Binomial — raw aggregate data: the event rate from your own records

Menu: Discrete ▸ Binomial ▸ Raw aggregate data (s / N)...

Part 1 — What the function does

What it calculates. The same binomial question as chapter 2.D1 - will a run of n trials see no more than C events? - when the event rate is not given but counted: s events found in N past tests. ReliaEn estimates the rate as $\hat{p} = s / N$ and calculates the reliability $R = P(X \le C)$ for the planned run. It also gives two rates at which the planned run would fail its allowance at the confidence levels you choose, a plot of R against the number of trials, and a table of service intervals.

What ReliaEn prints	What it tells you
$\hat{p} = s / N$	The event rate your records give
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	R against the number of trials, at $\hat{p}$ and at both rates
Service intervals	How many further cycles keep reliability at or above a target

From which data. Four numbers typed in the form: the total tests N and the events found s in your records, the allowed events C and the trials n of the planned run. No worksheet data is needed.

When an engineer uses it. When the plant's own records give the event count - failed starts, rejected parts - and the question is whether the next run or batch will stay within its allowance.

When not to use it.

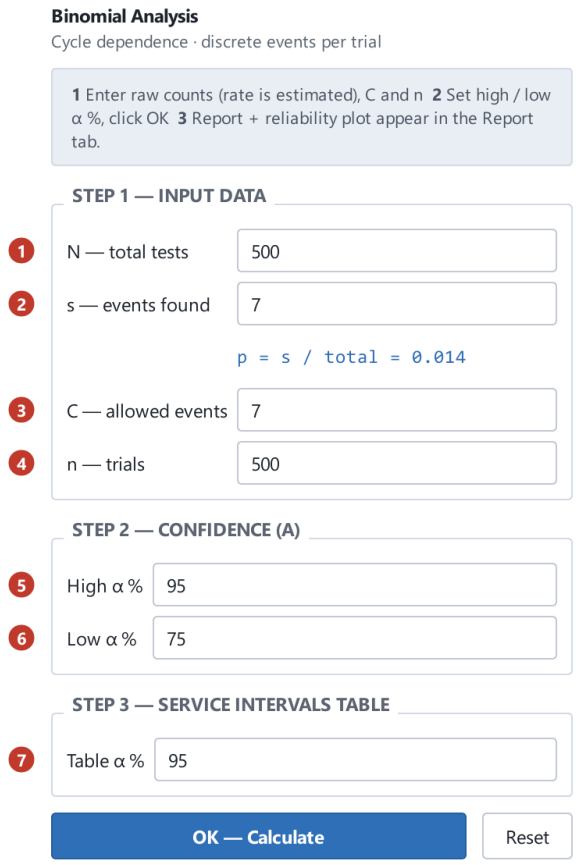
Situation	Use instead
The event rate is already known from a supplier or a standard	Discrete ▸ Binomial ▸ Known parameters...
The records sit in a worksheet, one row per batch	Discrete ▸ Binomial ▸ Raw table data (worksheet)...
Events happen in continuous time or area, not per trial	Discrete ▸ Poisson ▸ Raw aggregate data (s / T)...

Part 2 — The example's input data

Setting. A plant's test log for its relief valves shows 7 failed cycles in 500 recorded test cycles. The next acceptance test runs 500 cycles and allows at most 7 failures. The reliability engineer wants the chance that a valve passes, at the rate the log gives.

Input	Value
N — total tests / s — events found	500 / 7 - the test log
C — allowed events / n — trials	7 / 500 - the acceptance test
High α % / Low α % / Table α %	95 / 75 / 95
File in the worked-example zip	2-Binomial-Raw-Aggregate-Data/Example-1.csv — the values to type, one per row (field, value)

The form opens with these seven values already in place: this example uses them as they are. This function reads no worksheet, so the example's data is the form itself:

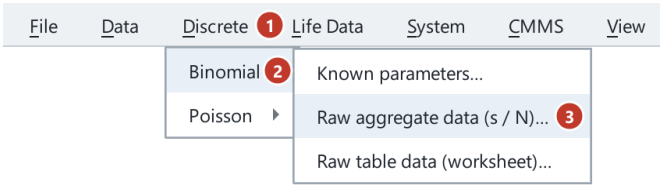


The example's values in the form

- ① and ② N — total tests 500, s — events found 7: the test log.
- ③ and ④ C — allowed events 7, n — trials 500: the acceptance test.
- ⑤ to ⑦ High α % 95, Low α % 75, Table α % 95.

Part 3 — How to use it, step by step

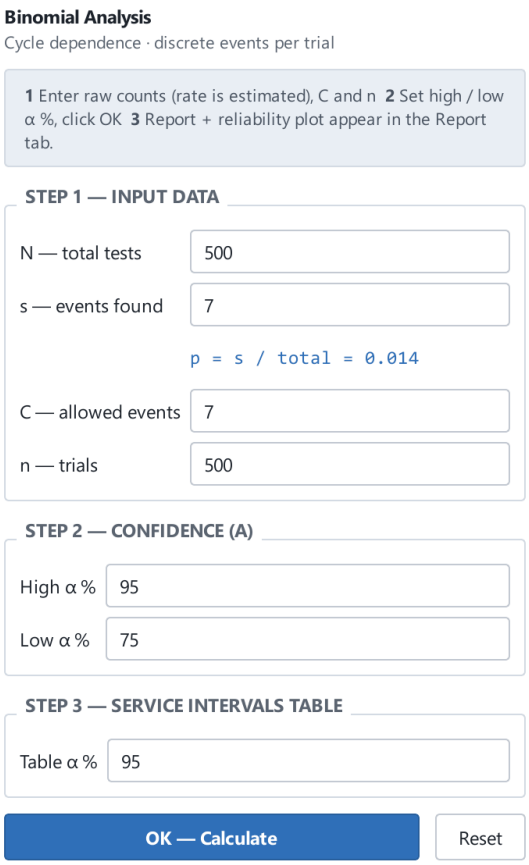
1. **Choose Discrete ▸ Binomial ▸ Raw aggregate data (s / N)...** in the menu bar. The form Binomial Analysis opens in the left panel.



Step 1 — the menu path

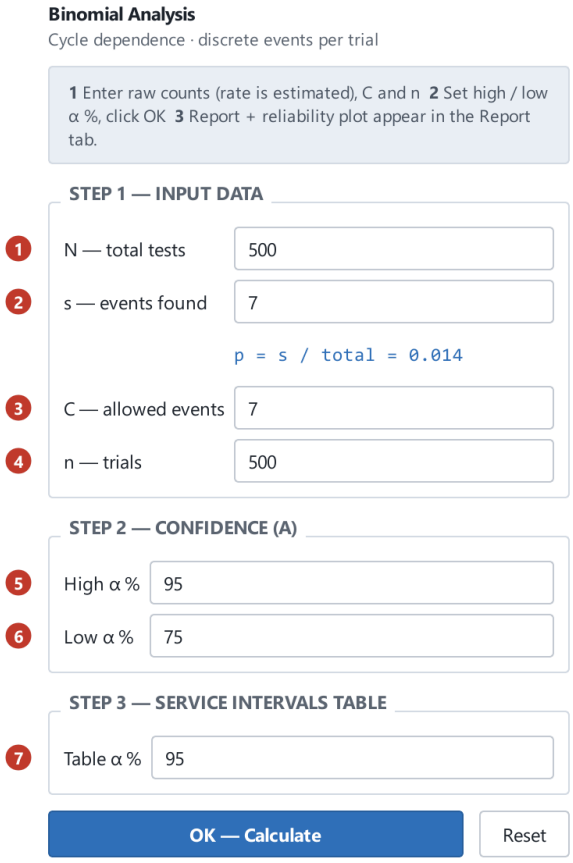
- ① Discrete: the menu.
- ② Binomial: the submenu.
- ③ Raw aggregate data (s / N)...: the entry to click.

The form as it opens:



Step 1 — the form as it opens

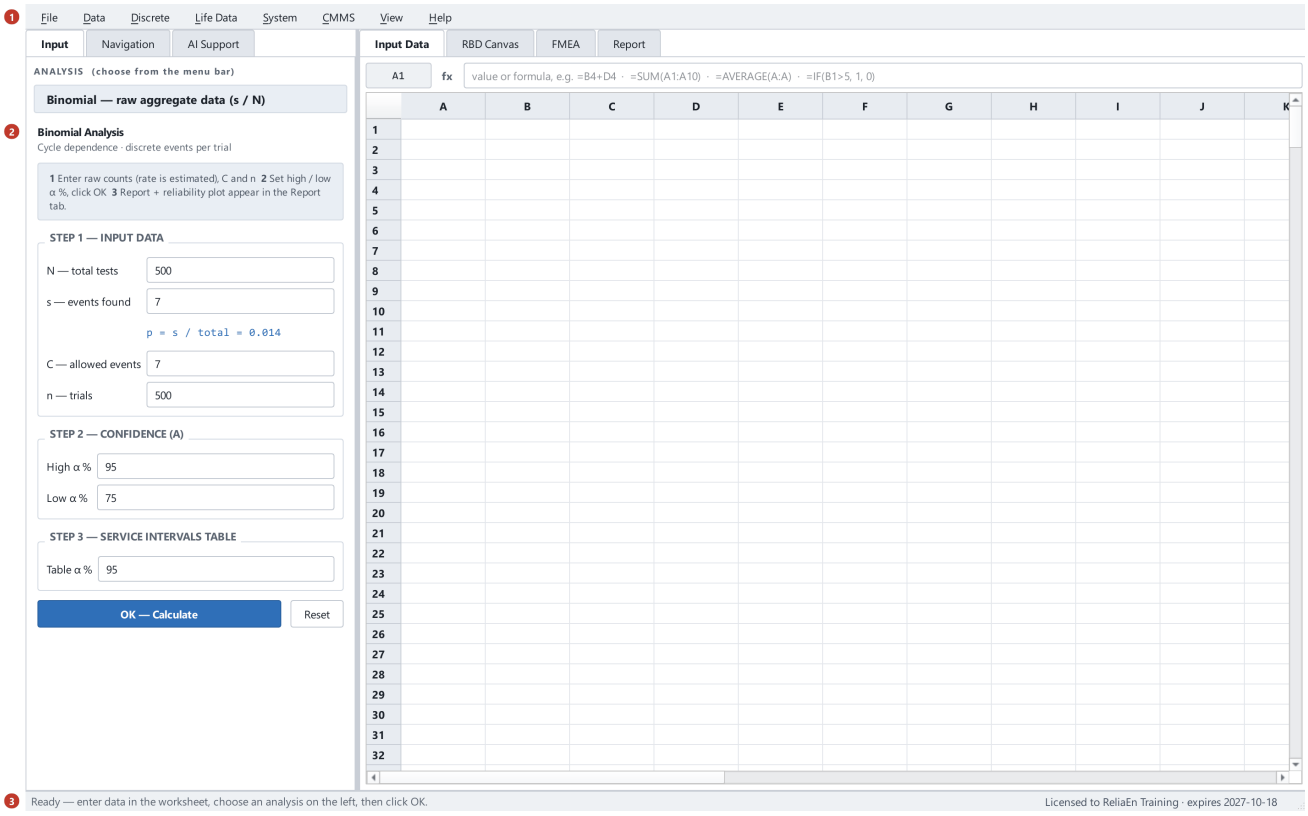
Steps 2 to 8 check the form's seven boxes, marked ① to ⑦ in the picture:



Steps 2 to 8 — the form for this example

2. ① **Check that N — total tests reads 500.**
3. ② **Check that s — events found reads 7.** The line under it shows the estimate: p = s / total = 0.014.
4. ③ **Check that C — allowed events reads 7.**
5. ④ **Check that n — trials reads 500.**
6. ⑤ **Check that High α % reads 95.** It sets the conservative rate.
7. ⑥ **Check that Low α % reads 75.** It sets the second, less conservative rate.
8. ⑦ **Check that Table α % reads 95.** It sets the rate the service-interval table uses beside p̂.

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



Step 9 — the window just before OK

- ① The menu bar: File, Data, Discrete, Life Data, System, CMMS, View, Help.
- ② The form, as in steps 2 to 8; OK — Calculate at its foot.
- ③ 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 21:18:28

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

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	500
2	s — events found	7
3	p̂ = s / N	0.014
4	C — allowed events	7
5	n — trials	500
6	α low / high	0.75 / 0.95

Input data

- ① N — total tests 500.
- ② s — events found 7.
- ③ p̂ = s / N 0.014: the event rate the log gives.
- ④ C — allowed events 7.
- ⑤ n — trials 500.
- ⑥ α low / high 0.75 / 0.95.

RESULTS

1	Reliability R = P(X ≤ 7)	0.598716
2	f at high α (0.95) — conservative bound	0.0261347
3	f at low α (0.75) — lower bound	0.0193168

Results

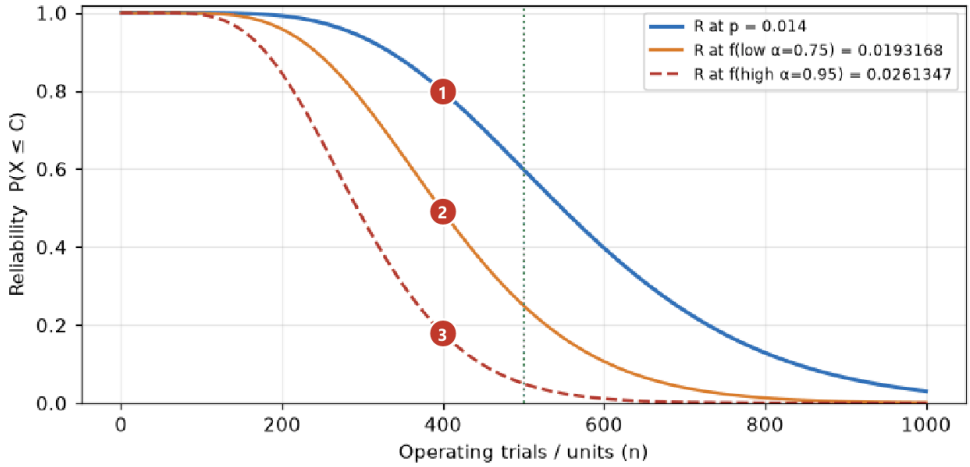
- ① Reliability R = P(X ≤ 7) 0.598716: at the log's rate, a valve passes 500 cycles with at most 7 failures about 6 times in 10.
- ② f at high α (0.95) — conservative bound 0.0261347: the event rate at which a valve would fail the test 95 times in 100.
- ③ f at low α (0.75) — lower bound 0.0193168: the same at 75 times in 100.

INTERPRETATION

1 With event rate p = 0.014 (estimated), the probability of completing n = 500 trials with at most C = 7 events is **R = 0.598716**. With 95% confidence the true event rate could be as high as 0.0261347 (conservative bound); at 75% confidence, up to 0.0193168.

Interpretation

- ① ReliaEn's reading: With event rate p = 0.014 (estimated), the probability of completing n = 500 trials with at most C = 7 events is R = 0.598716. With 95% confidence the true event rate could be as high as 0.0261347 (conservative bound); at 75% confidence, up to 0.0193168.



Interactive Plot

Reliability against the number of trials

- ① R at p = 0.014: R falls as the run gets longer; at 500 cycles, the dotted line, it is 0.60.
- ② R at f(low α=0.75) = 0.0193168: at this rate R at 500 cycles is 0.25.
- ③ R at f(high α=0.95) = 0.0261347: at this rate R at 500 cycles is 0.05.

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 = 0.014	4 n at f(α = 0.95) = 0.0261347
95%	3	1
5 90%	7	3
85%	11	6
80%	15	8
75%	20	10
70%	25	13
65%	30	16
60%	36	19
55%	42	22
50%	49	26
45%	56	30
40%	64	34
35%	74	39
30%	85	45
25%	98	52
20%	114	60
15%	134	71
10%	163	86
5%	212	113

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 = 0.014, n at f(α = 0.95) = 0.0261347.
- ⑤ The 90% row: 7 cycles at p̂, 3 cycles at the conservative rate.

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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 log says. Seven failures in 500 logged cycles give p̂ = 0.014 per cycle. At that rate a valve completes the 500-cycle acceptance test with 7 failures or fewer with probability 0.598716 - about 6 times in 10. Four valves in ten would fail a test they are expected to pass: the allowance of 7 is tight for this rate.

What the two rates mean. The rates come from the test plan (C = 7 in n = 500), not from the log: at 0.0261347 a valve would fail the test 95 times in 100, and at 0.0193168, 75 times in 100. The log's 0.014 sits below both, so the plan is not yet failing on average - but more failures in the log would move p̂ towards them quickly.

How often to service. Without any failure allowed between services, keeping reliability at 90% means servicing every 7 cycles at the log's rate, or every 3 at the conservative rate (the service-interval table's 90% row).