for female | **0.1** |
| **Final**  **probability** | Male | **0.704** | Weight>  130 for male | **0.696** | Weight>130 for female | **0.373** | Height>55 for male | **0.852** | Height>55 for female | **0.002** |
| **Iteration** | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| **Likelihood** | **-49.976** | **-29.761** | **-29.273** | **-29.038** | **-28.884** | **-28.777** | **-28.698** | **-28.640** | **-28.595** | **-28.561** |
| **Iteration** | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| **Likelihood** | **-28.514** | **-28.498** | **-28.486** | **-28.476** | **-28.469** | **-28.463** | **-28.459** | **-28.455** | **-28.452** | **-28.450** |
| **Iteration** | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 |  |
| **Likelihood** | **-28.448** | **-28.447** | **-28.446** | **-28.445** |  |  |  |  |  |  |

**//The third times:**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Initial**  **probability** | Male | **0.7** | Weight>130 for male | **0.1** | Weight>130 for female | **0.1** | Height>55 for male | **0.1** | Height>55 for female | **0.1** |
| **Final**  **probability** | Male | **0.704** | Weight>  130 for male | **0.696** | Weight>130 for female | **0.373** | Height>55 for male | **0.852** | Height>55 for female | **0.002** |
| **Iteration** | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| **Likelihood** | **-61.986** | **-29.883** | **-29.090** | **-28.812** | **-28.705** | **-28.643** | **-28.597** | **-28.562** | **-28.536** | **-28.515** |
| **Iteration** | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| **Likelihood** | **-28.499** | **-28.487** | **-28.477** | **-28.469** | **-28.463** | **-28.459** | **-28.455** | **-28.452** | **-28.450** | **-28.449** |
| **Iteration** | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 |  |
| **Likelihood** | **-28.447** | **-28.446** | **-28.445** |  |  |  |  |  |  |  |

**//The forth times:**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Initial**  **probability** | Male | **0.1** | Weight>130 for male | **0.9** | Weight>130 for female | **0.9** | Height>55 for male | **0.9** | Height>55 for female | **0.9** |
| **Final**  **probability** | Male | **0.704** | Weight>  130 for male | **0.696** | Weight>130 for female | **0.373** | Height>55 for male | **0.852** | Height>55 for female | **0.002** |
| **Iteration** | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| **Likelihood** | **-48.896** | **-32.252** | **-30.715** | **-29.863** | **-29.369** | **-29.083** | **-28.909** | **-28.793** | **-28.710** | **-28.648** |
| **Iteration** | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| **Likelihood** | **-28.601** | **-28.566** | **-28.538** | **-28.517** | **-28.501** | **-28.488** | **-28.478** | **-28.470** | **-28.464** | **-28.459** |
| **Iteration** | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 |  |
| **Likelihood** | **-28.456** | **-28.453** | **-28.450** | **-28.449** | **-28.447** | **-28.446** | **-28.445** |  |  |  |

Input 70

Gender Weight Height

- 1 1

1 1 0

0 0 1

- 1 0

0 1 0

- 0 0

1 1 1

- 0 1

1 1 1

- 1 0

- 1 1

- 1 1

- 0 1

1 1 1

0 1 0

- 0 1

- 1 1

- 0 0

0 1 0

- 1 1

**//The first times:**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Initial**  **probability** | Male | **0.7** | Weight>130 for male | **0.8** | Weight>130 for female | **0.4** | Height>55 for male | **0.7** | Height>55 for female | **0.3** |
| **Final**  **probability** | Male | **0.541** | Weight>  130 for male | **0.479** | Weight>130 for female | **0.089** | Height>55 for male | **0.576** | Height>55 for female | **0.192** |
| **Iteration** | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| **Likelihood** | **-36.404** | **-29.740** | **-29.736** | **-29.733** | **-29.731** | **-29.730** | **-29.728** | **-29.727** | **-29.726** | **-29.724** |
| **Iteration** | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| **Likelihood** | **-29.723** | **-29.722** |  |  |  |  |  |  |  |  |

**//The second times:**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Initial**  **probability** | Male | **0.1** | Weight>130 for male | **0.5** | Weight>130 for female | **0.1** | Height>55 for male | **0.5** | Height>55 for female | **0.1** |
| **Final**  **probability** | Male | **0.541** | Weight>  130 for male | **0.479** | Weight>130 for female | **0.089** | Height>55 for male | **0.576** | Height>55 for female | **0.192** |
| **Iteration** | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| **Likelihood** | **-37.613** | **-30.336** | **-29.986** | **-29.885** | **-29.841** | **-29.815** | **-29.798** | **-29.785** | **-29.775** | **-29.750** |
| **Iteration** | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| **Likelihood** | **-29.760** | **-29.755** | **-29.750** | **-29.746** | **-29.743** | **-29.740** | **-29.737** | **-29.735** | **-29.733** | **-29.731** |
| **Iteration** | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 |  |
| **Likelihood** | **-29.730** | **-29.728** | **-29.727** | **-29.725** | **-29.724** | **-29.723** | **-29.722** |  |  |  |

**//The third times:**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Initial**  **probability** | Male | **0.7** | Weight>130 for male | **0.1** | Weight>130 for female | **0.1** | Height>55 for male | **0.1** | Height>55 for female | **0.1** |
| **Final**  **probability** | Male | **0.542** | Weight>  130 for male | **0.479** | Weight>130 for female | **0.088** | Height>55 for male | **0.575** | Height>55 for female | **0.192** |
| **Iteration** | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| **Likelihood** | **-41.218** | **-30.445** | **-29.939** | **-29.782** | **-29.74** | **-29.73** | **-29.727** | **-29.725** | **-29.724** | **-29.723** |
| **Iteration** | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| **Likelihood** | **-29.722** |  |  |  |  |  |  |  |  |  |
| **Iteration** | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 |  |
| **Likelihood** |  |  |  |  |  |  |  |  |  |  |

**//The forth times:**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Initial**  **probability** | Male | **0.1** | Weight>130 for male | **0.9** | Weight>130 for female | **0.9** | Height>55 for male | **0.9** | Height>55 for female | **0.9** |
| **Final**  **probability** | Male | **0.542** | Weight>  130 for male | **0.479** | Weight>130 for female | **0.089** | Height>55 for male | **0.576** | Height>55 for female | **0.192** |
| **Iteration** | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| **Likelihood** | **-70.974** | **-31.201** | **-30.402** | **-30.085** | **-29.944** | **-29.876** | **-29.838** | **-29.814** | **-29.797** | **-29.784** |
| **Iteration** | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| **Likelihood** | **-29.774** | **-29.766** | **-29.760** | **-29.754** | **-29.750** | **29.746** | **-29.743** | **-29.740** | **-29.737** | **-29.735** |
| **Iteration** | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 |  |
| **Likelihood** | **-29.733** | **-29.731** | **-29.729** | **-29.728** | **-29.727** | **-29.725** | **-29.724** | **-29.723** | **-29.722** |  |

Input 100

Gender Weight Height

- 0 1

- 1 0

- 0 1

- 0 0

- 1 0

- 0 0

- 0 0

- 1 1

- 1 1

- 0 1

- 0 0

- 0 0

- 1 0

- 1 1

- 0 0

- 0 0

- 0 0

- 0 0

- 0 0

- 0 1

**//The first times:**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Initial**  **probability** | Male | **0.7** | Weight>130 for male | **0.8** | Weight>130 for female | **0.4** | Height>55 for male | **0.7** | Height>55 for female | **0.3** |
| **Final**  **probability** | Male | **0.721** | Weight>  130 for male | **0.830** | Weight>130 for female | **0.364** | Height>55 for male | **0.780** | Height>55 for female | **0.341** |
| **Iteration** | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| **Likelihood** | **-25.003** | **-24.773** | **-24.762** | **-24.756** | **-24.754** | **-24.753** | **-24.752** |  |  |  |
| **Iteration** | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| **Likelihood** |  |  |  |  |  |  |  |  |  |  |

**//The second times:**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Initial**  **probability** | Male | **0.1** | Weight>130 for male | **0.5** | Weight>130 for female | **0.1** | Height>55 for male | **0.5** | Height>55 for female | **0.1** |
| **Final**  **probability** | Male | **0.457** | Weight>  130 for male | **0.914** | Weight>130 for female | **0.520** | Height>55 for male | **0.889** | Height>55 for female | **0.449** |
| **Iteration** | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| **Likelihood** | **-50.317** | **-24.754** | **-24.753** | **-24.753** |  |  |  |  |  |  |
| **Iteration** | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| **Likelihood** |  |  |  |  |  |  |  |  |  |  |
| **Iteration** | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 |  |
| **Likelihood** |  |  |  |  |  |  |  |  |  |  |

**//The third times:**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Initial**  **probability** | Male | **0.7** | Weight>130 for male | **0.1** | Weight>130 for female | **0.1** | Height>55 for male | **0.1** | Height>55 for female | **0.1** |
| **Final**  **probability** | Male | **0.7** | Weight>  130 for male | **0.7** | Weight>130 for female | **0.7** | Height>55 for male | **0.65** | Height>55 for female | **0.65** |
| **Iteration** | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| **Likelihood** | **-63.539** | **-25.166** | **-25.166** |  |  |  |  |  |  |  |
| **Iteration** | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| **Likelihood** |  |  |  |  |  |  |  |  |  |  |
| **Iteration** | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 |  |
| **Likelihood** |  |  |  |  |  |  |  |  |  |  |

**//The forth times:**

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Initial**  **probability** | Male | **0.1** | Weight>130 for male | **0.9** | Weight>130 for female | **0.5** | Height>55 for male | **0.5** | Height>55 for female | **0.9** |
| **Final**  **probability** | Male | **0.185** | Weight>  130 for male | **0.273** | Weight>130 for female | **0.797** | Height>55 for male | **0.203** | Height>55 for female | **0.752** |
| **Iteration** | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
| **Likelihood** | **-29.279** | **-25.466** | **-25.335** | **-25.260** | **-25.215** | **-25.183** | **-25.157** | **-25.132** | **-25.103** | **-25.069** |
| **Iteration** | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| **Likelihood** | **-25.025** | **-24.974** | **-24.918** | **-24.864** | **-24.820** | **-24.789** | **-24.770** | **-24.760** | **-24.755** | **-24.753** |
| **Iteration** | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 |  |
| **Likelihood** | **-24.752** |  |  |  |  |  |  |  |  |  |

1. **Do multiple starting points help in finding better solutions?**

According to the above result input 10, input 30, input 50, and input 70, we know even though we change the starting points, we still get the same result. But input 100, if we change the starting points, we will get the different results.

1. **Do some of the different solutions have the same likelihood scores?**

For input 10, input 30, input 50 and input 70, the starting likelihood is different, but the final likelihood’s result is the same according to the above results. For the input 100, if we miss all of gender, then we will get the different likelihood scores.

1. **How does the data missing rate affect your algorithm and the results?**

If there are less data missing rate, we would get more accurate results like input 10. But if we miss all of data, the different starting porting will get different result like input 100 which misses all of gender.