دربن واتسن: اختبار الارتباط الذاتي بين الأخطاء العشوائية

أولًا: اختبار الارتباط الذاتي الموجب (اختبار ذو اتجاه واحد)

بعد حساب قيمة دربن واتسن والتي تخرج ضمن نتائج تحليل الانحدار نقارنها بالحد الأدنى والحد الأعلى المستخرج من الجدول أدناه

Durbin-Watson statistic

First-order, positive autocorrelation:

To get a conclusion from the test, you can compare the displayed value for the Durbin-Watson statistic with the correct lower and upper bounds in the following table from (Savin and White; 1977). (1)

If D > DU, no correlation exists

if D < DL, positive correlation exists;

if D is in between the two bounds, the test is inconclusive.

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[1] Savin, N. E. and White, K. J. (1977). *The Durbin-Watson test for serial correlation with extreme sample sizes or many regressors.* Econometrica, 45(8), p. 1989-1996.

ثانيًا: اختبار الارتباط الذاتي السالب (اختبار ذو اتجاه واحد)

بسبب التماثل حول 2 يتم استخدام القيمة (4-D)

Durbin-Watson table provides values to test for first-order, **positive autocorrelation**. The significance level for the test is 0.05. The table is for models with an intercept.

You can also use this table to test for first-order, **negative autocorrelation.**

If D < (4 – DU), no correlation exists.

if D > (4 – DL), negative correlation exists

if D is between the two bounds (4 – DL) and (4 – DU), the test is inconclusive. (2)

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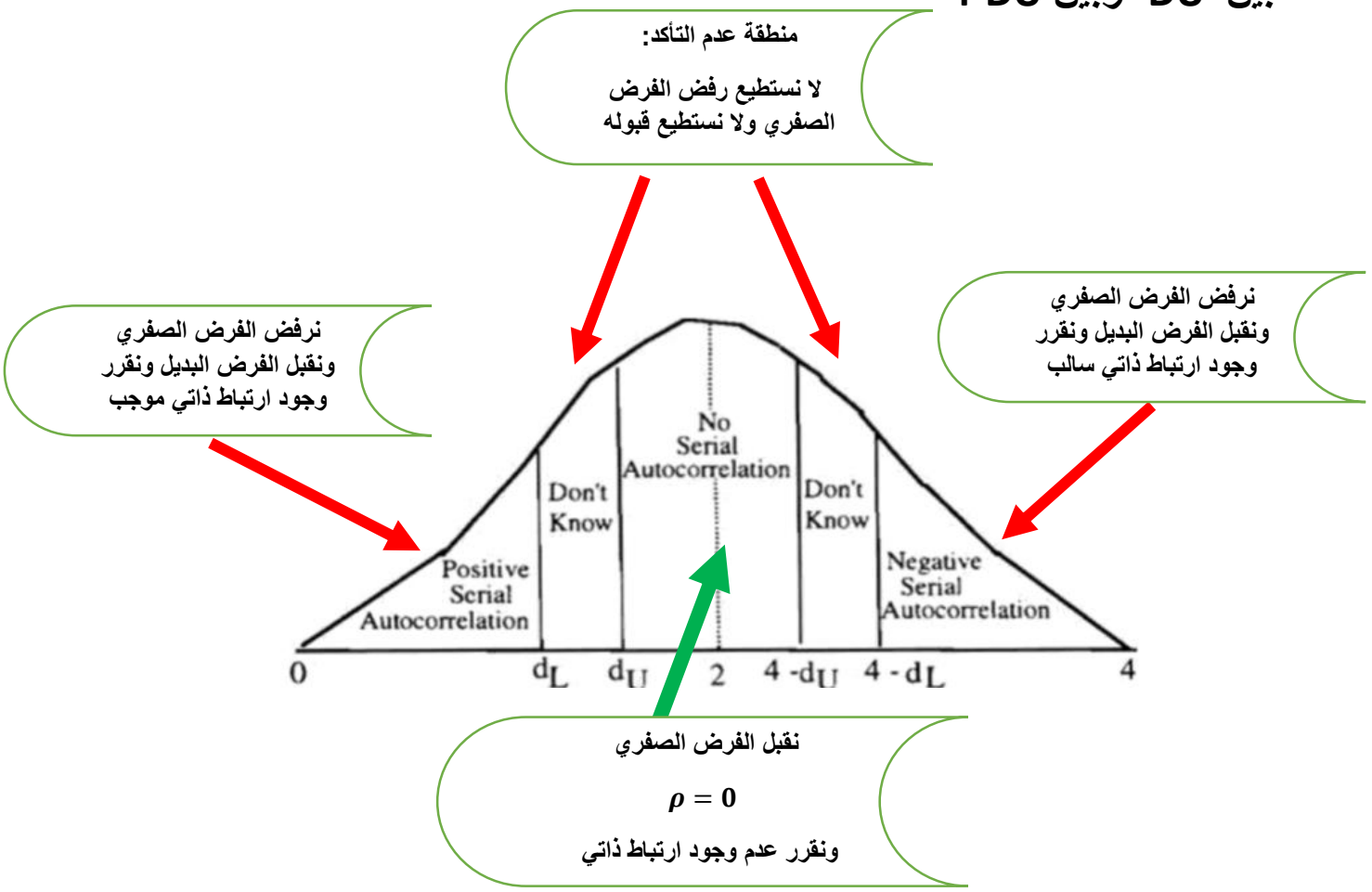
2 Durbin, J. and Watson, G.S. (1951). Testing for serial correlation in least squares regression II.Biometrika, 38(1/2) p. 159-177.

ثالثًا: اختبار الارتباط الذاتي (ذو الاتجاهين)

هنا يتم دمج الاختبارين السابقين فتكون منطقة الرفض يمين ويسار المنحنى تليها منطقة عدم التأكد من اليمين واليسار بينما تقع منطقة القبول:

بين DU وبين 4-DU



The test procedure is as follows:

$H_0 : \rho = 0$			
Nature of H_1	Reject H_0 when	Retain H_0 when	The test is inconclusive when
$H_1 : \rho > 0$	$d < d_L$	$d > d_U$	$d_L < d < d_U$
$H_1 : \rho < 0$	$d > (4 - d_L)$	$d < (4 - d_U)$	$(4 - d_U) < d < (4 - d_L)$
$H_1 : \rho \neq 0$	$d < d_L$ or $d > (4 - d_L)$	$d_U < d < (4 - d_U)$	$d_L < d < d_U$ or $(4 - d_U) < d < (4 - d_L)$
Values of d_L and d_U are obtained from tables.			

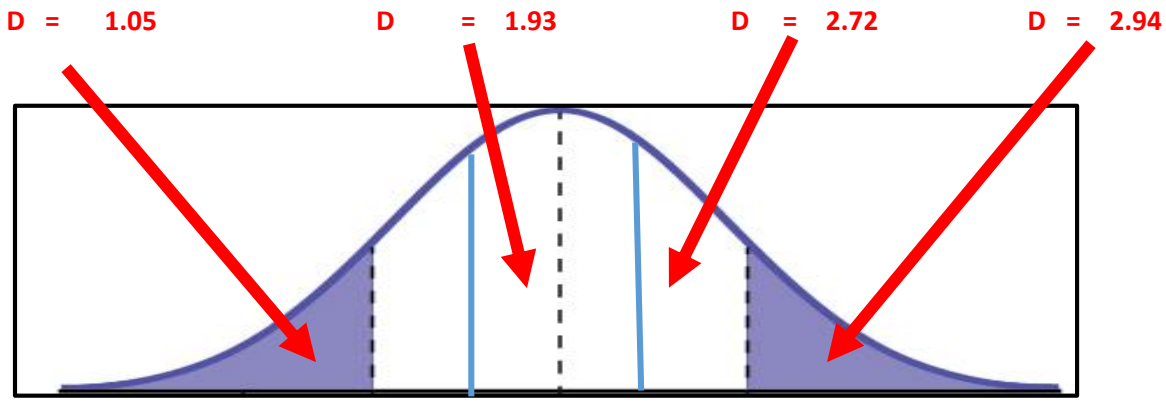
Example

Positive autocorrelation		
Year	X1	Y1
2000	4253	2000
2001	4160	2300
2002	3643	2000
2003	3625	1660
2004	3518	1400
2005	3479	1200
2006	3132	1289
2007	2357	1250
2008	2091	4330
2009	2007	4110
2010	1915	3667
2011	1692	3600
2012	1521	3500
2013	1274	3400
2014	1274	3100
2015	1230	2500
2016	1209	3000

NO autocorrelation	
X2	Y2
4253	1499
4160	1100
3643	2900
3625	1120
3518	2000
3479	2200
3132	2500
2357	1250
2091	4330
2007	4110
1915	3667
1692	2000
1521	1900
1274	3400
1274	3100
1230	2500
1209	2200

Inconclusive	
X3	Y4
500	4300
600	5500
500	5600
700	2200
1700	4900
3456	1200
800	1000
2357	5500
2091	4000
2007	5000
1915	4570
1692	1660
1521	3560
1274	1200
1274	6900
1230	1250
1209	4300

Negative autocorrelation	
X4	Y4
4300	900
5500	800
5600	3600
2200	100
4900	3000
1200	1140
1000	2800
5500	190
4000	1800
5000	1990
4570	3000
1660	1400
3560	1240
1200	800
6900	900
1250	1900
4300	1000



1.13 1.38 2 2.62 2.87

DL DU 2 4-DU 4-DL

TABLE C.5 5% significance points of d_l and d_u for Durbin-Watson test statistic.

	$k = 1$		$k = 2$		$k = 3$		$k = 4$		$k = 5$	
n	d_l	d_u	d_l	d_u	d_l	d_u	d_l	d_u	d_l	d_u
15	1.08	1.36	0.95	1.54	0.82	1.75	0.69	1.97	0.56	2.21
16	1.10	1.37	0.98	1.54	0.86	1.73	0.74	1.93	0.62	2.15
17	1.13	1.38	1.02	1.54	0.90	1.71	0.78	1.90	0.67	2.10
18	1.16	1.39	1.05	1.53	0.93	1.69	0.82	1.87	0.71	2.06
19	1.18	1.40	1.08	1.53	0.97	1.68	0.86	1.85	0.75	2.02
20	1.20	1.41	1.10	1.54	1.00	1.68	0.90	1.83	0.79	1.99
21	1.22	1.42	1.13	1.54	1.03	1.67	0.93	1.81	0.83	1.96
22	1.24	1.43	1.15	1.54	1.05	1.66	0.96	1.80	0.86	1.94
23	1.26	1.44	1.17	1.54	1.08	1.66	0.99	1.79	0.90	1.92
24	1.27	1.45	1.19	1.55	1.10	1.66	1.01	1.78	0.93	1.90
25	1.29	1.45	1.21	1.55	1.12	1.66	1.04	1.77	0.95	1.89
26	1.30	1.46	1.22	1.55	1.14	1.65	1.06	1.76	0.98	1.88
27	1.32	1.47	1.24	1.56	1.16	1.65	1.08	1.76	1.01	1.86
28	1.33	1.48	1.26	1.56	1.18	1.65	1.10	1.75	1.03	1.85
29	1.34	1.48	1.27	1.56	1.20	1.65	1.12	1.74	1.05	1.84
30	1.35	1.49	1.28	1.57	1.21	1.65	1.14	1.74	1.07	1.83
31	1.36	1.50	1.30	1.57	1.23	1.65	1.16	1.74	1.09	1.83
32	1.37	1.50	1.31	1.57	1.24	1.65	1.18	1.73	1.11	1.82
33	1.38	1.51	1.32	1.58	1.26	1.65	1.19	1.73	1.13	1.81
34	1.39	1.51	1.33	1.58	1.27	1.65	1.21	1.73	1.15	1.81
35	1.40	1.52	1.34	1.53	1.28	1.65	1.22	1.73	1.16	1.80
36	1.41	1.52	1.35	1.59	1.29	1.65	1.24	1.73	1.18	1.80
37	1.42	1.53	1.36	1.59	1.31	1.66	1.25	1.72	1.19	1.80
38	1.43	1.54	1.37	1.59	1.32	1.66	1.26	1.72	1.21	1.79
39	1.43	1.54	1.38	1.60	1.33	1.66	1.27	1.72	1.22	1.79
40	1.44	1.54	1.39	1.60	1.34	1.66	1.29	1.72	1.23	1.79
45	1.48	1.57	1.43	1.62	1.38	1.67	1.34	1.72	1.29	1.78
50	1.50	1.59	1.46	1.63	1.42	1.67	1.38	1.72	1.34	1.77
55	1.53	1.60	1.49	1.64	1.45	1.68	1.41	1.72	1.38	1.77
60	1.55	1.62	1.51	1.65	1.48	1.69	1.44	1.73	1.41	1.77
65	1.57	1.63	1.54	1.66	1.50	1.70	1.47	1.73	1.44	1.77
70	1.58	1.64	1.55	1.67	1.52	1.70	1.49	1.74	1.46	1.77
75	1.60	1.65	1.57	1.68	1.54	1.71	1.51	1.74	1.49	1.77
80	1.61	1.66	1.59	1.69	1.56	1.72	1.53	1.74	1.51	1.77
85	1.62	1.67	1.60	1.70	1.57	1.72	1.55	1.75	1.52	1.77
90	1.63	1.68	1.61	1.70	1.59	1.73	1.57	1.75	1.54	1.78
95	0.10	1.69	1.62	1.71	1.60	1.73	1.58	1.75	1.56	1.78
100	1.65	11.69	1.63	1.72	1.61	1.74	1.59	1.76	1.57	1.78

Note: n is the number of observations, and k is the number of explanatory variables including the intercept.

Source: J. Durbin and G.S. Watson, "Testing for Serial Correlation in Least Squares Regression," *Biometrika* 38 (1951), 159–177.