**Crypto Currency Conundrum[[1]](#footnote-1)**

For Classroom discussion only

“I understand that crypto currencies are banned in India. It is the same in China and South Korea also”, said Ratnamala.

“Not really. All that the Finance Minister said was ‘The government does not consider cryptocurrencies as legal tender or coin and will take all measures to eliminate use of these crypto-assets in financing illegitimate activities, or as part of the payment system’. You should actually read the article in Times of India which appeared on 2nd Feb 2018. I will get you a copy of the same. I know, there is a lot of debate going on about Bitcoin and it is getting a bad name mainly because of two reasons. The first is that “WannaCry” created the scare and the very fact that the ransom was demanded to be paid in Bitcoins added to the concern about its possible linkage with financial illegal activities (see Box 1). The second was the phenomenally large increase in its dollar value. Even I agree that such an increase is not sustainable and it is certain that its dollar value is going to plunge very soon”, replied Karthik Skanda.

Karthik Skanda is the managing director of “Vins Investment Advisory Services (VIAS)”, which has a large clientele and they have been ensuring fairly good returns on the investments of their clients. VIAS is very selective with respect to their clients. They accept only High Net worth Individuals (HNI’s) as their clients. In order to enrol as a client of VIAS, one has to assure an investment of Rs. 10 million at the minimum. In addition, they should have a fairly high risk bearing ability. VIAS keeps scanning the environment for good, albeit somewhat risky investments and advise the clients on various opportunities. The advice is individual specific and designed to meet the risk profile of the client. Once the client agrees to the advice, VIAS will carry out the necessary processes to make the investments and also keeps track of them on behalf of the clients. Ratnamala is one of the executives who connects directly with the clients.

“We do not suggest that they invest in Bitcoin. It is already over-priced and over-heated. We are sure many people are going to burn their fingers on Bitcoin very soon. There are other cryptocurrencies which are a much safer bet. What I would really like you to do is collect data on some of the other crypto currencies. Let us look at the trends in terms of returns. Also analyse the risk component. Try to see which of them gives the best return with minimum risk. You should try to build a portfolio of crypto currencies so that we maximize the returns with minimum risk”.

“What happens if Government of India bans crypto currencies?” asked Ratnamala.

“I am absolutely certain that we should not take any chances on that front. If such a thing happens, we will liquidate all the investments. I am sure it is very unlikely to happen”.

Ratnamala has spent the next 6 days collecting various details with respect to different crypto currencies for the past half year. She had calculated the weekly returns and summarized the data. She knows that the variance of the weekly returns is a good indicator for the risk involved in the investment. She felt that the weekly returns of each of the crypto currencies follow normal distribution.

**--- Question: what happens if the weekly returns don’t follow a normal distribution? What advantage do we get of normally distributed feature?**

The data corresponding to these four crypto currencies, along with the mean and standard deviations are presented in the table below and the following graph.

Table 1. Weekly returns of selected crypto currencies

| Week No. | Weekly Return % | | | |
| --- | --- | --- | --- | --- |
| Ripple | Dash | Ethereum | Litecoin |
| 1 | 11.1 | 7.32 | 16.3 | 17.03 |
| 2 | 10.2 | 9.15 | 14.2 | 17.75 |
| 3 | 10.7 | 7.89 | 14.8 | 16.84 |
| 4 | 10.3 | 6.69 | 15.9 | 15.92 |
| 5 | 8.9 | 10.25 | 14.9 | 16.98 |
| 6 | 10.2 | 6.4 | 15.1 | 17.88 |
| 7 | 11.4 | 7.22 | 15.9 | 17.78 |
| 8 | 9.9 | 9.67 |  | 18.19 |
| 9 | 9.6 | 8.8 | 16.4 | 16.71 |
| 10 | 11.7 | 9.31 | 16.3 | 15.47 |
| 11 | 10.4 | 6.94 | 14.4 | 15.45 |
| 12 | 9.6 | 8.01 | 15.4 | 17.71 |
| 13 | 11.7 | 6.29 | 16.1 | 17.23 |
| 14 | 9 | 7.24 | 12.9 | 16.49 |
| 15 | 12.2 | 7.62 | 15.2 |  |
| 16 | 10.8 | 9.52 | 13.6 | 15.33 |
| 17 | 10 | 7.05 | 14.6 | 16.42 |
| 18 | 9 | 8.11 | 16.3 | 18.72 |
| 19 | 10.9 | 9.3 | 16 | 18.6 |
| 20 | 9.3 | 9.43 | 14.2 | 19.19 |
| 21 | 11.6 | 7.24 |  | 15.94 |
| 22 | 11.8 | 8.35 | 14.9 | 18.87 |
| 23 | 10.1 | 8.94 | 12.8 | 16.15 |
| 24 | 11.5 |  | 12.9 | 16.86 |
| 25 | 12.1 | 6.94 | 15.9 | 17.47 |
| 26 | 8.9 | 6.65 | 13.5 | 18.88 |
| Average | 10.5 | 8.01 | 14.94 | 17.19 |
| Standard Deviation | 1.05 | 1.18 | 1.17 | 1.15 |

Figure 1. Graph showing weekly trend in returns.

Ratnamala wants to be sure, beyond reasonable doubt, that there is a difference in the weekly returns between the four crypto currencies. In addition, she would also like to check if one or more of the crypto currencies have a higher risk.

She started wondering whether she can create a portfolio with these four crypto currencies in order to minimize the risk while maximizing the return.

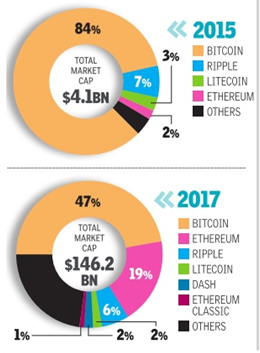
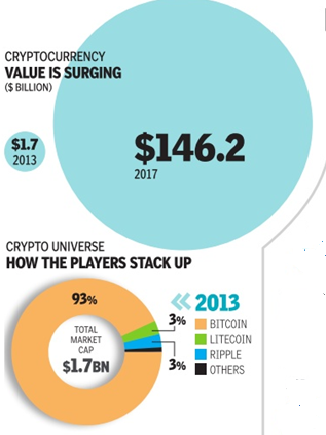


Figure 2 . Growth of Crypto Currencies

Box 1. Extract from Wikipedia on WannaCry

***WannaCry – Extract from Wikipedia.org.***

The **WannaCry ransomware attack** was a May 2017 [worldwide](https://en.wikipedia.org/wiki/Global_issue) [cyberattack](https://en.wikipedia.org/wiki/Cyberattack) by the WannaCry [ransomware](https://en.wikipedia.org/wiki/Ransomware) [cryptoworm](https://en.wikipedia.org/wiki/Cryptovirology), which targeted computers running the [Microsoft Windows](https://en.wikipedia.org/wiki/Microsoft_Windows) [operating system](https://en.wikipedia.org/wiki/Operating_system) by encrypting data and demanding ransom payments in the [Bitcoin](https://en.wikipedia.org/wiki/Bitcoin) [cryptocurrency](https://en.wikipedia.org/wiki/Cryptocurrency). It propagated through [EternalBlue](https://en.wikipedia.org/wiki/EternalBlue), an exploit in older Windows systems released by [The Shadow Brokers](https://en.wikipedia.org/wiki/The_Shadow_Brokers) a few months prior to the attack. While [Microsoft](https://en.wikipedia.org/wiki/Microsoft) had released patches previously to close the exploit, much of WannaCry's spread was from organizations that had not applied these, or were using older Windows systems that were past their [end-of-life](https://en.wikipedia.org/wiki/End-of-life_(product)). WannaCry also took advantage of installing [backdoors](https://en.wikipedia.org/wiki/Backdoor_(computing)) onto infected systems.

The attack was stopped within a few days of its discovery due to emergency patches released by Microsoft, and the discovery of a [kill switch](https://en.wikipedia.org/wiki/Kill_switch) that prevented infected computers from spreading WannaCry further. The attack was estimated to have affected more than 200,000 computers across 150 countries, with total damages ranging from hundreds of millions to billions of [dollars](https://en.wikipedia.org/wiki/United_States_dollar). Security experts believed from preliminary evaluation of the worm that the attack originated from North Korea or agencies working for the country.

In December 2017, the [United States](https://en.wikipedia.org/wiki/United_States), [United Kingdom](https://en.wikipedia.org/wiki/United_Kingdom) and [Australia](https://en.wikipedia.org/wiki/Australia) formally asserted that [North Korea](https://en.wikipedia.org/wiki/North_Korea) was behind the attack.

More details available at <https://en.wikipedia.org/wiki/WannaCry_ransomware_attack>

Box 2. News item from Times of India dated 2 Feb 2018.

**Crypto cash not legal; but wait, it’s not illegal**

*TEAM TOI*

2 Feb 2018

With all the buzz around bitcoin, did the Budget just do a buzzkill? Enthusiasts of cryptocurrency in India have come up with different interpretations of the finance minister’s Budget speech, with some claiming that it had been declared illegal. What the FM actually said was that the government did not consider “cryptocurrencies legal tender or coin and will take all measures to eliminate use of these crypto assets in financing illegitimate activities or as part of the payment system”.

For the uninitiated, cryptocurrency is a digital currency where encryption techniques are used to regulate the generation of units of currency and verify the transfer of funds, operating independently of a central bank.

Nischint Sanghavi, head of exchange at Zebpay, which is a bitcoin exchange, points out that the speech simply reiterated the RBI’s stand that cryptocurrency is not recognised as legal tender in India. “This is being misreported as bitcoin is illegal. This is not true,” said Sanghavi, adding that bitcoin exchanges in India adopted the highest standards of KYC with transactions that are transparent and via bank accounts.

Richie Sancheti, partner with the law firm of Nishith Desai Associates, said a case-to-case view may need to be taken on whether income from virtual currency is treated as “capital gains” or “profits and gains of business” keeping in mind the facts and circumstances of each transaction. “In any case, given the level of scrutiny for tax compliance, it is advisable to ensure that inventory of cryptocurrency held is valued accurately and all taxes paid as and when due,” added Sancheti. If the bitcoins are held for regular trading and the transactions are substantial and frequent, the net profits on sale of bitcoins would be business income.

With high interest from investors, cryptocash is already under the tax lens. Last month, the I-T department sent notices to those transacting in cryptocurrency. Clarity was expected in this budget, but now there are fears of more litigation.

Jaitley, however, made it clear that the government is not against blockchain, the technology that underpins cryptocurrencies. “The government will explore use of blockchain technology proactively for ushering in the digital economy,” he said.

The Blockchain and Cryptocurrency Committee of India (BACC) — a lobby grouping of cryptocurrency exchanges operating in India — welcomed Jaitley’s remarks, viewing them as a possibility of government regulation in the future to check illicit activity.

<https://timesofindia.indiatimes.com/business/india-business/budget-2018-crypto-cash-not-legal-but-wait-its-not-illegal/articleshow/62748323.cms>

**Crypto Currency Conundrum**

(Chapter 2 – Mitigate Risk)

Ratnamala has built a portfolio of the four crypto currencies. The portfolio is such that it minimizes the risk while assuring a certain guaranteed return on the investment. While carrying out her research on the risk minimization strategies, she came across a concept called “financial options”. Further research on financial options brought her to “call” and “put” options.

A *call option* gives the owner of the option, the right to buy, without any obligation, a share for a price called the *exercise price*. A *put option* gives the owner of the option the right to sell, without any obligation, a share for the exercise price.

When Ratnamala presented her portfolio to Karthik, Karthik suggested that they should look deeper into each of the crypto currencies. He suggested that Ratnamala should start with Ripple because it has the lowest variance as well as high proportion in the portfolio. He wanted to know if they can take advantage of the financial options available with these crypto currencies. He posed two questions to Ratnamala:

1. Should we go for call or put options?
2. Can we consider going short and/or long with these currencies?

He also told Ratnamala that he heard about “Black and Scholes” model which is fundamental to financial options. Ratnamala said that she will start with Ripple and also look into various aspects of financial options. She said that she will try and put together all the information that she can get on Black and Scholes model (See Appendix 1 and Appendix 2).

Ratnamala collected the US$-Ripple data for one complete year. The data consisted of daily Open, High, Low and Close prices of Ripple in US dollars. The data is presented in Figure 3. Karthik and Ratnamala noticed that there is a decreasing trend, both in short term (recent data) as well as in long term. Based on this conclusion, they decided on put options. Ratnamala summarized various put options available on one of the Crypto Currency exchanges, as presented in Table 2.

Table 2. Put options available (all for 6 months period)

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Put Option Information** | | | | | | | |
| Exercise Price | $ 0.2000 | $ 0.2500 | $ 0.3000 | $ 0.3500 | $ 0.4000 | $ 0.4500 | $ 0.5000 |
| Premium | $ 0.0125 | $ 0.0235 | $ 0.0400 | $ 0.0600 | $ 0.1050 | $ 0.1350 | $ 0.2250 |

The exercise or strike price is the price at which the option owner can buy or sell the underlying asset. The call option value (C) at expiration is the maximum of two values: (1) zero and (2) the difference between the underlying asset value (S) at the time when the asset is bought at maturity and the exercise price (X) at maturity: C = Max [0, S – X ]

The put option value (P) at expiration is the maximum of two values: (1) zero and (2) the difference between the exercise price (X) at maturity and the underlying asset value (S) when the asset is sold at maturity: P = Max [0, X – S]

A call option is in the money if (S – X) > 0, at the money if (S – X) = 0, out of the money if (S – X) < 0.

A put option is in the money if (S – X) < 0, at the money if (S – X) = 0, out of the money if (S – X) > 0.

Figure 3. US$ prices of Ripple

**Appendix 1**

**Call Option**

Buy one option on the underlying stock of NSIS today at the market price of Rs. 2 that gives you a right — without any obligation whatsoever — to buy the stock one year from now at a price of Rs. 35. One year from now, if NSIS’s stock price drops below Rs. 35, you can walk away with no obligation to buy the stock (of course you lose the Rs. 2 paid to acquire the option).

If the stock price goes above Rs. 35, to say Rs. 55, you will exercise the option and buy one share of the stock by paying Rs. 35. This would be worth Rs. 55. You make a gross profit of Rs. 20 and net profit of Rs. 18.

You would exercise your option (i.e., buy the stock) only if it goes above your exercise price; otherwise, you would walk away and take your up-front fee as a loss.

**Put Option**

If you believe that the stock price of NSIS will be below Rs. 35 a share, one year from now, you may buy one option of the stock at the market price of Rs. 2. This option gives you a right — with no obligation — to sell the stock one year from now at a price of Rs. 35 per share.

If the stock price (Market price) is above Rs. 35 per share on that day, you will not exercise the option. If the stock price drops below Rs. 35, say Rs.20 (Market price), you will exercise your option to sell one share of the stock worth Rs. 20 for a price of Rs. 35, making a gross profit of Rs. 15 and a net profit of Rs. 13.

**Long and Short Position**

In a long position, the investor is hoping for the price to rise. An investor in a long position will profit from a rise in price. The typical stock purchase is a long stock asset purchase.

A long call position is one where an investor purchases a call option. Thus, a long call also benefits from a rise in the underlying assets price.

A long put position involves the purchase of a put option. The logic behind the “long” aspect of the put follows the same logic of the long call. A put option rises in value when the underlying asset drops in value. A long put rises in value with a drop in the underlying asset.

A short position is the exact opposite of a long position. The investor hopes for and benefits from a drop in the price of the security. When the investor hopes to profit from a drop in the stock price, he borrows X number of shares of the company from a stockbroker, and then sells the stock at the current market price. When the price drops in the future, the investor purchases the required number of shares at the lower price and returns them to the stockbroker. The difference is the profit.

**Other Short Positions**

Short call positions are entered into when the investor sells, or “writes”, a call option. A short call position is the counter-party to a long call. The writer will profit from the short call position if the value of the call drops, or the value of the underlying asset drops.

Short put positions are entered into when the investor writes a put option. The writer will profit from the position if the value of the put drops, or when the value of the underlying exceeds the strike price of the option.

**Appendix 2**

**Stock Pricing using Log Normal method**

The future stock price can be simulated by using the equation:

Where St is the stock price in time period t

S0 is the current stock price

µ is the annual average

σ is the annual standard deviation

X is a random number generated from standard normal distribution, X ~ N(0,1)

And t is the time period (in years)

µ and σ are calculated using the following procedure:

As a first step, the average log returns, , is calculated using the formula

Similarly, the standard deviation of the daily log returns is calculated as

The daily average log returns is calculated using the formula

Finally, µ and σ are calculated using and

1. Vishnuprasad Nagadevara [↑](#footnote-ref-1)