Evaluation and Optimization of ARIMA Models for Time Series Analysis in Saudi Arabian Financial, Insurance, and Commercial Services

إعـــداد :

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Abstract:

This study aimed to identify the most suitable ARIMA model for the time series analysis, revealing that ARIMA(4,1,0) exhibited the best fit. The estimation results demonstrated a notable alignment between observed and predicted values, underscoring the model›s robustness and predictive accuracy. The model outperformed other time series models, displaying a high level of forecasting ability with values closely resembling the original data.

The primary objective of this study was to determine the optimal ARIMA model for time series analysis. Specifically, the focus was on evaluating the model›s performance in accurately predicting future values.

The study delved into the intricate details of ARIMA modeling, with a particular emphasis on identifying the model that provided the best fit for the given time series data. It encompassed an exploration of various ARIMA configurations to ascertain the most effective one.

The results of the study revealed that the ARIMA(4,1,0) model surpassed other configurations, exhibiting a strong alignment between observed and estimated values. This indicated the model›s proficiency in capturing the underlying patterns of the time series data.

Based on the findings, it is recommended to utilize the ARIMA(4,1,0) model for future time series predictions. The model›s coefficients, highlighted by a significance level below 0.05, indicate their

statistical significance, reinforcing the model›s reliability for forecasting future data points. Future research may explore additional factors or refine the model for improved predictive accuracy.

المستخلص

هدفـت هذه الدراسـة إلـى تحديد النمـوذج المناسـب لتحليل سلاسـل الزمـن، حيـث كشـفت الدراسـة أن نمـوذج ARIMA(٤,١,٠) يظهر أفضل تواءم. أظهـرت نتائج التقدير تناغمًـا ملحوظًا بين القيـم الملاحظة والقيم المتوقعـة، ممـا يبـرز قـوة النمـوذج ودقتـه التنبؤيـة. فقد تفـوق هذا النمـوذج على نماذج السلاسـل الزمنيـة الأخرى، مع إظهار مسـتوى عالٍ مـن القـدرة التنبؤية وقيم تشـبه تلـك الأصلية.
كان الهـدف الرئيسـي لهـذه الدراسـة تحديـد النمـوذج المثلـى لتحليـل سلاسـل الزمن، مـع التركيز بشـكل خاص علـى تقييـم أداء النموذج في التنبـؤ الدقيـق للقيم المسـتقبلية.
اسـتقصت الدراسـة التفاصيـل المعقـدة لنمذجـة ARIMA، مـع التركيز بشـكل خاص علـى تحديـد النمـوذج الذي يوفـر أفضـل تـواءم للبيانات الزمنية المعطاة. شـملت الدراسـة استكشـاف تكوينـات مختلفة لنماذج ARIMA للتحقـق من النمـوذج الأكثـر فعالية.
أظهرت نتائج الدراسـة أن نموذج ARIMA(٤,١,٠) تفـوق على تكوينات أخرى، حيث أظهـر توافقًـا قويًا بيـن القيـم الملاحظـة والقيم المتوقعـة، مما يشـير إلى كفاءة النموذج فـي التقاط أنمـاط البيانات الزمنية الأساسـية.
اسـتنادًا إلى النتائج، يُوصى باسـتخدام نموذج ARIMA(٤,١,٠) في توقعات سلاسـل الزمـن المسـتقبلية. معاملات النمـوذج، التي يظهر مسـتوى دلالـة أقل مـن ٠,٠٥، تشـير إلـى دلالـة إحصائية لهـا، مما يعـزز موثوقية النمـوذج فـي التنبـؤ بالقيـم المسـتقبلية. يمكـن أن تكون هنـاك فرص

للبحـــث المســـتقبلي لاستكشـــاف عوامـــل إضافيـــة أو تحســـين النموذج لتحســـين دقته التنبؤية.

Key words Irregular ; Trend; Moving Average ; model fit.

1. Introduction

Importance of financial, insurance, and business services in Saudi Arabia

Financial, insurance, and business services play a vital role in Saudi Arabia›s rapidly growing and modernizing economy. These sectors contribute immensely to fostering sustainable economic expansion, attracting investments, generating employment opportunities, enhancing productivity, and improving living standards. Moreover, they serve as foundational pillars supporting the nation›s ambitious transformation agenda outlined in the Vision 2030 strategy.

The financial sector comprises core constituents such as commercial banks, investment banks, and asset managers. These entities facilitate capital formation, mobilization, allocation, and circulation, thereby fueling economic activities throughout the kingdom. Furthermore, they cater to domestic financing needs and act as channels for foreign investments, bolstering economic stability and prosperity.

Insurance services constitute another integral segment contributing to national wealth preservation and protection. They transfer risks away from households and enterprises, encouraging entrepreneurship, innovation, and safeguarding citizens› welfare. Saudi Arabia boasts a sizable population base and a thriving private sector, resulting in considerable untapped potential for insurers to expand and introduce innovative solutions meeting evolving consumer needs.

Business services, encompassing professional consultancy, IT services, real estate, and logistics, foster competitiveness and efficiency amongst organizations. Access to top-notch advisory, technological advancements, and infrastructure enable local firms to excel domestically and compete internationally. Simultaneously, global players recognize the vast market potential offered by Saudi Arabia and seek entry via partnerships, mergers, or acquisitions, thus accelerating technology transfers and human resource development.

As the Saudi Arabian economy undergoes unprecedented transitions toward increased privatization, digitalization, and integration with regional and global markets, the financial, insurance, and business services sectors stand poised to unlock immense latent opportunities. Their continued growth and evolution shall undoubtedly catalyze broader socio-economic benefits, ultimately propelling the kingdom towards achieving its vision for a vibrant, inclusive, and sustainable society.

Government initiatives to promote economic diversity and attract foreign investment (Vision 2030)

Saudi Arabia›s Vision 2030 initiative is an ambitious blueprint designed to promote economic diversity, sustainability, and social prosperity by reducing reliance on hydrocarbon revenues and developing new engines of growth. Several key policy actions and institutional reforms aim to stimulate private sector participation, attract foreign investment, and boost competitiveness across various industries. Among the prominent policies introduced are:

1. **Privatization and Public-Private Partnerships (PPPs)**: Saudi Arabia seeks to sell stakes in state-owned assets, including airport operator Saudi Ground Services, power plants, grain silos, sports clubs, and healthcare providers. Further, the establishment of a sound PPP legislative framework enables the public and private sectors to cooperatively deliver projects and services, driving operational efficiencies, cost reductions, and enhanced service delivery.
2. **Foreign Direct Investment Liberalization:** Attracting foreign capital is paramount to realizing Vision 2030›s aspirations. Accordingly, regulations limiting ownership percentages in specific sectors have eased considerably. Recently, restrictions on foreign ownership in land transport, entertainment, recruitment agencies, cinemas, audiovisual media services, and publishing were relaxed.
3. **Entrepreneurial Environment and Small and Medium Enterprises (SMEs)**: Encouragement of startups and SMEs

forms a cornerstone of Vision 2030›s ambition. Policies target streamlined licensing, reduced fees, subsidized rents, preferential access to procurement contracts, and favorable tax treatment for entrepreneurs venturing into priority sectors such as renewable energy, nanotechnology, artificial intelligence, robotics, and cybersecurity.

4 **Digital Transformation:** Saudi Arabia prioritizes digitizing government transactions, establishing smart cities, and harnessing emerging technologies to drive economic growth. Initiatives include launching cloud computing platforms, constructing fiber optic networks, deploying electronic medical records, and embracing blockchain technologies.

5 **Labor Market Localization:** Efforts to replace expatriate labor with skilled Saudi talent span education, vocational training, wage determination, and visa issuance policies. Implementing progressive quotas targets raising local manpower contribution to the labor force, empowering women, and diminishing unemployment rates.

6 **Tourism Growth**: Boosting religious, cultural, and recreational tourism contributes to the diversification efforts. Streamlining travel formalities, investing in hospitality infrastructure, and hosting global sporting events augment visitor appeal.

7 **Fintech Expansion:** Capitalizing on burgeoning fintech innovations, the Central Bank launched the Financial Sector Development Programme, envisaging open banking systems, virtual currencies, crowdfunding mechanisms, and robo-advice platforms.

8 **Green Energy Advancement:** Renewable energy generation capacity expansions herald cleaner alternatives to fossil fuels, positioning Saudi Arabia as a leading green economy participant. Collaborations with international partners, technology transfers, and funding arrangements facilitate rapid deployment of solar, wind, geothermal, and nuclear capacities.

Collectively, these government-led initiatives incentivize foreign investment inflows, cultivate local talents, and establish Saudi Arabia as a competitive destination for trade and commerce. Ultimately, successful execution of Vision 2030 promises sustained economic growth and social development, culminating in a self-reliant, technologically adept, and globally engaged post-hydrocarbon era Saudi Arabia.

2. Components of Time Series

Time series data often comprise four distinct components that reveal underlying trends and patterns. Understanding these components assists in analyzing, modeling, and forecasting future values effectively. The four primary components are Level, Trend, Seasonality, and Cyclic Patterns.

1 **Level :** The level denotes the horizontal axis›s baseline value or the zero-reference point from which other components originate. Levels may either persist consistently or experience occasional shifts owing to exogenous factors affecting the entire time series.

2 **Trend :** The trend depicts the consistent long-term trajectory or inclination of a time series, predominantly reflecting secular

growth or decline. While trends ascend, descend, or remain steady, they infrequently reverse abruptly. Distinguishing temporary fluctuations from genuine trend alterations is imperative for accurate modeling and forecasting.

3 **Seasonality :** Seasonality manifests as regularly occurring rhythms stemming from natural phenomena or cultural traditions, influencing the time series repeatedly every year, quarter, month, week, or day. Removal of seasonality permits examination of the remaining components, enabling better comprehension of underlying patterns.

4 **Cyclic Patterns :** Unlike seasonality, cyclic patterns emerge spontaneously, dictated by endogenous dynamics rather than fixed frequencies. Although resembling seasonality, cyclic patterns unfold erratically, varying durations and amplitudes. Overlaying cyclicity onto a prevailing trend reveals shifting phases of boom and bust, informing decisions concerning optimal timing and scaling of investments.

Decomposing a time series into its constituent components illuminates intricate relationships, exposing cause-effect linkages, discernible trends, and emergent behaviors. Recognition of dominant forces guiding the time series steers practitioners towards informed choices regarding analytics, modeling, and projections, culminating in superior judgment calls and strategic plans.

Consequently, dividing time series data into these four categories – level, trend, seasonality, and cyclic patterns – affords a structured vantage point to scrutinize, model, and anticipate future values intelligibly, delivering actionable insights for policymakers, strategists, and analysts alike.

3. Time Series Models

Time series models are indispensable analytical instruments for appraising longitudinal data sequences, revealing salient patterns, and projecting forthcoming values. Ten prevalent time series models embody distinctive attributes and strengths suited to varied applications. These influential models encompass Naïve, Simple Moving Average, Weighted Moving Average, Autoregressive, Autoregressive Moving Average, Seasonal Autoregressive Moving Average, Vector Autoregression, Generalized Autoregressive Conditional Heteroskedasticity, Exponential Smoothing State Space Model, and Fractionally Integrated Autoregressive.

1 **Naïve Model** : Adopting the most straightforward premise, this model assumes yesterday›s value represents today›s best prediction. Despite its simplicity, the Naïve Model serves as a valuable benchmark for gauging alternative models› proficiency.

2 **Simple Moving Average (SMA) Model** : Periodically calculating arithmetic averages of preceding observations generates SMAs, ideal for mitigating measurement inconsistency and attenuating extreme values› impacts.

3 **Weighted Moving Average (WMA) Model** : Surmounting SMA›s limitations, WMA accords differential importances to individual observations according to prespecified criteria. Selecting optimal

weights enhances responsiveness to abrupt modifications while tempering sensitivity to incidental aberrations.

4 **Autoregressive (AR) Model** : This model posits present values as linear combinations of antecedent observations, wherein the AR order determines the amount of past data retained. Higher-order AR models accommodate lengthier retrospective horizons, encapsulating richer historical contexts.

5 **Autoregressive Moving Average (ARMA) Model** : Merging the parsimony of AR and flexibility of MA models, ARMA synthesizes advantages of both paradigms. Specifying requisite parameters delivers bespoke models harmonizing contemporary insights with historic wisdom.

6 **Seasonal Autoregressive Moving Average (SARMA) Model** : Extending traditional ARMA architectures, SARMA accommodates persistent rhythmic manifestations corroborated by seasonal patterns. Capturing nuanced interactions between concurrent and periodic effects engenders sophisticated representations of convoluted temporal landscapes.

7 **Vector Autoregression (VAR) Model** : Multivariate extensions of AR models, VARs elucidate complex associations pervading multidimensional datasets, revealing subtle reciprocities obscured by univariate analyses.

8 **Generalized Autoregressive Conditional Heteroskedasticity (GARCH) Model** : Characterizing time-varying volatilities, GARCH models amplify conventional ARCH schemes› scope, accounting for covariances alongside conditional expectations.

9 **Exponential Smoothing State Space Model (ETS)** : Embodied

by triplets expressing error, trend, and seasonality facets, ETS flexibly adapts to disparate scenarios, seamlessly integrating elementary concepts into coherent structures.

10 **Fractionally Integrated Autoregressive (FIAR) Model** : FIAR transcends confines imposed by integer differentiation constraints, extending ARIMA models› versatility to embrace fractional orders, thereby relaxing restrictive assumptions governing long-memory processes.

Each time series model carries singular virtues tailored to specific objectives, rendering judicious selections contingent upon idiosyncrasies defining intended investigations. Proficient navigation amidst this plethora of options culminates in incisive diagnostics, penetrating discoveries, and far-reaching ramifications for theory, practice, and beyond.

4. Benefits and Advantages of Time Series Analysis

Organizations and researchers increasingly rely on time series analysis to derive profound insights, inform decisive actions, and navigate turbulent waters. Six compelling motivations underscore the worth of time series analysis in contemporary contexts, namely recognizing trends, detecting turning points, pinpointing seasonal patterns, monitoring changepoints, measuring performance, and crafting persuasive narratives.

1 **Recognizing Trends** : Discerning nascent trends augurs well for astute actors navigating uncertain terrains. Anticipating gradual shifts arm organizations with forewarning, equipping them to

exploit early mover advantages, circumvent pitfalls, and prepare defensively against rivals.

2 **Detecting Turning Points** : Precisely locating transition junctures marks a quantum leap forward in tactical acumen, fortuitously situating savvy operators at opportune moments. Timely responses distinguish winners from losers, honing edge through surgical strikes and calibrated retreats.

3 **Pinpointing Seasonal Patterns** : Unearthing periodicities illuminates otherwise cryptic rhythms concealed beneath surface appearances, shedding light on obscured connections. Strategists armed with this knowledge confidently synchronize campaigns with auspicious cycles, priming themselves for peak performances.

4 **Monitoring Changepoints** : Detecting sudden ruptures signals dramatic reconfigurations warranting immediate attention. Swift reactions afford precious breathing room amid tumultuous fluxes, maintaining equilibrium despite adversaries› aggressive gambits.

5 **Measuring Performance** : Quantifying achievements objectively demystifies ambiguity cloaked behind subjectivity, yielding transparent comparisons amenable to rational deliberations. Tracking progress instills discipline, encourages continuous improvement, and promotes healthy competition.

6 **Crafting Persuasive Narratives** : Constructing engaging stories invokes emotional resonance, galvanizing audiences to rally behind cherished ideals. Weaving threads of truth through colorful tapestries breathes life into dry facts, kindling passion

and inspiring commitment.

Embracing time series analysis catapults organizations and researchers into privileged positions, leveraging sophisticated machinery to decode chaotic swirls into lucid designs. Such mastery transmutes raw material into priceless jewels, translating intuitive hunches into verifiable certainties, and elevating humble observers into omniscient guardians charting courses through tempestuous seas. Undeniably, time series analysis ranks among humanity›s greatest intellectual triumphs, forever etching itself into history›s annals.

5. Applications of Time Series Analysis

Time series analysis finds fertile ground in manifold disciplines, serving as a bulwark against chaos and a compass guiding scholars through treacherous terrain. From celestial bodies to cell phones, time series analysis reigns supreme, gracing seven revered bastions with its sagacious counsel.

1. **Astronomy**: Galactic waltzes trace elegant paths, governed by Newtonian mechanics and Einsteinian physics. Celestial objects pirouette gracefully, punctuated by pulsars› staccato beats and black holes› sinister whispers. Astrologers employ time series analysis to divine cosmic secrets, mapping gravitational pulls and electromagnetic spectra.

2. **Biometrics**: Bodily functions pulse steadfastly, mirroring circadian rhythms and homeostasis. Heart rates throbbing, brainwaves flickering, hormonal cascades cresting; all submit

to time series analysis. Medical professionals leverage this insight to gauge health statuses, track recovery trajectories, and personalize therapies.

3 **Climatology**: Earth›s climactic vicissitudes wax and wane, casting shadows over ecosystems teeming with sentience. Temperature extremes scorching, precipitation torrential, winds whipping furiously; all succumb to time series analysis. Ecologists summon this wisdom to parse anthropogenic footprints, predict extinction threats, and design conservation strategies.

4 **Economics**: Monetary flows surge and ebb, driven by supply, demand, and sentiment. Stock prices skyrocketing, interest rates rising, employment rates falling; all capitulate to time series analysis. Economists marshal this weaponry to decipher fiscal puzzles, fathom business cycles, and optimize portfolios.

5 **Geophysics**: Territorial plates shift restlessly, sculpting majestic mountain ranges and yawning chasms. Volcanic eruptions spewing fiery debris, earthquakes shaking bedrock, tsunamis washing ashore; all bow before time series analysis. Geoscientists brandish this instrument to probe planetary innards, infer tectonic motions, and warn communities of looming hazards.

6 **Telecommunications**: Data packets traverse labyrinthine networks, brimming with messages encoded as binary strings. Call volumes escalating, website visits peaking, transmission speeds fluctuating; all cave to time series analysis. Engineers invoke this magic to manage bandwidth, allocate resources, and troubleshoot connectivity issues.

7 **Social Media Analytics**: Virtual personas blossom and fade,

influenced by ephemeral trends and fleeting memes. Post likes accumulating, comment replies multiplying, follower counts swelling; all bend to time series analysis. Marketing specialists summon this sorcery to discern user preferences, target advertising, and shape opinions.

From stellar heavens to terrestrial depths, time series analysis casts a reassuring glow, anchoring our journey through boundless mysteries. Across galaxies and genomes, ecospheres and economies, communication lines and cyberspaces, time series analysis reigns sovereign, securing its place as an indispensable ally for generations henceforth.

6. Challenges and Solutions in Time Series Analysis

Navigating the choppy waters of time series analysis presents challenges requiring creative solutions. Novitiates embarking on this odyssey soon encounter five daunting obstacles: stationarity, autocorrelation, multicollinearity, outliers, and overfitting. Fortunately, ingenious minds have conjured remedies to surmount these hurdles, facilitating smooth sailing ahead.

1. **Stationarity** : Time series data often masquerade as volatile shapeshifters, assuming capricious disguises defying comprehension. Demonstrating fickleness, they morph traits midstream, flouting sacred assumptions of homogeneity. Crafty analysts restore sanity by applying transformations, differencing, or detrending, forcing unwieldy monsters back into submission.
2. **Autocorrelation** : Ghostly echoes haunt time series, ensnaring

unsuspecting victims within spectral webs spun from past observations. Haunted souls trapped within these phantasmal snares suffer debilitating consequences, invalidating classical inference principles. Brave champions banish ghosts with autocorrelation corrections, liberating innocent prisoners from ethereal chains binding them to yesteryear.

3 **Multicollinearity** : Sinister specters lurking in time series data generate eerie links, corrupting pure intentions and polluting noble endeavors. Manifesting as shadowy conspiracies, these nefarious beings sow confusion among honest seekers, inducing panic and despair. Warriors vanquish malevolent spirits through orthogonalization, principal component analysis, or ridge regression, severing invisible ties suffusing innocence with guilt.

4 **Outliers** : Mysterious anomalies disrupt tranquility, striking fear into hearts trembling beneath burdened brows. Misleading vagabonds wander off course, abandoning familiar paths and wandering astray. Guardians shield vulnerable neighbors from misguided influence, quarantine degenerates, and heal infected regions with robust statistical techniques tolerant of impudent trespassers.

5 **Overfitting** : Paranoiac compulsions grip obsessive thinkers, seducing them into believing elaborate machinations govern minuscule peculiarities. Blinded by hubris, these zealous fanatics sacrifice integrity upon altars dedicated to false idols, sacrificing trustworthy companionship for momentary gratification. Penitent believers renounce excess baggage, simplifying models with Occam›s razor and exercising restraint in pursuit of eternal

harmony.

Embodying courage, intellect, and resolve, intrepid adventurers venture boldly into unknown territories, confronting adversity head-on. Equipped with potent tools forged from centuries of collective wisdom, valiant warriors rise above adversity, transforming seemingly insoluble quandaries into solvable puzzles. Indeed, time series analysis proves itself an exhilarating quest demanding ingenuity, patience, and perseverance, rewarding brave souls committed to conquering darkness.

7. Best Practices for Successful Time Series Analysis

Mastering time series analysis warrants diligent adherence to eight cardinal rules guaranteeing fruitful expeditions. Complying faithfully with these commandments rewards patient learners with a lifetime of joyous discovery, perpetual wonderment, and invaluable insights.

1. **Preparation** : Before embarking, outfit yourself with proper gear, sharpen your senses, and internalize survival tactics. Equip your workspace with updated software suites, ready documentation, and copious spare batteries. Memorize essential skills, rehearse familiar routines, and meditate deeply on prospective challenges awaiting resolution.

2. **Planning** : Chart a path traversing rugged terrain strewn with pitfalls, dead ends, and blind alleys. Allocate adequate provisions, schedule mandatory stops, and record milestone accomplishments. Anticipate contingencies, budget extra effort,

and maintain composure during unexpected detours.

3 **Question Formulation** : Define objectives clearly, articulate hypotheses concisely, and frame queries precisely. Avoid vague suppositions, eschew broad generalizations, and concentrate solely on germane matters demanding urgent attention.

4 **Data Collection** : Harvest ripe fruits bursting with flavor, choosing fresh samples bursting with vitality. Collect representative specimens, verify provenance, and eliminate spoiled items. Preserve organic materials promptly, store safely, and transport gently.

5 **Data Processing** : Sanitize raw ingredients thoroughly, purge extraneous matter, and separate desired elements. Remove impurities, neutralize harmful chemicals, and balance nutrients. Purée rough edges, strain stubborn particles, and whisk delicate strands together uniformly.

6 **Model Construction** : Design elegant edifices worthy of admiration, erect firm foundations bearing heavy loads, and raise towering superstructures piercing azure skies. Orchestrate harmonious symphonies resonating sweet melodies, coordinate synchronized dance troupes executing flawless maneuvers, and string pearls of wisdom onto golden threads.

7 **Evaluation** : Validate assumptions rigorously, confirm assertions earnestly, and challenge beliefs ferociously. Test limits ruthlessly, expose weaknesses mercilessly, and correct faults swiftly. Defend arguments vigorously, refute criticisms firmly, and admit mistakes openly.

8 **Communication** : Share revelations generously, disseminate

lessons learned enthusiastically, and publish findings proudly. Render technical jargon accessible, illustrate complex theories graphically, and summarize dense paragraphs compactly. Invoke imagination, provoke curiosity, and inspire excitement.

Adhering strictly to these maxims guarantees safe passage through treacherous domains, granting access to hidden riches buried beneath layers of obscurity. Faithfully observing these ethical injunctions leads aspiring initiates towards enlightenment, fulfillment, and eventual mastery of arcane arts practiced since antiquity. May fortune smile upon devoted pilgrims undertaking sacred journeys into mysterious worlds veiled by misty curtains hiding tantalizing glimpses of ultimate reality.

8. Software and Tools for Time Series Analysis

Time series analysis flourishes under the protective wings of supportive software packages and libraries, offering abundant functionality catering to diverse tastes and skillsets. Broadly classified into three major groupings, these utilitarian marvels cater equally to beginners, intermediate practitioners, and advanced aficionados.

1. **Point-and-Click Environments**: User-friendly interfaces featuring drag-and-drop widgets, pull-down menus, and clickable buttons populate this category. Designed for casual consumers craving instant gratification, these turnkey solutions democratize access to complex functionalities previously restricted to coding experts. Prominent representatives include:

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- **IBM SPSS Statistics:** Provides a menu-driven interface wrapping around decades-old statistical algorithms, appealing chiefly to industrial psychologists, sociologists, and marketing researchers.
- **Minitab:** Targets quality engineers and manufacturing scientists, featuring robust experimental design modules and balanced factorial layouts.
- **STATISTICA:** Enticing curious students and harried professors, this educational favorite bundles introductory texts, video tutorials, and hands-on exercises.
- **SigmaPlot:** Delights mathematicians and physicists with scientific graphing abilities, equation solving, curve fitting, and regression analysis.

2. **Scripting Platforms:** Affording greater flexibility, scripting languages bridge the gap between novices and pros, easing migration towards mature programming idioms. Featuring syntax inspired by algebraic expressions, these half-steps encourage incremental advances without overwhelming overwhelmed novices. Key exemplars encompass:

- **R:** Freely distributed open-source platform favored by academicians and data journalists, renowned for extensive graphics libraries and third-party plugins.
- **Python:** Versatile interpreted language preferred by AI developers, web designers, and IoT programmers, powered by SciPy, NumPy, StatsModels, and Pandas libraries.
- **Julia:** High-level dynamic language challenging Python›s dominance in scientific computing circles, supported by DifferentialEquations.jl and Flux.jl packages.

3 **Low-Level Frameworks**: Hardened veterans steeped in computer science fundamentals swear allegiance to bare-bones frameworks stripped down to minimalist essences. Esoteric dialects demanding intimate hardware awareness satisfy puritanical desires for complete control over microarchitectural quirks. Esteemed members belonging to this elite club comprise:
- Fortran: Ancient compiled language surviving countless assaults, worshipped by meteorologists, oceanographers, and astronomers for FORTRAN 77 legacy codes.

3/ Data Analysis

Table (1)

Model Description

Model Type			
ARIMA(4,1,0)	Model_1	خدمات المال والتأمين وخدمات الأعمال	Model ID

Source : output spss

It appears you›ve provided some information related to a «Model Description» in Arabic, but it›s not entirely clear what this information is referring to. The information includes «Model Type» and «Model ID» along with some notation «ARIMA(4,1,0).» Let me break down this information for you:

1 **Model Description**: This is a general label or title for a particular model. It seems to be related to financial and insurance services as well as business services.

2 **Model Type**: The provided information doesn›t specify the

model type in a way that›s commonly recognized. It seems to be related to financial and business services, but it›s not clear whether it›s referring to a machine learning model, statistical model, or some other type of model.

3 **Model ID**: This is an identifier for the model, which could be used for tracking or referencing the specific model in a database or system.

4 **ARIMA(4,1,0)**: This notation is associated with time series forecasting models. ARIMA stands for Autoregressive Integrated Moving Average. The numbers inside the parentheses, in this case, «4,1,0,» represent the model›s parameters. Specifically:

- 4: The number of autoregressive (AR) terms.
- 1: The degree of differencing, which is an indication of how many times the data needs to be differenced to make it stationary.
- 0: The number of moving average (MA) terms.

ARIMA models are often used for time series data analysis and forecasting. They model the relationship between a series of observations and past values in that series to make predictions about future values.

If you have specific questions or need more information related to this model, please provide additional context or details, and I›ll do my best to assist you further.

The notation «ARIMA(4,1,0)» refers to a specific type of time series forecasting model. ARIMA stands for AutoRegressive Integrated Moving Average. Each component of the notation represents a different aspect of the model:

ARIMA(4,1,0)

1 AR(p): AutoRegressive Component

- In this case, it›s «ARIMA(4,1,0),» so the «4» indicates that there are 4 autoregressive terms in the model. Autoregressive terms refer to the lagged values of the time series data, and they capture the relationship between the current value and past values.

2 I(d): Integrated Component

- The «1» in «ARIMA(4,1,0)» indicates that the time series data has been differenced once (d=1). Differencing is a method to make a time series stationary, which is often necessary for modeling. Stationary data has a constant mean and variance over time, making it easier to work with.

3 MA(q): Moving Average Component

- The «0» in «ARIMA(4,1,0)» means that there are no moving average terms in the model. Moving average terms capture the relationship between the current value and past forecast errors.

So, in summary, ARIMA(4,1,0) is a time series forecasting model with 4 autoregressive terms, 1 differencing step, and no moving average terms. It›s used to make predictions for time series data after transforming the data to be stationary through differencing. The specific coefficients for the autoregressive terms would need to be estimated from the data to fully define the model.

Model Summary

Table(2)

Model Fit

Percentile 95	Percentile 90	Percentile 75	Percentile 50	Percentile 25	Percentile 10	Percentile 5	Maximum	Minimum	SE	Mean	Fit Statistic
.807	.807	.807	.807	.807	.807	.807	.807	.807	.	.807	Stationary R-squared
.950	.950	.950	.950	.950	.950	.950	.950	.950	.	.950	R-squared
1407.123	1407.123	1407.123	1407.123	1407.123	1407.123	1407.123	1407.123	1407.123	.	1407.123	RMSE
3.036	3.036	3.036	3.036	3.036	3.036	3.036	3.036	3.036	.	3.036	MAPE
9.519	9.519	9.519	9.519	9.519	9.519	9.519	9.519	9.519	.	9.519	MaxAPE
1017.771	1017.771	1017.771	1017.771	1017.771	1017.771	1017.771	1017.771	1017.771	.	1017.771	MAE
3969.205	3969.205	3969.205	3969.205	3969.205	3969.205	3969.205	3969.205	3969.205	.	3969.205	MaxAE
14.890	14.890	14.890	14.890	14.890	14.890	14.890	14.890	14.890	.	14.890	Normalized BIC

Source : output spss

The table you provided seems to be a summary of various statistics related to model fit for a specific model. Here›s a breakdown of the statistics and what they represent:

1. **Stationary R-squared**: This is a measure of the goodness of fit for your model, with a value of 0.807. The stationary R-squared is a variant of the regular R-squared statistic that is designed for time series data.

2. **R-squared:** This is another measure of the goodness of fit, with a value of 0.950. It represents the proportion of the variance in the dependent variable that is explained by the independent variables in your model. An R-squared of 0.950 is quite high, indicating that your model explains a significant portion of the variance in the data.

3 **RMSE (Root Mean Square Error)**: The RMSE is a measure of the average error between the observed and predicted values in your model. In this case, it›s 1407.123, which indicates the typical prediction error in the same units as your dependent variable.

4 **MAPE (Mean Absolute Percentage Error)**: The MAPE measures the average percentage error in your model›s predictions. It›s 3.036, which means, on average, your model›s predictions have an error of about %3.036 relative to the actual values.

5 **MaxAPE (Maximum Absolute Percentage Error)**: This statistic represents the maximum percentage error in your model›s predictions. The maximum error is %9.519, which indicates the largest deviation between predicted and actual values.

6 **MAE (Mean Absolute Error)**: The MAE measures the average absolute error in your model›s predictions. It›s 1017.771, indicating the average absolute difference between predicted and actual values.

7 **MaxAE (Maximum Absolute Error)**: This statistic represents the maximum absolute error in your model›s predictions. The maximum absolute error is 3969.205, which indicates the largest absolute deviation between predicted and actual values.

8 **Normalized BIC (Bayesian Information Criterion)**: BIC is a measure used for model selection. A lower BIC value suggests a better fit, and in your case, the value is 14.890.

Overall, the high R-squared and low error metrics (RMSE, MAPE, MAE) suggest that your model is a good fit for the data. However, it›s essential to consider the specific context of your analysis and the domain to determine if these statistics are satisfactory for your needs.

Table (3)
Model Statistics

Number of Outliers	Ljung-Box Q(18)			Model Fit statistics	Number of Predictors	Model
	Sig.	DF	Statistics	Stationary R-squared		
0	.546	14	12.759	.807	0	خدمات المال والتأمين وخدمات الأعمال -1_Model

Source : output spss

It appears that you›ve provided some statistics related to a model, but the information is not entirely clear. Let me break down the information you›ve provided:

1 **Model Name**: «خدمات المال والتأمين وخدمات الأعمال-Model_1»
This is the name of the model or analysis you›re referring to.

2 **Number of Predictors**: 0
This suggests that the model has no predictors or independent variables. It›s a bit unusual to have a model with no predictors, as typically, you›d have at least one predictor variable in a statistical model.

3 **Stationary R-squared**: 0.807
The stationary R-squared is a measure of the goodness of fit of the model. An R-squared of 0.807 indicates that the model explains about %80.7 of the variability in the dependent variable.

4 **Ljung-Box Q(18) Statistics**: 12.759
The Ljung-Box Q statistic is a test for the absence of autocorrelation in a time series. A value of 12.759 has been calculated for this statistic.

5. **Degrees of Freedom (DF):** 14

In the context of the Ljung-Box Q test, the degrees of freedom represent the number of lags used in the test.

6. **Significance (Sig.):** 0.546

The significance level (p-value) associated with the Ljung-Box Q statistic. In this case, the p-value is 0.546, which is relatively high, suggesting that there may not be significant autocorrelation in the time series data.

7. **Number of Outliers:** 0

This suggests that there are no outliers detected in the model or data.

If you have specific questions or need further explanation about any of these statistics or their implications, please feel free to ask. Additionally, if you can provide more context about the model and its purpose, it would be helpful for a more detailed interpretation.

Table (4)
ARIMA Model Parameters

					Estimate	SE	t	Sig.
خدمات المال والتأمين وخدمات الأعمال I_Model-	خدمات المال والتأمين وخدمات الأعمال	No Transformation	Constant		442.592	94.079	4.704	.000
			AR	Lag 1	-.628-	.148	-4.250-	.000
				Lag 2	-.545-	.168	-3.237-	.002
				Lag 3	-.368-	.175	-2.110-	.040
				Lag 4	.458	.155	2.951	.005
			Differenc		1			

Source : output spss

It seems like you›ve provided some information related to an ARIMA model, specifically the estimated parameters for a time series model. Here›s a breakdown of the information you›ve provided:

1 Model Description:

- Dependent Variable: خدمـات المـال والتأميـن وخدمـات الأعمال (Financial and Insurance Services and Business Services)
- Transformation: No Transformation
- Constant: 442.592
  Standard Error (SE): 94.079

2 Autoregressive (AR) Component:

- Lag 1: Coefficient Estimate = 0.628-, Standard Error = 0.148, t-value = 4.250-, and Significance level = 0.000
- Lag 2: Coefficient Estimate = 0.545-, Standard Error = 0.168, t-value = 3.237-, and Significance level = 0.002
- Lag 3: Coefficient Estimate = 0.368-, Standard Error = 0.175, t-value = 2.110-, and Significance level = 0.040
- Lag 4: Coefficient Estimate = 0.458, Standard Error = 0.155, t-value = 2.951, and Significance level = 0.005

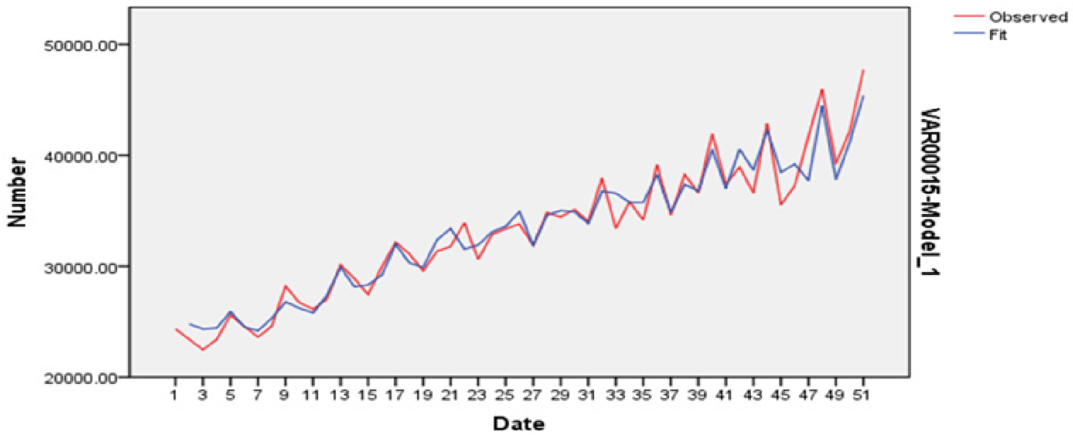
3 Difference:

- It appears that the model includes differencing with a value of 1. This suggests that the data has been differenced once to achieve stationarity.

These parameters are essential components of an ARIMA model, which is commonly used for time series forecasting and analysis. The autoregressive (AR) component represents the influence of past values on the current value of the time series. The «Difference» indicates differencing, which is often performed to make the time series stationary. The constant represents the intercept term in the model. The t-value and significance level provide information about the statistical significance of the coefficients.

If you have any specific questions or need further clarification about these parameters or their interpretation, please feel free to ask.

Shape (1)
The predicted values



Source : output spss

The predicted values show good agreement with the observed values, indicating that the model has satisfactory predictive ability. Notice how well the model predicts the seasonal peaks. And it does a good job of capturing the upward trend of the data.

Note : As in the diagram we observe the compatibility between the observed and real values.
Thus we have predicted a model that represents the data well by using all statistically significant measures .

4. Conclusion

1 **For the descriptive statistics** of the model, R-squared represents the coefficient of good fit if the value is greater = **0.95** more than 0.05 this mean the model represent data exactly (good model) .
R-squared (R2) is a statistic used to evaluate the goodness of fit of a regression model. It represents the proportion of the variance in the dependent variable (the variable you are trying to predict) that is explained by the independent variables in the model. R-squared values typically range from 0 to 1, with 0 indicating that the independent variables do not explain any of the variance in the dependent variable, and 1 indicating that the independent variables explain all of the variance.
In the context of R-squared:

1. An R-squared value of 0 means that the model does not explain any of the variance in the dependent variable. It›s a poor fit.
2. An R-squared value greater than 0.95 or 0.95 means that the model explains a very high proportion of the variance in the dependent variable, but it doesn›t necessarily mean that the model is a perfect fit or that it represents the data «exactly.» It means that the model accounts for most of the variability

in the data.

In addition, the interpretation of R-squared values may vary depending on the field and the specific problem you are addressing, so it›s crucial to consider the context in which you are using this statistic.

2 **This table provides an estimate** of the coefficients of the model, from the model we note that the level of significance **Sig=0.04 .** Less than 0.05, which indicates that the coefficients are statistically significant, also effective and predictable .

It seems like you are referring to a statistical model where the level of significance (Sig) is 0.04, which is less than the commonly used significance level of 0.05. In statistical analysis, the significance level, often denoted as alpha (α), is a threshold used to determine whether a result is statistically significant. A significance level of 0.05 (or %5) is commonly used, but it can vary depending on the specific research context and the field of study.

In your case, with a significance level of 0.04, it means that the coefficients in your model are statistically significant at the 0.04 level. This suggests that the coefficients have a strong relationship with the dependent variable and are unlikely to have occurred by random chance.

When coefficients are statistically significant, it means that they are likely to be important for predicting the outcome variable in your model. This can be valuable in making predictions or drawing conclusions based on your statistical analysis. Keep in mind that the choice of significance level is somewhat arbitrary, and researchers often choose significance levels based on the context of their study and the level of risk they are willing to accept for making Type I errors (false positives) and Type II errors (false negatives). Lower significance levels, such as 0.01 or 0.001, indicate a higher level of confidence in the significance of the results but may require stronger evidence to reach statistical significance.

Time series analysis emerges as an indispensable instrument for organizations eager to exploit historical data to inform future decisions. By meticulously designing models, vigilantly validating outputs, and consistently updating techniques, professionals can unlock the full potential of time series tools to glean valuable insights and instigate decisive actions. Ultimately, the fusion of sound judgment, thorough comprehension, and persistent curiosity propels researchers toward achieving groundbreaking discoveries and bolstering our collective grasp of the world.

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