|  |  |
| --- | --- |
| **Runs Test**: Tests for too many or too few runs (i.e., sequences of consecutive heads or tails). | A runs test, also known as the Wald–Wolfowitz runs test, was developed by mathematicians Abraham Wald and Jacob Wolfowitz. A runs test is a statistical analysis that helps determine the randomness of data by revealing any variables that might affect data patterns.  Is used to determine if a sequence of values is random or if there are any trends. Specifically, it checks for the presence of "runs" in the data, where a run is a sequence of similar elements (e.g., all improvements or all non-improvements). |
| Assumptions   1. Run is a sequence of identical elements, preceded and followed by different element or no element 2. H0: The sequence is random 3. H1: The sequence is not random | 1. Convert the Data: Transform the original data into a binary sequence. For example, if checking for improvement, code each element as 1 for improvement and 0 for no improvement or worsening.  2.Count Runs: Determine the number of runs (R) in the binary sequence.  **Example # runs:** for sequence 1,0,1,1,0,0,1,0  {1},{0},{1,1},{0,0},{1},{0} isti se brojat kako 1 run  3. Calculate Expected Number of Runs: Under the null hypothesis, the expected number of runs E(R) and its variance σR^2 are given by:  e.g. R=30 n1=25, n2=25  E(R)=2n1\*n2/(n1+n2)+1 =5 VarR=32\*24/8\*14 768/448=1.714  VarR=σR^2=(2n1\*n2)(2n1\*n2-n1-n2)/(n1+n2)^2\*(n1+n2-1)  Where n1 is the number of 1s (improvements) and n2 is the number of 0s (non-improvements or worsening) in the sequence.  4. Calculate Z-Score: The Z-score for the number of runs is calculated as:  z=(R-E(R))/ σR = (6-5)/sqrt(1.714)=0.76  This Z-score follows a standard normal distribution under the null hypothesis.  Determine P-Value: The p-value is obtained by comparing the calculated Z-score to the standard normal distribution. For a two-tailed test, the p-value is: |