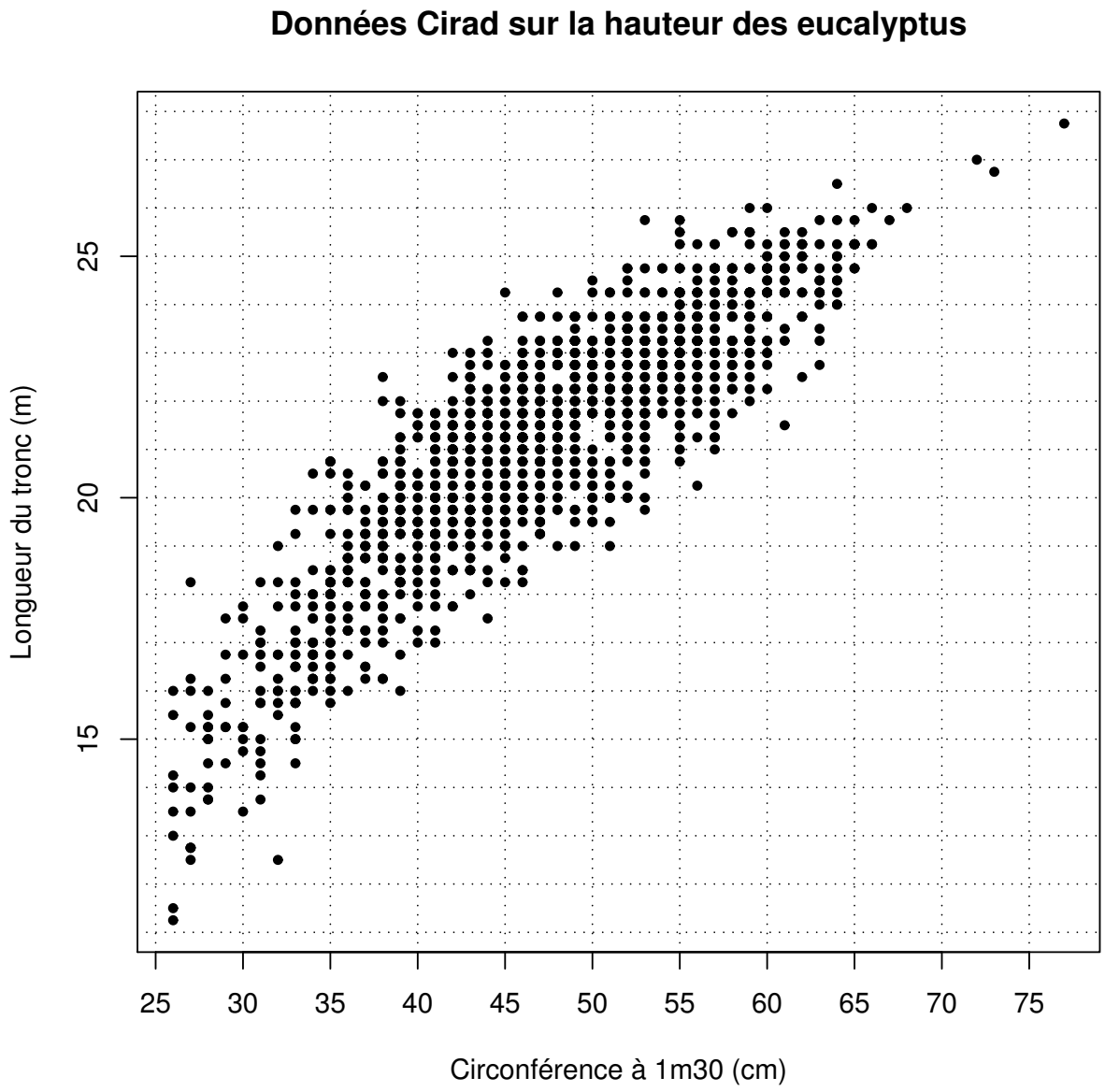
Master Statistique Appliquée

Mention Statistique pour l'Entreprise

Modèles de régression linéaire
ANNEXES

Magalie Fromont Renoir

ANNEXE 1.1 - Chapitre 2 - Exercice 2



ANNEXE 1.2 - Chapitre 3 - Exercice 8

The REG Procedure
Model: MODEL1
Dependent Variable: ht
Number of Observations Read 1429
Number of Observations Used 1429

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	7016.75963	3508.37982	2718.03	<.0001
Error	1426	1840.65613	1.29078		
Corrected Total	1428	8857.41576			

Root MSE	1.13613	R-Square	0.7922
Dependent Mean	21.21239	Adj R-Sq	0.7919
Coeff Var	5.35596		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	-24.35200	2.61444	-9.31	<.0001
circ	1	-0.48295	0.05793	-8.34	<.0001
racinecirc	1	9.98689	0.78033	12.80	<.0001

The REG Procedure
Model: MODEL1
Dependent Variable: ht
Number of Observations Read 1429
Number of Observations Used 1429

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	6805.33179	6805.33179	4732.36	<.0001
Error	1427	2052.08397	1.43804		
Corrected Total	1428	8857.41576			

Root MSE	1.19918	R-Square	0.7683
Dependent Mean	21.21239	Adj R-Sq	0.7682
Coeff Var	5.65322		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t |
Intercept	1	9.03748	0.17980	50.26	<.0001
circ	1	0.25714	0.00374	68.79	<.0001

The REG Procedure
Model: MODEL1
Dependent Variable: ht
Number of Observations Read 1429
Number of Observations Used 1429

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	6927.06398	6927.06398	5120.79	<.0001
Error	1427	1930.35178	1.35273		
Corrected Total	1428	8857.41576			

Root MSE	1.16307	R-Square	0.7821
Dependent Mean	21.21239	Adj R-Sq	0.7819
Coeff Var	5.48298		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	-2.73036	0.33600	-8.13	<.0001
racinecirc	1	3.49424	0.04883	71.56	<.0001

ANNEXE 1.3 - Chapitre 5 - Exercice 1

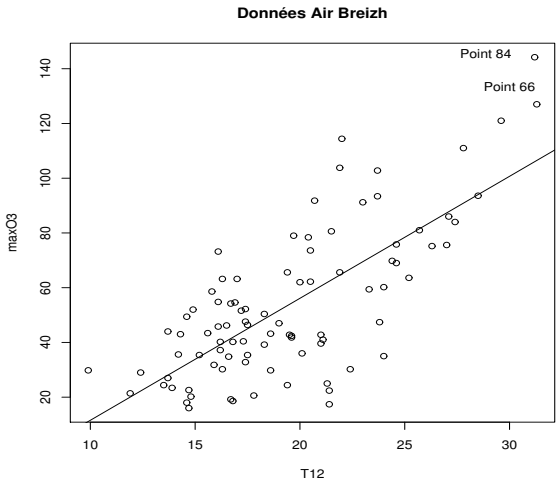


FIGURE 1 – Nuage de points, droite de régression

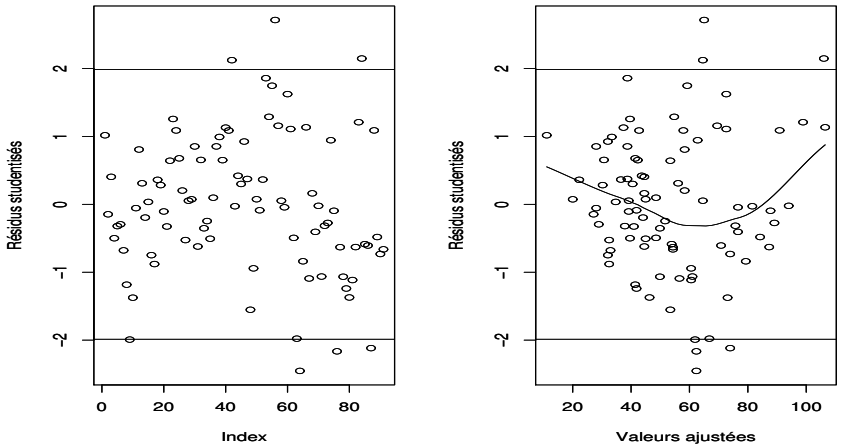


FIGURE 2 – Résidus studentisés en fonction du jour / des valeurs ajustées

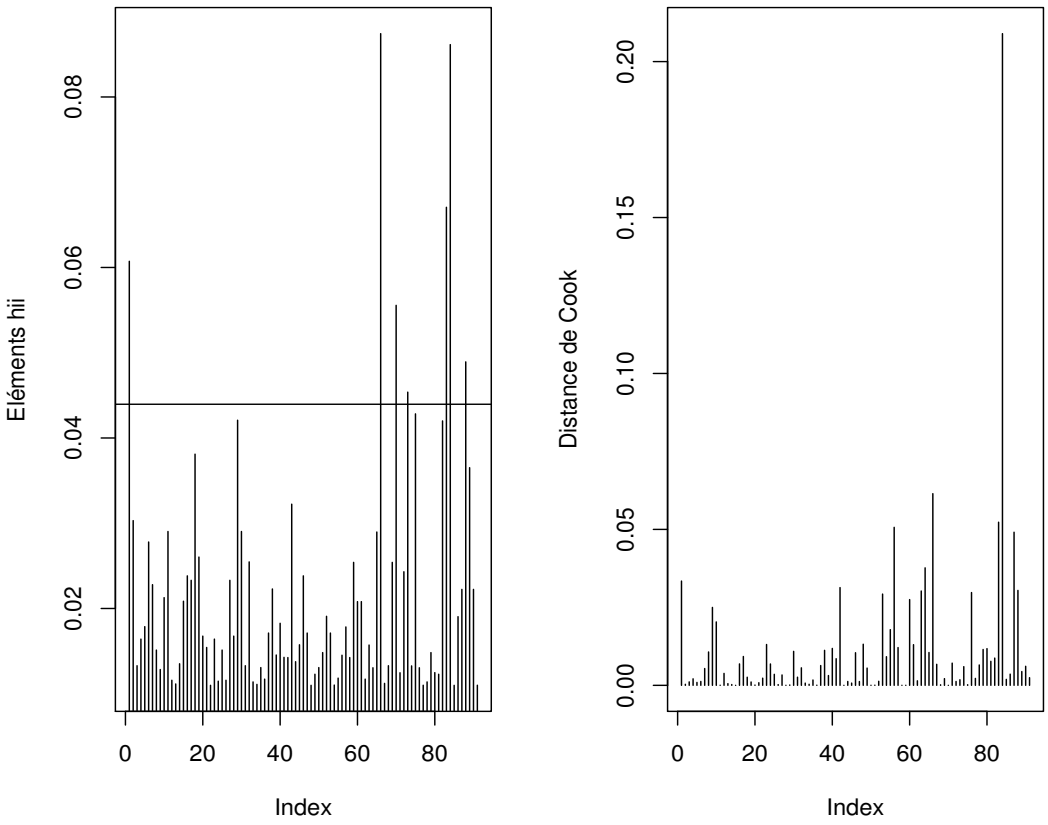


FIGURE 3 – Eléments diagonaux de la matrice de projection / Distance de Cook en fonction du jour

ANNEXE 1.4 - Chapitre 5 - Exercice 1

Modèle	Variables	R^2	R_a^2	AIC	BIC
M1	T_6	0.0212	0.02038	10849.66	10864.89
M2	T_9	0.1921	0.1914	10622.05	10637.29
M3	T_{12}	0.3076	0.3071	10439.05	10454.28
M4	N_6	0.1642	0.1635	10662.28	10677.52
M5	N_{12}	0.3421	0.3415	10378.53	10393.76
M6	V	0.161	0.1602	10666.95	10682.18
M12	T_6, T_9	0.3383	0.3372	10387.36	10407.67
M13	T_6, T_{12}	0.4307	0.4297	10209.02	10229.33
M14	T_6, N_6	0.2087	0.2074	10599.48	10619.79
M15	T_6, N_{12}	0.3565	0.3554	10354.28	10374.59
M16	T_6, V	0.1969	0.1955	10617.02	10637.34
M23	T_9, T_{12}	0.3565	0.3554	10354.23	10374.55
M24	T_9, N_6	0.3565	0.3554	10354.23	10374.55
M25	T_9, N_{12}	0.401	0.4	10269.27	10289.58
M26	T_9, V	0.3181	0.3169	10423.05	10443.36
M34	T_{12}, N_6	0.3692	0.3681	10330.66	10350.98
M35	T_{12}, N_{12}	0.4291	0.4281	10212.33	10232.65
M36	T_{12}, V	0.3936	0.3926	10283.77	10304.09
M45	N_6, N_{12}	0.3536	0.3525	10359.53	10379.84
M46	N_6, V	0.2536	0.2523	10530.24	10550.55
M56	N_{12}, V	0.3759	0.3749	10317.87	10338.18
M123	T_6, T_9, T_{12}	0.4307	0.4293	10210.91	10236.30
M124	T_6, T_9, N_6	0.3422	0.3406	10382.24	10407.64
M125	T_6, T_9, N_{12}	0.4348	0.4333	10202.41	10227.80
M126	T_6, T_9, V	0.3936	0.392	10285.90	10311.29
M134	T_6, T_{12}, N_6	0.435	0.4335	10202.05	10227.44
M135	T_6, T_{12}, N_{12}	0.4671	0.4657	10132.59	10157.98
M136	T_6, T_{12}, V	0.462	0.4607	10143.84	10169.23
M145	T_6, N_6, N_{12}	0.375	0.3734	10321.72	10347.11
M146	T_6, N_6, V	0.307	0.3053	10444.06	10469.45
M156	T_6, N_{12}, V	0.3973	0.3958	10278.47	10303.86
M234	T_9, T_{12}, N_6	0.4098	0.4083	10253.8	10279.19
M235	T_9, T_{12}, N_{12}	0.4377	0.4363	10196.23	10221.62
M236	T_9, T_{12}, V	0.4183	0.4169	10236.41	10261.80
M245	T_9, N_6, N_{12}	0.4089	0.4074	10255.56	10280.95
M246	T_9, N_6, V	0.3651	0.3635	10340.32	10365.71
M256	T_9, N_{12}, V	0.4385	0.4371	10194.59	10219.99
M345	T_{12}, N_6, N_{12}	0.4384	0.437	10194.8	10220.19
M346	T_{12}, N_6, V	0.4275	0.4261	10217.55	10242.95
M356	T_{12}, N_{12}, V	0.4628	0.4615	10142.07	10167.46
M456	N_6, N_{12}, V	0.3843	0.3827	10303.87	10329.26

ANNEXE 1.4 (suite)

Modèle	Variables	R^2	R_a^2	AIC	BIC
M1234	T_6, T_9, T_{12}, N_6	0.4355	0.4336	10202.91	10233.38
M1235	T_6, T_9, T_{12}, N_{12}	0.4675	0.4657	10133.68	10164.15
M1236	T_6, T_9, T_{12}, V	0.4621	0.4602	10145.75	10176.22
M1245	T_6, T_9, N_6, N_{12}	0.4351	0.4332	10203.67	10234.14
M1246	T_6, T_9, N_6, V	0.3964	0.3944	10282.29	10312.76
M1256	T_6, T_9, N_{12}, V	0.4601	0.4583	10149.96	10180.43
M1345	T_6, T_{12}, N_6, N_{12}	0.4675	0.4657	10133.76	10164.23
M1346	T_6, T_{12}, N_6, V	0.4654	0.4636	10138.44	10168.91
M1356	T_6, T_{12}, N_{12}, V	0.4875	0.4858	10088.22	10118.69
M1456	T_6, N_6, N_{12}, V	0.4126	0.4106	10250.01	10280.48
M2345	T_9, T_{12}, N_6, N_{12}	0.4495	0.4477	10173.02	10203.49
M2346	T_9, T_{12}, N_6, V	0.4506	0.4488	10170.68	10201.15
M2356	T_9, T_{12}, N_{12}, V	0.4681	0.4663	10132.33	10162.80
M2456	T_9, N_6, N_{12}, V	0.4436	0.4417	10185.84	10216.31
M3456	T_{12}, N_6, N_{12}, V	0.4693	0.4675	10129.66	10160.13
M12345	$T_6, T_9, T_{12}, N_6, N_{12}$	0.4676	0.4654	10135.39	10170.94
M12346	T_6, T_9, T_{12}, N_6, V	0.4658	0.4635	10139.48	10175.03
M12356	$T_6, T_9, T_{12}, N_{12}, V$	0.4878	0.4857	10089.51	10125.06
M12456	T_6, T_9, N_6, N_{12}, V	0.4603	0.4581	10151.53	10187.08
M13456	$T_6, T_{12}, N_6, N_{12}, V$	0.4879	0.4859	10089.31	10124.85
M23456	$T_9, T_{12}, N_6, N_{12}, V$	0.4764	0.4742	10115.70	10151.24

ANNEXE 1.5 - Chapitre 5 - Exercice 2

The REG Procedure
Model: MODEL1
Dependent Variable: Consommation

Number of Observations Read	17
Number of Observations Used	17

Note: No intercept in model. R-Square is redefined.

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	33022918	33022918	156.27	<.0001
Error	16	3381179	211324		
Uncorrected Total	17	36404096			

Root MSE	459.69953	R-Square	0.9071
Dependent Mean	804.92941	Adj R-Sq	0.9013
Coeff Var	57.11054		

Parameter Estimates

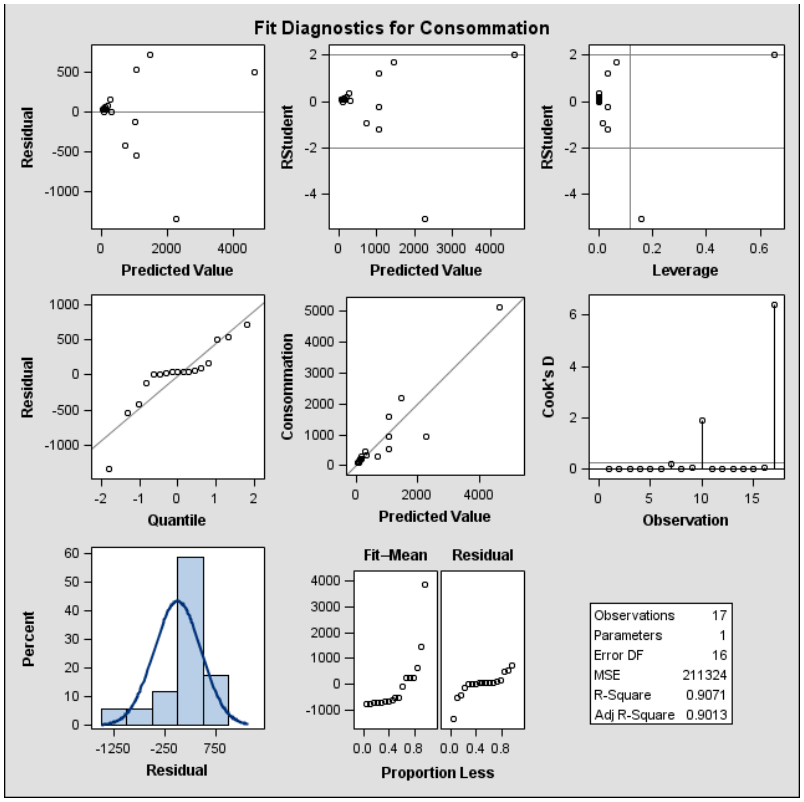
Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Population	1	18.36477	1.46910	12.50	<.0001

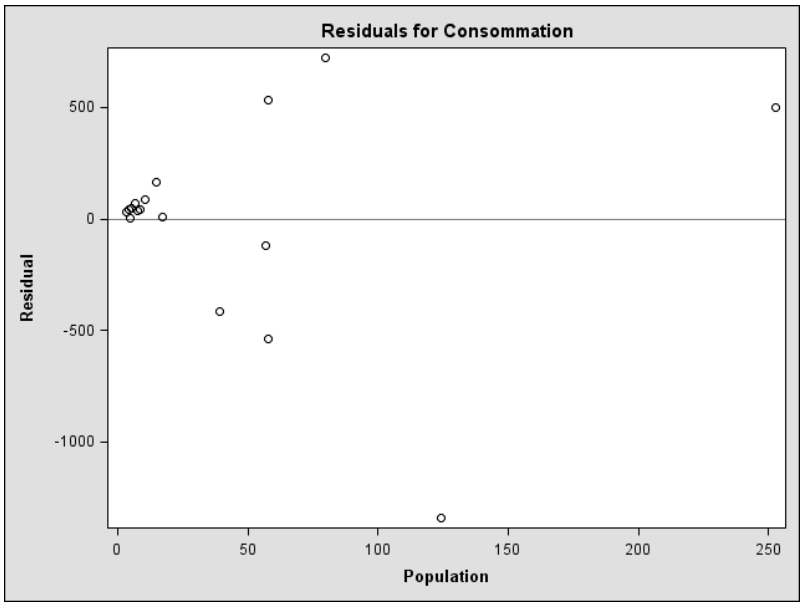
The REG Procedure
Model: MODEL1
Dependent Variable: Consommation

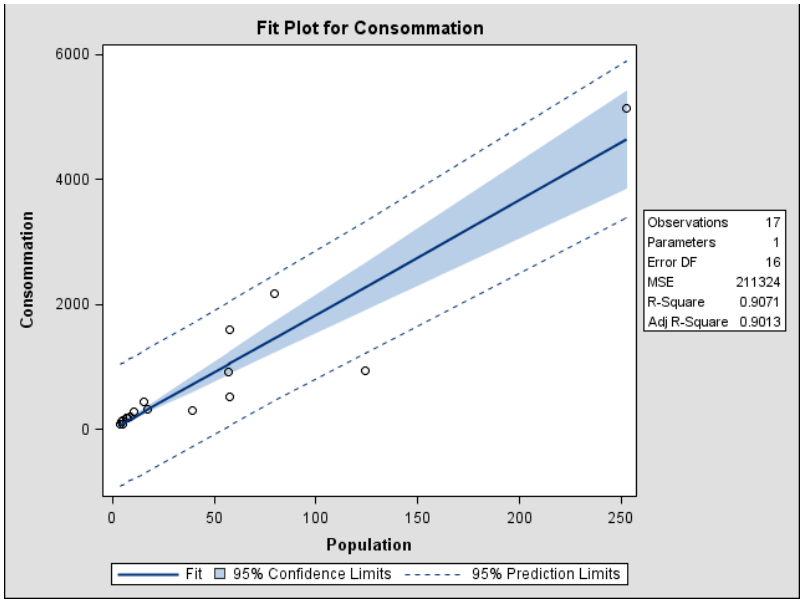
Output Statistics

Obs	Dependent Variable	Predicted Value	Std Error Mean Predict	Residual	Std Error Residual	Student Residual	-2-1 0 1 2	Cook's D	RStudent	Hat Diag H	Cov Ratio	DFFITS	DFBETAS Population
1	327.4000	317.7105	25.4155	9.6895	459.0	0.0211		0.000	0.0204	0.0031	1.0699	0.0011	0.0011
2	179.5000	141.4087	11.3121	38.0913	459.6	0.0829		0.000	0.0803	0.0006	1.0669	0.0020	0.0020
3	279.4000	190.9936	15.2787	88.4064	459.4	0.192		0.000	0.1865	0.0011	1.0654	0.0062	0.0062
4	139.1000	93.6603	7.4924	45.4397	459.6	0.0989		0.000	0.0957	0.0003	1.0663	0.0016	0.0016
5	92.5000	91.8239	7.3455	0.6761	459.6	0.00147		0.000	0.001424	0.0003	1.0669	0.0000	0.0000
6	926.7000	1045	83.5919	-118.2554	452.0	-0.262		0.002	-0.2538	0.0331	1.0984	-0.0469	-0.0469
7	2186	1464	117.0874	722.6278	444.5	1.626	***	0.183	1.7226	0.0649	0.9523	0.4537	0.4537
8	96.8000	64.2767	5.1419	32.5233	459.7	0.0708		0.000	0.0685	0.0001	1.0665	0.0008	0.0008
9	523.9000	1061	84.9141	-537.5837	451.8	-1.190	**	0.050	-1.2067	0.0341	1.0066	-0.2268	-0.2268
10	935.9000	2277	182.1686	-1341	422.1	-3.178	******	1.882	-5.0672	0.1570	0.4666	-2.1871	-2.1871
11	444.2000	277.3080	22.1834	166.8920	459.2	0.363		0.000	0.3534	0.0023	1.0603	0.0171	0.0171
12	119.7000	78.9685	6.3171	40.7315	459.7	0.0886		0.000	0.0858	0.0002	1.0663	0.0012	0.0012
13	300.7000	716.2260	57.2950	-415.5260	456.1	-0.911	*	0.013	-0.9059	0.0155	1.0273	-0.1138	-0.1138
14	201.9000	159.7735	12.7812	42.1265	459.5	0.0917		0.000	0.0888	0.0008	1.0669	0.0025	0.0025
15	194.7000	126.7169	10.1368	67.9831	459.6	0.148		0.000	0.1433	0.0005	1.0657	0.0032	0.0032
16	1593	1060	84.7672	533.2527	451.8	1.180	**	0.049	1.1960	0.0340	1.0081	0.2244	0.2244
17	5142	4641	371.2420	501.4225	271.1	1.849	***	6.414	2.0196	0.6522	2.4111	2.7655	2.7655

Sum of Residuals	-122.83439
Sum of Squared Residuals	3381179
Predicted Residual SS (PRESS)	6063496


Fit Diagnostics for Consommation
Residual
Predicted Value
RStudent
Predicted Value
RStudent
Leverage
Residual
Quantile
Consommation
Predicted Value
Cook's D
Observation
Percent
Residual
Fit–Mean
Residual
Proportion Less
Observations 17
Parameters 1
Error DF 16
MSE 211324
R-Square 0.9071
Adj R-Square 0.9013


Residuals for Consommation
Residual
Population


Fit Plot for Consommation
6000
4000
2000
0
Consommation
0
50
100
150
200
250
Population
Observations 17
Parameters 1
Error DF 16
MSE 211324
R-Square 0.9071
Adj R-Square 0.9013
Fit
95% Confidence Limits
95% Prediction Limits

The REG Procedure
Model: MODEL1
Dependent Variable: Consommation

Number of Observations Read	15
Number of Observations Used	15

Note: No intercept in model. R-Square is redefined.

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	7839395	7839395	88.04	<.0001
Error	14	1246572	89041		
Uncorrected Total	15	9085967			

Root MSE	298.39711	R-Square	0.8628
Dependent Mean	507.04667	Adj R-Sq	0.8530
Coeff Var	58.85003		

Parameter Estimates

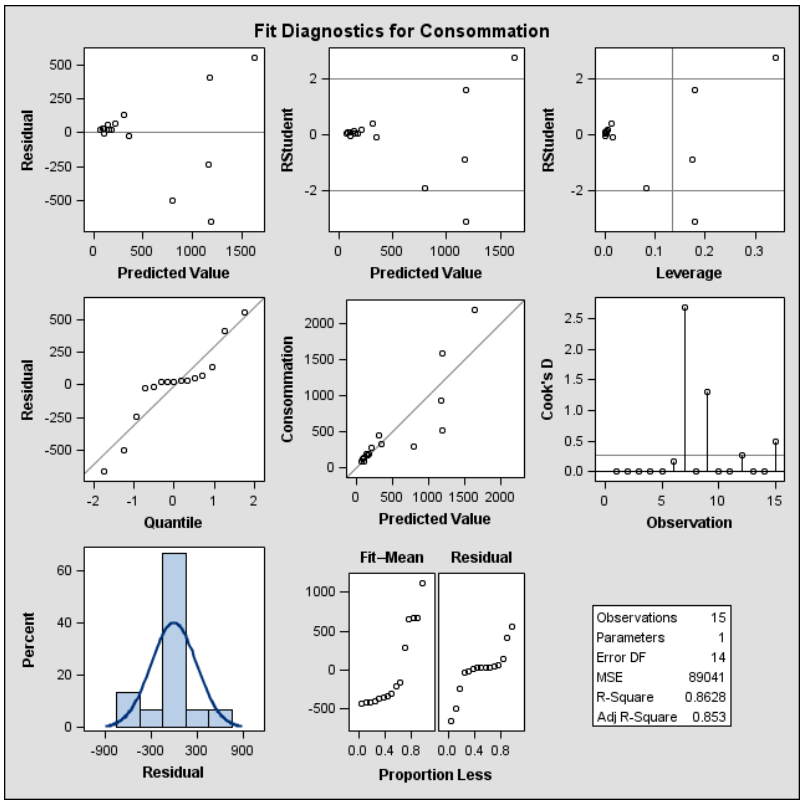
Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Population	1	20.48545	2.18323	9.38	<.0001

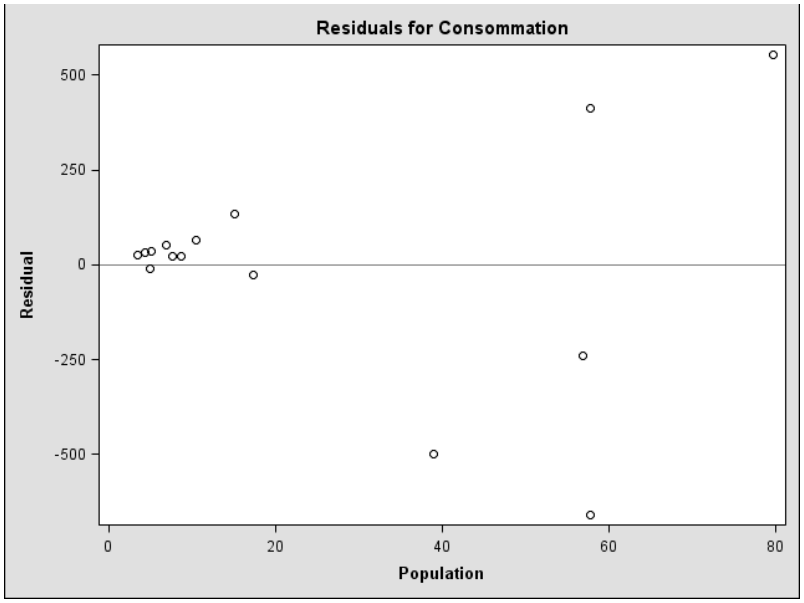
The REG Procedure
Model: MODEL1
Dependent Variable: Consommation

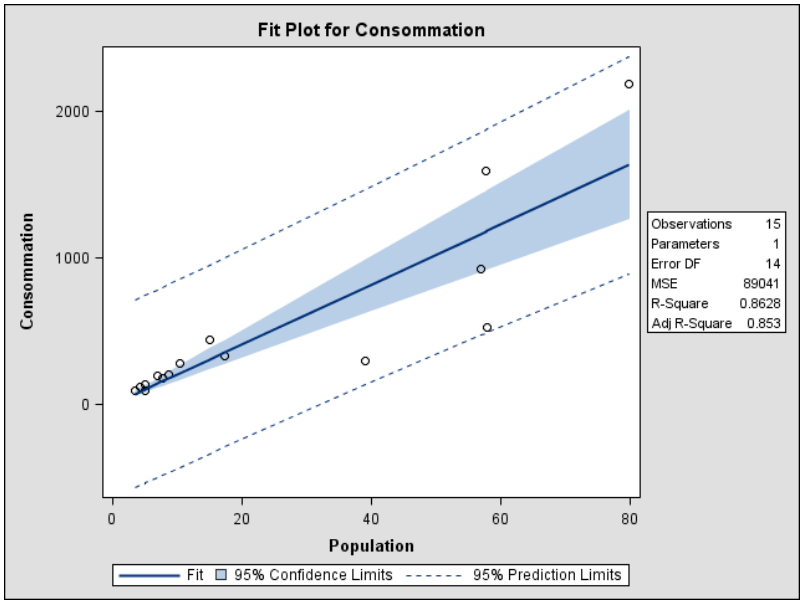
Output Statistics

Obs	Dependent Variable	Predicted Value	Std Error Mean Predict	Residual	Std Error Residual	Student Residual	-2-1 0 1 2	Cook's D	RStudent	Hat Diag H	Cov Ratio	DFFITS	DFBETAS Population
1	327.4000	354.3983	37.7698	-26.9983	296.0	-0.0912		0.000	-0.0879	0.0160	1.0938	-0.0112	-0.0112
2	179.5000	157.7380	16.8108	21.7620	297.9	0.0730		0.000	0.0704	0.0032	1.0799	0.0040	0.0040
3	279.4000	213.0487	22.7056	66.3513	297.5	0.223		0.000	0.2153	0.0058	1.0793	0.0164	0.0164
4	139.1000	104.4758	11.1345	34.6242	298.2	0.116		0.000	0.1119	0.0014	1.0774	0.0042	0.0042
5	92.5000	102.4273	10.9161	-9.9273	298.2	-0.0333		0.000	-0.0321	0.0013	1.0783	-0.0012	-0.0012
6	926.7000	1166	124.2256	-238.9221	271.3	-0.881	*|	0.163	-0.8731	0.1733	1.2305	-0.3998	-0.3998
7	2186	1633	174.0032	553.6096	242.4	2.284	|****	2.687	2.7782	0.3400	1.0239	1.9942	1.9942
8	96.8000	71.6991	7.6413	25.1009	298.3	0.0841		0.000	0.0811	0.0007	1.0771	0.0021	0.0021
9	523.9000	1184	126.1905	-660.1590	270.4	-2.441	****|	1.298	-3.1045	0.1788	0.7531	-1.4488	-1.4488
10	444.2000	309.3303	32.9667	134.8697	296.6	0.455		0.003	0.4415	0.0122	1.0741	0.0491	0.0491
11	119.7000	88.0874	9.3879	31.6126	298.2	0.106		0.000	0.1022	0.0010	1.0771	0.0032	0.0032
12	300.7000	798.9326	85.1458	-498.2326	286.0	-1.742	***|	0.269	-1.8969	0.0814	0.9182	-0.5648	-0.5648
13	201.9000	178.2234	18.9941	23.6766	297.8	0.0795		0.000	0.0766	0.0041	1.0808	0.0049	0.0049
14	194.7000	141.3496	15.0643	53.3504	298.0	0.179		0.000	0.1727	0.0025	1.0772	0.0087	0.0087
15	1593	1182	125.9722	410.8895	270.5	1.519	|***	0.500	1.6016	0.1782	1.0945	0.7459	0.7459

Sum of Residuals	-78.39246
Sum of Squared Residuals	1246572
Predicted Residual SS (PRESS)	2008383




Residuals for Consommation
Residual
500
250
0
-250
-500
0
20
40
60
80
Population


Fit Plot for Consommation
Consommation
2000
1000
0
0
20
40
60
80
Population
Observations 15
Parameters 1
Error DF 14
MSE 89041
R-Square 0.8628
Adj R-Square 0.853
Fit
95% Confidence Limits
95% Prediction Limits

ANNEXE 1.6 - Chapitre 5 - Exercice 3

The REG Procedure
Model: MODEL1
Dependent Variable: Log_x11

Number of Observations Read	33
Number of Observations Used	33

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	10	34.46616	3.44662	5.01	0.0008
Error	22	15.12986	0.68772		
Corrected Total	32	49.59603			

Root MSE	0.82929	R-Square	0.6949
Dependent Mean	-0.81328	Adj R-Sq	0.5563
Coeff Var	-101.96841		

Parameter Estimates

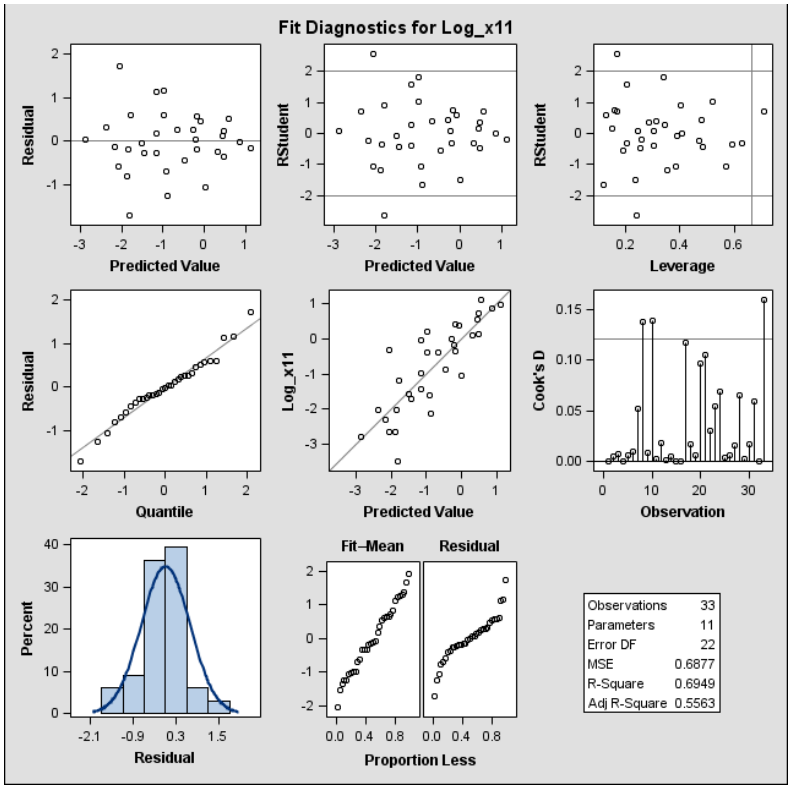
Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	10.99841	3.06027	3.59	0.0016
x1	1	-0.00443	0.00156	-2.85	0.0094
x2	1	-0.05383	0.02190	-2.46	0.0223
x3	1	0.06794	0.09947	0.68	0.5017
x4	1	-1.29364	0.56381	-2.29	0.0317
x5	1	0.23164	0.10438	2.22	0.0371
x6	1	-0.35680	1.56646	-0.23	0.8219
x7	1	-0.23747	1.00601	-0.24	0.8156
x8	1	0.18106	0.23672	0.76	0.4525
x9	1	-1.28532	0.86485	-1.49	0.1514
x10	1	-0.43311	0.73487	-0.59	0.5616

The REG Procedure
Model: MODEL1
Dependent Variable: Log_x11

Output Statistics

Obs	Dependent Variable	Predicted Value	Std Error Mean Predict	Residual	Std Error Residual	Student Residual	-2-1 0 1 2	Cook's D	RStudent	Hat Diag H	Cov Ratio	DFFITS	Intercept	
1	0.8629	0.8633	0.5286	-0.000362	0.639	-0.0006	| |	0.000	-0.000553	0.4064	2.8100	-0.0005	-0.0002	-0.0
2	0.3853	-0.0879	0.2978	0.4732	0.774	0.611	| *	0.005	0.6025	0.1289	1.5861	0.2318	0.0039	0.0
3	0.1222	0.4790	0.4180	-0.3568	0.716	-0.498	| |	0.008	-0.4895	0.2541	1.9740	-0.2857	-0.1550	0.0
4	-0.1625	-0.2162	0.4095	0.0537	0.721	0.0745	| |	0.000	0.0728	0.2438	2.1998	0.0413	0.0206	-0.0
5	-1.4271	-1.1539	0.4556	-0.2732	0.693	-0.394	| |	0.006	-0.3865	0.3018	2.2100	-0.2541	-0.0770	-0.0
6	0.3988	-0.1769	0.3294	0.5757	0.761	0.756	| *	0.010	0.7489	0.1578	1.4822	0.3242	0.1319	-0.0
7	-1.2040	-1.7951	0.5261	0.5912	0.641	0.922	| *	0.052	0.9189	0.4024	1.8093	0.7540	-0.2643	0.1
8	-2.6593	-2.0739	0.6248	-0.5853	0.545	-1.073	** |	0.138	-1.0773	0.5676	2.1351	-1.2344	0.1709	-0.1
9	1.0986	0.5723	0.3409	0.5264	0.756	0.696	| *	0.009	0.6879	0.1690	1.5710	0.3102	0.0652	-0.1
10	0.1906	-0.9704	0.4839	1.1610	0.673	1.724	| ***	0.139	1.8111	0.3405	0.5125	1.3013	0.1407	-0.8
11	-0.9676	-1.1456	0.4852	0.1780	0.673	0.265	| |	0.003	0.2590	0.3423	2.4491	0.1868	0.0472	-0.0
12	-0.3567	-0.1831	0.6582	-0.1736	0.504	-0.344	| |	0.018	-0.3371	0.6300	4.2481	-0.4399	-0.1722	0.2
13	0.9708	1.1165	0.4224	-0.1457	0.714	-0.204	| |	0.001	-0.1997	0.2595	2.2061	-0.1182	-0.0422	0.0
14	0.7178	0.4680	0.4427	0.2499	0.701	0.356	| |	0.005	0.3491	0.2850	2.1891	0.2204	0.0421	-0.0
15	0.5596	0.4332	0.3231	0.1264	0.764	0.165	| |	0.000	0.1618	0.1518	1.9400	0.0684	0.0004	-0.0
16	-2.8134	-2.8648	0.4561	0.0514	0.693	0.0742	| |	0.000	0.0725	0.3024	2.3848	0.0477	-0.0027	0.0
17	-2.0402	-2.3649	0.6987	0.3246	0.447	0.727	| *	0.117	0.7186	0.7098	4.4002	1.1239	-0.4761	0.1
18	0	-0.2731	0.5741	0.2731	0.598	0.456	| |	0.017	0.4479	0.4792	2.8848	0.4296	-0.0543	0.1
19	-0.8916	-0.4689	0.3610	-0.4227	0.747	-0.566	* |	0.007	-0.5572	0.1895	1.7514	-0.2695	0.0939	-0.0
20	-0.3285	-2.0590	0.3406	1.7305	0.756	2.289	| ****	0.097	2.5617	0.1687	0.1008	1.1539	-0.5259	0.5
21	-0.4005	-0.9966	0.5979	0.5962	0.575	1.037	| **	0.106	1.0393	0.5198	2.0009	1.0814	0.3415	0.0
22	-2.1203	-0.8871	0.2840	-1.2332	0.779	-1.583	*** |	0.030	-1.6427	0.1172	0.4999	-0.5987	0.1526	-0.2
23	-0.0305	-1.1658	0.3728	1.1353	0.741	1.533	| ***	0.054	1.5843	0.2021	0.6038	0.7973	-0.4664	0.2
24	-2.6593	-1.8742	0.4928	-0.7851	0.667	-1.177	** |	0.069	-1.1880	0.3531	1.2608	-0.8777	0.1801	-0.3
25	-2.3026	-2.1651	0.5688	-0.1375	0.604	-0.228	| |	0.004	-0.2228	0.4704	3.0691	-0.2100	-0.0442	-0.0
26	-0.3857	-0.6537	0.4652	0.2680	0.687	0.390	| |	0.006	0.3828	0.3147	2.2548	0.2594	-0.0829	0.1
27	-2.0402	-1.8540	0.6394	-0.1862	0.528	-0.353	| |	0.017	-0.3454	0.5945	3.8653	-0.4182	0.0479	-0.0
28	-1.6094	-0.9112	0.5140	-0.6982	0.651	-1.073	** |	0.065	-1.0767	0.3841	1.4998	-0.8503	0.1845	-0.3
29	0.0862	0.3243	0.3740	-0.2381	0.740	-0.322	| |	0.002	-0.3151	0.2034	1.9881	-0.1592	0.0075	-0.0
30	-1.7148	-1.4443	0.5768	-0.2705	0.596	-0.454	| |	0.018	-0.4456	0.4838	2.9138	-0.4314	-0.0071	0.0
31	-1.0498	0.009342	0.4029	-1.0592	0.725	-1.461	** |	0.060	-1.5024	0.2360	0.7103	-0.8350	-0.0180	0.3
32	-1.5606	-1.5107	0.5174	-0.0499	0.648	-0.0770	| |	0.000	-0.0752	0.3893	2.7235	-0.0601	-0.0022	0.0
33	-3.5066	-1.8076	0.4073	-1.6990	0.722	-2.352	**** |	0.160	-2.6558	0.2412	0.0909	-1.4972	0.6146	0.1

Sum of Residuals	0
Sum of Squared Residuals	15.12986
Predicted Residual SS (PRESS)	30.08652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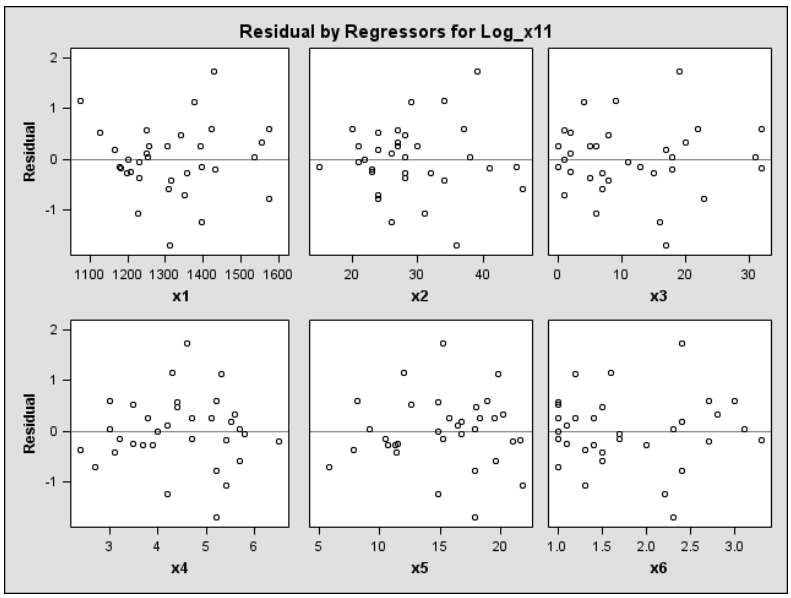
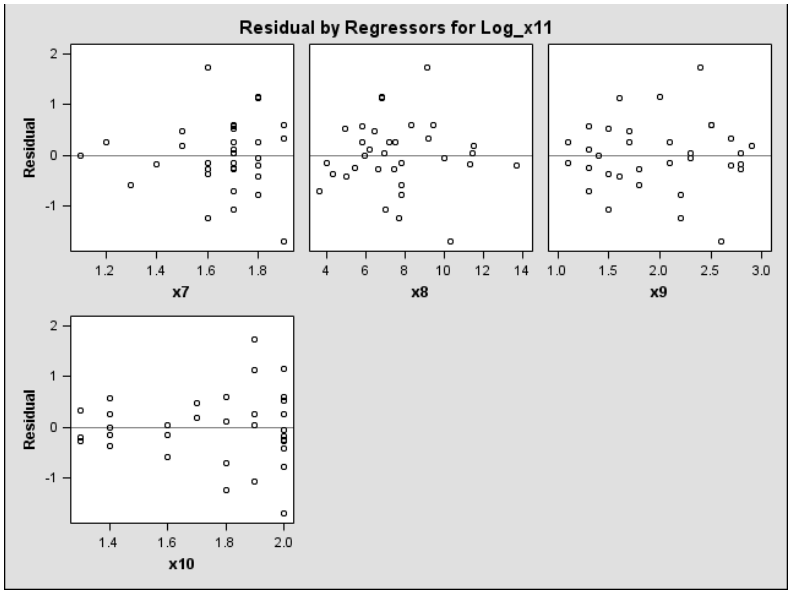
Residual
Predicted Value
RStudent
Predicted Value
RStudent
Leverage
Residual
Quantile
Log_x11
Predicted Value
Cook's D
Observation
Percent
Residual
Fit–Mean
Residual
Proportion Less
Observations 33
Parameters 11
Error DF 22
MSE 0.6877
R-Square 0.6949
Adj R-Square 0.5563


Residual by Regressors for Log_x11
Residual
x1
x2
x3
Residual
x4
x5
x6


Residual by Regressors for Log_x11
Residual
x7
x8
x9
x10

The REG Procedure
Model: MODEL2
Dependent Variable: Log_x11

Number of Observations Read	33
Number of Observations Used	33

Stepwise Selection: Step 1

Variable x9 Entered: R-Square = 0.3528 and C(p) = 17.6721

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	17.49867	17.49867	16.90	0.0003
Error	31	32.09735	1.03540		
Corrected Total	32	49.59603			

Variable	Parameter Estimate	Standard Error	Type II SS	F Value	Pr > F
Intercept	1.77374	0.65375	7.62205	7.36	0.0108
x9	-1.30538	0.31753	17.49867	16.90	0.0003

Bounds on condition number: 1, 1

Stepwise Selection: Step 2

Variable x1 Entered: R-Square = 0.4690 and C(p) = 11.2904

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	23.26290	11.63145	13.25	<.0001
Error	30	26.33313	0.87777		
Corrected Total	32	49.59603			

Variable	Parameter Estimate	Standard Error	Type II SS	F Value	Pr > F
Intercept	5.83839	1.69652	10.39561	11.84	0.0017
x1	-0.00353	0.00138	5.76422	6.57	0.0156
x9	-1.01284	0.31386	9.14074	10.41	0.0030

Bounds on condition number: 1.1525, 4.6099

Stepwise Selection: Step 3

Variable x2 Entered: R-Square = 0.5310 and C(p) = 8.8262

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	26.33301	8.77767	10.94	<.0001
Error	29	23.26301	0.80217		
Corrected Total	32	49.59603			

Variable	Parameter Estimate	Standard Error	Type II SS	F Value	Pr > F
Intercept	6.76034	1.68890	12.85278	16.02	0.0004
x1	-0.00352	0.00132	5.74447	7.16	0.0121
x2	-0.04486	0.02293	3.07012	3.83	0.0601
x9	-0.82500	0.31503	5.50133	6.86	0.0139

Bounds on condition number: 1.2705, 10.625

Stepwise Selection: Step 4

Variable x3 Entered: R-Square = 0.5799 and C(p) = 7.2958

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	4	28.76097	7.19024	9.66	<.0001
Error	28	20.83505	0.74411		
Corrected Total	32	49.59603			

Variable	Parameter Estimate	Standard Error	Type II SS	F Value	Pr > F
Intercept	9.54614	2.24151	13.49616	18.14	0.0002
x1	-0.00481	0.00145	8.13804	10.94	0.0026
x2	-0.04848	0.02217	3.55650	4.78	0.0373
x3	0.06911	0.03826	2.42796	3.26	0.0816
x9	-1.72321	0.58251	6.51184	8.75	0.0062

Bounds on condition number: 5.724, 52.201

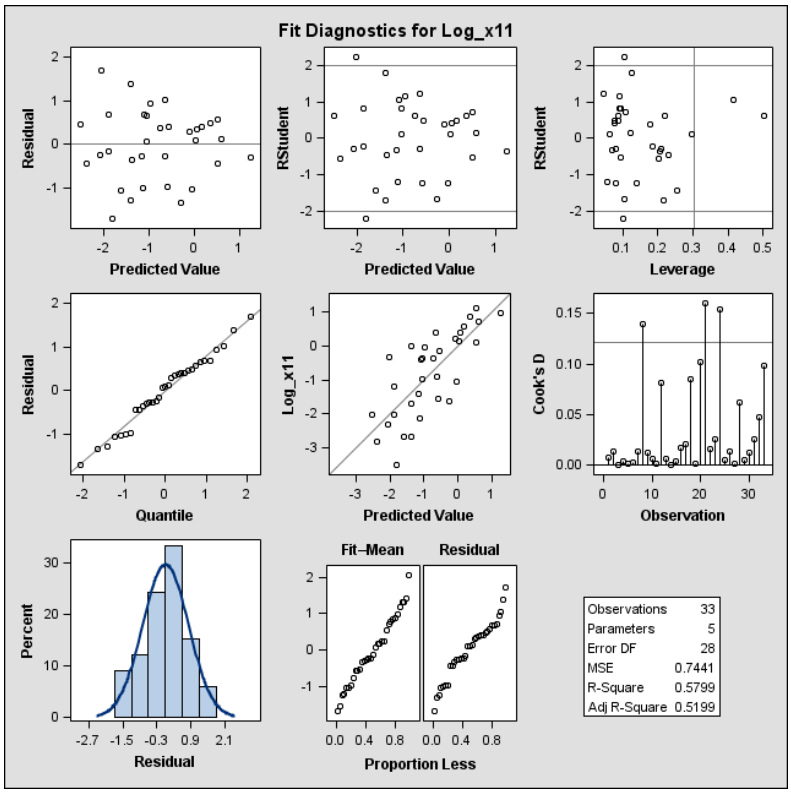
All variables left in the model are significant at the 0.1500 level.

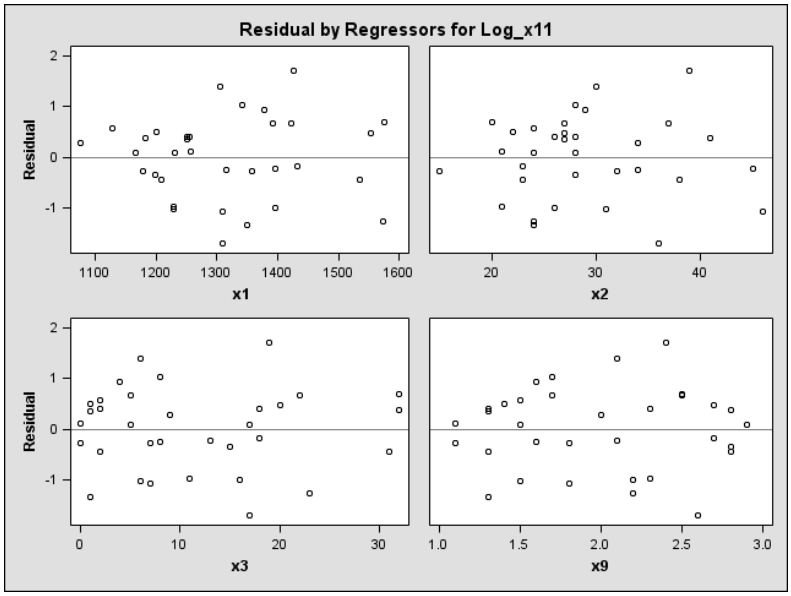
No other variable met the 0.1500 significance level for entry into the model.

Summary of Stepwise Selection

Step	Variable Entered	Variable Removed	Number Vars In	Partial R-Square	Model R-Square	C(p)	F Value	Pr > F
1	x9		1	0.3528	0.3528	17.6721	16.90	0.0003
2	x1		2	0.1162	0.4690	11.2904	6.57	0.0156
3	x2		3	0.0619	0.5310	8.8262	3.83	0.0601
4	x3		4	0.0490	0.5799	7.2958	3.26	0.0816

The REG Procedure
Model: MODEL2
Dependent Variable: Log_x11





The REG Procedure
Model: MODEL3
Dependent Variable: Log_x11

Number of Observations Read	33
Number of Observations Used	33

Forward Selection: Step 1

Variable x9 Entered: R-Square = 0.3528 and C(p) = 17.6721

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	17.49867	17.49867	16.90	0.0003
Error	31	32.09735	1.03540		
Corrected Total	32	49.59603			

Variable	Parameter Estimate	Standard Error	Type II SS	F Value	Pr > F
Intercept	1.77374	0.65375	7.62205	7.36	0.0108
x9	-1.30538	0.31753	17.49867	16.90	0.0003

Bounds on condition number: 1, 1

Forward Selection: Step 2

Variable x1 Entered: R-Square = 0.4690 and C(p) = 11.2904

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	23.26290	11.63145	13.25	<.0001
Error	30	26.33313	0.87777		
Corrected Total	32	49.59603			

Variable	Parameter Estimate	Standard Error	Type II SS	F Value	Pr > F
Intercept	5.83839	1.69652	10.39561	11.84	0.0017
x1	-0.00353	0.00138	5.76422	6.57	0.0156
x9	-1.01284	0.31386	9.14074	10.41	0.0030

Bounds on condition number: 1.1525, 4.6099

Forward Selection: Step 3

Variable x2 Entered: R-Square = 0.5310 and C(p) = 8.8262

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	26.33301	8.77767	10.94	<.0001
Error	29	23.26301	0.80217		
Corrected Total	32	49.59603			

Variable	Parameter Estimate	Standard Error	Type II SS	F Value	Pr > F
Intercept	6.76034	1.68890	12.85278	16.02	0.0004
x1	-0.00352	0.00132	5.74447	7.16	0.0121
x2	-0.04486	0.02293	3.07012	3.83	0.0601
x9	-0.82500	0.31503	5.50133	6.86	0.0139

Bounds on condition number: 1.2705, 10.625

Forward Selection: Step 4

Variable x3 Entered: R-Square = 0.5799 and C(p) = 7.2958

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	4	28.76097	7.19024	9.66	<.0001
Error	28	20.83505	0.74411		
Corrected Total	32	49.59603			

Variable	Parameter Estimate	Standard Error	Type II SS	F Value	Pr > F
Intercept	9.54614	2.24151	13.49616	18.14	0.0002
x1	-0.00481	0.00145	8.13804	10.94	0.0026
x2	-0.04848	0.02217	3.55650	4.78	0.0373
x3	0.06911	0.03826	2.42796	3.26	0.0816
x9	-1.72321	0.58251	6.51184	8.75	0.0062

Bounds on condition number: 5.724, 52.201

Forward Selection: Step 5

Variable x7 Entered: R-Square = 0.6077 and C(p) = 7.2884

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	5	30.14153	6.02831	8.37	<.0001
Error	27	19.45450	0.72054		
Corrected Total	32	49.59603			

Variable	Parameter Estimate	Standard Error	Type II SS	F Value	Pr > F
Intercept	11.10771	2.47748	14.48387	20.10	0.0001
x1	-0.00437	0.00147	6.40764	8.89	0.0060
x2	-0.05445	0.02224	4.31768	5.99	0.0212
x3	0.07150	0.03769	2.59350	3.60	0.0685
x7	-1.17585	0.84948	1.38055	1.92	0.1776
x9	-1.74523	0.57343	6.67422	9.26	0.0052

Bounds on condition number: 5.7361, 71.533

Forward Selection: Step 6

Variable x4 Entered: R-Square = 0.6179 and C(p) = 8.5530

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	6	30.64727	5.10788	7.01	0.0002
Error	26	18.94876	0.72880		
Corrected Total	32	49.59603			

Variable	Parameter Estimate	Standard Error	Type II SS	F Value	Pr > F
Intercept	11.19375	2.49378	14.68389	20.15	0.0001
x1	-0.00413	0.00150	5.48479	7.53	0.0109
x2	-0.05468	0.02237	4.35463	5.98	0.0216
x3	0.06920	0.03800	2.41678	3.32	0.0801
x4	-0.13884	0.16666	0.50574	0.69	0.4124
x7	-1.18826	0.85447	1.40941	1.93	0.1761
x9	-1.61328	0.59807	5.30301	7.28	0.0121

Bounds on condition number: 5.7664, 96.457

Forward Selection: Step 7

Variable x5 Entered: R-Square = 0.6806 and C(p) = 6.0336

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	7	33.75535	4.82219	7.61	<.0001
Error	25	15.84068	0.63363		
Corrected Total	32	49.59603			

Variable	Parameter Estimate	Standard Error	Type II SS	F Value	Pr > F
Intercept	9.88431	2.39925	10.75415	16.97	0.0004
x1	-0.00427	0.00140	5.86477	9.26	0.0055
x2	-0.05538	0.02086	4.46612	7.05	0.0136
x3	0.04705	0.03682	1.03496	1.63	0.2130
x4	-0.98358	0.41186	3.61378	5.70	0.0248
x5	0.20662	0.09329	3.10808	4.91	0.0361
x7	-0.49255	0.85641	0.20959	0.33	0.5703
x9	-0.99239	0.62415	1.60183	2.53	0.1244

Bounds on condition number: 9.2793, 238.58

Forward Selection: Step 8

Variable x8 Entered: R-Square = 0.6901 and C(p) = 7.3519

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	8	34.22419	4.27802	6.68	0.0001
Error	24	15.37184	0.64049		
Corrected Total	32	49.59603			

Variable	Parameter Estimate	Standard Error	Type II SS	F Value	Pr > F
Intercept	10.03082	2.41828	11.01978	17.21	0.0004
x1	-0.00413	0.00142	5.41761	8.46	0.0077
x2	-0.05460	0.02099	4.33161	6.76	0.0157
x3	0.04329	0.03728	0.86361	1.35	0.2570
x4	-1.20955	0.49115	3.88458	6.06	0.0213
x5	0.21450	0.09425	3.31773	5.18	0.0321
x7	-0.45605	0.86210	0.17923	0.28	0.6017
x8	0.17533	0.20493	0.46884	0.73	0.4007
x9	-1.39894	0.78713	2.02308	3.16	0.0882

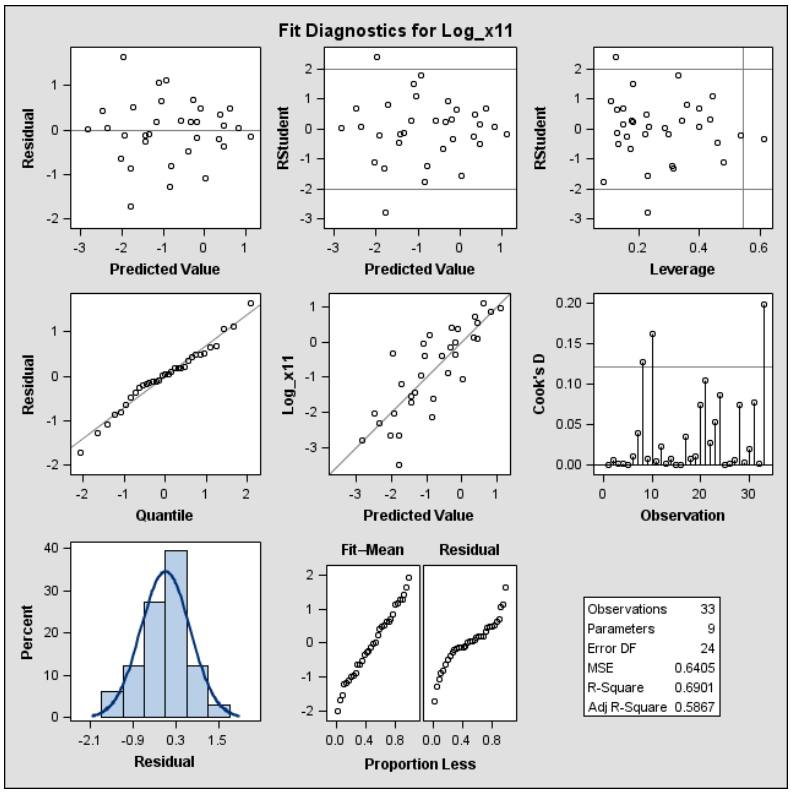
Bounds on condition number: 13.055, 426.22

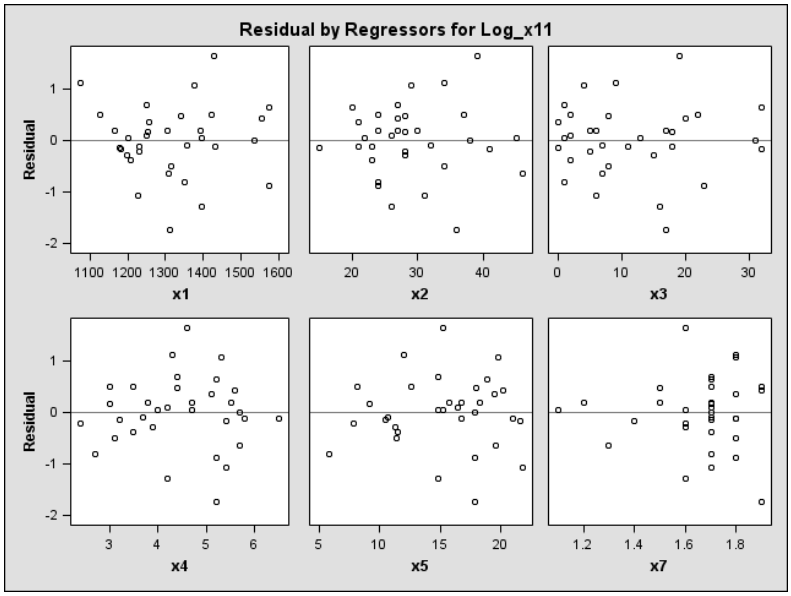
No other variable met the 0.5000 significance level for entry into the model.

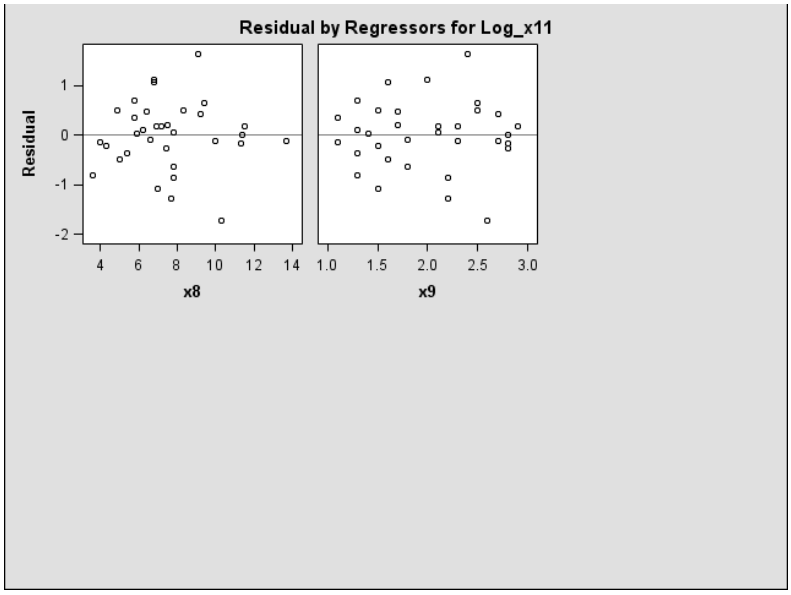
Summary of Forward Selection

Step	Variable Entered	Number Vars In	Partial R-Square	Model R-Square	C(p)	F Value	Pr > F
1	x9	1	0.3528	0.3528	17.6721	16.90	0.0003
2	x1	2	0.1162	0.4690	11.2904	6.57	0.0156
3	x2	3	0.0619	0.5310	8.8262	3.83	0.0601
4	x3	4	0.0490	0.5799	7.2958	3.26	0.0816
5	x7	5	0.0278	0.6077	7.2884	1.92	0.1776
6	x4	6	0.0102	0.6179	8.5530	0.69	0.4124
7	x5	7	0.0627	0.6806	6.0336	4.91	0.0361
8	x8	8	0.0095	0.6901	7.3519	0.73	0.4007

The REG Procedure
Model: MODEL3
Dependent Variable: Log_x11






Residual by Regressors for Log_x11
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-2
4
6
8
10
12
14
x8
1.0
1.5
2.0
2.5
3.0
x9

The REG Procedure
Model: MODEL4
Dependent Variable: Log_x11

Number of Observations Read	33
Number of Observations Used	33

Backward Elimination: Step 0

All Variables Entered: R-Square = 0.6949 and C(p) = 11.0000

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	10	34.46616	3.44662	5.01	0.0008
Error	22	15.12986	0.68772		
Corrected Total	32	49.59603			

Variable	Parameter Estimate	Standard Error	Type II SS	F Value	Pr > F
Intercept	10.99841	3.06027	8.88285	12.92	0.0016
x1	-0.00443	0.00156	5.57170	8.10	0.0094
x2	-0.05383	0.02190	4.15507	6.04	0.0223
x3	0.06794	0.09947	0.32081	0.47	0.5017
x4	-1.29364	0.56381	3.62051	5.26	0.0317
x5	0.23164	0.10438	3.38694	4.92	0.0371
x6	-0.35680	1.56646	0.03568	0.05	0.8219
x7	-0.23747	1.00601	0.03832	0.06	0.8156
x8	0.18106	0.23672	0.40232	0.59	0.4525
x9	-1.28532	0.86485	1.51898	2.21	0.1514
x10	-0.43311	0.73487	0.23888	0.35	0.5616

Bounds on condition number: 58.756, 1579.9

Backward Elimination: Step 1

Variable x6 Removed: R-Square = 0.6942 and C(p) = 9.0519

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	9	34.43048	3.82561	5.80	0.0003
Error	23	15.16554	0.65937		

Corrected Total	32	49.59603

Variable	Parameter Estimate	Standard Error	Type II SS	F Value	Pr > F
Intercept	10.71862	2.74454	10.05699	15.25	0.0007
x1	-0.00440	0.00152	5.53728	8.40	0.0081
x2	-0.05349	0.02139	4.12183	6.25	0.0200
x3	0.04712	0.03844	0.99087	1.50	0.2327
x4	-1.23982	0.50126	4.03386	6.12	0.0212
x5	0.22430	0.09722	3.51001	5.32	0.0304
x7	-0.32853	0.90393	0.08710	0.13	0.7196
x8	0.15831	0.21014	0.37419	0.57	0.4589
x9	-1.34718	0.80399	1.85129	2.81	0.1074
x10	-0.35176	0.62889	0.20630	0.31	0.5813

Bounds on condition number: 13.209, 502.54

Backward Elimination: Step 2

Variable x7 Removed: R-Square = 0.6925 and C(p) = 7.1785

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	8	34.34339	4.29292	6.75	0.0001
Error	24	15.25264	0.63553		
Corrected Total	32	49.59603			

Variable	Parameter Estimate	Standard Error	Type II SS	F Value	Pr > F
Intercept	10.40349	2.55646	10.52482	16.56	0.0004
x1	-0.00455	0.00143	6.39254	10.06	0.0041
x2	-0.05198	0.02061	4.04472	6.36	0.0187
x3	0.04583	0.03758	0.94545	1.49	0.2344
x4	-1.29868	0.46573	4.94159	7.78	0.0102
x5	0.23833	0.08760	4.70468	7.40	0.0119
x8	0.15914	0.20630	0.37817	0.60	0.4480
x9	-1.30613	0.78150	1.77522	2.79	0.1076
x10	-0.40941	0.59745	0.29843	0.47	0.4997

Bounds on condition number: 11.853, 409.71

Backward Elimination: Step 3

Variable x10 Removed: R-Square = 0.6864 and C(p) = 5.6125

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	7	34.04496	4.86357	7.82	<.0001
Error	25	15.55107	0.62204		
Corrected Total	32	49.59603			

Variable	Parameter Estimate	Standard Error	Type II SS	F Value	Pr > F
Intercept	9.39656	2.06965	12.82223	20.61	0.0001
x1	-0.00429	0.00137	6.10815	9.82	0.0044
x2	-0.05263	0.02036	4.15556	6.68	0.0160
x3	0.04044	0.03635	0.76992	1.24	0.2765
x4	-1.28944	0.46057	4.87567	7.84	0.0097
x5	0.23292	0.08631	4.53017	7.28	0.0123
x8	0.18070	0.20171	0.49920	0.80	0.3789
x9	-1.35066	0.77048	1.91155	3.07	0.0919

Bounds on condition number: 11.82, 344.52

Backward Elimination: Step 4

Variable x8 Removed: R-Square = 0.6764 and C(p) = 4.3383

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	6	33.54575	5.59096	9.06	<.0001
Error	26	16.05027	0.61732		
Corrected Total	32	49.59603			

Variable	Parameter Estimate	Standard Error	Type II SS	F Value	Pr > F
Intercept	9.19274	2.04928	12.42213	20.12	0.0001
x1	-0.00445	0.00135	6.67108	10.81	0.0029
x2	-0.05329	0.02027	4.26453	6.91	0.0142
x3	0.04410	0.03599	0.92718	1.50	0.2314
x4	-1.06259	0.38324	4.74568	7.69	0.0101
x5	0.22630	0.08566	4.30790	6.98	0.0138
x9	-0.92665	0.60565	1.44509	2.34	0.1381

Bounds on condition number: 8.2469, 181.27

Backward Elimination: Step 5

Variable x3 Removed: R-Square = 0.6577 and C(p) = 3.6865

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	5	32.61858	6.52372	10.37	<.0001
Error	27	16.97745	0.62879		
Corrected Total	32	49.59603			

Variable	Parameter Estimate	Standard Error	Type II SS	F Value	Pr > F
Intercept	7.48573	1.51707	15.30971	24.35	<.0001
x1	-0.00364	0.00119	5.85821	9.32	0.0051
x2	-0.05165	0.02042	4.02429	6.40	0.0176
x4	-1.17899	0.37472	6.22475	9.90	0.0040
x5	0.25142	0.08394	5.64062	8.97	0.0058
x9	-0.30223	0.33046	0.52593	0.84	0.3685

Bounds on condition number: 7.7403, 92.493

Backward Elimination: Step 6

Variable x9 Removed: R-Square = 0.6471 and C(p) = 2.4513

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	4	32.09265	8.02316	12.83	<.0001
Error	28	17.50338	0.62512		
Corrected Total	32	49.59603			

Variable	Parameter Estimate	Standard Error	Type II SS	F Value	Pr > F
Intercept	7.73214	1.48858	16.86620	26.98	<.0001
x1	-0.00392	0.00115	7.30671	11.69	0.0019
x2	-0.05734	0.01939	5.46832	8.75	0.0062
x4	-1.35614	0.31983	11.23888	17.98	0.0002
x5	0.28306	0.07626	8.61230	13.78	0.0009

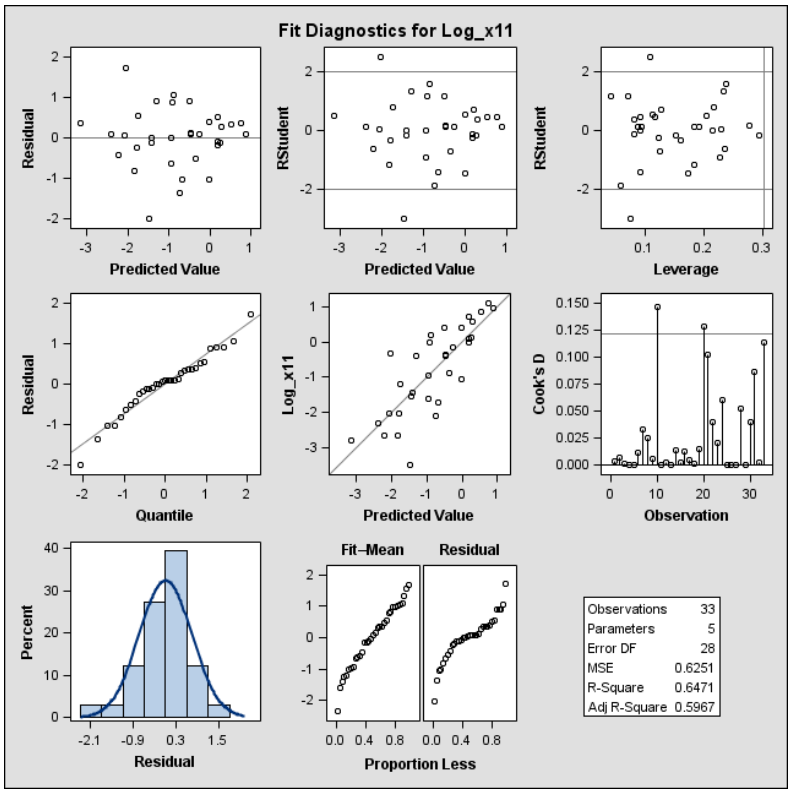
Bounds on condition number: 5.6721, 53.329

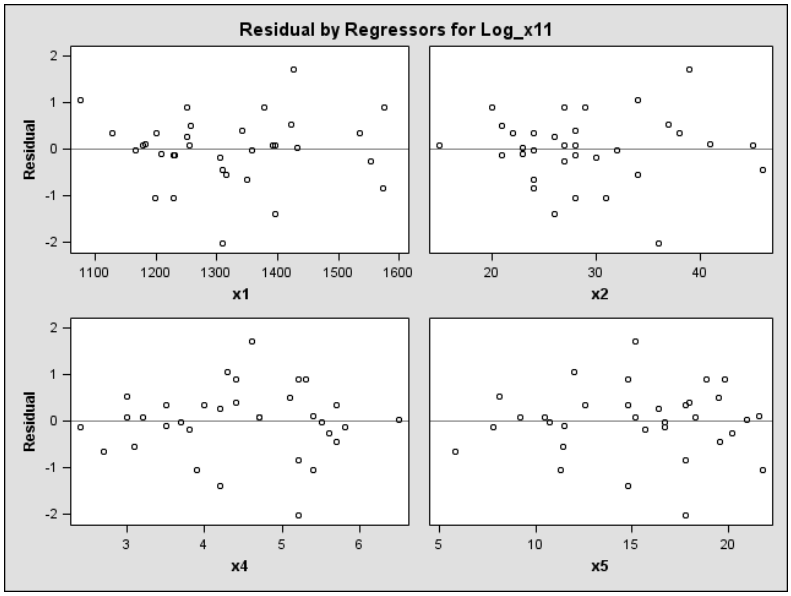
All variables left in the model are significant at the 0.1000 level.

Summary of Backward Elimination

Step	Variable Removed	Number Vars In	Partial R-Square	Model R-Square	C(p)	F Value	Pr > F
1	x6	9	0.0007	0.6942	9.0519	0.05	0.8219
2	x7	8	0.0018	0.6925	7.1785	0.13	0.7196
3	x10	7	0.0060	0.6864	5.6125	0.47	0.4997
4	x8	6	0.0101	0.6764	4.3383	0.80	0.3789
5	x3	5	0.0187	0.6577	3.6865	1.50	0.2314
6	x9	4	0.0106	0.6471	2.4513	0.84	0.3685

The REG Procedure
Model: MODEL4
Dependent Variable: Log_x11





The REG Procedure
Model: MODEL5
Dependent Variable: Log_x11

R-Square Selection Method

Number of Observations Read	33
Number of Observations Used	33

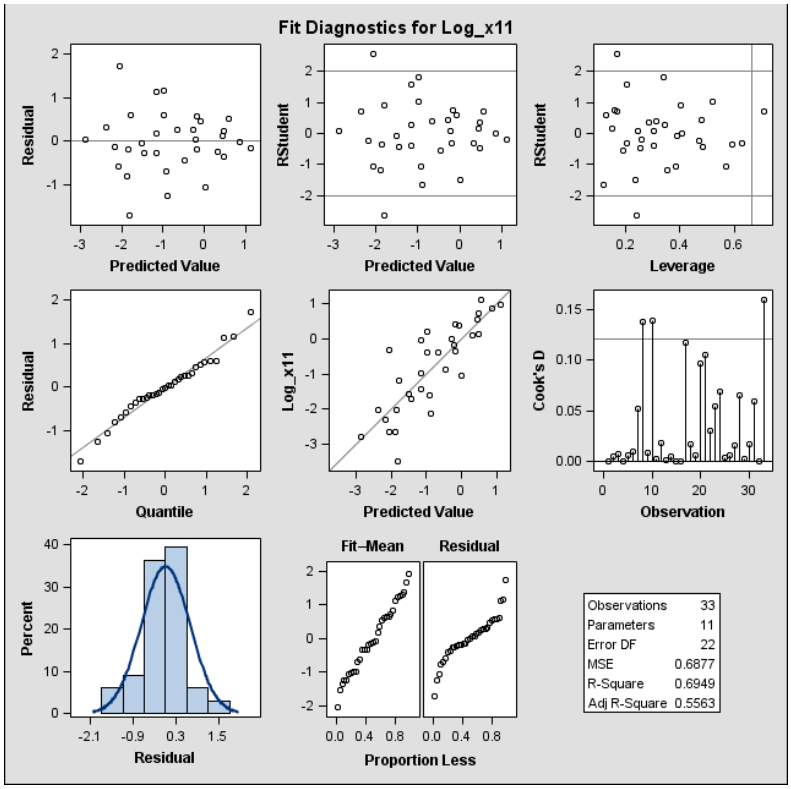
Number in Model	R-Square	C(p)	AIC	BIC	Variables in Model
1	0.3528	17.6721	3.0848	3.7414	x9
1	0.2931	21.9804	5.9985	6.3390	x8
2	0.4690	11.2904	-1.4474	-0.3146	x1 x9
2	0.4249	14.4777	1.1911	1.8812	x1 x8
3	0.5368	8.4026	-3.9541	-2.0508	x1 x4 x5
3	0.5310	8.8262	-3.5382	-1.7348	x1 x2 x9
4	0.6471	2.4513	-10.9258	-6.1357	x1 x2 x4 x5
4	0.5799	7.2958	-5.1757	-2.2991	x1 x2 x3 x9
5	0.6577	3.6865	-9.9325	-4.1182	x1 x2 x4 x5 x9
5	0.6550	3.8819	-9.6724	-3.9701	x1 x2 x4 x5 x10
6	0.6764	4.3383	-9.7858	-2.3328	x1 x2 x3 x4 x5 x9
6	0.6764	4.3392	-9.7846	-2.3322	x1 x2 x4 x5 x6 x9
7	0.6864	5.6125	-8.8285	0.0994	x1 x2 x3 x4 x5 x8 x9
7	0.6848	5.7284	-8.6597	0.1627	x1 x2 x3 x4 x5 x9 x10
8	0.6925	7.1785	-7.4679	2.8386	x1 x2 x3 x4 x5 x8 x9 x10
8	0.6901	7.3519	-7.2110	2.9101	x1 x2 x3 x4 x5 x7 x8 x9
9	0.6942	9.0519	-5.6569	5.7796	x1 x2 x3 x4 x5 x7 x8 x9 x10
9	0.6942	9.0557	-5.6512	5.7806	x1 x2 x3 x4 x5 x6 x8 x9 x10
10	0.6949	11.0000	-3.7346	8.7654	x1 x2 x3 x4 x5 x6 x7 x8 x9 x10

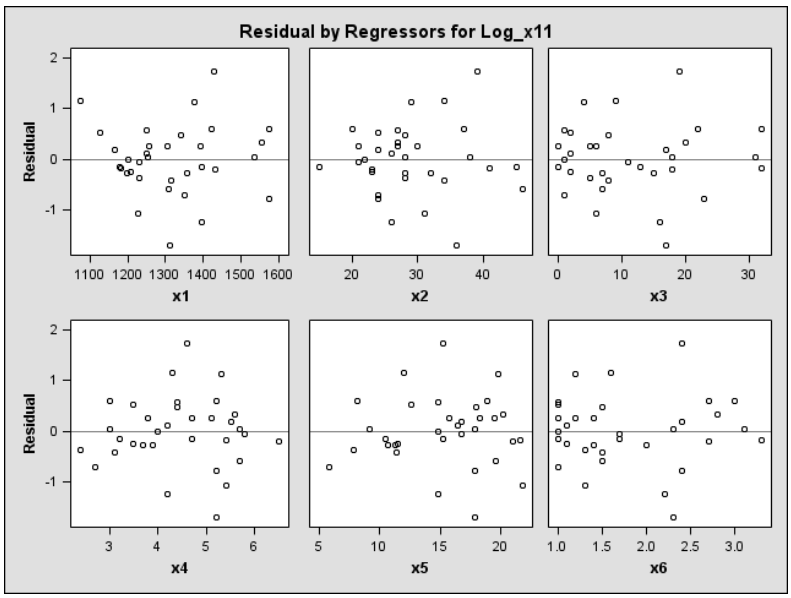
The REG Procedure
Model: MODEL5
Dependent Variable: Log_x11

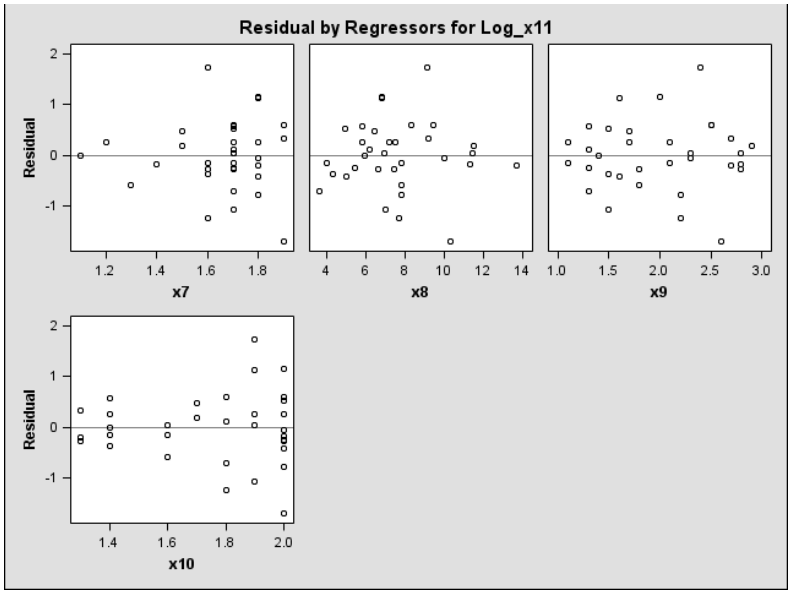
Output Statistics

Obs	Dependent Variable	Predicted Value	Std Error Mean Predict	Residual	Std Error Residual	Student Residual	-2-1 0 1 2	Cook's D
1	0.8629	0.8633	0.5286	-0.000362	0.639	-0.0006	| |	0.000
2	0.3853	-0.0879	0.2978	0.4732	0.774	0.611	| * |	0.005
3	0.1222	0.4790	0.4180	-0.3568	0.716	-0.498	| |	0.008
4	-0.1625	-0.2162	0.4095	0.0537	0.721	0.0745	| |	0.000
5	-1.4271	-1.1539	0.4556	-0.2732	0.693	-0.394	| |	0.006
6	0.3988	-0.1769	0.3294	0.5757	0.761	0.756	| * |	0.010
7	-1.2040	-1.7951	0.5261	0.5912	0.641	0.922	| * |	0.052
8	-2.6593	-2.0739	0.6248	-0.5853	0.545	-1.073	** | |	0.138
9	1.0986	0.5723	0.3409	0.5264	0.756	0.696	| * |	0.009
10	0.1906	-0.9704	0.4839	1.1610	0.673	1.724	| | ***	0.139
11	-0.9676	-1.1456	0.4852	0.1780	0.673	0.265	| |	0.003
12	-0.3567	-0.1831	0.6582	-0.1736	0.504	-0.344	| |	0.018
13	0.9708	1.1165	0.4224	-0.1457	0.714	-0.204	| |	0.001
14	0.7178	0.4680	0.4427	0.2499	0.701	0.356	| |	0.005
15	0.5596	0.4332	0.3231	0.1264	0.764	0.165	| |	0.000
16	-2.8134	-2.8648	0.4561	0.0514	0.693	0.0742	| |	0.000
17	-2.0402	-2.3649	0.6987	0.3246	0.447	0.727	| * |	0.117
18	0	-0.2731	0.5741	0.2731	0.598	0.456	| |	0.017
19	-0.8916	-0.4689	0.3610	-0.4227	0.747	-0.566	* | |	0.007
20	-0.3285	-2.0590	0.3406	1.7305	0.756	2.289	| | ****	0.097
21	-0.4005	-0.9966	0.5979	0.5962	0.575	1.037	| | **	0.106
22	-2.1203	-0.8871	0.2840	-1.2332	0.779	-1.583	*** | |	0.030
23	-0.0305	-1.1658	0.3728	1.1353	0.741	1.533	| | ***	0.054
24	-2.6593	-1.8742	0.4928	-0.7851	0.667	-1.177	** | |	0.069
25	-2.3026	-2.1651	0.5688	-0.1375	0.604	-0.228	| |	0.004
26	-0.3857	-0.6537	0.4652	0.2680	0.687	0.390	| |	0.006
27	-2.0402	-1.8540	0.6394	-0.1862	0.528	-0.353	| |	0.017
28	-1.6094	-0.9112	0.5140	-0.6982	0.651	-1.073	** | |	0.065
29	0.0862	0.3243	0.3740	-0.2381	0.740	-0.322	| |	0.002
30	-1.7148	-1.4443	0.5768	-0.2705	0.596	-0.454	| |	0.018
31	-1.0498	0.009342	0.4029	-1.0592	0.725	-1.461	** | |	0.060
32	-1.5606	-1.5107	0.5174	-0.0499	0.648	-0.0770	| |	0.000
33	-3.5066	-1.8076	0.4073	-1.6990	0.722	-2.352	**** | |	0.160

Sum of Residuals	0
Sum of Squared Residuals	15.12986
Predicted Residual SS (PRESS)	30.08652


Fit Diagnostics for Log_x11
Residual
Predicted Value
RStudent
Predicted Value
RStudent
Leverage
Residual
Quantile
Log_x11
Predicted Value
Cook's D
Observation
Percent
Residual
Fit–Mean
Residual
Proportion Less
Observations 33
Parameters 11
Error DF 22
MSE 0.6877
R-Square 0.6949
Adj R-Square 0.5563


Residual by Regressors for Log_x11
Residual
x1
x2
x3
Residual
x4
x5
x6


Residual by Regressors for Log_x11
Residual
x7
x8
x9
x10

The REG Procedure
Model: MODEL6
Dependent Variable: Log_x11

Number of Observations Read	33
Number of Observations Used	33

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	4	32.09265	8.02316	12.83	<.0001
Error	28	17.50338	0.62512		
Corrected Total	32	49.59603			

Root MSE	0.79065	R-Square	0.6471
Dependent Mean	-0.81328	Adj R-Sq	0.5967
Coeff Var	-97.21683		

Parameter Estimates

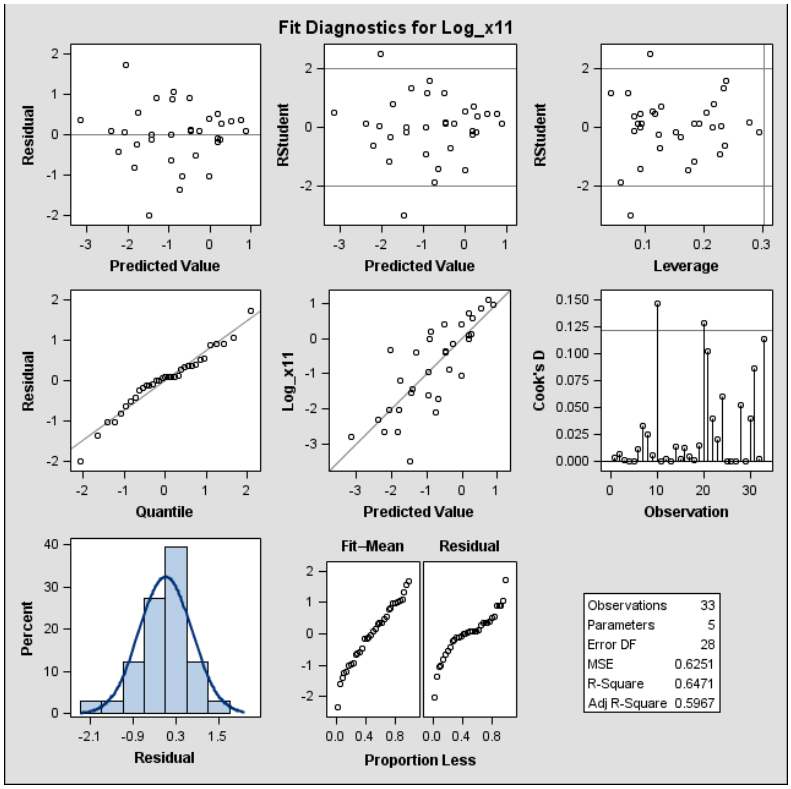
Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	7.73214	1.48858	5.19	<.0001
x1	1	-0.00392	0.00115	-3.42	0.0019
x2	1	-0.05734	0.01939	-2.96	0.0062
x4	1	-1.35614	0.31983	-4.24	0.0002
x5	1	0.28306	0.07626	3.71	0.0009

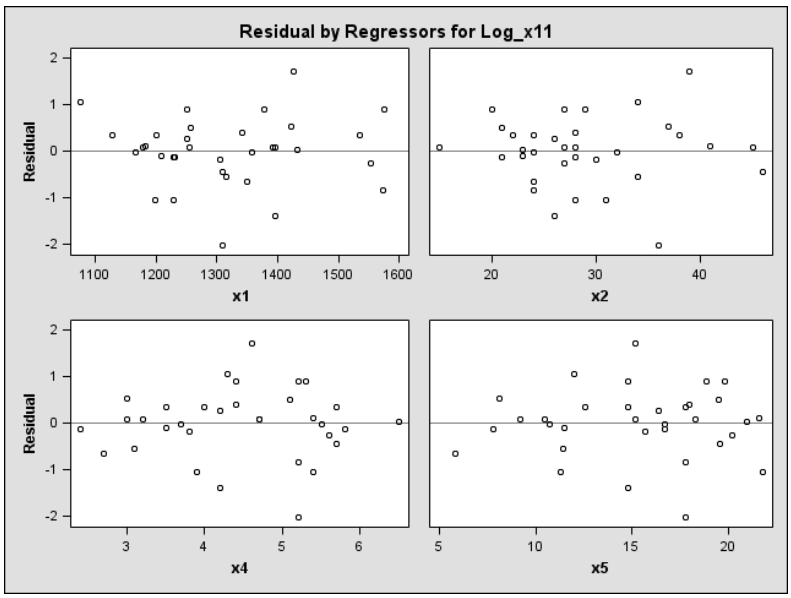
The REG Procedure
Model: MODEL6
Dependent Variable: Log_x11

Output Statistics

Obs	Dependent Variable	Predicted Value	Std Error Mean Predict	Residual	Std Error Residual	Student Residual	-2-1 0 1 2	Cook's D	RStudent	Hat Diag H	Cov Ratio	DFFITS	Intercept	
1	0.8629	0.5269	0.2391	0.3360	0.754	0.446	| |	0.004	0.4394	0.0915	1.2740	0.1394	0.0984	-0.0
2	0.3853	-0.0110	0.2662	0.3963	0.744	0.532	| *	0.007	0.5253	0.1134	1.2857	0.1878	0.0026	0.0
3	0.1222	0.2496	0.3090	-0.1274	0.728	-0.175	| |	0.001	-0.1720	0.1528	1.4079	-0.0730	-0.0289	0.0
4	-0.1625	-0.2580	0.2434	0.0955	0.752	0.127	| |	0.000	0.1247	0.0948	1.3212	0.0404	0.0150	-0.0
5	-1.4271	-1.4162	0.2386	-0.0109	0.754	-0.0144	| |	0.000	-0.0142	0.0910	1.3195	-0.0045	0.0008	-0.0
6	0.3988	-0.4985	0.1605	0.8972	0.774	1.159	| **	0.012	1.1664	0.0412	0.9784	0.2418	0.1293	-0.1
7	-1.2040	-1.7447	0.3679	0.5407	0.700	0.773	| *	0.033	0.7669	0.2166	1.3746	0.4032	-0.1331	0.1
8	-2.6593	-2.2238	0.3850	-0.4355	0.691	-0.631	* |	0.025	-0.6237	0.2371	1.4636	-0.3477	0.0700	0.0
9	1.0986	0.7540	0.2709	0.3446	0.743	0.464	| |	0.006	0.4574	0.1174	1.3075	0.1668	0.1443	-0.1
10	0.1906	-0.8702	0.3853	1.0608	0.690	1.536	| ***	0.147	1.5766	0.2374	1.0126	0.8798	0.4893	-0.6
11	-0.9676	-0.9508	0.3663	-0.0168	0.701	-0.0240	| |	0.000	-0.0236	0.2146	1.5270	-0.0123	-0.0055	0.0
12	-0.3567	-0.4658	0.4160	0.1091	0.672	0.162	| |	0.002	0.1594	0.2769	1.6508	0.0986	0.0204	-0.0
13	0.9708	0.8785	0.3391	0.0923	0.714	0.129	| |	0.001	0.1270	0.1840	1.4655	0.0603	0.0403	-0.0
14	0.7178	0.2031	0.2818	0.5147	0.739	0.697	| *	0.014	0.6902	0.1270	1.2589	0.2633	0.1026	-0.0
15	0.5596	0.2791	0.2259	0.2805	0.758	0.370	| |	0.002	0.3645	0.0817	1.2744	0.1087	0.0486	-0.0
16	-2.8134	-3.1652	0.3572	0.3518	0.705	0.499	| |	0.013	0.4919	0.2041	1.4412	0.2491	-0.1864	0.1
17	-2.0402	-1.7901	0.3167	-0.2501	0.724	-0.345	| |	0.005	-0.3398	0.1605	1.3985	-0.1485	0.1031	-0.1
18	0	0.1822	0.2768	-0.1822	0.741	-0.246	| |	0.002	-0.2418	0.1226	1.3523	-0.0904	-0.0118	-0.0
19	-0.8916	-0.3582	0.2800	-0.5334	0.739	-0.721	* |	0.015	-0.7150	0.1254	1.2487	-0.2708	-0.0066	-0.0
20	-0.3285	-2.0391	0.2611	1.7106	0.746	2.292	| ****	0.129	2.4973	0.1091	0.4763	0.8738	-0.4965	0.3
21	-0.4005	-1.2966	0.3829	0.8961	0.692	1.295	| **	0.103	1.3121	0.2345	1.1503	0.7262	-0.3821	0.5
22	-2.1203	-0.7467	0.1908	-1.3736	0.767	-1.790	*** |	0.040	-1.8681	0.0583	0.6935	-0.4646	0.1163	-0.2
23	-0.0305	-0.9167	0.2105	0.8862	0.762	1.163	| **	0.021	1.1705	0.0709	1.0079	0.3234	-0.0780	0.0
24	-2.6593	-1.8334	0.3399	-0.8258	0.714	-1.157	** |	0.061	-1.1642	0.1848	1.1518	-0.5543	0.3655	-0.4
25	-2.3026	-2.3971	0.3464	0.0945	0.711	0.133	| |	0.001	0.1306	0.1920	1.4797	0.0637	-0.0275	0.0
26	-0.3857	-0.4757	0.2340	0.0900	0.755	0.119	| |	0.000	0.1171	0.0876	1.3112	0.0363	-0.0074	0.0
27	-2.0402	-2.0800	0.3789	0.0398	0.694	0.0574	| |	0.000	0.0564	0.2296	1.5560	0.0308	-0.0083	0.0
28	-1.6094	-0.9570	0.3777	-0.6525	0.695	-0.939	* |	0.052	-0.9373	0.2282	1.3242	-0.5097	-0.0151	-0.1
29	0.0862	0.1821	0.2247	-0.0960	0.758	-0.127	| |	0.000	-0.1244	0.0808	1.3011	-0.0369	-0.0256	0.0
30	-1.7148	-0.6644	0.2400	-1.0504	0.753	-1.394	** |	0.039	-1.4194	0.0922	0.9219	-0.4522	-0.2460	0.2
31	-1.0498	-0.0162	0.3291	-1.0336	0.719	-1.438	** |	0.087	-1.4670	0.1733	0.9887	-0.6716	-0.1842	0.2
32	-1.5606	-1.4328	0.4292	-0.1279	0.664	-0.193	| |	0.003	-0.1892	0.2947	1.6893	-0.1223	-0.0307	0.0
33	-3.5066	-1.4857	0.2155	-2.0209	0.761	-2.657	***** |	0.113	-3.0164	0.0743	0.3033	-0.8545	0.0975	0.2

Sum of Residuals	0
Sum of Squared Residuals	17.50338
Predicted Residual SS (PRESS)	22.88434


Fit Diagnostics for Log_x11
Residual
Predicted Value
RStudent
Predicted Value
RStudent
Leverage
Residual
Quantile
Log_x11
Predicted Value
Cook's D
Observation
Percent
Residual
Fit–Mean
Residual
Proportion Less
Observations 33
Parameters 5
Error DF 28
MSE 0.6251
R-Square 0.6471
Adj R-Square 0.5967


Residual by Regressors for Log_x11
Residual
x1
x2
Residual
x4
x5

ANNEXE 2.1 - Examens partiels - Sujet 1

Modèle $(\mathcal{M}^{(1)})$: $P_i = \beta_0 + \beta_2 M_i + \varepsilon_i$ **pour** $i \in \{1, \ldots, 47\}$.

```
Call: lm(formula = PIB  MacDo, data = croissance)

                          Estimate  Std. Error  t value  Pr(>|t|)
Coefficients: (Intercept)  4.25486     0.32686   13.018    <2e-16  ***
              MacDo        -0.05283     0.02573   -2.053    0.0459  *
—
Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Residual standard error:  1.672 on  45 degrees of freedom
Multiple R-squared: 0.08568, Adjusted R-squared: 0.06536
F-statistic: 4.217 on  1 and  45 DF, p-value: 0.04587
```

Modèle $(\mathcal{M}^{(2)})$: $P_i = \beta_0 + \beta_1 C_i + \varepsilon_i$ **pour** $i \in \{1, \ldots, 47\}$.

```
Call: lm(formula = PIB  Consommation, data = croissance)

                          Estimate  Std. Error  t value  Pr(>|t|)
Coefficients: (Intercept)  4.420602    0.384777   11.489   5.65e-15  ***
              Consommation -0.004431    0.002153   -2.058    0.0454  *
—
Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Residual standard error: 1.671 on  45 degrees of freedom
Multiple R-squared: 0.08604, Adjusted R-squared: 0.06573
F-statistic: 4.236 on  1 and  45 DF, p-value: 0.04539
```

Modèle $(\mathcal{M}_{1^2})$: $P_i = \beta_0 + \beta_1 C_i + \beta_2 C_i^2 + \varepsilon_i$ **pour** $i \in \{1, \ldots, 47\}$.

```
Call: lm(formula = PIB  Consommation + I(Consommation^2), data = croissance)

                            Estimate  Std. Error  t value  Pr(>|t|)
Coefficients: (Intercept)   5.260e+00   5.115e-01   10.284   2.79e-13  ***
              Consommation  -1.551e-02   5.133e-03   -3.022   0.00418  **
              I(Consommation^2)  2.168e-05   9.205e-06    2.355   0.02305  *
—
Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Residual standard error:  1.593 on  44 degrees of freedom
Multiple R-squared: 0.1883, Adjusted R-squared: 0.1514
F-statistic: 5.105 on  2 and  44 DF, p-value: 0.01014
```

Modèle ($\mathcal{M}_{2^2}$) : $P_i = \beta_0 + \beta_1 M_i + \beta_2 M_i^2 + \varepsilon_i$ **pour** $i \in \{1, \ldots, 47\}$.

```
Call: lm(formula = PIB  MacDo + I(MacDo^2), data = croissance)

                          Estimate  Std. Error  t value  Pr(>|t|)
Coefficients: (Intercept)  4.537538   0.379447   11.958  2.03e-15  ***
              MacDo       -0.137012   0.064436   -2.126    0.0391  *
              I(MacDo^2)   0.002662   0.001872    1.422    0.1621
---
Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
Residual standard error: 1.653 on 44 degrees of freedom
Multiple R-squared: 0.1259, Adjusted R-squared: 0.08612
F-statistic: 3.167 on 2 and 44 DF, p-value: 0.05187
```

ANNEXE 2.2 - Examens partiels - Sujet 3

```
Call:
lm(formula = murder ~ poverty, data = cr)

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) -10.1364     4.1206  -2.460   0.0175 *
poverty       1.3230     0.2754   4.804 1.51e-05 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 8.926 on 49 degrees of freedom
Multiple R-squared:  0.3202,        Adjusted R-squared:  0.3063
F-statistic: 23.08 on 1 and 49 DF,  p-value: 1.508e-05
```

```
Call:
lm(formula = murder ~ poverty - 1, data = cr)

Coefficients:
        Estimate Std. Error t value Pr(>|t|)
poverty  0.67748    0.08765    7.73 4.37e-10 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 9.366 on 50 degrees of freedom
Multiple R-squared:  0.5444,        Adjusted R-squared:  0.5353
F-statistic: 59.75 on 1 and 50 DF,  p-value: 4.365e-10
```

```
Call:
lm(formula = murder ~ single, data = cr)

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) -40.4153     4.2573  -9.493 1.10e-12 ***
single        4.3391     0.3696  11.740 7.54e-16 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 5.544 on 49 degrees of freedom
Multiple R-squared:  0.7377,        Adjusted R-squared:  0.7324
F-statistic: 137.8 on 1 and 49 DF,  p-value: 7.536e-16
```

```
Call:
lm(formula = murder ~ single - 1, data = cr)

Coefficients:
       Estimate Std. Error t value Pr(>|t|)
single   0.8893     0.1124    7.91  2.3e-10 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 9.248 on 50 degrees of freedom
Multiple R-squared:  0.5558,        Adjusted R-squared:  0.5469
F-statistic: 62.56 on 1 and 50 DF,  p-value: 2.295e-10
```

```
Call:
lm(formula = murder ~ pctmetro, data = cr)

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept) -1.67083    4.68444  -0.357   0.7229
pctmetro     0.15430    0.06615   2.332   0.0238 *
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 10.27 on 49 degrees of freedom
Multiple R-squared:  0.09993,        Adjusted R-squared:  0.08156
F-statistic:  5.44 on 1 and 49 DF,  p-value: 0.02383
```

```
Call:
lm(formula = murder ~ pctmetro - 1, data = cr)


Coefficients:
         Estimate Std. Error t value Pr(>|t|)
pctmetro  0.13184    0.02013   6.549 3.05e-08 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 10.18 on 50 degrees of freedom
Multiple R-squared:  0.4617,        Adjusted R-squared:  0.4509
F-statistic: 42.88 on 1 and 50 DF,  p-value: 3.053e-08
```

```
Call:
lm(formula = murder ~ pcths, data = cr)

Coefficients:
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  50.5187    20.0501    2.52   0.0151 *
pcths        -0.5483     0.2624   -2.09   0.0418 *
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 10.37 on 49 degrees of freedom
Multiple R-squared:  0.08184,        Adjusted R-squared:  0.0631
F-statistic: 4.367 on 1 and 49 DF,  p-value: 0.04185
```

```
Call:
lm(formula = murder ~ pcths - 1, data = cr)

Coefficients:
      Estimate Std. Error t value Pr(>|t|)
pcths    0.111      0.020   5.551 1.08e-06 ***
---
Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

Residual standard error: 10.91 on 50 degrees of freedom
Multiple R-squared:  0.3813,        Adjusted R-squared:  0.369
F-statistic: 30.82 on 1 and 50 DF,  p-value: 1.08e-06
```

ANNEXE 3.1 - Examens terminaux - Sujet 1

Procédure de sélection backward

Le Système SAS

The REG Procedure
Model: MODEL1
Dependent Variable: lg **(=ln(abondance))**
Number of Observations Read 20
Number of Observations Used 20

Backward Elimination: Step 0

All Variables Entered: R-Square = 0.9423 and C(p) = 7.0000

Analyse de variance

Source	DF	Somme des carrés	Carré moyen	Valeur F	Pr > F
Model	6	38.61969	6.43661	35.37	<.0001
Error	13	2.36569	0.18198		
Corrected Total	19	40.98538			

Variable	Résultat estimé des paramètres	Erreur std	Type II SS	Valeur F	Pr > F
Intercept	-1.09321	1.20633	0.14945	0.82	0.3813
surface	0.66273	0.17389	2.64325	14.53	0.0022
humidite	-0.27885	0.74313	0.02562	0.14	0.7135
altitude	-1.89071	2.13164	0.14317	0.79	0.3912
s2	-0.01346	0.01108	0.26886	1.48	0.2458
h2	-0.11406	0.08577	0.32179	1.77	0.2065
a2	1.65057	1.81540	0.15043	0.83	0.3798

Bounds on condition number: 185.59, 3432.6

Backward Elimination: Step 1

Variable humidite Removed: R-Square = 0.9417 and C(p) = 5.1408

Analyse de variance

Source	DF	Somme des carrés	Carré moyen	Valeur F	Pr > F
Model	5	38.59406	7.71881	45.19	<.0001
Error	14	2.39131	0.17081		
Corrected Total	19	40.98538			

Variable	Résultat estimé des paramètres	Erreur std	Type II SS	Valeur F	Pr > F
Intercept	-1.36963	0.92548	0.37409	2.19	0.1610
surface	0.64680	0.16337	2.67724	15.67	0.0014
altitude	-1.90430	2.06489	0.14527	0.85	0.3720
s2	-0.01394	0.01066	0.29210	1.71	0.2120
h2	-0.14054	0.04720	1.51466	8.87	0.0100
a2	1.73446	1.74542	0.16867	0.99	0.3372

Bounds on condition number: 183.14, 1826.5

Backward Elimination: Step 2

Variable altitude Removed: R-Square = 0.9381 and C(p) = 3.9391

Analyse de variance

Source	DF	Somme des carrés	Carré moyen	Valeur F	Pr > F
Model	4	38.44879	9.61220	56.84	<.0001
Error	15	2.53658	0.16911		
Corrected Total	19	40.98538			

Variable	Résultat estimé des paramètres	Erreur std	Type II SS	Valeur F	Pr > F
Intercept	-1.84317	0.76613	0.97877	5.79	0.0295
surface	0.64727	0.16256	2.68111	15.85	0.0012
s2	-0.01429	0.01060	0.30719	1.82	0.1977
h2	-0.13603	0.04671	1.43434	8.48	0.0107
a2	0.16955	0.40670	0.02939	0.17	0.6827

Bounds on condition number: 182.91, 1209.7

Backward Elimination: Step 3

Variable a2 Removed: R-Square = 0.9374 and C(p) = 2.1006

Analyse de variance

Source	DF	Somme des carrés	Carré moyen	Valeur F	Pr > F
Model	3	38.41940	12.80647	79.85	<.0001
Error	16	2.56597	0.16037		
Corrected Total	19	40.98538			

Variable	Résultat estimé des paramètres	Erreur std	Type II SS	Valeur F	Pr > F
Intercept	-1.59556	0.47128	1.83825	11.46	0.0038
surface	0.60704	0.12740	3.64112	22.70	0.0002
s2	-0.01198	0.00880	0.29710	1.85	0.1924
h2	-0.14385	0.04165	1.91301	11.93	0.0033

Bounds on condition number: 132.89, 644.35

Backward Elimination: Step 4

Variable s2 Removed: R-Square = 0.9301 and C(p) = 1.7332

Analyse de variance

Source	DF	Somme des carrés	Carré moyen	Valeur F	Pr > F
Model	2	38.12231	19.06115	113.18	<.0001
Error	17	2.86307	0.16842		
Corrected Total	19	40.98538			

Variable	Résultat estimé des paramètres	Erreur std	Type II SS	Valeur F	Pr > F
Intercept	-1.04941	0.25329	2.89100	17.17	0.0007
surface	0.43813	0.02952	37.10709	220.33	<.0001
h2	-0.19711	0.01463	30.56093	181.46	<.0001

Bounds on condition number: 2.9171, 11.668

All variables left in the model are significant at the 0.1000 level.

Summary of Backward Elimination

Étape	Variable supprimée	Nombre var. dans	R carré partiel	R carré du modèle	C(p)	Valeur F	Pr > F
1	humidite	5	0.0006	0.9417	5.1408	0.14	0.7135
2	altitude	4	0.0035	0.9381	3.9391	0.85	0.3720
3	a2	3	0.0007	0.9374	2.1006	0.17	0.6827
4	s2	2	0.0072	0.9301	1.7332	1.85	0.1924

ANNEXE 3.2 - Examens terminaux - Sujet 1

Procédure de régression et détection des écarts au modèle

Le Système SAS

The REG Procedure
Model: MODEL1
Dependent Variable: lg

Number of Observations Read 20
Number of Observations Used 20

Analyse de variance

Source	DF	Somme des carrés	Carré moyen	Valeur F	Pr > F
Model	2	38.12231	19.06115	113.18	<.0001
Error	17	2.86307	0.16842		
Corrected Total	19	40.98538			

Root MSE	0.41039	R-Square	0.9301
Dependent Mean	2.03689	Adj R-Sq	0.9219
Coeff Var	20.14762		

Résultats estimés des paramètres

Variable	DF	Résultat estimé des paramètres	Erreur std	Valeur du test t	Pr > |t|
Intercept	1	-1.04941	0.25329	-4.14	0.0007
surface	1	0.43813	0.02952	14.84	<.0001
h2	1	-0.19711	0.01463	-13.47	<.0001

ANNEXE 3.3 - Examens terminaux - Sujet 1

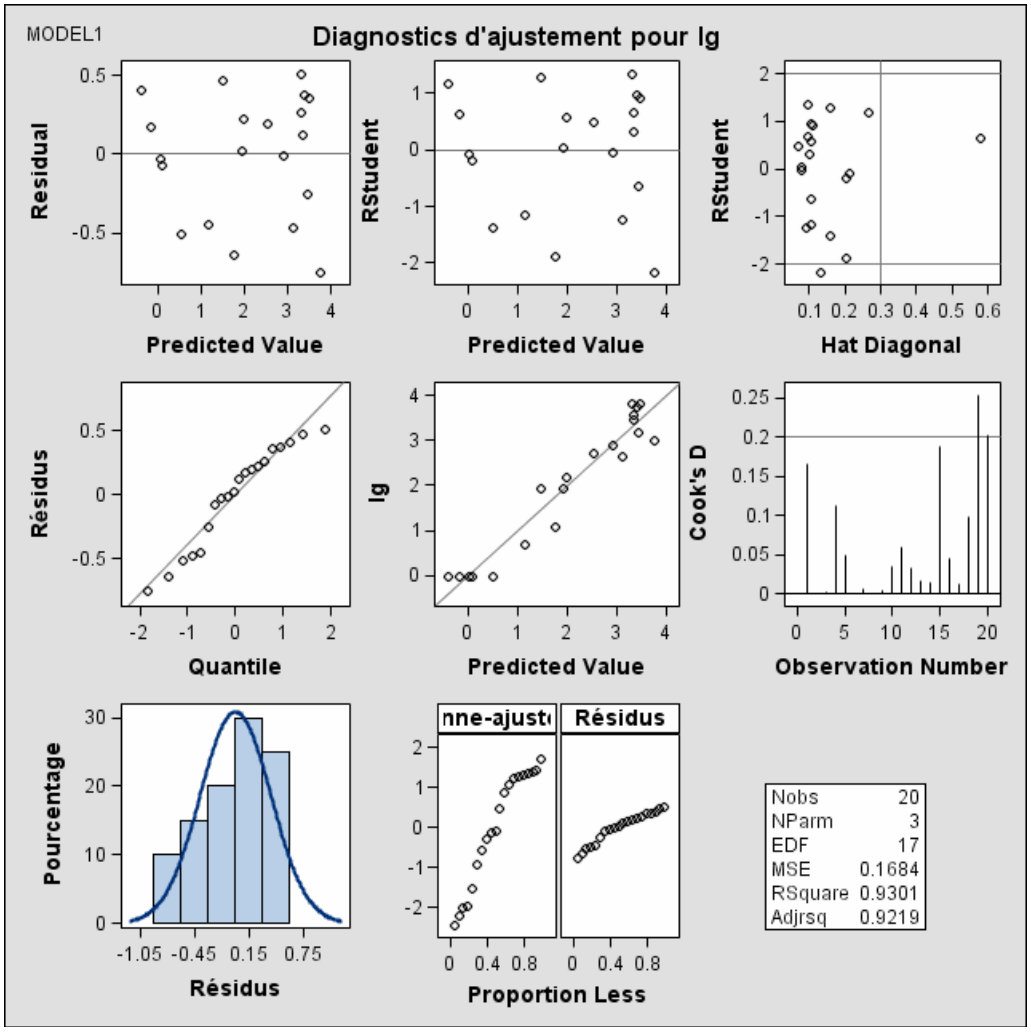
Le Système SAS

The REG Procedure
Model: MODEL1
Dependent Variable: lg

Statistiques de sortie

Obs.	Variable dépendante	Valeur	Erreur standard Prédiction de la moyenne	Résidus	Résidus de l'erreur standard	Résidus de Student	-2-1 0 1 2	D de Cook	RStudent	Hat Diag H	Rapport de cov.	DFFITS	Intercept	DFBE sur
1	0	-0.4117	0.2116	0.4117	0.352	1.171	|** |	0.165	1.1845	0.2658	1.2697	0.7128	0.7104	-0
2	0	0.0265	0.1876	-0.0265	0.365	-0.0725	| |	0.000	-0.0704	0.2091	1.5151	-0.0362	-0.0357	0
3	0	0.0688	0.1844	-0.0688	0.367	-0.188	| |	0.003	-0.1822	0.2019	1.4936	-0.0916	-0.0903	0
4	0	0.5069	0.1624	-0.5069	0.377	-1.345	**| |	0.112	-1.3803	0.1566	1.0148	-0.5947	-0.5708	0
5	0.6931	1.1359	0.1318	-0.4427	0.389	-1.139	**| |	0.050	-1.1499	0.1032	1.0540	-0.3901	-0.3419	0
6	1.9459	1.9245	0.1125	0.0214	0.395	0.0542	| |	0.000	0.0526	0.0751	1.2962	0.0150	0.0092	-0
7	2.7081	2.5065	0.1047	0.2016	0.397	0.508	| * |	0.006	0.4966	0.0650	1.2253	0.1310	0.0328	0
8	2.8904	2.9008	0.1138	-0.0104	0.394	-0.0264	| |	0.000	-0.0256	0.0769	1.2992	-0.0074	-0.0002	-0
9	3.4657	3.3389	0.1297	0.1268	0.389	0.326	| |	0.004	0.3170	0.0999	1.3078	0.1056	-0.0186	0
10	3.7612	3.3827	0.1316	0.3785	0.389	0.974	| * |	0.036	0.9721	0.1028	1.1255	0.3290	-0.0636	0
11	3.8067	3.2919	0.1255	0.5148	0.391	1.317	| ** |	0.060	1.3489	0.0935	0.9578	0.4332	-0.0880	0
12	3.8286	3.4671	0.1332	0.3615	0.388	0.931	| * |	0.034	0.9275	0.1054	1.1458	0.3184	-0.0856	0
13	3.5835	3.3138	0.1254	0.2697	0.391	0.690	| * |	0.016	0.6792	0.0934	1.2149	0.2180	-0.0535	0
14	3.1781	3.4267	0.1303	-0.2487	0.389	-0.639	| * |	0.015	-0.6275	0.1008	1.2401	-0.2102	0.0710	-0
15	2.9957	3.7486	0.1468	-0.7528	0.383	-1.965	***| |	0.189	-2.1677	0.1280	0.6353	-0.8306	0.3698	-0
16	2.6391	3.1080	0.1214	-0.4689	0.392	-1.196	**| |	0.046	-1.2125	0.0875	1.0097	-0.3754	0.1258	-0
17	2.1972	1.9692	0.1302	0.2280	0.389	0.586	| * |	0.013	0.5742	0.1006	1.2544	0.1920	-0.0083	0
18	1.9459	1.4711	0.1619	0.4748	0.377	1.259	| ** |	0.097	1.2829	0.1556	1.0590	0.5507	0.0159	-0
19	1.0986	1.7383	0.1836	-0.6397	0.367	-1.743	**| |	0.253	-1.8655	0.2001	0.8308	-0.9329	0.1191	-0
20	0	-0.1766	0.3122	0.1766	0.266	0.663	| * |	0.201	0.6515	0.5788	2.6325	0.7637	0.0798	-0

Sum of Residuals	0
Sum of Squared Residuals	2.86307
Predicted Residual SS (PRESS)	4.02861


MODEL1
Diagnostics d'ajustement pour lg
Residual
Predicted Value
RStudent
Predicted Value
RStudent
Hat Diagonal
Résidus
Quantile
lg
Predicted Value
Cook's D
Observation Number
Pourcentage
Résidus
nne-ajust
Résidus
Proportion Less
Nobs 20
NParm 3
EDF 17
MSE 0.1684
RSquare 0.9301
Adjrsq 0.9219

ANNEXE 3.4 - Examens terminaux - Sujet 2

Régressions linéaires simples

```
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  64.7362     1.6312  39.687  < 2e-16 ***
X1            0.6069     0.1786   3.399 0.000938 ***
---
Residual standard error: 9.896 on 112 degrees of freedom
Multiple R-squared: 0.0935,     Adjusted R-squared: 0.0854
F-statistic: 11.55 on 1 and 112 DF,  p-value: 0.0009383
```

```
             Estimate Std. Error t value Pr(>|t|)
(Intercept) 6.096e+01  1.259e+00  48.424  < 2e-16 ***
X2          6.752e-03  8.093e-04   8.343 2.11e-13 ***
---
Residual standard error: 8.163 on 112 degrees of freedom
Multiple R-squared: 0.3833,     Adjusted R-squared: 0.3778
F-statistic: 69.61 on 1 and 112 DF,  p-value: 2.107e-13
```

```
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  6.27903    3.74398   1.677   0.0963 .
X3           0.73450    0.04322  16.993   <2e-16 ***
---
Residual standard error: 5.495 on 112 degrees of freedom
Multiple R-squared: 0.7205,     Adjusted R-squared: 0.718
F-statistic: 288.8 on 1 and 112 DF,  p-value: < 2.2e-16
```

```
             Estimate Std. Error t value Pr(>|t|)
(Intercept) 6.199e+01  9.644e-01   64.28   <2e-16 ***
X4          5.220e-04  4.861e-05   10.74   <2e-16 ***
---
Residual standard error: 7.296 on 112 degrees of freedom
Multiple R-squared: 0.5072,     Adjusted R-squared: 0.5028
F-statistic: 115.3 on 1 and 112 DF,  p-value: < 2.2e-16
```

```
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  52.6710     2.1041  25.033  < 2e-16 ***
X5            2.9036     0.3426   8.474 1.06e-13 ***
---
Residual standard error: 8.113 on 112 degrees of freedom
Multiple R-squared: 0.3907,     Adjusted R-squared: 0.3852
F-statistic: 71.81 on 1 and 112 DF,  p-value: 1.061e-13
```

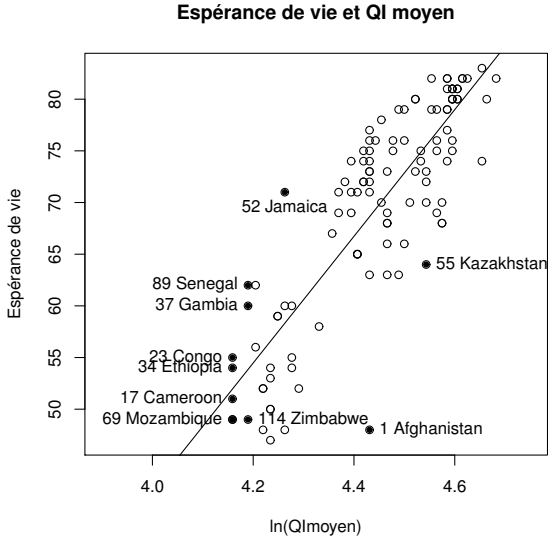
```
            Estimate Std. Error t value Pr(>|t|)
(Intercept)  20.3950     4.6363   4.399 2.49e-05 ***
log(X2)       7.2761     0.6822  10.665  < 2e-16 ***
---
Residual standard error: 7.321 on 112 degrees of freedom
Multiple R-squared: 0.5039,     Adjusted R-squared: 0.4994
F-statistic: 113.7 on 1 and 112 DF,  p-value: < 2.2e-16
```

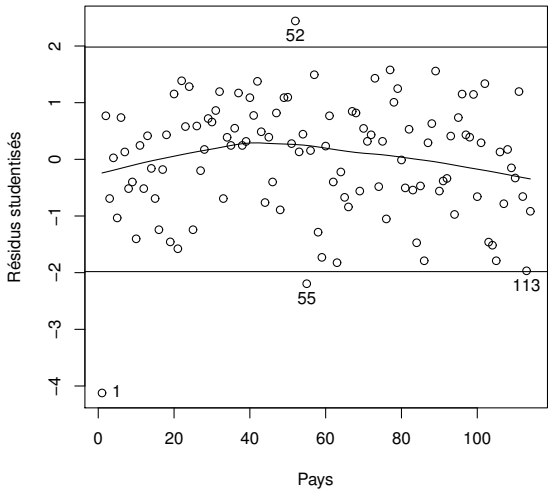
```
            Estimate Std. Error t value Pr(>|t|)
(Intercept) -202.970     15.530  -13.07   <2e-16 ***
log(X3)       61.295      3.494   17.54   <2e-16 ***
---
Residual standard error: 5.369 on 112 degrees of freedom
Multiple R-squared: 0.7331,     Adjusted R-squared: 0.7308
F-statistic: 307.7 on 1 and 112 DF,  p-value: < 2.2e-16
```

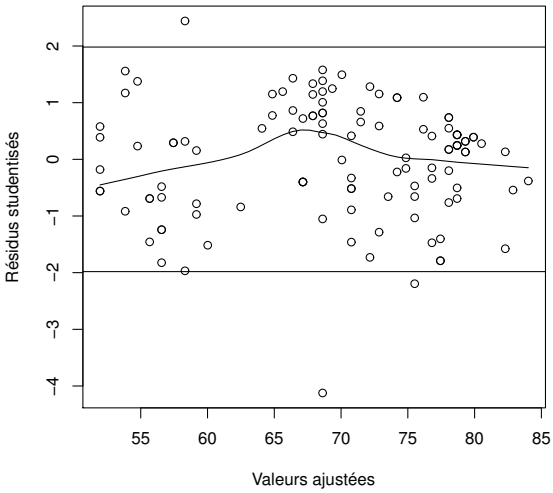
```
            Estimate Std. Error t value Pr(>|t|)
(Intercept)   9.6451     3.5873   2.689  0.00827 **
log(X4)       6.7184     0.3998  16.806  < 2e-16 ***
---
Residual standard error: 5.539 on 112 degrees of freedom
Multiple R-squared: 0.716,      Adjusted R-squared: 0.7135
F-statistic: 282.4 on 1 and 112 DF,  p-value: < 2.2e-16
```

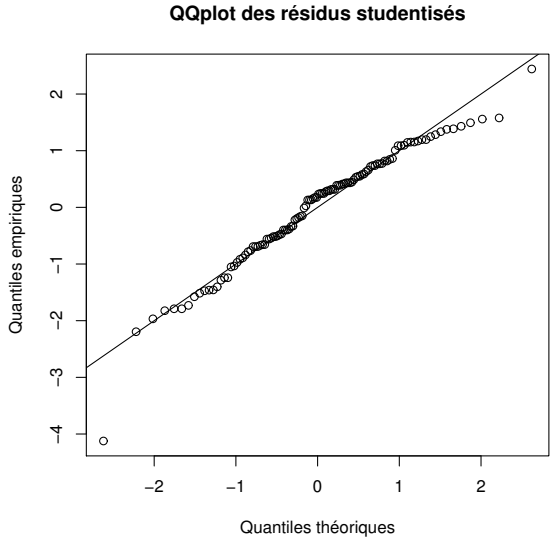
ANNEXE 3.5 : Examens terminaux - Sujet 2

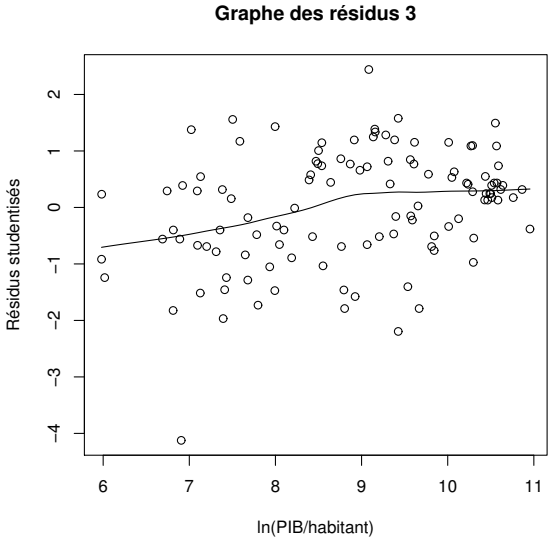
Analyse des résidus, recherche d'écarts au modèle

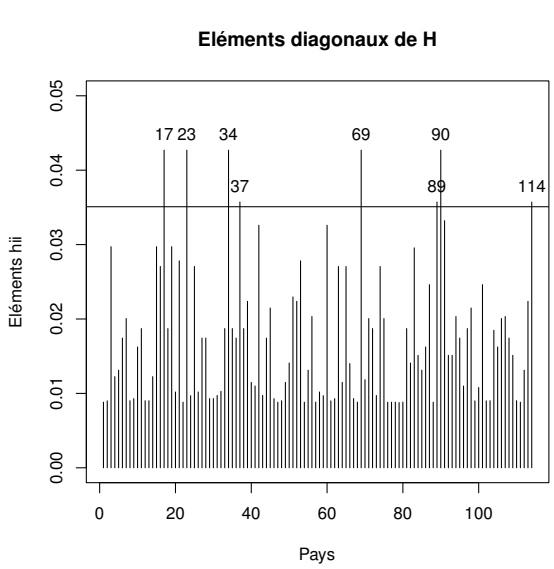


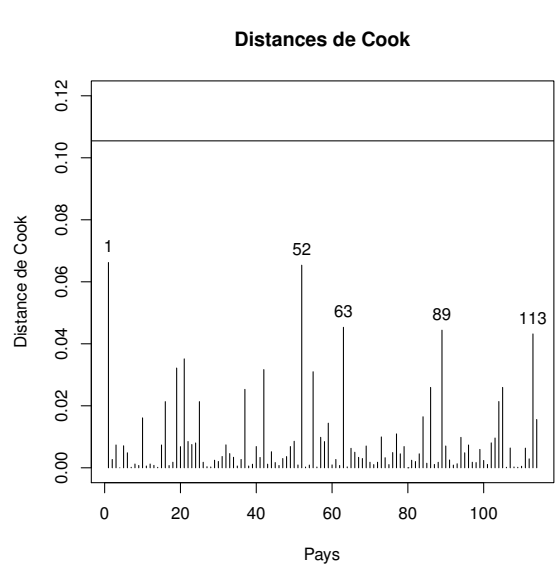





QQplot des résidus studentisés
Quantiles empiriques
Quantiles théoriques
−4
−3
−2
−1
0
1
2


Graphe des résidus 3
Résidus studentisés
ln(PIB/habitant)
6
7
8
9
10
11


Eléments diagonaux de H
Eléments hii
Pays
17 23
34
37
69
89
90
114
0.00
0.01
0.02
0.03
0.04
0.05
0
20
40
60
80
100


Distances de Cook
Distance de Cook
Pays
1
52
63
89
113
0.00
0.02
0.04
0.06
0.08
0.10
0.12
0
20
40
60
80
100

ANNEXE 3.6 : Examens terminaux - Sujet 2

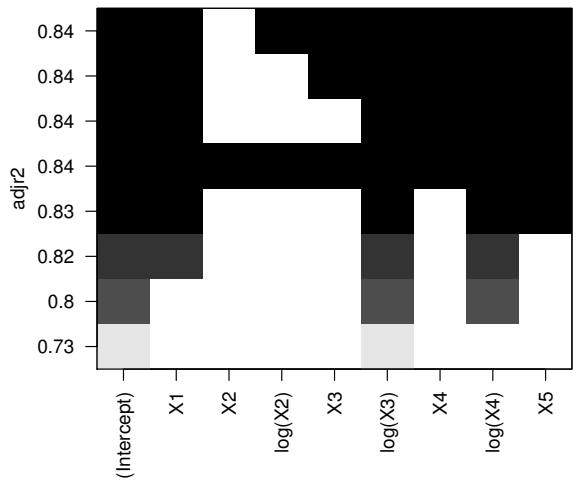
Sortie SAS obtenue avec le code suivant :

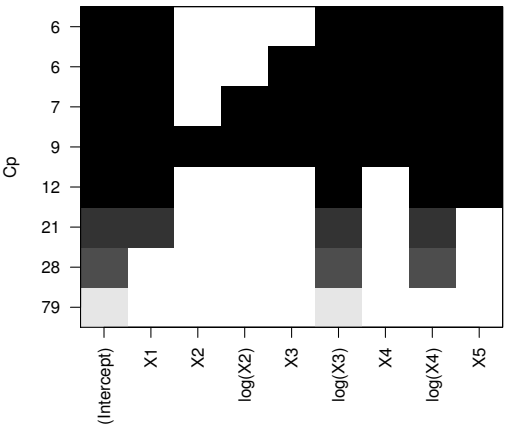
```
proc reg data=examen.espvie;
model Y=X1 X2 logX2 X3 logX3 X4 logX4 X5 / selection=adjrsq cp bic best=10;
run;
```

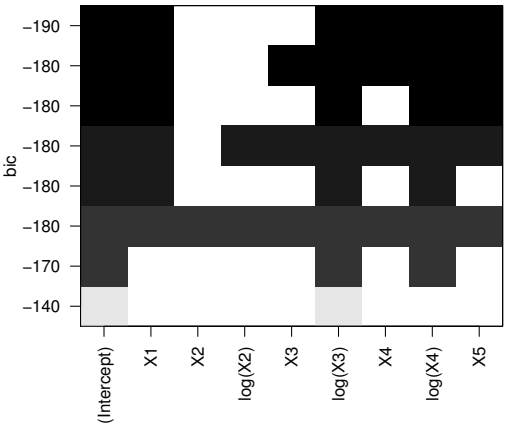
The REG Procedure
Dependent Variable: Y

Number in Model	Adjusted R-Square	R-Square	C(p)	BIC	Variables in Model
7	0.8422	0.8520	7.0358	333.3514	X1 logX2 X3 logX3 X4 logX4 X5
6	0.8422	0.8506	6.0391	332.1240	X1 X3 logX3 X4 logX4 X5
7	0.8420	0.8518	7.1899	333.4936	X1 X2 X3 logX3 X4 logX4 X5
6	0.8409	0.8494	6.8889	332.9167	X1 logX2 X3 logX3 logX4 X5
5	0.8408	0.8478	5.9781	331.8130	X1 logX3 X4 logX4 X5
8	0.8407	0.8520	9.0000	335.4897	X1 X2 logX2 X3 logX3 X4 logX4 X5
6	0.8403	0.8488	7.2997	333.2979	X1 logX2 logX3 X4 logX4 X5
6	0.8402	0.8487	7.3376	333.3329	X1 X2 logX3 X4 logX4 X5
5	0.8401	0.8472	6.4118	332.2201	X1 X3 logX3 logX4 X5
6	0.8398	0.8483	7.6155	333.5900	X1 X2 X3 logX3 logX4 X5

Sorties R obtenues avec la fonction `regsubsets` du package `leaps`




Cp
6
6
7
9
12
21
28
79
(Intercept)
X1
X2
log(X2)
X3
log(X3)
X4
log(X4)
X5


bic
−190
−180
−180
−180
−180
−180
−170
−140
(Intercept)
X1
X2
log(X2)
X3
log(X3)
X4
log(X4)
X5

ANNEXE 3.7 : Examens terminaux - Sujet 2

Sélection backward

The SAS System
The REG Procedure
Model: MODEL1
Dependent Variable: Y

Number of Observations Read 114
Number of Observations Used 114

Backward Elimination: Step 0

All Variables Entered: R-Square = 0.8520 and C(p) = 9.0000

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	8	10309	1288.67063	75.57	<.0001
Error	105	1790.49462	17.05233		
Corrected Total	113	12100			

Variable	Parameter Estimate	Standard Error	Type II SS	F Value	Pr > F
Intercept	-394.26969	173.92868	87.62501	5.14	0.0254
X1	-0.35200	0.10232	201.83099	11.84	0.0008
X2	0.00020667	0.00109	0.61121	0.04	0.8502
logX2	0.50759	1.16474	3.23853	0.19	0.6639
X3	-0.95894	0.63954	38.33801	2.25	0.1368
logX3	114.21904	51.95619	82.41119	4.83	0.0301
X4	-0.00010736	0.00007857	31.84106	1.87	0.1747
logX4	3.69954	0.95234	257.33542	15.09	0.0002
X5	1.06998	0.26134	285.83146	16.76	<.0001

Bounds on condition number: 387.62, 6401.2

Backward Elimination: Step 1

Variable X2 Removed: R-Square = 0.8520 and C(p) = 7.0358

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	7	10309	1472.67912	87.16	<.0001
Error	106	1791.10583	16.89722		
Corrected Total	113	12100			

Variable	Parameter Estimate	Standard Error	Type II SS	F Value	Pr > F
Intercept	-395.93927	172.91318	88.59646	5.24	0.0240
X1	-0.34593	0.09672	216.17418	12.79	0.0005
logX2	0.68595	0.68170	17.10857	1.01	0.3166
X3	-0.96196	0.63643	38.60449	2.28	0.1336
logX3	114.53056	51.69341	82.94454	4.91	0.0289
X4	-0.00010375	0.00007586	31.59965	1.87	0.1744
logX4	3.64333	0.90075	276.44060	16.36	<.0001
X5	1.07082	0.26011	286.36369	16.95	<.0001

Bounds on condition number: 387.37, 5493.4

Backward Elimination: Step 2

Variable logX2 Removed: R-Square = 0.8506 and C(p) = 6.0391

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	6	10292	1715.27421	101.50	<.0001
Error	107	1808.21440	16.89920		
Corrected Total	113	12100			

Variable	Parameter Estimate	Standard Error	Type II SS	F Value	Pr > F
Intercept	-381.30167	172.31026	82.75254	4.90	0.0290
X1	-0.32818	0.09510	201.25528	11.91	0.0008
X3	-0.88357	0.63168	33.06431	1.96	0.1648
logX3	110.11195	51.50957	77.22523	4.57	0.0348
X4	-0.00011589	0.00007490	40.45928	2.39	0.1247
logX4	4.00863	0.82441	399.55327	23.64	<.0001
X5	1.01265	0.25362	269.40331	15.94	0.0001

Bounds on condition number: 381.57, 4627.5

Backward Elimination: Step 3

Variable X3 Removed: R-Square = 0.8478 and C(p) = 5.9781

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	5	10259	2051.71619	120.34	<.0001
Error	108	1841.27871	17.04888		
Corrected Total	113	12100			

Variable	Parameter Estimate	Standard Error	Type II SS	F Value	Pr > F
Intercept	-141.51231	17.48569	1116.65421	65.50	<.0001
X1	-0.37686	0.08889	306.42093	17.97	<.0001
logX3	38.34686	4.59731	1186.17174	69.57	<.0001
X4	-0.00017512	0.00006206	135.77333	7.96	0.0057
logX4	4.48660	0.75357	604.34559	35.45	<.0001
X5	1.03470	0.25425	282.35489	16.56	<.0001

Bounds on condition number: 6.3935, 89.792

All variables left in the model are significant at the 0.1000 level.

Summary of Backward Elimination

Step	Variable Removed	Number Vars In	Partial R-Square	Model R-Square	C(p)	F Value	Pr > F
1	X2	7	0.0001	0.8520	7.0358	0.04	0.8502
2	logX2	6	0.0014	0.8506	6.0391	1.01	0.3166
3	X3	5	0.0027	0.8478	5.9781	1.96	0.1648

Sélection forward

The SAS System
The REG Procedure
Model: MODEL1
Dependent Variable: Y

Number of Observations Read 114
Number of Observations Used 114

Forward Selection: Step 1

Variable logX3 Entered: R-Square = 0.7331 and C(p) = 79.3580

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	8870.86409	8870.86409	307.69	<.0001
Error	112	3228.99556	28.83032		
Corrected Total	113	12100			

Variable	Parameter Estimate	Standard Error	Type II SS	F Value	Pr > F
Intercept	-202.96980	15.52981	4924.70006	170.82	<.0001
logX3	61.29540	3.49438	8870.86409	307.69	<.0001

Bounds on condition number: 1, 1

Forward Selection: Step 2

Variable logX4 Entered: R-Square = 0.8079 and C(p) = 28.3193

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	2	9775.29827	4887.64914	233.39	<.0001
Error	111	2324.56138	20.94199		
Corrected Total	113	12100			

Variable	Parameter Estimate	Standard Error	Type II SS	F Value	Pr > F
Intercept	-121.03741	18.18304	927.94930	44.31	<.0001
logX3	35.70823	4.90196	1111.25943	53.06	<.0001
logX4	3.57280	0.54366	904.43418	43.19	<.0001

Bounds on condition number: 2.7091, 10.837

Forward Selection: Step 3

Variable X1 Entered: R-Square = 0.8214 and C(p) = 20.7465

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	9938.53648	3312.84549	168.61	<.0001
Error	110	2161.32317	19.64839		
Corrected Total	113	12100			

Variable	Parameter Estimate	Standard Error	Type II SS	F Value	Pr > F
Intercept	-136.56224	18.41768	1080.23558	54.98	<.0001
X1	-0.26035	0.09033	163.23821	8.31	0.0047
logX3	39.48608	4.92573	1262.62517	64.26	<.0001
logX4	3.65177	0.52732	942.30930	47.96	<.0001

Bounds on condition number: 2.9156, 20.723

Forward Selection: Step 4

Variable X5 Entered: R-Square = 0.8366 and C(p) = 11.9403

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	4	10123	2530.70190	139.52	<.0001
Error	109	1977.05204	18.13809		
Corrected Total	113	12100			

Variable	Parameter Estimate	Standard Error	Type II SS	F Value	Pr > F
Intercept	-132.60327	17.73921	1013.51766	55.88	<.0001
X1	-0.34880	0.09111	265.81361	14.65	0.0002
logX3	39.07770	4.73436	1235.73762	68.13	<.0001
logX4	2.98036	0.54869	535.15189	29.50	<.0001
X5	0.78258	0.24552	184.27113	10.16	0.0019

Bounds on condition number: 3.1861, 37.493

Forward Selection: Step 5

Variable X4 Entered: R-Square = 0.8478 and C(p) = 5.9781

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	5	10259	2051.71619	120.34	<.0001
Error	108	1841.27871	17.04888		
Corrected Total	113	12100			

Variable	Parameter Estimate	Standard Error	Type II SS	F Value	Pr > F
Intercept	-141.51231	17.48569	1116.65421	65.50	<.0001
X1	-0.37686	0.08889	306.42093	17.97	<.0001
logX3	38.34686	4.59731	1186.17174	69.57	<.0001
X4	-0.00017512	0.00006206	135.77333	7.96	0.0057
logX4	4.48660	0.75357	604.34559	35.45	<.0001
X5	1.03470	0.25425	282.35489	16.56	<.0001

Bounds on condition number: 6.3935, 89.792

Forward Selection: Step 6

Variable X3 Entered: R-Square = 0.8506 and C(p) = 6.0391

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	6	10292	1715.27421	101.50	<.0001
Error	107	1808.21440	16.89920		
Corrected Total	113	12100			

Variable	Parameter Estimate	Standard Error	Type II SS	F Value	Pr > F

Intercept	-381.30167	172.31026	82.75254	4.90	0.0290
X1	-0.32818	0.09510	201.25528	11.91	0.0008
X3	-0.88357	0.63168	33.06431	1.96	0.1648
logX3	110.11195	51.50957	77.22523	4.57	0.0348
X4	-0.00011589	0.00007490	40.45928	2.39	0.1247
logX4	4.00863	0.82441	399.55327	23.64	<.0001
X5	1.01265	0.25362	269.40331	15.94	0.0001

Bounds on condition number: 381.57, 4627.5

Forward Selection: Step 7

Variable logX2 Entered: R-Square = 0.8520 and C(p) = 7.0358

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	7	10309	1472.67912	87.16	<.0001
Error	106	1791.10583	16.89722		
Corrected Total	113	12100			

Variable	Parameter Estimate	Standard Error	Type II SS	F Value	Pr > F
Intercept	-395.93927	172.91318	88.59646	5.24	0.0240
X1	-0.34593	0.09672	216.17418	12.79	0.0005
logX2	0.68595	0.68170	17.10857	1.01	0.3166
X3	-0.96196	0.63643	38.60449	2.28	0.1336
logX3	114.53056	51.69341	82.94454	4.91	0.0289
X4	-0.00010375	0.00007586	31.59965	1.87	0.1744
logX4	3.64333	0.90075	276.44060	16.36	<.0001
X5	1.07082	0.26011	286.36369	16.95	<.0001

Bounds on condition number: 387.37, 5493.4

No other variable met the 0.5000 significance level for entry into the model.

Summary of Forward Selection

Step	Variable Entered	Number Vars In	Partial R-Square	Model R-Square	C(p)	F Value	Pr > F
1	logX3	1	0.7331	0.7331	79.3580	307.69	<.0001
2	logX4	2	0.0747	0.8079	28.3193	43.19	<.0001
3	X1	3	0.0135	0.8214	20.7465	8.31	0.0047
4	X5	4	0.0152	0.8366	11.9403	10.16	0.0019
5	X4	5	0.0112	0.8478	5.9781	7.96	0.0057
6	X3	6	0.0027	0.8506	6.0391	1.96	0.1648
7	logX2	7	0.0014	0.8520	7.0358	1.01	0.3166

ANNEXE 3.8 : Examens terminaux - Sujet 2 bis

Annexe à rendre : Modèle de régression linéaire multiple ($\mathcal{M}_m$)

NOM .....

The REG Procedure
Model: MODEL1
Dependent Variable: Y
Number of Observations Read 114
Number of Observations Used 114

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	9854.62270	3284.87423	**(1)**	<.0001
Error	110	**(2)**	**(3)**		
Corrected Total	113	12100			

Root MSE	4.51788	R-Square	0.8144
Dependent Mean	69.29825	Adj R-Sq	0.8094
Coeff Var	6.51947		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	-1.93409	3.32351	**(4)**	0.5618
X1	1	-0.27729	0.09293	-2.98	**(5)** .....
X3	1	0.46832	0.06163	7.60	<.0001
ln(X4)	1	3.73188	0.54014	6.91	<.0001

Commande SAS utilisée pour obtenir cette sortie :

Justification des calculs :

Calcul de **(1)** :

Calcul de **(2)** :

Calcul de **(3)** :

Calcul de **(4)** :

Calcul de **(5)** :

ANNEXE 3.9 : Examens terminaux - Sujet 2 bis

Modèle de régression linéaire simple ($\mathcal{M}_s$)

The REG Procedure
Model: MODEL1
Dependent Variable: Y
Number of Observations Read 114
Number of Observations Used 114

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	1	1131.30968	1131.30968	11.55	0.0009
Error	112	10969	97.93348		
Corrected Total	113	12100			

Root MSE	9.89613	R-Square	0.0935
Dependent Mean	69.29825	Adj R-Sq	0.0854
Coeff Var	14.28050		

Parameter Estimates

Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
Intercept	1	64.73615	1.63118	39.69	<.0001
X1	1	0.60686	0.17855	3.40	0.0009

ANNEXE 3.10 : Examens terminaux - Sujet 2 bis

Modèle de régression linéaire multiple sans constante

The REG Procedure
Model: MODEL1
Dependent Variable: Y
Number of Observations Read 114
Number of Observations Used 114

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	3	557304	185768	9155.81	<.0001
Error	111	2252.14936	20.28963		
Corrected Total	114	559556			

Root MSE	4.50440	R-Square	0.9960
Dependent Mean	69.29825	Adj R-Sq	0.9959
Coeff Var	6.50002		

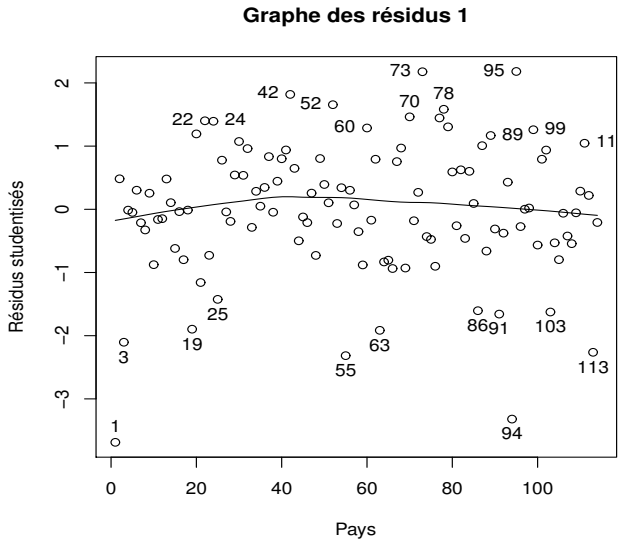
Parameter Estimates

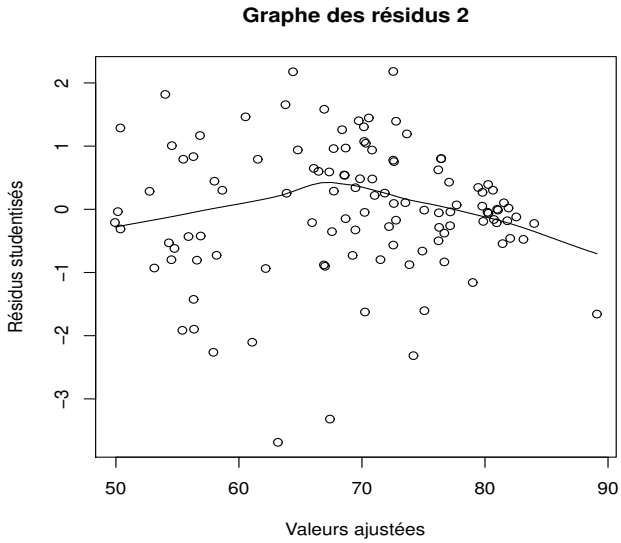
Variable	DF	Parameter Estimate	Standard Error	t Value	Pr > |t|
X1	1	-0.26121	0.08847	-2.95	0.0038
X3	1	0.45251	0.05515	8.21	<.0001
ln(X4)	1	3.65679	0.52294	6.99	<.0001

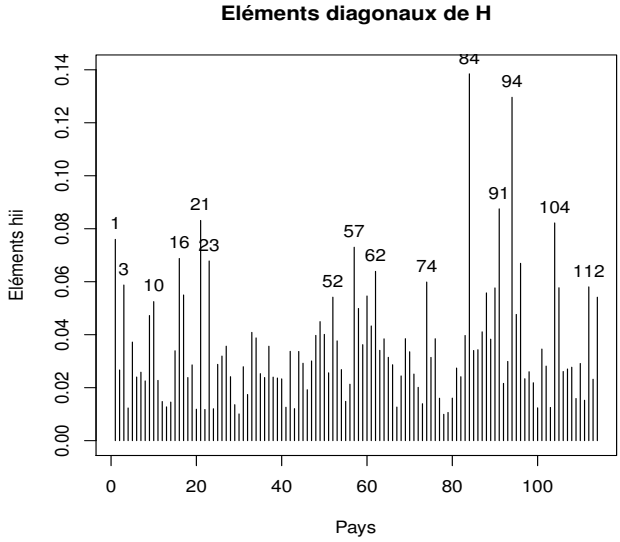
ANNEXE 3.11 : Examens terminaux - Sujet 2 bis

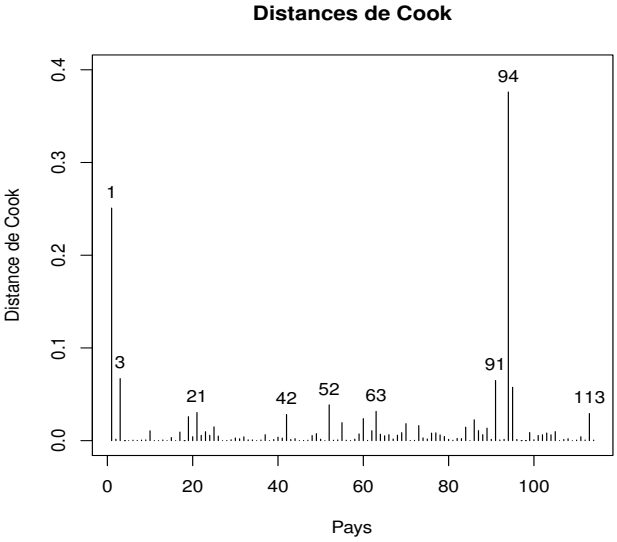
Annexe à rendre : Détection des écarts au modèle

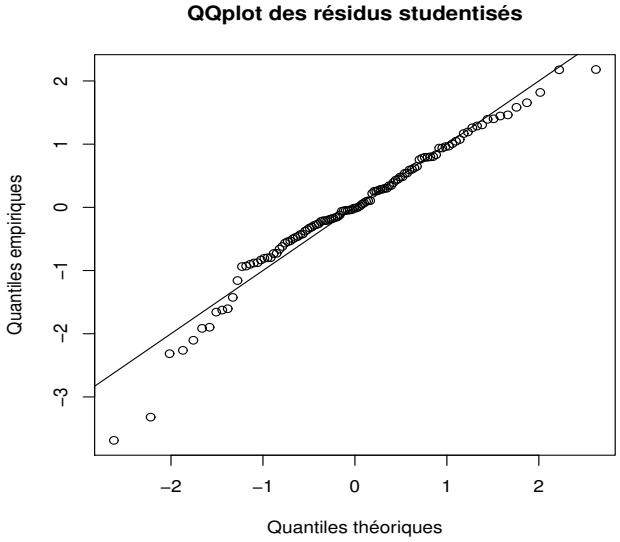
NOM .....











1. Détecte-t-on des valeurs aberrantes ?

□ Oui : les pays n° ...

□ Non

2. Détecte-t-on des données à effet levier ?

□ Oui : les pays n° ...

□ Non

3. Détecte-t-on des données influentes ?

□ Oui : les pays n° ...

□ Non

4. Quelle(s) hypothèse(s) du modèle sont à remettre en cause ? (plusieurs réponses possibles)

□ La non corrélation des ε_i : c.f. graphe(s) ...

□ L'homoscédasticité des ε_i : c.f. graphe(s) ...

□ La normalité des ε_i : c.f. graphe(s) ...

ANNEXE 3.12 : Examens terminaux - Sujet 2 bis

Annexe à rendre : Sélection de variables

NOM .....

1. Avec quel(s) critère(s) de sélection de variables peut-on utiliser une procédure de sélection exhaustive ?

□ Tests de validité de sous-modèles
□ Critère du R^2 ajusté
□ Critère du C_p de Mallows
□ Critères BIC et AIC

2. Avec quel(s) critère(s) de sélection de variables peut-on utiliser une procédure de sélection backward ou forward ?

□ Tests de validité de sous-modèles
□ Critère du R^2 ajusté
□ Critère du C_p de Mallows
□ Critères BIC et AIC

3. Avec quel(s) critère(s) de sélection de variables peut-on utiliser une procédure de sélection stepwise ?

□ Tests de validité de sous-modèles
□ Critère du R^2 ajusté
□ Critère du C_p de Mallows
□ Critères BIC et AIC

4. Si vous aviez un fichier de données avec un très grand nombre de variables explicatives potentielles, quelle méthode algorithmique et quel critère de sélection préféreriez-vous utiliser pour sélectionner les variables de votre modèle de régression linéaire (une seule réponse possible pour la procédure, comme pour le critère) ?

□ Procédure exhaustive
□ Procédure backward
□ Procédure forward
□ Procédure stepwise

□ Tests de validité de sous-modèles
□ Critère du R^2 ajusté
□ Critère du C_p de Mallows
□ Critère BIC
□ Critère AIC

5. Si vous aviez un fichier de données avec un nombre raisonnable de variables explicatives potentielles, quelle méthode algorithmique et quel critère de sélection préféreriez-vous utiliser pour sélectionner les variables de votre modèle de régression linéaire (une seule réponse possible pour la procédure, comme pour le critère) ?

□ Procédure exhaustive
□ Procédure backward
□ Procédure forward
□ Procédure stepwise

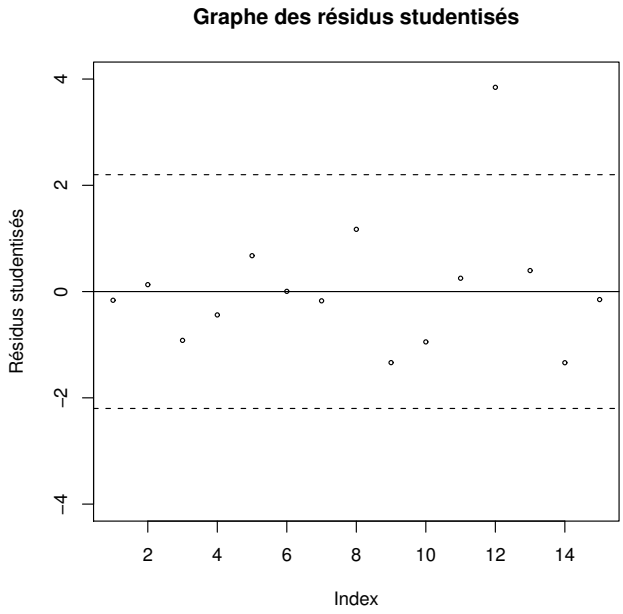
□ Tests de validité de sous-modèles
□ Critère du R^2 ajusté
□ Critère du C_p de Mallows
□ Critère BIC
□ Critère AIC

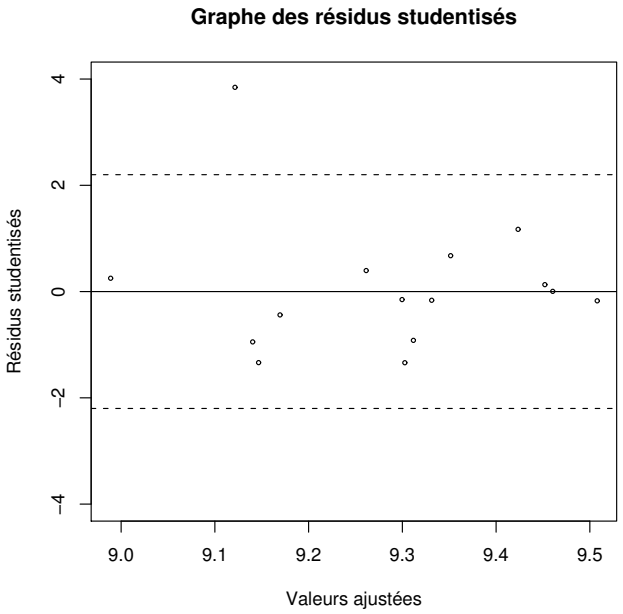
ANNEXE 3.13 : Examens terminaux - Sujet 3

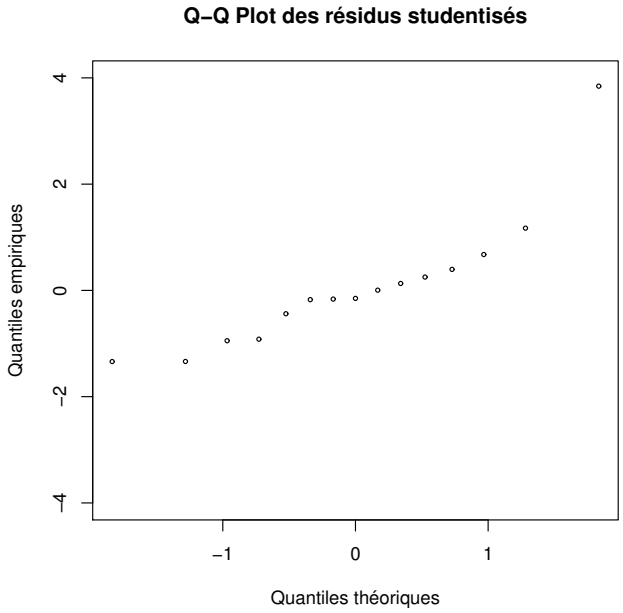
Sélection de variables

Modèle	Variables	R_a^2	AIC	BIC
M1	$\ln K$	0.7388	-28.16966	-26.04551
M2	$\ln L$	0.7881	-31.3069	-29.18275
M3	$\ln^2 K$	0.7393	-28.19717	-26.07302
M4	$\ln^2 L$	0.7885	-31.33371	-29.20956
M5	$\ln K \ln L$	0.8028	-32.38566	-30.26151
M12	$\ln K, \ln L$	0.7881	-30.50563	-27.67343
M13	$\ln K, \ln^2 K$	0.7247	-26.58004	-23.74784
M14	$\ln K, \ln^2 L$	0.7885	-30.53344	-27.70124
M15	$\ln K, \ln K \ln L$	0.789	-30.56996	-27.73776
M23	$\ln L, \ln^2 K$	0.7883	-30.52094	-27.68874
M24	$\ln L, \ln^2 L$	0.7729	-29.46545	-26.63325
M25	$\ln L, \ln K \ln L$	0.7886	-30.54473	-27.71253
M34	$\ln^2 K, \ln^2 L$	0.7887	-30.54835	-27.71615
M35	$\ln^2 K, \ln K \ln L$	0.7889	-30.55992	-27.72771
M45	$\ln^2 L, \ln K \ln L$	0.7888	-30.55531	-27.72311
M123	$\ln K, \ln L, \ln^2 K$	0.7802	-29.26232	-25.72207
M124	$\ln K, \ln L, \ln^2 L$	0.7738	-28.83233	-25.29208
M125	$\ln K, \ln L, \ln K \ln L$	0.7794	-29.20627	-25.66602
M134	$\ln K, \ln^2 K, \ln^2 L$	0.78	-29.25093	-25.71068
M135	$\ln K, \ln^2 K, \ln K \ln L$	0.7802	-29.26219	-25.72194
M145	$\ln K, \ln^2 L, \ln K \ln L$	0.789	-29.87491	-26.33466
M234	$\ln L, \ln^2 K, \ln^2 L$	0.7739	-28.83902	-25.29877
M235	$\ln L, \ln^2 K, \ln K \ln L$	0.7783	-29.13118	-25.59093
M245	$\ln L, \ln^2 L, \ln K \ln L$	0.774	-28.84642	-25.30617
M345	$\ln^2 K, \ln^2 L, \ln K \ln L$	0.7961	-30.38632	-26.84607
M1234	$\ln K, \ln L, \ln^2 K, \ln^2 L$	0.7625	-27.52743	-23.27913
M1235	$\ln K, \ln L, \ln^2 K, \ln K \ln L$	0.7582	-27.26232	-23.01402
M1245	$\ln K, \ln L, \ln^2 L, \ln K \ln L$	0.7791	-28.61384	-24.36554
M1345	$\ln K, \ln^2 K, \ln^2 L, \ln K \ln L$	0.7829	-28.87478	-24.62648
M2345	$\ln L, \ln^2 K, \ln^2 L, \ln K \ln L$	0.7794	-28.6346	-24.3863
M12345	$\ln K, \ln L, \ln^2 K, \ln^2 L, \ln K \ln L$	0.7605	-26.98389	-22.02754

ANNEXE 3.14 : Examens terminaux - Sujet 3







Cook's distances

1	2	3	4	5	6	7	8	9	10
1.18e-03	1.17e-03	1.31e-01	2.15e-02	1.68e-02	1.37e-06	4.18e-03	7.83e-02	8.42e-02	6.48e-02
11	12	13	14	15					
1.25e-02	4.3e-01	5.01e-03	1.05e-01	5.89e-03					

Hat values

1	2	3	4	5	6	7	8	9	10
0.108	0.159	0.315	0.237	0.095	0.184	0.275	0.15	0.131	0.177
11	12	13	14	15					
0.355	0.158	0.082	0.157	0.416					