THOMAS EAPEN · SELECTED WORK

Exploring the assumptions behind a staffing model

A research-focused Erlang-C illustration: calculate, cross-check and compare scenarios while keeping the model's assumptions explicit.

Original tools: **Excel / Python** · Example calculations: **Python**

Synthetic example · independently invented data · One-page A3 landscape

84	210s	4.9	7
invented arrivals per hour	mean service time	erlangs of offered load	servers in the highlighted scenario

SELECTED PYTHON

Offered load = arrivals per hour × mean service seconds ÷ 3,600. The function requires positive load below the number of interchangeable servers.

```
from math import isfinite
from scipy.stats import poisson

def erlang_c(load, agents):
    if type(agents) is not int or agents < 1:
        raise ValueError('Use a positive integer server count.')
    if not isfinite(load) or not 0 < load < agents:
        raise ValueError('A stable example needs 0 < load < agents.')
    at_capacity = poisson.pmf(agents, load)
    below_capacity = poisson.cdf(agents - 1, load)
    return float(at_capacity / (
        at_capacity + (1 - load / agents) * below_capacity
    ))
```

Extracted from the new helper that computes this example.

Equivalent Excel probability expression

```
=POISSON.DIST(Agents,Load,FALSE) /
 (POISSON.DIST(Agents,Load,FALSE) +
  (1-Load/Agents)*POISSON.DIST(Agents-1,Load,TRUE))
```

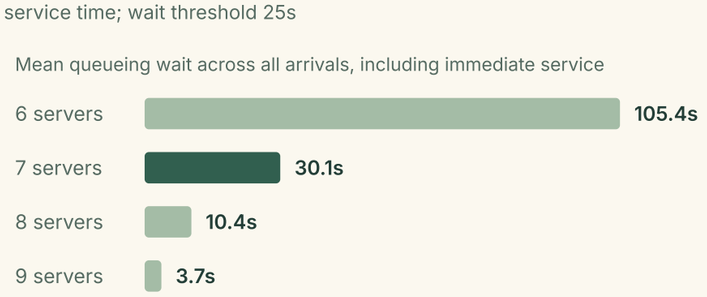
Agents and Load are named input cells. This expression is provided for comparison; Excel was not executed for this new example.

COMPUTED SCENARIOS

Inspect the sensitivity to capacity

Servers	Must wait	Mean wait	Within 25s
6	55.2%	105.4s	51.6%
7	**30.1%**	**30.1s**	**76.6%**
8	15.3%	10.4s	89.4%
9	7.3%	3.7s	95.5%

Same arrivals and service time; wait threshold 25s



Two independent Python formulations agree

The Poisson-ratio result matches an Erlang-B recurrence followed by the B-to-C identity within 1e−12 for every shown scenario.

Mean wait = C × mean service time ÷ (servers − load). The within-threshold fraction is 1 − C × exp(−(servers − load) × threshold ÷ mean service time).

The research approach

I explored these models in Excel and Python, then examined their limitations. This new study illustrates that approach with invented parameters and an independent implementation check. Agreement between formulas does not validate a real-world forecast.

State the assumptions

A stable long-run model with constant rates: Poisson arrivals, exponential service times, interchangeable servers, one unbounded FIFO queue and no abandonment. Skills-based routing and temporary surges need further investigation.

Thomas Eapen
nowlabs.net/tangerine-ida

New illustrative material explaining the approach. Values, configurations and results shown here are not historical workplace records.