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COMPARISON OF SINGLE MOVING AVERAGE AND WINTER EXPONENTIAL SMOOTHING METHODS IN PREDICTING THE NUMBER OF DIVORCE CASES AT THE RELIGIOUS COURT OF CIBINONG

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ABSTRACT

Based on data from the Central Bureau of Statistics, the divorce rate in Indonesia shows a tendency to increase from year to year. Similar conditions were experienced by Cibinong district. The forecasting method that will be used in this study is the Single Moving Average and Winter's Exponential Smoothing. The results of forecasting the number of lawsuits in 2023 from July to December with movements with two obtained forecasts in July were 602, August 283, MAD value = 67.29, MSE value = 8.722, MAPE = 11.61, RMSE = 1.46, Accuracy value of 88.39%. Movements with four forecasting periods in July were 620, August 448, September 301, October 141. MAD value = 99.33, MSE value = 14,722, MAPE = 16.59, RMSE = 1.90, Accuracy value of 83.41%. Forecasting with the Winters Exponential Smoothing Method with Alpha: 0.1, Beta: 0.3 and Gamma: 0.5, the forecast results obtained in July were 504.10026, August 491.61306, September 663.18788, October 745.41004, November 732.42766 and December 732.10904. MAE value is 171.65116, MSE value is 686.63361, MAD value is 38.74, MSE value is 2.797 MAPE value is 6.0 and RMSE value is 0.83 and accuracy value is 94.00%. Based on the calculation results above, it is concluded that forecasting the number of divorce filings at Cibinong Religious Court from January 2018 to December 2023 with the Winter Exponential Smoothing method has MAD, MSE, MAPE, RMSE values smaller than values in the Single Moving Average method. Winter Exponential Smoothing method is more appropriate with an accuracy value of 94.00%.

KEYWORDS *Forecasting, Divorce, Single Moving Average, Winter's Exponential Smoothing*

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INTRODUCTION

According to the Indonesian Statistics report, the number of divorce cases in the country reached 447,743 cases in 2021, increasing by 53.50% compared to 2020, which reached 291,677 cases. The report indicates that wives initiate divorce proceedings more often than husbands. A total of 337,343 cases or 75.34% of divorces occurred as a result of divorce suits, meaning the cases were filed by the wives and adjudicated by the court. Meanwhile, 110,400 cases or 24.66% of divorces occurred due to divorce by talak, where the husband initiated the proceedings and the court made the decision. In terms of provinces, the highest number of divorce cases in 2021 was in West Java, totaling 98,088 cases, followed by East Java and Central Java with 88,235 cases and 75,509 cases, respectively (Annur, 2022). Over the past 4 years, the number of divorce filings in the Cibinong Religious Court has tended to increase. The main causes of the high divorce rate are continuous disputes and economic factors (Novrizaldi, 2020).

Based on the background discussion above, the problem arises that a suitable method is needed to predict the number of divorce filings received by the Cibinong Religious Court. The data used in this study is the number of divorce filings received over the past 5 (five) years, from 2018 to 2023, at the Cibinong Religious Court. There are several algorithms that can be used for forecasting, such as Single Moving Average, ARIMA, Long-Short Term Memory, Support Vector Machine, and Exponential Smoothing. Among these algorithms, the authors will test the performance, particularly in terms of accuracy and error percentage using MSE, to determine which algorithm performs best between the Single Moving Average and Winter's Exponential Smoothing methods for forecasting future divorce rates, both monthly and annually.

RESEARCH METHOD

The steps in this research utilize the CRISP-DM (Cross-Industry Standard Process for Data Mining) methodology as depicted in Figure 1.

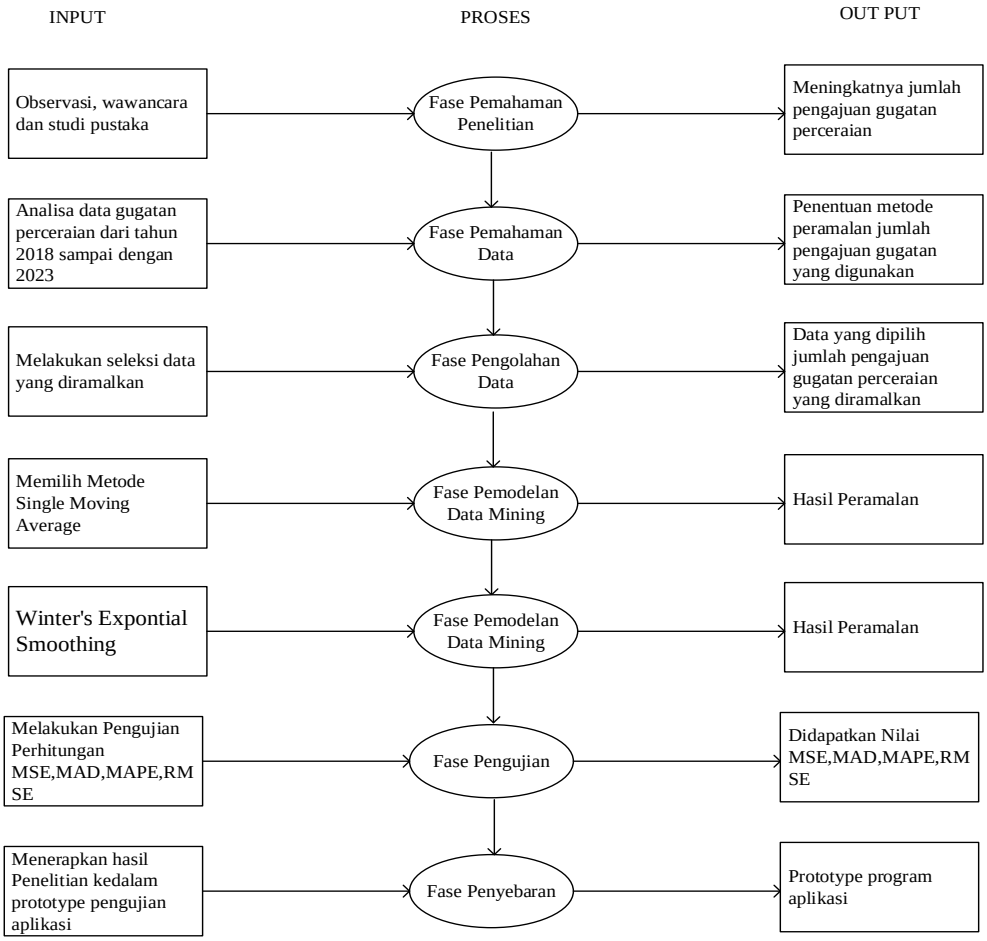

Figure 1 Research Steps

In the research understanding phase, there is a high divorce rate in Cibinong Regency. If the number of divorce filings can be predicted, then the factors causing the high divorce rate can be identified. In the data understanding phase, the data used in this research is the number of divorce filings from 2018 to 2023. In the data processing phase, the divorce filing data from 2018 consists of three columns: month, year, and number of filings in an Excel file format. The next step is to explore the trend of divorce filings using the single moving average method, which has the advantage of easy calculation. However, the single moving average method requires historical data over a certain period, and the longer the period, the smoother/more accurate the result will be. The Winter's exponential smoothing method is used for forecasting if the data exhibits a seasonal pattern. The Winter's method is based on three smoothing equations: overall smoothing equation, trend smoothing equation, and seasonal smoothing equation. In the testing phase, there are three methods planned to be used: Mean Absolute Deviation (MAD), Mean Squared Error (MSE), Mean Absolute Error (MAE), Root Mean Square Error (RMSE), and Mean Absolute Percent Error (MAPE) against the forecasted number of divorce filings. The Divorce Filing Data has been collected from January 2018 to June 2023.

RESULT AND DISCUSSION

In forecasting, calculations are performed using the initial dataset as shown in the table below:

Table 1 Dataset

	Year					
Month	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
JAN	634	835	802	1156	512	456
FEB	469	512	575	655	550	454
MAR	559	550	442	747	505	234
APR	487	505	43	473	331	189
MAY	396	331	28	405	484	567
JUN	235	484	667	817	512	234
JUL	730	775	723	58	550	0
AGST	566	627	669	679	505	0
SEP	549	606	721	771	331	0
OCT	619	683	399	644	484	0
NOV	601	580	560	727	557	0
DEC	289	423	229	651	634	0

In this study, the forecasting data used is divorce lawsuit data from January 2018 to June 2023 with a movement value of 2,4,6 the data is contained in table 1, After preparing the data then calculating the data of the results of forecasting movements 2,4,6 using equation 1, with examples of calculating movement 2 and for movements 4 to 6 carried out in the same way, The calculation results of movement 2 to movement 6 are carried out below:

Single moving average method

For the calculation from 2019 to 2023, the calculation used is the same as in 2018, the final results of the calculation are obtained as follows:

Table 2 results of MAD, MSE and MAPE

Period	MAD	MSE	MAPE
2	1.738.692	56,388.965	74.45
4	1.833.889	55,033.478	92.99
6	1.657.541	47,463.022	94.89

Pemodelan *Winters Exponential Smoothing*

In this method, alpha (α), beta (β), and gamma (γ) values can be determined by trial and error which can minimize error values. The magnitude of alpha (α), beta (β), and gamma (γ) values is between 0 and 1. Based on the results of the R program, the optimum alpha (α), beta (β), and gamma (γ) values are as follows :

Alpha Value (α) = 0.2
Beta Value (β) = 0.3
Gamma Value (γ) = 0.5

The stages of calculation with this method start from calculating the level value, calculating the trend value, calculating the seasonal value, forecasting value

Bulan	tahun	Jml Gugatan	Level	Trend	Seasonal	Forecast	Error	Absolute Error	Squared Error
JAN	2018	634			1.24030				
FEB	2018	469			0.91751				
MAR	2018	559			1.09358				
APR	2018	487			0.95272				
MEI	2018	396			0.77470				
JUN	2018	235			0.45973				
JUL	2018	730			1.42811				
AGST	2018	566			1.10727				
SEP	2018	549			1.07401				
OKT	2018	619			1.21096				
NOV	2018	601			1.17574				
DES	2018	289	511.16667	5.39583	0.56537				
JAN	2019	835	547.89485	14.79554	1.38216	640.69245	194.30755	194.30755	37755.42325
FEB	2019	512	561.75885	14.51608	0.91447	516.27347	-4.27347	4.27347	18.26258
MAR	2019	550	561.60730	10.11579	1.03645	630.20088	-80.20088	80.20088	6432.18076
APR	2019	505	563.39045	7.61600	0.92454	544.69346	-39.69346	39.69346	1575.57109
MEI	2019	331	542.25776	-1.00861	0.69255	442.35778	-111.35778	111.35778	12400.55491
JUN	2019	484	643.55649	29.68359	0.60590	248.82990	235.17010	235.17010	55304.97483
JUL	2019	775	647.12745	21.84980	1.31285	961.45796	-186.45796	186.45796	34766.56961
AGST	2019	627	648.43322	15.68659	1.03711	740.73908	-113.73908	113.73908	12936.57870
SEP	2019	606	644.14357	9.69372	1.00740	713.27377	-107.27377	107.27377	11507.66215
OKT	2019	683	635.87333	4.30453	1.14253	791.76776	-108.76776	108.76776	11830.42467
NOV	2019	580	610.80341	-4.50780	1.06266	752.68386	-172.68386	172.68386	29819.71481
DES	2019	423	634.67213	4.00515	0.61593	342.78337	80.21663	80.21663	6434.70794
JAN	2020	802	626.99228	0.49965	1.33064	882.75261	-80.75261	80.75261	6520.98332
FEB	2020	575	627.74999	0.57707	0.91522	573.82006	1.17994	1.17994	1.39226
MAR	2020	442	587.95242	-11.53532	0.89411	651.23234	-209.23234	209.23234	43778.17148
APR	2020	43	470.43560	-43.32977	0.50797	532.92106	-489.92106	489.92106	240022.64159
MEI	2020	28	349.77066	-66.53032	0.38630	295.79410	-267.79410	267.79410	71713.68259
JUN	2020	667	446.76001	-17.47442	1.04944	171.61580	495.38420	495.38420	245405.50444
JUL	2020	723	453.57028	-10.18901	1.45344	563.58884	159.41116	159.41116	25411.91635
AGST	2020	669	483.71754	1.91187	1.21007	459.83450	209.16550	209.16550	43750.20692
SEP	2020	721	531.64445	15.71638	1.18178	489.22253	231.77747	231.77747	53720.79792
OKT	2020	399	507.73339	3.82815	0.96419	625.37853	-226.37853	226.37853	51247.23885
NOV	2020	560	514.64559	4.75336	1.07539	543.61363	16.38637	16.38637	268.51297
DES	2020	229	489.87831	-4.10283	0.54170	319.91318	-90.91318	90.91318	8265.20693
JAN	2021	1156	562.37135	18.87593	1.69311	646.39231	509.60769	509.60769	259699.99501
FEB	2021	655	608.13314	26.94169	0.99614	531.96792	123.03208	123.03208	15136.89394
MAR	2021	747	675.15378	38.96537	1.00026	567.82545	179.17455	179.17455	32103.51816
APR	2021	473	757.52582	51.98737	0.56619	362.75301	110.24699	110.24699	12154.39922
MEI	2021	405	857.29023	66.32049	0.42936	312.71780	92.28220	92.28220	8516.00397
JUN	2021	817	894.59116	57.61462	0.98135	969.27093	-152.27093	152.27093	23186.43518
JUL	2021	58	769.74571	2.87660	0.76439	1383.97051	-1,325.97051	1,325.97051	1758197.78948
AGST	2021	679	730.32243	-9.81337	1.06990	934.92981	-255.92981	255.92981	65500.06570
SEP	2021	771	706.88793	-13.89971	1.13624	851.48623	-80.48623	80.48623	6478.03260
OKT	2021	644	687.97422	-15.40391	0.95014	668.17224	-24.17224	24.17224	584.29737
NOV	2021	727	673.26283	-15.19615	1.07760	723.27635	3.72365	3.72365	13.86556
DES	2021	651	766.80942	17.42667	0.69533	356.47230	294.52770	294.52770	86746.56851
JAN	2022	512	687.86927	-11.48338	1.21872	1327.79848	-815.79848	815.79848	665527.16312
FEB	2022	550	651.53470	-18.93873	0.92015	673.77662	-123.77662	123.77662	15320.65219
MAR	2022	505	607.05039	-26.60241	0.91608	632.76125	-127.76125	127.76125	16322.93645
APR	2022	331	581.28091	-26.35253	0.56781	328.64205	2.35795	2.35795	5.55992
MEI	2022	484	669.39393	7.98714	0.57620	238.26469	245.73531	245.73531	60385.84424
JUN	2022	512	646.25075	-1.35196	0.88681	664.74892	-152.74892	152.74892	23332.23321
JUL	2022	550	659.82407	3.12563	0.79897	492.95610	57.04390	57.04390	3254.00680
AGST	2022	505	624.76111	-8.33095	0.93910	709.28984	-204.28984	204.28984	41734.33919
SEP	2022	331	551.40645	-27.83806	0.86826	700.41274	-369.41274	369.41274	136465.77037
OKT	2022	484	520.73489	-28.68811	0.93980	497.46105	-13.46105	13.46105	181.19974
NOV	2022	557	497.01494	-27.19766	1.09915	530.23145	26.76855	26.76855	716.55533
DES	2022	634	558.21214	-0.67920	0.91555	326.68009	307.31991	307.31991	94445.52890
JAN	2023	456	520.85902	-11.68138	1.04710	679.47602	-223.47602	223.47602	49941.53352
FEB	2023	454	506.02151	-12.62822	0.90867	468.52058	-14.52058	14.52058	210.84734
MAR	2023	234	445.80208	-26.90558	0.72049	451.98592	-217.98592	217.98592	47517.86180
APR	2023	189	401.68882	-32.06789	0.51916	237.85341	-48.85341	48.85341	2386.65570
MEI	2023	567	492.50285	4.79669	0.86373	212.97619	354.02381	354.02381	125332.86145
JUN	2023	234	450.61325	-9.20920	0.70305	441.00863	-207.00863	207.00863	42852.57128
JUL	2023	0	0.00000	0.00000	0.00000	**353.46944**	0.00000		
AGST	2023	0	0.00000	0.00000	0.00000	**425.05112**	0.00000		
SEP	2023	0	0.00000	0.00000	0.00000	**393.85500**	0.00000		
OKT	2023	0	0.00000	0.00000	0.00000	**427.24358**	0.00000		
NOV	2023	0	0.00000	0.00000	0.00000	**500.78602**	0.00000		
DES	2023	0	0.00000	0.00000	0.00000	**418.05300**	0.00000		

Prototype

After doing forecasting calculations, it can be applied to the development of a computerized forecasting system. In this section will be explained about the prototype form of the forecasting system using the *single moving average* method and *Winters Exponential Smoothing*.

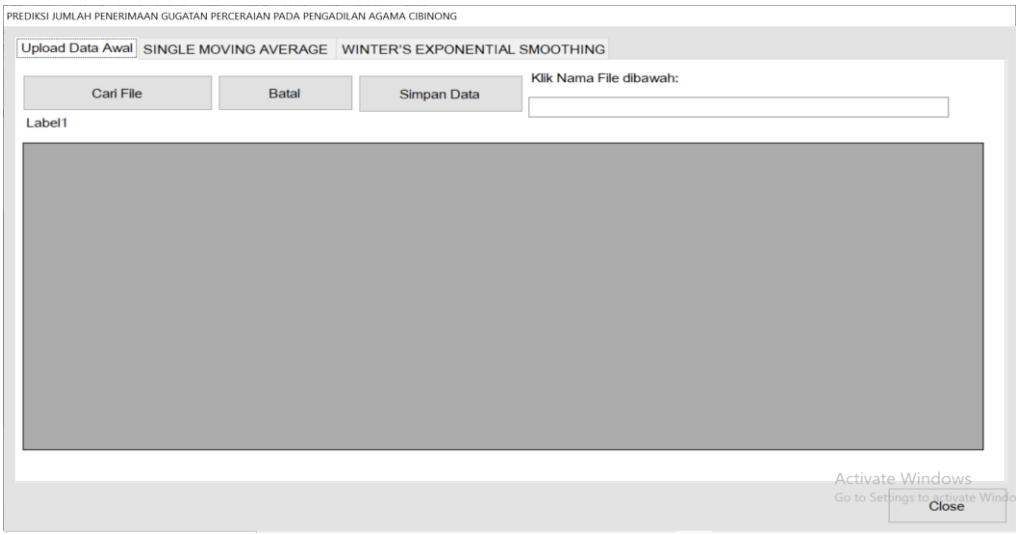

Figure 2 Main Menu Screen Display

This page is a feature to upload excel data to experience the number of divorce lawsuits.

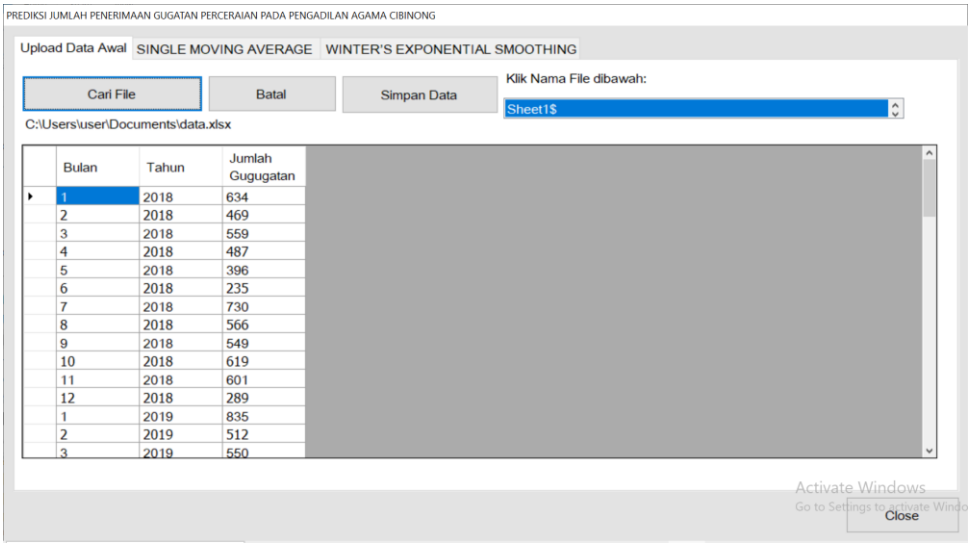

Figure 3 Initial Data Upload Screen View

Form Peramalan Metode Single Moving Average

This page allows users to experience the number of divorce lawsuits with the Single Moving Average method, starting with clicking the Refresh data button, then select the forecasting period and finally clicking the calculate button.

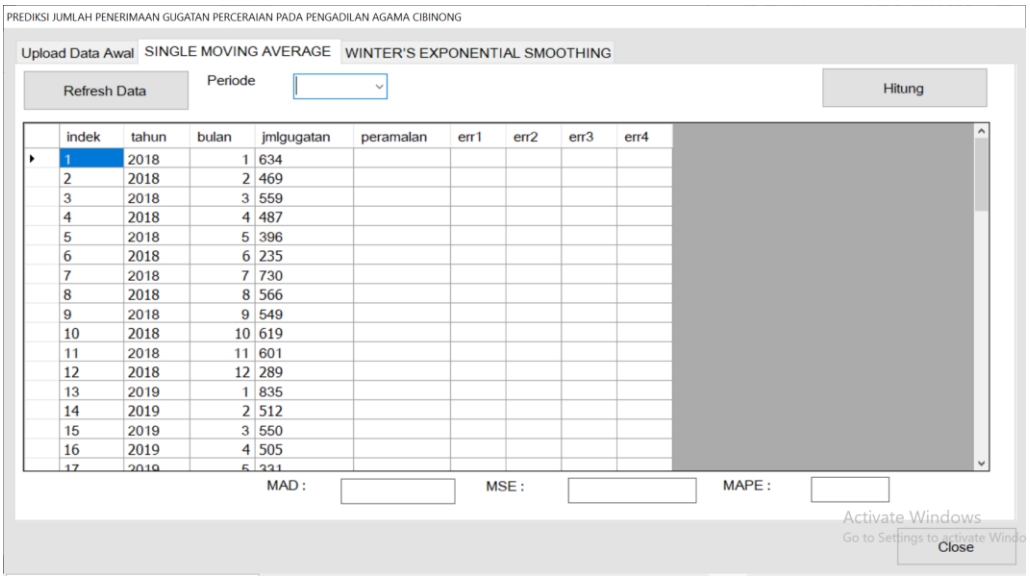

Figure 4 Screen Display of Single Moving Average calculation

Form Peramalan Metode Winters Exponential Smoothing

This page allows users to experience the number of divorce lawsuits with the Winters Exponential Smoothing method, starting with clicking the Refresh data button, then select alpha, beta and forecasting values and finally click the calculate button

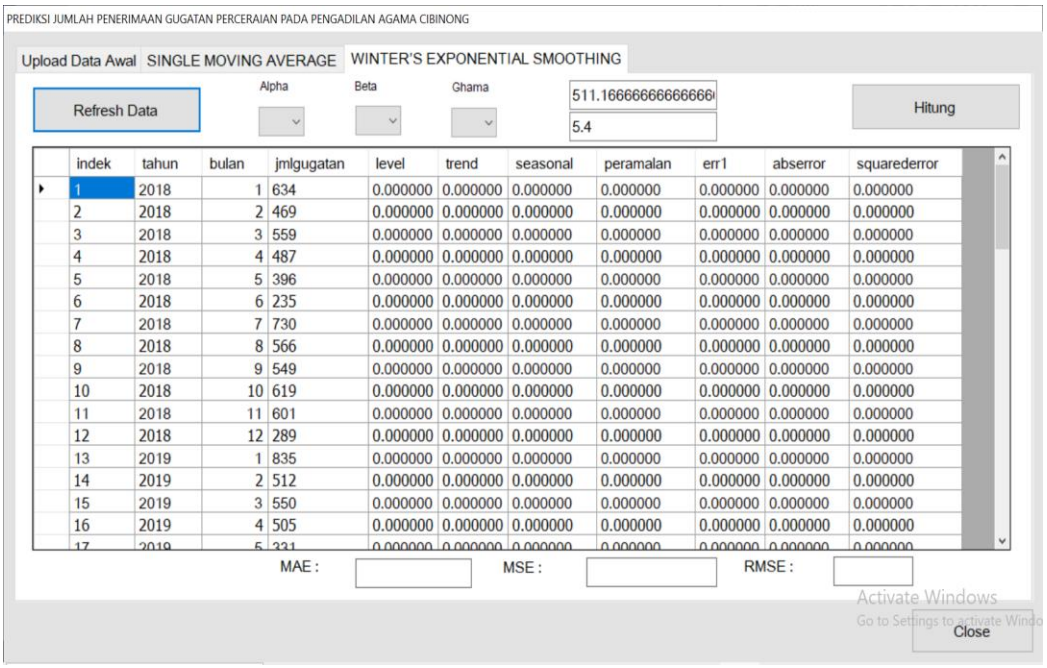

Figure 5 Screen Display of Winters Exponential Smoothing calculation

CONCLUSION

In this study, several conclusions can be drawn as follows: a. The Single Moving Average and Winters Exponential Smoothing methods can be used to forecast divorce filing data from January 2018 to June 2023. b. The forecasted number of filings in 2023 from July to December are as follows: a) Forecast with a movement of 2 Periods: - July: 602 - August: 283 - MAD: 67.29 - MSE: 8.722 - MAPE: 11.61 - RMSE: 1.46 - Accuracy: 88.39% b) Forecast with a movement of 4 Periods: - July: 620 - August: 448 - September: 301 - October: 141 - MAD: 99.33 - MSE: 14.722 - MAPE: 16.59 - RMSE: 1.90 - Accuracy: 83.41% c) Forecast with a movement of 6 Periods: - July: 645 - August: 508 - September: 414 - October: 299 - November: 201 - December: 94 - MAD: 119.31 - MSE: 18.736 - MAPE: 19.48 - RMSE: 2.14 - Accuracy: 80.52%. c. Forecasting results with the Winters Exponential Smoothing method were obtained with Alpha values: 0.1, Beta: 0.3 and Gamma: 0.5 obtained forecasting results in July as much as 504.1, August 491.61, September 663.19, October 745.41, November 732.43 and December 732.1. MAE value of 171.65, MSE value of 686.63, MAD value = 38.74, MSE value = 2.797 MAPE value of 6.0 and RMSE value of 0.83 and accuracy value of 94.00%.

Table 3: Final Calculation Results

Forecast Method	MAD	MSE	MAPE	RMSE	Accuracy
SMA Pergerakan 2	67.29	8,722.16	11.61	1.46	88.39
SMA Pergerakan 4	99.33	14,722.03	16.59	1.90	83.41
SMA Pergerakan 6	119.31	18,736.54	19.48	2.14	80.52
WES	38.74	2,797.22	6.00	0.83	94.00

Based on the above calculations, it can be concluded that the forecast of the number of divorce filings in the Cibinong Religious Court from January 2018 to December 2023 using the Winter Exponential Smoothing method has lower MAD, MSE, MAPE, RMSE values compared to those of the Single Moving Average method. Thus, the Winter Exponential Smoothing method is more appropriate for forecasting with an accuracy of 94.00%.

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