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

Menu: Discrete ▸ Poisson ▸ Raw aggregate data (s / T)...

Part 1 — What the function does

What it calculates. The Poisson question of chapter 2.D4 - will n units of exposure see no more than C events? - when the rate is not given but counted: s events in T units of past exposure. ReliaEn estimates the rate as $\hat{p}' = s / T$, the expected events $\mu = n \cdot \hat{p}'$ of the planned exposure, and the reliability $R = P(X \le C)$. It also gives two rates at which the planned exposure would exceed C at the confidence levels you choose, a plot of R against the exposure, and a table of service intervals.

What ReliaEn prints	What it tells you
$\hat{p}' = s / T$ and **$\mu = n \cdot p'$**	The rate your records give, and the events expected in the planned exposure
Reliability R = P(X ≤ C)	The chance that n units see at most C events, at $\hat{p}'$
f at high α and **f at low α**	The rates at which the planned exposure would exceed C, at two confidence levels
Reliability plot and **service intervals**	R against the exposure; how much further exposure keeps a target

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

When an engineer uses it. When the plant's own logs give an event count over hours or units of exposure, and the question is whether the next campaign will stay within its allowance.

When not to use it.

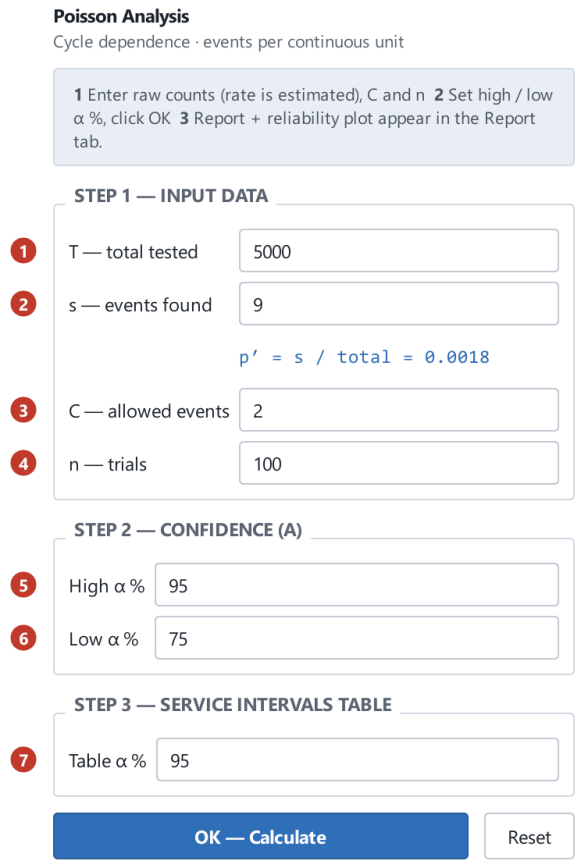
Situation	Use instead
The rate is already known from a supplier or a standard	Discrete ▸ Poisson ▸ Known parameters...
The records sit in a worksheet, one row per period	Discrete ▸ Poisson ▸ Raw table data (worksheet)...
Each trial ends in an event or not, at most once	Discrete ▸ Binomial ▸ Raw aggregate data (s / N)...

Part 2 — The example's input data

Setting. A pump fleet's log shows 9 seal leaks in 5,000 operating hours. The next 100-hour campaign allows at most 2 leaks. The reliability engineer wants the chance that the campaign stays within that, at the rate the log gives.

Input	Value
T — total tested / s — events found	5000 hours / 9 leaks - the log, typed
C — allowed events / n — trials	2 / 100 hours - the campaign, typed
High α % / Low α % / Table α %	95 / 75 / 95 - as the form opens
File in the worked-example zip	2-Poisson-Raw-Aggregate-Data/Example-1.csv — the values to type, one per row (field, value)

This function reads no worksheet, so the example's data is the form itself:

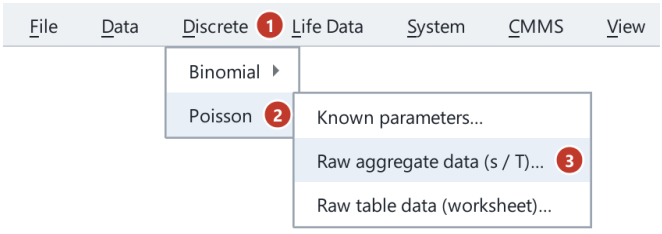


The example's values in the form

- ① and ② T — total tested 5000, s — events found 9: the log.
- ③ and ④ C — allowed events 2, n — trials 100: the campaign.
- ⑤ to ⑦ High α % 95, Low α % 75, Table α % 95.

Part 3 — How to use it, step by step

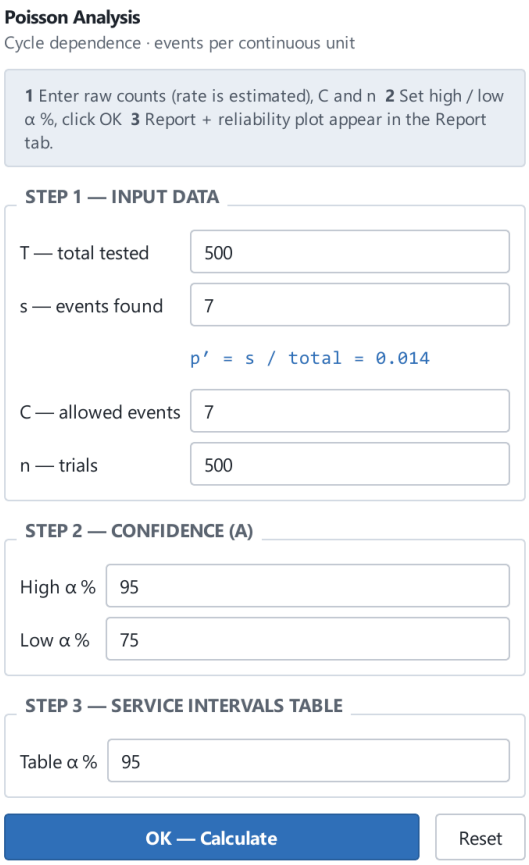
1. **Choose Discrete ▸ Poisson ▸ Raw aggregate data (s / T)...** in the menu bar. The form Poisson Analysis opens in the left panel.



Step 1 — the menu path

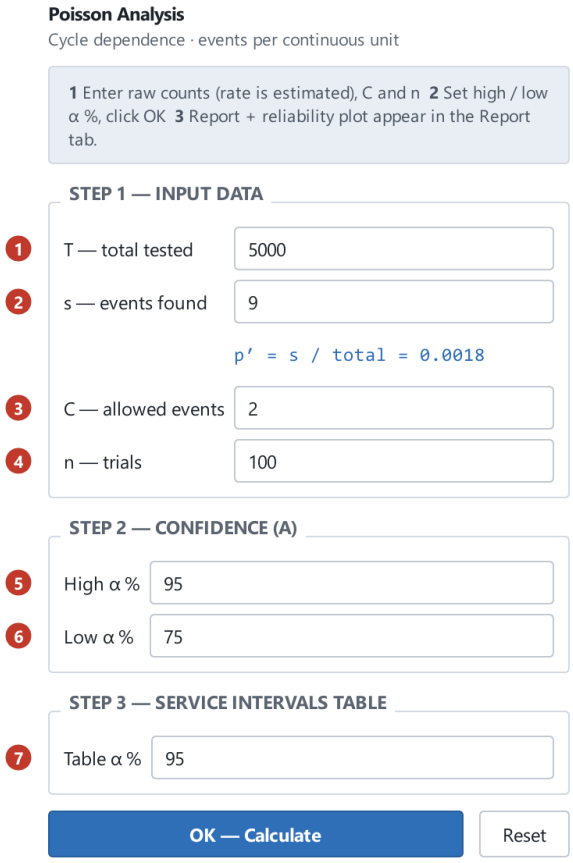
- ① Discrete: the menu.
- ② Poisson: the submenu.
- ③ Raw aggregate data (s / T)...: the entry to click.

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



Step 1 — the form as it opens

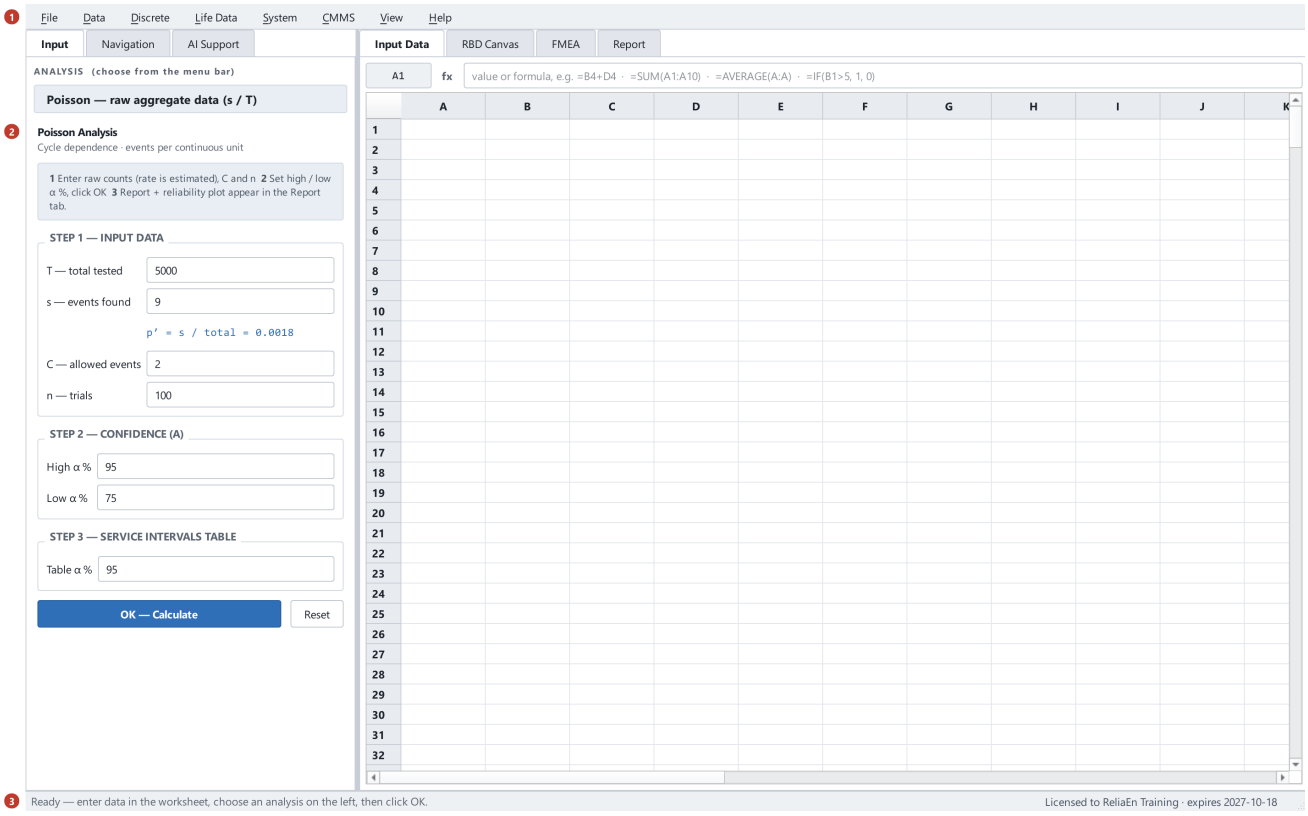
Steps 2 to 8 set or check the form's seven boxes, marked ① to ⑦ in the picture:



Steps 2 to 8 — the form set for this example

2. ① **In T — total tested, type 5000.** The log's operating hours.
3. ② **In s — events found, type 9.** The line under it shows the estimate: p’ = s / total = 0.0018.
4. ③ **In C — allowed events, type 2.**
5. ④ **In n — trials, type 100.** The campaign's hours.
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, set 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

Poisson Analysis — Cycle Dependence

2026-11-02 22:30:50

$R = P(X \le C) = \Sigma_{k=0}^{C} e^{-n \cdot p'} (n \cdot p')^k / k!$

The report's head

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

INPUT DATA

1	T — total tested	5,000
2	s — events found	9
3	p̂′ = s / T	0.0018
4	C — allowed events	2
5	n — trials	100
6	μ = n · p′ (expected events)	0.18
7	α low / high	0.75 / 0.95

Input data

- ① T — total tested 5,000.
- ② s — events found 9.
- ③ p̂′ = s / T 0.0018: the leak rate per hour the log gives.
- ④ C — allowed events 2.
- ⑤ n — trials 100.
- ⑥ μ = n · p′ (expected events) 0.18: fewer than one leak in five campaigns.
- ⑦ α low / high 0.75 / 0.95.

RESULTS

1	Reliability R = P(X ≤ 2)	0.99915
2	f at high α (0.95) — conservative bound	0.0629579
3	f at low α (0.75) — lower bound	0.039204

Results

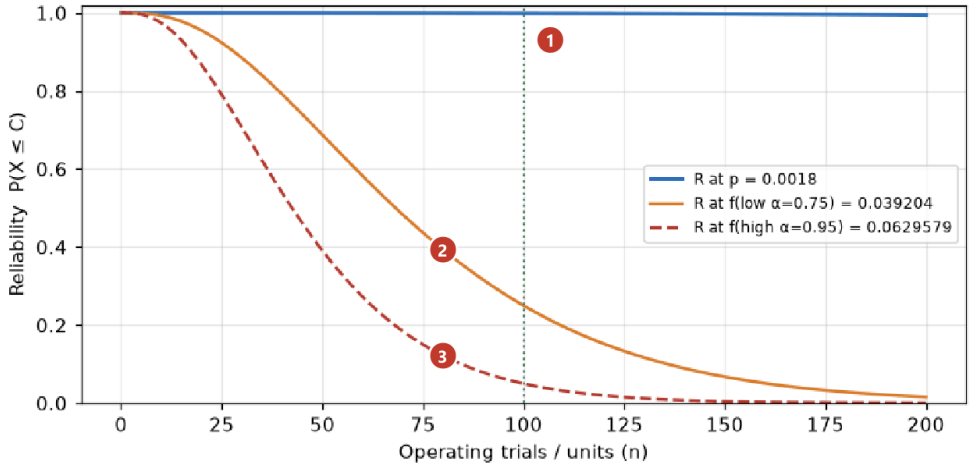
- ① Reliability R = P(X ≤ 2) 0.99915: at the log's rate the campaign stays within 2 leaks almost always.
- ② f at high α (0.95) — conservative bound 0.0629579: the rate at which the campaign would exceed 2 leaks 95 times in 100.
- ③ f at low α (0.75) — lower bound 0.039204: the same at 75 times in 100.

INTERPRETATION

1 With event rate p = 0.0018 (estimated), the probability of completing n = 100 trials with at most C = 2 events is **R = 0.99915**. With 95% confidence the true event rate could be as high as 0.0629579 (conservative bound); at 75% confidence, up to 0.039204.

Interpretation

- ① ReliaEn's reading: With event rate p = 0.0018 (estimated), the probability of completing n = 100 trials with at most C = 2 events is R = 0.99915. With 95% confidence the true event rate could be as high as 0.0629579 (conservative bound); at 75% confidence, up to 0.039204.



Interactive Plot

Reliability against the exposure

- ① R at p = 0.0018: almost flat at 1 over the plotted range.
- ② R at f(low α=0.75) = 0.039204: at this rate R at 100 hours is 0.25.
- ③ R at f(high α=0.95) = 0.0629579: at this rate R at 100 hours 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. $n = -\ln(R_{target}) / f$

2 Target R	3 n at p = 0.0018	4 n at f(α = 0.95) = 0.0629579
95%	28	1
5 90%	58	1
85%	90	2
80%	123	3
75%	159	4
70%	198	5
65%	239	6
60%	283	8
55%	332	9
50%	385	11
45%	443	12
40%	509	14
35%	583	16
30%	668	19
25%	770	22
20%	894	25
15%	1,053	30
10%	1,279	36
5%	1,664	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) / f
- ② to ④ The columns Target R, n at p = 0.0018, n at f(α = 0.95) = 0.0629579.
- ⑤ The 90% row: 58 hours at p̂′, 1 hour at the conservative rate. In the 95% row the conservative column also reads 1: the exact interval there is 0.81, 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 log says. Nine leaks in 5,000 hours give p̂′ = 0.0018 per hour, so a 100-hour campaign expects 0.18 leaks. With 2 allowed, it stays within the allowance with probability 0.99915.

What the two rates mean. They come from the campaign's plan (C = 2 in n = 100 hours), not from the log: at 0.0629579 leaks per hour the campaign would exceed 2 leaks 95 times in 100, and at 0.039204, 75 times in 100. The log's 0.0018 is about 35 times below the conservative rate: the allowance leaves a wide margin.

How often to service. Without any leak allowed between services, keeping reliability at 90% means servicing every 58 hours at the log's rate. At the conservative rate the interval is 1 hour at 90% (exact 1.67), and at 95% the table prints its minimum of 1 (exact 0.81).