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# Study of the Challenges of Human Errors and its Effects on Safety of Navigation

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**Abstract** Safety is generally agreed as an acceptable state of risk by the society. In maritime domain it is regarded as one of the major factors that are usually considered owing to the economic imparts resulting from shipping activities. Safety is unacceptable when there is threat to lives, cargoes, environment and equipment of the ship. These threats are usually caused by unsafe act or unsafe environment during shipping or offshore operations. Rules and regulations have been established by different statutory players in the industry to safeguard unaccepted risk. Despite these rules there are increasing incidences of maritime accidents. Human imperfection is mostly believed to contribute to the maritime mishap. This is treated in this paper with data collated from an online database published each year. Null and alternative hypothesis are setup and a suitable statistical analysis (Chi-square) was carried out. It is envisioned from the analysis results at 0.01 and 0.001 confident interval that human errors are still one of the components of maritime accident in favour of the null hypothesis.

**Keywords** Safety, human error, Maritime Accident, Rules and Regulations, Navigation

## 1. Introduction

Tracing back to the history of the unsinkable ship, Titanic [1] and the North Sea Oil platform incidences (Piper Alpha [2-3]), safety is said to be paramount for navigation, and depends on the environment and human action. The occurrence of maritime accidents and incidents has instigated formation of rules and regulation governing navigation by sea, by the united nation organ (International Maritime Organization (IMO)) responsible for maritime operation and as well as states and classification societies. Despite the various rules and regulations, it has been observed that there are still challenges that effect safety of navigation.

Several research works have been carried out in these regards and it was noted that human error could be the sole cause of maritime accidents. Humans are involved the problem solving of maritime activities, covering from the conception of the solution to maritime problem through design, build, operation, and maintenance to recycling. Assumptions are made during design that may lead to decision making which may favour the ship function or mission accomplishment and on the other hand may cause adverse effect on the structural function of the ship. Shipbuilding if not properly done, may lead structural deformation, instability and on so and so

forth. The operations on-board and offshore facilities are virtually handled by humans. These pose verifiable dangers to the live of screw or worker and passengers, and the total cost of ship or offshore platforms.
To ensure safety, human errors must be minimized since to err is human. This work on one part seeks to verify that human error truly is the cause of maritime accident and on the other part seeks to know at what trend is human error tends to. This is achieved by using published data of maritime accident record to carry out statistical analysis on them and as well as the use of regression analysis in the study of trend.

**Background of the Study**

The concern over the life and properties worth billions of dollars that are often lost on West African seacoast has necessitated research on the challenges of human error and its effect on the safety of navigation. Trade growth slowed at a time of record capacity, resulting in bankruptcies, and economic strains [4]. Some of these researchers have demonstrated that human error causes most of the maritime accidents. Rothblum [5] showed that human error causes more than 75% to 96% of maritime accidents, and Barsan, et al [6] opined that human error causes more than 80% of maritime accidents. It was explained that human error is mainly rooted in fatigue, the lack of situational awareness and the safety culture of crews on board ship.
However, in preventing human error, there are several limitations in terms of quantity and quality of information. Decision making to help prevent dangerous navigational situations and timely response to emergencies is inadequate. The important point from the findings above is that each human error in an accident acts as one of the conditions to cause the accident, which means that an accident caused by combined multiple human errors might be preventable if one of the errors had been eliminated in advance and the chain had been blocked [5].
One way to identify the types of human errors relevant to the maritime industry is to study marine accidents and determine how there happen and their effect on the safety of navigation. In looking at how accidents happen, it is therefore pertinent to trace the development of an accident through a number of discrete events. The forgoing investigation has provided an impetus into the study on the challenges of human error and the effect on safety of navigation.

**State-of-the-Art Review**

Research on the influence of human error on the safety of navigation has remained little known, challenges, and consequence on accident resulting from the negligence of marine crew onboard, fatigue, environmental and weather conditions have seen the light in the area of this research. Ugurlu et al. [7] showed that human error causes between 80 and 90% of maritime accidents. Wagenaar and Groeneweg [8] analysis 100 accidents at sea and showed that a large proportion of casualties are caused by multiple errors made by multiple people.
Some researchers have contributed immensely in the study of maritime accident and that of other sectors. Many scholars have defined the term accident; according to Ceyhun [9] accidents are undesired events that result from unexpected combination of human error, mechanical failure, and environmental conditions that lead to adverse consequences such as injury, loss of life, economic loss, environmental damage and loss of property thereby affecting the safety of navigation.
Akten [10] in his work explained that accident is anything that happens without anticipation and expectation an unusual event, which proceeds from unknown cause or is an unusual effect of a known cause. Narrowing down the definition to marine accident, IMO, (1996) define marine accident and incident' and 'marine casualty' as an undesirable event that arises from shipping operations.
From the above definition, it is a clear indication that accidents occur in almost all circles of human existence especially in most industrial occupations, manufacturing, construction, marine and air transportation. Marine vessel accident is common in inland and coastal navigation, when necessary safety regulations and human errors are not observed.
For marine organizations, an important concern is how to prevent vessel casualties involving personal injury, deaths, property and environmental damage through the establishment of maintenance culture of strict adherence to safety practices. Accidents are not only injurious to lives and properties, but also hinder corporate business success. Consequently, a high level of safety performance is essential.

Onwuegbuchunam [11] reported that in Nigeria, the number of marine accidents increases with increase in the level of oil prospecting and other maritime transport activities along the Niger-Delta and coastal regions. Dogarawa [12] recorded 552 deaths in Nigeria between year 2000 and 2009, resulting from either marine vessel and boat capsizing or collision in inland waters. Ekpo [13] recorded, an average fatality rate of about 55 deaths per year excluding vessel and cargo losses in Nigeria's coastal and inland waterways in the last ten years. Accidents such as described above if experience at sea, as a norm, the industry investigate, with the view to identify the cause(s), evaluate the effects of the accident on lives and property, proffer remedial solutions and establish a system that would prevent the reoccurrence of such accident in future.

From early research, the attribute of marine accidents was technological breakdown; human element was on the neglect. However, [12, 14] explained that with the continuous improvement in vessel design, technical infrastructure and global regulatory supervision, the frequency of technological failures has diminished and human factors have become more apparent determinant of marine accidents.

Lutzhoft and Dekker [15] argued that contrary to the widespread opinion that increased level of automation means more safety, however, technology can contribute to the occurrence of accidents caused by human error and hence defeat the defined purpose due to too many visual monitor and control for a single individual to control.

Wayne et al, [16] explained that the performance of a highly complex socio-technical system such as marine vessel is dependent upon the interaction between technical, social, environmental and human elements, which are likely, important contributors to incidents that could potentially lead to catastrophe at sea. Berg [17] added that the needs to repair break down equipment quickly for safety reasons contribute to stress and fatigue, which is one of the factors that cause maritime accidents.

MAIB [18] suggested that the introduction of new technology sometimes requires delivering of a type specific training in a short period. Therefore, it could be difficult to provide effective and sufficient training. Poor knowledge of the own ship systems contributed to 15% of accidents. Matthew and Parasuraman [19] argue that one of the factors that may lead to complacent behaviour is over reliance on new technology that lulled operators into thinking that the system will not make a mistake, and that it is safe to shift alertness to other tasks resulting in false sense of security.

Human factors have been extensively research upon by these researchers. Rothblum [20] enumerates some of the factors considered as human factor in the maritime industries and this includes incorrect decision, an improperly performed action or a lack of action. Darbra and, Casal [21] studied 471 cases of marine accidents from 1941–2002 in Hong Kong, and human factors accounted for about 57% of accidents that for which vessel was underway at sea and 43% that for which vessel was berthing at ports.

The Transportation Safety Board of Canada in 1994 reported 49% of marine vessel incidents attributed to human factors, 35% due to technical factors and 16% caused by environmental factors between the years 1995-1996. Similarly, Rothblum et al [20] reported that between 75 and 96% of marine vessel some form of human error causes casualties at least in part. Bryant [22] further presented empirical evidence that show that human error accounts for 84–88% of tanker accidents, 79% of towing vessel groundings, 89–96% of collisions, 75% of all collisions and 75% of fires and explosions.

These established and frightening statistics by local and international organizations seek to improve the standard of shipping and navigation. Based on these statistics, it is evident that two-third of marine accidents result from human error. O'Neil [23] traces this error to carelessness or recklessness under commercial pressures, a misplaced sense of overconfidence or lack of either knowledge or experience. Rothblum et al [20] also identified this human factors to include overloading, unsafe speed, poor attention to weather conditions, fatigue, carelessness, calculated risk, improper loading, lack of training, cultural differences, incompetence and inadequate navigational aids.

Frank [24] defined safety culture as a subset of the organizational culture while organizational culture is the product of multiple interactions between people, jobs and the organization. Conceiving this as the set of values, beliefs and norms about what is important, how to behave and what attitudes are appropriate when it comes to crew safety in a work group, it will correct workers' perception of safety in the workplace, which can be positive, negative or neutral.

Lu and, Tsai [25] suggested that learning safety culture in the work places and appropriately internalizing, safety culture would create an environment that influences how well people communicate, plan and make decisions concerning their health and safety when onboard. Hence, an effective safety culture requires the active collaboration between management and the workforce. Since effective safety performance thrives based on the prevailing safety culture in the organization, issues of safety culture appears to be associated with human causes of vessel accidents.

**Methodology**

This work is attended by starting with the test of hypothesis to ensure the validity of the general statement that human error is the causal factor in most maritime incidences and accidents. The following hypotheses were formulated and tested;

$H_0$: Safety of navigation is dependent on human error

$H_1$: Safety of navigation is independent on human error

**a. Population and Sampling Technique**

Data were obtained from Allianz Global Corporate & Specialty shipping review of 2017, and presented in table 1.1 below. The data are arranged into the various rows and columns. The rows show the classifications of maritime accidents.

Table 1.1: Observed frequency

| Causes of accident | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | G total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Foundered (sunk, submerged) | 69.00 | 73.00 | 61.00 | 64.00 | 45.00 | 55.00 | 70.00 | 50.00 | 65.00 | 46.00 | 598.00 |
| Wrecked/stranded (grounded) | 35.00 | 34.00 | 23.00 | 24.00 | 29.00 | 26.00 | 21.00 | 18.00 | 19.00 | 15.00 | 244.00 |
| Fire/explosion | 18.00 | 16.00 | 14.00 | 12.00 | 9.00 | 13.00 | 15.00 | 6.00 | 7.00 | 8.00 | 118.00 |
| Collision (involving vessels) | 17.00 | 13.00 | 13.00 | 10.00 | 3.00 | 5.00 | 2.00 | 2.00 | 6.00 | 1.00 | 72.00 |
| Machinery damage/failure | 14.00 | 8.00 | 7.00 | 4.00 | 6.00 | 15.00 | 2.00 | 5.00 | 2.00 | 8.00 | 71.00 |
| Hull damage (holed, cracks) | 11.00 | 4.00 | 8.00 | 4.00 | 3.00 | 7.00 | 1.00 | 4.00 | 2.00 | 4.00 | 48.00 |
| Miscellaneous | 3.00 | 1.00 | 2.00 | 6.00 | 1.00 | 1.00 | 1.00 | 2.00 | 0.00 | 1.00 | 18.00 |
| Contact (harbor wall) | 2.00 | 1.00 | 1.00 | 0.00 | 0.00 | 2.00 | 0.00 | 1.00 | 0.00 | 0.00 | 7.00 |
| Missing overdue | 1.00 | 1.00 | 0.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 2.00 | 5.00 |
| Piracy | 1.00 | 0.00 | 1.00 | 2.00 | 1.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 5.00 |
| G Total | 171.00 | 151.00 | 130.00 | 127.00 | 97.00 | 124.00 | 112.00 | 88.00 | 101.00 | 85.00 | 1186.00 |

The expected frequency where formulated and presented in table 1.2. Also, the following sets of equations (1 through 2) were used in the analysis.

Table 1.2: Expected frequency

| Causes of accident | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | G total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Foundered (sunk, submerged) | 86.22 | 76.14 | 65.55 | 64.04 | 48.91 | 62.52 | 56.47 | 44.37 | 50.93 | 42.86 | 598.00 |
| Wrecked/stranded (grounded) | 35.18 | 31.07 | 26.75 | 26.13 | 19.96 | 25.51 | 23.04 | 18.10 | 20.78 | 17.49 | 244.00 |
| Fire/explosion | 17.01 | 15.02 | 12.93 | 12.64 | 9.65 | 12.34 | 11.14 | 8.76 | 10.05 | 8.46 | 118.00 |
| Collision (involving vessels) | 10.38 | 9.17 | 7.89 | 7.71 | 5.89 | 7.53 | 6.80 | 5.34 | 6.13 | 5.16 | 72.00 |
| Machinery damage/failure | 10.24 | 9.04 | 7.78 | 7.60 | 5.81 | 7.42 | 6.70 | 5.27 | 6.05 | 5.09 | 71.00 |
| Hull damage (holed, cracks) | 6.92 | 6.11 | 5.26 | 5.14 | 3.93 | 5.02 | 4.53 | 3.56 | 4.09 | 3.44 | 48.00 |
| Miscellaneous | 2.60 | 2.29 | 1.97 | 1.93 | 1.47 | 1.88 | 1.70 | 1.34 | 1.53 | 1.29 | 18.00 |
| Contact (harbor wall) | 1.01 | 0.89 | 0.77 | 0.75 | 0.57 | 0.73 | 0.66 | 0.52 | 0.60 | 0.50 | 7.00 |
| Missing overdue | 0.72 | 0.64 | 0.55 | 0.54 | 0.41 | 0.52 | 0.47 | 0.37 | 0.43 | 0.36 | 5.00 |
| Piracy | 0.72 | 0.64 | 0.55 | 0.54 | 0.41 | 0.52 | 0.47 | 0.37 | 0.43 | 0.36 | 5.00 |
| Grand Total | 171.00 | 151.00 | 130.00 | 127.00 | 97.00 | 124.00 | 112.00 | 88.00 | 101.00 | 85.00 | 1186.00 |

b. Statistical Analysis Technique

In meeting the aim of this paper, it is imperative to analyze the hypotheses by applying chi-square ($\chi^2$) test. Chi-square($\chi^2$) is a suitable technique for observing frequency data and is employed in this work. The equations to be used in this paper are outlined below;

$$\chi^2 = \sum \frac{(|O-E|-0.5)^2}{E} df \quad (1)$$

Or,

$$\chi^2 = \sum \frac{(|O-E|)^2}{E} df > 1 \quad (2)$$

Where,

$O -$ observed frequency;

$E -$ expected frequency;

$df -$ degree of freedom

The observed frequency $(O)$ is the frequency extracted from the published data. While the expected frequencies $(E)$ is calculated as shown in equation (3).

$$E_{ij} = \frac{R_i \times C_j}{T} \quad (3)$$

The degree of freedom $(df)$is gotten as shown in equation (4)

$$df = (R-1)(C-1) \quad (4)$$

Where,

$E_{ij}$ = the expected frequency for cell i, j;

$R_i$ = thetotal frequency for row i;

$C_j$ = the total frequency for column j;

$T$ = the total frequency for the samples;

$R$ = the numbers of rows (variables/samples);

$C$ = the number of column (categories)

The 0.5 in equation (1) is used as continuity for continuity branded as Yates correction for continuity.

Both the calculated chi-square value $\chi_c^2$ and the table chi-square value $\chi_t^2$ are compared at a given significance and degree of freedom. In addition, the drawn conclusion on the setup hypothesis is arrived at from chi square analysis.

**Hypothesis Test Statistics**

Forecasting maritime accident that is dependent on human error is the aim of this project. Thus the research hypotheses were stated and the conclusion on this hypothesis is discussed in section (5) of this paper.

$H_0 -$ safety of navigation is dependent on human error

$H_i -$ safety of navigation is independent on human error

if

$$\chi_c^2 < \chi_t^2 \quad (5)$$

We accept $H_0$

and

if,

$$\chi_t^2 \geq \chi_c^2 \quad (6)$$

We reject $H_0$.

Where

$\chi_c^2 -$ calculated chi $-$ square

$\chi_t^2 -$ table chi $-$ square

**Results and Discussion**

In order to verify the hypothesis of equations (5) and (6) were used. Also as shown in equation (4), since there are 10 rows and 10 columns, the degree of freedom $(df)$ for the analysis is 81.Table 1.3 presents the result of the calculated values of the chi-square gotten by the application of equation (2) for $df > 1$

Table 1.3: chi square value calculated

| Causes of accident | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | G total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Foundered (sunk, submerged) | 3.44 | 0.13 | 0.32 | 0.00 | 0.31 | 0.91 | 3.24 | 0.71 | 3.89 | 0.23 | 13.18 |
| Wrecked/stranded (grounded) | 0.00 | 0.28 | 0.52 | 0.17 | 4.10 | 0.01 | 0.18 | 0.00 | 0.15 | 0.35 | 5.77 |
| Fire/explosion | 0.06 | 0.06 | 0.09 | 0.03 | 0.04 | 0.04 | 1.33 | 0.87 | 0.93 | 0.02 | 3.47 |
| Collision (involving vessels) | 4.22 | 1.60 | 3.31 | 0.68 | 1.42 | 0.85 | 3.39 | 2.09 | 0.00 | 3.35 | 20.91 |
| Machinery damage/failure | 1.38 | 0.12 | 0.08 | 1.71 | 0.01 | 7.73 | 3.30 | 0.01 | 2.71 | 1.67 | 18.72 |
| Hull damage (holed, cracks) | 2.40 | 0.73 | 1.43 | 0.25 | 0.22 | 0.78 | 2.75 | 0.05 | 1.07 | 0.09 | 9.78 |
| Miscellaneous | 0.06 | 0.73 | 0.00 | 8.60 | 0.15 | 0.41 | 0.29 | 0.33 | 1.53 | 0.07 | 12.18 |
| Contact (harbor wall) | 0.97 | 0.01 | 0.07 | 0.75 | 0.57 | 2.20 | 0.66 | 0.44 | 0.60 | 0.50 | 6.78 |
| Missing overdue | 0.11 | 0.21 | 0.55 | 0.40 | 0.41 | 0.52 | 0.47 | 0.37 | 0.43 | 7.52 | 10.99 |
| Piracy | 0.11 | 0.64 | 0.37 | 4.01 | 0.85 | 0.52 | 0.47 | 0.37 | 0.43 | 0.36 | 8.13 |
| Grand Total | 12.76 | 4.51 | 6.73 | 16.61 | 8.08 | 13.97 | 16.09 | 5.26 | 11.72 | 14.17 | 109.90 |

From the analysis of Table 1.3, it can be inferred that there is significance difference in the hypothesis setup. However, a more comprehensive analysis the chi-square techniques gave a calculated chai-square $\chi_c^2$value of 109.90. The table chi-square $\chi_t^2$ to be compared with the calculated value is based on the degree of freedom $df$ and level of significance as shown in Table A, Appendix A. Base on the degree of freedom 81; Table A, has 97.680, 103.010, 107.783, 113.512, and 126.083 for the level of significance 0.10, 0.05, 0.025, 0.01 and 0.001 respectively.

**Conclusion**

In consonant with the general view of human imperfection, this work has enjoined other research experts to conclude as follows;

That, from the analysis of the chi-square technique, calculated chi-square$\chi_c^2$ is 109.90 while the table chi-square $\chi_t^2$ values are 113.512 and 126.083 at level of significance of 0.01 and 0.001 respectively and as seen in Table A. Since the $\chi_c^2 < \chi_t^2$ , we accept $H_0$ and reject$H_i$.

This is evident that the human error is a contributing factor in the safety of navigation, and some of these critical factors are; complex automation, fatigue, situation awareness, increased cognitive demands, poor communication, cultural diversity, lack of teamwork, insufficient training, inadequate staffing, safety culture and safety climate and the working environment with its demanding aspects.

Again, as was stated in the objective, maritime system is a peoplesystem. People interact with technology, the environment, and organizational factors. Sometimes the weak link is with the people themselves but more often, the weak link is the way that technological, environmental, or organizational factors influence the way people perform. This can be linked to the design of the vessel, automation, poor maintenance, and inadequate knowledge of own vessel. Human factors affecting safety can be divided into organizational, group and individual factors. Some examples of organizational factors are management commitment to safety, safety training, open communication, environmental control and management, stable workforce, and positive safety promotion policy. Examples of group factors are line management style, good supervision and clear understanding of own and other team members' roles and responsibilities. Individual factors are related to factors, which affect a person's performance such as human-machine interface and competence, stress, motivation and workload of an individual.

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**APPENDIX**
**Table A**

**Upper critical values of chi-square distribution with $\nu$ degrees of freedom**

| $\nu$ | Probability of exceeding the critical value 0.10 | 0.05 | 0.025 | 0.01 | 0.001 |
|---|---|---|---|---|---|
| 1 | 2.706 | 3.841 | 5.024 | 6.635 | 10.828 |
| 2 | 4.605 | 5.991 | 7.378 | 9.210 | 13.816 |
| 3 | 6.251 | 7.815 | 9.348 | 11.345 | 16.266 |
| 4 | 7.779 | 9.488 | 11.143 | 13.277 | 18.467 |
| 5 | 9.236 | 11.070 | 12.833 | 15.086 | 20.515 |
| 6 | 10.645 | 12.592 | 14.449 | 16.812 | 22.458 |
| 7 | 12.017 | 14.067 | 16.013 | 18.475 | 24.322 |
| 8 | 13.362 | 15.507 | 17.535 | 20.090 | 26.125 |
| 9 | 14.684 | 16.919 | 19.023 | 21.666 | 27.877 |
| 10 | 15.987 | 18.307 | 20.483 | 23.209 | 29.588 |
| 11 | 17.275 | 19.675 | 21.920 | 24.725 | 31.264 |
| 12 | 18.549 | 21.026 | 23.337 | 26.217 | 32.910 |
| 13 | 19.812 | 22.362 | 24.736 | 27.688 | 34.528 |
| 14 | 21.064 | 23.685 | 26.119 | 29.141 | 36.123 |
| 15 | 22.307 | 24.996 | 27.488 | 30.578 | 37.697 |
| 16 | 23.542 | 26.296 | 28.845 | 32.000 | 39.252 |
| 17 | 24.769 | 27.587 | 30.191 | 33.409 | 40.790 |
| 18 | 25.989 | 28.869 | 31.526 | 34.805 | 42.312 |
| 19 | 27.204 | 30.144 | 32.852 | 36.191 | 43.820 |
| 20 | 28.412 | 31.410 | 34.170 | 37.566 | 45.315 |
| 21 | 29.615 | 32.671 | 35.479 | 38.932 | 46.797 |
| 22 | 30.813 | 33.924 | 36.781 | 40.289 | 48.268 |
| 23 | 32.007 | 35.172 | 38.076 | 41.638 | 49.728 |
| 24 | 33.196 | 36.415 | 39.364 | 42.980 | 51.179 |
| 25 | 34.382 | 37.652 | 40.646 | 44.314 | 52.620 |
| 26 | 35.563 | 38.885 | 41.923 | 45.642 | 54.052 |
| 27 | 36.741 | 40.113 | 43.195 | 46.963 | 55.476 |
| 28 | 37.916 | 41.337 | 44.461 | 48.278 | 56.892 |

| | | | | | |
|---|---|---|---|---|---|
| 74 | 89.956 | 95.081 | 99.678 | 105.202 | 117.346 |
| 75 | 91.061 | 96.217 | 100.839 | 106.393 | 118.599 |
| 76 | 92.166 | 97.351 | 101.999 | 107.583 | 119.850 |
| 77 | 93.270 | 98.484 | 103.158 | 108.771 | 121.100 |
| 78 | 94.374 | 99.617 | 104.316 | 109.958 | 122.348 |
| 79 | 95.476 | 100.749 | 105.473 | 111.144 | 123.594 |
| 80 | 96.578 | 101.879 | 106.629 | 112.329 | 124.839 |
| 81 | 97.680 | 103.010 | 107.783 | 113.512 | 126.083 |
| 82 | 98.780 | 104.139 | 108.937 | 114.695 | 127.324 |
| 83 | 99.880 | 105.267 | 110.090 | 115.876 | 128.565 |
| 84 | 100.980 | 106.395 | 111.242 | 117.057 | 129.804 |
| 85 | 102.079 | 107.522 | 112.393 | 118.236 | 131.041 |
| 86 | 103.177 | 108.648 | 113.544 | 119.414 | 132.277 |
| 87 | 104.275 | 109.773 | 114.693 | 120.591 | 133.512 |
| 88 | 105.372 | 110.898 | 115.841 | 121.767 | 134.746 |
| 89 | 106.469 | 112.022 | 116.989 | 122.942 | 135.978 |
| 90 | 107.565 | 113.145 | 118.136 | 124.116 | 137.208 |
| 91 | 108.661 | 114.268 | 119.282 | 125.289 | 138.438 |
| 92 | 109.756 | 115.390 | 120.427 | 126.462 | 139.666 |
| 93 | 110.850 | 116.511 | 121.571 | 127.633 | 140.893 |
| 94 | 111.944 | 117.632 | 122.715 | 128.803 | 142.119 |
| 95 | 113.038 | 118.752 | 123.858 | 129.973 | 143.344 |
| 96 | 114.131 | 119.871 | 125.000 | 131.141 | 144.567 |
| 97 | 115.223 | 120.990 | 126.141 | 132.309 | 145.789 |
| 98 | 116.315 | 122.108 | 127.282 | 133.476 | 147.010 |
| 99 | 117.407 | 123.225 | 128.422 | 134.642 | 148.230 |
| 100 | 118.498 | 124.342 | 129.561 | 135.807 | 149.449 |
| 100 | 118.498 | 124.342 | 129.561 | 135.807 | 149.449 |