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5BUIS019C.2 Business Analytics
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Individual Coursework

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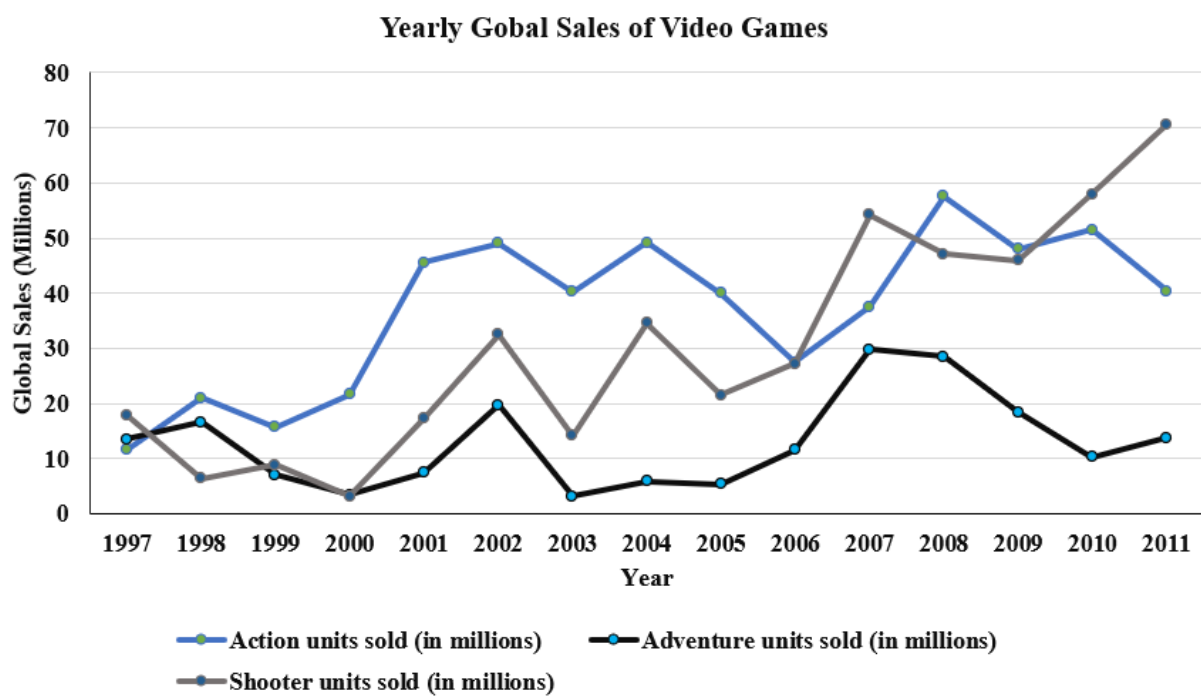
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Part A

1. Yearly global sales of video games between 1997 and 2011 in a time series graph



2. Chosen Video Game genre: Action

a. Naïve method

Naïve Method								
Action								
Year	Units sold (in millions)	Naïve Method	Forecast error	Squared forecast error		Absolute forecast error		Forecast error/Actual
1997	11.51							
1998	21.03	11.51	9.52	90.630		9.520		0.453
1999	15.66	21.03	-5.37	28.837		5.370		0.343
2000	21.68	15.66	6.02	36.240		6.020		0.278
2001	45.56	21.68	23.88	570.254		23.880		0.524
2002	49.02	45.56	3.46	11.972		3.460		0.071
2003	40.3	49.02	-8.72	76.038		8.720		0.216
2004	49.14	40.30	8.84	78.146		8.840		0.180
2005	39.99	49.14	-9.15	83.723		9.150		0.229
2006	27.41	39.99	-12.58	158.256		12.580		0.459
2007	37.47	27.41	10.06	101.204		10.060		0.268
2008	57.57	37.47	20.10	404.010		20.100		0.349
2009	48.05	57.57	-9.52	90.630		9.520		0.198
2010	51.5	48.05	3.45	11.903		3.450		0.067
2011	40.32	51.50	-11.18	124.992		11.180		0.277
2012		40.32	MSE	133.345	MAD	10.1	MAPE	27.9

b. The three-period moving average.

Moving Average(3)								
Action								
Year	Units sold (in millions)	Moving Average(3)	Forecast error	squared forecast error		absolute forecast error		Forecast error/Actual
1997	11.51							
1998	21.03							
1999	15.66							
2000	21.68	16.07	5.6	31.510		5.613		0.259
2001	45.56	19.46	26.1	681.384		26.103		0.573
2002	49.02	27.63	21.4	457.390		21.387		0.436
2003	40.3	38.75	1.5	2.392		1.547		0.038
2004	49.14	44.96	4.2	17.472		4.180		0.085
2005	39.99	46.15	-6.2	37.987		6.163		0.154
2006	27.41	43.14	-15.7	247.538		15.733		0.574
2007	37.47	38.85	-1.4	1.895		1.377		0.037
2008	57.57	34.96	22.6	511.363		22.613		0.393
2009	48.05	40.82	7.2	52.321		7.233		0.151
2010	51.5	47.70	3.8	14.465		3.803		0.074
2011	40.32	52.37	-12.1	145.283		12.053		0.299
2012		46.62	MSE	183.417	MAD	10.7	MAPE	25.6

c. The exponential smoothing forecast

Smoothing Method								
Action								
Year	Units sold (in millions)	Smoothing Method	Forecast error	squared forecast error		absolute forecast error		Forecast error/Actual
1997	11.51							
1998	21.03	11.51	9.5	90.630		9.520		0.453
1999	15.66	15.32	0.3	0.117		0.342		0.022
2000	21.68	15.45	6.2	38.753		6.225		0.287
2001	45.56	17.94	27.6	762.595		27.615		0.606
2002	49.02	28.99	20.0	401.164		20.029		0.409
2003	40.3	37.00	3.3	10.873		3.297		0.082
2004	49.14	38.32	10.8	117.039		10.818		0.220
2005	39.99	42.65	-2.7	7.070		2.659		0.066
2006	27.41	41.59	-14.2	200.941		14.175		0.517
2007	37.47	35.92	1.6	2.417		1.555		0.041
2008	57.57	36.54	21.0	442.382		21.033		0.365
2009	48.05	44.95	3.1	9.608		3.100		0.065
2010	51.5	46.19	5.3	28.194		5.310		0.103
2011	40.32	48.31	-8.0	63.906		7.994		0.198
2012		46.19	MSE	155.406	MAD	9.5	MAPE	24.5

3.

In basis of the analysis, I would suggest using the **Exponential Smoothing Method** to predict worldwide sales of video games. By balancing simplicity and precision, this approach smooths out data volatility while identifying underlying trends. It modifies projections by using historical data, emphasizing more recent information.

Here is why ;

Simplicity: Compared to more sophisticated forecasting techniques like ARIMA, exponential smoothing is very easy to use and comprehend. It can produce accurate forecasts with little processing resources and little parameter adjustment.

Adaptability: The technique can be adjusted to accommodate varying degrees of data fluctuations. Forecasting can be made more flexible by varying the smoothing parameter (alpha), which allows the model to respond to changes in the data either more rapidly or more slowly.

Action								
Year	Units sold (In millions)	W.Moving Average(3)	Forecast error	squared forecast error		absolute forecast error		[Forecast error/Actual]
1997	11.51							
1998	21.03							
1999	15.66							
2000	21.68	15.49	6.2	38.328		6.191		0.286
2001	45.56	20.28	25.3	639.028		25.279		0.555
2002	49.02	31.81	17.2	296.046		17.206		0.351
2003	40.3	40.13	0.2	0.030		0.174		0.004
2004	49.14	43.62	5.5	30.448		5.518		0.112
2005	39.99	47.34	-7.3	53.964		7.346		0.184
2006	27.41	41.91	-14.5	210.337		14.503		0.529
2007	37.47	36.45	1.0	1.051		1.025		0.027
2008	57.57	36.21	21.4	456.079		21.356		0.371
2009	48.05	44.50	3.5	12.588		3.548		0.074
2010	51.5	46.78	4.7	22.278		4.720		0.092
2011	40.32	52.63	-12.3	151.561		12.311		0.305
2012		44.88	MSE	159.312	MAD	9.9	MAPE	24.1

W1	0.5
W2	0.2
W3	0.3
SUM	1

c)

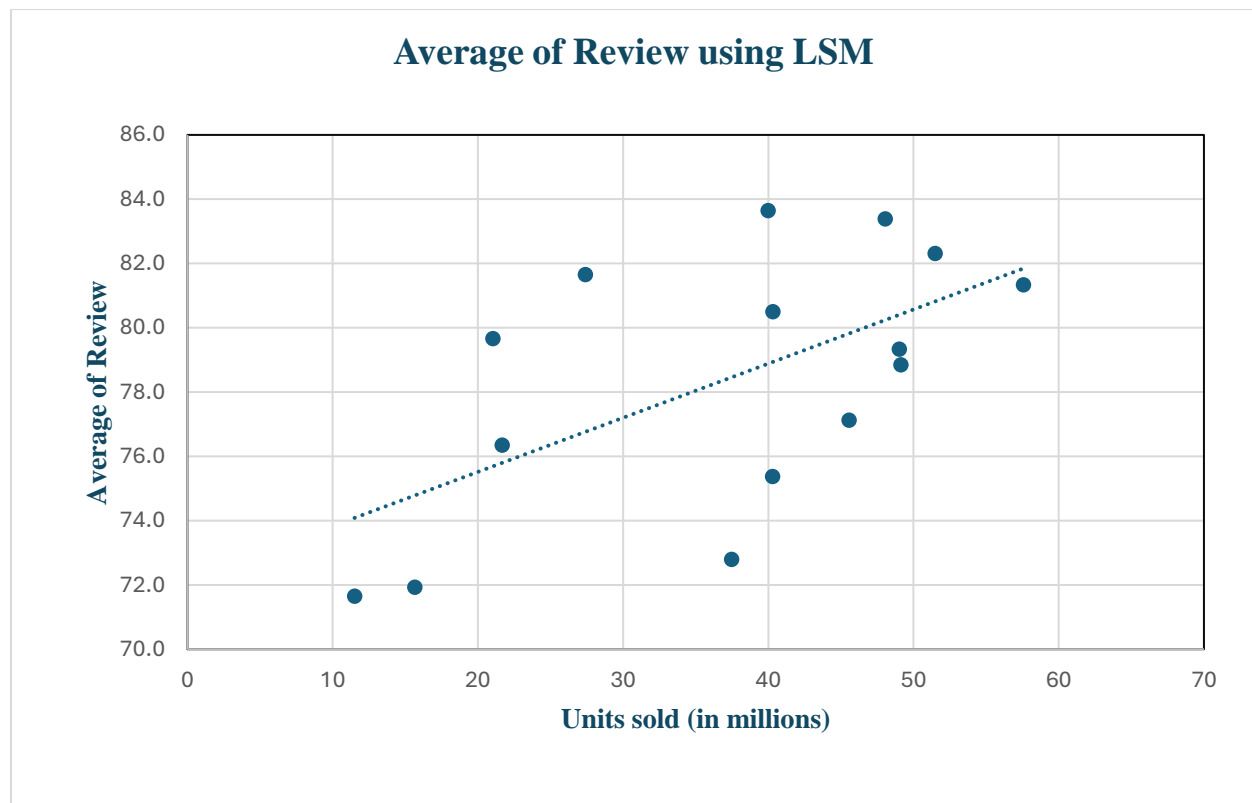
Comparison Against Previous Models:

	MSE	MAD	MAPE
Weighted Moving Average	159.312	9.9	24.1
Smoothing Method	155.406	9.5	24.5

Considering the performance measures, we can conclude that the **Smoothing Method** betters the Weighted Moving Average. This result is mostly based on decreasing MSE and MAD values, which indicate improved accuracy in forecasting real values. However, it is critical to evaluate the unique context and needs of the forecasting work when determining which approach is best suited to the problem's objectives and restrictions.

5.

	Action	
Year	Units sold (in millions) - X	Average of Review - Y
1997	11.51	71.7
1998	21.03	79.7
1999	15.66	71.9
2000	21.68	76.3
2001	45.56	77.1
2002	49.02	79.3
2003	40.3	75.4
2004	49.14	78.8
2005	39.99	83.6
2006	27.41	81.7
2007	37.47	72.8
2008	57.57	81.3
2009	48.05	83.4
2010	51.5	82.3
2011	40.32	80.5



$$Y = mx + c$$

$$Y = (2.099262)x + (-127.488)$$

In conclusion, in order to determine the link between average review score and global sales of video games, I will first evaluate the association between the two. I'll next investigate utilizing multiple regression analysis to incorporate the average review score into the forecast model if there is a strong association. Lastly, I'll create a straight-line estimate of the link between worldwide sales and the average review score for the action genre using the approach of least squares.

Part B

1.

Time between Calls(Min)	Probability	Lower Limit	Upper Limit
5	0.1	0	0.10
8	0.2	0.10	0.30
10	0.4	0.30	0.70
12	0.3	0.70	1.00

2.

Time between Calls(Min)	Probability	Lower Limit	Upper Limit	Time between Calls(Min)2
5	0.1	0	0.10	5
8	0.2	0.10	0.30	8
10	0.4	0.30	0.70	10
12	0.3	0.70	1.00	12

Iteration	Random Number	Time between Calls(Min)
1	0.54	10
2	0.71	12
3	0.83	12
4	0.37	10
5	0.01	5
6	0.31	10
7	0.49	10
8	0.12	8
9	0.1	5
10	0.286	8

3.

Iteration	Random Number	Time between Calls(Min)	Arrival Time	Service Time	Waiting Time	System Time
1	0.54	10	0	10	0	10
2	0.71	12	10	10	0	10
3	0.83	12	22	12	0	12
4	0.37	10	34	12	0	12
5	0.01	5	44	10	0	10
6	0.31	10	49	5	0	5
7	0.49	10	59	10	0	10
8	0.12	8	69	10	5	15
9	0.1	5	77	8	7	15
10	0.286	8	82	5	7	12

4.

Time between Calls(Min)	Probability	Lower Limit	Upper Limit	Service Time (min)
5	0.24	0	0.24	5
6	0.20	0.24	0.44	6
7	0.15	0.44	0.59	7
8	0.14	0.59	0.73	8
9	0.12	0.73	0.85	9
10	0.08	0.85	0.93	10
11	0.05	0.93	0.98	11
12	0.02	0.98	1.00	12

Customer	Time between Calls	Call Arrival Time	Service start Time	Waiting Time	Random Numbers	Service Time	Completion Time	Time in System
1	5.636	5.636	5.636	0.000	0.189871195	5	10.636	5.000
2	12.073	17.709	17.709	0.000	0.038286042	5	22.709	5.000
3	5.378	23.087	23.087	0.000	0.418621619	6	29.087	6.000
4	9.122	32.209	32.209	0.000	0.469322508	7	39.209	7.000
5	1.201	33.410	39.209	5.799	0.009924739	5	44.209	10.799
6	0.165	33.574	44.209	10.634	0.36097114	6	50.209	16.634
7	14.206	47.781	50.209	2.428	0.779942963	9	59.209	11.428
8	1.672	49.453	59.209	9.756	0.665536121	8	67.209	17.756
9	4.068	53.521	67.209	13.687	0.067193356	5	72.209	18.687
10	17.569	71.090	72.209	1.119	0.247418426	6	78.209	7.119
11	8.379	79.469	79.469	0.000	0.344596713	6	85.469	6.000
12	11.741	91.210	91.210	0.000	0.289976321	6	97.210	6.000
13	5.316	96.526	97.210	0.684	0.206704015	5	102.210	5.684
14	3.520	100.046	102.210	2.164	0.109038639	5	107.210	7.164
15	5.291	105.337	107.210	1.872	0.501041335	7	114.210	8.872
16	18.112	123.449	123.449	0.000	0.188196192	5	128.449	5.000
17	0.449	123.898	128.449	4.551	0.601448237	8	136.449	12.551
18	42.696	166.594	166.594	0.000	0.462592719	7	173.594	7.000
19	6.688	173.282	173.594	0.312	0.49915551	7	180.594	7.312
20	25.835	199.117	199.117	0.000	0.200830874	5	204.117	5.000
21	5.180	204.297	204.297	0.000	0.378840138	6	210.297	6.000
22	3.172	207.469	210.297	2.828	0.516375096	7	217.297	9.828
23	2.698	210.166	217.297	7.131	0.222495976	5	222.297	12.131
24	0.916	211.082	222.297	11.215	0.150777853	5	227.297	16.215
25	9.719	220.802	227.297	6.495	0.009153011	5	232.297	11.495
26	0.399	221.201	232.297	11.096	0.764956581	9	241.297	20.096
27	8.231	229.431	241.297	11.866	0.067630377	5	246.297	16.866
28	2.553	231.984	246.297	14.313	0.277279717	6	252.297	20.313
29	14.153	246.138	252.297	6.160	0.073551745	5	257.297	11.160
30	1.427	247.564	257.297	9.733	0.091837817	5	262.297	14.733
31	11.281	258.846	262.297	3.451	0.854879083	10	272.297	13.451
32	0.438	259.284	272.297	13.013	0.008619221	5	277.297	18.013
33	3.887	263.171	277.297	14.126	0.514301202	7	284.297	21.126
34	2.808	265.978	284.297	18.319	0.806104455	9	293.297	27.319
35	5.052	271.030	293.297	22.267	0.90619032	10	303.297	32.267
36	12.924	283.954	303.297	19.343	0.056912721	5	308.297	24.343
37	16.323	300.277	308.297	8.020	0.40446166	6	314.297	14.020
38	4.593	304.870	314.297	9.427	0.024997511	5	319.297	14.427
39	8.490	313.360	319.297	5.937	0.820770584	9	328.297	14.937
40	4.211	317.571	328.297	10.726	0.146587161	5	333.297	15.726
41	10.793	328.364	333.297	4.933	0.511079757	7	340.297	11.933
42	5.045	333.409	340.297	6.888	0.665139983	8	348.297	14.888
43	10.061	343.470	348.297	4.827	0.107237545	5	353.297	9.827
44	24.310	367.779	367.779	0.000	0.845055904	9	376.779	9.000
45	4.710	372.490	376.779	4.290	0.085187464	5	381.779	9.290
46	29.856	402.346	402.346	0.000	0.07592808	5	407.346	5.000
47	23.858	426.204	426.204	0.000	0.638729257	8	434.204	8.000
48	0.950	427.154	434.204	7.050	0.286639151	6	440.204	13.050
49	11.848	439.001	440.204	1.202	0.830964478	9	449.204	10.202
50	25.832	464.833	464.833	0.000	0.968826819	11	475.833	11.000

51	7.919	472.753	475.833	3.081	0.28988714	6	481.833	9.081
52	4.290	477.043	481.833	4.791	0.760321864	9	490.833	13.791
53	3.909	480.951	490.833	9.882	0.747808753	9	499.833	18.882
54	27.376	508.327	508.327	0.000	0.808972876	9	517.327	9.000
55	30.161	538.489	538.489	0.000	0.348123222	6	544.489	6.000
56	8.849	547.338	547.338	0.000	0.383207649	6	553.338	6.000
57	5.412	552.750	553.338	0.588	0.167809133	5	558.338	5.588
58	1.270	554.021	558.338	4.317	0.274657458	6	564.338	10.317
59	10.376	564.396	564.396	0.000	0.346711618	6	570.396	6.000
60	9.701	574.097	574.097	0.000	0.516320266	7	581.097	7.000
61	6.646	580.743	581.097	0.354	0.579405621	7	588.097	7.354
62	26.562	607.305	607.305	0.000	0.430810762	6	613.305	6.000
63	0.822	608.127	613.305	5.178	0.692987529	8	621.305	13.178
64	25.061	633.189	633.189	0.000	0.30185676	6	639.189	6.000
65	7.378	640.567	640.567	0.000	0.428552921	6	646.567	6.000
66	10.799	651.366	651.366	0.000	0.783071181	9	660.366	9.000
67	3.829	655.195	660.366	5.171	0.879099158	10	670.366	15.171
68	3.765	658.960	670.366	11.406	0.890983693	10	680.366	21.406
69	1.307	660.266	680.366	20.100	0.697935529	8	688.366	28.100
70	4.407	664.673	688.366	23.693	0.160872591	5	693.366	28.693
71	2.323	666.996	693.366	26.370	0.238933389	5	698.366	31.370
72	25.058	692.054	698.366	6.312	0.735014715	9	707.366	15.312
73	7.965	700.019	707.366	7.347	0.996312231	12	719.366	19.347
74	3.015	703.034	719.366	16.332	0.302644496	6	725.366	22.332
75	15.964	718.998	725.366	6.368	0.163969113	5	730.366	11.368
76	0.576	719.574	730.366	10.792	0.875523321	10	740.366	20.792
77	12.915	732.489	740.366	7.877	0.871977228	10	750.366	17.877
78	4.262	736.751	750.366	13.615	0.453334512	7	757.366	20.615
79	10.996	747.747	757.366	9.619	0.965851663	11	768.366	20.619
80	10.232	757.978	768.366	10.388	0.210097742	5	773.366	15.388
81	7.564	765.543	773.366	7.823	0.297068999	6	779.366	13.823
82	9.216	774.759	779.366	4.607	0.121455563	5	784.366	9.607
83	10.149	784.908	784.908	0.000	0.580131286	7	791.908	7.000
84	1.549	786.457	791.908	5.451	0.877321853	10	801.908	15.451
85	1.816	788.272	801.908	13.636	0.423372515	6	807.908	19.636
86	25.797	814.069	814.069	0.000	0.629660832	8	822.069	8.000
87	7.972	822.041	822.069	0.028	0.17184725	5	827.069	5.028
88	2.563	824.605	827.069	2.465	0.787846444	9	836.069	11.465
89	2.079	826.684	836.069	9.386	0.091834213	5	841.069	14.386
90	7.131	833.814	841.069	7.255	0.058338744	5	846.069	12.255
91	8.367	842.181	846.069	3.888	0.811743484	9	855.069	12.888
92	6.781	848.962	855.069	6.107	0.624809876	8	863.069	14.107
93	0.072	849.034	863.069	14.035	0.617839212	8	871.069	22.035
94	9.366	858.400	871.069	12.669	0.123734255	5	876.069	17.669
95	13.624	872.024	876.069	4.045	0.586414284	7	883.069	11.045
96	4.050	876.074	883.069	6.995	0.542933896	7	890.069	13.995
97	1.244	877.318	890.069	12.751	0.502276861	7	897.069	19.751
98	4.423	881.740	897.069	15.329	0.582882941	7	904.069	22.329
99	20.176	901.916	904.069	2.153	0.2238606	5	909.069	7.153
100	6.760	908.676	909.069	0.393	0.138354978	5	914.069	5.393

5.

Sammry Statics	
Number Waiting	71
Probability of Waitting	0.71
Average waiting time	12.412
Maximum waiting time	65.935
Avarage time in system	19.862
Standard deviation(Time in system)	14.22297
Maximum time in system	70.935
Minimum time in system	5.000