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MODELLING THE HARMONIZED TERITIARY INSTITUTIONS SALARY STRUCTURE (HATISS IV)

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ABSTRACT

This paper analyses the Harmonized Tertiary Institution Salary Structure (HATISS IV) used in Nigeria. The irregularities in the structure are highlighted. A model that assumes a polynomial trend for the zero step salary, and exponential trend for the incremental rates, is suggested for the regularization of the structure. Furthermore, a model for salary review is proposed.

KEYWORDS: Polynomial trend, exponential trend, Zero step salary, incremental rate, salary modelling.

1.0 INTRODUCTION

The Harmonized Tertiary Institutions Salary Structure (HATISS) consists of fifteen levels and variable steps, see Appendix A (Presidency, 2001) A staff is placed on a particular level and step according to his or her educational qualification and experience, and may be elevated to a higher level and step based on the gain in experience, or qualification and on the length of service (Unical, A & P, 2002).
The salary at each level and step is supposed to be adequate for the expected standard of living of a staff at that level and step. But this is seldom the case.
However, due to the observed increasing cost of living over the years, there is need for the corresponding review of the salary structure. In this paper, the existing salary Structure (HATISS IV) is modeled via a simple linear regression model, and the irregularities observed in the structure are highlighted, graphically. The structure is regularized by fitting a polynomial of degree 6 to the zero step salaries (salary got by subtracting incremental rate at level L from salary at level L step 1) and exponential function to the incremental rates. Furthermore, a model that takes into consideration the rate of inflation is proposed.

2.0. The Model For HATISS IV Structure:

Let y_{LS} be Salary of staff on level L and step S, c_L be salary at level L step 0 (y_{LS} intercept)

m_L be incremental rate at level L.

Then the model for HATISS IV structure can be formulated as follows:

$$y_{LS} = c_L + m_L S \begin{cases} L = 1 \text{ to } 15 \\ S = 1 \text{ to } n_L \end{cases} \qquad (1)$$

where n_L is the number of steps at level L..

The HATISS IV Data:

See appendix A for the HATISS IV data (Presidency, 2001)

Fitting this model (equation 1)to the HATISS IV data using least squares approach, we obtain the following:

$$y_{1s} = 59116 + 1801s, \; s = 1 \text{ to } 15$$

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y_{2s} = 60684 + 2253s, s = 1 to 15

y_{3s} = 63337 + 2708s, s = 1 to 15

y_{4s} = 72175 + 3148s, s = 1 to 15

y_{5s} = 88733 + 3836s, s = 1 to 15

y_{6s} = 119418 + 4729s, s = 1 to 15

y_{7s} = 157351 + 5680s, s = 1 to 15

y_{8s} = 185421 + 6764s, s = 1 to 15

y_{9s} = 218795 + 7437s, s = 1 to 11

y_{10s} = 254209 + 11756s, s = 1 to 11

y_{11s} = 284924 + 12429s, s = 1 to 11

y_{12s} = 315507 + 13381s, s = 1 to 11

y_{13s} = 349705 + 18066s, s = 1 to 9

y_{14s} = 385061 + 21711s, s = 1 to 9

y_{15s} = 428894 + 24639s, s = 1 to 9

3.0 Highlight Of Irregularity In The HATISS IV Structure:

The graph of the incremental rates, m_L, and the zero step salaries, c_L against the salary level, L are shown in fig. 1 and 2 by thin lines respectively. These graphs are obtained from Table 3.1 using '98 version of Ms Excel computer package. As can be seen in fig. 1. and 2, the graphs of the incremental rate and the zero step salary are non smooth curves.

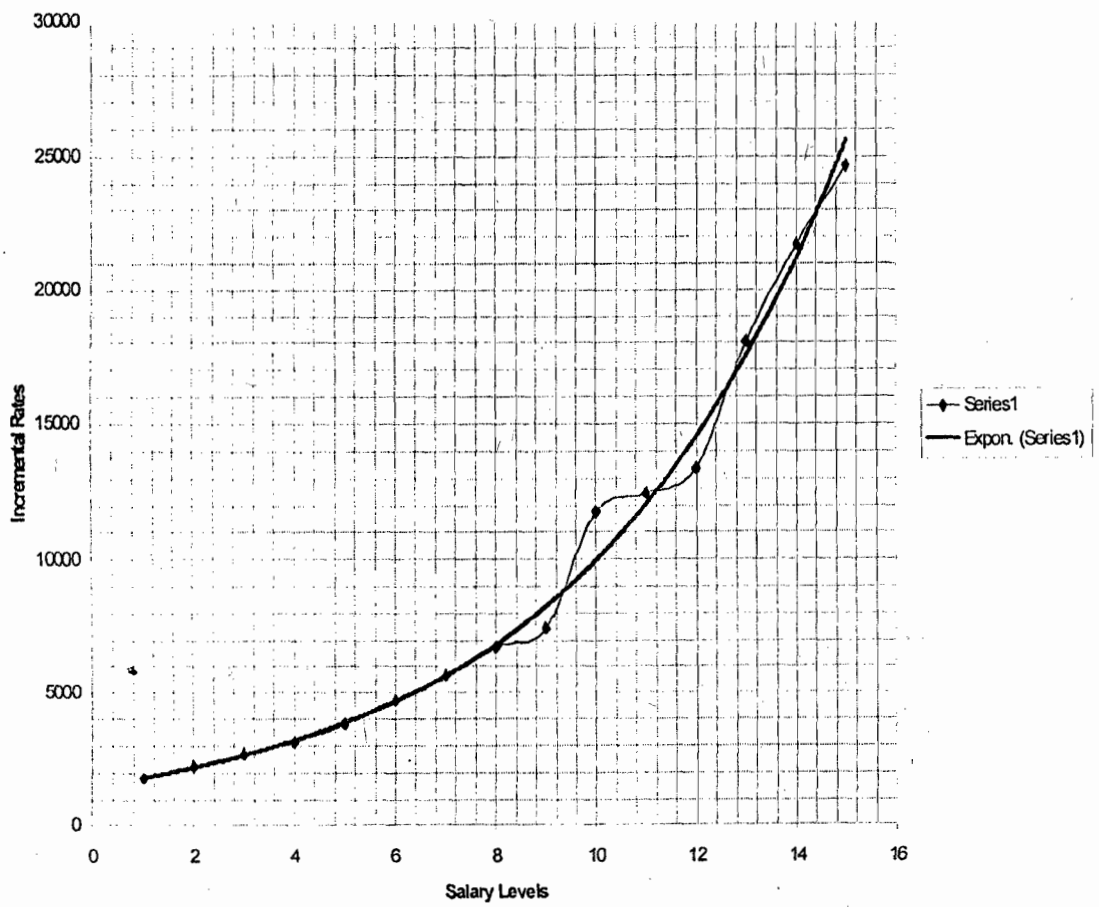

Fig. 1: Graph of incremental rate against level and its Exponential Approximation

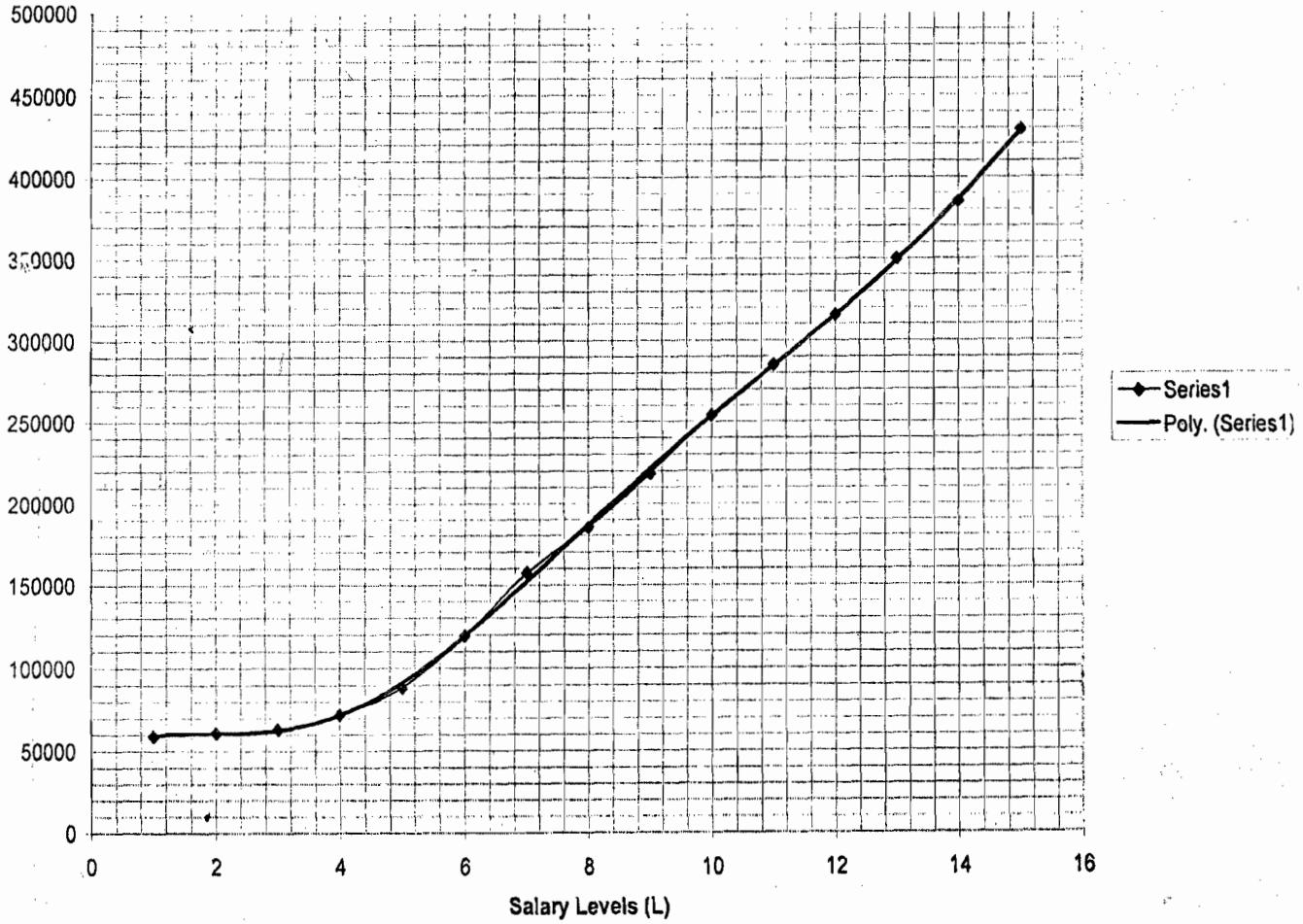

Fig. 2: Graph of Zero Step salary against level and its Polynomial Approximation

In fig. 1, series 1 is the graph of the incremental rate against the salary level, while Expon(series) is the exponential approximation of series 1. Observe that, if the approximating curve (see fig. 1 & 2) is used as the basis for salary payment, staff on levels 9, 12 and 15 would suffer underpayment in terms of the incremental rates, while those on levels 10, 11, 13 and 14 would experienced overpayment, and those on level 1 through 8 would still be on same salary.

In Fig. 2, series 1 is the graph of the zero step salary against the salary level, while poly(series 1) is the polynomial (of degree 6) approximation of series 1. It is observed that, if the zero step salary computations is based on the polynomial approximating curve, staff on salary level 7 would enjoy slight overpayment, and the rest would be on their normal salary.

4.0 A Preliminary Model:

The following proposition are made:

(i) The zero step salary at level L should follow a polynomial trend.

$$"c_l = \sum^{n} a_k L^k + e_l \qquad (2)$$

Table 3.1: Table Of Values For The Graph Of Incremental Rate and Zero Step Salary

Salary level (L)	Incremental Rate(m_L)	Zero Step Salary(C_L)
1	1801	59116
2	2253	60684
3	2708	63337
4	3148	72175
5	3836	88733
6	4729	119418
7	5680	157351
8	6764	185421
9	7437	218795
10	11756	254209
11	12429	284924
12	13381	315507
13	18066	349705
14	21711	385061
15	24639	428894

where e_L is a random error term assumed to have a normal distribution with zero mean and constant variance." (Mathews, 1987, McICave and Dietrich II, 1985, Olaji, 2000).

and a_k, k = 0,1, ..., n are constants to be Determine.

(ii) The incremental rate should follow exponential trend.

$$"m_L = ae^{bL} + e_L, L = 1 \text{ to } 15 \qquad (3)$$

where e_L is a random error term assumed to have a normal distribution with zero mean and constant variance, a and b are constants to be determined" (Mathews, 1987, McICave and Dietrich II, 1985)

4.1 Model Fitting:

By method of least squares, (Mason and Marchal, 1999) equation (2) is fitted to the data in table 3.1 using n = 15. The '98 version of Ms Excel is used to obtain the estimate of the parameters of the equation The estimated equation is therefore,

Also, applying the method of least squares to fit equation 3 to the linearized data of incremental rate

$$\hat{c}_L = 4224.93 + 32763.41L - 20797.40L^2 + 5624.88L^3 - 615.005L^4 + 30.61095L^5 - 0.5724304L^6 \qquad (4)$$

with standard error of estimate = 2428.709 and R^2 = 0.99793.

(Mathews, 1987), the following estimated equation is obtained.

$$\hat{m}_L = 1176\, e^{0.22L} \qquad (5)$$

with, standard error = 857.8116 and R2 = 0.99225.

Substituting for $\hat{c}_L$ and $\hat{m}_L$ in the HATISS IV model yields

The table based on equations (4), (5) and (6) are presented in appendix B, C and D, respectively.

$$\hat{y}_{LS} = 4224.93 + 32763.41L - 20797.40L^2 + 5624.88L^3 - 615.005L^4 + 30.61095L^5 - 0.5724304L^6 + 1176Se^{0.22L} \qquad (6)$$

4.2 The Model For Regularizing The Salary Structure :

As can be observed in appendix A and D, the above approximating model (equation 6) would cause some staff to earn less than their current salaries, some to earn more, (e.g. those on level 1 step 1 would now earn N60,714 instead of N60,917 and e.g. those on level 9 step 1 would now earn N229,864 instead of N226,232). To correct these anomaly, addition of maximum positive deviations of C_L and m_L from their respective estimates to equation (6) is suggested (see appendix B and C).

Therefore, the proposed new model for the HATISS IV structure is

$$\max\{(c_L - \hat{c}_L) > 0: L = 1 \text{ to } 15\} = 4997.6 \qquad (7)$$

and

$$\max\{(m_L - \hat{m}_L) > 0: L = 1 \text{ to } 15\} = 1142.58 \qquad (8)$$

$$\hat{y}_{LS}^{proposed} = 447238.93 + 32763.41L - 20797.40L^2 + 5624.88L^3 - 615.005L^4 + 30.61095L^5 - 0.5724304L^6 + 1143S + 1176Se^{0.22L}, \quad L = 1 \text{ to } 15,\ S = 1 \text{ to } n_L \qquad (9)$$

4.3 A Model For Salary Review:

Let the salary structure be as given in equation (9), and let

r_t be a measure of inflation after a period of time t. Then the following model is proposed for its review.

Supposing the annual rate of inflation at the end of the year 2003 is 31%, the salary has to be adjusted accordingly. By setting $r_t = 0.31$ in equation (10), a new salary table as shown in Appendix F is obtained.

$$\hat{y}_{LS}^{Review} = [447238.933 + 32763.41L - 20797.40L^2 + 5624.88L^3 - 615.005L^4 + 30.61095L^5 - 0.5724304L^6](1 + r_t) + 1143S + 1176Se^{0.22L}, \qquad (10)$$

$L = 1 \text{ to } 15,\ S = 1 \text{ to } n_L \text{ and } t > 0$

The table for the new model (equation 9) is given in appendix E. This table is an improvement on the HATISS IV table given in appendix A.

5. CONCLUSION

The models proposed in this paper would not only correct the irregularity in the HATISS IV structure, but would also serve as a tool for reviewing salary at appropriate time. The arbitrary assignment of percentage increase in salary by the Government should be discouraged. The percentage increase in salary should be based on a well-calculated inflation indices. The models can easily be adapted to any salary structure in use in Nigeria.

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APPENDIX A

HARMONIZE TERTIARY INSTITUTION SALARY STRUCTURE (HATISS IV) STEPS

Level	1 N	2 N	3 N	4 N	5 N	6 N	7 N	8 N	9 N	10 N	11 N	12 N	13 N	14 N	15 N	IR N
1	60917	62718	64519	66320	68121	69922	71723	73524	75325	77126	78927	80728	82529	84330	86131	1801
2	62937	65190	67443	69696	71949	74202	76455	78708	80961	83214	85467	87720	89973	92226	94479	2253
3	66085	68793	71501	74209	76917	79625	82333	85041	87749	90457	93165	95873	98581	101289	103997	2708
4	75323	78471	81619	84767	87915	91063	94211	97359	100507	103655	106803	109951	113099	116247	119395	3148
5	92569	96405	100241	104077	107913	111748	115585	119421	123257	127093	130929	134765	138601	142437	146273	3836
6	124147	128876	133605	138334	143063	147792	152521	157250	161979	166708	171437	176166	180895	185624	190353	4729
7	163031	168711	174391	180071	185751	191431	197111	202791	208471	214151	219831	225511	231191	236871	242551	5680
8	192185	198949	205713	212477	219241	226005	232769	239533	246297	253061	259825	266589	273353	280117	286881	6764
9	226232	233669	241106	248543	255980	263417	270854	278291	285728	293165	300602	308039	315476	322913	330350	7437
10	265965	277721	289477	301233	312989	324745	336501	348257	360013	371769	383525					11756
11	297353	309782	322211	334640	347069	359498	371927	384356	396785	409214	421643					12429
12	328888	342269	355650	369031	382412	395793	409174	422555	435936	449317	462698					13381
13	367771	385837	403903	421969	440035	458101	476167	494233	512299							18066
14	406772	428483	450194	471905	493616	515327	537038	558749	580460							21711
15	453533	478172	502811	527450	552089	576728	601367	626006	650645							24639

Source: National Salaries and Wages Commission, The Presidency, Abuja. Nigeria (2001).

TABLE B:

TABLE OF ZERO STEP SALARY

L	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
C_L	59116	60654	63337	72175	887533	119418	157351	185421	218795	254209	284924	315507	349705	385061	428894
$\hat{C}_L$	59248.85	60682.02	62434.07	72090.07	91571.85	119368	152353.4	187195.1	221346.9	253631.6	284410.9	315343.1	348729.5	386447.2	428771.1
$\hat{C}_L - C_L$	132.85	1.98	902.93	84.85	-2838.85	50	4997.6	-1774.1	-2551.9	577.4	513.1	163.9	975.5	-1386.2	122.9

TABLE C:

TABLE OF INCREMENTAL RATE

$$\hat{m}_L = 1176\, e^{.22l}$$

L	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
M_L	1801	2253	2708	3148	3836	4729	5680	6764	7437	11756	12429	13381	18066	21711	24639
$\hat{M}_L$	1465.386	1825.984	2275.316	2835.218	3532.899	4402.264	5485.558	6835.426	8517.466	10613.42	13225.13	16479.53	20554.76	25587.68	31884.46
$\hat{M}_L - M_L$	335.614	427.016	432.684	312.782	303.101	326.736	194.442	-71.426	-1080.47	1142.58	-796.13	-3098.53	-2468.76	-3876.88	-7245.46

TABLE D:

TABLE BASED ON THE PRELIMINARY MODEL

$$\hat{Y}_{LS} = 42242.93 + 32763.41L - 20797.40L^2 + 5624.88L^3 - 615.005L^4 + 30.61095L^5 - 0.5724304L^6 + 1176Se^{0.22L}$$

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	INR
	60714	62180	63646	65112	66578	68044	69510	70976	72442	73908	75374	76840	78306	79772	81238	1466
	62508	64334	66160	67986	69812	71638	73464	75290	77116	78942	80768	82594	84020	86246	88072	1826
	64709	66985	69261	71537	73813	76089	78365	8064'	82917	85193	87469	89745	92021	94297	96573	2276
	74925	77761	80597	83433	86269	89105	91941	94777	97613	100449	103285	106121	108957	111793	114629	2836
	95105	98638	102171	105704	109237	112770	116303	119836	123369	126902	130435	133968	137501	141034	144567	3533
6	123770	128173	132576	136979	141382	145785	150188	154591	158994	163397	167800	172203	176606	181009	185412	4403
7	157839	163325	168811	174297	179783	185269	190755	196241	201727	207213	212699	218185	223671	229157	234643	5486
8	194031	200866	207701	214536	221371	228206	235041	241876	248711	255546	262381	269216	276051	282886	289721	6835
9	229864	236382	246900	256418	263936	272454	280972	289490	298008	306526	315044	323562	332080	340598	349116	8518
10	264245	274859	285473	296087	306701	317315	327929	338543	349157	359771	370385					10614
11	297636	310861	324086	337311	350536	363761	376986	390211	403436	416661	429886					13225
12	331823	348302	364781	381260	397739	414218	430697	447176	463655	480134	496613					16479
13	369264	389799	410364	430903	451464	472019	492574	513129	5338640							20711
14	412035	437623	463211	488799	514387	539975	565563	591151	616739							25588
15	460356	492240	524124	556008	587892	619776	651660	683544	715428							31884

TABLE E:

PROPOSED TABLE FOR HATISS IV

$$\hat{Y}_{LS}^{Proposal} = 47239.6 + 32763.41L - 20797.40L^2 + 5624.88L^3 - 615.005L^4 + 30.61095L^5 - 0.5724304L^6 + 1142 + 1176Se^{0.22L}$$

L/S	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	INR
1	66853	69461	72069	74677	77285	19893	82501	85109	87717	90325	92933	95541	98149	100757	103365	2608
2	68647	71616	74585	77554	80523	83492	86461	89430	92399	95368	98337	101306	104275	107244	110213	2969
3	70849	74267	77685	81103	84521	87939	91357	94775	98193	101611	105029	108447	11865	115283	118701	3418
4	81065	85043	89021	92999	96977	100955	104933	108911	112889	116867	120845	124823	128801	132779	136757	3978
5	101244	105920	110596	115272	119948	124624	129300	133976	138652	143328	148004	152680	157356	162032	166708	4676
6	129910	135455	141000	146545	152090	157635	163180	168725	174270	179815	185360	190905	196450	210995	207540	5545
7	163978	170606	177234	183862	190490	197118	203746	210374	217002	223630	250258	236886	243514	250142	256770	6628
8	200170	208148	216126	224104	232082	240060	248038	256016	263994	271972	279950	287928	295906	303884	311862	7978
9	236004	245664	255324	264984	274644	284304	293964	303624	313284	322944	332604	342264	351924	361584	371244	9660
10	270384	282140	293896	305652	317408	329164	340920	352676	364432	376188	387944					11756
11	303775	318143	332511	346879	361247	375615	389983	404351	418719	433087	447455					14368
12	337962	355584	373206	390828	408450	426072	443694	461316	478938	496560	514182					17622
13	375404	397081	418758	440435	462112	483789	505466	527143	548820							21677
14	418174	444905	471636	498367	525098	551829	578560	605291	632022							26731
15	466495	499522	532549	565576	598603	631630	664657	697684	730711							33027

TABLE F:

TABLE FOR SALARY REVIEW (2003)

$$\hat{Y}_{LS}^{Review} = (47239.6 + 32763.41L - 20797.40L^2 + 5624.88L^3 - 615.005L^4 + 30.61095L^5 - 0.5724304L^6)(1 + r_t) + 11435 + 1176Se^{0.22L},\ Y_{2003} = 0.31$$

L/S	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	INR
1	84161	86769	89377	91985	94593	97201	99809	102417	105025	107633	110241	112849	115457	118065	120673	2608
2	86038	89007	91976	94945	97914	100883	103852	106821	109790	112759	115728	118697	121666	124635	127604	2969
3	88335	91753	95171	98589	102007	105425	108843	112261	115679	119097	122515	125933	129351	132769	136187	3418
4	100984	104962	108940	112918	116896	120874	124852	128830	132808	136786	140764	144742	148720	152698	156676	3978
5	131180	135856	140532	145208	149884	154560	159236	163912	168588	173264	177940	182616	187292	191968	196644	4676
6	162918	168463	174008	179553	185098	190643	196188	201733	207278	212823	218368	223913	229458	235003	240548	5545
7	212757	2198385	226013	232641	239269	245897	252525	259153	265781	272409	279037	285665	292293	298921	305549	6628
8	259750	267728	275706	283684	291662	299640	307618	315596	323574	331552	339530	347508	355486	363464	371442	7978
9	306171	315831	325491	335151	344811	354471	364131	373791	383451	393111	402771	412431	422091	431751	441411	9660
10	350559	362315	374071	385827	397583	409339	421095	432851	444607	456363	468119					11756
11	393491	407859	422227	436595	450963	465331	479699	494067	508435	522803	527171					14368
12	437267	454889	472511	490133	507755	525377	542999	560621	578243	595865	613487					17622
13	485059	506736	528413	550090	571767	593444	615121	636798	658475							21677
14	539521	566252	592983	619714	646445	673176	699907	726638	753369							26731
15	600870	633897	666924	699951	732978	766005	799032	832059	865086							33027