How to Calculate the Kuder-Richardson Formula 20 (KR-20) for Test Reliability

Authored by

stats writer

December 1, 2025

Kuder-Richardson Formula 20 is a formula used to measure the internal consistency of a test or assessment. It is a statistical measure that estimates the reliability of a test by calculating the correlation between the items on the test. The Kuder-Richardson Formula 20 is most often used in educational and psychological testing to assess the accuracy of test results.

The **Kuder-Richardson Formula 20**, often abbreviated KR-20, is used to measure the reliability of a test in which each question only has two answers: right or wrong.

The Kuder-Richardson Formula 20 is as follows:

KR-20 = (k / (k-1)) * (1 - Σpjqj / σ2)

where:

k: Total number of questions
pj: Proportion of individuals who answered question j correctly
qj: Proportion of individuals who answered question j incorrectly
σ**2**: Variance of scores for all individuals who took the test

The value for KR-20 ranges from 0 to 1, with higher values indicating higher reliability.

The following example shows how to calculate the value for KR-20 in practice.

Example: Calculating Kuder-Richardson Formula 20

Suppose we administer a test with 7 questions to 10 students.

The results of the test are listed below in Excel, with 1 indicating a correct answer and 0 indicating an incorrect answer:

	A	B	C	D	E	F	G	H	I	J
1	**Student**	**Q1**	**Q2**	**Q3**	**Q4**	**Q5**	**Q6**	**Q7**	**Total Correct**	
2	**1**	0	1	1	0	1	1	1	5	
3	**2**	1	1	1	1	0	0	0	4	
4	**3**	1	1	1	1	0	1	1	6	
5	**4**	1	1	0	0	1	1	0	4	
6	**5**	0	1	1	1	1	0	1	5	
7	**6**	1	0	1	0	1	1	0	4	
8	**7**	1	1	0	0	0	0	0	2	
9	**8**	1	1	0	1	0	1	0	4	
10	**9**	0	0	1	1	0	0	0	2	
11	**10**	1	1	1	0	1	0	1	5	
12										
13										
14										
15										
16										
17										
18										
19										

The following screenshot shows how to calculate the KR-20 value for this test:

	A	B	C	D	E	F	G	H	I
1	**Student**	**Q1**	**Q2**	**Q3**	**Q4**	**Q5**	**Q6**	**Q7**	**Total Correct**
2	**1**	0	1	1	0	1	1	1	5
3	**2**	1	1	1	1	0	0	0	4
4	**3**	1	1	1	1	0	1	1	6
5	**4**	1	1	0	0	1	1	0	4
6	**5**	0	1	1	1	1	0	1	5
7	**6**	1	0	1	0	1	1	0	4
8	**7**	1	1	0	0	0	0	0	2
9	**8**	1	1	0	1	0	1	0	4
10	**9**	0	0	1	1	0	0	0	2
11	**10**	1	1	1	0	1	0	1	5
12									
13	**p**	0.7	0.8	0.7	0.5	0.5	0.5	0.4	
14	**q**	0.3	0.2	0.3	0.5	0.5	0.5	0.6	
15	**pq**	0.21	0.16	0.21	0.25	0.25	0.25	0.24	
16									
17	**k**	7.0000							
18	**Σpq**	1.5700							
19	**σ^2**	1.6556							
20	**KR-20**	0.0603							
21									
22									
23									

Here are the formulas used in various cells:

B13: =SUM(B2:B11) / 10
B14: =1-B13
B15: =B13*B14
B17: =COUNTA(B1:H1)
B18: =SUM(B15:H15)
B19: =VAR.S(I2:I11)
B20: =(B17/(B17-1))*(1-B18/B19)

The KR-20 value turns out to be **0.0603**.

Since this value is extremely low, this indicates that the test has low reliability.

The following tutorials provide explanations of terms commonly used when assessing the validity of tests and questionnaires: