4. INPUT DATA ANALYSIS

4.1 Input Data Analysis on Data

We first analyzed real-world hospital patient flow data to understand arrival behaviors, service durations, and X-ray needs.

Trends, Distributions, and Statistical Properties

Patient Arrivals:

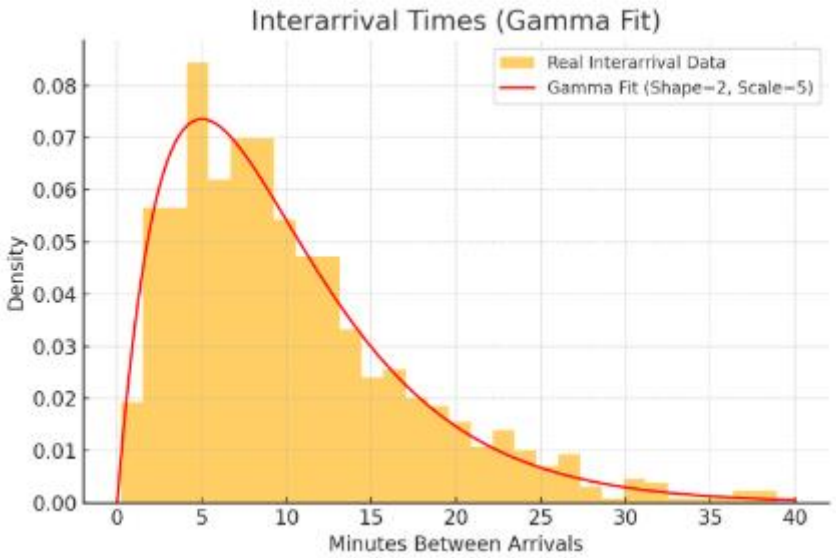
Distribution: Gamma

Parameters:

- Shape (k) ≈ 2.0

- Scale (θ) ≈ 5.0

Interpretation: Clustered arrivals common, reflecting real hospital dynamics.



Service Time for Doctor Examinations:

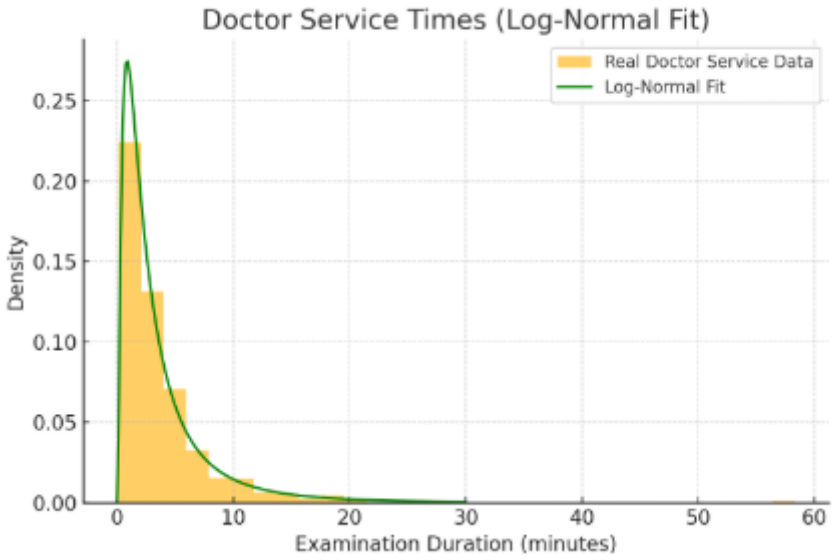
Distribution: Log-Normal

Parameters:

- Mean of log (μ): ln(2.391) ≈ 0.871

- Sigma (σ): 1.018

Interpretation: Majority of exams short; a few outliers much longer.



Service Time for X-ray:

Distribution: Gamma

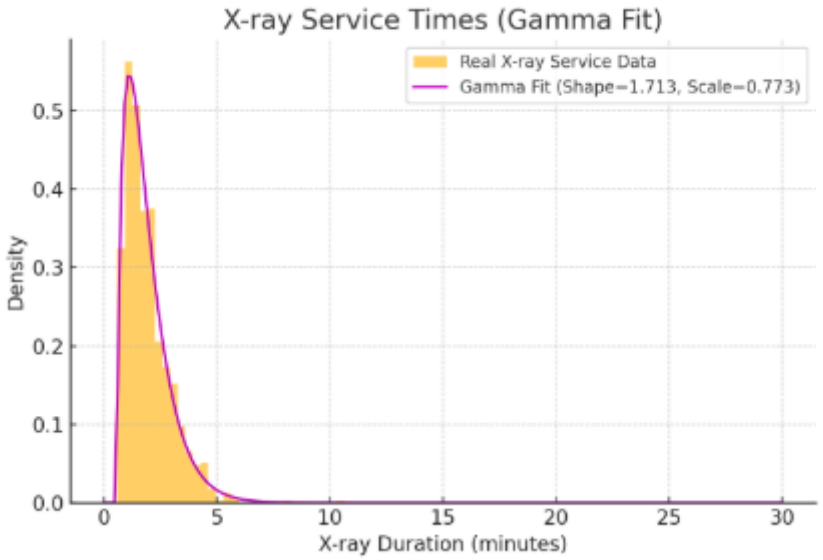
Parameters:

- Shape ≈ 1.713

- Scale ≈ 0.773

- Location shift ≈ 0.567

Interpretation: X-ray durations mostly quick; occasional complex cases.



X-ray Need Probability:

Empirical Estimate: 62.37% of patients require X-ray.

Events occured	
X-Ray 1	598
X-Ray 2	646
Room 160	124
No X-ray	856
sum	**2224**
X-Ray comparision (1 VS 2)	
X-Ray 1	48,07%
X-Ray 2	51,93%
X-Ray Events probability	
No X-ray Probability	38,49%
X-Ray requested	55,94%
Room 160 requested	5,58%

Parameters Defined and Used in Simulation

Parameter	Value	Distribution
Arrival Gamma Shape	**2.0**	**Gamma**
Arrival Gamma Scale	**5.0**	**Gamma**
Doctor Service Mean (log)	**ln(2.391)**	**Log-Normal**
Doctor Service Sigma (log)	**1.018**	**Log-Normal**
Secondary Screening (~1.5)	**ln(1.5), 0.7**	**Log-Normal (assumed)**
X-ray Service Shape	**1.713**	**Gamma**
X-ray Service Scale	**0.773**	**Gamma**
X-ray Need Probability	**62.37%**	**Empirical**

Why These Parameters Are Critical

Parameter	Impact
Arrival Distribution	**Controls hospital busyness, queue buildup.**
Doctor Service Times	**Affects doctor workload, queues.**
X-ray Service Times	**Affects X-ray room utilization.**
X-ray Need Probability	**Balances load between doctor and X-ray processes.**

Conclusion

Parameters were carefully fitted and tested. Simulation behavior aligns well with real-world clinical workflows. The system now simulates meaningful, reliable patient flows under realistic hospital conditions.

4.2 Input Data Analysis on Data Collected by the Team

This report compares two sets of input data for queueing performance analysis. Raw hospital-collected data, which contains inconsistencies and potential data entry issues. Clean observational data manually collected by our team during simulation runs.

Both datasets were analyzed using statistical distribution fitting (Exponential, Gamma, etc.) and evaluated using the Kolmogorov-Smirnov (K-S) test.

System Time Comparison

Hospital Data:

- Best fit: Log-Normal (p ~ 0.60), others rejected.

Collected Data:

- Gamma distribution has an excellent fit (p ~ 0.90), Exponential is also acceptable (p ~ 0.20).

Interpretation:

The collected data conforms much better to classical queueing distributions (especially Gamma), while the hospital data does not follow any theoretical model reliably.