# #K-S TEST

Ques:- Following data set gives six tensile strength values obtained from samples drawn from same populations.

| | | | | | |
|---|---|---|---|---|---|
| 338.7 | 308.5 | 317.7 | 313.1 | 322.7 | 294.2 |

Can it be assumed that Data is from the Normal distribution?

Solution:->

1. We will define the hypothesis

$H_0$: Data is from the Normal distribution

$H_1$: Data is not from the Normal distribution.

2. Arrange the Data is ascending order

294.2, 308.5, 313.1, 317.7, 322.7, 338.7

3. Calculate $\mu$ and $\sigma$ of the Data.

We will $\sigma$ and $\mu$ using scientific calculator

$\mu = 315.82$ $\sigma = 14.85$

4. Now we will calculate Z-score of each data point.

$$Z_i = \frac{x_i - \mu}{\sigma}$$

($\mu$ ← mean, $\sigma$ ← standard deviation)

$$Z_{294.2} = \frac{294.2 - 315.82}{14.85} = -1.456$$

5 Now, we calculate theoretical probability at each using, it can be using the help of calculator.

For my scientific calculator - fx-991ES PLUS

Calculator command: STAT → Distr → P ( ← enter Z-score and get theoretical probability at the point)

$F_0(294.2) = \Phi\left[\frac{294.2 - 315.02}{14.85}\right]_2 \quad \Phi\left[-1.456\right] = 0.0727$

6 Calculate Empirical probability at each point ($f_n$)

$$f_n = \frac{\text{Number of point} \leq n}{\text{Total data points}}$$

$f_n(294.2) = 1/6$

7 Calculate $f_{n-1}$

$$f_{n-1} = \frac{\text{Number of points} < n}{\text{Total data points}}$$

8 Calculation of $D+$ and $D-$ and then maximum of $D+$ and $D-$

$D+ = |f_n - f_0| \quad D- = |f_0 - f_{n-1}|$

| n | Data | Z-score | $f_0$ | $f_n$ | $f_{n-1}$ | $D+$ | $D-$ |
|---|---|---|---|---|---|---|---|
| 1 | 294.2 | -1.456 | 0.0727 | 0.1667 | 0.0000 | 0.0940 | 0.0727 |
| 2 | 308.5 | -0.493 | 0.3110 | 0.3333 | 0.1667 | 0.0223 | 0.1443 |
| 3 | 313.1 | -0.183 | 0.4274 | 0.5000 | 0.3333 | 0.0726 | 0.0941 |
| 4 | 317.7 | 0.127 | 0.5505 | 0.6667 | 0.5000 | 0.1162 | 0.0505 |
| 5 | 322.7 | 0.463 | 0.6783 | 0.8333 | 0.6667 | 0.1550 | 0.0116 |
| 6 | 330.7 | 1.541 | 0.9383 | 1.0000 | 0.8333 | 0.0617 | 0.1050 |

$D(n) = \max(D+, D-) = 0.1550$

Now, we will check critical value using RMMR Table and make the decision.

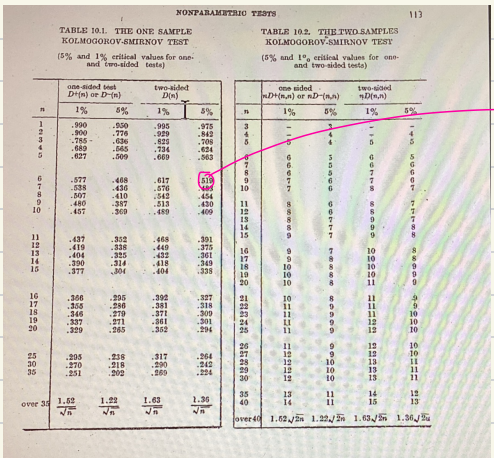

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TABLE 10.1. THE ONE SAMPLE KOLMOGOROV-SMIRNOV TEST

(5% and 1% critical values for one- and two-sided tests)

| n | one-sided test $D^+(n)$ or $D^-(n)$ 1% | one-sided test $D^+(n)$ or $D^-(n)$ 5% | two-sided $D(n)$ 1% | two-sided $D(n)$ 5% |
|---|---|---|---|---|
| 1 | .990 | .950 | .995 | .975 |
| 2 | .900 | .776 | .929 | .842 |
| 3 | .785 | .636 | .829 | .708 |
| 4 | .689 | .565 | .734 | .624 |
| 5 | .627 | .509 | .669 | .563 |
| 6 | .577 | .468 | .617 | .519 |
| 7 | .538 | .436 | .576 | .483 |
| 8 | .507 | .410 | .542 | .454 |
| 9 | .480 | .387 | .513 | .430 |
| 10 | .457 | .369 | .489 | .409 |
| 11 | .437 | .352 | .468 | .391 |
| 12 | .419 | .338 | .449 | .375 |
| 13 | .404 | .325 | .432 | .361 |
| 14 | .390 | .314 | .418 | .349 |
| 15 | .377 | .304 | .404 | .338 |
| 16 | .366 | .295 | .392 | .327 |
| 17 | .355 | .286 | .381 | .318 |
| 18 | .346 | .279 | .371 | .309 |
| 19 | .337 | .271 | .361 | .301 |
| 20 | .329 | .265 | .352 | .294 |
| 25 | .295 | .238 | .317 | .264 |
| 30 | .270 | .218 | .290 | .242 |
| 35 | .251 | .202 | .269 | .224 |
| over 35 | $\frac{1.52}{\sqrt{n}}$ | $\frac{1.22}{\sqrt{n}}$ | $\frac{1.63}{\sqrt{n}}$ | $\frac{1.36}{\sqrt{n}}$ |

TABLE 10.2. THE TWO SAMPLES KOLMOGOROV-SMIRNOV TEST

(5% and 1% critical values for one- and two-sided tests)

| n | one sided $nD^+(n,n)$ or $nD^-(n,n)$ 1% | one sided $nD^+(n,n)$ or $nD^-(n,n)$ 5% | two-sided $nD(n,n)$ 1% | two-sided $nD(n,n)$ 5% |
|---|---|---|---|---|
| 3 | – | – | – | – |
| 4 | – | 4 | – | 4 |
| 5 | 5 | 4 | 5 | 5 |
| 6 | 6 | 5 | 6 | 5 |
| 7 | 6 | 5 | 6 | 6 |
| 8 | 6 | 5 | 7 | 6 |
| 9 | 7 | 6 | 7 | 6 |
| 10 | 7 | 6 | 8 | 7 |
| 11 | 8 | 6 | 8 | 7 |
| 12 | 8 | 6 | 8 | 7 |
| 13 | 8 | 7 | 9 | 7 |
| 14 | 8 | 7 | 9 | 8 |
| 15 | 9 | 7 | 9 | 8 |
| 16 | 9 | 7 | 10 | 8 |
| 17 | 9 | 8 | 10 | 8 |
| 18 | 10 | 8 | 10 | 9 |
| 19 | 10 | 8 | 10 | 9 |
| 20 | 10 | 8 | 11 | 9 |
| 21 | 10 | 8 | 11 | 9 |
| 22 | 11 | 9 | 11 | 9 |
| 23 | 11 | 9 | 11 | 10 |
| 24 | 11 | 9 | 12 | 10 |
| 25 | 11 | 9 | 12 | 10 |
| 26 | 11 | 9 | 12 | 10 |
| 27 | 12 | 9 | 12 | 10 |
| 28 | 12 | 10 | 13 | 11 |
| 29 | 12 | 10 | 13 | 11 |
| 30 | 12 | 10 | 13 | 11 |
| 35 | 13 | 11 | 14 | 12 |
| 40 | 14 | 11 | 15 | 13 |
| over 40 | $1.62\sqrt{2n}$ | $1.22\sqrt{2n}$ | $1.63\sqrt{2n}$ | $1.36\sqrt{2n}$ |

Critical value = 0.519

D calculated is less than critical value :-

FAIL TO REJECT THE NULL HYPOTHESIS.