ON THE EFFECTIVENESS OF COAST GUARD MARINE SAFETY UNIT (MSU) PORT ARTHUR SAFETY INSPECTIONS
PORT ARTHUR, TX

Final Report

Daniel E. Salazar, PhD
University of Southern California

Point of Contact:
Isaac Maya, PhD, PE
University of Southern California
213-740-3865
imaya@usc.edu

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EXECUTIVE SUMMARY

In this report we present the results of a statistical analysis performed on the data provided by the USCG MSU Port Arthur to determine the effectiveness of the safety inspection performed by this USCG unit. The dataset analyzed consists of three batches of information provided asynchronously, containing arrival and inspection registries for U.S. and foreign vessels, as well as incidents occurred during the period from 2006 to 2010.

Two statistical techniques, hypothesis test for two proportions and survival analysis, were considered for the assessment. Throughout the data analysis, we worked closely with the MSU Port Arthur personnel and data sources. Unfortunately, despite the MSU’s persistent efforts to provide consistent and complete datasets, the inherent lack of information available to them and the existing inconsistencies in the collection and processing of vessel data among different pieces at the point of origin of information precluded a statistically valid analysis. In particular, the lack of specific and consistent knowledge about the incident and inspection history of each individual vessel was the most important hurdle.

Based on the findings, a group of recommendations is provided to help the USCG and the MSU Port Arthur to collect sufficient and relevant information for future statistical analyses. To enable reliable assessments of the impact of the safety inspections performed by the different MSU, data collection processes and procedures need to be established to validate their subsequent statistical analysis. In addition, survival analysis is recommended as the most appropriate technique for future analysis since it provides more information than the hypothesis test. To support future statistical analyses of the impact of safety inspections, the following steps are recommended:

1. Select the specific type of inspections that will constitute the subject of the analysis. For instance, if the goal is to reduce incidents, then list all the inspections deemed to reduce the likelihood of incidents. For the selected types, define whether the inspections performed by different MSU’s can be considered equivalent.
2. Define the vessel categories under study.
3. Select a time window to discriminate whether a ship involved in an incident was inspected.
4. Select the duration of the study (preferably ≥ 5 years)
5. Define a group of ports or MSU’s that will constitute the subject of analysis.
6. Select randomly a group of at least 100 vessels (the more the better) within the category of interest that travel between the selected ports. Exclude any vessels whose history of inspections and incidents is unavailable.
7. For each vessel, collect information about all the incidents it was involved in anywhere and all the inspection it received during the period of study.
8. Analyze the data using survival analysis. This analysis should differentiate between the inspections performed by USCG MSU’s and any other exogenous inspection (performed by other Port Control Systems, such as foreign ports). This way the effect of the USCG inspections can be quantified in connection with inspections performed elsewhere.
1. INTRODUCTION

The United States Coast Guard (USCG) Marine Safety Unit (MSU) Port Arthur, located at Port Arthur, TX, “is responsible for carrying out the Coast Guard's homeland security, marine safety, and marine environmental protection missions in a zone of responsibility that includes Southwest Louisiana and Southeast and East Texas. Included in this zone are the Ports of Lake Charles, Louisiana; Sabine, Port Arthur, Orange and Beaumont, Texas; 141 miles of the Gulf Intra coastal Waterway; and 4 Outer Continental Shelf Lease Zones.” [MSU].

To meet its mission, the MSU Port Arthur performs numerous safety inspections of U.S. and foreign vessels, offshore platforms and drilling units and designated platform facilities. Most of these inspections are mandatory and affect certain vessel categories, but some vessels belonging to non-regulated categories can undergo voluntary inspections as well. Inspection of a vessel is deemed to decrease its probability of incurring any type of incident right after the inspection and during a time window that spans from a six months to a year. Also, there are certain features that can contribute to either increase or decrease the aforementioned probability, namely flag, classification society, physical characteristics of the vessel, etc.

Although inspections contribute positively in decreasing the risk of maritime casualties, they are costly and therefore represent a burden on both MSU Port Arthur and the companies operating the vessels as well. Hence, MSU Port Arthur is interested in determining the most cost-effective manner of performing inspections. Determining the impact of an inspection in reducing the likelihood of an incident is a key task for this assessment. In this report, we present the results of the statistical analysis of the inspection and incidents data. In addition, we review the challenges presented by current inconsistencies in and lack of certain key data, and offer recommendations for future analyses.

2. STATISTICAL METHODS FOR THE ANALYSIS OF SAFETY INSPECTION EFFECTIVENESS

A safety inspection has the purpose of verifying that the physical conditions of the vessels as well as the working conditions of the crew meet pre-established standards of safety. Typically, inspections focus on such areas as vessel registration and administration, crew living and working conditions, International Safety Management code, safety and fire appliances, navigation and communication equipment and procedures, ship and cargo operations including pollution prevention, machinery related areas and finally, stability and structure [Knapp07].

To determine the effectiveness of an inspection, it is necessary to define the goal to be achieved with the inspection (e.g., avoiding accidents, reducing the environmental footprint, interdicting criminal activities, etc.) and the figures of merit and objectives associated with the inspection goal. For example, if an inspection is aimed at reducing the number of accidents, then the number of accidents per year is a natural figure of merit and the objective is to minimize that number. By contrast, if the environmental footprint is the fundamental concern, then the figure of merit could be tons of CO₂ released per vessel in a particular category per year and the objective
is to minimize that number. Also, some goals can be established for the objectives, such as a reduction of at least 20% in the yearly number accidents.

Once the goal is established and an appropriate figure of measure is defined, statistical analysis can be used to qualify and quantify the effectiveness of the inspections, and determine whether the fluctuations in the figures of merit actually reflect a significant improvement in the associated objective and by how much. In this report, the goal of the statistical analysis is to determine whether the inspections are reducing the likelihood of maritime incidents; therefore the discussion hereafter refers to that reduction. Nevertheless, the statistical techniques described can be employed to verify the effectiveness of inspections with other disparate goals.

There are two statistical techniques that can be used to answer the aforementioned questions by making comparisons between inspected and non-inspected vessels. The first one, called hypothesis test for two proportions, is useful to decide whether the figures of merit of two populations are significantly different, provided that only one of such populations undertook inspections. The second technique, called survival analysis, is useful to characterize the life expectancy of an entity after receiving an intervention – e.g. the probability of not incurring incidents during the first year after the inspection. Both techniques are explained in the next sections.

2.1 Hypothesis Test for Two Proportions

A hypothesis test is a statistical technique employed to infer if two populations can be considered the same by the characteristics of the samples drawn from such populations. With respect to the safety inspections, inspected and non-inspected vessels define the two populations under consideration. The test is applied to see if the proportion of vessels involved in accidents is the same across both groups of vessels, or if the evidence reveals a difference between them. Note that the proportion of incidents between both groups is always going to be different, numerically speaking, but this does not mean that such difference is statistically significant.

Consider two sample sets, \( X_1, \cdots X_{n_1} \) and \( Y_1, \cdots Y_{n_2} \) of sizes \( n_1 \) and \( n_2 \), representing inspected and non-inspected vessels respectively. As a vessel could be either involved or not (never) involved in an incident during a time period of interest, the populations from where these samples were drawn are said to follow binomial distributions \( B(1, p_1) \) and \( B(1, p_2) \) respectively. This means that the probability of finding a vessels involved in an incident is \( p_1 \) for the first population and \( p_2 \) for the second one. Intuitively, the proportions estimated from the two sample sets shown initially are expected to resemble those of the populations.

If the inspections are not contributing in any significant way to diminish the number of incidents, then inspected and non-inspected vessels are essentially equal and therefore \( p_1 = p_2 = p \). On the other hand, if the inspection do have an impact, then \( p_1 \neq p_2 \). The statistical test is built using the first conditional statement as default (or null) hypotheses –denoted \( H_0 \)- to avoid the risk of accepting that there is an impact when the evidence does not support such a statement, whereas the second conditional statement constitutes the alternative hypothesis –denoted \( H_1 \).

Notice that the inspection effectiveness evaluation requires more than proving that the proportions are not equal, since the desirable outcome is reached only when \( p_1 < p_2 \) and
accepting $p_1 \neq p_2$ entails the possibility of $p_1 > p_2$. Hence, the hypothesis test for this problem should be formulated in the following terms:

$$H_0: p_1 \geq p_2$$
$$H_1: p_1 < p_2$$

The optimal statistics for this test are given by

| Accept $H_0$: | $z = \frac{\hat{p}_1 - \hat{p}_2}{\sqrt{\frac{\hat{p}(1-\hat{p})}{n_1} + \frac{\hat{p}(1-\hat{p})}{n_2}}} \geq z_{1-\alpha}$ |
| Reject $H_0$: | $z = \frac{\hat{p}_1 - \hat{p}_2}{\sqrt{\frac{\hat{p}(1-\hat{p})}{n_1} + \frac{\hat{p}(1-\hat{p})}{n_2}}} < z_{1-\alpha}$ |

where the population parameters $p_1$ and $p_2$ are estimated as the proportions between the events of interest ($x$ and $y$) and the sample sizes, i.e. $\hat{p}_1 = x/n_1$ and $\hat{p}_2 = y/n_2$; $z_{1-\alpha}$ is the value of the $(1-\alpha)$-quantile of a standard normal distribution and $\hat{p} = (x + y)/(n_1 + n_2)$. The events of interest in this context are the number of incidents involving inspected vessels ($x$) and non-inspected vessels ($y$).

### 2.1.1. Conditions

There are some conditions that should be satisfied to reliably apply the statistical test for proportions. These conditions are:

1. The samples should be drawn randomly.
2. The coefficients $n_1$ and $n_2$ that represent the sample sizes are assumed to be similar and big enough - e.g. $n_1 \approx n_2$ and $n_1 + n_2 > 100$.
3. The number of events of interest and their complements must be at least larger than five, i.e. $\hat{p}_1 * n_1 \geq 5$; $(1 - \hat{p}_1) * n_1 \geq 5$; $\hat{p}_2 * n_2 \geq 5$; $(1 - \hat{p}_2) * n_2 \geq 5$.

### 2.1.2. Example

Suppose a group of 717 vessels is studied to determine if the safety inspections are reducing the proportion of incidents. The sample consists of two sets of 69 and 648 inspected and non-inspected vessels respectively. The number of vessels involved in incidents for both groups are $x = 6$ and $y = 25$. The estimated proportions are $\hat{p}_1 = 6/69 = 0.0869$ and $\hat{p}_2 = 25/648 = 0.0385$. The pooled proportion $\hat{p} = (6 + 25)/(69 + 648) = 0.0432$. With a level of confidence $(1-\alpha) = 95\%$, the calculated statistic $z = 1.878$ which is larger than $z_{0.95} = 1.645$, indicating that the null hypothesis should be accepted. In this example, the evidence collected does not support the alternative hypothesis that the inspections are reducing the proportion of incidents.

### 2.1.3. Confidence Intervals

The formulation presented in the hypothesis test can be manipulated to yield a confidence interval for the difference of proportions. This interval can also be useful to perform the
hypothesis test, so if zero belongs to that interval the null hypothesis $H_0$ is accepted, and is rejected otherwise. The interval is given by the following formula

\[
I = \hat{p}_1 - \hat{p}_2 \mp z_{1-\alpha/2} \sqrt{\frac{\hat{p}_1(1-\hat{p}_1)}{n_1} + \frac{\hat{p}_2(1-\hat{p}_2)}{n_2}}
\]

Assuming that the hypothesis test leads to reject the null hypothesis, the previous formula provides bounds for real difference between the population proportions. Thus, the reduction induced by the inspections can be estimated via this formula.

### 2.1.4. Example

For the problem stated in 2.1.2 the resulting interval is:

\[
I - 0.0869 - 0.0385 \mp z_{0.975} \sqrt{\frac{0.0432 \ast (1-0.0432)}{69} + \frac{0.0432 \ast (1-0.0432)}{648}}
\]

With yields (-0.0197, 0.1165) with $z_{0.975} = 1.959$. As this interval contains zero, the proportions $p_1$ and $p_2$ are considered non different statistically speaking. If, on the other hand, the resulting interval had two negative bounds, then $p_1$ would be considered lower than $p_2$ and therefore interval $I$ would stand for an estimate of the reduction in likelihood achieved by the safety inspections.

### 2.2 Survival Analysis

Survival analysis is a statistical technique used to estimate the probability of a subject surviving a period of time $t$. Here the term survival could be interpreted in different ways, as death, disease, relapse or recovery when applied to living subjects, or as operation without failures or accidents when used in the technological realm. In the context of safety inspections, survival analysis can be employed to characterize probabilistically the time between incidents, or the time until the next incident, for inspected and non-inspected ships. If the inspections are having an impact on the incident rate, then the survival time for the former group should be significantly larger than the latter.

Figure 1 shows the expected outcome of a survival analysis for inspection effectiveness. The probability of surviving at least until time $t$ is given by the survival function $S(t)$. The survival function is a non-increasing function, which means that the probability of survival is expected to be constant or decrease with time. If the inspections reduce the probability of incidents, then the probability of incidents after $t$ units of time should be greater for the inspected vessels. Conversely, if a probability of reference is fixed, say 0.5, then the expected time until an incident occurs should be lower for the non-inspected vessels. This is exemplified in Figure 1 where median times $M_N$ and $M_I$, corresponding to non-inspected and inspected vessels, verify $M_I > M_N$. 


To perform survival analysis, vessels should be characterized according to their features that are related to the survival process. For example, Knapp and coauthors estimated incident cost savings due to inspections [Knapp11] using arrivals data provided by the USCG and the Australian Maritime Safety Authority, along with casualty data from Lloyd’s Register Fairplay. The authors demonstrate the value of inspections in reducing risk of incidents by considering the arrivals and accident history, as well as some ship particulars, namely tonnage, flag history, classification society and past port state control detentions and deficiencies.

There are certain characteristics of the survival analysis that make it a preferential statistical technique to analyze the influence of safety inspection on the likelihood of accidents. The foremost advantage of survival analysis over the hypothesis test for two proportions is that the former is designed to account for the temporal component while the latter is not. This is of particular relevance in the present context since vessels age and the effects of inspections weaken over time. Also, survival analysis is performed over a period of time, so the dynamics of inspections and accidents are transformed into time intervals ranging from the last inspection to the time of the incident or the times between inspections. Moreover, in survival analysis some inspections are performed before the start of the analysis (left-censorship) and all the vessels will have time intervals truncated when the study ends (right-censorship); a hypothesis test cannot handle this censorship properly. Finally, in contrast with hypothesis testing, survival analysis provides useful information upon which new inspection can be scheduled.

3. STATISTICAL ANALYSIS APPLIED TO THE MSU PORT ARTHUR DATA

An inspection effectiveness analysis was conducted using the statistical techniques previously described. After several iterations of data analysis, it was determined that none of the techniques could be applied successfully due to either lack of information or inconsistencies in the data available. This section reports on the reasons that hampered the analysis. Recommendations about how to overcome the current data deficiencies are presented in subsequent sections.
3.1. Data Sources

The MSU provided us with several different batches of information regarding vessels arrivals and inspections, organized in Excel spreadsheets. The first batch comprised inspections on and arrivals of U.S. and foreign vessels from 2006 to 2010. The arrivals were registered at the following ports: Beaumont, Nederland, Orange, Port Arthur, Port Neches and Sabine Pass.

The information contained in the first batch was partially incomplete and conflicting, since different vessels had repeated names; some vessels had changed names or flags along their history and others lacked ID number and/or flag information. The MSU then provided us with a second batch of information containing unique registries of ships across the different vessel categories. This information enhanced significantly the identification process of vessels for statistical analysis purposes. Finally, a third batch of information was requested to clarify the total number of vessels in each category, since the data continued presenting inconsistencies (identified below). This last batch was generated by the E-Tracking System Support and comprises information on the distinct ships that passed through Port Arthur, TX during 10/1/2008 through 09/30/2010.

3.2. Results of the Analysis

After extensive analysis of the three batches of data, it was determined that it was not possible to apply the statistical techniques to analyze the data. The reasons for this result are explained in detail in the next subsections. A key assumption is that a time frame of six months from the date of inspection was established to consider an inspection as an active contributing factor to decrease the likelihood of incidents. Each vessel involved in incidents was checked to determine whether or not the last inspection was performed within the six months prior to the incident. Vessels inspected within the previous 6 months were considered as inspected and therefore counted to determine \( \hat{p}_1 \) (see Section 2.1); whereas vessels not inspected within the previous 6 months are used to calculate \( \hat{p}_2 \). Changes in this time frame will significantly impact the results of the hypothesis test. In our time frame selection we followed [Heij10].

3.2.1. Problems applying the hypothesis test

As describe in Section 2.1.1., the hypothesis test requires that certain conditions be satisfied regarding the sample size and the number of incidents. Initially, we tried to employ the whole dataset for the analysis. The sample size could not be established reliably because the data received presented inconsistencies. More specifically, the number of ships in each vessel category was extracted from the list or arrivals (first batch of information) and then refined with the list of unique registries (second batch of information). The number of inspections was extracted from the list of inspected vessels (first batch). When both lists were contrasted, we found that some vessels that received inspections do not appear in the arrival list. Therefore, the true total number of vessels is not known. Moreover, when the third batch of information was analyzed, the number ships across different categories mismatched. This casts uncertainty on the completeness of the information provided, and therefore on the randomness of the samples that can be taken from the dataset. As the lack of randomness invalidates the analysis, it is important to assure the completeness of the data before applying the hypothesis test.
The hypothesis test requires the number of incidents to be greater than five, following the conditions to apply the test in Section 2.1.1., for both the inspected and non-inspected vessel datasets. There are two fundamental problems with this requirement. First, although the total number of incidents registered across all categories is greater than five, when this number is broken down into incidents involving inspected and uninspected vessels, there are not enough incidents in each category, so the test cannot be applied. Though this is fortunate in that it means that only a small number of incidents occurred, the low number statistically invalidates the test.

There is a second, even more important and impactful consequence of the manner in which the data is collected. Since the complete history of incidents and inspections for every vessel is not available, it is possible that some vessels that received inspections by the USCG in other ports are counted as non-inspected since they were not inspected in Port Arthur. Similarly vessels involved in accidents but not inspected in Port Arthur could have received inspections prior to that accident at other ports nationally or internationally. In consequence, there is no reliable way of extracting the true number of inspections and incidents from the available information restricted to MSU Port Arthur.

### 3.2.2. Problems Applying the Survival Analysis

Survival analysis requires much more information that the hypothesis test. The same data deficiencies that hampered application of the hypothesis test hold for the survival model. Therefore, this technique, although ideal since it provides more useful information to assess the effectiveness of MSU Port Arthur safety inspections, cannot be employed with the current data.

## 4. RECOMMENDATIONS FOR FUTURE STATISTICAL ANALYSES

The MSU Port Arthur is engaged in optimizing the use of resources to achieve high standards of homeland security in a cost effective manner. As shown by [Knapp11], safety inspections have shown to be an effective way to reduce risk of incidents, reducing costly impacts and protecting the quality of the waterways and the environment. Maritime traffic, on the other hand, is a global process and thus the MSU Port Arthur cannot assess its action in isolation from the actions of other USCG MS Units and from other foreign Maritime Control Agencies, unless the subject of study is a local fleet. Thus, the goal of assessing the economic cost-benefit impact of safety inspections at MSU Port Arthur in isolation from the rest of the USCG MS units cannot be met at this time.

To understand why the analysis should not be centered on a particular US port but rather on the USCG safety inspection system nationwide, consider the network depicted in Figure 2. Nodes A, B and C represent ports in the US whereas node F represents a foreign port. Likewise, the blue links denote US vessels traveling only through national traffic routes, while the dashed black links symbolize international traffic of US and foreign vessels as well.
Figure 2. Example of a maritime transportation network. Circed nodes represent national ports whereas the black node represents a foreign port. Blue links represent local (national) fleet traffic routes, while black dashed lines represent international fleet traffic routes.

Suppose that we want to analyze the effectiveness of safety inspections performed by the USCG at port A only. A database of inspections and incidents occurring at port A is available. In this case, only those vessels departing from and arriving to port A exclusively can be analyzed, since otherwise the effect of possible inspections performed at ports B and C, as well as incidents occurring at ports B and C (and elsewhere) would not be considered. To exemplify how the inspections and incidents can impact the results of the statistical test, consider the two cases shown in Table I. This table presents a hypothetical but yet plausible situation where the result of the two-proportion hypothesis test changes depending on the number of ports analyzed.

<table>
<thead>
<tr>
<th>Ports</th>
<th>Total vessels</th>
<th>Inspected Vessels</th>
<th>Non-Inspected Vessels</th>
<th>Statistics</th>
<th>Test Result</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Incidents (x)</td>
<td>Total (n₁)</td>
<td>p₁̂</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>717</td>
<td>6</td>
<td>69</td>
<td>0.0869</td>
<td></td>
</tr>
<tr>
<td>A, B, C</td>
<td>717</td>
<td>8</td>
<td>221</td>
<td>0.0362</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>p₂̂</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>A</td>
<td>25</td>
<td>648</td>
<td>0.0385</td>
<td>0.0432</td>
<td>1.878</td>
</tr>
<tr>
<td>A, B, C</td>
<td>37</td>
<td>496</td>
<td>0.0746</td>
<td>0.0627</td>
<td>-1.956</td>
</tr>
</tbody>
</table>

In the example presented in Table I, it is assumed that a population of 717 vessels travels through the different local (blue) routes depicted in Figure 2. A total of 69 vessels were inspected at port A, out of which 6 were involved in accidents. Moreover, the number of vessels non-inspected at port A equals 648, out of which 25 were involved in accidents at port A. Constraining the analysis to the incidents occurred and inspections performed at port A only, the hypothesis test indicates that the null hypothesis should accepted, which leads to conclude that the safety inspections are doing poorly. Nevertheless, when the incidents occurred at ports B and C (2 with inspected vessels and 12 with non-inspected vessels) as well as the inspections performed at those ports (152) are included, the numbers change favoring the alternative hypothesis as shown.
in the last row of Table 1. In this example including more information works in favor of the safety inspections since the final result supports statistically the value of these inspections in reducing accidents. It is important to note that the statistical results could support the opposite conclusion, i.e., that the inspections do not add value, but in either case the conclusion and knowledge gained will be valuable for decision-making and policy analysis by the USCG.

To enable reliable assessments of the impact of the safety inspections performed by the different MSU, data collection processes and procedures need to be established to validate their subsequent statistical analysis. In addition, survival analysis is recommended as the most appropriate technique for future analysis since it provides more information than the hypothesis test. To support future statistical analyses of the impact of safety inspections, the following steps are recommended:

1. Select the specific type of inspections that will constitute the subject of the analysis. For instance, if the goal is to reduce incidents, then list all the inspections deemed to reduce the likelihood of incidents. For the selected types, define whether the inspections performed by different MSU’s can be considered equivalent.
2. Define the vessel categories under study.
3. Select a time window to discriminate whether a ship involved in an incident was inspected.
4. Select the duration of the study (preferably ≥ 5 years)
5. Define a group of ports or MSU’s that will constitute the subject of analysis.
6. Select randomly a group of at least 100 vessels (the more the better) within the category of interest that travel between the selected ports. Exclude any vessels whose history of inspections and incidents is unavailable.
7. For each vessel, collect information about all the incidents it was involved in anywhere and all the inspection it received during the period of study.
8. Analyze the data using survival analysis. This analysis should differentiate between the inspections performed by USCG MSU’s and any other exogenous inspection (performed by other Port Control Systems, such as foreign ports). This way the effect of the USCG inspections can be quantified in connection with inspections performed elsewhere.

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1 Please note that we are not commenting or making distinctions between incidents that occur at ports and incidents that occur in other domestic waters, since it is the mission of the USCG to protect both. The implication of this distinction is that future analysis should consider this aspect and therefore be formulated vessel-centered (reducing the chances of any vessel experiencing an incident anywhere), instead of port-centered (reducing the chances of having accidents at a particular port).
2 In this example it is assumed that the safety inspections produce the same effect irrespective of the port where they are performed. This is a reasonable assumption among different USCG MSU, but this does not necessarily hold when other Port Control Systems are considered, e.g., foreign ports of inspection. Moreover, it is assumed that an inspection produces an improvement in the survival function of a vessel that lasts some period of time within which no additional inspection is performed. If these assumptions do not hold, the hypothesis test should be replaced in favor of the survival analysis. In general the latter technique is more powerful and preferred.
3 This recommendation is not to preclude the collection of information regarding inspections with no direct impact on the incident likelihood. Instead, the idea here is the MSU Unit could perform different types of inspections that do not contribute to the survival process and are performed for other goals (such as law enforcement), therefore, there should be a clear data classification of what inspections constitute the latter group so as to exclude them from the dataset used for statistical analysis.
5. REFERENCES


