STATE OF RHODE ISLAND AND PROVIDENCE PLANTATIONS
DIVISION OF PUBLIC UTILITIES AND CARRIERS

In Re: Rhode Island Fast Ferry, Inc.   )   Docket No. D-13-51

REBUTTAL TESTIMONY OF
STEPHANIE A. COSTA, PhD

REDACTED

1. Q. Ms. Costa what is your educational and professional background?

   A. I hold a PhD in Mathematics from the University of Rhode Island and am currently an Associate Professor of Mathematics at Rhode Island College. I have taught courses in Business Statistics at the college level for the last twelve years.

2. Q. Is Exhibit A attached hereto a true and accurate copy of your current Curriculum Vitae?

   A. Yes.

3. Q. What experience do you have designing and administering surveys?

   A. In my statistics courses I educate students about good survey design, random sampling techniques, and sources of bias. I am part of the departmental assessment committee whose goal is to collect, organize, and analyze data on student learning. I am also the director of assessment for the Rhode Island College's new General Education program; as such I am responsible for collecting and analyzing data collected in our First Year Writing and First Year Seminar courses which are required of all freshmen entering the college.

4. Q. Ms. Costa have you had the opportunity to review the testimony of Messrs. Mazze and Edge, as well as Interstates responses to RIFFs Data Requests?

   A. Yes.

5. Q. Do you have an opinion with a reasonable degree of mathematical certainty as to whether the Interstate survey methodology was sound and whether the conclusions drawn from it by Messrs. Mazze and Edge are supported by the data collected in the survey?

   A. Yes. In my opinion the methodology had significant weaknesses and the conclusions were presented in a worst case scenario not necessarily supported by the data.

6. Q. Please explain what you mean by that?

   A. Generally, surveys are conducted using a sample to estimate population parameters since a census of the population demands more resources than are generally available. Whenever a sample is taken, a sample statistic is calculated and used to create an interval that is likely to contain the population parameter. In this case the parameter of interest is the percentage of all Interstate ferry riders who would choose to take a fast ferry from Quonset, while the sample statistic is the percentage of Interstate ferry riders in the sample who would choose to take a fast ferry from Quonset. Associated with every interval is a level of confidence (typically 90%, 95% or 99%) which essentially measures how confident we are that the interval we create actually contains the population parameter. Since the confidence interval is based on our sample data, there is always a chance that our population parameter lies outside of the confidence interval. In this case the proportion of the sample that would choose to take the ferry from Quonset is denoted $\hat{p}$ and the proportion of the population that would choose to take the ferry from Quonset is denoted p. The lower endpoint of a 95% confidence interval for p is $\hat{p} - E$, and the upper endpoint is $\hat{p} + E$ where E represents the margin of error, $E = 1.96 * \sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$, and n represents the size of the sample. In his report, Mr. Mazze simply reports sample statistics, but fails to provide an interval estimate for the population parameter.

   Also, Interstates witnesses describe the survey as a marketing device designed to determine whether Interstates customers would use an Interstate operated fast ferry from Quonset under certain conditions. However, nowhere in the survey questions did Interstate inform the respondents of that precise purpose. This affects the reliability of their answers, since the answers may have been different had the respondents known that the true purpose was to determine whether Interstates customers would use a Quonset fast ferry service not operated

by Interstate.

7. Q. How so?

A. Whenever a face-to-face survey is conducted there are a number of opportunities for bias. First of all, it is important that the purpose of the survey as well as the identity of the interviewer and sponsor is presented to the interviewee prior to the start of the survey. Not knowing the purpose of the survey or identity of the sponsor can lead to social desirability bias. Social desirability bias describes the tendency of the interviewee to respond in a way that he or she believes is desirable to the interviewer.

The presence of other individuals at the time of data collection is practically unavoidable in face-to-face surveys, and introduces opportunity for bias as well. For example, family members or friends present during an interview usually offer opinions and may influence responses of the interviewee.

Finally, and perhaps most importantly, bias can be introduced by the interviewer conducting the survey. Any reaction from the interviewer may influence the respondent's subsequent answers.

All of the above sources of bias may have affected the responses of individuals who participated in Interstate's surveys. In particular, interviewees were told that the survey was being conducted for marketing and promotion purposes; people might have indicated that they would choose to take the Quonset ferry thinking that Interstate would be expanding their service to Quonset and that the desirable answer was to respond yes, they would be willing to take a ferry from Quonset.

8. Q. What is the basis of your opinion that the data does not support the conclusions Interstate's witnesses drew from it?

A. In my opinion the data was selectively analyzed to present a worst case scenario. Interstate conducted a survey by using a systematic sample

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of ferry riders on three different dates during the summer of 2013. The population of interest was all people who ride Interstate's ferries to Block Island, which according to Interstate was ▇▇▇▇▇ in 2013. The obvious focus of Mr. Mazze was on the responses to questions 4 and 5 as presented to conventional ferry riders and questions 4, 5 and 6 for fast ferry riders.

Question 4 asked conventional ferry riders:

"If there was a $50 round trip ferry ride from Quonset Point in North Kingstown to Old Harbor, would you take the Quonset fast ferry instead of the Point Judith conventional ferry?"

The conventional ferry customer responses to question 4 are summarized in Table I below:

Date	July 31	August 12	September 7	Total
Yes	23	22	14	59
No	94	94	104	292
Total	117	116	118	351

Figure 1: Table I

In summary, we can see that 59/351=17% of the 351 people surveyed answered "yes" to question 4. This is the number that Mr. Mazze chose to report when asked to summarize his testimony in line four of page four of his testimony. However, what is important to note is that this 17% is the percentage of the sample that responded yes to question 4, but this is not necessarily the proportion of all Point Judith conventional ferry riders that would respond yes to question 4. What we can conclude from this data is that we are 95% sure that the percentage of all Point Judith conventional ferry riders that would take the fast ferry from Quonset to Old Harbor is between 13% and 21% if it cost $50 round trip ($\hat{p} = 59/351$, so the lower end of the interval estimate for p

is $\hat{p} - E = \frac{59}{351} - 1.96 * \sqrt{\frac{\frac{59}{351}(1 - \frac{59}{351})}{351}} = 0.1290$ and the upper endpoint of the interval estimate for p is $\hat{p} + E = \frac{59}{351} + 1.96 * \sqrt{\frac{\frac{59}{351}(1 - \frac{59}{351})}{351}} = 0.2072)$.

Thus, from this data we can conclude with 95% certainty that between 13% and 21% of the entire population of all Point Judith conventional ferry riders would take the $50 fast ferry from Quonset.

Clearly this interval is fairly wide, due to the fact that the margin of error, E, is approximately 4%, producing an interval with endpoints that are eight percentage points apart. At 95% confidence if we wished to get a narrower interval, producing tighter bounds on the proportion of all Point Judith conventional ferry riders who would take the $50 fast ferry from Quonset, we would need to increase the size of the sample. For example, if we wanted our margin of error to be 0.5%, to get an estimate within 1% of the population parameter, Interstate would need a sample of at least 21,488 people, or 3.5% of Interstate's 2013 total clientele, rather than 351, which represents .06% of Interstate's 2013 total clientele.

9. Q. What then is the flaw in the analysis of this data?

A. The flaw is that since the cost of the Interstate conventional ferry is in fact $27 less than the hypothetical $50 ferry from Quonset, the real answer to the question of interest lies in the results of question 5:

"If the conventional ferry cost is about $27 less per person from Point Judith, than the Quonset fast ferry, does that change your answer to question 4?"

Taking into account the answers to questions four and five, the number of people who would choose to take the fast ferry from Quonset is summarized in Table II below:

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Date	July 31	August 12	September 7	Total
Yes	8	7	10	25
No	109	109	108	326
Total	117	116	118	351

Figure 2: Table II

Thus, we see that of the 351 people surveyed, only 25/351 = 7% would choose to ride the hypothetical $50 fast ferry from Quonset to Old Harbor, given that the conventional ferry from Point Judith costs approximately $27 dollars less. In this case, we can conclude that the percentage of all Point Judith conventional ferry users that would choose to take the fast ferry from Quonset instead of Point Judith is between 4% and 10%, with 95% confidence ($\hat{p} = 25/351$, so the lower end of the interval estimate for p is $\hat{p} - E = \frac{25}{351} - 1.96 * \sqrt{\frac{\frac{25}{351}(1-\frac{25}{351})}{351}} = 0.0443$ and the upper endpoint of the interval estimate for p is $\hat{p} + E = \frac{25}{351} + 1.96 * \sqrt{\frac{\frac{25}{351}(1-\frac{25}{351})}{351}} = 0.0981$).
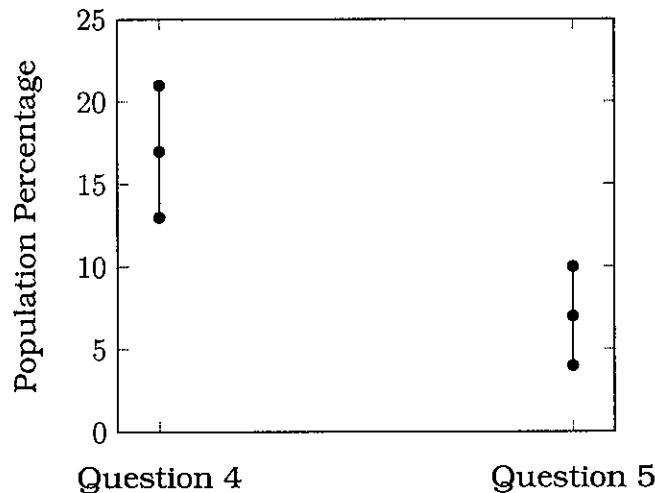

Figure 3: 95% Confidence Intervals - Conventional Ferry Riders

10. Q. Was this same flawed analysis used in analyzing the Interstate fast

ferry customer

responses?

A. Yes. For fast ferry riders from Point Judith, question 4 was presented as follows:

"If there was a $50 round trip ferry ride from Quonset Point to Old Harbor in North Kingstown, and took one hour on the water, would you take the Quonset fast ferry instead of the Point Judith fast ferry?"

The fast ferry customer responses to question 4 are summarized in the Table III below:

Date	July 31	August 12	September 7	Total
Yes	27	29	15	71
No	54	52	86	192
Total	81	81	101	263

Figure 4: Table III

Thus, we see from the above that 71/263 = 27% of the fast ferry riders sampled would choose the Quonset service over the Point Judith fast ferry. But what we can conclude is that we are 95% sure that the percentage of all Point Judith fast ferry users that take the fast ferry from Quonset to Old Harbor is between 22% and 32%.

Again, the fact that Mr. Mazze chose to report that Interstate would lose as much as 27% of its hi-speed ferry passengers on line four of page four of his testimony is questionable. Since the cost of the Point Judith fast ferry is in fact $15 less and the on water travel time is in fact about a half an hour less than the hypothetical $50 ferry from Quonset, what we should be focusing on are responses to questions 5 and 6 as well.

11. Q. What does that data reveal?

A. Question 5 asked fast ferry riders:

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"If the cost from Point Judith is about $15 less per person does that change your answer to question 4?"

The number of fast ferry riders who would choose to take a $50 fast ferry from Quonset given that there was a fast ferry from Point Judith that cost $15 less is summarized in Table IV below:

Date	July 31	August 12	September 7	Total
Yes	11	11	9	31
No	70	70	92	232
Total	81	81	101	263

Figure 5: Table IV

Thus, we see from the above table that only 31/263 = 12% of the fast ferry riders sampled would choose the Quonset service over the Point Judith fast ferry if the cost was $15 less. We can conclude then that the percentage of all Point Judith fast ferry riders who would choose to take the fast ferry from Quonset that cost $15 more is between 8% and 16% with 95% confidence.

12. Q. And what happens to that number when the travel time variable is introduced?

A. Focusing on the results of question 6, "If the on water travel time is about half an hour less from Point Judith than from Quonset, does that change your answer to question 4?", we report on the number of Point Judith fast ferry riders who would choose to take a fast ferry from Quonset given that there was a fast ferry from Point Judith for which the on water travel time was about half an hour less, in Table V below:

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Date	July 31	August 12	September 7	Total
Yes	5	12	10	27
No	76	69	91	236
Total	81	81	101	263

Figure 6: Table V

In this case we see that only 27/236 = 11% would choose the fast ferry from Quonset over the Point Judith fast ferry under the given conditions. We can conclude then that the percentage of all Point Judith fast ferry riders who would choose to take the fast ferry from Quonset is between 7% and 14% with 95% confidence, if it cost $15 more and travel time over water was a half hour more, as reflected in Figure 7.
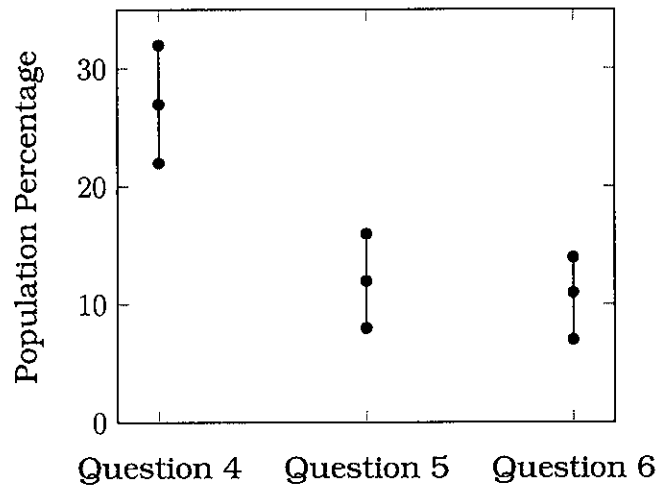

Figure 7: 95% Confidence Intervals - Fast Ferry Riders

13. Q. What then do you see as the fundamental flaw in the analysis of the survey?

   A. The piece of information that we are missing here is the number of Interstate fast ferry users who responded "yes" to both questions 5 and 6, that they would change their response to question 4 given that the fast

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ferry from Point Judith cost less and was shorter, respectively. This would allow us to calculate the percentage of people who would choose to take the fast ferry from Quonset given that it costs more and takes longer than the fast ferry from Point Judith with greater certainty. By refusing to provide all of the results of the survey, Mr. Mazze has made it difficult to calculate this percentage. He reports that on July 31st, of the 27 people that responded "yes" to question 4, 16 would change their response to "no" if the cost were more from Quonset and 22 would change their response to "no" if the ride was longer. Thus, potentially all of the 27 people might have changed their response question 4 to "no" (since at least 11 people who responded "yes" to question 5 would have to be the same as those who responded "yes" to question 6, as 16+22=38 and there were only 27 "yes" responses to question 4 originally).

Similarly, on August 12th, 29 people responded "yes" to question 4, but 18 would change their response to "no" if the cost were more, and 17 would change to "no" if it took longer. So again, potentially all 29 people might have changed their response to no (again, at least 6 of the people who answered "yes" to question 5 must have also answered "yes" to question 6, since 18+17=35 and only 29 responded "yes" to question 4.) Finally on September 7th, 15 people responded "yes" to question 4, and of the 15, 6 would change their response to "no" if the cost were more from Quonset and 5 would change their response to "no" if the ride was longer. It is possible that the 6 people that would have changed their response to question 4 to "no" because the cost was higher are different from the five people that would have changed their response to question 4 because the on water time is longer giving us a total of 6+5=11 out of fifteen people who would have answered question 4 differently.

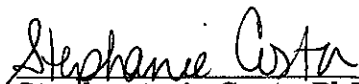Without all of the data, we could conclude that the number of people

surveyed who would choose to take the fast ferry from Quonset given that it costs more and takes longer than the fast ferry from Point Judith could be as low as 4 (15-11), or 1.5% of the sample. We could conclude then that the percentage of all Point Judith fast ferry riders who would choose to take the fast ferry from Quonset given that it costs more and takes longer than the fast ferry from Point Judith is between 0.04% and 3%, with 95% confidence based upon the survey results and data provided by Interstate.
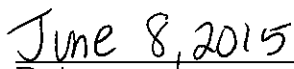
14. Q. Then to summarize, is it your opinion with a reasonable degree of mathematical certainty that based upon the relatively small sample Interstate chose to survey, somewhere between 4% and 10% of its conventional ferry passengers might use a Quonset fast ferry that cost $50 and took longer and between .04% and 3% of its fast ferry customers would use the Quonset fast ferry at that price and a longer ride over the water, with a level of certainty of 95%?

    A. Yes. But again, this survey had significant weaknesses which I believe affect the reliability of the results.

15. Q. Does that conclude your testimony?

    A. Yes.

Stephanie A. Costa PhD.

June 8, 2015
Date

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