Edge Ratio of Nifty for Last 15 Years on Donchian Channel

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***Abstract*—**Quality entry in derivatives trading is essential element for long run success. Trading with an edge is what separates the professionals from the amateurs. Without an edge in games of chance, player will lose money in the long run. Many researchers believe that market is efficient and cannot be predicted or market behaves randomly so any entry strategy is as good as entering randomly in market. Index data of S&P CNX Nifty of National Stock Exchange from Jan 2000 to May 2014 was studied to find out the edge of a truly random entry and entry using 20 day Donchian channel.3588 trading days were considered in which Donchian channel generated 86 entry signals, 43 each for long and short. Edge of an entry system using 20 day Donchian channel on highly traded CNX Nifty futures for period of fifteen (15) years revealed that the system has an edge over the truly random entry.E20 for Donchian channel was 1.60 whereas for random entry, it was 1.08. E50 and E100 for Donchian channel was 1.27 and 1.25 respectively which was 1 and 0.99 respectively for truly random entry. The results clearly show that a truly random entry does not have edge at all whereas an entry near the breakouts or breakdowns has an edge. It is desirable for traders to find out the Edge of a strategy before its implementation. It will not only increase the chances of long run success but also give confidence while trading. Application of edge ratio for determining stoploss is mentioned in the study.

***Keywords*—**Donchian Channel; Edge Ratio; Efficient Market Hypothesis; Nifty; Random Walk Theory.

***Abbreviations*—**Average True Range (ATR); Compounded Annual Growth Rate (CAGR); Maximum Adverse Excursion (MAE); Maximum Favorable Excursion (MFE).

I. INTRODUCTION

EFFICIENT MARKET HYPOTHESIS (EMH) asserts that financial markets are "informationally efficient". In consequence of this, one cannot consistently achieve returns in excess of average market returns on a risk-adjusted basis, given the information available at the time the investment is made.

Investors and researchers have disputed the efficient-market hypothesis both empirically and theoretically. Behavioral economists attribute the imperfections in financial markets to a combination of cognitive biases such as overconfidence, overreaction, representative bias, information bias, and various other predictable human errors in reasoning and information processing. These have been researched by psychologists such as Daniel Kahneman, Amos Tversky, Richard Thaler, and Paul Slovic. These errors in reasoning lead most investors to avoid value stocks and buy growth stocks at expensive prices, which allow those who reason correctly to profit from bargains in neglected value stocks and the overreacted selling of growth stocks [Francis Nicholson, 1968; Sanjoy Basu, 1977; Rosenberg et al., 1985].

The Random Walk Theory by Burton G. Malkiel states that market and securities prices are random and not influenced by past events. The idea is also referred to as the "weak form efficient-market hypothesis."

The random walk theory also states that all methods of predicting stock prices are futile in the long run. Malkiel calls the notion of intrinsic value undependable because it relies on subjective estimates of future earnings using factors like expected growth rates, expected dividend payouts, estimated risk, and interest rates.

The random walk theory also considers technical analysis undependable because, according to Malkiel, chartists buy only after price trends are established and sell only after price trends are broken; essentially, the chartists buy or sell too late and miss the boat. According to the theory, this happens because stock prices already reflect the information by the time the analyst moves on the stock. Malkiel also notes that the widespread use of technical analysis reduces the advantages of the approach.

Further, Malkiel finds fundamental analysis flawed because analysts often collect bad or useless information and then poorly or incorrectly interpret that information when predicting stock values. Factors outside of a company or its industry may affect a stock price, rendering further the fundamental analysis irrelevant.

Malkiel constantly states that a long-term buy-and-hold strategy is the best and that individuals should not attempt to time the markets. Attempts based on technical, fundamental, or any other analysis are futile. He backs this up with statistics showing that most mutual funds fail to beat benchmark averages like the S&P 500 [Burton G. Malkiel, 2007].

There are many theorists and researchers who advocate that there is no point in doing any kind of analysis or making any strategy because market is truly random and efficient and it is useless to trade on any strategy as such. The best strategy is buy and hold.

But many technical analysts have challenged this and proved that market is not random and there is certainly a scope for creating a strategy which has an edge in trading. A similar attempt is made in this study.

II. EDGE RATIO

When you are testing entry signals, one of the most important aspects you want to look at is if the technique you are using has a distinct "edge", for the time-frame you are trading (short-term, swing, long-term, etc).

The edge ratio quantifies the edge by calculating the overall amount trades go in your favor versus the overall amount trades go against you. The higher value the value of the e-ratio, the more trades move in your favor – giving you a good indication of the edge measured [Jez Liberty, 2009].

The Maximum Favorable Excursion (MFE) is a term used to measure how much a trade moves in your favor, from your Entry. So, if your entry price on a long position is 34, and for as long as the trade lasted, the market moved in your favor to a price of 35.50, this represents a MFE of 1.50 (35.50 – 34).

The Maximum Adverse Excursion (MAE) is a term used to measure how much a trade moves against you, from your Entry. So, if your entry price on a long position is 34, and for as long as the trade lasted, the market moved against you to a low price of 33.25, this represents a MAE of .75 (34 – 33.25). [TJS, 2011].

E10-ratio measurement computes the MFE and MAE for 10 days, including the day of entry; an E50-ratio uses 50 days, and so on.

When measuring an entry's Edge Ratio it is important to pick a suitable time frame to measure the maximum favourable and adverse excursions over. For example, say we were trying to test a 20-day Donchian channel breakout and we found that from the moment of the breakout until 5 days in the future there was a negative expectancy, but from the moment of the breakout until 50 days in the future the breakout had a positive expectancy. This would tell us that within the first 5 days of a breakout there was more chance of the price moving against the breakout than with it, but over a period of 50 days the price was more likely than not to move in the direction of the breakout. So which time frame should we use, the 5 day time frame or the 50 day time frame? The answer is that it depends upon the trading system and that you should use a time frame that is similar to the trading system's time frame. In the case of the 20-day Donchian channel breakout, measuring the edge of such a trading system's entry with a time frame of 50 days would certainly be preferable to 5 days as 20-day Donchian channel systems are medium to long term trading systems where trades are far more likely to last around 50 days than they are to last around 5 days [David, 2010].

When traders are determining when to enter a market, most beginners employ a strategy that is no better than throwing darts at the chart. Experienced traders would say that their strategy has no edge. The term edge is borrowed from gambling theory and refers to the statistical advantage held by the casino. It also refers to the advantage that can be gained by counting cards when one is playing blackjack. Without an edge in games of chance, you will lose money in the long run. This is true in trading as well. If you do not have an edge, the costs of trading will cause you to lose money. Commissions, slippage, computer costs, and exchange and pricing data fees add up very quickly. An edge in trading is an exploitable statistical advantage based on market behavior that is likely to recur in the future [Curtis Faith, 2007]

III. EDGE RATIO CALCULATION

Following steps are used to calculate E-ratio:

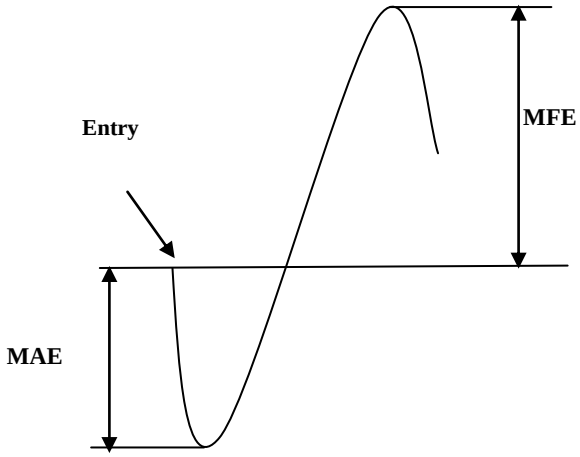
1. Compute the MFE and MAE for the Time Frame Specified

For each trade, measure the Maximum Favorable Excursion and the Maximum Adverse Excursion.

Maximum Excursions are the maximum amount the price goes against you (Adverse) or in your favor (Favorable) during the trade. For a long position, MAE is calculated between the entry price and the lowest price during the trade. MFE is calculated between the entry price and the highest price during the trade. Note that both values are positive. Consider zero (0) for negative values. The calculation is reversed for short entry.

2. Divide each of them by the ATR at Entry to Adjust for Volatility and Normalize across Markets

To be able to compute the e-ratio across different markets, the Excursion values should be normalized to a common denominator – such as a unit of volatility. The Average True Range is a good measure of volatility. In many systems it is also used to drive the position sizing, making it really relevant. Divide all MAE and MFE values by the ATR calculated at the beginning of the trade. In this example we use the same period for the ATR and the Donchian Channel. This gives you comparable values across all markets and conditions.



Average True Range

Average True Range (ATR) is an indicator that measures volatility.

$$ATR_t = \frac{ATR_{t-1} \times (n-1) + TR_t}{n}$$

Where, TR=True Range, n=time period

The true range is the largest of the:

- Most recent period's high minus the most recent period's low
- Absolute value of the most recent period's high minus the previous close
- Absolute value of the most recent period's low minus the previous close

3. Sum each of these Values Separately and Divide by the Total Number of Signals to Get the Average Volatility-Adjusted MFE and MAE

Just add all normalized MAE values calculated in step 2 and divide by the number of trades. Repeat the operation for the MFE values.

4. The E-ratio is the Average Volatility-Adjusted MFE Divided by the Average Volatility-Adjusted MAE

Simply divide the average MFE by the average MAE to give you the e-ratio. The higher the number, the better. With any values above 1 implies a positive edge [Welles Wilder, 1978; Curtis Faith, 2007A; Jez Liberty, 2009].

IV. DONCHIAN CHANNEL

The Donchian channel is an indicator used in market trading developed by Richard Donchian. It is formed by taking the highest high and the lowest low of the last *n* periods. The area between the high and the low is the channel for the period chosen.

Donchian Channel can be used as an entry point in derivatives trading. A buy, or long, signal is created when the price action breaks through and closes above the upper band. A sell, or short, signal is created when the price action breaks through and closes below the lower band [Richard Lee, 2010].

V. SIGNIFICANCE OF THE RESEARCH

The edge ratio term was first used by Curtis Faith in his book Way of the Turtles in 2007. He explained how „turtles" (Turtles was name given to the group of traders selected by legendary speculator Richard Dennis to trade in his personal account) used Donchian channel to enter and exit positions which made them multimillionaire in few years. There have been countless strategies that explain the set ups to be used to enter the market but not much has been written about edge ratio after 2007. This study is an attempt to study edge ratio on the most traded underlying asset in India i.e. CNX Nifty. The traders should be able to find out the edge of their entry system before putting real money on stake.

VI. RESEARCH OBJECTIVES

- To find out the edge of Donchian Channel entry using Edge-ratio on Nifty index for last 15 years.
- To compare the edge ratio between Donchian Channel entry and a random entry.

VII. RESEARCH METHODOLOGY

7.1. Type of Study

Analytical study was made to obtain objectives of study.

7.2. Collection of Data

Data for the purpose of this study was collected through secondary sources. CNX Nifty Index data from Jan 2000-April 2014 was collected from National Stock Exchange website.

7.3. Sample Size

Purposive sampling of 3588 trading days were considered under the study; of which 86 entry signals were generated by Donchian Channel entry system. Same number of trades was considered for random entry too. (43 long and 43 short positions).

7.4. Entry Signals

A buy or long entry signal for Donchian channel system was generated when market crossed upper band of channel and sell or short entry was initiated when market crosses below lower band of channel.

For random entry signals, 86 random dates were selected and long position was initiated for first date, then short for second date, likewise alternate positions were initiated till the last date.

7.5. Hypothesis Testing

Hypothesis was tested using IBM SPSS software with 95% confidence level i.e. at 5% significant level.

VIII. HYPOTHESIS

$H0_1$ =There is no significant difference between edge ratio of Donchian channel entry system and random entry system.

IX. LITERATURE REVIEW

There has been very few studies conducted on Edge ratio and MFE & MAE; below are some studies related to the topic which tells that market is not efficient and this inefficiency is caused because emotional biases of humans and thus it makes sense to devise an entry strategy which can give an edge. Reasons behind the edge are also discussed in these studies.

Curtis Faith ran a test of the E-ratio for the period of 10 years from January 1, 1996, to June 30, 2006using a set of 28 high-volume U.S. futures markets by using an entry that randomly enters long or short at the open. The average of 30 individual tests showed anE5-ratio of 1.01, an E10-ratio of 1.005, and an E50-ratio of 0.997.These numbers are very close to the 1.0. This is the case because the price is just as likely to go against a position as it is to go in a direction favorable to a position over any reasonable time period.

When the same data was used to calculate edge of Donchian Channel trading system, E5-ratio for the sample was 0.99, and the E10-ratio was 1.0, E70-ratio for our entry was 1.20. It showed that the system had an edge over medium term, if not over short term [Curtis Faith, 2007].

Jez used a system which “tosses a coin” to decide whether to go long or short the market. The system tested was composed of random entries with additional “classic” components: a volatility-based fixed fractional money management and volatility-based trailing stop exits. The volatility measure was used as 39 day ATR, stop loss distance at 2 ATR and risk per trade was 1% of the total equity. The test was run for 22 most liquid derivatives contract from Jan 1990 to Jan 2011. The results showed the CAGR of 18.11% with maximum drawdown of 33.57% having standard deviation of 6.34%. It was further observed that draw downs and standard deviation reduce substantially with increase in stoploss from 2 ATR to 10 ATR [Jez Liberty, 2011].

David ran test the Donchian channel entry strategy on the EUR/USD currency pair and measure the entry's edge over periods of 5, 10, 20, 40 and 80 days. The results showed that E5, E10, E20, E40 AND E80 ratio were 1.19, 1.27, 1.40, 1.42 and 1.29 respectively. He concluded that to those traders who say that 'entries don't matter, only exits do', it is important to look carefully at the results of using a time based exit as it seems that the statistical edge than can be harnessed from an entry is far greater than the statistical edge than can be harnessed from an exit, and, even if this weren't the case, any edge that you can add to your trading system matters. Clearly a trading system's entry matters [David, 2010A].

Cognitive and emotional biases in investing are the reasons that challenge the popular efficient market hypothesis. Market is run by humans and humans have emotions and these emotions cause imperfection in market. Confirmation bias, gambler‟s fallacy, status quo bias, negativity bias, bandwagon effect, loss aversion bias, overconfidence bias, endowment bias etc. are the emotional biases that cause imperfect market and if these biases are controlled in disciplined way, it can give an edge while trading [Tim, 2010].

It‟s safe to say the market is not going to achieve perfect efficiency anytime soon. For greater efficiency to occur, the following criteria must be met: (1) universal access to high-speed and advanced systems of pricing analysis, (2) a universally accepted analysis system of pricing stocks, (3) an absolute absence of human emotion in investment decision-making, (4) the willingness of all investors to accept that their returns or losses will be exactly identical to all other market participants. It is hard to imagine even one of these criteria of market efficiency ever being met [Jason Van Bergen, 2011].

Predictive power of support and resistance levels for intraday exchange rates was examined using technical signals published by six active market participants from January 1996 through March 1998. The statistical tests, which use the bootstrap technique, cover support and resistance levels for three currency pairs: dollar-mark, dollar-yen, and dollar-pound. The results indicate that intraday exchange rate trends were interrupted at published support and resistance levels substantially more often than would have occurred had the levels been arbitrarily chosen. This finding is consistent across all three exchange rates and across all six firms studied. The predictive power of published support and resistance levels varies considerably across firms and across exchange rates. It lasts at least one week. The strength estimates published with the levels are not meaningful. These results are highly statistically significant and are robust to alternative parameterizations [Carol Oscar, 2000].

X. DATA ANALYSIS AND INTERPRETATION

10.1. Edge Ratio of Random Entry

Out of 3588 trading days, 86 random trades were initiated (43 short & 43 long) and Edge ratio was calculated using the standard process (given in this study).

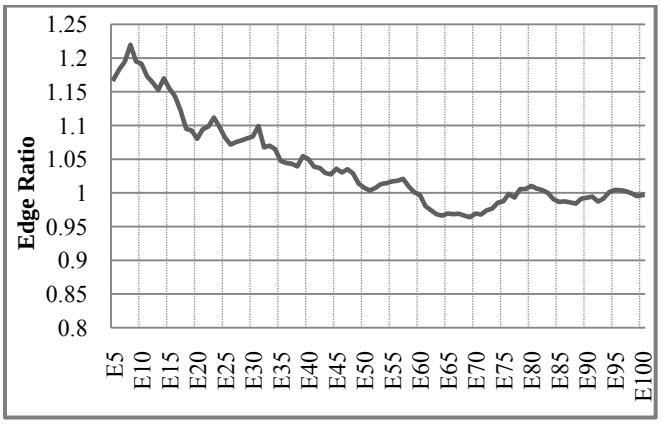
The observations of edge ratio for the random entry are shown in table 1.

Table 1: Edge Ratio of Random Entry for Different Time Frames

Time Frame	Edge Ratio
10	1.19
20	1.08
30	1.08
40	1.04
50	1.00
60	0.99
70	0.96
80	1.01
90	0.99
100	0.99

It is clear from Table 1 that a truly random entry has little edge in short run as E10 and E20 are 1.19 and 1.08 respectively. As we increase the time frame, the edge ratio tends to move near 1 which signifies that when we enter randomly in market, in long run, there is no edge. That means that there is an equal chance for a position to move in your favor and against.

Graph 1 displays the edge ratio of random entry from E5 to E100.



Graph 1: Edge Ratio of Random Entry as Number of Days Varies

It can be interpreted from the analysis that a random entry may have an edge in short run but in medium and long run, it does not. It is important to know that the ratio is near one, it has not gone substantially below and above one. This signifies that post entry favorable and adverse movement is more or the less equal at any given point of time. In this case, edge ratio till 100th day was calculated and it showed no edge and even if we increase the number of days, it may not improve. In random entry, market behaves randomly and does not show any definite direction.

But is this the same case when we trade with some kind of entry strategy which gives substantial reason for entering any position?

10.2. Edge Ratio of Entry using Donchian Channel

Donchian channel is already introduced in the introductory part. The concept of entry using Donchian channel is very simple and logical. Donchian channel enters the position on the basis of upper or lower band of the channel. These bands basically are nothing but the recent support and resistance levels for *n* number of days. Entering the positions after breaking these levels makes sense because there is higher probability of market to make drastic move from that point. The move may be in the direction of against the direction but there is higher chance of movement. It is expected that the market will move in the direction of the band once it is broken. So if support is broken, it is most likely that market will go down and if resistance is broken, it is likely to go up.

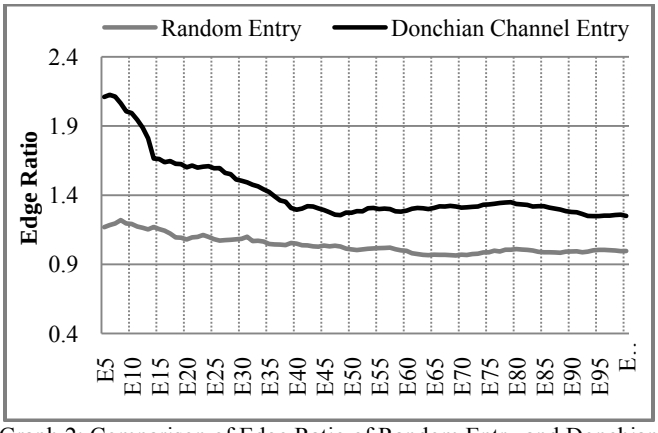
Let‟s observe the Edge ratio of entry strategy using Donchian channels as entry points and see whether the edge ratio makes any difference or not as compared to random entry.

Table 2: Edge Ratio of Donchian Channel Entry for Different Time Frames

Time Frame	Edge Ratio
10	1.99
20	1.60
30	1.50
40	1.29
50	1.27
60	1.28
70	1.30
80	1.33
90	1.27
100	1.25

Table 2 shows that in short term, the E-ratio is very high (i.e. 2) but it falls to 1.30 and then throughout the period, it remains more or the less at the same level. E100 is 1.25 which is the lowest. Although, the E-ratio fells from 2 to 1.3, it is to be noted that it remains at that level that means in medium term, the strategy has an edge so it is better to trade with the strategy which has some kind of an edge rather than throwing darts in dark and entering the positions without any kind of logic.

Graph 2 shows the Edge ratio for both kinds of entry strategies.



Graph 2: Comparison of Edge Ratio of Random Entry and Donchian Channel Entry

XI. Using E-Ratio for Stoploss

Stoploss is the most crucial component of technical analysis and derivatives trading. The biggest dilemma for traders is „where to place the stoploss?" If stoploss is placed closer, then market may hit your stoploss and bounce back and you may miss the opportunity. If stoploss is placed farther than required, it may result into higher losses. There have been countless techniques devised that explain where, why and how to place stoplosses. There is no universal consensus on any of these techniques. The E-ratio can be used for placing the stoploss for the position.

An important component of E-ratio is MFE and MAE. E-ratio is calculated by dividing each MFE & MAE by its ATR. It is possible to find out average MAE at a particular point of time, say E10; average ATR adjusted MAE of E10 is 1.67.This can be used as base for placing stoploss so if your view is short term (say 10 days), you can place stoploss at 1.67*ATR and get logical level for placing the stoploss. But this is rough calculation as it is also equally important to take into account the average deviation for this 1.67. The stoploss needs to be adjusted for the standard deviation of MAE. In this case, S.D. of MAE of E10 is 1.51 so stoploss can be adjusted for half standard deviation. So the stoploss in this case would be (1.67+0.75)*ATR.

It is simplified in following equation.

$$STOPLOSS = \left\lfloor \frac{\sum_{i=1}^{n} \frac{MAE_i}{ATR_i}}{N} + \frac{\sigma\left(\sum_{i=1}^{n} \frac{MAE_i}{ATR_i}\right)}{2} \right\rfloor \times ATR_t$$

Here, N=Total number of entries under study,

σ=Standard Deviation,

ATR_t=ATR of the entry day

Suppose, the Donchian channel has given a long entry signal on Nifty on June 2014 at 7125, the ATR on that day is 85 so in this case, the stoploss would be calculated as follows. (For more details, refer appendix)

Stoploss= [(144/86)+ (1.51/2)]*85=205

XII. Conclusion

It is clear that when a random entry is made to initiate a position, it does not have an edge in medium or long run whereas an entry using Donchian channels as an entry points had an edge throughout the 100 days. Edge ratios in both cases go down in short term and remain more or less constant in future. E20, E50 and E100 for random entry were 1.08, 1 and 0.99 respectively whereas for Donchian channel entry, it was 1.60, 1.27 and 1.25 respectively. Entry is an important component of any trading strategy and it is desirable to know whether the system has an edge over long run. E-ratio can also be used for placing the stoploss for any position depending upon the duration which a trader wants to hold.

XIII. Scope for Further Study

More instruments (including overseas) and different types of trading strategies may be studied and e-ratio of the same may be found out. Comparison of major indices of one country from another can also be done on the basis of E-ratio and know whether they are significantly different or not. Comparison of e-ratio of unrelated market can be done to find out difference.

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APPENDICE

Edge Ratio calculation for Random Entry and Donchian Channel Entry
(Underlying Asset=CNX Nifty, Duration=15 years, Total Entries=N=86)

RANDOM ENTRY					DONCHIAN CHANNEL ENTRY			
	$\frac{\sum_{i=1}^{n} \frac{MFE_i}{ATR_i}}{N}$	$\frac{\sum_{i=1}^{n} \frac{MAE_i}{ATR_i}}{N}$	E-RATIO			$\frac{\sum_{i=1}^{n} \frac{MFE_i}{ATR_i}}{N}$	$\frac{\sum_{i=1}^{n} \frac{MAE_i}{ATR_i}}{N}$	E-RATIO
E1	0.75	0.58	1.29		E1	0.94	0.31	2.99
E2	0.97	0.74	1.31		E2	1.21	0.50	2.43
E3	1.09	0.88	1.24		E3	1.43	0.64	2.22
E4	1.22	1.00	1.22		E4	1.54	0.75	2.06
E5	1.34	1.15	1.17		E5	1.69	0.80	2.11
E6	1.45	1.22	1.18		E6	1.89	0.89	2.13
E7	1.58	1.32	1.19		E7	2.05	0.97	2.11
E8	1.73	1.42	1.22		E8	2.22	1.08	2.06
E9	1.85	1.55	1.20		E9	2.36	1.17	2.01
E10	2.00	1.68	1.19		E10	2.51	1.26	1.99
E11	2.07	1.77	1.17		E11	2.56	1.32	1.95
E12	2.15	1.85	1.16		E12	2.67	1.41	1.89
E13	2.26	1.96	1.15		E13	2.76	1.52	1.81
E14	2.33	1.99	1.17		E14	2.81	1.69	1.66
E15	2.38	2.06	1.15		E15	2.90	1.75	1.66
E16	2.44	2.14	1.14		E16	3.00	1.83	1.64
E17	2.51	2.24	1.12		E17	3.09	1.88	1.65
E18	2.55	2.33	1.10		E18	3.15	1.94	1.63
E19	2.61	2.39	1.09		E19	3.22	1.98	1.62
E20	2.68	2.48	1.08		E20	3.29	2.06	1.60
E21	2.79	2.55	1.09		E21	3.37	2.09	1.61
E22	2.88	2.62	1.10		E22	3.46	2.17	1.60
E23	2.98	2.68	1.11		E23	3.53	2.20	1.61
E24	3.02	2.75	1.10		E24	3.62	2.25	1.61
E25	3.05	2.82	1.08		E25	3.68	2.31	1.59
E26	3.08	2.87	1.07		E26	3.79	2.37	1.60
E27	3.15	2.93	1.08		E27	3.87	2.48	1.56
E28	3.21	2.98	1.08		E28	3.94	2.54	1.55
E29	3.27	3.02	1.08		E29	3.98	2.63	1.51
E30	3.35	3.09	1.08		E30	4.04	2.69	1.50
E31	3.41	3.10	1.10		E31	4.10	2.75	1.49
E32	3.44	3.22	1.07		E32	4.12	2.79	1.48
E33	3.52	3.29	1.07		E33	4.16	2.84	1.46
E34	3.57	3.35	1.07		E34	4.25	2.95	1.44
E35	3.60	3.44	1.05		E35	4.32	3.04	1.42
E36	3.65	3.50	1.04		E36	4.39	3.15	1.39
E37	3.71	3.55	1.04		E37	4.43	3.25	1.36
E38	3.76	3.62	1.04		E38	4.49	3.32	1.35
E39	3.83	3.63	1.05		E39	4.47	3.41	1.31
E40	3.87	3.68	1.05		E40	4.51	3.48	1.30
E41	3.90	3.75	1.04		E41	4.57	3.51	1.30
E42	3.94	3.80	1.04		E42	4.66	3.52	1.32
E43	3.98	3.86	1.03		E43	4.69	3.56	1.32
E44	4.03	3.93	1.03		E44	4.71	3.61	1.30
E45	4.10	3.96	1.04		E45	4.75	3.68	1.29
E46	4.18	4.06	1.03		E46	4.78	3.75	1.28
E47	4.27	4.13	1.04		E47	4.81	3.82	1.26
E48	4.31	4.19	1.03		E48	4.84	3.86	1.26
E49	4.32	4.27	1.01		E49	4.89	3.83	1.27
E50	4.37	4.33	1.01		E50	4.94	3.88	1.27
E51	4.41	4.39	1.00		E51	5.00	3.90	1.28
E52	4.47	4.43	1.01		E52	5.04	3.92	1.28
E53	4.52	4.46	1.01		E53	5.16	3.95	1.31
E54	4.58	4.51	1.01		E54	5.24	4.01	1.31

E55	4.60	4.52	1.02		E55	5.29	4.07	1.30
E56	4.64	4.56	1.02		E56	5.36	4.12	1.30
E57	4.68	4.58	1.02		E57	5.44	4.18	1.30
E58	4.69	4.65	1.01		E58	5.51	4.29	1.28
E59	4.73	4.73	1.00		E59	5.57	4.35	1.28
E60	4.75	4.77	1.00		E60	5.65	4.39	1.29
E61	4.77	4.86	0.98		E61	5.76	4.43	1.30
E62	4.79	4.92	0.97		E62	5.85	4.48	1.31
E63	4.84	5.00	0.97		E63	5.92	4.53	1.31
E64	4.92	5.09	0.97		E64	5.99	4.61	1.30
E65	5.00	5.16	0.97		E65	6.06	4.63	1.31
E66	5.07	5.23	0.97		E66	6.15	4.66	1.32
E67	5.15	5.31	0.97		E67	6.18	4.69	1.32
E68	5.19	5.37	0.97		E68	6.22	4.71	1.32
E69	5.23	5.42	0.96		E69	6.28	4.76	1.32
E70	5.32	5.48	0.97		E70	6.32	4.83	1.31
E71	5.37	5.54	0.97		E71	6.39	4.87	1.31
E72	5.43	5.58	0.97		E72	6.45	4.91	1.32
E73	5.49	5.62	0.98		E73	6.51	4.94	1.32
E74	5.56	5.64	0.99		E74	6.60	4.96	1.33
E75	5.57	5.64	0.99		E75	6.62	4.97	1.33
E76	5.63	5.64	1.00		E76	6.66	4.98	1.34
E77	5.60	5.64	0.99		E77	6.71	5.00	1.34
E78	5.67	5.64	1.01		E78	6.74	5.00	1.35
E79	5.65	5.62	1.01		E79	6.80	5.04	1.35
E80	5.72	5.66	1.01		E80	6.85	5.12	1.34
E81	5.77	5.73	1.01		E81	6.86	5.15	1.33
E82	5.82	5.80	1.00		E82	6.91	5.19	1.33
E83	5.83	5.83	1.00		E83	6.91	5.24	1.32
E84	5.87	5.92	0.99		E84	6.94	5.26	1.32
E85	5.92	6.00	0.99		E85	6.99	5.29	1.32
E86	5.95	6.03	0.99		E86	7.00	5.34	1.31
E87	6.00	6.09	0.99		E87	7.02	5.39	1.30
E88	6.04	6.14	0.98		E88	7.07	5.46	1.30
E89	6.11	6.17	0.99		E89	7.10	5.53	1.28
E90	6.17	6.22	0.99		E90	7.15	5.59	1.28
E91	6.22	6.26	0.99		E91	7.17	5.62	1.28
E92	6.24	6.32	0.99		E92	7.19	5.69	1.26
E93	6.30	6.35	0.99		E93	7.21	5.77	1.25
E94	6.40	6.40	1.00		E94	7.27	5.82	1.25
E95	6.47	6.44	1.00		E95	7.31	5.86	1.25
E96	6.54	6.51	1.00		E96	7.39	5.90	1.25
E97	6.56	6.54	1.00		E97	7.41	5.92	1.25
E98	6.58	6.58	1.00		E98	7.51	5.97	1.26
E99	6.60	6.63	1.00		E99	7.57	6.01	1.26
E100	6.61	6.64	1.00		E100	7.60	6.08	1.25

