

Assessing the impact of seasonal changes on advertising revenues in the age of digitalization and sustainability: A print-visual media business example

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ABSTRACT

This study mainly aimed to investigate the impact of seasonal changes on media advertising revenues (AR) in R environment through a visual-print media company example. So, the study primarily aimed to examine whether visual, print and internet ARs were affected by seasonal change. The study also aimed to indicate the trends of visual/ print/ and internet ARs over time in the light of seasonality. Furthermore, it was also aimed to make AR estimates for the next year with the best performing methods covering ARIMA and ETS. Methodologically, R programming language and its libraries were used together with ARIMA and ETS time series models. The data set consisted of a monthly ARs series consisting of 180 rows covering the period between January/2007-December/2021 and having a sufficient number of observations for the application of the models. Data were analyzed with R and next year's forecasts were done with ARIMA and ETS. The study revealed that all AR types were affected by seasonal changes in the specified period and included seasonality, i.e. specially in the summer months. Additionally, it was observed that AR types have different trends despite containing seasonality. The study found that visual ARs denoted a slight downward trend including seasonality during the period. It was also indicated that print ARs reflected a very rapid and drastic downward trend covering seasonality. The study also revealed that internet ARs showed a very rapid and sharp upward trend compared to the other two AR types despite having seasonality. Furthermore, taking into account the calculated error metrics, it was found that the ARIMA model showed the best estimation performance in both i.e. visual and internet ARs. On the other hand, the ETS model indicated the best estimation performance in print ARs. Accordingly, estimations of the visual/print and internet ARs for the next year were made with the best performing methods. It was pointed out that estimated ARs included seasonality in the summer months and revealed similar results to the previous trends based on historical data.

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Introduction

Media companies are organizations with social responsibility. In this respect, these organizations, which have a social nature, aim to meet the society's need for information and news and also fulfill a public duty. Written and visual media have begun to experience various changes and transformations since their inception, also under the influence of developments and advances in the field of communication and technology. With the technological development and digitalization era we are in, developments in mass communication tools have brought new media to a much more effective position. Although media companies are social institutions, they also have the nature of commercial enterprises and, like other businesses, they must generate income in order to perform their duties and continue their activities.

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Advertising revenues are one of the most important income items for media companies. From a sectoral perspective, the largest revenue item in the media sector is also advertising revenues. In particular, with the impact of technological developments, sustainability, seasonality, intense competition and digitalization, the importance of analyzing advertising revenues and its subcomponents (visual media, written media, internet media) and making accurate future forecasts has increased significantly in the current era in order for media companies to continue their existence and maintain their sustainability.

Media companies, which are also commercial businesses, try to estimate advertising revenues, which are the most important income item, while making short and long-term plans to continue their activities. Media companies also make decisions about advertising investments according to these estimates. However, in the light of technological developments, increasing digitalization and intensive competition, it has become increasingly difficult for media companies to maintain the height of advertising revenues, ensure their increase and make accurate forecasts for the future.

R environment language together with the time series models and forecasting methods such as ARIMA and ETS, help in making these decisions. It is assumed that advertising revenues estimated by ARIMA or ETS analysis will be similar to the past in the future, for this purpose, forecasting models are obtained with many programming languages such as the R environment, and after the validity of these models is investigated, the future period values of the desired variable are tried to be estimated in the analyses made with forecasting models such as ARIMA and ETS.

This study mainly aimed to investigate the impact of seasonal changes on media advertising revenues through a print & visual media company example. In the study, time series analysis was performed in the R environment and the changes in advertising revenue types over time were visually analyzed. Advertising revenue types were analyzed by separating them into visual, print and internet advertising revenue sub-components that include trend and seasonal change effects. Furthermore, it was also aimed to make future advertising revenue estimates for the next year based on seasonal time series simulations. For this purpose, it was also investigated to reveal which types of advertising revenues ETS and ARIMA models provide better performance.

Studies conducted in the R environment for media companies are very rare. Therefore, it is evaluated that our study is important and will contribute to the literature because it is the first study to examine a number of important variables and items (i.e. media business, seasonal changes, media advertising revenues, visual advertising revenues, print advertising revenues, internet advertising revenues, R programming language and libraries, covered period, data set in the R environment, ARIMA and ETS methods, data visualization, future forecasting) together with a print& visual media company example.

Methodologically, R language and its libraries were used together with ARIMA and ETS models in order to analyze the effects of seasonal changes on advertising revenues and forecasting the revenues for the next year. The data set consisted of a monthly advertising revenues series consisting of 180 rows covering the period between January/2007-December/2021. Data set has a sufficient number of observations for the application of R, ARIMA and ETS models which are convenient for seasonal time series simulation analysis.

The study consists of four sections. The first section covers introduction. Second part contains conceptual and theoretical background. In this section, important concepts and related sub-titles such as advertising and media economics, budgeting in media businesses, increasing importance of ARs in media business budgets, effects of digitalization and sustainability on media ARs, impact of seasonal changes on media ARs, estimating ARs for media companies are briefly introduced. Agency theory and related studies are also included in this section. The third part includes a research and methodology. In this part, the impact of seasonal changes on ARs is analyzed using R programming language and libraries through a written-visual media company example. ARs are analyzed in the R environment by separating them into visual, print and internet AR subcomponents. Based on the analysis in the selected period, seasonality and trends are also visualized in terms of visual/print/internet ARs. This part also includes the aim of the research, its significance and contribution to literature, research model and method, used data, sample, R and its libraries, and limitations. The fourth part consists of statistical analysis and findings. In this chapter, ARs for the next year are estimated using ARIMA and ETS methods, taking into account seasonality effects. By determining which method provides the best performance with sub- AR revenue components, the media company's final ARs for the next year are estimated in detail. The study ends with conclusions and references.

Literature Review

Conceptual and Theoretical Background

The Concept of Media, Its Definition and Scope

Media is defined in the dictionary in its most general form as “communication medium” and “communication tools” (TDK, 2024). In fact, media refers to the infrastructure necessary for communication between people and the environment in which this communication is established. Thanks to the opportunities it has, media fulfills the functions of informing, holding together and informing the society with sound, writing and images, while it is a mass communication tool that directs and influences the society through advertisements (Lokmanoglu, 2022).

Media, which is divided into two main groups as visual and written press and is frequently encountered in daily life, includes various mass communication tools such as newspapers, magazines, radio, television and the internet. Mass communication tools within the

scope of media have emerged mainly due to the need to receive and disseminate news. In this context, it can be said that one of the basic functions of the media is to provide news. Beyond the function of providing news, media is a player that plays important roles in the economy today and has an economic function by being in the service sector. In the economic conditions we are in, media is a large sector that feeds on advertising revenues and can direct people with its publications. Although media generally refers to communication tools and news, it also refers to a sector that has an economic role in itself. Today, those who use communication tools are active players in the media. Those who are not professionally involved in the media sector can easily do business, earn income over the internet, make publications and increase their awareness by using the internet and social media. Therefore, the area covered by the media sector is expanding day by day (Akgul & Ayer, 2018).

Traditional Media and New Media

Media tools can be grouped under two headings as traditional and new media. While traditional media includes radio, television and written press, new media tools do not include such distinct categories. The reason for this is that a new media tool emerges every day. Basically, new media tools can be examined as social media, internet news sites, personal sites and forums, blogs, dictionaries where people can share (Dai & Yacuz, 2019).

With the spread of digitalization and the internet, ways of doing business have changed and the media sector has also been affected by this transformation. In a sector where technology is a prerequisite for competition, the investments required by digitalization require serious financial power for media companies. Thanks to the internet, newspapers, magazines, television broadcasts and radio content have become accessible online. Media companies should take steps in line with the requirements of the changing age and adapt to the different behaviors of readers, viewers and listeners. Printed media is one of the areas where the transformation towards new media is most intensely felt with the advantages offered by the internet. News can now be followed on the websites of printed publications or on digital platforms. Therefore, printed media should turn to online subscription models and develop their technical infrastructure to adapt to future digital innovations. The situation is different for visual media. While radios are rapidly transferring their content to the internet and becoming accessible from anywhere, televisions offer content to viewers with digital infrastructures. While access to past content has become possible with the advantages of the internet such as archiving, the future direction of televisions' integration with the internet remains uncertain (Bulunmaz, 2013).

Advertising and Media Economics

Advertising is the non-personal presentation and promotion of ideas, goods or services by an identified sponsor (Kotler (2000). Advertising can also be defined as any non-personal communication and paid message about an organization, product, service or ideas presented by a sponsor through various media such as television, radio, magazines, newspapers or billboards (Bennet, 2006). Advertising can take a number of forms, including retail, trade, industrial, institutional, advocacy, comparative, cooperative, direct-mail, informational, outdoor, persuasive, product, reminder, point-of-purchase, and specialty advertising (Adekoya, 2011; Kumar et al., 2013).

Media companies need a strong financial structure that will ensure that revenues exceed expenses in order to survive in economic conditions. The intensity of competition and low advertising revenues lead to financial difficulties and trigger a race to get a larger share of the advertising pie. Advertising revenues are vital to the sustainability of businesses since other resources are insufficient to cover costs (Media companies have two basic customer groups: viewers/readers who consume content and advertisers who purchase advertising space. Dependence on advertising revenues makes it difficult to balance between these groups. Circulation in the written press and ratings in the visual press are critical factors affecting advertising preferences. For this reason, media companies try to meet customer expectations by increasing quality in competition (Bulunmaz, 2011; Bulunmaz, 2013).

With the spread of new media technologies, circulation and advertising revenues in the written press have decreased, and there has been a shift from paid print publications to internet journalism. To ensure sustainability, circulation increasing strategies, conversion to new media tools and efforts to increase advertising revenues are important. Advertising revenues in internet journalism depend on the number of site visitors and the duration of their visits (Dai & Yavuz, 2019).

Agency Theory and Media Businesses Budgeting

Agency theory is a theoretical approach that essentially explains the relationship between the power holder (principal) and the executer (agent). In other words, this approach addresses the relationship between an executive party (agent) who undertakes the work and another party (principal) who grants the authority to do this work. It is very likely that conflicts of interest will arise from time to time between the principal (shareholder/owner) and the agent (senior management/managers). The agent has the responsibility and obligation to look after the interests of the principal (Denkdemir & Aksoy, 2024). However, personal interests may lead to a conflict of interest between the parties and the agent may push this responsibility and obligation to the background and sometimes violate it (Oner, 2018). Agents generally have much more knowledge about the structure and activities of the business than the principal because they have the executive function and the executive role (Eilifsen et al., 2006).

This situation increases the responsibility of establishing and monitoring/supervising the management processes of basic internal systems (accounting, internal control, auditing, risk management, IT, purchasing, procurement, sales, communication, etc.), especially the budget system, in order to ensure that the interests of the principals are protected and to achieve the goals of the

business. Similarly, agents are responsible for ensuring that the internal systems are operated effectively in order to protect the interests of the business owners and shareholders and to achieve the business goals (Pratt & Zeckhauser, 1985).

In line with this theoretical framework, it is important to establish, operate and supervise the budget system for monitoring and managing income and expenses in corporate media businesses. The responsibility for establishing the budgeting system for activities including income and expenses and for monitoring and supervising to prevent conflicts of interest belongs to the principal (owner/shareholder). A strategic and effective budget management, including company income and expenses, contributes positively to corporate governance and sustainability (Aksoy, & Hacıoglu, 2021). The responsibility for the effective operation of the budget system and informing about the results belongs to the agent (top management) who assumes the executive role.

Increasing importance of advertising revenues in media budgets

For businesses, budgeting is one of the main corporate instruments and safety valves for achieving targets, corporate governance, good management, risk assessment and sustainability. Failure to manage budgets well, including the revenue budget, and failure to accurately estimate revenues poses risks in terms of achieving targets and sustainability (Yuzbasioglu & Aksoy, 2021).

In order to maintain their competitive advantage and use their budgets as effectively as possible, they need to identify and analyze their most important sustainability activities (Aksoy et al., 2022).

For businesses in the media sector, advertising revenues are in the most important sustainability activity category. Advertising revenues are generally one of the most important financial resources and largest income items of media companies. This type of revenue plays a critical role in the budgets of media companies. These revenues are of great importance to media companies in terms of covering expenses, operational sustainability, digitalization, competitive advantage, content production compatible with fluctuations due to economic/cyclical conditions, financing of operational expenses and technological investments, etc. It is observed that a business model based on advertising revenues is valid and dominant in both traditional media and digital media.

Media companies depend on advertising revenues to cover costs, make profits, achieve goals, ensure growth and sustainability. Digitalization, changing consumer habits and fiercely competitive environment have greatly increased the importance of advertising revenues for media companies and the dependence of media companies on advertising revenues. Advertising revenues are the main income item of media organizations that offer free content in particular. Traditional media, on the other hand, tries to balance its budget with advertising revenues to a large extent in addition to subscription and sales revenues in the face of economic conditions and fluctuations.

The main elements that reveal the increasing importance of advertising revenues in the media can be summarized as follows: Advertising revenues are the main source of financing and the basic element of the media sector. The opportunities brought by digitalization and digital platforms have become attractive to advertisers with targeting, performance measurement and innovative advertising formats. Advertising revenues support content production and enable users to consume free content. Tools such as programmatic advertising and social media ads contribute to the increase in media revenues. Advertising revenues enable media organizations to offer diverse and high-quality content. New formats such as video, podcasts and interactive content are becoming widespread thanks to advertising revenues. In addition, it has been observed that the importance of benefiting from new media and the potential of increasing internet advertising revenue streams has increased recently (Miklosik et al., 2018).

It is natural that awareness of internet advertising revenue will contribute positively to the media revenue budget. Additionally, advertising revenues create local and global impact. Thanks to media advertising revenues, small businesses have the opportunity to reach their target audience, and media companies have the chance to grow internationally. On the other hand, advertising revenues enable media organizations to maintain their market share, invest in new technologies, and strengthen their competitive positions by providing a competitive advantage. Furthermore, advertising revenues are also important in terms of sustainability and social responsibility. Consequently, advertising revenues are indispensable for the media sector to continue its existence, adapt to innovations, and produce quality content. Factors such as digitalization, sustainability, and increasing competition have further increased the strategic importance of proper management of advertising revenues and future forecasting for media companies.

Effects of Digitalization and Sustainability on Media Advertising Revenues

Media advertising revenues generally refer to advertising revenues generated through channels such as TV, radio, digital platforms and social media. Increasing competition, digitalization and sustainability have created significant and multi-dimensional effects on media advertising revenues. These effects are shaped by a combination of factors such as technological transformation, changes in consumer behavior and increased environmental awareness.

Digitalization and technological developments have caused a wide range of effects on businesses, especially changes in business models (Hacıoglu & Aksoy, 2021). Digitalization has also fundamentally changed the advertising sector. The spread of digital technologies has had a major impact on business models. In the advertising world, digitalization has had a changing effect on methods of reaching target audiences and advertising revenue estimates. While traditional media platforms (TV, radio, newspaper) experienced a decline in advertising revenues, digital platforms quickly filled this gap. Digital advertising budgets have increased, platforms such as Google, Facebook, Instagram and TikTok have become attractive to advertisers by offering targeting and measurement opportunities. Automated advertising buying and selling has made advertising budgets more effective and has put

media organizations under pricing pressure. Recently, the change in content consumption and the fact that consumers now consume content from smartphones and other digital devices has caused digital media advertising revenues to grow.

Sustainability creates both direct and indirect effects in the advertising sector. In the age of sustainability, the necessity of integrating environmental, economic and social sustainability into advertising strategies in business processes has become evident. The increase in green advertising and transparency is that advertisers are emphasizing the environmental sensitivity of their brands with sustainability-focused messages. This has created a new advertising segment that appeals especially to consumers with environmental awareness. While written/printed media advertising revenues are decreasing in parallel with the decrease in paper use, the tendency towards environmentally friendly digital alternatives is increasing. Brands' social responsibility projects and sustainability-focused advertising campaigns increase the reputation of brands and are also effective in shaping advertising revenues. On the other hand, the intensification of competition requires a more strategic and measurable distribution of advertising budgets. New players are emerging, influencers and content producers are attracting a portion of advertising revenues to themselves instead of traditional media. In addition, the pressure of global platforms is increasing, global platforms such as YouTube and Netflix are seriously suppressing the advertising revenues of local media organizations. In addition, subscription-based models have emerged as a new revenue model, while reducing revenue from advertising. Therefore, while media advertising revenues are growing with the transformation brought about by digitalization, they are also shaped by the pressures created by sustainability and competition. In the future, Artificial Intelligence (AI)-supported advertising, metaverse-based advertising experiences and campaigns that prioritize environmental awareness will be the growth points of the sector. Media companies must quickly adapt to these changes, both to catch up with digitalization trends and to create a sustainable and competitive business model.

Seasonal Changes and Media Advertising Revenues

Seasonality refers to systematic changes and fluctuations in advertising revenues, especially those related to the seasons, during certain periods. Seasonality can directly affect advertising revenues of businesses in the media sector. While seasonal fluctuations shape advertisers' strategies, media organizations also need to make effective plans in revenue management. For example, holiday periods or major sporting events can lead to significant increases in advertising revenues. This necessitates accurate modeling of seasonal components in time series analyses.

Significance of Accurately Estimating Advertising Revenues for Media Companies

In the age of digitalization, sustainability and intense competition, the importance of estimating advertising revenues in the media sector is increasing due to the dynamic structure and changing conditions of the sector. These estimates play a critical role in media companies' ability to make strategic plans, use their resources efficiently, maintain competitiveness and achieve sustainable growth.

Accurately estimating advertising revenues provides a wide range of benefits and advantages for media companies (such as effective budget planning, sustainable growth, effective risk management in uncertain and volatile times, reducing income imbalances, rapid response to changing customer demands, early awareness of the risk of a decline in advertising revenue and turning to alternative sources of income, strategic decision-making, long-term reputation and brand management, providing competitive advantage, resource planning, predicting market trends, focusing on new sources of income, advanced forecasting models, accurate forecasting supported by artificial intelligence and big data analytics, developing long-term strategies, flexibility against economic fluctuations and market competition). In other words, in the media world shaped by digitalization, sustainability and competition, accurately estimating advertising revenues is a vital tool for companies to progress successfully. Accurate forecasts provide a clearer understanding of the opportunities and risks in the sector, helping media organisations operate in a competitive, flexible and sustainable manner (Hyndman & Khandakar, 2008).

Related Studies

In this part of the study, some studies in the literature are presented below.

In a study conducted by Ali Salman et al. (2011), the impact of new media on traditional mainstream mass media was examined through the example of Malaysia. It was revealed that the emergence of new media caused traditional media to struggle, but print newspapers were able to generate advertising revenues, albeit at a decreasing rate, despite the existence of online newspapers. Additionally, it was pointed out that the two types of media supported each other, would not replace each other, and that the content of newspapers would continue to be news-based. It was also stated that although traditional media, whose circulation was decreasing, had their own online versions, they were not able to fully adopt new technology. Furthermore, it was stated that some TV channels also had online presences, and it was predicted that the usage rate of newspapers on their websites would increase in Malaysia, and that new media and traditional media would continue to coexist and reinforce each other.

Abdullahi (2015) examined the impact of advertising expenditure on sales revenue and profitability through a sample of publicly listed food and beverage companies in Nigeria. The study analyzed the dataset containing advertising expenditure, sales revenue and sales profitability figures for the period 2000-2012 using Correlational and Ordinary Least Square regression method. The result showed that advertising expenditure has no positive and significant relationship with sales revenue of the companies. It also showed that there is a positive and significant relationship between advertising and profitability of the companies.

In his study, Atalay (2020) analyzed the data of unemployment and inflation rates among financial risk factors of Turkey between 2008-2014 by using TÜİK data and R programming language and its libraries in order to enable more effective understanding, summarization and interpretation of data visualizations. As a result, he visualized the data of unemployment and inflation rates among financial risk factors of Turkey and suggested that a Turkey library should be created in the future R programming language and animations should be developed in three dimensions.

Cosar's (2022) study examined the changing structure of media and advertising investments in Turkey during the transition from traditional media to digital media for the period 2010-2017. It revealed that digital media was on the rise in the selected period, but it has not yet displaced traditional media, which has the highest share in terms of advertising revenues. It also suggested that advertisers should not ignore digital media and that the operating structure of virtual media that appeals to today's target audience should be used as an alternative.

Kesek (2010) investigated the effects of marketing variables on advertising revenues in the Istanbul media sector and found that internet journalism surpassed television broadcasting and print publishing, and marketing variables such as high circulation, objective publishing, supplements, coupons and promotions increased advertising revenues.

Akanbi et.al. (2011) investigated the impact of advertising on sales revenues with particular reference to a Bottling Company using linear regression method using ordinary least square regression method. Secondary data was collected from the annual financial records of the period of 1999-2009. The study revealed that there was a positive and significant relationship between advertising and business sales revenues.

In another study by Bulunmaz (2010) analyzed the financial structure of media companies and their income before and after the 2001 crisis. He indicated that although advertising revenues had a significant share in media company revenues, a decrease in advertising revenues was observed during the 2001 crisis, media companies went through a difficult period during this period, and advertising revenues returned to normal levels in the four years following the crisis.

In their study, (Sajuyigbe et al., 2013) examined the impact of advertising on sales revenue through the case of Nigerian Breweries Plc. Data were obtained from structured questionnaire and annual reports and accounts of the companies for six years. The sample was 90 respondents and the data was analyzed using SPSS-16. The study concluded there was a strong positive significant relationship between advertising and sales revenues.

In another study, Sonmez and Ozkan (2021) examined the effect of advertising expenditures on profitability and net sales revenue growth with the help of data from 2011-2019 of 18 companies whose shares are traded on BIST and operate in the Food, Beverage and Tobacco sectors. The system GMM analysis method was used and it was concluded that there was a positive significant relationship between advertising expenditures and the change in profitability and sales revenue.

Dai and Yacuz (2019) presented a comparative revenue table in their study based on the data regarding the financial structures of the Hurriyet Newspaper and its internet channel in the third period of 2017 and 2018. They touched upon the circulation revenue and advertising revenue losses in traditional print media due to the emergence of new media tools and also showed the increase in advertising revenues through financial tables thanks to the functionality of new media. When annual advertising research studies are examined, they stated that the share of digital advertisements tends to grow rapidly and suggested that the financial reports of news sites should be published in order to provide important data for researchers.

In a study conducted by Adeolu et al. (2005) investigated the effect of advertising on consumers' purchase of Bournvita branded product manufactured by a company. The study indicated that advertising have a great impact and contribution on consumers' purchasing choices towards Bournvita.

In his study, Celik (2018) made the last 120, 60, 30 and 7-day forecasts using the ARIMA model using the time series analysis on a company basis using the R programming language using the BIST30 data for the period 2010-2018. As a result, the Root Mean Error in the forecast of the 7-day test data of the BIMAS index taken as an example was lower than other daily forecast data. And he concluded that R is an effective tool for time series analysis and that finding the most suitable ARIMA model automatically saves time for researchers.

In Adekoya's study (2011), it was examined whether advertising is an incentive to purchase the product and showed that advertising encourage repeat purchase of the product.

In another study conducted by Eksi (2020) on the banking sector with panel test data, the relationship between advertising expenses and financial performance was investigated. It was concluded that the effects of advertising expenditures on financial performance were found to be positively significant on the market value/book value ratio, return on assets (ROA), return on equity, total deposits, total loans, and net interest margin ratio.

Adebayo (2012), investigated whether there is a relationship between advertising revenues and sales revenues and whether advertising is a predictor of sales revenues. Consequently, he found that advertising is a predictor of sales revenues and turnover.

In another study conducted by Dogusoy (2018) it was created a forecasting model in the R programming language for time series analysis. It was made electricity price forecasts by comparing supply-demand based models and time series models in the Turkish electricity market. When comparing the results for 2014 and 2017, the absolute error values were the lowest in time series analysis.

In the study of Bağcı (2020), monthly USD and Euro sales prices for the periods of 2014-2020 were estimated with the moving average model and exponential smoothing models. Error terms were calculated with the help of the estimated values obtained for each observation, and new estimation results were obtained by applying fourier series modification. It was indicated that conventional estimation models frequently used in analyses can produce much more accurate estimates with various modifications.

In his study, Goztepe (2018) aimed to make estimations about the future by analyzing the data obtained from the sensor that measures air pollution and to present these predictions numerically. In the study, the time series analysis of the data obtained from the chemical sensors was done in the R environment, while the ARIMA method was used in the time series analysis. The study presented the prediction results that there would be an increase in the amount of carbon monoxide in the air with numerical values and graphs.

In conclusion, although there are various studies in the literature on the media sector in Turkey, the R programming language and time series separately, it has been observed that there is no applied analytical study that addresses all of the variables, concepts and methods (i.e. *R-environment programming language and its libraries, print-visual media company, media advertising revenues, visual advertising revenues, print advertising revenues, internet advertising revenues, seasonal changes, ARIMA & ETS methods, the period covered, time series analysis, data visualization and future forecasting*) together. Therefore, it is evaluated that our study, which we think is a first in this respect, is significant and will contribute to the literature.

Analysis of Seasonality Effect and Advertising Revenues in the light of R, ARIMA and ETS

Seasonality refers to predictable fluctuations that recur at certain times during a year. These effects on advertising revenues are often noticeable, such as increased demand during holiday seasons. Understanding and analyzing such seasonal fluctuations allows businesses to optimize their marketing strategies. Digitalization has accelerated the transition from traditional advertising models to digital platforms. Digitalization has significantly transformed the media sector, accelerating the shift from traditional advertising models to digital platforms. While internet-based advertising creates new sources of income for media organizations, declines in advertising revenues in traditional media are observed. In particular, the interactive structure of digital platforms, features such as data analytics and personalization necessitate the restructuring of advertising strategies.

However, the growth of digital advertising revenues increases competition in the sector and further increases the importance of forecasting methods. With this transformation, seasonality in digital advertising revenues has become more complex and the importance of forecasting methods has increased. With the adoption of data-driven methods in digital media, advanced different analysis methods and tools such as R environment and models such as ARIMA and ETS (SFU, 2024; Hyndman & Khandakar, 2008). help businesses optimize their advertising revenues. In the analysis and future forecasting of advertising revenues in light of the seasonality effect, time series analysis methods such as R programming language, ARIMA and ETS can be used. Through these tools and methods, it is possible to see the seasonal trend of advertising revenues, which are an important income item of media companies, whether they are exposed to seasonality and to estimate advertising revenues for the future (for example, next year) based on their past data. Explanatory information on R, ARIMA and ETS is provided under the following subheadings.

Research and Metodology

Aim of the Research

This study mainly aimed to investigate the impact of seasonal changes on media advertising revenues in the R environment through a visual-print media company example. Accordingly, the study primarily aimed to examine whether visual, print and internet media revenues were affected by seasonal change. The study also aimed to indicate the trends of visual/ print/ and internet advertising revenues in the selected period in the light of seasonality. Lastly, after determining which of the ARIMA and ETS time series analysis methods performed better in estimating advertising revenues in R, it was aimed to estimate the media advertising revenues for the next year with the best performing methods.

Significance and Contribution of the Research

Studies analyzing the impact of seasonal changes on media advertising revenues together with R programming language and, ARIMA and ETS models are quite rare. This study focuses on revealing the impact of seasonal changes on media advertising revenues using R programming language. Additionally, an estimation for the next year will be done with methods of ARIMA and ETS in R environment. Therefore, as far as is known, it is evaluated that our study is significant and will contribute to the literature because it is the first study to take into account several important variables and components (i.e. *R programming language and libraries, media business, seasonal changes, advertising revenues, print advertising revenues, visual advertising revenues, internet advertising revenues, data visualization, covered period, monthly data set in R environment, ARIMA and ETS methods, future estimation*) together through a print&visual media company example.

Methodologically, R language and its libraries were used together with ARIMA and ETS models in order to analyze the effects of seasonal changes on media advertising revenues and forecasting the ad revenues for the next year.

Scope, Universe, Sample, Data, Research Method

Within the scope of the research, one of the written & visual media companies, which is selected as a sample representative of the Turkish media sector, is considered. The main reasons for selecting the sample company in the study are briefly as follows: Being one of the written & visual media companies in media sector, having an established corporate structure, managed with corporate governance, operating in different media areas including publishing newspapers/magazines in the print media field, doing television and radio broadcasting in the visual media field and doing internet broadcasting in digital media field, etc.

The research scopes the advertising revenues of this media company together with the sub-components of these revenues (print media revenues, visual media revenues, internet media revenues) as well. The interaction of media advertising revenue components with seasonal changes is analyzed and future advertising revenue estimates are also made based on these sub-components of revenue.

The data set consisted of a monthly advertising revenues series covering the period between January/2007-December/2021. Data set consisting of 180 rows has a sufficient number of observations for the application of R, ARIMA and ETS models which are convenient for seasonal time series simulation analysis.

Limitations

The limitations of the study are as follows: the selected sample single print visual media company, sample period data, advertising revenues, and the statistical analysis method applied are limited. Therefore, in order to obtain more general data, it is recommended to expand the scope and address the subject more generally with more companies in the media sector, different periods, different data sets and different methods.

Analysis of Media Advertising Revenues with R

In this part of the study; the effect of seasonal changes on the advertising revenues of a media company with written and visual activities in USD was examined with the R programming language. In addition, the future of the advertising revenues including seasonality was estimated based on ARIMA and ETS time series models. The monthly revenue series used in our model consists of visual, print and internet advertising revenues that include trend and seasonal effects.

In order not to take up too much space in the text with detailed tables within the scope of statistical analyses and not to exceed the article page limit, it was preferred to present the majority of the analytical tables and graphs together in the Consolidated Table 1 in the Appendix.

R Programming Language and Its Popular Libraries

R is an open source programming language designed by Ihaka and Gentleman for statistical computing, data visualization and simulation. First published in 1997, R stands out with its updatable structure and extensive add-on package support. R stands out as an effective language for both beginners and advanced users with its easy-to-learn and easy-to-use structure (R-project, 2024).

The most basic advantages of R can be listed as follows: Flexible data processing for data analysis and processing, extensive library support, ease of creating advanced graphics and visualization, etc. In other words, open source R offers an integrated tool package for processing, calculating, and graphical display of data. It also supports the integration of codes written in different programming languages and provides extensive functionality for millions of users (Celik, 2018).

The “dplyr” Data Manipulation library is a package developed by Wickham in 2014. This library, which is the most widely used in R, is designed to perform data manipulation easily, quickly and flexibly. This library, which simplifies data processing processes, has a user-friendly structure that is different from basic R commands. *The “ggplot2” Data Visualization Library* is a package developed by Wickham and is a process performed in row or column breaks to obtain meaningful information about a data set. This library allows users to produce powerful and flexible visual graphics based on data. A wide range of advanced visual outputs can be created and exported, from simple graphics to customized visuals (Atalay, 2020; Nayansak, 2021). *The “lubridate” library* is an R package that makes it easy to work with dates and times. Created by Grolemund and Wickham and currently maintained by Spinu, Lubridate enables multidimensional analysis of date and time variables (Oztürk, 2021). *The “tsibble” (ts) package* is another R language library that support time series and forecasting in R environment. This package provides a data infrastructure for tidy temporal data. The “forecast” library is one of the packages used to make predictions from time series data using models such as ARIMA and ETS in the R environment (Goztepe, 2018; Hyndman & Khandakar, 2008).

Uploading Media Advertising Revenues to R Environment and Converting

In our study, before uploading the media advertising revenue series arranged by months and years into the R environment, basic libraries such as “library(ggplot2)”, “library(dplyr)”, “library(lubridate)”, “library(tsibble)” and “library(forecast)” were downloaded and R was made ready for use. Afterwards, our date and advertising revenue series consisting of 180 rows and 4 columns in R was

read with the “readxl” command and then, in order to find the relationship between date and revenue data, our data was converted into time series data with the “ts” function.

Accordingly, while reading our data, we define the data in the first column as date and the data in the second, third and fourth columns as numeric to the model. In the “ts” function, the starting year of the data set was selected as 2007 and since the data was assigned monthly, the frequency of the time series was selected as 12. Frequency is the number of observations per unit time. Accordingly, when the frequency is assigned daily, it is written as 7, when it is assigned seasonally or quarterly, it is written as 4, and when it is assigned annually, it is written as 1.

When this function is defined sequentially as follows, a partial screenshot of our 180-line “data” data in the R environment is presented under the relevant subheading of Consolidated Table 1: (1) in the Appendix due to the page limit of the article.

```
data = readxl::read_excel("_Ad_Revenue-usd.xlsx", col_types = c("date", "numeric", "numeric", "numeric", "numeric"))
data
```

Secondly, the screenshot of the statistical summary results of the date and advertising revenues data in the R environment of our model established with the “summary” function is given under the title of Consolidated Table 1: (2). The table includes the largest and smallest values of our data set, as well as statistical data such as mean value, median value and quartiles.

In order to find the relationships between the date and income data in (in order of Visual/ Print/ Internet/ Total) advertising revenues, our data was converted to time series with the “ts” function as follows.

```
Visual_Advertisement<- ts(data$Visual, frequency=12, start=c(2007,1))
Visual_Advertisement
```

```
Print_ Advertisement <- ts(data$Print, frequency=12, start=c(2007,1))
Print_ Advertisement
```

```
Internet_ Advertisement <- ts(data$Internet, frequency=12, start=c(2007,1))
Internet_ Advertisement
```

```
Total_ Advertisement <- ts(data$Total, frequency=12, start=c(2007,1))
Total_ Advertisement
```

In conclusion, new time series created which indicate the distribution of (in order of) Visual/ Print/ Internet/Total Advertising Revenues in the R environment by month and year between the selected analysis period were revealed in the Consolidated Table 1: (3, 4, 5, 6) in the Appendix in order not to exceed the page limit.

Analysis, Findings and Visualization of Advertising Revenues in R Environment

In order to better recognize the data distribution in the R environment, it is possible to visualize the data with the help of the “ggplot2” library. The ggplot() function is used in data visualization in R environment. In the ggplot() function, we include the data set name (data) and the aesthetic argument called aes() in the horizontal (x-axis) and vertical (y-axis) axes with the column names of the variables we will use. Then, when we add the “gam” model, which allows generalized linear models to work together with arbitrarily smooth functions, and the “lm” model, which allows the linear model to work, to the point distribution graph of the data with the geom_point() function, it will also help us see the trend in the shapes (Hyndman & Khandakar, 2008).

Accordingly, after applying the following functions to data set transferred to the R environment, it will be possible to visualize and show the trend of advertising revenues in terms of its main components in the R environment, taking into account the seasonality effect.

```
ggplot(data, aes(x=Date, y=Visual_Advertisement)) + geom_point() + geom_smooth(method="gam",color="red") +
geom_smooth(method="lm")
```

```
ggplot(data, aes(x=Date, y=Print_Advertisement) + geom_point() + geom_smooth(method="gam",color="red") +
geom_smooth(method="lm")
```

```
ggplot(data, aes(x=Date, y=Internet_Advertisement) + geom_point() + geom_smooth(method="gam",color="red") +
geom_smooth(method="lm")
```

In conclusion, based on the results of the analysis performed with the above functions in R environment, the final trends and visualization of advertising revenues in terms of its main components in the light of seasonality are presented in the table 2 below.

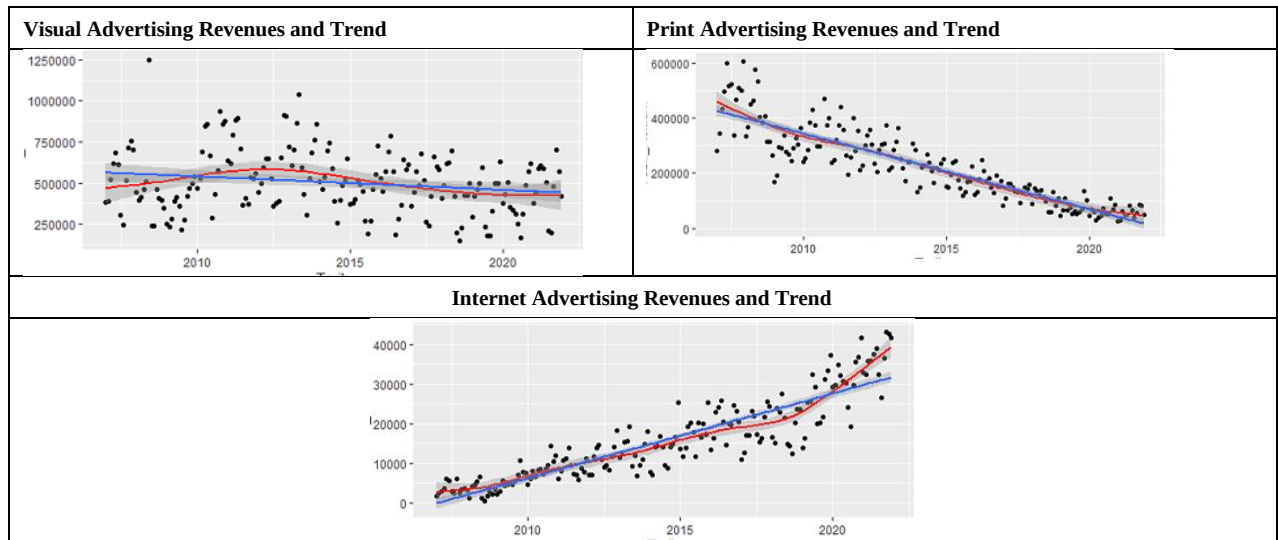


Figure 1: Visualized Trends of Advertising Revenues; Source: Authors

In the graphs in Table 2, the blue color (linear model) shows the trend of advertising revenues including seasonal effects, while the red color (gam model) point out the trend of net advertising revenues adjusted for seasonal changes.

In conclusion; the results of the analysis in R environment in analytical Table 2 indicated that;

- All advertising revenue types were affected by seasonal changes in the specified period and included seasonality, i.e. specially in the summertime.
- Advertising revenue types have different trends despite containing seasonality.
- Visual advertising revenues denoted a slight downward trend including seasonality during the period.
- Print advertising revenues reflected a very rapid and drastic downward trend including seasonality.
- Internet advertising revenues showed a very rapid and sharp upward trend compared to the other two advertising types despite having seasonality.

Estimating how seasonality affects advertising revenue trends using the R Decompose function and Findings

In time series analysis, the aim is to analyze the relationships between past and current data and to predict future data. The quality of the predictions makes it easier to achieve future plans, budget and business goals. The methods such as smoothing, exponential smoothing (ETS- Error Trend Seasonality), decomposition, Autoregressive Integrated Moving Average (ARIMA), SARIMA (Seasonal Autoregressive Integrated Moving Average), Stationary, Differences, trend, naive, regression, autorefractive, S-curve, etc. are used in time series analysis. It is important whether the series is stationary or not in time series analysis. In a stationary series, the mean is around a fixed value and the variance is low. The averages of the values at any moment are almost equal to each other. Correction means correcting the fluctuating parts of the series. Examples of correction are moving averages or exponential correction. Differences are the process of subtracting the values of the series from previous values. The degree is indicated by d. A time series is separated under four headings: observed, trend, seasonality and randomness (Hyndman & Khandakar, 2008).

Another method used in time series analysis is Decomposition. Decomposition method is one of the easiest methods to make and understand in short-term forecasts. This method is the method that calculates the prediction of the time series from the estimate of the components. Decomposition means separating the series into trend and seasonal effects. The course of the time series will be useful in determining the behavior pattern for the future. In R, time series can be separated into their components with the decompose function and the trend of the series can be revealed. Accordingly, advertising revenue time series in the R environment were decomposed into their sub-components with the following decompose functions. In this way, it was tried to reveal how the effect of seasonal changes (seasonality) appeared in the sub-components of media advertising revenue trends.

```
decomp <- decompose(Visual_Advertisement)
plot(decomp)
```

```
decomp <- decompose(Print_Advertisement)
plot(decomp)
```

```
decomp <- decompose(Internet_Advertisement)
plot(decomp)
```

Due to page limit, the trend analysis results made with the R-decomposition function in graphs were given in Consolidated Table 1: (7, 8, 9) in the Appendix.

In conclusion, According to the results of the trend analysis performed with the R-decomposition functions above revealed that;

- There is a seasonal effect on visual advertising revenues and they are subject to seasonality.
- Visual advertising revenues have a slightly increasing trend with fluctuations due to seasonality.
- There is a seasonal effect on print advertising revenues and they are subject to seasonality and they have a downward sharply decreasing trend.
- There is a seasonal effect on internet advertising revenues and that when seasonally adjusted, internet advertising revenues have a rapidly increasing trend upwards.

Seasonal Time Series Analysis, Findings and Forecasting Next Year's Ad Revenues with ARIMA

In this section, media advertising revenues for the next year were estimated with the ARIMA method in the R environment and it was revealed which advertising revenue subcomponent the next ARIMA method showed the best performance in estimating.

The ARIMA method procedure, analyzes and forecasts equally spaced univariate time series data using the AutoRegressive Integrated Moving-Average (ARIMA) model. It predicts a value in a response time series. ARIMA methods use differencing to convert a non-stationary time series into a stationary one, and then estimate future values from historical data. Thus, the general notation for the order of a seasonal ARIMA model with both seasonal and nonseasonal factors is $ARIMA(p,d,q) \times (P,D,Q)_s$. The term (p,d,q) gives the order of the nonseasonal part of the ARIMA model; the term $(P,D,Q)_s$ gives the order of the seasonal part. The term (p) is the number of autoregressive (AR) terms, the term (d) is the number of differencing operations required for stationarity and term (q) is the number of moving average (MA) terms. P represents the seasonal autoregressive degree, D represents the seasonal differencing number, and Q represents the seasonal moving average degree. The value of s is the number of observations in a seasonal cycle, i.e. it refers to the seasonal period. For example, the notation $ARIMA(0,1,2) \times (0,1,1)_{12}$ describes a seasonal ARIMA model for 12 month series (SFU, 2024).

The details of the modeling performed with the “auto.arma” function, which automatically selects the model that will give the best performance on R, were examined. First of all, the ARIMA model was automatically created on the data set with the “auto.arma” function below for the analysis. According to the selected automatic model, it was aimed to estimate the next year's advertising revenues for 12-month periods with the parameters we defined with the “forecast” function. In the analysis, the performance of the ARIMA model on advertising revenues and the forecast graph for the next year were drawn with the “plot” function. The numerical forecast results of the model were reached with the “frcA” command (Duru, 2007).

Visual, print and internet advertising revenues were estimated with the following functions, respectively, using ARIMA in the R environment. It was seen that the automatically generated model in the R environment was $ARIMA(2,0,1)(2,1,1)_{12}$ for visual advertising revenues, $ARIMA(1,0,1)(2,1,1)_{12}$ for print advertising revenues and $ARIMA(0,1,1)(0,1,2)_{12}$ for internet advertising revenues.

```
data_VISUAL = Visual_Advertisement
fitA = auto.arima(data_VISUAL)
frcA = forecast(fitA, h=12)
plot(frcA)
```

```
data_PRINT = Print_Advertisement
fitA = auto.arima(data_PRINT)
frcA = forecast(fitA, h=12)
plot(frcA)
```

```
data_INTERNET = Internet_Advertisement
fitA = auto.arima(data_INTERNET)
frcA = forecast(fitA, h=12)
plot(frcA)
```

As a result of the analysis made with the ARIMA method based on the above functions, seasonality-containing Visual/Print/Internet/Total advertising revenues were estimated, and the estimation results were given in the Consolidated Table 1: (respectively, 10, 11, 12) in the Appendix on a monthly and yearly basis, in order not to exceed the page limit.

Additionally, the graphs of estimation results of visual/print/internet advertising revenues with ARIMA in the light of seasonality are presented in the Graph 2 below.

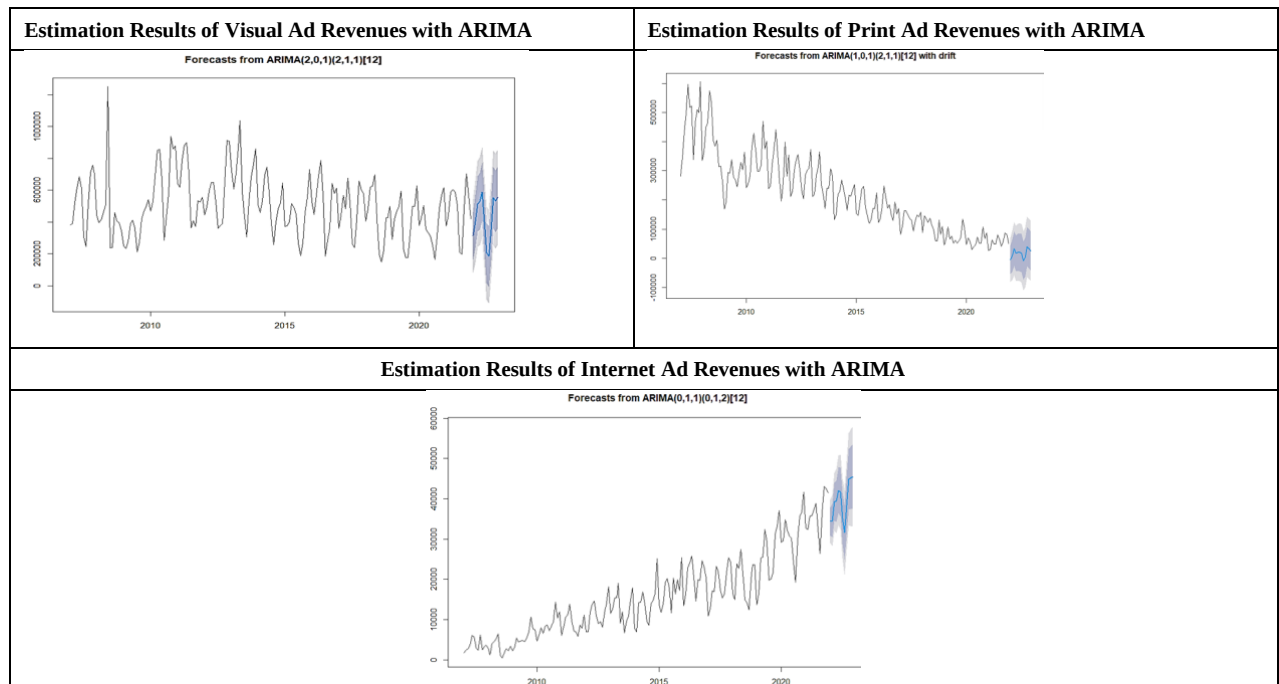


Figure 2: Estimation Results of Advertising Revenues with ARIMA for Next Year; *Source:* Authors

In conclusion, the estimating results of advertising revenues for the next year with ARIMA method above revealed that;

- i. There is a seasonal effect on visual advertising revenues. Seasonality is generally observed as decreases in the summer months and increases in other months similar to the past time series. Visual advertising revenues have a slightly increasing trend with fluctuations due to seasonality.
- ii. The print advertising revenues are also subject to seasonality and they have a downward decreasing trend similar to previous periods
- iii. There is a seasonal effect on internet advertising revenues that have an increasing trend upwards parallel to previous periods

Estimating Advertising Revenues for the Next Year with ETS

In this section, the advertising revenues for the next years were estimated by type with the ETS method. The ETS (Error, Trend, Seasonality) method is a model that clearly models seasonal and trend components and reveals seasonal effects and long-term trends more clearly. ETS has three components, namely error, trend and seasonality, and is a method that defines the specific interaction of the components with each other. In the model created with this method, if the time series is divided into these 3 components and the change of each over time changes exponentially, the multiplicative (M) model is selected, if it changes linearly, the additive (A) model is selected and the estimation is made accordingly. Therefore, the contents of error, trend and seasonality are given according to a certain taxonomy (Hyndman & Khandakar, 2008).

Error: "Additive" (A), or "Multiplicative" (M);

Trend: "None" (N), or "Additive" (A), or "Additive damped" (Ad), or "Multiplicative" (M), or "Multiplicative damped" (Md);

Seasonality: "None" (N), or "Additive" (A), or "Multiplicative" (M).

In this way, it was aimed to determine which model (ARIMA, ETS) showed the better performance in estimation. After the results and statistical error parameters of both methods were presented and compared, the model that gave the best performance for each advertising type was taken as the basis for estimating the next year's advertising revenues. Thus, it was aimed to have more realistic estimation results.

Accordingly, with the "ets" function which automatically selects the model that will give the performance on advertising revenues in the R environment, the ETS model was first automatically created on the data set with the "ets" function. According to the selected automatic model, the parameters we defined with the "forecast" function will be used to estimate the next year's advertising revenues for 12-month periods. The "plot" function also plotted the performance of the automatically determined model on advertising revenues and the forecast graph for the next year. We reach the numerical estimation results of the model with the "frcE" command. While modeling the advertising revenue forecast, the error component was selected as Multiplicative, the trend as None and the seasonality as Multiplicative, and automatic forecasting was performed. Likewise, for the estimation of visual ad revenues, the error component was selected as Multiplicative, the trend as None and the seasonality as Multiplicative, and automatic forecasting was

performed. For the estimation of print ad revenues, the error component was selected as Multiplicative, the trend as None and the seasonality as Multiplicative, and automatic forecasting was performed. For the estimation of internet ad revenues, the error component was selected as Multiplicative, the trend as Additive damped and the seasonality as Multiplicative, and automatic forecasting was performed. In the analysis, it is seen that the automatically generated model for visual advertising revenues is ETS(M,N,M), for print advertising revenues it is ETS(M,N,M), and for internet advertising revenues it is ETS(M,Ad,M). A model is created in which the error is calculated multiplicatively and seasonality is calculated multiplicatively.

```
data_VISUAL = Visual_Advertisement
fitE = ets(data_VISUAL)
frcE = forecast(fitE, h=12)
plot(frcE)
```

```
data_PRINT = Print_Advertisement
fitE = ets(data_PRINT)
frcE = forecast(fitE, h=12)
plot(frcE)
```

```
data_INTERNET = Internet_Advertisement
fitE = ets(data_INTERNET)
frcE = forecast(fitE, h=12)
plot(frcE)
```

As a result of the analysis made with the ETS method based on the above functions, seasonality-containing Visual/Print/Internet/Total advertising revenues were estimated, and the estimation results were given in the Consolidated Table 1: (respectively 13, 14, 15) in the Appendix on a monthly and yearly basis, in order not to exceed the page limit.

Additionally, the graphs of estimation results of visual/print/internet advertising revenues with ETS in the light of seasonality are presented in the Graph 3 below.

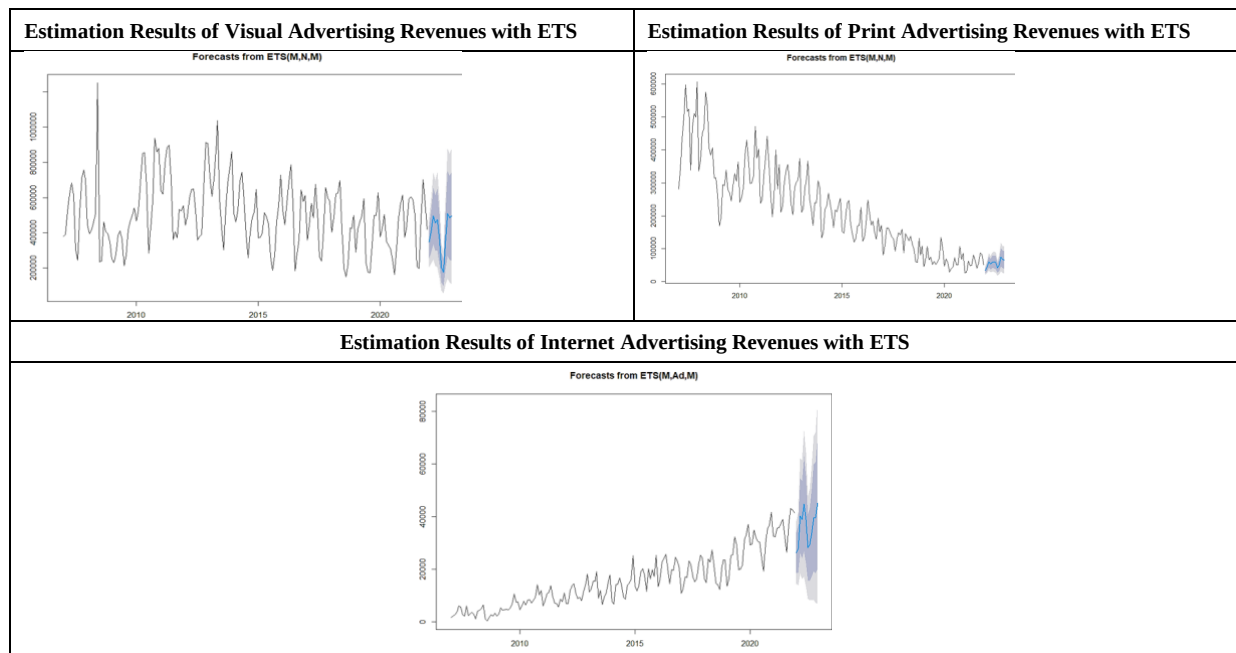


Figure 3: Estimation Results of Advertising Revenues with ETS for next year; Source: Authors

In conclusion, the estimating results of advertising revenues for the next year with ETS method above revealed that;

- Seasonality for all types of ad revenue appears to be similar to previous periods.
- There is a seasonal effect on visual advertising revenues. The seasonal decrease in visual advertising revenues in the summer months and the increase in other months are more clearly visible. Visual advertising revenues have a slightly increasing trend with fluctuations due to seasonality.
- The print advertising revenues are also subject to seasonality and downward decreasing trend is clearly visible.
- There is a seasonal effect on internet advertising revenues that have an increasing trend upwards parallel to previous periods. In addition, the seasonal decrease in visual advertising revenues in the summer months and the increase in other months are more clearly visible in the figures.

Comparison of ARIMA and ETS Estimation Results and Error Metrics

After the advertising revenue estimates for the next year were made with the ARIMA and ETS models, the error metrics were calculated with the “accuracy” function of the models used. It was revealed which model gave the lowest error value on the same data set and therefore showed the best performance for the next year forecast.

An evaluation was made in the light of the most used error metrics, RMSE (Root Mean Squared Error) and MAE (Mean Absolute Error). When the error metrics were examined; While the RMSE value of the visual advertising revenue estimates was 111.095 for the ARIMA model, it is 123.818 for the ETS model. The MAE value was 75.935 for the ARIMA model, it is 79.190 for the ETS model. The RMSE value of the print advertising revenue estimates was 36.856 for the ARIMA model, it is 36.071 for the ETS model. The MAE value was 25.598 for the ARIMA model, it is 25.390 for the ETS model. The RMSE value of internet advertising revenue estimates is 2.604 for the ARIMA model and 2.822 for the ETS model. The MAE value is 1.942 for the ARIMA model and 2.119 for the ETS model.

Screenshots of detailed Error Metrics for Visual/Print/Internet advertising revenue estimates were given in the Consolidated Table 1: (respectively 16,17,18) in the Appendix in order not to exceed the page limit.

In conclusion, based on the Error Metrics (RMSE and MAE), it was briefly revealed that;

- i. ARIMA model shown the best forecast performance of Visual Advertising revenues for the next year
- ii. ETS model indicated the best forecast performance of Print Advertising revenues for the next year
- iii. ARIMA model also denoted the best forecast performance of Internet Advertising revenues for the next year

Estimated Final Ad Revenues for Next Year Using Best-Performing Methods

Consequently, as another aim of the research, final advertising revenue estimates for the coming year using the best-performing methods, are provided in the table below.

Table 2: Estimated Next Year Advertisement Revenues with Best Performance

Methods				
Month	Visual Ad Rev (ARIMA)	Print Ad Rev (ETS)	Internet Ad Rev (ARIMA)	Total
Jan	313.318	33.898	34.358	381.573
Feb	402.363	44.201	34.588	481.152
Mar	514.032	60.006	39.230	613.268
Apr	529.536	53.263	39.426	622.225
May	588.100	59.370	42.071	689.541
Jun	402.211	60.524	41.656	504.390
July	205.214	58.542	35.144	298.900
Aug	184.356	41.918	31.606	257.880
Sept	350.593	49.997	38.291	438.881
Oct	552.392	74.143	44.788	671.323
Nov	530.780	68.297	45.194	644.270
Dec	555.035	66.090	45.489	666.614

Source: Authors

Consequently, the above table revealed that, in parallel with historical data;

- i. Seasonality was indicated in the summer months for all advertising revenue groups,
- ii. The forecast figures in all advertising revenue groups indicated similar developments to the trends in the previous analyses explained above sections.

Conclusion

Advertising revenues are one of the most important income items for media companies, which are also commercial enterprises. In order for media companies to cover their costs, maintain their assets, ensure their sustainability and continue their activities efficiently, it is very important to estimate future advertising revenues correctly. On the other hand, media advertising revenues are also affected by seasonal changes. Additionally, developments in digitalization, communication and technological tools are changing the habits of society in using media tools. In addition to seasonal changes, advertising revenues are also affected by these new conditions. While advertising revenues obtained by traditional media tools are decreasing, advertising revenues obtained by new media tools are increasing. The media economy has also been affected by the economic conditions experienced in recent years, which has shown the importance and necessity of correct planning of advertising revenues in the media sector, where there is an intense competitive environment.

This study mainly aimed to investigate the impact of seasonal changes on media advertising revenues in the R environment through a visual-print media company example. Accordingly, the study primarily aimed to examine whether visual, print and internet media revenues were affected by seasonal change. The study also aimed to indicate the trends of visual/ print/ and internet advertising revenues in the selected period in the light of seasonality. Lastly, after determining which of the ARIMA and ETS time series analysis methods performed better in estimating advertising revenues in R, it was aimed to estimate the media advertising revenues for the next year with the best performing methods. In the study, time series analysis of data obtained from advertising revenues was conducted in the R environment. Changes and trends in advertising revenues over time were analyzed using visuals.

In conclusion, the results of the analysis in R environment revealed that;

- i. All advertising revenue types were affected by seasonal changes in the specified period and included seasonality, i.e. specially in the summer months
- ii. Advertising revenue types have different trends despite containing seasonality.
- iii. Visual advertising revenues denoted a slight downward trend including seasonality during the period.
- iv. Print advertising revenues reflected a very rapid and drastic downward trend covering seasonality.
- v. -Internet advertising revenues showed a very rapid and sharp upward trend compared to the other two advertising types despite having seasonality.

Furthermore, taking into account the calculated error metrics, it was found that the ARIMA model showed the best estimation performance in both in visual and internet advertising revenues. On the other hand, the ETS model indicated the best estimation performance in print advertising revenues. Advertising revenues forecast The visual/print and internet for the next year was made with the best performing methods. It was observed that the estimated advertising revenues included seasonality in the summer months and revealed similar results to the previous trends in the analyses based on historical data.

Furthermore, income and expense estimates are of great importance in the media sector as well as in all other sectors. This study will help future researchers to make similar applications in different sectors as well as in the media sector by making the necessary updates.

Consequently, since internet-based advertising revenues are constantly and drastically increasing in the age of technological development, digitalization and sustainability, it was strongly recommended that media companies make investments in this area where competition will intensify even more.

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All authors have read and agreed to the published version of the manuscript.

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Data Availability Statement: The data presented in this study are available on request from the corresponding author. The data are not publicly available due to restrictions.

Conflicts of Interest: The authors declare no conflict of interest.

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Appendix

Consolidated Table 1: Some Computer Screenshots of the Analysis Results

1.Uploading Advertising Revenues in R Environment	2.Summary Statistics of Advertising Revenues in R
<pre># A tibble: 180 x 5 Tarth Gorsel Yazili Internet Toplam <dtm> <dbl> <dbl> <dbl> <dbl> 1 2007-01-01 00:00:00 381046 281634 1766 664446 2 2007-02-01 00:00:00 390862 345062 2344 738268 3 2007-03-01 00:00:00 522578 432781 2768 958127 4 2007-04-01 00:00:00 615984 495611 3665 1115260 5 2007-05-01 00:00:00 684126 597715 6036 1287877 6 2007-06-01 00:00:00 613857 517168 5658 1136683 7 2007-07-01 00:00:00 304557 522888 2882 830327 8 2007-08-01 00:00:00 246567 337888 2337 586792 9 2007-09-01 00:00:00 516852 467707 6135 990694 10 2007-10-01 00:00:00 710914 509913 2473 1223300 # ... with 170 more rows</pre>	<pre>Tarth Gorsel Yazili Internet Toplam Mfn. :149273 Mfn. :26459 Mfn. :522 Mfn. :223946 1st Qu.: 376508 1st Qu.:118511 1st Qu.: 7441 1st Qu.: 577009 Median : 493810 Median :211332 Median :14030 Median : 712473 Mean : 502232 Mean :122642 Mean :15744 Mean :740618 3rd Qu.: 619391 3rd Qu.:305236 3rd Qu.:22074 3rd Qu.: 887763 Max. :1249623 Max. :606013 Max. :43067 Max. :1790451</pre>
3.Visual Ad Revenues by Months and Years in R	4.Print Ad Revenues by Months and Years in R
<pre>2007 381046 390862 522578 615984 684126 613857 304557 516852 710914 755853 703026 2008 444550 394633 415420 459862 509881 1249623 235943 240490 460537 405797 395483 347399 2009 250006 232965 279190 385958 411830 361075 213779 272407 415973 466004 499217 541723 2010 467181 527593 686911 848878 855519 667541 284684 429698 573918 936382 859598 878731 2011 638424 610987 790178 884394 969046 108421 362377 371931 533768 525723 554850 2012 443538 495179 595498 647341 649007 528655 359219 379243 391180 652232 912571 906729 2013 720222 607484 702492 864212 1037990 592948 431062 304512 527904 682225 763735 859496 2014 509678 460517 330860 693371 744794 586186 391457 258305 397675 484162 517910 647238 2015 372395 374089 401749 515171 492440 450464 265864 187395 270248 463193 553133 728699 2016 528408 446414 569745 688408 758888 569870 185536 282429 362094 643678 578623 611773 2017 358461 440668 566493 484566 675424 517981 263526 240141 417909 656962 601784 579132 2018 404300 484331 618968 623980 696548 416308 196863 149273 237794 426383 423458 498151 2019 291015 418907 463837 497017 593660 232300 176017 175440 329562 497866 498009 627127 2020 377140 428070 503214 352676 333455 310638 250437 164367 487491 567495 615913 2021 374613 440370 590048 604513 588437 505024 208029 198082 482067 701672 567160 420712</pre>	<pre>2007 281634 345062 432781 495611 597715 517168 522888 337888 467707 509913 499702 606013 2008 335507 366475 450005 464951 575000 534431 403655 383811 405753 314741 315667 263360 2009 169309 192724 294761 291848 337911 278540 269483 244354 291073 318359 304068 363828 2010 241565 255577 282942 383464 429532 373511 298824 298885 320165 470522 375040 401625 2011 238006 247445 320481 374990 441568 357200 264321 196446 259514 399004 280907 334794 2012 211630 228631 302150 337141 357710 304837 233352 203798 284910 302670 308932 375786 2013 211043 220510 284925 313122 365407 251439 218864 171385 239979 240019 306433 283645 2014 132800 149011 220524 229246 268831 238747 206807 164144 217244 212668 234263 252636 2015 152440 147286 194560 239136 246183 173702 145147 120236 130986 169887 170733 232243 2016 123465 133599 177646 248094 208963 171679 183275 148036 128654 192294 151207 171057 2017 81521 109514 163326 163297 149424 135388 131015 93158 127452 148449 142230 158523 2018 87884 145939 135665 123415 137859 113335 98044 60423 59335 131410 81415 108127 2019 46184 65925 107473 66394 74785 52226 61621 52275 59808 70029 134025 102187 2020 47195 68740 57939 29683 38988 44740 73069 51042 51755 107641 67969 86690 2021 26459 29075 62790 48329 49247 80695 64287 40359 55839 87243 82019 50727</pre>
5.Internet Ad Revenues by Months and Years in R	6.Total Ad Revenues by Months and Years in R
<pre>2007 1766 2344 2768 3665 6036 5658 2882 2337 6135 2473 3232 3652 2008 3037 1194 4072 4503 5214 6397 1106 522 1671 2807 2246 3388 2009 2197 2959 5465 4379 4651 4745 4587 5451 6987 10690 7666 7505 2010 4629 6243 8018 6563 8315 8552 7168 8387 9349 14258 10358 11953 2011 6110 8053 10656 11168 13772 9557 7249 6975 5766 8601 7775 11110 2012 6955 7002 11720 13843 14629 10856 8915 9469 8118 11632 14064 18182 2013 11503 12601 15378 15517 19069 9128 11957 6676 9479 10834 14820 17918 2014 7713 6938 14150 14317 16821 13997 9451 8619 13947 14741 16386 25155 2015 13558 11722 13856 19090 20195 17712 11693 20278 16412 19896 17209 25312 2016 13444 16139 22868 24137 25717 20452 14621 19847 19758 24610 23065 20365 2017 10834 12665 17085 17007 23150 21857 17242 13115 16353 21734 25419 24247 2018 16492 14990 23903 22723 27357 21471 14798 14250 12391 20054 23551 23563 2019 13708 16357 25245 25495 32352 29163 19832 20088 21689 31040 33285 37105 2020 29171 29587 34797 32047 30690 30229 24060 19243 29738 35489 36736 41690 2021 32726 32367 35639 35845 37368 38855 32353 26422 36588 43067 42586 41512</pre>	<pre>2007 664446 738268 958127 1115260 1287877 1136683 830327 586792 990694 1223300 1258787 1312691 2008 783094 762302 869497 929216 1089895 1790451 640704 624823 867981 723245 712396 604147 2009 421512 428648 579416 682185 754392 644360 487849 522212 714033 805053 810951 913056 2010 713375 789313 977871 1238905 1293366 1049604 590676 736970 903432 1421162 1244996 1292309 2011 882540 874585 1121315 1270512 1332326 1075178 634147 610350 637232 941373 814405 920754 2012 662113 731044 909468 998365 1019346 844348 601486 592510 684208 966514 1235167 1298497 2013 942768 840595 1002795 1192851 1422466 853515 661883 482757 777362 933078 1084988 1161059 2014 650191 616466 765134 936934 1030446 838930 607715 431066 628866 711571 768559 925029 2015 538393 530997 610165 773397 758818 641878 427204 327909 437646 652976 741075 979254 2016 664317 596172 770259 960639 1020568 762001 383432 450312 510356 860582 752895 801395 2017 450996 562867 746904 964870 747998 675226 31783 346614 561714 827145 769433 761902 2018 508676 645260 778536 770118 861764 551114 309705 223946 295520 577847 530424 629841 2019 350907 501189 596555 588906 700797 313689 257470 247803 411059 598935 665310 766419 2020 435506 326397 995950 414406 403133 385607 37566 234652 392259 630621 672200 744293 2021 433798 502012 688477 688287 675052 624574 305669 264863 574404 831982 691767 512951</pre>
7.Decomposition of Visual Ad Revenues Time Series in R	8.Decomposition of Print Ad Revenues Time Series in R
9.Decomposition of Internet Ad Revenues Time Series in R	10.Estimation Results of Visual Ad Revenues with ARIMA
	<pre>Point Forecast Lo 80 Hi 80 Lo 95 Hi 95 Jan 2022 313318.0 163241.15 463394.8 83795.28 542840.6 Feb 2022 402363.1 235452.11 569274.1 147094.77 657631.5 Mar 2022 514031.6 339284.43 688778.8 246778.86 781284.4 Apr 2022 529535.9 349541.08 709530.8 254257.56 804814.3 May 2022 588099.8 404185.10 772014.5 306826.54 869373.1 Jun 2022 402211.0 215273.51 589148.4 116314.80 688107.1 Jul 2022 205214.2 15920.53 394508.0 -84285.51 494714.0 Aug 2022 184356.4 -6782.96 375495.8 -107966.03 476678.8 Sep 2022 350592.9 158003.72 543182.1 56053.16 645132.7 Oct 2022 552391.8 358661.38 746122.2 256106.70 848676.8 Nov 2022 530780.1 336150.12 725410.0 233119.25 828440.9 Dec 2022 555035.4 359695.57 750375.3 256288.89 853782.0</pre>
11. Estimation Results of Print Ad Revenues with ARIMA	12.Estimation Results of Internet Ad Revenues with ARIMA

Point Forecast							Lo 80	Hi 80	Lo 95	Hi 95
Jan 2022	-5280.346	-55068.37	44507.68	-81424.56	70863.86					
Feb 2022	9618.147	-45755.22	64991.51	-75068.11	94304.40					
Mar 2022	32909.962	-26187.33	92007.26	-57471.55	123291.47					
Apr 2022	16334.747	-45324.51	77994.00	-77964.95	110634.44					
May 2022	19544.487	-43909.38	82998.35	-77499.83	116588.80					
Jun 2022	20564.715	-44160.44	85289.87	-78423.87	119553.30					
Jul 2022	17120.195	-48512.18	82752.57	-83255.87	117496.26					
Aug 2022	-7800.656	-74083.68	58482.37	-109171.79	93570.48					
Sep 2022	2337.838	-64413.42	69089.10	-99749.40	104425.08					
Oct 2022	38819.127	-28269.91	105908.16	-63784.70	141422.95					
Nov 2022	32940.684	-34392.43	100273.80	-70036.43	135917.80					
Dec 2022	24524.270	-42985.44	92033.98	-78722.92	127771.46					

Point Forecast							Lo 80	Hi 80	Lo 95	Hi 95
Jan 2022	34357.52	30861.22	37853.83	29010.38	39704.67					
Feb 2022	34587.77	30455.28	38720.25	28267.67	40907.86					
Mar 2022	39230.15	34547.13	43913.18	32068.08	46392.22					
Apr 2022	39426.45	34251.12	44601.77	31511.47	47341.43					
May 2022	42071.37	36446.67	47696.07	33469.13	50673.61					
Jun 2022	41655.52	35614.78	47696.26	32417.00	50894.03					
Jul 2022	35143.57	28713.65	41573.48	25309.86	44977.28					
Aug 2022	31605.98	24809.13	38402.83	21211.10	42000.86					
Sep 2022	38290.94	31145.98	45435.89	27363.67	49218.21					
Oct 2022	44788.02	37311.14	52264.90	33553.13	56222.91					
Nov 2022	45193.67	37399.00	52988.35	33272.75	57114.60					
Dec 2022	45488.91	37388.90	53588.92	33101.01	57876.81					

Point Forecast							Lo 80	Hi 80	Lo 95	Hi 95
Jan 2022	347612.0	255435.64	439788.3	206640.45	488583.5					
Feb 2022	410586.1	289732.81	531439.4	225756.94	595415.3					
Mar 2022	494823.4	335926.96	653719.7	251812.28	737834.4					
Apr 2022	455663.1	297980.07	613346.1	214507.73	696818.4					
May 2022	474007.6	298851.86	649163.4	206129.98	741885.3					
Jun 2022	365620.1	222373.61	508866.6	146543.50	584696.7					
Jul 2022	203348.4	119354.09	287342.7	74890.19	331806.6					
Aug 2022	175983.5	99700.36	252266.6	59318.51	292648.5					
Sep 2022	352585.8	192814.45	512357.2	108236.58	596935.1					
Oct 2022	508207.4	268245.66	748169.1	141217.61	875197.1					
Nov 2022	484453.6	246762.74	722144.4	120936.81	847970.3					
Dec 2022	494768.0	243130.18	746405.8	109921.16	879614.9					

Point Forecast							Lo 80	Hi 80	Lo 95	Hi 95
Jan 2022	33897.52	25252.92	42542.12	20676.74	47118.30					
Feb 2022	44200.83	32218.70	56182.95	25875.75	62525.90					
Mar 2022	60006.10	42825.22	77186.98	33730.21	86281.99					
Apr 2022	53262.81	37238.52	69287.11	28755.77	77769.85					
May 2022	59369.79	40681.12	78058.46	30787.93	87951.65					
Jun 2022	60523.76	40660.54	80386.99	30145.58	90901.95					
Jul 2022	58542.18	38571.70	78512.66	27999.97	89084.39					
Aug 2022	41918.05	27093.40	56742.70	19245.71	64590.39					
Sep 2022	49997.27	31707.47	68287.07	22025.44	77969.11					
Oct 2022	74143.36	46143.85	102142.86	31321.80	116964.91					
Nov 2022	68296.52	41718.17	94874.87	27648.45	108944.60					
Dec 2022	66090.08	39627.27	92552.90	25618.70	106561.47					

Point Forecast							Lo 80	Hi 80	Lo 95	Hi 95
Jan 2022	26317.13	18589.35	34044.90	14498.515	38135.74					
Feb 2022	27860.73	18836.56	36884.90	14059.452	41662.01					
Mar 2022	40260.08	26094.19	54425.97	18595.222	61924.94					
Apr 2022	38890.94	24189.18	53592.70	16406.544	61375.34					
May 2022	44814.13	26765.13	62863.12	17210.573	72417.68					
Jun 2022	38928.47	22333.50	55523.44	13548.648	64308.29					
Jul 2022	28290.43	15592.57	40988.30	8870.727	47710.14					
Aug 2022	29385.00	15558.34	43211.66	8238.948	50531.05					
Sep 2022	33827.25	17201.34	50453.16	8400.119	59254.38					
Oct 2022	39506.69	19286.69	59726.68	8582.876	70430.50					
Nov 2022	39664.55	18580.35	60748.75	7419.043	71910.05					
Dec 2022	45153.23	20282.35	70024.11	7116.499	83189.96					

<pre>> data_GORSEL = Gorse1_Reklam > fita = auto.arima(data_GORSEL) > fite = ets(data_GORSEL) > accuracy(fita) ME RMSE MAE MPE MAPE MASE ACF1 Training set -4293.82 111095.7 75935.71 -3.681371 17.35058 0.5337443 0.004496104 > accuracy(fite)</pre>										
<pre>ME RMSE MAE MPE MAPE MASE ACF1 Training set -5906.327 123818 79190.58 -4.089511 16.89253 0.5566224 0.02774389</pre>										

<pre>> data_YAZILI = yazili_Reklam > fita = auto.arima(data_YAZILI) > fite = ets(data_YAZILI) > accuracy(fita) ME RMSE MAE MPE MAPE MASE ACF1 Training set -1225.868 36856.15 25598.77 -0.3275682 16.83545 0.5351974 -0.03423333 > accuracy(fite)</pre>										
<pre>ME RMSE MAE MPE MAPE MASE ACF1 Training set -6074.486 36071.18 24390.01 -6.534025 14.80555 0.5099257 0.2181036</pre>										

<pre>> data_INTERNET = internet_Reklam > fita = auto.arima(data_INTERNET) > fite = ets(data_INTERNET) > accuracy(fita) ME RMSE MAE MPE MAPE MASE ACF1 Training set 58.82933 2604.095 1942.764 -4.088441 18.48359 0.5372848 0.02491922 > accuracy(fite)</pre>										
<pre>ME RMSE MAE MPE MAPE MASE ACF1 Training set 260.0758 2822.928 2119.541 -5.810692 20.66283 0.5861736 0.1509769</pre>										

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