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MODEL FOR PREDICTING GAS FLARING IN NIGER DELTA

[1]Oloro John and [2]Ukrakpor Erhimudia Friday
[1]Delta State University, Petroleum Engineering Department, Oleh Campus, [2]Delta State University, Mechanical Engineering Department, Oleh Campus

ABSTRACT
Oil production has been going on in Nigeria for over45 years together with the flaring of natural gas. It is important to know the amount of gas been flared for every production of oil and gas. Hence, this paper is on development of a model to predict gas flaring. This was done by analyzing production data from NNPC record and multiple regressions was carried out and Durbin Watson statistic model was used to test for adequacy .It is clear that the model developed a sure-fire that can predict gas flaring in oil companies

KEYWORDS: Predicting, Gas flaring, Linear, Product

INTRODUCTION
Gas flaring is the burning of crude oil's associated gas. In Nigeria's Niger Delta, the flaring process is usually very close to communities and their farmlands have been implicated in serious environmental degradation of the region. Studies have suggested links between gas flaring and health problems in the communities and others have established relationship between gas flaring and poor agricultural yields[1]. The increase in the gas flaring necessitated the need to look into how much gas is been flared for every oil and gas produced. Consequently in this work model will be developed to predict gas flared for every oil and gas produced.

RESEARCH DESIGN
A 21-year gas flaring productivity data (1980 – 2000) was obtained from NNPC record. A data columns for the variables studied were examined for intercorrelations and graphs of relationship obtained (see appendix).The relationship between variable and final product(Gas flared)were essentially linear. With this insigt, a least square method of regression was adopted[2].The regression parameters were computed with Excel program me (Table 2)

The regression parameters were then substituted into regression model to obtain the required predictive equation. The predicting model would take the form:

$$Y=a_0 + a_1x_1+ a_2x_2 \text{---------------------} 1.0$$

Where Y= Gas flared (dependent variable)

X_1=Oil produced
X_2 = Gas produced
} Predictor variable

a_0,a_1,a_2 are the least squares regression estimates

Table 1: Production data

Year	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Gas flare(Y)	22214	13470	11940	11948	12813	13922	13917	12194	14740	18784	22410	24660
Prod.oil(X_1)	7.5E08	5.3E08	4.7E08	4.5E08	5.1E08	5.5E08	5.4E08	4.8E08	4.9E08	6.3E08	6.2E08	6.2E08
Prod.gas(X_2)	24551	17113	15362	15192	16251	18569	18738	17170	20250	25129	28430	31460

Year	1992	1993	1994	1995	1996	1997	1998	1999	2000
Gas flare	24575	25770	26910	26986	26590	24234	23632	22362	24255
Prod.oil	6.9E08	7.2E086	7.0E08	6.5E08	6.7E08	6.8E08	8.6E08	7.7E08	7.67E08
Prod.gas	32084	33680	33680	35100	35450	37150	37039	43636	42732

Table 2: Computation of regression of parameters

Year	Gas flared	Oil Produced.	Gas Produced					
	Y	X1	X2	$X1^2$	$X2^2$	YX1	YX2	X1X2
1980	22214	752223285	24551	5.7E+17	602751601	1.67099E+13	545375914	1.84678E+13
1981	13470	525500562	17113	2.8E+17	292854769	7.07849E+12	230512110	8.99289E+12
1982	11940	470687221	15362	2.2E+17	235991044	5.62001E+12	183422280	7.2307E+12
1983	11948	450974545	15192	2E+17	230796864	5.38824E+12	181514016	6.85121E+12
1984	12813	507998992	16251	2.6E+17	264095001	6.50899E+12	208224063	8.25549E+12
1985	13922	547089595	18569	3E+17	344807761	7.61658E+12	258517618	1.01589E+13
1986	13917	535296671	18738	2.9E+17	351112644	7.44972E+12	260776746	1.00304E+13
1987	12194	482886071	17170	2.3E+17	294808900	9.59495E+11	34116790	8.29115E+12
1988	14740	490440000	20250	2.4E+17	410062500	9.74995E+11	40257000	9.93141E+12
1989	18784	626449500	25129	3.9E+17	631466641	1.24601E+12	49981581	1.5742E+13
1990	22410	623245500	28430	3.9E+17	808264900	1.24026E+12	56575700	1.77189E+13
1991	24660	690981500	31460	4.8E+17	989731600	1.37574E+12	62636860	2.17383E+13
1992	24575	716262000	32084	5.1E+17	1.029E+09	1.42679E+12	63911328	2.29806E+13
1993	25770	695398000	33680	4.8E+17	1.134E+09	1.38593E+12	67124240	2.3421E+13
1994	26910	646285000	33680	4.2E+17	1.134E+09	1.28869E+12	67157920	2.17669E+13
1995	26986	672549000	35100	4.5E+17	1.232E+09	1.34174E+12	70024500	2.36065E+13
1996	26590	681894600	35450	4.6E+17	1.257E+09	1.36106E+12	70758200	2.41732E+13
1997	24234	855736287	37150	7.3E+17	1.38E+09	1.70891E+12	74188550	3.17906E+13
1998	23632	766500000	37039	5.9E+17	1.372E+09	1.53147E+12	74003922	2.83904E+13
1999	22362	767504000	43636	5.9E+17	1.904E+09	1.53424E+12	87228364	3.34908E+13
2000	24255	855736287	42732	7.3E+17	1.826E+09	1.71147E+12	85464000	3.65673E+13
41790	318102	1.3362E+10	578766	1.8E+20	3.35E+11	5.58383E+14	2.419E+10	7.73326E+15

MODEL TESTING

The model developed was used to generate values known as residuals (e_t).Durbin Watson Model (D.W) as given was used to test validity of the model developed.

$$D.W = \frac{\sum_{t=2}^{n}(e_t - e_{t-1})^2}{\sum_{t=1}^{n} e_t^2} - - - - - - - - 2.0$$

The Durbin Watson test for significance was accepted at p<0.5 sigificance level or probability.From equation 2.0 above,e_t = residuals which is the difference between actual value and that obtained with the model[3]

HYPOTHESIS

The test for this model using the D.W. statistic is unique, in that there are certain ranges of D.W.values for which we need to consider

H_0 : There exist no relationship between oil and gas production with gas flaring
H_1: There exist relationship between oil and gas production with gas flaring

DECISION CRITERIA

IF Computed D.W.> d_L accept H_0
If D.W.< d_n reject H_0
If $d_L \geq D.W \leq d_n$ the test is indecisive
d_L =Lower limit , d_n =upper limit

RESULTS AND DISCUSSION

$$\begin{bmatrix} 21 & 13361638616 & 578766 & 318102 \\ 1.33E+10 & 1.82E+20 & 7.73E+15 & 4.44E+15 \\ 578766 & 7.73E+15 & 3.35E+11 & 1.92E+11 \end{bmatrix} \begin{bmatrix} a_0 \\ a_1 \\ a_2 \end{bmatrix} \begin{bmatrix} -689.0913077 \\ 3.83504E-07 \\ 0.565770405 \end{bmatrix}$$

The least squares regression estimates (a_0,a_1 and a_2) are obtained from the matrix as shown above. These values are substituted into equation 1.0 to give the required predictive equation as shown in equation 3.0

$$Y = -689.091307 + 3.83504E-07X_1 + 0.565770405X_2 \text{-------------} 3.0$$

Using the Durbin Watson model given equation 2.0 above and table in appendix,

$$D.W = \frac{\sum_{t=2}^{n}(e_t - e_{t-1})^2}{\sum_{t=1}^{n} e_t^2} = \frac{1.44E+08}{6.16E+08}$$

D.W = 0.233898

Note that
H_0 : There exist no relationship between oil and gas production with gas flaring
H_1: There exists relationship between oil and gas production with gas flaring

From the table
d_L =1.125
d_n =1.538

Hence H_0 is Rejected

Since Durbin Watson computed value, D.W = 0.233898< than critical value from the statistical table we reject the null hypothesis .From table4.0 in appendix we can see that there exist relationship between oil and gas production with gas flaring. That is the more gas produced the gas flaring.

CONCLUSION

From the analysis carried out above and the subsequent discussion, it is clear that sure-fire model that can predict amount of gas been flared for given oil and gas produced. Such a model can provide oil companies in the country important information about gas flaring.

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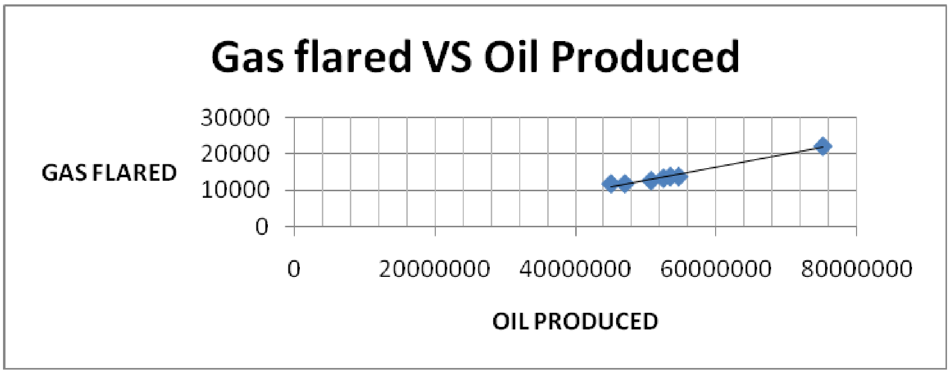
APPENDIX



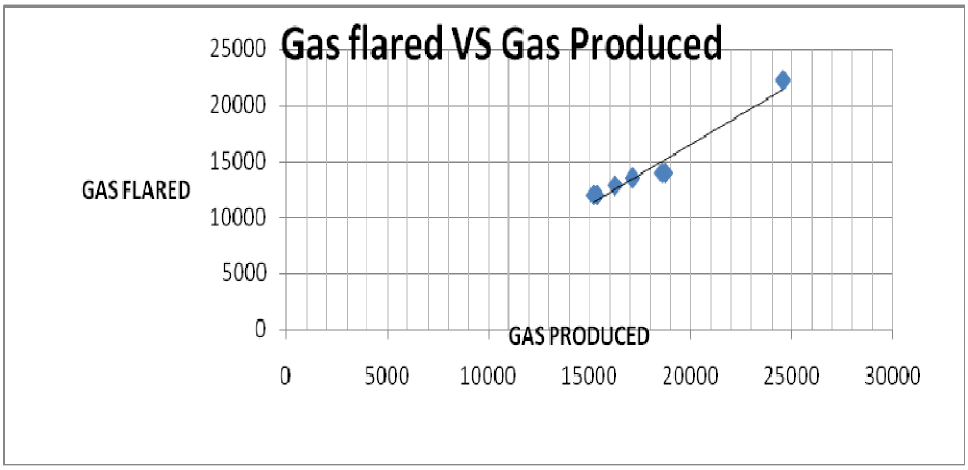


Table 4.0 :Durbin Watson computation

X1	X2	Y	$Y_{predict}$	e_t	e_{t-1}	e_t^2	$e_t - e_{t-1}$	$(e_t - e_{t-1})^2$
7.52E+08	24551	22214	13489.98	8724.02		76108525	8724.02	76108525
5.26E+08	17113	13470	9194.723	4275.277	8724.02	18277993	-4448.74	19791314
4.71E+08	15362	11940	8183.012	3756.988	4275.277	14114959	-518.289	268623.5
4.51E+08	15192	11948	8079.261	3868.739	3756.988	14967141	111.751	12488.29
5.08E+08	16251	12813	8700.309	4112.691	3868.739	16914227	243.952	59512.58
5.47E+08	18569	13922	10026.77	3895.23	4112.691	15172817	-217.461	47289.29
5.35E+08	18738	13917	10117.86	3799.14	3895.23	14433465	-96.09	9233.288
4.83E+08	17170	12194	9210.608	2983.392	3799.14	8900628	-815.748	665444.8
4.9E+08	20250	14740	10956.08	3783.92	2983.392	14318051	800.528	640845.1
6.26E+08	25129	18784	13768.7	5015.3	3783.92	25153234	1231.38	1516297
6.23E+08	28430	22410	15635.08	6774.92	5015.3	45899541	1759.62	3096263
6.91E+08	31460	24660	17375.37	7284.63	6774.92	53065834	509.71	259804.3
7.16E+08	32084	24575	17738.12	6836.88	7284.63	46742928	-447.75	200480.1
6.95E+08	33680	25770	18633.08	7136.92	6836.88	50935627	300.04	90024
6.46E+08	33680	26910	18614.22	8295.78	7136.92	68819966	1158.86	1342956
6.73E+08	35100	26986	19427.69	7558.31	8295.78	57128050	-737.47	543862
6.82E+08	35450	26590	19629.3	6960.7	7558.31	48451344	-597.61	357137.7
8.56E+08	37150	24234	20657.87	3576.13	6960.7	12788706	-3384.57	11455314
7.67E+08	37039	23632	20560.8	3071.2	3576.13	9432269	-504.93	254954.3
7.68E+08	43636	22362	24293.57	-1931.57	3071.2	3730963	-5002.77	25027708
8.56E+08	42732	24255	23816	439	1931.57	192721	-1492.57	2227765
						6.16E+08		1.44E+08

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Corresponding Author
Oloro John
Delta State State University, Petroleum Engineering Department, Oleh Campus, Nigeria
Email:joloroeng@yahoo.com