

## AQSH RAQAMLI BANK TIZIMI RIVOJLANISHINING EKONOMETRIK TAHLILI.

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**Annotatsiya:** Ushbu maqolada AQSH da raqamli bank tuzilmasining rivojlanishi, hozirgi holati va kelajak uchun prognozlar aks ettirilgan. Prognozlar ekonometrik tahlillar asosida amalga oshirilgan bo'lib, turli modellardan foydalanilgan va R studio dasturida yaratilgan.

**Key words:** AQSH, online banking ,raqamli texnologiyalar, snaive model, ekonometrik modellar.

Hozirgi vaqtda jadal rivojlanib, globallashib borayotgan zamonda iqtisodiyotning raqamlashishi va banklarning unga qo'shayotgan innovatsiyalari muhim o'rin tutadi. AQSH da raqamli bank 1967-yildan boshlab bankomatlarining kirib kelishi bilan rivojlana boshlagan. Yillar davomida ushbu tizimda kredit va debit kartalar, telefon banklar, mobil banking rivojlanib borgani sari o'z mijozlari sonini ham kengaytirib bordi. Hozirgi kunga kelib esa mukammal hech qanaqa xavfsiz online bank xizmatlari mavjud va deyarli 200 milliondan ko'p mijozlari bor. Quyida esa ushbu tizimda foydalanuvchilar sonining yillar kesimida qanday holatda rivojlanganini ekonometrik tahlil qilamiz.

2003-yildan boshlab AQSH da online bank xizmatlaridan foydalanuvchilar soni keltirilgan.

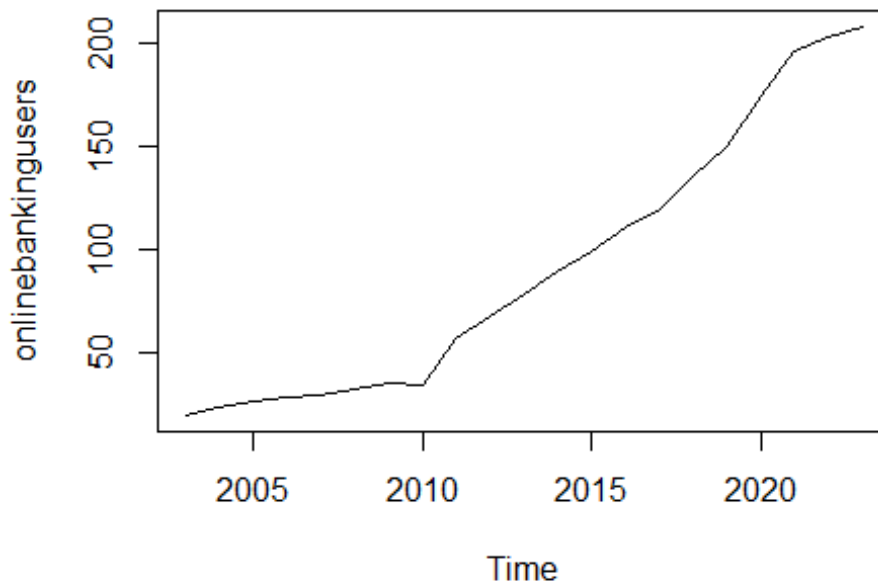
##Performing the data

```
#v0.United States of America
onlinebankingusers<-c(20,24,27,29,30,33,36,35,57,68,79,89,99,111,120,135,150,175,196,203,208)
onlinebankingusers<-ts(onlinebankingusers,start=(2003),frequency=1);onlinebankingusers
```

```
##                               Time                               Series:
##                               Start                               =                               2003
##                               End                                 =                               2023
##                               Frequency                           =                               1
## [1] 20 24 27 29 30 33 36 35 57 68 79 89 99 111 120 135 150 175 196
## [20] 203 208
```

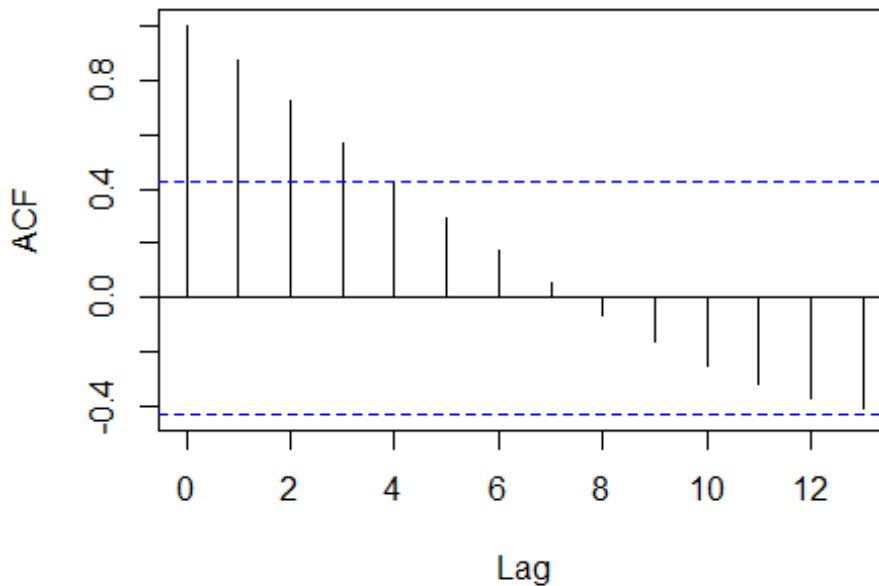
##Analyzing the data

```
X=ts(onlinebankingusers, start=c(2003), frequency=1)
plot(onlinebankingusers)
```



```
acf(onlinebankingusers)
```

### Series onlinebankingusers



Ko'rsatkichlar 2003-yildan boshlab 2023-yilgacha berilgan bo'lib, million hisobida.

Vaqt qatorlari bo'yicha ekonometrik modellardan biri bo'lgan Naive model yaratamiz (3 yiluchun prognoz, RMSE va MAE xatoliklarni tekshirish)

ACF funksiyasi bo'yicha tekshiradigan bo'lsak, Laglarimiz Nostatsionar

##1.2. Naive model (Prediction for 3 years, and checking for errors: MAE, RMSE). ##Naive model

```
library(forecast)
```

```
naive.x=naive(onlinebankingusers,h=3);naive.x
```

```
##      Point Forecast      Lo 80      Hi 80      Lo 95      Hi 95
## 2024              208 192.8636 223.1364 184.8508 231.1492
## 2025              208 186.5939 229.4061 175.2621 240.7379
## 2026              208 181.7830 234.2170 167.9045 248.0955
```

```
round(accuracy(naive.x),2)
```

```
##           ME   RMSE MAE   MPE   MAPE  MASE  ACF1
## Training set 9.4 11.81 9.5 10.64 10.93  1 0.47
```

$$X_n = X_{n+1}$$

### Xulosa Naive model bo'yicha RMSE ya,ni residuals qoldiqlar 11.81 ga teng bo'ldi. Prognozlar ushbu model bo'yicha 208 Eng past ko'rsatkich 192.8636 dan eng yuqori ko'rsatkich 223.1364 gacha kuzatilishi mumkin.

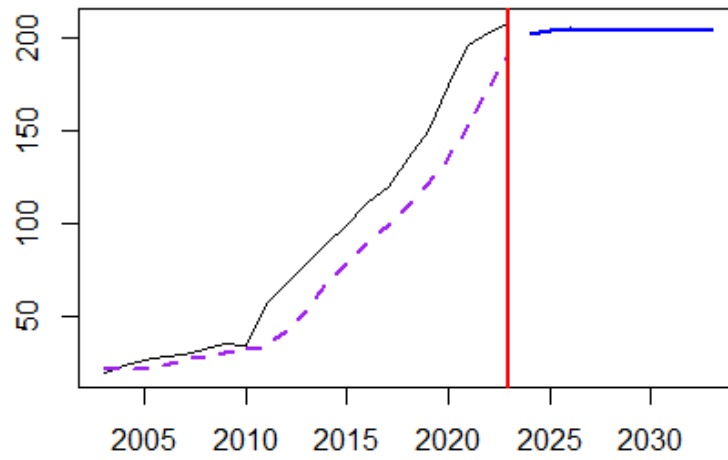
### ##MA smoothing models

```
ma3X=sma(onlinebankingusers,order=3,h=3,level=0.95);ma3X
```

```
##           Time           elapsed:           0.03           seconds
##   Model   estimated   using   sma()   function:   SMA(3)
##   Distribution   assumed   in   the   model:   Normal
##   Loss   function   type:   MSE;   Loss   function   value:   459.2076
##           ARMA           parameters           of           the           model:
##                                           AR:
##           phi1[1]           phi2[1]           phi3[1]
##           0.3333           0.3333           0.3333
##
##           Sample           size:           21
##   Number   of   estimated   parameters:           0
##   Number   of   degrees   of   freedom:           21
##                                           Information           criteria:
##           AIC           AICc           BIC           BICc
## 188.315 188.315 188.315 188.315
```

```
plot(forecast(ma3X))
```

### Forecast from SMA(3) with Normal distribution



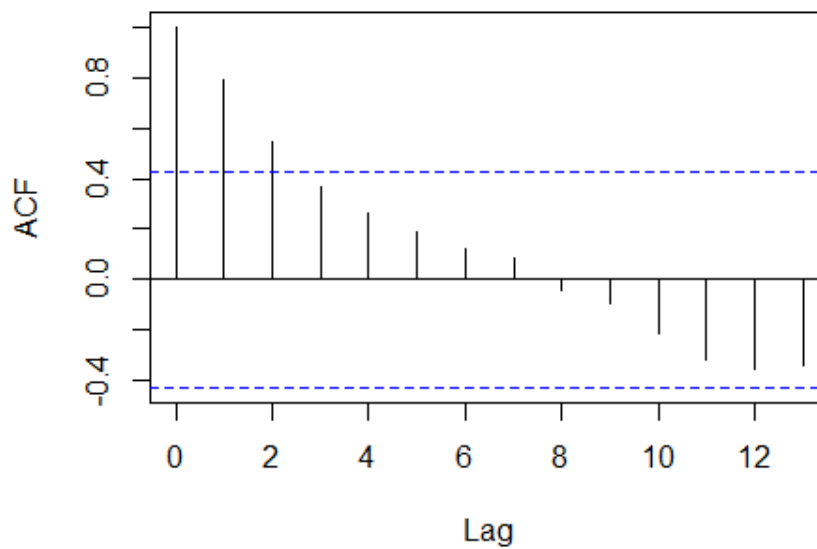
$$F_t = \frac{X_t + x_{t+1} + X_{t+2}}{3}$$

##Checking the residuals

```
errorma=residuals(ma3X)
```

```
acf(errorma)
```

### Series errorma



```

#maar=arima(errorma,c(1,0,0));maar
maar=arima(errorma,c(1,0,0),include.mean=F);maar

##
##
## Call:
## arima(x = errorma, order = c(1, 0, 0), include.mean = F)
##
## Coefficients:
## ar1
## 0.9270
## s.e. 0.0593
##
## sigma^2 estimated as 48.21: log likelihood = -71.47, aic = 146.94

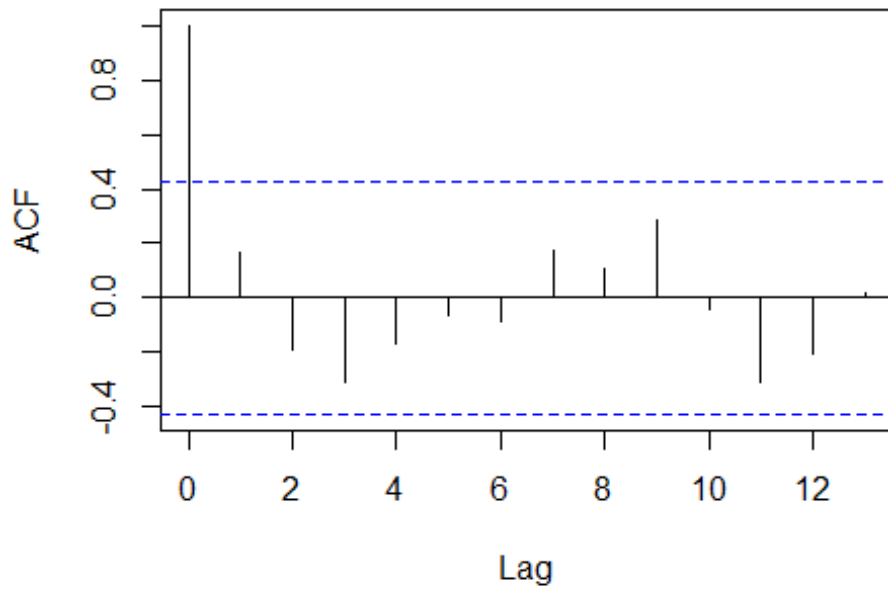
coeftest(maar)

##
## z test of coefficients:
##
## Estimate Std. Error z value Pr(>|z|)
## ar1 0.926953 0.059299 15.632 < 2.2e-16 ***
## ---
## Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

acf(maar$residuals)

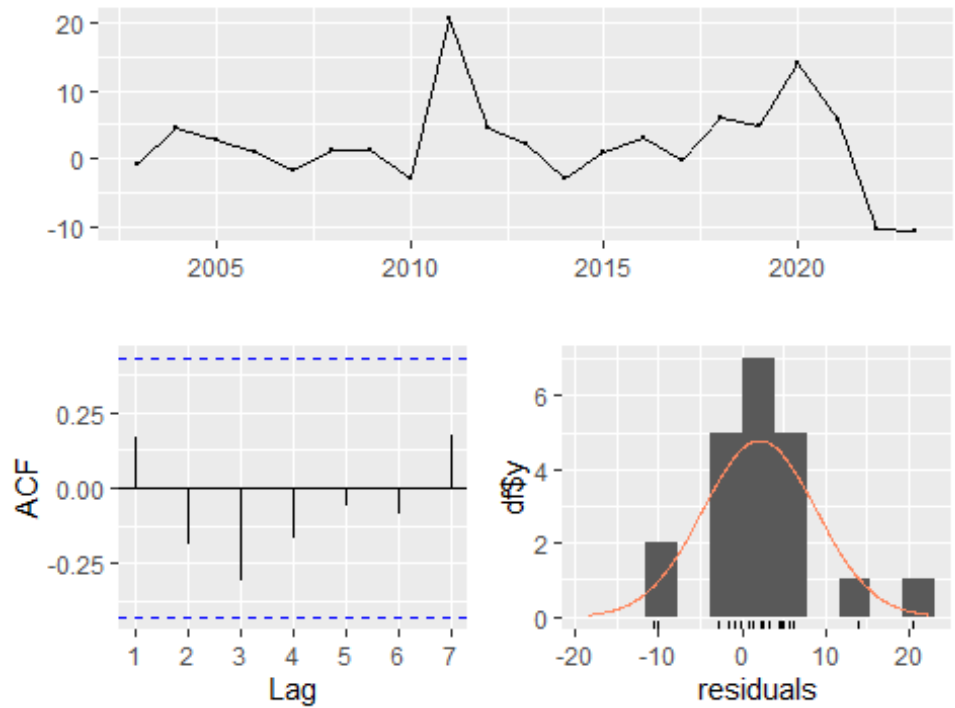
```

### Series maar\$residuals



`checkresiduals(maar)`

Residuals from ARIMA(1,0,0) with zero mean



##

##

Ljung-Box

test

```
##
## data: Residuals from ARIMA(1,0,0) with zero mean
## Q* = 4.8809, df = 3, p-value = 0.1807
##
## Model df: 1. Total lags used: 4
jarqueberaTest(maar$residuals)
##
## Title:
## Jarque - Bera Normality Test
## Test Results:
## STATISTIC:
## X-squared: 3.626
## P VALUE:
## Asymptotic p Value: 0.1632
```

##Smoothing model acf funksiyasi bo'yicha tekshiradigan bo'lsak, Laglarimiz nostatsionar.Jarquebera testiga ko'ra normal taqsimlangan.ARIMA modeldagi intercept =0 bo'lganda laglarimiz statsionar

$$\varepsilon_t = 0.926953 \cdot \varepsilon_{t-1} + w_t$$

**Modelning umumiy tenglamasi**

$$\widehat{X}_t = F_t + \varepsilon_t = \frac{X_t + X_{t+1} + X_{t+2}}{3} + 0.926953 \cdot \varepsilon_{t-1} + w_t$$

###Prediction

Forma3x=**forecast**(ma3X, h=3,level=95);Forma3x *#MA model bashorati qiymati*

```
## Time Series:
## Start = 2024
```



```
## End = 2026
## Frequency = 1
## [1] 202.3333 204.4444 204.9259
```

```
Forres=forecast(maar,h=3,level=95);Forres#Qoldiq model bashorati qiymati
```

```
## Point Forecast Lo 95 Hi 95
## 2024 15.44922 1.840546 29.05788
## 2025 14.32070 -4.235272 32.87666
## 2026 13.27461 -8.658318 35.20754
```

```
Finfor=Forma3x$mean+Forres$mean;Finfor #Umumiy o'rtacha bashorat
```

```
## Time Series:
## Start = 2024
## End = 2026
## Frequency = 1
## [1] 217.7825 218.7651 218.2005
```

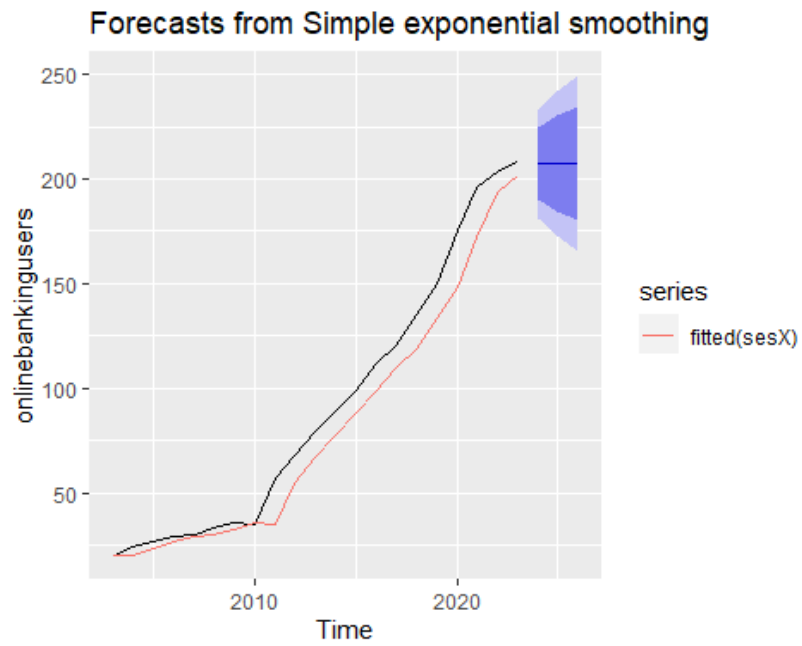
```
##Checking for errors
```

```
round(accuracy(maar),2)
```

```
## ME RMSE MAE MPE MAPE MASE ACF1
## Training set 2.07 6.94 4.84 13.34 42.58 1.01 0.16
```

```
##Exponential smoothing models
```

```
sesX<-ses(onlinebankingusers,alpha=0.9,h=3) #alpha=0.9
autoplot(sesX)+
autolayer(fitted(sesX))
```

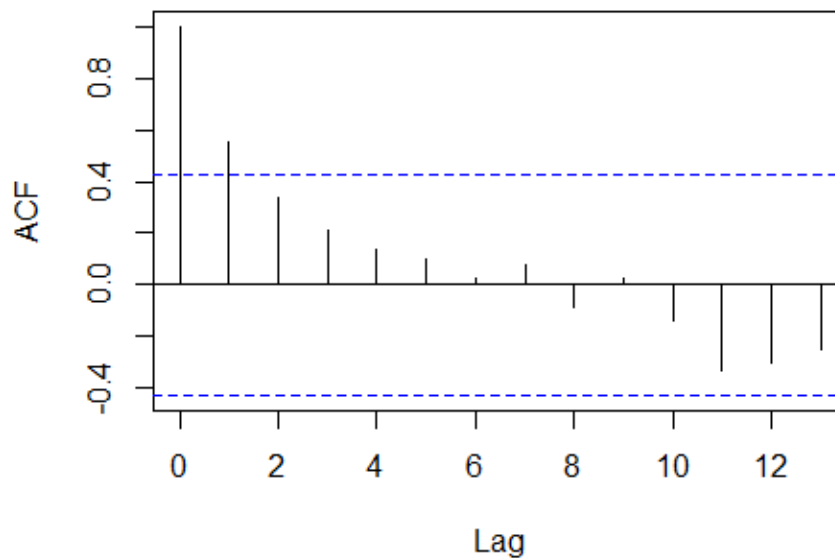


$$F_{t+1} = \alpha \cdot X_{t+1} + (1 - \alpha) \cdot F_t$$

`expoerror=residuals(sesX)`

`acf(expoerror)`

Series expoerror



`#expar=arima(expoerror,c(1,0,0),include.mean=F);expar`

`#coeftest(expar)`

```

#checkresiduals(expar)
jarqueberaTest(expoerror)

##
##
##                               Title:
##           Jarque       -       Bera       Normalality       Test
##
##                               Test                               Results:
##                               STATISTIC:
##                               X-squared:       1.3357
##                               P               VALUE:
##   Asymptotic p Value: 0.5128

##Prediction
ForsesX=forecast(sesX, h=3);ForsesX #MA model bashorati qiymati
##           Point Forecast       Lo 80       Hi 80       Lo 95       Hi 95
##   2024           207.4063   190.4732   224.3394   181.5094   233.3033
##   2025           207.4063   184.6252   230.1875   172.5656   242.2471
##   2026   207.4063 179.9977 234.8149 165.4885 249.3242
#Forres=forecast(expar,h=3);Forres#Qoldiq model bashorati qiymati
#Finfor=ForsesX$mean+Forres$mean;Finfor #Umumiy o'rtacha bashorat

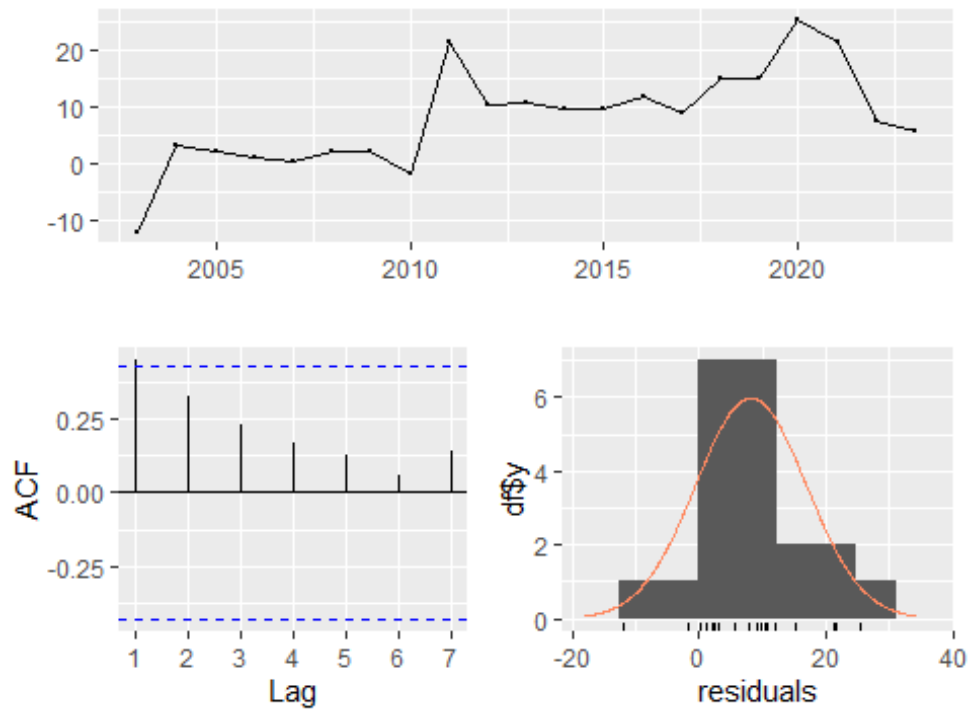
##AR(p)model
arx=arima(onlinebankingusers,c(1,0,0));arx

##
##
##                               Call:
##   arima(x = onlinebankingusers, order = c(1, 0, 0))
##
##                               Coefficients:
##                               ar1       intercept
##                               0.9914       112.2093

```

```
##          s.e.          0.0119          86.6844
##
## sigma^2 estimated as 139.2: log likelihood = -83.66, aic = 173.32
## arx=arima(x,c(1,0,0),include.mean=F);arx          without          intercept
coefest(arx)
##
##          z          test          of          coefficients:
##
##          Estimate Std. Error z value Pr(>|z|)
## ar1          0.991428    0.011927  83.1258    <2e-16 ***
## intercept    112.209294    86.684361    1.2945    0.1955
##
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
checkresiduals(arx)
```

Residuals from ARIMA(1,0,0) with non-zero mean



```
##
##                               Ljung-Box                               test
##
## data:      Residuals from ARIMA(1,0,0) with non-zero mean
## Q* = 9.776, df = 3, p-value = 0.02057
##
## Model df: 1. Total lags used: 4

jarqueberaTest(arx$residuals)

##
##                               Title:
## Jarque - Bera Normality Test
##
##                               Test                               Results:
##                               STATISTIC:
##                               X-squared: 0.0067
##                               P VALUE:
## Asymptotic p Value: 0.9966

round(accuracy(arx))

##                               ME RMSE MAE MPE MAPE MASE ACF1
## Training set 8 12 9 6 13 1 0

##Prediction

forarx=forecast(arx,h=3);forarx

## Point Forecast Lo 80 Hi 80 Lo 95 Hi 95
## 2024 207.1789 192.0590 222.2988 184.0550 230.3028
## 2025 206.3648 185.0735 227.6562 173.8025 238.9271
## 2026 205.5577 179.5924 231.5230 165.8473 245.2682
```

Modelimizni vaqt qatorlarining ekonometrik modellar bo'yicha tahlil qilganimizda trend model ma'qullanmadi. Chunki p-value 0.05 dan katta shuning uchun Exponential smoothing, Auregression model va AR va MA modellardan hamda Drift metodidan foydalanib tahlil qilamiz. Drift metodiga ko'ra, online bank foydalanuvchilari 202.6646 milliondan 262.9101 qayd etmoqda. Parabolic modelimizda esa ishonchilik darajasi boshqa modellarimizdan yuqori.

Xulosa qilib aytishimiz mumkinki, online bank foydalanuvchilarini iqtisodiy tahlil qiladigan nbo'lsak, 2015-2020-yillarda online bank foydalanuvchilari soni keskin o'sganini guvohi bo'lamiz. Buning sababi sifatida keltirishimiz mumkinki, ushbu yillarda raqamli texnologiyalar rivojlangan va AQSH to'liq raqamli iqtisodiyotga o'ta boshlagan Aytmoqchi bo'lgan taklifim shundan iboratki, raqamli bank foydalanuvchilari sonini ko'paytirish va barcha banklarni raqamli tizimga o'tkazish zarur. Bu borada AQSH da dunyoda eng rivojlangan banklar mavjud va tizim to'liq ishonchli. AQSh da online bank tizimining o'ziga xos rivojlanish omillariga nazar soladigan bo'lsak, O'rnatilgan infratuzilma, keng qo'llash, ilg'or moliyaviy texnologiyalar mavjud.