ASSIGNMENT # 1 - Solution

Total Point: 10 Points

After inputting the final grade on the 1st page, if the statement of integrity is missing or not signed by one or more of the group members give them a warning. In the subsequence assignments deduct 0.5 marks from each student who did not submit the integrity statement.

Problem # 1 (2 Points)

We need to find the smoothing constant α. We know in general that $F_t = F_{t-1} + \alpha(A_{t-1} - F_{t-1})$; $t = 2, 3, 4$. Choose either $t = 3$ or $t = 4$ ($t = 2$ won't let us find α because $F_2 = 50 = 50 + \alpha(50 - 50)$ holds for *any* α). Let's pick $t = 3$.

Then

$$F_3 = 48 = 50 + \alpha(42 - 50)$$

or $$48 = 50 + 42\alpha - 50\alpha$$

or $$-2 = -8\alpha$$

So, $$.25 = \alpha$$

Now we can find F_5:

$$F_5 = 50 + \alpha(46 - 50)$$

$$F_5 = 50 + 46\alpha - 50\alpha = 50 - 4\alpha$$

For $\alpha = .25$, $F_5 = 50 - 4(.25) = 49$

The forecast for time period 5 = 49 units.

If student used the right solution procedure but final answer is different (e.g. due to mistake in calculation), give them 50% of the total mark.

Problem # 2 (3.5 Points)

a) (3 Points)

	Method →	Exponential Smoothing		
		0.6 = α		
Year	Deposits (*Y*)	Forecast	|Error|	Error^2
1	0.25	0.25	0.00	0.00
2	0.24	0.25	0.01	0.0001
3	0.24	0.244	0.004	0.0000
4	0.26	0.241	0.018	0.0003
5	0.25	0.252	0.002	0.00
6	0.30	0.251	0.048	0.0023
7	0.31	0.280	0.029	0.0008
8	0.32	0.298	0.021	0.0004
9	0.24	0.311	0.071	0.0051
10	0.26	0.268	0.008	0.0000
11	0.25	0.263	0.013	0.0002
12	0.33	0.255	0.074	0.0055
13	0.50	0.300	0.199	0.0399
14	0.95	0.420	0.529	0.2808
15	1.70	0.738	0.961	0.925
16	2.30	1.315	0.984	0.9698
17	2.80	1.906	0.893	0.7990
18	2.80	2.442	0.357	0.1278
19	2.70	2.656	0.043	0.0018
20	3.90	2.682	1.217	1.4816
21	4.90	3.413	1.486	2.2108
22	5.30	4.305	0.994	0.9895
23	6.20	4.90	1.297	1.6845
24	4.10	5.680	1.580	2.499
25	4.50	4.732	0.232	0.0540
26	6.10	4.592	1.507	2.2712
27	7.70	5.497	2.202	4.8524
28	10.10	6.818	3.281	10.7658
29	15.20	8.787	6.412	41.1195
30	18.10	12.6350	5.46498	29.8660
31	24.10	15.9140	8.19	67.01
32	25.60	20.8256	4.774	22.7949
33	30.30	23.69	6.60976	43.69
34	36.00	27.6561	8.34390	69.62
35	31.10	32.6624	1.56244	2.44121
36	31.70	31.72	0.024975	0.000624
37	38.50	31.71	6.79	46.1042
38	47.90	35.784	12.116	146.798
39	49.10	43.0536	6.046	36.56
40	55.80	46.6814	9.11856	83.1481
41	70.10	52.1526	17.9474	322.11
42	70.90	62.9210	7.97897	63.66
43	79.10	67.7084	11.3916	129.768
44	94.00	74.5434	19.4566	378.561
TOTALS	787.30		150.3	1,513.22
AVERAGE	17.8932		3.416	34.39
			(MAD)	(MSE)
Next period forecast = 86.2173			Standard error = 6.07519	

Method → Linear Regression (Trend Analysis)				
Year	**Period (*X*)**	**Deposits (*Y*)**	**Forecast**	**Error²**
1	1	0.25	–17.330	309.061
2	2	0.24	–15.692	253.823
3	3	0.24	–14.054	204.31
4	4	0.26	–12.415	160.662
5	5	0.25	–10.777	121.594
6	6	0.30	–9.1387	89.0883
7	7	0.31	–7.50	61.0019
8	8	0.32	–5.8621	38.2181
9	9	0.24	–4.2238	19.9254
10	10	0.26	–2.5855	8.09681
11	11	0.25	–0.947	1.43328
12	12	0.33	0.691098	0.130392
13	13	0.50	2.329	3.34667
14	14	0.95	3.96769	9.10642
15	15	1.70	5.60598	15.2567
16	16	2.30	7.24427	24.4458
17	17	2.80	8.88257	36.9976
18	18	2.80	10.52	59.6117
19	19	2.70	12.1592	89.4756
20	20	3.90	13.7974	97.9594
21	21	4.90	15.4357	111.0
22	22	5.30	17.0740	138.628
23	23	6.20	18.7123	156.558
24	24	4.10	20.35	264.083
25	25	4.50	21.99	305.862
26	26	6.10	23.6272	307.203
27	27	7.70	25.2655	308.547
28	28	10.10	26.9038	282.367
29	29	15.20	28.5421	178.011
30	30	18.10	30.18	145.936
31	31	24.10	31.8187	59.58
32	32	25.60	33.46	61.73
33	33	30.30	35.0953	22.9945
34	34	36.00	36.7336	0.5381
35	35	31.10	38.3718	52.8798
36	36	31.70	40.01	69.0585
37	37	38.50	41.6484	9.91266
38	38	47.90	43.2867	21.2823
39	39	49.10	44.9250	17.43
40	40	55.80	46.5633	85.3163
41	41	70.10	48.2016	479.54
42	42	70.90	49.84	443.528
43	43	79.10	51.4782	762.964
44	44	94.00	53.1165	1,671.46
TOTALS	990.00	787.30		7,559.95
AVERAGE	22.50	17.893		171.817
				(MSE)

	Method → Least squares–Simple Regression on GDP				
	a	b			
	–17.636	13.5936			
Coefficients:	GDP	Deposits			
Year	(*X*)	(*Y*)	Forecast	|Error|	Error^2
1	0.40	0.25	–12.198	12.4482	154.957
2	0.40	0.24	–12.198	12.4382	154.71
3	0.50	0.24	–10.839	11.0788	122.740
4	0.70	0.26	–8.12	8.38	70.226
5	0.90	0.25	–5.4014	5.65137	31.94
6	1.00	0.30	–4.0420	4.342	18.8530
7	1.40	0.31	1.39545	1.08545	1.17820
8	1.70	0.32	5.47354	5.15354	26.56
9	1.30	0.24	0.036086	0.203914	0.041581
10	1.20	0.26	–1.3233	1.58328	2.50676
11	1.10	0.25	–2.6826	2.93264	8.60038
12	0.90	0.33	–5.4014	5.73137	32.8486
13	1.20	0.50	–1.3233	1.82328	3.32434
14	1.20	0.95	–1.3233	2.27328	5.16779
15	1.20	1.70	–1.3233	3.02328	9.14020
16	1.60	2.30	4.11418	1.81418	3.29124
17	1.50	2.80	2.75481	0.045186	0.002042
18	1.60	2.80	4.11418	1.31418	1.727
19	1.70	2.70	5.47354	2.77354	7.69253
20	1.90	3.90	8.19227	4.29227	18.4236
21	1.90	4.90	8.19227	3.29227	10.8390
22	2.30	5.30	13.6297	8.32972	69.3843
23	2.50	6.20	16.3484	10.1484	102.991
24	2.80	4.10	20.4265	16.3265	266.556
25	2.90	4.50	21.79	17.29	298.80
26	3.40	6.10	28.5827	22.4827	505.473
27	3.80	7.70	34.02	26.32	692.752
28	4.10	10.10	38.0983	27.9983	783.90
29	4.00	15.20	36.74	21.54	463.924
30	4.00	18.10	36.74	18.64	347.41
31	3.90	24.10	35.3795	11.2795	127.228
32	3.80	25.60	34.02	8.42018	70.8994
33	3.80	30.30	34.02	3.72018	13.8397
34	3.70	36.00	32.66	3.33918	11.15
35	4.10	31.10	38.0983	6.99827	48.9757
36	4.10	31.70	38.0983	6.39827	40.9378
37	4.00	38.50	36.74	1.76	3.10146
38	4.50	47.90	43.5357	4.36428	19.05
39	4.60	49.10	44.8951	4.20491	17.6813
40	4.50	55.80	43.5357	12.2643	150.412
41	4.60	70.10	44.8951	25.20	635.288
42	4.60	70.90	44.8951	26.00	676.256
43	4.70	79.10	46.2544	32.8456	1,078.83
44	5.00	94.00	50.3325	43.6675	1,906.85
TOTALS				451.223	9,016.45
AVERAGE				10.2551	204.92
				(MAD)	(MSE)

Forecasting Summary Table			
Method used:	**Exponential Smoothing**	**Linear Regression (Trend Analysis)**	**Linear Regression**
		$Y = -18.968 + 1.638 \times \text{YEAR}$	$Y = -17.636 + 13.59364 \times \text{GDP}$
MAD	3.416	10.587	10.255
MSE	34.39	171.817	204.919
Standard error using $n-2$ in denominator	6.075	13.416	14.651
Correlation coefficient		0.846	0.813

Given that one wishes to develop a five-year forecast, trend analysis is the appropriate choice. Exponential smoothing provides a forecast only of deposits for the *next* year—and thus does not address the five-year forecast problem. In order to use the regression model based upon GDP, one must first develop a model to forecast GDP, and then use the forecast of GDP in the model to forecast deposits. This requires the development of *two* models—one of which (the model for GDP) must be based solely on time as the independent variable (time is the only other variable we are given).

Exponential Smoothing and the next period forecast (1 Point)
Linear Regression (Trend Analysis) and the next period forecast (1 Point)
Least squares–Simple Regression on GDP and the next period forecast (1 Point)

Use of any of the error measure (MAD, MAPE, etc.) is perfectly acceptable.

If student used the right solution procedure for any of the above methods, but final answer is different for the forecast (e.g. due to mistake in calculation), give them 50% of the mark.

b) (0.5 Point)

One could make a case for exclusion of the older data. Were we to exclude data from roughly the first 25 years, the forecasts for the later years would likely be considerably more accurate. Our argument would be that a change that caused an increase in the rate of growth appears to have taken place at the end of that period. Exclusion of this data, however, would not change our choice of forecasting model because we still need to forecast deposits for a future five-year period.

If the student's answer is close to the above statement give them the mark.

Problem # 3 (3 Points)

SOLUTION: For further calculations,

Please refer to Excel Spreadsheet.

a) (1.5 Points)

Quarter	Sales (pounds)	CMA	Sales/CMA
1997 1	664		
2	1338		
3	1170	827.5	1.41
4	259	767.3	0.34
1998 1	422	833.4	0.51
2	1098	1030.8	1.07
3	1939	1179.6	1.64
4	1069	1268.8	0.84
1999 1	803	1218.6	0.66
2	1430	1098.8	1.30
3	1206	1057.4	1.14
4	843	1000.0	0.84
2000 1	698	948.6	0.74
2	1076		
3	1149		

	QUARTER				
Year	1	2	3	4	
1997			1.41	0.34	
1998	0.51	1.07	1.64	0.84	
1999	0.66	1.30	1.14	0.84	
2000	0.74				
					Total
Average:	0.63	1.18	1.40	0.67	3.89
Adjusted:	0.65	1.22	1.44	0.69	4.00

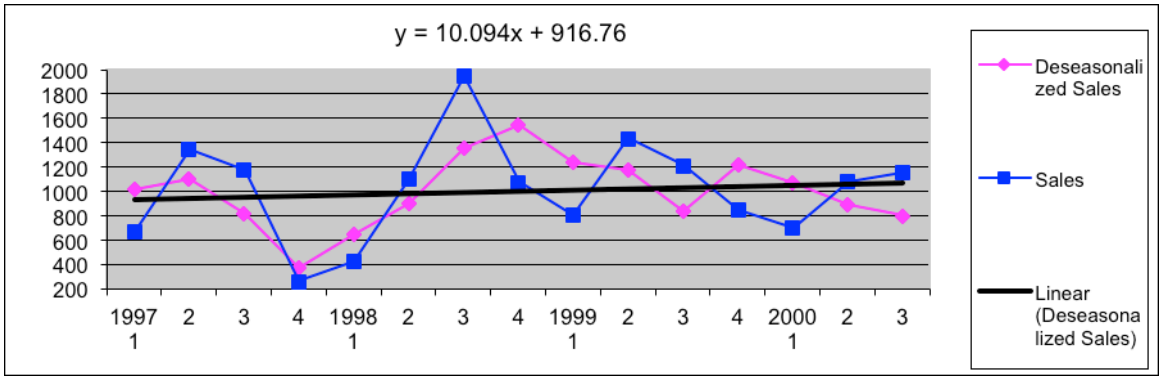
If they did not adjust seasonality indices, don't deduct any mark.

b) (1.5 Points)

Quarter	Sales (pounds)	Seasonal Relatives	Deseasonalized Sales
1997 1	664	0.65	1019.2
2	1338	1.22	1099.8
3	1170	1.44	813.3
4	259	0.69	373.6
1998 1	422	0.65	647.8

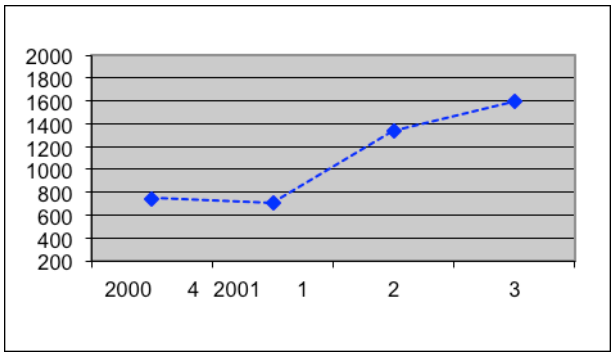
	2	1098	1.22	902.5
	3	1939	1.44	1347.8
	4	1069	0.69	1541.9
1999	1	803	0.65	1232.6
	2	1430	1.22	1175.4
	3	1206	1.44	838.3
	4	843	0.69	1215.9
2000	1	698	0.65	1071.4
	2	1076	1.22	884.5
	3	1149	1.44	798.7

Fit a linear trend to the deseasonalized data (pink):



Extend the line & reseasonalize:

Quarter		Trend Forecast	Reseasonalized Forecast
2000	4	1078.3	747.6
2001	1	1088.4	709.0
	2	1098.5	1336.3
	3	1108.5	1594.8



If student used the right solution procedure for any of the above parts, but final answer of the forecast is different (e.g. due to mistake in calculation), give them 50% of the mark for that part.

Drawing graphs are optional for part (b).

Problem # 4 (1.5 Point)

SOLUTION: for further calculations, Refer to the Excel Spreadsheet.

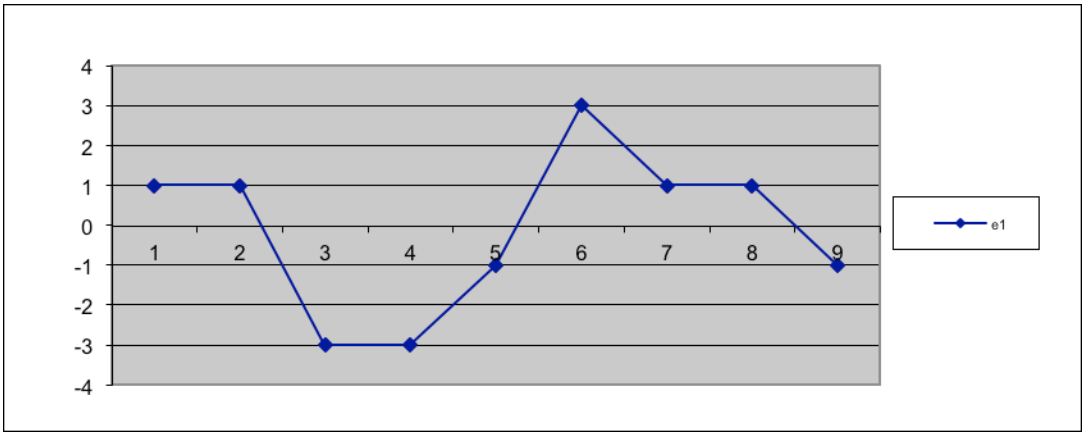
a) (1 Point)

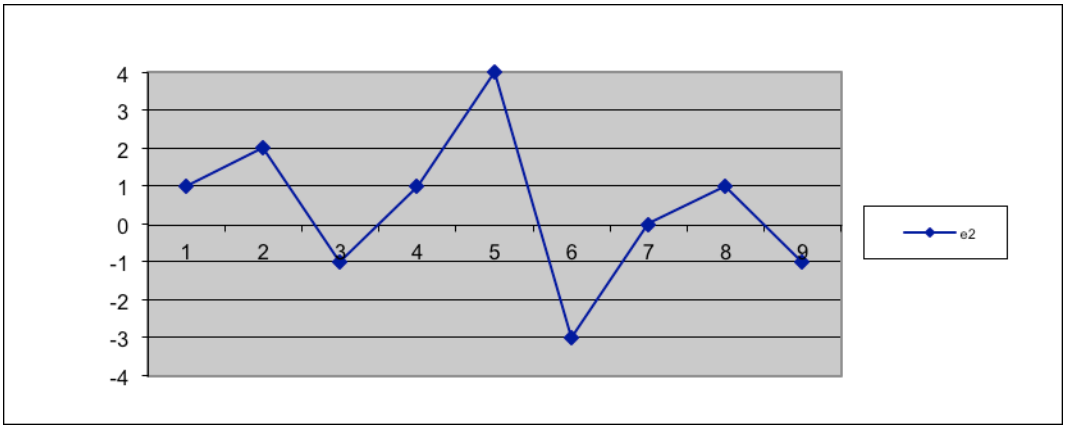
Both forecasting methods have approximately the same MSE.

Period	*Demand*	*Method 1*	e1	e1^2	*Method 2*	e2	e2^2	|e|/actual*100
1	37	36	1	1	36	1	1	2.70
2	39	38	1	1	37	2	4	5.13
3	37	40	-3	9	38	-1	1	2.70
4	39	42	-3	9	38	1	1	2.56
5	45	46	-1	1	41	4	16	8.89
6	49	46	3	9	52	-3	9	6.12
7	47	46	1	1	47	0	0	0.00
8	49	48	1	1	48	1	1	2.04
9	51	52	-1	1	52	-1	1	1.96
		avg:		3.666666667			3.8	3.57
				MSE			MSE	MAPE

If student used the right solution procedure, but final answer for MSE is different (e.g. due to mistake in calculation), give them 50% of the mark for that part.

b) (0.5 Point)





The 2s control limits for Method 1 are $0 \pm 2\sqrt{MSE} = 0 \pm 2\sqrt{3.7} = \pm 3.8$. The 2s control limits for Method 2 are $0 \pm 2\sqrt{3.8} = \pm 3.9$. The errors for Method 1 are all within its control limits. However, the error plot (see below) seems to be non-random (wavy). The period 5 error for Method 2 is just outside its control limits, but the error plot seems random. Based on the control charts, both methods have problems.

Graphs are essential.