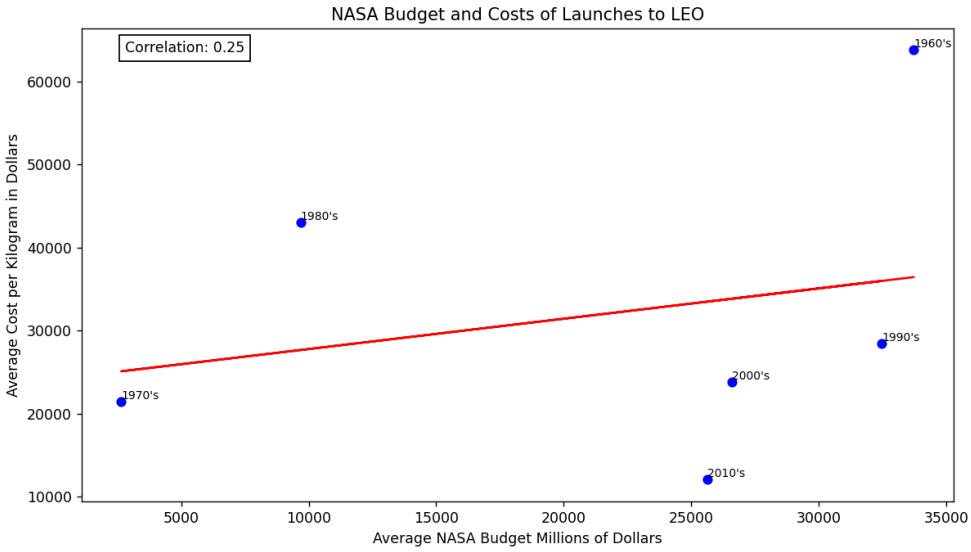
Costs of NASA Missions

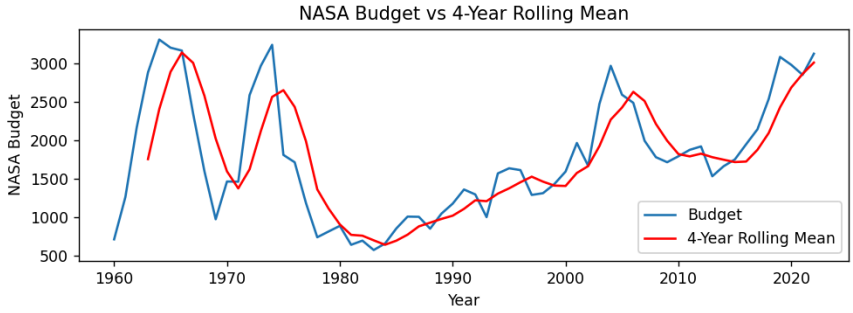
In this project, we looked at how the costs of NASA launches to low earth orbit (LEO) developed overtime and what is its relationship to the overall NASA budget. Furthermore, we looked at the relationship between NASA budget and wider macroeconomic indicators such as GDP, Federal spending and annual inflation rate.

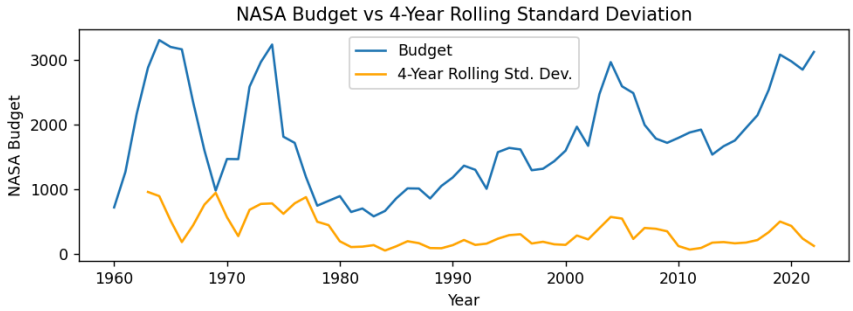


Our results from the LEO analysis point to two trends in the development of costs. One, is the general decline in cost-per-kg over time probably due to technological development. The most obvious indicator of this trend from the data is the difference between the costs during the 2000's and the 2010's where costs declined significantly while the budget remained relatively the same.
The second trend is the positive relationship between NASA budget and costs-per-kg. Signifying that with a larger budget NASA tends to be perhaps less efficient or bolder with its LEO launches.

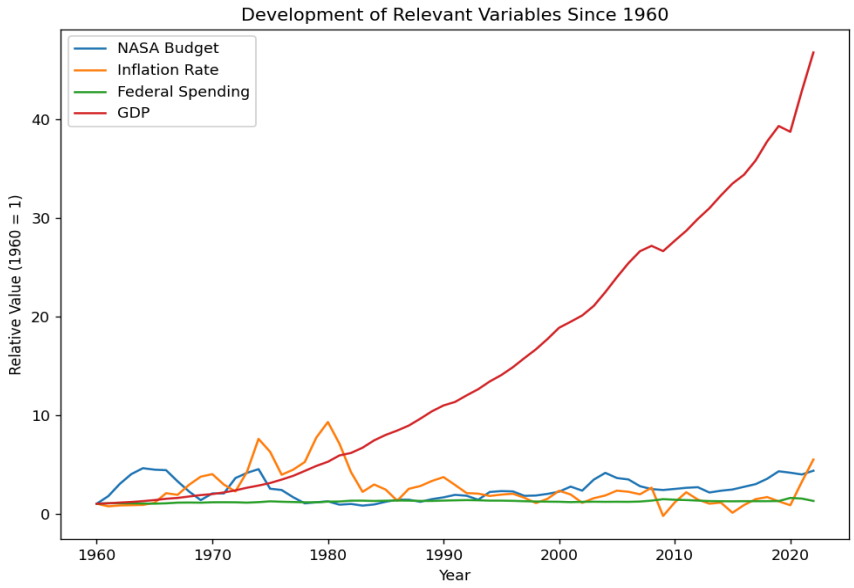
Furthermore, there is a significant outlier among the decades, which is the 1960's, which saw massive costs and spending. This is the decade of the Space Race between the US and the USSR during the Cold War, which explains why both budget and costs were way higher during this period as most likely the main priority for the US was to beat the USSR at any cost neccesary.

The other part of our project was the time series analysis of NASA budget and its relation to other macroeconomic variables.





The four year rolling standard deviation was chosen specifically to align with the terms of each U.S. president, and shows that the standard deviation was particularly high during the 1960s and 1970s, which corresponds to the Apollo era and the Cold War when NASA was receiving a significant amount of funding that varied greatly from year to year. Since then, the volatility in the budget has decreased, as shown by the generally lower levels of the rolling standard deviation. There were increases in the 4 year rolling standard deviation in the early-to-mid 2000s, which may have been caused by George Bush's Vision for Space Exploration in 2004, which set the goal of returning humans to the moon by 2020 and eventually pursuing human exploration of Mars. This initiative likely required increased funding for research, development, and preparation for future missions, contributing to an increase in NASA's budget and possibly its variability as well. Other causes include the end of the space shuttle program- the costs associated with retiring the shuttles and transitioning to new programs could have introduced budget variability, as well as the 2003 Space Shuttle Columbia disaster and later the 2008 financial crisis.



Next we wanted to illustrate how the variables we are investigating have developed overtime. As we have already mentioned, the 1960's and 1970's proved to be the most interesting for the NASA budget with the highest values and variation. Other than that we can observe the significant effect of 1970's and 80's oil shocks on inflation rate and the negative effect of the 2008 and 2020 crisis on GDP.
From the simple regressions we ran, NASA's budget does not appear to be correlated with federal spending or inflation rate, however, there appears to be a connection between NASA budget and GDP based on our linear regression which reported an R squared value of 0.11.

In conclusion, this analysis of NASA's mission costs and budget reveals insightful trends and relationships. The declining cost-per-kg for LEO launches, likely driven by technological advancements, stands out as a significant finding. Despite budget consistency, NASA's spending on these missions became more efficient or ambitious over time. The 1960s, marked by the Space Race, emerges as a distinct outlier with its exceptionally high costs and spending. Additionally, our time series analysis shows the fluctuating nature of NASA's budget in relation to U.S. presidential terms, macroeconomic variables, and key historical events like the Apollo era, the 2008 financial crisis, and major space missions. Notably, no direct correlation was found between NASA's budget and federal spending or inflation, but a mild connection with GDP was observed.