

# Problem Set 15

## Logistic Regression

**Part I:** Please dedicate 10-20 minutes to filling out a feedback form that I have prepared and linked at:

<https://forms.gle/a9RsSGacuWQRV2Eu6>

Your reflections on your experience in Stat 20 this semester are invaluable to improving it and I will be reading every response. Note that the google form does not collect your email, so your responses will be anonymous.

**Part II:** On January 28, 1986, a routine launch was anticipated for the Challenger space shuttle. Seventy-three seconds into the flight, disaster happened: the shuttle broke apart, killing all seven crew members on board (Wikipedia article and a recording of live CNN footage). An investigation into the cause of the disaster focused on a critical seal called an O-ring, and it is believed that damage to these O-rings during a shuttle launch may be related to the ambient temperature during the launch. The table below summarizes observational data on O-rings for 23 shuttle missions. **temperature** gives the temperature in Fahrenheit, **damaged** represents the number of damaged O-rings, and **undamaged** represents the number of O-rings that were not damaged.

mission	1	2	3	4	5	6	7	8	9	10	11	12
temperature	53	57	58	63	66	67	67	67	68	69	70	70
damaged	5	1	1	1	0	0	0	0	0	0	1	0
undamaged	1	5	5	5	6	6	6	6	6	6	5	6

  

mission	13	14	15	16	17	18	19	20	21	22	23
temperature	70	70	72	73	75	75	76	76	78	79	81
damaged	1	0	0	0	0	1	0	0	0	0	0
undamaged	5	6	6	6	6	5	6	6	6	6	6

1. Each column of the table above represents a different shuttle mission. Examine these data and describe what you observe with respect to the relationship between temperatures and damaged O-rings.
2. \*Failures have been coded as 1 for a damaged O-ring and 0 for an undamaged O-ring, and a logistic regression model was fit to these data. The regression output for this model is given above. Write out the null hypothesis corresponding to the p-value in each row of the table.

term	estimate	std.error	statistic	p.value
(Intercept)	11.66	3.30	3.54	4e-04
temperature	-0.22	0.05	-4.07	<0.0001

3. \*Write out the logistic model using the point estimates of the model parameters.
4. Based on the model, do you think concerns regarding O-rings are justified? Explain.
5. \*What is the probability of failure that this model assigns to an O-ring at 65 degrees? Based on the scatter plot of the data below, do you expect that the prediction from the logistic model would be lower or higher than a prediction from a least squares linear regression model? (hint: imagine fitting a logistic curve and straight line through this data.)

