Binomial — known parameters: will a run of n trials stay within C events?

Menu: Discrete ▸ Binomial ▸ Known parameters…

Part 1 — What the function does

What it calculates. When each trial of a mission - a cycle, a start, a demand - ends in an event (a failure, a reject) with the same probability p, the number of events X in n trials is binomial. ReliaEn calculates the reliability R = P(X ≤ C): the chance that a run of n trials sees no more than C events. It also gives two upper bounds on the event rate 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
Reliability R = P(X ≤ C)	The chance that n trials see at most C events
f at high α and **f at low α**	How high the event rate could be, at two confidence levels
Reliability plot	R against the number of trials, at p and at both bounds
Service intervals	How many further cycles keep reliability at or above a target

From which data. Three numbers typed in the form: the event rate p per trial, the allowed number of events C and the number of trials n. No worksheet data is needed.

When an engineer uses it. When the event rate per trial is already known - from a supplier, a standard or earlier data - and the question is whether a mission or a batch will stay within its allowance.

When not to use it.

Situation	Use instead
p is not known; you have counts of events and trials	Discrete ▸ Binomial ▸ Raw aggregate data (s / N)…
Events happen in continuous time or area, not per trial	Discrete ▸ Poisson ▸ Known parameters…

Part 2 — The example's input data

Setting. A relief valve must complete 500 test cycles, and its acceptance allows at most 7 failed cycles. The supplier states a failure probability of 0.014 per cycle. The reliability engineer wants the chance that the valve passes, and how high the true failure rate could be.

Input	Value
p — event rate	0.014 per cycle
C — allowed events	7
n — trials	500 cycles
High α % / Low α % / Table α %	95 / 75 / 95
File in the worked-example zip	2-Binomial-Known-Parameters/Example-1.csv — the values to type, one per row (field, value)

The form opens with these six 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:

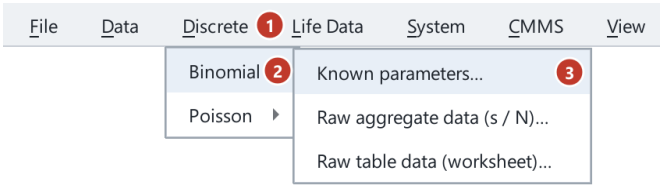


The example's values in the form

- ① to ③ p — event rate 0.014, C — allowed events 7, n — trials 500.
- ④ to ⑥ High α % 95, Low α % 75, Table α % 95.

Part 3 — How to use it, step by step

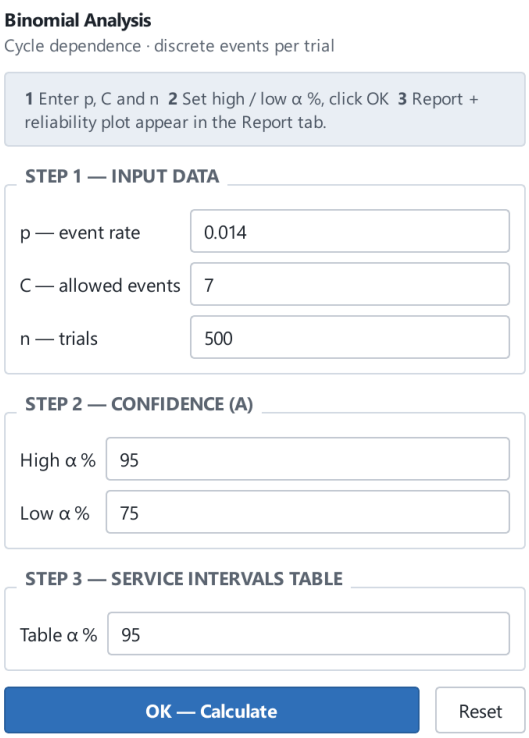
1. **Choose Discrete ▸ Binomial ▸ Known parameters...** in the menu bar. The form Binomial Analysis opens in the left panel.



Step 1 — the menu path

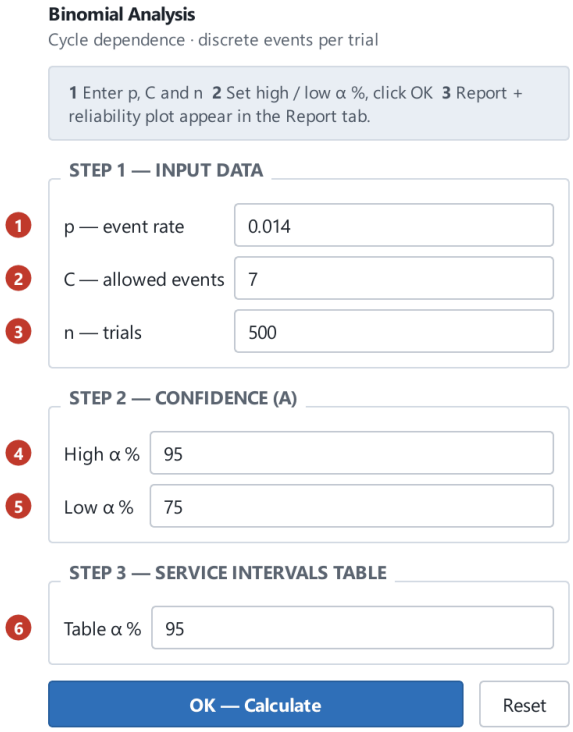
- ① Discrete: the menu.
- ② Binomial: the submenu.
- ③ Known parameters...: the entry to click.

The form as it opens:



Step 1 — the form as it opens

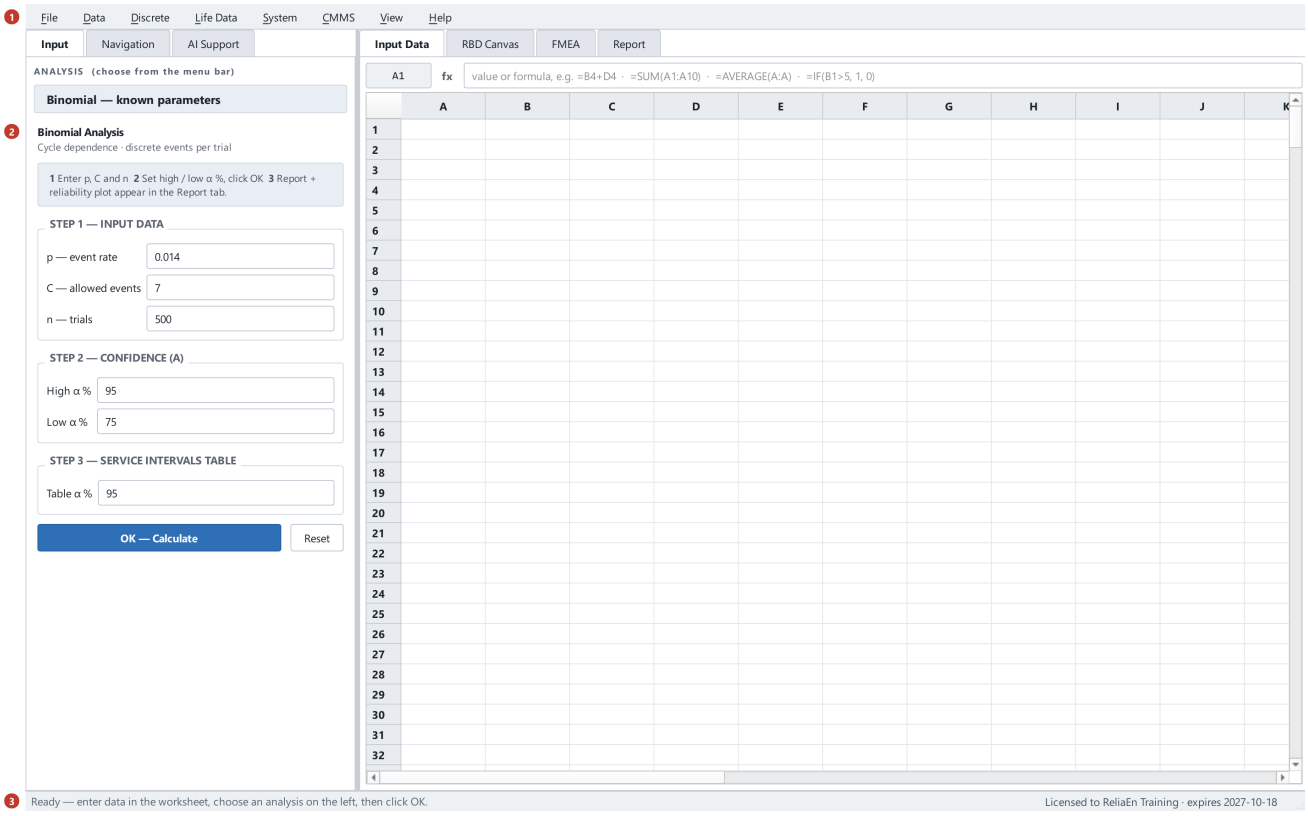
Steps 2 to 7 check the form's six boxes, marked ① to ⑥ in the picture:



Steps 2 to 7 — the form for this example

2. ① **Check that p — event rate reads 0.014.**
3. ② **Check that C — allowed events reads 7.**
4. ③ **Check that n — trials reads 500.**
5. ④ **Check that High α % reads 95.** It sets the conservative bound on the rate.
6. ⑤ **Check that Low α % reads 75.** It sets the second, less conservative bound.
7. ⑥ **Check that Table α % reads 95.** It sets the rate the service-interval table uses beside p.

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



Step 8 — 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 7; 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 20:33:24

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

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	p — event rate (known)	0.014
2	C — allowed events	7
3	n — trials	500
4	α low / high	0.75 / 0.95

Input data

- ① p — event rate (known) 0.014.
- ② C — allowed events 7.
- ③ n — trials 500.
- ④ 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

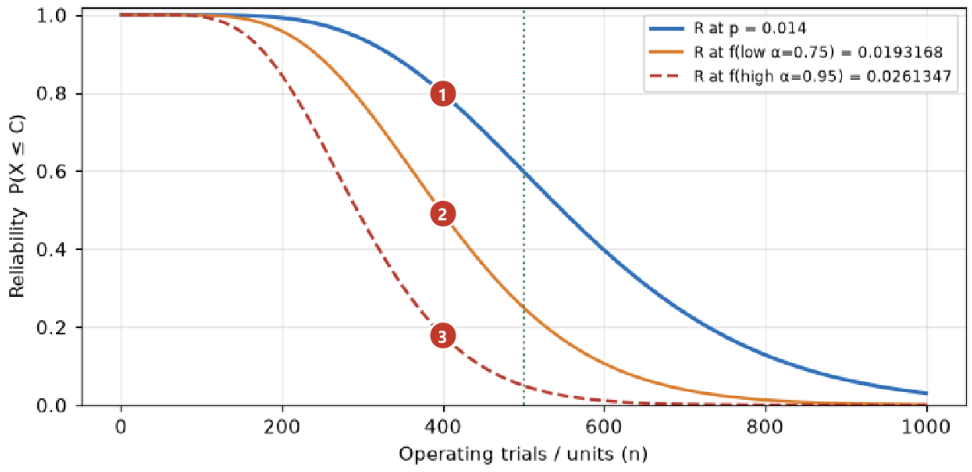
- ① Reliability R = P(X ≤ 7) 0.598716: the valve passes 500 cycles with at most 7 failures about 6 times in 10.
- ② f at high α (0.95) — conservative bound 0.0261347: the event rate at which the valve would fail the test 95 times in 100.
- ③ f at low α (0.75) — lower bound 0.0193168: the same at 75 times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

INTERPRETATION

1 With event rate p = 0.014 (known), 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 (known), 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 p, 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

Will the valve pass? At the supplier's rate of 0.014 per cycle, the valve completes 500 cycles with 7 failures or fewer with probability 0.598716 - about 6 times in 10. Four valves in ten would fail an acceptance test they are expected to pass: the allowance of 7 is tight for this rate.

How bad the rate could be. The two bounds say which rates the plan cannot tell apart from a failed test. At 0.0261347 the valve would fail the test 95 times in 100, and at 0.0193168, 75 times in 100 - the plot shows R at 500 cycles falling to 0.05 and 0.25 on those curves.

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