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Statistical Analysis of Industrial processed Cheese puffs

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ABSTRACT

This paper studied and fit a Multivariate linear regression model to the relationship between the response variables; Weight and Bulk density on one hand, and the predictor variables; Temperature, Moisture content before extrusion and Moisture content after extrusion on the other hand, of Cheese puffs product, manufactured by Zubix Company Limited, Anambra, Nigeria. A sample size of three hundred (300) cheese puffs packs were collected from a population of two-thousand, seventy-eight batches between August 2013 to June 2014, examined and used for analysis. A temperature of 186.67˚C was discovered to be significantly related to the response variable.

Introduction

Cheese puffs are a puffed corn snack, coated with a mixture of cheese or cheese-flavored powders. As a household name in Nigeria, Cheese puffs are commonly referred to as Cheese balls. They are either locally or industrially processed food in the form of confectionaries. Some common brand names include; Cheetos (U.S.), Cheez Doodles (Northeastern U.S.), Chee-Wees (New Orleans, South Central U.S.), Chizitos (Perú), Boliquesos (Perú), Cheezies (Canada), Twisties (Australia), Kurkure (India and Pakistan), Utz (U.S.) Wotsits (U.K.), Curl (Japan) and Chee.Toz (Iran) [1], etc. Cheese puffs were invented in the United States of America in the 1930s; there are two competing accounts of it origin [2]. According to one account, Edward Wilson and/or Clarence J. Schwebke of the Flakall Corporation of Beloit, Wisconsin (a producer of flaked, partially cooked animal feed) deep-fried and salted the puffed corn produced by their machines, and later added cheese. He applied for a patent in 1939 and the product, named *Korn Kurls*, was commercialized in 1946 by the Adams Corporation, formed by one of the founders of Flakall and his sons [3]. Adams was later bought by Beatrice Foods. Another account claims they were invented by the Elmer Candy Corporation of New Orleans, Louisiana some time during or prior to 1936 at which time the sales manager for Elmer's, Morel M. Elmer, Sr., decided to hold a contest in New Orleans to give this successful product a name. The winning name "CheeWees" is still being used today by the manufacturing company, Elmer's Fine Foods.The fictitious brand of cheese puffs called "Cheesy Poofs" appears regularly in the animated television series South Park, and the Frito-Lay company made a limited run of the snack in August 2011 [4].

Cheese puffs are manufactured by extruding heated corn dough through a die that forms the particular shape. They may be ball-shaped, animal-shaped, curly ("cheese curls"), straight, or irregularly shaped. Some cheese puffs are puffy while others are crunchy.

The Enriched cornmeal and seasoning are the two main components of Cheese puffs. Cornmeal as one of the major or primary ingredient of cheese puffs is made by grinding dried maize or corn into coarse flour [5] [6]. Iron,Niacin,Thiamine, Riboflavin and Folic acid are vitamins and minerals which are added to the cornmeal to enrich the nutrient content [7]. Food fortification plays an important role in ensuring the health of the consumers, as the added micronutrients can replace the nutrients that are lost during the manufacturing process of the cornmeal flour [8]. Other recipes used in the production of cheese puffs are; Salt, Refined vegetable oil, Natural Cheese solid, Natural and Artificial flavor, Sunset yellow FCF, Corn maltodextrin etc. Fig. 1 (a) shown the industrially package cheese puffs in a polytene sachets. Cheese puffs can be found in local grocery and corner stores and are enjoyed by many [9]. It is usually sold to the public for consumption as shown in the bowl, while (b) shown the opened packets and the cheese puffs in a bowl.

(a)

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(b)

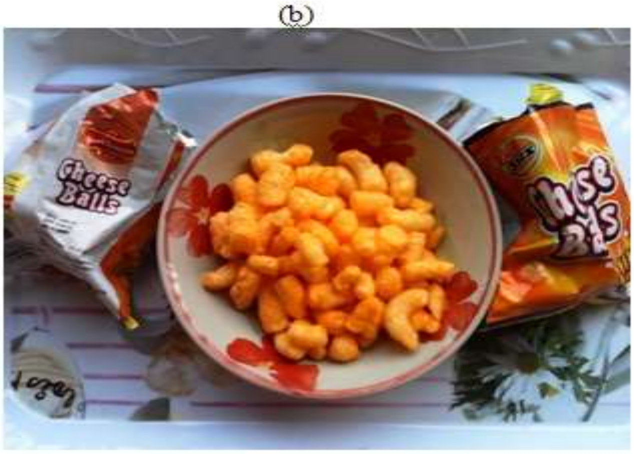

Fig. 1
(a) An industrial package Cheese puffs placed in a bowl.
(b) Cheese puffs and its pack in a bowl.

Cheese puffs, particularly the ball-shaped type are usually consumed in Nigeria by both children and adult, and its average weight and Bulk density are almost infinitesimal as can be observed in its light weight and volume per mass value. These parameters (average weight and Bulk density) which formed the amount of substance in the products, determines the quality of the products. However, the nature of this two parameters do not seems to affect its high consumption or sales either because of the taste or the inability of the consumers to make such judgments.

Despite the high consumption of cheese puffs products in Nigeria and the world in general, there is currently no known research work on the analysis of any of its parameters, as most write-up or articles deals on its recipe and preparations. Therefore, this study whose main aim and objective is to analyzed the relationship between the average weight and bulk density, on one hand, the oven temperature and moisture content before and after extrusion on the other hand, will stand in the gap of research work to be considered and used as reference points.

This paper used the Multivariate linear regression analysis which models the relationship between “m” responses and a set of predictor variables, where each response is assumed to follow its own regression model [10]. It is an extension of the multiple linear regressions.

Materials and methods

The Multivariate linear regression analysis was applied to the 300 data shown in appendix I, collected from Zubix Company Limited, Anambra, Nigeria. The multivariate modeled the relationship between the "p" responses $X_1, X_2, X_3, \dots \dots \dots X_p$ and a set of "q" predictor variable $Y_1, Y_2, Y_2, \dots \dots \dots Y_q$.

Each of the "p" responses is assumed to follow own regression model. Statistical software such as R version 3.0.1 (2013-05-16) and Minitab (2006) were used in carrying out the analysis.

The response variables used are;

$X_1 = Weight\ (grame), X_2 = Bulk\ density\ (grame/litre)$

While the predictor variable;

$Y_1 = Temperature(^\circ C), Y_2 = Moisture\ before\ Extrusion, Y_3 = Moisture\ after\ Extrusion$

Therefore,

$$\begin{aligned}
X_1 &= \beta_{01} + \beta_{11}Y_1 + \beta_{21}Y_2 + \cdots + \beta_{q1}Y_q \\
X_2 &= \beta_{02} + \beta_{12}Y_1 + \beta_{22}Y_2 + \cdots + \beta_{q2}Y_q \\
&\vdots \\
X_p &= \beta_{0p} + \beta_{1p}Y_1 + \beta_{2p}Y_2 + \cdots + \beta_{qp}Y_q
\end{aligned}$$

Where the error term is;

$$E(\varepsilon) = E\begin{bmatrix} \varepsilon_I \\ \varepsilon_2 \\ \cdot \\ \cdot \\ \varepsilon_p \end{bmatrix} = 0$$

And $Var(\varepsilon) = \sum$

Then, let $[Y_{j0}, Y_{j1}, Y_{j2} \cdots\cdots\cdots Y_{jq}]$ be the j^{th} trial for the predictor variable;

and

$$X_j = \begin{bmatrix} X_{j1} \\ X_{j2} \\ \cdot \\ \cdot \\ X_{jp} \end{bmatrix}, \quad \varepsilon_j = \begin{bmatrix} \varepsilon_{j1} \\ \varepsilon_{j2} \\ \cdot \\ \cdot \\ \varepsilon_{jp} \end{bmatrix}$$ be the response and errors for the j^{th} trial

Therefore,

$$Y_{(n\ X\ (q+1))} = \begin{bmatrix} Y_{10}, & Y_{11}, & \cdots & Y_{1q} \\ Y_{20}, & Y_{21}, & \cdots & Y_{2q} \\ \cdot & \cdot & & \cdot \\ \cdot & \cdot & & \cdot \\ \cdot & \cdot & & \cdot \\ Y_{n0}, & Y_{n1}, & \cdots & Y_{nq} \end{bmatrix}$$

and

$$X_{(n\ X\ p)} = \begin{bmatrix} X_{11}, & X_{12}, & \cdots & X_{1p} \\ X_{21}, & X_{22}, & \cdots & X_{2p} \\ \cdot & \cdot & & \cdot \\ \cdot & \cdot & & \cdot \\ \cdot & \cdot & & \cdot \\ X_{n1}, & X_{n2}, & \cdots & X_{np} \end{bmatrix} = [X_{(1)}, X_{(2)}, \ldots\ldots X_{(p)}]$$

$$\beta_{((q+1)\ X\ p)} = \begin{bmatrix} \beta_{01}, & \beta_{02}, & \cdots & \beta_{0p} \\ \beta_{11}, & \beta_{12}, & \cdots & \beta_{1p} \\ \cdot & \cdot & & \cdot \\ \cdot & \cdot & & \cdot \\ \cdot & \cdot & & \cdot \\ \beta_{q1}, & \beta_{q2}, & \cdots & \beta_{qp} \end{bmatrix} = [\beta_{(1)}, \beta_{(2)}, \ldots\ldots \beta_{(p)}]$$

Where,

"β" is the $((q+1)\ X\ p)$ matrix of parameter of regression, "X" is the $(n\ X\ p)$ matrix of the response variable, and "ε" is the $(n\ X\ p)$ matrix of errors or residuals.

$$\varepsilon_{(n\ X\ p)} = \begin{bmatrix} \varepsilon_{11}, & \varepsilon_{12}, & \cdots & \varepsilon_{1p} \\ \varepsilon_{21}, & \varepsilon_{22}, & \cdots & \varepsilon_{2p} \\ \cdot & \cdot & & \cdot \\ \cdot & \cdot & & \cdot \\ \cdot & \cdot & & \cdot \\ \varepsilon_{n1}, & \varepsilon_{n2}, & \cdots & \varepsilon_{np} \end{bmatrix} = [\varepsilon_{(1)}, \varepsilon_{(2)}, \ldots\ldots \varepsilon_{(p)}] = \begin{bmatrix} \varepsilon_{(1)} \\ \varepsilon_{(2)} \\ \cdot \\ \cdot \\ \varepsilon_{(p)} \end{bmatrix}$$

Then, the multivariate linear regression model is; $X = Y\beta + \varepsilon$

Where;

$E[\varepsilon_{(i)}] = 0$ and $Cov\ (\varepsilon_i, \varepsilon_k) = \sigma_{ik} I$

Therefore, the covariance matrix;

$$\Sigma = \begin{bmatrix} \sigma_{11}, & \sigma_{12}, & \cdots & \sigma_{1p} \\ \sigma_{21}, & \sigma_{22}, & \cdots & \sigma_{2p} \\ \vdots & \vdots & & \vdots \\ \sigma_{p1}, & \sigma_{p2}, & \cdots & \sigma_{pp} \end{bmatrix}$$

The ordinary leastsquare estimate given by;

$\hat{\beta}_{(i)} = (Y'Y)^{-1}Y'X_{(i)}$ for parameter $\beta = [b_{(1)}, b_{(2)} \cdots b_p]$

with matrix of error; $X - Y\beta$

Then the error sum of square and product is

$$(X - Y\beta)'(X - Y\beta) = \begin{bmatrix} (X_{(i)} - Yb_{(i)})'(X_{(i)} - Yb_{(i)}) \cdots & (X_{(i)} - Yb_{(i)})'(X_{(p)} - Yb_{(p)}) \\ \vdots & \vdots \\ (X_{(i)} - Yb_{(i)})'(X_{(i)} - Yb_{(i)}) \cdots & (X_{(i)} - Yb_{(i)})'(X_{(p)} - Yb_{(p)}) \end{bmatrix}$$

Where $b_{(i)} = \hat{\beta}_{(i)}$ minimizes the i^{th} diagonal sum of square $(X_{(i)} - Yb_{(i)})'(X_{(i)} - Yb_{(i)})$ therefore,

$tr[(X_{(i)} - Yb_{(i)})'(X_{(i)} - Yb_{(i)})]$

Then matrix of predicted and residuals values formed are;

$\hat{X} = Y\hat{\beta} = Y(Y'Y)^{-1}Y'X$, $\hat{\varepsilon} = X - \hat{X} = [1 - Y(Y'Y)^{-1}Y']X$ respectively

The hypothesis that the responses do not depend on predictor variables $Y_{u+1}, Y_{u+2}, \ldots Y_q$ is,

$$H_O : \beta_{(2)} = 0$$

Where

$$\beta = \frac{\beta_{(1)}}{\beta(2)}$$

Therefore the general model can be written as;

$$E[X] = Y\beta = [Y_{(1)}\ Y_{(2)}] \begin{bmatrix} \beta_{(1)} \\ \beta_{(2)} \end{bmatrix} = Y_{(1)}\beta_{(1)} + Y_{(2)}\beta_{(2)}$$

And the likelihood ratio for the hypothesis is given as;

$$H_O : \beta_{(2)} = 0$$

If the ratio of generalized variance is given by;

$$\Lambda = \frac{Max\,\beta_{(1),\Sigma}\, \mathcal{L}(\hat{\beta}_{(i)}, \hat{\Sigma}_{(i)})}{Max\,\beta,\Sigma\, \mathcal{L}(\hat{\beta}, \hat{\Sigma})} = \frac{\mathcal{L}(\hat{\beta}_{(i)}, \hat{\Sigma}_{(i)})}{\mathcal{L}(\hat{\beta}, \hat{\Sigma})}$$

$$\Lambda^{\frac{2}{n}} = \frac{|\hat{\Sigma}|}{|\hat{\Sigma}_{(i)}|}$$

The multivariate regression model with full rank $(Y) = q + 1,\ n \geq q + 1 + p$ normally distributed with error ε, and the null hypothesis is true,

$$-\left[n-q-1-\frac{1}{2}\,(p-q+w+1)\right] In[\frac{|\hat{\Sigma}|}{|\hat{\Sigma}_{(i)}|}] \sim \chi^2_{q(r-w)}$$

If the confidence interval for the predicted mean value of X_0 associated with Y_0 Model, with $\hat{\beta}'Y_0 \sim Np\,(\hat{\beta}Y_0, Y_0'(Y'Y)^{-1}Y_0\,\Sigma)$ and $n\hat{\Sigma} \sim W_n - r - 1\,(\Sigma)$. Then the $100(1-\alpha)\%$ confidence intervals for the mean value of X_i is;

$$Y_0'\hat{\beta}_{(i)} \pm \sqrt{\frac{p(n-q-1)}{n-q-p}\,F_{p,n-q-p(\alpha)}} * \sqrt{Y_0'(Y'Y)^{-1}Y_0\frac{n}{n-q-1}\,\hat{\sigma}_{ii}} \quad i = 1,2,,\ldots\ldots\ldots\ldots p$$

And the $100(1-\alpha)\%$ prediction interval for the X_0 is given as;

$$Y_0'\hat{\beta}_{(i)} \pm \sqrt{\frac{p(n-q-1)}{n-q-p}\,F_{p,n-q-p(\alpha)}} * \sqrt{1 + Y_0'(Y'Y)^{-1}Y_0\frac{n}{n-q-1}\,\hat{\sigma}_{ii}} \quad i = 1,2,,\ldots\ldots\ldots\ldots p$$

Where $\hat{\beta}_{(i)}$ and $\hat{\sigma}_{ii}$ is the i^{th} column of $\hat{\beta}$ and $\hat{\Sigma}$ respectively.

The statistical hypotheses for this study are;

H_O **:** All parameters (average weight, Bulk density, oven temperature, and moisture content before and after extrusion) are not significant.

Vs

H_1 **:** At least a parameter is significant.

Results and discussion

If the predictor and response variables are given by "Y" and "X" respectively, then the formed matrices are given as;

$$Y'Y = \begin{bmatrix} 300 & 56586 & 4536 & 846 \\ 56586 & 11076031 & 857142 & 159491 \\ 4536 & 857142 & 71084 & 12794 \\ 846 & 159491 & 12794 & 2427 \end{bmatrix}$$

and,

$$Y'X = \begin{bmatrix} 4262 & 12179 \\ 803410 & 2298686 \\ 64381 & 184173 \\ 12007 & 34339 \end{bmatrix}$$

Therefore,

$$(Y'Y)^{-1} = \begin{bmatrix} 0.389637 & -0.000472 & -0.005894 & -0.073758 \\ -0.000472 & 0.000002 & -0.000001 & 0.000009 \\ -0.005894 & -0.000001 & 0.000403 & 0.000031 \\ -0.073758 & 0.000009 & 0.000031 & 0.025386 \end{bmatrix}$$

$$\hat{\beta} = Y(Y'Y)^{-1}Y'X = \begin{bmatrix} 15.8796 & 41.3836 \\ -0.0011 & 0.0033 \\ -0.0240 & 0.0001 \\ -0.3896 & -0.4994 \end{bmatrix}$$

$$\hat{X} = Y\begin{bmatrix} 15.8796 & 41.3836 \\ -0.0011 & 0.0033 \\ -0.0240 & 0.0001 \\ -0.3896 & -0.4994 \end{bmatrix} + \varepsilon$$

$$\hat{X}_{(1)} = 15.8796 - 0.0011Y_1 + 0.0240Y_2 - 0.3896Y_3$$
$$\hat{X}_{(2)} = 41.3836 + 0.0033Y_1 + 0.0001Y_2 - 0.4994Y_3$$

Therefore,

$$\hat{\beta}_1 = \begin{bmatrix} 15.8796 \\ -0.0011 \\ -0.0240 \\ -0.3896 \end{bmatrix}, \hat{\beta}_2 = \begin{bmatrix} 41.3836 \\ 0.0033 \\ 0.0001 \\ -0.4994 \end{bmatrix}$$

The Regression Parameter test of Significance,

$$n\hat{\Sigma} = \begin{bmatrix} 571.362 & 6.806 \\ 6.806 & 1417.661 \end{bmatrix}$$

$$\hat{\Sigma} = \begin{bmatrix} 1.90454 & 0.02269 \\ 0.02269 & 4.72554 \end{bmatrix}$$

$$H_O \ : \ \beta_{(2)} = 0$$

Where

$$\beta = \frac{\beta_{(1)}}{\beta(2)}$$

Therefore,

$$\beta = \begin{bmatrix} 15.8796 & 41.3836 \\ -0.0011 & 0.0033 \\ \hline -0.0240 & 0.0001 \\ -0.3896 & -0.4994 \end{bmatrix}$$

$$Y = [Y_{(1)}/Y_{(2)}]$$

Where the dimension of both $Y_{(1)}$ and $Y_{(2)}$ is given as (500 X 2)

$$n\hat{\Sigma}_{(1)} = (X - Y_1\hat{\beta}_1)'(X - Y_1\hat{\beta}_1)$$

$$= \begin{bmatrix} 578.72 & 14.43 \\ 14.43 & 1427.49 \end{bmatrix}$$

$$\hat{\Sigma}_{(1)} = \begin{bmatrix} 1.9290 & 0.0481 \\ 0.0481 & 4.7583 \end{bmatrix}$$

$$n(\hat{\Sigma}_{(1)} - \hat{\Sigma}) = \begin{bmatrix} 7.35744 & -7.62435 \\ 7.62435 & 9.82716 \end{bmatrix}$$

$|\hat{\Sigma}| = 8.9994$, and $|\hat{\Sigma}_{(1)}| = 9.1767$

$$\Lambda^{\frac{2}{n}} = \frac{8.9994}{9.1767} = 0.9807$$

$$= -[500 - 3 - 1 - \tfrac{1}{2}(2 - 3 + 1 + 1)]ln\, 0.9807$$

$$= 5.7553$$

$$\chi^2_{4,\ 0.05} = 9.4900$$

Therefore,

5.7553 < 9.4900

Thus, the oven temperature affects the weight and bulk density of Zubix International company significantly. In order words, there is a joint relationship between average weight and bulk density on one hand, and the oven temperature on the other hand.
If the proposed model in predicting the values of the response variable, is given as;

$$\hat{X} = Y\hat{\beta}$$

$[X_{j1}/X_{j2}] = [Y_1][\hat{\beta}_1]$

Then the 16^{th} $trial$ is given as,

$$[X_{16(1)}/X_{16(2)}] = [1 \;\; 204.924]\begin{bmatrix} 15.8796 & 41.3836 \\ -0.0011 & 0.0033 \end{bmatrix}$$

$$[X_{16(1)}/X_{16(2)}] = [15.6541 \quad 42.0598]$$

The implication of this is that when the oven temperature is fix at 204.9240 ℃, then the average weight and bulk density are predicted to be 15.6541 grammes and 42.0598 grammes per litre respectively. This shows that the predictive model performs well given the predicted values as 15.6541 and 42.0598. Therefore, for the 16^{th} $trial$, the confidence interval for the predicted mean value of the Average weight is given as;

$$X_{16,1} = [15.65418363 \pm \sqrt{\frac{2(300-3-1)}{300-3-2} * F_{2,295}\,(0.05)} \;*\; \sqrt{41993.7455 * \frac{300}{296} * 1.90454}\,]$$

$$\therefore X_{16,1} = 15.65418363 \pm 698.5742927$$

$$= 714.2284 \geq X_{16,1} \geq -682.9201$$

While the bulk density is given as;

$$X_{16,2} = [42.0598492 \pm \sqrt{\frac{2(300) - 3 - 1}{300 - 3 - 2} * F_{2,295}\,(0.05)} \;*\; \sqrt{41993.7455 * \frac{300}{296} * 4.72554}\,]$$

$$X_{16,2} = 42.0598492 \pm 2699.937712$$

$$= 2741.9975 \geq X_{16,2} \geq -2657.8778$$

Similarly, the 16^{th} $trial$ for 95% prediction intervals for values of X_0 is given as;

$$X_{16,1} = [15.65418363 \pm \sqrt{\frac{592}{295} * 300} \;*\; \sqrt{1 + 41993.7455 * \frac{300}{296} * 1.90454}\,]$$

Therefore,

$$X_{16,1} = 15.65418363 \pm 1100.384215$$

$$= 1116.0383 \geq X_{16,1} \geq -1084.7300$$

while the bulk density is given as;

$$X_{16,2} = [42.0598492 \pm \sqrt{\frac{592}{295} * 300} \;*\; \sqrt{1 + 41993.7455 * \frac{300}{296} * 4.72554}\,]$$

$$X_{16,2} = 42.0598492 \pm 1100.38399$$

$$\Longrightarrow 1142.0398 \geq X_{16,2} \geq -1058.3241$$

Conclusion

In this study, a test of significance revealed that only the oven temperature is significance when a multivariate linear regression model was used in modeling the relationship between average weight and Bulk density of the Cheese balls on one hand, and oven temperature moisture content before extrusion and moisture content after extrusion on the other hand.

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Serial Numbers	Average Weight	Bulk Density	Oven Temp.	Moisture before Extrusion	Moisture after Extrusion	Serial Numbers	Average Weight	Bulk Density	Oven Temp.	Moisture before Extrusion	Moisture after Extrusion

Appendix 1

1	13.477	41.764	170.892	14.569	2.818	66	15.218	41.660	167.404	14.941	3.273
2	13.952	41.802	189.911	17.079	2.731	67	11.885	35.741	174.379	14.797	3.055
3	12.792	38.001	241.572	16.419	2.614	68	14.836	42.479	179.581	14.550	3.450
4	14.849	38.876	190.690	14.453	1.919	69	14.585	40.914	193.572	20.276	2.956
5	13.079	38.573	182.863	16.627	2.516	70	15.390	42.190	247.376	14.863	2.552
6	13.497	39.580	156.252	15.704	3.078	71	12.952	43.368	196.124	19.685	2.772
7	15.004	40.580	196.466	14.535	2.911	72	15.406	41.709	138.463	16.638	2.806
8	16.054	35.898	251.682	12.800	2.301	73	13.554	40.457	203.772	17.088	3.612
9	14.619	45.006	188.921	13.519	2.202	74	13.905	40.096	227.000	17.834	3.419
10	14.384	40.830	162.356	11.285	2.066	75	15.878	40.138	169.511	15.587	2.737
12	16.282	37.767	154.146	13.131	3.251	76	14.157	40.915	196.366	14.104	3.183
13	13.979	36.131	134.362	17.513	1.942	77	13.922	41.829	241.790	16.309	2.386
14	14.349	42.012	173.767	16.020	2.583	78	13.435	41.908	183.969	17.496	3.132
15	12.982	42.142	159.434	08.999	2.877	79	14.672	42.422	206.898	15.091	3.127
16	15.172	39.524	204.924	09.136	2.389	80	14.746	38.572	198.276	12.815	2.795
17	14.291	43.217	138.737	14.741	2.345	81	15.927	45.366	184.171	16.922	2.226
18	14.216	42.403	250.536	13.559	2.879	82	12.263	35.096	246.863	17.245	2.853
19	15.396	39.532	199.886	18.711	2.881	83	13.128	39.422	155.684	16.948	3.253
20	13.989	40.061	179.531	15.587	2.938	84	12.904	37.779	194.277	16.904	3.217
21	15.913	41.713	186.990	18.296	3.163	85	14.763	41.719	174.748	08.561	3.102
22	15.038	40.478	179.768	13.676	3.000	86	12.870	39.765	210.471	15.392	2.973
23	15.766	43.347	221.802	12.670	2.470	87	11.601	41.197	181.292	15.231	3.295
24	13.099	40.654	207.902	15.717	2.749	88	12.148	45.605	101.933	15.668	2.476
25	15.260	41.941	203.999	13.663	2.292	89	14.626	43.066	182.157	10.579	2.858
26	15.871	39.388	202.687	15.111	3.193	90	14.117	40.217	219.636	20.430	3.772
27	14.043	41.308	230.906	17.792	2.898	91	12.199	40.493	172.439	13.758	2.798
28	11.915	41.962	116.515	08.648	3.089	92	14.963	38.072	165.379	15.181	2.824
29	14.989	40.978	145.770	13.902	2.862	93	13.614	43.761	181.053	07.250	3.218
30	15.015	39.729	170.514	16.808	3.009	94	15.899	42.242	163.859	15.154	3.032
31	13.032	40.757	214.282	16.644	2.219	95	13.569	36.968	164.195	15.280	2.897
32	12.230	44.012	205.829	18.147	3.358	96	13.467	40.455	147.711	17.667	3.446
33	16.481	39.597	163.473	16.035	2.648	97	14.031	42.272	212.303	12.763	2.617
34	15.670	41.399	271.626	14.036	2.743	98	13.437	41.402	187.693	22.672	3.084
35	12.611	41.318	153.471	14.911	2.718	99	15.307	39.163	182.384	15.210	2.829
36	15.047	39.660	209.849	17.410	3.180	100	13.228	41.531	147.890	13.569	2.780
37	15.808	40.852	159.242	13.640	2.725	101	12.767	40.267	162.966	10.814	2.751
38	12.707	39.501	189.114	14.949	2.710	102	13.758	38.575	130.292	16.475	2.778
39	11.025	39.581	168.123	17.057	2.787	103	15.516	42.108	239.683	17.145	3.136
40	16.267	41.148	176.759	12.936	2.531	104	14.315	43.248	234.557	15.618	2.238
41	17.959	39.098	198.672	13.253	2.990	105	11.041	35.412	167.284	13.184	2.297
42	14.519	42.055	154.007	13.671	3.278	106	12.453	39.289	200.183	17.168	2.763
43	14.385	40.929	186.735	17.799	2.912	107	12.717	44.892	175.238	22.126	2.430
44	16.381	36.011	193.560	10.642	3.043	108	14.040	34.330	165.372	9.683	2.637
45	13.300	42.475	233.602	10.874	3.009	109	14.089	42.533	224.339	16.040	2.736
46	12.581	41.384	189.698	13.071	2.928	110	11.762	40.065	185.419	14.686	2.292
47	15.286	40.455	137.189	10.566	2.952	111	14.080	38.922	178.348	14.626	2.765
48	14.452	36.725	188.660	14.437	3.306	112	12.684	42.013	196.939	17.446	3.308
49	14.568	36.734	222.107	14.846	2.651	113	13.846	41.418	129.618	17.456	2.257
50	14.405	40.291	202.738	12.304	2.334	114	13.130	42.023	224.572	16.464	2.929
51	12.359	38.869	234.938	17.143	2.407	115	13.934	43.238	179.577	13.577	2.520
52	16.475	44.660	177.630	15.983	3.150	116	12.840	39.836	128.796	8.509	2.864
53	14.349	41.226	237.006	15.179	2.947	117	12.316	38.775	214.544	17.015	3.309
54	16.853	39.194	200.747	13.453	2.587	118	15.528	38.166	150.052	15.657	2.654
55	15.862	35.350	110.361	17.380	2.349	119	11.911	38.146	232.341	15.858	2.994
56	16.550	35.368	190.358	15.303	2.716	120	14.626	40.110	168.954	15.437	2.213
57	13.238	41.202	270.425	17.335	2.278	121	15.824	38.449	121.208	13.605	2.706
58	15.421	41.679	252.196	11.540	2.378	122	13.446	42.838	243.662	18.732	2.717
59	14.514	42.034	217.177	18.098	2.411	123	14.231	41.174	255.757	20.511	3.076
60	14.454	38.368	176.432	17.316	3.222	124	13.016	39.054	147.378	9.806	3.217
61	14.633	40.520	145.360	16.808	2.750	125	17.887	40.530	160.567	19.008	2.163
62	12.455	43.351	161.245	15.889	3.140	126	13.564	40.662	228.231	13.819	2.582
63	16.042	40.785	249.318	11.170	2.979	127	13.761	41.274	133.209	15.504	2.595
64	12.492	40.049	182.440	18.282	3.165	128	16.345	41.901	168.800	15.179	3.262
65	12.839	40.213	233.323	17.452	2.718	129	14.747	44.576	187.670	14.510	2.919

130	14.462	35.864	174.021	16.964	2.333	199	15.539	44.238	193.449	13.348	2.583
131	13.257	40.189	193.782	15.825	3.330	200	13.371	38.946	175.320	13.763	2.889
132	16.409	41.755	193.144	11.528	2.839	201	15.317	40.320	223.525	17.914	2.602
133	13.689	41.311	155.266	15.241	3.311	202	12.716	37.559	273.897	08.675	2.903
134	14.896	44.169	126.976	16.234	2.267	203	13.404	37.119	214.331	16.611	3.465
135	12.942	42.748	168.841	15.321	2.368	204	14.491	38.579	161.104	17.066	3.814
136	17.487	39.927	174.029	19.056	2.726	205	10.569	42.184	156.444	16.090	2.989
137	15.343	37.797	172.854	13.299	2.195	206	16.130	38.921	188.160	14.791	2.464
138	15.261	39.076	212.621	17.342	2.697	207	13.520	45.317	174.516	22.571	2.522
139	13.974	39.448	213.504	19.318	2.595	208	16.195	40.587	236.813	09.670	2.528
140	15.059	39.742	212.045	15.621	3.106	209	15.672	42.005	188.570	15.128	2.821
141	14.193	38.435	163.842	16.764	3.288	210	13.428	40.416	218.070	13.587	3.276
142	13.802	43.514	234.867	15.608	2.879	211	13.784	39.736	224.489	19.599	2.460
143	14.219	39.631	111.307	18.104	2.674	212	13.802	43.469	124.921	12.886	3.075
144	15.469	37.718	202.971	13.647	2.852	213	14.743	42.943	197.425	17.971	2.463
145	12.550	41.844	170.965	15.231	2.565	214	17.719	36.835	168.176	14.769	3.156
146	15.395	37.718	181.236	19.581	3.294	215	11.374	37.903	151.417	18.776	2.610
147	13.538	39.692	175.824	13.619	2.749	216	12.285	41.913	203.378	15.797	2.522
148	14.660	39.975	149.367	10.317	3.399	217	14.534	38.175	243.219	15.146	2.936
149	13.688	38.530	253.202	16.714	3.468	218	14.296	40.817	125.672	13.074	2.711
150	14.038	39.486	216.461	13.885	2.590	219	15.963	43.388	262.715	12.352	2.543
151	15.106	38.447	186.206	17.065	3.296	220	14.673	40.097	160.289	15.967	2.779
152	14.452	40.875	181.359	14.096	3.683	221	14.971	42.926	204.724	15.306	2.682
153	14.393	39.683	174.738	14.294	2.981	222	14.709	40.404	234.072	13.024	2.050
154	12.777	43.521	243.039	13.547	2.779	223	15.467	43.168	232.867	19.982	2.838
155	16.193	45.946	175.658	14.339	2.641	224	13.426	43.365	203.596	16.191	3.247
156	13.578	43.455	236.591	16.112	3.089	225	15.981	37.811	164.089	13.631	2.827
157	13.063	39.477	155.427	18.064	2.590	226	13.492	40.311	265.291	15.609	2.426
158	13.718	40.835	154.823	13.539	3.128	227	14.571	36.484	163.633	10.566	2.560
159	14.480	41.376	119.756	12.041	2.546	228	13.404	39.764	213.175	21.020	2.703
160	14.978	43.181	156.403	13.313	3.528	229	15.994	40.944	154.854	15.803	2.710
161	14.497	38.512	198.922	16.916	3.259	230	12.734	41.096	182.801	14.347	2.709
162	14.978	41.638	164.805	15.477	2.311	231	13.707	41.811	236.504	15.565	2.809
163	12.150	44.358	218.031	16.006	3.125	232	12.657	41.874	216.023	16.932	2.529
164	13.318	39.037	128.770	11.537	3.955	233	14.516	40.446	194.252	09.563	3.083
165	13.624	42.674	218.339	12.458	3.185	234	16.123	40.797	206.002	08.617	2.717
166	14.092	38.319	188.279	17.539	3.512	235	13.011	39.693	210.731	13.025	2.934
167	17.045	37.994	230.245	14.438	2.735	236	15.019	39.687	183.413	11.750	2.834
168	14.213	41.265	142.347	14.771	3.226	237	15.478	37.740	173.112	20.418	2.947
169	12.226	37.498	145.335	12.239	2.749	238	15.419	39.968	265.611	16.178	2.568
170	15.144	42.349	202.003	17.551	2.252	239	14.490	40.590	224.104	17.318	2.808
171	15.470	42.399	124.710	06.487	3.174	240	14.018	39.985	184.112	18.322	2.627
172	12.140	40.873	201.157	11.662	3.571	241	12.324	41.972	224.862	16.442	2.605
173	15.999	37.559	197.601	13.592	3.073	242	12.666	42.690	213.623	18.109	2.829
174	15.564	42.582	197.023	14.631	2.857	243	14.250	47.293	179.174	15.419	2.722
175	15.783	43.834	215.747	19.267	3.116	244	13.560	38.218	214.238	18.891	2.941
176	15.188	41.840	220.454	17.341	2.541	245	15.860	41.231	238.139	14.803	2.591
177	16.306	40.195	212.892	20.446	2.618	246	15.695	39.950	124.336	16.033	3.191
178	13.703	40.027	182.222	16.997	3.073	247	15.020	40.868	222.388	15.801	2.236
179	12.247	38.796	165.025	16.226	2.763	248	13.988	38.766	069.236	14.688	2.621
180	13.625	42.766	245.430	13.218	2.552	249	09.898	39.406	238.297	15.194	2.662
181	15.301	44.319	247.367	15.932	2.556	250	14.340	45.146	136.386	19.628	2.501
182	12.599	37.634	139.619	10.985	2.455	251	16.654	44.142	161.535	13.439	3.074
183	12.845	42.281	202.354	11.880	2.704	252	13.828	42.185	208.499	10.244	3.267
184	14.270	40.208	132.149	13.520	2.653	253	13.534	39.559	238.166	15.368	2.878
185	16.700	38.351	191.072	18.651	2.795	254	13.179	36.202	215.686	16.765	3.613
186	13.031	35.843	182.633	12.735	3.446	255	14.497	42.790	183.498	14.014	2.973
187	14.198	43.328	205.415	13.851	2.198	256	14.467	39.655	182.518	21.763	3.061
188	14.655	40.275	225.483	15.740	2.460	257	17.525	42.335	198.041	18.136	2.294
189	13.698	42.550	141.870	13.015	2.545	258	13.602	40.212	138.998	16.923	2.540
190	14.706	41.720	234.001	10.803	2.920	259	15.722	39.845	155.915	10.888	2.695
191	11.973	42.351	186.673	13.392	3.047	260	11.200	38.397	176.702	16.565	2.638
192	13.270	41.042	248.303	11.310	3.328	261	15.998	44.611	146.871	16.978	2.313
193	13.949	41.624	280.087	12.856	3.389	262	12.199	39.082	218.498	14.183	2.929

194	14.363	38.629	145.302	22.955	3.053	263	14.003	40.614	203.015	17.815	2.625
195	14.948	41.158	160.555	17.365	2.220	264	13.434	40.745	195.367	11.449	3.351
196	16.343	39.068	227.477	14.951	2.575	265	11.411	42.099	154.877	15.598	1.894
197	14.793	40.830	185.367	11.053	2.912	266	14.159	41.444	199.612	08.432	2.558
198	13.794	41.657	220.208	09.491	2.653	267	15.804	42.043	198.213	12.137	2.254
268	12.077	38.321	195.680	17.737	3.090						
269	12.922	39.447	141.024	11.460	2.786						
270	13.375	44.799	162.722	17.062	2.800						
271	14.675	42.903	167.284	17.385	3.504						
272	13.025	43.190	178.891	14.727	2.767						
273	16.211	40.992	161.401	18.777	2.907						
274	13.871	39.820	168.250	12.525	2.580						
275	14.141	40.805	245.134	15.174	2.555						
276	15.781	39.548	168.308	15.559	2.935						
277	13.617	39.542	136.368	20.301	2.690						
278	12.896	39.403	242.384	15.347	2.715						
279	12.453	40.370	272.821	16.657	2.468						
280	13.000	41.000	190.000	12.000	2.700						
281	13.000	40.000	190.000	18.500	2.700						
282	18.000	40.000	190.000	12.500	2.600						
283	14.200	39.000	190.000	13.100	2.900						
284	14.000	41.000	190.000	12.000	3.100						
285	13.000	44.000	180.000	12.000	3.000						
286	13.100	39.000	165.000	13.100	2.900						
287	13.000	38.000	200.000	19.100	2.100						
288	14.100	39.000	120.000	19.000	3.000						
289	16.800	40.000	095.000	18.000	2.900						
290	13.100	44.000	190.000	14.600	3.200						
291	14.200	44.000	185.000	18.300	3.400						
292	14.000	41.000	120.000	18.000	2.600						
293	13.100	40.000	190.000	12.500	2.900						
294	13.000	40.000	190.000	18.300	3.400						
295	14.500	39.000	180.000	14.600	2.500						
296	14.200	38.000	095.000	13.000	3.200						
297	13.100	38.000	200.000	18.100	2.900						
298	14.100	42.000	220.000	18.500	3.000						
299	13.200	44.000	190.000	12.000	2.500						
300	17.000	43.000	190.000	13.100	2.000						