Example 1

In a study conducted by the Department of Mechanical Engineering at Virginia Tech, the steel rods supplied by two diﬀerent companies were compared. Ten sample springs were made out of the steel rods supplied by each company, and a measure of ﬂexibility was recorded for each. The data are as follows:

|  |  |
| --- | --- |
| Company A | Company B |
| 9.3 | 11 |
| 8.8 | 9.8 |
| 6.8 | 9.9 |
| 8.7 | 10.2 |
| 8.5 | 10.1 |
| 6.7 | 9.7 |
| 8 | 11 |
| 6.5 | 11.1 |
| 9.2 | 10.2 |
| 7 | 9.6 |

Example 2

A dynamic cone penetrometer (DCP) is used for measuring material resistance to penetration (mm/blow) as a cone is driven into pavement or sub grade. Suppose that for a particular application, it is required that the true average DCP value (µ) for a certain type of pavement **be less than 30**. The pavement will not be used unless there is conclusive evidence that the specification has been met. Let’s state and test the appropriate hypotheses using the following data (“Probabilistic Model for the Analysis of Dynamic Cone Penetrometer Test Values in Pavement Structure Evaluation,” J. of Testing and Evaluation, 1999: 7–14):

14.1 14.5 15.5 16.0 16.0 16.7 16.9 17.1 17.5 17.8

17.8 18.1 18.2 18.3 18.3 19.0 19.2 19.4 20.0 20.0

20.8 20.8 21.0 21.5 23.5 27.5 27.5 28.0 28.3 30.0

30.0 31.6 31.7 31.7 32.5 33.5 33.9 35.0 35.0 35.0

36.7 40.0 40.0 41.3 41.7 47.5 50.0 51.0 51.8 54.4

55.0 57.0

Example 3

Suppose that an engineer is interested in testing the bias in a pH meter. Data are collected on a neutral substance (pH= 7.0). A sample of the measurements were taken with the data as follows:

7.07 7.00 7.10 6.97 7.00 7.03 7.01 7.01 6.98 7.08

It is, then, of interest to test $H\_{0}:μ=7$ vs $H\_{1}: μ\ne 7$

Example 4

The following data represent the running times of ﬁlms produced by two motion-picture companies.

|  |  |
| --- | --- |
| **Company** | **Time (minutes)** |
| **I** | 103 | 94 | 110 | 87 | 98 |  |  |
| **II** | 97 | 82 | 123 | 92 | 175 | 88 | 118 |

Compute a 90% conﬁdence interval for the diﬀerence between the average running times of ﬁlms produced by the two companies. Assume that the running-time differences are approximately normally distributed with **unequal variances**.

Example 5

To find out whether a new serum will arrest leukemia, 9 mice, all with an advanced stage of the disease, are selected. Five mice receive the treatment and 4 do not. Survival times, in years, from the time the experiment commenced are as follows:

Treatment 2.1 5.3 1.4 4.6 0.9

No Treatment 1.9 0.5 2.8 3.1

At the 0.05 level of significance, can the serum be said to be effective? Assume the two populations to be normally distributed with equal variances. Test $H\_{0}:μ\_{1}=μ\_{2}$ vs $H\_{1}: μ\_{1}\ne μ\_{2}$

Example 6:

A clinic provides a program to help their clients lose weight and asks a consumer agency to investigate the effectiveness of the program. The agency takes a sample of 15 people, weighing each person in the sample before the program begins and 3 months later to produce the table below

|  |  |  |
| --- | --- | --- |
| Person | Before | After |
| 1 | 210 | 197 |
| 2 | 205 | 195 |
| 3 | 193 | 191 |
| 4 | 182 | 174 |
| 5 | 259 | 236 |
| 6 | 239 | 226 |
| 7 | 164 | 157 |
| 8 | 197 | 196 |
| 9 | 222 | 201 |
| 10 | 211 | 196 |
| 11 | 187 | 181 |
| 12 | 175 | 164 |
| 13 | 186 | 181 |
| 14 | 243 | 229 |
| 15 | 246 | 231 |

Determine whether the program is effective?

Example 7

A flotoxins produced by mold on peanut crops in Virginia must be monitored. A sample of **64 batches** of peanuts reveals levels of 24.17 ppm, on average, **with a variance of 4.25** ppm. Test the hypothesis that $σ^{2}=4.2$ ppm against the alternative that $σ^{2}\ne 4.2$ ppm.

Example 8

Hydrocarbon emissions from cars are known to have decreased dramatically during the 1980s. A study was conducted to compare the hydrocarbon emissions at idling speed, in parts per million (ppm), for automobiles from 1980 and 1990. Twenty cars of each model year were randomly selected, and their hydrocarbon emission levels were recorded. The data are as follows:

1980 models:

141 359 247 940 882 494 306 210 105 880

200 223 188 940 241 190 300 435 241 380

1990 models:

140 160 20 20 223 60 20 95 360 70

220 400 217 58 235 380 200 175 85 65

Assume both populations are normal.

1- Test the hypothesis that $σ\_{1}=275$ against the alternative that $σ\_{1}\ne 275$.

2- Test the hypothesis that $σ\_{1}=σ\_{2}$ against the alternative that $σ\_{1}\ne σ\_{2}$.