

Hodrick Prescott Filter (HP-Filter) in Excel

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Background

The Hodrick Prescott Filter (HP-Filter), introduced by Hodrick and Prescott (1980), is a detrending method that is widely used in empirical macro analysis. The original series (Y_t) is made up of a trend component (T_t) and a cyclical component (C_t):

$$Y_t = T_t + C_t \quad (1)$$

The HP-Filter isolates the trend component by minimization the following loss function:

$$MIN_T \left\{ \sum_{t=1}^T (Y_t - T_t)^2 + \lambda \sum_{t=2}^{T-1} [(T_{t+1} - T_t) - (T_t - T_{t-1})]^2 \right\} \quad (2)$$

where λ is smoothing parameter. Normally, we use $\lambda = 100$, 1600, and 14400 for yearly, quarterly, and monthly data, respectively.

Install HP-Filter Excel Add-in

HP-Filter can be easily done in excel. To do so, we need to install the HP-Filter excel add-in. The package can be downloaded from the following link:

http://www.web-reg.de/hp_addin.html

After download and unzip, install it from the "HPFilter.xla" file.

HP-Filter in Excel

Step 1: Prepare the original data. In our example, we have unemployment rate (LUR) and logarithm of real GDP multiplied by 100 (LnY*100) of Alabama from 1976 to 2011. They need to be ordered by year.

C2								
	A	B	C	D	E	F	G	H
1	state	year	LUR	LnY*100	LUR_T	LnY*100_T	LUR_C	LnY*100_C
2	Alabama	1976	6.4	1627.04828				
3	Alabama	1977	6.8	1630.67418				
4	Alabama	1978	5.9	1635.57722				
5	Alabama	1979	6.8	1635.76559				
6	Alabama	1980	8.4	1633.05349				
7	Alabama	1981	9.7	1633.77466				
8	Alabama	1982	13.2	1633.53604				
9	Alabama	1983	12.8	1637.14114				
10	Alabama	1984	10.2	1642.97889				
11	Alabama	1985	8.6	1646.7595				
12	Alabama	1986	9.1	1650.21957				
13	Alabama	1987	7.6	1652.50409				
14	Alabama	1988	6.9	1655.57101				
15	Alabama	1989	6.6	1659.04754				
16	Alabama	1990	6.3	1659.81107				
17	Alabama	1991	6.9	1661.36446				
18	Alabama	1992	6.9	1665.23981				
19	Alabama	1993	6.6	1666.63989				
20	Alabama	1994	5.4	1670.0371				
21	Alabama	1995	5.2	1672.79703				
22	Alabama	1996	4.5	1674.18783				
23	Alabama	1997	4.4	1676.96522				
24	Alabama	1998	3.9	1681.32723				
25	Alabama	1999	4.3	1683.02886				
26	Alabama	2000	4.1	1684.91993				
27	Alabama	2001	4.7	1686.56627				
28	Alabama	2002	5.4	1687.98619				
29	Alabama	2003	5.4	1689.67683				
30	Alabama	2004	5	1693.46228				
31	Alabama	2005	3.8	1695.90459				
32	Alabama	2006	3.5	1699.02928				
33	Alabama	2007	3.4	1701.30532				
34	Alabama	2008	5	1702.78014				
35	Alabama	2009	9.8	1699.3235				
36	Alabama	2010	9.3	1702.21539				
37	Alabama	2011	8.7	1702.88083				




Step 2: Select the trend component area that is corresponding with the original data range. In our example, we select the area E2:E37.

E2								
	A	B	C	D	E	F	G	H
1	state	year	LUR	LnY*100	LUR_T	LnY*100_T	LUR_C	LnY*100_C
2	Alabama	1976	6.4	1627.04828				
3	Alabama	1977	6.8	1630.67418				
4	Alabama	1978	5.9	1635.57722				
5	Alabama	1979	6.8	1635.76559				
6	Alabama	1980	8.4	1633.05349				
7	Alabama	1981	9.7	1633.77466				
8	Alabama	1982	13.2	1633.53604				
9	Alabama	1983	12.8	1637.14114				
10	Alabama	1984	10.2	1642.97889				
11	Alabama	1985	8.6	1646.7595				
12	Alabama	1986	9.1	1650.21957				
13	Alabama	1987	7.6	1652.50409				
14	Alabama	1988	6.9	1655.57101				
15	Alabama	1989	6.6	1659.04754				
16	Alabama	1990	6.3	1659.81107				
17	Alabama	1991	6.9	1661.36446				
18	Alabama	1992	6.9	1665.23981				
19	Alabama	1993	6.6	1666.63989				
20	Alabama	1994	5.4	1670.0371				
21	Alabama	1995	5.2	1672.79703				
22	Alabama	1996	4.5	1674.18783				
23	Alabama	1997	4.4	1676.96522				
24	Alabama	1998	3.9	1681.32723				
25	Alabama	1999	4.3	1683.02886				
26	Alabama	2000	4.1	1684.91993				
27	Alabama	2001	4.7	1686.56627				
28	Alabama	2002	5.4	1687.98619				
29	Alabama	2003	5.4	1689.67683				
30	Alabama	2004	5	1693.46228				
31	Alabama	2005	3.8	1695.90459				
32	Alabama	2006	3.5	1699.02928				
33	Alabama	2007	3.4	1701.30532				
34	Alabama	2008	5	1702.78014				
35	Alabama	2009	9.8	1699.3235				
36	Alabama	2010	9.3	1702.21539				
37	Alabama	2011	8.7	1702.88083				

Step 3: Keep the area selected, and type the command:

=HP(C2:C37,100)

where **HP** is the main command, **C2:C37** is the range of the original data, **100** is the smoothing parameter. **Do not hit "Enter"**.

255					  	=HP(C2:C37,100)		
	A	B	C	D	E	F	G	H
1	state	year	LUR	LnY*100	LUR_T	LnY*100_T	LUR_C	LnY*100_C
2	Alabama	1976	6.4	1627.04828	=HP(C2:C37,100)			
3	Alabama	1977	6.8	1630.67418				
4	Alabama	1978	5.9	1635.57722				
5	Alabama	1979	6.8	1635.76559				
6	Alabama	1980	8.4	1633.05349				
7	Alabama	1981	9.7	1633.77466				
8	Alabama	1982	13.2	1633.53604				
9	Alabama	1983	12.8	1637.14114				
10	Alabama	1984	10.2	1642.97889				
11	Alabama	1985	8.6	1646.7595				
12	Alabama	1986	9.1	1650.21957				
13	Alabama	1987	7.6	1652.50409				
14	Alabama	1988	6.9	1655.57101				
15	Alabama	1989	6.6	1659.04754				
16	Alabama	1990	6.3	1659.81107				
17	Alabama	1991	6.9	1661.36446				
18	Alabama	1992	6.9	1665.23981				
19	Alabama	1993	6.6	1666.63989				
20	Alabama	1994	5.4	1670.0371				
21	Alabama	1995	5.2	1672.79703				
22	Alabama	1996	4.5	1674.18783				
23	Alabama	1997	4.4	1676.96522				
24	Alabama	1998	3.9	1681.32723				
25	Alabama	1999	4.3	1683.02886				
26	Alabama	2000	4.1	1684.91993				
27	Alabama	2001	4.7	1686.56627				
28	Alabama	2002	5.4	1687.98619				
29	Alabama	2003	5.4	1689.67683				
30	Alabama	2004	5	1693.46228				
31	Alabama	2005	3.8	1695.90459				
32	Alabama	2006	3.5	1699.02928				
33	Alabama	2007	3.4	1701.30532				
34	Alabama	2008	5	1702.78014				
35	Alabama	2009	9.8	1699.3235				
36	Alabama	2010	9.3	1702.21539				
37	Alabama	2011	8.7	1702.88083				
38								

Step 4: HP is an array formula, so instead of hitting "Enter", we use "**Shift+Ctrl+Enter**", and this should give us the trend component of unemployment rate.

	A	B	C	D	E	F	G	H
1	state	year	LUR	LnY*100	LUR_T	LnY*100_T	LUR_C	LnY*100_C
2	Alabama	1976	6.4	1627.04828	6.76469373			
3	Alabama	1977	6.8	1630.67418	7.28364966			
4	Alabama	1978	5.9	1635.57722	7.79895865			
5	Alabama	1979	6.8	1635.76559	8.30213727			
6	Alabama	1980	8.4	1633.05349	8.76571249			
7	Alabama	1981	9.7	1633.77466	9.14718994			
8	Alabama	1982	13.2	1633.53604	9.40041808			
9	Alabama	1983	12.8	1637.14114	9.4847735			
10	Alabama	1984	10.2	1642.97889	9.39762861			
11	Alabama	1985	8.6	1646.7595	9.16950806			
12	Alabama	1986	9.1	1650.21957	8.83896025			
13	Alabama	1987	7.6	1652.50409	8.43883846			
14	Alabama	1988	6.9	1655.57101	8.00460641			
15	Alabama	1989	6.6	1659.04754	7.56333939			
16	Alabama	1990	6.3	1659.81107	7.13106667			
17	Alabama	1991	6.9	1661.36446	6.71418409			
18	Alabama	1992	6.9	1665.23981	6.31077684			
19	Alabama	1993	6.6	1666.63989	5.92078828			
20	Alabama	1994	5.4	1670.0371	5.55005397			
21	Alabama	1995	5.2	1672.79703	5.21120163			
22	Alabama	1996	4.5	1674.18783	4.9153584			
23	Alabama	1997	4.4	1676.96522	4.67353942			
24	Alabama	1998	3.9	1681.32723	4.49260625			
25	Alabama	1999	4.3	1683.02886	4.37668506			
26	Alabama	2000	4.1	1684.91993	4.32397594			
27	Alabama	2001	4.7	1686.56627	4.33191215			
28	Alabama	2002	5.4	1687.98619	4.39568716			
29	Alabama	2003	5.4	1689.67683	4.51417536			
30	Alabama	2004	5	1693.46228	4.69629423			
31	Alabama	2005	3.8	1695.90459	4.95981953			
32	Alabama	2006	3.5	1699.02928	5.32556404			
33	Alabama	2007	3.4	1701.30532	5.80274238			
34	Alabama	2008	5	1702.78014	6.38231352			
35	Alabama	2009	9.8	1699.3235	7.03120898			
36	Alabama	2010	9.3	1702.21539	7.70253719			
37	Alabama	2011	8.7	1702.88083	8.37709445			
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Step 5: We can follow the similar steps and get the trend component of real output.

F2								
{=hp(D2:D37,100)}								
	A	B	C	D	E	F	G	H
1	state	year	LUR	LnY*100	LUR_T	LnY*100_T	LUR_C	LnY*100_C
2	Alabama	1976	6.4	1627.04828	6.76469373	1627.75917		
3	Alabama	1977	6.8	1630.67418	7.28364966	1629.48117		
4	Alabama	1978	5.9	1635.57722	7.79895865	1631.19606		
5	Alabama	1979	6.8	1635.76559	8.30213727	1632.90866		
6	Alabama	1980	8.4	1633.05349	8.76571249	1634.6676		
7	Alabama	1981	9.7	1633.77466	9.14718994	1636.5501		
8	Alabama	1982	13.2	1633.53604	9.40041808	1638.6172		
9	Alabama	1983	12.8	1637.14114	9.4847735	1640.90222		
10	Alabama	1984	10.2	1642.97889	9.39762861	1643.38765		
11	Alabama	1985	8.6	1646.7595	9.16950806	1646.01837		
12	Alabama	1986	9.1	1650.21957	8.83896025	1648.73519		
13	Alabama	1987	7.6	1652.50409	8.43883846	1651.4863		
14	Alabama	1988	6.9	1655.57101	8.00460641	1654.23477		
15	Alabama	1989	6.6	1659.04754	7.56333939	1656.95382		
16	Alabama	1990	6.3	1659.81107	7.13106667	1659.63005		
17	Alabama	1991	6.9	1661.36446	6.71418409	1662.27098		
18	Alabama	1992	6.9	1665.23981	6.31077684	1664.88595		
19	Alabama	1993	6.6	1666.63989	5.92078828	1667.47524		
20	Alabama	1994	5.4	1670.0371	5.55005397	1670.04266		
21	Alabama	1995	5.2	1672.79703	5.21120163	1672.58367		
22	Alabama	1996	4.5	1674.18783	4.9153584	1675.09368		
23	Alabama	1997	4.4	1676.96522	4.67353942	1677.57022		
24	Alabama	1998	3.9	1681.32723	4.49260625	1680.00177		
25	Alabama	1999	4.3	1683.02886	4.37668506	1682.37076		
26	Alabama	2000	4.1	1684.91993	4.32397594	1684.67288		
27	Alabama	2001	4.7	1686.56627	4.33191215	1686.91039		
28	Alabama	2002	5.4	1687.98619	4.39568716	1689.08802		
29	Alabama	2003	5.4	1689.67683	4.51417536	1691.20707		
30	Alabama	2004	5	1693.46228	4.69629423	1693.25782		
31	Alabama	2005	3.8	1695.90459	4.95981953	1695.21523		
32	Alabama	2006	3.5	1699.02928	5.32556404	1697.05633		
33	Alabama	2007	3.4	1701.30532	5.80274238	1698.76503		
34	Alabama	2008	5	1702.78014	6.38231352	1700.34496		
35	Alabama	2009	9.8	1699.3235	7.03120898	1701.82518		
36	Alabama	2010	9.3	1702.21539	7.70253719	1703.25908		
37	Alabama	2011	8.7	1702.88083	8.37709445	1704.67504		

Step 6: We can get the cyclical component by subtracting the trend component from the original data:

G2								
=C2-E2								
	A	B	C	D	E	F	G	H
1	state	year	LUR	LnY*100	LUR_T	LnY*100_T	LUR_C	LnY*100_C
2	Alabama	1976	6.4	1627.04828	6.76469373	1627.75917	-0.3646937	-0.7108916
3	Alabama	1977	6.8	1630.67418	7.28364966	1629.48117	-0.4836497	1.19301615
4	Alabama	1978	5.9	1635.57722	7.79895865	1631.19606	-1.8989586	4.38116461
5	Alabama	1979	6.8	1635.76559	8.30213727	1632.90866	-1.5021373	2.85693767
6	Alabama	1980	8.4	1633.05349	8.76571249	1634.6676	-0.3657125	-1.6141119
7	Alabama	1981	9.7	1633.77466	9.14718994	1636.5501	0.55281006	-2.7754343
8	Alabama	1982	13.2	1633.53604	9.40041808	1638.6172	3.79958192	-5.0811562
9	Alabama	1983	12.8	1637.14114	9.4847735	1640.90222	3.3152265	-3.7610769
10	Alabama	1984	10.2	1642.97889	9.39762861	1643.38765	0.80237139	-0.4087556
11	Alabama	1985	8.6	1646.7595	9.16950806	1646.01837	-0.5695081	0.74112488
12	Alabama	1986	9.1	1650.21957	8.83896025	1648.73519	0.26103975	1.48438823
13	Alabama	1987	7.6	1652.50409	8.43883846	1651.4863	-0.8388385	1.01778401
14	Alabama	1988	6.9	1655.57101	8.00460641	1654.23477	-1.1046064	1.33623467
15	Alabama	1989	6.6	1659.04754	7.56333939	1656.95382	-0.9633394	2.09371786
16	Alabama	1990	6.3	1659.81107	7.13106667	1659.63005	-0.8310667	0.18102213
17	Alabama	1991	6.9	1661.36446	6.71418409	1662.27098	0.18581591	-0.9065115
18	Alabama	1992	6.9	1665.23981	6.31077684	1664.88595	0.58922316	0.35386075
19	Alabama	1993	6.6	1666.63989	5.92078828	1667.47524	0.67921172	-0.8353489
20	Alabama	1994	5.4	1670.0371	5.55005397	1670.04266	-0.150054	-0.0055551
21	Alabama	1995	5.2	1672.79703	5.21120163	1672.58367	-0.0112016	0.21336273
22	Alabama	1996	4.5	1674.18783	4.9153584	1675.09368	-0.4153584	-0.9058508
23	Alabama	1997	4.4	1676.96522	4.67353942	1677.57022	-0.2735394	-0.604998
24	Alabama	1998	3.9	1681.32723	4.49260625	1680.00177	-0.5926063	1.32545668
25	Alabama	1999	4.3	1683.02886	4.37668506	1682.37076	-0.0766851	0.65809744
26	Alabama	2000	4.1	1684.91993	4.32397594	1684.67288	-0.2239759	0.24704814
27	Alabama	2001	4.7	1686.56627	4.33191215	1686.91039	0.36808785	-0.3441134
28	Alabama	2002	5.4	1687.98619	4.39568716	1689.08802	1.00431284	-1.101833
29	Alabama	2003	5.4	1689.67683	4.51417536	1691.20707	0.88582464	-1.53024
30	Alabama	2004	5	1693.46228	4.69629423	1693.25782	0.30370577	0.20446456
31	Alabama	2005	3.8	1695.90459	4.95981953	1695.21523	-1.1598195	0.68936348
32	Alabama	2006	3.5	1699.02928	5.32556404	1697.05633	-1.825564	1.97295077
33	Alabama	2007	3.4	1701.30532	5.80274238	1698.76503	-2.4027424	2.54028988
34	Alabama	2008	5	1702.78014	6.38231352	1700.34496	-1.3823135	2.43517634
35	Alabama	2009	9.8	1699.3235	7.03120898	1701.82518	2.76879102	-2.5016821
36	Alabama	2010	9.3	1702.21539	7.70253719	1703.25908	1.59746281	-1.0436938
37	Alabama	2011	8.7	1702.88083	8.37709445	1704.67504	0.32290555	-1.7942078