Pymaceuticals Analysis and Findings

Alexis Perumal, 12/15/19
UCSD Data Science Bootcamp, HW#5 Matplotlib

Summary

The growing Pymaceuticals Inc., has 9 drugs in the development pipeline that they want to analyze for efficacy in arresting cancer. A placebo is included as a control. Timeseries data over a 45-day treatment period has been provided for three key indicators: tumor volume, # of metastatic sites, and survival rates.

Approach

Analysis involved creating a jupyter notebook file and using Python, pandas and matplotlib to analyze the CSV dataset, generating tabular outputs and charts for the aforementioned indicators. Compounds studied include: Capomulin, Ceftamin, Infubinol, Ketaprill, Naftisol, Popriva, Ramicane, Stelasyn, Zoniferol.

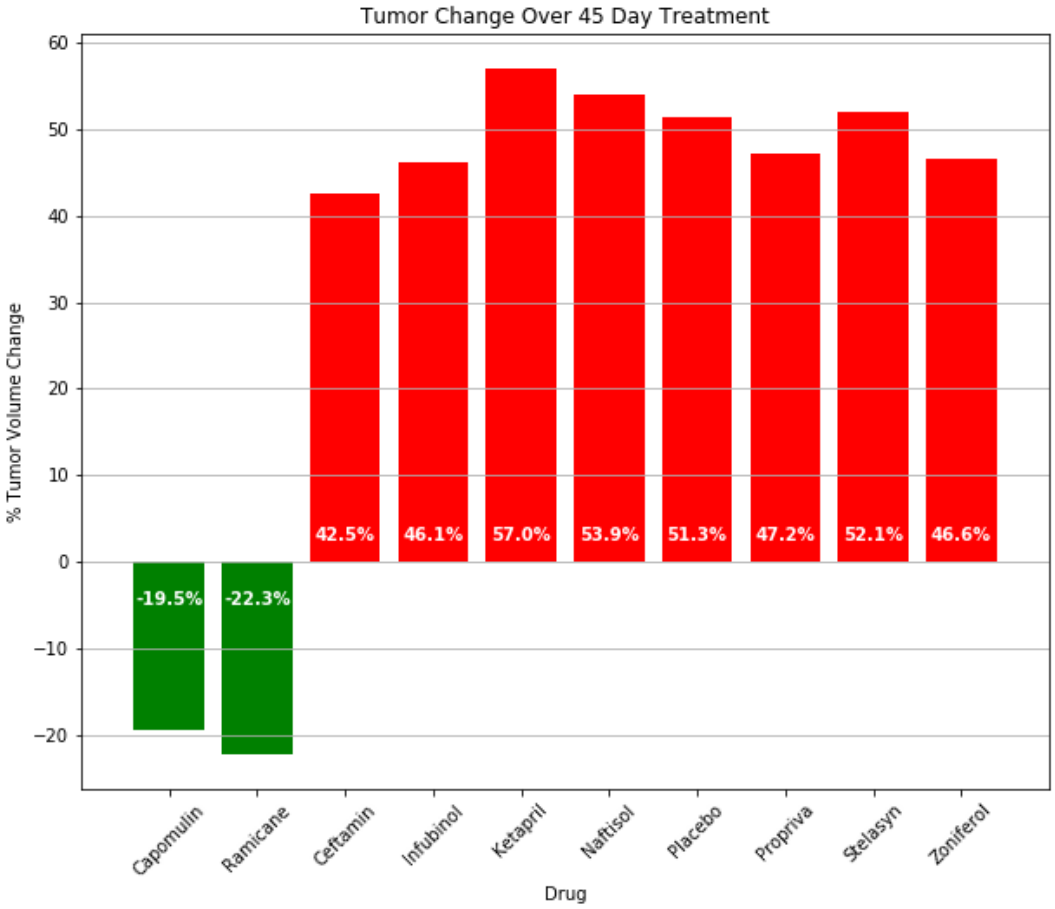
Findings

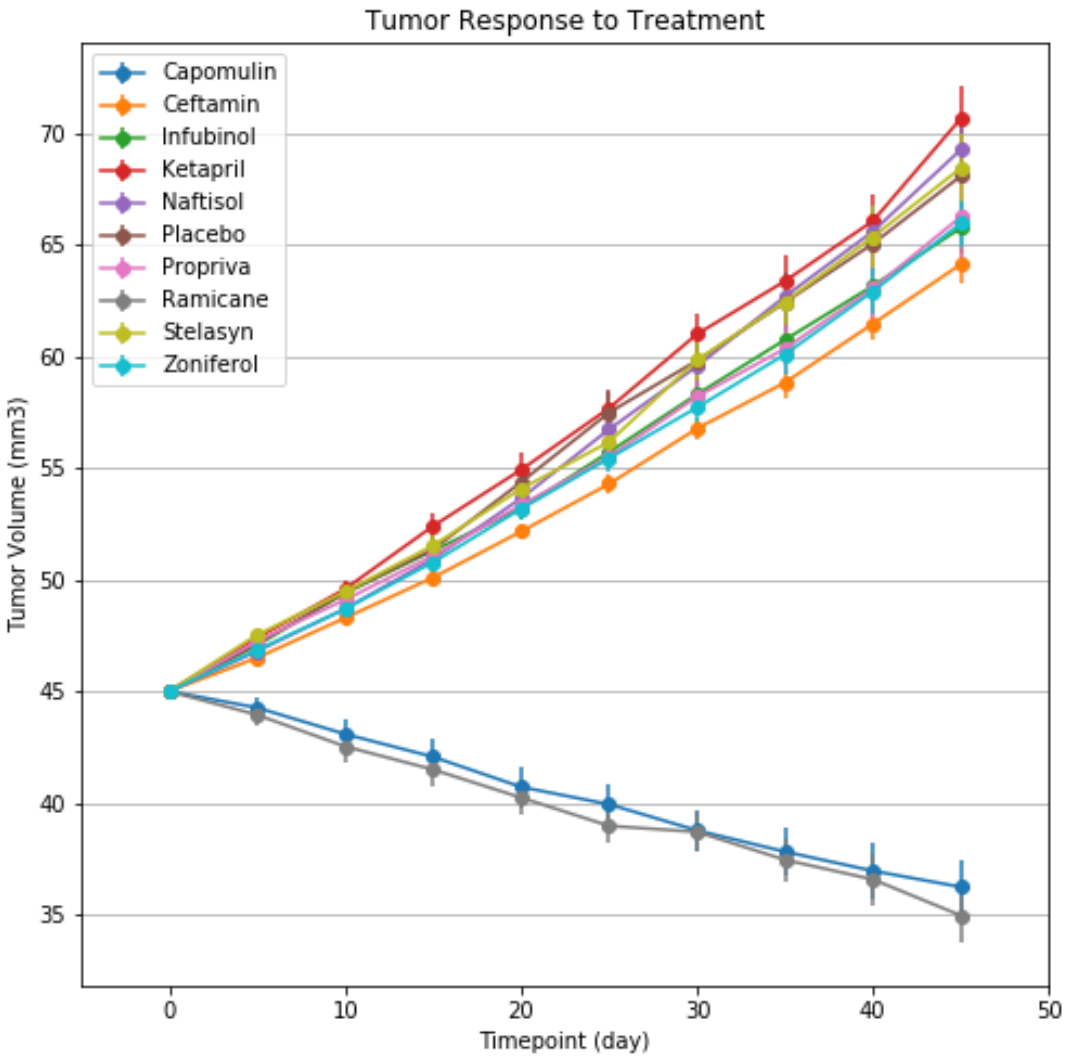
1. **Tumor volume: Two drugs, Ramicane (22.3% reduction) and Capomulin (19.5% reduction), demonstrated statistically significant (95% confidence) reduction in tumor volume over the 45-day day period vs. growth for the other seven drugs and placebo.**

   All other treatments, including the control, showed an *increase* in tumor volume between 42.5% and 57.0%.

   The difference between **Ramicane** and **Capomulin** was not statistically significant.

   Additionally, one drug, **Ceftamin**, had tumor growth at a rate that was lower than the control with statistical significance. However, that impact was small compared to the results from Ramicane and Capomulin.


Tumor Change Over 45 Day Treatment
% Tumor Volume Change
60
50
40
30
20
10
0
−10
−20
-19.5%
-22.3%
42.5%
46.1%
57.0%
53.9%
51.3%
47.2%
52.1%
46.6%
Capomulin
Ramicane
Ceftamin
Infubinol
Ketapril
Naftisol
Placebo
Propriva
Stelasyn
Zoniferol
Drug


Tumor Response to Treatment
Capomulin
Ceftamin
Infubinol
Ketapril
Naftisol
Placebo
Propriva
Ramicane
Stelasyn
Zoniferol
Tumor Volume (mm3)
Timepoint (day)
70
65
60
55
50
45
40
35
0
10
20
30
40
50

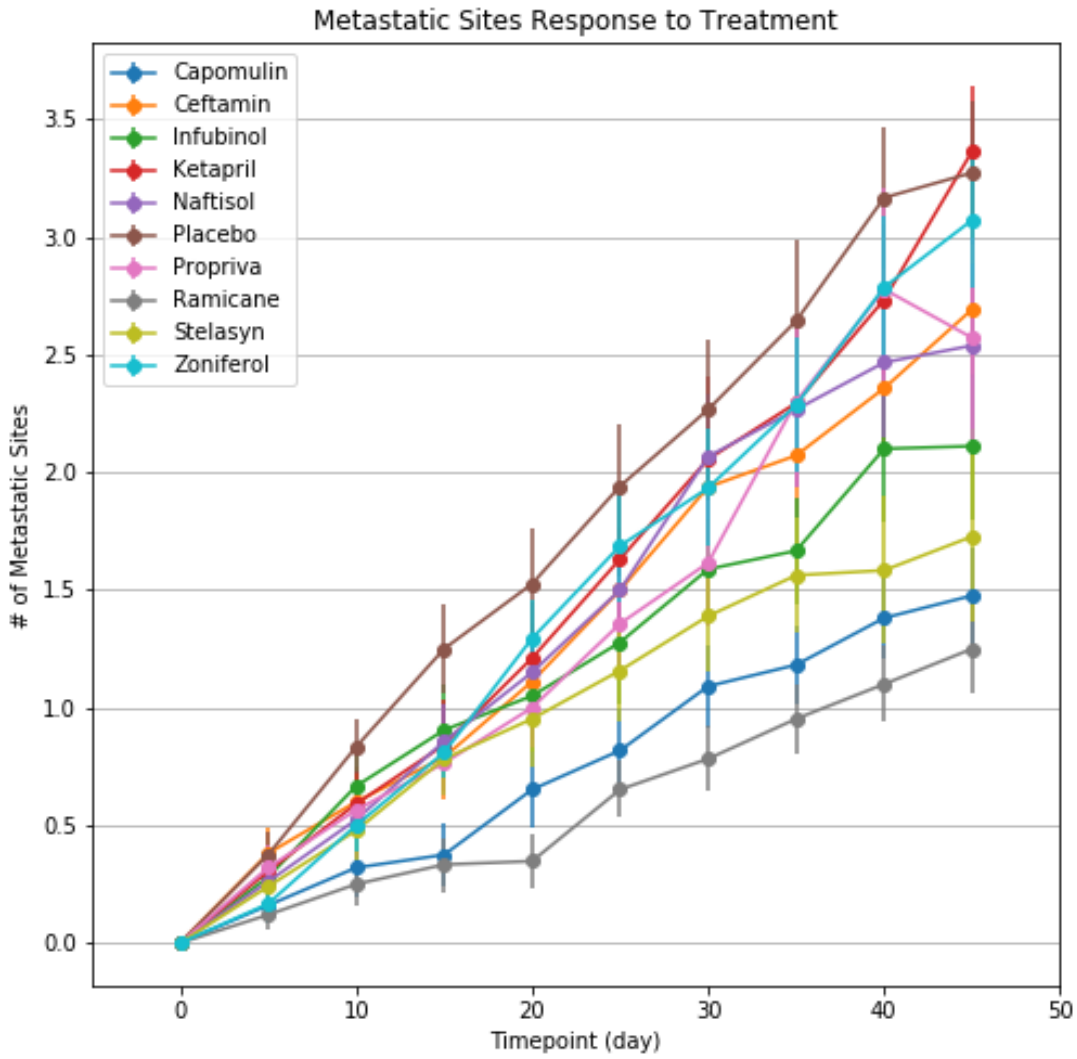
2. **Metastatic sites: All compounds and the placebo showed an increase in metastatic sites over the trial period. Ramicane, Capomulin and Stelasyn had the lowest growth.**

   Metastatic site growth with **Ramicane, Capomulin** and **Stelasyn** was lower with statistical significance than the placebo. Although the calculated growth rate for **Ramicane** was the lowest, the difference in growth rates among those three drugs was not statistically significant.

   Infubinol and **Naftisol** also showed growth that was lower, with statistical significance, than the control.

   None of the drugs showed growth with statistical significance higher than the control.

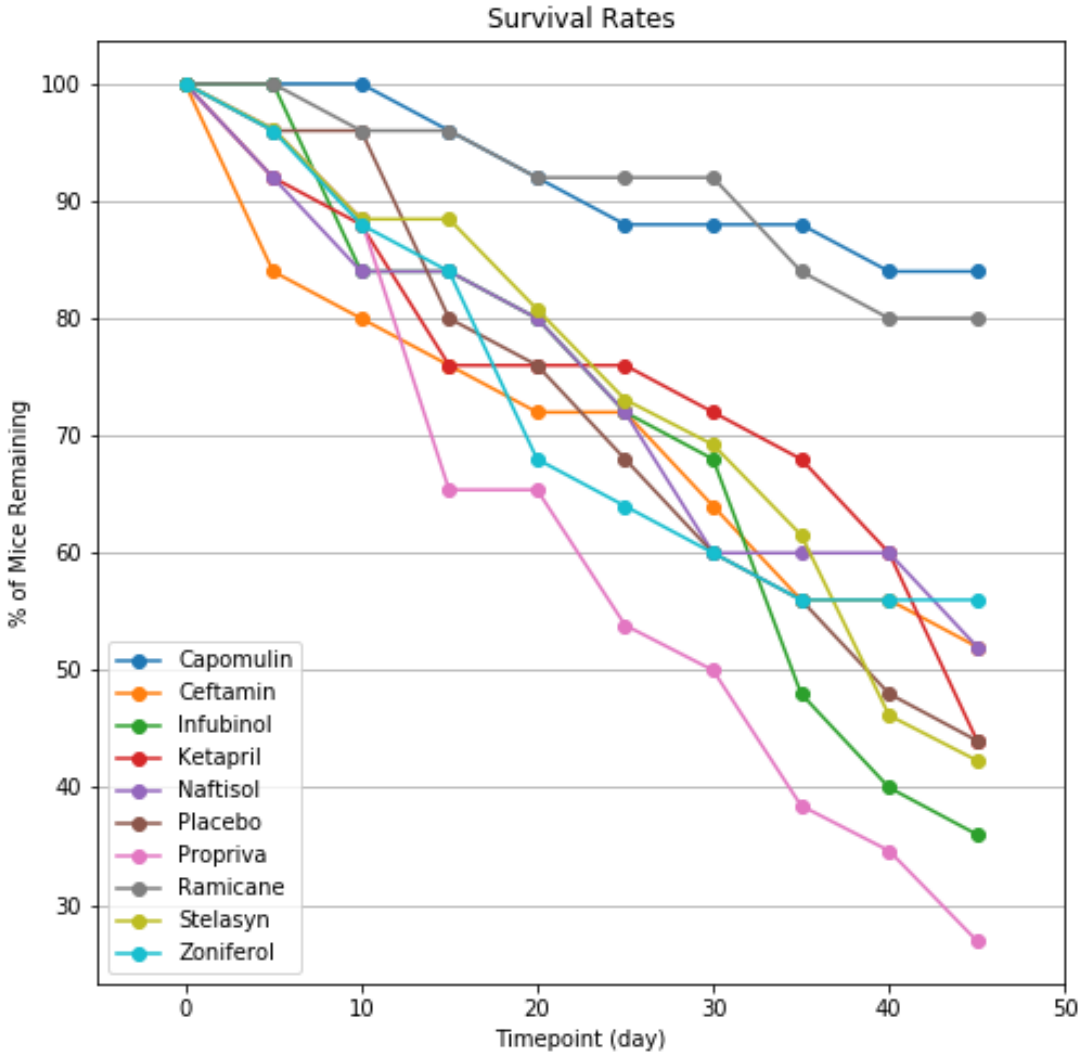
Reduction	Slower growth than control	Comparable Growth to Control	Greater Growth than Control
none	Ramicane Capomulin Stelasyn Infubinol Naftisol	Propriva Ceftamin Zoniferol Keftapril	*none*


Metastatic Sites Response to Treatment
Capomulin
Ceftamin
Infubinol
Ketapril
Naftisol
Placebo
Propriva
Ramicane
Stelasyn
Zoniferol
# of Metastatic Sites
Timepoint (day)
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
0
10
20
30
40
50

3. **Survival Rates: None of the drugs, nor the control, resulted in full survival. Capomulin had the highest survival rate at 84% followed by Ramicane at 80%.**

   Those survival rates compare with all the other treatments which resulted in 68% or lower.

   Since the survival rate was simply the number of mice from an original pool of 25 per treatment (26 for Propriva), and there were not multiple trials, a standard error measurement and confidence interval of the mean for hypothesis testing was not calculated. Therefore, these findings are not statistically significant without further experimentation and analysis.



Conclusion and Recommendations

1. **Ramicane** and **Capomulin** showed materially better results across tumor volume reduction and slower growth in metastatic sites with statistical significance. Additionally, they also demonstrated the highest survival rates although the statistical significance of that difference can't be evaluated. *Overall, we recommend continued aggressive evaluation of these two drugs.*

2. Three other drugs also demonstrated a weaker, but still statistically significant beneficial response:
    a. **Ceftamin** with slower tumor volume growth
    b. **Stelasyn**, **Infubinol**, **Naftisol** with slower growth in metastatic sites.

    These compounds may merit further evaluation in the event that Ramicane and Capomulin are disqualified based on further evaluation.

3. None of the compounds did worse than the control with statistical significance.

See the Jupyter Notebook for detailed analysis and dataset tables.