University Library

Simulation Project

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Data Collection

Data Excel File

Collected Data Points:

Arrival Time: Exact timestamp of each arrival.

Service Time: Start and End.

Activity Type: Categorized as either **Printing** or **Shopping**.

Walking Time: Difference in time of walking from the door to the cashier.

Shopping Time: Difference in time from starting shopping to ending shopping.

Time Period: Specified as either during a **Lecture** or **Break**.

Arrival Time Data Collection

Customer ID	Arrival Timestamp	Number	Inter-Arrival Times	Inter-Arrival Times in minutes	Period
1	9:40:58 AM	2	0:00:00	0	Lecture
2	9:50:46 AM	3	0:09:48	9.8	Lecture
3	9:54:06 AM	2	0:03:20	3.333333333	Lecture
4	9:55:55 AM	3	0:01:49	1.816666667	Lecture
5	9:58:18 AM	2	0:02:23	2.383333333	Lecture
6	10:01:15 AM	1	0:02:57	2.95	Lecture
39	10:39:24 AM	1	0:00:31	0.516666667	Break
40	10:39:54 AM	1	0:00:30	0.5	Break
41	10:40:24 AM	2	0:00:30	0.5	Break
42	10:41:32 AM	1	0:01:08	1.133333333	Break
43	10:41:50 AM	4	0:00:18	0.3	Break
44	10:41:51 AM	3	0:00:01	0.016666667	Break

Service Time Data Collection

Process Index	Service Start Timestamp	Service End Timestamp	Service Times	Service Time in minutes	Notes	Period	Action
1	9:40:58 AM	9:43:49 AM	0:02:51	2.85		Lecture	Print
2	9:52:34 AM	9:52:47 AM	0:00:13	0.216666667		Lecture	Shopping
3	9:54:06 AM	9:56:11 AM	0:02:05	2.083333333		Lecture	Print
4	9:56:11 AM	9:56:43 AM	0:00:32	0.533333333		Lecture	Print
5	9:58:18 AM	9:59:10 AM	0:00:52	0.866666667		Lecture	Print
6	10:01:15 AM	10:02:03 AM	0:00:48	0.8		Lecture	Print
7	10:05:40 AM	10:06:30 AM	0:00:50	0.833333333		Lecture	Print
8	10:07:05 AM	10:09:19 AM	0:02:14	2.233333333		Lecture	Print
9	10:10:27 AM	10:16:00 AM	0:05:33	5.55		Lecture	Print
10	10:16:00 AM	10:18:00 AM	0:02:00	2		Lecture	Print
11	10:38:39 AM	10:40:00 AM	0:01:21	1.35		Break	Print
12	10:40:00 AM	10:43:08 AM	0:03:08	3.133333333		Break	Shopping
13	10:44:00 AM	10:45:34 AM	0:01:34	1.566666667		Break	Print

ID	Shopping Start Timestamp	Shopping End Timestamp	Shopping Time	Time in Seconds
1	9:52:36 AM	9:54:32 AM	0.001342593	116
2	10:40:00 AM	10:40:44 AM	0.000509259	44
3	10:55:58 AM	10:56:51 AM	0.000613426	53
4	11:03:40 AM	11:04:19 AM	0.000451389	39
5	11:36:43 AM	11:37:44 AM	0.000706019	61
6	11:37:20 AM	11:39:00 AM	0.001157407	100
7	11:38:49 AM	11:39:25 AM	0.000416667	36

| ID	From the Door	To the Cashier	Walking Time	Time in Seconds
1	9:40:58 AM	9:41:05 AM	8.10185E-05	7
2	9:50:46 AM	9:50:51 AM	5.78704E-05	5
3	9:54:06 AM	9:54:14 AM	9.25926E-05	8
4	9:55:55 AM	9:56:04 AM	0.000104167	9
5	9:58:18 AM	9:58:30 AM	0.000138889	12
6	10:01:15 AM	10:01:20 AM	5.78704E-05	5
7	10:05:40 AM	10:05:47 AM	8.10185E-05	7

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Student Arrival Analysis

Break and Lecture
Period Arrival

Arrival Pattern

- Data was collected during the whole shift in the university library on Wednesday during lecture and break time.

- Break periods experience higher arrival rates creating a rush-hour effect.

- Student arrival depended on the break periods.

Arrival Distribution without Subsetting (Best Fit)
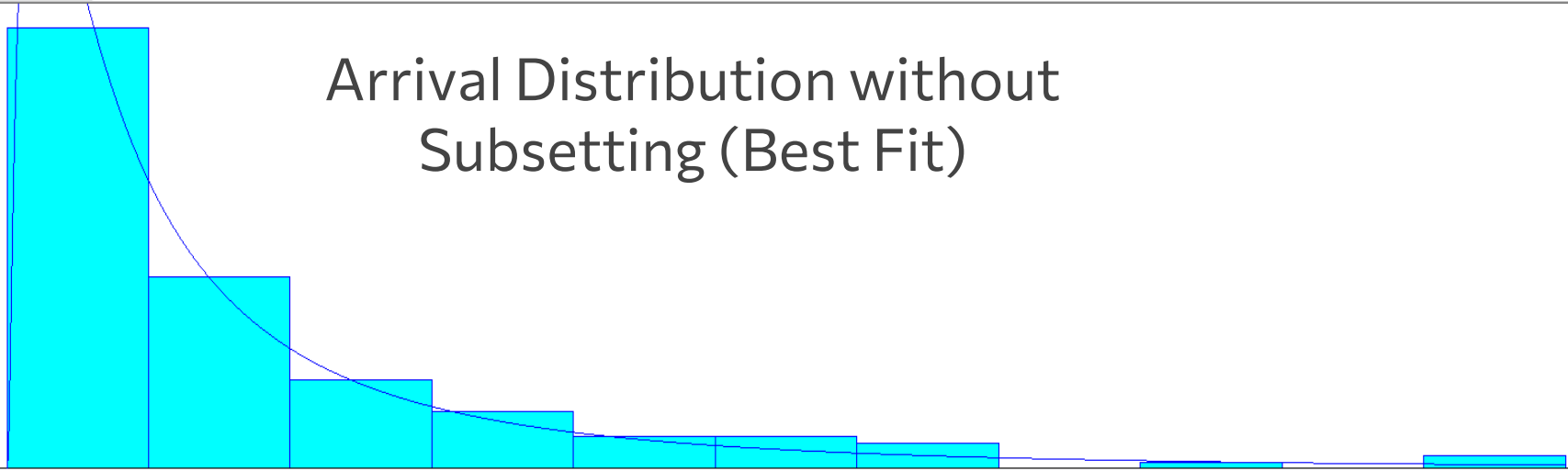
Distribution Summary

Distribution: Lognormal
Expression: LOGN(1.29, 2.42)
Square Error: 0.001266

Chi Square Test
  Number of intervals   = 4
  Degrees of freedom   = 1
  Test Statistic   = 1.62
  Corresponding p-value = 0.218

Kolmogorov-Smirnov Test
  Test Statistic   = 0.0644
  Corresponding p-value > 0.15
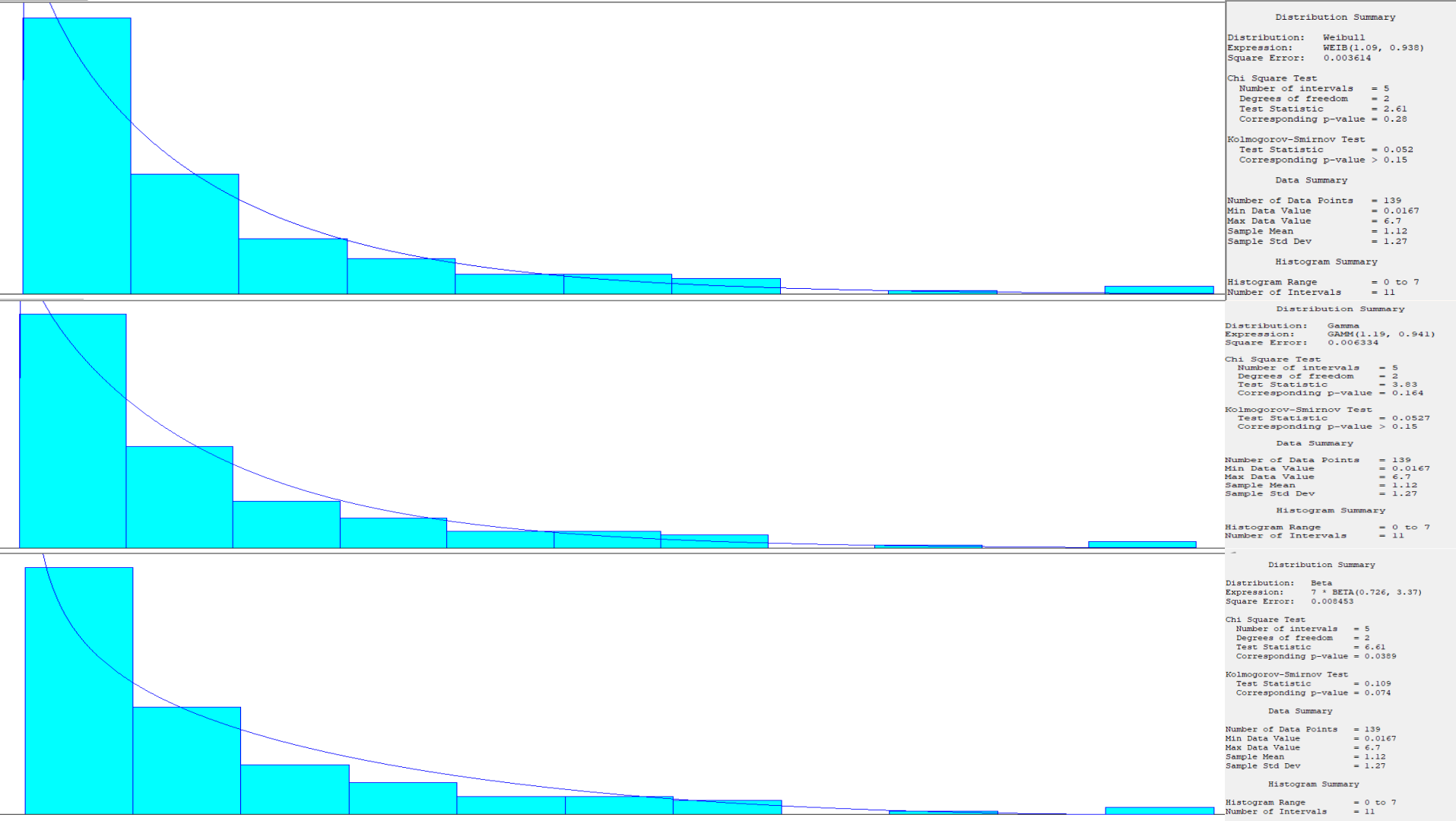
Data Summary

Number of Data Points = 139
Min Data Value   = 0.0167
Max Data Value   = 6.7
Sample Mean   = 1.12
Sample Std Dev   = 1.27

Histogram Summary

Histogram Range   = 0 to 7
Number of Intervals   = 11

Function	Sq Error
Lognormal	0.00127
Weibull	0.00361
Gamma	0.00633
Exponential	0.00723
Erlang	0.00723
Beta	0.00845
Normal	0.126
Triangular	0.158
Uniform	0.22

Distribution Summary

Distribution: Weibull
Expression: WEIB(1.09, 0.938)
Square Error: 0.003614

Chi Square Test
  Number of intervals   = 5
  Degrees of freedom   = 2
  Test Statistic   = 2.61
  Corresponding p-value = 0.28

Kolmogorov-Smirnov Test
  Test Statistic   = 0.052
  Corresponding p-value > 0.15

Data Summary

Number of Data Points   = 139
Min Data Value   = 0.0167
Max Data Value   = 6.7
Sample Mean   = 1.12
Sample Std Dev   = 1.27

Histogram Summary

Histogram Range   = 0 to 7
Number of Intervals   = 11

Distribution Summary

Distribution: Gamma
Expression: GAMM(1.19, 0.941)
Square Error: 0.006334

Chi Square Test
  Number of intervals   = 5
  Degrees of freedom   = 2
  Test Statistic   = 3.83
  Corresponding p-value = 0.164

Kolmogorov-Smirnov Test
  Test Statistic   = 0.0527
  Corresponding p-value > 0.15

Data Summary

Number of Data Points   = 139
Min Data Value   = 0.0167
Max Data Value   = 6.7
Sample Mean   = 1.12
Sample Std Dev   = 1.27

Histogram Summary

Histogram Range   = 0 to 7
Number of Intervals   = 11

Distribution Summary

Distribution: Beta
Expression: 7 * BETA(0.726, 3.37)
Square Error: 0.008453

Chi Square Test
  Number of intervals   = 5
  Degrees of freedom   = 2
  Test Statistic   = 6.61
  Corresponding p-value = 0.0389

Kolmogorov-Smirnov Test
  Test Statistic   = 0.109
  Corresponding p-value = 0.074

Data Summary

Number of Data Points   = 139
Min Data Value   = 0.0167
Max Data Value   = 6.7
Sample Mean   = 1.12
Sample Std Dev   = 1.27

Histogram Summary

Histogram Range   = 0 to 7
Number of Intervals   = 11
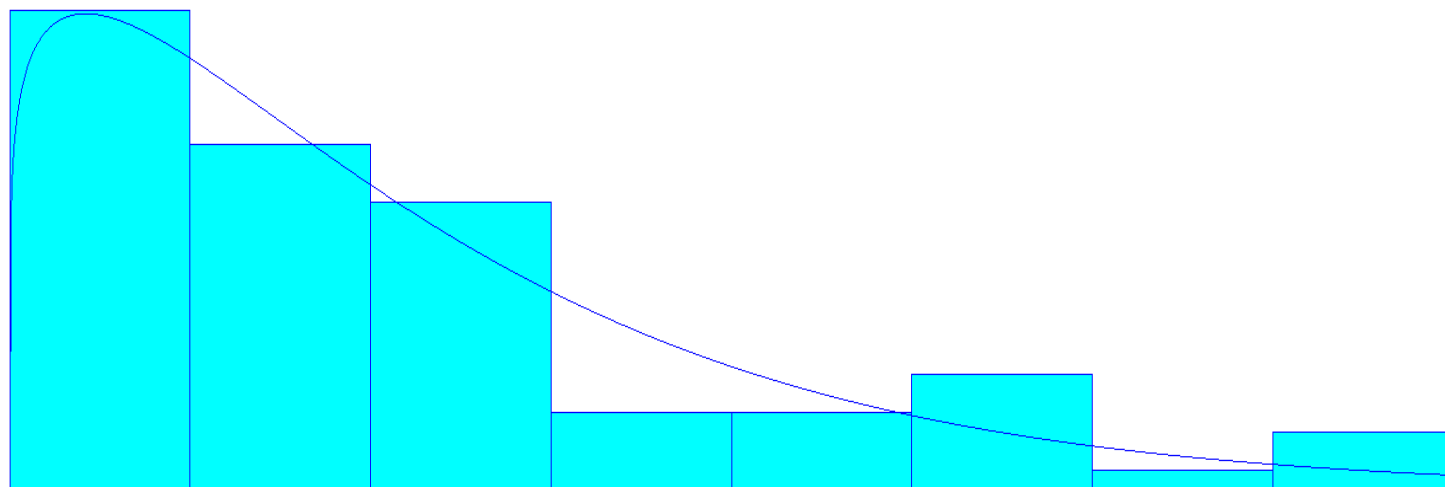
Arrival Break Distributions
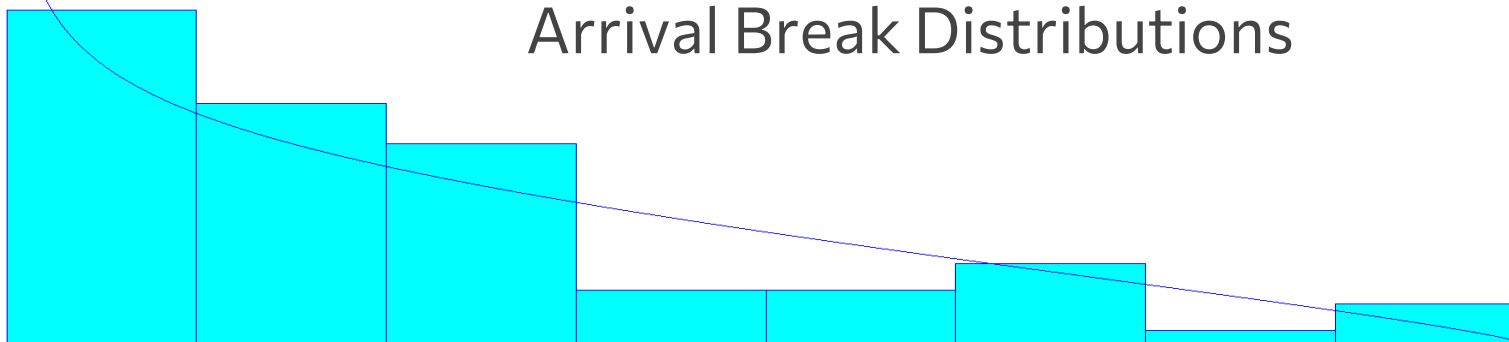
Distribution Summary

Distribution: Beta
Expression: 2 * BETA(0.799, 1.8)
Square Error: 0.012315

Chi Square Test
   Number of intervals   = 5
   Degrees of freedom   = 2
   Test Statistic   = 5.98
   Corresponding p-value = 0.0505

Kolmogorov-Smirnov Test
   Test Statistic   = 0.116
   Corresponding p-value > 0.15

         Data Summary

Number of Data Points   = 76
Min Data Value   = 0.0167
Max Data Value   = 1.97
Sample Mean   = 0.559
Sample Std Dev   = 0.484

       Histogram Summary

Histogram Range   = 0 to 2
Number of Intervals   = 8
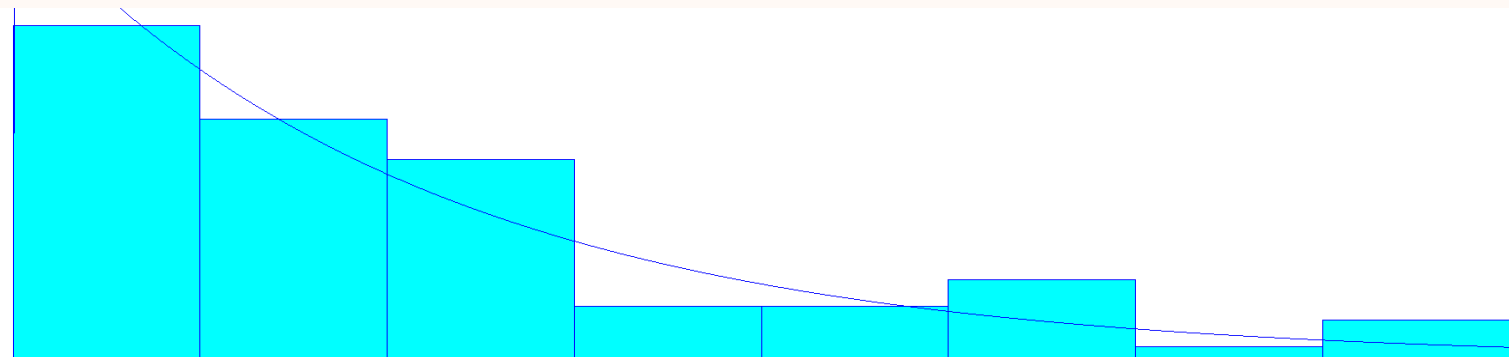
Distribution Summary

Distribution: Erlang
Expression: ERLA(0.559, 1)
Square Error: 0.007648

Chi Square Test
   Number of intervals   = 4
   Degrees of freedom   = 1
   Test Statistic   = 2.71
   Corresponding p-value = 0.0999

Kolmogorov-Smirnov Test
   Test Statistic   = 0.083
   Corresponding p-value > 0.15

         Data Summary

Number of Data Points   = 76
Min Data Value   = 0.0167
Max Data Value   = 1.97
Sample Mean   = 0.559
Sample Std Dev   = 0.484

       Histogram Summary

Histogram Range   = 0 to 2
Number of Intervals   = 8
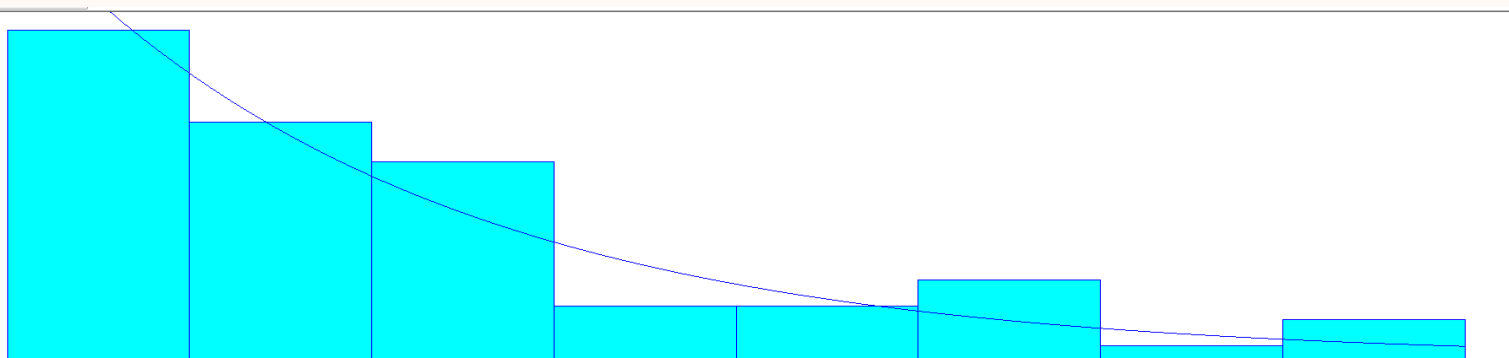
Distribution Summary

Distribution: Exponential
Expression: EXPO(0.559)
Square Error: 0.007648

Chi Square Test
   Number of intervals   = 4
   Degrees of freedom   = 2
   Test Statistic   = 2.71
   Corresponding p-value = 0.262

Kolmogorov-Smirnov Test
   Test Statistic   = 0.083
   Corresponding p-value > 0.15

         Data Summary

Number of Data Points   = 76
Min Data Value   = 0.0167
Max Data Value   = 1.97
Sample Mean   = 0.559
Sample Std Dev   = 0.484

       Histogram Summary

Histogram Range   = 0 to 2
Number of Intervals   = 8

Distribution Summary

Distribution: Weibull
Expression: WEIB(0.589, 1.16)
Square Error: 0.006970

Chi Square Test
  Number of intervals   = 5
  Degrees of freedom   = 2
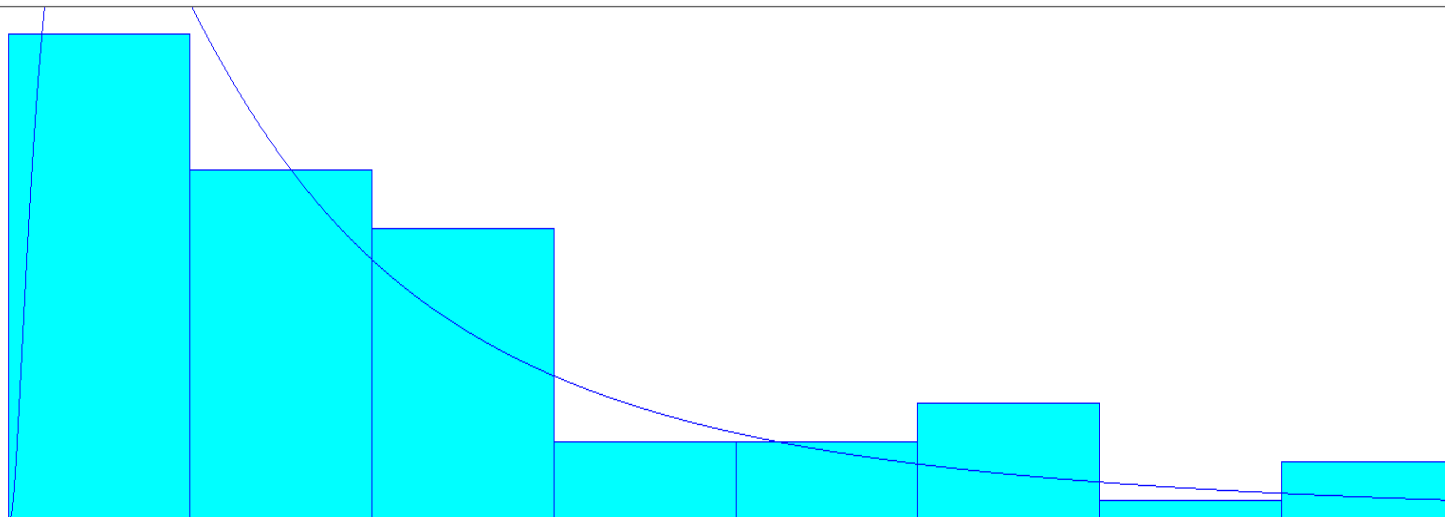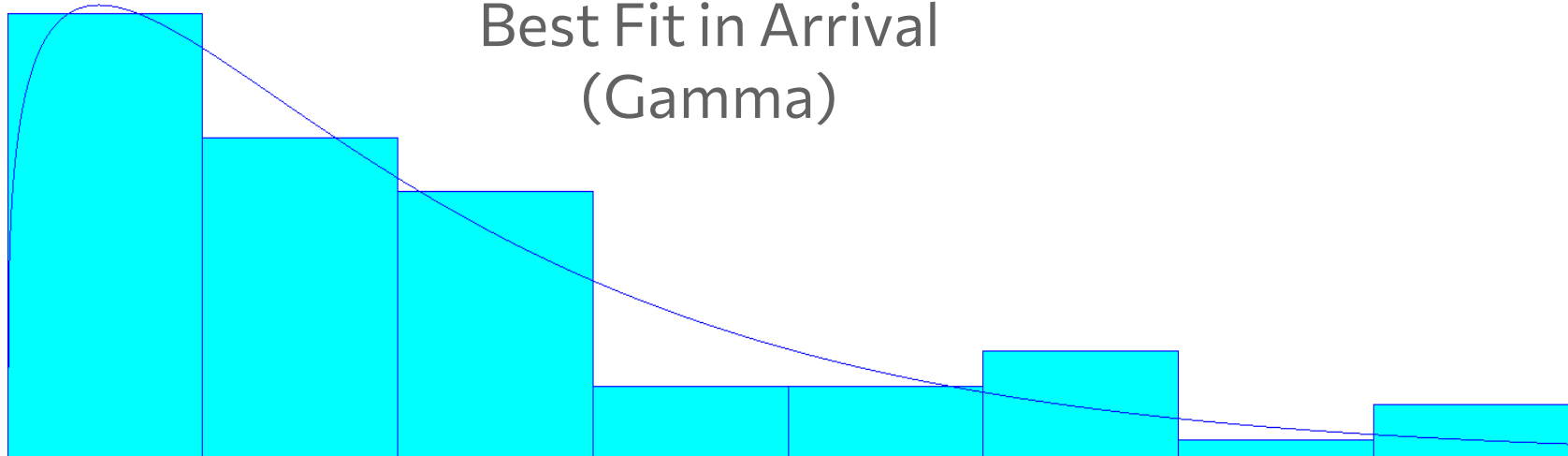 Test Statistic   = 4.12
  Corresponding p-value = 0.14

Kolmogorov-Smirnov Test
  Test Statistic   = 0.0432
  Corresponding p-value > 0.15
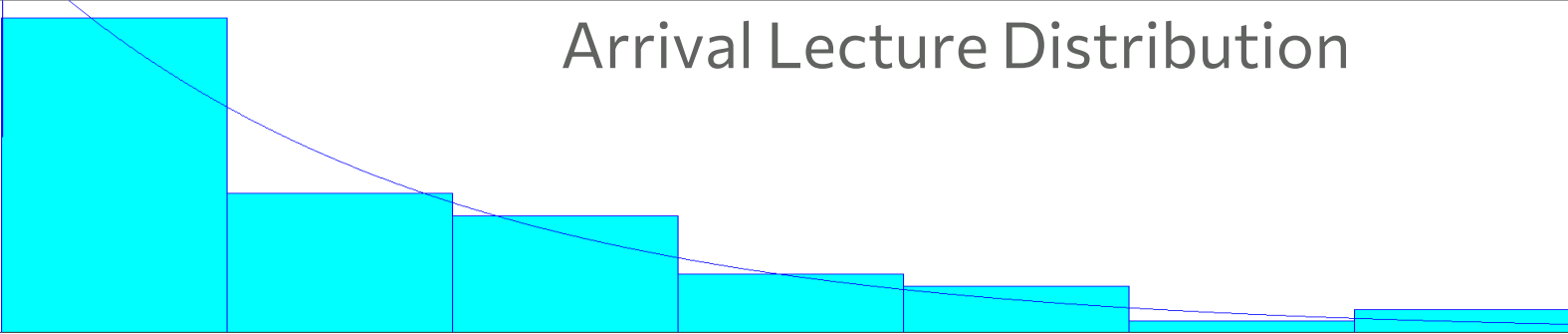
        Data Summary

Number of Data Points   = 76
Min Data Value   = 0.0167
Max Data Value   = 1.97
Sample Mean   = 0.559
Sample Std Dev   = 0.484

        Histogram Summary

Histogram Range   = 0 to 2
Number of Intervals   = 8

        Distribution Summary

Distribution: Lognormal
Expression: LOGN(0.642, 0.954)
Square Error: 0.009669

Chi Square Test
  Number of intervals   = 4
  Degrees of freedom   = 1
  Test Statistic   = 3.9
  Corresponding p-value = 0.0487

Kolmogorov-Smirnov Test
  Test Statistic   = 0.0949
  Corresponding p-value > 0.15

        Data Summary

Number of Data Points   = 76
Min Data Value   = 0.0167
Max Data Value   = 1.97
Sample Mean   = 0.559
Sample Std Dev   = 0.484

        Histogram Summary

Histogram Range   = 0 to 2
Number of Intervals   = 8

Best Fit in Arrival
(Gamma)


```
        Distribution Summary

Distribution:    Gamma
Expression:      GAMM(0.443, 1.26)
Square Error:    0.006810

Chi Square Test
  Number of intervals  = 5
  Degrees of freedom   = 2
  Test Statistic       = 4.48
  Corresponding p-value = 0.11

Kolmogorov-Smirnov Test
  Test Statistic       = 0.0408
  Corresponding p-value > 0.15

        Data Summary

Number of Data Points  = 76
Min Data Value         = 0.0167
Max Data Value         = 1.97
Sample Mean            = 0.559
Sample Std Dev         = 0.484

        Histogram Summary

Histogram Range        = 0 to 2
Number of Intervals    = 8
```

Arrival Lecture Distribution

Distribution Summary

Distribution: Erlang
Expression: ERLA(1.81, 1)
Square Error: 0.003912

Chi Square Test
   Number of intervals = 4
   Degrees of freedom   = 1
   Test Statistic   = 1.29
   Corresponding p-value = 0.259

Kolmogorov-Smirnov Test
   Test Statistic   = 0.0916
   Corresponding p-value > 0.15
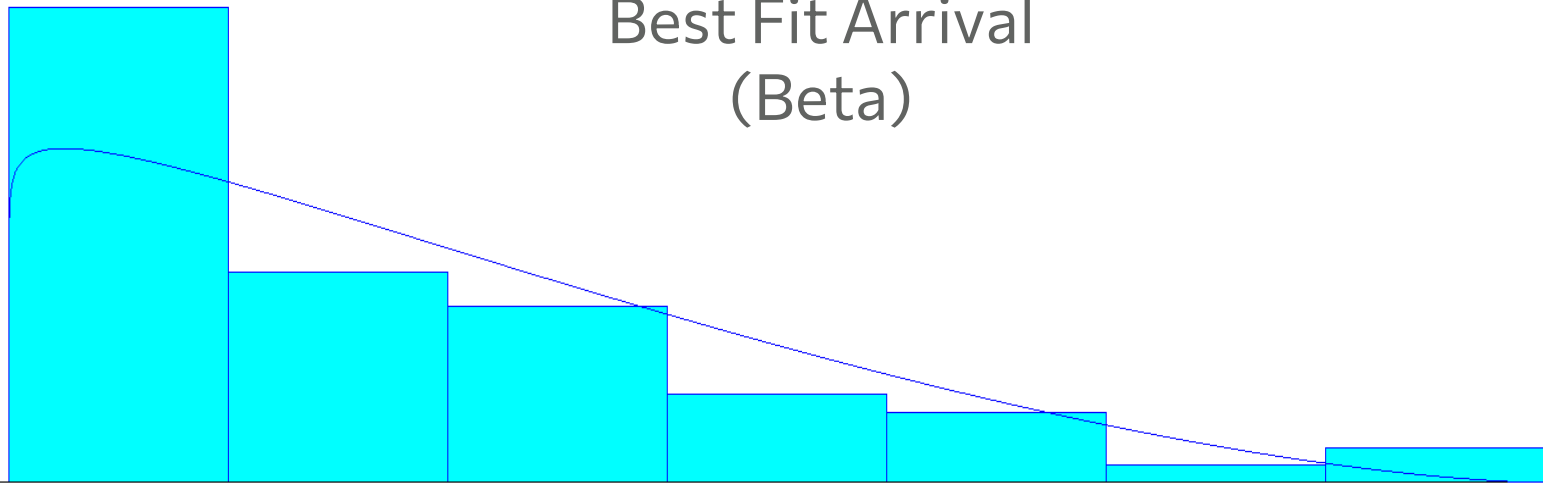
Data Summary

Number of Data Points = 61
Min Data Value   = 0.05
Max Data Value   = 6.7
Sample Mean   = 1.81
Sample Std Dev   = 1.58

Histogram Summary

Histogram Range   = 0 to 7
Number of Intervals   = 7

Distribution Summary

Distribution: Exponential
Expression: EXPO(1.81)
Square Error: 0.003912

Chi Square Test
   Number of intervals = 4
   Degrees of freedom   = 2
   Test Statistic   = 1.29
   Corresponding p-value = 0.529

Kolmogorov-Smirnov Test
   Test Statistic   = 0.0916
   Corresponding p-value > 0.15

Data Summary

Number of Data Points = 61
Min Data Value   = 0.05
Max Data Value   = 6.7
Sample Mean   = 1.81
Sample Std Dev   = 1.58

Histogram Summary

Histogram Range   = 0 to 7
Number of Intervals   = 7

Distribution Summary

Distribution: Weibull
Expression: WEIB(1.91, 1.15)
Square Error: 0.011085

Chi Square Test
   Number of intervals = 4
   Degrees of freedom   = 1
   Test Statistic   = 2.24
   Corresponding p-value = 0.15

Kolmogorov-Smirnov Test
   Test Statistic   = 0.0685
   Corresponding p-value > 0.15

Data Summary

Number of Data Points = 61
Min Data Value   = 0.05
Max Data Value   = 6.7
Sample Mean   = 1.81
Sample Std Dev   = 1.58

Histogram Summary

Histogram Range   = 0 to 7
Number of Intervals   = 7

Best Fit Arrival
(Beta)


```
        Distribution Summary

Distribution:  Beta
Expression:    7 * BETA(1.06, 2.59)
Square Error:  0.021155

Chi Square Test
  Number of intervals   = 4
  Degrees of freedom    = 1
  Test Statistic        = 4.26
  Corresponding p-value = 0.0411

Kolmogorov-Smirnov Test
  Test Statistic        = 0.0835
  Corresponding p-value > 0.15

        Data Summary

Number of Data Points = 61
Min Data Value        = 0.05
Max Data Value        = 6.7
Sample Mean           = 1.81
Sample Std Dev        = 1.58

        Histogram Summary

Histogram Range       = 0 to 7
Number of Intervals   = 7
```

Function	Sq Error
Beta	0.00272
Erlang	0.00391
Exponential	0.00391
Lognormal	0.00626
Gamma	0.011
Weibull	0.0111
Triangular	0.0676
Normal	0.081
Uniform	0.131

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Student Arrival
Break and Lecture Period Arrival

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Data Collection
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Arena Simulation Model

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Process Flow
Shopping and Printing
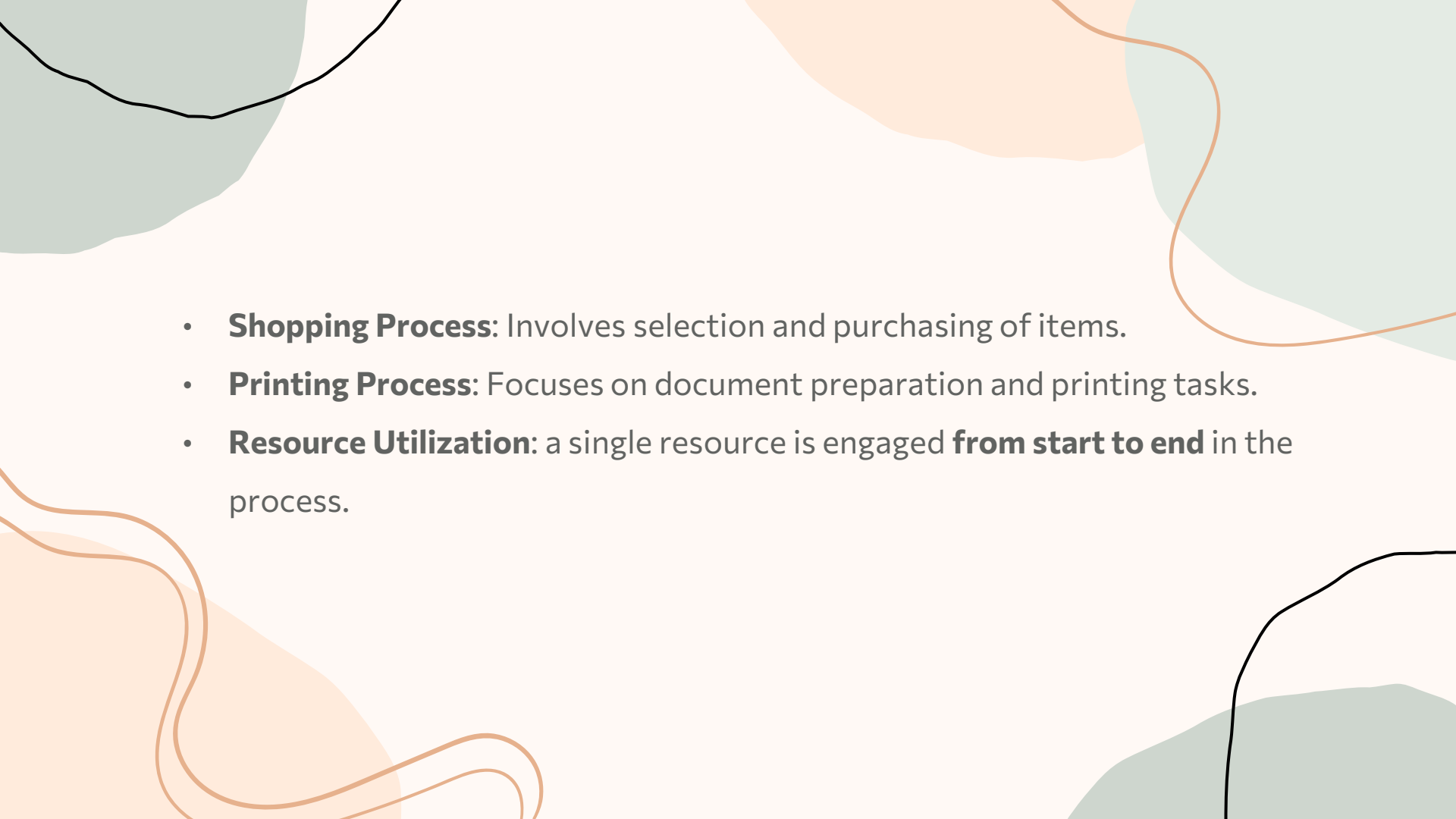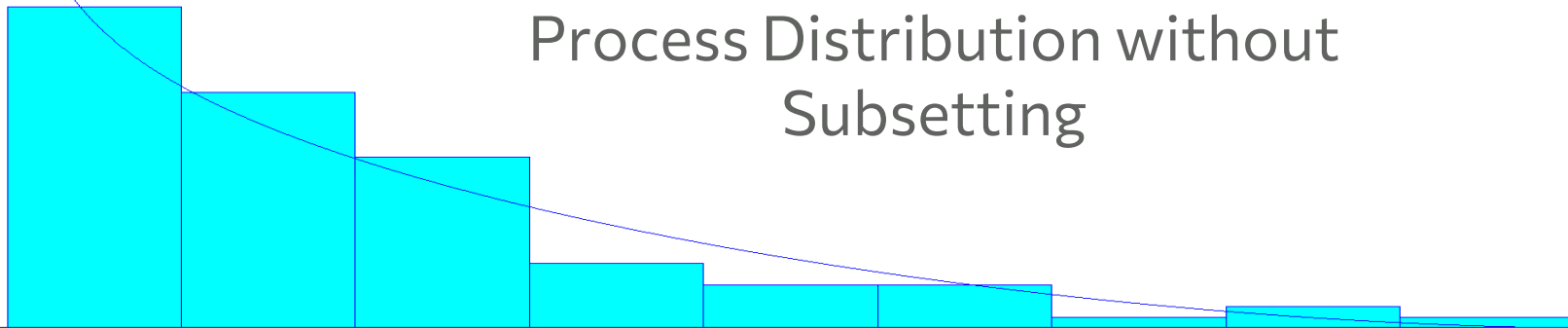
03

Process Flow

Shopping and Printing

- **Shopping Process**: Involves selection and purchasing of items.

- **Printing Process**: Focuses on document preparation and printing tasks.

- **Resource Utilization**: a single resource is engaged **from start to end** in the process.

Process Distribution without Subsetting

Distribution Summary

Distribution: Beta
Expression: 6.63 * BETA(0.808, 2.67)
Square Error: 0.005572

Chi Square Test
    Number of intervals   = 5
    Degrees of freedom   = 2
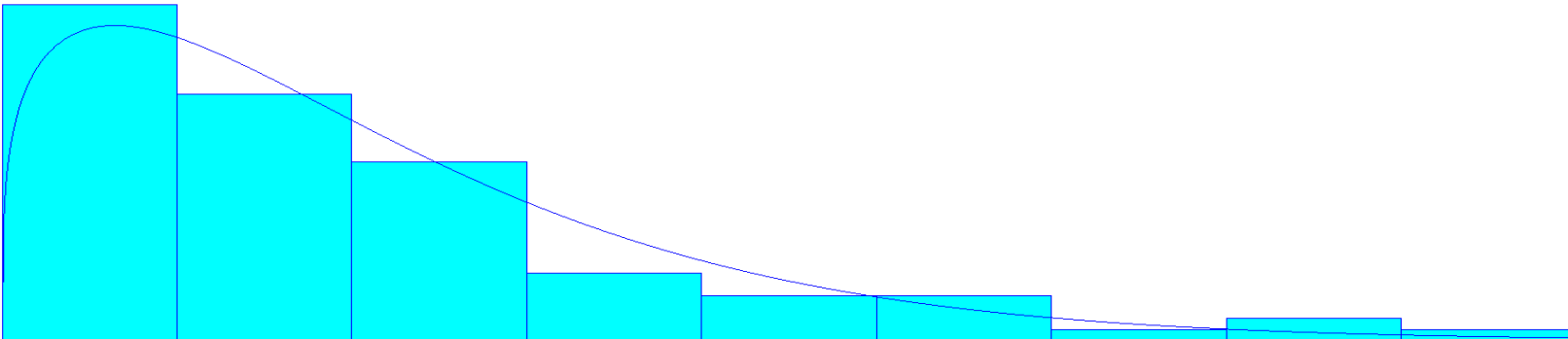   Test Statistic   = 3.33
    Corresponding p-value = 0.205

Kolmogorov-Smirnov Test
    Test Statistic   = 0.139
    Corresponding p-value = 0.068

        Data Summary

Number of Data Points   = 86
Min Data Value   = 0.12
Max Data Value   = 6.03
Sample Mean   = 1.54
Sample Std Dev   = 1.32

        Histogram Summary

Histogram Range   = 0 to 6.63
Number of Intervals   = 9

Distribution Summary

Distribution: Weibull
Expression: WEIB(1.66, 1.26)
Square Error: 0.005053

Chi Square Test
    Number of intervals   = 5
    Degrees of freedom   = 2
    Test Statistic   = 2.27
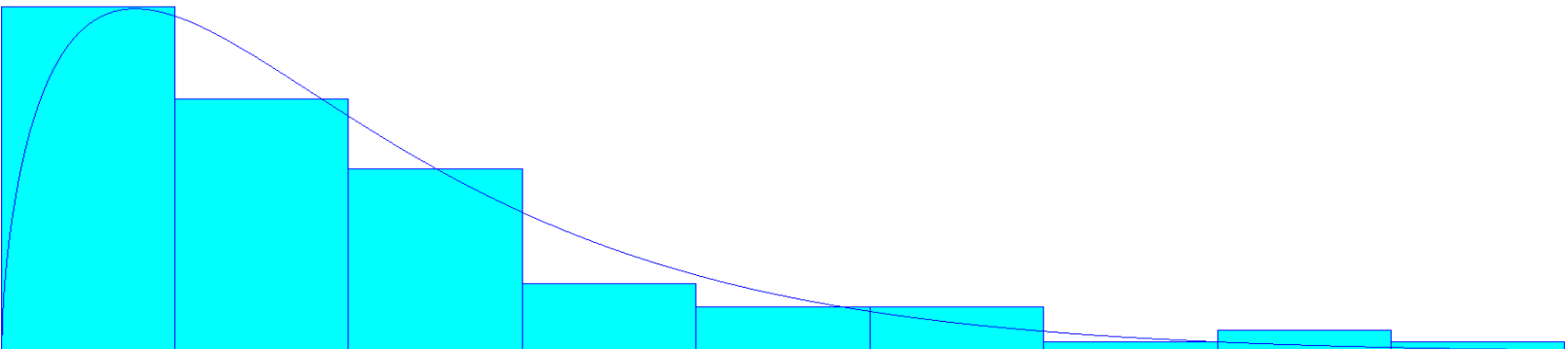   Corresponding p-value = 0.341

Kolmogorov-Smirnov Test
    Test Statistic   = 0.0662
    Corresponding p-value > 0.15

        Data Summary

Number of Data Points   = 86
Min Data Value   = 0.12
Max Data Value   = 6.03
Sample Mean   = 1.54
Sample Std Dev   = 1.32

        Histogram Summary

Histogram Range   = 0 to 6.63
Number of Intervals   = 9

Distribution Summary

Distribution: Gamma
Expression: GAMM(0.973, 1.58)
Square Error: 0.006609

Chi Square Test
    Number of intervals   = 5
    Degrees of freedom   = 2
    Test Statistic   = 2.81
    Corresponding p-value = 0.247

Kolmogorov-Smirnov Test
    Test Statistic   = 0.0711
    Corresponding p-value > 0.15
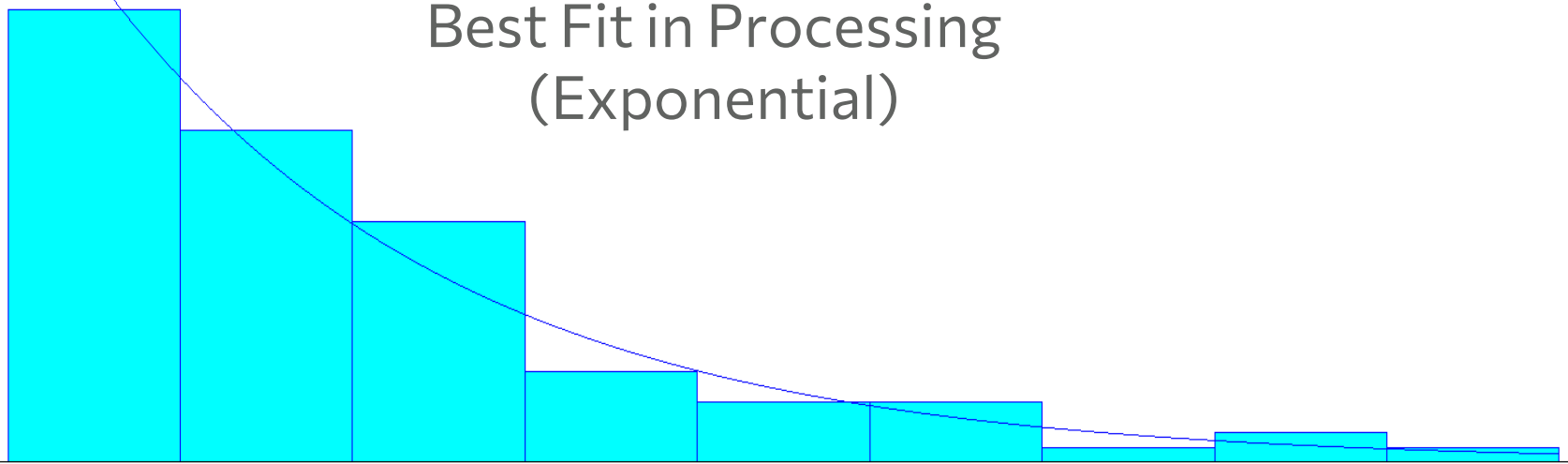
        Data Summary

Number of Data Points   = 86
Min Data Value   = 0.12
Max Data Value   = 6.03
Sample Mean   = 1.54
Sample Std Dev   = 1.32

        Histogram Summary

Histogram Range   = 0 to 6.63
Number of Intervals   = 9

Best Fit in Processing (Exponential)

Distribution Summary

Distribution: Exponential
Expression: EXPO(1.54)
Square Error: 0.003861

Chi Square Test
  Number of intervals   = 4
  Degrees of freedom   = 2
  Test Statistic   = 1.94
  Corresponding p-value = 0.4

Kolmogorov-Smirnov Test
  Test Statistic   = 0.136
  Corresponding p-value = 0.0802

Data Summary

Number of Data Points = 86
Min Data Value   = 0.12
Max Data Value   = 6.03
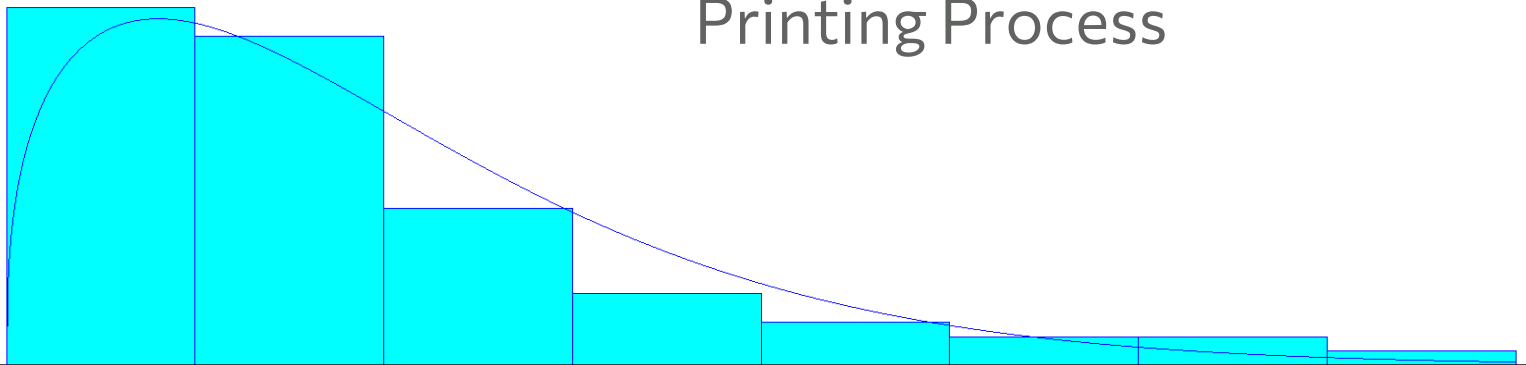Sample Mean   = 1.54
Sample Std Dev   = 1.32

Histogram Summary

Histogram Range   = 0 to 6.63
Number of Intervals = 9

| Function	Sq Error
Exponential	0.00386
Lognormal	0.00498
Weibull	0.00505
Beta	0.00557
Gamma	0.00661
Erlang	0.0179
Normal	0.0539
Triangular	0.0539
Uniform	0.121

Printing Process

Distribution Summary

Distribution: Weibull
Expression: WEIB(1.8, 1.35)
Square Error: 0.007537

Chi Square Test
   Number of intervals   = 5
   Degrees of freedom   = 2
   Test Statistic   = 2.72
   Corresponding p-value = 0.26

Kolmogorov-Smirnov Test
   Test Statistic   = 0.0811
   Corresponding p-value > 0.15

        Data Summary

Number of Data Points   = 72
Min Data Value   = 0.25
Max Data Value   = 6.03
Sample Mean   = 1.64
Sample Std Dev   = 1.34

      Histogram Summary

Histogram Range   = 0 to 6.62
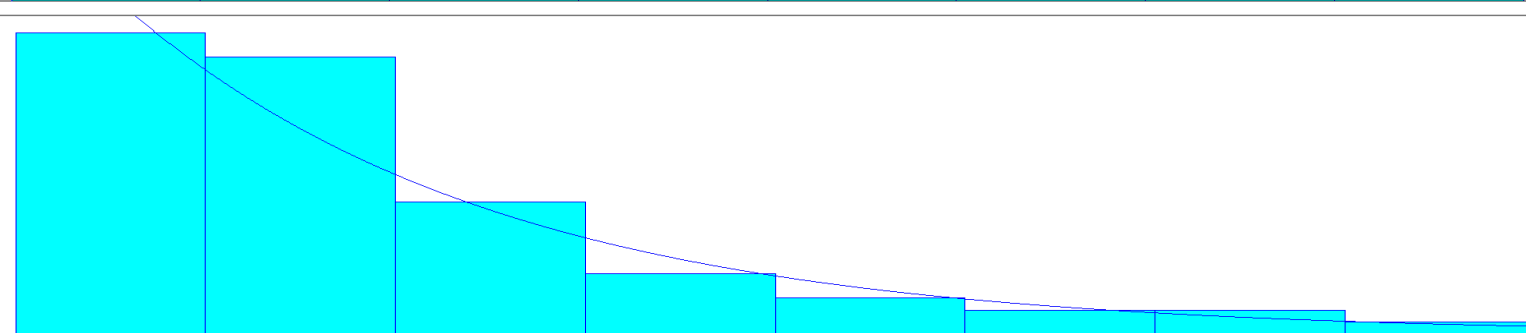Number of Intervals   = 8
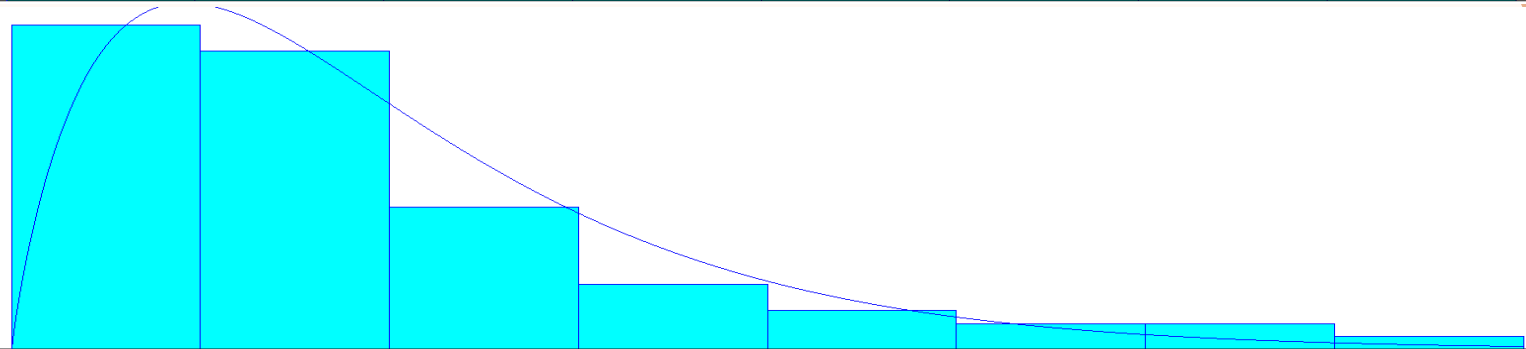
Distribution Summary

Distribution: Gamma
Expression: GAMM(0.88, 1.86)
Square Error: 0.008257

Chi Square Test
   Number of intervals   = 4
   Degrees of freedom   = 1
   Test Statistic   = 2.89
   Corresponding p-value = 0.0921

Kolmogorov-Smirnov Test
   Test Statistic   = 0.0798
   Corresponding p-value > 0.15

        Data Summary

Number of Data Points   = 72
Min Data Value   = 0.25
Max Data Value   = 6.03
Sample Mean   = 1.64
Sample Std Dev   = 1.34

      Histogram Summary

Histogram Range   = 0 to 6.62
Number of Intervals   = 8

Distribution Summary

Distribution: Exponential
Expression: EXPO(1.64)
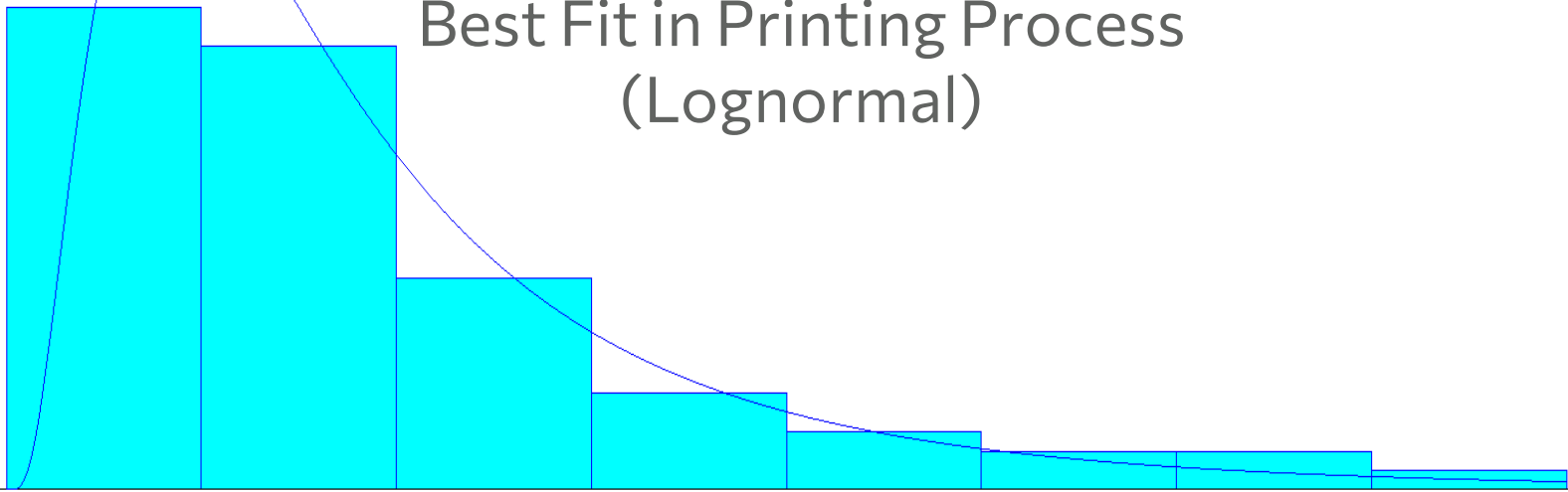Square Error: 0.009432

Chi Square Test
   Number of intervals   = 4
   Degrees of freedom   = 2
   Test Statistic   = 3
   Corresponding p-value = 0.231

Kolmogorov-Smirnov Test
   Test Statistic   = 0.175
   Corresponding p-value = 0.0224

        Data Summary

Number of Data Points   = 72
Min Data Value   = 0.25
Max Data Value   = 6.03
Sample Mean   = 1.64
Sample Std Dev   = 1.34

      Histogram Summary

Histogram Range   = 0 to 6.62
Number of Intervals   = 8

Best Fit in Printing Process
(Lognormal)


```
        Distribution Summary

istribution:    Lognormal
xpression:      LOGN(1.64, 1.47)
quare Error:    0.003402

hi Square Test
 Number of intervals   = 4
 Degrees of freedom    = 1
 Test Statistic        = 0.912
 Corresponding p-value = 0.368

olmogorov-Smirnov Test
 Test Statistic        = 0.0587
 Corresponding p-value > 0.15

        Data Summary

umber of Data Points   = 72
in Data Value          = 0.25
ax Data Value          = 6.03
ample Mean             = 1.64
ample Std Dev          = 1.34

        Histogram Summary

istogram Range         = 0 to 6.62
umber of Intervals     = 8
```
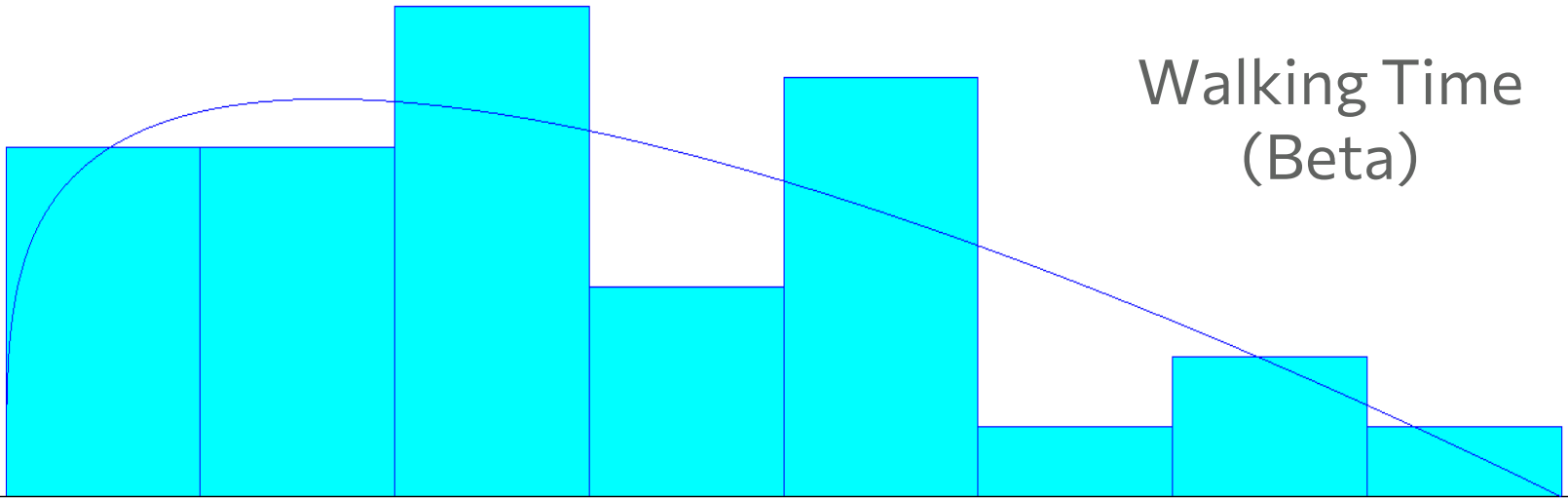
Walking Time (Beta)

```
        Distribution Summary

Distribution:   Beta
Expression:     4.5 + 8 * BETA(1.26, 2)
Square Error:   0.016193

Chi Square Test
  Number of intervals  = 4
  Degrees of freedom   = 1
  Test Statistic       = 0.917
  Corresponding p-value = 0.367

        Data Summary

Number of Data Points  = 30
Min Data Value         = 5
Max Data Value         = 12
Sample Mean            = 7.53
Sample Std Dev         = 1.94

        Histogram Summary

Histogram Range        = 4.5 to 12.5
Number of Intervals    = 8
```

Shopping Process

Distribution Summary

Distribution: Exponential
Expression: EXPO(0.517)
Square Error: 0.007113

Kolmogorov-Smirnov Test
  Test Statistic   = 0.202
  Corresponding p-value > 0.15

       Data Summary

Number of Data Points   = 11
Min Data Value   = 0.117
Max Data Value   = 1.27
Sample Mean   = 0.517
Sample Std Dev   = 0.389

      Histogram Summary

Histogram Range   = 0 to 1.39
Number of Intervals = 5

Distribution Summary

Distribution: Gamma
Expression: GAMM(0.28, 1.85)
Square Error: 0.008828

Kolmogorov-Smirnov Test
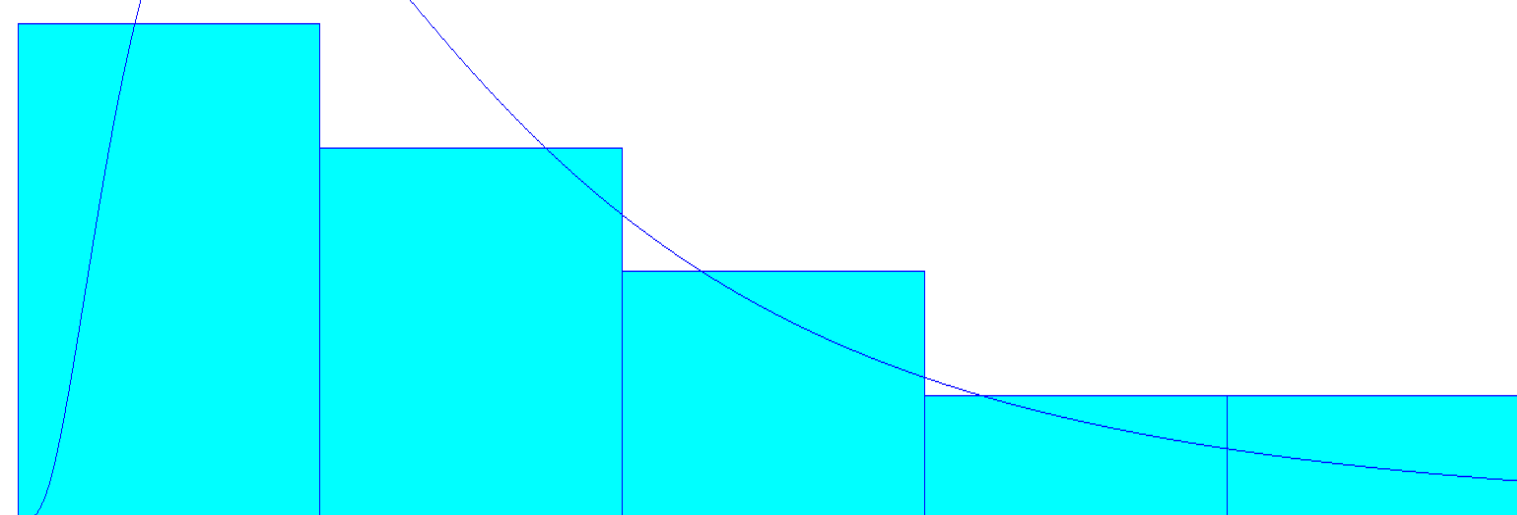 Test Statistic   = 0.142
  Corresponding p-value > 0.15

       Data Summary

Number of Data Points   = 11
Min Data Value   = 0.117
Max Data Value   = 1.27
Sample Mean   = 0.517
Sample Std Dev   = 0.389

      Histogram Summary

Histogram Range   = 0 to 1.39
Number of Intervals = 5

Distribution Summary

Distribution: Lognormal
Expression: LOGN(0.532, 0.507)
Square Error: 0.007847

Kolmogorov-Smirnov Test
  Test Statistic   = 0.152
  Corresponding p-value > 0.15

          Data Summary

Number of Data Points = 11
Min Data Value   = 0.117
Max Data Value   = 1.27
Sample Mean   = 0.517
Sample Std Dev   = 0.389

        Histogram Summary

Histogram Range   = 0 to 1.39
Number of Intervals   = 5

Distribution Summary

Distribution: Weibull
Expression: WEIB(0.571, 1.43)
Square Error: 0.008604

Kolmogorov-Smirnov Test
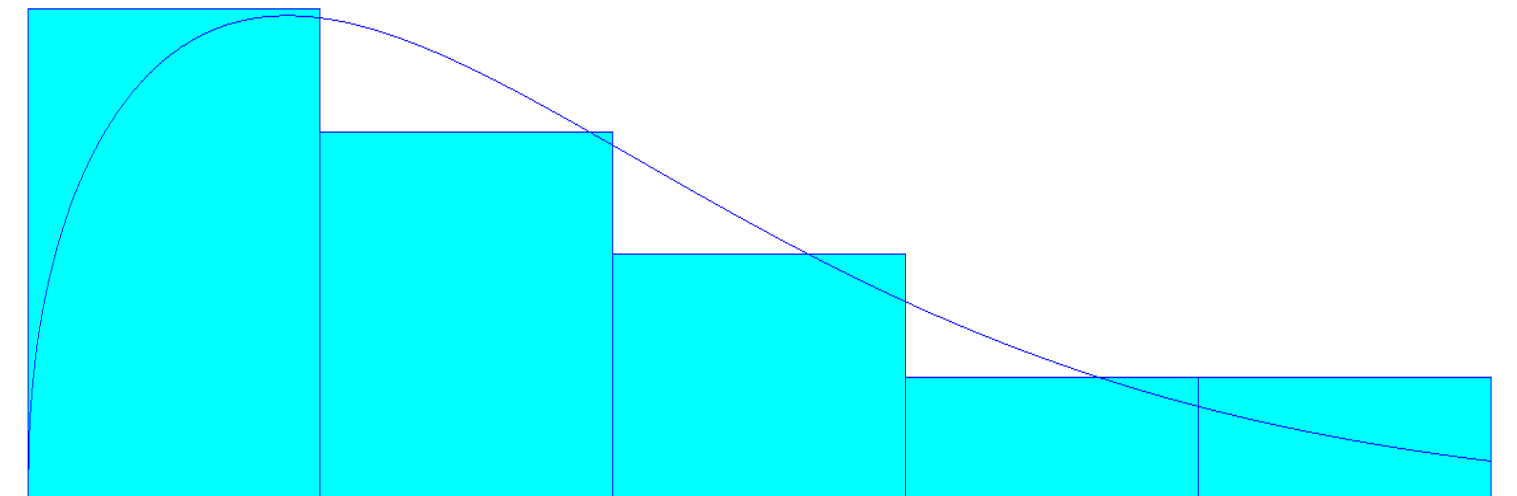 Test Statistic   = 0.142
  Corresponding p-value > 0.15

          Data Summary

Number of Data Points = 11
Min Data Value   = 0.117
Max Data Value   = 1.27
Sample Mean   = 0.517
Sample Std Dev   = 0.389

        Histogram Summary

Histogram Range   = 0 to 1.39
Number of Intervals   = 5

Best Fit in Shopping Process (Beta)


```
        Distribution Summary

Distribution:   Beta
Expression:     1.39 * BETA(0.736, 1.24)
Square Error:   0.005454


Kolmogorov-Smirnov Test
  Test Statistic     = 0.199
  Corresponding p-value > 0.15

        Data Summary

Number of Data Points   = 11
Min Data Value          = 0.117
Max Data Value          = 1.27
Sample Mean             = 0.517
Sample Std Dev          = 0.389

        Histogram Summary

Histogram Range         = 0 to 1.39
Number of Intervals     = 5
```
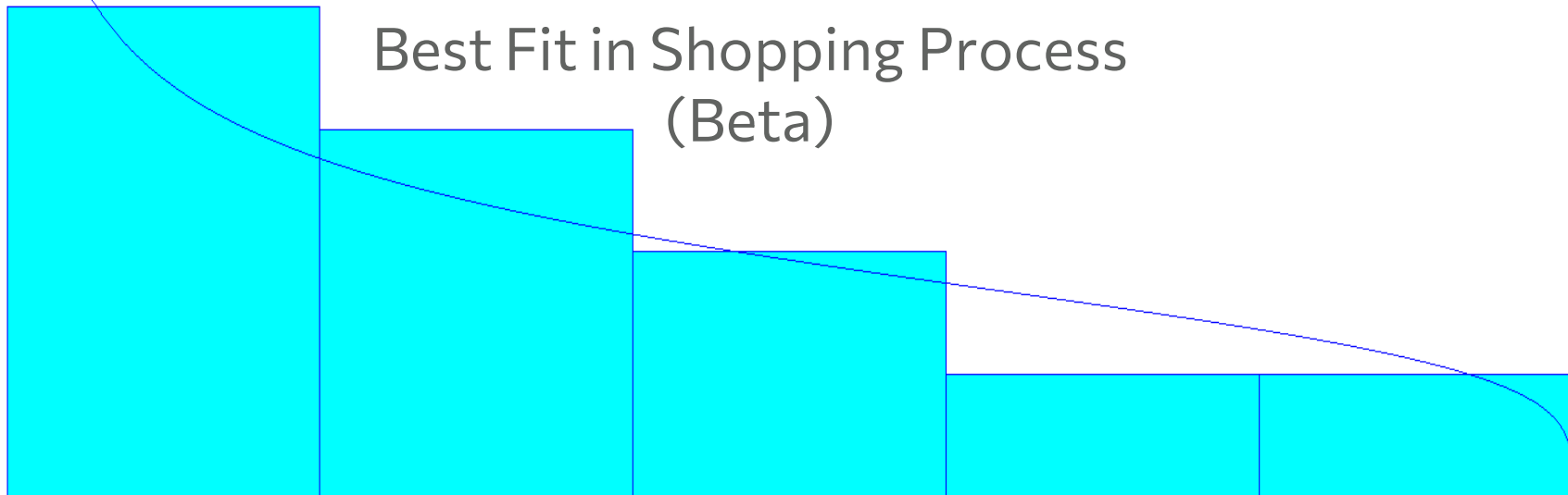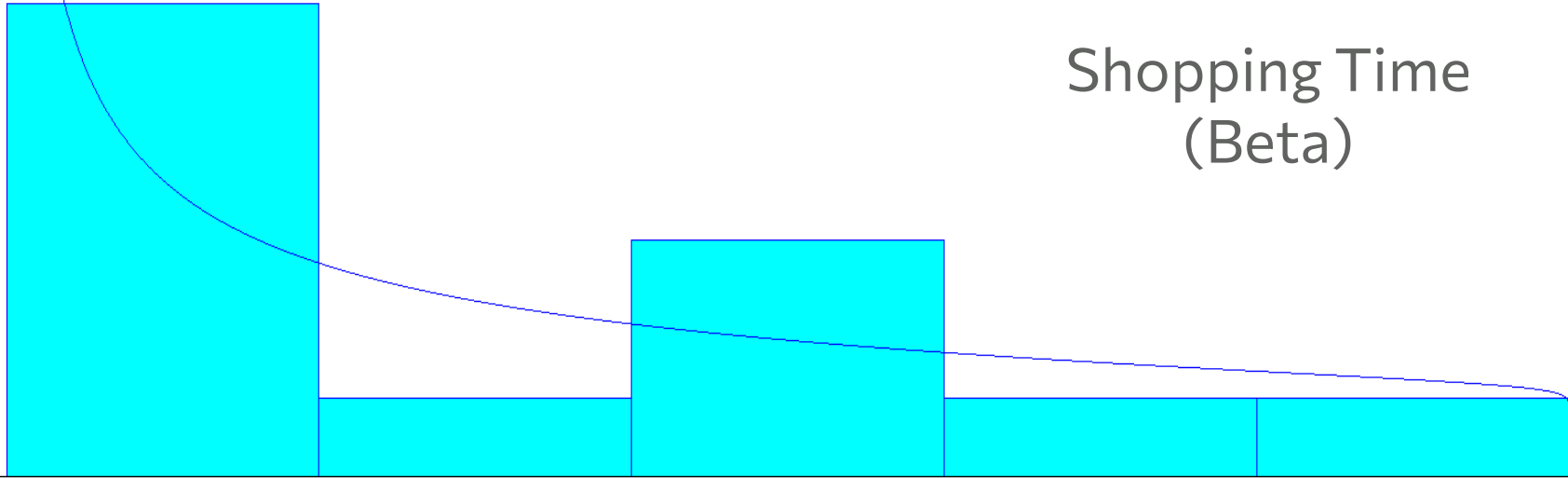
Shopping Time
(Beta)

Distribution Summary

Distribution: Beta
Expression: 22 + 170 * BETA(0.535, 1.04)
Square Error: 0.023859

Kolmogorov-Smirnov Test
  Test Statistic   = 0.243
  Corresponding p-value > 0.15

        Data Summary

Number of Data Points   = 12
Min Data Value   = 22
Max Data Value   = 192
Sample Mean   = 79.7
Sample Std Dev   = 50.1

        Histogram Summary

Histogram Range   = 22 to 192
Number of Intervals   = 5

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04

Arena Simulation Model

Arena Model
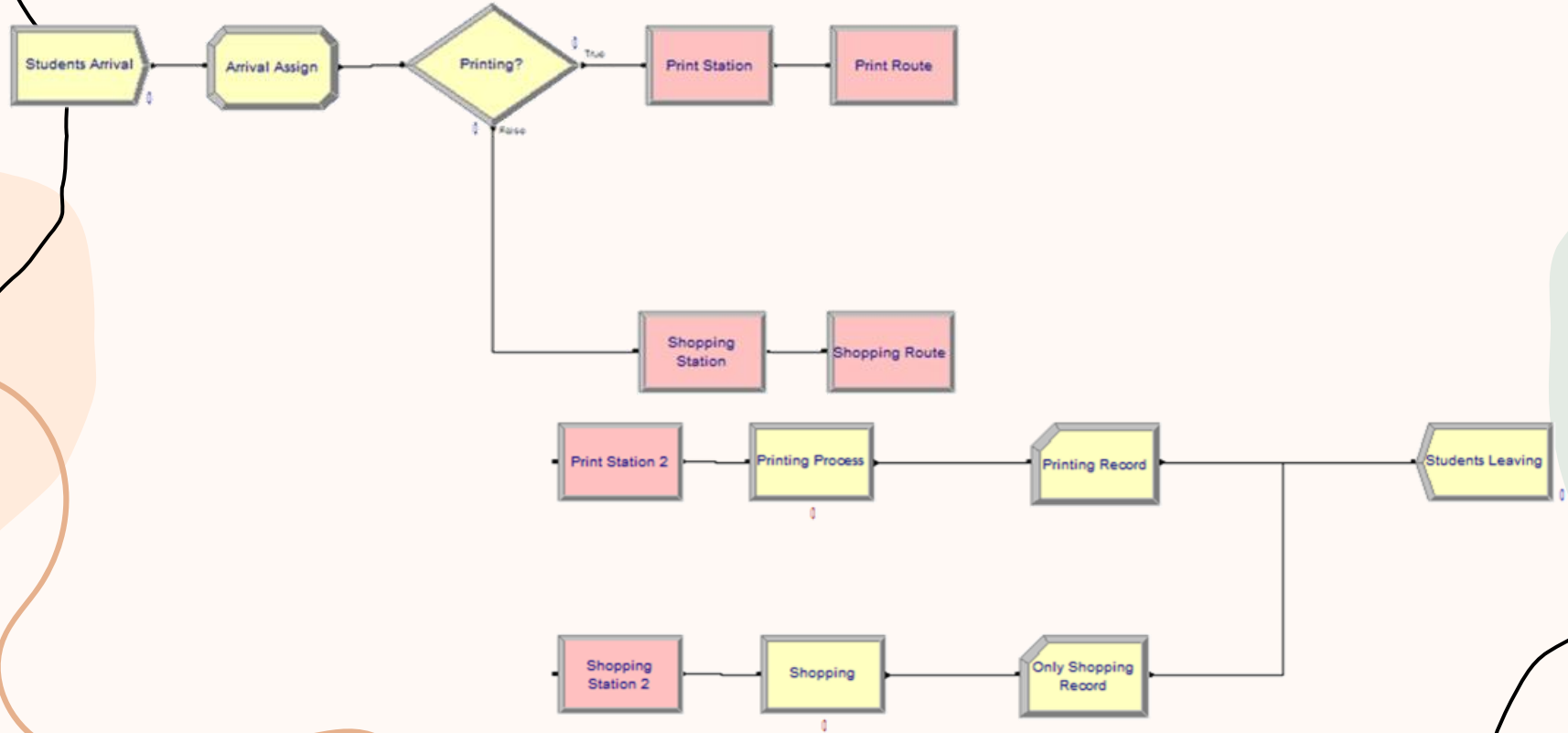
Simulation Assumptions

1. The simulation runs for 20 minutes, with entities processed only during breaks.

Customer Arrival Per 15 mins

Time	Customers
9:45 AM - 10:00 AM	5
10:00 AM - 10:15 AM	6
10:15 AM - 10:30 AM	11
10:30 AM - 10:45 AM	35
10:45 AM - 11:00 AM	6
11:00 AM - 11:15 AM	11
11:15 AM - 11:30 AM	11
11:30 AM - 11:45 AM	3
11:45 AM - 12:00 PM	7
12:00 PM - 12:15 PM	6
12:15 PM - 12:30 PM	47
12:30 PM - 12:45 PM	9
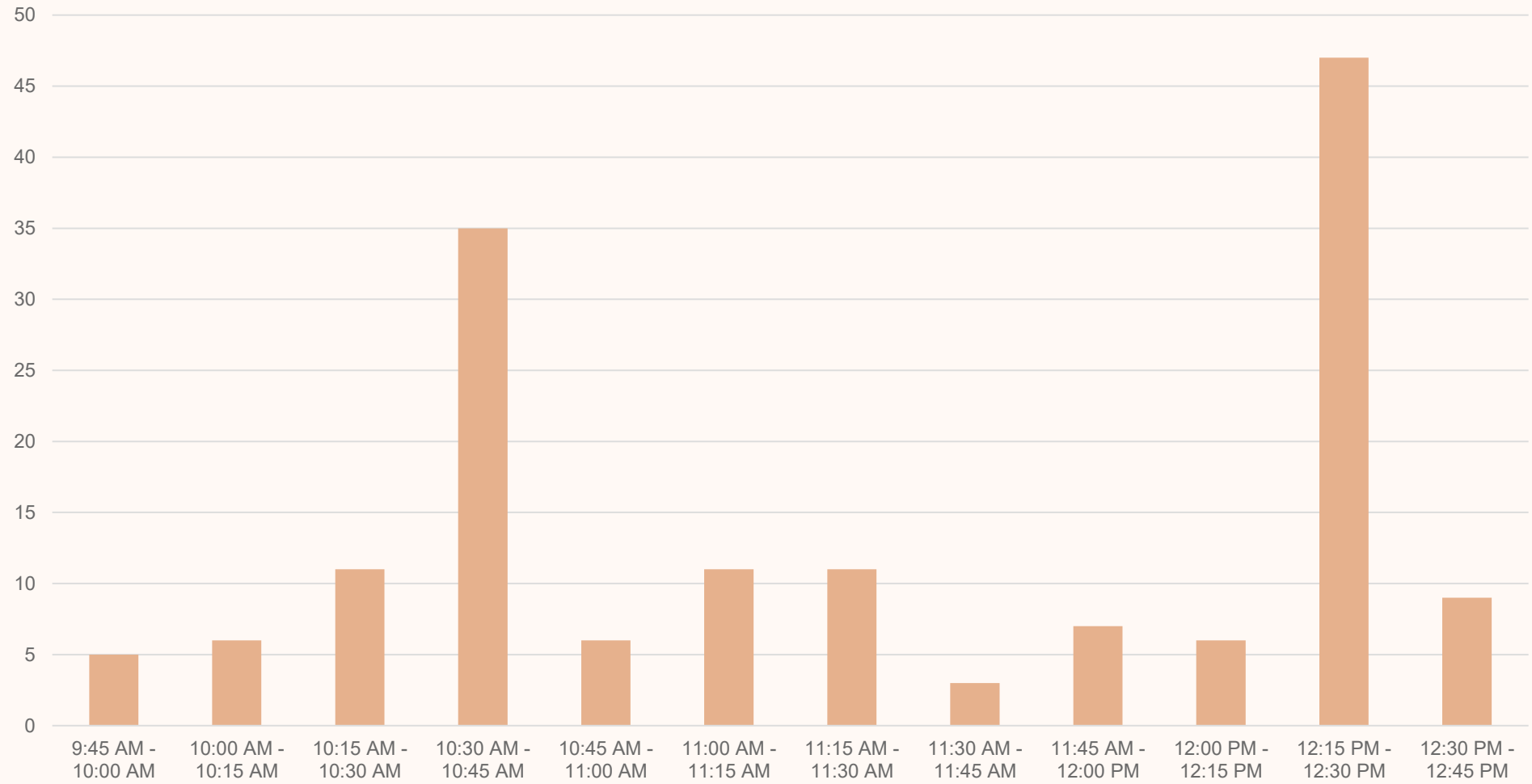
Simulation Assumptions

2. Entities are processed using the FIFO method.

3. There are no resource failures.

Simulation Assumptions

4. Processing times are identical for both lectures and breaks.

Printing Process at Breaks

$\bar{x}_1 = 1.52$

$s_1 = 0.7053$

$n_1 = 15$

Printing Process at Lectures

$\bar{x}_2 = 1.576$

$s_2 = 1.2199$

$n_2 = 27$

$$H_0: \bar{x}_1 - \bar{x}_2 = 0$$
$$H_a: \bar{x}_1 - \bar{x}_2 \neq 0$$

$$t_o = -0.0262, \qquad p - value > 0.05$$

Shopping Process at Breaks
$$\bar{x}_1 = 1.167$$
$$s_1 = 1.3692$$
$$n_1 = 4$$

Shopping Process at Lectures
$$\bar{x}_2 = 0.878$$
$$s_2 = 1.1362$$
$$n_2 = 9$$

$$H_0: \bar{x}_1 - \bar{x}_2 = 0$$
$$H_a: \bar{x}_1 - \bar{x}_2 \neq 0$$

$$t_o = 0.1204, \qquad p - value > 0.05$$

Simulation Assumptions

5. The printer's availability depends on the employee, and it is not considered a resource.

6. The choice for entities to go shopping or print papers is probabilistic.

Report Results

Replications: 1   Time Units: Minutes

Entity

Wait Time	Average	Half Width	Minimum Value	Maximum Value
Student	5.2861	(Insufficient)	0.00	11.5610

Total Time	Average	Half Width	Minimum Value	Maximum Value
Student	6.5689	(Insufficient)	0.5669	12.6830

Other

Number In	Value
Student	44.0000

Number Out	Value
Student	16.0000

WIP	Average	Half Width	Minimum Value	Maximum Value
Student	14.2995	(Insufficient)	0.00	28.0000

Resource

Usage

Scheduled Utilization

	Value
Employee	0.9298

Queue

Time

Waiting Time

	Average	Half Width	Minimum Value	Maximum Value
Printing Process.Queue	5.6453	(Insufficient)	0.00	11.8141
Shopping.Queue	5.8563	(Insufficient)	2.7286	8.9839

Other

Number Waiting

	Average	Half Width	Minimum Value	Maximum Value
Printing Process.Queue	10.7858	(Insufficient)	0.00	22.0000
Shopping.Queue	1.9852	(Insufficient)	0.00	3.0000

Replications: 30   **Time Units:**   Minutes

Entity

Wait Time	Average	Half Width	Minimum Average	Maximum Average	Minimum Value	Maximum Value
Student	5.3929	0.69	1.7918	9.5753	0.00	16.4450

Total Time	Average	Half Width	Minimum Average	Maximum Average	Minimum Value	Maximum Value
Student	7.2779	0.79	3.2568	12.9430	0.2874	17.6258

Other

Number In	Average	Half Width	Minimum Average	Maximum Average
Student	37.5333	2.47	24.0000	50.0000

Number Out	Average	Half Width	Minimum Average	Maximum Average
Student	12.4333	1.43	5.0000	20.0000

WIP	Average	Half Width	Minimum Average	Maximum Average	Minimum Value	Maximum Value
Student	12.8729	1.47	4.6392	19.7350	0.00	43.0000

Resource

Usage
Scheduled Utilization

	Average	Half Width	Minimum Average	Maximum Average
Employee	0.9805	0.01	0.9002	0.9961

Queue

Time

Waiting Time

	Average	Half Width	Minimum Average	Maximum Average	Minimum Value	Maximum Value
Printing Process.Queue	5.7539	0.68	2.0937	10.6714	0.00	17.2479
Shopping.Queue	5.3426	1.61	0.00	14.8386	0.00	14.8386

Other

Number Waiting

	Average	Half Width	Minimum Average	Maximum Average	Minimum Value	Maximum Value
Printing Process.Queue	9.7785	1.30	2.4712	17.6245	0.00	39.0000
Shopping.Queue	1.5629	0.33	0.00	3.7812	0.00	8.0000

Thank You