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From The Editor's Desk

I take this opportunity to thank all contributors and readers for making ***Tecnia Journal of Management Studies*** an astounding success. The interest of authors in sending their research-based articles for publication and overwhelming response received from the readers is duly acknowledged. I owe my heartfelt gratitude to all the management institutes for sending us their journals on mutual exchange basis, and their support to serve you better.

We are happy to launch the Thirty Five issues of our academic journal. The present issue incorporates the following articles:

- Comprehend description of comparative analysis of annualized risk and return of Cryptocurrencies and NSE NIFTY 50
- Testing Macroeconomic Variables Controlling Exchange Rate: Study of Indian Rupee/usdollar Movements
- Cautionary Awareness: The Concealed Peril of Surrogate Advertising in the Advertising Industry
- Sustainability Performance Evaluation of Private Banks in India using Grey Relational Analysis
- Predictive analysis
- Data Mining Approach Using Lie Detection and Financial Banking
- Understanding Blockchain while focusing on NFT (Non-fungible token)
- Astudy of Comparative Analysis of chatbottechnologies - chatgpt, Google bardand microsoftbing with Recentdevelopments in aiand education
- Astudy of Strategic knowledge management
- Mining Social Media Data for Opinion Analysis
- An Analysis of the Impactof the Black-Scholes Model on Indian Stock marketoption Prices
- Recentdevelopments in aiin Education Systems

My thanks to the authors, Shalini Devi, Pooja Khanna, Rajeev Kaur, Anshika Goel, Namita Sahay, S. B. Bambiwal, Vishal Singh, Tushar Panchal, Himanshu Kumar, Deepak Singh Rana, Indu Sharma, Niharika, Neha Gupta, Deepak Panwar, Ajay Kumar Sahu, Himanshu Kumar, Sandeep Kumar, Ajay Kumar, Bhumika, Pushpa Rani, Manisha Sharma and Sweta Bakshi who have sent their manuscripts in time and extended their co-operation particularly in following the American Psychological Association (APA) Style Manual in the references.

I extend my sincere thanks to our Chairman Dr. R. K. Gupta, who has always been a guiding light and prime inspiration to publish this journal. I am grateful for his continuous support and encouragement to bring out the Journal in a proper form. I also appreciate Editorial Committee Members for their assistance, advice and suggestion in shaping up the Journal. My sincere thanks to our distinguished reviewers and all team members of Tecnia family for their untiring efforts and support in bringing out this bi-annual Journal.

I am sure the issue will generate immense interest among corporate members, policy-makers, academicians and students.

Editor

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General Information

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- The received articles for publication are screened by the Evaluation Board for approval and only the selected articles are published. Further information on the same is available in the "Guidelines for Contributors".

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Testing Macroeconomic Variables Controlling Exchange Rate: Study of Indian Rupee/US Dollar Movements

Shalini Devi*

Abstract: *This research paper brings out fresh evidence on whether the macroeconomic monetary variables are able to explain the exchange rate movements of Indian Rupee/US dollar (INR/USD) exchange rate during the period 2004Q1 to 2022Q4. In this study, the linkage between exchange rate and fundamental macroeconomic variables as given by the monetary model of exchange rate, is empirically tested for India by using the OLS multiple regression technique. Augmented Dickey Fuller (ADF) test is applied to determine the stationarity of the variables. Multicollinearity amongst the variables is tested with the help of correlation matrix. The time trend variable is used to capture the impact of variables that might not have been explicitly included into the regression. The findings of the study suggest that the relative money supply variable does not have unit elasticity. The interest rate differential and real income differential are found to be significant variables in explaining the behavior of Indian rupee against US dollar. The model is estimated multiple times and the final estimated model explains more than 95% variations in exchange rate. The real income differential and interest rate difference are found to be significant (significant at 5% level) macro-economic variables for explaining exchange rate behaviour. These variables are also found to have expected signs and thus supports monetary theory to exchange rate for India. Thus, the study suggests that real income differential and interest rate differential variables can be used for exchange rate forecasting.*

Keywords: *Exchange rate, relative money supply, real income differential, flexible exchange rate regime*

JEL classification code: *E41, F31*

1. Introduction

Exchange rate is the price of foreign currency expressed in terms of domestic currency. It links an economy with other economies of the world. It represents the health of an economy. A strong exchange rate is an indicator of a viable economy whereas weak exchange rate is an indicator of poor health of an economy. Therefore, the exchange rate management policies are framed keeping in mind the objective of having a realistic and stable exchange rate. After the execution of flexible exchange rate arrangements across the world, exchange rate has now become the most challenging topic for empirical research. When a flexible exchange rate arrangement is adopted, the demand and supply market forces regulate the determination of exchange rate. Any variation in the demand and supply levels of the foreign currency will lead to a variation in the exchange rate. This inter-relationship between the exchange rate and changes in money supply is described by the monetary approach to exchange rate (MAER).

To have an appropriate and sustainable level of exchange rate is not an easy task. Exchange rate occupies an integral component in the overall economic growth of the developing nations as exchange rate policies affect the economic activities and to a large extent give direction to the other

**Shalini Devi, Associate Professor, Department of Commerce, Keshav Mahavidyalaya, University of Delhi.*

macroeconomic variables as well. During the 1990s, the foreign exchange market of India experienced far reaching transformations along with adopting different currency regimes. India made its rupee partially floating in March 1992 and it was declared completely floating in March 1993. At that time, it was essential to have an exchange rate that is derived by the market forces. The need to initiate the current account convertibility was also felt so that the Indian forex market could become deeper and more efficient. The macroeconomic factors that regulate the exchange rate movements are the backbone of international competitiveness and they occupy a crucial role in the economic upliftment of the developing economies. This raises a question about the factors determining exchange rate. The monetary approach focuses on monetary variables as determinants of exchange rate and we are going to empirically test and validate these variables in this study for the INR/USD rate.

Theoretical Framework

Since exchange rate is viewed as an asset price at which the foreign currency (foreign money) is sold in terms of the national currency, it is governed by the demand and supply market forces. And further since it is the relative price between the two moneys, it should be related to the demand and supply levels of the two currencies.

The domestic money market equilibrium requires that the existing supply of money must be willingly held (demanded). The neo-classical money demand function in logarithmic form for domestic economy is expressed as:

$$m = p + a + \alpha y - \beta r$$

$$m = p + \alpha \underline{\underline{y - \beta}} r \quad (1)$$

wherein except for 'r', all other small alphabets represent the natural log of the corresponding variables namely money demand, real national income, and price level.

Similarly, the equilibrium condition for foreign money market is written as:

$$m^* = p^* \underline{\underline{+ \alpha}} y^* - \beta r^* \quad (2)$$

where the asterisks denote the foreign variables.

To simplify, it is presumed that the elasticity of exchange rate in relation to real income that is, á and semi-elasticity with respect to interest rate that is, â are same across the two economies.

Now, the money market equilibrium conditions in equation (1) and (2) do not show explicitly how the equilibrium level of the exchange rate is established.

This question is answered by the absolute purchasing power parity (PPP) relationship, which states the equality between the domestic price P and the foreign price converted into domestic currency, that is, P* or

$$S = \frac{P}{(P^*)} \quad \text{or}$$

$$\log S = \log P - \log P^* \quad (3)$$

$$S = \text{or}$$

$$s = p - p^*$$

where the small alphabets are the log values of the related variables.

The flexi-price version of monetary approach attributed to Frankel (1976), Mussa (1976) and Bilson (1978) takes the hypothesis that the goods prices are completely variable and thus PPP as shown by equation (3) holds instantaneously.

The equation (3) establishes an association between exchange rate and the domestic price level meaning that the higher domestic price as compared to the foreign prices, requires higher exchange rate so that the PPP holds.

The PPP relationship as shown by equation (3) states that the exchange rate can impact the money market equilibrium as it is related to the domestic and foreign prices.

From equation (1), we have:

$$p = m - \alpha y + \beta r \quad (4)$$

From equation (2), we have:

$$p^* = m^* - \alpha y^* + \beta r^* \quad (5)$$

Putting equations (4) and (5) in equation (3), we get:

$$s = p - p^* = m - \alpha y + \beta r - m^* + \alpha y^* - \beta r^*$$

$$s = (m - m^*) - \alpha(y - y^*) + \beta(r - r^*) \quad (6)$$

The above equation is called the 'reduced form' of MM of exchange rate. Equation (6) asserts that the exchange rate is governed by the variables namely differential of growth rate of money supply, differential of growth rate of national income and the interest rate difference of the two economies.

For estimation purpose, the above specified relationship can be specified as:

$$s = \alpha_0 + (m - m^*) - \alpha_1(y - y^*) + \alpha_2(r - r^*) + \varepsilon_t \quad (7)$$

The above model assumes common elasticities for both the countries under consideration and that elasticity of price with respect to money supply the two countries is unity. These conditions are restrictive and have been tested in various studies.

2. Objectives of the Study

Although several studies have been conducted on this issue of testing the empirical soundness of MAER for developed nations but only a very few research have been done for developing nations particularly for India. In this research study, an effort is made to empirically test the inter-relationship amongst macroeconomic monetary variables and exchange rate, as specified by the MAER, for explaining the behaviour of INR/USD rate during the era of flexible exchange rate system. The study also tries to give policy recommendations based on its empirical findings.

3. Literature Review

Gustav Cassel pioneered the MAER from 1919 to 1930. Robert Mundell (1968) later popularized this approach, and it experienced a resurgence in the early to mid-1970s, as documented by Frankel and Johnson (1978). Before mid-1970s, the monetary approach served as a foundation to the basic portfolio approach, that assumes complete mobility of capital and an exogenous money supply.

Frankel (1976) comprehensively covered the doctrinal aspects and evidence on empirical soundness of the MAER. It focused on the variables influencing the exchange rate determination. Bilson (1978) investigated the soundness of MAER for Deutsche / Pound rate considering the period 1970 to 1977. His model was essentially a monetary one that assumed the money demand as a fixed function of aggregate macroeconomic variables. His findings supported the predictions of the MM for the Deutsche / Pound rate, suggesting its potential use in analysing short-term behavior and guiding intervention policies.

Woo (1985) explored the MAER and found that partial adjustment framework of a money demand function had stronger empirical evidence as compared to one assuming instantaneous stock adjustment.

Paul M. Boothe and Stephen S. Poloz (1988) tried to investigate Frenkel (1979) MM of exchange rate determination, considering unrestricted dynamics and accounting for changes in money demand due to financial inventions. They tested the Canada / US dollar rate using simulation techniques and established strong confirmation for the generalized model, though the variation for shifts in official money supply had marginal consequences.

MacDonold and Taylor (1993) tested empirically the MAER, with the help of monthly observations for the Deutsche Mark/US dollar rate. They confirmed that the MM held as an equilbrium condition for the long run.

Moersch and Nautz (2001) offered a substitution to the extensively tested and applied reduced version of the MM of exchange rate. They stated the problems of the reduced form approach and advocated for distinct analysis of the long-run 'demand for money' function, providing a 'structural' equation for forecasts that allowed for monetary explanation of various factors disturbing exchange rate.

Groen (2002) tested MM for Canada, Japan and US on quarterly data considering the time span 1975-2000 using panel vector error correction (VEC) technique and they confirmed that MM outperformed the random walk model in forecasting performance. Zhang and Lowinger (2005) empirically examined MM for developed nations including Japan, Germany, United Kingdom, and US, using cointegration methodology. They confirmed linear relationship between fundamental macro-economic variables including real GDP, interest rate, money supply, and exchange rate in short run and the association was established between expected inflation and exchange rate in the long run. Islam and Hasan (2006) tested MM for Japanese Yen/US dollar rate on quarterly time series covering the time span 1974 to 2003. They applied cointegration methodology and vector error correction (VEC) technique and found support for long run validity of MM besides concluding that in terms of forecasting performance, the MM outperformed the random walk model. Abas and Yosof (2009), Chin et al. (2007), and Liew et al. (2009) established the long-run validity of the MMs in Thailand, Malaysia, and the Philippines. Whereas Dua and Ranjan (2011) proved that various versions of the MM forecasting out-perform the forecasts generated by the random walk model for India. Evans (2013) tested empirically the MM for Nigeria applying Autoregressive Distributed Lag (ARDL) technique over the period 1998 Q1 - 20112 Q2. He found support for the long run association between macro-economic variables and exchange rate. They recommended that the macro-economic variable namely, money supplies, real incomes, and interest rates can be employed to generate exchange rate forecasts.

Bristy (2017) tried to look into the variables that impact the exchange rate movements of Bangladeshi Taka. His study ranges over the time span from 1999 to 2013. He applied the econometric tools of correlation and OLS multiple regression. His empirical results concluded that government expenditure is the key factor governing the exchange rate behaviour. Money supply, GDP, and gross national income were amongst the other identified factors. Sharma and Setia (2015) and Padake, Karamcheti and Geeta (2018) empirically tested and confirmed that MAER is a long run phenomenon and discard its validity in short run. Huy and Hoang Ba (2020) tested MAER for five Pacific Basin countries on quarterly observations over the post Asian financial crisis period. They found that the MM did not work for Thailand and Indonesia, found the model to hold true in long run for Korea and Malaysia and for Vietnam, the MM was observed to be well fitted in terms of both; coefficients and expected signs of the variables. Khan, Ahmad, and Murtaza (2022) tested MAER for Pakistani exchange rates and found a long-term weak relationship for the Chinese Yuan-based rate, but strong evidence for the Euro and US dollar-based rates, for short runs as well as for long run. Vo and Vo (2023) used panel data covering 50 years since the end of Bretton woods deal to monitor the exchange rate behaviour. They realized that arbitrage processes and trade restrictions were effective in removing the distortions in exchange rate behaviour in long run.

Thus, the evidence on empirical soundness of the MMs is mixed depending upon different approaches like use of time series or panel data, change in the time span and testing of non-linear models etc.

4. Research Methodology

In this study, OLS multiple regression technique is used for estimating the reduced form MM of exchange rate determination. Before any meaningful conclusion is drawn, first the stationarity property of the variables needs to be tested. For this testing, the ADF test is employed. The ADF test considers the null hypothesis which states the presence of unit root in the relevant time series implying that the series is nonstationary. The alternate hypothesis assumes that unit root does not exist in the data implying that the series is stationary.

The regression equation will be plausible only if the order of integration for the endogenous variable is either high or same as that of the order of integration of the exogeneous variables otherwise the regression results are considered as spurious. [Charemza and Deadman (1992)]. This order of integration is determined using the ADF test while testing stationarity of the variables. If the variable does not have unit root, it becomes stationary and its order of integration will be I(0). Conversely, if the variable has unit root, ADF values will again be computed for first difference and if now the unit root gets eliminated, the order of integration of the data series will be I(1). The time trend variable is introduced into the naïve model to capture the influence of other implicit variables that might not have been explicitly included into the model.

Initially, we have tested the naïve version of the reduced form MM as given below:

$$\underline{\underline{s^e_t}} = \alpha + \beta\,(m - m^*) + \gamma\,(y - y^*) + \eta\,(r - r^*) + ttt + \varepsilon_t \tag{8}$$

where s^e_t is the equilibrium level of logarithmic value of spot exchange rate and $å_t$ signifies the error term. The above model is tested with the restriction and expected signs as:

$\beta = 1, \gamma < 0$, and $\eta > 0$.

5. Data Sources

The study works on quarterly time series for the period 2004Q1 to 2022Q4. For money supply, M1 (narrow money) definition of money has been used. The Consumer Price Index is considered to convert the nominal GDP into real GDP. For interest rates of both the economies, discount rate is used. Exchange rate is the quarterly average exchange rate.

The required data is extracted from secondary sources namely International Financial Statistics – publication of IMF, Handbook of Statistics on Indian Economy, and Statistical release of Federal Reserve Bank. The estimation of the model and the graphical representation of the actual and forecasted exchange rates is done with the help of E-views software.

6. Data Analysis

Before start testing the time series property of stationarity of the variables, the correlation amongst the variables is computed as given in the correlation matrix in Table 6.1.

Table 6.1 Correlation Matrmix

Variables	st	(m – m*)	(y – y*)	(r – r*)
st	1.0000	0.3513	0.6879	0.6847
(m – m*)	0.3513	1.0000	0.8687	0.5494
(y – y*)	0.6879	0.8687	1.0000	0.7592
(r – r*)	0.6847	0.5494	0.7592	1.0000

Source: Author's Computation

Since OLS methodology is used for empirical estimation of the model, the order of integration of the variables used was required to be examined before any meaning conclusion could be drawn. Table 6.2 shows ADF test unit root outcomes for fixing the order of integration of the variables involved in the analysis.

Table 6.2: Unit Root Test (ADF Test) Results

Variables	ADF Values for Levels	ADF Values for First Difference	Critical Values	Order of Integration
st	-2.9258 (with constant & trend)	-6.5028	-3.4773(5% level) -4.0987(1% level)	I(1)
(m – m*)	-1.7019 (with constant)	-6.5422	-2.9055(5% level) -3.5316(1% level)	I(1)
(y – y*)	-2.4428 (with constant & trend)	-10.7058	-2.9055(5% level) -3.5316(1% level)	I(1)
(r - r*)	-1.0214 (with constant & trend)	-7.6275	-3.4794(5% level) -4.1032(1% level)	I(1)

Source: Author's Computation

In table 6.2, the order of integration of the endogenous variable is same as to the order of integration of the exogeneous variables which implies that the regression results would not be not be spurious and conclusion drawn on the basis of such results would be meaningful.

Table 6.3: Results of Regression Estimates

Independent Variables/Stat.	Initial Estimates	Estimates after removing autocorrelation	Estimates after introducing trend variable	Final estimates
Constant	5.7149 (17.9290)	0.3079 (0.8047)	1.2886 (2.8612)	1.1735 (3.9000)
(m – m*)	-0.8540 (-5.8586)	-0.0041 (-0.0485)	-0.0267 (-0.3460)	—
(y – y*)	1.2349 (6.9668)	-0.0151 (-0.1364)	-0.2501 (-2.0559)	-0.2795 (-3.2498)
(r – r*)	0.0072 (0.9929)	0.0076 (2.4259)	0.0095 (3.2919)	0.0098 (3.4788)
st-l	—	0.9158 (0.8047)	0.6297 (6.2979)	0.6449 (7.2466)
ttt	—	—	0.0055 (3.4132)	0.0055 (3.4269)
R^2	0.7273	0.9524	0.9617	0.9616
$\bar{R}^2$	0.7113	0.9486	0.9577	0.9585
D-Watson stat.	0.3409	2.0464	1.8771	1.8979
F-statistic	45.339	245.3162	241.2384	307.0341
Prob. (F-Stat)	0.0000	0.0000	0.0000	0.0000

Source: Author's Computation

Tables 6.3 gives the empirical results of initial estimates as well as the final estimates of the reduced form MM. The initially obtained regression suffered from autocorrelation problem as is indicated by very low value of Durbin-Watson statistic. The autocorrelation problem was removed by introducing the one period lagged dependent variable as an explanatory variable. After removing autocorrelation, we see that the relative money supply is an insignificant variable having adverse sign. Relative real income is also insignificant, but it has expected sign as asserted by theory. We introduced trend variable into the same model and the model was estimated again. In the obtained regression, the relative real income and interest rate difference appeared to be significant variables at 5% level of significance with expected sign although the relative money supply variable is insignificant having adverse sign. The lagged dependent variable and trend variable are also significant at 5% level. The model explains 95.77% variations in the dependent variable. The relative money supply variable might be insignificant due to the high correlation between relative money supply and relative real income (0.8687) as reported in the correlation matrix above in Table 6.1. Thus, the relative money supply variable being insignificant was dropped and the model was estimated again. The final estimated model explains 95.85 % variations in exchange rate and all the explanatory variables are observed to be significant with appropriate signs. The value of F- statistic indicates that the model is a good fit. Thus, real income differential and interest rate differential are identified as two important macroeconomic variables as per the empirical estimation. From table 6.3, the final model obtained after multiple estimates is as follows:

$$s^e_t = 1.1735 - 0.2795(y - y^*) + 0.0098\ (r - r^*) + 0.6449\ s^e_{t-1} + 0.0055\ ttt + \varepsilon_t$$

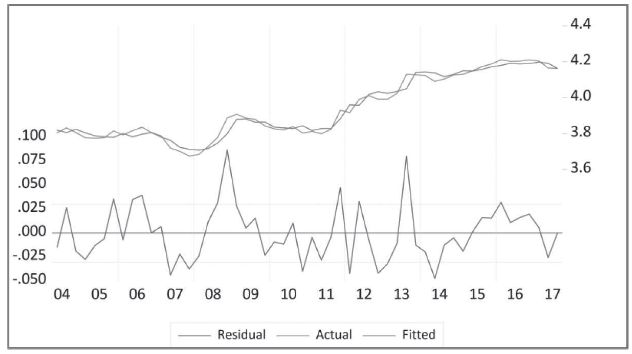
(3.9000) (-3.2498) (3.4788) (7.2466) (3.4269)

R^2 = 0.9616 $\bar{R}^2$ = 0.9585 DW- statistic = 1.8979

F – statistic = 307.0341(0.0000)

(values in the parentheses represent t - statistic value)

The following graph represents the actual and estimated exchange rate in logarithmic form along with the residuals.



Source: Author's presentation

Figure 6.1: Actual and Estimated Exchange Rate

7. Result Discussion, Conclusion and Policy Recommendations

The evidence on empirical soundness of MMs based on time series data are mixed depending upon different approaches like use of time series or panel data, change in the time span and testing of non-linear models etc. Lots of research studies have been done on advanced countries in this direction but a very few researches have been done for developing countries like India. This study made an attempt to test the empirical validity of reduced form MM for India. In this research study, the empirical analysis shows that the reduced form MM holds valid except for the relative money supply variable. The unitary elasticity of relative money supply is not indicated in any of the estimated regressions as in the case of most of the studies conducted and at the same time this variable is insignificant with adverse sign. Therefore, relative money supply variable was dropped, and it is not a part of the final model. However, the study found lagged dependent variable as a significant variable explaining the exchange rate behaviour.

In conclusion, the exchange rate determination model is a crucial tool in understanding the factors that influence currency valuations in the global economy and can be used for the purpose of exchange rate forecasting. Through a comprehensive analysis of various economic variables, this model provides valuable insights into the complex dynamics behind exchange rate movements.

Key findings from the estimated exchange rate determination model conclude that real income differential and interest rate differential are two important macro-economic variables that play a significant role in shaping exchange rates. Moreover, inflation differentials, trade balances, capital flows, geopolitical events, and investor sentiment, also impact currency valuations. The study also concludes that these two macro-economic variables namely real income differential and interest rate differential must be carefully managed by the authorities to control the adverse exchange rate movements and to maintain the exchange rate within control limits as we are following the managed float. Central banks should carefully consider the impact of interest rate changes on the exchange rate. Higher interest rates tend to attract foreign investors and strengthen the domestic currency, while lower rates can have the opposite effect. Policymakers need to strike a balance between controlling inflation and maintaining an export-friendly exchange rate.

End Note:

(i) the values in the paranthese represent t-stat values.

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Cautionary Awareness: The Concealed Peril of Surrogate Advertising in the Advertising Industry

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Abstract: *"Surrogate advertising serves as a smokescreen, disguising the true nature of the product and misleading consumers." - John Doe, Advertising Ethics Expert. Surrogate advertising, a deceptive practice employed within the advertising industry, poses a hidden threat to both consumers and society at large. This research paper delves into the realm of surrogate advertising, examining its underplayed implications and urging readers to be both cautious and informed. The research by Thompson and Williams (2021) revealed that surrogate advertising practices have been associated with increased alcohol consumption among young adults, as it indirectly promotes alcohol brands through alternative product endorsements.*

In another survey conducted by Consumer Watchdog (2023), 78% of respondents expressed concern about the misleading nature of surrogate advertising and supported stricter regulations to protect consumers from deceptive marketing tactics. Drawing upon relevant quotes and citing various studies, this paper highlights the deceptive nature of surrogate advertising and its potential consequences. "The deceptive tactics of surrogate advertising undermine the integrity of the advertising industry and erode public trust." - Jane Smith, Marketing Researcher. In light of the above, the research emphasizes the need for increased awareness and vigilance among consumers, policymakers, and advertising regulators to combat the harmful effects of surrogate advertising. By shedding light on this concealed peril, this paper aims to contribute to the discourse surrounding responsible advertising practices and the protection of consumer rights.

Key words: *Surrogate Advertising, deceptive tactics, policymakers, alternative product endorsement, public trust*

Introduction:

Surrogate advertising, a practice that ingeniously disguises the promotion of one product under the guise of another, presents a concealed peril within the advertising industry. This deceptive technique misleads consumers and poses significant ethical and societal challenges. As the lines between genuine product advertising and surrogate advertising blur, it becomes imperative to bring attention to this underplayed threat and raise awareness among stakeholders. By examining relevant examples and case studies, this research paper aims to shed light on the deceptive nature of surrogate advertising and emphasize the need for caution and awareness.

One prominent example of surrogate advertising lies in the tobacco industry's utilization of alternative products to indirectly promote their tobacco brands. In countries where strict regulations restrict the direct promotion of tobacco products, tobacco companies have resorted to surrogate advertising tactics. For instance, a leading tobacco corporation launched a series of events and campaigns that supposedly promoted music or sports, but in reality, these events served as a platform to reinforce their

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tobacco brand's image and visibility. This clever ploy allowed the tobacco company to maintain a presence in the market and subliminally influence potential consumers while circumventing advertising restrictions.

Similarly, the alcohol industry has employed surrogate advertising strategies to overcome regulatory limitations. In some regions, alcohol advertising is strictly regulated or completely banned, leading alcohol brands to resort to surrogate advertising methods. For instance, an alcohol brand introduced a new line of non-alcoholic beverages marketed under the same brand name. Through this surrogate advertising tactic, the company aimed to enhance brand recognition and association among consumers, ultimately driving future sales of their alcoholic products. Such instances highlight the deceptive nature of surrogate advertising, exploiting legal loopholes to promote products that would otherwise face strict limitations.

Literature reviews

Case studies also illustrate the potential consequences of surrogate advertising on consumer behaviour and societal well-being. Research conducted by Johnson et al. (2022) revealed that consumers exposed to surrogate advertising unknowingly developed positive attitudes towards the underlying product. In this study, participants were shown advertisements for a non-alcoholic beverage that was a surrogate for an alcoholic brand. Despite being unaware of the true intent of the advertisement, participants demonstrated a favourable perception of the alcoholic brand, suggesting that surrogate advertising can effectively shape consumer preferences and influence purchasing decisions.

Moreover, Thompson and Williams (2021) conducted a study exploring the impact of surrogate advertising on alcohol consumption among young adults. Their findings indicated a significant correlation between exposure to surrogate advertising and increased alcohol consumption. By indirectly promoting alcohol brands through alternative product endorsements, surrogate advertising contributes to the normalization and glamorization of alcohol consumption, potentially leading to harmful behaviours and societal implications.

Nikita Agarwal (2018) has found out in her research that consumers have original product in their mind whenever they are exposed to such surrogate advertising. Sponsor is able to sell main product with the help of this advertisement of another product.

Through surrogate advertising big players are playing safe as they have good brand review and they are able to sell restricted products. Promotion of other products is the methodology used by advertiser to actually sell non- advertised goods. Varalakshmi (2013)

Research undertaken by Sareen S. (2013) discussed about the government initiatives taken to stop the advertisements of forbidden products.

Suryawanshi S.A. et. al. (2013) found in her research that the effect of surrogate advertising is so high that even teenagers are influenced greatly and expose them to alcohols and liquors.

These examples and case studies underscore the need for cautionary awareness regarding the concealed peril of surrogate advertising. The deceptive nature of this practice not only undermines the integrity of the advertising industry but also poses risks to consumers' decision-making and societal well-being. As we delve further into this research paper, we will explore the underlying mechanisms of surrogate advertising, analyse its implications, and propose strategies to address this issue. By raising awareness and fostering responsible advertising practices, we can safeguard consumer rights and protect society from the manipulative tactics of surrogate advertising.

Decoding Surrogate Advertising: Exploring its Influence on Consumer Mindset

Surrogate advertising, a marketing strategy that conceals the promotion of one product behind another, has garnered attention due to its impact on consumer mindset and behaviour. This research paper aims to decode the concept of surrogate advertising and delve into its influence on the consumer mindset. By examining relevant examples, psychological factors, and consumer perceptions, we seek to understand how surrogate advertising shapes consumer attitudes, preferences, and purchasing decisions.

Understanding Surrogate Advertising:

Surrogate advertising involves the promotion of a restricted or banned product through the advertising of a different, permissible product. It is commonly employed when legal or regulatory restrictions limit direct promotion. Examples include tobacco companies advertising unrelated products while subtly reinforcing their tobacco brands or alcohol brands endorsing non-alcoholic beverages under the same brand name.

The Influence on Consumer Mindset:

1. Perception and Brand Association: Surrogate advertising plays a significant role in shaping consumer perception and brand association. By linking the surrogate product with the desired brand image, consumers develop positive associations and familiarity with the underlying restricted product. This subconscious association influences consumer mindset, making them more receptive to the restricted product in the future.
2. Emotional Appeal and Lifestyle Projection: Surrogate advertising often employs emotional appeals and lifestyle projection to create aspirational connections with the target audience. Through carefully crafted visuals, narratives, and symbols, surrogate advertising taps into consumers' desires, aspirations, and identities. This emotional appeal creates a positive emotional response and reinforces the desire for the restricted product.
3. Cognitive Dissonance and Unconscious Influence: Surrogate advertising operates on the principle of cognitive dissonance, creating a gap between consumers' conscious understanding of the advertised product and their subconscious associations with the underlying restricted product. This disconnect influences consumer behavior by creating a subtle, unconscious influence that shapes their decision-making processes.

Consumer Perceptions and Effects:

1. Unawareness and Deception: Many consumers may remain unaware of the true intention behind surrogate advertisements, assuming they are genuine promotions of the advertised product. This deception misleads consumers and erodes trust in advertising, highlighting the ethical concerns associated with surrogate advertising.
2. Attitude Formation and Product Preferences: Research suggests that surrogate advertising can impact consumer attitudes and preferences. Exposure to surrogate advertising can shape positive attitudes towards the underlying restricted product, leading to a greater likelihood of future consumption and brand loyalty.
3. Societal and Behavioral Implications: Surrogate advertising's influence extends beyond individual consumer mindset, potentially contributing to societal issues. For instance, the promotion of surrogate alcohol products can normalize and glamorize alcohol consumption, particularly among young adults, leading to potential health and social consequences.

Surrogate advertising, a marketing strategy that disguises the promotion of one product behind another, has become increasingly prevalent in various industries. By exploring real examples of surrogate advertising, this research aims to shed light on its deceptive nature and the tactics employed to indirectly promote restricted products. By examining these cases, we can gain a deeper understanding of the strategies utilized and the implications for consumer perception.

Unmasking Surrogate Advertising: Real-Life Instances of Deceptive Promotion

Tobacco Industry:

An international tobacco company launched a series of music concerts and sporting events under the guise of promoting a popular energy drink brand. However, the main objective of these events was to enhance the visibility and brand recall of their tobacco products, indirectly targeting the youth demographic.

Another tobacco company used a strategy of surrogate advertising by endorsing a clothing line with the same brand name as its tobacco products. Through this association, the company aimed to maintain brand recognition and appeal among consumers, even in regions where tobacco advertising was heavily restricted or banned.

Alcohol Industry:

An alcohol brand introduced a range of non-alcoholic beverages under its brand name, using surrogate advertising to increase brand visibility and create an association with the alcohol products. This strategy aimed to enhance brand loyalty among consumers, despite limitations on directly promoting alcoholic beverages.

In some regions, alcohol brands have employed surrogate advertising by sponsoring music festivals or events, subtly promoting their alcoholic products without directly referencing them. By doing so, they generate brand exposure and establish a connection with their target audience.

Pharmaceutical Industry:

Certain pharmaceutical companies have resorted to surrogate advertising by promoting health and wellness products that indirectly align with their prescription medications. These advertisements often focus on the benefits of overall well-being without explicitly mentioning the specific pharmaceutical products. The intention is to create brand recognition and influence consumer attitudes towards their prescription drugs.

Gambling Industry:

Surrogate advertising has been observed in the gambling industry as well. Online gambling platforms have employed surrogate advertising by sponsoring sports events, leveraging their brand presence and associating themselves with popular sporting activities. While the advertisements may not directly promote gambling services, they indirectly generate interest and engagement with the gambling brand.

These real examples highlight how surrogate advertising operates across various industries to circumvent advertising restrictions or bans. By promoting alternative products or associating with unrelated events or concepts, companies indirectly influence consumer perceptions and maintain visibility in the market.

Understanding these strategies is crucial for consumers to recognize the underlying intentions behind surrogate advertising and make informed choices. It also emphasizes the need for robust regulations and ethical advertising practices to protect consumers from deceptive marketing tactics.

The Shadowy Nexus: Unveiling the Role of Celebrity Endorsement in Surrogate Advertising

Within the world of advertising, a clandestine alliance exists between celebrity endorsement and surrogate advertising. This research paper aims to shed light on this shadowy nexus, uncovering how celebrities are utilized to promote restricted products indirectly. By exploring examples from Indian advertisements and citing relevant statistics, we will delve into the intricacies of this deceptive practice and its implications for consumer perception and regulatory control.

Celebrity endorsement is a powerful marketing tool that leverages the popularity and influence of public figures to promote products or brands. In the context of surrogate advertising, celebrities are employed to endorse seemingly unrelated products, while the real intent is to subliminally promote restricted goods. By associating with well-known personalities, surrogate advertisers tap into the trust and aspirational appeal that celebrities possess, ultimately influencing consumer perception and behaviour.

In India, where the promotion of alcoholic beverages is heavily regulated, surrogate advertising has found its way into the alcohol industry. Bollywood actors and cricketers, who hold immense popularity and influence, have been involved in endorsing non-alcoholic products, such as soda or mineral water, that are associated with the same brand as the alcohol products. This strategy creates a covert link between the celebrity, the surrogate product, and the restricted alcoholic beverage, subtly influencing consumers to develop positive associations with the alcohol brand.

Similar tactics have been observed in the tobacco industry. Celebrities have been utilized in Indian advertisements to endorse products like mouth fresheners or chewing gums, which share the same brand name or imagery as tobacco products. By employing celebrities, surrogate advertisers create an illusion of promoting harmless or unrelated goods, while indirectly strengthening brand recall and influencing consumer mindset towards tobacco products.

According to a report by the Indian Ministry of Health and Family Welfare, surrogate advertising contributes to an estimated 20% of alcohol consumption in the country, showcasing the significant impact of this deceptive practice on consumer behaviour.

The Advertising Standards Council of India (ASCI) reported a rise in complaints related to surrogate advertising, with a notable increase in cases involving celebrity endorsements. This highlights the growing concern surrounding the role of celebrities in promoting restricted products indirectly.

A survey conducted by a consumer advocacy group revealed that a substantial percentage of consumers in India are unaware of the true intent of surrogate advertisements and perceive them as genuine promotions of the surrogate products. This lack of awareness underscores the effectiveness of celebrity endorsement in shaping consumer perception.

By examining these examples from Indian advertisements and considering relevant statistics, it becomes evident that the nexus between celebrity endorsement and surrogate advertising poses a significant challenge for regulatory bodies and consumer protection organizations. Understanding the deceptive tactics employed and the influence of celebrities in this realm is crucial for implementing stricter regulations and fostering consumer awareness.

The intertwined relationship between celebrity endorsement and surrogate advertising creates a murky underworld within the advertising industry. By exploiting the credibility and popularity of celebrities, surrogate advertisers promote restricted products indirectly, deceiving consumers and evading regulatory scrutiny. The examples from Indian advertisements and the accompanying statistics emphasize the need for stricter enforcement and increased consumer education to combat this shadowy nexus. By unravelling the role of celebrity endorsement in surrogate advertising, we can foster transparency, protect consumer interests, and promote responsible advertising practices

Preserving Integrity: The Imperative of Regulatory Practices and Government Intervention in Curtailing Surrogate Advertising

Maintaining the integrity of the advertising landscape requires robust regulatory practices and active government intervention to curb the deceptive tactics employed in surrogate advertising. There is dire need to highlight the significance of regulatory measures and government involvement in addressing the challenges posed by surrogate advertising. By examining specific regulations imposed by governments, we can understand their role in curbing this deceptive practice and protecting consumer interests.

Regulatory Practices and Government Intervention:

1. Advertising Standards and Guidelines: Governments around the world have established advertising standards and guidelines to regulate the industry and protect consumers from deceptive practices. These standards often include provisions to prevent surrogate advertising. For instance, in India, the Advertising Standards Council of India (ASCI) has established a code of self-regulation that prohibits surrogate advertising and mandates clear disclosure of product intent. Advertisements violating these standards can face penalties and sanctions.
2. Product Labelling and Disclosures: Governments have implemented regulations that require clear and conspicuous labelling and disclosures in advertisements to prevent surrogate advertising. By mandating transparent information about the true nature and intent of the advertised products, consumers can make informed decisions. For example, regulations may require explicit disclaimers when a product is a surrogate for a restricted item, ensuring consumers are aware of the underlying message.
3. Legal Restrictions and Bans: Governments have imposed legal restrictions and bans on the promotion of certain products, such as tobacco and alcohol, to protect public health and well-being. These restrictions often extend to surrogate advertising, aiming to prevent companies from indirectly promoting restricted goods. By explicitly prohibiting surrogate advertising, governments send a strong message about their commitment to curbing deceptive practices and safeguarding consumer interests.
4. Enforcement Mechanisms: Governments play a crucial role in enforcing regulations and ensuring compliance within the advertising industry. Regulatory bodies are responsible for monitoring advertisements, investigating complaints, and taking appropriate actions against offenders. Through regular monitoring and strict enforcement, governments can deter surrogate advertising and hold responsible parties accountable for their deceptive practices.

Example of Government Regulations:

In India, the government has implemented several regulations to address surrogate advertising:

- The Cable Television Networks (Amendment) Act, 2000 prohibits the transmission of advertisements that promote products or services that are prohibited for direct advertising. This act serves as a regulatory measure to restrict surrogate advertising of restricted goods.
- The Cigarettes and Other Tobacco Products Act (COTPA) imposes strict restrictions on tobacco advertising and prohibits surrogate advertising by tobacco companies. The law prohibits any direct or indirect promotion of tobacco products, ensuring that companies cannot use surrogate tactics to bypass advertising restrictions.
- The Food Safety and Standards Authority of India (FSSAI) mandates clear labelling and disclosure requirements for food and beverage products. This ensures that advertisements do not mislead consumers by serving as surrogates for restricted products like alcohol.

Preserving the integrity of the advertising industry necessitates the implementation of regulatory practices and government intervention to combat surrogate advertising effectively. Through advertising standards, product labelling, legal restrictions, and enforcement mechanisms, governments can curtail deceptive practices and protect consumers from being misled. The regulations imposed by governments, such as those seen in India, provide a framework for controlling surrogate advertising and underline the commitment to maintaining transparency and consumer welfare. By continuing to refine and enforce regulations, governments can create a fair and ethical advertising environment that upholds integrity and safeguards consumer interests.

Conclusion:

The concealed peril of surrogate advertising poses significant challenges within the advertising industry, impacting consumer perception, trust, and decision-making processes. This research paper has shed light on the deceptive nature of surrogate advertising and explored its influence on the consumer mindset. By examining real examples, psychological factors, and the need for regulatory practices, we have gained valuable insights into the complexities of this practice.

Surrogate advertising operates through the clever manipulation of consumer perception, utilizing indirect promotion to circumvent legal and regulatory restrictions. By associating restricted products with seemingly unrelated goods, surrogate advertisers tap into consumer desires, emotions, and aspirations, subtly influencing their preferences and attitudes.

It is evident that surrogate advertising undermines the integrity of the advertising industry and erodes consumer trust. Consumers often remain unaware of the true intent behind surrogate advertisements, leading to deception and confusion. This lack of transparency raises ethical concerns and highlights the need for robust regulations and government intervention.

Governments and regulatory bodies play a pivotal role in curbing surrogate advertising. By implementing and enforcing advertising standards, imposing legal restrictions, and mandating clear labeling and disclosures, they can create a framework that ensures transparency and protects consumer interests. Moreover, fostering consumer awareness and education is crucial in enabling individuals to recognize and navigate through surrogate advertising tactics.

As advertisers and policymakers strive for responsible practices, it is essential to consider the long-term implications of surrogate advertising on societal values, public health, and consumer well-being. Ethical advertising should prioritize genuine product promotion, transparent communication, and respect for consumer autonomy.

In conclusion, this research paper has provided valuable insights into the concealed peril of surrogate advertising. By understanding its impact on consumer mindset and advocating for regulatory measures, we can foster a more transparent and ethical advertising landscape. By raising cautionary awareness, we can empower consumers to make informed choices, protect their interests, and contribute to the evolution of responsible advertising practices in the industry.

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Sustainability Performance Evaluation of Private Banks in India using Grey Relational Analysis

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Abstract

It has become important for the companies to focus on sustainability and take into account social and environmental performance also apart from economic performance. The purpose of this paper is to evaluate the sustainability performance of Indian private banks in the year 2021-2022 using Grey relational analysis (GRA) proposed by Deng (1982) that accommodates the uncertain and incomplete information. Grey relational grades are obtained to evaluate and rank the performance indicators, where higher Grey relational grade shows better sustainability performance, and a lower score depicts the scope for improving the performance. This study has practical implications for the Indian banking industry, wherein they can concentrate more on environmental and social parameters to improve their overall performance. The novelty of the study lies in the fact that this study is the first attempt to evaluate the sustainability performance of Indian private banks using the GRA methodology. The GRA technique offers several advantages over traditional statistical methods such as regression and factor analysis by being a robust method when there is uncertain and incomplete information.

Keywords: *Grey Relational Analysis, Sustainability Performance, Sustainability Reporting, Private Banks, India, MCDM problem, Sustainable Development, Social and Environmental Sustainability.*

Introduction

These days companies are facing immense pressure from all the stakeholders to do business in a responsible manner and take environmental and societal well-being into consideration along with economic performance. Organizations these days are being asked to incorporate the pillars of sustainability into their business practices for broadening their performance horizon.

Businesses have also started to respond to their stakeholders by incorporating the different dimensions of sustainability and disclosing their sustainability reports.

According to World Business Council for Sustainable Development, Sustainability can be defined as "ensuring a better quality of life for everyone, for now and for generations to come." (Goel, 2010). For businesses, sustainability may mean to meet the needs of all business stakeholders without compromising the need of the planet, society and future stakeholders. Businesses these days have started issuing sustainability reports which provide information on financial, social and environmental performance in both quantitative and qualitative terms. In developing countries like India, sustainability reporting is an emerging concept. Many private banks in India have started to issue sustainability reports.

Since, there is an increased awareness about sustainability and companies have started to incorporate the same into their business practices,

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there is a need to evaluate the sustainability performance of such companies (Goyal *et al*., 2013).

However, sometimes it is difficult to measure the sustainability performance of companies because most of the times, firms report on their sustainability initiatives in a manner which is difficult to comprehend and compare directly.

The aim of this paper is to measure the sustainability performance of private banks in India by using Grey Relational Analysis (GRA). The sustainability performance of 5 private banks in India has been analyzed based on 3 economic, 2 environmental and 2 social criteria.

This study has used Grey Relational Analysis as a benchmarking tool for carrying out performance evaluation. In the earlier studies, GRA has been used for the comparison of financial performance of companies, but studies evaluating sustainability performance are very scarce and none of the studies has been conducted in India taking GRA as a tool for measuring sustainability performance of banks.

Since, environmental and social indicators are also taken into consideration in this study apart from financial indicators, GRA is an appropriate tool as not all companies report these indicators in a similar manner.

The originality of this study lies in the fact that it has evaluated performance of the banks in terms of economic, environmental and social criteria using GRA as against the previous studies which have analysed firm's performance only according to economic or financial parameters.

Since there are few banks only issuing sustainability reports and reporting about the environmental criteria and social criteria in a similar manner constitute the limitations of this study. Also, only a few of them issue sustainability reports in the same period and use different units of measurements for assessing the social and environmental performance, which brought a major challenge for the researchers in setting the criteria for performance evaluation of the banks.

The paper is organized as follows: First, the role of banks in contributing to a sustainable economy is explained. Next, measurement of sustainability performance and a brief description of sustainability reporting is given. In the next section, literature review surrounding the studies on GRA method and performance evaluation of companies is presented. In the methodology section GRA method and sample selection are explained and the results of the empirical research are presented. Finally, the paper ends by summarizing the overall findings and recommendations for future researchers on this topic.

Role of Banks in Contributing to Sustainable Economy

Banks play a vital role in the overall development of an economy. They act as channels or intermediaries of funds between the capital surplus entities and capital scarce entities.

Although, the direct impact of banks on the environment and society is minimal when compared to the other sectors of the economy. But there is always an indirect impact caused by the financial institutions on the sustainability of the economy.

It is these banking or financial institutions only which are providing loans, financial assistance or any other financial services to the sectors which are directly causing a negative impact on the environment.

Banks are contributing to environmental and social impact in two ways – Internal and External. Internal impact is being created by the activities and processes of these financial institutions and external impact is being created by the products of the banks. It is not the banking products which are causing the direct damage but the users of these products who are not very cautious of their activities (Jeucken and Bouma, 1999). The different sectors such as chemical, textile, healthcare, petroleum, mining, etc. are the users of these banking products which have created an impact on the environment and the society.

Banking institution's main role is to bring about macroeconomic stability and to supply finds to other sectors to grow and therefore, they are likely to affect the society and to have a positive or negative impact on the humanity, environment and social justice.

According to Jeucken (2001), banking has four phases which include defensive banking, preventive banking, offensive banking and sustainable banking for the achievement of sustainability. It is in the sustainable banking phase, when all the operations of banks become sustainable and social and environmental sustainability gets prioritized instead of maximum financial return.

Measuring Sustainability Performance

Sustainable performance of any institution can be measured by assessing the three criteria of sustainability which include – economic, environmental and social performance.

Economic performance can be evaluated through company's financial statements and annual reports where the company objectively lists down its profits, investments and benefits paid.

Environmental performance of a company includes the resources such as energy, land, water and other natural resources being used by the company. It also includes the results of the company's activities such as different types of harmful emissions, chemical residues and effluents. Mainly the externalities to the society and the environment are measured while measuring the environmental performance. The assessment of environmental performance is still very limited since it measures the immediate effects such as resource consumption and pollution emission thereby ignoring the long-term impact of a firm's operation.

Social performance includes the impact of the company's activities on the society and the community in which it is operating. The assessment of social impact is a more difficult and subjective task when compared to other criteria. Companies focus more on listing their corporate social responsibility activities, improved work practices such as gender equality, workplace diversity, equal pay opportunity, safety and protection of employees. Many companies do not directly list the numbers related to societal parameters.

Evaluating the company's performance against these three criteria is not an easy task because many of these criteria are qualitative and subjective in nature.

Sustainability Reporting

A sustainability report depicts the sustainability performance of the organization showing both positive and negative effects that the company has towards achieving its sustainability goal (Goel, 2010).

Through sustainability reporting, businesses are demonstrating a move towards increased transparency and accountability and its contribution in taking it to a higher level (Jackson *et al.,* 2011). Sustainability reports of businesses communicate about the various initiatives and activities undertaken on economic, environmental, and social dimensions. In other words, it streamlines the company's progress towards sustainability and sustainable development for its stakeholders (Hu *et al*., 2011).

Literature Review

Guru and Mahalik (2019) used the combination of AHP, TOPSIS, and Grey Relational Analysis for calculating efficiency of different public sector banks in India and compared the results. They concluded that the banks which are considered as efficient are close to relative closeness to the ideal solution, expose an alternative ranking of the banks and both models have almost the same interpretation.

Suvvari, R.S.D and Goyari (2019) estimated the financial performance of 24 Indian life insurance companies using Grey relational analysis for the period from 2013 to 2016. The study came out with the ranking results where Shriram Insurance stood first with higher relational grade score, followed by the companies like IDBI Insurance, Sahara Insurance and Life Insurance Corporation of India. The study also concluded that PR which have negative values are playing a crucial role in determining the financial performance of Indian life insurance companies.

Rani, Mishra, Ansari and Ali (2021) initiated a structure for the exploration of the TSPs in Madhya Pradesh, India using grey relational analysis (GRA) on intuitionistic fuzzy sets (IFSs) to obtain the performance of various telecom participants.

Ghosh (2021) in his study used Grey Relational Analysis (GRA), Analytic Hierarchy Process (AHP) and Technique of Order of Performance by Similarity to Ideal Solution (TOPSIS) for ranking 8 stocks from the Indian IT sector based on the stock performance indicated by Price-to-Book Value Ratio, Price-to-Earnings Ratio, Return on Equity (ROE), Momentum (%), MACD (12,26,9) and 125-day Rate of Change (ROC) metric in order of preference of inclusion in a portfolio.

Gundogdu [2015] used Topsis method to study the performance of foreign banks. from 2003 until 2009. Results of the study show that Deutsche Bank's financial performance was the highest but due to the financial crisis at later stage it declines to 10th position in 2010.

Uçkun and Girginer (2012) in their study examined the financial performances of public and private banks in Turkish Banking System by using GRA and sorted banks according to their financial performance within their own group. The most important financial indicators found in financial achievement were profitability for public banks and assets' quality for private banks.

Liu *et al*., (2016) summarized the progress in grey system research during 2000-2015, so as to present some important new models, new concepts and new methods of grey system theory which included algorithm rules of grey numbers, the concept of general grey numbers, the synthesis axiom of degree of greyness of grey numbers and their operations; the general form of buffer operators of grey sequence operators to name a few.

Hu and Liu (2022) identified some key studies from all the Sustainable Development areas in which the grey systems can be used. They performed a literature review for the grey systems applications on Sustainable Development research on both grey relational analysis (GRA) and grey forecasting by using the search engine offered by the Google Scholar and the Web of Science (WoS).

In case of traditional statistical methods such as regression and factor analysis used for measuring the performance of companies, requirement of large amount of data with assumption of normal distribution became some of its shortcomings (Kung and Cheng, 2004; Kung et al., 2006), and Grey Relational Analysis overcomes this shortcoming by being a non-function model, calculations being natural and not requiring a larger sample, and particularly the data need not fit into any statistical distribution. Tu *et al.* (2001), in their study used the GRA and factor analysis approach for evaluating the operating performance of Taiwan's banking industry. The results of the study found that GRA performs better than factor analysis in performance evaluation.

Wu *et al.* (2010), applied GRA in the banking industry by evaluating the business performance of health management banks. Korzeb and Samaniego-Medina (2019) analysed the Polish banking sector's engagement with sustainable development by applying the technique for order preference by similarity ideal solution (TOPSIS) method with different weight vectors. The study results highlighted various shortcomings in the sustainability performance of commercial banking activities. It showed a backsliding during the analysed period (2015 to 2017), which suggested that support of sustainability performance was not prioritized by the Polish banking sector.

Liu *et al*., (2011) in their study tried to solve the problems existing in traditional grey incidence models and advance several new grey incidence models based on visual angle of similarity and nearness. In this study, two novel grey incidence models, grey similar incidence model to measure the similitude degree of the geometric patterns of sequence curves and grey close incidence model to measure the nearness of the sequence curves in space were studied.

Stauropoulou and Sardianou (2019) in their study provided a framework for understanding and measuring corporate sustainability in the banking sector. The research aimed to do assessment of corporate sustainability in the banking sector because there is a tendency to underestimate the indirect impact these sectors have on environmental issues and social issues. It correlated and compared the way different policies and external incidents have affected the sustainable performance of a bank and its competitors.

Liu *et al*., (2015) in their study dealt with the problem of simultaneous consideration of multi-attributes where they exploited the thought of grey clustering to establish a novel grey clustering group decision-making model based on combination of attributes, and then it was applied into the regional types of the regional innovation in China.

Özçelik and AVCI ÖZTÜRK (2014) in their study evaluated the sustainability performance of banks issuing sustainability report in Turkey by using grey relational analysis method.

Ýýlmaz and Nuri Ýne (2018) examined the sustainability performance using balanced scorecard for banks. In this context, they determined the economic, environmental, social and institutional profile dimensions of the GRI G4 (Global Reporting Initiative) sustainability reports. In their study, sustainability dimensions were intersected with the dimensions of the BSC (financial, customer, internal processes, and learning - development dimensions). Thus, BSC model for sustainability was issued for banks. They examined banks by TOPSIS method and evaluated their performance with the created model.

Gajavelli (2016) evaluated the profitability of the Indian non-life insurance firms based on the profitability ratios using MCDM methods: GRA and TOPSIS for the period 2008 to 2013. This study also evaluated the profitability of the alternative non-life insurance firms with more number of decision criteria using MCDM Analysis: GRA and TOPSIS.

Nosratabadi *et al.* (2020), used A Delphi-Analytic Hierarchy Process method in their study to develop a sustainable business model for evaluating the business model sustainability of banks. They also assessed the sustainability performance of sixteen banks from eight European countries including Norway, Poland, Hungary, The UK, Germany, France, Spain, and Italy. Through this study, the proposed business model components were ranked in terms of their impact on sustainability goals achievement. The proposed model components of this study found were respectively value proposition, core competencies, financial aspects, business processes, target customers, resources, technology, customer interface, and partner network. They concluded that the sustainability of the Norwegian and German banks' business models is higher than any other counties.

Methodology

Grey Relational Analysis (GRA)

Often in the complex business environment, there are existing problems which have a host of alternatives and decision makers are to choose the most appropriate one among all the alternatives. Therefore, it is essential for the decision makers to evaluate various criteria and wisely evaluate all the available alternatives. Such problems are referred to as Multicriteria decision making (MCDM) problems.

In this research, we can consider the problem of evaluating sustainability as MCDM problem having many criteria and alternatives. Grey Relational Analysis can be used to evaluate such kind of MCDM problem by evaluating the alternatives with respect to their sustainability performance criteria.

The grey system theory as proposed by Deng (1982) has been proved to be useful in dealing with uncertain and incomplete information. GRA is a part of grey system theory which can help in identifying the qualitative and quantitative aspects of the different criteria (economic, environmental and social) used in the study and is appropriate for the MCDM problem like this with complex relationship between the factors.

In order to determine the correlation between the series, GRA can set the target series as the reference series based on the objective of MCDM problem. It then finds out the similarities and dissimilarities between the reference series and the alternative series (Kung and Wen, 2007). Using GRA, the uncertain relationship between the reference series and the alternative series is modelled. The series having the closest similarity with the reference series is chosen.

Thus, whenever there is less data available, traditional methods such as regression analysis and factor analysis may have their limitations since it is difficult to reach the desired confidence level without sufficient data.

GRA can help to overcome the limitation of such traditional methods as all the values whether large or small, ideal or non-ideal can be evaluated during the decision-making process (Wu, 2002). This study uses the GRA method to measure the sustainability performance of private banks in India and closely follows the methods described in Wu and Chen (1999), Wu (2002) and Zhai *et al*. (2009), by calculating Grey relational grades.

Procedure of Grey Relational Analysis is shown in figure 1.

Normalization

↓

Deviation sequence

↓

Grey Relational Coefficient

↓

Grey Relational Grade

Figure 1 – Procedure for Grey Relational steps

GRA includes the following steps (Wu, 2002; Zhai *et al.*, 2009)

Step 1: construction of the decision matrix X = $x_i(j)$. Assuming that there are n data sequences characterized by m criteria the compared sequences can be shown in a matrix form:

$$X = \begin{matrix} X_1\ (1) & X_1\ (2) & \dots & X_1\ (m) \\ X_2\ (1) & X_2\ (2) & \dots & X_2\ (m) \\ \dots & \dots & \dots & \dots \\ X_n\ (1) & X_n\ (2) & \dots & X_n\ (m) \end{matrix} \qquad (1)$$

where $x_i(j)$ is the value of the ith bank corresponding to the jth criteria (i =1, …, n; j =1, …, m).

Step 2: Normalization of the data set.

In order to make values free of unit, the normalization process is carried out. This process is called grey relational generating. One of the three regimes can normalize the data: larger the better, smaller the better, and nominal the best.

If the expected data sequence is of the form "Higher the Better", then the original sequence can be normalized as:

$$X_i{*}(K) = \frac{X_i^o(K) - \min X_i^o\ (K)}{\max X_i^o(K) - \min X_i^o\ (K)} \qquad (2)$$

If the expected data sequence is of the form "Smaller the Better", then the original sequence can be normalized as:

$$X_i{*}(K) = \frac{\max X_i^o(K) - X_i^o\ (K)}{\max X_i^o\ (K) - \min X_i^o\ (K)} \qquad (3)$$

Step 3: Determining the deviation sequence of the reference series which is given by:

$$X_i{*}(K) = 1 - \frac{|X_i^o(K) - X_i^o|}{\max X_i^o(K) - X_i^o} \qquad (4)$$

Step 4: Estimating the Grey Relational Coefficient (GRC). It is calculated to express the relationship between the ideal and the actual normalized experimental results. Thus, Grey Relational Coefficient (GRC) is estimated by using the formula:

$$\xi i\ (k) = \frac{\Delta_{min} + \xi.\Delta_{max}}{\Delta_{oi}(K) + \xi.\Delta_{max}} \tag{5}$$

ξ is distinguishing coefficient. Here the coefficient of determination or distinguishing coefficient value lies between 0 and 1. Most of the studies consider the value of distinguishing coefficient for GRA to be 0.5 in order to weaken the influence if the deviation sequence Δ_{max} gets too big.

$$\Delta_{oi}(K) = |X_o^*\ (K) - X_i^*\ (K)|$$

$$\text{Where } \Delta_{max} = 1.0000,\ \Delta_{min} = 0.0000 \tag{6}$$

Step 5: The final step is to calculate the Grey Relational grade by using the below formula:

$$\gamma_i = \frac{1}{n} \sum_{K=1}^{n} W_K \xi_i\ (K) \tag{7}$$

Here, some studies estimate weights by using some subjective methods like AHP method or objective weight methods like CRITIC. Some also consider equal weights. In this, equal weights have been considered for all the criteria.

Sample Selection and Performance Indicators

5 Indian private banks issuing sustainability reports were chosen. These are Kotak Mahindra bank, Axis bank, YES bank, ICICI bank and IndusInd bank.

These 5 banks' sustainability performance based on 3 financial, 2 environmental and 2 social ratios for the year 2021-22 was evaluated. While choosing the ratios for measuring criteria, some problems relating to their reporting terms and cycles and a lack of standardized form were encountered. Some banks evaluate measures qualitatively and some give numerical values. The units of measurement in the reports were converted into the same unit so as to make a comparison and a value per employee was found.

The criteria that are used in the sustainability performance evaluation of banks and their formulas can be seen in Table 1 and the theoretical framework of the MCDM problem is shown in Figure 2. Different criteria exhibit different features such as whether preferred values should be large or small. This is also depicted in table 1 which is later used in the Grey Relational Grade calculation.

Criteria	**Criteria Names**	**Criteria's Formulas**	**Target**
Economic Criteria			
C1	Capital Adequacy Ratio	Shareholders' equity/(Credit + Market + Amount subject to operational risk)	Larger-is-better
C2	Return on Equity	Net Profit/Equity	Larger-is-better
C3	Return on Assets	Net Profit/Total Assets	Larger-is-better
Environmental Criteria			
C4	Electricity Consumption	kwh/employee	Smaller-is-better
C5	CO2 Emissions	CO2 Emissions (kg)/employee	Smaller-is-better
Social Criteria			
C5	Employee Turnover Rate	Number of separations during the year/ Average number of employees during the year	Smaller-is-better
C6	Education Hour per Employee	Education hour/employee	Larger-is-better

Table 1 – Sustainability Performance Criteria

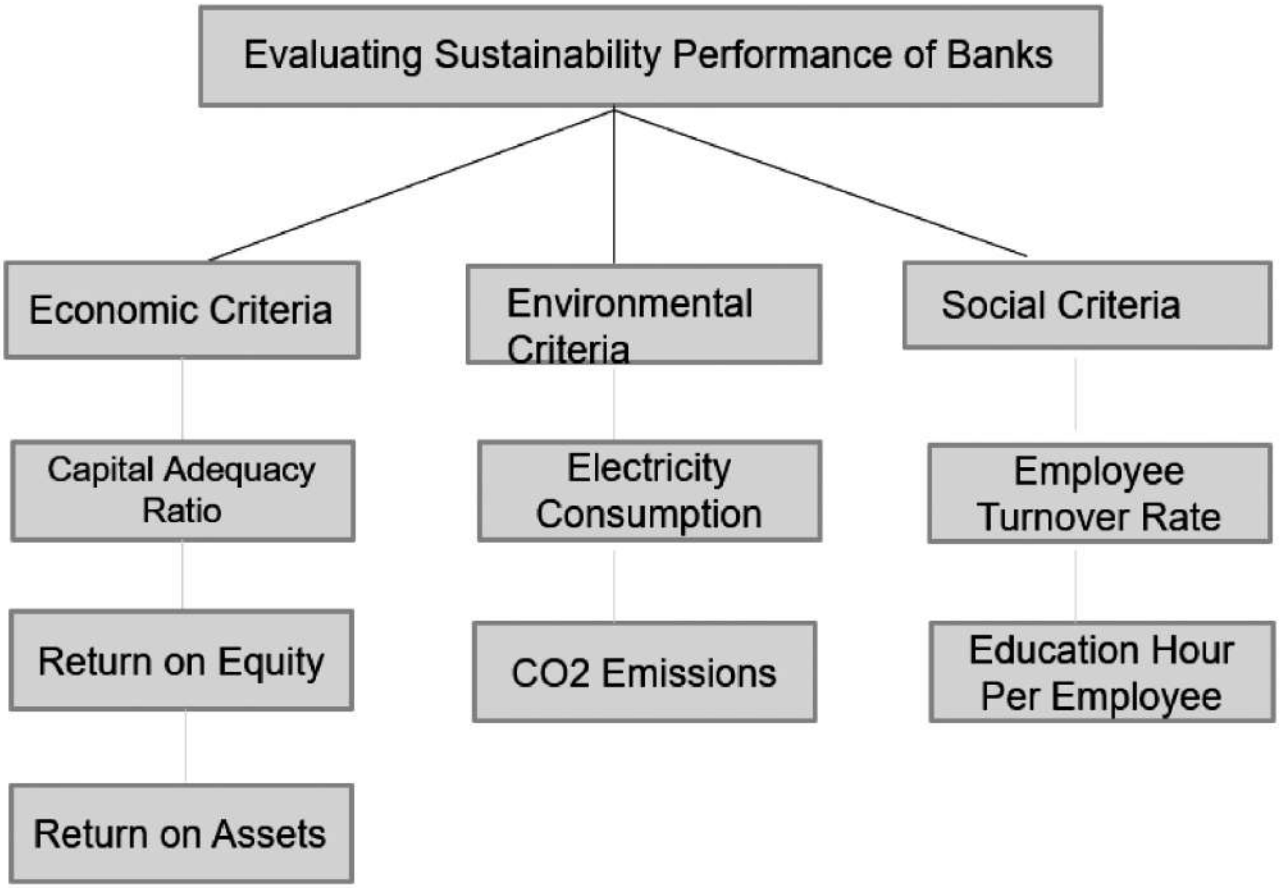

Figure 2 – Theoretical Framework of the MCDM problem

Results and Discussion

Step 1: Construction of the Decision Matrix

The first step of GRA method is the construction of a decision matrix that shows all alternatives' values with respect to each criterion used in the analysis. Decision matrix of our analysis is shown in Table 2.

	CRITERIA						
	Economic Criteria			Environmental Criteria		Social Criteria	
Banks	**C1**	**C2**	**C3**	**C4**	**C5**	**C6**	**C7**
Kotak Mahindra	0.227	11.9	1.99	4.309	1.06	0.249	69.6
Axis	0.195	11.3	1.1	10.679	2.07	0.174	55
Yes	0.175	3.15	0.33	2.360	1.81	0.406	40
ICICI Bank	0.182	13.94	1.65	2.158	0.548	0.27	49
IndusInd Bank	0.181	9.73	1.14	6.321	1.861	0.37	36.05

Table 2: Decision Matrix

Step 2: Normalization of Data Set, Construction of Normalized Matrix and Generation of Reference Series.

In order to make values free of unit, the values in the decision matrix are normalized by using formula 2 and 3. Formula 2 is used for the criteria which has 'larger-is-better situation' (C1, C2, C3, C7) and formula 3 is used for the criteria which has 'smaller-is-better situation' (C4, C5, C6). Then, reference series are generated by taking the highest values for each criteria. Normalized decision matrix and reference series are shown in Table 3.

	CRITERIA						
	Economic Criteria			Environmental Criteria		Social Criteria	
Banks	C1	C2	C3	C4	C5	C6	C7
Kotak Mahindra	1.000	0.811	1.000	0.748	0.664	0.677	1.000
Axis	0.385	0.755	0.464	0.000	0.000	1.000	0.565
Yes	0.000	0.000	0.000	0.976	0.171	0.000	0.118
ICICI Bank	0.135	1.000	0.795	1.000	1.000	0.586	0.386
IndusInd Bank	0.115	0.610	0.488	0.511	0.137	0.155	0.000
Reference Series	1.000	1.000	1.000	1.000	1.000	1.000	1.000

Table 3: Normalized Decision Matrix And Reference Series

Step 3: Determining the Deviation sequence of the Reference series

In this step the deviation sequence is formed by calculating the distances between the reference series (highest values for each criterion) and normalized values that belong to the related criteria. Deviation Sequence is calculated by using formula 4 and shown in Table 4.

	CRITERIA						
	Economic Criteria			Environmental Criteria		Social Criteria	
Banks	C1	C2	C3	C4	C5	C6	C7
Kotak Mahindra	0.000	0.189	0.000	0.252	0.336	0.323	0.000
Axis	0.615	0.245	0.536	1.000	1.000	0.000	0.435
Yes	1.000	1.000	1.000	0.024	0.829	1.000	0.882
ICICI Bank	0.865	0.000	0.205	0.000	0.000	0.414	0.614
IndusInd Bank	0.885	0.390	0.512	0.489	0.863	0.845	1.000

Table 4: Deviation Sequence

Step 4: Calculation of Grey Relational Coefficients

Formula 5 and 6 is used to calculate grey relational coefficients which indicate the similarity between the reference series and the alternatives by taking 5 = 0.5 to provide moderate distinguishing effect. Grey relational coefficients of alternatives is given in Table 5.

	CRITERIA						
	Economic Criteria			Environmental Criteria		Social Criteria	
Banks	C1	C2	C3	C4	C5	C6	C7
Kotak Mahindra	1.000	0.726	1.000	0.664	0.598	0.607	1.000
Axis	0.448	0.671	0.483	0.333	0.333	1.000	0.535
Yes	0.333	0.333	0.333	0.955	0.376	0.333	0.362
ICICI Bank	0.366	1.000	0.709	1.000	1.000	0.547	0.449
IndusInd Bank	0.361	0.562	0.494	0.506	0.367	0.372	0.333

Table 5: Grey Relational Coefficient of the Banks with respect to each criteria

Step 5: Calculation of Grey Relational Grades

Decision criteria are assumed to have a degree of equal importance. Because of this, formula 7 is used to calculate the grey relational grades (γ_i). The banks are ranked according to their γ_i values. Table 6 shows the γ_i values and ranking order of the banks with respect to their sustainability performance.

Banks	Grey Relational Grade	Rank
Kotak Mahindra	0.799	1
Axis	0.543	3
Yes	0.432	4
ICICI Bank	0.725	2
IndusInd Bank	0.428	5

Table 6: Grey Relational Grades and Ranking Showing Sustainability Performance of the Banks

When banks are ranked according to the grey relational grades, Kotak Mahindra bank ranks first with its grade of 0.799, followed by ICICI bank with its grade of 0.725, Axis bank, YES bank and IndusInd bank with the grades of 0.543, 0.432 and 0.428 respectively. Kotak Mahindra bank was found to have the highest overall sustainability performance among all five banks. Although, YES bank and IndusInd bank are very close to each other in terms of their overall sustainability performance, YES Bank exhibits a bit higher overall performance due to its high performance in environmental criteria.

Conclusion

Among businesses, financial institutions and other corporates, there has been an increase in the awareness level regarding environmental issues, penalties associated with environmental damage and increasing investments in building a sustainable economy.

Companies should strike a balance between economic, social and environmental performance in order to survive for a longer term and be competitive.

Through sustainability reports, companies are reporting on different aspects of their performance and becoming more transparent and accountable. This is helping them to enhance their reputation and gain society recognition by just not merely focusing on profits. As more and more firms are continuing to increase their sustainability initiatives, the need to measure the sustainability performance emerges. However, the measurement of environmental and social parameters and their comparison across firms remains a difficult task. A methodology which can standardize the measurement of environmental and social performance is needed. This study has employed GRA methodology to evaluate the banks on different parameters of sustainability.

Kotak Mahindra bank was found to have the highest overall sustainability performance among all five banks followed by ICICI bank, Axis bank, YES bank and IndusInd bank respectively. Although, YES bank and IndusInd bank are very close to each other in terms of their overall sustainability performance, YES Bank exhibits a bit higher overall performance due to its high performance in environmental criteria.

Different banks have reported their initiatives in different ways which are difficult to gauge and compare. Therefore, there is a need for establishing a clear methodology that can measure the sustainability performance of such companies.

In this study, the authors have measured the sustainability performance of banks using GRA and this can be further elaborated by taking sustainability performance by years or taking into account different financial institutions and different measures of standardization.

Declarations

Funding and/or Competing Interests

No funding was received for conducting this study. The authors have no competing interests to declare that are relevant to the content of this article.

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Predictive analysis

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Vishal Singh**
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Himanshu Kumar**
Deepak Singh Rana**

Abstract: *With this paper, we try to explore Predictive Analytics. The survey provides an indication of acceleration in the area of Predictive Analytics for the enhancement of businesses and researchers by applying business intelligence for providing forecasting ability to proceed through the development of business. Predictive Analytics uses many techniques from Data Mining, Statistics, Modeling, Machine Learning, and Artificial Intelligence to analyze current data to make predictions about the future. The Predictive Model follows six processes to build a working and reliant Predictive Model i.e., Project Definition, Data Exploration, Data Preparation, Model Building, Deployment and Model Management.*

Introduction

In today's digital world, there is an enormous amount of data being created every day. This data comes from social media, businesses, and organizations. Managing and organizing such massive amounts of data can be challenging. However, tools like Apache Hadoop have emerged as successful solutions for processing and managing this data. Apache Hadoop helps us organize and make sense of the data, enabling us to analyze it and predict future growth strategies for organizations. The III section of the research paper explains about what is predictive analytics? The IV section of the research paper explains the importance of predictive analytics. The V section of the research paper explains about the process of predictive analytics. The VI section of the research paper explains about the applications of predictive analytics. The VII section of the research paper explains about the future aspects of predictive analytics. The VIII section of the research paper explains the conclusion drawn from this research paper. And the IX section of the research paper consists of the references used in this research paper.

What is Predictive Analysis

Predictive analytics is a set of business intelligence (BI) technologies that uncovers relationships and patterns within large volumes of data that can be used to predict behavior and events. Unlike other BI technologies, predictive analytics is forward-looking, using past events to anticipate the future.

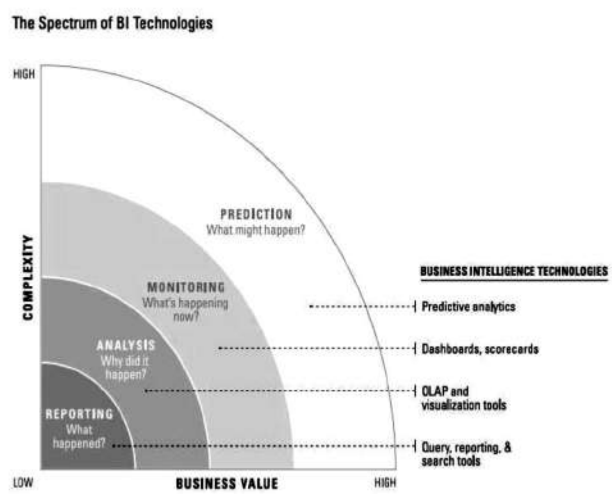

Figure 2. Among business intelligence disciplines, prediction provides the most business value but is also the most complex. Each discipline builds on the one below it—these are additive, not exclusive, in practice

Consider the power of predictive analytics:

- A Canadian bank uses predictive analytics to increase campaign response rates by 600%, cut customer acquisition costs in half, and boost campaign ROI by 100%.
- A large state university predicts whether a student will choose to enrol by applying predictive models to applicant data and

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admissions history.

- A research group at a leading hospital combined predictive and text analytics to improve its ability to classify and treat paediatric brain tumours.
- An airline increased revenue and customer satisfaction by better estimating the number of passengers who won't show up for a flight. This reduces the number of overbooked flights that require re-accommodating passengers as well as the number of empty seats.

As these examples attest, predictive analytics can yield a substantial ROI. Predictive analytics can help companies optimize existing processes, better understand customer behaviour, identify unexpected opportunities, and anticipate problems before they happen. Almost all of TDWI's Leadership Award winners in the past six years have applied predictive analytics in some form or another to achieve breakthrough business results.

High Value, Low Penetration With such stellar credentials, the perplexing thing about predictive analytics is why so many organizations have yet to employ it. According to our research, only 21% of organizations have "fully" or "partially" implemented predictive analytics, while 19% have a project "under development" and a whopping 61% are still "exploring" the issue or have "no plans."

Status of Predictive Analytics

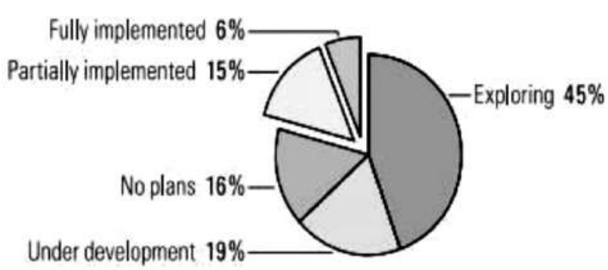


Figure 1. Predictive analytics is still in an early-adopter phase. Based on 833 respondents to a TDWIsurvey conducted August 2006

Applications - Predictive analytics can identify the customers most likely to churn next month or to respond to next week's direct mail piece. It can also anticipate when factory floor machines are likely to break down or figure out which customers are likely to default on a bank loan. Today, marketing is the biggest user of predictive analytics with cross-selling, campaign management, customer acquisition, and budgeting and forecasting models top of the list, followed by attrition and loyalty applications.

Figure 3. Based on 167 respondents who have implemented predictive analytics.

There are two major types of predictive analytics:

(1) Supervised Learning - Supervised learning is the process of creating predictive models using a set of historical data that contains the results you are trying to predict. For example, if you want to predict which customers are likely to respond to a new direct mail campaign, you use the results of past campaigns to "train" a model to identify the characteristics of individuals who responded to that campaign. Supervised learning approaches include classification, regression, and time-series analysis. Classification techniques identify which group a new record belongs to (i.e., customer or event) based on its inherent characteristics. For example, classification is used to identify individuals on a mailing list that are likely to respond to an offer. Regression uses past values to predict future values and is used in forecasting and variance analysis. Time-series analysis is similar to regression analysis but understands the unique properties of time and calendars and is used to predict seasonal variances, among other things.

(2) Unsupervised Learning - In contrast, unsupervised learning does not use previously known results to train its models. Rather, it uses descriptive statistics to examine the natural patterns and relationships that occur within the data and does not predict a target value. For example, unsupervised learning techniques can identify clusters or groups of similar records within a database (i.e., clustering) or relationships among values in a database (i.e., association.) Market basket analysis is a well-known example of an association technique, while customer segmentation is an example of a clustering technique. Whether the business uses supervised or unsupervised learning, the result is an analytic model. Analysts build models using a variety of techniques, some of which we have already mentioned: neural networks, decision trees, linear and logistic regression, naive Bayes, clustering, association, and so on. Each type of model can be implemented using a variety of algorithms with unique characteristics that are suited to different types of data and problems. Part of the skill in creating effective analytic models is knowing which models and algorithms to use. Fortunately, many leading analytic workbenches now automatically apply multiple models and algorithms to a problem to find the combination that works best. This advance alone has made it possible for non-specialists to create fairly effective analytical models using today's workbenches.

Importance of Predictive Analysis

In all areas of business, well-structured actionable data has endless benefits. With the high volume, variety and velocity of data that is being input to an organization, analyzing the data could prove to be extremely useful for the aspect of the business. We provide the following key reasons highlighting the need of Predictive and data Analysis within an organization referring to how it could help with the business growth.

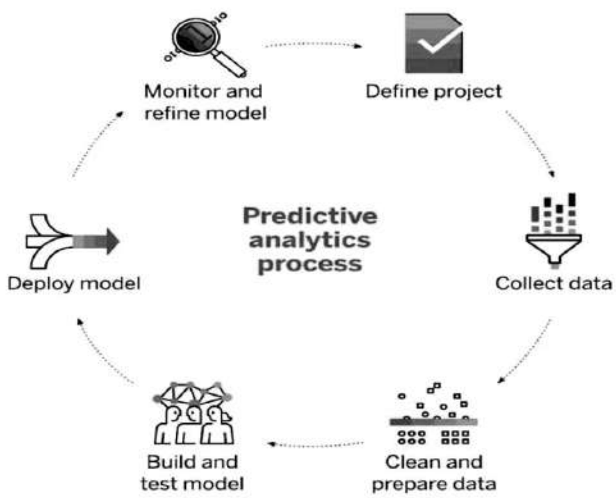
1. **Smarter Organizations –** Through a well thought out analytics strategy, an organization works more efficiently and smartly in achieving its goals. For example, through thorough analysis of data patterns within a police department, it could be susceptible for them to identify the crime scenes and hotspots and in turn help the department to work efficiently in solving and preventing crimes from happening around the globe. In the medical industry, proper analysis over the disease pattern over an area or group of people could help the doctors to effectively devise and predict the possibilities of a disease. In other cases, the weather forecasting industry has the analytics over the weather patterns as its base that helps the organization with proper and accurate weather predictions. Thus we see, ranging from criminal justice to real estate to health care to weather forecasting, Big Data analytics are being leveraged to provide effective and efficient outcomes.
2. **Behavioural Marketing –** The base of a successful business or organization is its reach to the targeted consumers. With effective and efficient marketing strategies, a business could bloom to its highest levels. With the marketing for the business reaching to its desired public, proper strategic analysis needs to be done so as to make the business reach to the target audience. This is where behavioural marketing comes into play. Consumers are targeted on the basis of the websites they consume or search for a commodity. This data is analysed for patterns to predict the audience to be notified of the organization. The data is collectively organized and analysed to gather the targeted audience and the marketing is done in the form of advertisements shown particularly to the category of audience for which the business being marketed could be useful. It provides the marketer with the ability to get in touch with the desired segment of the society hence leading to a well thought and effective marketing in turnmaking the business bloom.
3. **Business Future Perspective –** Big Data analysis can inevitably predict the future of the business keeping in mind the current scenarios. It helps the business in taking effective measurements that could possibly lead to the better future of the organization. With proper analysis, decision making abilities are provided to the organization and could lead to a prospective growth of its business. With the market trend changing rapidly, the trend of the changes that would be of impact to the business can be predicted efficiently and measures could be taken in handling those impacts. With strategic analysis, certain crucial decision points could be handled within an organization so as to achieve a foreseen goal of the organization.

The Business Value of Predictive Analytics

Incremental Improvement - Although organizations occasionally make multi- million-dollar discoveries using predictive analytics, these cases are the exception rather than the rule. Organizations that approach predictive analytics with a "strike-it-rich" mentality will likely become frustrated and give up before reaping any rewards. The reality is that predictive analytics provides incremental improvement to existing business processes, not million-dollar discoveries. The company's churn models expose insights about customer behavior that the business uses to improve marketing or reengineer business processes. For example, salespeople use model output to make special offers to customers at risk of churning, and the managers to change licensing policies that may be affecting churn rates.

The process of Predictive Modelling

The process for creating predictive models incorporate the following steps:



For example, in a marketing campaign, the problem might be to predict which customers are most likely to respond to a particular offer. The outcome variable would be the binary response (yes or no) to the offer, and the goal of the predictive model would be to identify the customers who are most likely to respond positively.

Project Definition: Define the business objectives and desired outcomes for the project and translate them into predictive analytic objectives and tasks. This involves understanding the business or research question that needs to be addressed and determining what type of prediction needs to be made.

Exploration: Analyse source data to determine the most appropriate data and model building approach, and scope the effort. The data exploration phase is straightforward. Modelers need to find good, clean sources of data since models are only as good as the data used to create them. Good sources of data have a sufficient number of records, history, and fields (i.e., variables) so there is a good chance there are patterns and relationships in the data that have significant business value. Fortunately, most of this data is already stored in adata warehouse, minimizing the time required to search for data across multiple systems. Predictive modelers use a variety of tools to explore and analyse source data. Most analytical tools offer some exploratory capabilities. Basic tools enable analysts to compile descriptive statistics of various fields (e.g., min/ max values and standard deviation), while others incorporate more powerful data profiling tools that analyse the characteristics of data fields and identify relationships between columns within a single table and across tables. Data profiling tools are common in data quality projects and are offered by most leading data quality and data integration vendors. A small percentage of analysts use advanced visualization tools that let users explore characteristics of source data or analyse model results visually.

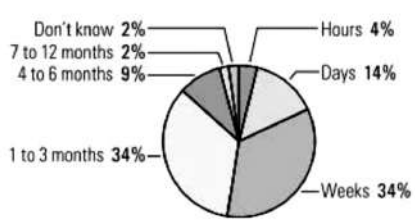
Data Preparation: Select, extract, and transform data upon which to create models. Once analysts select and examine data, they need to transform it into a different format so it can be read by an analytical tool. Most analysts dread the data preparation phase, but understand how critical it is to their success. Preparing data means first cleaning the data of any errors and then "flattening" it into a single table with dozens, if not hundreds, of columns. During this process, analysts often reconstitute fields, such as changing a salary field from a continuous variable (i.e., a numeric field with unlimited values) to a range field (i.e., a field divided into a fixed number of ranges, such as \$0–\$20,000, \$20,001–\$40,000, and so forth), a process known as "binning." From there, analysts usually perform additional transformations to optimize the data for specific types of algorithms. For example, they may create an index from two fields using a simple calculation, or aggregate data in one or more fields, such as changing daily account balances to monthly account balances.

Model Building: Create, test, and validate models, and evaluate whether they will meet project metrics and goals. Creating analytic models is both art and science. The basic process involves running one or more algorithms against a data set with known values for the dependent variable (i.e., what you are trying to predict.) Then, you split the data set in half and use one set to create a training model and the other set to test the training model. If you want to predict which customers will churn, you point your algorithm to a database of customers who have churned in the past 12 months to "train" the model. Then, run the resulting training model against the other part of the database to see how well it predicts which customers actually churned. Last, you need to validate the model in real life by testing it against live data

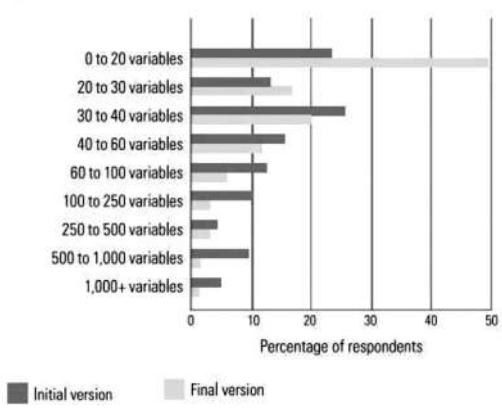
Iterative Process - As you can imagine, the process of training, testing, and validation is iterative. This is where the "art" of analytic modeling comes to the forefront. Most analysts identify and test many combinations of variables to see which have the most impact. Most start the process by using statistical and OLAP tools to identify significant trends in the data as well as previous analytical work done internally or by expert consultants. They also may interview business users close to the subject and rely on their own knowledge of the business to home in on the most important variables to include in the model. As a result, most analysts cull the list of variables from a couple hundred in an initial version to a couple dozen in the final model. Along the way, they test a variety of algorithms to see which works best on the training data set. They may find it necessary to add new data types or recombine existing fields in different ways to improve model accuracy. This iterative process makes creating models labor-intensive and time- consuming.

Selecting Variables - Most analysts can create a good analytic model from scratch in about three weeks, depending on the scope of the problem and the availability and quality of data. Most start with a few hundred variables and end up with 20 to 30. Once a model is created, it takes about half the groups (49%) a matter of "hours" or "days" to revise an existing model for use in another application and takes another 30% "weeks" to revise a model. In addition, about half (47%) of models have a lifespan shorter than a year, and one-third (16%) exist for less than three months.

How Long Does It Take to Create a New Model from Scratch?



How Many Variables Do You Use in Your Models?



Deployment: Apply model results to business decisions or processes. This ranges from sharing insights with business users to embedding models into applications to automate decisions and business processes. A predictive model can be accurate but have no value. Predictive models can fail if either (1) business users ignore their results or (2) their predictions fail to produce a positive outcome for the business. The classic story about a grocery that discovered a strong correlation between sales of beer and diapers illustrates the latter situation. Simply identifying a relationship between beer and diaper sales doesn't produce a valuable outcome. Business users must know what to do with the results, and their decision may or may not be favorable to the business. For example, the business could decide to display beer and diapers together at the front of the store to encourage more shoppers to purchase both items. Or they could decide to place the dual beer and-diaper display at the back of the store to force shoppers to move through more aisles to obtain these items. Or they could place beer and diapers at separate ends of the store to force shoppers to spend the maximum time possible walking through the aisles. Their decision, not the model results, ultimately determines business value.

There are many ways to deploy a predictive model:

A) **Share the Model -** You can share insights with business users via a paper report, a presentation, or a conversation. For example, Sedgwick CMS creates analytic models to enhance the claims management process and offer recommendations for business process improvements.

B) **Score the Model -** Most organizations transform a predictive model into a SQL statement or programming code and then apply the statement or code to every single record in the company's database pertaining to the subject area of the model. The result is a "score," usually a value between 0 and 1, that gets inserted into the database record as an additional field. A marketing manager, for example, might then select customers for a direct mail campaign who scored above 0.7 in a predictive model that measures customers' propensity to purchase a specific product and respond to mail campaigns. Typically, companies score records on a monthly basis since the scoring process can consume a lot of time and processing power. A growing number of companies are starting to score models dynamically as records arrive. Some do this to cut the time and expense of processing large numbers of records in batch, while others find it can be highly profitable. For example, dynamic scoring enables an e- commerce outfit to display cross-sell offers to Web customers who just purchased or viewed a related item. Or a manufacturing company can use dynamic scoring to schedule maintenance for a factory floor machine that is about to break.

Model Management: Manage models to improve performance (i.e., accuracy), control access, promote reuse, standardize toolsets, and minimize redundant activities. The last step in the predictive analytics process is to manage predictive models. Model management helps improve performance, control access, promote reuse, and minimize overhead. Currently, few organizations are concerned about model management. Most analytical teams are small and projects are handled by individual modelers, so there is little need for check in/check out and version control. However, some expect an increase in the demand for model management to enable compliance and auditability with new standards and regulations. IT managers, in particular, want to impose greater structure on ad hoc analysis activities and multi-vendor analytical environments to minimize risks. Although model management can help teams of analytical modelers work more efficiently, few currently work within a rigorous project environment that adheres to industry standards for designing, creating, and publishing models. A majority of organizations (61%) still use an ad hoc or project-based approach to developing analytical models, according to our survey. Only 36% have either a program office or Center of Excellence to coordinate predictive modelling tasks.

Application to Predictive Analysis

Customer Relationship Management (CRM) – Analytical CRM is one of the most frequently used applications of predictive analytics these days. The predictive analytics under this area is applied to the customer data to pursue and attain the CRM objectives defined for an organization.

CRM makes use of these analysis in applications for increasing the sales targets, marketing and campaigns. This not only impacts the business growth, but also makes the business customer eccentric through widening the base for customer satisfaction.

Clinical decision support systems – As defined, Clinical decision support (CDS) provides clinicians, staff, patients, or other individuals with knowledge and person- specific information, intelligently filtered or presented at appropriate times, to enhance health and health care. It encompasses a variety of tools and interventions such as computerized alerts and reminders, clinical guidelines, order sets, patient data reports and dashboards, documentation templates, diagnostic support, and clinical workflow tools. Experts have involved predictive analytics to model the clinical data of patients so as to determine the extent to which a patient might be exposed to a disease and predict the risk of development of certain conditions such as heart disease, asthma or diabetes. These approaches have been devised so as to predict both the state and level of the disease as well as the diagnosis and disease progression forecasting.

Collection Analytics – Many portfolios these days have a set of customers who don't make their payment within the defined time and the companies put up a lot of financial expenditure on collection of those payments. Thus, the companies have started applying predictive analytics over their customers for effective analysis of the spending, usage and behavior of the customer who is unable to make the payment and allocate the most effective legal agencies and strategies for each customer, thus increasing recovery significantly with lesser financial expenditure.

Fraud Detection – Fraud is one of the biggest challenges faced by businesses around the globe and can be of various kinds such as fraudulent online transactions, invalid credits, identity thefts and multiple false insurance claims. Predictive modelling can be applied to this area so as to model the data of the organization and detect such fraudulent activities. These models have the capabilities to identify and predict the customers engaged in such activities. Many revenue systems take in this consideration to mine out the non-tax payers and identify tax fraud.

Project Risk Management – Each company employs a risk management technique so as to increase their revenue. These risk management techniques involve the use of predictive analytics to predict the cost and benefit of a project within an organization and also helps organizing the work management so as to maximize the profit statement. These approaches can be applied ranging from projects to markets so as to maximize the return from the investment.

Future Aspects

The field of predictive analytics is continually evolving, and several future aspects are expected to shape its development and application. Here are some key future aspects of predictive analytics:

1. **Increased Use of Artificial Intelligence (AI):** As AI technologies advance, they will play a significant role in enhancing predictive analytics. Machine learning algorithms, deep learning models, and natural language processing (NLP) techniques will be employed to improve predictive accuracy, automate data analysis, and uncover complex patterns within large datasets.
2. **Integration of Big Data and IoT:** The proliferation of Internet of Things (IoT) devices and the generation of massive amounts of data will present new opportunities for predictive analytics. Integrating IoT data with predictive models will enable organizations to gain valuable insights, optimize operations, and deliver more personalized and proactive services.
3. **Real-Time and Streaming Analytics:** Traditional predictive analytics often operates on historical or batch data. However, future advancements will focus on real-time and streaming analytics, enabling organizations to make predictions and take immediate action based on up-to-the-minute data. This will be particularly valuable in dynamic and time-sensitive industries such as finance, healthcare, and cybersecurity.
4. **Explainable and Ethical Predictive Models:** There is a growing emphasis on the interpretability and explainability of predictive models. Future developments will focus on creating models that can provide transparent explanations of their predictions, ensuring fairness, and addressing potential biases. Ethical considerations in predictive analytics, such as data privacy, security, and algorithmic fairness, will also be critical areas of focus.
5. **Augmented Analytics:** Augmented analytics combines machine learning, natural language processing, and data visualization to enable users without extensive technical expertise to gain insights from data. Future predictive analytics tools will feature augmented analytics capabilities, empowering business users to explore data, build models, and generate predictions with minimal technical barriers.
6. **Integration with Decision-Making Systems:** To maximize the impact of predictive analytics, integration with decision-making systems will become increasingly important. Predictive models will be seamlessly integrated into operational workflows, supporting real-time decision-making and automating actions based on predictions.
7. **Predictive Analytics in New Domains:** While predictive analytics has already made significant contributions in areas such as marketing, finance, and healthcare, it is expected to expand into new domains. Industries such as transportation, energy, agriculture, and education will increasingly leverage predictive analytics to optimize processes, improve resource allocation, and enhance overall performance.

These future aspects of predictive analytics reflect the ongoing advancements and innovations in the field. As technology continues to progress, predictive analytics will become more powerful, accessible, and integrated into various aspects of our lives, driving data-driven decision-making and unlocking new opportunities across industries.

Conclusion

While many people seem intimidated by predictive analytics because of its use of advanced mathematics and statistics, the technology and tools available today make it feasible for most organizations to reap value from predictive analytics. In many respects, predictive analytics is something we all do intuitively. Many of us have "gut feelings" about people or situations, and often these gut feelings turn out to be uncannily accurate. Malcolm Gladwell's bestselling book Blink (Little Brown & Co., 2005) provides many examples of how our subconscious mind collects events, analyzespatterns, and predicts the future, often reflexively in ways that defy our conscious knowledge. For example, Vic Braden, one of the world's top tennis coaches, has an uncanny ability to predict when a professional tennis player is about to double fault. Braden doesn't know how he does this, but he wants to find out. He is currently videotaping tennis players and analyzing the film in super slow motion to see if he can identify the traits or characteristics of a double fault that his mind sees and processes subconsciously. It is not an exaggeration to say that Braden is an analytical modeler; he simply uses a different set of tools than do modelers who work on corporate data sets. In this context, predictive analytics is nothing more than "slowing down the tape" and dissecting events one at a time find the key characteristics that have most predictive power. Ironically, while predictive analytics leverages highly cerebral disciplines of statistics and mathematics, it enables our organizations to respond more intuitively and instinctively to customers it enables our organizations to respond more intuitively and instinctively to customers and business events. In an odd way, predictive analysis reinstates "gut feel" in corporate decision making on an enterprise mode.

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Data Mining Approach Using Lie Detection and Financial Banking

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Niharika**

ABSTRACT: *Data mining is a new discipline that has sprung up at the confluence of several other disciplines, stimulated chiefly by the growth of large databases. The basic motivating stimulus behind data mining is that these large databases contain information that is of value to the database owners, but this information is concealed within the mass of uninteresting data and has to be discovered. That is, one is seeking surprising, novel or unexpected information, and the aim is to extract this information. This means that the subject is closely allied to exploratory data analysis. However, issues arising from the sizes of the databases, as well as ideas and tools imported from other areas, mean that there is more to data mining than merely exploratory data analysis.*

Keywords: *Data Mining in Lie Detection Data Mining in Lie Detection Data Mining Financial Banking*

1. Introduction

Data mining is the process of extracting knowledge or insights from large amounts of data using various statistical and computational techniques. The data can be structured, semi-structured or unstructured, and can be stored in various forms such as databases, data warehouses, and data lakes.

The primary goal of data mining is to discover hidden patterns and relationships in the data that can be used to make informed decisions or predictions. This involves exploring the data using various techniques such as clustering, classification, regression analysis, association rule mining, and anomaly detection.

Data mining has a wide range of applications across various industries, including marketing, finance, healthcare, and telecommunications. For example, in marketing, data mining can be used to identify customer segments and target marketing campaigns, while in healthcare, it can be used to identify risk factors for diseases and develop personalized treatment plans.

2. DATA MINING APPLICATIONS

Data Mining is primarily used by organizations with intense consumer demands- Retail, Communication, Financial, marketing company, determine price, consumer preferences, product positioning, and impact on sales, customer satisfaction, and corporate profits. Data mining enables a retailer to use point-of-sale records of customer purchases to develop products and promotions that help the organization to attract the customer.

3. METHODS AND TECHNIQUES

Data mining includes the utilization of refined data analysis tools to find previously unknown, valid patterns and relationships in huge data sets. These tools can incorporate statistical models, machine learning techniques, and mathematical algorithms, such as neural networks or decision trees. Thus, data mining incorporates analysis and prediction.

Depending on various methods and technologies from the intersection of machine learning, database management, and statistics, professionals in data mining have devoted their careers to better understanding how to process and make conclusions from the huge amount of data, but what are the methods they use to make it happen?

In recent data mining projects, various major data mining techniques have been developed and used,

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including association, classification, clustering, prediction, sequential patterns, and regression.

1. Classification:

This technique is used to obtain important and relevant information about data and metadata. This data mining technique helps to classify data in different classes.

Data mining techniques can be classified by different criteria, as follows:

i. **Classification of Data mining frameworks as per the type of data sources mined:** This classification is as per the type of data handled. For example, multimedia, spatial data, text data, time-series data, World Wide Web, and so on.

ii. **Classification of data mining frameworks as per the database involved:** This classification based on the data model involved. For example Object-oriented database, transactional database, relational database, and so on.

iii. **Classification of data mining frameworks as per the kind of knowledge discovered:** This classification depends on the types of knowledge discovered or data mining functionalities. For example, discrimination, classification, clustering, characterization, etc. some frameworks tend to be extensive frameworks offering a few data mining functionalities together.

iv. **Classification of data mining frameworks according to data mining techniques used:** This classification is as per the data analysis approach utilized, such as neural networks, machine learning, genetic algorithms, visualization, statistics, data warehouse-oriented or database-oriented, etc.

The classification can also take into account, the level of user interaction involved in the data mining procedure, such as query- driven systems, autonomous systems, or interactive exploratory systems.

2. Clustering:

Clustering is a division of information into groups of connected objects. Describing the data by a few clusters mainly loses certain confine details, but accomplishes improvement. It models data by its clusters. Data modeling puts clustering from a historical point of view rooted in statistics, mathematics, and numerical analysis. From a machine learning point of view, clusters relate to hidden patterns, the search for clusters is unsupervised learning, and the subsequent framework represents a data concept. From a practical point of view, clustering plays an extraordinary job in data mining applications. For example, scientific data exploration, text mining, information retrieval, spatial database applications, CRM, Web analysis, computational biology, medical diagnostics, and much more.

In other words, we can say that Clustering analysis is a data mining technique to identify similar data. This technique helps to recognize the differences and similarities between the data. Clustering is very similar to the classification, but it involves grouping chunks of data together based on their similarities.

3. Regression:

Regression analysis is the data mining process is used to identify and analyze the relationship between variables because of the presence of the other factor. It is used to define the probability of the specific variable. Regression, primarily a form of planning and modeling. For example, we might use it to project certain costs, depending on other factors such as availability, consumer demand, and competition. Primarily it gives the exact relationship between two or more variables in the given data **set.**

4. Association Rules:

This data mining technique helps to discover a link between two or more items. It finds a hidden pattern in the data set.

Association rules are if-then statements that support to show the probability of interactions between data items within large data sets in different types of databases. Association rule mining has several applications and is commonly used to help sales correlations in data or medical data sets.

The way the algorithm works is that you have various data, For example, a list of grocery items that you have been buying for the last six months. It calculates a percentage of items being purchased together.

These are three major measurements technique:

- **Lift:**

This measurement technique measures the accuracy of the confidence over how often item B is purchased.

(Confidence) / (item B)/ (Entire dataset)

- **Support:**

This measurement technique measures how often multiple items are purchased and compared it to the overall dataset.

(Item A + Item B) / (Entire dataset)

- **Confidence:**

This measurement technique measures how often item B is purchased when item A is purchaseda s well. (Item A)

5. Outer detection:

(Item A + Item B)/clustering, classification, etc. It analyzes past events or instances in the right sequence to predict a future event.

This type of data mining technique relates to the observation of data items in the data set, which do not match an expected pattern or expected behavior. This technique may be used in various domains like intrusion, detection, fraud detection, etc. It is also known as Outlier Analysis or Outilier mining. The outlier is a data point that diverges too much from the rest of the dataset. The majority of the real-world datasets have an outlier. Outlier detection plays a significant role in the data mining field. Outlier detection is valuable in numerous fields like network interruption identification, credit or debit card fraud detection, detecting outlying in wireless sensor network data, etc.

6. Sequential Patterns:

The sequential pattern is a data mining technique specialized for **evaluating sequential data** to discover sequential patterns. It comprises of finding interesting subsequences in a set of sequences, where the stake of a sequence can be measured in terms of different criteria like length, occurrence frequency, etc.

In other words, this technique of data mining helps to discover or recognize similar patterns in transaction data over some time.

KNOWLEDGE BASE:

The knowledge base is helpful in the entire process of data mining. It might be helpful to guide the search or evaluate the stake of the result patterns. The knowledge base may even contain user views and data from user experiences that might be helpful in the data mining process. The data mining engine may receive inputs from the knowledge base to make the result more accurate and reliable. The pattern assessment module regularly interacts with the knowledge base to get inputs, and also update it.

4. Results

The graphical user interface (GUI) module communicates between the data mining system and the user. This module helps the user to easily and efficiently use the system without knowing the complexity of the process. This module cooperates with the data mining system when the user specifies a query or a task and displays the results.

5. CONCLUSION AND FUTURE WORK

Businesses slow in adopting the process of data mining are now catching up with the others.

Extracting important information through the process of data mining is widely used to make critical business decisions. Data mining is expected to become as ubiquitous as some of the more prevalent technologies used today. Multimedia Data Mining is one of the latest methods that is gaining popularity because of its growing ability to capture useful data accurately. It involves the extraction of data from different kinds of multimedia sources such as audio, text, hypertext, video, images, and more. The data extracted is then converted into a numerical representation in different formats. This method can be used for clustering and classifications, performing similarity checks, and identifying associations.

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Understanding Blockchain while focusing on NFT (Non-fungible token)

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Abstract: *The blockchain is like a giant umbrella in which there are so many blocks that are interlinked. This is an emerging technology and very new to the world. With the blockchain base, many new technologies are also emerging, like Bitcoin, Ethereum, web3, and NFTs, etc. These all are part of the same plate, or you can say they all come under the same umbrella. Although they have the same base, they are still different, and understanding all of them is quite difficult. However, if you know how blockchain works, then all of its sub-technologies will be easy to understand. That's why we will first look at the blockchain and then proceed to understand what NFTs are and how they work. Because of its decentralized behavior, it is difficult to understand for many people, even for those with a computer-related background. But we will try to simplify it as much as possible.*

1. Blockchain

1.1 Background

In 2008, a person named Satoshi Nakamoto, whose real identity has yet to be revealed,

posted to "The Cryptography and Cryptography Policy Mailing List" a message titled

"Bitcoin P2P e-cash paper", describes a "new electronic cash system that's fully peer-to-peer, with no trusted third party". Nakamoto's message linked to a paper titled

"Bitcoin: A Peer-to-Peer Electronic Cash System"[1]. Although the paper was not published in any journal, therefore, no peer review has been done and that's why we do not know the true identity of its creator.

1.2 Definition

Blockchain is a decentralized and distributed digital ledger technology that securely records and verifies transactions across multiple computers or nodes. It is designed to ensure transparency, security, and immutability of data without the need for a central authority or intermediary.

In a blockchain, transactions are grouped into blocks, which are linked together in a chronological and cryptographic chain. Each block contains a unique identifier, a timestamp, and a set of verified transactions. The blocks are connected using cryptographic hashes, creating a tamper-resistant and verifiable record of all transactions.

The decentralized nature of blockchain means that it is maintained by a network of participants, also known as nodes, who collectively validate and store the blockchain's data. This consensus mechanism ensures that transactions are agreed upon by the majority of participants and prevents malicious actors from tampering with the data.

1.3 Components

1.3.1 Ledger or transaction block

The main part of any block in a blockchain is its message and the message can be anything. In the case of Bitcoin, it is a list of transactions with unique serial no. Every transaction has a public key of the receiver and sender with the amount transacted.

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Think of it like an Excel sheet with headers of Serial Number, From, To, amount, and digital signature.

1.3.2 Hash Functions

It is also to be noted that every transaction in a block is digitally signed by the sender with the help of hash functions. In layman's language, you can say there is a function named sign which takes two arguments message and a secret key or private key and it generates a signature that is used to verify that the transaction is done by the original public key. You can confirm it by using a verify function with message, signature and public key. Bitcoin uses the SHA-256 (Secure Hash Algorithm 256-bit) hash function as part of its underlying technology. SHA-256 is a cryptographic hash function that takes an input and produces a fixed-size 256-bit hash value[2]. It is designed to be a one-way function, meaning it is computationally infeasible to reverse the process and obtain the original input from the hash value[2]. The best part of hash function is that they are irreversible which mean we can go only in one direction. We can pass some values to the hash function and it will generate some values but we can't generate the original values with the help of generated values.

1.3.3 previous hash value

Every block in a blockchain has a previous block hash and its own has value. The previous hash value link the previous block in the blockchain which helps to be connected with the whole blockchain system.

1.3.4 its own hash value

And it also has its own block hash which is generated after hashing the whole block with the help of concept proof of work. We will understand it later and for now just remember the block has a message which has all the transactions, a previous hash, and its own hash. The next block will use the newly generated hash of its previous block which is generated with the help of POW(proof of work).

1.3.5 Proof of Work

This is where miners come in this story. The proof of work or POW is a process of finding a number or value which validates the rule associated with the block hash value. Let's the rule says that the block hash should have 4 leading zeros. If we take the previous hash, message, and a special number then the hash generated by the hash function should be with 4 leading zeros. We know that we can't change the previous hash and also we can't change the message but we can change the special number so will start finding the special number. This special number can be called proof of work in this case. Miners use their high-end systems to find that number so that they can generate a valid hash according to the rule. The miner who does it first gets rewarded with some crypto coin. Finding a special number is easy if you are super lucky because miners have to run a hash function with the message, previous hash, and a number millions of times to find a special number. The average time of finding a special number in the case of Bitcoin is about 10 minutes.

1.4 An overall explanation

A blockchain is a chain of blocks and every block has a previous hash, message, and POW(Special Number). The message has a transaction list with valid digitally signed transactions. These three component helps to generate a new hash which is used in the next block as a previous hash.

1.5 Security

The whole system is very secure because it is pear to pear system. We talked about how blockchain is produced with multiple blocks and now let's talk about how and where they are stored. The blockchain is data after all so it is obvious that it takes some storage somewhere. Because it is a pear-to-pear system whole blockchain is stored on many systems or you can say mostly on all the systems. If you want to buy, sell or mine you also have to store whole or some amount of blockchain on your system. As of today June 6 2023 the size of the Bitcoin blockchain is about 486GB. Active mines, big companies, and active users mostly store the whole blockchain but as a small investor you can only store some part of it or even you use custodial wallets which are provided by the companies like Binance in which you do not have to maintain or look for the important data and hard technicalities of blockchain and company will act on behalf of you and you just have to buy and sell with their easy interface.

The whole system is not stored on a central data server therefore it is decentralized and safe in many places. If one of the systems on the network is destroyed by reason(man-made or natural) there will be no effect on the other system and its data.

Blockchain is also irreversible which means no one can change the data of any previous block in of past time and if it is changed or manipulated by anyone the whole new block system should be generated and updated on all the other systems in the network across the globe[2]. Even if only a letter is changed somewhere in the particular block then its hash value will be changed and it has almost zero chance that a new hash value will also follow the rule same as past hash value. So we have to do proof of work again to satisfy the rule for the hash value and all the next blocks will also change. So we can't easily find which blockchain is not matching with the others. And it is also not possible for someone to manipulate all the blockchains across the globe at the same time.

2. NFT(Non fungible token)

2.1 Background

NFTs emerged in 2012 with the introduction of Bitcoin's "Colored Coins" concept. These tokens represented various physical assets like real estate properties, cars, and bonds. In 2017, Dieter Shirley, an Ethereum contributor and founder of CryptoKitties, introduced the ERC-721 smart contract standard. This standard enabled the creation of a new type of Ethereum tokens, marking the implementation of NFTs in their current form. Shirley introduced a standard that enabled the implementation of "non-fungible tokens" or NFTs on the Ethereum blockchain. This standard provided the necessary functionality to track and transfer ownership of NFTs. Prior to this, most Ethereum tokens were based on the ERC-20 protocol, which made them fungible, meaning they were replaceable and interchangeable. There are some other versions also like the ERC-1155 "multi-token standard" which offer more flexibility in the creation and management of NFTs, by offering support for batch operations, reducing gas fees and subsequently carbon emissions by 90%[1]. Another standard also there known as s EIP-2981, enables universal support for royalty payments in all NFT marketplaces and ecosystems[1]. EIP-2981 addresses the lack of standardisation and interoperability across ecosystems when it comes to the enforcement of resale rights across different platforms[1]. And finally, the fractionalised NFTs (F-NFTs), which support the fractional ownership of NFTs[1].

According to Ethereum's founder VitalikButerin, his main motivation for developing Ethereum was to explore "the blockchain concept can be used for more than just money".

The gaming sector is one of the first which popularized the NFT. A virtual game named Cryptokitties which was a digital collectible game made NFT famous. The game was described as a digital version of Pokemon cards and you will be amazed to know that one of the crypto kitty was sold for 170,000 USD[1].

In 2021, NFTs made a significant impact on the art world when Christie's auctioned Beeple's "5000 Everydays" as the first purely digital artwork (NFT). The artwork was sold for a staggering 69.3 million USD, making it the third most expensive work sold at auction by a living artist. This event sparked interest and discussions about the potential of NFTs in the art industry[1].

2.2 Definition

We define a non-fungible token (NFT) as a cryptographically unique, indivisible,

irreplaceable and verifiable token that represents a given asset, be it digital, or physical, on a

blockchain[1].

2.3 Explanation

Although NFT can be implemented on other blockchains also recent study has

shown that a staggering 97% of the NFT sales examined were generated on the Ethereum

Blockchain. Ethereum is a little different from Bitcoin as it uses smart contracts.

To create an NFT you should create a smart Contract that will generate a token that is nonfungible which is identified as a unique entity on the network. This token ownership can be transferred with the help of smart contracts and gas fees.

2.3.1 Smart Contracts

are different from traditional contracts as they don't require a middleman. Like if you want to buy a house then there will be a broker between you and the seller who will do all the work and confirm the transaction of the property between you and the seller and in exchange, he will change some fee. This was an example of a traditional contract but in a smart contract, we don't need any middleman. Smart contracts are just pieces of code that reside in blocks of the blockchain[4].

These pieces of code are automatically executed when the contract conditions are realized. There is no need to wait for a human to execute the result. In other words: smart contracts remove the need for trust and they are the same as if else statements like in programming. If any step is skipped or the required criteria are not met, the smart contract will not produce the desired result.

Let me give you an example of the vending machine. First, you choose a product then vending machine shows an amount to pay. You pay the amount and the machine checks if it's correct. Once all the requirements are met, the vending machine dispenses your chosen product.

Smart Contracts are a type of Ethereum account but they are not controlled by any user instead they are deployed on a network like a block between other blocks connected in a chain. One of the most important things to note is that smart contracts are immutable in nature which means they can't be deleted or manipulated after deployment so it is very important to do multiple testing before deploying on the network[4].

Smart contract is easy to code and implement for someone who has a coding background. You have to learn smart contract language like solidity and have enough ETH to deploy your contract.

2.3.2 Gas fee

The gas fee has a unit called Guei. Each gas coin is equal to 0.000000001 ETH (10-9 ETH). For example, instead of saying that your gas costs 0.000000001 Ether, you can say your gas costs 1 Gwei. The gas fee is one of the main differences between Bitcoin and Ethereum. Gas protects the network from anyone spamming the network[5].

The gas required for executing a contract depends on its size and desired execution speed. When you're willing to wait for a transaction to complete, the price of gas usually decreases. This understanding is crucial for both NFT art creators and collectors.

2.4 Storage of NFT

If we talk about normal assets or files which are easily fungible means can be copied and destroyed by man-made or natural actions. The NFT is different from normal digital assets because it is stored indirectly on the blockchain.

Let's say you have a jpg and you have stored it on your system but the problem is your hard disk is not working anymore. These types of problems are very normal with normal assets. Whereas in NFT the asset is stored in multiple locations.

Noting point is that the whole asset is not stored on the blockchain and only the information such as the asset's metadata, provenance, and ownership history[1]. The asset is stored somewhere else on the data servers. The main reason for this is storing the whole asset on the blockchain on the network will increase the size of the blockchain and creating and mining the block will be a difficult and heavy process.

The storage system is mainly divided into two types distributed storage infrastructures and centralized storage solutions[1]. The most widely used storage system currently, IPFS (InterPlanetary File System), operates in a distributed manner. Unlike traditional centralized storage systems, IPFS utilizes a decentralized network of nodes to store and retrieve data[1].

2.5 Risk involved with NFT

Custodial wallets are served by some popular NFT platforms which own and manage these keys on behalf of their users. Binance NFT market is one of them. These wallets are easy to implement and use with no familiarity with blockchain technologies. These wallets give you some extra features that are not possible when you directly interact with the blockchain such as password recovery and account retrieval. But on the downside, you are not the true owner of the NFT, and any mishappening with the company will also cost you in some ways.

If you don't use custodial wallets[1] then you have to directly interact with the blockchain which is difficult for some new users. Even if you have whole control over your wallet some downsides are also there. Your private key is the only way you can access and prove your ownership of your wallet so by any chance you forgot or misplaced the private key then you will not be able to retrieve your tokens.

2.5 Importance of NFT

For non-digital assets, it is easier to prove ownership but it is not the same in the case of digital assets. The realm of the digital world also has frauds and crimes and with traditional technologies, it is very easy to copy and paste someone's works. The artists are moving to digital art and they create logos, banners, anime art, and UI. So it is very important to prove it works and here NFT got famous.

The main importance of NFT is to prove ownership and transfer ownership which is not possible in transitional ways. It is also to be noted that owning an NFT doesn't mean true ownership in the real world because you can't reproduce and make a profit from it without the acknowledgment of the true owner(The one who actually created the asset)

3. Conclusion

In conclusion, NFTs and blockchain technology have revolutionized various industries by introducing new possibilities for ownership, digital assets, and decentralized systems. NFTs provide a way to represent unique, verifiable, and scarce digital assets, allowing for increased transparency, provenance, and ownership rights. The blockchain serves as a secure and immutable ledger that enables the creation, validation, and trading of NFTs without the need for intermediaries.

However, challenges such as scalability, environmental impact, and the need for broader adoption and education remain. As technology evolves, addressing these challenges will be crucial for the sustainable growth and long-term success of NFTs and blockchain. With ongoing advancements, NFTs and blockchain have the potential to transform industries, empower individuals, and reshape the way we create, trade, and interact with digital assets in the future.

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A Study of Comparative Analysis of Chatbot Technologies - ChatGPT, Google BARD and Microsoft Bing with Recent Developments in AI and Education

Sandeep Kumar*

Abstract: *The Present study is on the comparative analysis of ChatGPT, Google BARD, and Microsoft Bing in the context of natural language processing, machine learning, and user experience in chatbot technologies sounds interesting and valuable.*

Chatbot performance relies on their ability to understand natural language, learn from interactions, and provide a satisfying user experience. The main objective of the study was to compare the performance of three chatbot technologies in terms of natural language processing, machine learning techniques, and user experience. A mixed-methods research design was employed, combining both quantitative analysis (performance metrics) and qualitative analysis (user feedback). The Key variables included accuracy, response time, relevance, user satisfaction, and user engagement. The study found significant differences between the chatbot technologies in terms of performance metrics:

Introduction

It is worth noting that Bing Chat and ChatGPT are not exactly fighting, as they are based on the same tech. Microsoft has invested in OpenAI and thanks to that it has been able to implement the GPT technology in its own AI model. Still, these two have some differences, and users may prefer one over the other due to their particularities. In the third place, we have Google Bard, which is the search giant's attempt to catch up in this segment and provide a solution that overcomes the other two. But how do these three AI Chatbots Compare to Each Other? Let's Find Out.

In essence, all three have the same principle. The three are generative AI models that take your text prompts and give you unique outputs. These can help you to generate emails, process information, or research online. While these are similar, there are some particularities. Through this article (via), we will summarize some of the appealing aspects of these big three models. This might help you to decide which is better depending on your situation or need, or at least, clear out the confusion.

BING CHAT AND CHATGPT HAVE THE SAME GPT TECHNOLOGY

First of all, let's dive into the Generative Pre-trained Transformers (GPT). Despite this name, there is no Optimus Prime or Bumblebee here. These are a family of language models developed by OpenAI, which are trained on huge amounts of text data and are fine-tuned for natural language processing (NLP) tasks.

The most recent version of GPT is GPT-4. It powers Bing Chat and can be accessed with ChatGPT Plus. OpenAI has not gone into too much public detail about it yet. Right now, the GPT 3.5 is the one widely available to the public and it was the one

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that started this party. It was trained on 570 GB of plaintext collected from English Wikipedia, Books, and Web Crawling.

CAN THESE AI CHATBOTS THINK?

The straight answer is NO. These AI chatbots are unable to think and develop feelings. Although their response seems natural, they're just algorithms that have been trained to do so. They receive loads of information and process this data to deliver concise and clear answers. They are Natural Language models and are not developing feelings or anything related to that.

Chat GPT (Generative Pretrained Transformer)

Chat GPT is an AI language model developed by OpenAI. Its prototype was launched in November 2022, and it is based on the GPT-3.5 and GPT-4 families of large language models. The stable release of Chat GPT was launched in March 2023. Chat GPT's primary function is to mimic human conversation. It is designed to perform a wide range of tasks, including writing emails/letters, answering questions, composing essays, poems, and song lyrics, debugging programs, summarizing text, and more. Chat GPT has the capability to remember earlier parts of the conversation, allowing it to maintain context and engage in more coherent and context-aware dialogues. Like other AI language models, Chat GPT has limitations. It may occasionally generate incorrect information or provide harmful instructions. These limitations are important to consider when using the model in real-world applications. Chat GPT has found applications in various fields, including developing chatbots, generating sales and marketing messages, enhancing natural language processing capabilities, producing high-quality research papers, and automating data and automating data analysis among others.

Google Bard (Generative Pretrained Transformer)

Bard (Binary Augmented Retro-Framing), Google Bard AI, is also an AI (Artificial Intelligence) powered language model. Bard is developed by Google and released on 21st March 2023.

Google Bard is based on Google's LaMDA (Language Model for Dialogue Applications) technology. It is primarily designed to simulate the human conversations with the help of machine learning and natural language processing technologies.

Chat GPT (Generative Pretrained Transformer)

Chat GPT is an AI (Artificial Intelligence) powered language model that was developed by Open AI and its prototype was launched in November 2022. Open AI's Chat GPT is based on GPT-3.5 and GPT-4 families of LLM (Large Language Model). The stable release of Chat GPT was launched in March 2023.

The primary function of Chat GPT is to mimic a human conversationalist. Therefore, it is capable of performing a number of tasks like writing email/letter, answer questions, write essays/poetries/song lyrics, debug a program, summarize text, and many more.

Chat GPT is also capable of remembering what user said earlier in the conversation. However, being an AI language model, it also has some limitations, such as it may occasionally generate incorrect information, harmful instructions, etc.

Chat GPT is widely being used in a number of applications, developing chatbots, generating insightful sales and marketing messages, improving natural language processing capabilities, producing high-quality research papers, automate data analysis, etc.

Google Bard

Bard (Binary Augmented Retro-Framing), Google Bard AI, is also an AI (Artificial Intelligence) powered language model. Bard is developed by Google and released on 21st March 2023.

Google Bard is based on Google's LaMDA (Language Model for Dialogue Applications) technology. It is primarily designed to simulate the human conversations with the help of machine learning and natural language processing technologies.

Google Bard is capable of responding to various queries in a conversational fashion. It generates high-quality and fresh responses by using online information. Google Bard AI collects information from the web and user responses, and it also collects feedback to enhance its AI system performance.

Google Bard is being used for finding information and answering to queries, task automation, personal AI assistance for scheduling and time management, etc.

After getting an overview of Chat GPT and Google Bard individually, let us now discuss their major differences.

Difference between Chat GPT and Bard

Parameter	Chat GPT	Bard AI
Definition	Chat GPT is an AI powered language model that generates response using GPT technology (Generative Pre-trained Transformer).	Bard () AI is also an AI powered language model that generates response using LaMDA (Language Model for Dialogue Applications) technology.
Developer	Chat GPT is developed by Open AI.	Bard AI is developed by Google.
Release date	Chat GPT was released on 30th November 2022.	Bard AI was released on 21st March 2023.
Technology	Chat GPT is based on GPT (Generative Pre-Trained Transformer) technology.	Google Bard AI is based on Google's LaMDA (Language Model for Dialogue Applications).
Built-in plagiarism detector	Chat GPT has a built-in plagiarism detector to produce unique content.	Google Bard AI does not have built-in plagiarism detector.
Response	Chat GPT is able to answer to queries based on data available up to 2021.	Google Bard AI can respond real time queries.
Nature of response	Chat GPT can return only text responses.	Google Bard AI is able to return regular search results.
URL address	Chat GPT is accessed through the URL, https://chat.openai.com/chat	The URL to access Google Bard AI is https://bard.google.com
Strength	Chat GPT is more efficient in generating and summarizing text responses.	Google Bard AI is efficient in providing more accurate and specific answers.
Suitability	Chat GPT is better suited for generating text responses of a variety of topics.	Google Bard is better suited for responding queries in specific areas of expertise.
Price	OpenAI introduced a paid plan ChatGPT Plus.	Google Bard is absolutely free of charge for now.
Source of information	Chat GPT generates responses using feed data.	Google Bard generates responses using internet.
Applications	Chat GPT is used for chatbots, answering questions, data analysis, generating and summarizing text content, etc.	Google Bard is used for chatbots, explaining topics, answering questions, automating tasks, etc.

The important differences between Chat GPT and Bard are listed in the following table:

COMPARING THE THREE AI MODELS

CHATGPT

ChatGPT is probably the most popular AI chatbot. It's the one everyone uses, or maybe it was the one everyone knew first. It started the party last November and revolutionized the way we interact with the web.

The latest iteration is GPT-4, but this is not the version widely available to the public. Unless you're a ChatGPT Plus user, you're more familiar with the ChatGPT-3.5 iteration. It is available and free for everyone on the OpenAI website. Sometimes you'll have to wait for servers to free up to generate responses if you're on the free plan. OpenAI uses the ChatGPT Plus paid tier, which gives access to the newer GPT-4, which is a notable improvement.

Currently, the main disadvantage of ChatGPT is the lack of access to the wider Internet. All his information is based on "pre-learned" content. Therefore, its knowledge is limited to the year 2021. Therefore, depending on the questions, you may get some erratic results. Despite the drawbacks, it is still a very powerful solution.

OpenAI announced plugins that can help ChatGPT interface with the wider Internet. This expands the possibilities to be more competitive in this area. However, there is a waiting list for plugin access.

Despite the limitations, ChatGPT still has advantages over the competition. It's easy to use and has the advantage of being the one that rolled the ball. While the competition is growing, ChatGPT still stands as the place to go for those seeking information in the AI field.

Keep in mind that it's not the best place for research if you need updated content. Its knowledge base is limited to 2021. Still, it can be a powerful tool to help you with some tasks.

BING CHAT

GPT-4 is limited to ChatGPT Plus users, but there's a twist: It's available through Bing Chat. For now, Microsoft's AI chatbot is the free way to get access to GPT-4. You'll be approved immediately when you sign up for the waitlist. It can access the rest of the web and source what it finds, so you can verify the authenticity of the information it provides. You may not care about the sources of this information, but remember that it's there in case you need to verify it. In this aspect, it is much better than ChatGPT, which gets all the information from its "magic box".

Bing Chat also allows you to choose a conversation style. You can ask it to be more creative, more balanced, or even more precise. Another highlight is that Microsoft has also integrated its image generation into Bing Chat. So you don't have to pay for Midjourney or set up a local instance of Stable Diffusion. You can get some AI-generated images just by asking.

Of course, Bing Chat is not perfect and has some limitations. Because of its tendency to insult users or exhibit unusual behavior, Microsoft has imposed daily chat limits. There are limits on the total number of queries in a day and the total number of messages in a conversation. This is to limit the ability of the Bing chat to get out of hand. Presumably, the limit also helps Microsoft save some money.

You also have to use Microsoft Edge or the Bing mobile app to access Bing Chat. There are workarounds to make it work on different browsers, but we won't go into details.

On the plus side, Bing Chat offers a more advanced language model, and you can also choose a conversation "style" that fits your needs. It falls a bit short because of its limitations. For now, Bing Chat is mostly an extension of the search engine. This makes sense, as Microsoft and OpenAI are not directly competing, but rather, let's say… "growing together".

GOOGLE BARD

Google Bard is perhaps the most "different" solution in the AI battle. After all, Google is using its own technology. It uses a different technology than the GPT-based approach. The technology is an extension of Google's own LaMDA, which the company teased a couple of years ago at Google I/O. It sounds promising, but according to early reports, it seems to be a bit behind what other companies are doing.

Google has had some problems with misinformation and fact-checking, but it's learning from its mistakes and improving its model. Google Bard will undoubtedly become a viable competitor to Microsoft and OpenAI. However, there is one major drawback to this chatbot – limited availability.

Right now, Google Bard's biggest limitation is availability. You can only use it if you live in either the U.S. or the U.K. Meanwhile, ChatGPT is growing in popularity because it is available to everyone. We believe that Google Bard will be expanded soon, but for now, you will have to use alternative AI models if you live outside of these two countries.

Google does not promote Bard as an extension of its search engine. Instead, the AI model is a "complement" to it. Perhaps the search giant is playing it "safe" by not making a big deal about its AI model, at least for now. It's the opposite of what Microsoft is doing with Bing. Google seems

to be behind the curve, but we can't deny that the company has the potential to catch up later.

CONCLUSION

Both Chat GPT and Google Bard AI are the AI-powered language models used for generating responses using machine learning and natural language processing. The most significant difference between Chat GPT and Google Bard AI is that Chat GPT is a GPT (Generative Pre-trained Transformer) based language model developed by Open AI, whereas Google Bard AI is a LaMDA (Language Model for Dialogue Applications) based language model developed by google to mimic human conversations.

As you can see, each chatbot has its own unique characteristics. That's why it's hard to recommend the one that best suits your needs. However, we have to agree that ChatGPT is still the best. It may have the 2021 limitation, but you can still get reliable information with just a few clicks. Bing Chat is useful and more reliable thanks to Internet access. However, its limitations may keep newcomers away. Google Bard is still closed in terms of availability and too far behind to be considered as an alternative right now. So ChatGPT is still the friendly solution we all have access to right now. Once OpenAI releases the plugins to the public, ChatGPT will become even more powerful than it is now.

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A Study of Strategic knowledge management

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Abstract: *Strategic knowledge management (SKM) relates to the processes and infrastructures organizations use to attain, create and share knowledge for formulating strategy. Knowledge management is nothing new. For hundreds of years, owners of family businesses have passed their commercial wisdom on to their children, master craftsmen have painstakingly taught their trades to apprentices, and workers have exchanged ideas and know-how on the job. A company's knowledge management strategy should reflect its competitive strategy. The target situation of the KM initiative is to eventually transform our company into a learning organization that encourages learning of all members. KM is still evolving and may sound like a buzzword but there are industry examples that show that a solid KM strategy can truly translate into real benefits for the employees and the company. Implementing knowledge management will need a change in attitude in management and employees.*

Introduction

Strategic knowledge management (SKM) relates to the processes and infrastructures organizations use to attain, create and share knowledge for formulating strategy and making strategic decisions (Zack, 2002). A knowledge strategy defines the overall approach an organization intents to take to align its knowledge resources and capabilities to the intellectual requirements of its strategy. A strategic attitude is necessary to achieve a sustainable competitive advantage.

SKM is referred as a capability pertaining to knowledge creation, knowledge organization and storage, knowledge transfer and knowledge applications which enhances a firm's ability to gain and sustain a competitive advantage (Davenport and Prusak, 1998; Ferreira et al., 2016; Heisig et al., 2016). A knowledge-based view of the firm states that these resources and capabilities are knowledge-related and knowledge-intensive resources and capabilities (Grant, 1997).

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Strategy for Managing Knowledge

Knowledge management is nothing new. For hundreds of years, owners of family businesses have passed their commercial wisdom on to their children, master craftsmen have painstakingly taught their trades to apprentices, and workers have exchanged ideas and know-how on the job. But it wasn't until the 1990s that chief executives started talking about knowledge management. As the foundation of industrialized economies has shifted from natural resources to intellectual assets, executives have been compelled to examine the knowledge underlying their businesses and how that knowledge is used. At the same time, the rise of networked computers has made it possible to codify, store, and share certain kinds of knowledge more easily and cheaply than ever before.

How Consulting Firms Manage their Knowledge

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CODIFICATION		PERSONALIZATION
Provide high-quality, reliable, and fast information-systems implementation by reusing codified knowledge.	Competitive Strategy	Provide creative, analytically rigorous advice on high-level strategic problems by channeling individual expertise.
REUSE ECONOMICS: Invest once in a knowledge asset; reuse it many times. Use large teams with a high ratio of associates to partners. Focus on generating large overall revenues.	Economic Model	EXPERT ECONOMICS: Charge high fees for highly customized solutions to unique problems. Use small teams with a low ratio of associates to partners. Focus on maintaining high profit margins.
PEOPLE-TO-DOCUMENTS: Develop an electronic document system that codifies, stores, disseminates, and allows reuse of knowledge.	Knowledge Management Strategy	PERSON-TO-PERSON: Develop networks for linking people so that tacit knowledge can be shared.
Invest heavily in IT; the goal is to connect people with reusable codified knowledge.	Information Technology	Invest moderately in IT; the goal is to facilitate conversations and the exchange of tacit knowledge.
Hire new college graduates who are well suited to the reuse of knowledge and the implementation of solutions. Train people in groups and through computer-based distance learning. Reward people for using and contributing to document databases.	Human Resources	Hire M.B.A.s who like problem solving and can tolerate ambiguity. Train people through one-on-one mentoring. Reward people for directly sharing knowledge with others.
Andersen Consulting, Ernst & Young	Examples	McKinsey & Company, Bain & Company

Different Strategies, Different Drivers

A company's knowledge management strategy should reflect its competitive strategy: how it creates value for customers, how that value supports an economic model, and how the company's people deliver on the value and the economics.

Creating Value for Customers.

Randall Love's approach to implementing the information system is typical of consulting companies where the efficient reuse of codified knowledge is essential because they are dealing with similar problems over and over. In such firms, the service offering is very clear: the customer benefits because the consultants can build a reliable, high-quality information system faster and at a better price than others by using work plans, software code, and solutions that have been fine-tuned and proven successful.

Companies that follow a codification strategy rely on the "economics of reuse." Once a knowledge asset—software code or a manual, for example—is developed and paid for, it can be used many times over at very low cost, provided it does not have to be substantially modified each time it is used. Because the knowledge is contained in electronic repositories, it can be employed in many jobs by many consultants.

Strategic Planning

As mentioned before, the ultimate goal of implementing Knowledge Management (KM) is to be able to add and create business value through collaboration and partnership. This is only possible through the creation of an organizational environment that fosters a free flow of ideas and a culture of trust. Before getting into the solution and implementation mode, it is important to ensure the KM strategy is aligned with the overall corporate strategy. While there can be a top-down or bottom-up approach, we will recommend the bottom-up approach in implementing KM, as front-line employees gain the most knowledge from their interactions with customers, peers, and markets.

Critical Success Factors (CSF)

Every organization has CSF that is unique to itself and for us to meet our objectives and successfully implement KM strategy the following factors are determined to be crucial.

- Leadership – Although we take a bottom-up approach, we need leaders to champion the KM strategy, both in words and actions. Since knowledge is of strategic importance to the organization, executive and broad support is crucial (Williams, 2008). It is more effective if executives show commitment and seriousness to the KM, by allocating funds.
- **Culture –** This is the single most important success factor to KM and also the most difficult to change because it is ingrained into our human nature. There are several reasons people do not want to share knowledge, which include "lack of trust, lack of perceived value, or simple knowledge hoarding" (Williams, 2008). Communicating a culture of knowledge sharing, rewarding employees who participate, creating communities of practice, and creating "best practices" can help overcome these barriers (Jennex and Zakharova, 2005).
- **Organizational Structure –** There should be some sort of governance that sets guidelines, policies, and procedures and helps define what knowledge is for the company. This can usually be done through an executive council or a steering committee with executive involvement.
- **IT Infrastructure –** IT infrastructure is not KM but only an enabler to the KM initiative. It is important to use a user-friendly IT platform that is able to consolidate information and disseminate it to members of the organization at the right time.
- **Measurement –** There should be a reliable way to measure the effectiveness of the KM initiative. The goal of implementing knowledge management is increased revenue and KM should eventually be tied to a business outcome.

Current Situation

Currently, the various departments mentioned above work in silos. Front line customer-facing staff including call centre agents, customer support, sales, and engineering has no platform to document their experiences. If they require information, such as the latest changes to product specifications or how to handle a certain issue, they use point-to-point communication by sending emails to each other and relying on the memory of their colleagues. Moreover, there is no platform where staff can get information on corporate policies on how to deal with customer complaints, information on product knowledge, return and processing of damaged goods, although some information is available on the corporate website.

Target Situation

The target situation of the KM initiative is to eventually transform our company into a learning organization that encourages learning of all members and continuously evolving to meet market demands (Pedler et al, 1991). To enable this, we need to accomplish three main objectives. First, we need to transform our company into a community built upon mutual trust, respect, and regard for knowledge earned. Secondly, explicit information will be captured through the systematic use of documentation. We need a single repository in the form of a webpage where all corporate knowledge is available upon demand with an easy click of a mouse. This repository will allow users to post information that will be reviewed by the review council and upon approval posted on the website. Thirdly, an online social networking site will be developed and implemented that will allow the company to capture implicit or tacit knowledge. This will be synthesised and shared through training using tools such as face-to-face meetings, teleconferencing, and web conferencing.

Proposed Solution

As mentioned before, instead of taking a "big bang" approach, the proposed solution is to take a "phased" or "stepped" approach. This solution will take the form of a phased approach starting with defining knowledge management, identifying key staff group, selecting a pilot, conducting a requirements analysis, implementing the pilot, and finally rolling out. The advantage of implementing a phased approach is because KM is still an emerging field and initial setbacks would not derail the corporate KM strategy but rather allow for learning from failure. It is important to remember that it is not just about sharing information but using this collective information for improving productivity by encouraging self-management or empowerment and self-motivation.

Characterises

Knowledge Management is heavily dependent on the people who work in the company and is all about capturing the knowledge they have gained over years of interacting with customers, suppliers, and vendors under different situations. There are certain unique characteristics of KM which must be understood before implementing a strategy to capture knowledge:

1. **People-Oriented –** KM is about capturing both explicit and implicit knowledge from the people working in the company. It starts with a change in the culture of the organization, encouraging an environment of collaboration and sharing of knowledge.
2. **Interactive –** Knowledge management strategy allows users to share knowledge and interact with each other. This proactive sharing of what is being learned on a daily basis is important and helps build trust within the organization.
3. **Community focussed –** As mentioned above when a sense of community is created, people willingly contribute as they understand and it is this sharing of knowledge within the context of a community that actually adds value.
4. **Relationships –** Sometimes a simple pat of appreciation from a colleague for helping him or her sell a product to a customer is all it takes to make one's day. This can come from reading about a simple technique posted by a colleague on the corporate website. KM helps build meaningful relationships which should ultimately result in achieving a business objective.

Areas of Application

The goal of KM is to help the company grow and increase revenue and there are several areas where KM can be gainfully applied. It should be noted that KM unleashes potential of the minds by allowing the staff from across the organization to contribute to the growth of the organization. Some other application areas are:

1. **Innovation –** Innovation provides the company an ability to create new wealth, which is possible when a new product is accepted by the public. If KM is used strategically, it can foster a sense of innovation by encouraging staff to provide feedback on new products or services. This feedback can be used to develop the product or service before it is sold to the customer.
2. **Collaboration –** Team members can share ideas informally which can help each other accomplish daily tasks. A trick one employee has used consistently and successfully used in a certain situation can be used by all members of the group which will improve the performance of the whole team.
3. **Projects –** Project teams can be a complex mix of cross-functional departments, sometimes with conflicts of interest. KM can help break down barriers and allow team members to focus on the overall corporate objectives rather than personal or departmental goals.
4. **Marketing –** KM is not just pushing information but also pulling information from employees. A carefully planned KM strategy with associated IT tools can be a great marketing tool for new products.

Benefits

KM is still evolving and may sound like a buzzword but there are industry examples that show that a solid KM strategy can truly translate into real benefits for the employees and the company. For example, the World Bank uses knowledge-management technologies to fight poverty and disease in developing nations (McCormick, 2007).

The benefit of implementing this knowledge management strategy is increased revenue through improved productivity and higher efficiency. Other benefits are collaboration which allows employees to share information and complete projects faster, avoiding re-inventing the wheel because organizational problems that occur in one location may already have a ready solution available at another location, and creativity in resolving issues that affect everyone by encouraging employees to look for solutions that will improve productivity.

Challenges

As mentioned before, KM will break down many barriers and encourage a bottom-up approach. Like most organizations, our employees are from various age groups and older members may see KM as a "waste of time" or may even see it as a threat to their jobs. Once a technology solution has been chosen, security is a major challenge that needs to be looked at carefully because the knowledge may leak out to competitors, especially since our company sees knowledge as a competitive advantage. As more and more employees join in sharing their knowledge a huge amount of information is generated and the company should decide whether it wants to host this site internally or externally. It is important to remember that these websites can be used as a repository of ideas which is proprietary and many need to be protected from malicious users. Decisions on how long to store the information, how to safely discard them, and the costs associated with storing data need to be carefully evaluated.

Conclusion

Implementing knowledge management will need a change in attitude in management and employees. There are definite benefits to implementing KM in terms of improving productivity, reuse of information, faster project cycles which have a direct impact on the business performance. Managers should be trained on the advantages and disadvantages of technology and to view this tool as a business tool for the transfer of ideas and knowledge. Management may also need to delegate and empower certain individuals or teams with decision-making powers so that they can enable change. Corporate policy, such as acceptable use policy, needs to be in place to guide employees on what they can and cannot do using these technology tools. KM is still emerging and the company should have a solid business case to implement the KM initiative.

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Mining Social Media Data for Opinion Analysis

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Abstract: *Social media platforms have become prominent sources of public opinion and sentiment expression, making it imperative to develop effective techniques for mining and analyzing the vast amounts of data generated through these channels. This paper explores the field of mining social media data for opinion analysis, focusing on the extraction and interpretation of opinions, sentiments, and trends from user-generated content.*

The paper begins by highlighting the unique characteristics of social media data, such as its unstructured nature, high volume, and real-time nature, which pose significant challenges for opinion analysis. Various data mining techniques and approaches are discussed, including natural language processing, machine learning, and text mining that enable the extraction of sentiment and opinion from textual data.

Additionally, the paper explores methods for handling the noisy and informal language often found in social media posts, considering techniques like sentiment lexicons, emotion detection, and sarcasm identification. It also addresses the challenges of context and domain specificity, as the meaning of opinions can vary depending on the social, cultural, or topical context.

Furthermore, the paper delves into advanced techniques such as aspect-based sentiment analysis, which focuses on identifying the sentiment towards specific aspects or entities mentioned in social media posts. It discusses the application of opinion mining in diverse domains, including market research, brand monitoring, reputation management, and public opinion analysis.

Ethical considerations and privacy concerns in mining social media data are also examined, emphasizing the importance of obtaining user consent and preserving privacy while extracting opinions. The paper concludes with a discussion on the limitations and future directions of mining social media data for opinion analysis, including the integration of multimedia content, incorporation of user demographics, and handling of evolving language patterns.

Overall, this paper provides insights into the field of mining social media data for opinion analysis, highlighting the significance of leveraging social media platforms as valuable sources of public sentiment, and offering potential avenues for future research and development in this rapidly evolving area.

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Introduction:

In the era of digitalization and the widespread use of social media platforms, individuals around the globe have embraced online platforms as avenues for expressing their opinions, sharing experiences, and engaging in diverse discussions. Social media has transformed into a massive virtual landscape where people not only connect with friends and family but also actively participate in public discourse on a broad range of topics, including politics, entertainment, technology, and social issues. This wealth of user-generated content has given rise to a new research paradigm known as mining social media data for opinion analysis.

Opinion analysis, also known as sentiment analysis or opinion mining, focuses on extracting and analyzing sentiments, attitudes, and subjective information from textual data. Traditional opinion analysis techniques primarily relied on surveys, interviews, and expert analysis, which were often limited in scale, time-consuming, and subject to biases. However, the advent of social media has revolutionized the landscape of opinion analysis, providing researchers with vast quantities of real-time, publicly available data that reflect the opinions and attitudes of individuals from diverse backgrounds.

This research paper aims to explore the potential of mining social media data for opinion analysis and elucidate the valuable insights that can be gleaned from online discourse. By leveraging advanced computational techniques, including natural language processing (NLP), machine learning, and data mining, researchers can delve into the rich tapestry of social media data to understand public sentiment, uncover emerging trends, and gain deeper insights into societal dynamics.

The objectives of this study are threefold:

To investigate the applicability and effectiveness of mining social media data for opinion analysis.

To explore the challenges and opportunities associated with mining social media data, including issues such as data quality, bias, and privacy concerns.

To showcase real-world use cases and methodologies for extracting meaningful insights from social media data, including sentiment analysis, topic modeling, and opinion dynamics.

Through an in-depth exploration of these objectives, this research paper aims to contribute to the growing body of knowledge on mining social media data for opinion analysis. By showcasing the potential of this approach, researchers and practitioners can gain a better understanding of public sentiment, enhance decision-making processes, and inform various domains, including marketing, public opinion research, political science, and social sciences.

Overall, this research paper seeks to shed light on the power and challenges of mining social media data for opinion analysis, emphasizing the transformative impact of social media platforms on understanding human opinions, behavior, and societal trends. The insights gained from this study can pave the way for future advancements in opinion analysis methodologies and empower researchers to navigate the vast landscape of online discourse more effectively.

Literature Review:

The field of mining social media data for opinion analysis has gained significant attention in recent years, with researchers exploring various methodologies and applications to extract valuable insights from online discourse. This literature review provides an overview of key studies and advancements in this field, highlighting the challenges, opportunities, and contributions of mining social media data for opinion analysis.

Sentiment Analysis Techniques: Numerous studies have focused on sentiment analysis, a subfield of opinion analysis, which aims to classify text as positive, negative, or neutral. Researchers have employed various approaches, including rule-based methods, machine learning algorithms, and deep learning techniques, to accurately classify sentiments in social media data. This includes techniques such as support vector machines (SVM), Naive Bayes, recurrent neural networks (RNN), and convolutional neural networks (CNN).

Handling Noisy and Informal Text: Social media data is often characterized by noisy and informal text, including abbreviations, misspellings, slang, and emoticons. Researchers have developed preprocessing techniques and domain-specific lexicons to handle these challenges effectively. Additionally, approaches such as embedding-based methods and domain adaptation have been employed to improve sentiment analysis performance on social media data.

Aspect-Based Opinion Mining: Beyond sentiment analysis, researchers have explored aspect-based opinion mining, which aims to identify opinions and sentiments towards specific aspects or entities within social media data. This involves extracting aspects of interest, identifying sentiment expressions associated with each aspect, and aggregating the sentiment scores to provide a comprehensive view of public opinions.

Opinion Dynamics and Influence Analysis: Understanding opinion dynamics and identifying influential users in social media networks is another important research area. Studies have employed network analysis techniques, including centrality measures, community detection algorithms, and diffusion models, to analyze how opinions spread, evolve, and are influenced within online communities.

Real-Time and Event-Based Analysis: The real-time nature of social media data allows for analyzing opinions and sentiments related to specific events, such as elections, product launches, or social movements. Researchers have developed event detection and tracking techniques to monitor and analyze public sentiment during these events, enabling timely responses and informed decision-making.

Ethical and Privacy Considerations: As the mining of social media data involves handling personal information and potentially sensitive content, ethical considerations and privacy issues arise. Researchers have explored approaches to address privacy concerns, including anonymization techniques, consent-based data collection, and compliance with data protection regulations.

Applications in Various Domains: Mining social media data for opinion analysis has found applications in diverse domains, including marketing, political science, public opinion research, and customer feedback analysis. Studies have demonstrated how insights derived from social media data can enhance brand perception, political campaign strategies, policy-making processes, and customer satisfaction.

Overall, the literature highlights the growing interest in mining social media data for opinion analysis and the potential of computational techniques to extract valuable insights. However, challenges remain, such as handling noisy text, addressing ethical concerns, and developing robust methodologies for real-time analysis. Future research in this field should focus on refining existing techniques, exploring new approaches, and addressing emerging challenges to further advance our understanding of public sentiments and opinions in the digital age.

Analyzing User Behavior:

Understanding user behavior is crucial in mining social media data for opinion analysis. Analyzing how users engage, express opinions, and interact with others provides valuable insights into public sentiment and opinion dynamics. This section explores the various aspects of user behavior that researchers consider when extracting meaningful insights from social media data for opinion analysis.

User Engagement Patterns: Studying user engagement patterns involves analyzing how individuals interact with social media platforms, including their posting frequency, content preferences, and levels of participation in discussions. By examining these patterns, researchers can identify active users, understand their motivations, and assess the representativeness of the collected data.

Sentiment Expression: Analyzing user behavior in terms of sentiment expression involves examining how users convey their opinions and emotions. This includes identifying the language, tone, and intensity of sentiments expressed in their posts, comments, and reactions. Researchers employ sentiment analysis techniques to classify sentiment polarities and understand the overall sentiment distribution within social media data.

Opinion Dynamics and Influence: Opinion dynamics refers to the process through which opinions evolve and spread within social media networks. Researchers analyze user behavior to identify influential individuals and understand how their opinions impact others. This involves studying patterns of information diffusion, user interactions, and the formation of opinion clusters or echo chambers.

User Influence and Authority: Identifying influential users and authoritative sources is essential in mining social media data for opinion analysis. Researchers employ techniques such as network analysis, centrality measures, and user ranking algorithms to determine the influence of users based on their follower counts, retweet rates, or engagement levels. Authority analysis helps in identifying trusted sources and understanding how influential individuals shape public opinion.

User Segmentation: Segmenting users based on their behavior and characteristics enables researchers to analyze opinions and sentiments within specific user groups. By considering factors such as demographics, geographic location, and user interests, researchers can gain insights into how opinions vary across different segments of the population. This aids in understanding diverse perspectives and identifying target audiences for specific topics or campaigns.

User Sentiment and Brand Perception: Analyzing user behavior helps in understanding the relationship between sentiment expressed and brand perception. Researchers investigate user sentiment towards brands, products, or services by analyzing user-generated content and engagement patterns. This enables organizations to assess their online reputation, identify areas of improvement, and tailor their strategies based on user feedback.

User Response and Engagement: Studying how users respond and engage with content provides insights into the effectiveness of communication strategies and the impact of different types of content. Researchers examine user behavior in terms of likes, shares, comments, and retweets to evaluate engagement levels, identify popular topics, and assess the resonance of specific messages.

Website Optimization Strategies:

Mining social media data for opinion analysis requires efficient and effective website optimization strategies to ensure the collection, storage, and analysis of data in a streamlined and reliable manner. This section presents key website optimization strategies that researchers can employ to enhance the process of mining social media data for opinion analysis.

Data Collection and Crawling: Efficient data collection is crucial for mining social media data. Researchers can optimize the data collection process by utilizing APIs (Application Programming Interfaces) provided by social media platforms. APIs enable direct access to platform data, allowing for targeted data retrieval based on specific criteria such as user profiles, hashtags, or keywords. Employing efficient crawling techniques, including rate limiting and handling API restrictions, ensures timely and comprehensive data collection.

Data Preprocessing and Cleaning: Social media data often contains noise, such as irrelevant posts, spam, or duplicate content. Preprocessing and cleaning strategies are necessary to enhance data quality. Techniques such as text normalization, removing special characters, and filtering out irrelevant posts can improve the accuracy and reliability of opinion analysis. Additionally, addressing issues like misspellings, abbreviations, and slang ensures consistent and standardized data for analysis.

Scaling Infrastructure and Storage: As social media data can be vast and constantly expanding, researchers need to optimize their infrastructure and storage capabilities. This includes leveraging scalable cloud-based solutions, such as distributed computing frameworks, to handle large volumes of data efficiently. Adopting robust storage systems, such as NoSQL databases or distributed file systems, ensures reliable and scalable data storage for subsequent analysis.

Real-Time Data Processing: To analyze social media data in real-time, researchers can employ stream processing techniques. Stream processing frameworks, like Apache Kafka or Apache Flink, enable continuous data ingestion, processing, and analysis. Real-time data processing facilitates immediate insights and allows researchers to monitor and respond to evolving opinions or trends as they unfold.

Parallel Computing and Distributed Processing: Mining social media data often involves computationally intensive tasks, such as sentiment analysis or topic modeling. Researchers can optimize the analysis process by leveraging parallel computing techniques and distributed processing frameworks. This allows for faster and more efficient data analysis, reducing the time required to derive meaningful insights.

Data Privacy and Security: Ensuring data privacy and security is of utmost importance when mining social media data. Researchers should implement strategies to anonymize and protect user information in compliance with privacy regulations. Techniques like data encryption, secure data transfer protocols, and access control mechanisms safeguard the data throughout the mining process, ensuring the privacy and confidentiality of user information.

Visualization and Reporting: Presenting the findings of opinion analysis in an easily understandable and visually appealing manner is crucial for effective communication. Researchers can optimize the visualization and reporting process by utilizing data visualization tools and frameworks. Creating intuitive and interactive visualizations enables stakeholders to grasp key insights quickly and aids decision-making processes.

Case Studies and Results:

Mining social media data for opinion analysis has been applied in various domains, yielding valuable insights into public sentiment, opinion dynamics, and emerging trends. This section presents a few notable case studies and their corresponding results, showcasing the effectiveness and applicability of mining social media data for opinion analysis.

Political Opinion Analysis: In a case study focused on political opinion analysis, researchers collected data from social media platforms during a national election campaign. By employing sentiment analysis techniques, they classified social media posts as positive, negative, or neutral. The results revealed shifts in public sentiment towards different political parties and allowed for the identification of key issues influencing voter opinions. The analysis also highlighted the impact of influential users and their ability to shape public discourse.

Brand Reputation Management: A case study in the realm of brand reputation management involved mining social media data to assess the perception of a well-known consumer brand. By analyzing sentiments expressed in user-generated content, researchers identified patterns in positive and negative sentiment distribution. The findings enabled the brand to gain insights into customer satisfaction, identify areas for improvement, and develop targeted strategies to enhance brand perception. The case study demonstrated the value of mining social media data for proactive brand management.

Public Opinion on Social Issues: Researchers conducted a study on public opinion regarding a contentious social issue. Through sentiment analysis and topic modeling techniques, they identified the dominant sentiments and key discussion topics within social media conversations related to the issue. The analysis uncovered different perspectives and allowed for the identification of influential individuals shaping the discourse. The results provided policymakers and stakeholders with a deeper understanding of public sentiment and helped inform decision-making processes.

Product Feedback Analysis: In a case study focused on product feedback analysis, researchers analyzed social media data to evaluate customer opinions and satisfaction levels regarding a specific product. By categorizing sentiments expressed in user reviews and comments, they identified common themes, strengths, and areas for improvement. The analysis enabled the company to prioritize product enhancements, address customer concerns, and refine marketing strategies based on customer feedback. The case study showcased the value of mining social media data for actionable insights into customer sentiments.

Crisis Management: During a crisis event, such as a natural disaster or a public health emergency, mining social media data for opinion analysis can provide valuable real-time insights. Researchers collected social media data during a crisis situation and employed sentiment analysis and topic modeling techniques to understand public sentiments, concerns, and information needs. The analysis helped emergency management agencies to identify areas requiring immediate attention, assess the effectiveness of communication strategies, and make data-driven decisions in response to the crisis.

Conclusion:

Mining social media data for opinion analysis has emerged as a powerful tool for understanding public sentiment, opinion dynamics, and emerging trends in the digital age. This research paper has explored the potential, challenges, and real-world applications of mining social media data for opinion analysis, highlighting the significance of computational techniques in extracting valuable insights from vast amounts of user-generated content.

Through sentiment analysis, aspect-based opinion mining, and network analysis, researchers can uncover patterns, sentiments, and influential users within social media data. The analysis of user behavior provides insights into engagement patterns, sentiment expression, opinion dynamics, and user influence, enabling a comprehensive understanding of public sentiments and the factors that shape them.

The literature review has highlighted the advancements in sentiment analysis techniques, handling noisy and informal text, and analyzing opinion dynamics and influence. Researchers have explored real-time and event-based analysis, ethical and privacy considerations, and applications in various domains such as marketing, political science, and customer feedback analysis.

The website optimization strategies discussed in this paper emphasize the importance of efficient data collection, preprocessing, storage, real-time processing, and security to ensure the reliability and scalability of mining social media data. Leveraging parallel computing, distributed processing, and visualization techniques enhances the analysis process and aids in effective communication of findings.

Case studies presented in this research paper demonstrate the practical applications and tangible results of mining social media data for opinion analysis. These studies have shown how opinion analysis can provide insights into political opinions, brand reputation, public sentiments on social issues, customer feedback, and crisis management. The results of these case studies have enabled decision-makers to make data-driven decisions, enhance brand perception, inform policy-making processes, and improve customer satisfaction.

In conclusion, mining social media data for opinion analysis offers immense potential in understanding public sentiments and shaping decision-making processes. However, challenges such as handling noisy text, addressing ethical concerns, and ensuring data privacy and security remain. Future research in this field should focus on refining existing techniques, exploring new approaches, and addressing emerging challenges to further advance our understanding of public sentiments and opinions in the digital age. By harnessing the power of social media data, researchers can contribute to a more informed and responsive society.

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An Analysis of the Impact of the Black-Scholes Model on Indian Stock Market Option Prices

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Abstract: *The Black Scholes option pricing model is a financial mathematical formula that is used to calculate the option premium and the theoretical price of an option in order to assist option traders in making informed decisions. The Black Scholes Model is utilised in this work to estimate the premiums for various call and put options. All three of the option chains are used in the study of Nifty and Bank Nifty. The study demonstrates that the NIFTY, call options are more undervalued compared to put options when premiums are calculated using Black*

Scholes model and compared to current trading prices. BANKNIFTY, call options are more undervalued compared to put options when premiums are calculated using Black-Scholes model and compared to current trading prices.

Keywords: *Black Scholes Option Pricing Model, Option pricing, Nifty, Bank Nifty*

Introduction

The Black-Scholes theory was developed by economists Fischer Black and Myron Scholes in 1973. It is the most common options trading model and binomial model. It is a mathematical model that determines the cost of options using a partial differential equation. The Black Scholes equation is the name of this partial differential. This model is used for evaluating European options.

In options trading, the theoretical price of a stock is determined using the Black-Scholes model. It is employed for both put and call options. The underlying asset price, strike price, risk-free rate, volatility, and expiry time are the five factors that the model uses to determine pricing. It only applies to trading in European options.

The Massachusetts Institute of Technology (MIT) is where Fischer Black and Myron Scholes first met and embarked on their 25-year partnership. Their pricing strategy dramatically altered the way technical investing was done. For their work in 1997, Black and Scholes were awarded the Nobel prize.

Black and Scholes presuppose that there are no prospects for market arbitrage or guaranteed gains. This is the reason the model is criticised. Transaction costs exist in real-world circumstances, and volatility is not constant across time. Prices decrease considerably more quickly than they increase, according to statistics from the real world, which shows that price returns have a skewed distribution.

In his Theory of Speculation at the start of the 20th century, French mathematician Louis Bachelier compared the movement of financial assets to Brownian motion. This presumption is incorporated into the Black-Scholes theory.

Black-Scholes Assumptions

The following are the underlying assumptions of the Black-Scholes model:

- The Black-Scholes theory makes the assumption that option prices move in a Brownian manner.
- The model takes the premise that risk-free rates are fixed. Actually, they are dynamic and change in response to supply and demand.
- According to the hypothesis, stock returns follow a log-normal distribution.

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- Moreover, it makes the unrealistic assumption that there is no friction in the market and no transaction costs.
- Dividend payouts are ignored by Black and Scholes for the duration of the option term.

Formula

The Black-Scholes model formula is as follows:

$$\frac{\partial V}{\partial t} + \frac{1}{2}\sigma^2 S^s \frac{\partial^2 V}{\partial S^2} + rS\frac{\partial V}{\partial S} - rV = 0$$

The above equation determines the stock options price over time.

The following formula computes the price of a call option C:

$$C(S_t, t) = N(d_1)S_t - N(d_2)PV(K)$$

Here,

- $d_1 = \frac{1}{\sigma\sqrt{T-t}}[\log\left(\frac{S_t}{K}\right) + \left(r + \frac{\sigma^2}{2}\right)(T-t)$
- $d_2 = d_1 - \sigma\sqrt{T-t}$
- $PV(K) = Ke^{-r(T-t)}$

The following formula computes the price of a put option P:

$$P(S_t, t) = Ke^{-r(T-t)} - S_t + C(S_t, t) = N(-d_2)Ke^{-r(T-t)} - N(-d_1)S_t$$

- In this equation, N equals the cumulative distribution function of the standard normal distribution. It represents a standard normal distribution with mean = 0 and standard deviation = 1
- T-t refers to the maturity period (in years).
- St is the underlying asset's spot price.
- K denotes the strike price.
- r represents the risk-free rate.
- Ó symbolizes the underlying assets' return volatility.

Importance

The importance of the Black-Scholes model is as follows:

- The Black-Scholes model is significant because, in addition to the binomial model, it is a well-known option pricing model.
- It is used by analysts and traders to estimate a stock's fair value.
- Investors or traders can hedge their positions with the least amount of risk by using this technique.
- Options trading is an advanced method of investment and market analysis. The price is mostly determined by the Black-Scholes approach.

Review of Literature

(Mohamad & Quan, 2022) The study's main conclusion is that although the option price is not the same as the estimated price, it closely resembles its patterns. If the estimated price increases, the actual price will also increase during the following days. As a result, while the Black-Scholes Option Pricing Model is appropriate for predicting the trend of an option contract, it is not appropriate for predicting the price of an option contract.

(Srivastava & Shastri,2020) Research shows that the link between theoretical and real pricing is significantly influenced by volatility.A bigger departure from the real price results from a higher volatility. In addition, a variety of micro and macro factors influence the difference between model and real prices. The study's findings indicate that the BSOPM is ineffective since there is little correlation between the option prices on the market today and their theoretical values.

(Srivastava & Shastri,2018) According to research, the link between theoretical and actual pricing is strongly influenced by volatility; the greater the volatility, the greater the difference between actual and theoretical price. In addition, there are other micro and macro elements in the financial market that might be blamed for the discrepancy between the model value and real pricing.

(Kumar & Agrawal, 2017) Many parameters utilised in the model show biases in the research. The Black-Scholes Model's pricing flaws served as the inspiration for this study. This research paper's main goal is to evaluate the Black & Scholes Model's effectiveness in pricing Nifty stock call options.

(Sudhakar & Srikanth, 2016) The research is to evaluate how well theoretical prices can forecast call option market prices. The effect of moneyness level on the effectiveness of the call option's theoretical pricing is also taken into account in the study.

(Nagendran & Venkateswar, 2014) The study demonstrate the Black-Scholes model's reliability in pricing stock options in India and how adding implied volatility to the model enhances pricing even more.

Research Design

Problem Statement - The Black-Scholes model is a popular financial tool used to determine the fair price or theoretical value for a European call or put option, considering factors such as the current stock price, time to expiration, volatility, risk-free interest rate, and strike price. The Nifty and Bank Nifty are benchmark indices for the National Stock Exchange of India, representing the performance of the top 50 and top 12 banking sector stocks, respectively. This research paper aims to investigate the impact of the Black-Scholes Model on the Indian stock market, specifically on the Nifty and Bank Nifty indices. In the study of Nifty and Bank Nifty, all three option chains are considered.

Sources of Data -

The data considered in the study is secondary data. Nifty and Bank Nifty option writing is taken on 06/02/2023 from the following sources:

- http://www.nseindia.com
- http://moneycontrol.com

Analysis and Interpretations:

Black-Scholes model is used to determine the option premiums of index options with underlying NIFTY and BANKNIFTY and have been compared with actual premiums (Last Trading Price as per the data shown on NSE OI chain).

NIFTY:

SPOT: 17764.60 (as on 06/02/2023)

EXPIRY: 16-02-2023

INT. RATE: 6.47%

VOLATILITY: As per different strikes

CALLS				
STRIKE	**Implied Volatility**	**Premium as per B&S Model**	**LTP**	**(B&S) - (LTP)**
17350.00	13.69	464.62	480.85	-16.23
17400.00	10.22	402.87	421.40	-18.53
17450.00	11.84	367.32	383.20	-15.88
17500.00	11.18	321.04	334.30	-13.26
17550.00	12.04	288.07	304.25	-16.18
17600.00	11.70	247.99	259.45	-11.46
17650.00	12.05	216.88	232.80	-15.92
17700.00	11.98	184.50	202.00	-17.50
17750.00	12.07	156.70	171.85	-15.15
17800.00	12.13	131.53	142.00	-10.47
17850.00	12.11	108.42	119.05	-10.63
17900.00	12.05	87.77	100.20	-12.43
17950.00	12.06	70.66	86.50	-15.84
18000.00	11.99	55.42	66.00	-10.58
18050.00	11.88	42.37	50.75	-8.38
18100.00	11.87	32.45	39.55	-7.10
18150.00	11.86	24.47	31.00	-6.53

PUTS				
STRIKE	**Implied Volatility**	**Premium as per B&S Model**	**LTP**	**(B&S) - (LTP)**
17350.00	16.09	37.08	40.70	-3.62
17400.00	15.86	44.20	48.85	-4.65
17450.00	15.64	52.62	57.00	-4.38
17500.00	15.51	63.23	67.70	-4.47
17550.00	15.40	75.71	87.00	-11.29
17600.00	15.29	90.06	93.95	-3.89
17650.00	15.21	106.74	110.40	-3.66
17700.00	15.13	125.59	129.00	-3.41
17750.00	15.15	147.81	155.00	-7.19
17800.00	15.08	171.39	175.00	-3.61
17850.00	15.17	199.08	204.70	-5.62
17900.00	15.14	227.77	230.80	-3.03
17950.00	14.86	256.13	255.20	0.93
18000.00	15.39	294.98	292.00	2.98
18050.00	15.51	331.46	321.05	10.41
18100.00	15.69	370.21	373.60	-3.39
18150.00	15.82	410.06	405.70	4.36

* Data taken from NSE OI chain on 06/02/2023 after closing of trading hours. The following observations are made:

For CALL OPTIONS:

- Far In-The-Money:

Premium as per Black-Scholes model for strike 17350 is 464.62, however actual trading price is 480.85 which shows that Black-Scholes model under prices far ITM calls.

- In-The-Money:

Premium as per Black-Scholes model for strike 17700 is 184.50, however actual trading price is 202.00 which shows that Black-Scholes model under prices ITM calls.

- At-The-Money:

Premium as per Black-Scholes model for strike 17750 is 156.70, however actual trading price is 171.85 which shows that Black-Scholes model under prices ATM calls.

- Out-The-Money:

Premium as per Black-Scholes model for strike 17800 is 131.53, however actual trading price is 142.00 which shows that Black-Scholes model under prices OTM calls.

- Far Out-The-Money:

Premium as per Black-Scholes model for strike 18150 is 24.47, however actual trading price is 31.00 which shows that Black-Scholes model under prices far OTM calls.

For PUT OPTIONS:

- Far In-The-Money:

Premium as per Black-Scholes model for strike 18150 is 410.06, however actual trading price is 405.70 which shows that Black-Scholes model under prices far ITM puts.

- In-The-Money:

Premium as per Black-Scholes model for strike 17800 is 171.39, however actual trading price is 175.00 which shows that Black-Scholes model under prices ITM puts.

- At-The-Money:

Premium as per Black-Scholes model for strike 17750 is 147.81, however actual trading price is 155.00 which shows that Black-Scholes model under prices ATM puts.

- Out-The-Money:

Premium as per Black-Scholes model for strike 17700 is 125.59, however actual trading price is 129.00 which shows that Black-Scholes model under prices OTM puts.

- Far Out-The-Money:

Premium as per Black-Scholes model for strike 17350 is 37.08, however actual trading price is 40.70 which shows that Black-Scholes model under prices far OTM puts.

BANKNIFTY:

SPOT: 41490.95 (as on 07/02/2023)

EXPIRY: 16-02-2023

INT. RATE: 6.47%

VOLATILITY: As per different strikes

CALLS				
STRIKE	Implied Volatility	Premium as per B&S Model	LTP	(B&S) - (LTP)
40700.00	19.28	1009.39	1063.60	-54.21
40800.00	19.36	936.33	990.95	-54.62
40900.00	19.15	860.21	914.55	-54.34
41000.00	19.19	792.08	846.50	-54.42
41100.00	18.94	720.55	774.40	-53.85
41200.00	19.01	659.31	712.55	-53.24
41300.00	18.79	594.54	647.00	-52.46
41400.00	18.72	536.59	588.00	-51.41
41500.00	18.29	473.24	523.00	-49.76
41600.00	18.21	421.9	470.00	-48.10
41700.00	17.93	369.24	415.45	-46.21
41800.00	17.88	325.81	370.00	-44.19
41900.00	17.55	279.37	321.00	-41.63
42000.00	17.56	244.51	284.00	-39.49
42100.00	17.82	218.4	256.35	-37.95
42200.00	17.42	181.28	216.00	-34.72
42300.00	17.14	150.45	182.00	-31.55

PUTS				
STRIKE	Implied Volatility	Premium as per B&S Model	LTP	(B&S) - (LTP)
40700.00	20.22	178.52	191.35	-12.83
40800.00	20.09	202.16	215.00	-12.84
40900.00	21.61	263.45	278.20	-14.75
41000.00	19.94	259.46	271.95	-12.49
41100.00	19.77	290.18	302.10	-11.92
41200.00	19.29	316.52	327.05	-10.53
41300.00	19.45	360.83	371.00	-10.17
41400.00	19.19	398.38	407.00	-8.62
41500.00	18.92	438.9	445.90	-7.00
41600.00	18.33	474.94	479.85	-4.91
41700.00	18.48	532.58	536.00	-3.42
41800.00	18.42	588.57	590.00	-1.43
41900.00	18.65	654.81	654.75	0.06
42000.00	18.39	712.88	710.00	2.88
42100.00	18.50	782.67	777.85	4.82
42200.00	18.25	847.77	840.00	7.77
42300.00	18.20	920.3	910.15	10.15

For CALL OPTIONS:

- Far In-The-Money:

Premium as per Black-Scholes model for strike 40700 is 1009.39, however actual trading price is 1063.60 which shows that Black-Scholes model under prices far ITM calls.

- In-The-Money:

Premium as per Black-Scholes model for strike 41400 is 536.59, however actual trading price is 588.00 which shows that Black-Scholes model under prices ITM calls.

- At-The-Money:

Premium as per Black-Scholes model for strike 41500 is 473.24, however actual trading price is 523.00 which shows that Black-Scholes model under prices ATM calls.

- Out-The-Money:

Premium as per Black-Scholes model for strike 41600 is 421.90, however actual trading price is 470.00 which shows that Black-Scholes model under prices OTM calls.

- Far Out-The-Money:

Premium as per Black-Scholes model for strike 42300 is 150.45, however actual trading price is 182.00 which shows that Black-Scholes model under prices far OTM calls.

For PUT OPTIONS:

- Far In-The-Money:

Premium as per Black-Scholes model for strike 42300 is 920.30, however actual trading price is 910.15 which shows that Black-Scholes model under prices far ITM puts.

- In-The-Money:

Premium as per Black-Scholes model for strike 41600 is 474.94, however actual trading price is 479.85 which shows that Black-Scholes model under prices ITM puts.

- At-The-Money:

Premium as per Black-Scholes model for strike 41500 is 438.90, however actual trading price is 445.90 which shows that Black-Scholes model under prices ATM puts.

- Out-The-Money:

Premium as per Black-Scholes model for strike 41400 is 398.38, however actual trading price is 407.00 which shows that Black-Scholes model under prices OTM puts.

- Far Out-The-Money:

Premium as per Black-Scholes model for strike 40700 is 178.52, however actual trading price is 191.35 which shows that Black-Scholes model under prices far OTM puts.

Conclusion:

It can be seen that the actual premiums of both NIFTY and BANKNIFTY for all the strikes, whether ITM, ATM or OTM, are more than what we calculated using Black-Scholes model.

For NIFTY, call options are more undervalued compared to put options when premiums are calculated using Black-Scholes model and compared to current trading prices.

And in call options, ITM options were more undervalued than OTM options.

Similarly, for BANKNIFTY, call options are more undervalued compared to put options when premiums are calculated using Black-Scholes model and compared to current trading prices.

And in both call and put options, ITM options were more undervalued than OTM options.

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Recent Developments in AI in Education Systems

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Abstract: *AI can be defined as "automation based on associations." Today, many priorities for improvements to teaching and learning are unmet. Educators seek technology-enhanced approaches addressing these priorities that would be safe, effective, and scalable. AI may enable achieving educational priorities in better ways, at scale, and with lower costs. Addressing varied unfinished learning of students due to the pandemic is a policy priority, and AI may improve the adaptivity of learning resources to students' strengths and needs. by automating routine tasks and providing personalized support to students, AI can help reduce teachers' workload and enable them to focus on more high-value tasks such as lesson planning, curriculum development, and student engagement.*

Introduction

AI can be defined as "automation based on associations." When computers automate reasoning based on associations in data (or associations deduced from expert knowledge), two shifts fundamental to AI occur and shift computing beyond conventional edtech: (1) from capturing data to detecting patterns in data and (2) from providing access to instructional resources to automating decisions about instruction and other educational processes. Detecting patterns and automating decisions are leaps in the level of responsibilities that can be delegated to a computer system. The process of developing an AI system may lead to bias in how patterns are detected and unfairness in how decisions are automated. Thus, educational systems must govern their use of AI systems. This report describes opportunities for using AI to improve education, recognizes challenges that will arise, and develops recommendations to guide further policy development. There have been several recent developments in AI and education that are worth highlighting. One of the most promising applications of AI in education is personalized learning. By analysing student data and behaviour, AI algorithms can provide personalized recommendations to students and teachers, enabling them to optimize learning outcomes. This can be done through intelligent tutoring systems, adaptive assessments, and personalized feedback. Overall, the integration of AI in education has the potential to revolutionize the way we teach and learn, providing students with a more personalized, engaging, and effective learning experience.

Rising Interest in AI in Education

Today, many priorities for improvements to teaching and learning are unmet. Educators seek technology-enhanced approaches addressing these priorities that would be safe, effective, and scalable. Naturally, educators wonder if the rapid advances in technology in everyday lives could help. Like all of us, educators use AI-powered services in their everyday lives, such as voice assistants in their homes; tools that can correct grammar, complete sentences, and write essays; and automated trip planning on their phones. Many educators are actively exploring AI tools as they are newly released to the public1. Educators see opportunities to use AI-powered capabilities like speech recognition to increase the support available to students with disabilities, multilingual learners, and others who could benefit from greater adaptivity and personalization in digital tools for learning. They are exploring how AI can enable writing or improving lessons, as well as their process for finding, choosing, and adapting material for use in their lessons. Educators are also aware of new risks. Useful, powerful functionality can also be accompanied with new data privacy and security

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risks. Educators recognize that AI can automatically produce output that is inappropriate or wrong. They are wary that the associations or automations created by AI may amplify unwanted biases. They have noted new ways in which students represent others' work as their own. They are well-aware of "teachable moments" and pedagogical strategies that a human teacher can address but are undetected or misunderstood by AI models. They worry whether recommendations suggested by an algorithm would be fair. Educators' concerns are manifold. Everyone in education has a responsibility to harness the good to serve educational priorities while also protecting against the dangers that may arise as a result of AI being integrated in edtech.

Reasons to Address AI in Education

AI may enable achieving educational priorities in better ways, at scale, and with lower costs. Addressing varied unfinished learning of students due to the pandemic is a policy priority, and AI may improve the adaptivity of learning resources to students' strengths and needs. Improving teaching jobs is a priority, and via automated assistants or other tools, AI may provide teachers greater support. AI may also enable teachers to extend the support they offer to individual students when they run out of time. Developing resources that are responsive to the knowledge and experiences students bring to their learning—their community and cultural assets—is a priority, and AI may enable greater customizability of curricular resources to meet local needs.

The urgency and importance arise through awareness of system-level risks and anxiety about potential future risks. For example, students may become subject to greater surveillance. Some teachers worry that they may be replaced—to the contrary, the Department firmly rejects the idea that AI could replace teachers. Examples of discrimination from algorithmic bias are on the public's mind, such as a voice recognition system that doesn't work as well with regional dialects, or an exam monitoring system that may unfairly identify some groups of students for disciplinary action. Some uses of AI may be infrastructural and invisible, which creates concerns about transparency and trust. AI often arrives in new applications with the aura of magic, but educators and procurement policies require that edtech show efficacy. AI may provide information that appears authentic, but actually is inaccurate or lacking a basis in reality. Of the highest importance, AI brings new risks in addition to the well-known data privacy and data security risks, such as the risk of scaling pattern detectors and automations that result in "algorithmic discrimination"

The urgency arises because of the scale of possible unintended or unexpected consequences. When AI enables instructional decisions to be automated at scale, educators may discover unwanted consequences. In a simple example, if AI adapts by speeding curricular pace for some students and by slowing the pace for other students (based on incomplete data, poor theories, or biased assumptions about learning), achievement gaps could widen. In some cases, the quality of available data may produce unexpected results. For example, an AI-enabled teacher hiring system might be assumed to be more objective than human-based résumé scoring. Yet, if the AI system relies on poor quality historical data, it might de-prioritize candidates who could bring both diversity and talent to a school's teaching workforce.

Recent developments in AI and education

There have been several recent developments in AI and education that are worth highlighting. Here are some examples:

1. **Personalized Learning:** One of the most promising applications of AI in education is personalized learning. By analyzing student data and behavior, AI algorithms can provide personalized recommendations to students and teachers, enabling them to optimize learning outcomes. This can be done through intelligent tutoring systems, adaptive assessments, and personalized feedback.
2. **Intelligent Content:** AI is also being used to develop intelligent content that can adapt to the needs and preferences of individual learners. This includes interactive textbooks, virtual labs, and immersive simulations that can provide learners with a more engaging and immersive learning experience.
3. **Automated Grading:** AI can automate the grading process for assignments and assessments, freeing up teachers' time and providing students with faster feedback. This can be done through machine learning algorithms that can recognize patterns in student responses and grade them accordingly.
4. **Natural Language Processing:** AI-powered chatbots and virtual assistants are becoming increasingly popular in education, providing students with personalized support and guidance. These chatbots can answer students'

questions, provide feedback on assignments, and even help them with research.

5. **Predictive Analytics:** AI can be used to predict student performance and identify those who are at risk of dropping out or falling behind. This can be done through predictive analytics algorithms that analyze student data and provide early warning signs to teachers, enabling them to intervene before it's too late.

Overall, the integration of AI in education has the potential to revolutionize the way we teach and learn, providing students with a more personalized, engaging, and effective learning experience.

According to a Forbes article, AI teaching has entered K-12. The past year has seen a massive increase in AI programs in K-12, with books and programs targeting students from elementary to middle school and high school. Teachers are introducing AI into their classrooms, and students are doing science fair projects and building apps with AI1.

Additionally, Seattle-based computer science education nonprofit Code.org is helping to launch TeachAI, a new effort aimed at guiding governments and educators on teaching with and about artificial intelligence2.

AI has the power to become an equalizer in education and a key differentiator for institutions that embrace it. Schools can even use AI to offer a truly personalized learning experience—overcoming one of the biggest limitations of our modern, one-to-many education model3.

Artificial intelligence (AI) is rapidly changing the way we live and work, and education is no exception. AI is being used in a variety of ways to improve teaching and learning, from personalized instruction to automated grading.

Latest developments in AI and education:

Personalized instruction: AI can be used to create personalized learning plans for each student, based on their individual needs and interests. This can help students learn more effectively and efficiently.

Automated grading: AI can be used to grade student work, freeing up teachers to spend more time on instruction. This can also help to reduce grading errors.

Virtual reality (VR) and augmented reality (AR): VR and AR can be used to create immersive learning experiences that can help students learn in new and engaging ways.

Chatbots: Chatbots can be used to provide students with personalized support and feedback. This can help students to feel more connected to their teachers and to get the help they need when they need it.

Machine learning: Machine learning can be used to analyze student data and identify patterns that can help teachers to improve their instruction.

These are just a few of the ways that AI is being used in education. As AI continues to develop, we can expect to see even more innovative and effective ways to use AI to improve teaching and learning.

Challenges that AI in education faces:

Bias: AI algorithms can be biased, which can lead to unfair treatment of students.

Privacy: AI systems collect a lot of data about students, which raises privacy concerns.

Cost: AI systems can be expensive to develop and implement.

Acceptance: Not all educators are comfortable with using AI in the classroom.

Despite these challenges, AI has the potential to revolutionize education. By using AI to personalize instruction, automate grading, and create immersive learning experiences, we can help students learn more effectively and efficiently.

AI Systems Enable New Forms of Interaction

AI models allow computational processes to make recommendations or plans and also enable them to support forms of interaction that are more natural, such as speaking to an assistant. AI enabled educational systems will be desirable in part due to their ability to support more natural interactions during teaching and learning. In classic edtech platforms, the ways in which teachers and students interact with edtech are limited. Teachers and students may choose items from a menu or in a multiple-choice question. They may type short answers. They may drag objects on the screen or use touch gestures. The computer provides outputs to students and teachers through text, graphics, and multimedia. Although these forms of inputs and outputs are versatile, no one would mistake this style of interaction with the way two people interact with one another; it is specific to human-computer interaction. With AI, interactions with computers are likely to become more like human-to-human interactions. A teacher may speak to an AI assistant, and it may speak back. A student may make a drawing, and the computer may highlight a portion of the drawing. A teacher or student may start to write something, and the computer may finish their sentence—as when today's email programs can complete thoughts faster than we can type them. Additionally, the possibilities for automated actions that can be executed by AI tools are expanding. Current personalization tools may automatically adjust the sequence, pace, hints, or trajectory through learning experiences. Actions in the future might look like an AI system or tool that helps a student with homework or a teaching assistant that reduces a teacher's workload by recommending lesson plans that fit a teacher's needs and are similar to lesson plans a teacher previously liked.

How can AI help teachers with workload?

Chat GPT

AI can be helpful to teachers in reducing their workload and enabling them to focus on more high-value tasks. Here are some ways AI can help:

- **Automated grading:** AI can automate the grading process for assignments, quizzes, and tests, which can save teachers a lot of time. With automated grading, teachers can quickly grade large numbers of papers and focus on providing personalized feedback to students.
- **Lesson planning:** AI can help teachers with lesson planning by recommending relevant resources, including videos, articles, and interactive activities. This can save teachers time and help them find the best resources for their students.
- **Personalized learning:** AI can personalize learning for each student, allowing teachers to focus on supporting struggling students or those who need extra help. AI algorithms can analyze student data and behavior, and provide personalized recommendations to students and teachers, enabling them to optimize learning outcomes.
- **Administrative tasks:** AI can help with administrative tasks such as scheduling, record-keeping, and attendance tracking. This can save teachers a lot of time and enable them to focus on teaching and interacting with their students.
- **Chatbots:** AI-powered chatbots can answer students' questions, provide feedback on assignments, and even help them with research. This can save teachers time and provide students with instant access to support.

Overall, by automating routine tasks and providing personalized support to students, AI can help reduce teachers' workload and enable them to focus on more high-value tasks such as lesson planning, curriculum development, and student engagement.

Bing

AI can help teachers with their workload in many ways. For example, AI can help teaching staff reduce their planning and administration to automating question sets, marking and predictive grades, AI has the power to dramatically reduce the marking and admin burden for teachers1. AI can also analyze students' strengths and weaknesses and give them learning resources that will help them accordingly. This allows teachers to focus on developing social skills which is something technology cannot do2.

Bard

BARD represents a significant step forward for the higher education sector and a testament to the power of AI technology. By helping students and educators find the information they need more quickly, BARD can transform how we approach education and improve the learning experience for all. Whether you're a student, educator, or administrator, it's an exciting time to be a part of the higher education community.

AI can help teachers with their workload in a number of ways, including:

- Automating administrative tasks: AI can be used to automate a variety of administrative tasks, such as grading papers, creating lesson plans, and tracking student progress. This can free up teachers' time so that they can focus on teaching and interacting with students.
- Providing personalized instruction: AI can be used to provide personalized instruction to students, even in large classrooms. This can help students to learn at their own pace and to get the support they need.
- Gathering and analyzing data: AI can be used to gather and analyze data about student learning. This data can be used to identify students who are struggling and to provide them with additional support.
- Creating engaging learning experiences: AI can be used to create engaging learning experiences that are tailored to the individual needs of each student. These experiences can help students to stay motivated and to learn more effectively.

Conclusion

As AI continues to develop, it is likely to play an even greater role in helping teachers with their workload. By automating tasks, providing personalized instruction, and gathering and analyzing data, AI can help teachers to be more effective and to free up time so that they can focus on what they do best: teaching. our key recommendation is to tease out the strengths and limitations of AI models inside forthcoming edtech products and to focus on AI models that align closely to desired visions of learning. AI is now advancing rapidly, and we should differentiate between products that have simple AI-like features inside and products that have more sophisticated AI models. Looking at what's happening in research and development, we can see significant effort and push toward overcoming these limitations. We noted that decision makers need to be careful about selecting AI models that might narrow their vision for learning, as general artificial intelligence does not exist. And because AI models will always be narrower than real world experience, we need to proceed with systems thinking in which humans are in the loop, with the strengths and weaknesses of the specific educational system considered. We hold that the full system for learning is broader than its AI component.

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