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Who Survived the Titanic? A Logistic Regression Analysis

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by

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Abstract

A logistic regression analysis of an extensive data set on the *Titanic* passengers is presented which tests the likelihood that a *Titanic* passenger survived the accident--based upon passenger characteristics. The main finding is that underneath the strong overt preference afforded in the rescue by the authorities to women and children over men, there was a complex class determination of survival rates among men, on the one hand, and women and children, on the other. We hypothesize that the statistical interactions of gender and class are explained by two crucial decisions made by the ship's authorities: 1. to encourage, and perhaps direct, some three to four hundred 3rd Class men quartered in the lower decks at the forward end back to the afterend of the stern; 2. to restrict the access of men at the after-end of the ship to the lifeboats launched from the after Boat and Promenade Decks.

The great attention that has been paid to the sinking of the Titanic, especially in recent years, affords an opportunity to address questions that cannot often be scientifically posed, let alone answered, when it comes to less celebrated historical events. The recently published work of Soldner (2000) and Beavis (2002) has provided robust and accurate information about those aboard the Titanic. This data lends itself to statistical investigations (see Dawson, 1995).   Beavis has sorted out, without absolutely resolving the issue, the question of the individuals who were actually aboard on the evening of April 14, 1912. Soldner has painstakingly documented the characteristics of each of 1,318 passengers, compiling, within a very narrow margin of error given Beavis's findings, the most accurate passenger list currently available.

Using the data published by Soldner, we have engaged in a logistic regression analysis of the likelihood of a *Titanic* passenger surviving the accident, based on his or her particular characteristics (*cf.*, Dawson, 1995).[1] In broad terms, regression analysis comprises a set of statistical methodologies and analytic techniques used extensively in many fields, including economics, finance, political science and history.   It enables one, with a quantifiable degree of certainty, to sort out various hypothetical causes of a particular observable effect. Here, we are interested in the characteristics of who was able to survive the accident--the probability of survival being the 'dependent' or the 'criterion' variable.

A number of 'explanatory variables' are readily seen in the data, and are put forward by us: age/gender, class (of the purchased ticket), responsibility for children, and nationality. Each has been put forward at one time or another as a significant factor in whether a passenger lived or died. 'Significant factor' or statistical significance means that in the

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[1] See **Appendix I** for a technical discussion of logistic regression analysis.

absence of a relationship, the probability of observing what has actually occurred in the data would be very small, *e.g.*, one, five, or ten percent. In the analysis that follows, we will reject the hypothesis of no significant difference or no significant effect when this probability is less than either ten, five, or one percent.

A general difficulty is that more than one explanatory variables are likely to have influenced the dependent variable contemporaneously. Logistic regression analysis enables us to quantify the effect on the ability of a passenger to survive of, for example, the gender of a particular passenger, controlling for other explanatory variables; *i.e.*, '*ceteris paribus.*' In other words, it tells us within a certain degree of confidence that if we imagine two passengers identical in all respects save one, *e.g.*, one is an adult male and one is an adult woman, what would have been the likelihood of one of the passengers surviving relative to the other based on that single difference.

Therefore, logistic regression analysis enables us to reach conclusions as to which of the explanatory variables has had a statistically significant effect on the dependent variable and the direction of the effect. In the case of significant explanatory variables it also enables us to calculate 'odds ratios', measuring, for instance, how much more likely an adult woman passenger had of surviving compared to an adult man.

Our analysis is also complicated by the potential existence of 'interactions' between pairs of explanatory variables. This occurs when there are significant joint effects on the dependent variable. Consider a possible interaction between class and gender/age. Suppose an adult woman in First Class had a significantly greater chance of surviving than an adult woman in Third Class did, while there was no significant difference at all between First and Third Class adult men, (or there was a significant difference between the adult men, but it was of a very different magnitude or even in a different direction). In that case, one cannot

express a likelihood of survival that separates gender/age and class--they jointly have an effect on survival.

We are able to test for the existence of interactions between any two explanatory variables and where there are interactions, to ascertain specific significant joint effects. Examining the tests of selected interactions, (**Table 1**), and comparing the likelihood of a Second Class adult woman surviving with that of a Third Class adult woman, we find there was, indeed, a significant difference between them (P<.0001). On the other hand, there was no significant difference when it came to Second and Third Class adult men (P=.2419).

[Insert Table 1 Here]

2. The Data

The data that underlies our analysis is summarized in **Tables 2** and **3**. A number of things implicit in the organization of this data might be noted. First, age is treated by denoting 'children' as a category distinct from adult men and adult women. Following the *Titanic* ticket designation, a child is one who is under 14 years of age. Second, 'nationalities' are composites of countries by geographic region and culture. Third, in the case of couples with children, each parent is treated as having responsibility for the same children.

[Insert Table 2 Here]

[Insert Table 3 Here]

3. Class Culture and Family Disadvantage

Tests reveal that there were significant interactions of gender/age and class (**Table 1**). We will address these interactions in detail in due course. There were no significant interactions of nationality or responsibility for children with class. The lack of interaction with class undercuts a popular explanation that has been offered for the apparently low survival rates of Third Class passengers on the *Titanic*, relative to the other two Classes.

Wyn Craig Wade, in his influential *The Titanic: End of a Dream* (1980), most pointedly advances the idea that there was a class culture present on the *Titanic* akin to the notion of a 'culture of poverty.' As a class, the Third Class passengers, according to Wade, lacked a faith in themselves, setting them apart from the self-motivated passengers in the other classes. In particular, he asserts:[2]

> Undoubtedly, the worst barriers were the ones within the steerage passengers themselves. Years of conditioning *as third-class citizens* led a great many of them to give up hope as soon as the crisis became evident… Barriers to steerage? Yes, but of a kind less indictable to the White Star Line than to the whole of civilization (1980: 277-8; also see Butler, 1998: 107).

We find from our analysis that contrary to Wade's hypothesis, there was no less likelihood of surviving if one were, let us say, British and in the Third Class, than if you were British and in the First Class (or Second) and similarly for any other nationality, *ceteris paribus* (P=.4255, **Table 1**). There was simply no class culture visible, as far as that goes, in this data. The rejection of the Wade hypothesis is further supported by the fact that class itself cannot be separated from gender/age, as already noted, *i.e.* there is no unitary class effect on likelihood of survival to which one can refer to on the basis of a class culture.

Another popular explanation of the low survival rate of Third Class passengers is suggested in the most widely read of the popular *Titanic* tracts, the two books written by Walter Lord, *A Night to Remember* (1956) and *The Night Lives On* (1986). This is the hypothesis that Third Class families had a particular disadvantage in reaching the upper decks where lifeboats were being launched, attributed to: 1) the design of the ship, which putatively made it difficult to find ones way from where the Third Class women and children

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[2] Wade bases his conclusion on a single (unsubstantiated) account by a Third Class man, August Wennerstrom, that appeared years after the accident, in which he describes a putative crowd of Third Class passengers praying in a public room below in the stern, and by implication not making an attempt to be rescued..

were almost all located--the Third Class quarters down in the stern--to the upper decks; and 2) the lack of any organized effort on the part of the authorities to assist Third Class women and children to get to the upper decks (see Lord, 1956: 66-7; 1986: 81-98; also see Butler, 1998: 104-5).

In a chapter entitled 'What Happened to the Goodwyns?' Lord asks, somewhat rhetorically (and perhaps also with Wade in mind):

> How, then, to explain the loss of the entire Goodwin family—father, mother, and six children? There was no "language barrier" here; they were from London. Nor is there any reason to suppose they were unwilling to leave the ship…(1986: 83).

The implication that Third Class adults with children were less likely to survive than those from other classes, is not supported by the data either, since there also is no significant joint effect of either class or gender and responsibility for children (P=.2014, **Table 1**). The likelihood of the Goodwins surviving, *ceteris parabis*, was no less than that of a family in the First or Second Class, for whom there presumably was no problem of the ship's design, or assistance from the authorities. In this regard, it might be noted that as an explanatory variable it is indicated by the analysis that responsibility for children did not have a significant effect altogether on the survivability of a passenger (P=.1532, **Appendix 2**). In other words, controlling for class as well as all other variables, whether a passenger had a child on board or not, did not matter for survival.

4. Gender/Age Interactions Qua Class

A striking aspect of our analysis is the finding that the likelihood of an individual passenger surviving the *Titanic* is almost entirely explained by various pair wise joint effects of gender/age, and class. Our results in this regard are summarized in **Table 4** and **Table 5**. [Insert Table 4 Here]

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[Insert Table 5 Here]

Table 4 contains the odds ratios of a passenger surviving in relation to each joint class and gender variable and each class and age variable, *ceteris parabis*, relative to the survival of a First Class man. Looking at **Table 4**, we see, for example, that a Second Class man had a seven hundredths (7%) likelihood of surviving relative to a First Class man, while a Second Class woman had greater than three and a half times (350%) of survival (note that an odds ratio less than one means less likelihood of surviving and more than one, more likelihood relative to a First Class man.)

Table 5 indicates which interactions are significant between gender/age and class, and shows the relative odds ratios in each of these interactions. This involves, on the one hand, a matrix of interactions of genders/age within each given class, and, on the other, a matrix of interactions of classes within each given gender/age category.

As far as the significant gender/age interactions are concerned, what we find confirms what would be expected by virtually anyone familiar with the *Titanic*. Looking at the two left hand columns of the matrix of within class interactions (**Table 5**), we can see that within each of the three classes, the likelihood of a woman or a child surviving, was significantly greater than that of a man. In conjunction with this, the right hand column of the same matrix indicates that with the exception of the Second Class, there was no significant difference between the likelihood of a woman versus a child surviving, *ceteris paribus*.[3]

If these gender/age interactions within class were the only significant interactions, then our analysis would be wholly consistent with what, according to the authorities, was the general policy they pursued in conducting the rescue. Such a policy was attested to by,

among many others, two of the highest ranking surviving officers, Second Officer Charles Lightoller (the only senior officer to survive) and Fifth Officer Harold Lowe. Each testified at both the *American* and *British inquiries*, which immediately followed--in succession--the event. Each asserted that the policy was to not discriminate between passengers in the rescue effort (there is some ambiguity when it came to crew members), *other than to give absolute preference to women and children over men.*

This policy was exposited in the most certain terms by Lowe in the following exchange with Senator Smith, Chair of the Senate Sub-committee that carried out the *American inquiry* (also see *A*: 888-90 [Lightoller]; *B:* 13992-4008 [Lightoller]). The topic under discussion was the entry of people into lifeboats from the Boat Deck:

> SMITH. What did you do about it yourself? Did you arbitrarily select from the deck?
> LOWE. You say "select." There was no such thing as selecting. It was simply the first woman, whether first class, second class, third class, or sixty-seventh class. It was all the same; women and children were first.
> SMITH. You mean that there was a procession of women -
> LOWE. The first woman was first into the boat, and the second woman was second into the boat, no matter whether she was a first-class passenger or any other class.
> SMITH. So there was a procession -
> LOWE. A procession at both ends of the boat.
> SMITH. Coming toward these lifeboats?
> LOWE. Yes.
> SMITH. Did that extend beyond the upper deck?
> LOWE. No; no; there were only little knots around the deck, little crowds.
> SMITH. Now, as they came along, you would pass them, one at a time, into the lifeboat? What orders did you have; to pass women and children?
> LOWE. I simply shouted, "Women and children first; men stand back."
> SMITH. Do you know how many women there were on the boat?
> LOWE. I do not, sir.
> SMITH. You put them aboard as they came along, the first being served first?
> LOWE. The first, first; second, second.
> SMITH. Regardless of class?
> LOWE. Regardless of class, or nationality, or pedigree.

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[3] The 'N/As' in Table 5 result from the fact that of the twenty-five Second Class children on the *Titanic,* none died in the accident.

Based on this testimony, if what Lowe thought had happened, actually had, then we should find that there were no significant class interactions with respect to gender/age. That is to say, for example, a woman's likelihood of survival would not have been significantly different if she was from the First Class Second or Third Class, and similarly for men. A glance at the class interactions matrix in **Table 5** indicates that the data does not support this conclusion. Gender/age mattered to a passenger's likelihood of surviving, within each class, but class mattered too, within each gender and age category. We turn to these class interactions next.

5. Class Interactions Within Gender/Age

The matrix of class interactions contained in **Table 5** reveals how class and gender/age were intertwined in ways that could not have been fully contemplated by senior officers like Lightoller, who were involved in formulating and carrying out policy.[4] As we shall see, the class interactions may well be understood, nonetheless, as the consequence of certain actions the authorities took that evening.

Across the within gender/age categories we see a variety of interactions. A telling commonality, however, is that, looking down the two left hand columns of the matrix, whether one was a man or a woman or, with one exception, a child, and if you were from the Second or Third Class, you had a significantly lower likelihood of surviving than a corresponding man or woman from the First Class.[5] We see that a First Class man was roughly fourteen times as likely to survive as a Second Class man, and around nine times as likely as a Third Class man was to survive. Along similar lines, a woman from First Class was about nine times as likely to have survived relative to a Second Class woman.

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[4] The other senior officers were: Captain Smith, Chief Officer Wilde, and First Officer Murdoch. Murdoch, along with Lightoller, were the ones primarily in charge of preparing and loading the lifeboats.

The privileged position of the First Class relative to the other two classes does not exhaust the role played by class in determining who survived the *Titanic*. We can see from the matrix of class interactions that there were notable interactions, as well, between Second and Third Class passengers. There was no significant difference between the likelihood to survive of a man from the Second Class and one from the Third Class (both had significantly less likelihood of surviving than a man from the First Class). This apparent linkage in the bitter fate of Second and Third Class men is something of a mystery with regard to Lord's hypothesis concerning the low rate of survival among the Third Class passengers, since the Second Class men, like the First Class men--and unlike men from the Third Class--are generally presumed to have had unfettered access to the Boat Deck throughout the evening.

With respect to women, we can see that the likelihood of surviving was strictly in order of class. A First Class woman was significantly more likely to have survived than a Second Class woman, and both First and Second Class women were significantly more likely to have survived than a Third Class woman, *ceteris paribus*. More than any other result, this flies in the face of the claim that a simple preference of women and children over men was exercised, or shall we say accomplished, in the rescue effort.[6]

The logistic regression analysis, in sum, points to a complex class determination of survival rates among the women and children on the *Titanic*, on the one hand, and men, on the other; one which is overlain by a gender/age determination. This, in turn, suggests that one needs to look more concretely at how the rescue effort affected passengers along the specific dimensions of gender and class, to get beneath statistical analysis, toward an

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[5] The exception is children from the 2nd Class in relation to the 1st Class. We cannot test for significance in this case for reasons already noted.

'explanation.' Abstract explanations like class culture, family disadvantage, class conflict, *etc.* do not suffice. We now sketch an explanation that accommodates the requisite complexity, and is supported, in almost all important respects, by the data.

Our basic thesis is that the findings of our logistic regression analysis are comprehensible in light of how the rescue effort on the *Titanic* actually was carried out by the ship authorities, and how passengers responded to that effort. This requires a serious examination of the record of what actions the authorities took that evening.

There is no question that, as already alluded to, in the loading of the lifeboats-- which occurred primarily on the Boat Deck, but, in the case of several boats, from the Promenade Deck as well--women and children were given a strong preference over men. Lightoller, who was in authority over boats launched on the port side, pursued an extreme 'women and children only' policy, not allowing men into a boat even when there were no women readily available, and with the boat still having excess capacity (*B:* 13992-4008 [Lightoller]). Murdoch, in charge on the starboard side, instituted a somewhat more moderate 'women and children first' policy, allowing men in, once all women and children in the vicinity had been loaded into the boat (*B*: 6487-6553 [Rule]). For this reason, a remarkable 80% of the mere 131 male passengers who survived the *Titanic*, were rescued on boats launched from the starboard side (see **Appendix IV**).

In addition to gender preferences in the loading of the lifeboats, were less obvious preferences given to *some* men relative to others, and also *some* women and children relative to others, when it came to access to the upper decks from the lower decks. The following exchange between Senator Smith and Officer Low, in testimony quoted above, may be recalled in this context:

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[6] Statistically, there is not much to discuss for children, given the problem of 100 percent survival rate of all

> LOWE. The first woman was first into the boat, and the second woman was second into the boat, no matter whether she was a first-class passenger or any other class.
> SMITH. So there was a procession -
> LOWE. A procession at both ends of the boat.
> SMITH. Coming toward these lifeboats?
> LOWE. Yes.
> SMITH. Did that extend beyond the upper deck?
> LOWE. No; no; there were only little knots around the deck, little crowds.

It is in the matter of who made it into those 'little knots' on the upper decks where we find the elements of class determination of survival rates captured by the statistical analysis. First, we consider the treatment of men, in terms of class, and then women and children.

6. Class Determination of Survival Rates Among Male Passengers

It is certain that both men and women from the First Class, who, with minor exception, were quartered much closer to the upper decks than the passengers from the other classes, were virtually all directed by individually assigned stewards right up to the forward end of the Boat Deck, or the Promenade Deck, within an hour or so of the accident, which occurred at 11:40PM. Thirty-eight of the fifty-seven First Class men who survived were loaded by Murdoch into the very first three lifeboats launched from the starboard side, which occurred between 12:45AM and 1:00AM (**Appendix IV**). The forward end of the Boat Deck, where the rescue effort began, was normally an exclusively First Class area of the ship. In addition to there being not enough women on hand to fill these boats, there were almost no men from other classes in the vicinity. On the port side, by contrast, a mere three male passengers altogether were loaded by Lightoller into the four boats launched from the forward end, one of these men being from the First Class.

The treatment of the Second and Third Class men is not as clear-cut as that of the First Class men. There were, however, two crucial decisions taken by the authorities that

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Second Class children.

bore heavily on the chances these men had of surviving relative to those from the First Class. Each we know of with some certitude from multiple witnesses who testified at the *American* or *British* investigations.

First, beginning some time shortly after 12 midnight, and lasting as late perhaps as 1AM, some three to four hundred Third Class men quartered deep below on E, F and G Decks, in the bow of the ship took their belongings from their quarters, and made a trek aft along E Deck, virtually the entire length of the *Titanic* (*B.*: 4222-38, 4441-6 [Cavell]; *B.*: 4946-56 [Hendrickson]; *B.*: 9891-9903 [Hart]; *B*: 10357-86 [Pearcey]; *B.*: 11064-8 [Wheat]; also see Gleicher, 2000).

Even without prodding by the authorities, there would have been a strong inclination to head toward the stern for safety. It was obvious the water was coming in at the bow. According to the simulation of Hackett and Bedford (1996: 238), during the first hour after the accident the angle of the ship's trim to the water surface was increasing at the almost linear rate of .18 degrees per minute, enough for many to notice that the ship was sinking from the bow. Water had already begun to enter the Third Class quarters on G Deck within twenty minutes of the accident, and by 12:20AM it had risen to the uppermost quarters on E Deck (Hackett and Bedford, 1996: 181).

From 12:40AM until 1:45AM the increase in the angle decreased at an increasing rate until the change was virtually zero, the average over that period being a mere .015 degrees per minute. Once having gotten to the stern, (between 12:30AM and 1:00AM, or so) and observing virtually no more increase in the tilt of the deck for the next hour, these men may then have come to feel a false sense of assurance staying put even as the end was nearing.

The key decision made by the authorities, was to not direct these Third Class men in the forward quarters right up to the upper decks on the forward end, where they, like the

men of the First Class, would have been immediately available to fill boats which otherwise might be, and were indeed, launched with excess capacity. This would have been, so to speak, a class-neutral policy toward the men passengers. But rather, if anything the men were encouraged to make their journey to the stern by various stewards, and there is also some suggestion that a policy of restricting access to the forward Boat Deck (similar to that effected at the afterend) might have been briefly pursued, roughly between 12 midnight and 12:30AM (*B*.: 2874-904 [Poingdestre]).

The importance of the authorities in the movement of Third Class men to the stern is vividly brought out by the attorney for the Third Class passengers at the *British investigation*, WD Harbinson, in a pointed exchange with Steward John Edward Hart, who had testified to being one of those on hand as the event unfolded:

> HARBINSON: You told us about a rush of men from the forward part of the ship coming aft?
> HART: Yes.
> HARBINSON: They were coming towards the Third Class quarters [in the stern: DG]?
> HART: Yes.
> HARBINSON: They were Third Class passengers?
> HART: They were.
> HARBINSON: Why do you think they were coming aft?
> HART: Because I saw them coming aft.
> HARBINSON: I quite realise that you saw them. But what was it caused them, do you think, to do that? Was it because they could not escape to the boat deck by the companion ladder leading to the forward part of the ship?
> HART: I do not believe so.
> …
> HARBINSON: Did you form any opinion at the time?
> HART: I knew why they were coming aft.
> HARBINSON: That is what I want to know, why did they come aft?
> HART: Because the forward section had already taken water.
> HARBINSON: And that was the only way they could escape?
> HART: Not necessarily, no. They could escape from the fore part of the ship.
> HARBINSON: Up the companion ladder would have been the nearest way for them, would not it?
> HART: Yes.
> HARBINSON: But they did not do that; they chose the other way?
> HART: They chose the other way.
> HARBINSON: That is rather curious is it not?
> HART: No, it is not curious at all.

HARBINSON: Is it not?

HART: No..

HARBINSON: That is to say, they go the whole length of the ship and come up from the Well Deck at the back, rather than go up the companion ladder leading from the fore deck to the boat deck?

HART: Perhaps the people did not stop to think where they were going to.

HARBINSON: If there had been anybody to show them, they would not have had occasion to think?

HART: That may be so (*B.*: 10231-45).

The second crucial decision taken by the authorities followed, it would seem, from the first. The two Masters-at-Arms, Joseph Bailey and Thomas King, assisted by various other crew members, manned key entry points to the upper decks leading from the after Well Deck, and screened passengers' access to the lifeboats being loaded from the afterend of the Boat Deck and Promenade Deck, respectively (*A.*: 103e7-8 [Abelseth]; *B.*: 20125-50 [MaugJ]; *B:* 3207-10 [Poingdestre]). The evidence suggests that, in particular, Third Class men, and most likely Second Class men as well, were stopped at those points, their access to the rescue effort cut off.

This policy seems to have been first implemented some time between 12:30AM and 1:00AM, just as the huge contingent of Third Class men were arriving from the forward end, and as lifeboats were about to be prepared, loaded and launched from the afterend of the ship. It concluded around 1:35AM, when the last lifeboats at the afterend of the ship had been launched (**Appendix IV**).

The men located in the stern while this policy was in effect--the vast majority of whom were the hundreds of Third Class men from the forward end--apparently followed the word of the authorities, whose legitimacy, after all, they had no reason to question. The other men located in the stern primarily were from the Second Class, all of whom were quartered in the lower decks of the stern. Despite the impression given by popular films pf the event, there is no evidence of any attempt to storm the upper decks *en masse*, or anything

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of the sort. It is also probable that the passengers in the stern, both men and women, were not informed, or were even misled, about the urgency of the situation by the authorities, and in that sense their trust may well have been betrayed by the authorities (Davie, 1986: 102; Brown, 2001: 184).

The most detailed and revealing testimony concerning the restriction of access by men to the afterend of the upper decks, while lifeboats were being launched from there, is that of Paul Mauge, the secretary to the chef of the *a la carte restaurant*. The latter was an independent concession, servicing the First Class passengers. Mauge's testimony referred to a crucial entryway leading to the upper decks from the after Well Deck, through the Second Class entrance on C Deck, and concerned the fate of the employees of the restaurant. There were sixty or so of these restaurant workers, all men, from France and Italy. The treatment of these employees has been an issue in its own right, and this has obscured somewhat the import of Mauge's testimony with regard to the restriction of access in general.

Mauge explained, in an exchange with the Attorney-General, how, having been up to the forward Boat Deck immediately after the accident, and then coming down again, he and the restaurant chef, Pierre Rousseau, eventually became separated from the 60 workers:

> ATTORNEY-GENERAL: What became of all the other persons who were employed in the restaurant;…
> MAUGE: Well, I go down again, and I said to the chef. 'There is some danger happening; we must get up." He lost his temper—he lost himself.
> . . .
> ATTORNEY-GENERAL: [L]ost his head—is that what you mean?
> MAUGE: Yes. I said to the other cooks to wait for us. After that we had been by the third class deck just at the back and we have been trying to go on the second class passenger deck. Two or three stewards were there, and would not let us go. I was dressed and the chef was too. He was not in his working dress; he was just like me. I asked the stewards to pass. I said I was the secretary to the chef, and the stewards said, 'Pass along, get away.' So the other cooks were obliged to stay on the deck there; they could not go up. That is where they die.
> ATTORNEY-GENERAL: The other cooks were not allowed to pass?
> MAUGE: They could not go on *this* deck [referring to C Deck: DG].
> ATTORNEY-GENERAL: Why?

MAUGE: Because some stewards were there, and would not let them pass.

. . .

ATTORNEY-GENERAL: You say they would not let them pass. You were allowed to pass?

MAUGE: They let me pass, me and the chef, because I was dressed like a passenger. I think that was why they let me pass.

ATTORNEY-GENERAL: You think?

MAUGE: I think, I cannot say.

ATTORNEY-GENERAL: When you got on deck were they still putting the women and children in the boats?

MAUGE: Oh, yes.

ATTORNEY-GENERAL: Was this right, that they were preventing the men the cooks and the other persons engaged in the restaurant, from coming up on the deck where they were putting the women and children into the boats. Is that what you mean?

MAUGE: No. I mean exactly this that it was not possible for the number of the crew of the restaurant to be saved because on the third class passenger deck [the Poop Deck: DG] there was no lifeboat at all and it was not possible for them to go on the second class passenger deck.

. . .

ATTORNEY-GENERAL: You mean they could not get into a lifeboat unless they had got up on the boat deck?

MAUGE: That is right.

ATTORNEY-GENERAL: And they were not allowed to get up on the boat deck?

MAUGE: No Sir; they were not.

COMMISSIONER: Why were they not allowed to get up on the boat deck? Why was it they were kept from getting to the boat deck?

MAUGE: Well, I cannot say; I do not know.

. . .

COMMISSIONER: Who was keeping them back?

MAUGE: Who was keeping the men from the restaurant from going on the second class deck?

COMMISSIONER: Yes?

MAUGE: Some stewards.

COMMISSIONER: How many stewards?

MAUGE: Well, there were two or three on each side.

COMMISSIONER: Am I to understand two or three stewards were keeping back 60 men?

MAUGE: I cannot say after that how they managed to try to pass. Anyway they could not pass because I stood on the second class passenger deck for half-an-hour.

COMMISSIONER: And you did not see them?

MAUGE: I did not see them (*B.*: 20125-50).

The nature of the restriction of access to the upper decks revealed by Mauge's testimony is more nuanced than is usually implied in the popular accounts. More often than not the matter is presented as an issue of when certain gates were locked and when they were unlocked (*e.g.*, Quinn, 1997). In Mauge's account, by contrast, the activity at the

Second Class entrance, carried out by crew members identified as stewards, was a selection process--an individual judgment. Those in charge of the restaurant, the restaurant chef and his personal assistant, were allowed to proceed to the top decks, but the restaurant workers (cooks and waiters) were not. Everyone involved was male.

Mauge's opinion that the selection was based on him and Rousseau being dressed as passengers is doubtful, since there is no evidence that crew members were restricted from the Boat Deck. What is more likely, and may be what Mauge was trying to say, is that the stewards were making a 'class' distinction between the executives of the restaurant, who they treated as if they were from the First Class, and the restaurant workers, as such. The latter were likely not treated in the way the other crewmen of the ship were, both because they were not directly employed by the ship, and, on top of that, they were southern Europeans (the ubiquitous 'Italians') whom the authorities on the *Titanic* saw everywhere, and clearly feared and abhorred (Lightoller, 1935: 296; *A.*: 417 [Lowe]).

Lord (1955: 68) writes along these lines: "[T]he employees [of the *a la carte restaurant* had no status at all. And to make matters worse, they were French and Italian—subjects of deep Anglo-Saxon suspicion at a time like this in 1912." One can reasonably infer that the restaurant workers, in the mind of the authorities, were little different from the Third Class men who had come out of the forward quarters, and they were detained in the same way, as a consequence.

Mauge's depiction of a selection process at the Second Class entrance suggests that Third Class women and children who managed to reach the after Well Deck might well have been allowed to pass through the Second Class entrance, and to get into lifeboats; in other words, it was male passengers alone who were overtly detained at these crucial entry points, as lifeboats were being launched from the afterend of the Boat Deck and the Promenade

Deck (**Appendix IV**). This assertion is substantiated by the relatively successful rescue of Second Class women and children, who were also quartered in the lower decks of the stern; a point we will return to shortly.

This leaves open the treatment of the Second Class men, a large number of whom would also have been in the lower decks of the stern during this time. As mentioned above, the latter, unlike the men from the Third Class, were entirely quartered in the lower decks of the stern. There is virtually no direct evidence, one way or the other, as to whether their access to the upper decks was also impeded by the authorities.

Nonetheless, it is striking that only one Second Class man made it into any of the six remaining lifeboats to leave the ship after 1:35AM, as opposed to eleven men from the First Class and eighteen men from the Third Class (**Appendix IV**). This indicates that extremely few Second Class men ever did make it to the upper decks, relative to men of either of the other classes.

Indeed, it appears that the Third Class men who survived, overwhelmingly were men who'd been quartered at the forward end, who went directly up to the forward Boat Deck soon after the accident, never making the journey to the stern at all. Supporting this is the fact that almost all of the admittedly tiny number of surviving Third Class men whose path to the lifeboats are definitively known, were men of this sort; *i.e.*, Olaus Abelseth, Daniel Buckley, Carl Jansson, and Bernt Johannesen. The only clear exception to this is Berk Pickard (aka Trembisky), a Third Class man quartered at the afterend, who testified at the *American investigation*. He---like Lawrence Beesley of the Second Class—appears to have reached the after Boat Deck very early on (entering the first lifeboat to leave the afterend), before any cut off of access to the upper decks the afterend of the ship was instituted.

The upshot of these two decisions by the authorities, we conclude, was that, from around 1AM until five to ten minutes before the ship literally started to break apart, a mass of some five hundred men, comprising eighty to ninety percent of the Second Class and Third Class men on the *Titanic*, filled the stern of the ship from C Deck to as low, perhaps, as G Deck, with another one hundred or so men standing on the after Well and Poop Decks (*B.*: 3848-57 [Dillon]).

Once the lifeboats from the afterend of the ship had been launched, the sharp angle of the ship in the water, sinking at the bow, and the fact that the bow itself was on the verge of going under completely, discouraged those men on the after Well Deck and Poop—and any of the others who may have made it up to the Boat Deck at that late stage--from heading to the extreme forward end, from where the last lifeboats, four collapsibles, were leaving the ship (**Appendix IV**). To the contrary, there was in the last few minutes a mad rush aft by those on the upper decks, with the exception of those at the extreme forward end (Gracie, 1913: 138; *B*: 6040-8 [Joughin]).

Ultimately, then, eighty to ninety percent of Second and Third Class men remained at the afterend of the ship until it sank, being thrown from the ship or, in the case of those still below, being plunged into the water, between 2:10 and 2:20AM, as the ship was breaking apart. A mere handful of men (including here crew members), who entered the water from the afterend of the ship, managed then to get into a lifeboat from the water and survive. Those known, with some certainty, to have done so, were Olaus Abelseth, a Third Class passenger, and three crew members, John Collins, Thomas Dillon and Charles Joughin. None of the rest of the roughly five hundred men from the Second and Third Classes, at the stern, survived.

Looking back now at **Table 5,** a First Class man—who, as we have said, would have been ushered by a steward to the upper decks within an hour or so of the accident-- was about fourteen times more likely to survive, *ceteris paribus,* than a Second Class man, and nine times more likely than a Third Class man. There was no significant difference in the likelihood of Second and Third Class men surviving. In sum, statistical analysis confirms the hypothesis that it was the concentration of Second and Third Class men at the stern of the ship—a situation brought about by the authorities—that was the significant factor determining which male passengers survived the accident.

7. Class Determination of Survival Rates Among Female Passengers

First Class women, like their male counterparts, were ushered up to the forward Boat and Promenade Decks within an hour of the accident taking place. Only four First Class women did not survive, at least two of them, Bessie Allison and Isidor Strauss, staying on the ship voluntarily. Note that our hypothesis is that class gender interactions emanated from class differences (within each gender category), in access to the Boat and Promenade Decks. This implies then that the pure effect of gender preference—that is, where access to the upper decks was not an issue--is seen in the finding that a First Class woman was over thirty-two times more likely to survive than a First Class man (**Table 5**).

Our knowledge of the treatment of Second and Third Class women, respectively, particularly with regard to access to the upper decks, is very murky indeed. It therefore requires some intelligent speculation to reach any conclusions. Women and children in both these classes were almost all quartered at the afterend of the stern, on the lower decks from D Deck down to G Deck. The Second Class quarters were just forward of the Third Class and were clearly separated from the latter by gates.

A number of signs point to there having been, as with the First Class, an organized rescue of Second Class women and children by stewards, bringing women and children up to the after Boat and Promenade Decks. This may have been joined at certain points to routes taken by the First Class passengers located on E Deck. The rescue may have begun as early as 12 midnight and lasted as late perhaps as shortly after 1AM. This effort was largely successful. Amazingly, all twenty-five Second Class children survived, as we have noted.

There are a few witness accounts of what appears to have been the rescue of the Second Class women and children (*i.e.*, Beesley, 1912: 37; *B.*: 5961-80 [Joughin]). The stronger evidence for such an effort, however, is the fact that eighty Second Class women and children were assembled and loaded into the first five lifeboats launched from the after end of the Boat and Promenade Decks between 1:20AM and 1:30AM (**Appendix IV**). Another seven Second Class women and children entered Lifeboat 4, which, was not launched until 1:55AM (due to a series of mishaps), but had actually been loaded about an hour earlier. And yet another eight entered Lifeboat 13, launched from the after Promenade Deck at 1:35AM. Thus on the order of eighty to ninety percent of the Second Class women and children on the ship had made it to the Boat and Promenade Decks by around 1AM.

There were two noteworthy differences in the circumstances of the rescue of Second Class women and children, and that of the First Class. The first is that, in regard to a small number of women of the Second Class who responded relatively late to the accident-- perhaps because the stewards were late in directing then out of their cabin--once the mass of Third Class men had arrived in the stern, access to help from the authorities most likely ceased. By 1AM or shortly thereafter, in other words, the authorities stopped actively seeking out Second Class women and children from the lower decks of the stern. A handful

of Second Class women may well have remained below for this reason. Compounding the problem was that in the absence of the authorities, information about what was happening to the ship, as well as the progress of the rescue effort itself, was no longer available to these women either.

The second difference derives from the likely possibility, alluded to earlier, that Second Class men, like those from the Third Class, were restricted from the after Boat and Promenade Decks, during the period that lifeboats were being launched from the afterend of the ship. Five of the twelve Second Class women who did not survive were with their husbands on the ship (none of those who died had children). It is not unreasonable, then, that some or all of these women stayed with their husbands below. In doing so--unlike their one First Class counterpart, the much written about, Rosalie Strauss—they may well not have known they were sacrificing their lives, but may have believed, instead, that they could wait with their husbands until it was time for those below to be brought up to be rescued. And their husbands, too, may not have realized that by not insisting their wives go up to the Boat Deck, without delay, they effectively were denying them their one chance to survive.

Finally, what of the Third Class women and children? There is no indication of an organized rescue effort, as such, on their behalf. There was a claim made by the Third Class steward, John Edward Hart, in testimony to both the *British* and *American inquiries*, of having single-handedly brought to the upper decks, in two separate shifts, fifty-eight Third Class women and children. This has been cited in many of the popular accounts (Lord, 1955: 64-66; 1986: 85-88; Butler, 1998: 104-5; Marcus, 1969: 147; Wade, 1979: 116; and Geller, 1998: 153-40), but has been discredited (Gleicher, 2000).

There is, however, some indication that many of, if not virtually all, the Third Class women and children who survived, made their way into the Second Class area on E Deck.

This would have been some time between 12 midnight and shortly after 1AM; the same period in which the Second Class rescue was conducted. These women and children appear to have then gone forward and joined the rescue of Second and perhaps even of First Class passengers taking place at the several stairways leading from E Deck to the upper decks.

The key testimony in this regard is that of Charles Joughin, the chief baker on the ship, in an exchange with the Solicitor-General before the *British inquiry* (also see Beesley, 1912: 37).

> SOLICITOR-GENERAL: You know the way, I suppose, that third class people would have to go in order to get on to this top deck, they would have to mount some stairs, would not they?
> JOUGHIN: They have to go up some stairs, but there was an emergency door from the third class into the second class leading up the broad staircase that was open very early.
> SOLICITOR-GENERAL: …There was an emergency door from there leading from the third class to the second class?
> JOUGHIN: From the third class alleyway, what we call the working alleyway, there is a wide door, and that was open early on.
> …
> SOLICITOR-GENERAL: What staircase is that, who uses it as a. rule?
> JOUGHIN: Second class passengers as a rule while at sea.
> . . .
> SOLICITOR-GENERAL: And the third class people come along their alleyway through this emergency door and get direct into that staircase?
> JOUGHIN: Yes.
> SOLICITOR-GENERAL: And all they have to do is to go straight up on to the boat deck?
> JOUGHIN: Yes, that is right.
> …
> SOLICITOR-GENERAL: When you went down to your room and found this door open, did you at that time see third class people coming up?
> JOUGHIN: Coming along the alleyway some women, with two bags in their hands. They would not let go of them.
> SOLICITOR-GENERAL: A number of third class passengers were coming up?
> JOUGHIN: Yes.
> …
> SOLICITOR-GENERAL: Does that mean it would be about a quarter-past twelve?
> JOUGHIN A little after that.
> SOLICITOR-GENERAL: Something between a quarter-past twelve and half-past twelve?
> JOUGHIN Yes, about that (*B.*: 5961-5980).

Joughin's account is consistent with the fact that, in addition to twelve Third Class women and children who entered the first five lifeboats that left the afterend of the Boat and Promenade Decks, another eighty-seven entered the remaining three lifeboats that were launched from these decks at 1:35AM, as well as Collapsible C, which was launched from the forward end at 1:40AM (**Appendix IV**). These passengers seem to have been assembled on the after Boat and Promenade Decks about the same time as the Second Class women and children were, perhaps reaching the decks, on average, slightly later.

That there was no organized effort to rescue the Third Class women and children, as opposed to those in the Second Class, is indicated by the fact that these ninety-ninety Third Class women and children were a mere forty percent of the total number of women and children from the Third Class on the ship. By contrast, as observed above, eighty to ninety percent of Second Class women and children reached the upper decks and entered boats.

It is reasonably clear from the evidence that very few additional Third Class (or for that matter Second Class) women were reaching the upper decks as the lifeboats were being launched from the afterend, as well as Collapsible C. There is testimony of women and children having formed small crowds near the lifeboats on the afterend as they were being prepared and loaded (*A*: 400 [Lowe]; *A:* 520 [Ray]). For the most part, therefore, these women and children had arrived somewhat earlier than the actual loading process.

There are also several references in witness accounts of there having been a shortage of women and children in the loading of the last two boats launched on the starboard side of the after Promenade Deck, at 1:35AM, Lifeboats 13 and 15, (Dodge, 1913; *B*: 6487-6553 [Rule]), as well as in the loading of Collapsible C (*A:* 520 [Rowe]), launched from the forward end at 1:40AM--this, despite the fact that about sixty percent of the Third Class women and children were still on the ship. There is also considerable testimony that once

Collapsible C was launched (containing thirty-two Third Class women and children), until, perhaps, the last ten minutes or so, when the ship was literally breaking apart and most likely there was a rush of people in general up from below in the stern, there were at most a handful of women and children left on either the after or forward ends of the Boat Deck (*e.g.* A.: 81 [Lightoller]; *B.*: 3828-44 [Dillon]),

We can draw the inference, then, that, absent a rescue effort, Third Class women and children who had not found there way into the Second Class area by 1AM or so, had little opportunity to make it to the upper decks thereafter. It is not altogether surprising --once the stern had filled with Third Class men, who were now being restricted from entering the Boat and Promenade Decks—that the authorities did not go down into the stern to bring these women and children up from the lower decks. Nor is it even certain that those in charge actually were aware that so many women and children—on the order of one hundred and forty—remained below, as the lifeboats on the afterend were being launched. In addition, without assistance from the authorities, in providing information, the Third Class women who remained in the stern were likely ignorant of the fact that it was crucial to get to the upper decks as soon as possible if they were to survive. Like those around them, they seem to have waited to be told what to do next, until it was far too late.

Our statistical analysis supports the above hypothesis that, in a nutshell, large numbers of Third Class women and children were effectively left stranded on the lower decks of the stern by the authorities, as the loading and launching of lifeboats above them was going forward. It is indicated in **Table 5** that the odds ratio of First Class women surviving relative to Third Class women was 78.96, and that of Second Class women relative to Third Class was 8.95. Interestingly enough, the analysis also supports the speculation that the crowding of the stern by Third Class men may have affected the survival of Second Class

women as well. We see from **Table 5** that the odds ratio of First Class women surviving relative to Second Class women was 8.82.

8. Concluding Summary

Our key findings, gleaned from the logistic regression analysis of the extensive data on the *Titanic* passengers, show that underneath the strong overt preference afforded in the rescue by the authorities to women and children over men, there was as well a complex class determination of survival rates both among men, on the one hand, and women and children, on the other.

A First Class man had a significantly greater likelihood of surviving than either a man from the Second Class or Third Class, *ceteris paribus*, while there was no significant difference between the likelihood of a Second Class man and a Third Class man surviving. By the same token, a First Class woman had a significantly greater likelihood of surviving than either a woman from the Second Class or the Third Class, *ceteris paribus*. However, unlike among the men, there was a significantly greater likelihood of a Second Class woman surviving than a woman from the Third Class.

We have suggested that a reasonable explanation of each of these findings lies in the effects of two crucial decisions made by the authorities on the ship. The first decision, taken within the first hour at most of the accident, was to encourage, and perhaps direct, some three to four hundred Third Class men quartered in the lower decks at the forward end, along E Deck, the length of the ship, back to the afterend of the stern.   The second decision, taken roughly between 12:30 and 1AM--not long after the first--was to restrict the access to the after Boat and Promenade Decks of men at the after end of the ship, both those below in the stern as well as those on the after Poop and Well Decks.

The direct effect of these decisions was to cut off from the rescue effort—both physically and in terms of information--almost all the men from the Second and Third Classes. By the time the authorities vacated their posts, the lifeboats at the afterend of the ship were gone and the few remaining boats were at the forward end, which by that time was under the water. First Class men, by contrast, were quickly brought up to the forward end of the Boat Deck by stewards, many, if not all, prior to 1AM, as the first lifeboats boats were prepared and launched. How much did that access to the rescue improve their chances? From **Tables 4** and **5** we see that, while it is true that, *ceteris paribus*, a First Class woman was more than thirty-two times more likely to survive than a First Class man, it is nonetheless also true that a First Class man was over fourteen times more likely to survive than a Second Class man, and over nine times more likely than a Third Class man.

The major secondary effect of the two decisions was that, absent any organized rescue effort on their behalf, on the order of one-hundred and forty Third Class women and children---approximately sixty percent of those on board---who remained below in the stern after the mass of Third Class men had finished there journey there from the forward quarters; men who, themselves, were not being restricted from entry onto the after Boat and Promenade Decks. With these men filling the stern by 1AM or so, thereafter the authorities seem to have no longer considered extracting women and children from the lower decks of the stern. By contrast, it appears that large majority of Second Class women and children had already been directed up to the after Boat and Promenade Decks by 1AM. Hence (**Table 5**), *ceteris paribus*, a Second Class woman's likelihood of survival was almost nine times that of a Third Class woman.

References

A.: *American. inquiry*, 1912. In *Wreck of the Steamship Titanic*: *6Second Congress, Second Session, 1911-*
>	*1912* (1998) Congressional Information Service.

B.: *British inquiry*, 1912. In *Titanic Inquiry Project*, 1999, on-line.

Beavis, Debbie, 2002. *Who Sailed on Titanic? The Definitive Passenger Lists.* Ian Allen.

Beesley, Lawrence, 1912. *The Loss of the SS Titanic.* In Jack Winocour, ed., *The Story of the Titanic as Told by Its Survivors*, (1960) Dover.

Brown, David, 2001. *The Last Log of the Titanic,* International Marine.

Butler, Daniel, 1998. *Unsinkable*, Stackpole.

Davie, Michael, 1986. *Titanic: The Full Story of a Tragedy,* Collins.

Dawson, Robert, 1995. "The 'Unusual Episode' Data Revisited," *Journal of Statistics Education 5:3.*

Dodge, Washington, 1912. An address Delivered before the Commonwealth Club San Francisco, May 11. lodelink.com/titanic (1998) on-line.

Gleicher, David, 2000. "The Fatal Journey of Third Class Men Inside the Titanic," Philip Hind, ed., 1996-2003, *Research Articles: Encyclopedia Titanica* (on-line).

_____, 2000. "John Edward Hart: Dubious Hero?," Philip Hind, ed., 1996-2003, *Research Articles: Encyclopedia Titanica* (on-line).

Gracie, Archibald, 1913. *The Truth About the Titanic.* In Jack Winocour, ed., *The Story of the Titanic as Told by Its Survivors* (1960) Dover.

Hackett, C. and Bedford, J.G., 1996. The sinking of SS Titanic—investigated by modern techniques, *Transactions of The Royal Institution of Naval Architects.*

Lightoller, Charles, 1935. *Titanic and Other Ships* (Nicholson & Watson) Chs. 30-5. In Jack Winocour, ed., *The Story of the Titanic as Told by Its Survivors*, (1960) Dover.

Lord, Walter, 1955. *A Night to Remember,* Bantam.

_____, 1986. *The Night Lives On*, Avon.

Marcus, Geoffrey, 1969. *The Maiden Voyage*, Viking.

Mersey, 1912. *Report on the Loss of the S.S. Titanic.* Reprint (1998) Sutton.

Mitcham, Lester, 2001. The statistics of the disaster, Philip Hind, ed., 1996-2003, *Research Articles: Encyclopedia Titanica* (on-line).

Quinn, Paul J., 1997. *Titanic at Two*, Fantail.

_____, 1999. *Dusk to Dawn: Survivor Accounts of the Last Night on the Titanic*, Faintail.

Soldner, Hermann, 2000. *RMS Titanic: Passenger and Crew List*, Awie Arger Verlag.

Wade, Craig Wyn, 1979. *The Titanic: End of a Dream*, Penguin.

Table 1

Tests of Selected Interactions

Interaction	Wald Chi-Square	DF	Pr > ChiSq
Gender/Age by Class	24.3100	4	<.0001
Gender/Age by Region	27.3464	14	0.0174
Class by Region	7.0323	7	0.4255
Class by Responsibility for Children	3.2053	2	0.2014
Second and Third Class Women	27.8957	1	<.0001
Second and Third Class Men	1.3696	1	.2419

Table 2

Passenger Survival by Class, Gender and Age

| | Males | | | Females | | | Children | |
	w/o Child	w Child	Sub-total	w/o Child	w Child	Sub-total	Sub-total	Total
First Class								
Survived	54	3	57	134	4	138	6	**201**
Died	116	2	118	3	1	4	1	**123**
Sub-total	170	5	175	137	5	142	7	**324**
Second Class								
Survived	12	1	13	66	15	81	25	**119**
Died	146	8	154	12	0	12	0	**166**
Sub-total	158	9	167	78	15	93	25	**285**
Third Class								
Survived	57	4	61	73	16	89	29	**179**
Died	374	13	387	74	18	92	51	**530**
Sub-total	431	17	448	147	34	181	80	**709**
Total	**759**	**31**	**790**	**362**	**54**	**416**	**112**	**1318**

Table 3[7]

Passenger Survival by Class, Gender and Region

	First Class			Second Class			Third Class			Sub-total		Total
	M	W&C	Total	M	W&C	Total	M	W&C	Total	M	W&C	
Americas												
Survived	38	112	**150**	4	22	**26**	2	11	**13**	44	145	**189**
Died	83	5	**88**	21	4	**25**	24	14	**38**	128	23	**151**
Sub-total	121	117	**238**	25	26	**51**	26	25	**51**	172	168	**340**
Britainia												
Survived	8	13	**21**	6	62	**68**	7	17	**24**	21	92	**113**
Died	27	0	**27**	95	6	**101**	88	30	**118**	210	36	**246**
Sub-total	35	13	**48**	101	68	**169**	95	47	**142**	231	128	**359**
Central & E. Asia												
Survived	0	0	**0**	1	3	**4**	4	3	**7**	5	6	**11**
Died	0	0	**0**	6	0	**6**	15	1	**16**	21	1	**22**
Sub-total	0	0	**0**	7	3	**10**	19	4	**23**	26	7	**33**
Eastern Europe												
Survived	0	0	**0**	0	1	**1**	1	3	**4**	1	4	**5**
Died	0	0	**0**	2	0	**2**	58	6	**64**	60	6	**66**
Sub-total	0	0	**0**	2	1	**3**	59	9	**68**	61	10	**71**
Ireland												
Survived	0	0	**0**	0	1	**1**	6	31	**37**	6	32	**38**
Died	1	0	**1**	3	0	**3**	44	21	**65**	48	21	**69**
Sub-total	1	0	**1**	3	1	**4**	50	52	**102**	54	53	**107**
Scandinavia												
Survived	2	3	**5**	0	4	**4**	25	24	**49**	31	27	**58**
Died	1	0	**1**	9	1	**10**	89	52	**141**	91	61	**152**
Sub-total	3	3	**6**	9	5	**14**	114	76	**190**	122	88	**210**
Southern Europe												
Survived	0	3	**3**	2	4	**6**	0	0	**0**	2	7	**9**
Died	2	0	**2**	3	0	**3**	9	0	**9**	14	0	**14**
Sub-total	2	3	**5**	5	4	**9**	9	0	**9**	16	7	**23**
Southwest Asia												
Survived	1	0	**1**	0	1	**1**	8	27	**35**	9	28	**37**
Died	0	0	**0**	1	0	**1**	42	11	**53**	43	11	**54**
Sub-total	1	0	**1**	1	1	**2**	50	38	**88**	52	39	**91**
Western Europe												
Survived	8	12	**20**	0	8	**8**	8	2	**10**	16	22	**38**
Died	2	0	**2**	12	1	**13**	14	8	**22**	28	9	**37**
Sub-total	10	12	**22**	12	9	**21**	22	10	**32**	44	31	**75**
Adj.	2	1	**3**	2	0	**2**	4	0	**4**	8	1	**9**
Total	**175**	**149**	**324**	**167**	**118**	**285**	**448**	**261**	**709**	**786**	**532**	**1318**

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[7] See **Appendix II** for the groupings of nations into the nine regions in **Table 2**.

Table 4

Survival Odds Ratios of Gender, Age and Class

	First Class	Second Class	Third Class
Man	Reference	0.07	0.11
Woman	32.46	3.67	0.41
Child	6.05	N/A[8]	0.85

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[8] This results from the fact that of the twenty-five Second Class children on the *Titanic,* none died in the accident.

Table 5

Gender, Age and Class Interactions

Note: Odds Ratios are bolded and italicized.

Within Class

	Man/Woman	Man/Child	Woman/Child
First Class	*32.46* P<.0001	*6.05* P=.0180	Insignificant P=.1593
Second Class	*52.44* P<.0001	N/A[9]	N/A[10]
Third Class	*3.85* P<.0001	*8.06* P=.0014	Insignificant P=.3111

Within Gender/Age

	Second/First Class	Third/First Class	Third/Second Class
Man	*14.29* P<.0001	*9.09* P<.0001	Insignificant P=.2419
Woman	*8.82* P<.0001	*78.96* P<.0001	*8.95* P<.0001
Child	N/A[11]	*7.00* P=.1092	N/A[12]

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[9] Ibid.

[10] Ibid.

[11] Ibid.

[12] Ibid.

Appendix I
Logistic Regression

The dependent or criterion variable in Logistic Regression is dichotomous, e.g. values of "1" or "0." In this paper, the outcome "1" indicates that the passenger survived while "0" denotes that the passenger did not survive. The probability that a passenger survived, p_i, is modeled as the Logistic Probability distribution,

$$p_i = \frac{1}{1 + \exp^{-(\alpha + \beta_1 x_{i1} + \beta_2 x_{i2} + ... + \beta_k x_{ik})}},$$
(1)

"exp" is the exponential function.

There is a simple relationship between probability and odds,

$$\text{Odds} = \frac{p}{1 - p},$$
(2)

$$p = \frac{\text{Odds}}{1 + \text{Odds}}.$$

The "Logit" model is specified as the log odds of equation (1),

$$Ln\left(\frac{p_i}{1 - p_i}\right) = \alpha + \beta_1 x_{i1} + \beta_2 x_{i2} + ... + \beta_k x_{ik}.$$
(3)

"Ln" is the natural logarithm. The explanatory variables, "x," may be either continuous or dummy (indicator) variables.

The purpose of this exercise is to obtain estimates of the "slope" coefficients, $\beta_1, \beta_2, \beta_3, ..., \beta_k$, using the Titanic dataset. This is accomplished by the method of Maximum Likelihood, which we will not review in this appendix. The reader is referred to a short text by Allison (1999) for the estimation details. It is important to note that the betas do not represent the change in the probability of survival, p_i, for a one unit change in "x_i," since the relationship between p_i and the explanatory variables is nonlinear. We can only determine the direction of relationship, based upon the sign of any coefficient, between any given explanatory variable and the probability of survival. However, the betas do represent the change in "log odds" or in the "Logit" as a result of a one unit change in "x_i."

The "Logit" model (3) lends itself to further interpretation when at least one of the explanatory variables are dichotomous. Consider the following simple example of a single indicator or dummy variable, "x_i,"

$$Ln\left(\frac{p_i}{1-p_i}\right) = \alpha + \beta_1 x_{i1}. \tag{4}$$

When $x_{i1} = 1$,

$$Ln\left(\frac{p_i}{1-p_i}\right) = \alpha + \beta_1, \tag{5}$$

and when $x_{i1} = 0$,

$$Ln\left(\frac{p_i}{1-p_i}\right) = \alpha. \tag{6}$$

Next, we convert (5) and (6) to odds by taking the exponent (exp) of each,

$$\exp^{Ln\left(\frac{p_i}{1-p_i}\right)} = \frac{p_i}{1-p_i} = \exp^{\alpha+\beta}, \tag{7}$$

$$\exp^{Ln\left(\frac{p_i}{1-p_i}\right)} = \frac{p_i}{1-p_i} = \exp^{\alpha}. \tag{8}$$

The "odds ratio" is defined as the ratio of the odds for $x_{i1} = 1$ to the odds for $x_{i1} = 0$,

$$\text{Odds Ratio} = \frac{\exp^{\alpha+\beta}}{\exp^{\alpha}} = \exp^{\beta}. \tag{9}$$

For example, if $x_{i1} = 1$ represented adult females and $x_{i1} = 0$ represented adult males, then the odds ratio (9) would tell us how much more likely females were to survive relative to males. Of course, if there were multiple explanatory variables then all of this would have to be qualified with the phrase, *ceteris paribus*.

Appendix II
Logistic Regression Results

Parameter	Estimate	Standard Error	Wald Chi-Square	Prob> Chi-Square
Intercept	-0.8006	0.1863	18.4692	<.0001
Britannia	0.3003	0.3322	0.8174	0.3659
Ireland	0.1376	0.5437	0.0640	0.8002
Scandinavia	0.8983	0.3897	5.3153	0.0211
Western Europe	1.3530	0.4164	10.5598	0.0012
Southern Europe	0.1193	0.8208	0.0211	0.8845
Eastern Europe	-1.8517	1.0629	3.0348	0.0815
Southwest Asia	0.6144	0.4931	1.5527	0.2127
Central East Asia	0.9084	0.5936	2.3417	0.1260
Child Responsibility	0.6507	0.4555	2.0403	0.1532
Female Adult	4.2776	0.5493	60.6528	<.0001
Child	2.5924	1.0961	5.5940	0.0180
Second Class	-1.8592	0.3812	23.7819	<.0001
Third Class	-1.4406	0.3254	19.6025	<.0001

Interactions:[13]

Parameter	Estimate	Standard Error	Wald Chi-Square	Prob> Chi-Square
Female Second Class	-0.3179	0.7491	0.1801	0.6713
Female Third Class	-2.9284	0.7345	15.8941	<.0001
Child Second Class	17.0826	692.5000	0.0006	0.9803
Child Third Class	-0.5053	1.2578	0.1614	0.6879
Female Britannia	0.9297	0.5867	2.5107	0.1131
Female Ireland	1.1476	0.7707	2.2172	0.1365
Female Scandinavia	-0.4813	0.6564	0.5376	0.4634
Female Western Europe	-1.5039	0.8823	2.9055	0.0883
Female Southern Europe	14.3219	1257.1000	0.0001	0.9909
Female Eastern Europe	1.7899	1.3766	1.6906	0.1935
Female Southwest Asia	1.0837	0.8108	1.7866	0.1813
Female Central East Asia	15.4648	1297.3000	0.0001	0.9905
Child Britannia	0.3928	0.8111	0.2345	0.6282
Child Scandinavia	2.4024	0.8712	7.6045	0.0058
Child Western Europe	2.5852	1.3164	3.8566	0.0496
Child Eastern Europe	18.3300	3505.4000	0.0000	0.9958
Child Southwest Asia	0.5513	0.9453	0.3402	0.5597
Child Central East Asia	17.0437	3445.1000	0.0000	0.9961
Female with Child	0.5493	0.5906	0.8649	0.3524

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[13]Statistically insignificant interactions are not included (see **Table 1**).

Appendix III
Groupings of Nationalities into Regions

<u>Americas</u>
Brazil
Canada
Cuba
Mexico
Uruguay
United States

<u>Britannia</u>
Australia
Great Britain

<u>Central & East Asia</u>
China
Japan
Russia

<u>Eastern Europe</u>
Bosnia
Bulgaria
Hungary
Croatia
Slovenia
Yugoslavia

<u>Ireland</u>
Ireland

<u>Scandinavia</u>
Denmark
Finland
Norway
Sweden

<u>Southern Europe</u>
Spain
Greece
Italy
Portugal

<u>Southwest Asia</u>
India
Lebanon
Syria
Turkey

<u>Western Europe</u>
Austria
Belgium
Germany
France
Netherlands
Switzerland

Lifeboat Departure Times, Locations, and Occupants by Gender and Class

Time	Boat #	Loc.	First Class		Sub-total	Second Class		Sub-total	Third Class		Sub-total	Passengers		
			Males	W&C		Males	W&C		Males	W&C		Males	W&C	Total
12:45	7	F/Star	13	12	**25**	0	0	**0**	0	0	**0**	13	12	**25**
12:55	5	F/Star	13	15	**28**	0	0	**0**	0	0	**0**	13	15	**28**
12:55	6	F/Port	1	19	**20**	0	0	**0**	1	0	**1**	2	19	**21**
1:00	3	F/Star	12	14	**26**	0	0	**0**	0	0	**0**	12	14	**26**
1:10	8	F/Port	0	23	**23**	0	0	**0**	0	0	**0**	0	23	**23**
1:10	1	F/Star	3	2	**5**	0	0	**0**	0	0	**0**	3	2	**5**
1:20	9	R/Star	2	4	**6**	4	13	**17**	3	0	**3**	9	17	**26**
1:20	10	R/Port	0	9	**9**	1	14	**15**	1	5	**6**	2	28	**30**
1:25	11	R/Star	1	5	**6**	0	15	**15**	3	2	**5**	4	22	**26**
1:25	12	R/Port	0	0	**0**	0	16	**16**	1	1	**2**	1	17	**18**
1:30	14	R/Port	0	4	**4**	2	22	**24**	2	4	**6**	4	30	**34**
1:35	16	R/Port	0	0	**0**	0	3	**3**	2	20	**22**	2	23	**25**
1:35	13	R/Star	1	0	**1**	4	8	**12**	8	19	**27**	13	27	**40**
1:35	15	R/Star	1	0	**1**	1	0	**1**	22	16	**38**	24	16	**40**
1:40	C	F/Star	2	0	**2**	0	0	**0**	6	32	**38**	8	32	**40**
1:45	2	F/Port	0	8	**8**	0	0	**0**	1	5	**6**	1	13	**14**
1:55	4	F/Port	0	24	**24**	0	7	**7**	0	0	**0**	0	31	**31**
2:05	D	F/Port	3	5	**8**	0	2	**2**	1	8	**9**	4	15	**19**
2:20	B	F/Port	3	0	**3**	1	0	**1**	6	0	**6**	10	0	**10**
2:20	A	F/Star	3	0	**3**	0	0	**0**	4	1	**5**	7	1	**8**
		Adj.*	-1	0	**-1**	0	5	**5**	0	5	**5**	-1	10	**9**
		Total	57	144	**201**	13	105	**118**	61	118	**179**	131	367	**498**

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[14] Departure times are those determined by the *British inquiry*, and are found in their Report (Mersey, 1912.) Lifeboat occupancy data derives from, Philip Hind, ed., 1996-2003, *Lifeboats*: *Encyclopedia Titanica* (on-line). Aggregates are adjusted to conform to the number of survivors in various categories found in Soldner (2000).