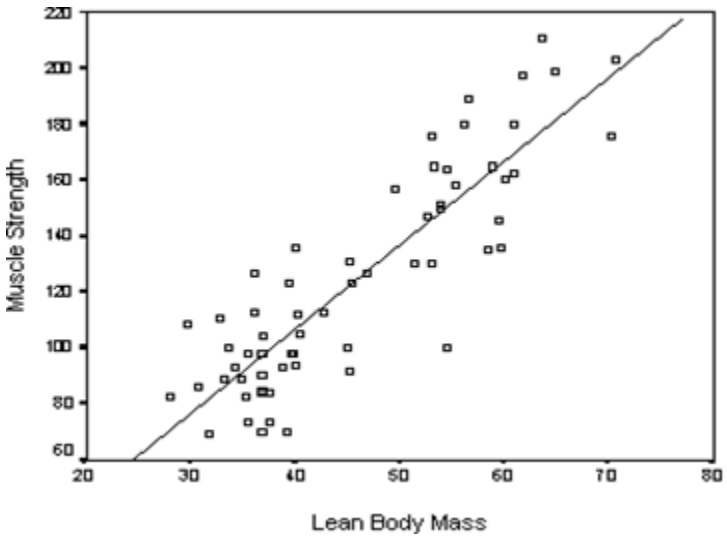
Application

1). Least Square problems

In real life, there might be times when we want to find a “best-fitting” curve to a set of some given points. For example, people might want to find the relationship between the lean body mass of human bodies and their muscle strength or analyze how the housing price changes by years to obtain an estimation of the price in the future. Most of the time, we might not be able to find such a linear equation that can be satisfied by all of those points, so finding the “closest” solution is the best we can do. We call this solution to be the least-square solution.[1]



Least square solution of the relation between human lean body mass and muscle strength

2). Recommendation System

A recommender system is an intelligent system that predicts the rating and preferences of users on products. The primary application of recommender systems is finding a relationship between users and products in order to maximize user-product engagement. The major application of recommender systems is in suggesting related

video or music for generating a playlist for the user when they are engaged with a related item. Companies such as Amazon and Netflix collect tons of data, for example, users' browsing or purchasing records, and provide recommendations to them according to some analyses on the data. How to know the user better and recommend them the products they truly like then becomes a crucial problem that needs an elective solution. This is done by using singular value decomposition.[2]

Suppose we are given the ratings of seven people towards five different movies respectively,

User\movie	**Matrix**	**Inspection**	**Martin**	**Titanic**	**War**	**Bahubali**
Madhu	1	1	1	0	0	2
Dablu	3	3	3	1	0	1
Chandrakisor	4	4	4	0	0	2
Rashmi	5	5	5	1	2	0
Rohit	0	0	0	4	3	5
Jyoti	5	4	2	1	5	6
Aarohi	0	0	0	2	2	1

(movie matrix)

3) Removing Background from Videos[3]

Think of how you would distinguish the background of a video from its foreground. The background of a video is essentially static – it does not see a lot of movement. All the movement is seen in the foreground. This is the property that we exploit to separate the background from the foreground.

The following approach is used for removing Background from the video:--

1.Create matrix M from video – This is done by sampling image snapshots from the video at regular intervals, flattening these image matrices to arrays, and storing them as the columns of matrix M

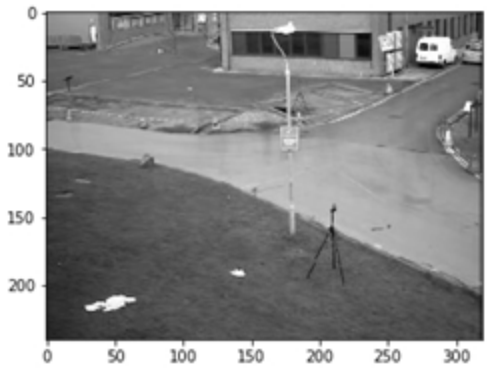
2. Matrix M is the sum of two matrices – one representing the background and the other the foreground

3. The background matrix does not see a variation in pixels and is thus redundant i.e. it does not have a lot of unique information. So, it is a low-rank matrix, a low-rank approximation of M is the background matrix. We use SVD in this step

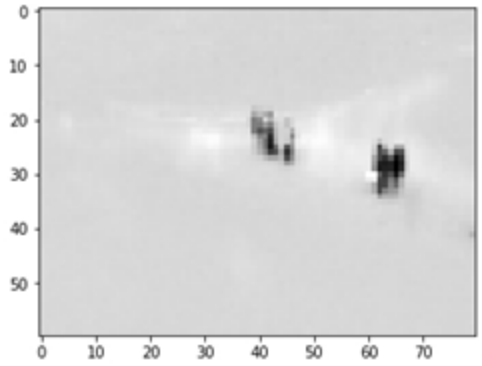
4. We can obtain the foreground matrix by simply subtracting the background matrix from the matrix M

Here is a frame of the video after removing the background:

BACKGROUND REMOVAL - RANK 2 APPOXIMATION



LOW RANK BACKGROUND



FOREGROUND

References

[1] G. Dallal, Introduction to Simple Linear Regression, available at http://www.jerrydallal.com/lhsp/slr.htm.

[2] J. Leskovec, A. Rajaraman, J. Ullman, Mining of Massive Datasets, Cambridge University Press, 2011, 418-427.

[3] https://www.analyticsvidhya.com/blog/2019/08/5-applications-singular-value-decomposition-svd-data-science/