FORECASTING TRENDS OF DOMESTIC TOURIST VISITS USING THE ARIMA METHOD

Gerard S. G. (00000068198)

Jovan F. (00000067827)

Ryu I. W. (00000065448)

Vianca V. B. (00000065031)

IF540 – G | Group 4

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Background

The tourism sector has become the backbone of Indonesia's economy sector, drawing on its natural beauty and cultural diversity to attract visitors [1], [2]. However, maintaining growth in domestic tourism while ensuring sustainable management is a challenge [3]. Accurate predictions of tourist numbers, based on provincial destinations, are essential for implementing effective strategies [4]. Predictive analysis, such as using the ARIMA method, can help forecast trends in domestic tourism by analyzing past data and accommodating complex seasonal patterns [9], [10]. Failure to predict accurately can result in overcrowding or financial losses, while reliable forecasts aid in improving tourist facilities, decision-making, and long-term sustainable destination management [5], [6], [7].

Problem

Problem 01

How can the trend of domestic tourist visits be predicted using the ARIMA method?

Problem 02

How can the ARIMA method be implemented to predict the trend of domestic tourist visits?

Limitation

- The dataset used is the domestic tourist dataset by destination province obtained from the Badan Pusat Statistik (BPS).

- The predictions of provincial visits are conducted for 34 provinces within the range of the years 2019–2023, as four provinces were introduced during this time period, affecting the overall dataset.

- The study focuses solely on domestic tourism, excluding international tourist data, which may provide a broader context for tourism trends.

- The analysis is confined to monthly data, potentially overlooking daily fluctuations in tourist visits that could offer more detailed insights.

Objectives

Objective 01

To forecast the trend of domestic tourist visits using the ARIMA method.

Objective 02

To implement the ARIMA method to forecast the trend of domestic tourist visits.

Benefits

- This research will enrich the literature on tourism data analysis by utilizing the ARIMA method for predicting visit trends.

- It will contribute to the analytical methods in understanding the travel patterns of domestic tourists, serving as a reference for similar studies in the future.

- The prediction results can assist the government in formulating more effective tourism development policies that align with the characteristics of each province.

- The findings of this research can be utilized to develop promotional programs and offerings that are more relevant to the travel behaviors of tourists in each province.

- This study can serve as a foundation for formulating more targeted marketing strategies, aiming at different segments of domestic tourists based on their travel patterns.

Literature Review

Trend

A trend is a long-term tendency, either upward or downward, based on average changes over time [11]. Trend forecasting predicts future developments by analyzing historical data [14].

Tourist

A tourist is someone who travels away from home for leisure, recreation, or business. Domestic tourists travel within their own country, exploring different regions for varied experiences [15], [16].

ARIMA

The Auto-Regressive Integrated Moving Average (ARIMA) model is a statistical tool for forecasting time series data [11]. ARIMA offer high forecasting accuracy rather than other method with lack the same level of transparency [18].

Literature Review – Testing

Mean Square Error (MSE)

MSE measures model performance by summing squared differences between predicted and actual values, indicating average error magnitude [24].

$$\text{MSE} = \frac{1}{m}\sum_{i=1}^{m}(X_i - Y_i)^2$$

Root Mean Square Error (RMSE)

RMSE assesses the dispersion of data points from the linear regression line, reflecting the average magnitude of errors [27].

$$\text{RMSE} = \sqrt{\frac{1}{m}\sum_{i=1}^{m}(X_i - Y_i)^2}$$
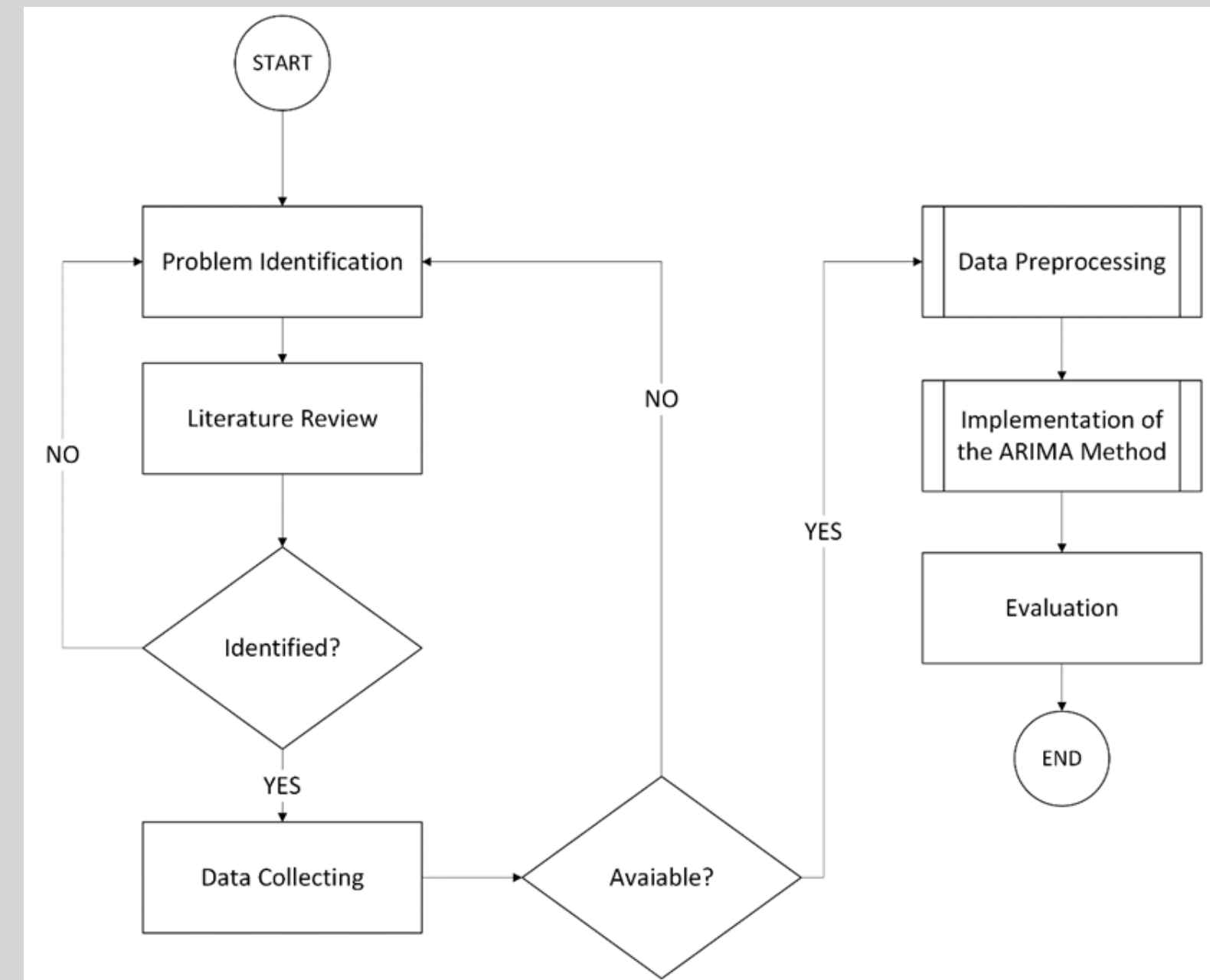
Mean Absolute Error (MAE)

MAE indicates the average absolute error between forecasted results and actual values, measuring overall prediction accuracy [30].

$$\text{MAE} = \frac{1}{m}\sum_{i=1}^{m}|X_i - Y_i|$$

Methodology (1) – Research Stages

The research stages are the steps that the author will take to provide an overview and facilitate the research process.

Methodology (2) – Problem Identification

This initial stage involves defining the core issue to be investigated in the research. It ensures clarity on what the research aims to address, focusing on understanding the trends in domestic tourism in Indonesia. The key problems identified include the need for accurate forecasting methods to predict tourist visits and understanding the factors influencing these trends.

Methodology (3) – Literature Review

The literature review in this research is conducted by studying and understanding sources related to **trends**, **tourism**, and the **Autoregressive Integrated Moving Average (ARIMA) method**. The author examines previous studies concerning these topics through journals, books, and articles. The related sources studied are research conducted over the last five years.

Methodology (4) – Formulation

Based on the literature review and problem identification, the following research problems can be formulated.

- **How can the trend of domestic tourist visits be predicted using the ARIMA method?**
- **How can the ARIMA method be implemented to predict the trend of domestic tourist visits?**

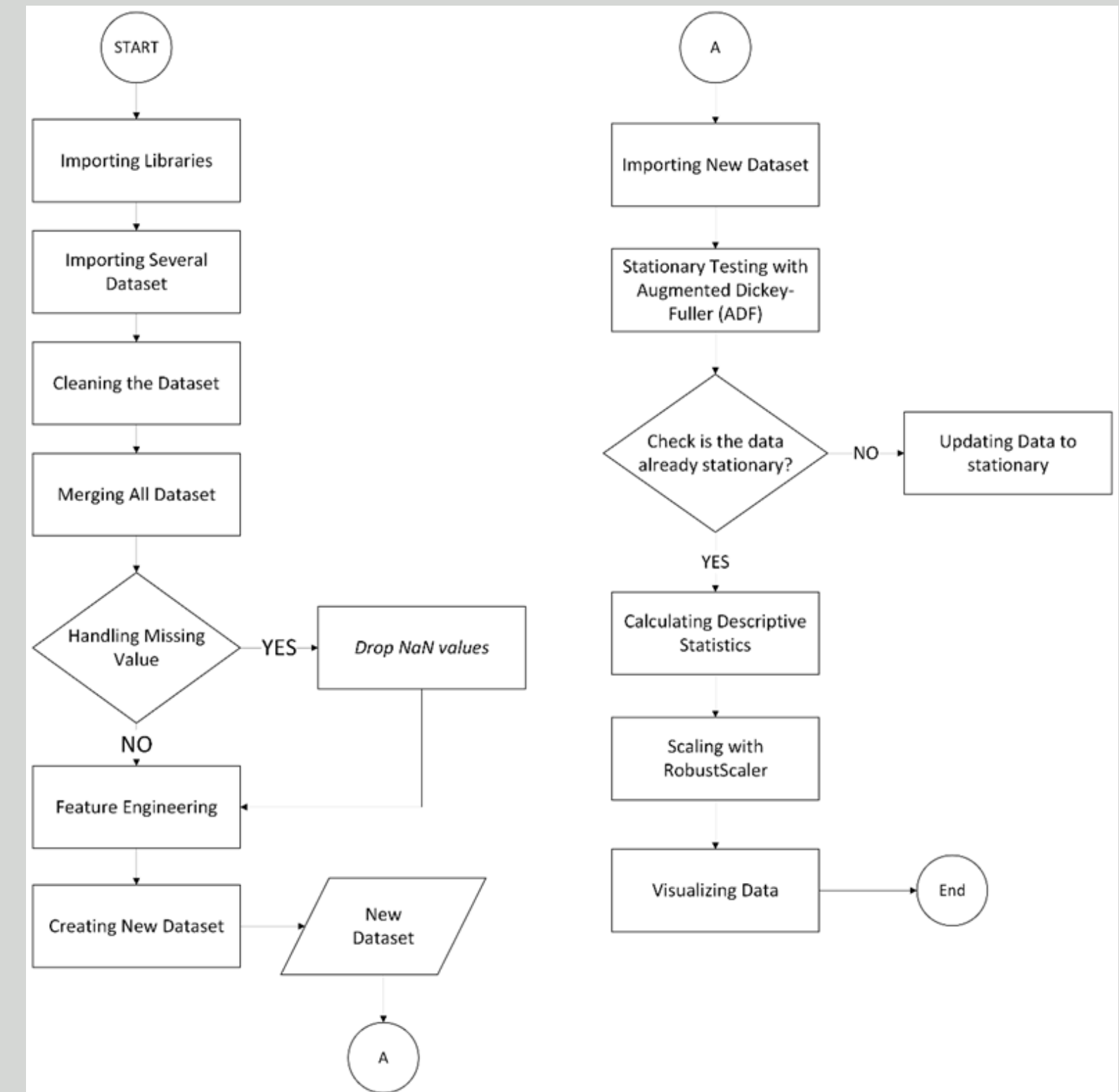From these problems, the research objectives are outlined as follows.

- **To forecast the trend of domestic tourist visits using the ARIMA method.**
- **To implement the ARIMA method to forecast the trend of domestic tourist visits.**

Methodology (5) – Data Collection

The data used in this research is obtained from the **Badan Pusat Statistik (BPS).** The data collection process involves gathering information from statistical tables related to tourism, which includes data on the number of trips made by domestic tourists based on their destination provinces. This dataset consists of **38 entities representing the 38 provinces in Indonesia** and includes **monthly data covering the period from 2019 to 2023**. The collected data contains information related to the number of tourists, which can be utilized to analyze visit trends.

Methodology (6) – Data Preprocessing

After the dataset collection is complete, the dataset will then be processed to the next stage, which is dataset pre-processing.

38 Provins

Jumlah Perjalanan Wisatawan Nusantara Menurut Provinsi Tujuan (Perjalanan)

2019

	Januari	Februari	Maret	April	Mei	Juni	Juli	Agustus	September	Oktober	November	Desember	Tahunan
ACEH	1387574	1111607	1113176	1155705	1070909	1800152	1323272	1508073	1174513	1219323	1198958	1597524	15660786
SUMATER/	5094564	3282713	3442407	3676763	3469100	5774370	3996409	3699782	3208776	3419415	3416228	5440703	47921230
SUMATER/	1667509	1313185	1420799	1573606	1511963	2910574	1719018	1207708	1011691	1094813	1078273	2292513	18801652
RIAU	1990985	1425092	1541155	1563303	1574681	2179811	1646721	1227426	1018291	1131194	1119316	2087900	18505875
JAMBI	828879	652908	716028	547378	438508	572785	498688	620967	580974	533651	526013	702943	7219722
SUMATER/	1763349	1294947	1356470	1099872	917156	1380350	848202	1265112	1121514	1276480	1168308	1575018	15066778
BENGKULl	414287	304721	336570	287546	258241	407898	292552	353997	347174	342352	340572	412683	4098593
LAMPUNG	2082997	1612674	1606207	1164672	877643	1653991	992730	1422192	1191629	1269517	1276815	1871463	17022530
KEP. BANG	298322	240226	255054	199678	122301	178462	148190	182592	171412	195073	198154	239683	2429147
KEP. RIAU	434786	351865	358547	360392	358416	460205	413445	286867	244300	274522	287732	448736	4279813
DKI JAKAR1	5397751	4349186	4859467	4798553	4428139	5181301	5727689	5927808	5562321	6491736	6602925	5290943	64617819
JAWA BAR	11116072	9942434	11088052	11993275	10148348	17758640	12666376	13851900	11808826	13129658	13649852	14443528	1.52E+08
JAWA TEN	5499613	3635334	8111673	9858616	6842427	11212167	7224219	8383154	5921102	6370710	5998022	8363789	87420826
DI YOGYAl	1411202	914238	1838076	2187942	1206999	2259780	2001306	1852091	1510369	1684368	1704053	1836652	20407076
JAWA TIM	7370689	3397447	6166799	5021927	6577537	9120727	4493144	7666096	7960768	9665026	9788588	8254457	85483205
BANTEN	3499099	2693769	2938462	2963258	2694170	3763715	3571783	3972592	3532654	4205610	4339169	3633256	41807537
BALI	1316977	1225808	1465586	1483415	1185662	1822787	1682553	1618973	1445303	1627142	1618206	1571722	18064134
NUSA TEN	638044	650532	615424	623576	672162	905622	768494	752154	691694	745786	742083	773833	8579404
NUSA TEN	730527	588445	609906	656777	668972	800071	761909	643008	323446	365828	354781	768865	7272535
KALIMANT	868324	718122	702067	667426	668813	965873	737058	750991	611793	644920	647391	919685	8902463
KALIMANT	583298	422358	478327	459150	481899	578068	495108	490930	468770	455242	467380	583207	5963737
KALIMANT	798371	624476	1065096	684460	686310	995857	781045	807828	685513	718103	763093	899515	9509667
KALIMANT	979211	691855	782692	774765	797668	999931	845422	845716	747355	817926	799348	991646	10073535
KALIMANT	143744	109695	132047	127958	136905	143427	129237	128417	112758	120089	121255	144538	1550070
SULAWESI	256496	112937	197795	221246	235233	325311	336575	305167	267290	307207	286146	293133	3144536
SULAWESI	451254	308973	374463	374029	368161	380756	323650	506559	404438	469816	494853	418240	4875192
SULAWESI	2054894	1402775	1654575	1799377	1653101	2395339	1917506	2516211	2106120	2341121	2345045	2230009	24416073
SULAWESI	534762	405350	436423	487941	445093	621228	487514	532628	439248	303878	300770	580664	5575499
GORONTA	90789	48019	84467	102283	109827	163192	123297	131352	106151	139035	120291	127908	1346611
SULAWESI	197588	134391	163587	174495	152740	221961	173239	262037	204889	242300	236861	210792	2374880
MALUKU	258094	193290	206894	216036	228658	224863	111095	104002	91767	96055	97869	243228	2071851
MALUKU l	125514	76500	166014	190003	163855	119683	102619	99582	85337	177456	163370	124114	1594047
PAPUA BA	185287	143094	159903	152087	161711	172118	164784	158220	73498	93397	94620	180580	1739299
PAPUA BA	-		-		-		-		-		-		-
PAPUA	313389	209857	224960	209282	235428	240501	234623	224909	174820	204906	212794	280181	2765650

province	january_2019	february_2019	march_2019	april_2019	may_2019	june_2019	july_2019	august_2019	september_2019	october_2019	november_2019	december_2019	january_2020	february_2020	march_2020	april_2020	may_2020	june_2020	july_2020	august_2020	september_2020	october_2020	no...
ACEH	1387574	1111607	1113176	1155705	1070909	1800152	1323272	1508073	1174513	1219323	1198958	1597524	483897	430589	351710	157764	258310	298482	333571	392055	293602	340415	
SUMATER	5094564	3282713	3442407	3676763	3469100	5774370	3996409	3699782	3208776	3419415	3416228	5440703	2012511	1466193	1109440	442072	576278	864667	1082687	1291700	1016798	1232110	1
SUMATER	1667509	1313185	1420799	1573606	1511963	2910574	1719018	1207708	1011691	1094813	1078273	2292513	863282	779785	623248	226466	250931	562966	754303	827245	555478	672099	
RIAU	1990985	1425092	1541155	1563303	1574681	2179811	1646721	1227426	1018291	1131194	1119316	2087900	619363	548129	464347	215636	249411	390121	440119	497048	422867	520924	
JAMBI	828879	652908	716028	547378	438508	572785	498688	620967	580974	533651	526013	702943	264201	250082	206088	114969	133020	183620	235975	258405	228973	240877	
SUMATER	1763349	1294947	1356470	1099872	917156	1380350	848202	1265112	1121514	1276480	1168308	1575018	620543	584230	483516	234250	223800	339725	486690	555501	484199	557537	
BENGKULU	414287	304721	336570	287546	258241	407898	292552	353997	347174	342352	340572	412683	155102	140647	117920	61421	67769	100775	131746	154764	127706	146378	
LAMPUNG	2082997	1612674	1606207	1164672	877643	1653991	992730	1422192	1191629	1269517	1276815	1871463	876254	782363	658446	356647	395199	559053	779034	880796	686462	788792	
KEP. BANG	298322	240226	255054	199678	122301	178462	148190	182592	171412	195073	198154	239683	127282	107273	83654	34757	48428	53351	70022	87978	73888	81326	
KEP. RIAU	434786	351865	358547	360392	358416	460205	413445	286867	244300	274522	287732	448736	138085	112726	68659	19843	17661	29392	47791	46331	48314	60644	
DKI JAKAR	5397751	4349186	4859467	4798553	4428139	5181301	5727689	5927808	5562321	6491736	6602925	5290943	4285490	3980736	2731511	800210	1102095	1730939	2338540	2588398	1961247	2466514	3
JAWA BAR	11116072	9942434	11088052	11993275	10148348	17758640	12666376	13851900	11808826	13129658	13649852	14443528	10492510	9453029	7069903	2572442	3478828	6047886	8293439	9436215	6769447	8455505	8
JAWA TEN	5499613	3635334	8111673	9858616	6842427	11212167	7224219	8383154	5921102	6370710	5998022	8363789	13945958	12527304	11005404	8810623	7558284	8741458	10624146	11468963	10031173	11470617	11
DI YOGYAK	1411202	914238	1838076	2187942	1206999	2259780	2001306	1852091	1510369	1684368	1704053	1836652	2564209	2165645	1653382	731738	665050	966026	1407181	1835908	1570374	1937169	1
JAWA TIM	7370689	3397447	6166799	5021927	6577537	9120727	4493144	7666096	7960768	9665026	9788588	8254457	11480621	10963390	9901042	6570521	7672138	9184613	11452136	11299515	12304681	11175527	11
BANTEN	3499099	2693769	2938462	2963258	2694170	3763715	3571783	3972592	3532654	4205610	4339169	3633256	3493296	3108353	2403198	1058760	1372881	1757307	2276198	2660062	1938669	2516445	2
BALI	1316977	1225808	1465586	1483415	1185662	1822787	1682553	1618973	1445303	1627142	1618206	1571722	1198046	1076140	684140	273450	261406	427300	596736	773886	737473	798998	
NUSA TEN	638044	650532	615424	623576	672162	905622	768494	752154	691694	745786	742083	773833	357562	346046	266947	114758	134465	219509	292720	345466	303882	321857	
NUSA TEN	730527	588445	609906	656777	668972	800071	761909	643008	323446	365828	354781	768865	196280	177430	161512	102092	78698	123912	180686	208219	204091	269250	
KALIMANT	868324	718122	702067	667426	668813	965873	737058	750991	611793	644920	647391	919685	238250	192950	133713	58284	70612	114469	156207	188940	139666	157775	
KALIMANT	583298	422358	478327	459150	481899	578068	495108	490930	468770	455242	467380	583207	199469	184057	162270	78802	75118	105229	153741	178547	177946	191431	
KALIMANT	798371	624476	1065096	684460	686310	995857	781045	807828	685513	718103	763093	899515	453132	525682	388598	142599	140584	217081	299967	378968	340628	401871	
KALIMANT	979211	691855	782692	774765	797668	999931	845422	845716	747355	817926	799348	991646	314243	286192	217704	91121	95763	153412	179746	193051	179654	209778	
KALIMANT	143744	109695	132047	127958	136905	143427	129237	128417	112758	120089	121255	144538	27906	28952	22807	9670	8536	12698	17870	19917	20879	22363	
SULAWESI	256496	112937	197795	221246	235233	325311	336575	305167	267290	307207	286146	293133	156614	154197	158677	66627	58036	112243	193492	259030	282281	335445	
SULAWESI	451254	308973	374463	374029	368161	380756	323650	506559	404438	469816	494853	418240	185796	176960	145200	65380	65852	86803	119534	157123	132882	109312	
SULAWESI	2054894	1402775	1654575	1799377	1653101	2395339	1917506	2516211	2106120	2341121	2345045	2230009	1027653	932636	759362	287133	308242	547513	663996	909748	850322	959171	
SULAWESI	534762	405350	436423	487941	445093	621228	487514	532628	439248	303878	300770	580664	206468	193500	143516	71545	71224	106867	146936	181890	206855	193265	
GORONTA	90789	48019	84467	102283	109827	163192	123297	131352	106151	139035	120291	127908	48443	44850	54723	33603	27476	49003	68769	83192	94892	108500	
SULAWESI	197588	134391	163587	174495	152740	221961	173239	262037	204889	242300	236861	210792	105991	97671	69873	26873	22014	49222	61561	80440	75891	75517	
MALUKU	258094	193290	206894	216036	228658	224863	111095	104002	91767	96055	97869	243228	38562	36768	29688	10479	7978	11914	15625	21065	23965	29428	
MALUKU U	125514	76500	166014	190003	163855	119683	102619	99582	85337	177456	163370	124114	46810	47758	38527	22439	12649	23881	36540	43536	47792	50275	
PAPUA BA	185287	143094	159903	152087	161711	172118	164784	158220	73498	93397	94620	180580	46741	44158	34282	9348	11657	17414	22301	23616	23906	26119	
PAPUA	313389	209857	224960	209282	235428	240501	234623	224909	174820	204906	212794	280181	75045	73078	57571	24783	26829	35260	45320	46725	50583	55847	

Methodology (6) – Data Preprocessing

Feature engineering: growth rate calculation of a certain province per year, by using the following formula.

$$PR = \frac{(V_{Present} - V_{Past})}{V_{Past}} \times 100$$

Where:

PR = percent rate

V_present = present or future value

V_past = past or present value

BJ	BK	BL	BM
growth_rate_2020	growth_rate_2021	growth_rate_2022	growth_rate_2023
-73.55063149	33.61095694	25.66080726	28.602857
-70.68863216	26.42544322	30.66908929	18.99923446
-58.02059308	21.67906485	28.48163332	19.06906434
-70.24878856	11.57971652	36.80397196	32.6361254
-62.8162691	13.5070451	24.08190952	26.50644026
-61.30497177	17.10509299	24.38764924	29.46328019
-62.90539217	16.46560643	19.36846195	39.90695712
-49.91507138	7.637405958	19.05702884	25.94792061
-60.22896103	10.13272994	48.34805623	50.97303801
-82.57912203	12.0833283	80.85492873	51.8834105
-52.15839767	21.73845029	48.8211312	13.59546748
-40.71020197	7.1580678	28.25763542	26.46496132
51.48836388	11.50912346	-25.2775866	4.734684079
-3.996623524	16.55065196	12.74235789	18.23164135
48.68612144	25.15802036	26.0691188	3.269257994
-31.01249423	27.36273245	5.073543724	15.03164105
-51.176569	13.21589699	42.80978377	46.1004267
-60.68843477	-6.935397121	30.34518419	215.8539706
-68.46103869	35.53818707	23.82058759	31.56299253
-79.16747309	30.02165417	36.01533886	43.63520671
-68.07699602	3.728745186	35.89299531	49.92234324
-56.53273664	3.603089032	24.00936456	48.18745496
-76.12702989	3.658811436	117.8926374	45.50345683
-81.82875612	9.647562547	14.80988599	66.07563878
-21.10737482	50.47349512	18.45448528	22.09459605
-67.76286965	28.9693705	218.367062	-2.540672061
-62.25824685	10.99321827	179.6145319	-11.09209582
-64.43346147	30.16335756	395.2451906	-13.40133643
-37.02279277	40.18262902	24.39230167	28.88181264

Methodology (6) – Data Preprocessing

Perform a stationarity test on the entire dataset using the Augmented Dickey-Fuller (ADF) test to assess whether the time series is stationary. If non-stationary months are identified, apply differencing techniques to transform the data and achieve stationarity.

```
Months that are not stationary before differencing:
january_2019
february_2019
march_2019
...
december_2021
january_2022
february_2022
march_2022
```
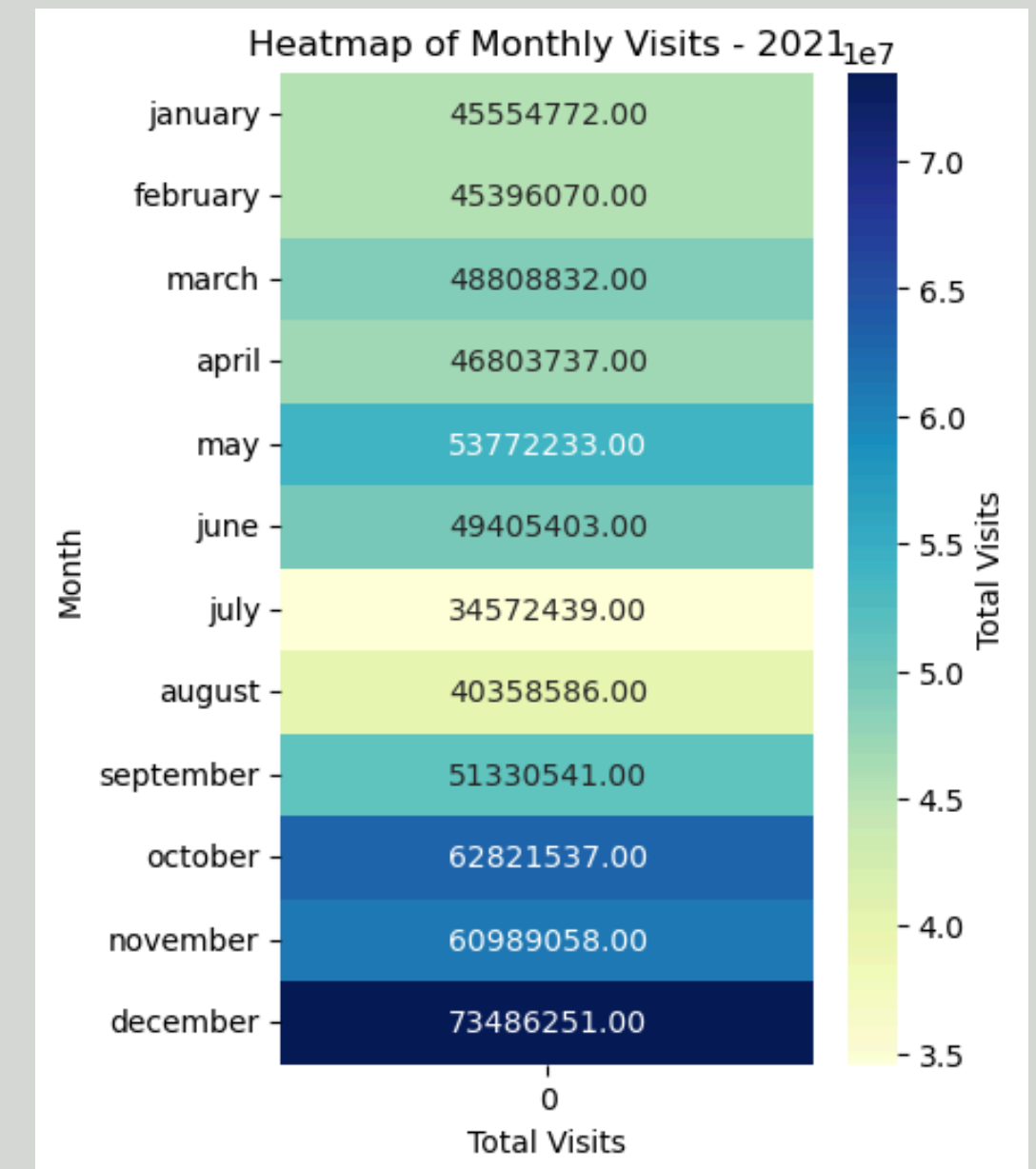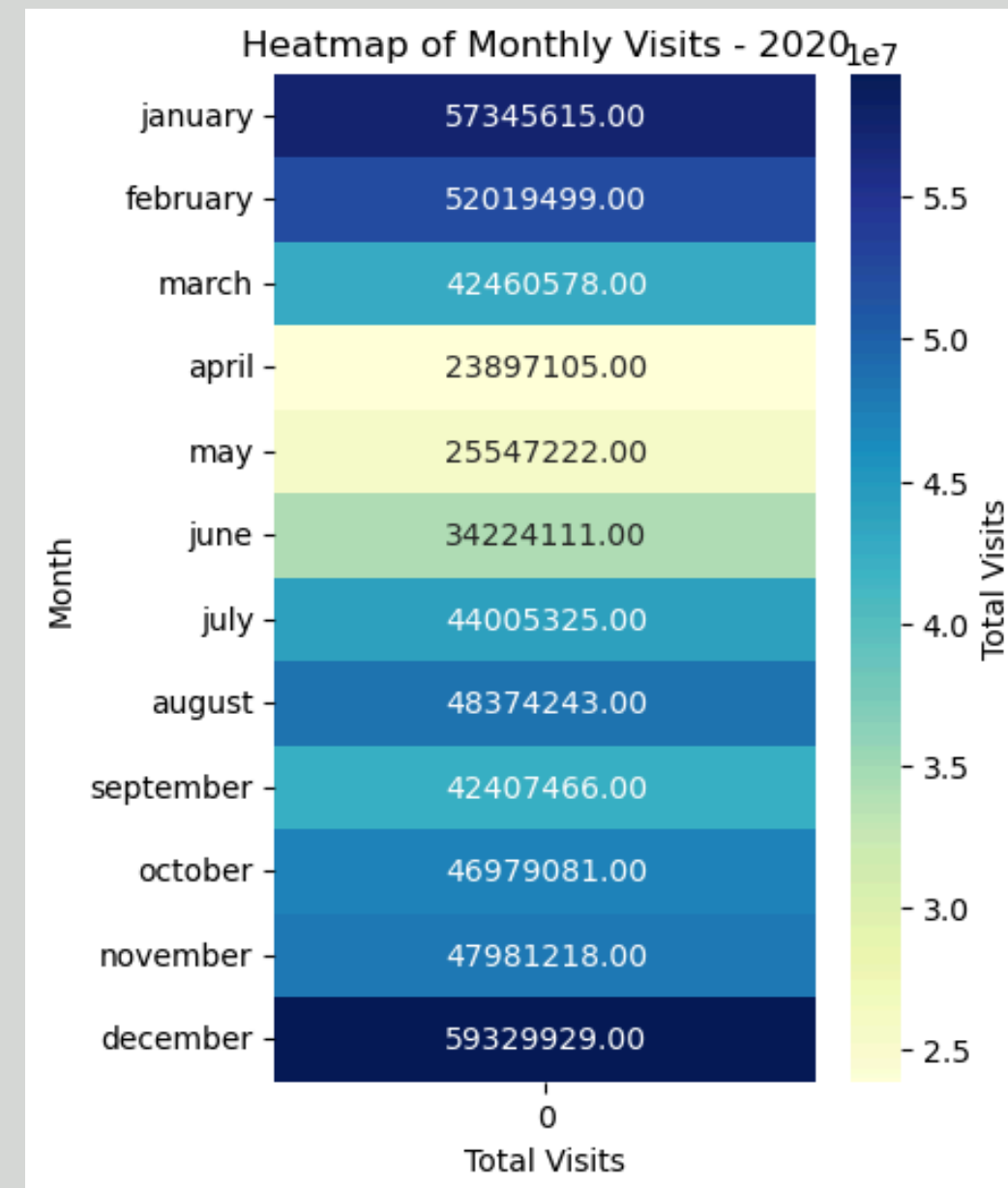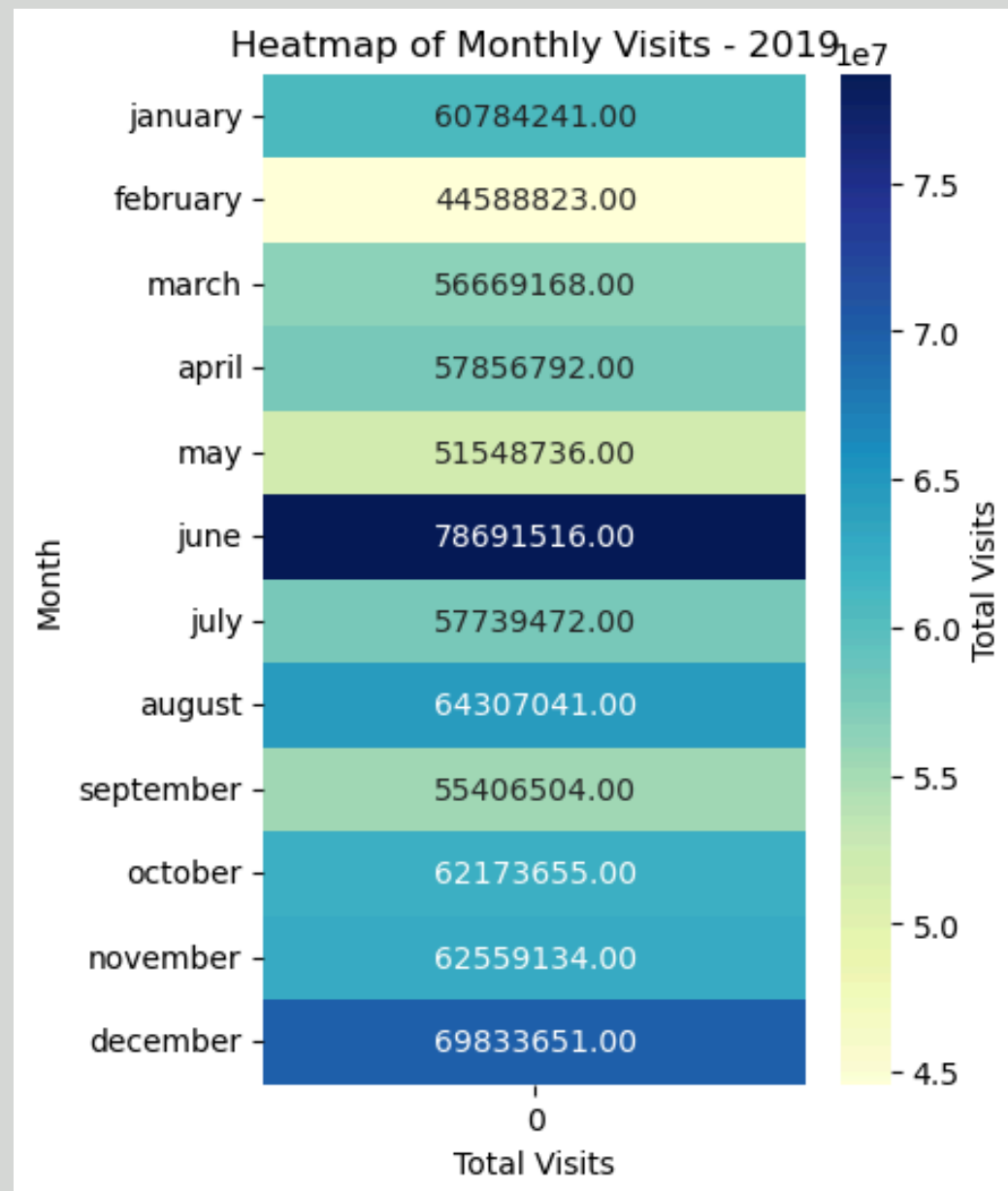
Months after differencing:

```
All months are stationary
```

Methodology (6) – Data Preprocessing

Data scaling: The monthly data was scaled using RobustScaler, as it is more effective in handling outliers by using the median and interquartile range (IQR), making it less sensitive to extreme values compared to other scaling methods.

	january_2019	february_2019
0	0.359738	0.409142
1	2.683196	2.340683
2	0.535195	0.588477
3	0.737943	0.688036
4	0.009561	0.001057

Methodology (6) – Data Preprocessing

Heatmap of Monthly Visits - 2019

Month	Total Visits
january	60784241.00
february	44588823.00
march	56669168.00
april	57856792.00
may	51548736.00
june	78691516.00
july	57739472.00
august	64307041.00
september	55406504.00
october	62173655.00
november	62559134.00
december	69833651.00

Heatmap of Monthly Visits - 2020

Month	Total Visits
january	57345615.00
february	52019499.00
march	42460578.00
april	23897105.00
may	25547222.00
june	34224111.00
july	44005325.00
august	48374243.00
september	42407466.00
october	46979081.00
november	47981218.00
december	59329929.00

Heatmap of Monthly Visits - 2021

Month	Total Visits
january	45554772.00
february	45396070.00
march	48808832.00
april	46803737.00
may	53772233.00
june	49405403.00
july	34572439.00
august	40358586.00
september	51330541.00
october	62821537.00
november	60989058.00
december	73486251.00

Methodology (б) – Data Preprocessing

Mean number of domestic tourist visits per month.

Mean Number of Domestic Tourist Visits per Month (2019-2023)
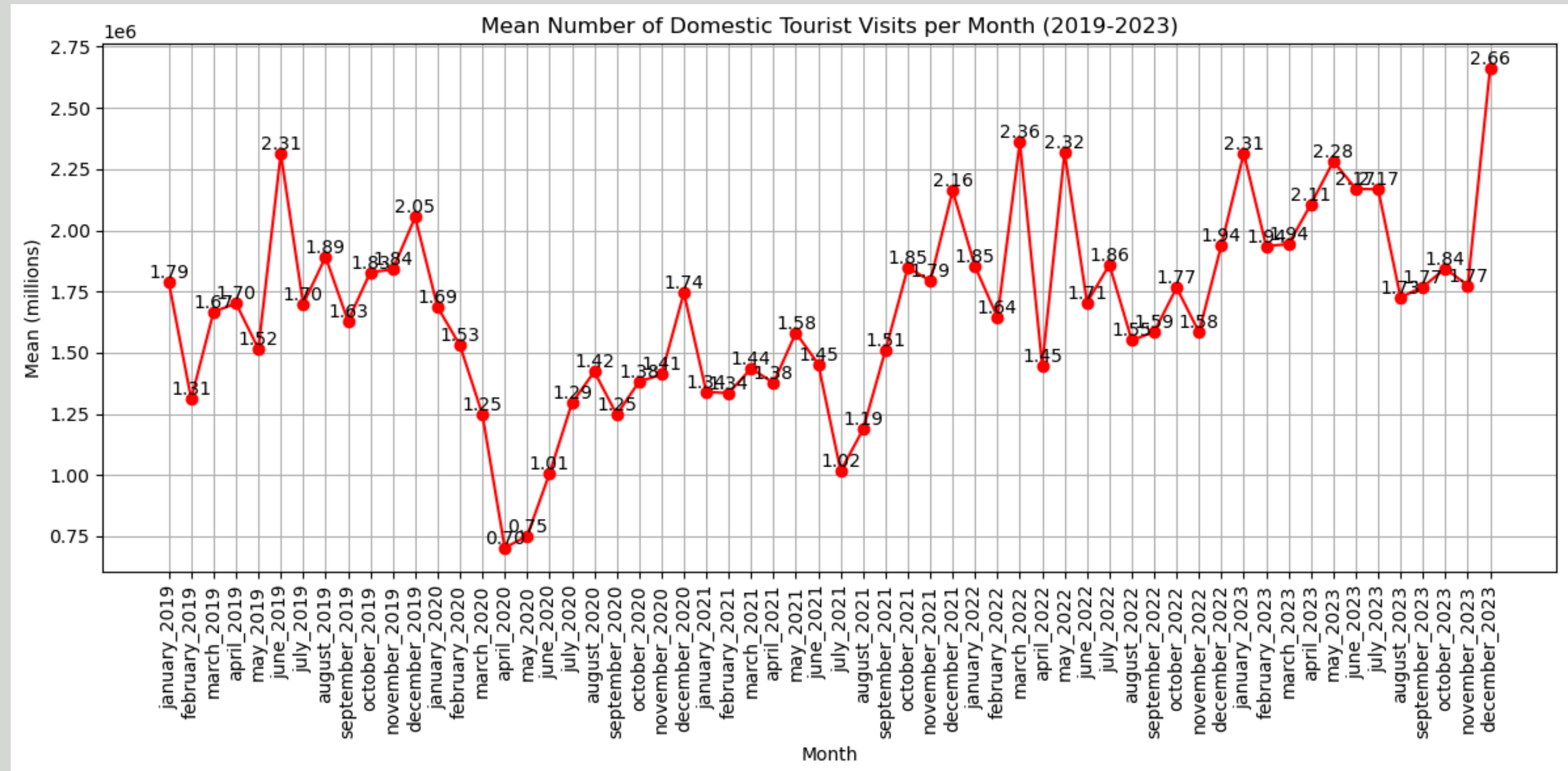
Methodology (6) – Data Preprocessing

Median number of domestic tourist visits per month.

Median Number of Domestic Tourist Visits per Month (2019-2023)
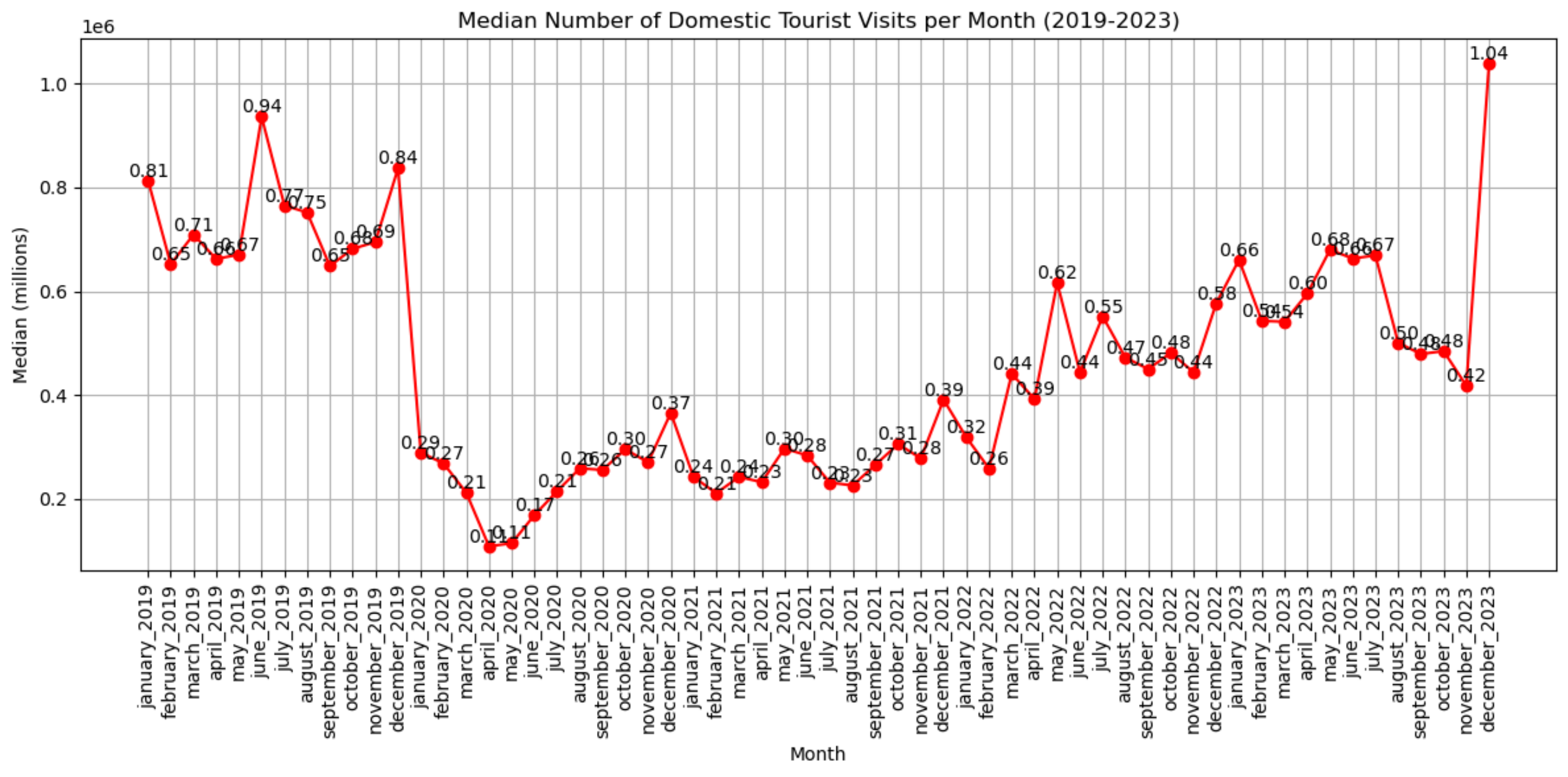
Methodology (6) – Data Preprocessing

Standar deviation of domestic tourist visits per month.

Standard Deviation of Domestic Tourist Visits per Month (2019-2023)
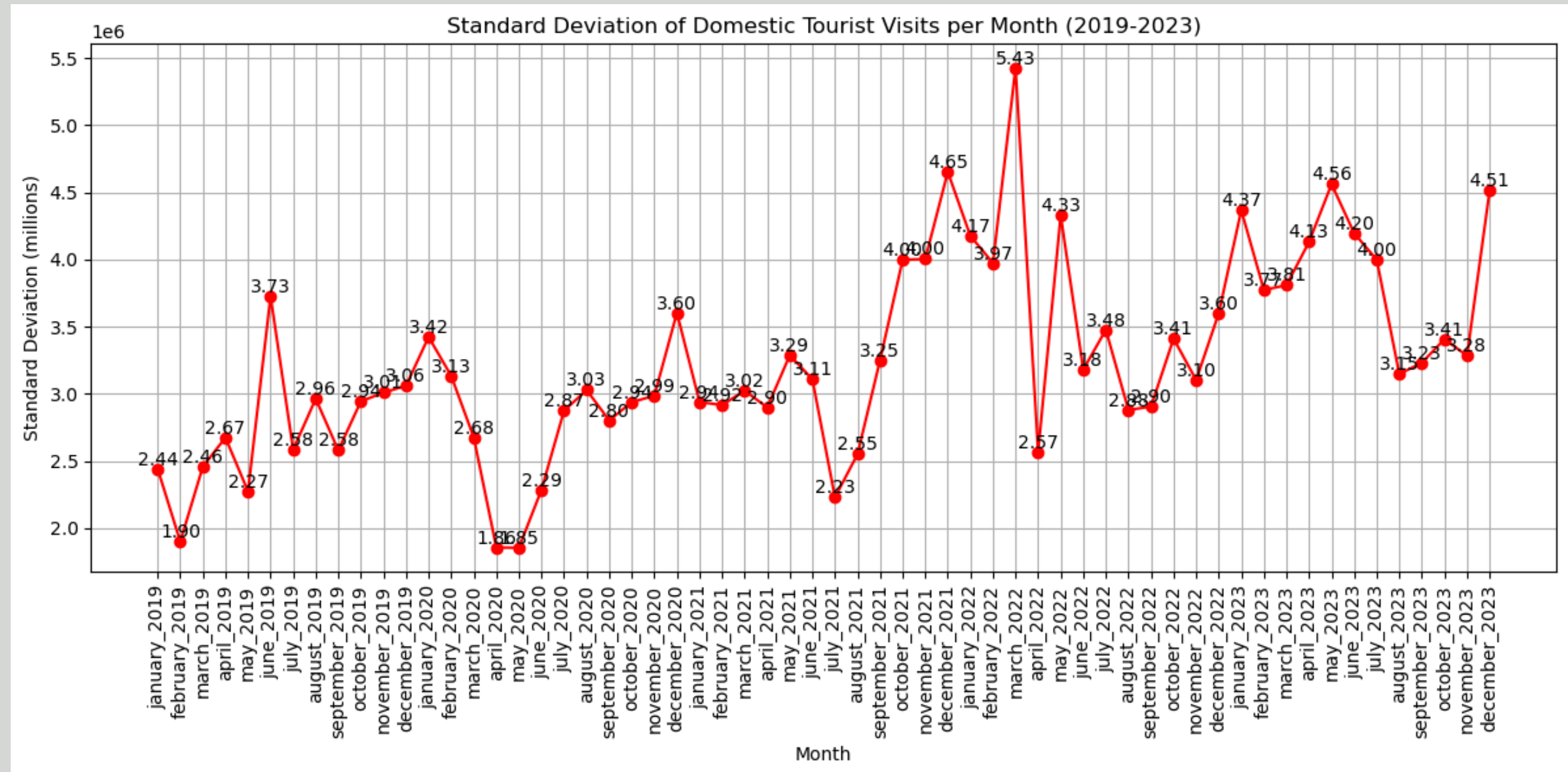
Methodology (6) – Data Preprocessing

Min and max value of domestic tourist visits per month.

Min and Max Value of Domestic Tourist Visits per Month (2019-2023)
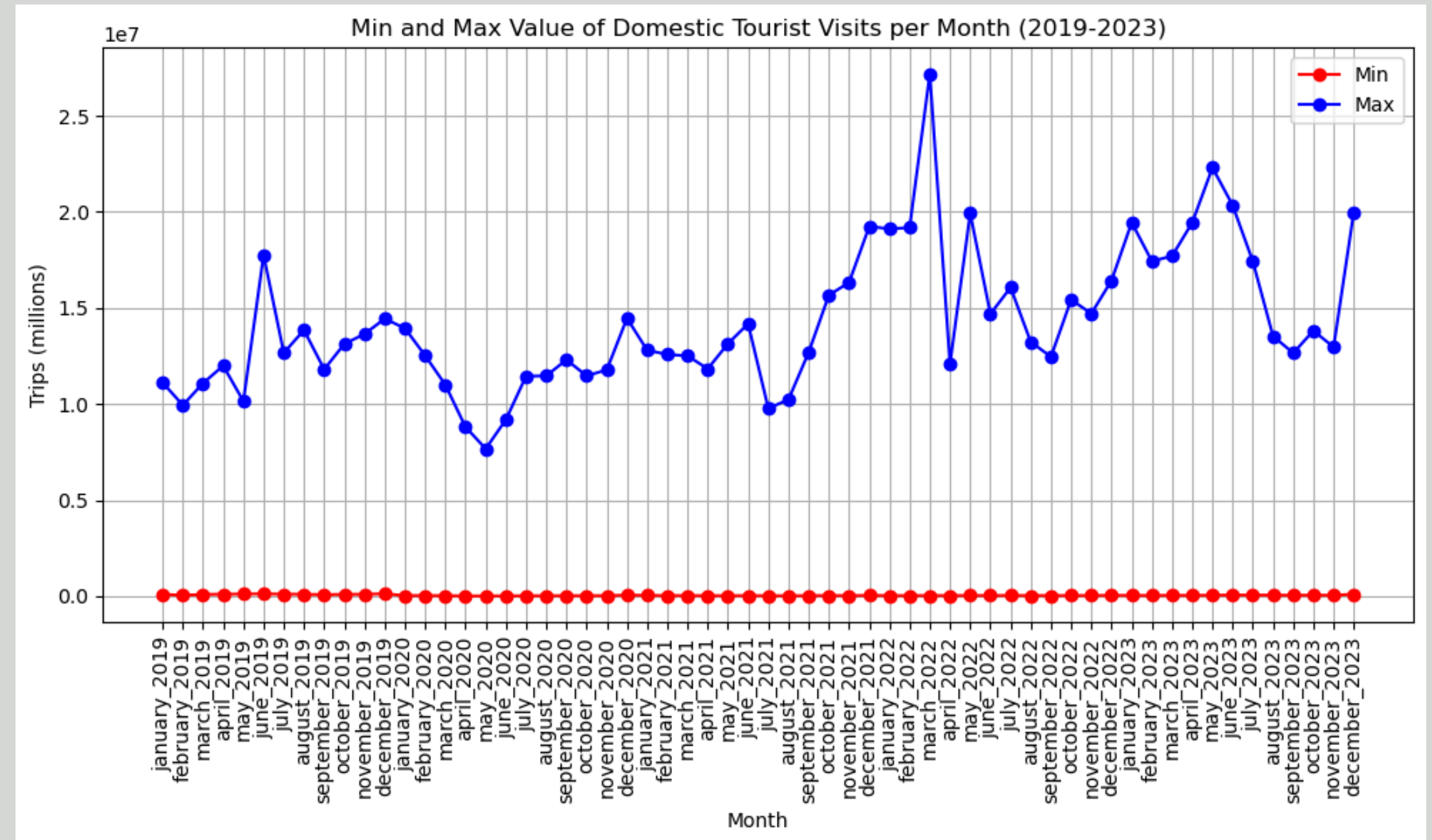
Methodology (7) – Implementation ARIMA

After the dataset preparation is complete, the dataset will then be processed to the next stage, which is ARIMA implementation itself.
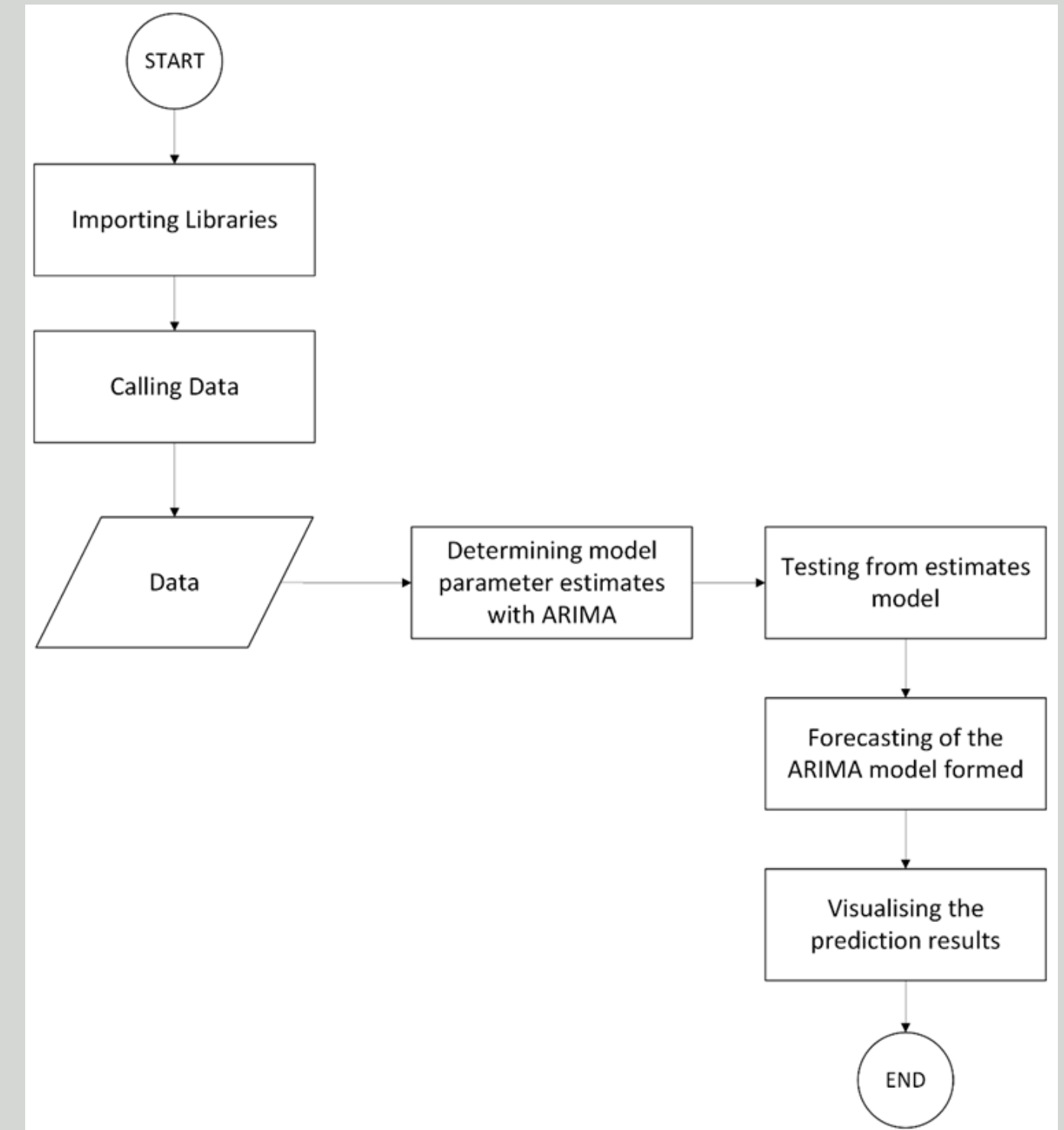
Methodology (8) – Evaluation

After the ARIMA model is implemented, the predictive results of the model will be evaluated by comparing them to the actual data in the testing period.

Research Dataset Exploration
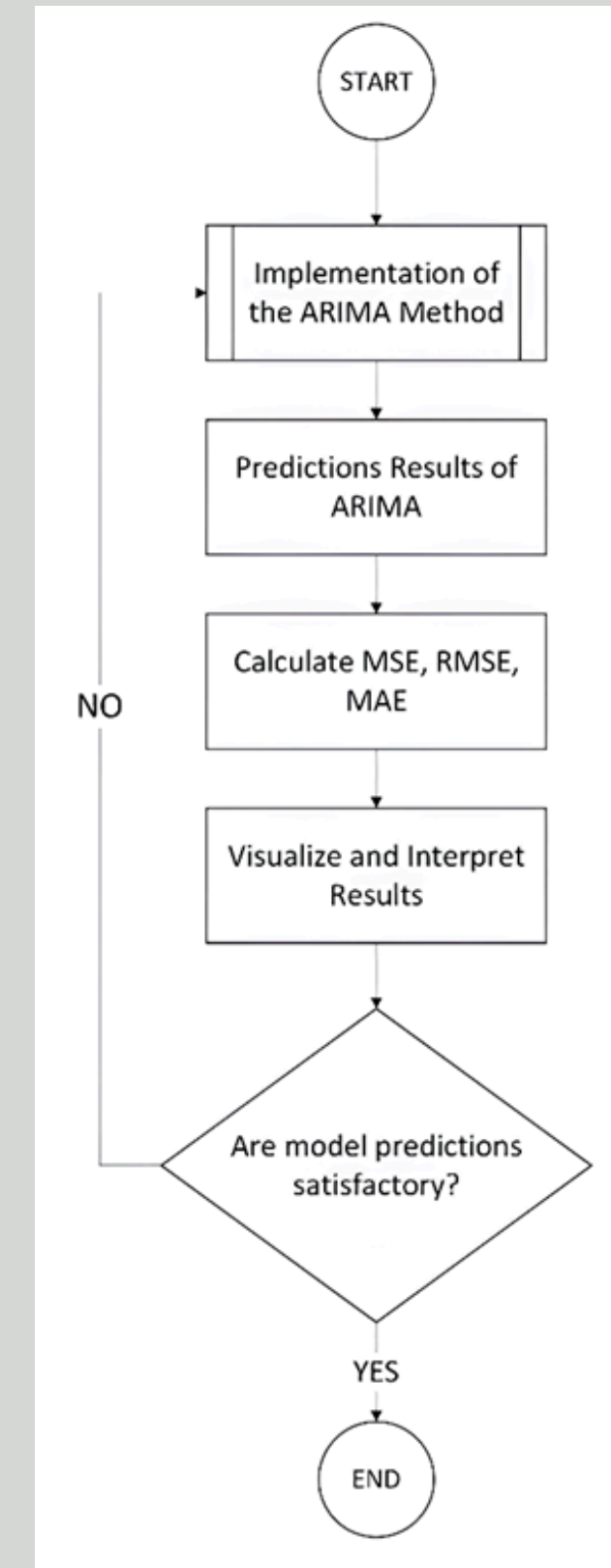
Year	Dataset Link
2019	
2020	
2021	https://www.bps.go.id/id/statistics-table/2/MjIwMSMy/jumlah-perjalanan-wisatawan-nusantara-menurut-provinsi-tujuan.html
2022	
2023	

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THANK YOU

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