INTELLIGENCE ANALYTICS CHALLENGE

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COMPLETE EXPLANATION on This Link:

https://youtu.be/Pl7aWUykvvE

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INTRODUCTION: UNICEF MISSION

To reach the world's most disadvantaged children. To save their lives. To defend their rights. To help them fulfill their potential. Across 190 countries and territories, we work for every child, everywhere, every day, to build a better world for everyone.

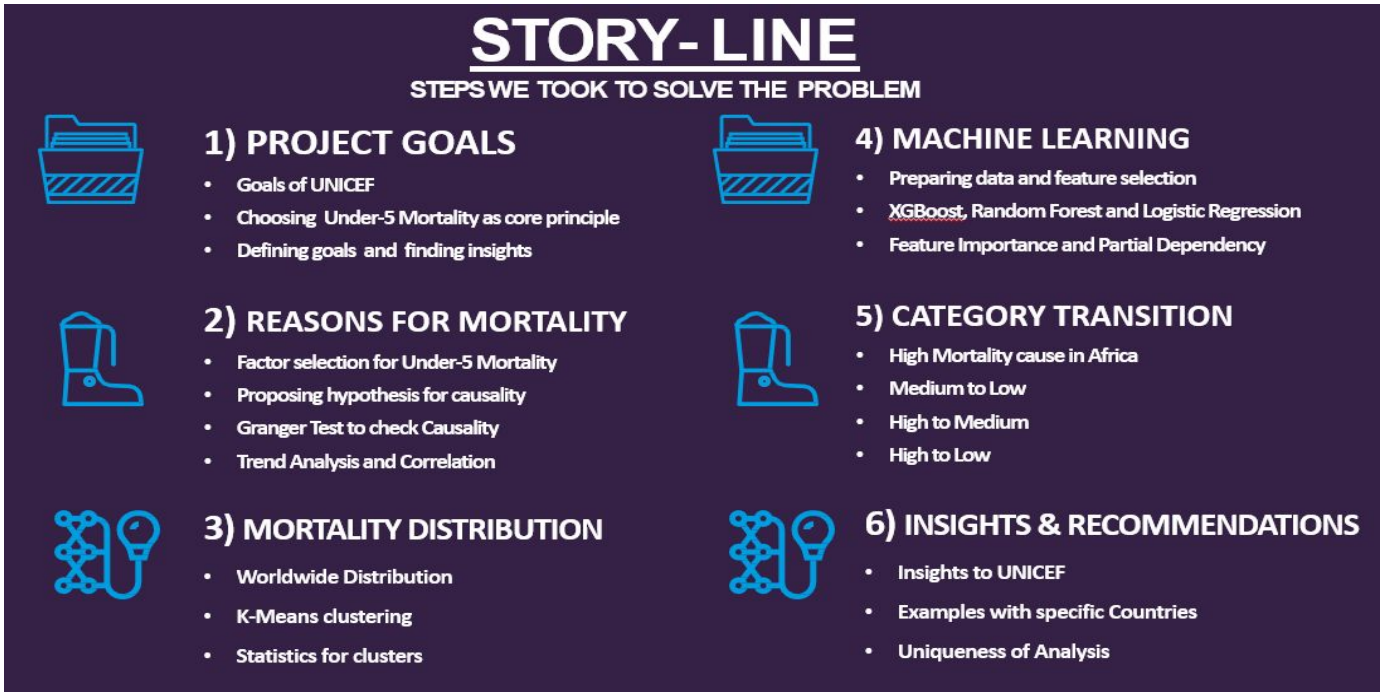
REASONS TO CONSIDER UNDER 5 MORTALITY AS CORE PRINCIPLE:

According to UNICEF:

- **69 million** children under age 5 will die between 2016 and 2030.
- The **poorest** children are 1.9 times as likely to die before age 5 compared to the riches.
- An estimated 5.3 million children under age five died in 2018–roughly half of those deaths occurred in sub-Saharan Africa.

ANALYSIS GOAL:

In this project, we are identifying and analyzing the factors causing Mortality in Children under the age of 5 years. We are performing trend analysis and based on our findings we are providing recommendations to improve the mortality rate. Also, we aim to provide insights and recommendations for countries and UNICEF to improve the quality of life of children and help countries in the endeavor to improve the quality of life.



Factors used and their definitions:

1. **Breastfeeding:** Exclusive breastfeeding as a source of food from 0-5 Months(in %).
2. **Mortality:** Under 5 Mortality Rate(in 1000's)
3. **ITN:** Households having Insecticide Treated Nets(ITN's) and Indoor Residual Spraying(IRS) for treating pests(in %).
4. **Punishment:** Use of Violent Treatment to Discipline children of ages between 2 and 5(in %).
5. **Books(Early_childhood):** Children having 4 or more children books(indicates the involvement of parents)(in %)
6. **Left_alone(Supervision):** Leaving children under the supervision of people under 10 years of age for a period of 1 hour or more(in %).
7. **Postnatal:** Postnatal care of newborns(in %).
8. **Literacy:** Adult literacy rate of people between 15-24 years(in %).
9. **MMR:** Maternal Mortality rate measured in 1 death in the given value.
10. **Low Birth_wt:** Children having a low birth weight compared to average birth weight(in %).
11. **Use_drinking_water:** % of households having access to safe drinking water.
12. **Use_sanitation:** % of households having access to basic sanitation services.
13. **Total fertility:** Average number of children born.
14. **Atleast_4_visits**: % of women visiting a doctor during pregnancy at least 4 times. (recommended no by UNICEF is 8 visits).

❖ What are the causes and correlations of Under 5 Mortality?

Due to the limitation of the data provided, to perform Trend Analysis, we retrieved data from the UNICEF Data Warehouse according to each year as per our need.

Causality:

Hypothesis: We hypothesize that Under 5 mortality is caused by:

Exclusive Breastfeeding (Breastfeeding)
Children Sleeping under ITN's (ITN)
Violent Discipline by parents (Punishment)
Having Children Books (Books)
Irresponsible Supervision (Left_alone)
Postnatal Care of Newborns (Postnatal)
Youth Literacy 15-24 years (Literacy)

To test the hypothesis, we carried out the Granger Causality Test for each factor separately.

Null Hypothesis: It states that the above-listed factors do **not** cause Under 5 mortality.

Alternate Hypothesis: It states that all the above-listed factors cause Under 5 mortality.

Our confidence interval was 90% or a p-value of 0.1 as a reference to reject the null hypothesis.

Results of Granger Causality Test (Confidence Interval : 90%, P-Value = 0.1): Lag_1:

Lag_n indicates the effect of the factor on under 5 Mortality after n years.

	Mortality_lag_1	Breastfeeding_lag_1	ITN_lag_1	Punishment_lag_1	Left_alone_lag_1	Books_lag_1	Postnatal_lag_1	Literacy_lag_1
Mortality	1.0	0.0079	0.2104	0.8312	0.0008	0.0018	0.4405	0.5527

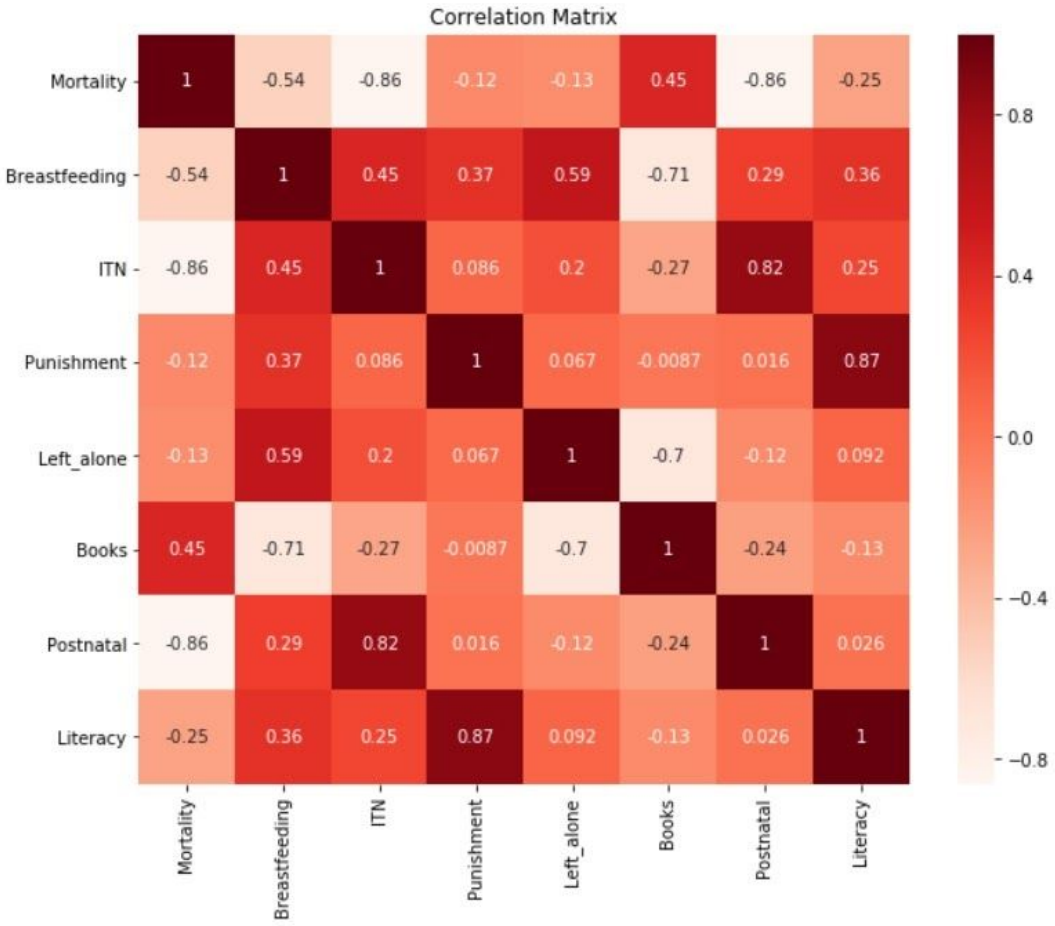
	Mortality_lag_2	Breastfeeding_lag_2	ITN_lag_2	Punishment_lag_2	Left_alone_lag_2	Books_lag_2	Postnatal_lag_2	Literacy_lag_2
Mortality	1.0	0.0079	0.2104	0.0006	0.0008	0.0	0.189	0.0001

Insights:

The test shows that the p-value of Breastfeeding, Left_alone and Books_lag_1 is less than 0.1, hence we reject the null hypothesis. This means that these three factors cause under 5 Mortality after 1 year.

The test shows that the p-value of Breastfeeding, Punishment, Books_lag_2, Left_alone, and Literacy is less than 0.1, hence we reject the null hypothesis. This shows that these factors cause under 5 Mortality after 2 years.

Correlation:



Insights:

- ❏ Postnatal is negatively correlated to Under_5 Mortality but doesn't cause it.
- ❏ Left Alone, Books, Punishment are not correlated to Under_5 Mortality but cause it.
- ❏ Breastfeeding is negatively correlated to Under-5 Mortality and causes it.

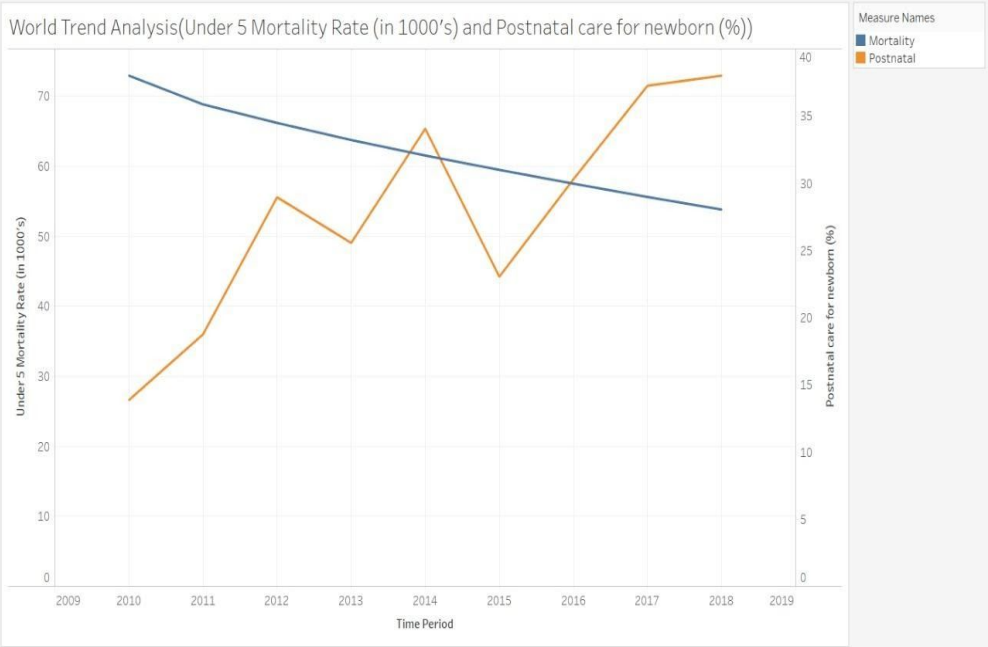
❖ What are the Trends for correlated factors Postnatal and Breastfeeding?

TREND ANALYSIS:

Under 5 Mortality Rate in 1000s and Exclusive Breastfeeding %: Exclusive Breastfeeding for newborns (0-5 months) severely impacts under-5 mortality and decreases mortality when its percentage increases from 2012-2016.

★ **Recommendations:** Exclusive Breastfeeding for newborns (0-5 months) severely impacts under-5 mortality, so UNICEF should educate pregnant and new mothers about the benefits of breastfeeding and discourage them to introduce other sources of food to newborns.

Under 5 Mortality Rate (in 1000's) and Postnatal care for a newborn (%): The graph shows that an increase in postnatal care, decreases under 5 mortality from 2011 - 2018

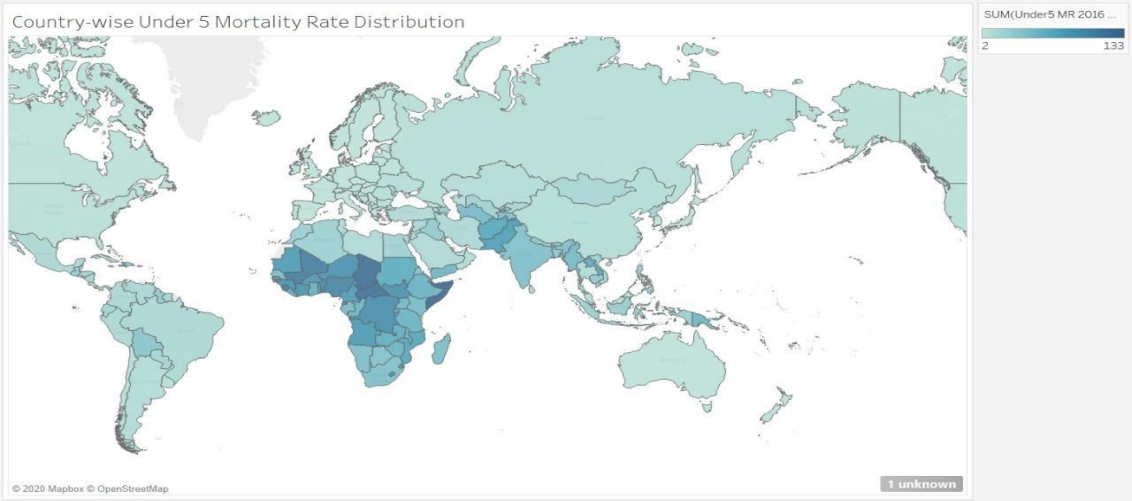


- Insights: As posited, from the timeline graph, we see, an increase in postnatal care, decrease under 5 mortality from 2011 - 2018.

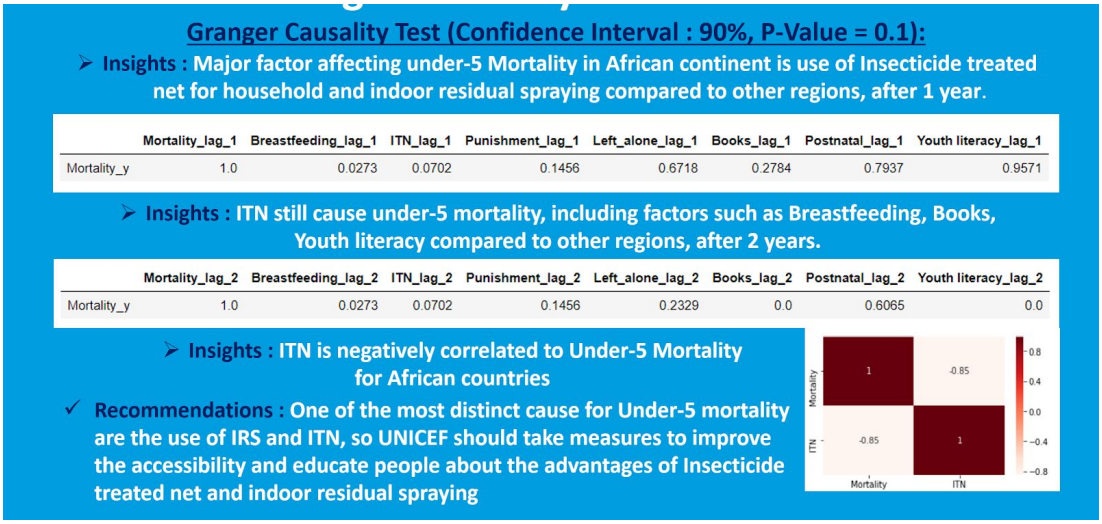
- After seeing the trend of the Mortality over several years, let's see it's distribution worldwide:

★How is Under 5 Mortality distributed World-wide?

Insights: African Continent and SAARC Nations have high under 5 mortality compared to other countries.



What causes high mortality in the African continent?

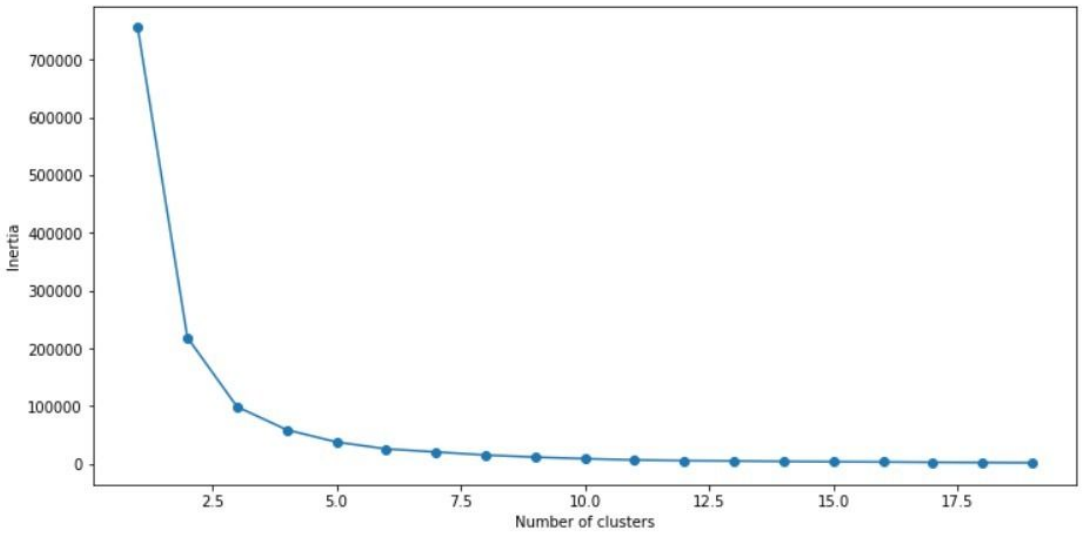


The test shows that the p-value of ITN (Insecticide Treated Net) is greater than 0.1, hence we fail to reject the null hypothesis. This means that ITN causes Under 5 mortality in African countries. The results also show that the effects of ITN can be seen even after 2 years.

★How are the countries categorized based on Under-5 Mortality?

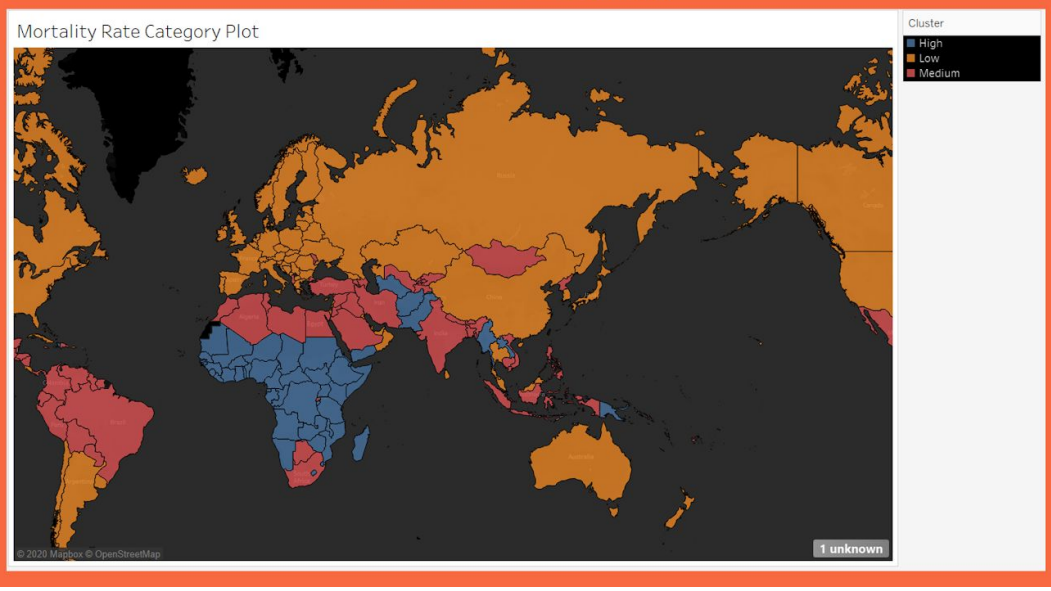
Countries categorized based on Under-5 Mortality: We used K-Means clustering to group the countries. Based on the elbow graph we chose 3 clusters.

Elbow Plot:



Categorized distribution of countries into Low, Medium and High categories based on Mortality rates:

K-Means Clustering :



❖What factors influence the categories for Under-5 Mortality?

Statistics based on category:

Category	No. of Countries in Category	Mortality (Deaths in 1000)	Adult_Literacy (in %)	Low_Birthweight (in %)	fert_rate (No.of children)	MMR_Risk_death (1 in below value)	Poverty (in %)
Low	73	6.08	97.12	7.48	1.89	7424	1.13
Medium	70	23.21	87.49	10.64	2.57	822.3	10.45
High	52	73.5	56.74	14.77	4.65	80.3	41.65

- From the above statistics, we can see that the countries in the Low category have higher adult literacy rates and MMR compared to those countries falling in the High category.

❖How can a country transit into the next better category?

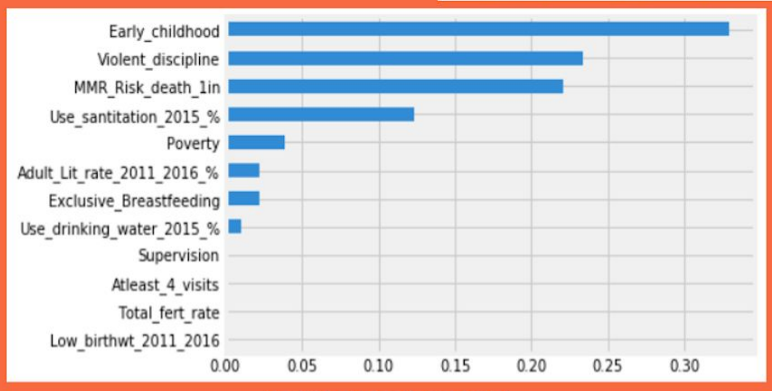
By doing clustering, we could convert the Under 5 mortality into 3 classes; Low, Medium and High. Using these classes, we transformed our problem into a classification supervised machine learning problem. We used models such as XgBoost, Random Forest and Logistic Regression.

➔ *How can a country in Medium Category move to Low Category Mortality?*

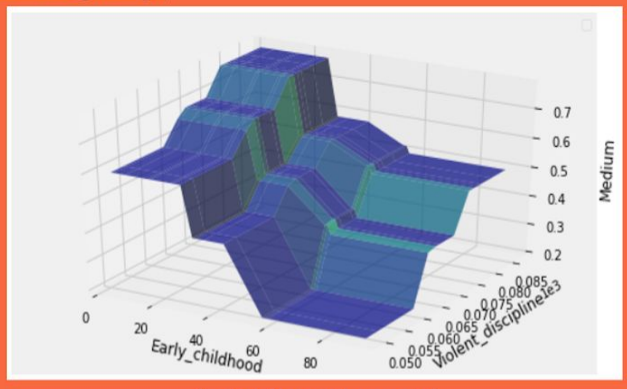
When we built the classification model for Medium and Low, we found the below relations and importance of features.

❑ *Interesting Insights:*

Medium to Low category



Feature Importance plot



Partial Dependency plot

➢ **Insights :** Early childhood, Violent discipline and MMR Risk death are top 3 major factors influencing a Country's transition from Medium to Low Category of Under-5 Mortality

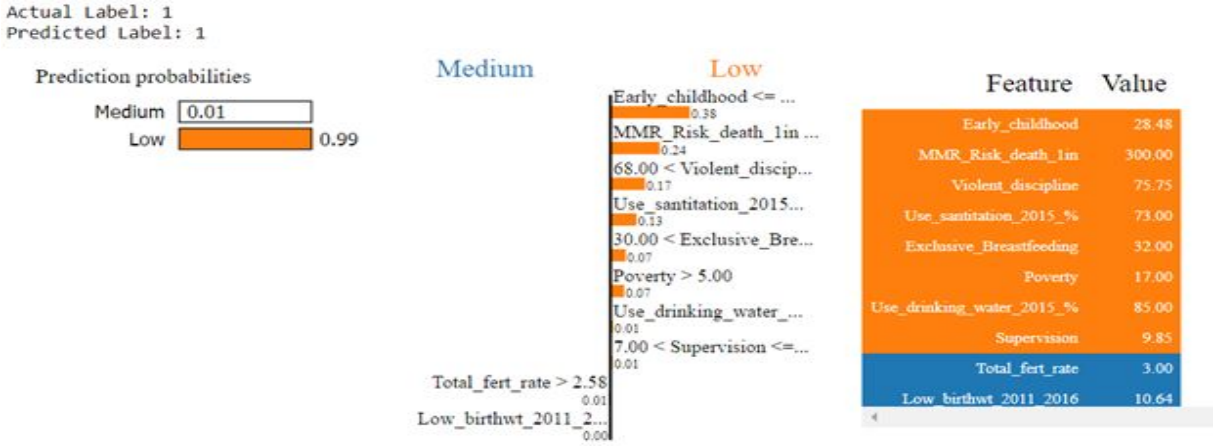
➢ **Insights :** If Early childhood is greater than 60%, which indicates greater involvement of parents, and violent discipline less than 65%, which says child growing in safe environment, the probability of falling into Low category becomes 0.8 (1-0.2) as seen from partial dependency plot

❖ **Example**: Recommendation for India's Journey into Low Category

- For the partial dependence plot, we took the interaction of factors; Early_childhood and Violent Discipline, to know their mutual effect.
- The steep fall in the plot denotes that, as the early_childhood and violent_discipline decreases, the particular country steers away from being in the medium category, i.e., it's probability to fall in the medium decreases and low increases.

★ Example: What does India need to do to move to the Low Category?

Countries	Use_santitation	Total_fert	MMR_Risk_death	Breastfeeding	Antenatal	Violent_discipline	Early_childhood	Supervision	Poverty
India	44	2	220	55	51	75.75	28.484848	9.852941	21



- This graph shows the interpretation of the rules which decides whether a county falls in the category. For eg., in the first graph, if the Early_childhood is more than 33.0%, it will influence the country to fall in the Low Category.

By looking at the above graphs, the **recommendations for India** to move into the 'Low' category are:

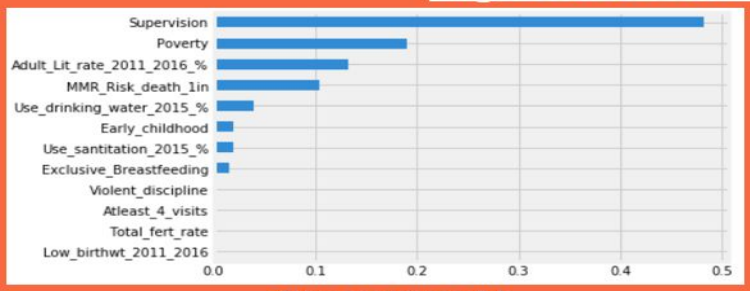
- ❑ **5% increase in the Early childhood of India would account for India's transition into Low category.**
- ❑ **Approx. an 8% decrease in violent discipline practiced would make the case for India's transition.**
- ❑ **Reducing the Supervision, which means leaving children alone with individuals under 10 years, to 6.89% from the present 9.85%, would help to reduce the Mortality.**

Similarly, for a country to move from high to medium and from high to low, below are the insights:

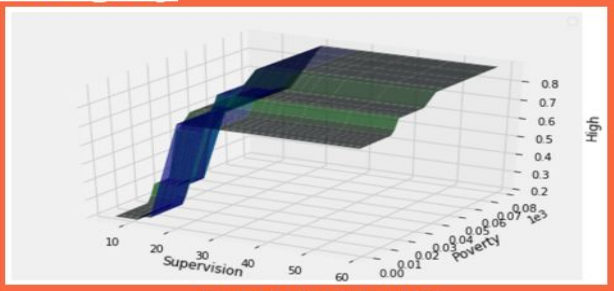
For the below graphs, the graph on the left shows the features which influence the country's category the most and the graph on the left plots a dependency of the top two features.

Country's Transit into next better category

High to Medium category



Feature Importance plot



Partial Dependency plot

➢ **Insights : Supervision, Poverty and Adult Literacy Rate are top 3 major factors influencing a Country's transition from High to Medium Category of Under-5 Mortality**

➢ **Insights : If Supervision by individuals under 10 years is less than 10%, which indicates greater responsibility by parents, and poverty is less than 30%, which says child growing in an economically reliable environment, the probability of falling into Medium category becomes 0.8, i.e., (1-0.2)**

❖ **Example: Recommendation for Nigeria's Journey into Medium Category**

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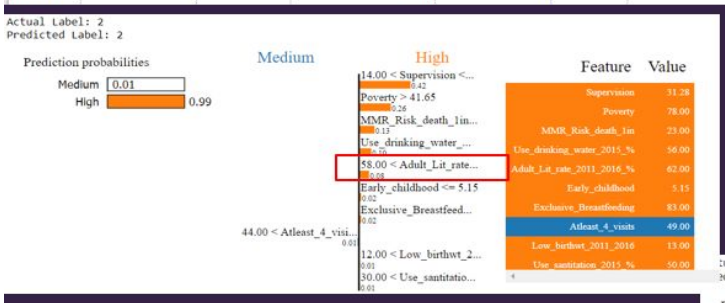
What Should Nigeria do to transit into Medium category? (Recommendations)

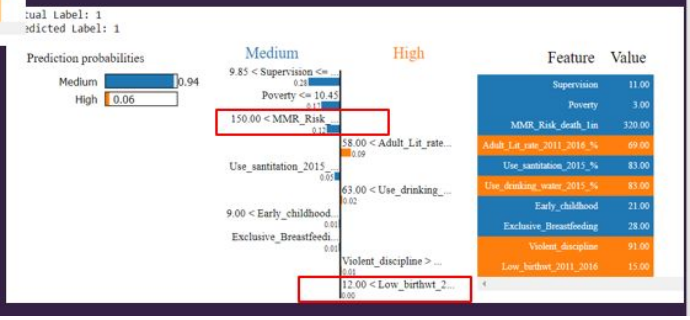
Countries	Adult_Literacy	Low_birthwt	Use_drinking_water	Use_santitation	Total_fert	MMR_Risk_death	Breastfeeding	Atleast_4_visits	Violent_discipline	Early_childhood	Supervision	Poverty
Nigeria	51	15	67	33	6	22	17	51	91	6	40	54



✓ **Recommendations: Rise of literacy rate by 7%, by ensuring more access to education will help transition into Medium category.**

✓ **Recommendations: If Low Birth is reduced to 12% from 15% will make a case for Nigeria into Medium Category.**

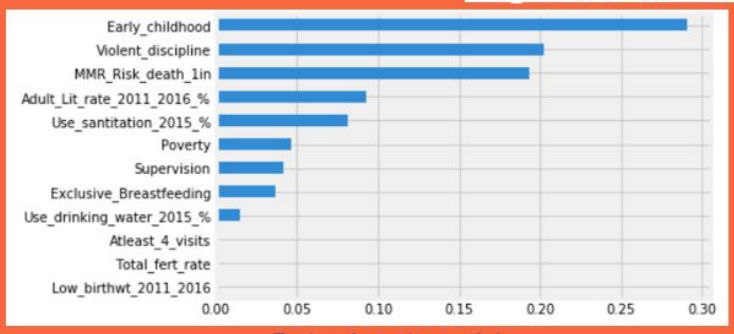
✓ **Recommendations : Reducing the Maternal deaths from 1 in 22 to 1 in 150, by ensuring safer delivery practices will help Nigeria migrate into the Medium Category. This can also be ensured by carrying out delivery in the presence of skilled practitioners.**



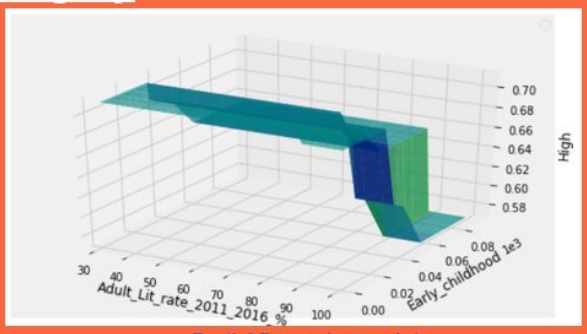
High to Low Category:

Country's Transit into next better category

High to Low category



Feature Importance plot



Partial Dependency plot

- **Insights :** Early Childhood, Violent Discipline and MMR are top 3 major factors influencing a Country's transition from High to Low Category of Under-5 Mortality
- **Insights :** If Adult Literacy rate is greater than 90%, which indicates better accessibility of education, and Early childhood involvement is more than 60%, which says parents are better involved with children in their well-being and growth, the probability of falling into Low category becomes 0.42, i.e., (1-0.58)

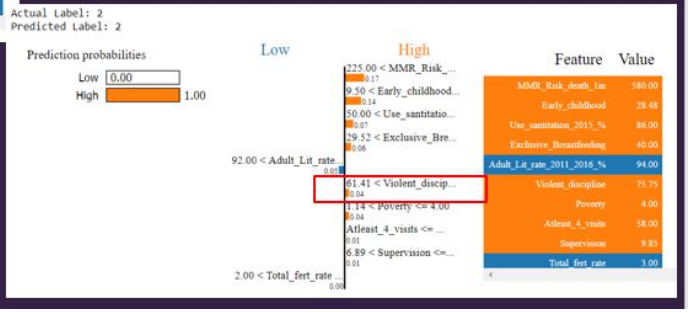
❖ **Example: Recommendation for Ghana's Journey into Low Category**

What Should Ghana do to transit into Low category? (Recommendations)

Countries	Adult_Literacy	Low_birthwt	Use_drinking_water	Use_santitation	Total_fert	MMR_Risk_death	Breastfeeding	Atleast_4_visits	Violent_discipline	Early_childhood	Supervision	Poverty
Ghana	71	11	78	14	4	74	52	87	94	6	21	25

- ✓ **Recommendations:** Early childhood involvement is extremely low and needs to improve by assuring better maternity/paternity leaves.
- ✓ **Recommendations:** If the fertility rate of Ghana can be brought down to 2, by ensuring better birth control, it can help in its journey to a Low Category.

- ✓ **Recommendations:** Violent Discipline for Ghana is 94%, one of the highest and needs drastic decrease to up to 61%. This needs to propagate by better awareness drives and ensuring that parents know the long-term psychological effects violent discipline leaves in children.



Conclusions, Key Findings & Recommendations:

- We see that the Under 5 Mortality Rate does not depend on the geographical factors such as location of a certain country in a certain region, etc., but depends on the socio-economic conditions prevalent in the country.
- Non-Exclusive breastfeeding, i.e., using supplemental nutrition apart from breast milk during the first 5 months of a baby, causes Under 5 mortality.
- Similarly, violent discipline, i.e., using physical beating as a way to discipline children from 2-4 years, severely affects the mortality rate, as the child's psychological state is always in a state of fear from his/her own parents. Such an environment can be hostile to a child's development.
- Leaving a child under the supervision under an individual of ages 10 and less is a cause that affects mortality, as the inexperienced and immature individual cannot cater to the constant needs of a newborn child.
- The presence of children's books indicate a sense of responsibility and yield a feeling of trust among parents and children. This also is an indicator of the constant presence of parents during the formation years of a child.
- Though Postnatal care to mothers does not cause under 5 mortality, it is negatively correlated.
- High under 5 mortality is clustered in the sub-Saharan region of the African continent. The major reason for this as we discovered is the use of ITN's and IRS's, which is not for the other countries. Maybe, insects and pests play a role in the mortality and affect the newborns. African regions need to make efforts to eradicate Malaria causing mosquitoes and other diseases by pests.
- Based on the mortality rate, we can categorize the countries into 3 classes. We see that the mortality for the High Class is 73 in 1000, Medium has 23 in 1000 and Low 6 in 1000.
- This pattern also follows for adult literacy, low birth weight, fertility rate, maternal mortality, poverty and so on for under 5 mortality categories.
- If a country wants to progress from medium to low category; their focus should be on children's books & absence of violent discipline the most among others.
- If a country wants to progress from high to medium category; their focus should be on absence of underage supervision & improvement of economic conditions the most among others.
- If a country wants to progress from medium to low category; their focus should be on children's books & absence of violent discipline the most among others.