

Forecasting Drug Demand Using The Single Moving Average At Prof. dr. I.G.N.G. Ngoerah Hospital

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ABSTRACT

Problems that often occur in inventory planning are excess and shortages of drug supplies. The single moving average (SMA) forecasting smooths drug demand data fluctuations. This study aims to see the potential and magnitude of errors using the SMA method based on the MAPE values. This research is non-experimental descriptive research. The study sample was the seven highest order drug items based on category A of the ABC analysis results in 2020 and 2021. The sampling technique was purposive sampling using retrospective data. The results obtained were highly accurate forecasting (MAPE <10%) for four drug items, namely Human Albumin 20% Injection 100 mL (MAPE = 2%), Eksemestan 25 mg tablets (MAPE = 3%), Trastuzumab 440 mg/20 mL injection (MAPE = 4%), Deferasirok 500 mg tablets (MAPE = 3%); Good forecasting (MAPE = 10-20%) for one drug item, namely Nilotinib 200 mg capsules (MAPE = 16%), and Reasonable forecasting (20-50%) for two drug items, namely Ifosfamide injection 1 gram (MAPE = 35%), Fentanyl injection 100 mcg / 2 mL (MAPE = 23%) with an average MAPE value of 12%. This study concluded that Prof. Dr. I.G.N.G. Ngoerah Denpasar Hospital could use the SMA forecasting method.

Keywords: Pharmaceutical Forecasting, Single Moving Average, MAPE

INTRODUCTION

Pharmaceutical inventory management includes selection, planning needs, procurement, receipt, storage, distribution, destruction and withdrawal, control, and administrative processes (Kemenkes RI, 2016). One of the effective drug management processes is ensuring the availability of drugs in terms of type and quantity by the needs to avoid shortages and excess drugs (Kemenkes RI, 2019). Problems often occur in inventory planning are drug oversupply and drug shortage (Rosmania and Supriyanto, 2015). Problems with drug availability always occur in each district every year (Suryagama et al., 2019). If there is a shortage of drugs for the accompanying symptoms, it may affect the continuity of the patient's therapy (Puspikaryani et al., 2022).

The drug budget in hospitals must be managed effectively and efficiently, which can be achieved through good drug planning (Kemenkes RI, 2019). The planning calculation approach is done through forecasting. There is no perfect forecasting, so forecasting error measures are carried out, such as Mean Absolute Percent Error (MAPE), to measure the accuracy of the method (Satibi, 2016).

The Single Moving Average (SMA) method is relatively simple and easy to understand (Makridakis et al., 2018). The SMA method helps smooth out temporary fluctuations in drug demand data. The SMA method with three months tends to be more responsive to changes in drug demand in the medium term (Render et al., 2021).

Hudaningsih research in 2020, the forecasting method with a 3-month SMA produces smaller MAPE values than the Single Exponential Smoothing (SES) method on Aknil® medicinal products. Forecasting Easy Touch® Medical Devices using SMA by Hayuningtyas and Sari in 2021, found that the best period used was an average of 3 months. The forecasting accuracy values obtained are MAPE = 11.56%, which indicates SMA forecasting provides good forecasting (MAPE = 10%-20%). Based on this background, the researcher was encouraged to conduct a forecasting simulation using the SMA method at Prof. Dr. I.G.N.G. Ngoerah Denpasar Hospital to predict future drug needs.

METHODOLOGY

This research is a non-experimental descriptive study. The study population was all drug items used at Prof. dr. I.G.N.G. Ngoerah Hospital from January 2020 to December 2021. The study sample was the seven highest drug items based on category A of the ABC analysis results in 2020 and 2021 with inclusion and exclusion criteria. The sampling technique was purposive sampling using retrospective data. The inclusion criteria in this study were drugs with Pareto category A and supply from distributors that were stable for 24 months, while the exclusion criteria were incomplete drug usage data. The research was conducted by collecting drug data and classifying using ABC, then analyzing the forecasting of drug needs using the SMA method with the Eviews 12 application. The MAPE values were calculated using Microsoft Excel to assess the accuracy of the forecasting method used, and then the MAPE value was interpreted.

RESULTS AND DISCUSSION

Data on drug use at Prof. Dr. I.G.N.G. Hospital. Ngoerah in January 2020 - December 2021 revealed that drugs included in Pareto A with the top seven sequences that met the inclusion and exclusion criteria were Human Albumin 20% Injection 100 mL, Ifosamid 1 gram injection, Nilotinib 200 mg capsule, Eksemestan 25 mg tablet, Fentanyl 100 mcg/2 mL injection, Trastuzumab 440 mg/20 mL injection, and Deferasiroks 500 mg tablet. The data on the use of the seven drugs were then utilized for SMA forecasting using Eviews 12. The forecasting results were subsequently conducted with error calculations in Excel to obtain the MAPE values. The formula used for performing forecasting using a 3-month SMA in January 2022 in tables II, III, IV, V, VI, VII, and VIII was as follows:

$$F_t = (Y_{t-1} + Y_{t-2} + \dots + Y_{t-n}) / n \dots\dots\dots(1)$$

F_t : forecast score in period t

$Y_{t-1} + Y_{t-2} + \dots + Y_{t-n}$: previous n data

n = number of periods in the moving average

The formulas used to calculate MAPE for forecasting in January 2022 are as follows.

$$MAPE = \frac{\sum [actual - forecasting]}{nilai actual} \times 100\% \dots\dots\dots(2)$$

n = number of data periods

(Ginantra and Anandita, 2019).

The MAPE value indicates how much the error in forecasting was compared to the real value (Ginantra and Anandita, 2019). The obtained MAPE value can then be interpreted as follows.

The actual data of medicine usage was informed by the Real Number (R). The SMA forecasting result was informed by the Number of Forecasting per Month (N). The difference between usage data and SMA forecasting was informed by the Deviation (D). The data for Real Number (R), Number of Forecasting per Month (N), and Deviation (D) for each product were listed in Tables II, III, IV, V, VI, VII, and VIII.

The results of forecasting Human Albumin 20% Injection 100 mL using the SMA method for the January 2022 period, with a MAPE value of 2%, was obtained in Table II. The SMA method on Human Albumin 20% Injection 100 mL was indicated to provide highly accurate forecasting, as evidenced by the less than 10% MAPE value. This result was obtained by research (Astuti et al., 2019) to predict sales with a MAPE value of 4.2638%. The MAPE value of less than 10% in forecasting with the single moving average method can be caused by the stability of historical data. Suppose forecasting is being done with the single moving average method. Highly Accurate results can be produced if the historical data used for forecasting is relatively stable and there are no sudden fluctuations or changes in the data pattern. A low MAPE can be achieved. (Makridakis et al., 2018).

The results of forecasting Ifosamid 1 Gram Injection using the SMA method for the January 2022 period, with a MAPE value of 35%, was obtained in Table III. The SMA method on Ifosamid 1 Gram Injection provided good forecasting, as indicated by the MAPE value falling within the 20%-50% range. This result was consistent with the research conducted by Fauziah and Fauziah in 2022, where an average MAPE value of 49% was obtained. The findings also supported the research by Hady et al. (2022) on drug sales forecasting in pharmacies, where the MAPE value generated using the 3-month SMA method was 26.23%. MAPE values between 20% and 50% in forecasting with the single moving average method could be attributed to seasonal solid trends or patterns, high variability in historical data, and delays in pattern changes. The single-moving average method was typically ineffective in handling strong, clearly defined trends or seasonal patterns. When historical

Table I. MAPE Interpretation

MAPE (%)	Interpretation
<10	Highly accurate forecasting
10-20	Good forecasting
20-50	Reasonable forecasting
>50	Inaccurate forecasting

Source: Lewis (1982) in (Montaño Moreno et al., 2013).

Table II. Forecasting Results of Human Albumin 20% Injection 100 mL

Month	R	F (pcs)	D (pcs)	MAPE (%)
Jan-20	359	-	-	-
Feb-20	311	-	-	-
Mar-20	374	-	-	-
Apr-20	223	348	125	56
May-20	317	303	-14	5
Jun-20	411	305	-106	26
Jul-20	286	317	31	11
Aug-20	306	338	32	10
Sep-20	275	334	59	22
Oct-20	304	289	-15	5
Nov-20	391	295	-96	25
Dec-20	391	323	-68	17
Jan-21	336	362	26	8
Feb-21	427	373	-54	13
Mar-21	533	385	-148	28
Apr-21	574	432	-142	25
May-21	598	511	-87	14
Jun-21	512	568	56	11
Jul-21	363	561	198	55
Aug-21	517	491	-26	5
Sep-21	525	464	-61	12
Oct-21	621	468	-153	25
Nov-21	456	554	98	22
Dec-21	588	534	-54	9
Jan-22	568	555		

data exhibited significant trends or substantial seasonal fluctuations, this method might not accurately capture those patterns, leading to higher MAPE values (Makridakis et al., 2018)

The results of forecasting Nilotinib 200 mg using the SMA method for the January 2022 period, with a MAPE value of 16%, was obtained in Table IV. These results indicate that the forecasting of Nilotinib 200 mg Capsules in January 2021 was good as the MAPE value fell within the 10%-20% range. Similar findings were also reported in the Research by Hayuningtyas and Sari in 2021, where the MAPE value generated in forecasting Medical Devices using a 3-month SMA was 11.56%. The study by Sam et al. in 2022 also supported these results, showing a MAPE value of 17.8% in predicting smartphone demand. MAPE values between 10% and 20% in forecasting with the single moving average method can be attributed to more complex data patterns and irregularities in the data. The single-moving average method proved ineffective in handling such complex data patterns, including emerging trends or significant seasonal fluctuations. If the historical data exhibited clear trends or seasonal patterns, this method failed to capture them accurately, resulting in slightly higher MAPE values (Makridakis et al., 2018).

Table III. Forecasting Results of Ifosfamid 1 Gram Injection

Month	R	F (pcs)	D (pcs)	MAPE (%)
Jan-20	193	-	-	-
Feb-20	146	-	-	-
Mar-20	207	-	-	-
Apr-20	170	182	12	7
May-20	193	174	-19	10
Jun-20	144	190	46	32
Jul-20	102	169	67	66
Aug-20	70	146	76	109
Sep-20	109	105	-4	3
Oct-20	186	94	-92	50
Nov-20	149	122	-27	18
Dec-20	255	148	-107	42
Jan-21	155	197	42	27
Feb-21	118	186	68	58
Mar-21	145	176	31	21
Apr-21	187	139	-48	25
May-21	162	150	-12	7
Jun-21	125	165	40	32
Jul-21	124	158	34	27
Aug-21	125	137	12	10
Sep-21	121	125	4	3
Oct-21	93	123	30	33
Nov-21	101	113	12	12
Dec-21	202	105	-97	48
Jan-22	203	132		

The results of forecasting Eksemestan 25 mg Tablets using the SMA method for the January 2022 period, with a MAPE value of 3%, was obtained in Table V. It can be observed from these results that Eksemestan 25 mg Tablets in January 2021 had a highly accurate forecasting outcome, as the MAPE value was below 10%. These results supported the research Suryana, 2018, which obtained a MAPE value of 8% when forecasting Turning Product demand using the 3-month SMA method. This result can be attributed to simple data patterns. The SMA method is considered suitable for application when data patterns are simple and do not exhibit significant trends or seasonality. When data follows a consistent pattern or undergoes prolonged changes over time, this forecasting method can yield favorable outcomes with low MAPE values (Montgomery et al., 2015).

The results of forecasting Fentanyl 100 mcg/2 mL Injection using the SMA method for the January 2022 period, with a MAPE value of 23%, was obtained in Table VI. It can be inferred that the 3-month SMA forecasting for Fentanyl 100 mcg/2 mL Injection was found within a reasonable category. This finding is supported by research by Rusdiana et al. in 2020, which yielded a MAPE value of 43.43%. If historical data exhibited high variability, characterized by substantial fluctuations between periods, the single moving average method could not effectively capture changes. In such cases, high MAPE values might occur due to the method's limited responsiveness to significant variations in the data (Montgomery et al., 2015).

The results of forecasting Trastuzumab 440 mg/20 mL Injection using the SMA method for the January 2022 period, with a MAPE value of 4%, was obtained in Table VI. The MAPE value below 10% shows that Trastuzumab 440 mg/20 mL has highly accurate forecasting. This finding is supported by research by Agustian et al. in 2020, where the MAPE in the SMA method was 3.407%. This result can be attributed to the absence of outlier data. Forecasting inaccuracies can occur when there are outlier data or anomalies present in the data. If the historical data does not contain significant outliers or

Table IV. Forecasting Results of Nilotinib 200 mg Capsule

Month	R	F (pcs)	D (pcs)	MAPE (%)
Jan-20	2520	-	-	-
Feb-20	836	-	-	-
Mar-20	3090	-	-	-
Apr-20	780	2149	1369	175
May-20	480	1569	1089	227
Jun-20	990	1450	460	46
Jul-20	1290	750	-540	42
Aug-20	2738	920	-1818	66
Sep-20	2208	1673	-535	24
Oct-20	1440	2079	639	44
Nov-20	2040	2129	89	4
Dec-20	1680	1896	216	13
Jan-21	1830	1720	-110	6
Feb-21	2010	1850	-160	8
Mar-21	2130	1840	-290	14
Apr-21	2040	1990	-50	2
May-21	2400	2060	-340	14
Jun-21	2386	2190	-196	8
Jul-21	2474	2275	-199	8
Aug-21	2280	2420	140	6
Sep-21	1920	2380	460	24
Oct-21	1890	2225	335	18
Nov-21	2520	2030	-490	19
Dec-21	2250	2110	-140	6
Jan-22	1920	2220		

Table Va. Forecasting Results of Eksemestan 25 mg Tablet

Month	R	F (pcs)	D (pcs)	MAPE (%)
Jan-20	3173	-	-	-
Feb-20	2946	-	-	-
Mar-20	2801	-	-	-
Apr-20	3060	2973	-87	3
May-20	2872	2936	64	2
Jun-20	3248	2911	-337	10
Jul-20	3060	3060	0	0
Aug-20	3187	3060	-127	4
Sep-20	3150	3165	15	0
Oct-20	2910	3132	222	8
Nov-20	3330	3082	-248	7
Dec-20	3390	3130	-260	8
Jan-21	3060	3210	150	5
Feb-21	1500	3260	1760	117
Mar-21	3480	2650	-830	24
Apr-21	3325	2680	-645	19
May-21	2994	2768	-226	8
Jun-21	3379	3266	-113	3
Jul-21	3425	3233	-192	6
Aug-21	3040	3266	226	7

Table Vb. Forecasting Results of Eksemestan 25 mg Tablet

Month	R	F (pcs)	D (pcs)	MAPE (%)
Sep-21	3281	3281	0	0
Oct-21	3159	3249	90	3
Nov-21	3308	3160	-148	4
Dec-21	3264	3249	-15	0
Jan-22	3330	3244		

Table VI. Forecasting Results of Fentanyl 100 mcg/2 mL Injection

Month	R	F (pcs)	D (pcs)	MAPE (%)
Jan-20	3875	-	-	-
Feb-20	3316	-	-	-
Mar-20	3516	-	-	-
Apr-20	1900	3569	1669	88
May-20	2262	2911	649	29
Jun-20	2580	2559	-21	1
Jul-20	2133	2247	114	5
Aug-20	4525	2325	-2200	49
Sep-20	4907	3079	-1828	37
Oct-20	5641	3855	-1786	32
Nov-20	4502	5024	522	12
Dec-20	4249	5017	768	18
Jan-21	5212	4797	-415	8
Feb-21	6356	4654	-1702	27
Mar-21	5563	5272	-291	5
Apr-21	6104	5710	-394	6
May-21	4305	6008	1703	40
Jun-21	3964	5324	1360	34
Jul-21	7441	4791	-2650	36
Aug-21	7201	5237	-1964	27
Sep-21	9698	6202	-3496	36
Oct-21	5455	8113	2658	49
Nov-21	3896	7451	3555	91
Dec-21	4925	6350	1425	29
Jan-22	3875	4759		

Table VIIa. Forecasting Results of Trastuzumab 440 mg/20 mL Injection

Month	R	F (pcs)	D (pcs)	MAPE (%)
Jan-20	28	-	-	-
Feb-20	17	-	-	-
Mar-20	14	-	-	-
Apr-20	18	20	2	9
May-20	20	16	-4	18
Jun-20	22	17	-5	21
Jul-20	18	20	2	11
Aug-20	19	20	1	5
Sep-20	19	20	1	4
Oct-20	19	19	0	2
Nov-20	20	19	-1	5
Dec-20	16	19	3	21

Table VIIb. Forecasting Results of Trastuzumab 440 mg/20 mL Injection

Month	R	F (pcs)	D (pcs)	MAPE (%)
Jan-21	17	18	1	8
Feb-21	21	18	-3	16
Mar-21	18	18	0	0
Apr-21	22	19	-3	15
May-21	26	20	-6	22
Jun-21	17	22	5	29
Jul-21	33	22	-11	34
Aug-21	26	25	-1	3
Sep-21	19	25	6	33
Oct-21	23	26	3	13
Nov-21	17	23	6	33
Dec-21	16	20	4	23
Jan-22	18	19		

Table VIII. Forecasting Results of Deferasiroks 500 mg Tablet

Month	R	F (pcs)	D (pcs)	MAPE (%)
Jan-20	1280	-	-	-
Feb-20	305	-	-	-
Mar-20	392	-	-	-
Apr-20	990	659	-331	33
May-20	1356	562	-794	59
Jun-20	1569	913	-656	42
Jul-20	1312	1305	-7	1
Aug-20	1608	1412	-196	12
Sep-20	1333	1496	163	12
Oct-20	1285	1418	133	10
Nov-20	1545	1409	-136	9
Dec-20	1713	1388	-325	19
Jan-21	810	1514	704	87
Feb-21	1933	1356	-577	30
Mar-21	2282	1485	-797	35
Apr-21	2409	1675	-734	30
May-21	1583	2208	625	39
Jun-21	2386	2091	-295	12
Jul-21	1921	2126	205	11
Aug-21	1994	1963	-31	2
Sep-21	2169	2100	-69	3
Oct-21	2038	2028	-10	0
Nov-21	2633	2067	-566	21
Dec-21	2729	2280	-449	16
Jan-22	2540	2467		

anomalies that affect forecasting, then a low MAPE value can be achieved using the single moving average method (Chatfield, 2000).

The results of forecasting Deferasirox 500 mg Tablets using the SMA method for the January 2022 period, with a MAPE value of 3%, was obtained in Table VI. The SMA method was used to forecast Deferasirox 500 mg Tablets with a MAPE value below 10%, indicating highly accurate forecasting. This finding is supported by research by Aziza in 2022 that obtained a MAPE value of 5% in forecasting the demand for LPG gas cylinders. Additionally, the SMA method used in production forecasting also achieved a MAPE value below 10%, specifically 8.779% (Nathania et al., 2021).

Table IX. Forecasting Whole Drug Forecasting with SMA Forecasting

No	Name of Medicine	MAPE	MAPE Interpretation
1	Human Albumin 20% Injeksi 100 mL	2%	Highly Accurate Forecasting
2	Ifosfamid 1 Gram Injeksi	35%	Reasonable Forecasting
3	Nilotinib 200 mg Kapsul	16%	Good Forecasting
4	Eksemestan 25 mg Tablet	3%	Highly Accurate Forecasting
5	Fentanil 100 mcg/2 mL Injeksi	23%	Reasonable Forecasting
6	Trastuzumab 440 mg/20 mL Injeksi	4%	Highly Accurate Forecasting
7	Deferasiroks 500 mg Tablet	3%	Highly Accurate Forecasting
	Mean	12%	

Based on the results obtained in Table IX, it was determined that four drug items had highly accurate forecasting, one drug item had good forecasting, and two drug items had reasonable forecasting, with an average MAPE value of 12%. It indicates that good forecasting was achieved using the SMA method on the seven highest-order drug items based on category A of the ABC analysis results for January 2022.

These results are aligned with the research conducted by Kurnia in 2022, which obtained a MAPE value of 16.09% in sales forecasting. A MAPE value of 14.34% was obtained by Hay's et al. in 2017, predicting sales data. Furthermore, a MAPE value of 18.9% was achieved in forecasting inventory, demonstrating effective forecasting (Azhari et al., 2022). The implementation of SMA forecasting is also supported by its advantages, such as continuous calculation within a specific period based on data movement and an easy, efficient calculation process without requiring data weighting (Dewi and Chamid, 2019).

CONCLUSION

Research conducted at the Prof. Dr. I.G.N.G. Ngoerah Denpasar Hospital using the SMA method simulation on the seven highest order drug items based on category A of the ABC analysis results, for forecasting drug needs in January 2022, obtained highly accurate forecasting of four drugs, good forecasting of one drug item; reasonable forecasting of two drug items. Good forecasts are suggested by the SMA method, as indicated by the average MAPE value of 12% across seven drug products. This study concluded that Prof. Dr. I.G.N.G. Ngoerah Denpasar Hospital could use the SMA forecasting method.

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REFERENCES

- Agustian, H., Pujiastuti, A., Sayoga, M.V., 2020. Comparison Of Simple Moving Average and Exponential Smoothing Methods To Predict Seaweed Prices. *CCIT Journal* 13, 175–184.
- Astuti, Y., Novianti, B., Hidayat, T., Maulina, D., 2019. Penerapan Metode Single Moving Average untuk Peramalan Penjualan Mainan Anak, *Sensitif* 1, 253–261.
- Azhari, Y., Azhar, Z., Nehe, N., 2022. Prediksi Persediaan Kedelai Di Ud Tahu Home Industry Dengan Menggunakan Metode Single Moving Average. *JUTSI (Jurnal Teknologi Dan Sistem Informasi)* 2, 121–128.
- Aziza, J.N.A., 2022. Perbandingan Metode Moving Average, Single Exponential Smoothing, dan Double Exponential Smoothing Pada Peramalan Permintaan Tabung Gas LPG PT Petrogas Prima Services. *Jurnal Teknologi dan Manajemen Industri Terapan* 1, 35–41.
- Chatfield, 2000. *Time-Series Forecasting, 2nd ed.* Chapman & C Hall / CRC, USA.
- Dewi, E.N.S., Chamid, A.A., 2019. Implementation of Single Moving Average Methods For Sales Forecasting Of Bag In Convection Tas Loram Kulon. *Jurnal Transformatika* 16, 113–125.

- Fauziah, L., Fauziah, F., 2022. Penerapan Metode Single Exponential Smoothing dan Moving Average Pada Prediksi Stock Produk Retail Berbasis Web. *STRING* 7, 159-168.
- Ginantra, N.L.W.S.R., Anandita, I.B.G., 2019. Penerapan Metode Single Exponential Smoothing Dalam Peramalan Penjualan Barang. *J-SAKTI (Jurnal Sains Komputer dan Informatika)* 3, 433-441.
- Hady, S., Hamsinar, H., Hardiyanti, R.P., 2022. Penerapan Data Mining dengan Metode Single Moving Average untuk Menentukan Jumlah Penjualan Obat. *Jurnal Informatika* 11, 166-175.
- Hay's, R. naufal, Anharudin, Adrean, R., 2017. Sistem Informasi Inventory Berdasarkan Prediksi Data Penjualan Barang Menggunakan Metode Single Moving Average Pada CV.Agung Youanda. *ProTekInfo(Pengembangan Riset dan Observasi Teknik Informatika)* 4, 29-33.
- Hayuningtyas, R.Y., Sari, R., 2021. Aplikasi Peramalan Alat Kesehatan Menggunakan Single Moving Average. *Infortech* 3, 40-45.
- Hudaningsih, N., Utami, S.F., Jabbar, W.A.A., 2020. Perbandingan Peramalan Penjualan Produk Aknil Pt.Sunthi Sepuri menggunakan Metode Single Moving Average dan Single Exponential Smoothing. *Jurnal Informatika Teknologi dan Sains (Jinteks)* 2, 15-22.
- Kemendes RI. 2016. *Permenkes Nomor 72 Tahun 2016*. Kementerian Kesehatan Republik Indonesia, Jakarta
- Kemendes RI. 2019. *Petunjuk Teknis Standar Pelayanan Kefarmasian di Rumah Sakit*. Kementerian Kesehatan Republik Indonesia, Jakarta
- Kurnia, N., 2022. Penerapan Peramalan Penjualan Sembako Menggunakan Metode Single Moving Average (Studi Kasus Toko Kelontong Dedeh Retail). *Infinity: Jurnal Matematika dan Aplikasinya* 2, 93-103.
- Makridakis, Wheelwright, Hyndman, 2018. *Forecasting, Methods and Applications, 3rd ed*. Wiley India Pvt. Limited, India.
- Montaño Moreno, J.J., Palmer Pol, A., Sesé Abad, A., 2013. Using the R-MAPE Index as a Resistant Measure Of Forecast Accuracy. *Psicothema* 25, 500-506.
- Montgomery, D.C., Jennings, C.L., Kulahci, M., 2015. *Introduction to Time Series Analysis and Forecasting*. John Wiley & Sons, USA.
- Nathania, C.J., Iskandar, F.R., Wicaksonoputra, A.F., Nurcahyo, R., 2021. Production Planning Forecasting using Single Moving Average and Exponential Smoothing Method in PT. Semen Indonesia. *IEOM Society International* 1, 324-330.
- Puspikaryani, G.A.P., Iin Kristanti, I.G.A.M., Wibawa, I.M.A.Y., 2022. Strategi Perencanaan dan Pengadaan Obat Dalam Penanganan Pandemi Covid-19 di Instalasi Farmasi RSUD Bali Mandara. *Majalah Farmaseutik* 18, 85-89.
- Render, Stair, Hanna, 2015. *Quantitative Analysis For Management, 13th ed*. Pearson, United Kingdom
- Rosmania, F., Supriyanto, S., 2015. Analisis Pengelolaan Obat Sebagai Dasar Pengendalian Safety Stock pada Stagnant dan Stockout Obat. *Jurnal Administrasi Kesehatan Indonesia* 3, 1-10.
- Rusdiana, S., Yuni, S.M., Khairunnisa, D., 2020. Comparison of Rainfall Forecasting in Simple Moving Average (SMA) and Weighted Moving Average (WMA) Methods (Case Study at Village of Gampong Blang Bintang, Big Aceh District-Sumatera-Indonesia). *Journal of Research in Mathematics Trends and Technology* 2, 21-27.
- Sam, M., Kurniawati, E., Fausia, S.R., 2022. Peramalan Permintaan Smartphone Oppo Android Menggunakan Metode Single Moving Average. *Infinity: Jurnal Matematika dan Aplikasinya* 2, 93-103.
- Satibi, S., 2016. *Manajemen Obat di Rumah Sakit*.
- Suryagama, D., Satibi, S., Sumarni, S., 2019. Analisis Perencanaan dan Ketersediaan Obat di Kabupaten dan Kota Provinsi Jawa Timur. *Jurnal Manajemen Dan Pelayanan Farmasi (Journal of Management and Pharmacy Practice)* 9, 243-251.
- Suryana Asrul Sani, 2018. Perbandingan Metode Peramalan Beban Listrik Jangka Pendek Menggunakan Metode Moving Average, Single Exponential Smoothing dan Autoregressive Moving Average di Yogyakarta.