To construct the 99% confidence intervals for the mean durability of print-heads:

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one using the sample standard deviation and the other using the known population standard deviation.

1. **99% Confidence Interval Using Sample Standard Deviation**

Step1 - Calculate the Sample Mean and Standard Deviation

First, we need to calculate the sample mean (𝑥ˉxˉ) and the sample standard deviation (s) from the given data: Durability data (in millions of characters):1.13, 1.55, 1.43, 0.92, 1.25, 1.36, 1.32, 0.85, 1.07, 1.48, 1.20, 1.33, 1.18, 1.22, 1.29

* Sample Size (n): 15
* Sample Mean (𝑥ˉxˉ):

𝑥ˉ=∑𝑥𝑖𝑛=1.13+1.55+1.43+0.92+1.25+1.36+1.32+0.85+1.07+1.48+1.20+1.33+1.18+1.22+1.2915=19.1415≈1.276xˉ=n∑xi=151.13+1.55+1.43+0.92+1.25+1.36+1.32+0.85+1.07+1.48+1.20+1.33+1.18+1.22+1.29=1519.14≈1.276

* *Sample Standard Deviation (s):*

𝑠=∑(𝑥𝑖−𝑥ˉ)2𝑛−1≈(0.854−1.276)2+...+(1.29−1.276)214≈0.0964≈0.310s=n−1∑(xi−xˉ)2≈14(0.854−1.276)2+...+(1.29−1.276)2≈0.0964≈0.310

*Step 2: Determine the t-Score*

Since the sample size is small (n < 30), we use the t-distribution for our confidence interval calculation:

* Degrees of Freedom (df): 𝑛−1=14n−1=14
* t-Score for a two-tailed test at a confidence level of 99%: From t-distribution tables or calculators, 𝑡0.005,14≈2.977t0.005,14≈2.977.

*Step 3: Calculate the Standard Error*

The standard error is calculated as 𝑆𝐸=𝑠𝑛=0.31015≈0.3103.873≈0.080SE=ns=150.310≈3.8730.310≈0.080

*Step 4: Calculate Margin of Erro*r

The margin of error is given by:𝑀𝐸=𝑡0.005×𝑆𝐸=2.977×0.080≈0.238ME=t0.005×SE=2.977×0.080≈0.238

Step 5: Construct the Confidence Interval

Finally, we construct the confidence interval:

𝐶𝐼=(𝑥ˉ−𝑀𝐸,𝑥ˉ+𝑀𝐸)=(1.276−0.238,1.276+0.238)=(1.038,1.514)CI=(xˉ−ME,xˉ+ME)=(1.276−0.238,1.276+0.238)=(1.038,1.514)

***Thus, the 99% confidence interval using sample standard deviation is approximately (1.038 million characters, 1.514 million characters).***

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**B. 99% Confidence Interval Using Known Population Standard Deviation**

*Step 1: Given Population Standard Deviation*

Assuming we know that the population standard deviation (𝜎*σ*) is **0.2 million characters**.

*Step 2: Calculate Standard Error (SE)*

Using the known population standard deviation:

𝑆𝐸=𝜎𝑛=0.215≈0.23.873≈0.052*SE*=*n*​*σ*​=15​0.2​≈3.8730.2​≈0.052

*Step 3: Calculate Margin of Error (ME)*

Using the z-score for a two-tailed test at a confidence level of **99%**:

* **z-Score for a two-tailed test at a confidence level of 9999**: 𝑧0.005=2.576*z*0.005​=2.576.

The margin of error is:

𝑀𝐸=𝑧0.005×𝑆𝐸=2.576×0.052≈0.134*ME*=*z*0.005​×*SE*=2.576×0.052≈0.134

*Step 4: Construct the Confidence Interval*

Constructing the confidence interval:

𝐶𝐼=(𝑥ˉ−𝑀𝐸,𝑥ˉ+𝑀𝐸)=(1.276−0.134,1.276+0.134)=(1.142,1.410)*CI*=(*x*ˉ−*ME*,*x*ˉ+*ME*)=(1.276−0.134,1.276+0.134)=(1.142,1.410)

Thus, the 99% confidence interval using known population standard deviation is approximately (1.142 million characters, 1.410 million characters).In summary:

* Using sample standard deviation: (1.038 million characters, 1.514 million characters)
* Using known population standard deviation: (1.142 million characters, 1.410 million characters)