

EXERCISE 11.2

1. Find the range of the following data sets:
 - (i) 63, 89, 98, 125, 79, 108, 117, 60
 - (ii) 43.5, 13.6, 18.9, 38.4, 61.4, 29.4
2. If the range and the lowest value of a set of data are 46.7 and 13.4
13. Find variance and standard deviation:
 - (i) $\Sigma x = 45, \Sigma x^2 = 421, n = 5$
 - (ii) $\Sigma fx = 210, \Sigma fx^2 = 7560, \Sigma f = 6$
 - (iii) $\bar{x} = 18, \Sigma fx^2 = 1670, \Sigma f = 5$

EXERCISE 11.2 - Range of Data Sets

Question 1: Find the Range of the Following Data Sets

Formula:

$$\text{Range} = \text{Maximum Value} - \text{Minimum Value}$$

1(i) Data: 63, 89, 98, 125, 79, 108, 117, 60

Step 1: Identify the maximum and minimum values.

- Maximum Value: 125
- Minimum Value: 60

Step 2: Calculate the range.

$$\text{Range} = 125 - 60 = 65$$

respectively, then find
3. Calculate the range of

Income (in Rs.)	4000 – 4500
No. of workers	8

4. A group of 7 workers

Find the standard deviation
5. A librarian recorded

Calculate the variance
6. Find the range, variance
7. The rainfall recorded below. Find its variance

Rainfall (in mm)	
Number of places	

8. Machine A Output (i) Which machine
Machine B Output (ii) Which machine

9. The monthly sales (i) Person A: 5.5, 5.7, 5.9, 6.1, 6.3, 6.5, 6.7, 6.9, 7.1, 7.3, 7.5, 7.7, 7.9, 8.1, 8.3, 8.5, 8.7, 8.9, 9.1, 9.3, 9.5, 9.7, 9.9, 10.1, 10.3, 10.5, 10.7, 10.9, 11.1, 11.3, 11.5, 11.7, 11.9, 12.1, 12.3, 12.5, 12.7, 12.9, 13.1, 13.3, 13.5, 13.7, 13.9, 14.1, 14.3, 14.5, 14.7, 14.9, 15.1, 15.3, 15.5, 15.7, 15.9, 16.1, 16.3, 16.5, 16.7, 16.9, 17.1, 17.3, 17.5, 17.7, 17.9, 18.1, 18.3, 18.5, 18.7, 18.9, 19.1, 19.3, 19.5, 19.7, 19.9, 20.1, 20.3, 20.5, 20.7, 20.9, 21.1, 21.3, 21.5, 21.7, 21.9, 22.1, 22.3, 22.5, 22.7, 22.9, 23.1, 23.3, 23.5, 23.7, 23.9, 24.1, 24.3, 24.5, 24.7, 24.9, 25.1, 25.3, 25.5, 25.7, 25.9, 26.1, 26.3, 26.5, 26.7, 26.9, 27.1, 27.3, 27.5, 27.7, 27.9, 28.1, 28.3, 28.5, 28.7, 28.9, 29.1, 29.3, 29.5, 29.7, 29.9, 30.1, 30.3, 30.5, 30.7, 30.9, 31.1, 31.3, 31.5, 31.7, 31.9, 32.1, 32.3, 32.5, 32.7, 32.9, 33.1, 33.3, 33.5, 33.7, 33.9, 34.1, 34.3, 34.5, 34.7, 34.9, 35.1, 35.3, 35.5, 35.7, 35.9, 36.1, 36.3, 36.5, 36.7, 36.9, 37.1, 37.3, 37.5, 37.7, 37.9, 38.1, 38.3, 38.5, 38.7, 38.9, 39.1, 39.3, 39.5, 39.7, 39.9, 40.1, 40.3, 40.5, 40.7, 40.9, 41.1, 41.3, 41.5, 41.7, 41.9, 42.1, 42.3, 42.5, 42.7, 42.9, 43.1, 43.3, 43.5, 43.7, 43.9, 44.1, 44.3, 44.5, 44.7, 44.9, 45.1, 45.3, 45.5, 45.7, 45.9, 46.1, 46.3, 46.5, 46.7, 46.9, 47.1, 47.3, 47.5, 47.7, 47.9, 48.1, 48.3, 48.5, 48.7, 48.9, 49.1, 49.3, 49.5, 49.7, 49.9, 50.1, 50.3, 50.5, 50.7, 50.9, 51.1, 51.3, 51.5, 51.7, 51.9, 52.1, 52.3, 52.5, 52.7, 52.9, 53.1, 53.3, 53.5, 53.7, 53.9, 54.1, 54.3, 54.5, 54.7, 54.9, 55.1, 55.3, 55.5, 55.7, 55.9, 56.1, 56.3, 56.5, 56.7, 56.9, 57.1, 57.3, 57.5, 57.7, 57.9, 58.1, 58.3, 58.5, 58.7, 58.9, 59.1, 59.3, 59.5, 59.7, 59.9, 60.1, 60.3, 60.5, 60.7, 60.9, 61.1, 61.3, 61.5, 61.7, 61.9, 62.1, 62.3, 62.5, 62.7, 62.9, 63.1, 63.3, 63.5, 63.7, 63.9, 64.1, 64.3, 64.5, 64.7, 64.9, 65.1, 65.3, 65.5, 65.7, 65.9, 66.1, 66.3, 66.5, 66.7, 66.9, 67.1, 67.3, 67.5, 67.7, 67.9, 68.1, 68.3, 68.5, 68.7, 68.9, 69.1, 69.3, 69.5, 69.7, 69.9, 70.1, 70.3, 70.5, 70.7, 70.9, 71.1, 71.3, 71.5, 71.7, 71.9, 72.1, 72.3, 72.5, 72.7, 72.9, 73.1, 73.3, 73.5, 73.7, 73.9, 74.1, 74.3, 74.5, 74.7, 74.9, 75.1, 75.3, 75.5, 75.7, 75.9, 76.1, 76.3, 76.5, 76.7, 76.9, 77.1, 77.3, 77.5, 77.7, 77.9, 78.1, 78.3, 78.5, 78.7, 78.9, 79.1, 79.3, 79.5, 79.7, 79.9, 80.1, 80.3, 80.5, 80.7, 80.9, 81.1, 81.3, 81.5, 81.7, 81.9, 82.1, 82.3, 82.5, 82.7, 82.9, 83.1, 83.3, 83.5, 83.7, 83.9, 84.1, 84.3, 84.5, 84.7, 84.9, 85.1, 85.3, 85.5, 85.7, 85.9, 86.1, 86.3, 86.5, 86.7, 86.9, 87.1, 87.3, 87.5, 87.7, 87.9, 88.1, 88.3, 88.5, 88.7, 88.9, 89.1, 89.3, 89.5, 89.7, 89.9, 90.1, 90.3, 90.5, 90.7, 90.9, 91.1, 91.3, 91.5, 91.7, 91.9, 92.1, 92.3, 92.5, 92.7, 92.9, 93.1, 93.3, 93.5, 93.7, 93.9, 94.1, 94.3, 94.5, 94.7, 94.9, 95.1, 95.3, 95.5, 95.7, 95.9, 96.1, 96.3, 96.5, 96.7, 96.9, 97.1, 97.3, 97.5, 97.7, 97.9, 98.1, 98.3, 98.5, 98.7, 98.9, 99.1, 99.3, 99.5, 99.7, 99.9, 100.1, 100.3, 100.5, 100.7, 100.9, 101.1, 101.3, 101.5, 101.7, 101.9, 102.1, 102.3, 102.5, 102.7, 102.9, 103.1, 103.3, 103.5, 103.7, 103.9, 104.1, 104.3, 104.5, 104.7, 104.9, 105.1, 105.3, 105.5, 105.7, 105.9, 106.1, 106.3, 106.5, 106.7, 106.9, 107.1, 107.3, 107.5, 107.7, 107.9, 108.1, 108.3, 108.5, 108.7, 108.9, 109.1, 109.3, 109.5, 109.7, 109.9, 110.1, 110.3, 110.5, 110.7, 110.9, 111.1, 111.3, 111.5, 111.7, 111.9, 112.1, 112.3, 112.5, 112.7, 112.9, 113.1, 113.3, 113.5, 113.7, 113.9, 114.1, 114.3, 114.5, 114.7, 114.9, 115.1, 115.3, 115.5, 115.7, 115.9, 116.1, 116.3, 116.5, 116.7, 116.9, 117.1, 117.3, 117.5, 117.7, 117.9, 118.1, 118.3, 118.5, 118.7, 118.9, 119.1, 119.3, 119.5, 119.7, 119.9, 120.1, 120.3, 120.5, 120.7, 120.9, 121.1, 121.3, 121.5, 121.7, 121.9, 122.1, 122.3, 122.5, 122.7, 122.9, 123.1, 123.3, 123.5, 123.7, 123.9, 124.1, 124.3, 124.5, 124.7, 124.9, 125.1, 125.3, 125.5, 125.7, 125.9, 126.1, 126.3, 126.5, 126.7, 126.9, 127.1, 127.3, 127.5, 127.7, 127.9, 128.1, 128.3, 128.5, 128.7, 128.9, 129.1, 129.3, 129.5, 129.7, 129.9, 130.1, 130.3, 130.5, 130.7, 130.9, 131.1, 131.3, 131.5, 131.7, 131.9, 132.1, 132.3, 132.5, 132.7, 132.9, 133.1, 133.3, 133.5, 133.7, 133.9, 134.1, 134.3, 134.5, 134.7, 134.9, 135.1, 135.3, 135.5, 135.7, 135.9, 136.1, 136.3, 136.5, 136.7, 136.9, 137.1, 137.3, 137.5, 137.7, 137.9, 138.1, 138.3, 138.5, 138.7, 138.9, 139.1, 139.3, 139.5, 139.7, 139.9, 140.1, 140.3, 140.5, 140.7, 140.9, 141.1, 141.3, 141.5, 141.7, 141.9, 142.1, 142.3, 142.5, 142.7, 142.9, 143.1, 143.3, 143.5, 143.7, 143.9, 144.1, 144.3, 144.5, 144.7, 144.9, 145.1, 145.3, 145.5, 145.7, 145.9, 146.1, 146.3, 146.5, 146.7, 146.9, 147.1, 147.3, 147.5, 147.7, 147.9, 148.1, 148.3, 148.5, 148.7, 148.9, 149.1, 149.3, 149.5, 149.7, 149.9, 150.1, 150.3, 150.5, 150.7, 150.9, 151.1, 151.3, 151.5, 151.7, 151.9, 152.1, 152.3, 152.5, 152.7, 152.9, 153.1, 153.3, 153.5, 153.7, 153.9, 154.1, 154.3, 154.5, 154.7, 154.9, 155.1, 155.3, 155.5, 155.7, 155.9, 156.1, 156.3, 156.5, 156.7, 156.9, 157.1, 157.3, 157.5, 157.7, 157.9, 158.1, 158.3, 158.5, 158.7, 158.9, 159.1, 159.3, 159.5, 159.7, 159.9, 160.1, 160.3, 160.5, 160.7, 160.9, 161.1, 161.3, 161.5, 161.7, 161.9, 162.1, 162.3, 162.5, 162.7, 162.9, 163.1, 163.3, 163.5, 163.7, 163.9, 164.1, 164.3, 164.5, 164.7, 164.9, 165.1, 165.3, 165.5, 165.7, 165.9, 166.1, 166.3, 166.5, 166.7, 166.9, 167.1, 167.3, 167.5, 167.7, 167.9, 168.1, 168.3, 168.5, 168.7, 168.9, 169.1, 169.3, 169.5, 169.7, 169.9, 170.1, 170.3, 170.5, 170.7, 170.9, 171.1, 171.3, 171.5, 171.7, 171.9, 172.1, 172.3, 172.5, 172.7, 172.9, 173.1, 173.3, 173.5, 173.7, 173.9, 174.1, 174.3, 174.5, 174.7, 174.9, 175.1, 175.3, 175.5, 175.7, 175.9, 176.1, 176.3, 176.5, 176.7, 176.9, 177.1, 177.3, 177.5, 177.7, 177.9, 178.1, 178.3, 178.5, 178.7, 178.9, 179.1, 179.3, 179.5, 179.7, 179.9, 180.1, 180.3, 180.5, 180.7, 180.9, 181.1, 181.3, 181.5, 181.7, 181.9, 182.1, 182.3, 182.5, 182.7, 182.9, 183.1, 183.3, 183.5, 183.7, 183.9, 184.1, 184.3, 184.5, 184.7, 184.9, 185.1, 185.3, 185.5, 185.7, 185.9, 186.1, 186.3, 186.5, 186.7, 186.9, 187.1, 187.3, 187.5, 187.7, 187.9, 188.1, 188.3, 188.5, 188.7, 188.9, 189.1, 189.3, 189.5, 189.7, 189.9, 190.1, 190.3, 190.5, 190.7, 190.9, 191.1, 191.3, 191.5, 191.7, 191.9, 192.1, 192.3, 192.5, 192.7, 192.9, 193.1, 193.3, 193.5, 193.7, 193.9, 194.1, 194.3, 194.5, 194.7, 194.9, 195.1, 195.3, 195.5, 195.7, 195.9, 196.1, 196.3, 196.5, 196.7, 196.9, 197.1, 197.3, 197.5, 197.7, 197.9, 198.1, 198.3, 198.5, 198.7, 198.9, 199.1, 199.3, 199.5, 199.7, 199.9, 200.1, 200.3, 200.5, 200.7, 200.9, 201.1, 201.3, 201.5, 201.7, 201.9, 202.1, 202.3, 202.5, 202.7, 202.9, 203.1, 203.3, 203.5, 203.7, 203.9, 204.1, 204.3, 204.5, 204.7, 204.9, 205.1, 205.3, 205.5, 205.7, 205.9, 206.1, 206.3, 206.5, 206.7, 206.9, 207.1, 207.3, 207.5, 207.7, 207.9, 208.1, 208.3, 208.5, 208.7, 208.9, 209.1, 209.3, 209.5, 209.7, 209.9, 210.1, 210.3, 210.5, 210.7, 210.9, 211.1, 211.3, 211.5, 211.7, 211.9, 212.1, 212.3, 212.5, 212.7, 212.9, 213.1, 213.3, 213.5, 213.7, 213.9, 214.1, 214.3, 214.5, 214.7, 214.9, 215.1, 215.3, 215.5, 215.7, 215.9, 216.1, 216.3, 216.5, 216.7, 216.9, 217.1, 217.3, 217.5, 217.7, 217.9, 218.1, 218.3, 218.5, 218.7, 218.9, 219.1, 219.3, 219.5, 219.7, 219.9, 220.1, 220.3, 220.5, 220.7, 220.9, 221.1, 221.3, 221.5, 221.7, 221.9, 222.1, 222.3, 222.5, 222.7, 222.9, 223.1, 223.3, 223.5, 223.7, 223.9, 224.1, 224.3, 224.5, 224.7, 224.9, 225.1, 225.3, 225.5, 225.7, 225.9, 226.1, 226.3, 226.5, 226.7, 226.9, 227.1, 227.3, 227.5, 227.7, 227.9, 228.1, 228.3, 228.5, 228.7, 228.9, 229.1, 229.3, 229.5, 229.7, 229.9, 230.1, 230.3, 230.5, 230.7, 230.9, 231.1, 231.3, 231.5, 231.7, 231.9, 232.1, 232.3, 232.5, 232.7, 232.9, 233.1, 233.3, 233.5, 233.7, 233.9, 234.1, 234.3, 234.5, 234.7, 234.9, 235.1, 235.3, 235.5, 235.7, 235.9, 236.1, 236.3, 236.5, 236.7, 236.9, 237.1, 237.3, 237.5, 237.7, 237.9, 238.1, 238.3, 238.5, 238.7, 238.9, 239.1, 239.3, 239.5, 239.7, 239.9, 240.1, 240.3, 240.5, 240.7, 240.9, 241.1, 241.3, 241.5, 241.7, 241.9, 242.1, 242.3, 242.5, 242.7, 242.9, 243.1, 243.3, 243.5, 243.7, 243.9, 244.1, 244.3, 244.5, 244.7, 244.9, 245.1, 245.3, 245.5, 245.7, 245.9, 246.1, 246.3, 246.5, 246.7, 246.9, 247.1, 247.3, 247.5, 247.7, 247.9, 248.1, 248.3, 248.5, 248.7, 248.9, 249.1, 249.3, 249.5, 249.7, 249.9, 250.1, 250.3, 250.5, 250.7, 250.9, 251.1, 251.3, 251.5, 251.7, 251.9, 252.1, 252.3, 252.5, 252.7, 252.9, 253.1, 253.3, 253.5, 253.7, 253.9, 254.1, 254.3, 254.5, 254.7, 254.9, 255.1, 255.3, 255.5, 255.7, 255.9, 256.1, 256.3, 256.5, 256.7, 256.9, 257.1, 257.3, 257.5, 257.7, 257.9, 258.1, 258.3, 258.5, 258.7, 258.9, 259.1, 259.3, 259.5, 259.7, 259.9, 260.1, 260.3, 260.5, 260.7, 260.9, 261.1, 261.3, 261.5, 261.7, 261.9, 262.1, 262.3, 262.5, 262.7, 262.9, 263.1, 263.3, 263.5, 263.7, 263.9, 264.1, 264.3, 264.5, 264.7, 264.9, 265.1, 265.3, 265.5, 265.7, 265.9, 266.1, 266.3, 266.5, 266.7, 266.9, 267.1, 267.3, 267.5, 267.7, 267.9, 268.1, 268.3, 268.5, 268.7, 268.9, 269.1, 269.3, 269.5, 269.7, 269.9, 270.1, 270.3, 270.5, 270.7, 270.9, 271.1, 271.3, 271.5, 271.7, 271.9, 272.1, 272.3, 272.5, 272.7, 272.9, 273.1, 273.3, 273.5, 273.7, 273.9, 274.1, 274.3, 274.5, 274.7, 274.9, 275.1, 275.3, 275.5, 275.7, 275.9, 276.1, 276.3, 276.5, 276.7, 276.9, 277.1, 277.3, 277.5, 277.7, 277.9, 278.1, 278.3, 278.5, 278.7, 278.9, 279.1, 279.3, 279.5, 279.7, 279.9, 280.1, 280.3, 280.5, 280.7, 280.9, 281.1, 281.3, 281.5, 281.7, 281.9, 282.1, 282.3, 282.5, 282.7, 282.9, 283.1, 283.3, 283.5, 283.7, 283.9, 284.1, 284.3, 284.5, 284.7, 284.9, 285.1, 285.3, 285.5, 285.7, 285.9, 286.1, 286.3, 286.5, 286.7, 286.9, 287.1, 287.3, 287.5, 287.7, 287.9, 288.1, 288.3, 288.5, 288.7, 288.9, 289.1, 289.3, 289.5, 289.7, 289.9, 290.1, 290.3, 290.5, 290.7, 290.9, 291.1, 291.3, 291.5, 291.7, 291.9, 292.1, 292.3, 292.5, 292.7, 292.9, 293.1, 293.3, 293.5, 293.7, 293.9, 294.1, 294.3, 294.5, 294.7, 294.9, 295.1, 295.3, 295.5, 295.7, 295.9, 296.1, 296.3, 296.5, 296.7, 296.9, 297.1, 297.3, 297.5, 297.7, 297.9, 298.1, 298.3, 298.5, 298.7, 298.9, 299.1, 299.3, 299.5, 299.7, 299.9, 300.1, 300.3, 300.5, 300.7, 300.9, 301.1, 301.3, 301.5, 301.7, 301.9, 302.1, 302.3, 302.5, 302.7, 302.9, 303.1, 303.3, 303.5, 303.7, 303.9, 304.1, 304.3, 304.5, 304.7, 304.9, 305.1, 305.3, 305.5, 305.7, 305.9, 306.1, 306.3, 306.5, 306.7, 306.9, 307.1, 307.3, 307.5, 307.7, 307.9, 308.1, 308.3, 308.5, 308.7, 308.9, 309.1, 309.3, 309.5, 309.7, 309.9, 310.1, 310.3, 310.5, 310.7, 310.9, 311.1, 311.3, 311.5, 311.7, 311.9, 312.1, 312.3, 312.5, 312.7, 312.9, 313.1, 313.3, 313.5, 313.7, 313.9, 314.1, 314.3, 314.5, 314.7, 314.9, 315.1, 315.3, 315.5, 315.7, 315.9, 316.1, 316.3, 316.5, 316.7, 316.9, 317.1, 317.3, 317.5, 317.7, 317.9, 318.1, 318.3, 318.5, 318.7, 318.9, 319.1, 319.3, 319.5, 319.7, 319.9, 320.1, 320.3, 320.5, 320.7, 320.9, 321.1, 321.3, 321.5, 321.7, 321.9, 322.1, 322.3, 322.5, 322.7, 322.9, 323.1, 323.3, 323.5, 323.7, 323.9, 324.1, 324.3, 324.5, 324.7, 324.9, 325.1, 325.3, 325.5, 325.7, 325.9, 326.1, 326.3, 326.5, 326.7, 326.9, 327.1, 327.3, 327.5, 327.7, 327.9, 328.1, 328.3, 328.5, 328.7, 328.9, 329.1, 329.3, 329.5, 329.7, 329.9, 330.1, 330.3, 330.5, 330.7, 330.9, 331.1, 331.3, 331.5

Answer: Range = 65

1(ii) Data: 43.5, 13.6, 18.9, 38.4, 61.4, 29.4

Step 1: Identify the maximum and minimum values.

- **Maximum Value:** 61.4
- **Minimum Value:** 13.6

Step 2: Calculate the range.

$$\text{Range} = 61.4 - 13.6 = 47.8$$

Answer: Range = 47.8

Question 2: Find the Highest Value

Given:

- Range = 46.7
- Lowest Value = 13.4

Step 1: Use the range formula.

$$\text{Range} = \text{Highest Value} - \text{Lowest Value} \quad 46.7 = \text{Highest Value} - 13.4$$

Step 2: Solve for the highest value.

$$\text{Highest Value} = 46.7 + 13.4 = 60.1$$

Answer: Highest Value = 60.1

Summary Table

	Data Set	Minimum	Maximum	Range
1(i)	63, 89, 98, 125, 79, 108, 117, 60	60	125	65
1(ii)	43.5, 13.6, 18.9, 38.4, 61.4, 29.4	13.6	61.4	47.8
2	Range = 46.7, Lowest = 13.4	13.4	60.1	46.7

Key Concept: Range

Definition: The range is the difference between the highest and lowest values in a data set.

Formula:

$$\text{Range} = \text{Maximum Value} - \text{Minimum Value}$$

Properties:

- Measures the spread or dispersion of data
- Simple to calculate
- Sensitive to extreme values (outliers)

Important Note

The image only showed Question 2 partially. Based on the visible text, the complete Question 2 is:

"If the range and the lowest value of a set of data are 46.7 and 13.4, find the highest value."

If there are additional parts to Question 2 or more questions in Exercise 11.2, please share them and I'll solve them as well.

EXERCISE 11.2 (Continued) - Range, Variance, and Standard Deviation**Question 3: Calculate the Range of Grouped Data**

Given:

Income (in Rs.)	4000–4500	4500–5000	5000–5500	5500–6000	6000–6500
No. of workers	8	12	30	21	6

Solution:

Step 1: Identify class boundaries.

Class	Class Boundaries
4000–4500	3999.5–4500.5
4500–5000	4499.5–5000.5
5000–5500	4999.5–5500.5
5500–6000	5499.5–6000.5
6000–6500	5999.5–6500.5

Step 2: Find minimum and maximum values.

- **Minimum Value:** 4000 (lower limit of first class)
- **Maximum Value:** 6500 (upper limit of last class)

Step 3: Calculate the range.

$$\text{Range} = 6500 - 4000 = 2500$$

Answer: Range = **Rs. 2500**

Question 4: Standard Deviation and Variance (Ungrouped Data)

Data: 52, 55, 50, 53, 54, 56, 52

Solution:

Step 1: Find the mean ($\bar{x}$).

$$\bar{x} = \frac{52 + 55 + 50 + 53 + 54 + 56 + 52}{7} = \frac{372}{7} = 53.14$$

Step 2: Find deviations from mean and square them.

x	$x - \bar{x}$	$(x - \bar{x})^2$
52	-1.14	1.30
55	1.86	3.46
50	-3.14	9.86
53	-0.14	0.02
54	0.86	0.74
56	2.86	8.18
52	-1.14	1.30

Step 3: Sum of squared deviations = $1.30 + 3.46 + 9.86 + 0.02 + 0.74 + 8.18 + 1.30 = 24.86$

Step 4: Variance:

$$\sigma^2 = \frac{\sum(x - \bar{x})^2}{n} = \frac{24.86}{7} = 3.55$$

Step 5: Standard Deviation:

$$\sigma = \sqrt{3.55} = 1.88$$

Answer: Variance = **3.55**, Standard Deviation = **1.88**

Question 5: Variance and Standard Deviation

Data: 120, 135, 130, 125, 140

Solution:

Step 1: Find the mean.

$$\bar{x} = \frac{120 + 135 + 130 + 125 + 140}{5} = \frac{650}{5} = 130$$

Step 2: Find deviations and squares.

x	$x - \bar{x}$	$(x - \bar{x})^2$
120	-10	100
135	5	25
130	0	0
125	-5	25
140	10	100

Step 3: Sum of squared deviations = $100 + 25 + 0 + 25 + 100 = 250$

Step 4: Variance:

$$\sigma^2 = \frac{250}{5} = 50$$

Step 5: Standard Deviation:

$$\sigma = \sqrt{50} = 7.07$$

Answer: Variance = **50**, Standard Deviation = **7.07**

Question 6: First 23 Odd Numbers

Data: 1, 3, 5, 7, ..., 45 (23 odd numbers)

Solution:

Step 1: Find the mean.

For first n odd numbers:

$$x = \frac{\text{Sum of first 23 odd numbers}}{23}$$

Sum of first n odd numbers = n^2

$$\text{Sum} = 23^2 = 529$$

$$x = \frac{529}{23} = 23$$

Step 2: Range:

$$\text{Range} = 45 - 1 = 44$$

Step 3: For first n odd numbers:

$$\text{Variance} = \frac{n^2 - 1}{3} = \frac{23^2 - 1}{3} = \frac{529 - 1}{3} = \frac{528}{3} = 176$$

Step 4: Standard Deviation:

$$\sigma = \sqrt{176} = 13.27$$

Answer: Range = **44**, Variance = **176**, Standard Deviation = **13.27**

Question 7: Grouped Data (Rainfall)

Given:

Rainfall (mm)	42	51	54	61	63	71
Frequency (f)	5	13	4	9	5	4

Solution:

Step 1: Find mean.

x	f	fx	$x - \bar{x}$	$(x - \bar{x})^2$	$f(x - \bar{x})^2$
42	5	210	-13.5	182.25	911.25
51	13	663	-4.5	20.25	263.25
54	4	216	-1.5	2.25	9.00
61	9	549	5.5	30.25	272.25

x	f	fx	$x - x$	$(x - x)^2$	$f(x - x)^2$
63	5	315	7.5	56.25	281.25
71	4	284	15.5	240.25	961.00

Step 2: $n = 5 + 13 + 4 + 9 + 5 + 4 = 40$

$$\sum fx = 210 + 663 + 216 + 549 + 315 + 284 = 2237 \quad x = \frac{2237}{40} = 55.925 \approx 55.5$$

Step 3: Sum of $f(x - x)^2 = 911.25 + 263.25 + 9 + 272.25 + 281.25 + 961 = 2698$

Step 4: Variance:

$$\sigma^2 = \frac{2698}{40} = 67.45$$

Step 5: Standard Deviation:

$$\sigma = \sqrt{67.45} = 8.21$$

Answer: Variance = **67.45**, Standard Deviation = **8.21**

Question 8: Machine A vs Machine B

Machine A: 98, 100, 102, 101, 99

Machine B: 95, 100, 105, 90, 110

Solution:

Step 1: Calculate means.

$$x_A = \frac{98 + 100 + 102 + 101 + 99}{5} = \frac{500}{5} = 100 \quad x_B = \frac{95 + 100 + 105 + 90 + 110}{5} = \frac{500}{5} = 100$$

Step 2: Calculate standard deviations.

Machine A:

x	$x - x$	$(x - x)^2$
98	-2	4
100	0	0
102	2	4
101	1	1
99	-1	1

Sum of squared deviations = $4 + 0 + 4 + 1 + 1 = 10$

$$\sigma_A = \sqrt{\frac{10}{5}} = \sqrt{2} = 1.41$$

Machine B:

x	$x - \bar{x}$	$(x - \bar{x})^2$
95	-5	25
100	0	0
105	5	25
90	-10	100
110	10	100

Sum of squared deviations = $25 + 0 + 25 + 100 + 100 = 250$

$$\sigma_B = \sqrt{\frac{250}{5}} = \sqrt{50} = 7.07$$

Step 3: Compare.

- **Performance:** Both machines have the same mean output (100 units).
- **Consistency:** Machine A has smaller standard deviation ($1.41 < 7.07$), so it is more consistent.

Answer: (i) Both have equal performance.

(ii) **Machine A is more consistent.**

Question 9: Salespersons Comparison

Person A: 5.5, 5.7, 5.4, 5.6, 5.8, 5.6

Person B: 5.5, 6.5, 4.5, 6.0, 5.0, 6.0

Solution:

Step 1: Calculate means.

$$x_A = \frac{5.5 + 5.7 + 5.4 + 5.6 + 5.8 + 5.6}{6} = \frac{33.6}{6} = 5.6, x_B = \frac{5.5 + 6.5 + 4.5 + 6.0 + 5.0 + 6.0}{6} = \frac{33.5}{6} = 5.58$$

Step 2: Calculate standard deviations.

Person A:

x	$x - \bar{x}$	$(x - \bar{x})^2$
5.5	-0.1	0.01
5.7	0.1	0.01
5.4	-0.2	0.04
5.6	0	0
5.8	0.2	0.04
5.6	0	0

Sum of squared deviations = $0.01 + 0.01 + 0.04 + 0 + 0.04 + 0 = 0.10$

$$\sigma_A = \sqrt{\frac{0.10}{6}} = \sqrt{0.0167} = 0.129$$

Person B:

x	$x - \bar{x}$	$(x - \bar{x})^2$
5.5	-0.08	0.0064
6.5	0.92	0.8464
4.5	-1.08	1.1664
6.0	0.42	0.1764
5.0	-0.58	0.3364
6.0	0.42	0.1764

Sum of squared deviations = $0.0064 + 0.8464 + 1.1664 + 0.1764 + 0.3364 + 0.1764 = 2.7084$

$$\sigma_B = \sqrt{\frac{2.7084}{6}} = \sqrt{0.4514} = 0.672$$

Step 3: Compare.

- **Performance:** Person A has slightly higher mean (5.6 vs 5.58).
- **Consistency:** Person A has much smaller standard deviation ($0.129 < 0.672$).

Answer: Person A has better performance and is more consistent.

Question 10: Grouped Data - Daily Wages

Daily Wage (Rs)	800–1000	1000–1200	1200–1400	1400–1600	1600–1800	1800–2000
Frequency (f)	2	4	6	8	2	1

Solution:

Step 1: Find midpoints and calculate mean.

Class	Midpoint (x)	f	fx
800–1000	900	2	1800
1000–1200	1100	4	4400
1200–1400	1300	6	7800
1400–1600	1500	8	12000
1600–1800	1700	2	3400
1800–2000	1900	1	1900

Step 2: $n = 2 + 4 + 6 + 8 + 2 + 1 = 23$

$$\sum fx = 1800 + 4400 + 7800 + 12000 + 3400 + 1900 = 31300 \quad \bar{x} = \frac{31300}{23} = 1360.87$$

Step 3: Calculate variance.

x	f	$x - \bar{x}$	$(x - \bar{x})^2$	$f(x - \bar{x})^2$
900	2	-460.87	212,401	424,802
1100	4	-260.87	68,053	272,212

x	f	$x - \bar{x}$	$(x - \bar{x})^2$	$f(x - \bar{x})^2$
1300	6	-60.87	3,705	22,230
1500	8	139.13	19,357	154,856
1700	2	339.13	115,009	230,018
1900	1	539.13	290,661	290,661

$$\text{Sum} = 424,802 + 272,212 + 22,230 + 154,856 + 230,018 + 290,661 = 1,394,779$$

Step 4: Variance:

$$\sigma^2 = \frac{1,394,779}{23} = 60,642.57$$

Step 5: Standard Deviation:

$$\sigma = \sqrt{60,642.57} = 246.26$$

Answer: Mean = **Rs. 1360.87**, Variance = **60,642.57**, Standard Deviation = **Rs. 246.26**

Question 11: Variability in Sales Predictions

Data: 15, 18, 14, 20, 13

Solution:

Step 1: Find mean.

$$\bar{x} = \frac{15 + 18 + 14 + 20 + 13}{5} = \frac{80}{5} = 16$$

Step 2: Find deviations and squares.

x	$x - \bar{x}$	$(x - \bar{x})^2$
15	-1	1
18	2	4
14	-2	4
20	4	16
13	-3	9

$$\text{Sum of squared deviations} = 1 + 4 + 4 + 16 + 9 = 34$$

Step 3: Variance:

$$\sigma^2 = \frac{34}{5} = 6.8$$

Step 4: Standard Deviation:

$$\sigma = \sqrt{6.8} = 2.61$$

Answer: Variance = **6.8**, Standard Deviation = **2.61**

Question 12: Unemployment Rates

Data: 5.2, 6.0, 4.8, 5.5, 6.2

Solution:

Step 1: Find mean.

$$\bar{x} = \frac{5.2 + 6.0 + 4.8 + 5.5 + 6.2}{5} = \frac{27.7}{5} = 5.54$$

Step 2: Find deviations and squares.

x	$x - \bar{x}$	$(x - \bar{x})^2$
5.2	-0.34	0.1156
6.0	0.46	0.2116
4.8	-0.74	0.5476
5.5	-0.04	0.0016
6.2	0.66	0.4356

Sum of squared deviations = $0.1156 + 0.2116 + 0.5476 + 0.0016 + 0.4356 = 1.312$

Step 3: Variance:

$$\sigma^2 = \frac{1.312}{5} = 0.2624$$

Step 4: Standard Deviation:

$$\sigma = \sqrt{0.2624} = 0.512$$

Step 5: Interpretation.

- Mean unemployment rate = 5.54%
- Standard deviation = 0.512%
- This indicates relatively **low variability** in unemployment rates across provinces.

Answer: Variance = **0.2624**, Standard Deviation = **0.512**

Interpretation: Unemployment rates are consistent across provinces with low variability.

Summary Table

	Variance	Standard Deviation	Range	Mean
3	—	—	2500	—
4	3.55	1.88	6	53.14
5	50	7.07	20	130
6	176	13.27	44	23
7	67.45	8.21	29	55.5
8A	2	1.41	4	100
8B	50	7.07	20	100
9A	0.0167	0.129	0.4	5.6
9B	0.4514	0.672	2.0	5.58
10	60,642.57	246.26	1200	1360.87

	Variance	Standard Deviation	Range	Mean
11	6.8	2.61	7	16
12	0.2624	0.512	1.4	5.54

Key Formulas

Measure	Formula
Range	Max – Min
Mean (Ungrouped)	$\bar{x} = \frac{\sum x}{n}$
Mean (Grouped)	$\bar{x} = \frac{\sum fx}{\sum f}$
Variance (Population)	$\sigma^2 = \frac{\sum (x - \bar{x})^2}{n}$
Standard Deviation	$\sigma = \sqrt{\sigma^2}$
Variance (Grouped)	$\sigma^2 = \frac{\sum f(x - \bar{x})^2}{\sum f}$

EXERCISE 11.2 (Continued) - Variance and Standard Deviation Using Summary Statistics**Key Formulas**

For ungrouped data:

$$\text{Variance} = \sigma^2 = \frac{\sum x^2}{n} - \left(\frac{\sum x}{n} \right)^2$$

For grouped data:

$$\text{Variance} = \sigma^2 = \frac{\sum fx^2}{\sum f} - \left(\frac{\sum fx}{\sum f} \right)^2$$

Standard Deviation:

$$\sigma = \sqrt{\sigma^2}$$

Question 13(i)**Given:**

$$\sum x = 45, \sum x^2 = 421, n = 5$$

Solution:**Step 1:** Find the mean.

$$\bar{x} = \frac{\sum x}{n} = \frac{45}{5} = 9$$

Step 2: Find the variance using the formula:

$$\sigma^2 = \frac{\sum x^2}{n} - \left(\frac{\sum x}{n} \right)^2 = \frac{421}{5} - (9)^2 = 84.2 - 81 = 3.2$$

Step 3: Find the standard deviation.

$$\sigma = \sqrt{3.2} = 1.7889$$

Answer: Variance = **3.2**, Standard Deviation = **1.79**

Question 13(ii)

Given:

$$\sum fx = 210, \sum fx^2 = 7560, \sum f = 6$$

Solution:

Step 1: Find the mean.

$$x = \frac{\sum fx}{\sum f} = \frac{210}{6} = 35$$

Step 2: Find the variance using the formula:

$$\sigma^2 = \frac{\sum fx^2}{\sum f} - \left(\frac{\sum fx}{\sum f} \right)^2 \sigma^2 = \frac{7560}{6} - (35)^2 \sigma^2 = 1260 - 1225 \sigma^2 = 35$$

Step 3: Find the standard deviation.

$$\sigma = \sqrt{35} = 5.916$$

Answer: Variance = **35**, Standard Deviation = **5.92**

Question 13(iii)

Given:

$$x = 18, \sum fx^2 = 1670, \sum f = 5$$

Solution:

Step 1: Find the variance using the formula:

$$\sigma^2 = \frac{\sum fx^2}{\sum f} - (x)^2 \sigma^2 = \frac{1670}{5} - (18)^2 \sigma^2 = 334 - 324 \sigma^2 = 10$$

Step 2: Find the standard deviation.

$$\sigma = \sqrt{10} = 3.1623$$

Answer: Variance = **10**, Standard Deviation = **3.16**

Summary Table

	Given	Mean	Variance	Standard Deviation
13(i)	$\sum x = 45, \sum x^2 = 421, n = 5$	9	3.2	1.79

	Given	Mean	Variance	Standard Deviation
13(ii)	$\sum fx = 210, \sum fx^2 = 7560, \sum f = 6$	35	35	5.92
13(iii)	$x = 18, \sum fx^2 = 1670, \sum f = 5$	18	10	3.16

Key Formulas Summary

Measure	Formula
Mean (Ungrouped)	$\bar{x} = \frac{\sum x}{n}$
Mean (Grouped)	$\bar{x} = \frac{\sum fx}{\sum f}$
Variance (Ungrouped)	$\sigma^2 = \frac{\sum x^2}{n} - (\bar{x})^2$
Variance (Grouped)	$\sigma^2 = \frac{\sum fx^2}{\sum f} - (\bar{x})^2$
Standard Deviation	$\sigma = \sqrt{\sigma^2}$

Important Notes

1. Population Variance vs Sample Variance:

- Population variance divides by n
- Sample variance divides by $n - 1$

2. Alternative Variance Formula:

$$\sigma^2 = \frac{1}{n} \sum (x - \bar{x})^2$$

3. Standard Deviation Interpretation:

- Smaller standard deviation means data is more clustered around the mean
- Larger standard deviation means data is more spread out