UNIVERSIDAD NACIONAL DE PIURA

FACULTAD DE ECONOMIA

DEPARTAMENTO ACADEMICO DE ECONOMIA

ECONOMETRIA II:

EJEMPLOS

.

PIURA, SETIEMBRE 2013

MODELO MULTIECUACIONAL

MODELO:

$$DD_t = \alpha_0 + \alpha_1 I_t + \alpha_2 ENC_t + \alpha_3 DD_{t-1} + U_{1t}$$
$$I_t = \beta_0 + \beta_1 DD_t + \beta_2 INF_t + U_{2t}$$
$$INF_t = \delta_0 + \delta_1 DD_t + \delta_2 CIN_t + U_{3t}$$

FORMA REDUCIDA:

$$\begin{bmatrix} 1 & -b & 0 \\ -f & 1 & -g \\ -i & 0 & 1 \end{bmatrix} \begin{bmatrix} DD_t \\ I_t \\ INF_t \end{bmatrix} = \begin{bmatrix} a & d & c & 0 \\ e & 0 & 0 & 0 \\ h & 0 & 0 & j \end{bmatrix} \begin{bmatrix} 1 \\ DD_{t-1} \\ ENC_t \\ CIN_t \end{bmatrix} + \begin{bmatrix} U_{1t} \\ U_{2t} \\ U_{3t} \end{bmatrix}$$

$$\begin{bmatrix} DD_t \\ I_t \\ INF_t \end{bmatrix} = \begin{bmatrix} 1 & -b & 0 \\ -f & 1 & -g \\ -i & 0 & 1 \end{bmatrix}^{-1} \begin{bmatrix} a & d & c & 0 \\ e & 0 & 0 & 0 \\ h & 0 & 0 & j \end{bmatrix} \begin{bmatrix} 1 \\ DD_{t-1} \\ ENC_t \\ CIN_t \end{bmatrix} + \begin{bmatrix} 1 & -b & 0 \\ -f & 1 & -g \\ -i & 0 & 1 \end{bmatrix}^{-1} \begin{bmatrix} U_{1t} \\ U_{2t} \\ U_{3t} \end{bmatrix}$$

MAXIMA:

```
(%i1) A:160.631355780087;

(%o1) 160.631355780087

(%i2) B:-2.40303284579524;

(%o2) -2.40303284579524

(%i3) C:0.180523794507474;

(%o3) 0.18052379450747

(%i4) D:0.484041294675356;

(%o4) 0.48404129467536

(%i5) E:30.6008890447692;

(%o5) 30.6008890447692

(%i6) F:-0.0591399932005206;
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(%o6) -0.059139993200521

(%i7) G:4.50263825018064;

(%o7) 4.50263825018064

(%i8) H:7.82840417741987;

(%o8) 7.82840417741987

(%i9) I:-0.0328139422669769;

(%o9) -0.032813942266977

(%i10) J:0.000497542475302914;

(%o10) $4.9754247530291401\ 10^{-4}$

(%i11) A1:matrix([1,-B,0],[-F,1,-G],[-I,0,1]);

(%o11) $$\begin{bmatrix} 1 & 2.40303284579524 & 0 \\ 0.059139993200521 & 1 & -4.50263825018064 \\ 0.032813942266977 & 0 & 1 \end{bmatrix}$$

(%i12) B1:matrix([A,C,0, D],[E,0,0,0],[H,0,J,0]);

(%o12) $$\begin{bmatrix} 160.631355780087 & 0.18052379450747 & 0 & 0.48404129467536 \\ 30.6008890447692 & 0 & 0 & 0 \\ 7.82840417741987 & 0 & 4.9754247530291401\ 10^{-4} & 0 \end{bmatrix}$$

(%i13) FR:invert(A1).B1;

(%o13) $$\begin{bmatrix} 4.759340243112973 & 0.35900970264578 & -0.010706034987248 & 0.96261837251866 \\ 64.86470453773219 & -0.07427526779362 & 0.0044552179159687 & -0.19915544586946 \\ 7.672231461453463 & -0.011780523655903 & 8.4884968928270854\ 10^{-4} & -0.031587303700959 \end{bmatrix}$$

MULTIPLICADORES DE LA INVERSIÓN:

IMPACTO.-

```
(%i21) MIENC: FR[2,2];

(%o21) -0.07427526779362

(%i22) %MICIN:FR[2,3];

(%o22) 0.0044552179159687
```

DINÁMICO.-

```
(%i23) %MD1RENC: FR[2,4]*FR[1,2];

(%o23) -0.071498737401882

(%i24) %MD1RCINC: FR[2,4]*FR[1,3];

(%o24) 0.0021321651713794

(%i25) %MD2RENC: FR[2,4]*FR[1,2]*FR[1,4];

(%o25) -0.068825998234939

(%i27) %MD2RCINC: FR[2,4]*FR[1,3]*FR[1,4];

(%o27) 0.0020524613672142
```

TOTAL.-

```
(%i28) %MTENC: FR[2,2]+(FR[2,4]*FR[1,2])/(1-FR[1,4]);

(%o28) -1.986945801936993

(%i29) %MTCIN:FR[2,3]+(FR[2,4]*FR[1,3])/(1-FR[1,4]);

(%o29) 0.06149300131488
```

CONDICIONES DE ESTABILIDAD:

$$\begin{bmatrix}1 & 0 & 0\\0 & 1 & 0\\0 & 0 & 1\end{bmatrix}\begin{bmatrix}DD_t\\I_t\\INF_t\end{bmatrix}-\begin{bmatrix}P4 & 0 & 0\\P8 & 0 & 0\\P12 & 0 & 0\end{bmatrix}\begin{bmatrix}DD_{t-1}\\I_{t-1}\\INF_{t-1}\end{bmatrix}=\begin{bmatrix}P1+P2\ ENC_t+P3\ CIN_t+V_{1t}\\P5+P6\ ENC_t+P7\ CIN_t+V_{2t}\\P9+P10\ ENC_t+P11\ CIN_t+V_{3t}\end{bmatrix}$$

$$\begin{bmatrix}1 & 0 & 0\\0 & 1 & 0\\0 & 0 & 1\end{bmatrix}\begin{bmatrix}DD_t\\I_t\\INF_t\end{bmatrix}-\begin{bmatrix}P4 & 0 & 0\\P8 & 0 & 0\\P12 & 0 & 0\end{bmatrix}\begin{bmatrix}DD_{t-1}\\I_{t-1}\\INF_{t-1}\end{bmatrix}=\mathbf{0}$$

$$\left\|\begin{bmatrix}1 & 0 & 0\\0 & 1 & 0\\0 & 0 & 1\end{bmatrix}\boldsymbol{\lambda}-\begin{bmatrix}P4 & 0 & 0\\P8 & 0 & 0\\P12 & 0 & 0\end{bmatrix}\right\|=\mathbf{0}$$

(%i14) C1:matrix([FR[1,4],0,0],[FR[2,4],0,0],[FR[3,4],0,0]);

(%o14) $\begin{bmatrix}0.96261837251866 & 0 & 0\\-0.19915544586946 & 0 & 0\\-0.031587303700959 & 0 & 0\end{bmatrix}$

(%i15) D1:matrix([L,0,0],[0,L,0],[0,0,L]);

(%o15) $\begin{bmatrix}L & 0 & 0\\0 & L & 0\\0 & 0 & L\end{bmatrix}$

(%i16) E1:determinant(D1-C1);

(%o16) $(L-0.96261837251866)\,L^2$

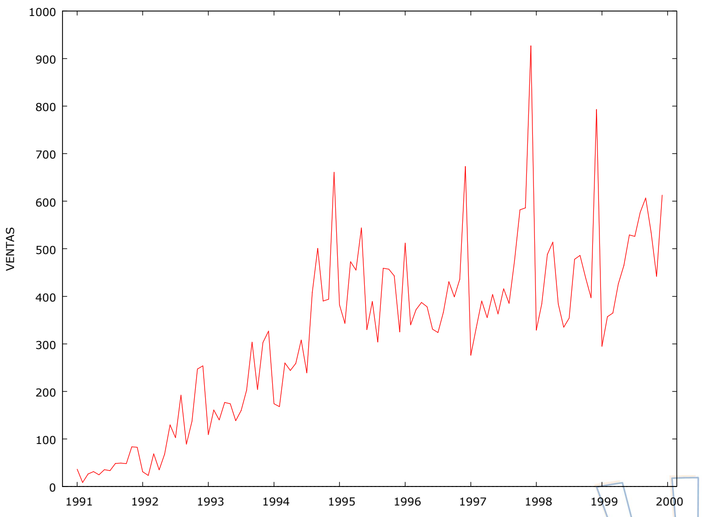
(%i17) F1: solve(E1=0,L);

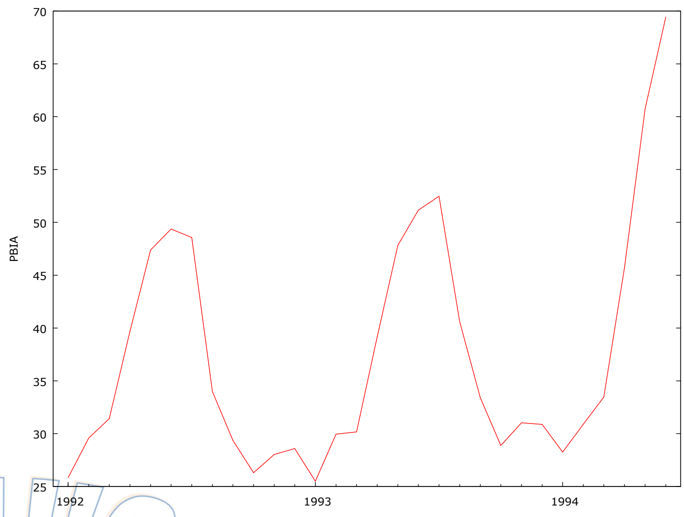
rat: replaced -0.9626183725187 by -5794/6019 = -0.9626183751454

(%o17) $[L=\frac{5794}{6019}, L=0]$

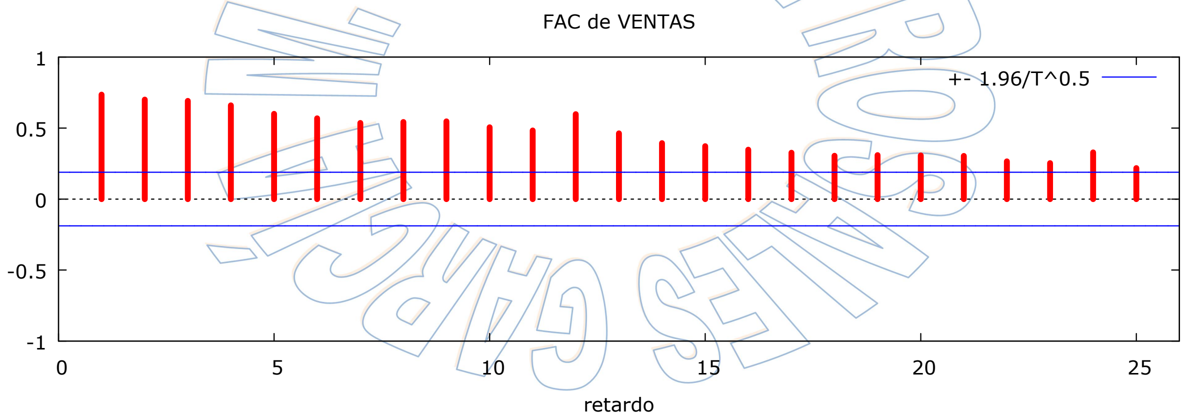
GRETL

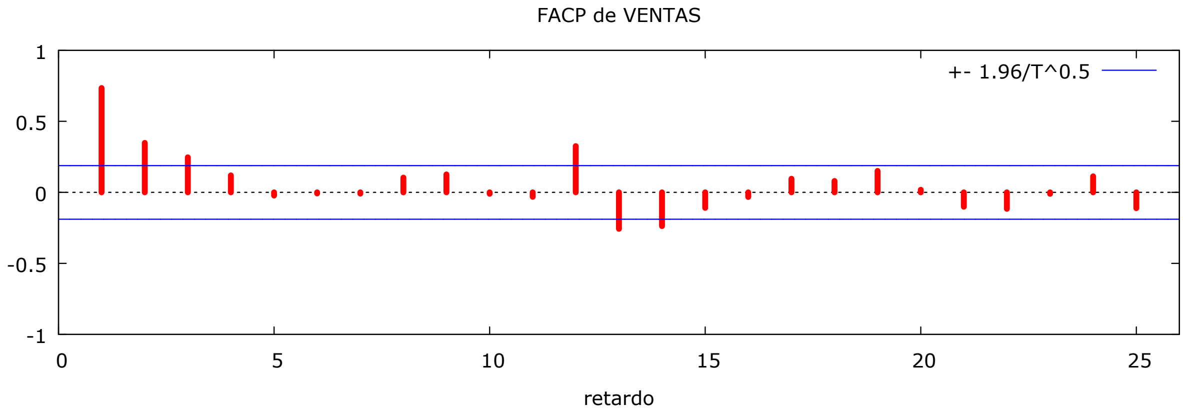
PLOTEO:





CORRELOGRAMA:

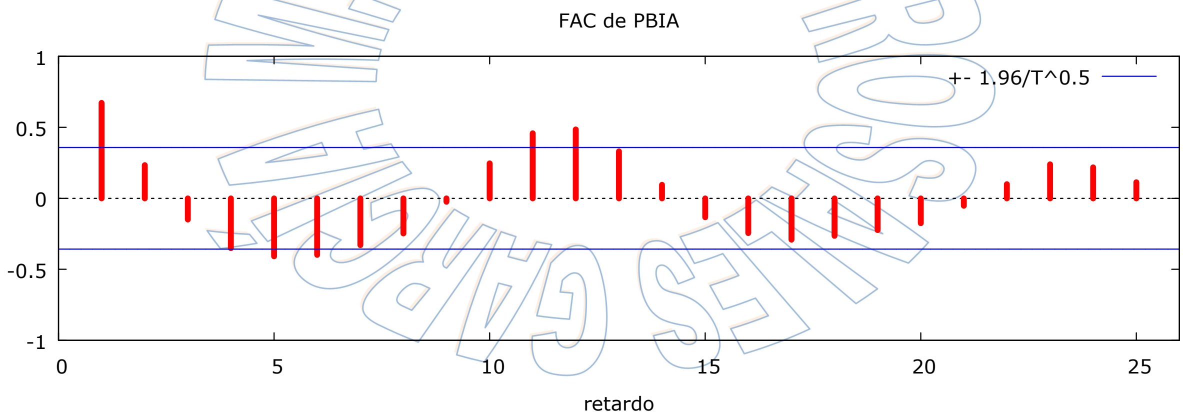


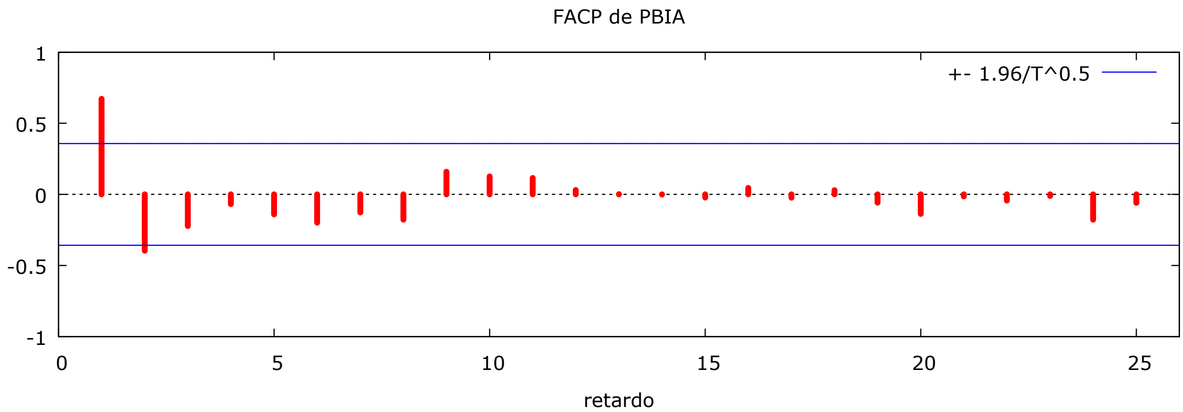


Funci ▪ de autocorrelaci ▪ para VENTAS

RETARDO	FAC		FACP		Estad-Q.	[valor p]
1	0.7351	***	0.7351	***	59.9920	[0.000]
2	0.7007	***	0.3490	***	115.0244	[0.000]
3	0.6917	***	0.2474	**	169.1648	[0.000]

4	0.6602	***	0.1200		218.9587	[0.000]
5	0.6003	***	-0.0214		260.5243	[0.000]
6	0.5686	***	-0.0075		298.1747	[0.000]
7	0.5362	***	-0.0088		331.9884	[0.000]
8	0.5427	***	0.1041		366.9746	[0.000]
9	0.5470	***	0.1271		402.8820	[0.000]
10	0.5057	***	-0.0092		433.8828	[0.000]
11	0.4828	***	-0.0307		462.4264	[0.000]
12	0.5979	***	0.3259	***	506.6644	[0.000]
13	0.4631	***	-0.2564	***	533.4791	[0.000]
14	0.3938	***	-0.2379	**	553.0806	[0.000]
15	0.3728	***	-0.1087		570.8350	[0.000]
16	0.3480	***	-0.0326		586.4766	[0.000]
17	0.3260	***	0.0958		600.3492	[0.000]
18	0.3047	***	0.0808		612.6026	[0.000]
19	0.3092	***	0.1512		625.3633	[0.000]
20	0.3071	***	0.0184		638.0938	[0.000]
21	0.3037	***	-0.1014		650.6873	[0.000]
22	0.2651	***	-0.1155		660.3951	[0.000]
23	0.2531	***	-0.0101		669.3505	[0.000]
24	0.3290	***	0.1132		684.6633	[0.000]
25	0.2182	**	-0.1115		691.4782	[0.000]





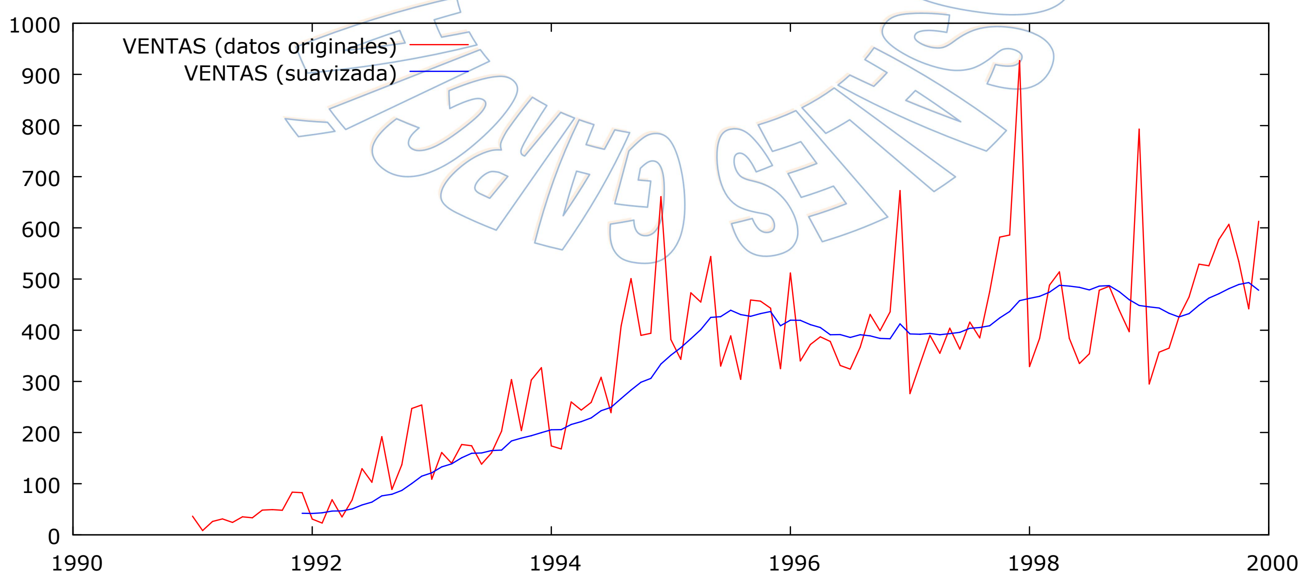
Funci▪ de autocorrelaci▪ para PBIA

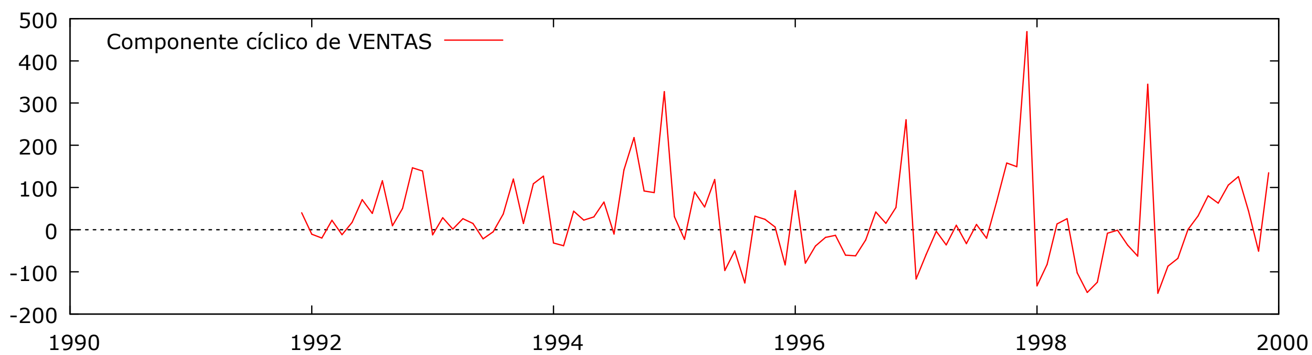
RETARDO	FAC		FACP		Estad-Q.	[valor p]
1	0.6715	***	0.6715	***	14.9268	[0.000]
2	0.2336		-0.3957	**	16.7981	[0.000]
3	-0.1498		-0.2224		17.5955	[0.001]

4	-0.3505	*	-0.0686	22.1305	[0.000]
5	-0.4084	**	-0.1407	28.5342	[0.000]
6	-0.3980	**	-0.1985	34.8690	[0.000]
7	-0.3300	*	-0.1271	39.4139	[0.000]
8	-0.2474		-0.1772	42.0847	[0.000]
9	-0.0243		0.1598	42.1118	[0.000]
10	0.2460		0.1266	45.0154	[0.000]
11	0.4576	**	0.1155	55.5937	[0.000]
12	0.4845	***	0.0308	68.1132	[0.000]
13	0.3304	*	0.0013	74.2778	[0.000]
14	0.0947		-0.0002	74.8163	[0.000]
15	-0.1334		-0.0222	75.9556	[0.000]
16	-0.2455		0.0450	80.0877	[0.000]
17	-0.2906		-0.0235	86.3221	[0.000]
18	-0.2638		0.0301	91.8911	[0.000]
19	-0.2235		-0.0577	96.2502	[0.000]
20	-0.1751		-0.1367	99.1920	[0.000]
21	-0.0522		-0.0146	99.4830	[0.000]
22	0.0995		-0.0431	100.6720	[0.000]
23	0.2396		-0.0111	108.5450	[0.000]
24	0.2178		-0.1773	116.1376	[0.000]
25	0.1138		-0.0596	118.6240	[0.000]

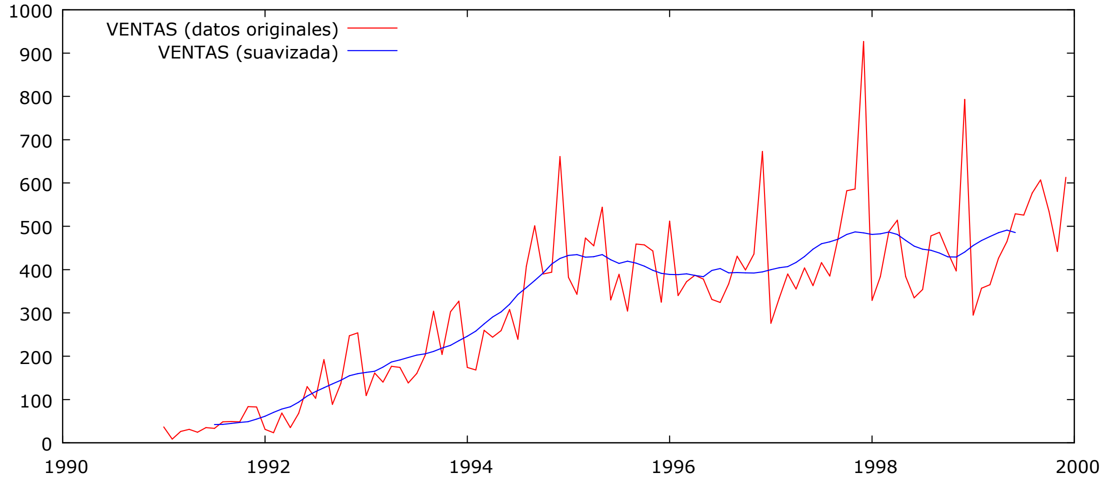
FILTROS:

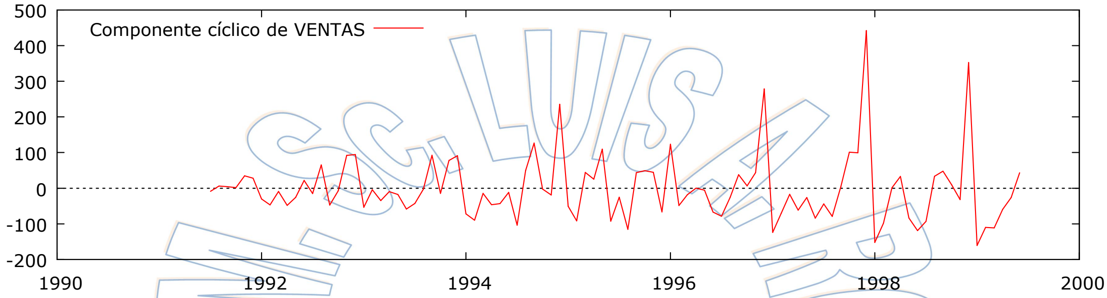
MEDIA MÓVIL SIMPLE



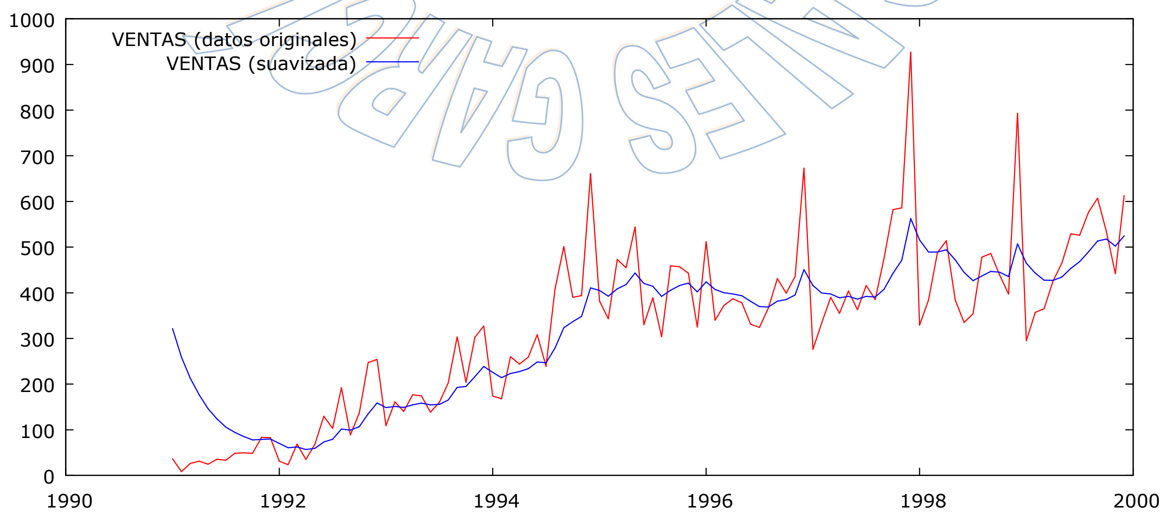


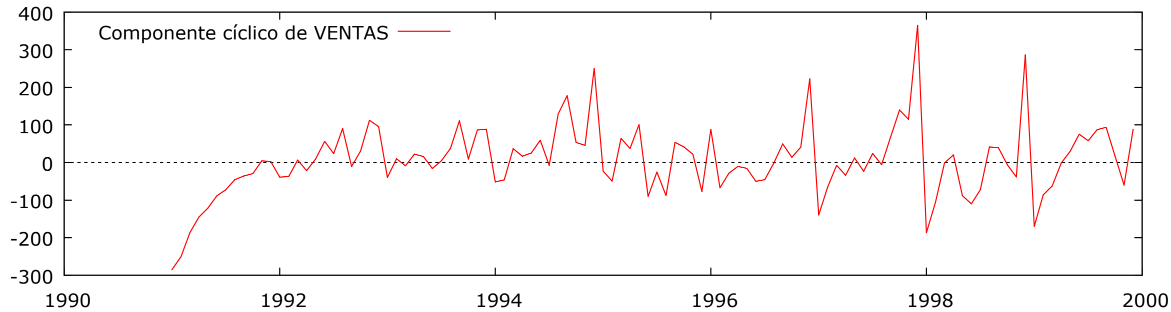
MEDIA MÓVIL CENTRADA



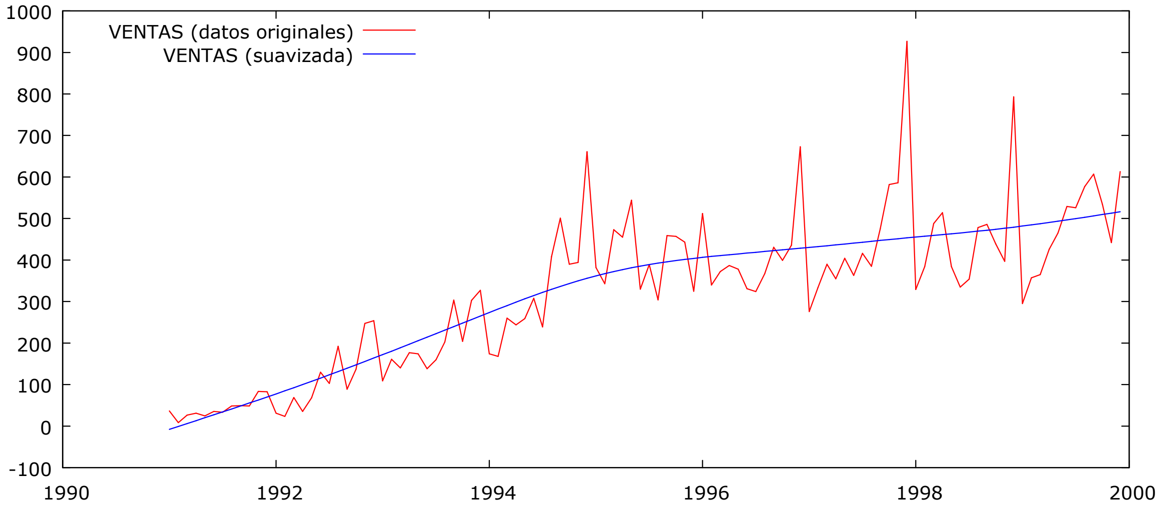


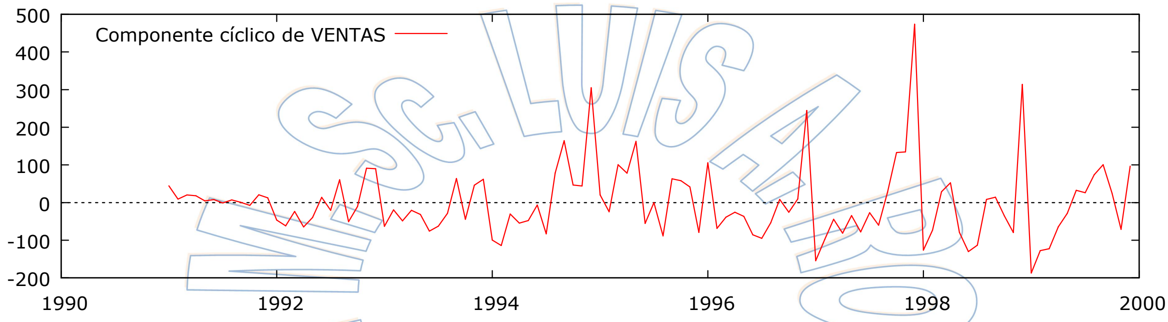
MEDIA MÓVIL EXPONENCIAL



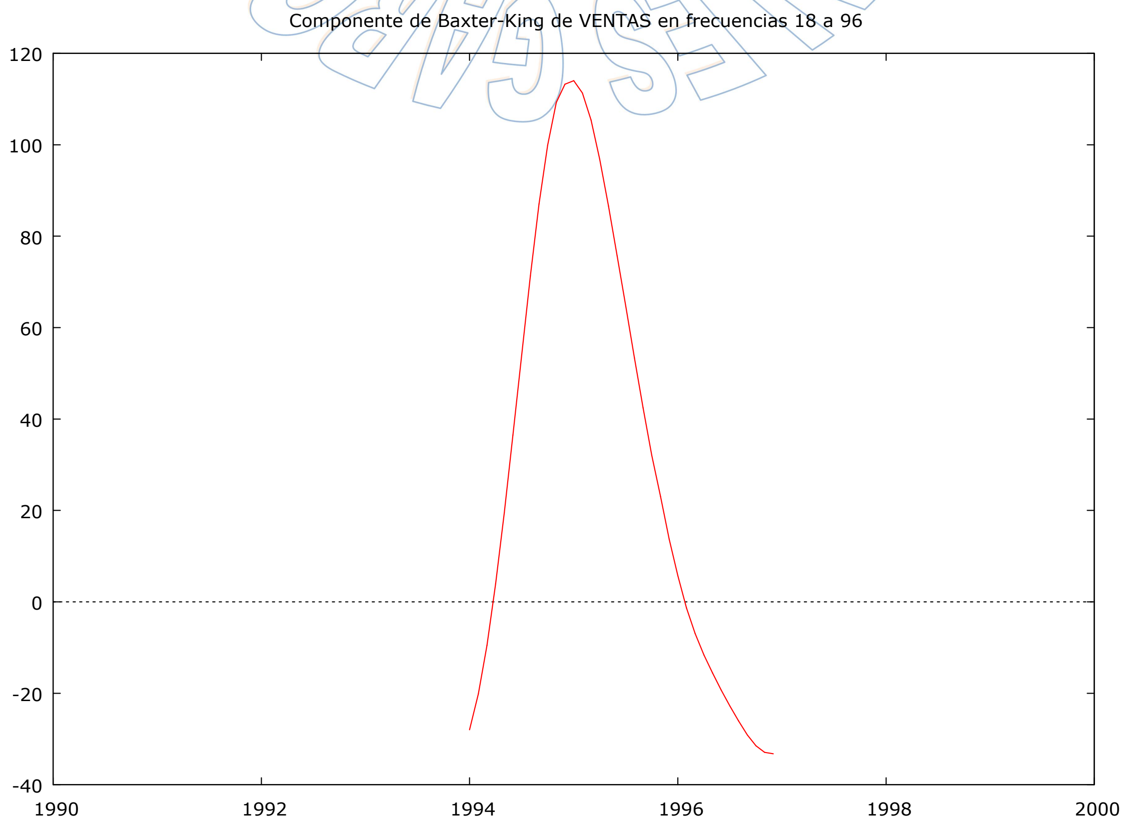


HODRICK-PRESCOTT

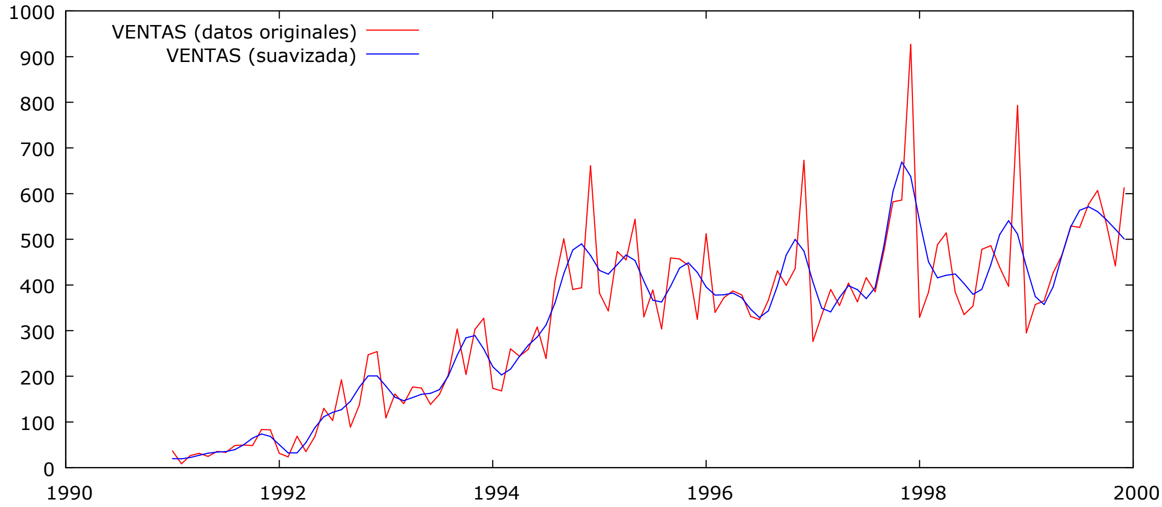


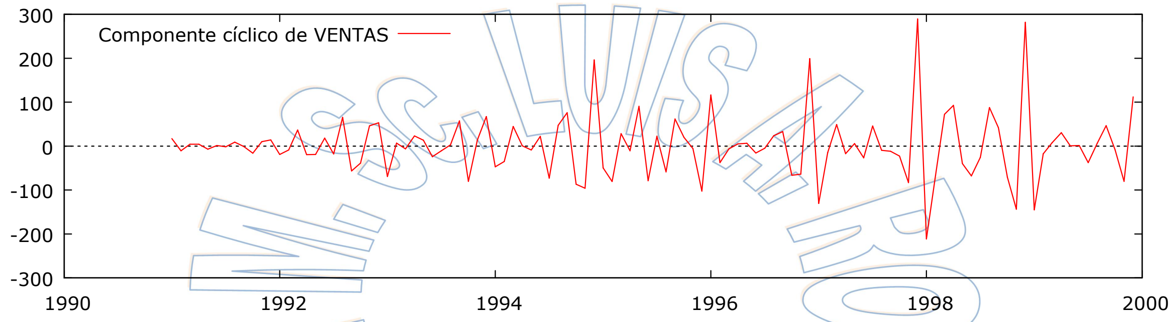


BAXTER-KING

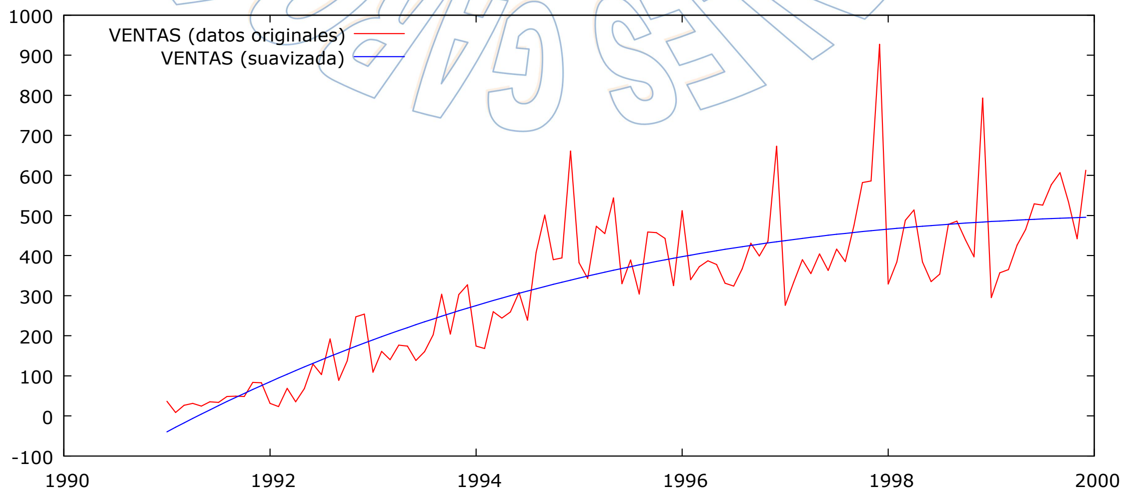


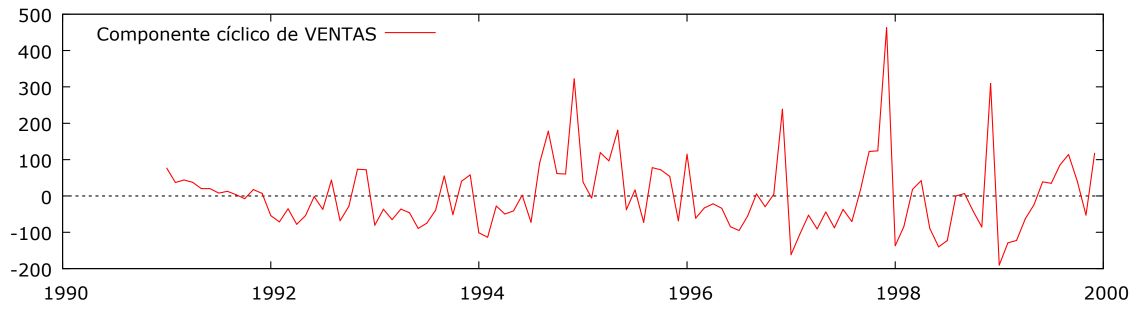
BUTTERWORTH



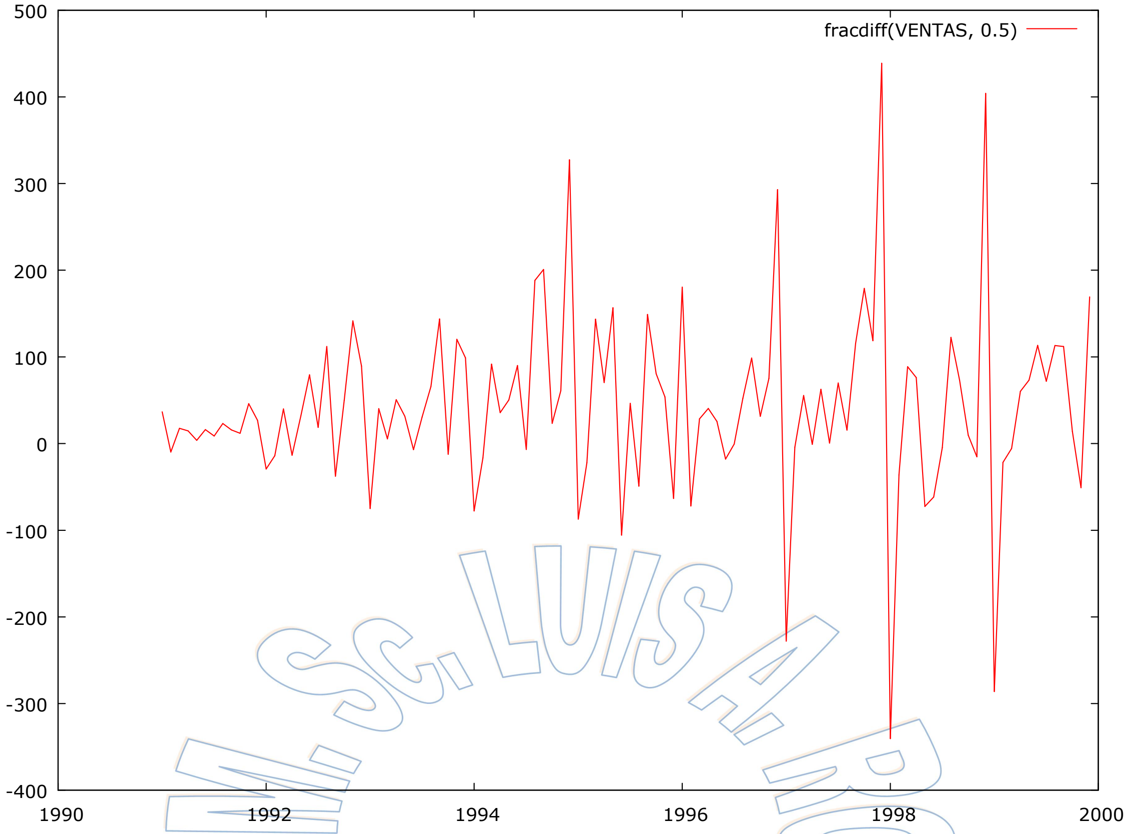


TENDENCIA POLINOMICA



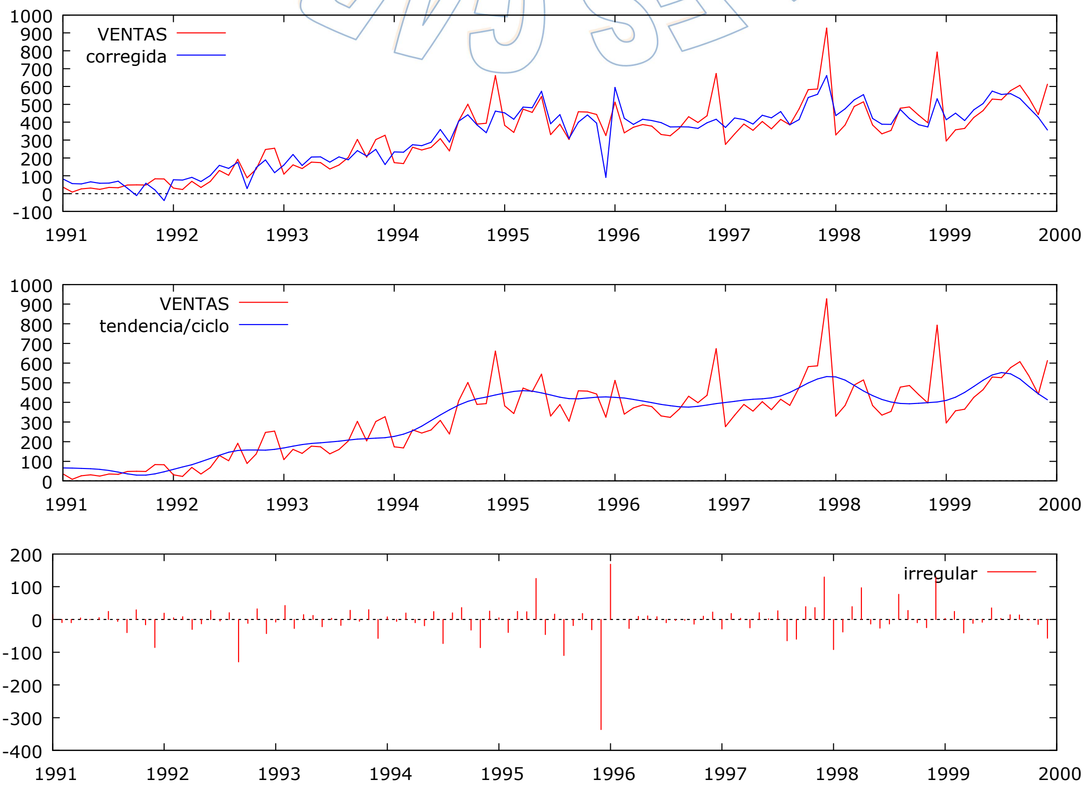


DIFERENCIA FRACCIONAL

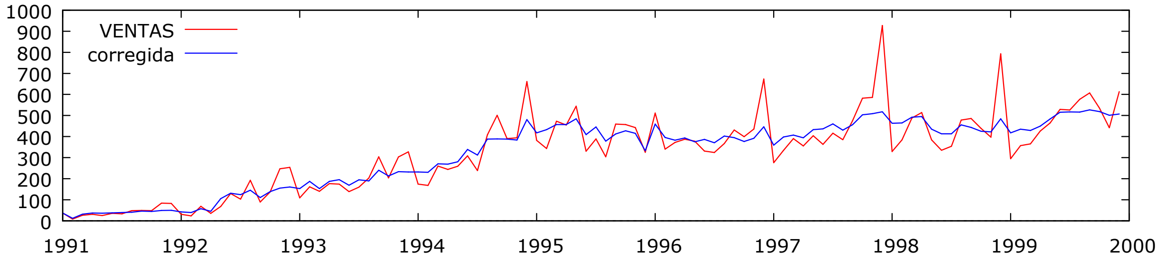


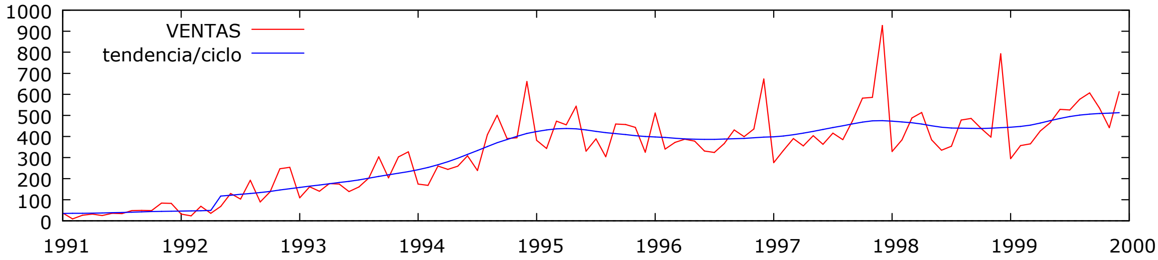
DESCOMPOSICIÓN DE LA SERIE:

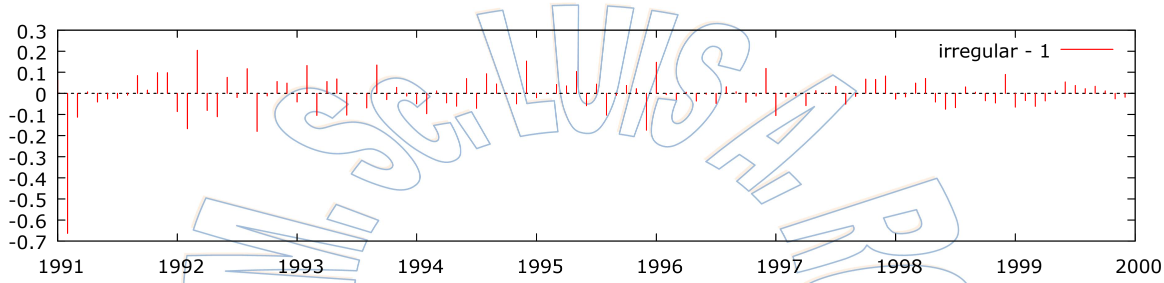
ARIMA X-12



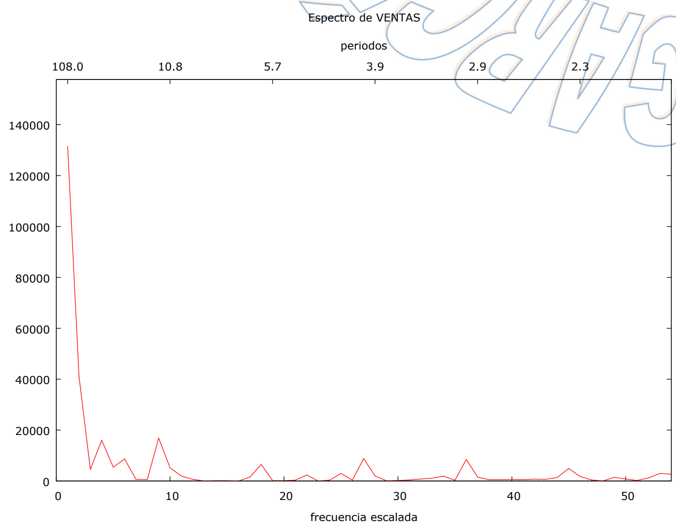
TRAMO SEATS

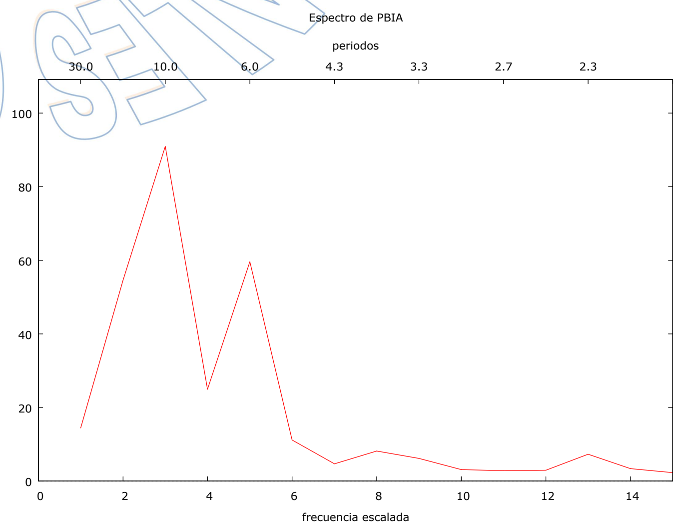






PERIDIOGRAMA:





Periodograma de VENTAS
Número de observaciones = 108

omega	frecuencia escalada	periodos	densidad espectral
0.05818	1	108.00	1.3147e+05
0.11636	2	54.00	41105
0.17453	3	36.00	4535.7
0.23271	4	27.00	16044
0.29089	5	21.60	5389.5
0.34907	6	18.00	8598.8

0.40724	7	15.43	631.90
0.46542	8	13.50	536.42
0.52360	9	12.00	16858
0.58178	10	10.80	5164.6
0.63995	11	9.82	1917.1
0.69813	12	9.00	662.40
0.75631	13	8.31	19.761
0.81449	14	7.71	153.80
0.87266	15	7.20	117.44
0.93084	16	6.75	20.880
0.98902	17	6.35	1526.2
1.04720	18	6.00	6494.6
1.10538	19	5.68	103.72
1.16355	20	5.40	123.29
1.22173	21	5.14	333.38
1.27991	22	4.91	2309.9
1.33809	23	4.70	8.6622
1.39626	24	4.50	318.37
1.45444	25	4.32	2980.4
1.51262	26	4.15	322.79
1.57080	27	4.00	8792.3
1.62897	28	3.86	1983.4
1.68715	29	3.72	73.159
1.74533	30	3.60	180.70
1.80351	31	3.48	366.93
1.86168	32	3.38	775.51
1.91986	33	3.27	1094.0
1.97804	34	3.18	1874.2
2.03622	35	3.09	240.74
2.09440	36	3.00	8412.9
2.15257	37	2.92	1521.0
2.21075	38	2.84	500.59
2.26893	39	2.77	529.31
2.32711	40	2.70	580.11
2.38528	41	2.63	561.90
2.44346	42	2.57	719.68
2.50164	43	2.51	633.68
2.55982	44	2.45	1379.4
2.61799	45	2.40	4887.1
2.67617	46	2.35	1735.9
2.73435	47	2.30	351.43
2.79253	48	2.25	27.510
2.85070	49	2.20	1455.9
2.90888	50	2.16	778.90
2.96706	51	2.12	170.84
3.02524	52	2.08	1190.3
3.08342	53	2.04	2976.5
3.14159	54	2.00	2667.9

Periodograma de PBIA
Número de observaciones = 30

omega	frecuencia escalada	periodos	densidad espectral
0.20944	1	30.00	14.390
0.41888	2	15.00	54.582
0.62832	3	10.00	90.947
0.83776	4	7.50	24.931
1.04720	5	6.00	59.581
1.25664	6	5.00	11.126
1.46608	7	4.29	4.6497
1.67552	8	3.75	8.1509
1.88496	9	3.33	6.1591
2.09440	10	3.00	3.0801

2.30383	11	2.73	2.7802
2.51327	12	2.50	2.9292
2.72271	13	2.31	7.2473
2.93215	14	2.14	3.3572
3.14159	15	2.00	2.2644

CONTRASTE DE RAÍZ UNITARIA:

ADF

```
Contraste aumentado de Dickey-Fuller para VENTAS
incluyendo 11 retardos de (1-L)VENTAS (el máximo fue 12)
tamaño muestral 96
hipótesis nula de raíz unitaria: a = 1

   con constante y tendencia
   modelo: (1-L)y = b0 + b1*t + (a-1)*y(-1) + ... + e
   Coef. de autocorrelación de primer orden de e: 0.035
   diferencias retardadas: F(11, 82) = 2.490 [0.0095]
   valor estimado de (a - 1): -0.201985
   Estadístico de contraste: tau_ct(1) = -1.08947
   valor p asintótico 0.9294
```

ADF-GLS

```
Contraste aumentado de Dickey-Fuller (GLS) para VENTAS
incluyendo 11 retardos de (1-L)VENTAS (el máximo fue 12)
tamaño muestral 96
hipótesis nula de raíz unitaria: a = 1

   con constante y tendencia
   modelo: (1-L)y = b0 + b1*t + (a-1)*y(-1) + ... + e
   Coef. de autocorrelación de primer orden de e: 0.042
   diferencias retardadas: F(11, 84) = 2.476 [0.0097]
   valor estimado de (a - 1): -0.167671
   Estadístico de contraste: tau = -0.92302

                        10%      5%     2.5%      1%
   Valores críticos: -2.74   -3.03   -3.29   -3.58

Regresión aumentada de Dickey-Fuller
MCO, usando las observaciones 1992:01-1999:12 (T = 96)
Variable dependiente: d_yd
```

	Coeficiente	Desv. Típica	Estadístico t	Valor p	
yd_1	-0.167671	0.181655	-0.9230	NA	
d_yd_1	-0.640238	0.190839	-3.355	0.0012	***
d_yd_2	-0.523876	0.193019	-2.714	0.0081	***
d_yd_3	-0.413750	0.192472	-2.150	0.0345	**
d_yd_4	-0.313648	0.186503	-1.682	0.0963	*
d_yd_5	-0.326010	0.178290	-1.829	0.0710	*
d_yd_6	-0.356465	0.172669	-2.064	0.0421	**
d_yd_7	-0.412470	0.169540	-2.433	0.0171	**
d_yd_8	-0.397567	0.167348	-2.376	0.0198	**
d_yd_9	-0.304817	0.158532	-1.923	0.0579	*
d_yd_10	-0.322445	0.138046	-2.336	0.0219	**
d_yd_11	-0.417693	0.104979	-3.979	0.0001	***

```
AIC: 1170.9   BIC: 1201.67   HQC: 1183.34
```

KPSS

Regresión KPSS
MCO, usando las observaciones 1991:01-1999:12 (T = 108)
Variable dependiente: VENTAS

	Coeficiente	Desv. Típica	Estadístico t	Valor p	
const	59.9475	21.1035	2.841	0.0054	***
time	4.80489	0.336114	14.30	1.78e-026	***

AIC: 1321.6   BIC: 1326.96   HQC: 1323.77

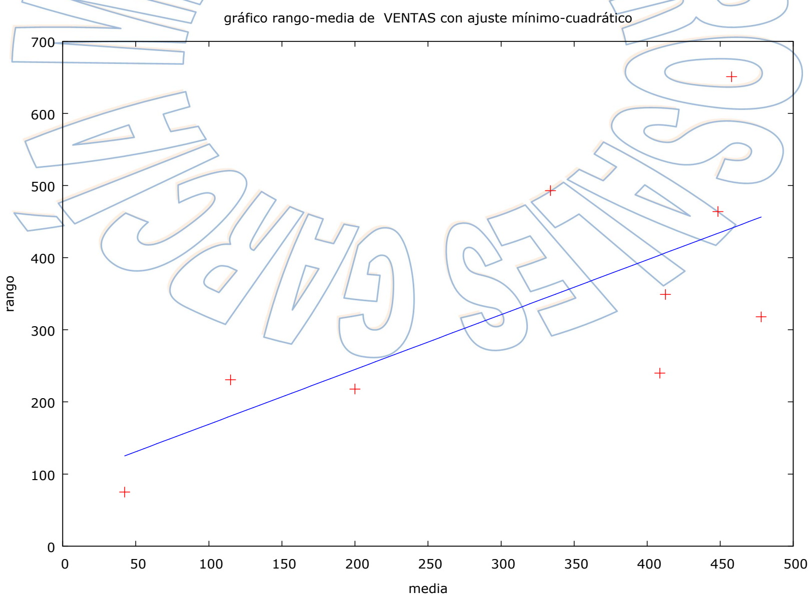
Estimación robusta de la varianza: 23782.6
Suma de cuadrados de los residuos acumulados: 8.09759e+007

Contraste KPSS para VENTAS(incluyendo tendencia)

T = 108
Parámetro de truncamiento de los retardos = 4
Estadístico de contraste = 0.29191

	10%	5%	1%
Valores críticos:	0.120	0.148	0.216

RANGO - MEDIA:



Estadísticos de rango-media para VENTAS
utilizando 9 submuestras de tamaño 12

	rango	media
1991:01 - 1991:12	75.0000	42.3417
1992:01 - 1992:12	230.700	114.867
1993:01 - 1993:12	217.900	199.950
1994:01 - 1994:12	493.000	333.833
1995:01 - 1995:12	240.000	408.667
1996:01 - 1996:12	349.000	412.500
1997:01 - 1997:12	651.000	457.750
1998:01 - 1998:12	464.000	448.417
1999:01 - 1999:12	318.000	478.000

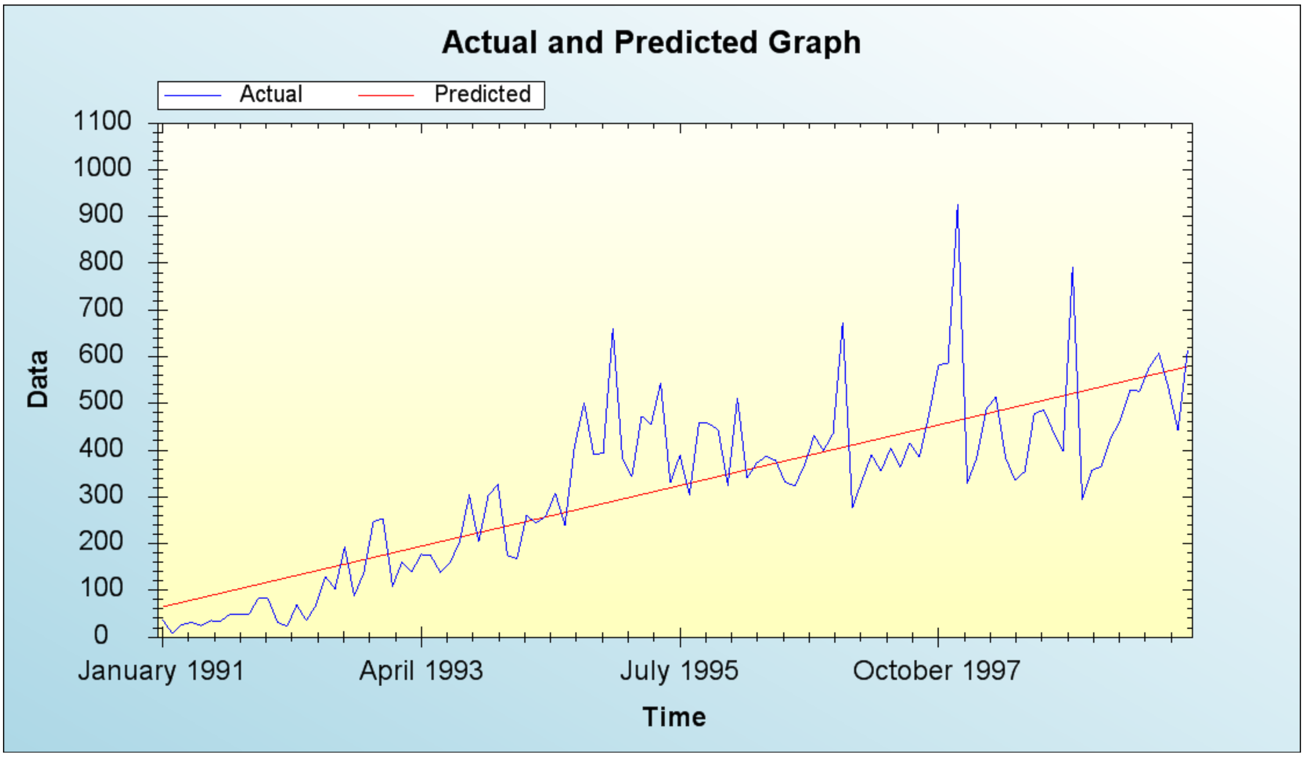
pendiente de 'rango' con respecto a 'media' = 0.760072
el valor p para H0: pendiente = 0 es 0.0330274

ZAITUN

ANÁLISIS DE TENDENCIA:

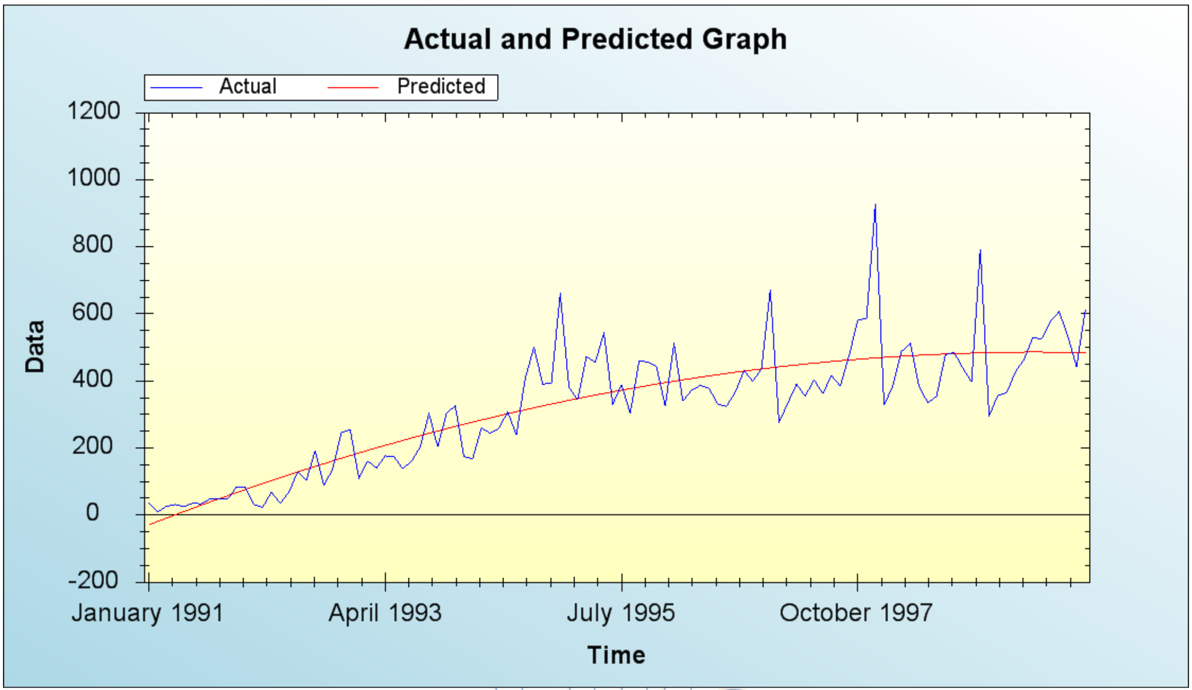
LINEAL

Variable	Value VENTAS
Included Observation	108
Linear Trend Equation	Yt = 59.948 +4.8049*t
R	0.811456
R-Squared	0.658460
R-Square Adjusted	0.999695
Sum Square Error (SSE)	1256987.221519
Mean Squared Error (MSE)	11858.370014



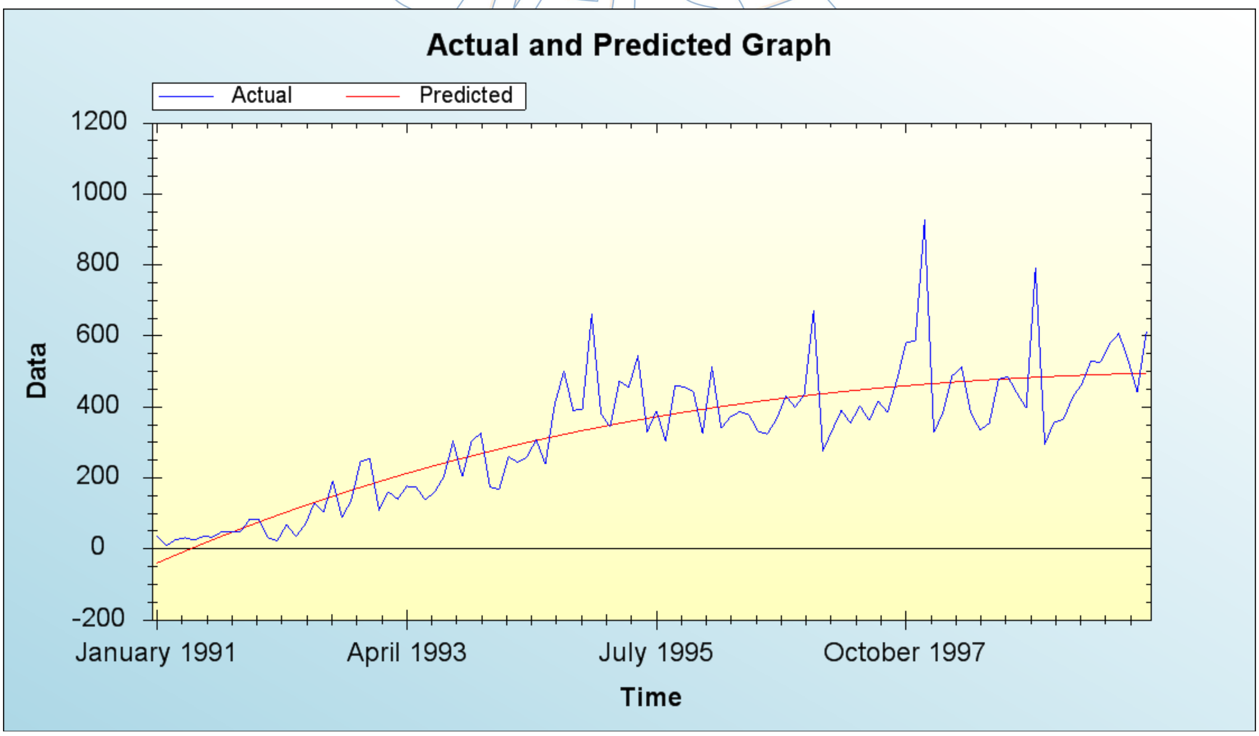
CUADRÁTICA

Variable	Value VENTAS
Included Observation	108
Quadratic Trend Equation	Yt = -39.39 +10.223*t -0.04971*t**2
R	0.844539
R-Squared	0.713245
R-Square Adjusted	0.999721
Sum Square Error (SSE)	1055358.949789
Mean Squared Error (MSE)	10051.037617



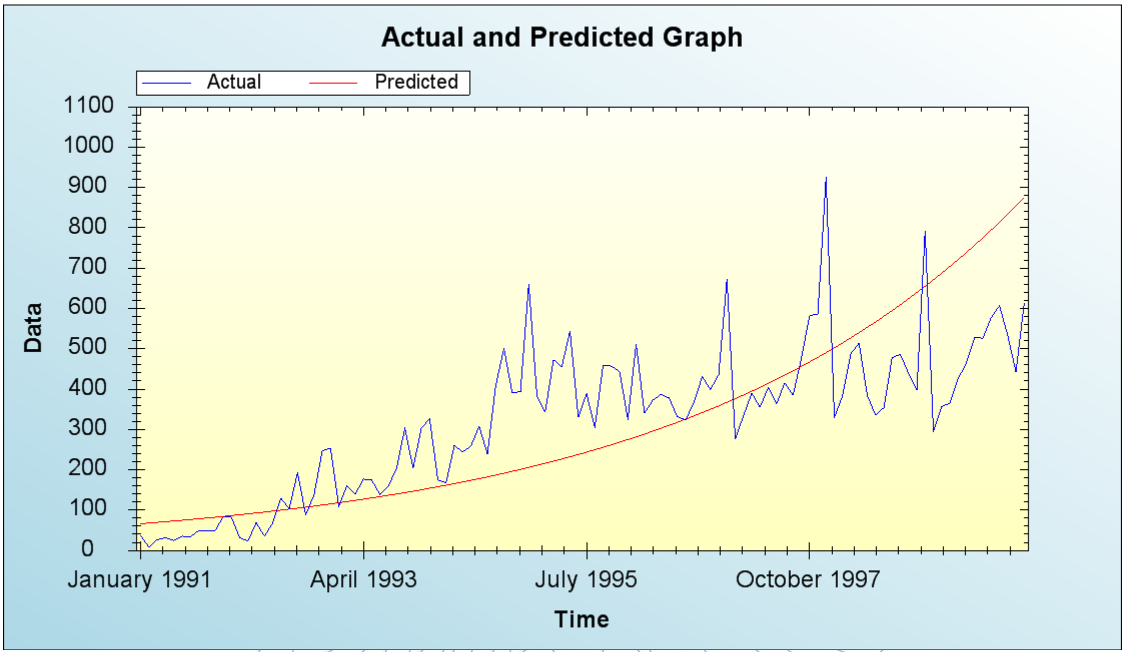
CUBICA

	Value
Variable	VENTAS
Included Observation	108
Cubic Trend Equation	Yt = -51.117 +11.485*t -0.078523*t**2 +0.00017622*t**3
R	0.844844
R-Squared	0.713761
R-Square Adjusted	0.999721
Sum Square Error (SSE)	1053460.409323
Mean Squared Error (MSE)	10129.427013



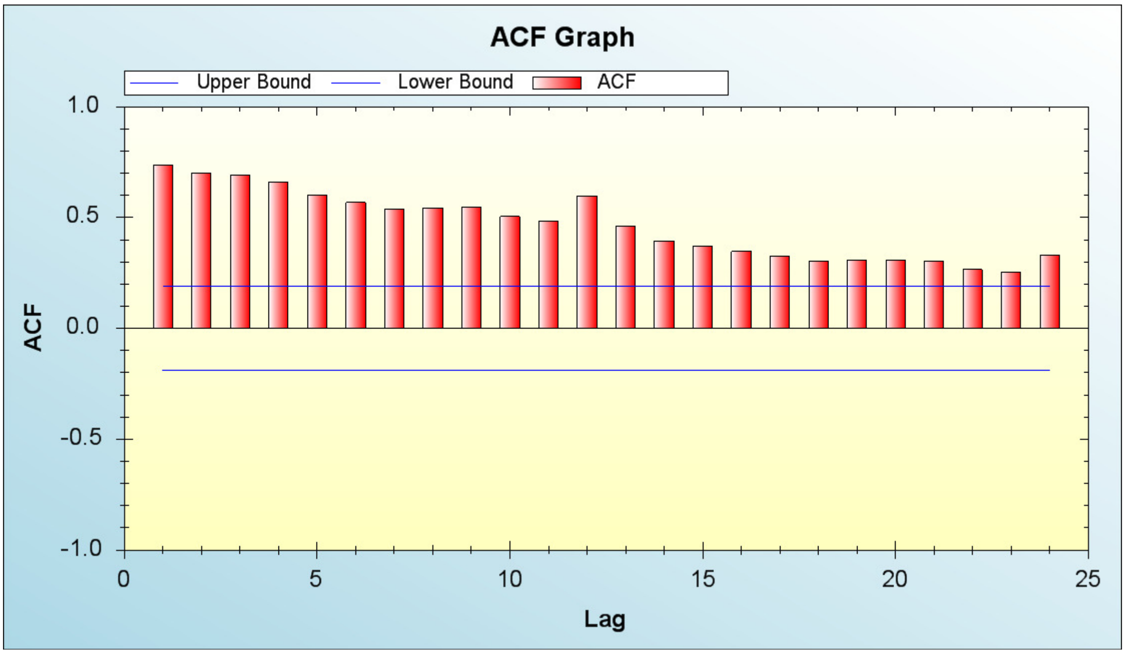
EXPONENCIAL

	Value
Variable	VENTAS
Included Observation	108
Exponential Trend Equation	Yt = 64.654 * (1.0244**t)
R	0.808755
R-Squared	0.654085
R-Square Adjusted	0.859855
Sum Square Error (SSE)	6.092369
Mean Squared Error (MSE)	0.057475

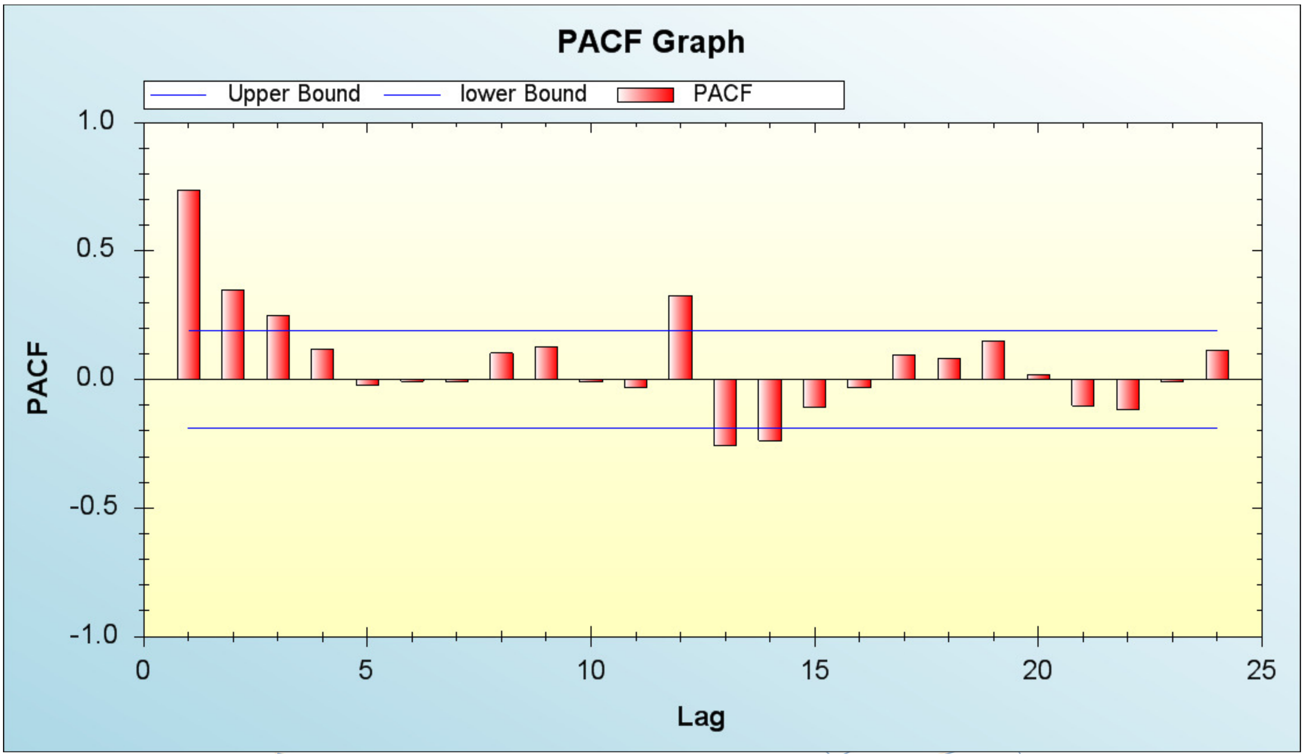


CORRELOGRAMA:

SIMPLE



PARCIAL

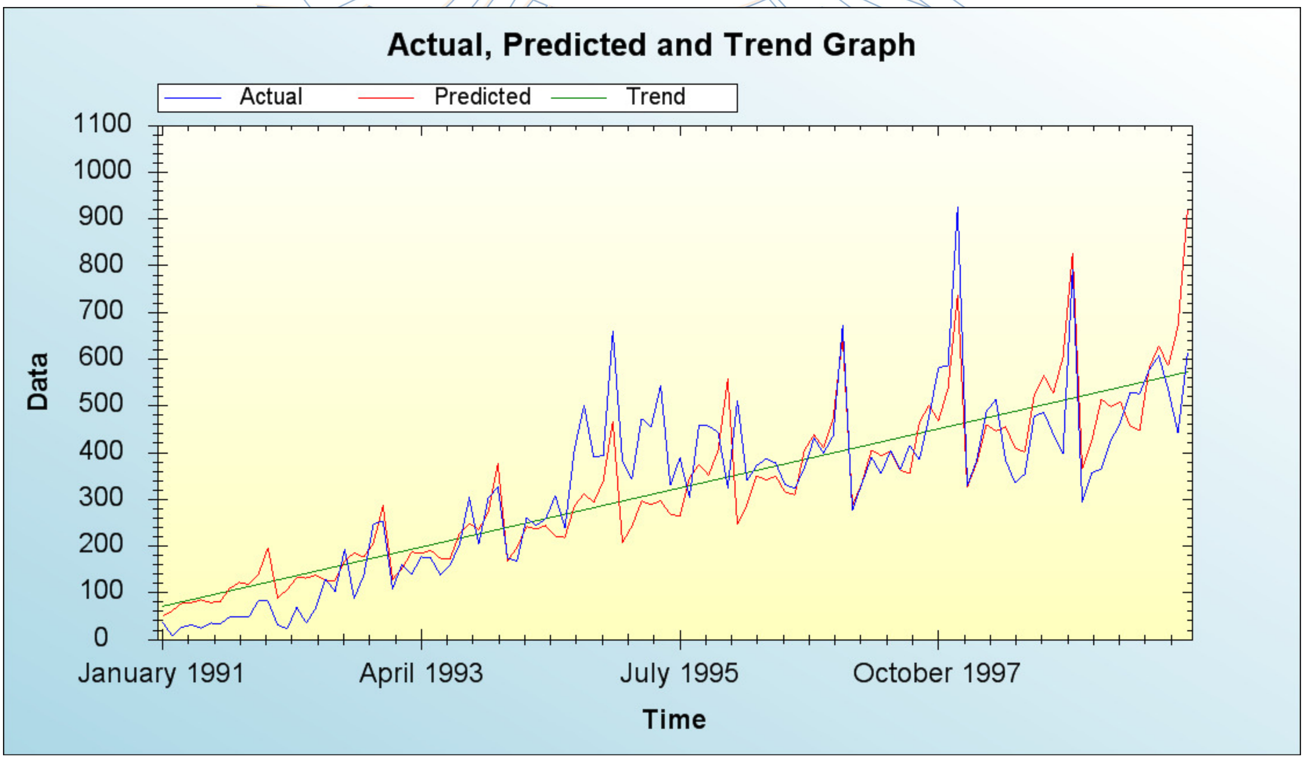


	ACF	PACF	Q-Stat	Prob
1	0.7351	0.7351	59.9920	0.000
2	0.7007	0.3490	115.0244	0.000
3	0.6917	0.2474	169.1648	0.000
4	0.6602	0.1200	218.9587	0.000
5	0.6003	-0.0214	260.5243	0.000
6	0.5686	-0.0075	298.1747	0.000
7	0.5362	-0.0088	331.9884	0.000
8	0.5427	0.1041	366.9746	0.000
9	0.5470	0.1271	402.8820	0.000
10	0.5057	-0.0092	433.8828	0.000
11	0.4828	-0.0307	462.4264	0.000
12	0.5979	0.3259	506.6644	0.000
13	0.4631	-0.2564	533.4791	0.000
14	0.3938	-0.2379	553.0806	0.000
15	0.3728	-0.1087	570.8350	0.000
16	0.3480	-0.0326	586.4766	0.000
17	0.3260	0.0958	600.3492	0.000
18	0.3047	0.0808	612.6026	0.000
19	0.3092	0.1512	625.3633	0.000
20	0.3071	0.0184	638.0938	0.000
21	0.3037	-0.1014	650.6873	0.000
22	0.2651	-0.1155	660.3951	0.000
23	0.2531	-0.0101	669.3505	0.000
24	0.3290	0.1132	684.6633	0.000

DESCOMPOSICIÓN DE LA SERIE:

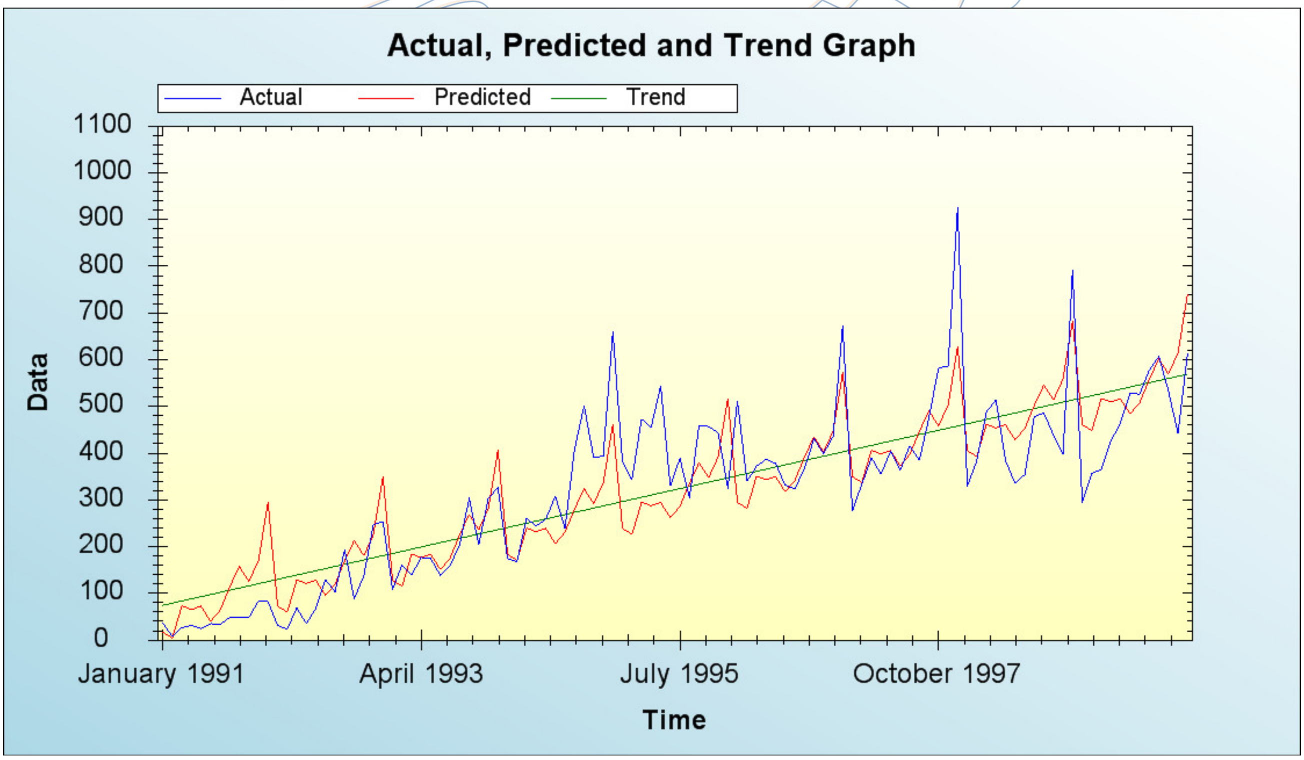
MÉTODO MULTIPLICATIVO

	Value
Variable	VENTAS
Model Type	Multiplicative
Included Observation	108
Seasonal Length	12
Linear Trend Equation	Yt = 66.581 +4.6878*t
Seasonal Index	
period 1	0.70057
period 2	0.80799
period 3	0.96886
period 4	0.93076
period 5	0.94207
period 6	0.83792
period 7	0.81463
period 8	1.05088
period 9	1.12390
period 10	1.03955
period 11	1.18077
period 12	1.60211
Accuracy Measures	
Sum Square Error (SSE)	887885.479313
Mean Absolute Error (MAE)	65.892777
Mean Squared Error (MSE)	8221.161845
Mean Percentage Error (MPE)	-30.181536
Mean Absolute Percentage Error (MAPE)	44.428341



MÉTODO ADITIVO

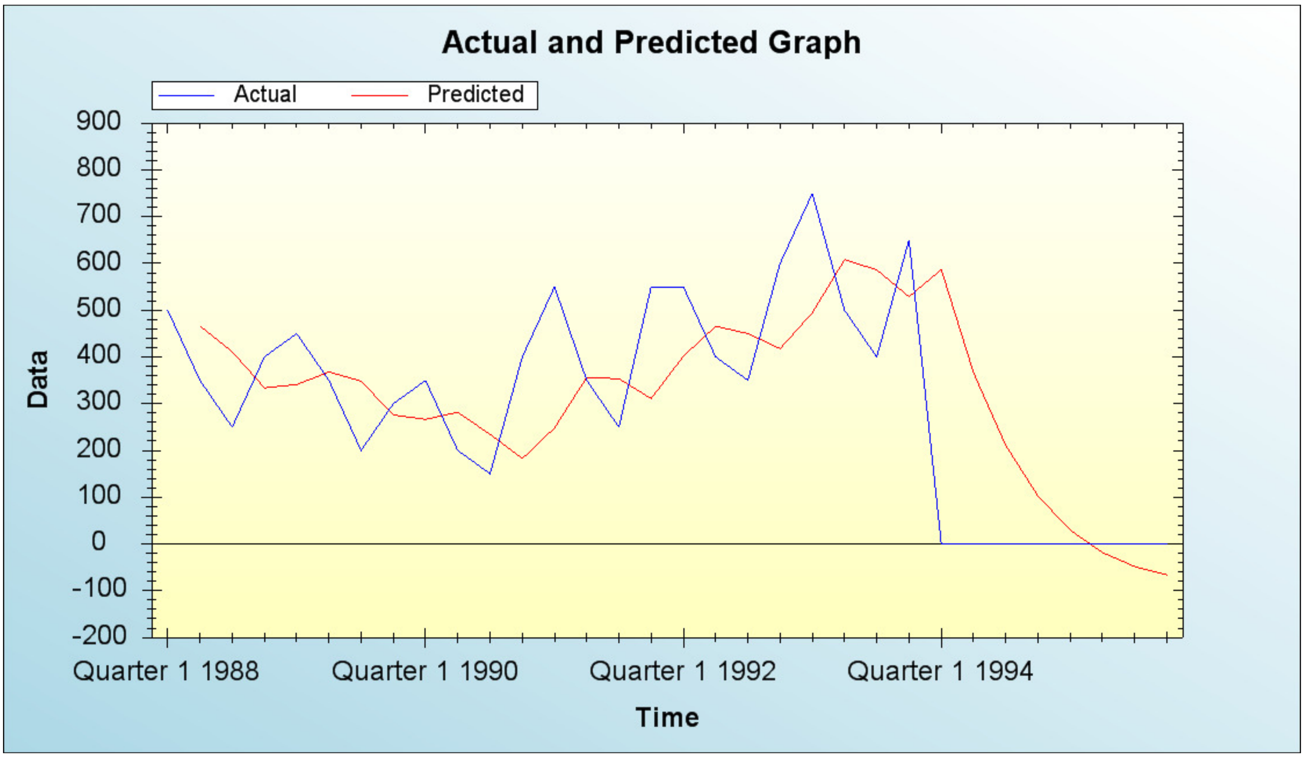
	Value
Variable	VENTAS
Model Type	Additive
Included Observation	108
Seasonal Length	12
Linear Trend Equation	Yt = 69.78 +4.6245*t
Seasonal Index	
period 1	-57.48646
period 2	-74.85729
period 3	-10.53854
period 4	-22.90313
period 5	-20.60104
period 6	-57.51146
period 7	-38.01354
period 8	6.81771
period 9	46.23229
period 10	9.28646
period 11	49.54479
period 12	170.03021
Accuracy Measures	
Sum Square Error (SSE)	874051.140019
Mean Absolute Error (MAE)	66.392223
Mean Squared Error (MSE)	8093.066111
Mean Percentage Error (MPE)	-20.066352
Mean Absolute Percentage Error (MAPE)	36.861462



MODELO DE ALISADO EXPONENCIAL:

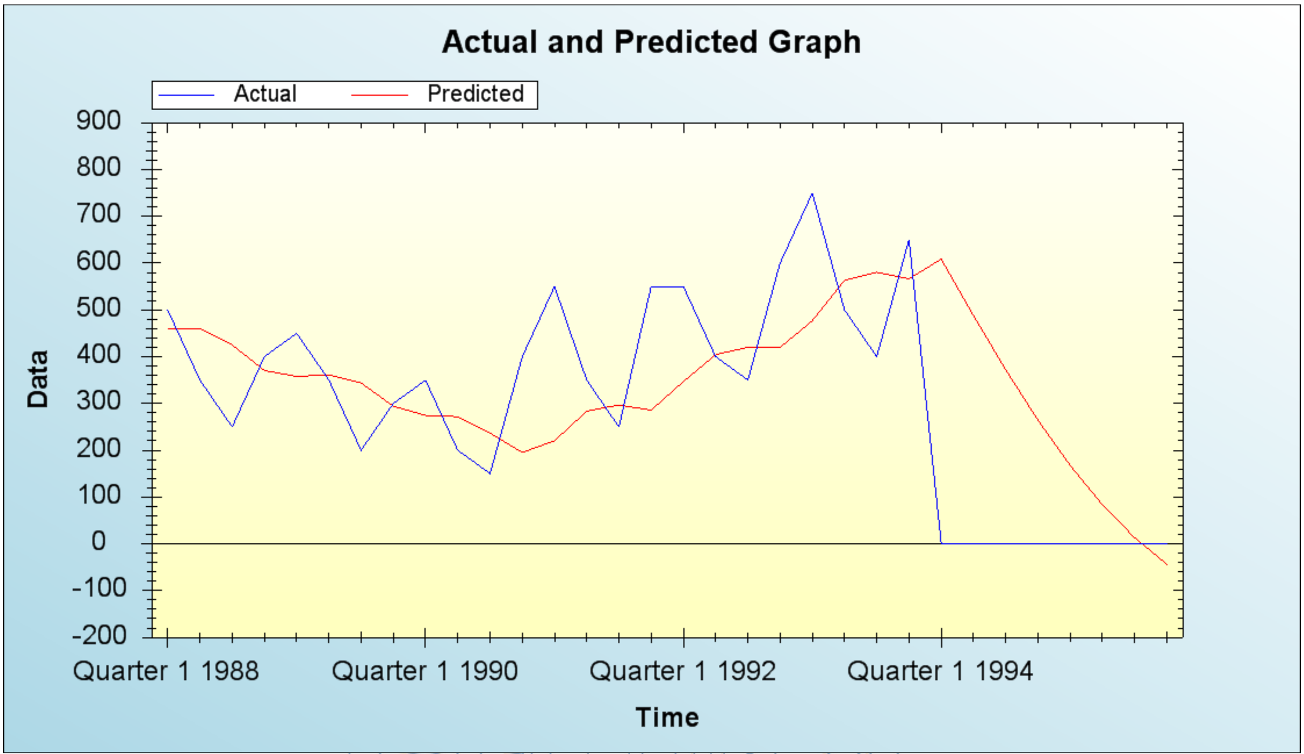
BROWN

	Value
Variable	VENTA
Included Observation	32
Smoothing Constant	
Alpha (for data)	0.200
Accuracy Measures	
Mean Absolute Error (MAE)	140.531553
Sum Square Error (SSE)	1043165.177579
Mean Squared Error (MSE)	33650.489599
Mean Percentage Error (MPE)	NaN
Mean Absolute Percentage Error (MAPE)	Infinity



HOLT

	Value
Variable	VENTA
Included Observation	32
Smoothing Constant	
Alpha (for data)	0.200
Gamma (for trend)	0.200
Accuracy Measures	
Mean Absolute Error (MAE)	151.671275
Sum Square Error (SSE)	1370760.257164
Mean Squared Error (MSE)	42836.258036
Mean Percentage Error (MPE)	NaN
Mean Absolute Percentage Error (MAPE)	Infinity

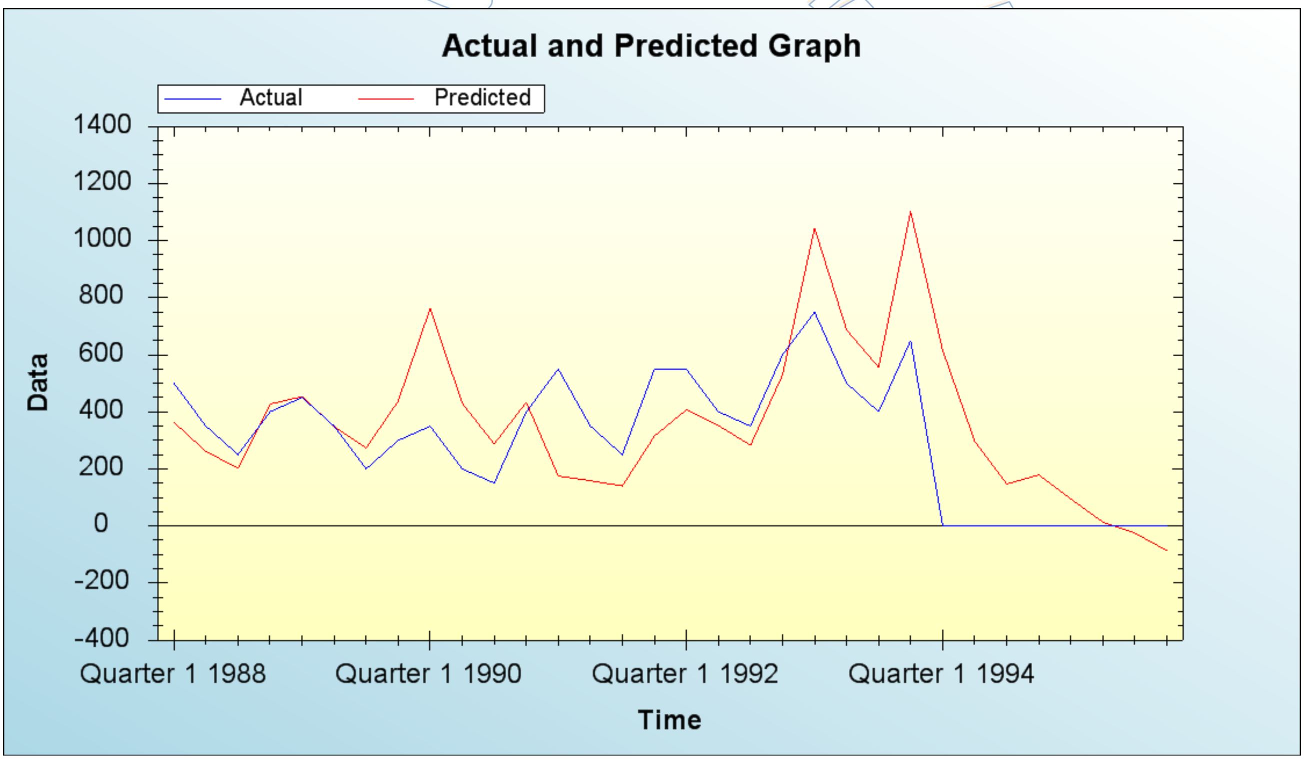


WINTER

	Value
Variable	VENTA
Model Type	Multiplicative
Included Observation	32
Seasonal Length	12
Smoothing Constant	
Alpha (for data)	0.200
Gamma (for trend)	0.200
Beta (for seasonal)	0.200
Accuracy Measures	
Mean Absolute Error (MAE)	159.823267
Sum Square Error (SSE)	1460508.833570
Mean Squared Error (MSE)	45640.901049
Mean Percentage Error (MPE)	NaN
Mean Absolute Percentage Error (MAPE)	Infinity

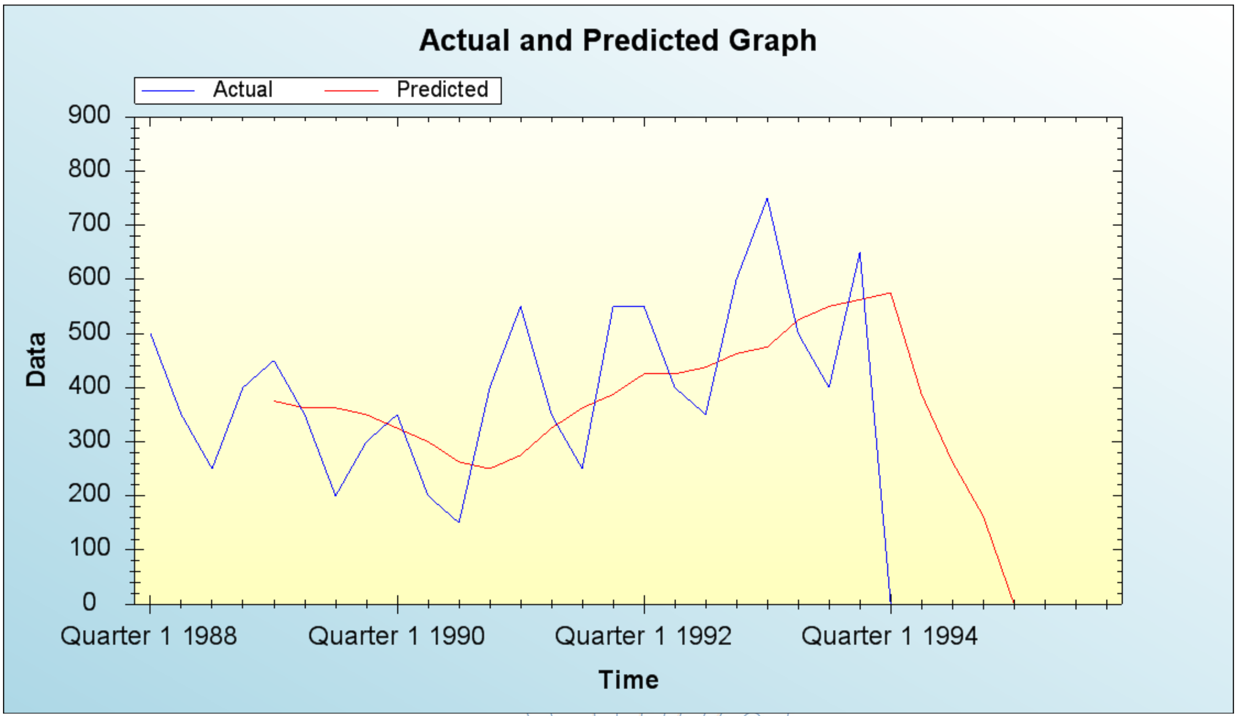
	Actual	Smoothed	Trend	Seasonal	Predicted	Residual
Quarter 1 1988	500.0000	434.1795	-8.2690	0.9504	363.4894	136.5106
Quarter 2 1988	350.0000	455.1694	-2.4172	0.6431	260.5162	89.4838
Quarter 3 1988	250.0000	473.5972	1.7518	0.4647	203.2184	46.7816
Quarter 4 1988	400.0000	469.2631	0.5346	0.8897	427.3571	-27.3571
Quarter 1 1989	450.0000	469.0643	0.3879	0.9642	453.5403	-3.5403
Quarter 2 1989	350.0000	469.9144	0.4804	0.7425	348.2857	1.7143
Quarter 3 1989	200.0000	445.1645	-4.5657	0.5546	273.2918	-73.2918
Quarter 4 1989	300.0000	412.9272	-10.1000	0.9394	437.3322	-137.3322
Quarter 1 1990	350.0000	359.2381	-18.8178	1.7093	762.5938	-412.5938
Quarter 2 1990	200.0000	304.0081	-26.1003	1.1419	429.9338	-229.9338

Quarter 3 1990	150.0000	251.3113	-31.4196	0.9474	287.6390	-137.6390
Quarter 4 1990	400.0000	216.4899	-32.0999	1.9468	433.5349	-33.5349
Quarter 1 1991	550.0000	263.2558	-16.3268	1.1781	175.2396	374.7604
Quarter 2 1991	350.0000	306.3869	-4.4352	0.7430	158.8060	191.1940
Quarter 3 1991	250.0000	349.1679	5.0080	0.5149	140.3037	109.6963
Quarter 4 1991	550.0000	406.9764	15.5681	0.9821	315.1142	234.8858
Quarter 1 1992	550.0000	452.1213	21.4835	1.0146	407.4120	142.5880
Quarter 2 1992	400.0000	486.6306	24.0887	0.7584	351.6430	48.3570
Quarter 3 1992	350.0000	534.7830	28.9014	0.5746	283.2661	66.7339
Quarter 4 1992	600.0000	578.6924	31.9030	0.9589	529.5099	70.4901
Quarter 1 1993	750.0000	576.2294	25.0298	1.6278	1043.7152	-293.7152
Quarter 2 1993	500.0000	568.5780	18.4936	1.0894	686.5994	-186.5994
Quarter 3 1993	400.0000	554.1001	11.8993	0.9023	556.1837	-156.1837
Quarter 4 1993	650.0000	519.5757	2.6145	1.8076	1101.8871	-451.8871
Quarter 1 1994	0.0000	417.7522	-18.2731	0.9425	615.2156	-615.2156
Quarter 2 1994	0.0000	319.5833	-34.2522	0.5944	296.8004	-296.8004
Quarter 3 1994	0.0000	228.2649	-45.6655	0.4119	146.9234	-146.9234
Quarter 4 1994	0.0000	146.0795	-52.9695	0.7856	179.3226	-179.3226
Quarter 1 1995	0.0000	74.4881	-56.6939	0.8117	94.4739	-94.4739
Quarter 2 1995	0.0000	14.2354	-57.4056	0.6067	13.4948	-13.4948
Quarter 3 1995	0.0000	-34.5362	-55.6788	0.4597	-24.8060	24.8060
Quarter 4 1995	0.0000	-72.1720	-52.0702	0.7671	-86.5038	86.5038



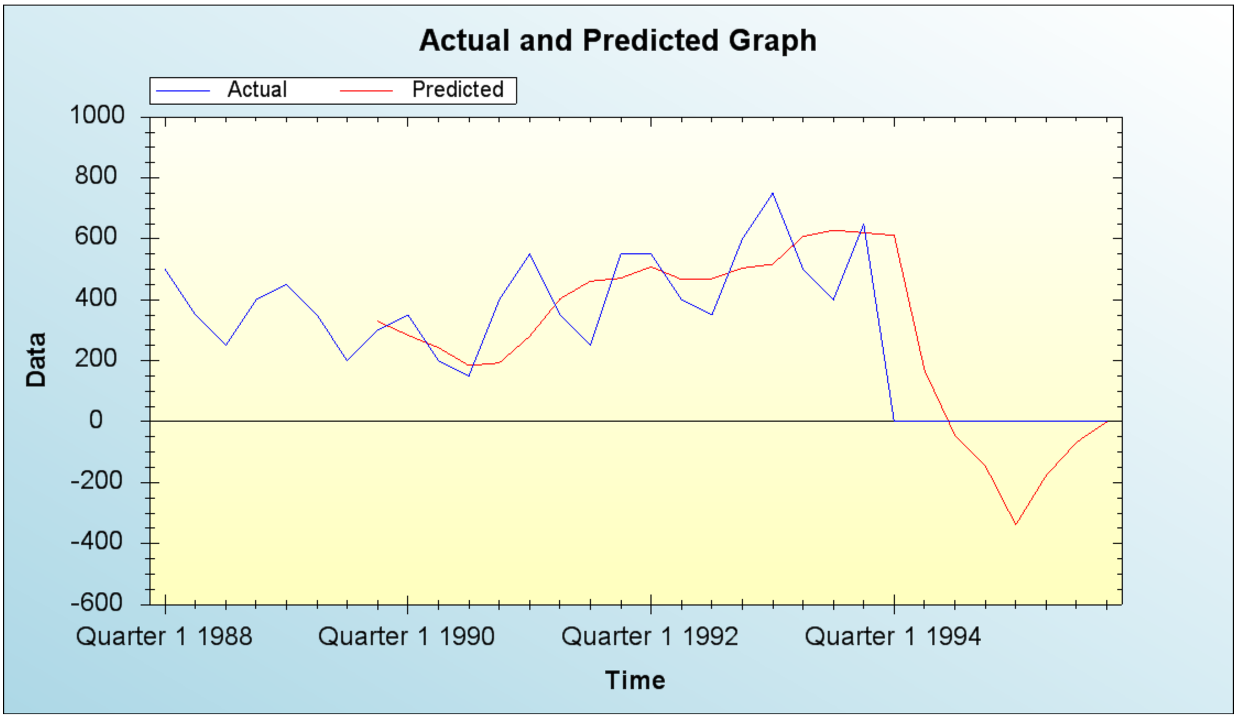
PROMEDIO MÓVIL:

SIMPLE



DOBLE

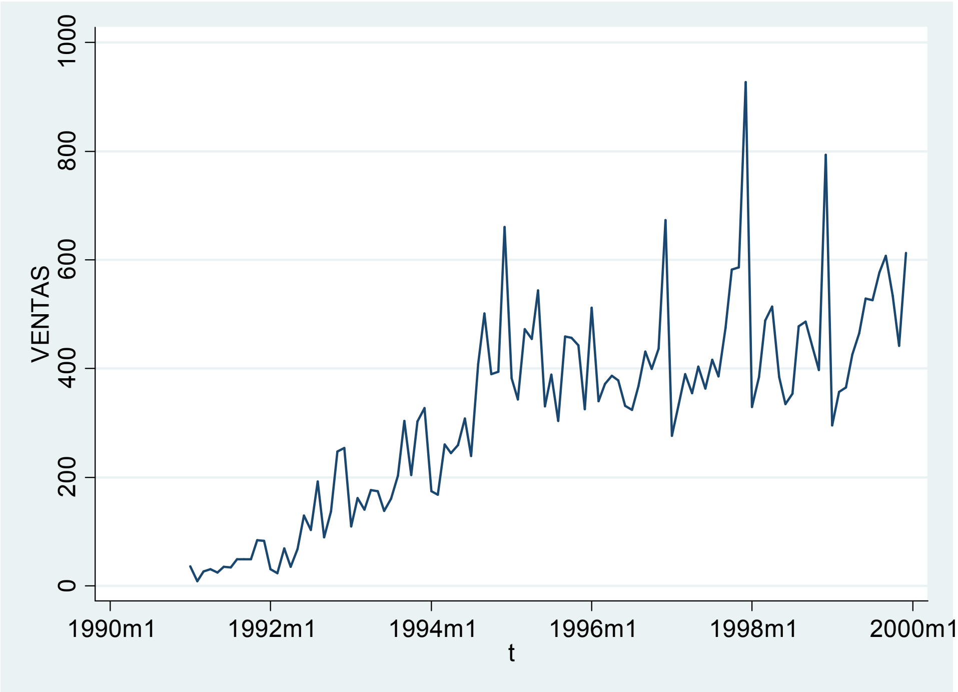
	Value
Variable	VENTA
Model MA	(4 X 4)
Included Observation	25
Accuracy Measures	
Mean Absolute Error (MAE)	138.791667
Sum Square Error (SSE)	902344.835069
Mean Squared Error (MSE)	36093.793403
Mean Percentage Error (MPE)	NaN
Mean Absolute Percentage Error (MAPE)	NaN



STATA

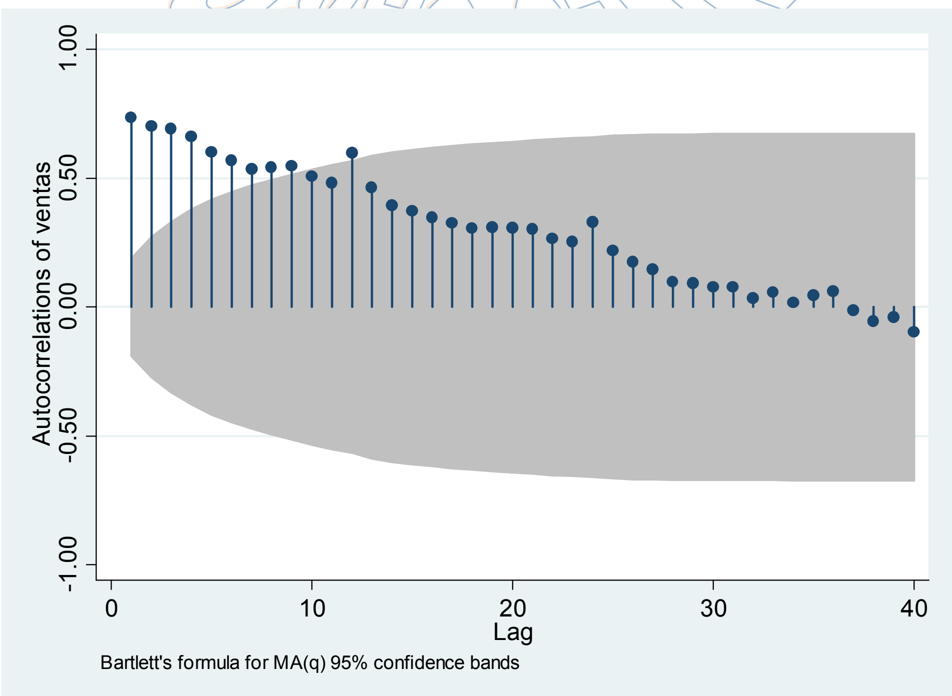
PLOTEO:

tsline ventas

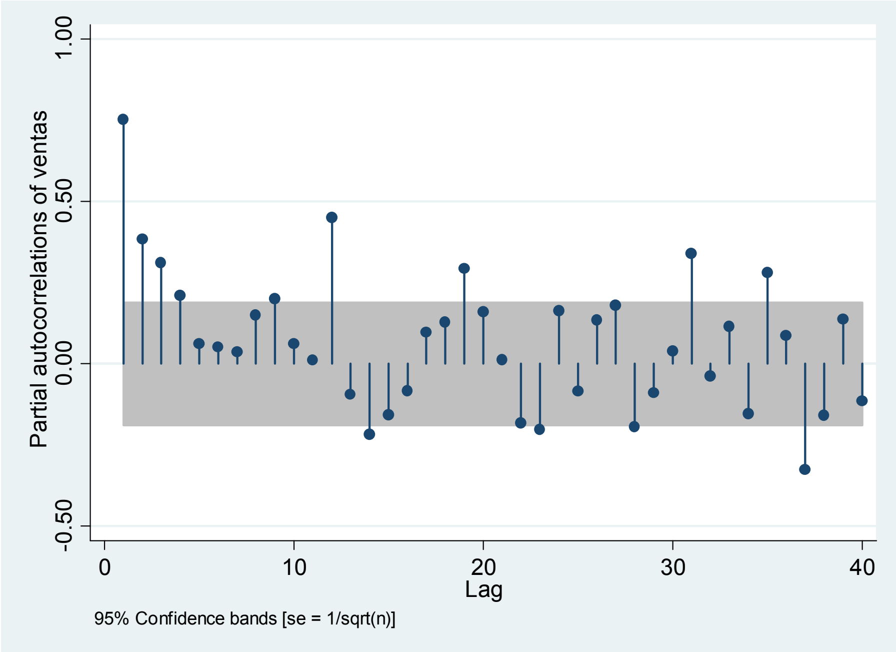


CORRRELOGRAMA:

ac ventas



pac ventas

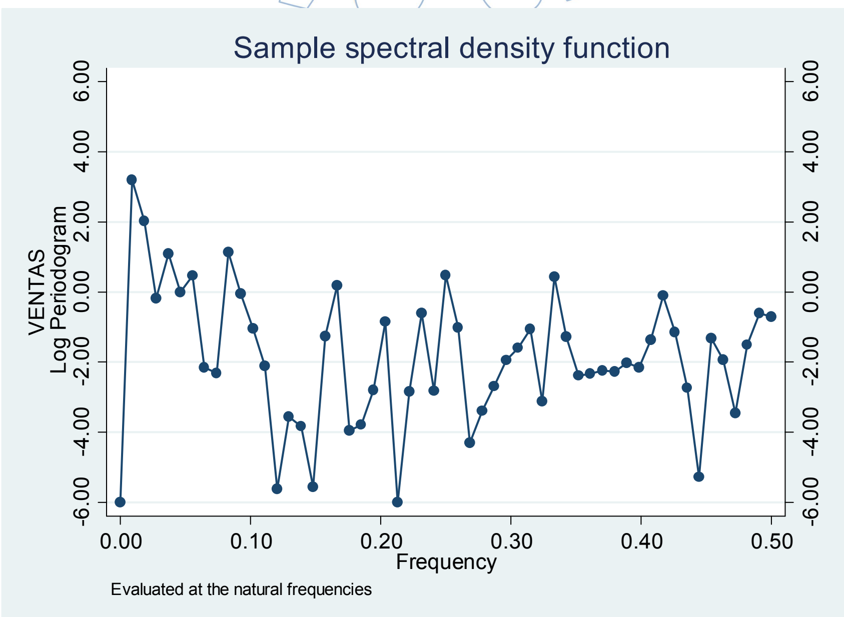



```
. corrgram ventas, lags(12)

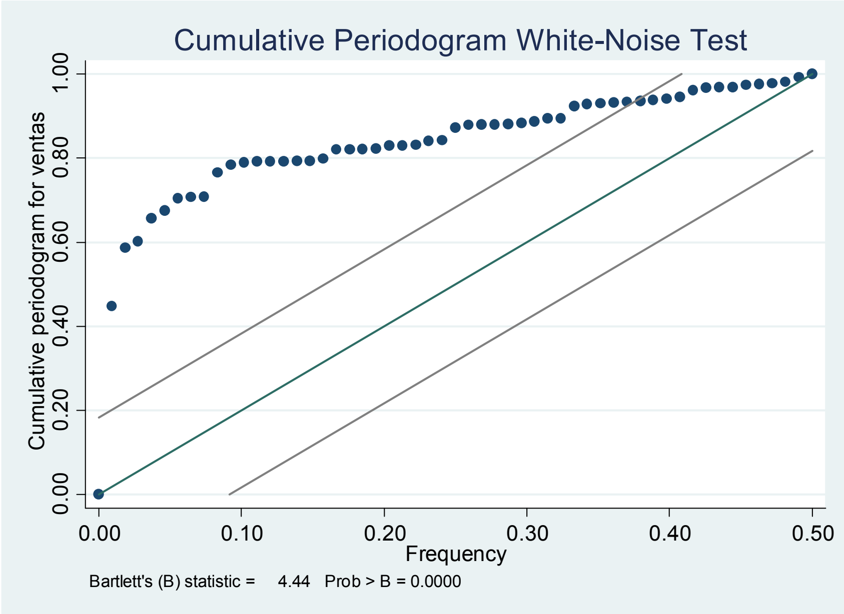
                                          -1       0       1 -1       0       1
LAG       AC       PAC      Q     Prob>Q  [Autocorrelation]  [Partial Autocor]
-------------------------------------------------------------------------------
1       0.7351   0.7528   59.992  0.0000
2       0.7007   0.3828   115.02  0.0000
3       0.6917   0.3102   169.16  0.0000
4       0.6602   0.2104   218.96  0.0000
5       0.6003   0.0604   260.52  0.0000
6       0.5686   0.0504   298.17  0.0000
7       0.5362   0.0349   331.99  0.0000
8       0.5427   0.1503   366.97  0.0000
9       0.5470   0.2006   402.88  0.0000
10      0.5057   0.0613   433.88  0.0000
11      0.4828   0.0111   462.43  0.0000
12      0.5979   0.4510   506.66  0.0000
```

PERIDIOGRAMA:

pergram ventas



wntestb ventas



MODELO DE ALISADO EXPONENCIAL:

BROWN SIMPLE

```
. tssmooth exponential ventasbs=ventas

computing optimal exponential  coefficient (0,1)

optimal exponential coefficient =        0.2892
sum-of-squared residuals        =     1224513.4
root mean squared error         =     106.48046
```

BROWN DOBLE

```
. tssmooth dexponential ventasbd=ventas
computing optimal double-exponential coefficient (0,1)

optimal double-exponential coefficient =        0.0760
sum-of-squared residuals               =     3945677.9
root mean squared error                =     191.13884
```

HOLT WINTER NO ESTACIONAL

```
. tssmooth hwinters ventashw=ventas
computing optimal weights

Iteration 0:   penalized RSS = -1678816.7  (not concave)
Iteration 1:   penalized RSS = -1247923.8  (not concave)
Iteration 2:   penalized RSS = -1153656.8
Iteration 3:   penalized RSS = -1141919.4
Iteration 4:   penalized RSS = -1140999.9
Iteration 5:   penalized RSS = -1140993.8
Iteration 6:   penalized RSS = -1140993.8

Optimal weights:
                              alpha = 0.1918
                               beta = 0.0184
penalized sum-of-squared residuals = 1140994
          sum-of-squared residuals = 1140994
           root mean squared error = 102.785
```

HOLT WINTER ESTACIONAL

```
. tssmooth shwinters ventassh=ventas, snt_v(fe)
computing optimal weights

Iteration 0:   penalized RSS =  -16016914  (not concave)
Iteration 1:   penalized RSS =  -13523942  (not concave)
Iteration 2:   penalized RSS =  -13285023  (not concave)
Iteration 3:   penalized RSS =  -13158856
Iteration 4:   penalized RSS =  -12510529
Iteration 5:   penalized RSS =  -12466016
Iteration 6:   penalized RSS =  -12438593
Iteration 7:   penalized RSS =  -12438173
Iteration 8:   penalized RSS =  -12438173

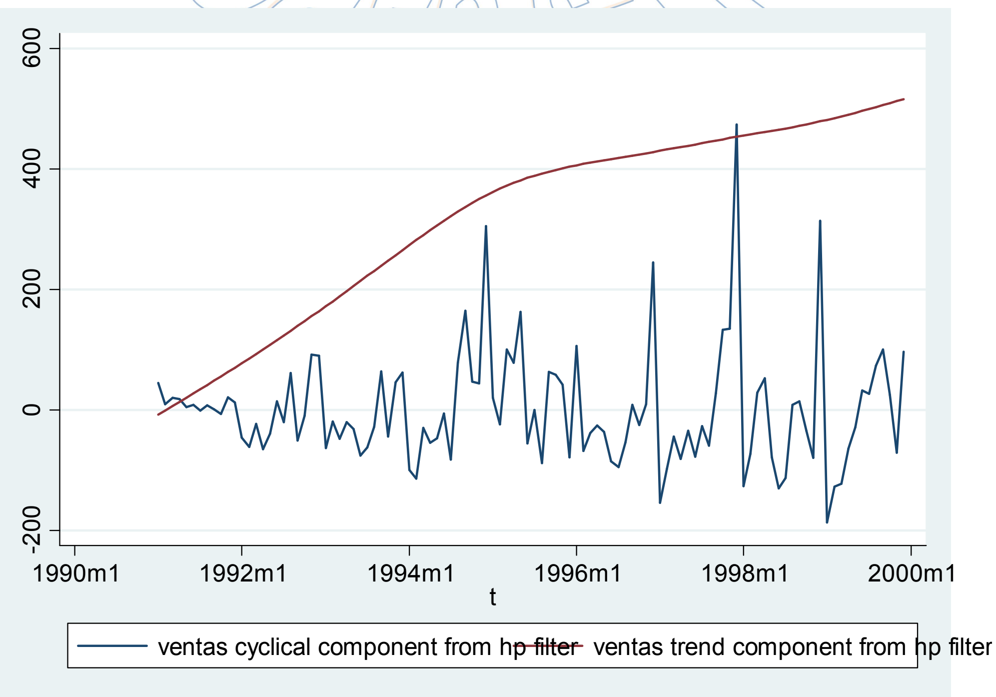
Optimal weights:
                             alpha = 0.4959
                              beta = 0.5684
                             gamma = 0.4832
penalized sum-of-squared residuals = 1.24e+07
          sum-of-squared residuals = 1.24e+07
          root mean squared error  = 339.3645
```

FILTROS:

HODRICK-PRESCOTT

```
. tsfilter hp ventashp=ventas, smooth(14400) trend(ventast)

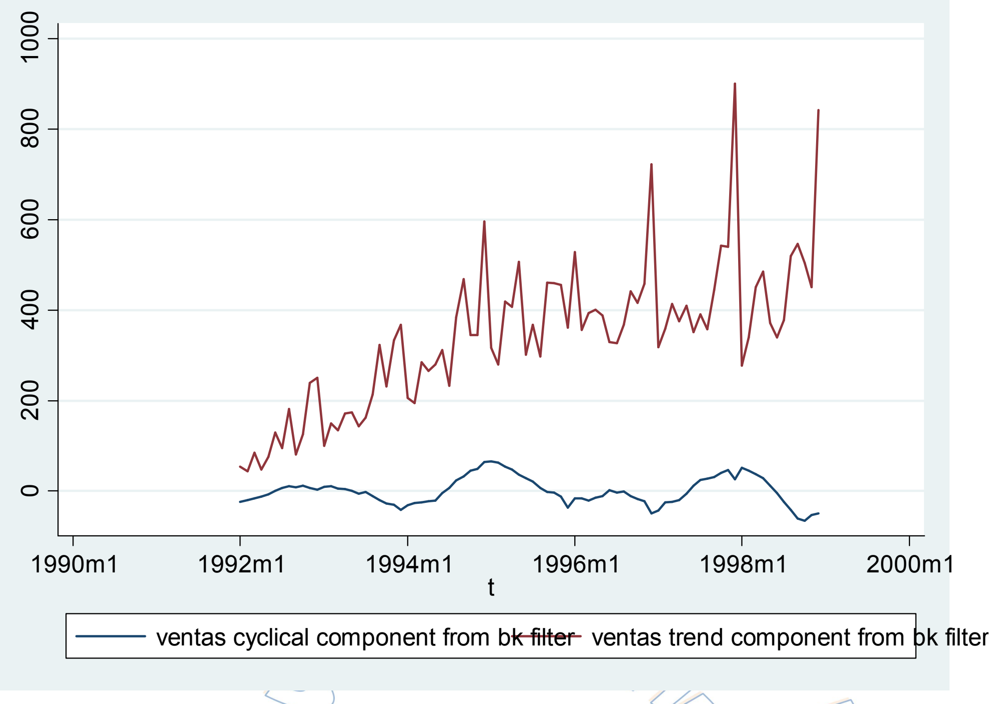
. tsline ventashp ventast
```



BASTER-KING

```
. tsfilter bk ventasbk=ventas, smaorder(12) trend(ventastbk)

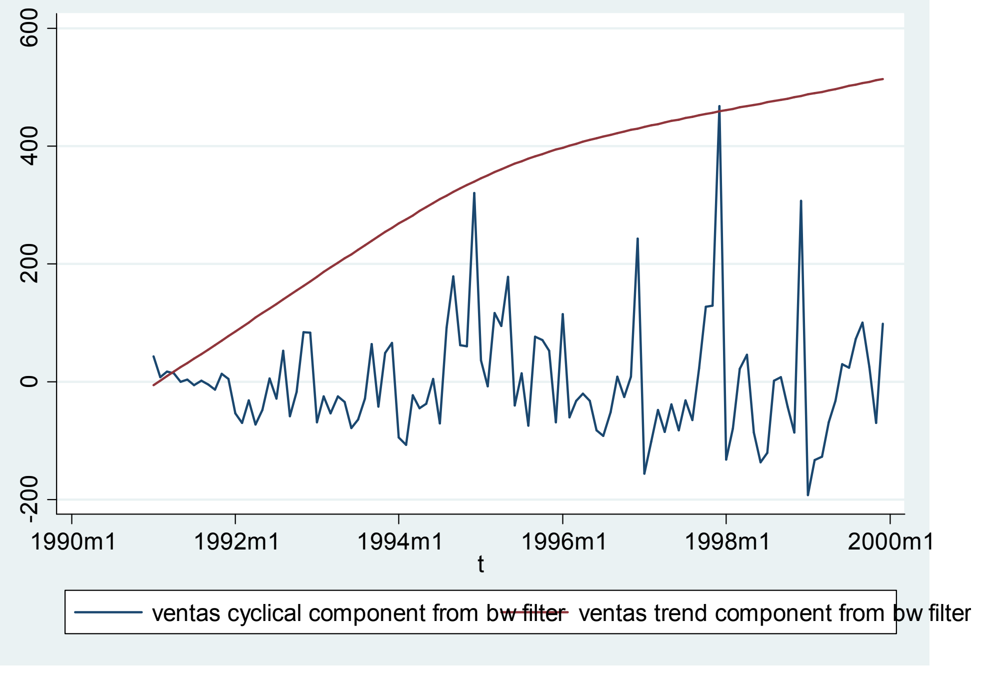
. tsline ventasbk ventastbk
```



BUTTERWORTH

```
. tsfilter bw ventasbw=ventas, trend(ventastbw)

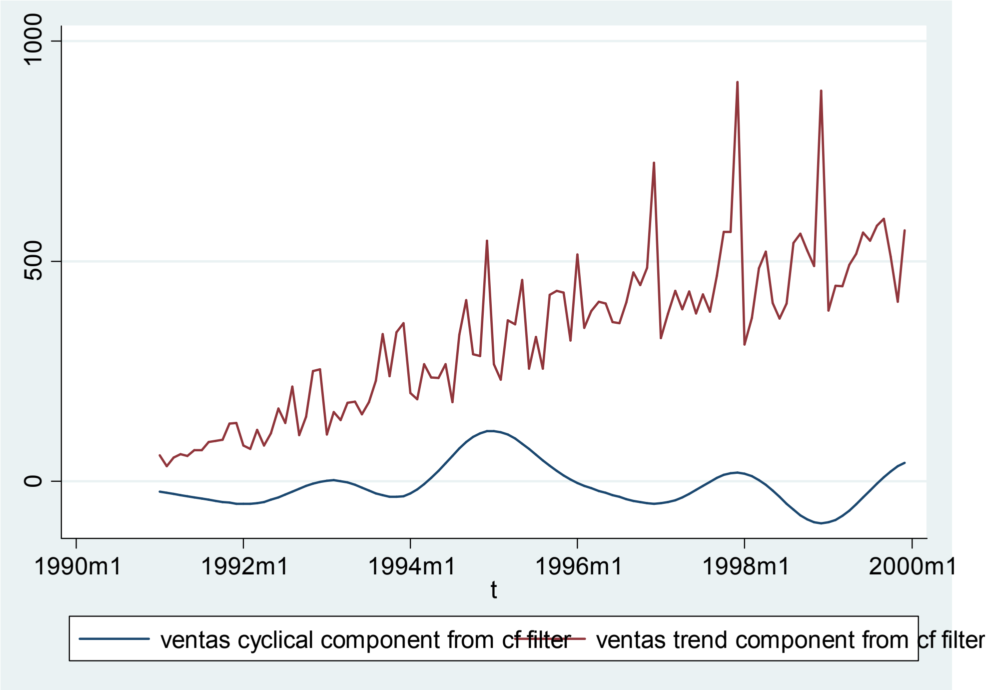
. tsline ventasbw ventastbw
```



CHRISTIANO-FITZGERALD

```
. tsfilter cf ventascf=ventas, trend(ventastcf)

. tsline ventascf ventastcf
```



TEST DE RAIZ UNITARIA:

DICKEY-FULLER

Veentas tiene tendencia e intercepto.

```
. dfuller ventas, trend

Dickey-Fuller test for unit root                   Number of obs   =       107

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -7.555            -4.038            -3.449            -3.149
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000

. dfuller ventas, trend regress

Dickey-Fuller test for unit root                   Number of obs   =       107

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -7.555            -4.038            -3.449            -3.149
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000

------------------------------------------------------------------------------
D.ventas     |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      ventas |
         L1. |  -.7088921   .0938269    -7.56   0.000    -.8949545   -.5228298
      _trend |   3.396509   .5567975     6.10   0.000     2.292359     4.50066
       _cons |   48.17759   21.24763     2.27   0.025     6.042747    90.31243
------------------------------------------------------------------------------
```

PHILLIPS-PERRONN

```
. pperron ventas, trend regress

Phillips-Perron test for unit root                 Number of obs   =       107
                                                   Newey-West lags =         4

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(rho)          -86.985           -27.447           -20.728           -17.523
 Z(t)             -7.835            -4.038            -3.449            -3.149
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000

------------------------------------------------------------------------------
ventas       |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      ventas |
         L1. |   .2911079   .0938269     3.10   0.002     .1050455    .4771702
      _trend |   3.396509   .5567975     6.10   0.000     2.292359     4.50066
       _cons |   48.17759   21.24763     2.27   0.025     6.042747    90.31243
------------------------------------------------------------------------------


. pperron ventas, lags(6) trend regress

Phillips-Perron test for unit root                 Number of obs   =       107
                                                   Newey-West lags =         6

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(rho)          -96.079           -27.447           -20.728           -17.523
 Z(t)             -8.075            -4.038            -3.449            -3.149
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000

------------------------------------------------------------------------------
ventas       |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      ventas |
         L1. |   .2911079   .0938269     3.10   0.002     .1050455    .4771702
      _trend |   3.396509   .5567975     6.10   0.000     2.292359     4.50066
       _cons |   48.17759   21.24763     2.27   0.025     6.042747    90.31243
------------------------------------------------------------------------------
```

DICKEY-FULLER AUMENTADO

```
. dfuller ventas, lags(6) trend regress

Augmented Dickey-Fuller test for unit root         Number of obs   =       101

                               ---------- Interpolated Dickey-Fuller ---------
                  Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value             Value
------------------------------------------------------------------------------
 Z(t)             -2.871            -4.040            -3.450            -3.150
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.1721

------------------------------------------------------------------------------
D.ventas     |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      ventas |
         L1. |  -.4713045   .1641641    -2.87   0.005    -.7973486   -.1452605
         LD. |  -.3419981   .1675436    -2.04   0.044    -.6747542   -.0092419
        L2D. |  -.2423568   .1657045    -1.46   0.147    -.5714602    .0867467
        L3D. |  -.0851503   .1622235    -0.52   0.601    -.4073402    .2370396
        L4D. |   .0473448   .1526176     0.31   0.757     -.255767    .3504566
        L5D. |   .0431587   .1345308     0.32   0.749    -.2240311    .3103485
        L6D. |   .0321742    .104959     0.31   0.760    -.1762834    .2406317
      _trend |   2.099621   .8642113     2.43   0.017     .3832231    3.816019
       _cons |   47.07478   25.12689     1.87   0.064    -2.829393    96.97896
------------------------------------------------------------------------------
```

DICKEY-FULLER GLS

```
. dfgls ventas

DF-GLS for ventas                                        Number of obs =     95
Maxlag = 12 chosen by Schwert criterion

               DF-GLS tau      1% Critical       5% Critical      10% Critical
  [lags]     Test Statistic        Value             Value             Value

    12           -1.087           -3.570            -2.760            -2.486
    11           -0.950           -3.570            -2.789            -2.514
    10           -1.882           -3.570            -2.817            -2.541
    9            -1.855           -3.570            -2.845            -2.567
    8            -1.945           -3.570            -2.872            -2.592
    7            -2.373           -3.570            -2.898            -2.616
    6            -2.721           -3.570            -2.922            -2.640
    5            -2.763           -3.570            -2.946            -2.661
    4            -2.852           -3.570            -2.968            -2.681
    3            -2.972           -3.570            -2.988            -2.700
    2            -3.617           -3.570            -3.007            -2.717
    1            -4.889           -3.570            -3.024            -2.732

Opt Lag (Ng-Perron seq t) = 11 with RMSE  95.33724
Min SC   =  9.466304 at lag  1 with RMSE  108.3337
Min MAIC =  9.433874 at lag 11 with RMSE  95.33724

. dfgls ventas, maxlag(8)

DF-GLS for ventas                                        Number of obs =     99

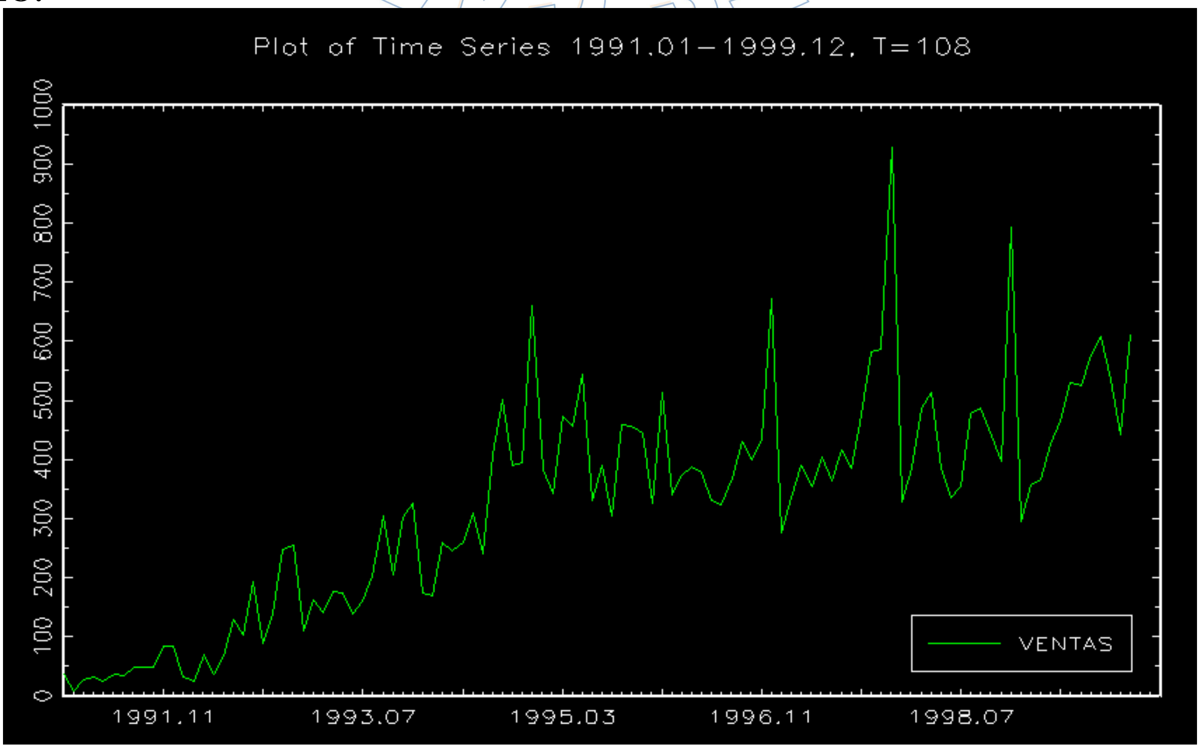
               DF-GLS tau      1% Critical       5% Critical      10% Critical
  [lags]     Test Statistic        Value             Value             Value

    8            -1.967           -3.570            -2.872            -2.593
    7            -2.403           -3.570            -2.897            -2.616
    6            -2.757           -3.570            -2.921            -2.638
    5            -2.801           -3.570            -2.943            -2.658
    4            -2.893           -3.570            -2.964            -2.677
    3            -3.017           -3.570            -2.983            -2.695
    2            -3.672           -3.570            -3.001            -2.711
    1            -4.970           -3.570            -3.017            -2.725

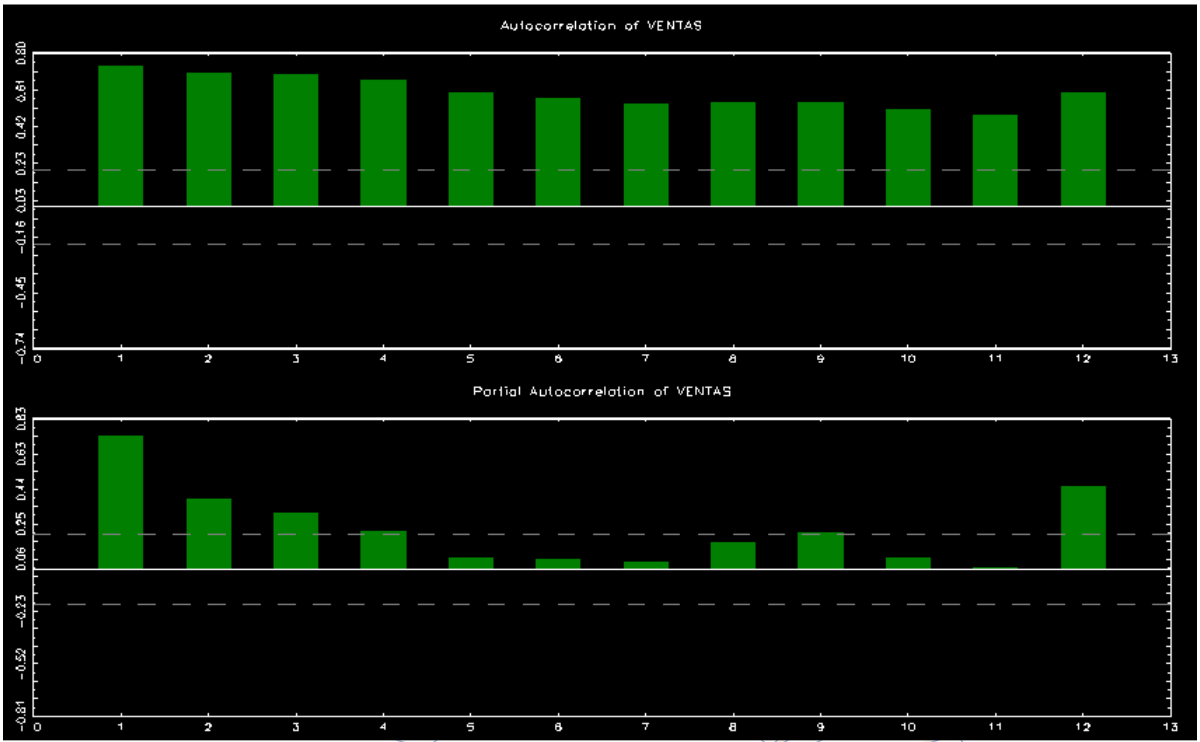
Opt Lag (Ng-Perron seq t) =  2 with RMSE  104.6655
Min SC   =  9.427036 at lag  1 with RMSE   106.389
Min MAIC =  9.701753 at lag  8 with RMSE  102.1697
```


JMULTI

PLOTEO:



CORRELOGRAMA:



AUTOCORRELATION FUNCTION (p <= 20)

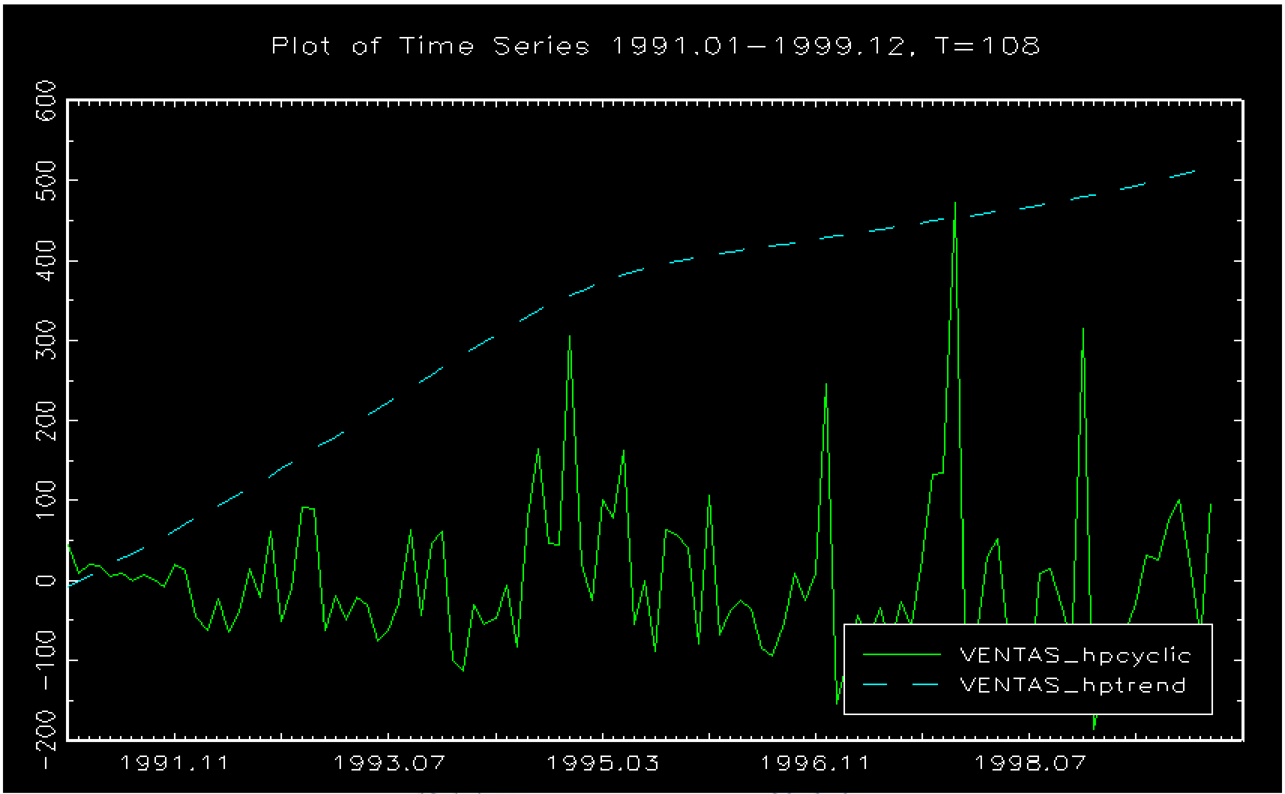
VENTAS

port	580.5555
p-val	0.0000
L&B	638.0938
p-val	0.0000

lag	ac	pac
1	0.7351	0.7351
2	0.7007	0.3828
3	0.6917	0.3102
4	0.6602	0.2104
5	0.6003	0.0604
6	0.5686	0.0504
7	0.5362	0.0349
8	0.5427	0.1503
9	0.5470	0.2006
10	0.5057	0.0613
11	0.4828	0.0111
12	0.5979	0.4510
13	0.4631	-0.0948
14	0.3938	-0.2184
15	0.3728	-0.1569
16	0.3480	-0.0842
17	0.3260	0.0965
18	0.3047	0.1284
19	0.3092	0.2927
20	0.3071	0.1607

FILTROS:

HODRICK-PRESCOTT



TEST DE RAÍZ UNITARIA:

DICKEY-FULLER AUMENTADO

```
ADF Test for series:          VENTAS
sample range:                 [1991 M3, 1999 M12], T = 106
lagged differences:           1
intercept, time trend
asymptotic critical values
reference: Davidson, R. and MacKinnon, J. (1993),
"Estimation and Inference in Econometrics" p 708, table 20.1,
Oxford University Press, London
 1%          5%          10%
-3.96       -3.41       -3.13
value of test statistic: -5.1283
regression results:
---------------------------------------
variable       coefficient   t-statistic
---------------------------------------
 x(-1)         -0.5971       -5.1283
dx(-1)         -0.1604       -1.6280
constant        199.8462      5.1410
trend           2.8203        4.3276
RSS             1117702.5267

OPTIMAL ENDOGENOUS LAGS FROM INFORMATION CRITERIA

sample range:                 [1992 M2, 1999 M12], T = 95

optimal number of lags (searched up to 12 lags of 1. differences):
Akaike Info Criterion:        11
Final Prediction Error:       11
Hannan-Quinn Criterion:       0
Schwarz Criterion:            0
```

KPSS

```
KPSS test for series:  VENTAS
sample range:          [1991 M1, 1999 M12], T = 108
number of lags:        2
KPSS test based on y(t)=a+bt+e(t) (trend stationarity)
asymptotic critical values:
 10%        5%         1%
0.119      0.146      0.216
value of test statistic: 0.3872
reference: reprinted from JOURNAL OF ECONOMETRICS,
Vol 54, No 1, 1992, pp 159-178, Kwiatkowski et al:
"Testing the null hypothesis of stationarity ...",
with permission from Elsevier Science
```

SCHMIDT-PHILLIPS

```
Schmidt-Phillips test for series: VENTAS
sample range:      [1991 M1, 1999 M12], T = 108
number of lags:    2
reference: Schmidt, P. and Phillips, P. C. B. (1992),
"LM tests for a unit root in the presence of deterministic trends",
Oxford Bulletin of Economics and Statistics, vol. 54, p. 257-287, table 1A
critical values (T=2000, Z(tau) statistic):
 1%         5%         10%
-3.56      -3.02      -2.75
value of test statistic: -7.5201
```

HEGY

```
HEGY Test for series:     VENTAS
sample range:             [1992 M3, 1999 M12], T = 94
lagged differences:       2
intercept, time trend
regression results:
---------------------------------------
variable      coefficient   t-statistic
---------------------------------------
const           63.8173       2.1100
trend           0.9807        0.9845
pi1             0.0062        0.2751
pi2            -0.0266       -0.6863
pi3            -0.0480       -1.1554
pi4             0.0030        0.0546
pi5            -0.1088       -2.1040
pi6            -0.1475       -2.7913
pi7             0.0446        1.1666
pi8            -0.0965       -1.7175
pi9            -0.1354       -2.3624
pi10           -0.1024       -2.1923
pi11            0.1381        2.1014
pi12           -0.1625       -2.9398
AR1             0.0367        0.2891
AR2             0.2416        1.9535
sigma:          100.0932

critical values
reference: P.H. Franses and B. Hobijn (1997)
Numbers from all the tables in
"Critical values for unit root tests in seasonal time series",
```

```
Journal of Applied Statistics 24: 25-46
Taylor & Francis Ltd.,www.tandf.co.uk/journals
---------------------------------------
statistic   1%         5%         10%
t(pi1)     -3.93      -3.37      -3.09
t(pi2)     -2.54      -1.94      -1.59
F34         4.71       3.05       2.35
F56         4.60       3.05       2.38
F78         4.69       3.08       2.39
F910        4.73       3.08       2.34
F1112       4.65       3.09       2.39
F1-12       2.36       1.88       1.66
F2-12       2.75       2.30       2.07

values of test statistics:
t(pi1):            0.2751
t(pi2):           -0.6863
F34:               0.6695
F56:               3.9452
F78:               1.7051
F910:              3.2579
F1112:             4.4576
F1-12:             2.3589
F2-12:             2.3889

OPTIMAL ENDOGENOUS LAGS FROM INFORMATION CRITERIA

sample range:               [1992 M11, 1999 M12], T = 86

optimal number of lags (searched up to 10 lags of 12. differences):
Akaike Info Criterion:    3
Final Prediction Error:   3
Hannan-Quinn Criterion:   0
Schwarz Criterion:        0
```

UR

```
UR Test with structural break for series: VENTAS
sample range:                    [1991 M4, 1999 M12], T = 105
number of lags (1st diff):       2
value of test statistic:       -3.8762
used break date:                 1991 M6
shiftfunction:                   shift dummy
time trend included
critical values (Lanne et al. 2002):
---------------------------------------
 T          1%         5%         10%
---------------------------------------
1000       -3.55      -3.03      -2.76
---------------------------------------
regression results:
---------------------------------------
variable      coefficient   t-statistic
---------------------------------------
d(trend)        4.9353        0.0455
d(const)       15.8188        1.5140
d(shiftfkt)    -2.0271       -0.1940
dx(-1)         -0.6144       -6.7978
dx(-2)         -0.3432       -3.7979

OPTIMAL ENDOGENOUS LAGS FROM INFORMATION CRITERIA
```

ANALISIS DE COINTEGRACIÓN

GRETL

ENGLE – GRANGER

$$IB_t = \beta_0 + \beta_1 PBI_t + u_t$$

```
Etapa 1: contrastando la existencia de una raíz unitaria en IB

Contraste aumentado de Dickey-Fuller para IB
incluyendo 3 retardos de (1-L)IB (el máximo fue 7)
tamaño muestral 145
hipótesis nula de raíz unitaria: a = 1

   con constante y tendencia
   modelo: (1-L)y = b0 + b1*t + (a-1)*y(-1) + ... + e
   Coef. de autocorrelación de primer orden de e: 0.009
   diferencias retardadas: F(3, 139) = 7.651 [0.0001]
   valor estimado de (a - 1): -0.192282
   Estadístico de contraste: tau_ct(1) = -4.41815
   valor p asintótico 0.001992

Etapa 2: contrastando la existencia de una raíz unitaria en PBI

Contraste aumentado de Dickey-Fuller para PBI
incluyendo un retardo de (1-L)PBI (el máximo fue 7)
tamaño muestral 145
hipótesis nula de raíz unitaria: a = 1

   con constante y tendencia
   modelo: (1-L)y = b0 + b1*t + (a-1)*y(-1) + ... + e
   Coef. de autocorrelación de primer orden de e: -0.049
   valor estimado de (a - 1): -0.0404284
   Estadístico de contraste: tau_ct(1) = -2.08376
   valor p asintótico 0.5544

Etapa 3: regresión cointegrante

Regresión cointegrante -
MCO, usando las observaciones 1950:1-1988:1 (T = 153)
Variable dependiente: IB
```

	Coeficiente	Desv. Típica	Estadístico t	Valor p	
const	-185.179	19.4754	-9.508	4.53e-017	***
PBI	0.337910	0.0184626	18.30	4.68e-040	***
time	-2.92224	0.332517	-8.788	3.26e-015	***

Media de la vble. dep.	401.1804	D.T. de la vble. dep.	145.1782
Suma de cuad. residuos	104229.9	D.T. de la regresión	26.36031
R-cuadrado	0.967465	R-cuadrado corregido	0.967032
Log-verosimilitud	-716.1772	Criterio de Akaike	1438.354
Criterio de Schwarz	1447.446	Crit. de Hannan-Quinn	1442.047
rho	0.838238	Durbin-Watson	0.323994

```
Etapa 4: contrastando la existencia de una raíz unitaria en uhat

Contraste aumentado de Dickey-Fuller para uhat
incluyendo 3 retardos de (1-L)uhat (el máximo fue 7)
tamaño muestral 145
hipótesis nula de raíz unitaria: a = 1

   modelo: (1-L)y = b0 + b1*t + (a-1)*y(-1) + ... + e
   Coef. de autocorrelación de primer orden de e: 0.003
   diferencias retardadas: F(3, 141) = 6.311 [0.0005]
   valor estimado de (a - 1): -0.252612
   Estadístico de contraste: tau_ct(2) = -5.10938
   valor p asintótico 0.0005373

Hay evidencia de una relación cointegrante si:
(a) La hipótesis de existencia de raíz unitaria no se rechaza para
las variables individuales.
(b) La hipótesis de existencia de raíz unitaria se rechaza para los
residuos (uhat) de la regresión cointegrante.
```

JOHANSEN

```
Contraste de Johansen:
Número de ecuaciones = 3
Orden del retardo = 4
Periodo de estimación: 1951:1 - 1988:1 (T = 149)
Caso 3: constante no restringida

Log-verosimilitud = -942.239 (Incluyendo un término constante: -
1365.08)

Rango Valor propio Estad. traza  Valor p   Estad. Lmáx  Valor p
   0     0.37622      77.249 [0.0000]     70.321 [0.0000]
   1    0.042027      6.9287 [0.5920]     6.3975 [0.5701]
   2   0.0035586     0.53118 [0.4661]    0.53118 [0.4661]

Corregido por el tamaño muestral (gl = 136)
Rango Estad. traza Valor p
   0      77.249 [0.0000]
   1      6.9287 [0.5981]
   2     0.53118 [0.4706]

valor propio     0.37622     0.042027    0.0035586

beta (vectores cointegrantes)
IB              0.045407    -0.010694   -0.0067344
PBI           -0.0092648   0.00039521  -0.00065930
TIB              0.32915      0.53844      0.15453

alfa (vectores de ajuste)
IB               -10.678      -1.3808     -0.27878
PBI              -8.7406      -1.1632      -1.0289
TIB             0.039716     -0.14849   -0.0039077

beta renormalizado
IB                1.0000      -27.059    -0.043581
PBI             -0.20404       1.0000   -0.0042666
```

```
TIB             7.2489       1362.4       1.0000

alfa renormalizado
IB             -0.48488  -0.00054572    -0.043079
PBI            -0.39688  -0.00045970     -0.15899
TIB           0.0018034 -5.8683e-005  -0.00060385

matriz de largo plazo (alfa * beta')
                     IB          PBI          TIB
IB             -0.46823     0.098572      -4.3014
PBI            -0.37751     0.081198      -3.6622
TIB           0.0034176  -0.00042407    -0.067482
```

STATA

JOHANSEN

```
. vecrank ib pbi tib, trend(constant) lags(4)

                       Johansen tests for cointegration
Trend: constant                                         Number of obs =     149
Sample:  1951q1 - 1988q1                                         Lags =       4
-------------------------------------------------------------------------------
                                                         5%
maximum                                      trace    critical
  rank    parms       LL       eigenvalue  statistic    value
    0      30    -1403.7074         .       77.2494     29.68
    1      35     -1368.547     0.37622      6.9287*    15.41
    2      38    -1365.3482     0.04203      0.5312      3.76
    3      39    -1365.0826     0.00356
-------------------------------------------------------------------------------
```


JMULTI

JOHANSEN

```
Johansen Trace Test for:  IB PBI TIB
sample range:             [1950 Q3, 1988 Q1], T = 151
included lags (levels):   2
dimension of the process: 3
trend and intercept included
response surface computed:
-----------------------------------------------
 r0  LR        pval      90%       95%       99%
-----------------------------------------------
 0   70.02     0.0000    39.73     42.77     48.87
 1   15.70     0.5242    23.32     25.73     30.67
 2   3.05      0.8596    10.68     12.45     16.22

OPTIMAL ENDOGENOUS LAGS FROM INFORMATION CRITERIA

sample range:             [1951 Q1, 1988 Q1], T = 149

optimal number of lags (searched up to 4 lags of levels):
```

```
Akaike Info Criterion:    4
Final Prediction Error:   4
Hannan-Quinn Criterion:   4
Schwarz Criterion:        2
```

SAIKKONEN & LUTKEPOHL

```
S&L Test for:              IB PBI TIB
sample range:              [1950 Q3, 1988 Q1], T = 151
included lags (levels):    2
dimension of the process: 3
trend and intercept included
response surface computed:
-----------------------------------------------
 r0  LR       pval     90%      95%      99%
-----------------------------------------------
 0   55.10    0.0000   26.07    28.52    33.50
 1   13.13    0.1298   13.88    15.76    19.71
 2   0.76     0.8551   5.47     6.79     9.73

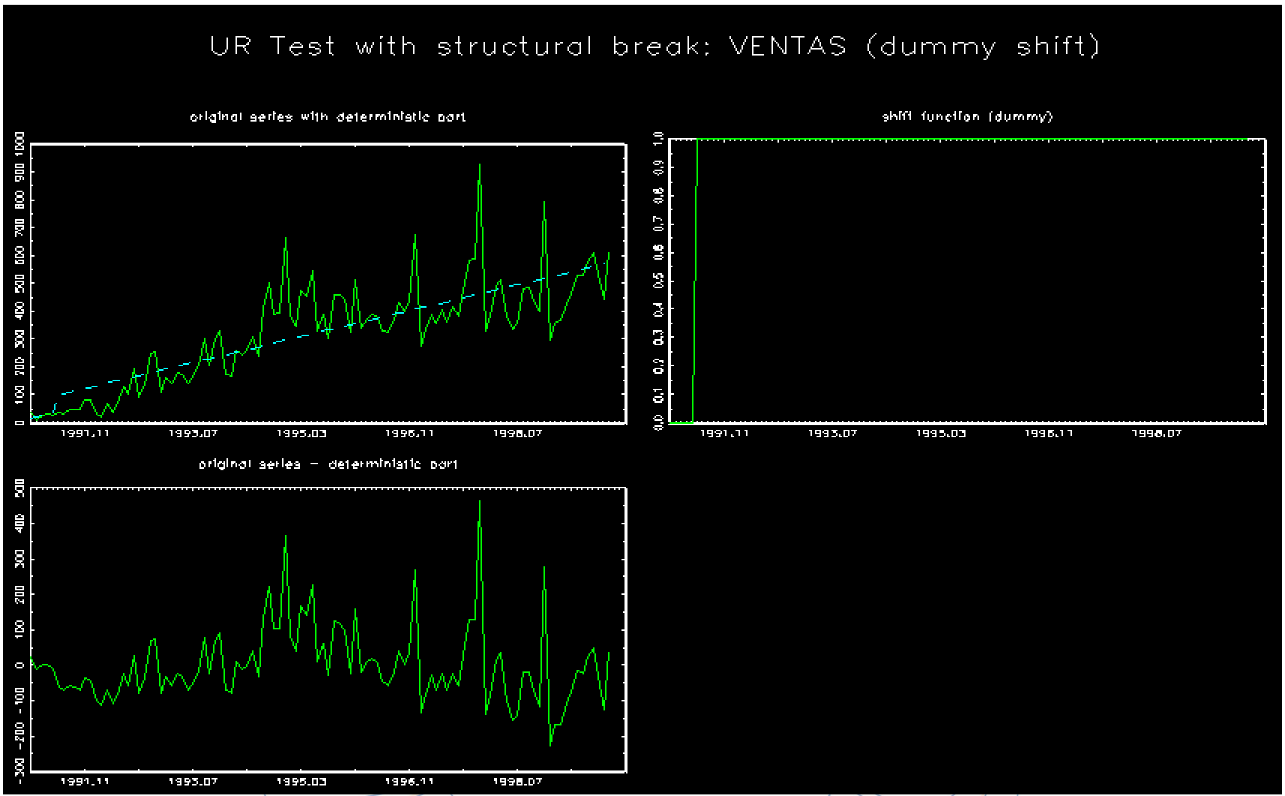
OPTIMAL ENDOGENOUS LAGS FROM INFORMATION CRITERIA

sample range:              [1951 Q1, 1988 Q1], T = 149

optimal number of lags (searched up to 4 lags of levels):
Akaike Info Criterion:    4
Final Prediction Error:   4
Hannan-Quinn Criterion:   4
Schwarz Criterion:        2
```

```
sample range:              [1991 M12, 1999 M12], T = 97

optimal number of lags (searched up to 10 lags of 1. differences):
Akaike Info Criterion:     2
Final Prediction Error:    2
Hannan-Quinn Criterion:    0
Schwarz Criterion:         0
```



CONSTRUCCIÓN DE UN MODELO VEC

EVIEWS

ESPECIFICACION:

Sample: 1950Q1 1988Q1
Included observations: 148
Series: IB PBI TIB
Lags interval: 1 to 4

Selected (0.05 level*) Number of Cointegrating Relations by Model

Data Trend:	None	None	Linear	Linear	Quadratic
Test Type	No Intercept No Trend	Intercept No Trend	Intercept No Trend	Intercept Trend	Intercept Trend
Trace	3	2	1	1	1
Max-Eig	3	1	1	1	1

*Critical values based on MacKinnon-Haug-Michelis (1999)

Information Criteria by Rank and Model

Data Trend:	None	None	Linear	Linear	Quadratic
Rank or No. of CEs	No Intercept No Trend	Intercept No Trend	Intercept No Trend	Intercept Trend	Intercept Trend
	Log Likelihood by Rank (rows) and Model (columns)				
0	-1385.074	-1385.074	-1377.441	-1377.441	-1376.220
1	-1371.966	-1357.131	-1350.308	-1350.127	-1348.943
2	-1364.896	-1349.189	-1346.191	-1345.651	-1345.106
3	-1361.670	-1345.960	-1345.960	-1341.844	-1341.844
	Akaike Information Criteria by Rank (rows) and Model (columns)				
0	19.20370	19.20370	19.14110	19.14110	19.16513
1	19.10766	18.92070	18.85551*	18.86658	18.87761
2	19.09320	18.90796	18.88096	18.90069	18.90684
3	19.13068	18.95892	18.95892	18.94384	18.94384
	Schwarz Criteria by Rank (rows) and Model (columns)				
0	19.93276	19.93276	19.93090	19.93090	20.01569
1	19.95822	19.79151	19.76682*	19.79814	19.84967
2	20.06526	19.92053	19.91378	19.97402	20.00042
3	20.22426	20.11326	20.11326	20.15892	20.15892

ESTIMACION:

Vector Error Correction Estimates
Sample (adjusted): 1951Q2 1988Q1
Included observations: 148 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1
IB(-1)	1.000000
PBI(-1)	-0.200796
	(0.00621)
	[-32.3533]

TIB(-1)	6.580751		
	(1.47825)		
	[4.45173]		
C	48.19494		

Error Correction:	D(IB)	D(PBI)	D(TIB)
CointEq1	-0.477430	-0.332421	0.004387
	(0.08020)	(0.10492)	(0.00365)
	[-5.95320]	[-3.16820]	[1.20203]
D(IB(-1))	0.114193	0.105561	-0.000231
	(0.12950)	(0.16943)	(0.00589)
	[0.88179]	[0.62304]	[-0.03914]
D(IB(-2))	-0.038550	-0.009287	0.008654
	(0.12746)	(0.16677)	(0.00580)
	[-0.30244]	[-0.05569]	[1.49185]
D(IB(-3))	0.283128	0.147033	0.001576
	(0.12868)	(0.16835)	(0.00586)
	[2.20028]	[0.87336]	[0.26915]
D(IB(-4))	0.025394	-0.152716	-0.002841
	(0.12809)	(0.16758)	(0.00583)
	[0.19825]	[-0.91130]	[-0.48741]
D(PBI(-1))	0.098111	0.219295	0.004590
	(0.10680)	(0.13973)	(0.00486)
	[0.91865]	[1.56945]	[0.94439]
D(PBI(-2))	0.156376	0.163110	-0.002773
	(0.10589)	(0.13854)	(0.00482)
	[1.47680]	[1.17738]	[-0.57536]
D(PBI(-3))	-0.164724	-0.010863	-0.002498
	(0.10588)	(0.13852)	(0.00482)
	[-1.55579]	[-0.07842]	[-0.51843]
D(PBI(-4))	0.058765	0.221749	2.63E-06
	(0.10331)	(0.13516)	(0.00470)
	[0.56884]	[1.64066]	[0.00056]
D(TIB(-1))	11.76569	5.327464	0.188339
	(2.25599)	(2.95157)	(0.10267)
	[5.21532]	[1.80496]	[1.83441]
D(TIB(-2))	-1.605143	-8.254347	-0.495581
	(2.55377)	(3.34116)	(0.11622)
	[-0.62854]	[-2.47050]	[-4.26408]
D(TIB(-3))	5.779149	1.494139	0.176821
	(2.41641)	(3.16145)	(0.10997)
	[2.39163]	[0.47261]	[1.60789]
D(TIB(-4))	-2.023848	-6.544069	-0.050944
	(2.45469)	(3.21153)	(0.11171)
	[-0.82448]	[-2.03768]	[-0.45602]
C	-0.993507	7.539049	0.027246
	(2.72026)	(3.55898)	(0.12380)
	[-0.36523]	[2.11832]	[0.22008]
R-squared	0.468708	0.450768	0.230115
Adj. R-squared	0.417164	0.397484	0.155425
Sum sq. resids	37846.83	64783.13	78.38718
S.E. equation	16.80592	21.98764	0.764839
F-statistic	9.093476	8.459765	3.080928
Log likelihood	-620.2656	-660.0404	-162.9721
Akaike AIC	8.571157	9.108655	2.391514
Schwarz SC	8.854677	9.392175	2.675035
Mean dependent	3.379730	18.60676	0.029459
S.D. dependent	22.01351	28.32659	0.832245
Determinant resid covariance (dof adj.)		22740.15	

Determinant resid covariance	16878.06
Log likelihood	-1350.308
Akaike information criterion	18.85551
Schwarz criterion	19.76682

EVALUACION:

VEC Lag Exclusion Wald Tests
Sample: 1950Q1 1988Q1
Included observations: 148

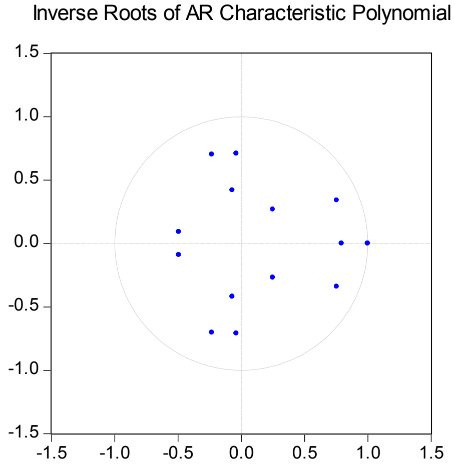
Chi-squared test statistics for lag exclusion:
Numbers in [ ] are p-values

	D(IB)	D(PBI)	D(TIB)	Joint
DLag 1	43.62929	19.56642	7.052547	64.47929
	[1.81e-09]	[0.000209]	[0.070242]	[1.82e-10]
DLag 2	4.354901	8.530181	19.84530	37.93549
	[0.225604]	[0.036236]	[0.000183]	[1.79e-05]
DLag 3	14.20274	2.785358	2.891110	26.11759
	[0.002642]	[0.425916]	[0.408720]	[0.001954]
DLag 4	1.741483	6.237987	1.188619	13.89767
	[0.627751]	[0.100589]	[0.755735]	[0.126012]
df	3	3	3	9

Roots of Characteristic Polynomial
Endogenous variables: IB PBI TIB
Exogenous variables:
Lag specification: 1 4

Root	Modulus
1.000000	1.000000
1.000000	1.000000
0.755952 - 0.339738i	0.828785
0.755952 + 0.339738i	0.828785
0.793050	0.793050
-0.231748 - 0.702281i	0.739531
-0.231748 + 0.702281i	0.739531
-0.037894 - 0.710487i	0.711496
-0.037894 + 0.710487i	0.711496
-0.492285 - 0.091079i	0.500640
-0.492285 + 0.091079i	0.500640
-0.071128 - 0.419687i	0.425672
-0.071128 + 0.419687i	0.425672
0.250586 - 0.268882i	0.367548
0.250586 + 0.268882i	0.367548

VEC specification imposes 2 unit root(s).



VEC Residual Portmanteau Tests for Autocorrelations
Null Hypothesis: no residual autocorrelations up to lag h
Sample: 1950Q1 1988Q1
Included observations: 148

Lags	Q-Stat	Prob.	Adj Q-Stat	Prob.	df
1	0.641179	NA*	0.645540	NA*	NA*
2	3.333999	NA*	3.375249	NA*	NA*
3	5.759258	NA*	5.850685	NA*	NA*
4	7.825314	NA*	7.974132	NA*	NA*
5	12.95975	0.1644	13.28809	0.1500	9

*The test is valid only for lags larger than the VAR lag order.
df is degrees of freedom for (approximate) chi-square distribution

VEC Residual Serial Correlation LM Tests
Null Hypothesis: no serial correlation at lag order h
Sample: 1950Q1 1988Q1
Included observations: 148

Lags	LM-Stat	Prob
1	12.37380	0.1930
2	23.28593	0.0056
3	13.63803	0.1358
4	7.201334	0.6162
5	7.693663	0.5653

Probs from chi-square with 9 df.

VEC Residual Normality Tests
Orthogonalization: Cholesky (Lutkepohl)
Null Hypothesis: residuals are multivariate normal
Sample: 1950Q1 1988Q1
Included observations: 148

Component	Skewness	Chi-sq	df	Prob.
1	-0.163340	0.658102	1	0.4172
2	-0.054973	0.074542	1	0.7848
3	-0.227590	1.277669	1	0.2583

Joint		2.010313	3	0.5703
Component	Kurtosis	Chi-sq	df	Prob.
1	4.367250	11.52780	1	0.0007
2	2.817371	0.205679	1	0.6502
3	5.070764	26.44307	1	0.0000
Joint		38.17655	3	0.0000

Component	Jarque-Bera	df	Prob.
1	12.18590	2	0.0023
2	0.280221	2	0.8693
3	27.72074	2	0.0000
Joint	40.18686	6	0.0000

VEC Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)
Sample: 1950Q1 1988Q1
Included observations: 148

Joint test:

Chi-sq	df	Prob.
272.1764	156	0.0000

Individual components:

Dependent	R-squared	F(26,121)	Prob.	Chi-sq(26)	Prob.
res1*res1	0.282258	1.830164	0.0154	41.77419	0.0259
res2*res2	0.235235	1.431482	0.1005	34.81478	0.1157
res3*res3	0.634935	8.094152	0.0000	93.97040	0.0000
res2*res1	0.260979	1.643465	0.0384	38.62486	0.0529
res3*res1	0.469066	4.111544	0.0000	69.42172	0.0000
res3*res2	0.387520	2.944514	0.0000	57.35291	0.0004

VEC Residual Heteroskedasticity Tests: Includes Cross Terms
Sample: 1950Q1 1988Q1
Included observations: 148

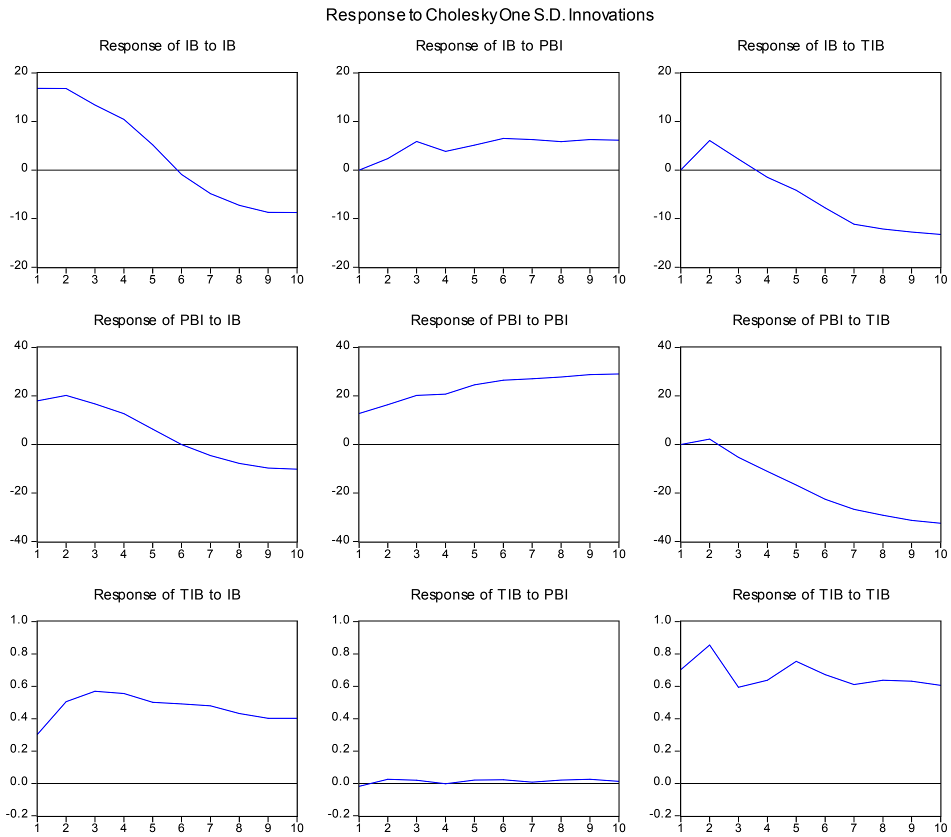
Joint test:

Chi-sq	df	Prob.
757.7352	624	0.0002

Individual components:

Dependent	R-squared	F(104,43)	Prob.	Chi-sq(104)	Prob.
res1*res1	0.882474	3.104575	0.0000	130.6061	0.0398
res2*res2	0.815293	1.825011	0.0140	120.6634	0.1262
res3*res3	0.962734	10.68133	0.0000	142.4846	0.0073
res2*res1	0.858898	2.516778	0.0005	127.1170	0.0614
res3*res1	0.925269	5.119218	0.0000	136.9398	0.0168
res3*res2	0.901223	3.772338	0.0000	133.3810	0.0276

PREDICCION:



Variance Decomposition of IB:

Period	S.E.	IB	PBI	TIB
1	16.80592	100.0000	0.000000	0.000000
2	24.61851	93.05969	0.888017	6.052289
3	28.71287	90.11089	4.816986	5.072127
4	30.82054	89.62705	5.726031	4.646923
5	31.93986	86.06915	7.901262	6.029587
6	33.53153	78.16661	10.92983	10.90356
7	36.22309	68.79433	12.36726	18.83841
8	39.32761	61.78210	12.69788	25.52002
9	42.72435	56.52355	12.89842	30.57803
10	46.00560	52.36780	12.91840	34.71380

Variance Decomposition of PBI:

Period	S.E.	IB	PBI	TIB
1	21.98764	66.23474	33.76526	0.000000
2	34.09448	62.47570	37.10598	0.418313
3	43.29363	53.53379	44.65539	1.810820
4	50.88716	44.99356	48.87859	6.127853
5	59.27559	34.27591	53.18965	12.53444
6	68.75253	25.47800	54.37880	20.14320
7	78.71844	19.77403	53.28020	26.94577
8	88.78271	16.31387	51.69946	31.98667
9	98.92932	14.11308	50.10191	35.78500

Period	S.E.	IB	PBI	TIB
10	108.5651	12.60225	48.74657	38.65119

Variance Decomposition of TIB:

Period	S.E.	IB	PBI	TIB
1	0.764839	15.62806	0.057698	84.31425
2	1.253252	22.01021	0.061373	77.92842
3	1.499050	29.79431	0.059532	70.14616
4	1.720805	33.01683	0.045547	66.93763
5	1.944482	32.48838	0.046546	67.46508
6	2.115340	32.82777	0.050146	67.12209
7	2.253560	33.45222	0.045174	66.50261
8	2.381608	33.23522	0.047536	66.71725
9	2.496626	32.82986	0.052929	67.11722
10	2.600057	32.65777	0.050864	67.29136

Cholesky Ordering: IB PBI TIB

STATA

ESPECIFICACION:

```
. vecrank ib pbi tib, lag(4)

                    Johansen tests for cointegration
Trend: constant                                     Number of obs =     149
Sample:  1951q1 - 1988q1                                     Lags =       4
---------------------------------------------------------------------------
                                                         5%
maximum                                     trace    critical
  rank    parms        LL       eigenvalue  statistic    value
    0      30      -1403.7074        .       77.2494     29.68
    1      35      -1368.547     0.37622      6.9287*    15.41
    2      38      -1365.3482    0.04203      0.5312      3.76
    3      39      -1365.0826    0.00356
---------------------------------------------------------------------------
```

ESTIMACION:

```
. vec ib pbi tib, lag(5) rank(1)

Vector error-correction model

Sample:  1951q2 - 1988q1                        No. of obs      =       148
                                                AIC             =    18.842
Log likelihood = -1350.308                      HQIC            =  19.20403
Det(Sigma_ml)  =  16878.06                      SBIC            =  19.73306

Equation           Parms      RMSE     R-sq      chi2     P>chi2
----------------------------------------------------------------
D_ib                 14     16.8059   0.4810   124.2007   0.0000
D_pbi                14     21.9876   0.6171   215.9623   0.0000
D_tib                14     .764839   0.2311   40.27164   0.0002
----------------------------------------------------------------

------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
D_ib         |
        _ce1 |
         L1. |  -.4774297    .0801972    -5.95   0.000    -.6346133   -.3202461
             |
          ib |
         LD. |   .1141926    .1295007     0.88   0.378    -.1396241    .3680093
        L2D. |  -.0385498    .1274648    -0.30   0.762    -.2883763    .2112766
        L3D. |   .2831276     .128678     2.20   0.028     .0309234    .5353318
        L4D. |    .025394    .1280885     0.20   0.843    -.2256548    .2764428
             |
         pbi |
         LD. |   .0981108    .1067984     0.92   0.358    -.1112101    .3074317
        L2D. |   .1563758    .1058882     1.48   0.140    -.0511613    .3639129
        L3D. |  -.1647242    .1058779    -1.56   0.120    -.3722411    .0427928
        L4D. |   .0587653    .1033065     0.57   0.569    -.1437117    .2612423
             |
         tib |
         LD. |   11.76569    2.255986     5.22   0.000     7.344042    16.18734
        L2D. |  -1.605143    2.553767    -0.63   0.530    -6.610434    3.400148
        L3D. |   5.779149    2.416407     2.39   0.017     1.043078    10.51522
        L4D. |  -2.023848    2.454689    -0.82   0.410    -6.834949    2.787253
             |
       _cons |  -3.859376    2.812705    -1.37   0.170    -9.372175    1.653424
```

D_pbi						
_ce1						
L1.	-.3324206	.1049241	-3.17	0.002	-.538068	-.1267731
ib						
LD.	.1055612	.1694292	0.62	0.533	-.226514	.4376364
L2D.	-.0092865	.1667656	-0.06	0.956	-.3361411	.3175681
L3D.	.1470331	.1683528	0.87	0.382	-.1829324	.4769986
L4D.	-.1527164	.1675816	-0.91	0.362	-.4811702	.1757375
pbi						
LD.	.2192952	.1397271	1.57	0.117	-.054565	.4931553
L2D.	.1631096	.1385364	1.18	0.239	-.1084167	.4346359
L3D.	-.0108626	.1385229	-0.08	0.937	-.2823625	.2606374
L4D.	.2217488	.1351587	1.64	0.101	-.0431573	.4866549
tib						
LD.	5.327464	2.951566	1.80	0.071	-.4574995	11.11243
L2D.	-8.254347	3.341161	-2.47	0.013	-14.8029	-1.705791
L3D.	1.494139	3.16145	0.47	0.636	-4.702189	7.690467
L4D.	-6.544069	3.211535	-2.04	0.042	-12.83856	-.2495766
_cons	5.543628	3.679936	1.51	0.132	-1.668915	12.75617
D_tib						
_ce1						
L1.	.0043872	.0036498	1.20	0.229	-.0027663	.0115406
ib						
LD.	-.0002307	.0058936	-0.04	0.969	-.0117819	.0113206
L2D.	.0086541	.0058009	1.49	0.136	-.0027155	.0200237
L3D.	.0015762	.0058561	0.27	0.788	-.0099017	.013054
L4D.	-.0028412	.0058293	-0.49	0.626	-.0142665	.008584
pbi						
LD.	.0045901	.0048604	0.94	0.345	-.0049361	.0141163
L2D.	-.0027727	.004819	-0.58	0.565	-.0122177	.0066724
L3D.	-.0024981	.0048185	-0.52	0.604	-.0119422	.0069461
L4D.	2.63e-06	.0047015	0.00	1.000	-.0092121	.0092174
tib						
LD.	.1883389	.1026701	1.83	0.067	-.0128909	.3895686
L2D.	-.4955812	.1162222	-4.26	0.000	-.7233725	-.2677899
L3D.	.1768209	.1099709	1.61	0.108	-.0387181	.39236
L4D.	-.0509435	.1117131	-0.46	0.648	-.2698972	.1680102
_cons	.0535803	.1280065	0.42	0.676	-.1973077	.3044684

Cointegrating equations

Equation	Parms	chi2	P>chi2
_ce1	2	3257.739	0.0000

Identification: beta is exactly identified
Johansen normalization restriction imposed

beta	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
_ce1						
ib	1	.	.	.	.	.
pbi	-.2007958	.0062063	-32.35	0.000	-.21296	-.1886316
tib	6.580751	1.478246	4.45	0.000	3.683442	9.478059
_cons	42.19223	.	.	.	.	.

EVALUACION:

. vecstable

Eigenvalue stability condition

Eigenvalue	Modulus
1	1
1	1
.7559521 + .3397376*i*	.828785
.7559521 - .3397376*i*	.828785
.7930496	.79305
-.2317476 + .7022814*i*	.739531
-.2317476 - .7022814*i*	.739531
-.0378936 + .7104865*i*	.711496
-.0378936 - .7104865*i*	.711496
-.4922854 + .09107944*i*	.50064
-.4922854 - .09107944*i*	.50064
-.07112829 + .419687*i*	.425672
-.07112829 - .419687*i*	.425672
.2505862 + .2688825*i*	.367548
.2505862 - .2688825*i*	.367548

The VECM specification imposes 2 unit moduli.

```
. vecnorm

  Jarque-Bera test

  ┌──────────────────────────────────────────────────────┐
  │        Equation │        chi2   df  Prob > chi2      │
  ├──────────────────────────────────────────────────────┤
  │            D_ib │      34.293   2    0.00000         │
  │           D_pbi │       1.277   2    0.52804         │
  │           D_tib │      64.304   2    0.00000         │
  │             ALL │      99.874   6    0.00000         │
  └──────────────────────────────────────────────────────┘

  Skewness test

        Equation | Skewness   chi2    df  Prob > chi2
            D_ib | -.18959    0.887   1   0.34638
           D_pbi | -.06381    0.100   1   0.75131
           D_tib | -.26417    1.721   1   0.18951
             ALL |            2.709   3   0.43878

  Kurtosis test

        Equation | Kurtosis   chi2    df  Prob > chi2
            D_ib |  5.3275   33.406   1   0.00000
           D_pbi |  3.4368    1.177   1   0.27802
           D_tib |  6.1857   62.583   1   0.00000
             ALL |           97.165   3   0.00000
```

```
. veclmar, mlag(5)

   Lagrange-multiplier test

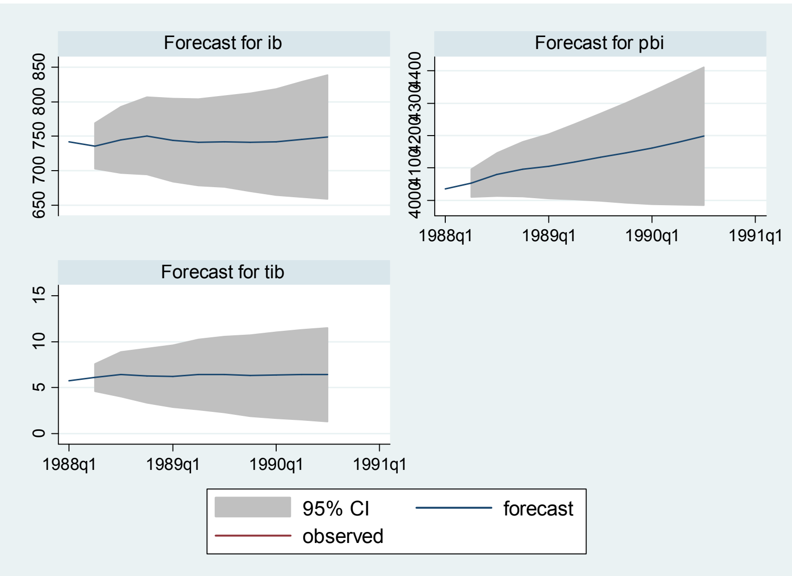
    lag |      chi2    df   Prob > chi2
      1 |   12.3738     9     0.19305
      2 |   23.2859     9     0.00559
      3 |   13.6380     9     0.13580
      4 |    7.2013     9     0.61617
      5 |    7.6937     9     0.56529

   H0: no autocorrelation at lag order
```


PREDICCION:

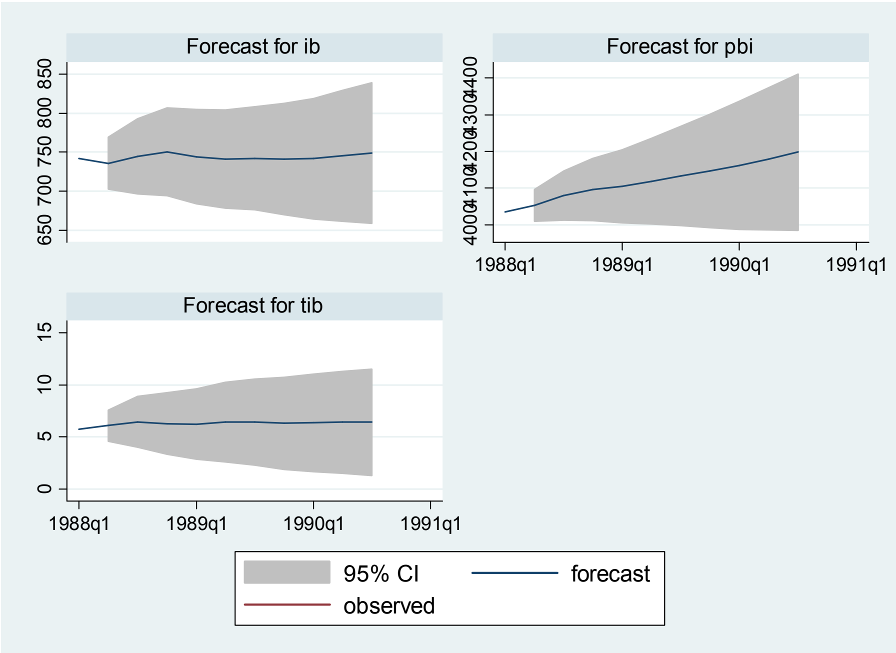
fcast compute ib_, step(10)

fcast graph ib_ib ib_pbi ib_tib, observed



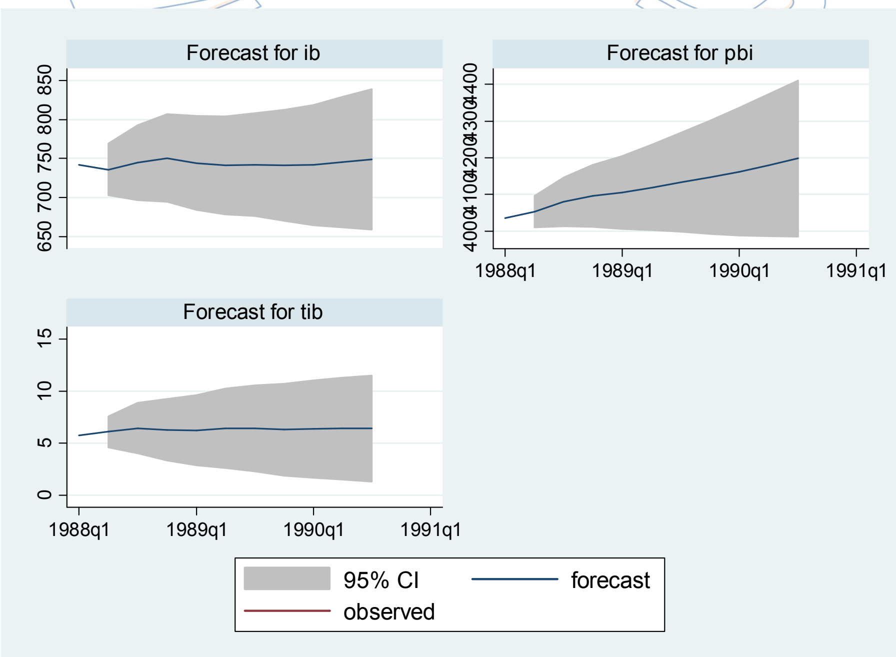
fcast compute pbi_, step(10)

fcast graph pbi_ib pbi_pbi pbi_tib, observed



fcast compute tib_, step(10)

fcast graph tib_ib tib_pbi tib_tib, observed



JMULTI

ESPECIFICACION:

```
Johansen Trace Test for:   IB PBI TIB
sample range:              [1951 Q1, 1988 Q1], T = 149
included lags (levels):    4
dimension of the process: 3
intercept included
response surface computed:
-----------------------------------------------
 r0   LR        pval      90%       95%       99%
-----------------------------------------------
 0    96.68     0.0000    32.25     35.07     40.78
 1    23.88     0.0135    17.98     20.16     24.69
 2    6.33      0.1722    7.60      9.14      12.53

OPTIMAL ENDOGENOUS LAGS FROM INFORMATION CRITERIA

sample range:              [1951 Q1, 1988 Q1], T = 149

optimal number of lags (searched up to 4 lags of levels):
Akaike Info Criterion:     4
Final Prediction Error:    4
Hannan-Quinn Criterion:    3
Schwarz Criterion:         2


S&L Test for:              IB PBI TIB
sample range:              [1951 Q1, 1988 Q1], T = 149
included lags (levels):    4
dimension of the process: 3
intercept included
response surface computed:
-----------------------------------------------
 r0   LR        pval      90%       95%       99%
-----------------------------------------------
 0    58.68     0.0000    21.76     24.16     29.11
 1    14.64     0.0187    10.47     12.26     16.10
 2    2.43      0.1406    2.98      4.13      6.93

OPTIMAL ENDOGENOUS LAGS FROM INFORMATION CRITERIA

sample range:              [1951 Q1, 1988 Q1], T = 149

optimal number of lags (searched up to 4 lags of levels):
Akaike Info Criterion:     4
Final Prediction Error:    4
Hannan-Quinn Criterion:    3
Schwarz Criterion:         2
```

ESTIMACION:

Coeficientes:

$$\begin{bmatrix} d(IB)(t) \\ d(PBI)(t) \\ d(TIB)(t) \end{bmatrix} = \begin{bmatrix} -0.452 \\ -0.264 \\ 0.004 \end{bmatrix} \left[\begin{bmatrix} 1.000 & -0.201 & 6.710 \end{bmatrix} \begin{bmatrix} IB(t-1) \\ PBI(t-1) \\ TIB(t-1) \end{bmatrix} + \begin{bmatrix} 58.814 \end{bmatrix} \begin{bmatrix} CONST \end{bmatrix} \right] + \begin{bmatrix} 0.052 & 0.154 & 11.482 \\ -0.057 & 0.366 & 4.495 \\ 0.000 & 0.004 & 0.191 \end{bmatrix} \begin{bmatrix} d(IB)(t-1) \\ d(PBI)(t-1) \\ d(TIB)(t-1) \end{bmatrix} + \begin{bmatrix} -0.114 & 0.211 & -1.583 \\ -0.207 & 0.307 & -8.324 \\ 0.009 & -0.003 & -0.493 \end{bmatrix} \begin{bmatrix} d(IB)(t-2) \\ d(PBI)(t-2) \\ d(TIB)(t-2) \end{bmatrix}$$

$$+ \begin{bmatrix} 0.211 & -0.117 & 5.843 \\ -0.041 & 0.116 & 1.591 \\ 0.002 & -0.003 & 0.178 \end{bmatrix} \begin{bmatrix} d(IB)(t-3) \\ d(PBI)(t-3) \\ d(TIB)(t-3) \end{bmatrix} + \begin{bmatrix} -0.039 & 0.100 & -1.664 \\ -0.323 & 0.331 & -5.685 \\ -0.003 & -0.000 & -0.051 \end{bmatrix} \begin{bmatrix} d(IB)(t-4) \\ d(PBI)(t-4) \\ d(TIB)(t-4) \end{bmatrix} + \begin{bmatrix} u1(t) \\ u2(t) \\ u3(t) \end{bmatrix}$$

Desviación Estándar:

$$\begin{bmatrix} d(IB)(t) \\ d(PBI)(t) \\ d(TIB)(t) \end{bmatrix} = \begin{bmatrix} 0.075 \\ 0.101 \\ 0.003 \end{bmatrix} \left[\begin{bmatrix} --- & 0.006 & 1.416 \end{bmatrix} \begin{bmatrix} IB(t-1) \\ PBI(t-1) \\ TIB(t-1) \end{bmatrix} + \begin{bmatrix} 8.189 \end{bmatrix} \begin{bmatrix} CONST \end{bmatrix} \right] + \begin{bmatrix} 0.118 & 0.096 & 2.156 \\ 0.159 & 0.129 & 2.896 \\ 0.005 & 0.004 & 0.097 \end{bmatrix} \begin{bmatrix} d(IB)(t-1) \\ d(PBI)(t-1) \\ d(TIB)(t-1) \end{bmatrix} + \begin{bmatrix} 0.113 & 0.096 & 2.453 \\ 0.152 & 0.128 & 3.295 \\ 0.005 & 0.004 & 0.111 \end{bmatrix} \begin{bmatrix} d(IB)(t-2) \\ d(PBI)(t-2) \\ d(TIB)(t-2) \end{bmatrix}$$

$$+ \begin{bmatrix} 0.115 & 0.097 & 2.319 \\ 0.155 & 0.130 & 3.115 \\ 0.005 & 0.004 & 0.105 \end{bmatrix} \begin{bmatrix} d(IB)(t-3) \\ d(PBI)(t-3) \\ d(TIB)(t-3) \end{bmatrix} + \begin{bmatrix} 0.116 & 0.096 & 2.348 \\ 0.156 & 0.128 & 3.154 \\ 0.005 & 0.004 & 0.106 \end{bmatrix} \begin{bmatrix} d(IB)(t-4) \\ d(PBI)(t-4) \\ d(TIB)(t-4) \end{bmatrix} + \begin{bmatrix} u1(t) \\ u2(t) \\ u3(t) \end{bmatrix}$$

T estadístico:

$$\begin{bmatrix} d(IB)(t) \\ d(PBI)(t) \\ d(TIB)(t) \end{bmatrix} = \begin{bmatrix} -6.020 \\ -2.616 \\ 1.218 \end{bmatrix} \left[\begin{bmatrix} --- & -33.800 & 4.738 \end{bmatrix} \begin{bmatrix} IB(t-1) \\ PBI(t-1) \\ TIB(t-1) \end{bmatrix} + \begin{bmatrix} 7.182 \end{bmatrix} \begin{bmatrix} CONST \end{bmatrix} \right] + \begin{bmatrix} 0.440 & 1.599 & 5.325 \\ -0.360 & 2.832 & 1.552 \\ 0.014 & 0.996 & 1.966 \end{bmatrix} \begin{bmatrix} d(IB)(t-1) \\ d(PBI)(t-1) \\ d(TIB)(t-1) \end{bmatrix} + \begin{bmatrix} -1.009 & 2.208 & -0.645 \\ -1.365 & 2.393 & -2.526 \\ 1.771 & -0.703 & -4.452 \end{bmatrix} \begin{bmatrix} d(IB)(t-2) \\ d(PBI)(t-2) \\ d(TIB)(t-2) \end{bmatrix}$$

$$+ \begin{bmatrix} 1.837 & -1.206 & 2.519 \\ -0.268 & 0.888 & 0.511 \\ 0.367 & -0.618 & 1.702 \end{bmatrix} \begin{bmatrix} d(IB)(t-3) \\ d(PBI)(t-3) \\ d(TIB)(t-3) \end{bmatrix} + \begin{bmatrix} -0.333 & 1.043 & -0.709 \\ -2.070 & 2.583 & -1.803 \\ -0.478 & -0.044 & -0.480 \end{bmatrix} \begin{bmatrix} d(IB)(t-4) \\ d(PBI)(t-4) \\ d(TIB)(t-4) \end{bmatrix} + \begin{bmatrix} u1(t) \\ u2(t) \\ u3(t) \end{bmatrix}$$

MODELO VAR:

$$\begin{bmatrix} d(IB)(t) \\ d(PBI)(t) \\ d(TIB)(t) \end{bmatrix} = \begin{bmatrix} -6.020 \\ -2.616 \\ 1.218 \end{bmatrix} \left[\begin{bmatrix} --- & -33.800 & 4.738 \end{bmatrix} \begin{bmatrix} IB(t-1) \\ PBI(t-1) \\ TIB(t-1) \end{bmatrix} + \begin{bmatrix} 7.182 \end{bmatrix} \begin{bmatrix} CONST \end{bmatrix} \right] + \begin{bmatrix} 0.440 & 1.599 & 5.325 \\ -0.360 & 2.832 & 1.552 \\ 0.014 & 0.996 & 1.966 \end{bmatrix} \begin{bmatrix} d(IB)(t-1) \\ d(PBI)(t-1) \\ d(TIB)(t-1) \end{bmatrix} + \begin{bmatrix} -1.009 & 2.208 & -0.645 \\ -1.365 & 2.393 & -2.526 \\ 1.771 & -0.703 & -4.452 \end{bmatrix} \begin{bmatrix} d(IB)(t-2) \\ d(PBI)(t-2) \\ d(TIB)(t-2) \end{bmatrix}$$

$$+ \begin{bmatrix} 1.837 & -1.206 & 2.519 \\ -0.268 & 0.888 & 0.511 \\ 0.367 & -0.618 & 1.702 \end{bmatrix} \begin{bmatrix} d(IB)(t-3) \\ d(PBI)(t-3) \\ d(TIB)(t-3) \end{bmatrix} + \begin{bmatrix} -0.333 & 1.043 & -0.709 \\ -2.070 & 2.583 & -1.803 \\ -0.478 & -0.044 & -0.480 \end{bmatrix} \begin{bmatrix} d(IB)(t-4) \\ d(PBI)(t-4) \\ d(TIB)(t-4) \end{bmatrix} + \begin{bmatrix} u1(t) \\ u2(t) \\ u3(t) \end{bmatrix}$$

EVALUACION:

```
PORTMANTEAU TEST (H0:Rh=(r1,...,rh)=0)

tested order:                16
test statistic:              136.1864
 p-value:                    0.0220
adjusted test statistic:     146.1387
 p-value:                    0.0049
degrees of freedom:          105.0000
```

```
LM-TYPE TEST FOR AUTOCORRELATION with 5 lags

LM statistic:            111.2327
 p-value:                0.0000
 df:                     45.0000

TESTS FOR NONNORMALITY

Reference: Doornik & Hansen (1994)
joint test statistic:    81.3743
 p-value:                0.0000
degrees of freedom:      6.0000
skewness only:           5.5262
 p-value:                0.1371
kurtosis only:           75.8481
 p-value:                0.0000

Reference: Lütkepohl (1993), Introduction to Multiple Time
Series Analysis, 2ed, p. 153
joint test statistic:    97.9643
 p-value:                0.0000
degrees of freedom:      6.0000
skewness only:           3.4101
 p-value:                0.3326
kurtosis only:           94.5542
 p-value:                0.0000
```

JARQUE-BERA TEST

variable	teststat	p-Value(Chi^2)	skewness	kurtosis
u1	32.1574	0.0000	-0.1169	5.2716
u2	12.8558	0.0016	0.3159	4.2983
u3	137.5534	0.0000	-0.2487	7.6966

ARCH-LM TEST with 16 lags

variable	teststat	p-Value(Chi^2)	F stat	p-Value(F)
u1	25.6478	0.0592	1.9896	0.0193
u2	24.7996	0.0734	1.9085	0.0262
u3	60.8148	0.0000	7.0481	0.0000

```
MULTIVARIATE ARCH-LM TEST with 5 lags

VARCHLM test statistic:  301.2774
 p-value(chi^2):         0.0000
 degrees of freedom:     180.0000
```

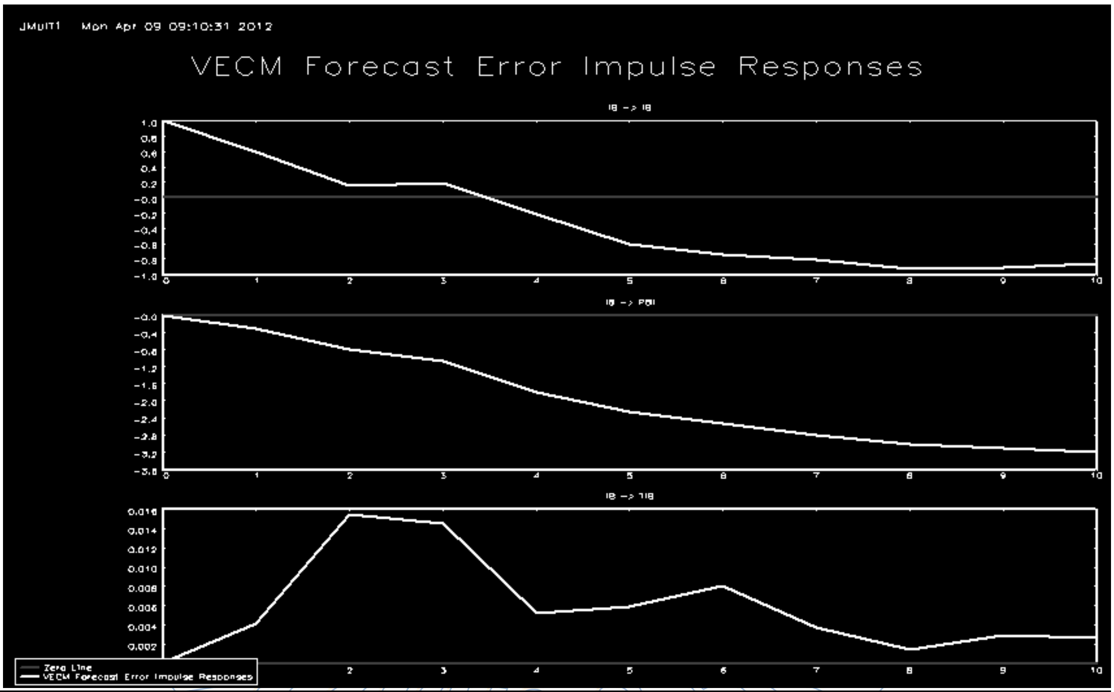

PREDICCION:

VECM Forecast Error Impulse Responses

Selected Impulse Responses: "impulse variable -> response variable"

time	IB ->IB	IB ->PBI	IB ->TIB
point estimate	1.0000	0.0000	0.0000

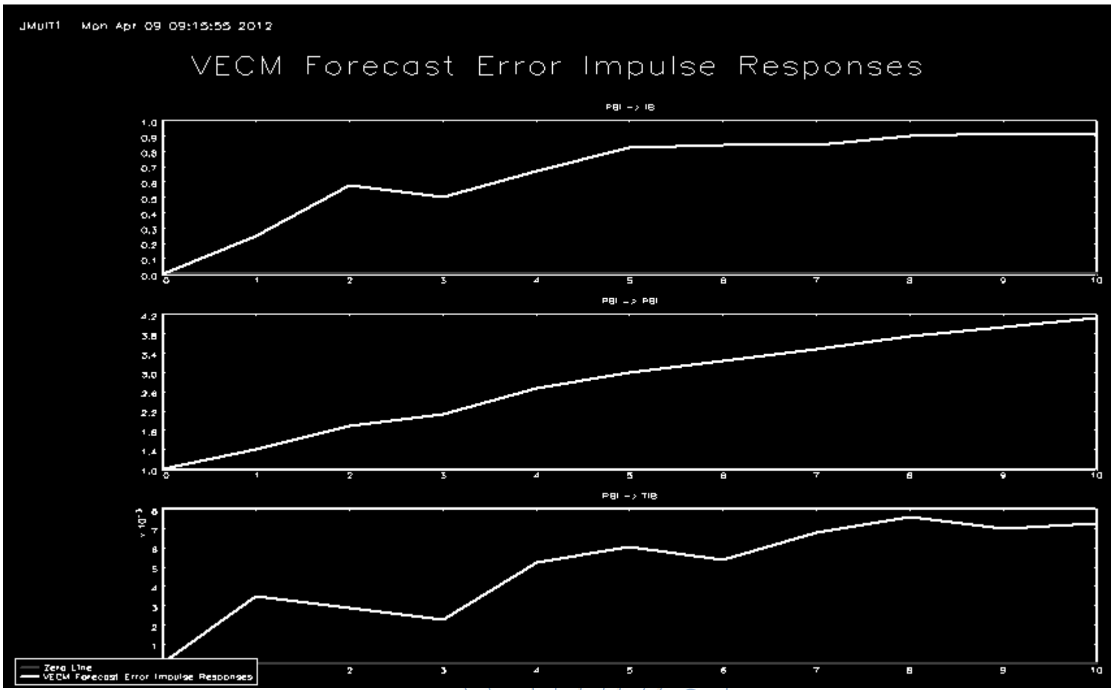
1 point estimate	0.6000	-0.3208	0.0042
2 point estimate	0.1511	-0.7864	0.0155
3 point estimate	0.1815	-1.0817	0.0145
4 point estimate	-0.2241	-1.8075	0.0052
5 point estimate	-0.6044	-2.2452	0.0059
6 point estimate	-0.7373	-2.5233	0.0081
7 point estimate	-0.8167	-2.8070	0.0037
8 point estimate	-0.9255	-3.0330	0.0014
9 point estimate	-0.9100	-3.1224	0.0030
10 point estimate	-0.8541	-3.2065	0.0027



VECM Forecast Error Impulse Responses

Selected Impulse Responses: "impulse variable -> response variable"

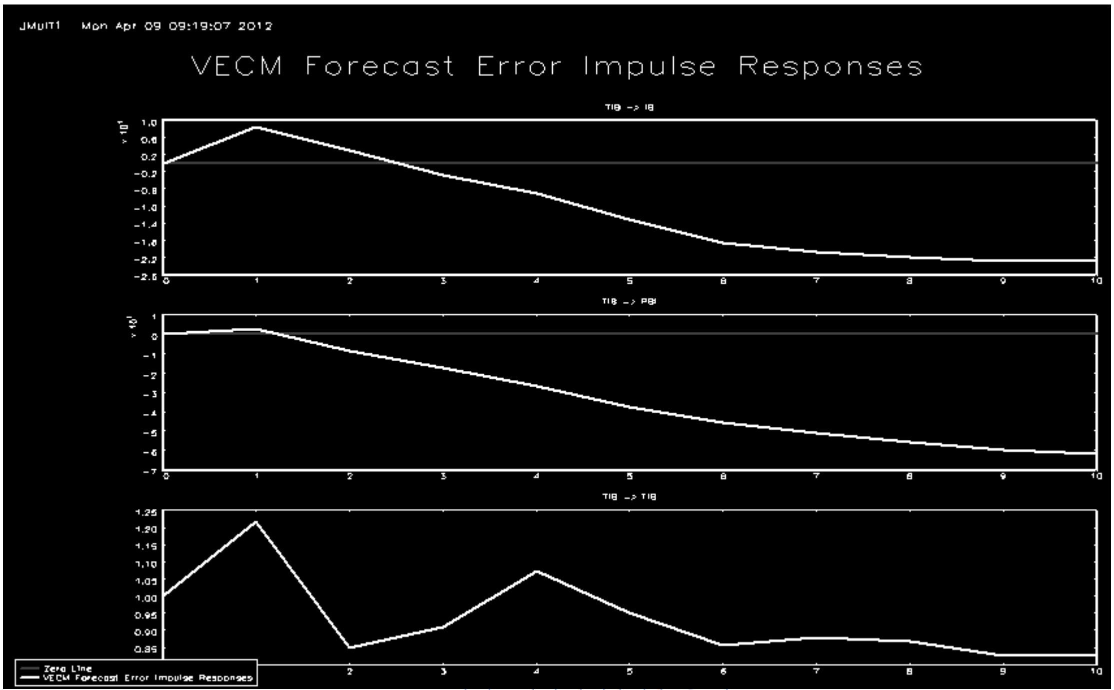
time	PBI ->IB	PBI ->PBI	PBI ->TIB
point estimate	0.0000	1.0000	0.0000
1 point estimate	0.2448	1.4194	0.0035
2 point estimate	0.5811	1.8866	0.0029
3 point estimate	0.5017	2.1422	0.0023
4 point estimate	0.6746	2.6690	0.0053
5 point estimate	0.8244	2.9996	0.0061
6 point estimate	0.8447	3.2293	0.0054
7 point estimate	0.8419	3.4845	0.0068
8 point estimate	0.8983	3.7423	0.0076
9 point estimate	0.9124	3.9339	0.0070
10 point estimate	0.9074	4.1223	0.0072



VECM Forecast Error Impulse Responses

Selected Impulse Responses: "impulse variable -> response variable"

time	TIB ->IB	TIB ->PBI	TIB ->TIB
point estimate	0.0000	0.0000	1.0000
1 point estimate	8.4493	2.7247	1.2191
2 point estimate	2.9723	-8.3401	0.8466
3 point estimate	-2.8533	-17.6253	0.9078
4 point estimate	-6.9853	-26.7452	1.0716
5 point estimate	-13.0994	-37.4582	0.9518
6 point estimate	-18.5838	-45.6169	0.8548
7 point estimate	-20.6040	-50.9581	0.8809
8 point estimate	-21.9245	-55.8697	0.8671
9 point estimate	-23.0467	-59.5787	0.8258
10 point estimate	-22.6040	-61.5970	0.8242



VECM FORECAST ERROR VARIANCE DECOMPOSITION

Proportions of forecast error in "IB"
accounted for by:

forecast horizon	IB	PBI	TIB
1	1.00	0.00	0.00
2	0.93	0.01	0.06
3	0.88	0.07	0.04
4	0.85	0.10	0.04
5	0.78	0.16	0.06
6	0.67	0.22	0.11
7	0.55	0.26	0.18
8	0.47	0.28	0.25
9	0.40	0.30	0.30
10	0.35	0.31	0.35

Proportions of forecast error in "PBI"
accounted for by:

forecast horizon	IB	PBI	TIB
1	0.66	0.34	0.00
2	0.61	0.39	0.00
3	0.50	0.49	0.02
4	0.40	0.55	0.05
5	0.29	0.61	0.10
6	0.20	0.64	0.16
7	0.15	0.64	0.21
8	0.11	0.64	0.25
9	0.09	0.64	0.28
10	0.07	0.63	0.30

Proportions of forecast error in "TIB"
accounted for by:

forecast horizon	IB	PBI	TIB
1	0.15	0.00	0.85
2	0.21	0.00	0.78
3	0.29	0.00	0.71
4	0.33	0.00	0.67
5	0.32	0.00	0.68
6	0.33	0.00	0.67
7	0.34	0.00	0.66
8	0.34	0.00	0.66
9	0.33	0.00	0.66
10	0.34	0.00	0.66