Lampiran 1. Hasil Estimasi Parameter $\hat{a}_x, \hat{b}_x^{(0)}, \hat{\iota}_{t-x}, \hat{b}_x^{(1)}, \hat{k}_t$

Hasil Estimasi Parameter $\hat{a}_x$

$\hat{a}_x$								
Age	**Female**	**Male**	**Age**	**Female**	**Male**	**Age**	**Female**	**Male**
0	0.696721	0.694986	36	0.686861	0.689442	72	0.690946	0.691565
1	0.688955	0.688338	37	0.687173	0.689598	73	0.690968	0.691574
2	0.681941	0.68236	38	0.687524	0.689741	74	0.690984	0.691581
3	0.675636	0.678298	39	0.687831	0.689893	75	0.691001	0.691588
4	0.670475	0.675301	40	0.688141	0.690068	76	0.691017	0.691595
5	0.666638	0.672036	41	0.688415	0.690187	77	0.691033	0.691601
6	0.662899	0.670602	42	0.688674	0.690315	78	0.691047	0.691607
7	0.659469	0.668752	43	0.688877	0.690427	79	0.691061	0.691613
8	0.653255	0.665244	44	0.689088	0.690539	80	0.691072	0.691617
9	0.651699	0.663195	45	0.68927	0.690638	81	0.691081	0.691621
10	0.652327	0.660202	46	0.689462	0.690742	82	0.69109	0.691623
11	0.650689	0.663131	47	0.689616	0.690826	83	0.691098	0.691625
12	0.653856	0.666579	48	0.689791	0.690905	84	0.691105	0.691626
13	0.659303	0.672301	49	0.689928	0.690988	85	0.691111	0.691626
14	0.664307	0.676389	50	0.690049	0.691062	86	0.691116	0.691623
15	0.669795	0.680038	51	0.690141	0.691113	87	0.691119	0.691618
16	0.674828	0.684413	52	0.690226	0.691171	88	0.691122	0.69161
17	0.676832	0.686127	53	0.690304	0.691218	89	0.691122	0.691598
18	0.679309	0.687606	54	0.690358	0.691254	90	0.691122	0.691582
19	0.681367	0.688289	55	0.690407	0.691291	91	0.691119	0.691557
20	0.682093	0.688635	56	0.690459	0.691322	92	0.691112	0.69152
21	0.682413	0.688895	57	0.690501	0.691349	93	0.691103	0.691469
22	0.683089	0.688956	58	0.690536	0.691374	94	0.691089	0.691401
23	0.683045	0.688886	59	0.690578	0.691395	95	0.691069	0.691299
24	0.682907	0.688854	60	0.690613	0.691417	96	0.69104	0.69115
25	0.68318	0.688741	61	0.690646	0.691434	97	0.690998	0.690928
26	0.683557	0.688602	62	0.690677	0.69145	98	0.690935	0.690583
27	0.683786	0.68858	63	0.690705	0.691465	99	0.690842	0.689979
28	0.68402	0.688683	64	0.690735	0.691478	100	0.690712	0.68906
29	0.684496	0.688739	65	0.690765	0.691489			
30	0.684834	0.68883	66	0.690792	0.691502			
31	0.685282	0.688819	67	0.690817	0.691512			
32	0.685569	0.68896	68	0.690844	0.691523			
33	0.685757	0.689026	69	0.69087	0.691534			
34	0.686262	0.689177	70	0.690895	0.691545			
35	0.686624	0.689309	71	0.690921	0.691555			

Hasil Estimasi Parameter $\hat{b}_x^{(1)}$

$\hat{\boldsymbol{b}}_x^{(1)}$								
Age	**Female**	**Male**	**Age**	**Female**	**Male**	**Age**	**Female**	**Male**
0	-0.001723	-0.001597	36	0.001937	0.000485	72	2.46E-05	5.52E-05
1	0.013305	0.019442	37	0.002207	0.000697	73	6.41E-06	3.29E-05
2	0.027423	0.040179	38	0.002412	9.43E-04	74	1.67E-05	5.16E-05
3	0.041148	0.055452	39	0.002348	0.001028	75	2.22E-05	5.76E-05
4	0.05118	0.061718	40	0.002458	0.0013	76	1.88E-05	5.08E-05
5	0.057888	0.073266	41	0.002586	0.001552	77	1.12E-05	4.94E-05
6	0.061196	0.080917	42	0.002671	0.001833	78	-3.44E-06	4.39E-05
7	0.078155	0.084731	43	0.002772	0.001795	79	5.87E-07	4.06E-05
8	0.08935	0.083138	44	0.002434	0.00178	80	7.39E-07	4.39E-05
9	0.082212	0.086927	45	0.002252	0.001688	81	1.18E-05	5.22E-05
10	0.070473	0.101287	46	0.001845	0.001512	82	1.06E-05	5.38E-05
11	0.077132	0.080886	47	0.001605	0.00139	83	8.1E-06	5.19E-05
12	0.071704	0.069993	48	0.001241	0.001243	84	4E-06	4.43E-05
13	0.054965	0.049208	49	0.001038	0.001017	85	-5.76E-07	3.17E-05
14	0.036904	0.036737	50	0.000724	0.000836	86	-6.28E-06	1.52E-05
15	0.030519	0.028003	51	0.000528	0.000693	87	-1.58E-05	-1.58E-05
16	0.025387	0.023008	52	0.000339	0.000513	88	-2.62E-05	-5.36E-05
17	0.021612	0.016309	53	0.000167	0.000368	89	-3.78E-05	-0.000105
18	0.017343	0.009616	54	0.00013	0.000327	90	-5.03E-05	-0.000169
19	0.010277	0.006332	55	7.66E-05	0.000279	91	-6.49E-05	-0.000248
20	0.00716	0.002655	56	-8.03E-06	0.000208	92	-8.62E-05	-0.000378
21	0.006894	-0.000422	57	-5.14E-05	0.000176	93	-0.000113	-0.000538
22	0.002779	-0.001271	58	-4.24E-05	0.000159	94	-0.000149	-0.000732
23	0.003269	-0.00108	59	-3.39E-07	0.00015	95	-0.000194	-0.00104
24	0.004076	-0.001575	60	-1.1E-06	0.00012	96	-0.000255	-0.001444
25	0.002739	-0.001095	61	2.83E-05	0.000119	97	-0.000342	-0.002058
26	0.002401	-0.000447	62	2.91E-05	0.000125	98	-0.000487	-0.003064
27	0.002502	-0.000924	63	6.16E-05	0.000122	99	-0.000668	-0.00504
28	0.003676	-0.000713	64	0.000115	0.000137	100	-0.000913	-0.007946
29	0.002937	-0.000379	65	0.000125	0.000158			
30	0.003015	-0.001154	66	0.000154	0.000158			
31	0.002651	-0.000247	67	0.000154	0.000153			
32	0.002488	-0.000249	68	0.000165	0.000157			
33	0.003183	-0.00013	69	0.000149	0.000152			
34	0.001975	-0.000123	70	0.000116	0.00013			
35	0.002253	0.000161	71	6.42E-05	9.34E-05			

Hasil Estimasi Parameter $\hat{k}_t$

Years	$\hat{k}_t$	
	Female	Male
1990	0.21334	0.15823
1991	0.19909	0.14735
1992	0.21131	0.15043
1993	0.21572	0.14279
1994	0.16302	0.13963
1995	0.22523	0.16012
1996	0.146	0.10834
1997	0.12828	0.09654
1998	0.15277	0.11162
1999	0.1253	0.09302
2000	0.05269	0.06739
2001	0.04362	0.04049
2002	0.06547	0.02336
2003	0.07035	0.00866
2004	-0.036	0.00786
2005	-0.0166	0.01711
2006	-0.0118	-0.0099
2007	-0.0662	-0.043
2008	-0.0612	-0.0491
2009	-0.071	-0.0866
2010	-0.0968	-0.069
2011	0.13948	0.04381
2012	-0.1113	-0.0948
2013	-0.2163	-0.1264
2014	-0.209	-0.0945
2015	-0.1607	-0.1441
2016	-0.2536	-0.1896
2017	-0.3775	-0.1905
2018	-0.2413	-0.2043
2019	-0.2223	-0.2149

Hasil estimasi parameter $\hat{b}_x^{(0)}$

$\hat{\boldsymbol{b}}_{\boldsymbol{x}}^{(\mathbf{0})}$								
Age	**Female**	**Male**	**Age**	**Female**	**Male**	**Age**	**Female**	**Male**
0	1	1	36	1	1	72	1	1
1	1	1	37	1	1	73	1	1
2	1	1	38	1	1	74	1	1
3	1	1	39	1	1	75	1	1
4	1	1	40	1	1	76	1	1
5	1	1	41	1	1	77	1	1
6	1	1	42	1	1	78	1	1
7	1	1	43	1	1	79	1	1
8	1	1	44	1	1	80	1	1
9	1	1	45	1	1	81	1	1
10	1	1	46	1	1	82	1	1
11	1	1	47	1	1	83	1	1
12	1	1	48	1	1	84	1	1
13	1	1	49	1	1	85	1	1
14	1	1	50	1	1	86	1	1
15	1	1	51	1	1	87	1	1
16	1	1	52	1	1	88	1	1
17	1	1	53	1	1	89	1	1
18	1	1	54	1	1	90	1	1
19	1	1	55	1	1	91	1	1
20	1	1	56	1	1	92	1	1
21	1	1	57	1	1	93	1	1
22	1	1	58	1	1	94	1	1
23	1	1	59	1	1	95	1	1
24	1	1	60	1	1	96	1	1
25	1	1	61	1	1	97	1	1
26	1	1	62	1	1	98	1	1
27	1	1	63	1	1	99	1	1
28	1	1	64	1	1	100	1	1
29	1	1	65	1	1			
30	1	1	66	1	1			
31	1	1	67	1	1			
32	1	1	68	1	1			
33	1	1	69	1	1			
34	1	1	70	1	1			
35	1	1	71	1	1			

Hasil Estimasi Parameter $\hat{\iota}_{t-x}$

Years	$\hat{\iota}_{t-x}$	
	Female	**Male**
1990	-0.0037	-0.00203
1991	-0.0036	-0.00221
1992	-0.00383	-0.0023
1993	-0.00412	-0.00254
1994	-0.00463	-0.00265
1995	-0.00412	-0.00232
1996	-0.00511	-0.0026
1997	-0.00446	-0.0023
1998	-0.00438	-0.00253
1999	-0.0045	-0.00243
2000	-0.00472	-0.00221
2001	-0.00406	-0.00304
2002	-0.00488	-0.00272
2003	-0.00442	-0.00287
2004	-0.00405	-0.00266
2005	-0.00446	-0.00313
2006	-0.00579	-0.00316
2007	-0.00525	-0.00297
2008	-0.00477	-0.00247
2009	-0.00581	-0.00335
2010	-0.00588	-0.00363
2011	-0.00584	-0.00366
2012	-0.00584	-0.00424
2013	-0.00634	-0.00372
2014	-0.006	-0.00408
2015	-0.00585	-0.004
2016	-0.00612	-0.00409
2017	-0.00679	-0.00455
2018	-0.00652	-0.00444
2019	-0.00658	-0.00442

Lampiran 2 Hasil RMSE

Years	RMSE	
	Female	Male
1990	1.9379153	1.932698
1991	1.9395821	1.933488
1992	1.940474	1.933726
1993	1.9393939	1.933531
1994	1.9393587	1.935312
1995	1.9415384	1.933804
1996	1.9408997	1.936142
1997	1.9425636	1.936619
1998	1.9442559	1.937917
1999	1.9426246	1.935957
2000	1.943367	1.938678
2001	1.9452733	1.937485
2002	1.9449536	1.938897
2003	1.9460062	1.93793
2004	1.9453566	1.939406
2005	1.9441396	1.936477
2006	1.9424081	1.937873
2007	1.9427137	1.938137
2008	1.9436581	1.93813
2009	1.9422682	1.937181
2010	1.9408615	1.935373
2011	1.9449097	1.937278
2012	1.9403007	1.933666
2013	1.9377045	1.935488
2014	1.9394146	1.936253
2015	1.9406651	1.935906
2016	1.9388938	1.934912
2017	1.9352341	1.933842
2018	1.9386368	1.93457
2019	1.9391912	1.93529

Lampiran 3 Hasil ARIMA $\hat{k}_t$ dan $\hat{\iota}_{t-x}$

ARIMA $\hat{\boldsymbol{k}}_t$

- Hasil Uji Augmeted Dikey-Fuller (ADF)

Female

```
        Augmented Dickey-Fuller Test

data:  female
Dickey-Fuller = -3.47, Lag order = 3, p-value = 0.0666
alternative hypothesis: stationary
```

Male

```
        Augmented Dickey-Fuller Test

data:  male
Dickey-Fuller = -3.7804, Lag order = 3, p-value = 0.03601
alternative hypothesis: stationary
```

- Identifikasi Model dengan auto.arima

Female

```
> #Identifikasi Model
> #Female
> model <- auto.arima(ktf,ic=c("aicc","aic","bic"),trace=T)

 ARIMA(2,1,2) with drift         : Inf
 ARIMA(0,1,0) with drift         : -56.88512
 ARIMA(1,1,0) with drift         : -57.10563
 ARIMA(0,1,1) with drift         : Inf
 ARIMA(0,1,0)                    : -58.28591
 ARIMA(1,1,1) with drift         : Inf

 Best model: ARIMA(0,1,0)
```

Male

```
> #Male
> model2 <- auto.arima(ktm,ic=c("aicc","aic","bic"),trace=T)

 ARIMA(2,1,2) with drift         : Inf
 ARIMA(0,1,0) with drift         : -101.7729
 ARIMA(1,1,0) with drift         : -101.8109
 ARIMA(0,1,1) with drift         : Inf
 ARIMA(0,1,0)                    : -101.0536
 ARIMA(2,1,0) with drift         : -108.2671
 ARIMA(3,1,0) with drift         : -105.3313
 ARIMA(2,1,1) with drift         : -105.3496
 ARIMA(1,1,1) with drift         : Inf
 ARIMA(3,1,1) with drift         : Inf
 ARIMA(2,1,0)                    : -99.63838

 Best model: ARIMA(2,1,0) with drift
```

- Hasil Penaksiran Model

Female

```
> #Penaksiran Parameter Model
> #Female
> arima1 <- arima(ktf,c(0,1,0))
> print(arima1)

Call:
arima(x = ktf, order = c(0, 1, 0))


sigma^2 estimated as 0.007286:  log likelihood = 30.22,  aic = -58.43
> AIC(arima1)
[1] -58.43406
> accuracy(arima1)
                      ME       RMSE       MAE     MPE     MAPE      MASE       ACF1
Training set -0.01451576 0.08392299 0.0549426 15.7028 52.47383 0.9667918 -0.3026912
```

Male

```
> #Male
> arima2 <- arima(ktm,c(2,1,0))
> print(arima2)

Call:
arima(x = ktm, order = c(2, 1, 0))

Coefficients:
          ar1      ar2
      -0.2132  -0.2839
s.e.   0.1758   0.1713

sigma^2 estimated as 0.001473:  log likelihood = 53.3,  aic = -100.6
> AIC(arima2)
[1] -100.5984
> accuracy(arima2)
                      ME       RMSE        MAE      MPE     MAPE     MASE       ACF1
Training set -0.01827317 0.03773485 0.02745193 6.086899 58.35785 1.003426 -0.1902863
```

- Hasil Uji Autokorelasi

Female

```
> # Uji autokorelasi
> #Female
> Box.test(resid, lag = 23 ,type = "Ljung")

        Box-Ljung test

data:  resid
X-squared = 23.444, df = 23, p-value = 0.4351
```

Male

```
> #Male
> Box.test(resid2, lag = 23 ,type = "Ljung")

        Box-Ljung test

data:  resid2
X-squared = 12.486, df = 23, p-value = 0.9623
```

ARIMA $\hat{\imath}_{t-x}$

- Hasil Uji *Augmented Dickey-Fuller* (ADF).

Female

```
	Augmented Dickey-Fuller Test

data:  femaleco
Dickey-Fuller = -2.5871, Lag order = 3, p-value = 0.3476
alternative hypothesis: stationary
```

Male

```
	Augmented Dickey-Fuller Test

data:  maleco
Dickey-Fuller = -4.4597, Lag order = 3, p-value = 0.01
alternative hypothesis: stationary
```

Identifikasi model dengan auto.arima

Female

```
> #Identifikasi Model
> #Female
> modelc <- auto.arima(ctf,ic=c("aicc","aic","bic"),trace=T)

 ARIMA(2,1,2) with drift         : -354.9242
 ARIMA(0,1,0) with drift         : -351.7988
 ARIMA(1,1,0) with drift         : -353.7709
 ARIMA(0,1,1) with drift         : -360.7993
 ARIMA(0,1,0)                    : -353.0796
 ARIMA(1,1,1) with drift         : Inf
 ARIMA(0,1,2) with drift         : Inf
 ARIMA(1,1,2) with drift         : Inf
 ARIMA(0,1,1)                    : -356.2203

 Best model: ARIMA(0,1,1) with drift
```

Male

```
> #Male
> modelc2 <- auto.arima(ctm,ic=c("aicc","aic","bic"),trace=T)

 ARIMA(2,1,2) with drift         : Inf
 ARIMA(0,1,0) with drift         : -375.1863
 ARIMA(1,1,0) with drift         : -379.5711
 ARIMA(0,1,1) with drift         : -382.4492
 ARIMA(0,1,0)                    : -375.9235
 ARIMA(1,1,1) with drift         : -379.7552
 ARIMA(0,1,2) with drift         : -379.753
 ARIMA(1,1,2) with drift         : Inf
 ARIMA(0,1,1)                    : -377.9782

 Best model: ARIMA(0,1,1) with drift
```

- **Hasil Penaksiran Parameter**

Female

```
> #Penaksiran Parameter Model
> #Female
> arimac1 <- arima(ctf,c(0,1,1))
> print(arimac1)

Call:
arima(x = ctf, order = c(0, 1, 1))

Coefficients:
          ma1
      -0.4428
s.e.   0.1431

sigma^2 estimated as 2.306e-07:  log likelihood = 180.34,  aic = -356.68
> AIC(arimac1)
[1] -356.6819
> accuracy(arimac1)
                        ME         RMSE          MAE      MPE     MAPE    MASE       ACF1
Training set -0.0001701281 0.0004721073 0.0003511581 2.773226 6.897286 0.83635 -0.177242
> 
```

Male

```
> #Male
> arimac2 <- arima(ctm,c(0,1,1))
> print(arimac2)

Call:
arima(x = ctm, order = c(0, 1, 1))

Coefficients:
          ma1
      -0.3573
s.e.   0.1505

sigma^2 estimated as 1.092e-07:  log likelihood = 191.22,  aic = -378.44
> AIC(arimac2)
[1] -378.4398
> accuracy(arimac2)
                        ME         RMSE          MAE      MPE     MAPE      MASE       ACF1
Training set -0.0001228382 0.0003248872 0.0002520709 3.203269 8.247704 0.8921177 -0.2358512
> 
```

- **Hail Uji Autokorelasi**

Female

```
> # Uji autokorelasi
> #Female
> Box.test(residc, lag = 23 ,type = "Ljung")

        Box-Ljung test

data:  residc
X-squared = 28.23, df = 23, p-value = 0.2072
```

Male

```
> #Male
> Box.test(residc2, lag = 23 ,type = "Ljung")

        Box-Ljung test

data:  residc2
X-squared = 21.016, df = 23, p-value = 0.5801
```

Lampiran 4 Scrip R Mencari Nilai Estimator dan ARIMA

Scrip R Mencari Nilai Estimator

```
library(forecast)
library(demography)
library(StMoMo)
library(readr)

setwd("D:/DATA JEPANG")
JPN<-read.demogdata("Mx_1x1.txt","Exposures_1x1.txt", type =
"mortality", label="Japan",max.mx = 10000000)
summary(JPN)

##======FEMALE======
JPNStMoMo<-StMoMoData(JPN,series = "female", type="central")
JPNDStMoMo<-central2initial(JPNStMoMo)
summary(JPNDStMoMo)
summary(JPNStMoMo)
LCfit <-  fit(lc(), data=JPNDStMoMo,series="female",
ages.fit = 0:100,years.fit = 1990:2019)
wxt <- genWeightMat(0:100, 1990:2019, clip = 0)
RHfit <- fit(rh(), data = JPNDStMoMo, series="female",
ages.fit = 0:100,years.fit =  1990:2019,
             wxt = wxt, start.ax = LCfit$ax,
             start.bx = LCfit$bx, start.kt = LCfit$kt)
names(LCfit)
plot(RHFor)
axdata<-RHfit$ax
bxdata<-RHfit$bx
ktdata<-RHfit$kt
bx0<-RHfit$b0x
i_tx<-RHfit$gc
#Menampilkan hasil estimasi parameter
axdata
bxdata
ktdata
bx0
i_tx

##==========MALE=============
JPNStMoMomale<-StMoMoData(JPN,series = "male",
type="central")
```

```
JPNDStMoMomale<-central2initial(JPNStMoMomale)
LCfitm <-  fit(lc(), data=JPNDStMoMomale,series="male",
ages.fit = 0:100,years.fit = 1990:2019)
wxtm <- genWeightMat(0:100, 1990:2019, clip = 0)
RHfitm <- fit(rh(), data = JPNDStMoMomale, series="male",
ages.fit = 0:100,years.fit =  1990:2019,
             wxt = wxtm, start.ax = LCfitm$ax,
             start.bx = LCfitm$bx, start.kt = LCfitm$kt)
RHfitm$kt
RHform<-forecast(RHfitm,h=5)
RHform$kt.f
plot(RHfitm)
axdatamale<-RHfitm$ax
bxdatamale<-RHfitm$bx
ktdatamale<-RHfitm$kt
bx0male<-RHfitm$b0x
i_txmale<-RHfitm$gc
#Menampilkan hasil Estimasi parameter
axdatamale
bxdatamale
ktdatamale
bx0male
i_txmale
```

Scrip R ARIMA k_t

```
#Library
library(tseries)
library(forecast)

#Mengambil data
datakt=read.csv(file.choose())
View(datakt)
##Menyatakan data dalam bentuk data time series
#Female
ktf=ts(datakt$Female)
#Male
ktm=ts(datakt$Male)

#plot data
#Female
plot.ts(ktf, col = "blue", xlab = "Years", ylab = "Series
Female", main = "Hasil Estimasi kt Female")
#Male
plot.ts(ktm, col = "red", xlab = "Years", ylab = "Series
Male", main = "Hasil Estimasi kt Male")

#mendifensiasi data
#Female
par(mfrow=c(1,1))
female<-diff(ktf,differences = 1)
plot(female,main="Female")
abline(h=mean(female),col="red",lwd=1)

#Male
male<-diff(ktm,differences = 1)
plot(male, main="Male")
abline(h=mean(male),col="red",lwd=1)

#Cek Kestasioneran
#Female Sebelum differencing
adf.test(ktf) #Rata-rata
BoxCox.lambda(ktf) #Varian

#Female Setelah differencing
adf.test(female) #Rata-rata
BoxCox.lambda(female) #Varian
```

```
#Male Sebelum differencing
adf.test(ktm) #Rata-rata
BoxCox.lambda(ktm) #Varian

#Male setelah differencing
adf.test(male) #Rata-rata
BoxCox.lambda(male) #Varian

#Plot ACF dan PACF
par(mfrow=c(2,1))
#Female Awal
acf(ktf, main="Plot ACF Female")
pacf(ktf, main="Plot PACF Female")

#Female Diff
acf(female, main="Plot ACF Female")
pacf(female, main="Plot PACF Female")

#Male diff
acf(male, main="Plot ACF Male")
pacf(male, main="Plot PACF Male")

#Male awal
acf(ktm, main="Plot ACF Male")
pacf(ktm, main="Plot PACF Male")


#Identifikasi Model
#Female
model <- auto.arima(ktf,ic=c("aicc","aic","bic"),trace=T)
summary(model)
#Male
model2 <- auto.arima(ktm,ic=c("aicc","aic","bic"),trace=T)
summary(model2)

#Penaksiran Parameter Model
#Female
arima1 <- arima(ktf,c(0,1,0))
print(arima1)
accuracy(arima1)
#Male
arima2 <- arima(ktm,c(2,1,0))
print(arima2)
accuracy(arima2)
```

```
#Peramalan
#Female
fore = forecast(arima1,h=5)
fore
#Male
fore2 = forecast(arima2,h=5)
fore2


#Plot Peramalan
par(mfrow=c(1,1))
#Female
plot(fore)
#Male
plot(fore2)


#Diagnostic Checking
#Female
par(mfrow=c(1,1))
resid = arima1$residuals
resid
qqnorm(resid, main="Q-Q Plot Residual ARIMA Female")
qqline(resid, col = "red", lwd = 2)
#Male
resid2 = arima2$residuals
resid2
qqnorm(resid2, main="Q-Q Plot Residual ARIMA Male")
qqline(resid2, col = "red", lwd = 2)

# Uji autokorelasi
#Female
Box.test(resid, lag = 5 ,type = "Ljung")
#Male
Box.test(resid2, lag = 5 ,type = "Ljung")
```

Scrip R ARIMA ι_{t-x}

```
#Library
library(tseries) #adf test
library(forecast) #auto arima


#Mengambil data
datacoh=read.csv(file.choose())
View(datacoh)

##Menyatakan data dalam bentuk data time series
#Female
ctf=ts(datacoh$Female)
#Male
ctm=ts(datacoh$Male)

#plot data
#Female
plot.ts(ctf, col = "blue", xlab = "Years", ylab = "Series
Female", main = "Hasil Estimasi i_(t-x) Female")
#Male
plot.ts(ctm, col = "red", xlab = "Years", ylab = "Series
Male", main = "Hasil Estimasi i_(t-x) Male")

#mendifensiasi data
#Female
par(mfrow=c(1,1))
femaleco<-diff(ctf,differences = 1)
plot(female,main="Female")
abline(h=mean(female),col="red",lwd=1)

#Male
maleco<-diff(ctm,differences = 1)
plot(male, main="Male")
abline(h=mean(male),col="red",lwd=1)

#Cek Kestasioneran
#Female Sebelum
adf.test(ctf) #Rata-rata
BoxCox.lambda(ctf)#Varian
#MaleSebelum
adf.test(ctm) #Rata-rata
BoxCox.lambda(ctm)#Varian
```

```
#Female Sesudah diff
adf.test(femaleco) #Rata-rata
BoxCox.lambda(femaleco)#Varian
#Male Sesudah diff
adf.test(maleco) #Rata-rata
BoxCox.lambda(maleco)#Varian


#Plot ACF dan PACF
par(mfrow=c(2,1))
#Female Awal
acf(ctf, main="Plot ACF Female")
pacf(ctf, main="Plot PACF Female")
#Female Diff
acf(female, main="Plot ACF Female")
pacf(female, main="Plot PACF Female")
#Male diff
acf(male, main="Plot ACF Male")
pacf(male, main="Plot PACF Male")
#Male awal
acf(ctm, main="Plot ACF Male")
pacf(ctm, main="Plot PACF Male")


#Identifikasi Model
#Female
modelc <- auto.arima(ctf,ic=c("aicc","aic","bic"),trace=T)
summary(modelc)
#Male
modelc2 <- auto.arima(ctm,ic=c("aicc","aic","bic"),trace=T)
summary(modelc2)

#Penaksiran Parameter Model
#Female
arimac1 <- arima(ctf,c(0,1,1))
print(arimac1)
accuracy(arimac1)
#Male
arimac2 <- arima(ctm,c(0,1,1))
print(arimac2)
accuracy(arimac2)

#Peramalan
#Female
```

```
foreco = forecast(arimac1,h=5)
foreco
names(foreco)
#Male
foreco2 = forecast(arimac2,h=5)
foreco2

#Plot Peramalan
par(mfrow=c(1,1))
#Female
plot(foreco)
#Male
plot(foreco2)

#Diagnostic Checking
#Female
par(mfrow=c(1,1))
residc = arimac1$residuals
residc
qqnorm(residc, main="Q-Q Plot Residual ARIMA Female")
qqline(residc, col = "red", lwd = 2)
#Male
residc2 = arimac2$residuals
residc2
qqnorm(residc2, main="Q-Q Plot Residual ARIMA Male")
qqline(residc2, col = "red", lwd = 2)

# Uji autokorelasi
#Female
Box.test(residc, lag = 23 ,type = "Ljung")
#Male
Box.test(residc2, lag = 23 ,type = "Ljung")
```