T-test

2024-02-15

Test for equality of variance in R.

null hypothesis: population means are equal. alternative hypothesis:population means are unequal. F formula = Larger sample/smaller sample alfa = 0.05 F- critical Value=1.525

df <- read.csv("C:/Users/SCIENCE/Downloads/Advertising.csv")  
df

## X TV Radio Newspaper Sales  
## 1 1 230.1 37.8 69.2 22.1  
## 2 2 44.5 39.3 45.1 10.4  
## 3 3 17.2 45.9 69.3 9.3  
## 4 4 151.5 41.3 58.5 18.5  
## 5 5 180.8 10.8 58.4 12.9  
## 6 6 8.7 48.9 75.0 7.2  
## 7 7 57.5 32.8 23.5 11.8  
## 8 8 120.2 19.6 11.6 13.2  
## 9 9 8.6 2.1 1.0 4.8  
## 10 10 199.8 2.6 21.2 10.6  
## 11 11 66.1 5.8 24.2 8.6  
## 12 12 214.7 24.0 4.0 17.4  
## 13 13 23.8 35.1 65.9 9.2  
## 14 14 97.5 7.6 7.2 9.7  
## 15 15 204.1 32.9 46.0 19.0  
## 16 16 195.4 47.7 52.9 22.4  
## 17 17 67.8 36.6 114.0 12.5  
## 18 18 281.4 39.6 55.8 24.4  
## 19 19 69.2 20.5 18.3 11.3  
## 20 20 147.3 23.9 19.1 14.6  
## 21 21 218.4 27.7 53.4 18.0  
## 22 22 237.4 5.1 23.5 12.5  
## 23 23 13.2 15.9 49.6 5.6  
## 24 24 228.3 16.9 26.2 15.5  
## 25 25 62.3 12.6 18.3 9.7  
## 26 26 262.9 3.5 19.5 12.0  
## 27 27 142.9 29.3 12.6 15.0  
## 28 28 240.1 16.7 22.9 15.9  
## 29 29 248.8 27.1 22.9 18.9  
## 30 30 70.6 16.0 40.8 10.5  
## 31 31 292.9 28.3 43.2 21.4  
## 32 32 112.9 17.4 38.6 11.9  
## 33 33 97.2 1.5 30.0 9.6  
## 34 34 265.6 20.0 0.3 17.4  
## 35 35 95.7 1.4 7.4 9.5  
## 36 36 290.7 4.1 8.5 12.8  
## 37 37 266.9 43.8 5.0 25.4  
## 38 38 74.7 49.4 45.7 14.7  
## 39 39 43.1 26.7 35.1 10.1  
## 40 40 228.0 37.7 32.0 21.5  
## 41 41 202.5 22.3 31.6 16.6  
## 42 42 177.0 33.4 38.7 17.1  
## 43 43 293.6 27.7 1.8 20.7  
## 44 44 206.9 8.4 26.4 12.9  
## 45 45 25.1 25.7 43.3 8.5  
## 46 46 175.1 22.5 31.5 14.9  
## 47 47 89.7 9.9 35.7 10.6  
## 48 48 239.9 41.5 18.5 23.2  
## 49 49 227.2 15.8 49.9 14.8  
## 50 50 66.9 11.7 36.8 9.7  
## 51 51 199.8 3.1 34.6 11.4  
## 52 52 100.4 9.6 3.6 10.7  
## 53 53 216.4 41.7 39.6 22.6  
## 54 54 182.6 46.2 58.7 21.2  
## 55 55 262.7 28.8 15.9 20.2  
## 56 56 198.9 49.4 60.0 23.7  
## 57 57 7.3 28.1 41.4 5.5  
## 58 58 136.2 19.2 16.6 13.2  
## 59 59 210.8 49.6 37.7 23.8  
## 60 60 210.7 29.5 9.3 18.4  
## 61 61 53.5 2.0 21.4 8.1  
## 62 62 261.3 42.7 54.7 24.2  
## 63 63 239.3 15.5 27.3 15.7  
## 64 64 102.7 29.6 8.4 14.0  
## 65 65 131.1 42.8 28.9 18.0  
## 66 66 69.0 9.3 0.9 9.3  
## 67 67 31.5 24.6 2.2 9.5  
## 68 68 139.3 14.5 10.2 13.4  
## 69 69 237.4 27.5 11.0 18.9  
## 70 70 216.8 43.9 27.2 22.3  
## 71 71 199.1 30.6 38.7 18.3  
## 72 72 109.8 14.3 31.7 12.4  
## 73 73 26.8 33.0 19.3 8.8  
## 74 74 129.4 5.7 31.3 11.0  
## 75 75 213.4 24.6 13.1 17.0  
## 76 76 16.9 43.7 89.4 8.7  
## 77 77 27.5 1.6 20.7 6.9  
## 78 78 120.5 28.5 14.2 14.2  
## 79 79 5.4 29.9 9.4 5.3  
## 80 80 116.0 7.7 23.1 11.0  
## 81 81 76.4 26.7 22.3 11.8  
## 82 82 239.8 4.1 36.9 12.3  
## 83 83 75.3 20.3 32.5 11.3  
## 84 84 68.4 44.5 35.6 13.6  
## 85 85 213.5 43.0 33.8 21.7  
## 86 86 193.2 18.4 65.7 15.2  
## 87 87 76.3 27.5 16.0 12.0  
## 88 88 110.7 40.6 63.2 16.0  
## 89 89 88.3 25.5 73.4 12.9  
## 90 90 109.8 47.8 51.4 16.7  
## 91 91 134.3 4.9 9.3 11.2  
## 92 92 28.6 1.5 33.0 7.3  
## 93 93 217.7 33.5 59.0 19.4  
## 94 94 250.9 36.5 72.3 22.2  
## 95 95 107.4 14.0 10.9 11.5  
## 96 96 163.3 31.6 52.9 16.9  
## 97 97 197.6 3.5 5.9 11.7  
## 98 98 184.9 21.0 22.0 15.5  
## 99 99 289.7 42.3 51.2 25.4  
## 100 100 135.2 41.7 45.9 17.2  
## 101 101 222.4 4.3 49.8 11.7  
## 102 102 296.4 36.3 100.9 23.8  
## 103 103 280.2 10.1 21.4 14.8  
## 104 104 187.9 17.2 17.9 14.7  
## 105 105 238.2 34.3 5.3 20.7  
## 106 106 137.9 46.4 59.0 19.2  
## 107 107 25.0 11.0 29.7 7.2  
## 108 108 90.4 0.3 23.2 8.7  
## 109 109 13.1 0.4 25.6 5.3  
## 110 110 255.4 26.9 5.5 19.8  
## 111 111 225.8 8.2 56.5 13.4  
## 112 112 241.7 38.0 23.2 21.8  
## 113 113 175.7 15.4 2.4 14.1  
## 114 114 209.6 20.6 10.7 15.9  
## 115 115 78.2 46.8 34.5 14.6  
## 116 116 75.1 35.0 52.7 12.6  
## 117 117 139.2 14.3 25.6 12.2  
## 118 118 76.4 0.8 14.8 9.4  
## 119 119 125.7 36.9 79.2 15.9  
## 120 120 19.4 16.0 22.3 6.6  
## 121 121 141.3 26.8 46.2 15.5  
## 122 122 18.8 21.7 50.4 7.0  
## 123 123 224.0 2.4 15.6 11.6  
## 124 124 123.1 34.6 12.4 15.2  
## 125 125 229.5 32.3 74.2 19.7  
## 126 126 87.2 11.8 25.9 10.6  
## 127 127 7.8 38.9 50.6 6.6  
## 128 128 80.2 0.0 9.2 8.8  
## 129 129 220.3 49.0 3.2 24.7  
## 130 130 59.6 12.0 43.1 9.7  
## 131 131 0.7 39.6 8.7 1.6  
## 132 132 265.2 2.9 43.0 12.7  
## 133 133 8.4 27.2 2.1 5.7  
## 134 134 219.8 33.5 45.1 19.6  
## 135 135 36.9 38.6 65.6 10.8  
## 136 136 48.3 47.0 8.5 11.6  
## 137 137 25.6 39.0 9.3 9.5  
## 138 138 273.7 28.9 59.7 20.8  
## 139 139 43.0 25.9 20.5 9.6  
## 140 140 184.9 43.9 1.7 20.7  
## 141 141 73.4 17.0 12.9 10.9  
## 142 142 193.7 35.4 75.6 19.2  
## 143 143 220.5 33.2 37.9 20.1  
## 144 144 104.6 5.7 34.4 10.4  
## 145 145 96.2 14.8 38.9 11.4  
## 146 146 140.3 1.9 9.0 10.3  
## 147 147 240.1 7.3 8.7 13.2  
## 148 148 243.2 49.0 44.3 25.4  
## 149 149 38.0 40.3 11.9 10.9  
## 150 150 44.7 25.8 20.6 10.1  
## 151 151 280.7 13.9 37.0 16.1  
## 152 152 121.0 8.4 48.7 11.6  
## 153 153 197.6 23.3 14.2 16.6  
## 154 154 171.3 39.7 37.7 19.0  
## 155 155 187.8 21.1 9.5 15.6  
## 156 156 4.1 11.6 5.7 3.2  
## 157 157 93.9 43.5 50.5 15.3  
## 158 158 149.8 1.3 24.3 10.1  
## 159 159 11.7 36.9 45.2 7.3  
## 160 160 131.7 18.4 34.6 12.9  
## 161 161 172.5 18.1 30.7 14.4  
## 162 162 85.7 35.8 49.3 13.3  
## 163 163 188.4 18.1 25.6 14.9  
## 164 164 163.5 36.8 7.4 18.0  
## 165 165 117.2 14.7 5.4 11.9  
## 166 166 234.5 3.4 84.8 11.9  
## 167 167 17.9 37.6 21.6 8.0  
## 168 168 206.8 5.2 19.4 12.2  
## 169 169 215.4 23.6 57.6 17.1  
## 170 170 284.3 10.6 6.4 15.0  
## 171 171 50.0 11.6 18.4 8.4  
## 172 172 164.5 20.9 47.4 14.5  
## 173 173 19.6 20.1 17.0 7.6  
## 174 174 168.4 7.1 12.8 11.7  
## 175 175 222.4 3.4 13.1 11.5  
## 176 176 276.9 48.9 41.8 27.0  
## 177 177 248.4 30.2 20.3 20.2  
## 178 178 170.2 7.8 35.2 11.7  
## 179 179 276.7 2.3 23.7 11.8  
## 180 180 165.6 10.0 17.6 12.6  
## 181 181 156.6 2.6 8.3 10.5  
## 182 182 218.5 5.4 27.4 12.2  
## 183 183 56.2 5.7 29.7 8.7  
## 184 184 287.6 43.0 71.8 26.2  
## 185 185 253.8 21.3 30.0 17.6  
## 186 186 205.0 45.1 19.6 22.6  
## 187 187 139.5 2.1 26.6 10.3  
## 188 188 191.1 28.7 18.2 17.3  
## 189 189 286.0 13.9 3.7 15.9  
## 190 190 18.7 12.1 23.4 6.7  
## 191 191 39.5 41.1 5.8 10.8  
## 192 192 75.5 10.8 6.0 9.9  
## 193 193 17.2 4.1 31.6 5.9  
## 194 194 166.8 42.0 3.6 19.6  
## 195 195 149.7 35.6 6.0 17.3  
## 196 196 38.2 3.7 13.8 7.6  
## 197 197 94.2 4.9 8.1 9.7  
## 198 198 177.0 9.3 6.4 12.8  
## 199 199 283.6 42.0 66.2 25.5  
## 200 200 232.1 8.6 8.7 13.4

F\_statistics <- var(df$Newspaper / df$Radio, na.rm=T)  
print(F\_statistics)

## [1] NaN

var.test(df$Newspaper,df$Radio)

##   
## F test to compare two variances  
##   
## data: df$Newspaper and df$Radio  
## F = 2.1518, num df = 199, denom df = 199, p-value = 9.593e-08  
## alternative hypothesis: true ratio of variances is not equal to 1  
## 95 percent confidence interval:  
## 1.628426 2.843289  
## sample estimates:  
## ratio of variances   
## 2.151763

Since F > 1.525 and p > .05 we reject the H0.