```
import numpy as np
import pandas as pd
import matplotlib as mpl
import matplotlib.pyplot as plt
import seaborn
%matplotlib inline
from sklearn.preprocessing import LabelEncoder, MinMaxScaler
from sklearn.model_selection import train_test_split, cross_validation, cross_validation, KFold
from sklearn.ensemble import RandomForestClassifier, ExtraTreesClassifier, GradientBoostingClassifier, AdaBoostClassifier
from sklearn.linear_model import LogisticRegression, RidgeClassifier, PassiveAggressiveClassifier
from sklearn.tree import DecisionTreeClassifier
from sklearn.neighbors import KNeighborsClassifier
from sklearn.svm import SVC, LinearSVC
from sklearn.naive_bayes import GaussianNB
from sklearn.metrics import classification_report, confusion_matrix, roc_curve, roc_auc_score
from sklearn.feature_selection import RFECV

%matplotlib inline
%load_ext rpy2.ipython
```

	Survival	Pclass	Name	Sex	Age	SibSp	Parch	Ticket	Fare	Cabin	Embarked
0	0.0000000	3.0000000	Braund, Mr. Owen Harris	male	22.0000000	1.0000000	0.0000000	A/5 21171	7.2500000		S
1	1.0000000	1.0000000	Cumings, Mrs. John Bradley (Florence Briggs Thayer)	female	38.0000000	1.0000000	0.0000000	PC 17599	71.2833000	C85	C
2	1.0000000	3.0000000	Heikkinen, Miss. Laina	female	26.0000000	0.0000000	0.0000000	STON/O2. 3101282	7.9250000		S
3	1.0000000	1.0000000	Futrelle, Mrs. Jacques Heath (Lily May Peel)	female	35.0000000	1.0000000	0.0000000	113803	53.1000000	C123	S
4	0.0000000	3.0000000	Allen, Mr. William Henry	male	35.0000000	0.0000000	0.0000000	373450	8.0500000		S
5	0.0000000	3.0000000	Moran, Mr. James	male	NaN	0.0000000	0.0000000	330877	8.4583000		Q
6	0.0000000	1.0000000	McCarthy, Mr. Timothy J	male	54.0000000	0.0000000	0.0000000	17463	51.8625000	E46	S
7	0.0000000	3.0000000	Palsson, Master. Gosta Leonard	male	2.0000000	3.0000000	1.0000000	349909	21.0750000		S
8	1.0000000	3.0000000	Johnson, Mrs. Oscar W (Elisabeth Vilhelmina Berg)	female	27.0000000	0.0000000	2.0000000	347742	11.1333000		S
9	1.0000000	2.0000000	Nasser, Mrs. Nicholas (Adele Achem)	female	14.0000000	1.0000000	0.0000000	237736	30.0708000		C
10	1.0000000	3.0000000	Sandstrom, Miss. Marguerite Rut	female	4.0000000	1.0000000	1.0000000	PP 9549	16.7000000	G6	S
11	1.0000000	1.0000000	Bonnell, Miss. Elizabeth	female	58.0000000	0.0000000	0.0000000	113783	26.5500000	C103	S
12	0.0000000	3.0000000	Saundercock, Mr. William Henry	male	20.0000000	0.0000000	0.0000000	A/5. 2151	8.0500000		S
13	0.0000000	3.0000000	Andersson, Mr. Anders Johan	male	39.0000000	1.0000000	5.0000000	347082	31.2750000		S
14	0.0000000	3.0000000	Vestrom, Miss. Hulda Amanda Adolfina	female	14.0000000	0.0000000	0.0000000	350406	7.8542000		S
15	1.0000000	2.0000000	Hewlett, Mrs. (Mary D Kingcome)	female	55.0000000	0.0000000	0.0000000	248706	16.0000000		S
16	0.0000000	3.0000000	Rice, Master. Eugene	male	2.0000000	4.0000000	1.0000000	382652	29.1250000		Q
17	1.0000000	2.0000000	Williams, Mr. Charles Eugene	male	NaN	0.0000000	0.0000000	244373	13.0000000		S
18	0.0000000	3.0000000	Vanden Steen, Mr. Leo Peter	male	31.0000000	0.0000000	0.0000000	345773	18.0000000		S
19	1.0000000	3.0000000	Vanden Hulme, Mrs. William (Anna Mary)	female	NaN	1.0000000	0.0000000	2691	7.2292000		C
20	0.0000000	3.0000000	McEvoy, Mr. Michael	male	18.0000000	0.0000000	0.0000000	349924	24.0000000		S
21	1.0000000	3.0000000	Johnson, Mr. Malkolm Joackim	male	33.0000000	0.0000000	0.0000000	214746	7.8958000		S
22	0.0000000	3.0000000	Gustafsson, Mr. Anton Viktor	male	28.0000000	2.0000000	0.0000000	347351	7.7750000		S
23	1.0000000	2.0000000	Greenfield, Mrs. Leo David (Adelaide)	female	23.0000000	0.0000000	1.0000000	230136	13.0000000		S
24	0.0000000	3.0000000	Taylor, Mr. Elmer Zebley	male	10.0000000	1.0000000	0.0000000	19996	52.0000000	C126	S
25	1.0000000	3.0000000	Hoyt, Mrs. Frederick Maxfield (Jane Anne Forde)	female	19.0000000	1.0000000	0.0000000	19877	78.8500000		S
26	0.0000000	3.0000000	Kantor, Mr. Sidney	male	29.0000000	0.0000000	0.0000000	239865	26.0000000		S
27	1.0000000	3.0000000	Bjorklund, Mr. Ernst Gustaf Johannes	male	19.0000000	0.0000000	0.0000000	347232	7.8958000		S
28	0.0000000	3.0000000	Bachey, Miss. Gerda Ulrika	female	NaN	0.0000000	0.0000000	7.8958000			S
29	0.0000000	3.0000000	Baxter, Mr. Quigg Edmond	male	16.0000000	0.0000000	1.0000000	PC 17558	26.0000000	B51 B53 B55	C
30	1.0000000	2.0000000	Sagesser, Mr. Emil	male	25.0000000	0.0000000	0.0000000	11774	29.7000000	C123	S
31	0.0000000	3.0000000	Berglund, Mr. Karl Ivar Sven	male	22.0000000	0.0000000	0.0000000	26707	7.8958000		S
32	1.0000000	1.0000000	Winfield, Mrs. Deborah (Paul)	female	44.0000000	0.0000000	1.0000000	PC 17759	63.3583000	D10 D12	C
33	0.0000000	3.0000000	Johanson, Mr. Jakob Alfred	male	65.0000000	0.0000000	0.0000000	3101264	7.4958000		S
34	0.0000000	3.0000000	Olsen, Mr. Henry Margido	male	28.0000000	0.0000000	0.0000000	349239	8.0500000		S
35	0.0000000	3.0000000	Dantanian, Mr. Ernshaw Kaspar	male	25.0000000	0.0000000	0.0000000	2699	18.0000000		C
36	1.0000000	3.0000000	McCoy, Miss. Alicia	female	NaN	2.0000000	0.0000000	367226	23.2500000		Q
37	0.0000000	3.0000000	Bryhl, Mr. Kurt Arnold Gottfrid	male	25.0000000	1.0000000	0.0000000	347086	7.7750000		S
38	0.0000000	3.0000000	Rummenigge, Mr. Ernst	male	NaN	0.0000000	0.0000000	2651	11.2417000		C
39	1.0000000	2.0000000	Chapman, Mr. John Henry	male	37.0000000	1.0000000	0.0000000	237789	30.0000000		S
40	0.0000000	3.0000000	Johansson, Mr. Karl Johan	male	31.0000000	0.0000000	0.0000000	347062	7.7958000		S
41	0.0000000	3.0000000	Olsen, Mr. Oliver Ali	male	30.0000000	0.0000000	0.0000000	2543	7.8542000		S
42	1.0000000	1.0000000	Chaffee, Mrs. Herbert Fuller (Carrie Constance Toogood)	female	47.0000000	1.0000000	0.0000000	W.E.P. 5734	61.1750000	E31	S
43	0.0000000	3.0000000	Carlsson, Mr. August Sigfrid	male	28.0000000	0.0000000	0.0000000	350042	7.7958000		S
44	1.0000000	3.0000000	Bailey, Mr. Percy Andrew	male	18.0000000	0.0000000	0.0000000	29108	11.5000000		S
45	0.0000000	3.0000000	Foote, Mr. Harry	male	21.0000000	0.0000000	0.0000000	19988	43.4083000	C93	S
46	0.0000000	3.0000000	Pasic, Mr. Jakob	male	18.0000000	0.0000000	0.0000000	315090	8.6625000		S
47	1.0000000	3.0000000	Sage, Miss. Dorothy Edith "Dolly"	female	NaN	2.0000000	0.0000000	CA. 2343	69.5500000		S
48	0.0000000	3.0000000	Gustafsson, Mr. Karl Gustaf James	male	26.0000000	0.0000000	0.0000000	347077	31.3875000		S
49	0.0000000	3.0000000	Swan, Mr. John	male	NaN	0.0000000	0.0000000	4135	10.5000000		S
50	0.0000000	3.0000000	Sandstrom, Miss. Marguerite Rut	female	7.0000000	1.0000000	1.0000000	PP 9549	16.7000000	G6	S
51	1.0000000	1.0000000	Nicholson, Mrs. John Bleyl (Sarah Bernardine Harris)	female	54.0000000	1.0000000	0.0000000	693	51.8625000	D26	S
52	0.0000000	3.0000000	Storey, Mr. Thomas	male	60.5000000	0.0000000	0.0000000	3701	NaN		S
53	1.0000000	2.0000000	Chasseld, Mrs. Frank (Olive Louise Dunton)	female	31.0000000	1.0000000	0.0000000	W./C. 6608	26.2500000		S
54	0.0000000	3.0000000	Assaf Khalil, Mrs. Mariana (Qamar Elias Kharrat)	female	18.0000000	0.0000000	0.0000000	2677	7.2292000		C
55	1.0000000	3.0000000	Kirkland, Mr. George McDonald	male	35.0000000	0.0000000	0.0000000	234818	12.3500000		Q
56	0.0000000	3.0000000	Nankoff, Mr. Minko	male	NaN	0.0000000	0.0000000	349290	7.8958000		S
57	1.0000000	2.0000000	Hawksford, Mr. Walter James	male	45.0000000	0.0000000	0.0000000	A/5. 2816	8.0500000		S
58	0.0000000	3.0000000	Cacic, Miss. Marija	female	30.0000000	0.0000000	0.0000000	315084	7.8750000		S
59	1.0000000	3.0000000	Elias, Mr. Dimitrios Polyzoni	male	30.0000000	0.0000000	0.0000000	2675	7.2292000		C
60	0.0000000	3.0000000	Pekoniemi, Miss. Katriina	female	9.0000000	0.0000000	0.0000000	349240	7.8958000		S
61	0.0000000	3.0000000	Classens, Mr. Naboth	male	NaN	0.0000000	0.0000000	239854	13.0000000		S
62	1.0000000	3.0000000	Hansen, Mr. Henrik Juul	male	6.0000000	0.0000000	0.0000000	350046	7.8542000		S
63	0.0000000	3.0000000	Klasen, Mr. Klas Albin	male	23.0000000	0.0000000	0.0000000	350054	7.8542000		S
64	0.0000000	3.0000000	Lehmann, Miss. Bertha	female	NaN	0.0000000	0.0000000	SC/Paris 2123	7.7500000		C
65	1.0000000	1.0000000	Carter, Mr. William Ernest	male	36.0000000	0.0000000	0.0000000	113760	26.2875000	B96 B98	S
66	0.0000000	3.0000000	Crosby, Miss. Harriet R.	female	36.0000000	0.0000000	0.0000000	W./C. 6607	26.2500000		S
67	1.0000000	3.0000000	Andersson, Miss. Ingeborg Constanzia	female	9.0000000	4.0000000	2.0000000	347082	31.2750000		S
68	0.0000000	3.0000000	Andersson, Miss. Ebba Iduna	female	11.0000000	4.0000000	2.0000000	347082	31.2750000		S
69	1.0000000	3.0000000	Vestrom, Miss. Hulda Amanda Adolfina	female	14.0000000	0.0000000	0.0000000	350406	7.8542000		S
70	0.0000000	3.0000000	Hewlett, Mrs. (Mary D Kingcome)	female	55.0000000	0.0000000	0.0000000	248706	16.0000000		S
71	0.0000000	3.0000000	Rice, Master. Eugene	male	2.0000000	4.0000000	1.0000000	382652	29.1250000		Q
72	1.0000000	2.0000000	Williams, Mr. Charles Eugene	male	NaN	0.0000000	0.0000000	244373	13.0000000		S
73	0.0000000	3.0000000	Vanden Steen, Mr. Leo Peter	male	31.0000000	0.0000000	0.0000000	345773	18.0000000		S
74	1.0000000	3.0000000	Vanden Hulme, Mrs. William (Anna Mary)	female	NaN	1.0000000	0.0000000	2691	7.2292000		C
75	0.0000000	3.0000000	McEvoy, Mr. Michael	male	18.0000000	0.0000000	0.0000000	349924	24.0000000		S
76	1.0000000	3.0000000	Johnson, Mr. Malkolm Joackim	male	33.0000000	0.0000000	0.0000000	214746	7.8958000		S
77	0.0000000	3.0000000	Gustafsson, Mr. Anton Viktor	male	28.0000000	2.0000000	0.0000000	347351	7.7750000		S
78	1.0000000	2.0000000	Greenfield, Mrs. Leo David (Adelaide)	female	23.0000000	0.0000000	1.0000000	230136	13.0000000		S
79	0.0000000	3.0000000	Taylor, Mr. Elmer Zebley	male	10.0000000	1.0000000	0.0000000	19996	52.0000000	C126	S
80	1.0000000	3.0000000	Hoyt, Mrs. Frederick Maxfield (Jane Anne Forde)	female	19.0000000	1.0000000	0.0000000	19877	78.8500000		S
81	0.0000000	3.0000000	Kantor, Mr. Sidney	male	29.0000000	0.0000000	0.0000000	239865	26.0000000		S
82	1.0000000	3.0000000	Bjorklund, Mr. Ernst Gustaf Johannes	male	19.0000000	0.0000000	0.0000000	347232	7.8958000		S
83	0.0000000	3.0000000	Bachey, Miss. Gerda Ulrika	female	NaN	0.0000000	0.0000000	7.8958000			S
84	0.0000000	3.0000000	Baxter, Mr. Quigg Edmond	male	16.0000000	0.0000000	1.0000000	PC 17558	26.0000000	B51 B53 B55	C
85	1.0000000	2.0000000	Sagesser, Mr. Emil	male	25.0000000	0.0000000	0.0000000	11774	29.7000000	C123	S
86	0.0000000	3.0000000	Berglund, Mr. Karl Ivar Sven	male	22.0000000	0.0000000	0.0000000	26707	7.8958000		S
87	1.0000000	1.0000000	Winfield, Mrs. Deborah (Paul)	female	44.0000000	0.0000000	1.0000000	PC 17759	63.3583000	D10 D12	C
88	0.0000000	3.0000000	Johanson, Mr. Jakob Alfred	male	65.0000000	0.0000000	0.0000000	3101264	7.4958000		S
89	0.0000000	3.0000000	Olsen, Mr. Henry Margido	male	28.0000000	0.0000000	0.0000000	349239	8.0500000		S
90	0.0000000	3.0000000	Dantanian, Mr. Ernshaw Kaspar	male	25.0000000	0.0000000	0.0000000	2699	18.0000000		C
91	1.0000000	3.0000000	McCoy, Miss. Alicia	female	NaN	2.0000000	0.0000000	367226	23.2500000		Q
92	0.0000000	3.0000000	Bryhl, Mr. Kurt Arnold Gottfrid	male	25.0000000	1.0000000	0.0000000	347086	7.7750000		S
93	0.0000000	3.0000000	Rummenigge, Mr. Ernst	male	NaN	0.0000000	0.0000000	2651	11.2417000		C
94	1.0000000	2.0000000	Chapman, Mr. John Henry	male	37.0000000	1.0000000	0.0000000	237789	30.0000000		S
95	0.0000000	3.0000000	Johansson, Mr. Karl Johan	male	31.0000000	0.0000000	0.0000000	347062	7.7958000		S
96	0.0000000	3.0000000	Olsen, Mr. Oliver Ali	male	30.0000000	0.0000000	0.0000000	2543	7.8542000		S
97	1.0000000	1.0000000	Chaffee, Mrs. Herbert Fuller (Carrie Constance Toogood)	female	47.0000000	1.0000000	0.0000000	W.E.P. 5734	61.1750000	E31	S
98	0.0000000	3.0000000	Carlsson, Mr. August Sigfrid	male	28.0000000	0.0000000	0.0000000	350042	7.7958000		S
99	1.0000000	3.0000000	Bailey, Mr. Percy Andrew	male	18.0000000	0.0000000	0.0000000	29108	11.5000000		S
100	0.0000000	3.0000000	Foote, Mr. Harry	male	21.0000000	0.0000000	0.0000000	19988	43.4083000	C93	S
101	0.0000000	3.0000000	Pasic, Mr. Jakob	male	18.0000000	0.0000000	0.0000000	315090	8.6625000		S
102	1.0000000	3.0000000	Sage, Miss. Dorothy Edith "Dolly"	female	NaN	2.0000000	0.0000000	CA. 2343	69.5500000		S
103	0.0000000	3.0000000	Gustafsson, Mr. Karl Gustaf James	male	26.0000000	0.0000000	0.0000000	347077	31.3875000		S
104	0.0000000	3.0000000	Swan, Mr. John	male	NaN	0.0000000	0.0000000	4135	10.5000000		S
105	0.0000000	3.0000000	Sandstrom, Miss. Marguerite Rut	female	7.0000000	1.0000000	1.0000000	PP 9549	16.7000000	G6	S
106	1.0000000	1.0000000	Nicholson, Mrs. John Bleyl (Sarah Bernardine Harris)	female	54.0000000	1.0000000	0.0000000	693	51.8625000	D26	S
107	0.0000000	3.0000000	Storey, Mr. Thomas	male	60.5000000	0.0000000	0.0000000	3701	NaN		S
108	1.0000000	2.0000000	Chasseld, Mrs. Frank (Olive Louise Dunton)	female	31.0000000	1.0000000	0.0000000	W./C. 6608	26.2500000		S
109	0.0000000	3.0000000	Assaf Khalil, Mrs. Mariana (Qamar Elias Kharrat)	female	18.0000000	0.0000000	0.0000000	2677	7.2292000		C
110	1.0000000	3.0000000	Kirkland, Mr. George McDonald	male	35.0000000	0.0000000	0.0000000	234818	12.3500000		Q
111	0.0000000	3.0000000	Nankoff, Mr. Minko	male	NaN	0.0000000	0.0000000	349290	7.8958000		S
112	1.0000000	2.0000000	Hawksford, Mr. Walter James	male	45.0000000	0.0000000	0.0000000	A/5. 2816	8.0500000		S
113	0.0000000	3.0000000	Cacic, Miss. Marija	female	30.0000000	0.0000000	0.0000000	315084	7.8750000		S
114	0.0000000	3.0000000	Elias, Mr. Dimitrios Polyzoni	male	30.0000000	0.0000000	0.0000000	2675	7.2292000		C
115	0.0000000	3.0000000	Pekoniemi, Miss. Katriina	female	9.0000000	0.0000000	0.0000000	349240	7.8958000		S
116	0.0000000	3.0000000	Classens, Mr. Naboth	male	NaN	0.0000000	0.0000000	239854	13.0000000		S
117	1.0000000	3.0000000	Hansen, Mr. Henrik Juul	male	6.0000000	0.0000000	0.0000000	350046	7.8542000		S
118	0.0000000	3.0000000	Klasen, Mr. Klas Albin	male	23.0000000	0.0000000	0.0000000	350054	7.8542000		S
119	0.0000000	3.0000000	Lehmann, Miss. Bertha	female	NaN	0.0000000	0.0000000	SC/Paris 2123	7.7500000		C
120	1.0000000	1.0000000	Carter, Mr. William Ernest	male	36.0000000	0.0000000	0.0000000	113760	26.2875000	B96 B98	S
121	0.0000000	3.0000000	Crosby, Miss. Harriet R.	female	36.0000000	0.0000000	0.0000000	W./C. 6607	26.2500000		S
122	1.0000000	3.0000000	Andersson, Miss. Ingeborg Constanzia	female	9.0000000	4.0000000	2.0000000	347082	31.2750000		S
123	0.0000000	3.0000000	Andersson, Miss. Ebba Iduna	female	11.0000000	4.0000000	2.0000000	347082	31.2750000		S
124	1.0000000	3.0000000	Vestrom, Miss. Hulda Amanda Adolfina	female	14.0000000	0.0000000	0.0000000	350406	7.8542000		S
125	0.0000000	3.0000000	Hewlett, Mrs. (Mary D Kingcome)	female	55.0000000	0.0000000	0.0000000	248706	16.0000000		S
126	0.0000000	3.0000000	Rice, Master. Eugene	male	2.0000000	4.0000000	1.0000000	382652	29.1250000		Q
127	1.0000000	2.0000000	Williams, Mr. Charles Eugene	male	NaN	0.0000000	0.0000000	244373	13.0000000		S
128	0.0000000	3.0000000	Vanden Steen, Mr. Leo Peter	male	31.0000000	0.0000000	0.0000000	345773	18.0000000		S
129	1.0000000	3.0000000	Vanden Hulme, Mrs. William (Anna Mary)	female	NaN	1.0000000	0.0000000	2691	7.2292000		C
130	0.0000000	3.0000000	McEvoy, Mr. Michael	male	18.0000000	0.0000000	0.0000000	349924	24.0000000		S
131	1.0000000	3.0000000	Johnson, Mr. Malkolm Joackim	male	33.0000000	0.0000000	0.0000000	214746	7.8958000		S
132	0.0000000	3.0000000	Gustafsson, Mr. Anton Viktor	male	28.0000000	2.0000000	0.0000000	347351	7.7750000		S
133	1.0000000	2.0000000	Greenfield, Mrs. Leo David (Adelaide)	female	23.0000000	0.0000000	1.0000000	230136	13.0000000		S
134	0.0000000	3.0000000	Taylor, Mr. Elmer Zebley	male	10.0000000	1.0000000	0.0000000	19996	52.0000000	C126	S
135	1.0000000	3.0000000	Hoyt, Mrs. Frederick Maxfield (Jane Anne Forde)	female	19.0000000	1.0000000	0.0000000	19877	78.8500000		S
136	0.0000000	3.0000000	Kantor, Mr. Sidney	male	29.0000000	0.0000000	0.0000000	239865	26.0000000		S
137	1.0000000	3.0000000	Bjorklund, Mr. Ernst Gustaf Johannes	male	19.0000000	0.0000000	0.0000000	347232	7.8958000		S
138	0.0000000	3.0000000	Bachey, Miss. Gerda Ulrika	female	NaN	0.0000000	0.0000000	7.8958000			S
139	0.0000000	3.0000000	Baxter, Mr. Quigg Edmond	male	16.0000000	0.0000000	1.0000000	PC 17558	26.0000000	B51 B53 B55	C
140	1.0000000	2.0000000	Sagesser, Mr. Emil	male	25.0000000	0.0000000	0.0000000	11774	29.7000000	C123	S
141	0.0000000	3.0000000	Berglund, Mr. Karl Ivar Sven	male	22.0000000	0.0000000	0.0000000	26707	7.8958000		S
142	1.0000000	1.0000000	Winfield, Mrs. Deborah (Paul)	female	44.0000000	0.0000000	1.0000000	PC 17759	63.3583000	D10 D12	C
143	0.0000000	3.0000000	Johanson, Mr. Jakob Alfred	male	65.0000000	0.0000000	0.0000000	3101264	7.4958000		S
144	0.0000000	3.0000000	Olsen, Mr. Henry Margido	male	28.0000000	0.0000000	0.0000000	349239	8.0500000		S
145	0.0000000	3.0000000	Dantanian, Mr. Ernshaw Kaspar	male	25.0000000	0.0000000	0.0000000	2699	18.0000000		C
146	1.0000000	3.0000000	McCoy, Miss. Alicia	female	NaN	2.0000000	0.0000000	367226	23.2500000		Q
147	0.0000000	3.0000000	Bryhl, Mr. Kurt Arnold Gottfrid	male	25.0000000	1.0000000	0.0000000	347086	7.7750000		S
148	0.0000000	3.0000000	Rummenigge, Mr. Ernst	male	NaN	0.0000000	0.0000000	2651	11.2417000		C
149	1.0000000	2.0000000	Chapman, Mr. John Henry	male	37.0000000	1.0000000	0.0000000	237789	30.0000000		S
150	0.0000000	3.0000000	Johansson, Mr. Karl Johan	male	31.0000000	0.0000000	0.0000000	347062	7.7958000		S
151	0.0000000	3.0000000	Olsen, Mr. Oliver Ali	male	30.0000000	0.0000000	0.0000000	2543	7.8542000		S
152	1.0000000	1.0000000	Chaffee, Mrs. Herbert Fuller (Carrie Constance Toogood)	female	47.0000000	1.0000000	0.0000000	W.E.P. 5734	61.1750000	E31	S
153	0.0000000	3.0000000	Carlsson, Mr. August Sigfrid	male	28.0000000	0.0000000	0.0000000	350042	7.7958000		S
154	1.0000000	3.0000000	Bailey, Mr. Percy Andrew	male	18.0000000	0.0000000	0.0000000	29108	11.5000000		S
155	0.0000000	3.0000000	Foote, Mr. Harry	male	21.0000000	0.0000000	0.0000000	19988	43.4083000	C93	S
156	0.0000000	3.0000000	Pasic, Mr. Jakob	male	18.0000000	0.0000000	0.0000000	315090	8.6625000		S
157	1.0000000	3.0000000	Sage, Miss. Dorothy Edith "Dolly"	female	NaN	2.0000000	0.0000000	CA. 2343	69.5500000		S
158	0.0000000	3.0000000	Gustafsson, Mr. Karl Gustaf James	male	26.0000000	0.0000000	0.0000000	347077	31.3875000		S
159	0.0000000	3.0000000	Swan, Mr. John	male	NaN	0.0000000	0.0000000	4135	10.5000000		S
160	0.0000000	3.0000000	Sandstrom, Miss. Marguerite Rut	female	7.0000000	1.0000000	1.0000000	PP 9549	16.7000000	G6	S
161	1.0000000	1.0000000	Nicholson, Mrs. John Bleyl (Sarah Bernardine Harris)	female	54.0000000	1.0000000	0.0000000	693	51.8625000	D26	S
162	0.0000000	3.0000000	Storey, Mr. Thomas	male	60.5000000	0.0000000	0.0000000	3701	NaN		S
163	1.0000000	2.0000000	Chasseld, Mrs. Frank (Olive Louise Dunton)	female	31.0000000	1.0000000	0.0000000	W./C. 6608	26.2500000		S
164	0.0000000	3.0000000	Assaf Khalil, Mrs. Mariana (Qamar Elias Kharrat)	female	18.0000000	0.0000000	0.0000000	2677	7.2292000		C
165	1.0000000	3.0000000	Kirkland, Mr. George McDonald	male	35.0000000	0.0000000	0.0000000	234818	12.3500000		Q
166	0.0000000	3.0000000	Nankoff, Mr. Minko	male	NaN	0.0000000	0.0000000	349290	7.8958000		S
167	1.0000000	2.0000000	Hawksford, Mr. Walter James	male	45.0000000	0.0000000	0.0000000	A/5. 2816	8.0500000		S
168	0.0000000	3.0000000	Cacic, Miss. Marija	female	30.0000000	0.0000000	0.0000000	315084	7.8750000		S
169	0.0000000	3.0000000	Elias, Mr. Dimitrios Polyzoni	male	30.0000000	0.0000000	0.0000000	2675	7.2292000		C
170	0.0000000	3.0000000	Pekoniemi, Miss. Katriina	female	9.0000000	0.0000000	0.0000000	349240	7.8958000		S
171	0.0000000	3.0000000	Classens, Mr. Naboth	male	NaN	0.0000000	0.0000000	239854	13.0000000		S
172	1.0000000	3.0000000	Hansen, Mr. Henrik Juul	male	6.0000000	0.0000000	0.0000000	350046	7.8542000		S
173	0.0000000	3.0000000	Klasen, Mr. Klas Albin	male	23.0000000	0.0000000	0.0000000	350054	7.8542000		S
174	0.0000000	3.0000000	Lehmann, Miss. Bertha	female	NaN	0.0000000	0.0000000	SC/Paris 2123	7.7500000		C
175	1.0000000	1.0000000	Carter, Mr. William Ernest	male	36.0000000	0.0000000	0.0000000	113760	26.2875000	B96 B98	S
176	0.0000000	3.0000000	Crosby, Miss. Harriet R.	female	36.0000000	0.0000000	0.0000000	W./C. 6607	26.2500000		S
177	1.0000000	3.0000000	Andersson, Miss. Ingeborg Constanzia	female	9.0000000	4.0000000	2.0000000	347082	31.2750000		S
178	0.0000000	3.0000000	Andersson, Miss. Ebba Iduna	female	11.0000000	4.0000000	2.0000000	347082	31.2750000		S
179	1.0000000	3.0000000	Vestrom, Miss. Hulda Amanda Adolfina	female	14.0000000	0.0000000	0.0000000	350406	7.8542000		S
180	0.0000000	3.0000000	Hewlett, Mrs. (Mary D Kingcome)	female	55.0000000	0.0000000	0.0000000	248706	16.0000000		S
181	0.0000000	3.0000000	Rice, Master. Eugene	male	2.0000000	4.0000000	1.0000000	382652	29.1250000		Q
182	1.0000000	2.0000000	Williams, Mr. Charles Eugene	male	NaN	0.0000000	0.0000000	244373	13.0000000		S
183	0.0000000	3.0000000	Vanden Steen, Mr. Leo Peter	male	31.0000000	0.0000000	0.0000000	345773	18.0000000		S
184	1.0000000	3.0000000	Vanden Hulme, Mrs. William (Anna Mary)	female	NaN	1.0000000	0.0000000	2691	7.2292000		C
185	0.0000000	3.0000000	McEvoy, Mr. Michael	male	18.0000000	0.0000000	0.0000000	349924	24.0000000		S
186	1.0000000	3.0000000	Johnson, Mr. Mal

```
[0m[36m(1)[0m Q_Tests(0.75,2)  ARCH(1)  Q_Tests(0.75,3)  ARCH(2)
[0m[36m(2)[0m Q_Tests(0.75,4)  ARCH(3)  Q_Tests(0.75,5)  ARCH(4)
[0m[36m(3)[0m Q_Tests(0.75,6)  ARCH(5)  Q_Tests(0.75,7)  ARCH(6)
[0m[36m(4)[0m Q_Tests(0.75,8)  ARCH(7)  Q_Tests(0.75,9)  ARCH(8)
[0m[36m(5)[0m Q_Tests(0.75,10) ARCH(9)  Q_Tests(0.75,11) ARCH(10)
[0m[36m(6)[0m Q_Tests(0.75,12) ARCH(11) Q_Tests(0.75,13) ARCH(12)
[0m[36m(7)[0m Q_Tests(0.75,14) ARCH(13) Q_Tests(0.75,15) ARCH(14)
[0m[36m(8)[0m Q_Tests(0.75,16) ARCH(15) Q_Tests(0.75,17) ARCH(16)
[0m[36m(9)[0m Q_Tests(0.75,18) ARCH(17) Q_Tests(0.75,19) ARCH(18)
[0m[36m(10)[0m Q_Tests(0.75,20) ARCH(19) Q_Tests(0.75,21) ARCH(20)
[0m[36m(11)[0m Q_Tests(0.75,22) ARCH(21) Q_Tests(0.75,23) ARCH(22)
[0m[36m(12)[0m Q_Tests(0.75,24) ARCH(23) Q_Tests(0.75,25) ARCH(24)
[0m[36m(13)[0m Q_Tests(0.75,26) ARCH(25) Q_Tests(0.75,27) ARCH(26)
[0m[36m(14)[0m Q_Tests(0.75,28) ARCH(27) Q_Tests(0.75,29) ARCH(28)
[0m[36m(15)[0m Q_Tests(0.75,30) ARCH(29) Q_Tests(0.75,31) ARCH(30)
[0m[36m(16)[0m Q_Tests(0.75,32) ARCH(31) Q_Tests(0.75,33) ARCH(32)
[0m[36m(17)[0m Q_Tests(0.75,34) ARCH(33) Q_Tests(0.75,35) ARCH(34)
[0m[36m(18)[0m Q_Tests(0.75,36) ARCH(35) Q_Tests(0.75,37) ARCH(36)
[0m[36m(19)[0m Q_Tests(0.75,38) ARCH(37) Q_Tests(0.75,39) ARCH(38)
[0m[36m(20)[0m Q_Tests(0.75,40) ARCH(39) Q_Tests(0.75,41) ARCH(40)
[0m[36m(21)[0m Q_Tests(0.75,42) ARCH(41) Q_Tests(0.75,43) ARCH(42)
[0m[36m(22)[0m Q_Tests(0.75,44) ARCH(43) Q_Tests(0.75,45) ARCH(44)
[0m[36m(23)[0m Q_Tests(0.75,46) ARCH(45) Q_Tests(0.75,47) ARCH(46)
[0m[36m(24)[0m Q_Tests(0.75,48) ARCH(47) Q_Tests(0.75,49) ARCH(48)
[0m[36m(25)[0m Q_Tests(0.75,50) ARCH(49) Q_Tests(0.75,51) ARCH(50)
```

```
[0m[36m[1] "Ljung-Box test"[0m
[0m[36m$statistic[0m
[0m[36m[1] 0.0[0m
[0m[36m$p.value[0m
[0m[36m[1] 0.9[0m
[0m[36m$parameter[0m
[0m[36m[1] 1[0m
[0m[36m$method[0m
[0m[36m[1] "Box-Ljung test"[0m
[0m[36m$data.name[0m
[0m[36m[1] "residuals(fit)"[0m
[0m[36m$residuals[0m
[0m[36m[1] 0[0m
[0m[36m$fitted.values[0m
[0m[36m[1] 0[0m
[0m[36m$conf.int[0m
[0m[36m[1] 0.9[0m
[0m[36m$conf.level[0m
[0m[36m[1] 0.95[0m
[0m[36m$alternative[0m
[0m[36m[1] "two.sided"[0m
[0m[36m$method[0m
[0m[36m[1] "Box-Ljung test"[0m
[0m[36m$data.name[0m
[0m[36m[1] "residuals(fit)"[0m
[0m[36m$residuals[0m
[0m[36m[1] 0[0m
[0m[36m$fitted.values[0m
[0m[36m[1] 0[0m
[0m[36m$conf.int[0m
[0m[36m[1] 0.9[0m
[0m[36m$conf.level[0m
[0m[36m[1] 0.95[0m
[0m[36m$alternative[0m
[0m[36m[1] "two.sided"[0m
```

```
df_0_50_ven_medical_facilities_train =
df_0_50_ven_medical_facilities_test =
```

```
! pip install -U -q -f https://storage.googleapis.com/jax-releases/jax_releases.html jax[cuda] numpyro[cuda]
```

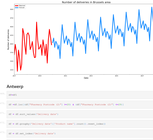
```
import numpyro
numpyro.set_platform('gpu')
numpyro.enable_x64()
# Assumption 1: Arrival intervals are IID
# Assumption 2: Infection times are IID
# Assumption 3: Infection times are independent of the arrival times
# Assumption 4: Infection times are independent of the recovery times
# Assumption 5: Infection times are independent of the infection times of other events
# Assumption 6: Infection times are independent of the recovery times of other events
print("Number of arrival intervals:", len(df_0_50_ven_medical_facilities_train.arrival_interval.dropna(), dtype=int))
print("Number of infection times:", len(df_0_50_ven_medical_facilities_train.infection_time.dropna(), dtype=int))
print("Number of recovery times:", len(df_0_50_ven_medical_facilities_train.recovery_time.dropna(), dtype=int))
```

```
Number of arrival intervals: 1
Number of infection times: 1
Number of recovery times: 1
```

```
numpyro.clear_compilation_cache()
mcmc = MCMC(sampler=NUTS(model=lambda *a, **k: sir_gamma_gamma_gamma(
            *a, **k, max_infectious_duration=1000000,
                                         infection_scale=10.0,
                                         infection_concentration=1.0,
                                         recovery_scale=10.0,
                                         recovery_concentration=1.0,
                                         beta_shape=1.0,
                                         beta_rate=1.0,
                                         gamma_shape=1.0,
                                         gamma_rate=1.0,
                                         rho_shape=1.0,
                                         rho_rate=1.0,
                                         sigma_shape=1.0,
                                         sigma_rate=1.0,
                                         omega_shape=1.0,
                                         omega_rate=1.0,
                                         kappa_shape=1.0,
                                         kappa_rate=1.0,
                                         phi_shape=1.0,
                                         phi_rate=1.0,
                                         psi_shape=1.0,
                                         psi_rate=1.0,
                                         chi_shape=1.0,
                                         chi_rate=1.0,
                                         zeta_shape=1.0,
                                         zeta_rate=1.0,
                                         eta_shape=1.0,
                                         eta_rate=1.0,
                                         upsilon_shape=1.0,
                                         upsilon_rate=1.0,
                                         theta_shape=1.0,
                                         theta_rate=1.0,
                                         kappa_0_shape=1.0,
                                         kappa_0_rate=1.0,
                                         tau_shape=1.0,
                                         tau_rate=1.0,
                                         infectious_rate_shape=1.0,
                                         infectious_rate_rate=1.0,
                                         recovery_rate_shape=1.0,
                                         recovery_rate_rate=1.0,
                                         infection_rate_shape=1.0,
                                         infection_rate_rate=1.0,
                                         recovery_rate_shape=1.0,
                                         recovery_rate
```

```
The Root Mean Squared Error of the Stationary is 187.17
```

```
# Fitting a model to the stationary series
arima.fit = auto.arima(Stationary, max.p=3, max.q=3, max.P=2, max.Q=2, max.d=2, max.D=1,
ic="aic", stepwise=FALSE, trace=TRUE, allowdrift=FALSE, allowmean=FALSE)
# Forecasting the next 12 months using the fitted model
forecast.arima = forecast(arima.fit, h=12, level=c(80,95))
# Plot the forecast
plot(forecast.arima, xlab="Time", ylab="Number of Bicycles")
```



Antwerp

```
dataset
```

```
df.NAC.ts=ts(df$Antwerp,frequency=12,start=c(2010,1))
```

```
# df.NAC.ts=ts(df$Antwerp,frequency=12)
```

```
# Plot the original time series
ts.plot(df.NAC.ts,xlab="Time",ylab="Number of Bicycles")
```

```
# Plot the seasonal plot
ts.plot(aggregate(df.NAC.ts),xlab="Time",ylab="Number of Bicycles")
```

```
# Decomposition
plot(decompose(df.NAC.ts))
```

```
# Decomposition
plot(stl(df.NAC.ts,s.window="periodic"))
```

```
# Stationarity
library(tseries)
adf.test(df.NAC.ts)
```

```
# Stationarity
library(tseries)
kpss.test(df.NAC.ts)
```

```
# Stationarity
library(tseries)
pp.test(df.NAC.ts)
```

```
# Stationarity
library(tseries)
Stationary=diff(df.NAC.ts,differences=1)
plot(Stationary,xlab="Time",ylab="Stationary")
```

```
# Stationarity
library(tseries)
adf.test(Stationary)
```

```
# Stationarity
library(tseries)
kpss.test(Stationary)
```

```
# Stationarity
library(tseries)
pp.test(Stationary)
```

```
# ACF and PACF plots
acf(Stationary,lag.max=36)
pacf(Stationary,lag.max=36)
```

```
# Fitting a model to the stationary series
library(forecast)
arima.fit = auto.arima(Stationary, max.p=3, max.q=3, max.P=2, max.Q=2, max.d=2, max.D=1,
ic="aic", stepwise=FALSE, trace=TRUE, allowdrift=FALSE, allowmean=FALSE)
# Forecasting the next 12 months using the fitted model
forecast.arima = forecast(arima.fit, h=12, level=c(80,95))
# Plot the forecast
plot(forecast.arima, xlab="Time", ylab="Number of Bicycles")
```

```
Forecasting Stationary using ARIMA(2,0,1)(1,0,0)[12] with zero mean
Warning messages:
1: In ts(fitfor, start = tsp(x)[2] + 1, frequency = tsp(x)[3]) :
  NaNs produced
2: In ts(fitfor, start = tsp(x)[2] + 1, frequency = tsp(x)[3]) :
  NaNs produced
3: In ts(fitfor, start = tsp(x)[2] + 1, frequency = tsp(x)[3]) :
  NaNs produced
4: In ts(fitfor, start = tsp(x)[2] + 1, frequency = tsp(x)[3]) :
  NaNs produced
5: In ts(fitfor, start = tsp(x)[2] + 1, frequency = tsp(x)[3]) :
  NaNs produced
6: In ts(fitfor, start = tsp(x)[2] + 1, frequency = tsp(x)[3]) :
  NaNs produced
7: In ts(fitfor, start = tsp(x)[2] + 1, frequency = tsp(x)[3]) :
  NaNs produced
8: In ts(fitfor, start = tsp(x)[2] + 1, frequency = tsp(x)[3]) :
  NaNs produced
9: In ts(fitfor, start = tsp(x)[2] + 1, frequency = tsp(x)[3]) :
  NaNs produced
10: In ts(fitfor, start = tsp(x)[2] + 1, frequency = tsp(x)[3]) :
  NaNs produced
11: In ts(fitfor, start = tsp(x)[2] + 1, frequency = tsp(x)[3]) :
  NaNs produced
12: In ts(fitfor, start = tsp(x)[2] + 1, frequency = tsp(x)[3]) :
  NaNs produced
```

```
# Checking the residuals
Box.test(arima.fit$residuals,lag=36,type="Ljung")
```

```
# Checking the residuals
Box.test(arima.fit$residuals,lag=36,type="Box-Pierce")
```

```
# Checking the residuals
shapiro.test(arima.fit$residuals)
```

```
# Checking the residuals
qqnorm(arima.fit$residuals)
qqline(arima.fit$residuals)
```

```
# Checking the residuals
hist(arima.fit$residuals,breaks=20)
```

```
# Checking the residuals
library(tsdiag)
tsdiag(arima.fit,gof.lag=36)
```

```
# Checking the residuals
library(TSPostPlot)
TSPostPlot(arima.fit,lag.max=36)
```

```
# Checking the residuals
library(TSPostPlot)
TSPostPlot(arima.fit,lag.max=36,plot.pacf=TRUE)
```

```
# Checking the residuals
library(TSPostPlot)
TSPostPlot(arima.fit,lag.max=36,plot.pacf=TRUE,plot.qqnorm=TRUE,shapiro.test=TRUE)
```

```
Warning messages:
1: In Box.test(x, type = "Ljung", lag = lag, fitdf = fitdf) :
  Ljung-Box test not defined for 0 degrees of freedom
2: In shapiro.test(x) : sample size must be between 3 and 5000
3: In ts(fitfor, start = tsp(x)[2] + 1, frequency = tsp(x)[3]) :
  NaNs produced
4: In ts(fitfor, start = tsp(x)[2] + 1, frequency = tsp(x)[3]) :
  NaNs produced
5: In ts(fitfor, start = tsp(x)[2] + 1, frequency = tsp(x)[3]) :
  NaNs produced
6: In ts(fitfor, start = tsp(x)[2] + 1, frequency = tsp(x)[3]) :
  NaNs produced
7: In ts(fitfor, start = tsp(x)[2] + 1, frequency = tsp(x)[3]) :
  NaNs produced
8: In ts(fitfor, start = tsp(x)[2] + 1, frequency = tsp(x)[3]) :
  NaNs produced
9: In ts(fitfor, start = tsp(x)[2] + 1, frequency = tsp(x)[3]) :
  NaNs produced
10: In ts(fitfor, start = tsp(x)[2] + 1, frequency = tsp(x)[3]) :
  NaNs produced
11: In ts(fitfor, start = tsp(x)[2] + 1, frequency = tsp(x)[3]) :
  NaNs produced
12: In ts(fitfor, start = tsp(x)[2] + 1, frequency = tsp(x)[3]) :
  NaNs produced
```

```
# Checking the residuals
library(TSPostPlot)
TSPostPlot(arima.fit,lag.max=36,plot.pacf=TRUE,plot.qqnorm=TRUE,shapiro.test=TRUE,Ljung.Box.Test=TRUE)
```

```
Warning messages:
1: In Box.test(x, type = "Ljung", lag = lag, fitdf = fitdf) :
  Ljung-Box test not defined for 0 degrees of freedom
2: In shapiro.test(x) : sample size must be between 3 and 5000
3: In ts(fitfor, start = tsp(x)[2] + 1, frequency = tsp(x)[3]) :
  NaNs produced
4: In ts(fitfor, start = tsp(x)[2] + 1, frequency = tsp(x)[3]) :
  NaNs produced
5: In ts(fitfor, start = tsp(x)[2] + 1, frequency = tsp(x)[3]) :
  NaNs produced
6: In ts(fitfor, start = tsp(x)[2] + 1, frequency = tsp(x)[3]) :
  NaNs produced
7: In ts(fitfor, start = tsp(x)[2] + 1, frequency = tsp(x)[3]) :
  NaNs produced
8: In ts(fitfor, start = tsp(x)[2] + 1, frequency = tsp(x)[3]) :
  NaNs produced
9: In ts(fitfor, start = tsp(x)[2] + 1, frequency = tsp(x)[3]) :
  NaNs produced
10: In ts(fitfor, start = tsp(x)[2] + 1, frequency = tsp(x)[3]) :
  NaNs produced
11: In ts(fitfor, start = tsp(x)[2] + 1, frequency = tsp(x)[3]) :
  NaNs produced
12: In ts(fitfor, start = tsp(x)[2] + 1, frequency = tsp(x)[3]) :
  NaNs produced
```

```
# Checking the residuals
library(TSPostPlot)
TSPostPlot(arima.fit,lag.max=36,plot.pacf=TRUE,plot.qqnorm=TRUE,shapiro.test=TRUE,Ljung.Box.Test=TRUE,Residuals.Test=TRUE)
```

```
Warning messages:
1: In Box.test(x, type = "Ljung", lag = lag, fitdf = fitdf) :
  Ljung-Box test not defined for 0 degrees of freedom
2: In shapiro.test(x) : sample size must be between 3 and 5000
3: In ts(fitfor, start = tsp(x)[2] + 1, frequency = tsp(x)[3]) :
  NaNs produced
4: In ts(fitfor, start = tsp(x)[2] + 1, frequency = tsp(x)[3]) :
  NaNs produced
5: In ts(fitfor, start = tsp(x)[2] + 1, frequency = tsp(x)[3]) :
  NaNs produced
6: In ts(fitfor, start = tsp(x)[2] + 1, frequency = tsp(x)[3]) :
  NaNs produced
7: In ts(fitfor, start = tsp(x)[2] + 1, frequency = tsp(x)[3]) :
  NaNs produced
8: In ts(fitfor, start = tsp(x)[2] + 1, frequency = tsp(x)[3]) :
  NaNs produced
9: In ts(fitfor, start = tsp(x)[2] + 1, frequency = tsp(x)[3]) :
  NaNs produced
10: In ts(fitfor, start = tsp(x)[2] + 1, frequency = tsp(x)[3]) :
  NaNs produced
11: In ts(fitfor, start = tsp(x)[2] + 1, frequency = tsp(x)[3]) :
  NaNs produced
12: In ts(fitfor, start = tsp(x)[2] + 1, frequency = tsp(x)[3]) :
  NaNs produced
```

```
# Checking the residuals
library(TSPostPlot)
TSPostPlot(arima.fit,lag.max=36,plot.pacf=TRUE,plot.qqnorm=TRUE,shapiro.test=TRUE,Ljung.Box.Test=TRUE,Residuals.Test=TRUE,Stationarity.Test=TRUE)
```

```
Warning messages:
1: In Box.test(x, type = "Ljung", lag = lag, fitdf = fitdf) :
  Ljung-Box test not defined for 0 degrees of freedom
2: In shapiro.test(x) : sample size must be between 3 and 5000
3: In ts(fitfor, start = tsp(x)[2] + 1, frequency = tsp(x)[3]) :
  NaNs produced
4: In ts(fitfor, start = tsp(x)[2] + 1, frequency = tsp(x)[3]) :
  NaNs produced
5: In ts(fitfor, start = tsp(x)[2] + 1, frequency = tsp(x)[3]) :
  NaNs produced
6: In ts(fitfor, start = tsp(x)[2] + 1, frequency = tsp(x)[3]) :
  NaNs produced
7: In ts(fitfor, start = tsp(x)[2] + 1, frequency = tsp(x)[3]) :
  NaNs produced
8: In ts(fitfor, start = tsp(x)[2] + 1, frequency = tsp(x)[3]) :
  NaNs produced
9: In ts(fitfor, start = tsp(x)[2] + 1, frequency = tsp(x)[3]) :
  NaNs produced
10: In ts(fitfor, start = tsp(x)[2] + 1, frequency = tsp(x)[3]) :
  NaNs produced
11: In ts(fitfor, start = tsp(x)[2] + 1, frequency = tsp(x)[3]) :
  NaNs produced
12: In ts(fitfor, start = tsp(x)[2] + 1, frequency = tsp(x)[3]) :
  NaNs produced
```

```
# Checking the residuals
library(TSPostPlot)
TSPostPlot(arima.fit,lag.max=36,plot.pacf=TRUE,plot.qqnorm=TRUE,shapiro.test=TRUE,Ljung.Box.Test=TRUE,Residuals.Test=TRUE,Stationarity.Test=TRUE,Seasonality.Test=TRUE)
```

```
Warning messages:
1: In Box.test(x, type = "Ljung", lag = lag, fitdf = fitdf) :
  Ljung-Box test not defined for 0 degrees of freedom
2: In shapiro.test(x) : sample size must be between 3 and 5000
3: In ts(fitfor, start = tsp(x)[2] + 1, frequency = tsp(x)[3]) :
  NaNs produced
4: In ts(fitfor, start = tsp(x)[2] + 1, frequency = tsp(x)[3]) :
  NaNs produced
5: In ts(fitfor, start = tsp(x)[2] + 1, frequency = tsp(x)[3]) :
  NaNs produced
6: In ts(fitfor, start = tsp(x)[2] + 1, frequency = tsp(x)[3]) :
  NaNs produced
7: In ts(fitfor, start = tsp(x)[2] + 1, frequency = tsp(x)[3]) :
  NaNs produced
8: In ts(fitfor, start = tsp(x)[2] + 1, frequency = tsp(x)[3]) :
  NaNs produced
9: In ts(fitfor, start = tsp(x)[2] + 1, frequency = tsp(x)[3]) :
  NaNs produced
10: In ts(fitfor, start = tsp(x)[2] + 1, frequency = tsp(x)[3]) :
  NaNs produced
11: In ts(fitfor, start = tsp(x)[2] + 1, frequency = tsp(x)[3]) :
  NaNs produced
12: In ts(fitfor, start = tsp(x)[2] + 1, frequency = tsp(x)[3]) :
  NaNs produced
```

```
# Checking the residuals
library(TSPostPlot)
TSPostPlot(arima.fit,lag.max=36,plot.pacf=TRUE,plot.qqnorm=TRUE,shapiro.test=TRUE,Ljung.Box.Test=TRUE,Residuals.Test=TRUE,Stationarity.Test=TRUE,Seasonality.Test=TRUE,Heteroscedasticity.Test=TRUE)
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```
[NeMo W 2026-01-31 19:11:49 nemo_logging:1161]
    [
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