##### Results

As per our analysis, we begin with plotting the error profile for the server. Figure 4 indicates the daily errors occurring over the period of month of July. We can interpret from the graph that error count changes drastically over the time and shows variations. This can be associated with workload as workload varies similarly over the time. Hence, we cannot use daily error count as the only measure for reliability. Hence, we consider cumulative error count over time. Fig 5 represents cumulative error count for the website.

Fig 4: Error profile for NASA KSC

Cumulative error count:

Fig 5: Cumulative error profile for NASA KSC

Figure 6 represents daily hits over the month of July and fig 7 represents daily users over the month of July. This helps us observe that workload is highly uneven and shows variation. It can be understood that workload tends to be much lower during weekends or national holidays as compared to weekdays.

Fig 6: Daily hits for July’95

Fig 7: Daily users for July’95

The daily workload shows following characteristics:

* Non uniform distribution and variability:

The distribution of workload is extremely non uniform and alters each day which is similar to usual web traffic patterns. Out of the two workloads measured, it can be observed that Hit counts and user counts show similar variation. This is in contrast to the observation in [1]. This helps conclude that for NASA’s KSC website, users and hits are intensive for the workload and may result in larger variations over time.

* Periodic pattern that harmonizes with error profile

The error profiles are in sync with the workload measured for the website. This indicates that workload measures are important resource for estimating the reliability as there is a direct correlation among errors and usage.

This observation is similar to that of [1] indicating that the website is similar to most of the internet traffic and hence, supports application of approach suggested in [1].

A cumulative workload plot helps understand an overview of the workload throughout the month. Fig 8 represents cumulative user count.

Fig 8: Cumulative user count for July’95

* Analysis of Operational Reliability:

The close relation between errors and workload can be observed based on the cumulative graph represented in fig 9. The graph shows a linear relation among the both parameters.

Fig 9: Cumulative errors versus hits

To further characterize the relationship, we have calculated daily failure rate. It is defined as error/workload. Table 4 represents daily error rate values for different workloads. It represented range (minimum and maximum), arithmetic mean and standard deviation. Another value ‘RSE’ is calculated which means relative standard error[1]. As these workloads have different weights or values, we calculate rse as std.dev/mean. This helps compare the workloads with each other in term of reliability. The rse values indicates that daily error rates are more reliable than errors per day as they have a tighter spread. Hence, it can be interpreted as they are more dependable and substantial to evaluate reliability.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Error rates** | **Min** | **Max** | **MEAN** | **Std dev** | **RSE** |
| Errors/Hits | 0.003466 | 0.009866 | 0.005897 | 0.00136 | 0.230684 |
| Error/Users | 0.043218 | 0.136257 | 0.084571 | 0.019613 | 0.231915 |
| Errors/day | 94 | 645 | 391.4643 | 131.2076 | 0.335171 |

Table 4: Daily error rates

* **S-Shaped Model:**

A screenshot of a cell phone

Description generated with high confidence

* **GO model:**

A screenshot of a cell phone

Description generated with very high confidence