Predictive Analysis of COVID-19 Positive Rate Using SAP Analytics Cloud: A Case Study

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Abstract. This paper explores the utilization of SAP Analytics Cloud for analyzing COVID-19 data and predicting the positive rate. Given the significant impact of the COVID-19 pandemic on global health and economies, accurate data analysis and forecasting have become vital for effective decision-making and resource allocation. The objective of this study is to forecast the positive rate by leveraging SAP Analytics Cloud's advanced analytics capabilities and its integration with multiple data sources. The research methodology involves collecting COVID-19 data from reputable sources, including Kaggle, and integrating it into SAP Analytics Cloud for data processing and visualization. Predictive analytics techniques are employed to analyze the positive rate, detect patterns, identify trends, and anticipate future events. In accordance with best practices, the implementation procedure includes data preparation such as collecting data, cleaning and modeling data, data calculations, and predictive analytics. The findings of this study offer valuable insights into the trends of the COVID-19 positive rate, empowering stakeholders to make informed decisions concerning pandemic management. Additionally, the study highlights the potential of SAP Analytics Cloud as a potent instrument for data analysis and prediction within the healthcare industry. The outcomes underscore the utility of employing advanced analytics to extract actionable insights from COVID-19 data. This study contributes to the growing body of knowledge on the application of advanced analytics in public health emergencies, underscoring the effectiveness of SAP Analytics Cloud for large-scale data analysis. The methodologies and insights derived from this research can be applied to future disease outbreaks or public health crises, expanding the practicality of the findings beyond the current pandemic. The study encompasses a comprehensive analysis of data from 117 countries, representing a significant dataset for robust analysis and forecasting.

Keywords: COVID-19, SAP Analytics Cloud, data analysis, predictive analytics, positive rate, public health.

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1 Introduction

The COVID-19 pandemic has become a global crisis, with significant effects on global public health, economies, and societies. Effective strategies for mitigating the impact of a virus are dependent on the ability to foretell its spread and trajectory. Predictive analytics, a potent data analysis technique, has the potential to forecast COVID-19 dynamics and facilitate decision making based on evidence. SAP Analytics Cloud (SAC), a digital service offered by SAP, provides a comprehensive platform for undertaking predictive analytics and enabling data-driven insights(Nazarov et al., 2020).

This paper intends to investigate the phases and essence of predictive analytics within the SAC digital service, with a particular emphasis on analyzing the COVID-19 positive rate. By leveraging SAC's sophisticated analytical capabilities, organizations can effectively process massive amounts of COVID-19 data to identify patterns, trends, and risk factors related to the virus' transmission. SAC enables the formulation of accurate forecasts through predictive modeling, providing decision-makers with valuable insights into the future trajectory of the pandemic.

Discovering underlying relationships and patterns within datasets is the substance of predictive analytics. SAC provides advanced algorithms and machine learning techniques (Kai Tubbesing, 2018), enabling the creation of predictive models that integrate a variety of factors, such as demographic data, geographic variables, and socioeconomic indicators. By integrating these datasets, organizations can utilize SAC to generate forecasts and predictions for the COVID-19 positive rate.

Using SAC, the implementation of predictive analytics involves a number of crucial phases. These include data acquisition and preprocessing, exploratory data analysis, model development and training, model evaluation and validation, and predictive model deployment. Each step is essential for ensuring the accuracy, dependability, and validity of the predictive analysis results. Moreover, data integrity and management are of utmost importance in the context of predictive analytics. Effective data administration practices, including data cleansing, normalization, and feature engineering, are essential for ensuring the integrity and dependability of SAC's developed predictive models.

This case study's findings have substantial implications for public health organizations, policymakers, and healthcare providers. Utilizing the power of predictive analytics in SAC enables decision-makers to obtain valuable insights into the pandemic's future course. This enables them to effectively allocate resources, implement targeted interventions, and devise evidence-based strategies to combat the virus's spread.

This paper concludes by emphasizing the significance of predictive analytics in understanding and managing the complexities of the COVID-19 pandemic. By leveraging the analytical capabilities of SAP Analytics Cloud, organizations can unlock the value

of their COVID-19 data, resulting in actionable insights that facilitate more informed decision-making and improved public health interventions.

2 Problem Statement and Data Preparations

2.1 Problem Statement

Accurate prediction of the positivity rate for COVID-19 is crucial in order to facilitate informed decision-making and optimise resource allocation for effective pandemic management. The objective of this study is to investigate the potential of SAP Analytics Cloud as a predictive tool for forecasting the positivity rate of COVID-19. The main obstacle pertains to the efficient utilisation of SAP Analytics Cloud for the purpose of analysing COVID-19 data and producing dependable predictions. By utilising the sophisticated analytical capabilities and functionalities offered by SAP Analytics Cloud, it is possible to discover valuable insights, detect patterns, and accurately predict the positive rate. This will furnish stakeholders with crucial information to facilitate informed decision-making and the formulation of proactive strategies aimed at mitigating the transmission of the virus.

This research aims to contribute to the advancement of data analysis methodologies in the context of the COVID-19 pandemic by examining the application of SAP Analytics Cloud in forecasting the positive rate of the virus. The results of this study will offer significant contributions to our understanding of the virus's future course, empowering policymakers, healthcare practitioners, and other relevant parties to make informed choices based on empirical evidence and efficiently distribute resources.

2.2 Data Preparations

2.2.1 Collecting Data

The COVID-19 data was obtained from Kaggle.com (Devakumar K. P., 2020)in the form of an Excel (XLSX) dataset, comprising 83,656 records collected from 219 countries across the globe. The dataset encompasses COVID-19 data spanning from January 1, 2020, to April 23, 2021. It includes various metrics such as daily new cases, cumulative total cases, death counts, daily deaths, daily testing figures, cumulative testing figures, positive rates, and other pertinent information. The primary objective of this study is to determine the global positivity rate of COVID-19 by utilising SAP Analytics Cloud.

One limitation of the dataset pertains to the incomplete positive rate data for 102 out of the total 219 countries. Hence, the forthcoming analysis will primarily concentrate on the existing data derived from a total of 117 countries, thereby acknowledging a constraint within the dataset. However, the primary aim of this study is to demonstrate the computation of the positivity rate utilising SAC Analytics Cloud.

The SAP Analytics Cloud platform does not impose any restrictions on the quantity of rows that can be imported when utilising file import functionality. Nevertheless, it is

important to note that there are specific constraints regarding file sizes for Excel and CSV formats, with a maximum limit of 100 MB for Excel files and 250 MB for CSV files (SAP Analytics Cloud, 2023). Hence, the dataset comprising 83,656 rows can be readily accommodated within the specified constraints.

As per the guidelines provided by the World Health Organisation (WHO), a positivity rate that falls below 5% is regarded as a standard for effectively managing cases within the communitysm(David Dowdy & Gypsyamber D'Souza, 2020). This standard is applicable to the outcomes derived from both rapid antigen tests and PCR tests, contingent upon the unique circumstances prevailing in each respective country. The calculation of the positive rate involves the division of the count of individuals who have received positive antigen/PCR results by the overall count of individuals who have undergone antigen/PCR testing (Mathieu et al., 2022).

2.2.2 Cleaning and Modelling Data

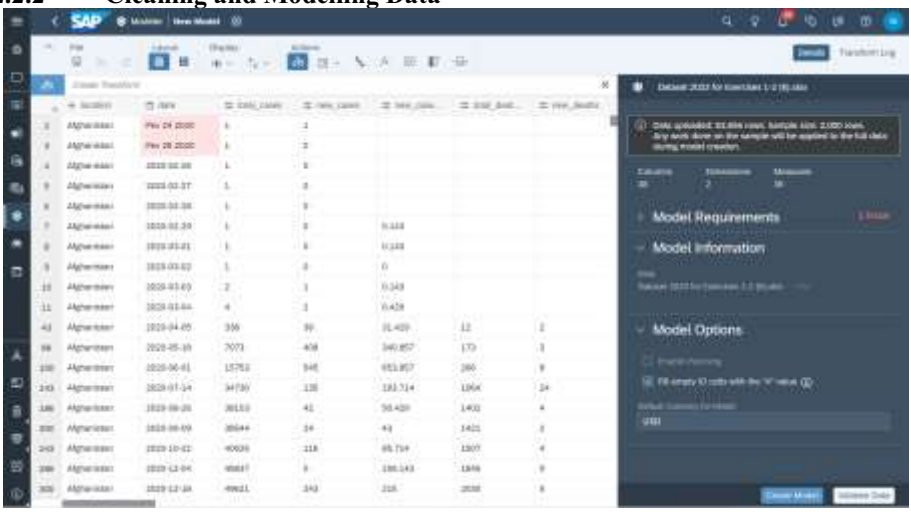

Fig 1. Identified a typo in the dataset's date entry that needs to be fixed

Data modeling in SAP Analytics Cloud is a critical step for preparing and enhancing the dataset for analysis. It involves tasks such as data wrangling, defining measures and dimensions, establishing hierarchies, and creating custom formulas (Nguyen, 2020b). In the Models component of SAP Analytics Cloud, data wrangling is performed to address inaccuracies, including correcting date format errors such as "Feb 24, 2020" and "Feb 25, 2020" to the "yyyy-mm-dd" format.

In order to address the date format errors in the COVID-19 dataset, a straightforward solution is to utilize the Smart Transformation and Replace function available in SAP Analytics Cloud (Elangovan, 2021). By applying this function, the incorrect date entries, such as "Feb 24, 2020" and "Feb 25, 2020," can be replaced with the correct format of "2020-02-24" and "2020-02-25," respectively. This process involves identifying

the column containing the date data and executing the replace function, specifying the incorrect date format as the search parameter and the desired correct format as the replacement value. Through this approach, the date format inconsistencies can be rectified, ensuring accurate and consistent representation of the dates within the COVID-19 dataset.

Accurate data modeling ensures data quality and integrity, enabling reliable analysis and insights generation(Elangovan, 2021). Once the data is prepared, the Stories component allows for data visualization using charts and graphs. Investing time in the Modeler view enhances analysis quality, as it ensures accurate and well-structured data for meaningful insights and informed decision-making.

2.2.3 Data Calculation

In this study, exception aggregation was implemented at the model level in SAP Analytics Cloud. The AVERAGE data type was utilised to determine the average COVID-19 positive rate across all countries included in the dataset. The dimensions used for exception aggregation were location and date, allowing an analysis of variations in the positive rate over time and across countries.

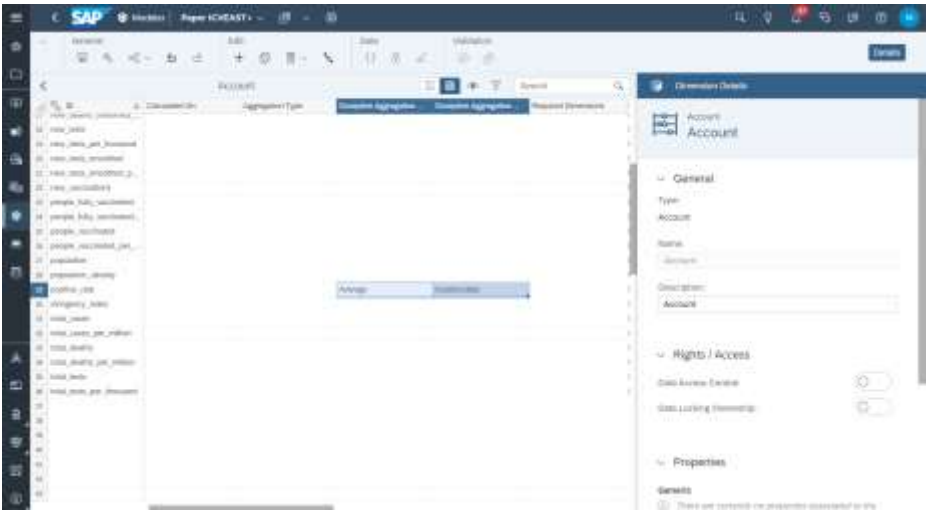

Fig 2. Implementing exception aggregation with the AVERAGE type and dimensions of location and date

By implementing exception aggregation with the AVERAGE type and dimensions of location and date, the study obtained an average positive rate that provided global context for COVID-19. This method allowed for a greater comprehension of the distribution, trends, and temporal variations of the positive rate in various nations.

Using SAP Analytics Cloud's model-level exception aggregation facilitated structured data modelling and automated the calculation of the average positive rate. This streamlined the analysis process and ensured that all stories based on the same model yielded consistent results (Nguyen, 2020a).

In the context of this study, the use of exception aggregation with the AVERAGE type and dimensions of location and date in COVID-19 data analysis yielded accurate and pertinent insights regarding the global positive rate. These insights have significant implications for decision-making and the development of COVID-19 pandemic response strategies.

2.2.4 Predictive Analytics on SAP Analytics Cloud (SAC): The Smart Discovery

Fig 3. The Choice of Smart Discovery as an Alternatives in Creating a Story in SAC

In the Smart Discovery phase, the positive rate variable was chosen as the objective variable and location was selected as the entity for our analysis. To gain a deeper comprehension of the relationship between specific factors and the COVID-19 positive rate, the positive rate was chosen as the focus. As the entity, location was chosen in order to investigate the variations and patterns of the positive rate across various geographical regions.

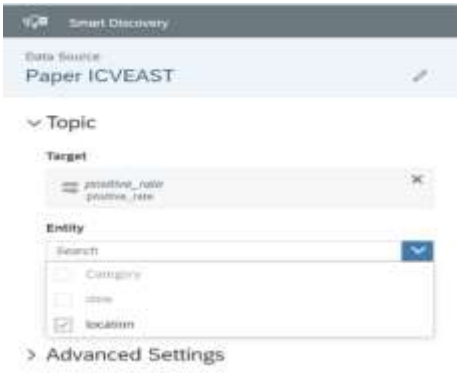

Fig 4. The target and entity must be defined prior to starting the Smart Discovery process. The positive rate has been chosen as the target in the analysis of the COVID-19 data, and Location has been designated as the entity.

The time dimension (date) could not be explicitly selected in the Smart Discovery settings, as it was automatically determined based on the used data. As a result, our primary focus was on investigating the relationship between the positive rate and location in an effort to uncover novel and valuable insights that could inform the COVID-19 pandemic decision-making process.

By executing the Smart Discovery procedure with the COVID-19 positive rate as the target and the location as the entity, we aimed to identify intriguing relationships or patterns between location and the COVID-19 positive rate. The results of Smart Discovery will aid in the identification of factors that influence the proliferation of viruses and the development of more effective pandemic management strategies (SAP Analytics Cloud, 2023).

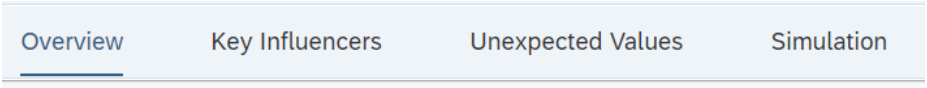

Fig 5. Result of the smart discovery devided into four tabs 1) overview, 2) key influencers, 3) unexpected values and 4) simulation

The Smart Discovery results provide valuable insights into the dataset, focusing on the positive rate of COVID-19 as the target and location as the entity. The Overview tab offers a comprehensive summary, presenting the current global positive rate and its distribution across 117 identified countries. Additionally, it highlights key influencers influencing the positive rate and provides a one-year prediction. However, this overview can be complemented with customized graphs for further analysis.

Moving to the Key Influencers tab, it reveals the correlation strength between each dimension in the dataset and the positive rate, categorizing it as weak, moderate, or strong. This analysis sheds light on the factors influencing the positive rate of COVID-19, contributing to a deeper understanding of its determinants.

The Unexpected Values tab focuses on outliers or unexpected data points, showcasing records where the actual positive rate significantly deviates from the model's expectations. Visually comparing expected versus actual values through scatter-plots and bar charts aids in detecting unusual trends or anomalies in the data(Abraham, 2020).

Moreover, the Simulation tab allows users to perform what-if scenarios by adjusting values and observing their impact on the positive rate. By leveraging the key influencers, this interactive simulation offers insights into how specific factors might influence the positive rate (Abraham, 2020).

In conclusion, Smart Discovery serves as a powerful tool for exploring the dataset's context and uncovering hidden relationships between variables, especially in relation to the positive rate of COVID-19 across various locations. These insights can prove instrumental in making informed decisions and formulating effective strategies to manage the pandemic more efficiently.

3 Result and Discussion

3.1. Visualisation Result

Predictive Analysis implementation using SAP Analytics Cloud (SAC) software resulting three visualizations which are called as Stories. Each story describes different events and knowledges (Liliana et al., 2023).

Fig 3. Total Positive Rate by Location

Figure 6 from SAP Analytics Cloud indicates a 0.09 or 9% total positive rate by country. COVID-19 patients have a high positive rate. The observed positive rate of 9% exceeds the World Health Organization (WHO) standard of 5%(David Dowdy & Gypsyamber D'Souza, 2020). COVID-19 prevalence is higher in populations with positive rates above 5%. It raises the risk of community transmission and emphasizes the necessity to control the virus. Insufficient testing capacity, contact tracing, or community transmission can cause a high positive rate.

Figure 6's greater positive rate suggests the need for further investigation to discover specific variables causing heightened rates in distinct places. Population density, testing procedures, healthcare capability, and prevention may contribute to higher positive rates in some nations. Understanding these indicators can assist authorities customize response methods, allocate resources, and target actions to lower the positive rate.

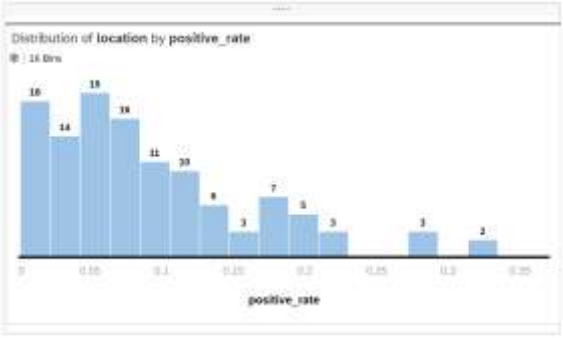

Fig 4. Distribution Location by Positive Rate

Figure 7 provides valuable insights into the distribution of positive rates across various countries. The data demonstrates distinct ranges of observed positive rates across the analyzed nations. First, we note that 18 nations lie within the range of 0-2%, indicating

a relatively low prevalence of COVID-19 cases in these regions. This is attributable to successful containment measures, robust testing strategies, and mitigation efforts.

Based on figure 7 above, 14 countries have positive rates of 2%–4%. These countries have moderate COVID-19 transmission, underscoring the need for sustained attention and prevention. 19 countries have a positive rate of 4%–6%. This shows a rising COVID-19 prevalence in these places, requiring more efforts to restrict the spread and protect public health. 16 countries show a positive rate increase between 6% and 8%. This indicates high COVID-19 transmission in these places, requiring prompt attention and focused efforts to minimize the impact and prevent further escalation. The fact that two nations have positive rates above 30% is troubling. Such high positive rates point to a serious outbreak situation that necessitates quick and effective action to stop the spread, safeguard individuals at risk, and lessen the strain on healthcare systems.

Figure 7 depicts the distribution of COVID-19-positive rates across countries, highlighting the variable degrees of impact and the need for tailored responses. Authorities must prioritize interventions and resources based on the severity of the positive rates in their respective regions. Focus should be placed on expanding testing capabilities, augmenting contact tracing efforts, bolstering healthcare infrastructure, and encouraging adherence to preventative measures.

Monitoring the distribution and trends of positive rates can provide valuable insights into the efficacy of implemented measures and guide decision-making processes. Countries with higher positive rates must take immediate action to reduce them, while those with lower rates must maintain vigilance to prevent a potential increase in cases.

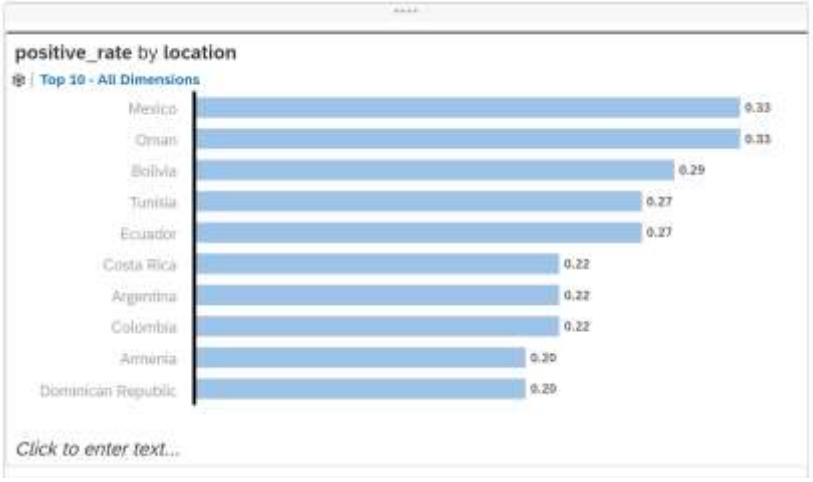

Fig 5. Positive Rate by Location

Comparing the positive rates in Mexico, Oman, Bolivia, Tunisia, and Ecuador to the World Health Organization (WHO) threshold of 5% is alarming. These nations have

positive rates well above the recommended threshold, indicating a substantial risk of pervasive COVID-19 transmission among their populations. As a measure of effective virus control and a prerequisite for contemplating the easing of restrictions and reopening of economies, the WHO has emphasized the significance of maintaining a positive rate below 5%.

With positive rates of 33%, Mexico and Oman have a significant disparity between their current rates and the World Health Organization's threshold. This indicates a high incidence of active cases and a possible strain on their healthcare systems. With prevalence rates of 29%, 27%, and 27%, respectively, Bolivia, Tunisia, and Ecuador confront a formidable challenge in containing the virus and preventing further transmission.

These nations should use the WHO threshold as a crucial metric for evaluating the efficacy of their containment efforts. The elevated positive rates highlight the imperative need to intensify testing efforts, strengthen contact tracing, and implement stringent measures such as social distancing, mask mandates, and lockdowns to prevent the virus's spread. In addition, targeted public health interventions and community involvement are necessary to increase awareness, promote adherence to preventive measures, and cultivate a collective sense of responsibility in order to reduce the positive rate.

Collaboration between these countries, international health agencies, and neighboring countries can facilitate the sharing of expertise, resources, and best practices in the fight against the pandemic. Learning from nations that have effectively reduced their positive rates below the WHO threshold can provide these nations with valuable insights and strategies. Mexico, Oman, Bolivia, Tunisia, and Ecuador can work toward achieving lower positive rates and mitigating the effects of COVID-19 on their populations by aligning their efforts with international guidelines and leveraging global support.

3.2. Forecasting Result

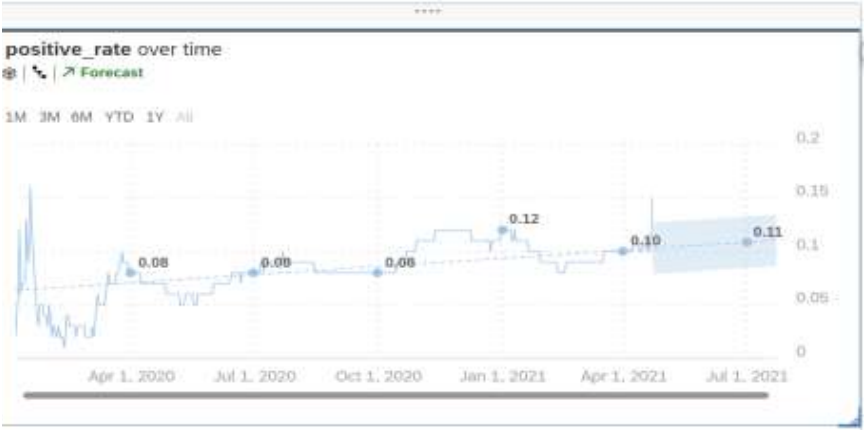

Fig 6. Positive Rate

Figure 9 shows the linear regression-based forecast of the COVID-19 positive rate, which provides vital insights for policy planning and decision-making. The prediction indicates that the positive rate will increase from 10% in April 2021 to 11% in July 2021. This information is essential for health authorities and policymakers to anticipate and prepare for future COVID-19 case spikes.

By utilizing forecasting models such as linear regression, health authorities can allocate resources proactively and implement targeted interventions to combat the virus's spread. The anticipated rise in the positive rate underscores the need for increased testing capacity, allocation of healthcare resources, and implementation of preventative measures to halt the spread of the virus.

Comparing the predicted positive rate to the World Health Organization (WHO) threshold of 5% further emphasizes the gravity of the situation. The projected positive rate of 11% exceeds the WHO threshold, indicating an increased risk of community transmission and the need for prompt action.

This forecasting analysis has multiple benefits. First, it allows policymakers to make informed judgments about public health measures, such as implementing stricter lockdown measures, intensifying vaccination campaigns, and enhancing public health communication. Second, it facilitates resource allocation, ensuring that healthcare facilities have adequate capacity to accommodate the anticipated increase in cases. In addition, the forecast increases public awareness of the prospective trajectory of the positive rate, thereby encouraging individuals to adhere to preventative measures and modify their behavior accordingly.

The forecasting analysis is a valuable instrument for proactive planning, risk assessment, and preparedness. By using linear regression to predict the positive rate, policymakers can take timely and targeted measures to mitigate the impact of the pandemic, safeguard public health, and effectively direct the allocation of resources.

3.3. Simulation

Fig 7. Expected Rate for Location

Figure 10, which shows the expected rate for various locations (countries) at 10%, provides valuable insights via simulation analysis utilizing SAP Analytic Cloud. This simulation provides a glimpse of prospective scenarios and enables policymakers and health authorities to assess the potential impact of various variables on the positive rate.

The 10% rate predicted by the simulation analysis can be used as a benchmark for decision-making and resource allocation. It aids policymakers in assessing the potential burden on healthcare systems, planning for adequate testing and treatment capacities, and implementing measures to control the virus's spread.

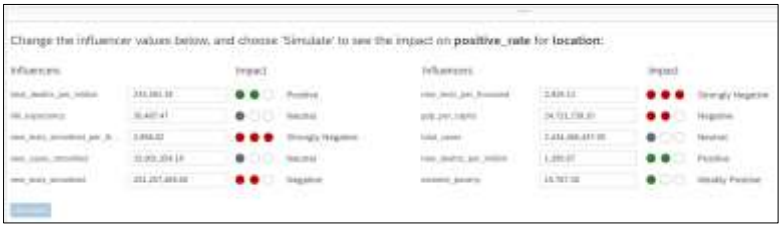

Fig 8. Change the Influecer

By using the predictive analytics and modeling features of SAP Analytic Cloud, decision-makers get a comprehensive understanding of the factors affecting the COVID-19 positive rate. The investigation of data, prediction, and simulation permits a comprehensive analysis of the dynamics of the pandemic.

In Figure 11, we observed that a number of influential factors have a substantial effect on the positive rate. The substantial negative correlations between "new_tests_per_thousand" and "new_tests_smoothed_per_thousand" suggest that increasing testing rates may reduce the positive rate. Conversely, "total_death_permillion" and "new_death_permillion" were identified as positive influencers, indicating a possible correlation between greater mortality rates and increased positive rates.

Figure 11 demonstrates how the simulation capabilities of SAP Analytic Cloud contribute to a deeper understanding of the interplay of these factors. The simulation results indicated a 10% expected rate of success. Using these simulations, decision-makers can investigate various scenarios by adjusting the influencing factors. For instance, they can assess the effect of increasing testing efforts or instituting more stringent preventative measures.

Simulations facilitate decision-making based on evidence by quantifying the potential outcomes of various scenarios. Observing the simulated outcomes allows decision-makers to evaluate the efficacy of interventions and policies. By manipulating the influencing factors, they are able to assess the prospective impact on the positive rate and determine the most effective strategies for preventing the spread of COVID-19.

This iterative process enables decision-makers to modify their strategies in light of real-time data and emergent insights. The interactive nature of the simulations allows users to investigate various "what-if" scenarios and evaluate the sensitivity of the positive rate to changes in influential factors. This iterative analysis enables decision-makers to comprehend the trade-offs and make informed decisions that strike a balance between public health and socioeconomic factors.

4 Conclusion

Several important conclusions can be drawn from the use of SAP Analytics Cloud (SAC) to process COVID-19 data, including:

- The results show that SAC is an excellent tool for data processing and can handle and evaluate COVID-19 data when it is valid and comprehensive. Users of the site can explore, visualize, and analyze data from numerous sources, which helps them gain a thorough picture of the COVID-19 situation.

- Decision-making is supported by predictive analysis and simulation: SAC's predictive analysis features and simulation capabilities offer helpful support for decision-making. SAC can provide forecasts and simulate various situations by utilizing machine learning algorithms and forecasting models, assisting decision-makers in anticipating trends and making wise decisions to stop the spread of the virus.

- Data integrity is essential: For reliable simulations and forecasts, there must be access to complete, reliable data. Only 117 of the 219 countries included in the analysis had complete data, it should be noted. This emphasizes how crucial it is to guarantee data completeness and dependability in order to provide insightful conclusions and accurate forecasts.

- SAC's contribution to data-driven decision-making: SAC is a useful tool for decision-makers, supplying them with insights that can be put into practice. Decision-makers can stay informed about the COVID-19 situation, spot patterns, and develop effective plans and actions because to the platform's ability to handle and analyze enormous amounts of data in real-time.

- Continuous data collection and improvement are required in order to increase the efficiency of SAC in the analysis of COVID-19 data. To preserve data completeness, validity, and timeliness, collaboration between data producers, health organizations, and governments is essential. To maximize the precision and dependability of forecasts and simulations, regular updates and data quality checks are important.

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