C:\INDOSTAT\DATA\dgw8

Multiple Regression

CORRELATION MATRIX

	Plant Height cm	Days to Maturity	Peduncle Volume	Eearhead Nos.	Eearhead Length cm	Spikes/ Main Eearhead	Seeds/ Spikelte M	Main Eearhead Wt.	Total Biomass	Grain Yield/ Plant g
Plant Height cm	1.00000	0.08032	-0.12772	0.33655	-0.11714	0.42853	0.03476	-0.10427	0.12759	0.12746
Days to Maturity		1.00000	0.09112	0.20265	0.32763	0.07769	0.29471	0.38008	0.51758	0.47030
Peduncle Volume			1.00000	-0.23176	0.52595	-0.18792	0.19751	0.46550	0.19457	0.15596
Eearhead Nos.				1.00000	-0.28280	0.45901	-0.07154	-0.20726	0.68637	0.56856
Eearhead Length cm					1.00000	0.11742	0.32080	0.67370	0.26975	0.26831
Spikes/Main Eearhead						1.00000	0.00705	0.01317	0.36025	0.36328
Seeds/Spikeltee of M							1.00000	0.71013	0.29884	0.49344
Main Eearhead Wt.								1.00000	0.34398	0.48519
Total Biomass									1.00000	0.90193
Grain Yield/Plant g										1.00000

Significance Levels	*0.05*	*0.01*	*0.005*	*0.001*
If correlation r =>	*0.24802*	*0.32227*	*0.34943*	*0.40476*

Individual Regressors

Yi Variable = Grain Yield/Plant g

			t Value	Probability
Y1 =	10.3656 +0.16238 x	Plant Height cm	1.0037	0.3195
Y1 =	-91.6979 +1.03460 x	Days to Maturity	4.1622	0.0001 ***
Y1 =	18.7525 +1.31174 x	Peduncle Volume	1.2332	0.2222
Y1 =	9.9108 +0.90578 x	Eearhead Nos.	5.3980	0.0000 ***
Y1 =	11.3545 +1.12806 x	Eearhead Length cm	2.1753	0.0335 *
Y1 =	-3.8787 +1.62346 x	Spikes/Main Eearhead	3.0454	0.0034 **
Y1 =	7.0579 +5.38550 x	Seeds/Spikeltee of M	4.4309	0.0000 ***
Y1 =	11.7217 +3.94812 x	Main Eearhead Wt.	4.3338	0.0001 ***
Y1 =	3.2263 +0.43247 x	Total Biomass	16.3108	0.0000 ***

Pooled n = 63		**Lowest**	**Highest**	**Kurtosis**	**Skewness**	**Mean**	**Std. Dev.**	**Std. Error**	**C.V.%**	**JarqueBera**	**χ^2 Prob**
Plant Height cm	X1	64.9800	84.3200	-0.3921	0.3285	75.1959	4.3283	0.5453	5.7560%	1.5364	0.4638
Days to Maturity	X2	105.0000	115.2000	-0.6219	0.0224	110.4524	2.5065	0.3158	2.2693%	1.0204	0.6004
Peduncle Volume	X3	1.1700	4.6800	0.3469	-0.0500	2.9148	0.6556	0.0826	22.4924%	0.3421	0.8428
Eearhead Nos.	X4	7.0000	21.8000	-0.7347	0.2453	13.9825	3.4611	0.4361	24.7533%	2.0489	0.3590
Eearhead Length cm	X5	6.7700	14.0800	0.5726	-0.0692	9.9475	1.3115	0.1652	13.1841%	0.9109	0.6342
Spikes/Main Eearhe	X6	13.7000	18.6000	-0.9669	-0.0287	16.2952	1.2339	0.1555	7.5719%	2.4628	0.2919
Seeds/Spikeltee of	X7	1.5800	3.9900	-0.2981	-0.1480	2.8814	0.5052	0.0637	17.5334%	0.4632	0.7932
Main Eearhead Wt.	X8	1.4700	4.2400	-0.7400	0.0828	2.7492	0.6776	0.0854	24.6479%	1.5093	0.4702
Total Biomass	X9	23.7800	83.5800	0.7402	0.6643	44.7422	11.4996	1.4488	25.7019%	6.0724	0.0480 *
Grain Yield/Plant	Y1	12.8900	40.1700	0.7278	0.8379	22.5759	5.5140	0.6947	24.4241%	8.7613	0.0125 *

Variable name	**R^2**	**Tolerance**	**VIF**	**F Test**	**Prob LGT(F)**
1 Plant Height cm	0.2870	0.7130	1.4026	2.7177	0.8953
2 Days to Maturity	0.3858	0.6142	1.6280	4.2390	0.7512
3 Peduncle Volume	0.4387	0.5613	1.7815	5.2749	0.6711
4 Eearhead Nos.	0.8077	0.1923	5.1998	28.3488	0.1966
5 Eearhead Length cm	0.6623	0.3377	2.9613	13.2391	0.3637
6 Spikes/Main Eearhead	0.4461	0.5539	1.8052	5.4354	0.6600
7 Seeds/Spikeltee of M	0.5800	0.4200	2.3808	9.3202	0.4695
8 Main Eearhead Wt.	0.7546	0.2454	4.0745	20.7526	0.2550
9 Total Biomass	0.8142	0.1858	5.3814	29.5742	0.1896

significance of VIF's are tested after taking log (10 base) of F-test and computing its probability.

in literature it is also advised to treat as significant if vlaue of F test is >10 or >20.

Multiple Regression on Grain Yield/Plant g

R^2	0.8862	R^2adj	0.8669
F	45.8531 (9 , 53)	Probability	0.0000 ***
RMS Error	2.0119	AIC	1.5428

Akaike Information Criteria : smaller is better

	Beta Wt.	**R square**	**Reg. Coeff.**	**Std.Err.**	**t-value**	**t Prob.**
INTERCEPT a		0.0000	8.10660	14.6881	0.552	0.583
Plant Height cm	-0.0057	-0.0007	-0.00723	0.0699	0.103	0.918
Days to Maturity	-0.0461	-0.0217	-0.10141	0.1301	0.780	0.439
Peduncle Volume	-0.0604	-0.0094	-0.50758	0.5202	0.976	0.334
Eearhead Nos.	-0.0354	-0.0201	-0.05632	0.1683	0.335	0.739
Eearhead Length cm	-0.1150	-0.0309	-0.48357	0.3353	1.442	0.155
Spikes/Main Eearhead	0.0773	0.0281	0.34553	0.2782	1.242	0.220
Seeds/Spikeltee of M	0.1632	0.0805	1.78085	0.7804	2.282	0.027 *
Main Eearhead Wt.	0.1906	0.0925	1.55126	0.7611	2.038	0.047 *
Total Biomass	0.8514	0.7679	0.40822	0.0515	7.920	0.000 ***

bu = plant height cm 0.01068

RESIDUAL ANALYSIS

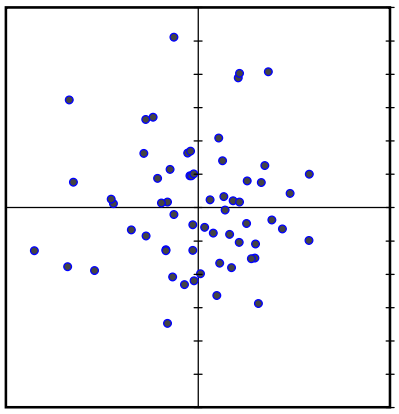
Durbin Watson d	1.9605	p	0.0197
Theil Nagar (Small Sample)		p	0.0461
Cochrane Orcutt		rho	-0.0677
Runs 28 (+)32 (-)31		Runs Mean	32.4921
Runs' 95% Confidence Limits	24.7785	< to >	40.2056
χ^2	0.5806	Prob.	0.4461

DW is for large population whereas Theil Nagar is corrected for small sample size

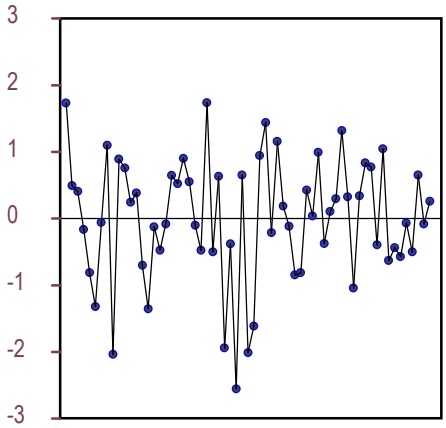
Random oscillations around mean

Equal Distribution in all 4 quadrants

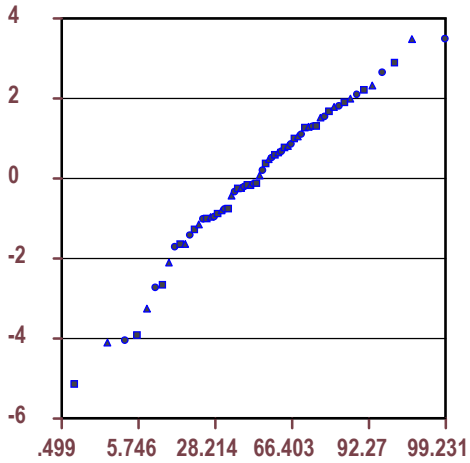
Standardised Residual's Plot et vs et-1



Standardised Residual's Plot et vs. time



Half Normal Plot of Residuals



No.	Est. Y	Residual	Std.Res.	No.	Est. Y	Residual	Std.Res.	No.	Est. Y	Residual	Std.Res.	No.	Est. Y	Residual	Std.Res.	No.	Est. Y	Residual	Std.Res.
1	20.515	3.485	1.73	14	18.643	-1.413	-0.70	27	20.249	1.271	0.63	40	20.273	-1.703	-0.85	53	26.011	1.549	0.77
2	19.405	0.995	0.49	15	17.903	-2.723	-1.35	28	25.549	-3.909	-1.94	41	21.742	-1.632	-0.81	54	17.928	-0.798	-0.40
3	21.144	0.816	0.41	16	28.679	-0.249	-0.12	29	26.360	-0.760	-0.38	42	12.089	0.861	0.43	55	31.958	2.102	1.04
4	30.248	-0.328	-0.16	17	24.464	-0.954	-0.47	30	27.938	-5.138	-2.55	43	25.909	0.081	0.04	56	21.128	-1.268	-0.63
5	23.028	-1.638	-0.81	18	26.101	-0.161	-0.08	31	17.762	1.308	0.65	44	31.593	1.997	0.99	57	25.638	-0.878	-0.44
6	26.007	-2.657	-1.32	19	32.142	1.298	0.65	32	26.163	-4.043	-2.01	45	22.694	-0.754	-0.37	58	23.575	-1.145	-0.57
7	21.898	-0.118	-0.06	20	17.956	1.054	0.52	33	22.349	-3.249	-1.61	46	16.361	0.209	0.10	59	28.684	-0.134	-0.07
8	15.856	2.214	1.10	21	17.153	1.817	0.90	34	24.219	1.901	0.94	47	18.616	0.594	0.30	60	20.479	-1.009	-0.50
9	20.156	-4.096	-2.04	22	20.713	1.107	0.55	35	31.623	2.897	1.44	48	15.324	2.656	1.32	61	29.392	1.308	0.65
10	21.909	1.791	0.89	23	21.639	-0.199	-0.10	36	19.217	-0.427	-0.21	49	24.307	0.653	0.32	62	23.433	-0.163	-0.08
11	27.575	1.525	0.76	24	18.298	-0.958	-0.48	37	37.843	2.327	1.16	50	23.626	-2.096	-1.04	63	19.538	0.522	0.26
12	15.813	0.487	0.24	25	20.173	3.497	1.74	38	16.033	0.377	0.19	51	12.211	0.679	0.34				
13	26.887	0.773	0.38	26	23.500	-1.000	-0.50	39	15.170	-0.230	-0.11	52	21.489	1.681	0.84				

R^2	0.8862	R^2adj	0.8693
F	52.5461 (8 , 54)	Probability	0.0000 ***
RMS Error	1.9934	AIC	1.5113

	Beta Wt.	R square	Reg. Coeff.	Std.Err.	t-value	t Prob.
INTERCEPT a		0.0000	8.01879	14.5286	0.552	0.583
Days to Maturity	-0.0471	-0.0222	-0.10367	0.1270	0.816	0.418
Peduncle Volume	-0.0613	-0.0096	-0.51557	0.5097	1.012	0.316
Eearhead Nos.	-0.0378	-0.0215	-0.06019	0.1626	0.370	0.713
Eearhead Length cm	-0.1147	-0.0308	-0.48241	0.3320	1.453	0.152
Spikes/Main Eearhead	0.0750	0.0272	0.33496	0.2564	1.306	0.197
Seeds/Spikeltee of M	0.1619	0.0799	1.76687	0.7615	2.320	0.024 *
Main Eearhead Wt.	0.1914	0.0929	1.55775	0.7516	2.073	0.043 *
Total Biomass	0.8539	0.7702	0.40944	0.0497	8.237	0.000 ***

bu = eearhead nos. 0.13703

R^2	0.8859	R^2adj	0.8714
F	60.9901 (7 , 55)	Probability	0.0000 ***
RMS Error	1.9777	AIC	1.4821

	Beta Wt.	R square	Reg. Coeff.	Std.Err.	t-value	t Prob.
INTERCEPT a		0.0000	7.21317	14.2515	0.506	0.615
Days to Maturity	-0.0458	-0.0215	-0.10068	0.1258	0.800	0.427
Peduncle Volume	-0.0581	-0.0091	-0.48891	0.5006	0.977	0.333
Eearhead Length cm	-0.1019	-0.0273	-0.42854	0.2961	1.447	0.153
Spikes/Main Eearhead	0.0676	0.0246	0.30230	0.2388	1.266	0.211
Seeds/Spikeltee of M	0.1644	0.0811	1.79375	0.7521	2.385	0.021 *
Main Eearhead Wt.	0.1976	0.0959	1.60820	0.7333	2.193	0.033 *
Total Biomass	0.8230	0.7423	0.39460	0.0292	13.529	0.000 ***

bu = days to maturity 0.64070

Beta Weight is standardised Partial Regression Coefficient and is equal to direct Path Effect.

Sum of R square column will be R^2, so we can directly estimate the contribution of each character to R^2.

R^2adj is R^2 adjsted to Degree of Freedom as is an estimate of population R^2.

R^2	0.8845	R^2adj	0.8722
F	71.5071 (6 , 56)	Probability	0.0000 ***
RMS Error	1.9714	AIC	1.4619

	Beta Wt.	R square	Reg. Coeff.	Std.Err.	t-value	t Prob.
INTERCEPT a		0.0000	-3.67063	4.2546	0.863	0.392
Peduncle Volume	-0.0473	-0.0074	-0.39773	0.4859	0.819	0.417
Eearhead Length cm	-0.1121	-0.0301	-0.47152	0.2902	1.625	0.110
Spikes/Main Eearhead	0.0758	0.0276	0.33895	0.2337	1.451	0.152
Seeds/Spikeltee of M	0.1643	0.0811	1.79354	0.7496	2.393	0.020 *
Main Eearhead Wt.	0.1900	0.0922	1.54627	0.7269	2.127	0.038 *
Total Biomass	0.7996	0.7212	0.38339	0.0255	15.032	0.000 ***

bu = peduncle volume 0.66998

By deleteing a variable whose t-value is <1, R^2 adj will increase, as we are dropping a variable whse contribution is nil

R^2	0.8832	R^2adj	0.8729
F	86.1734 (5 , 57)	Probability	0.0000 ***
RMS Error	1.9657	AIC	1.4420

	Beta Wt.	R square	Reg. Coeff.	Std.Err.	t-value	t Prob.
INTERCEPT a		0.0000	-4.86159	3.9865	1.220	0.228
Eearhead Length cm	-0.1306	-0.0350	-0.54889	0.2736	2.006	0.050 *
Spikes/Main Eearhead	0.0896	0.0325	0.40020	0.2207	1.813	0.075
Seeds/Spikeltee of M	0.1720	0.0849	1.87739	0.7405	2.535	0.014 *
Main Eearhead Wt.	0.1772	0.0860	1.44192	0.7135	2.021	0.048 *
Total Biomass	0.7925	0.7148	0.38001	0.0251	15.143	0.000 ***

^^ STEP DOWN ^^

R^2	0.8764	R^2adj	0.8679
F	102.8384 (4 , 58)	Probability	0.0000 ***
RMS Error	2.0041	AIC	1.4664

	Beta Wt.	R square	Reg. Coeff.	Std.Err.	t-value	t Prob.
INTERCEPT a		0.0000	0.72146	2.5816	0.279	0.781
Eearhead Length cm	-0.1150	-0.0309	-0.48367	0.2765	1.749	0.086
Seeds/Spikeltee of M	0.1726	0.0852	1.88411	0.7549	2.496	0.015 *
Main Eearhead Wt.	0.1553	0.0754	1.26377	0.7205	1.754	0.085
Total Biomass	0.8280	0.7468	0.39699	0.0237	16.726	0.000 ***

Marginal drop in R^2 adj, as we are dropping a variable who is contributing atleast something to R^2

R^2	0.8699	R^2adj	0.8633
F	131.5082 (3 , 59)	Probability	0.0000 ***
RMS Error	2.0387	AIC	1.4860

	Beta Wt.	R square	Reg. Coeff.	Std.Err.	t-value	t Prob.
INTERCEPT a		0.0000	-2.83768	1.6162	1.756	0.084
Seeds/Spikeltee of M	0.2100	0.1036	2.29206	0.7304	3.138	0.003 **
Main Eearhead Wt.	0.0538	0.0261	0.43748	0.5534	0.790	0.432
Total Biomass	0.8207	0.7402	0.39351	0.0241	16.355	0.000 ***

bu = main eearhead wt. 0.62485

Inrease in R^2 adj as tthe variable deleted is not contributing anything to R^2

R^2	0.8685	R^2adj	0.8641
F	198.1890 (2 , 60)	Probability	0.0000 ***
RMS Error	2.0323	AIC	1.4648

	Beta Wt.	R square	Reg. Coeff.	Std.Err.	t-value	t Prob.
INTERCEPT a		0.0000	-2.92938	1.6070	1.823	0.073
Seeds/Spikeltee of M	0.2459	0.1213	2.68338	0.5354	5.012	0.000 ***
Total Biomass	0.8285	0.7472	0.39724	0.0235	16.890	0.000 ***