Practice Problem Set

1. A campus shuttle service has **two pickup stops** and **one drop-off stop**. Shuttles arrive at Stop A, then proceed to Stop B, and then drop off passengers. Students arrive randomly at each stop and form queues.

1. State one clear objective for a simulation study (decision-oriented).
2. Define the system boundary (what you include/exclude).
3. List at least 4 inputs (stochastic + controllable) and at least 4 outputs (performance measures).
4. Give two simplifying assumptions and briefly state how each could bias results.

2. You are asked to evaluate whether adding a **third elevator** to a 6-floor building reduces peak-hour congestion. Write the main steps of a simulation study from start to finish (problem → model → data → verification/validation → experiments → output analysis → recommendation). Include at least one item under each: NW

- data collection / input modelling,
- verification vs. validation,
- experiment design (replications, warm-up, run length).

3. You recorded **interarrival times (minutes)** for 12 customers at a kiosk:

$$0.6,\ 1.1,\ 0.9,\ 2.4,\ 1.7,\ 0.8,\ 1.3,\ 0.5,\ 3.0,\ 1.6,\ 0.7,\ 1.0$$

Assume interarrival time T follows an **Exponential(λ)** model (rate λ).

1. Compute the MLE of λ. aps final reunion
2. Using your fitted model, estimate $P(T < 1)$.
3. Describe one diagnostic plot/test you would use to judge whether exponential is reasonable.

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4. You have the following **service-time observations (minutes)** from a repair desk:

$$4.2,\ 3.7,\ 5.1,\ 4.9,\ 3.5,\ 6.0,\ 4.1,\ 5.6$$

1. Construct the empirical CDF table (sort values + cumulative probabilities). rali
2. Using inverse-CDF lookup, generate one service time for each .dia

$$U \in \{0.12,\ 0.40,\ 0.88,\ 0.99\}.$$

3. Explain how you would modify the method if you wanted a piecewise-uniform (histogram) model instead of point-mass resampling.

5. A single-server cashier serves customers FCFS. The system is empty at time 0. For 7 customers:

with due respect

i	**Interarrival (min)**	**Service (min)**
1	0.0	1.3
2	0.9	0.7
3	1.4	1.0
4	0.5	1.8
5	2.0	0.6
6	0.4	1.2
7	1.1	0.9

1. Compute for each customer: arrival A_i, start B_i, departure D_i, queue wait $W_{q,i}$, time-in-system W_i.
2. Compute: average waiting time in queue $\overline{W_q}$, maximum queue waiting time, and server utilization over $[0, D_7]$.

i	A_i	B_i	D_i	$W_{q,i} = B_i - A_i$	$W_i = D_i - A_i$
1					
2					
3					
4					
5					
6					
7					

6. Consider a discrete-event simulation of a single-server queue using a **next-event time-advance** approach.

1. List the typical event types you need (minimum two). inter ST
2. Write pseudocode-level steps for handling an arrival event and a departure event (update state, schedule future events). 120 1 lakh
3. Suppose the current clock is $\boxed{10.0}$. The next arrival is scheduled at 12.5 and the next departure at 11.2. What is the next event? What does the clock advance to?

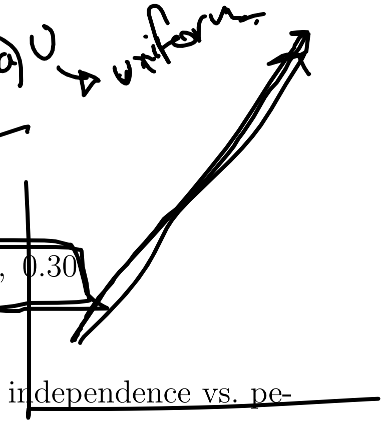
7. You want to estimate

$$p = P(X + Y < 1),$$

where $X \sim U(0,1)$ and $Y \sim U(0,1)$ are independent.

1. Write a clear Monte Carlo algorithm (plain English or pseudocode) to estimate p.
2. Define the estimator $\hat{p}$ and write its standard error estimate using $\hat{p}$.
3. Using the normal approximation, derive a formula for the required sample size n to achieve absolute error ≤ 0.03 at 95% confidence.

a+(b-a)U → uniform



8. A generator outputs the following $U(0,1)$ values:

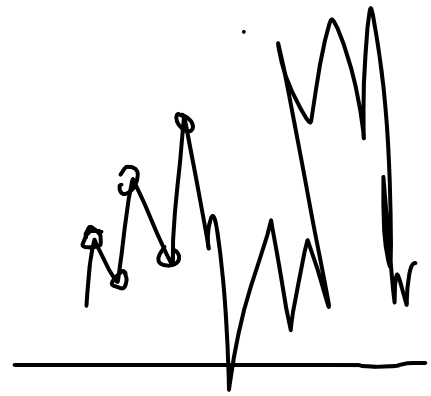
$$0.21,\ 0.22,\ 0.23,\ 0.24,\ 0.25,\ 0.26,\ 0.27,\ 0.28,\ 0.29,\ 0.30$$

1. Is this plausible for a good RNG? Why/why not?
2. Which RNG property is most clearly violated (uniformity vs. independence vs. period vs. something else)?
3. Name one simple test you could apply to detect the issue.

9. Let $U \sim U(0,1)$. You want to generate X with CDF:

$$F(x) = \sqrt{x}, \quad 0 \le x \le 1.$$

1. Derive the inverse-transform formula for X in terms of U.
2. Generate X for $U = 0.04,\ 0.81,\ 0.50$.



10. A random variable X has:

$$P(X=1) = 0.15, \quad P(X=2) = 0.10, \quad P(X=3) = 0.30, \quad P(X=4) = 0.25, \quad P(X=5) = 0.20.$$

1. Build the CDF table.
2. Generate X for $U \in \{0.05,\ 0.18,\ 0.44,\ 0.76,\ 0.99\}$ using "smallest x such that $F(x) \ge U$".

upto bottom

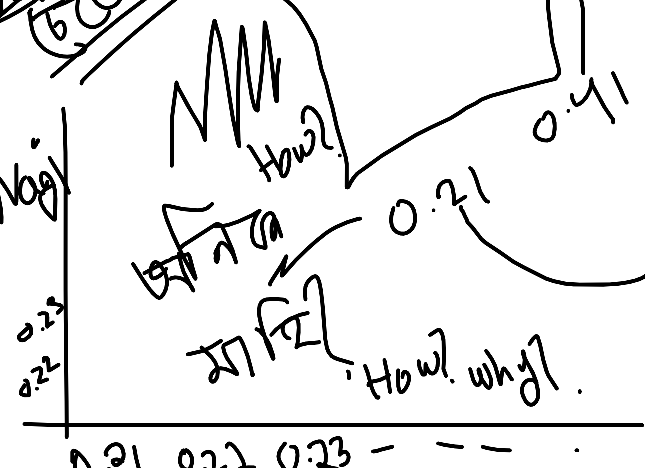
target: Abid & Anas

0.41 0.22 0.42 - ..

grp

gym Jabir Nagi

Tushin katrina



log=2

0.23 - -

deep

How?

Sensibility 0.21 0.22 0.23

Roast

Postabe karma

Nagi

নতুন

beaman নতুন

Sector

lag=1

lag=k

Junior

Cringe

add