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Random Walk Hypothesis : A Review of the Effectiveness of the Normality Test, Ljung-Box Q Statistic & Variance Ratio Test

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Abstract

The launching of online trading, operations of derivative markets, strong supervision by the regulatory authority, and global integration of the 'stock market' collectively work to make the market more efficient. However, researchers testing the validity of the Random Walk Hypothesis (RWH) present conflicting findings and mostly infer that the market is not efficient. This paper explores that the market is sometimes random and sometimes non-random. The conflicting findings are mostly attributed to the choice of the study period, the use of research methodology and the selection of empirical tests. Any change in the choice of test procedures and shifting of the period of study can produce conflicting results. The paper presents a comparative assessment of the merits of the four methods and unfolds their limitations by applying these methods to a Random Number Series.

JEL Code : C14, C46, G14
Keywords : Random Walk; Normality; Run Test; Market Efficiency; Variance Ratio Test; Scrips; Derivatives; BSE; India

I. Introduction

IN CONFORMITY WITH the advocates of the Academic Approach to Investment, Fama, Eugene (1965) argued in favour of the Random Walk Hypothesis (RWH). He argued that an efficient market rules out the possibility of abnormal profits, as it is reflected in the perfectly competitive market, where the firms earn only normal profits. Since then, researchers' enthusiasm for examining the presence of the Random Walk Hypothesis (RWH) in a market, in India or abroad, increased manyfold. Publication of thousands of research papers, in national or international journals, provides the evidence of academic interest in this field.

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Annexure I
A Specimen of the Output of the Ljung-Box Test

		Y_2001		
Lag period	**AC**	**PAC**	**Q-Stat**	**Prob**
1	0.143	0.143	5.1153	0.024
2	-0.085	-0.108	6.9282	0.031
3	-0.072	-0.044	8.2304	0.041
4	0.042	0.052	8.6719	0.070
5	0.082	0.059	10.3780	0.065
6	-0.072	-0.093	11.7150	0.069
7	0.011	0.056	11.7440	0.109
8	-0.007	-0.025	11.7550	0.162
9	0.064	0.060	12.8050	0.172
10	0.036	0.021	13.1490	0.215
11	0.025	0.037	13.3150	0.273
12	-0.078	-0.093	14.9120	0.246
13	-0.013	0.029	14.9560	0.310
14	0.119	0.098	18.7120	0.176
15	-0.003	-0.046	18.7150	0.227
16	0.012	0.041	18.7540	0.282
17	-0.107	-0.095	21.8430	0.191
18	0.018	0.028	21.9340	0.235
19	-0.014	-0.051	21.9910	0.285
20	-0.127	-0.117	26.3740	0.154
21	0.012	0.051	26.4120	0.191
22	0.028	0.021	26.6280	0.226
23	0.087	0.047	28.7090	0.190
24	0.002	0.004	28.7100	0.231
25	-0.052	-0.046	29.4720	0.245
26	-0.001	0.029	29.4730	0.290
27	-0.020	-0.034	29.5810	0.333
28	-0.069	-0.080	30.9240	0.320
29	-0.101	-0.071	33.7860	0.247
30	-0.023	-0.008	33.9340	0.283
31	0.042	0.051	34.4320	0.307
32	-0.002	-0.063	34.4330	0.352
33	0.010	0.056	34.4630	0.398
34	-0.058	-0.055	35.4410	0.400
35	0.066	0.093	36.6970	0.390
36	-0.008	-0.042	36.7150	0.436

Source: Self Calculation based on 2001 Sensex data

Annexure II
A Specimen of Variance Ratio Output for the year 2003

Null Hypothesis: LN_Y_2003 is a martingale
Date: 02/23/24 Time: 17:15
Sample: 1 254
Included observations: 252 (after adjustments)
Heteroskedasticity robust standard error estimates
User-specified lags: 2 4 8 16

Joint Tests	Value	Df	Probability
Max |z| (at period 2)*	5.266168	252	0

Individual Tests

Period	Var. Ratio	Std. Error	z-Statistic	Probability
2	0.548526	0.085731	-5.26617	0.0000
4	0.290367	0.150160	-4.72584	0.0000
8	0.145719	0.225120	-3.79479	0.0001
16	0.079432	0.319679	-2.87966	0.0040

Note: * Probability approximation using studentized maximum modulus with parameter value 4 and infinite degrees of freedom
Source: Self Calculation based on 2the Sensex data of 2003

Annexure III
Table of Random Digits

05950	13962	70992	65172	28053	02190	83634	66012	70305	66761	88344
05951	43905	46941	72300	11641	43548	30455	07686	31840	03261	89199
05952	00504	48658	38051	59408	16508	82979	92002	63606	41078	86326
05953	61274	57238	47267	35303	29066	02140	60867	39847	50968	96719
05954	43753	21159	16239	50595	62509	61207	86816	29902	23395	72640
05955	83503	51662	21636	68192	84294	38754	84755	34053	94582	29215
05956	36807	71420	35804	44862	23577	79551	42003	58684	09271	68396
05957	19110	55680	18792	41487	16614	83053	00812	16749	45347	88199
05958	82615	86984	03290	87971	60022	35415	20852	02909	99476	45568
05959	05621	26584	36493	63013	68181	57702	49510	75304	38724	15712
05960	06936	37293	55875	71213	83025	46063	74665	12178	10741	58362
05961	84981	60458	16194	92403	80951	80068	47076	23310	74899	87929
05962	66354	88441	96191	04794	14714	64749	43097	83976	83281	72038
05963	49602	94109	36460	62353	00721	66980	82554	90270	12312	56299
05964	78430	72391	96973	70437	97803	78683	04670	70667	58912	21883
05965	33331	51803	15934	75807	46561	80188	78984	29317	27971	16440
05966	62843	84445	56652	91797	45284	25842	96246	73504	21631	81223
05967	19528	15445	77764	33446	41204	70067	33354	70680	66664	75486
05968	16737	01887	50934	43306	75190	86997	56561	79018	34273	25196
05969	99389	06685	45945	62000	76228	60645	87750	46329	46544	95665
05970	36160	38196	77705	28891	12106	56281	86222	66116	39626	06080
05971	05505	45420	44016	79662	92069	27628	50002	32540	19848	27319
05972	85962	19758	92795	00458	71289	05884	37963	23322	73243	98185
05973	28763	04900	54460	22083	89279	43492	00066	40857	86568	49336
05974	42222	40446	82240	79159	44168	38213	46839	26598	29983	67645
05975	43626	40039	51492	36488	70280	24218	14596	04744	89336	35630
05976	97761	43444	95895	24102	07006	71923	04800	32062	41425	66862
05977	49275	44270	52512	03951	21651	53867	73531	70073	45542	22831
05978	15797	75134	39856	73527	78417	36208	59510	76913	22499	68467
05979	04497	24853	43879	07613	26400	17180	18880	66083	02196	10638
05980	95468	87411	30647	88711	01765	57688	60665	57636	36070	37285
05981	01420	74218	71047	14401	74537	14820	45248	78007	65911	38583
05982	74633	40171	97092	79137	30698	97915	36305	42613	87251	75608
05983	46662	99688	59576	04887	02310	35508	69481	30300	94047	57096
05984	10853	10393	03013	90372	89639	65800	88532	71789	59964	50681
05985	68583	01032	67938	29733	71176	35699	10551	15091	52947	20134
05986	75818	78982	24258	93051	02081	83890	66944	99856	87950	13952
05987	16395	16837	00538	57133	89398	78205	72122	99655	25294	20941
05988	53892	15105	40963	69267	85534	00533	27130	90420	72584	84576
05989	66009	26869	91829	65078	89616	49016	14200	97469	88307	92282
05990	45292	93427	92326	70206	15847	14302	60043	30530	57149	08642
05991	34033	45008	41621	79437	98743	84455	66769	94729	17975	50063
05992	13364	09937	00535	88122	47278	90758	23542	35273	67912	97670
05993	03343	62593	93332	09921	25306	57483	98115	33460	55304	43572
05994	46145	24476	62507	19530	41257	97919	02290	40357	38408	50031
05995	37703	51658	17420	30593	39637	64220	45486	03698	80220	12139
05996	12622	98083	17689	56977	56603	93316	79858	52548	67364	72416
05997	56043	00251	70085	28067	78135	53000	18138	40564	77086	49557
05998	43401	35924	28308	55140	07515	53854	23023	70268	80435	24269
05999	18053	53460	32125	81357	26935	67234	78460	47833	20498	35645

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