Poisson — known parameters: will a stretch of exposure stay within C events?

Menu: Discrete ▸ Poisson ▸ Known parameters...

Part 1 — What the function does

What it calculates. When events arrive at a steady rate p′ per unit of exposure - an hour, a kilometre, a square metre - and can happen any number of times, the number of events X in n units is Poisson with mean μ = n · p′. ReliaEn calculates the reliability R = P(X ≤ C): the chance that n units of exposure see no more than C events. It also gives two rates at which that 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
μ = n · p′	The expected number of events in the exposure
Reliability R = P(X ≤ C)	The chance that n units see at most C events
f at high α and **f at low α**	The rates at which the exposure would exceed C, at two confidence levels
Reliability plot	R against the exposure, at p′ and at both rates
Service intervals	How much further exposure keeps reliability at or above a target

From which data. Three numbers typed in the form: the event rate p′ per unit, the allowed events C and the exposure n. No worksheet data is needed.

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

When not to use it.

Situation	Use instead
Each trial ends in an event or not, at most once	Discrete ▸ Binomial ▸ Known parameters...
The rate is not known; you have counts of events and exposure	Discrete ▸ Poisson ▸ Raw aggregate data (s / T)...

Part 2 — The example's input data

Setting. A pump's seal leaks at a known 0.002 times per operating hour. A 1,000-hour campaign allows at most 3 leaks before the seal must be changed. The reliability engineer wants the chance that the campaign stays within that.

Input	Value
p′ — event rate	0.002 per hour - typed
C — allowed events / n — trials	3 / 1000 hours - typed
High α % / Low α % / Table α %	95 / 75 / 95 - as the form opens
File in the worked-example zip	2-Poisson-Known-Parameters/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:

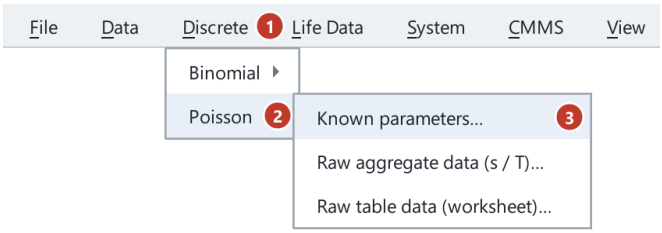


The example's values in the form

- ① to ③ p' — event rate 0.002, C — allowed events 3, n — trials 1000.
- ④ to ⑥ High α % 95, Low α % 75, Table α % 95.

Part 3 — How to use it, step by step

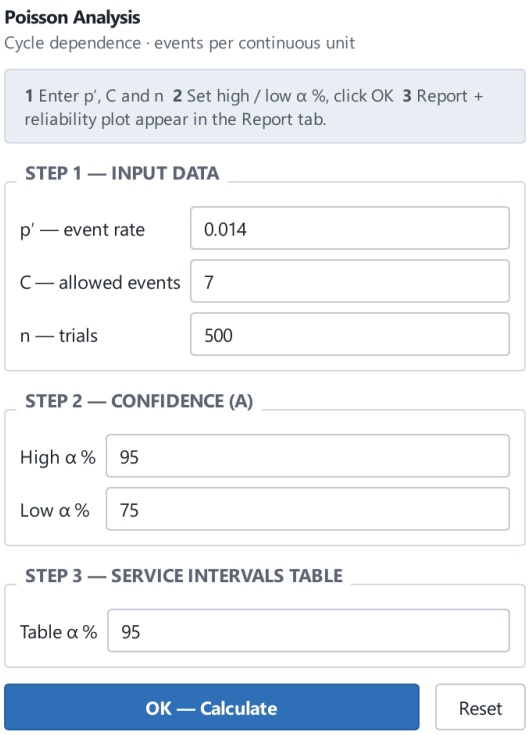
1. **Choose Discrete ▸ Poisson ▸ Known parameters...** in the menu bar. The form Poisson Analysis opens in the left panel.



Step 1 — the menu path

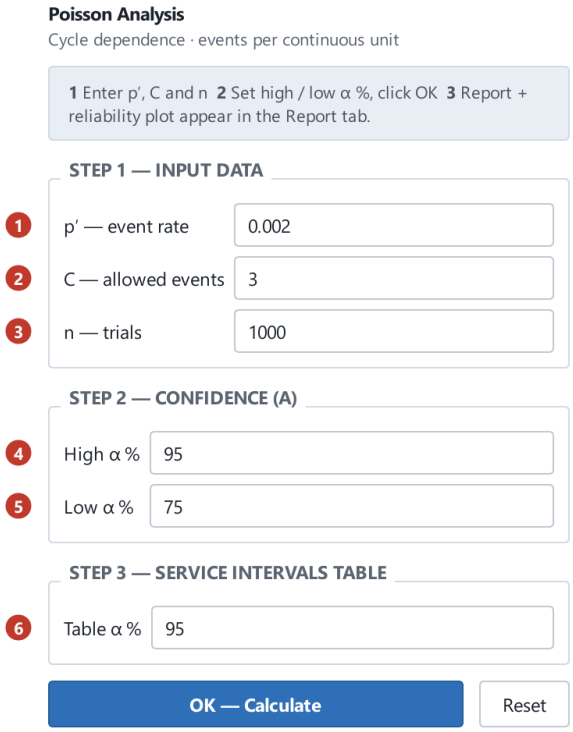
- ① Discrete: the menu.
- ② Poisson: the submenu.
- ③ Known parameters...: the entry to click.

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



Step 1 — the form as it opens

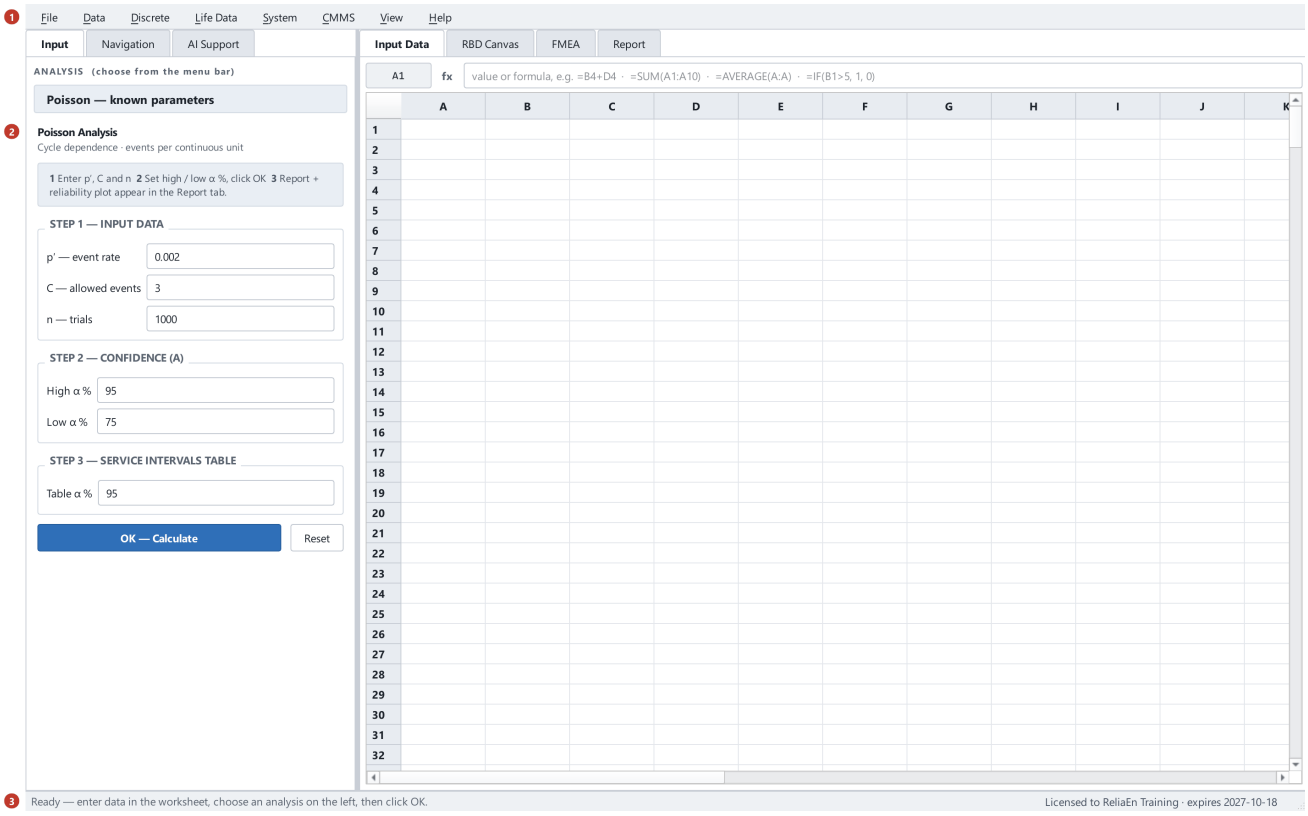
Steps 2 to 7 set or check the form's six boxes, marked ① to ⑥ in the picture:



Steps 2 to 7 — the form set for this example

2. ① **In p′ — event rate, type 0.002.**
3. ② **In C — allowed events, type 3.**
4. ③ **In n — trials, type 1000.** The exposure, in hours.
5. ④ **Check that High α % reads 95.** It sets the conservative rate.
6. ⑤ **Check that Low α % reads 75.** It sets the second, less conservative rate.
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, set 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

Poisson Analysis — Cycle Dependence

2026-11-02 22:29:48

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

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	p — event rate (known)	0.002
2	C — allowed events	3
3	n — trials	1000
4	μ = n · p′ (expected events)	2
5	α low / high	0.75 / 0.95

Input data

- ① p — event rate (known) 0.002.
- ② C — allowed events 3.
- ③ n — trials 1000.
- ④ μ = n · p′ (expected events) 2: two leaks expected in the campaign.
- ⑤ α low / high 0.75 / 0.95.

RESULTS

1	Reliability R = P(X ≤ 3)	0.857123
2	f at high α (0.95) — conservative bound	0.00775366
3	f at low α (0.75) — lower bound	0.00510943

Results

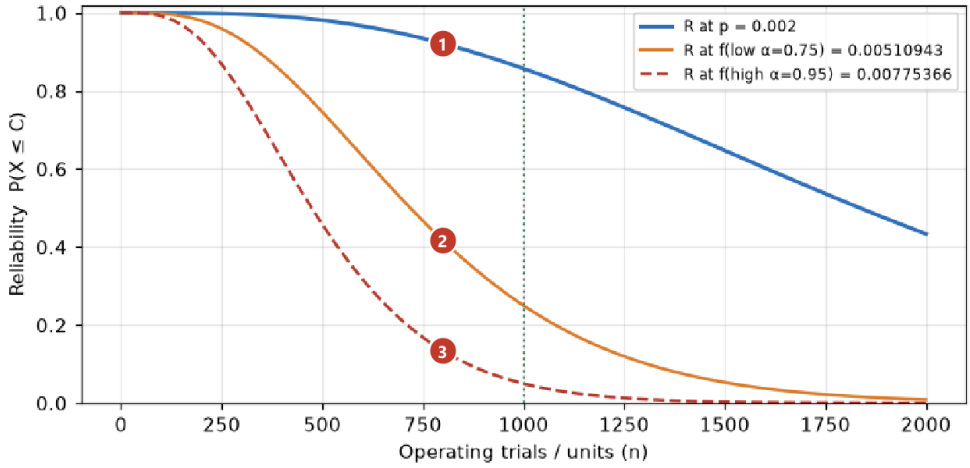
- ① Reliability R = P(X ≤ 3) 0.857123: the campaign stays within 3 leaks about 86 times in 100.
- ② f at high α (0.95) — conservative bound 0.00775366: the rate at which the campaign would exceed 3 leaks 95 times in 100.
- ③ f at low α (0.75) — lower bound 0.00510943: the same at 75 times in 100.

INTERPRETATION

1 With event rate p = 0.002 (known), the probability of completing n = 1000 trials with at most C = 3 events is **R = 0.857123**. With 95% confidence the true event rate could be as high as 0.00775366 (conservative bound); at 75% confidence, up to 0.00510943.

Interpretation

- ① ReliaEn's reading: With event rate p = 0.002 (known), the probability of completing n = 1000 trials with at most C = 3 events is R = 0.857123. With 95% confidence the true event rate could be as high as 0.00775366 (conservative bound); at 75% confidence, up to 0.00510943.



Interactive Plot

Reliability against the exposure

- ① R at p = 0.002: at 1,000 hours, the dotted line, R is 0.86.
- ② R at f(low α=0.75) = 0.00510943: at this rate R at 1,000 hours is 0.25.
- ③ R at f(high α=0.95) = 0.00775366: at this rate R at 1,000 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 = 0.002	4 n at f(α = 0.95) = 0.00775366
95%	25	6
5 90%	52	13
85%	81	20
80%	111	28
75%	143	37
70%	178	46
65%	215	55
60%	255	65
55%	298	77
50%	346	89
45%	399	102
40%	458	118
35%	524	135
30%	601	155
25%	693	178
20%	804	207
15%	948	244
10%	1,151	296
5%	1,497	386

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 = 0.002, n at f(α = 0.95) = 0.00775366.
- ⑤ The 90% row: 52 hours at p', 13 hours 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 campaign stay within its allowance? Two leaks are expected in 1,000 hours (μ = 2), and the allowance is 3: the campaign stays within it with probability 0.857123 - about 86 times in 100. One campaign in seven would need an extra seal change.

How bad the rate could be. At 0.00775366 leaks per hour the campaign would exceed 3 leaks 95 times in 100, and at 0.00510943, 75 times in 100 - the plot shows R at 1,000 hours of 0.05 and 0.25 on those curves. The known 0.002 is well below both.

How often to service. Without any leak allowed between services, keeping reliability at 90% means servicing every 52 hours at the known rate, or every 13 hours at the conservative rate (the service-interval table's 90% row).