Poisson — raw table data: the event rate pooled from a worksheet of periods

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

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? - with the rate pooled from a worksheet: one row per period or unit, the exposure in it and the events found in it. ReliaEn adds the rows into T and s, estimates $\hat{p}' = s / T$ exactly as chapter 2.D5 does, and calculates the expected events μ, the reliability $R = P(X \le C)$ for the planned exposure, two rates at which it would exceed C, a plot and a table of service intervals.

What ReliaEn prints	What it tells you
T, **s** and **$\hat{p}' = s / T$**	The pooled exposure, events and rate of the worksheet
$\mu = n \cdot p'$ and **Reliability $R = P(X \le C)$**	The events expected in the planned exposure, and the chance of at most C
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. Two worksheet columns, one row per period or unit: the amount tested in it and the events found in it. The allowed events C, the exposure n and the three α values are typed in the form.

When an engineer uses it. When the logs come period by period - a month, a machine, a batch of hours - and the question is whether the next campaign will stay within its allowance.

When not to use it.

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

Part 2 — The example's input data

Setting. The pump fleet of chapter 2.D5, its log kept per pump: 2,000 hours with 4 seal leaks, then two pumps of 1,500 hours with 3 and 2 leaks. The next 100-hour campaign allows at most 2 leaks. The reliability engineer wants the chance that the campaign stays within that.

Input	Value
Hours per pump (column A) / leaks per pump (column B)	2000 / 4 · 1500 / 3 · 1500 / 2
File in the worked-example zip	2-Poisson-Raw-Table-Data/Example-1.csv — columns Amount tested and Events, 3 rows
C — allowed events / n — trials	2 / 100 hours — typed in the form
High α % / Low α % / Table α %	95 / 75 / 95 — as the form opens

	① A	② B	C
1	2000	4	
2	1500	3	
3	1500	2	
4			

The example data in the worksheet

- ① Column A: the hours of each pump.
- ② Column B: the leaks of each pump.

Part 3 — How to use it, step by step

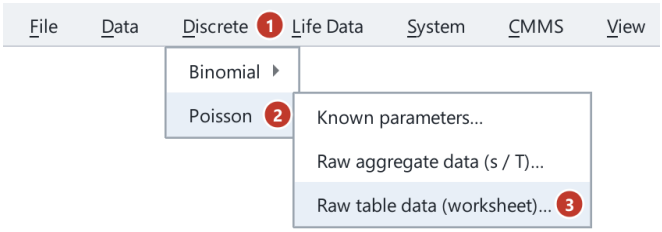
1. **Put the hours in column A and the leaks in column B.** Copy the 3 rows of Example-1.csv that stand under its headings Amount tested and Events into columns A and B of the worksheet, starting at row 1.

	① A	② B	C
1	2000	4	
2	1500	3	
3	1500	2	
4			

Step 1 — the pumps in columns A and B

- ① Column A: 2000, 1500, 1500 hours.
- ② Column B: 4, 3, 2 leaks.

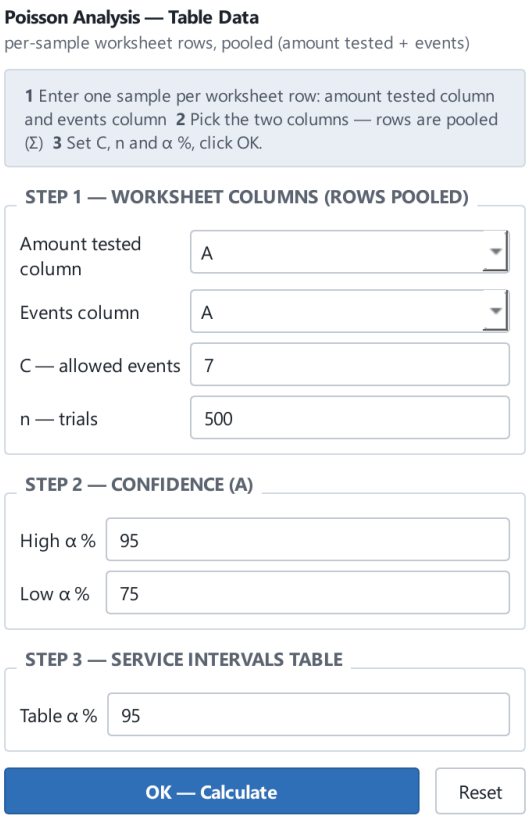
2. **Choose Discrete ▸ Poisson ▸ Raw table data (worksheet)...** in the menu bar. The form Poisson Analysis — Table Data opens in the left panel.



Step 2 — the menu path

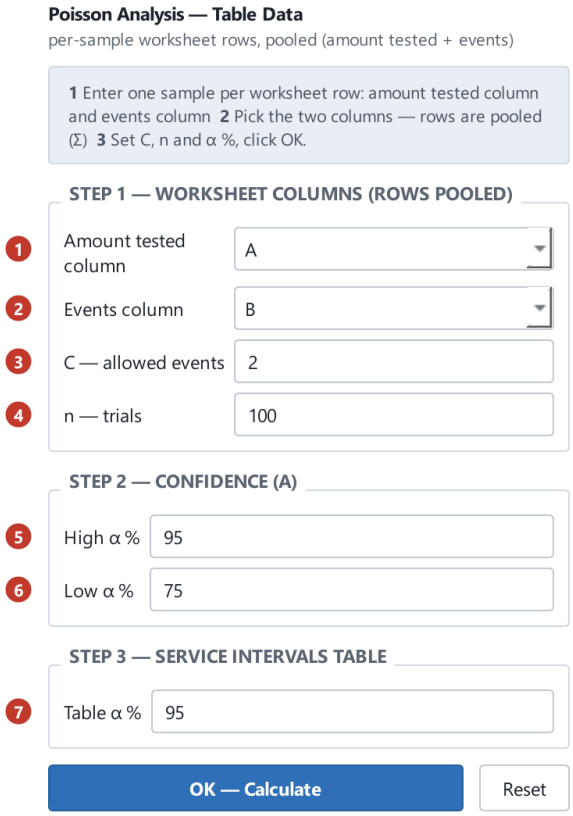
- ① Discrete: the menu.
- ② Poisson: the submenu.
- ③ Raw table data (worksheet)...: the entry to click.

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



Step 2 — the form as it opens

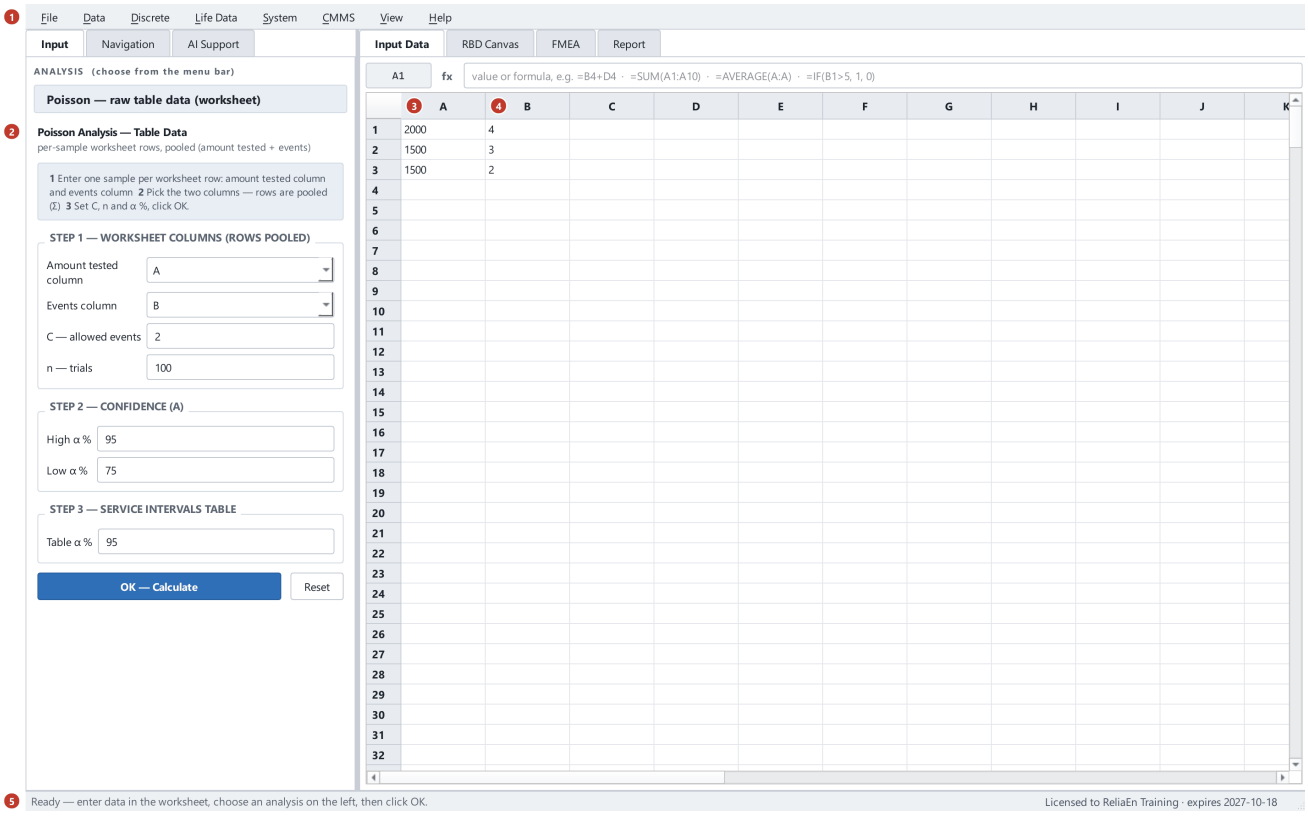
Steps 3 to 9 set or check the form's seven boxes, marked ① to ⑦ in the picture:



Steps 3 to 9 — the form set for this example

3. ① **Check that Amount tested 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.** The campaign's hours.
7. ⑤ **Check that High α % reads 95.** It sets the conservative rate.
8. ⑥ **Check that Low α % reads 75.** It sets the second, less conservative rate.
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 hours per pump.
- ④ Column B: the leaks per pump.
- 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

Poisson Analysis — Cycle Dependence

2026-11-02 22:31:48

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

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: the three pumps' hours added.
- ② s — events found 9.
- ③ p̂′ = s / T 0.0018: the pooled leak rate per hour.
- 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.

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

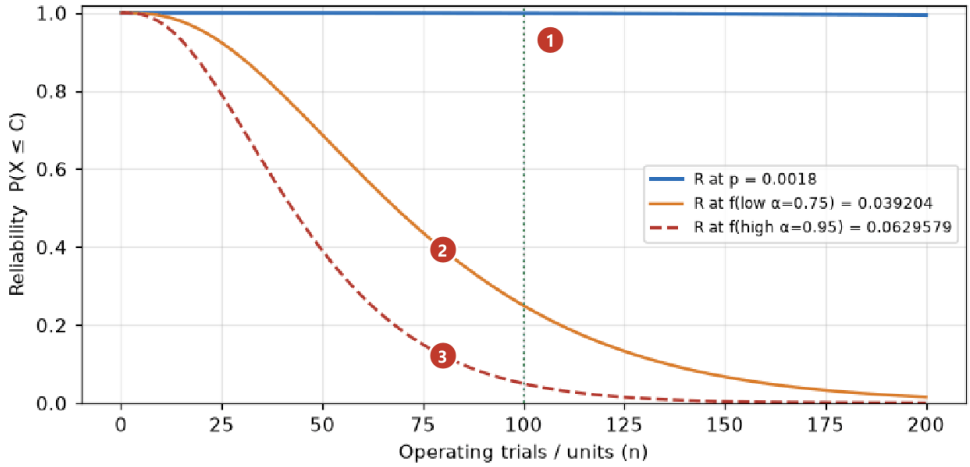
Results

- ① Reliability R = P(X ≤ 2) 0.99915: the same as chapter 2.D5 - the worksheet pools to the same 9 leaks in 5,000 hours.
- 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 pumps say. Pooled, the three pumps give 9 leaks in 5,000 hours: p̂′ = 0.0018 per hour, and a 100-hour campaign expects 0.18 leaks. With 2 allowed, it stays within the allowance with probability 0.99915. Keeping the log per pump changes nothing in the result - the report is the same as chapter 2.D5's - but it keeps the source of each count visible.

What the two rates mean. They come from the campaign's plan (C = 2 in n = 100 hours), not from the pumps: 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 pooled 0.0018 is about 35 times below the conservative rate.

How often to service. Without any leak allowed between services, keeping reliability at 90% means servicing every 58 hours at the pooled 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).