Binomial — raw table data: the event rate pooled from a worksheet of batches

Menu: Discrete ▸ Binomial ▸ Raw table data (worksheet)…

Part 1 — What the function does

What it calculates. The binomial question of chapter 2.D1 - will a run of n trials see no more than C events? - with the event rate pooled from a worksheet: one row per batch, its tests and the events found in it. ReliaEn adds the rows into N tests and s events, estimates $\hat{p} = s / N$ exactly as chapter 2.D2 does, and calculates the reliability $R = P(X \le C)$ for the planned run, two rates at which the planned run would exceed C, a plot and a table of service intervals.

What ReliaEn prints	What it tells you
N, **s** and **$\hat{p}$ = s / N**	The pooled tests, events and event rate of the worksheet
Reliability R = P(X ≤ C)	The chance that n trials see at most C events, at $\hat{p}$
f at high α and **f at low α**	The rates at which the planned run would exceed C, at two confidence levels
Reliability plot and **service intervals**	R against the number of trials; how many further cycles keep a target

From which data. Two worksheet columns, one row per batch: the tests in it and the events found in it. The allowed events C, the trials n and the three α values are typed in the form.

When an engineer uses it. When the records come batch by batch - a lot, a shift, a production week - and the question is whether the next run will stay within its allowance.

When not to use it.

Situation	Use instead
The records are already one total: N tests and s events	Discrete ▸ Binomial ▸ Raw aggregate data (s / N)…
The event rate is known from a supplier or a standard	Discrete ▸ Binomial ▸ Known parameters…

Part 2 — The example's input data

Setting. A connector line records three batches of insertion tests: 2,000 tests with 50 failures, then two of 3,000 tests with 75 failures each. A customer run of 100 insertions allows at most 2 failures. The reliability engineer wants the chance that a run passes, with the two rates read as a 95% pair (97.5% and 2.5%).

Input	Value
Tests per batch (column A) / events per batch (column B)	2,000 / 50 · 3,000 / 75 · 3,000 / 75
File in the worked-example zip	2-Binomial-Raw-Table-Data/Example-1.csv — columns Tests and Events, 3 rows
C — allowed events / n — trials	2 / 100 — typed in the form
High α % / Low α % / Table α %	97.5 / 2.5 / 95 — the first two typed, the third as the form opens

	① A	② B	C
1	2,000	50	
2	3,000	75	
3	3,000	75	
4			

The example data in the worksheet

- ① Column A: the tests in each batch.
- ② Column B: the events found in each batch.

Part 3 — How to use it, step by step

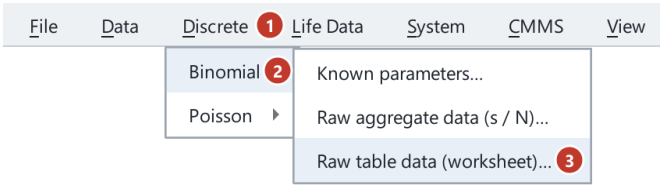
1. **Put the tests in column A and the events in column B.** Copy the 3 rows of Example-1.csv that stand under its headings Tests and Events into columns A and B of the worksheet, starting at row 1.

	① A	② B	C
1	2,000	50	
2	3,000	75	
3	3,000	75	
4			

Step 1 — the batches in columns A and B

- ① Column A: 2,000, 3,000, 3,000 tests.
- ② Column B: 50, 75, 75 events.

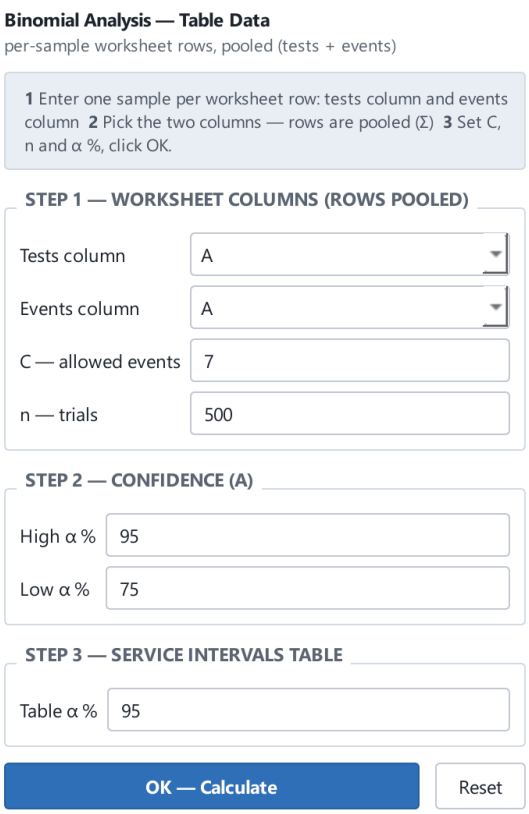
2. **Choose Discrete ▸ Binomial ▸ Raw table data (worksheet)...** in the menu bar. The form Binomial Analysis — Table Data opens in the left panel.



Step 2 — the menu path

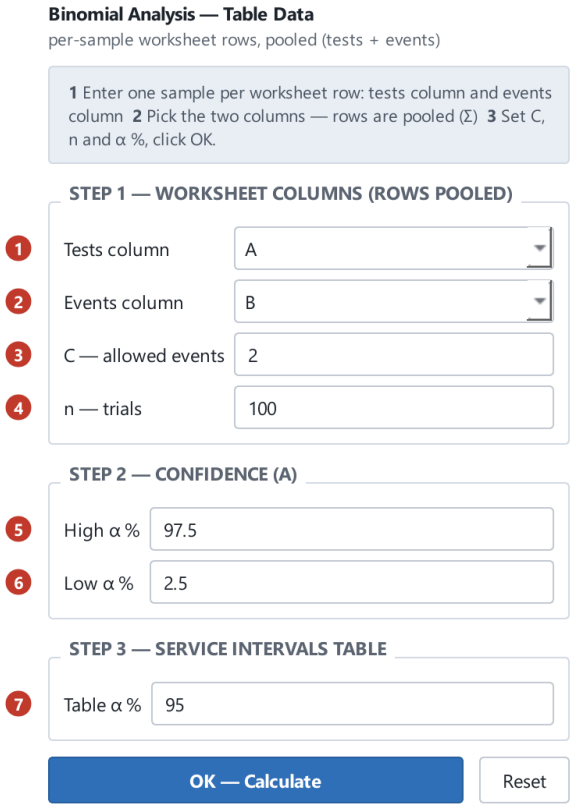
- ① Discrete: the menu.
- ② Binomial: the submenu.
- ③ Raw table data (worksheet)...: the entry to click.

The form as it opens, before any box is set:



Step 2 — the form as it opens

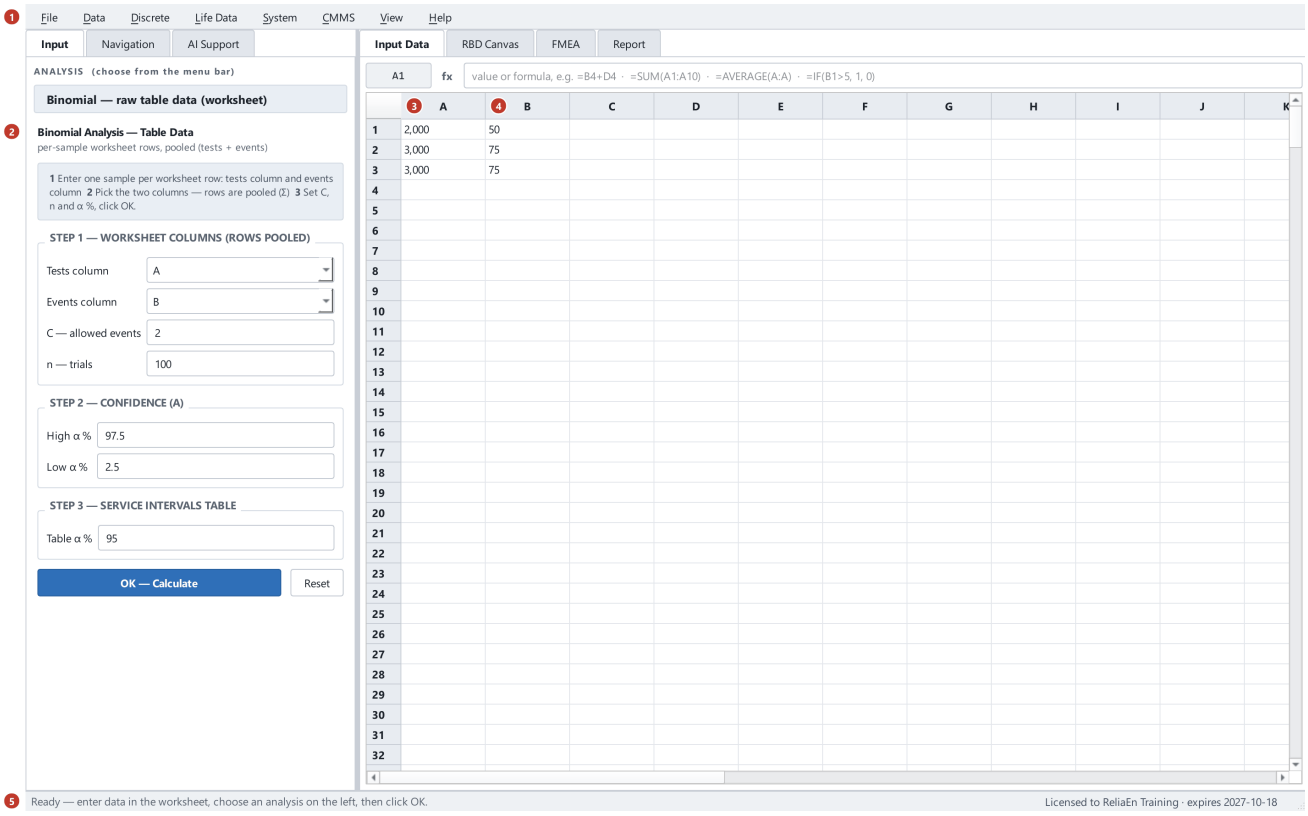
Steps 3 to 9 set or check the form's seven boxes, marked ① to ⑦ in the picture:



Steps 3 to 9 — the form set for this example

3. ① **Check that Tests column reads A.**
4. ② **In Events column, choose B.**
5. ③ **In C — allowed events, type 2.**
6. ④ **In n — trials, type 100.**
7. ⑤ **In High α %, type 97.5.** It sets the conservative rate.
8. ⑥ **In Low α %, type 2.5.** With 97.5 it makes a 95% pair.
9. ⑦ **Check that Table α % reads 95.** It sets the rate the service-interval table uses beside p̂.

10. **Click OK — Calculate** at the foot of the form (② in the picture below). ReliaEn calculates and shows the report.



Step 10 — the window just before OK

- ① The menu bar: File, Data, Discrete, Life Data, System, CMMS, View, Help.
- ② The form, set as in steps 3 to 9; OK — Calculate at its foot.
- ③ Column A: the tests per batch.
- ④ Column B: the events per batch.
- ⑤ The status bar: Ready — enter data in the worksheet, choose an analysis on the left, then click OK. and Licensed to ReliaEn Training · expires 2027-10-18.

Part 4 — The report, card by card

Binomial Analysis — Cycle Dependence

2026-11-02 21:19:14

$$R = P(X \le C) = \Sigma_{k=0}^{C}\, C(n,\, k) \cdot p^{k}\, (1 - p)^{n-k}$$

The report's head

- The title Binomial Analysis — Cycle Dependence, the date and time of the run, and the model in one line: R = P(X ≤ C) = Σ C(n, k) · p^k (1 − p)^(n−k), summed from k = 0 to C.

INPUT DATA	
1 N — total tests	8,000
2 s — events found	200
3 p̂ = s / N	0.025
4 C — allowed events	2
5 n — trials	100
6 α low / high	0.025 / 0.975

Input data

- ① N — total tests 8,000: the three batches added.
- ② s — events found 200.
- ③ p̂ = s / N 0.025: the pooled event rate.
- ④ C — allowed events 2.
- ⑤ n — trials 100.
- ⑥ α low / high 0.025 / 0.975.

RESULTS	
1 Reliability R = P(X ≤ 2)	0.542192
2 f at high α (0.975) — conservative bound	0.0703839
3 f at low α (0.025) — lower bound	0.00622997

Results

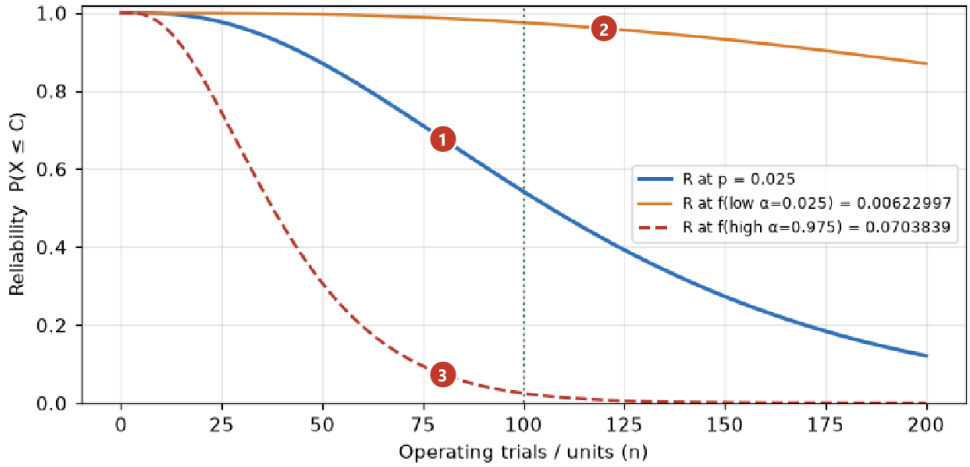
- ① Reliability R = P(X ≤ 2) 0.542192: at the pooled rate, a run of 100 insertions has 2 failures or fewer a little more than half the time.
- ② f at high α (0.975) — conservative bound 0.0703839: the rate at which a run would exceed 2 failures 97.5 times in 100.
- ③ f at low α (0.025) — lower bound 0.00622997: the rate at which it would exceed them only 2.5 times in 100.

INTERPRETATION

1 With event rate p = 0.025 (estimated), the probability of completing n = 100 trials with at most C = 2 events is **R = 0.542192**. With 97.5% confidence the true event rate could be as high as 0.0703839 (conservative bound); at 2.5% confidence, up to 0.00622997.

Interpretation

- ① ReliaEn's reading: With event rate p = 0.025 (estimated), the probability of completing n = 100 trials with at most C = 2 events is R = 0.542192. With 97.5% confidence the true event rate could be as high as 0.0703839 (conservative bound); at 2.5% confidence, up to 0.00622997.



Interactive Plot

Reliability against the number of trials

- ① R at p = 0.025: at 100 insertions, the dotted line, R is 0.54.
- ② R at f(low α=0.025) = 0.00622997: at this rate R at 100 insertions is 0.975.
- ③ R at f(high α=0.975) = 0.0703839: at this rate R at 100 insertions is 0.025.

SERVICE INTERVALS — MAINTENANCE INTERVAL N FOR TARGET RELIABILITY

1 n is the **maintenance interval in operating cycles** (same unit as the trials n of this analysis): service the equipment before it accumulates n further cycles to keep reliability at or above the target. $n = \ln(R_{target}) / \ln(1 - f)$

2 Target R	3 n at p = 0.025	4 n at f(α = 0.95) = 0.0616192
95%	2	1
5 90%	4	1
85%	6	2
80%	8	3
75%	11	4
70%	14	5
65%	17	6
60%	20	8
55%	23	9
50%	27	10
45%	31	12
40%	36	14
35%	41	16
30%	47	18
25%	54	21
20%	63	25
15%	74	29
10%	90	36
5%	118	47

SERVICE INTERVALS — maintenance interval n for target reliability

- ① n is the maintenance interval in operating cycles (same unit as the trials n of this analysis): service the equipment before it accumulates n further cycles to keep reliability at or above the target. n = ln(Rtarget) / ln(1 − f)
- ② to ④ The columns Target R, n at p = 0.025, n at f(α = 0.95) = 0.0616192.
- ⑤ The 90% row: 4 cycles at p̂, 1 at the table's rate. In the 95% row above it the table's column also reads 1: the exact interval there is 0.81, below one cycle, and the table never prints less than 1.

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The report's foot

- ① The licence line Licensed to ReliaEn Training · RL-2026-0017: the licence the report was made under.

Part 5 — How to interpret the results

What the batches say. The three batches pool into 200 failures in 8,000 tests: p̂ = 0.025 per insertion. At that rate a 100-insertion run stays within 2 failures with probability 0.542192 - a coin toss. The allowance is too tight for this line: the expected count in 100 insertions is 2.5, already above C.

What the two rates mean. They come from the run's plan (C = 2 in n = 100), not from the batches: at 0.0703839 a run would fail its allowance 97.5 times in 100, at 0.00622997 only 2.5 times. The pooled 0.025 sits between them, much nearer the upper one - the plot shows R at 100 insertions of 0.54 against 0.975 and 0.025.

How often to service. Keeping reliability at 90% without any failure allowed means servicing every 4 cycles at p̂. At the table's conservative rate no whole cycle keeps 95%: its column prints the minimum interval 1, which leaves R at 0.938 after that cycle.