O-ring degradation during flight was a known risk. What was unknown is the relationship between temperature and o-ring degradation

|  |  |
| --- | --- |
| **Temp** | **Issues** |
| 53 | 11 |
| 57 | 4 |
| 58 | 4 |
| 63 | 2 |
| 70 | 4 |
| 70 | 4 |
| 75 | 4 |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Regression output | |  |  |  | *confidence interval* | |
| *variables* | *coefficients* | *std. error* | *t (df=5)* | *p-value* | *95% lower* | *95% upper* |
| Intercept | 16.4499 |  |  |  |  |  |
| T | -0.1842 | 0.1340 | -1.374 | .2278 | -0.5287 | 0.1603 |

PRA/Failure Analysis

|  |  |  |
| --- | --- | --- |
| **Temp** | **Issues** | **Incident** |
| 53 | 11 | 1 |
| 57 | 4 | 1 |
| 58 | 4 | 1 |
| 63 | 2 | 1 |
| 66 | 0 | 0 |
| 67 | 0 | 0 |
| 67 | 0 | 0 |
| 67 | 0 | 0 |
| 68 | 0 | 0 |
| 69 | 0 | 0 |
| 70 | 4 | 1 |
| 70 | 0 | 0 |
| 70 | 4 | 1 |
| 70 | 0 | 0 |
| 72 | 0 | 0 |
| 73 | 0 | 0 |
| 75 | 0 | 0 |
| 75 | 4 | 1 |
| 76 | 0 | 0 |
| 76 | 0 | 0 |
| 78 | 0 | 0 |
| 79 | 0 | 0 |
| 81 | 0 | 0 |



|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Regression output | |  |  |  | *confidence interval* | |
| *variables* | *coefficients* | *std. error* | *t (df=21)* | *p-value* | *95% lower* | *95% upper* |
| Intercept | 18.3651 |  |  |  |  |  |
| T | -0.2434 | 0.0635 | -3.833 | .0010 | -0.3754 | -0.1113 |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Predicted values for: I | |  |  |  |  |  |
|  |  | *95% Confidence Interval* | | *95% Prediction Interval* | |  |
| *T* | *Predicted* | *lower* | *upper* | *lower* | *upper* | *Leverage* |
| 36 | 9.604 | 5.079 | 14.128 | 3.313 | 15.895 | 1.072 |



**1.  Identify Risk** — NASA managers had known the design of the solid rocket boosters (SRBs) contained a potentially catastrophic flaw in the O-rings since 1977, but failed to address it properly.  
**2.  Analyze Data** — The O-rings, as well as other critical components, had no test data to support the expectation of a successful launch in such cold conditions. Engineers who

worked on the Shuttle delivered a biting analysis: “We're only qualified to 40° F. No one was even thinking of 18° F. We were in no man's land.”  
**3.**  **Control Risk** — NASA had “Launch Fever” that morning and disregarded advice not to launch. Later, we learned that concerns about the launch never made it up the chain of command. It was these lapses in judgment that triggered this catastrophic event.  
**4.  Transfer Risk** — While there may be some risk transferred to an insurance company for a satellite aboard, there is no place to transfer the loss of life in this case. NASA put all shuttle launches on hold for 32 months and some would argue that they never recovered from the damage to their reputation.  
**5.**  **Measure Results** — This is where we ask the question, “What went wrong?” In fact, the Rogers Commission did an extensive review. They found NASA’s organization culture and decision-making processes had been key contributing factors to the accident. NASA managers had known since 1977 that the design of the solid rocket boosters (SRB’s) contained a potentially catastrophic flaw in the O-rings yet failed to address it properly. They also disregarded warnings (an example of “go fever”) from engineers about the dangers of launching because of the low temperatures that morning, while also failing to adequately report these technical concerns to their superiors.