FA7 1-4

Elisha Sophia Borromeo

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Github Link:

Campus-Related Issues Using Exponential Distribution

1. Identify a Practical Campus Problem

For this assessment, the group identified time between students arriving at an elevator- a practical campus problem where events occur randomly over time.

2. Collect Data

The table below shows the time intervals between the arrival of each person. The time is standardized.

Table 1: Waiting Time Between Student Arrivals at the Elevator (in Seconds)

Person	Waiting_Time_Seconds
1	62.00
2	45.00
3	22.78
4	2.00
5	104.20
6	43.00
7	104.20
8	115.34
9	91.63
10	29.25
11	36.01
12	7.36
13	13.82
14	61.91
15	11.75
16	2.81
17	15.46
18	75.10
19	85.47
20	10.99
21	13.60

Person	Waiting_Time_Seconds
22	131.94
23	41.26
24	28.84
25	46.69
26	21.80
27	53.86
28	202.49
29	120.00
30	40.91

3. Verify if Exponential Distribution is Applicable

Instruction 1: Check if events occur randomly and independently over time.

Because the group recorded interarrival times, this implies independence — since each record is a time interval not influenced by the last one. Since students come from various locations at random, this also indicates random occurrence.So, it's safe to assume events are independent and random over time. Therefore, we can apply the exponential distribution.

Instruction 2: Identify the average rate of event occurrence per unit of time.

The formula for lambda is:

$$\text{Lambda} = \frac{n}{\sum(\text{waiting times})}$$

Where n is the number of events, and $\sum$(waiting times) is the sum of all the waiting times. Through manual calculation, we get:

$$\text{Lambda} = \frac{30}{1,641.47}$$

$$\text{Lambda} = 0.0182763$$

For number 4, we will be calculating lambda using a statistical tool.

4. Compute Key Parameters

Mean (Expected Value)

For the exponential distribution, the mean (expected value μ) is the reciprocal of the rate λ:

$$\lambda = \frac{\text{Number of Observations}}{\text{Total Waiting Time}}$$

$$\mu = \frac{1}{\lambda}$$

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## Mean waiting time: 54.716 seconds
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Probability Density Function (PDF)

$$f(x) = \lambda e^{-\lambda x}, \quad \text{for } x \geq 0$$

Table 2: PDF Values for Each Data Point

Time_Seconds	PDF
62.00	0.00589
45.00	0.00803
22.78	0.01205
2.00	0.01762
104.20	0.00272
43.00	0.00833
104.20	0.00272
115.34	0.00222
91.63	0.00342
29.25	0.01071
36.01	0.00946
7.36	0.01598
13.82	0.01420
61.91	0.00590
11.75	0.01474
2.81	0.01736
15.46	0.01378
75.10	0.00463
85.47	0.00383
10.99	0.01495
13.60	0.01425
131.94	0.00164
41.26	0.00860
28.84	0.01079
46.69	0.00779
21.80	0.01227
53.86	0.00683
202.49	0.00045
120.00	0.00204
40.91	0.00865

Cumulative Distribution Function (CDF)

$$F(x) = 1 - e^{-\lambda x}, \quad \text{for } x \geq 0$$

Table 3: CDF Values for Each Data Point

Time_Seconds	CDF
62.00	0.67798
45.00	0.56064
22.78	0.34054
2.00	0.03589
104.20	0.85109
43.00	0.54428

Time_Seconds	CDF
104.20	0.85109
115.34	0.87852
91.63	0.81263
29.25	0.41409
36.01	0.48218
7.36	0.12586
13.82	0.22320
61.91	0.67745
11.75	0.19325
2.81	0.05006
15.46	0.24614
75.10	0.74654
85.47	0.79030
10.99	0.18197
13.60	0.22008
131.94	0.91031
41.26	0.52956
28.84	0.40968
46.69	0.57400
21.80	0.32862
53.86	0.62632
202.49	0.97530
120.00	0.88844
40.91	0.52654