

## **SYS-660-B: Decision and Risk Analysis**

### **Decision Analysis for Regulation of Cryptocurrencies using Multi-Attribute Utility Theory**



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## Background Research:

### Introduction:

A cryptocurrency is a digital asset designed to work as a medium of exchange that uses cryptography to secure its transactions. In other word, it is a virtual currency in which encryption techniques are used to regulate the generation of units of currency and verify the transfer of funds, operating independently of a central bank.

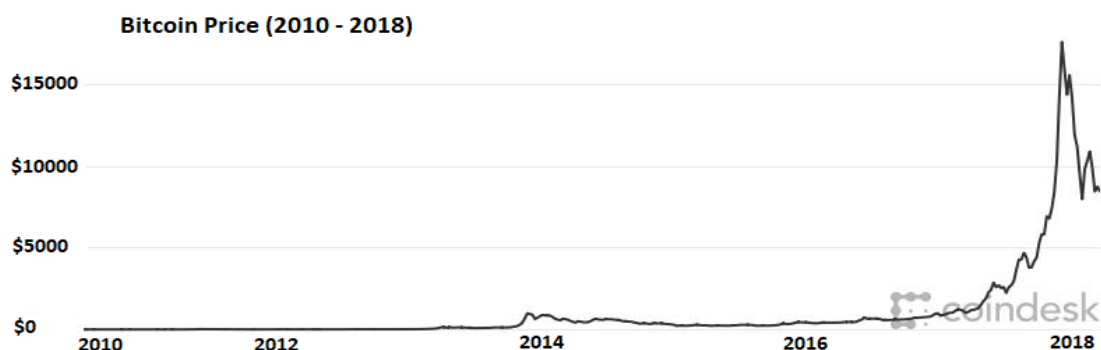
Cryptocurrencies use decentralized control as opposed to centralized electronic money and central banking systems. It works through a blockchain, which is a public transaction database, functioning as a distributed ledger. Essentially, cryptocurrencies are limited entries in a database that no one can change unless specific conditions are fulfilled.

### History:

There have been many attempts at creating a digital currency during the 90s tech boom, with systems like Flooz, Beenz and DigiCash emerging on the market but inevitably failing. There were many different reasons for their failures, such as fraud, financial problems and even frictions between companies' employees and their bosses. These systems utilized a Third-Party approach, meaning that the companies behind them verified and facilitated the transactions. Due to the failures of these companies, the creation of a digital cash system was a lost cause for a long while.

Then, in early 2009, an anonymous programmer or a group of programmers under an alias Satoshi Nakamoto introduced Bitcoin. Nakamoto described it as a 'peer-to-peer electronic cash system.' It is completely decentralized, meaning there are no servers involved and no central controlling authority. The concept closely resembles peer-to-peer networks for file sharing.

Nakamoto released Bitcoin to the public, and a group of enthusiastic supporters began exchanging and mining the currency. By late 2010, the first of what would eventually be dozens of similar cryptocurrencies – including popular alternatives like Litecoin – began appearing. The first public Bitcoin exchanges appeared around this time as well. In late 2012, WordPress became the first major merchant to accept payment in Bitcoin. Others, including Newegg.com (an online electronics retailer), Expedia, and Microsoft, followed. Dozens of merchants now view the world's most popular cryptocurrency as a legitimate payment method.

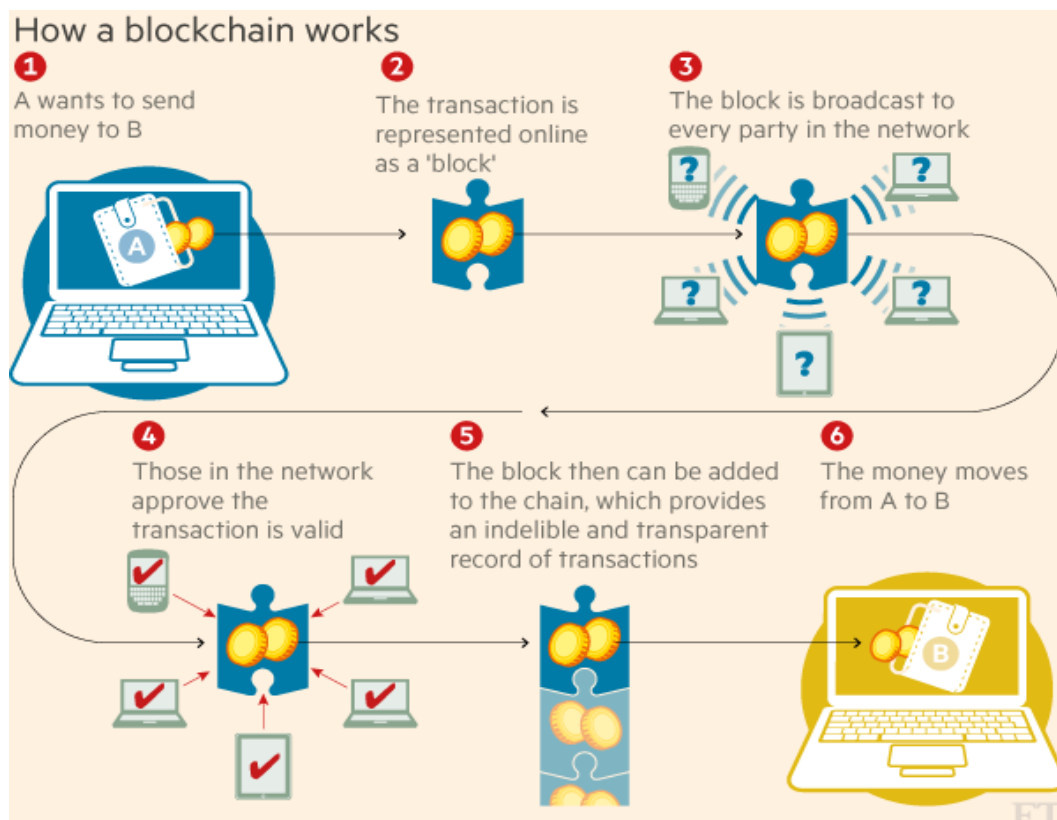


## How it Works:

Cryptocurrencies are based on the blockchain model. A blockchain is the master ledger that records and stores all prior transactions and activity, validating ownership of all units of the currency at any given point in time. As the record of a cryptocurrency's entire transaction history to date, a blockchain has a finite length – containing a finite number of transactions – that increases over time. Each block typically contains a hash pointer as a link to a previous block, a timestamp and transaction data. By design, blockchains are inherently resistant to modification of the data.

Identical copies of the blockchain are stored in every node of the cryptocurrency's software network – the network of decentralized server farms, run by computer-savvy individuals or groups of individuals known as miners, that continually record and authenticate cryptocurrency transactions.

A cryptocurrency transaction technically isn't finalized until it's added to the blockchain, which usually occurs within minutes. Once the transaction is finalized, it's usually irreversible. During the lag time between the transaction's initiation and finalization, the units aren't available for use by either party. Instead, they're held in a sort of escrow – limbo, for all intents and purposes. The blockchain thus prevents double-spending, or the manipulation of cryptocurrency code to allow the same currency units to be duplicated and sent to multiple recipients.



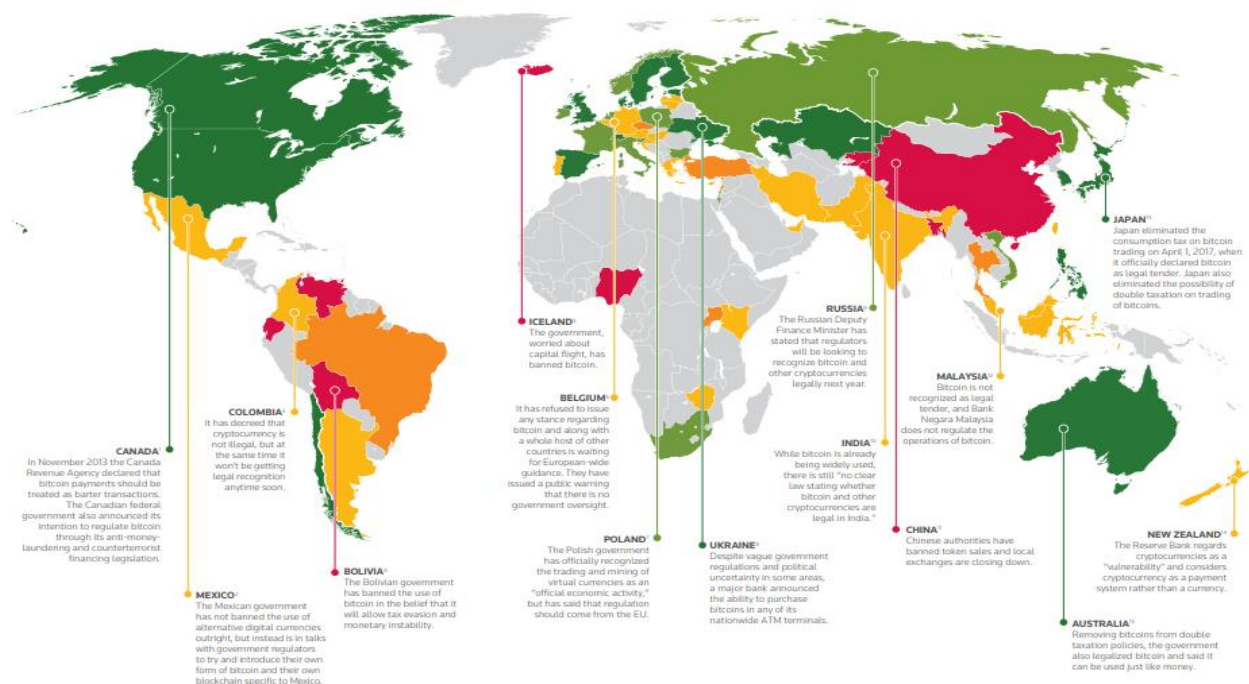
## Regulations:

The cryptocurrency market is in constant flux, regulators worldwide are grappling with ways to control trading, and traditional banking systems are far from isolated from the global phenomenon. There does seem to be an element of confusion worldwide when it comes to cryptocurrency, with some countries readily accepting it, some attempting to steer it, and others banning it.

Russia is drafting a bill to allow cryptocurrency trading on several platforms in the country soon. Japan eliminated the consumption tax on cryptocurrency trading in 2017, when it officially declared Bitcoin as legal tender. Sweden, Denmark, and Estonia are permitting cryptocurrency trading. Venezuela hopes to launch an oil-backed state cryptocurrency to climb out of the country's economic crisis.

In USA, the Commodity Futures Trading Commission (CFTC) has decreed cryptocurrency to be a commodity, and the Internal Revenue Service (IRS) now requires profit made on virtual currency to be declared. However, the country has yet to decide on a federal level what to do about the phenomenon. In Canada, the Revenue Agency has declared that Bitcoin payments should be treated as barter transactions.

India's government has ruled out cryptocurrency as legal tender. Chinese authorities have banned token sales and local exchanges are closing down. The UK and EU are planning a crackdown on cryptocurrency trading. South Korea intends to ban virtual accounts currently used for cryptocurrency trading. Vietnam has banned payments in Bitcoin and other cryptocurrencies.



**Advantages:**

- **Highly Secure** – All your transactions will be secure as it is using NSA created cryptography. It is next to impossible for any person other than the owner of the wallet to make any payment from the wallet.
- **No Third Party** – You are the master of your money. You can keep it in your wallet and use it as per your wishes. There is no third party involved like a bank or agency.
- **Private and Anonymous**– You don't need to share your identity, location, or the details of the transactions made between you and the beneficiary. No information is required to share with the government and the bank regarding the deal.
- **Fast Payment** – Make payment without using your credit card or sign any document. You just need to know the wallet address of person or organization to whom you want to transfer money, payment transfer processing is very fast and happens in a matter of seconds.
- **Easy access** – Cryptocurrency is readily available to the general public. Almost anyone can make use of it. It is a decentralized operation and investors from all over the world have easy access to them.
- **Low or No Fees** – Banks and Payment Processing companies charge fees to conduct payment and fund transfer but with crypto currencies, these fees can be eliminated and are very low.

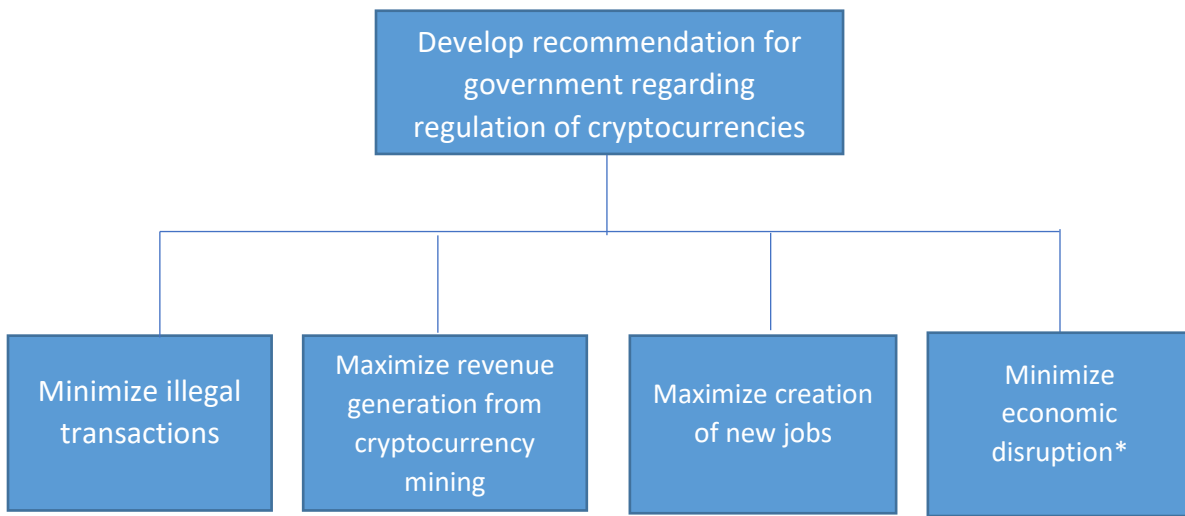
**Disadvantages:**

- **Uncertainty & Volatility** – Since cryptocurrencies are so new, they are also very volatile. This is one of the main reasons mass adoption is taking longer than it should. Many corporations don't want to deal with a form of money that is going to go through huge swings in volatility.
- **Illegal Activities** – Since cryptocurrencies are anonymous, these can be used for illegal and nefarious activities like – money laundering, drug trafficking, and terrorism. This makes it difficult for the government to track such activities.
- **Irreversible Payment** – If you mistakenly pay someone by using cryptocurrency, then there is no way to get a refund of the amount paid. All you can do is to ask the person for a refund and if your request is turned down, then just forget about the money.
- **Losing your Wallet** – There is a possibility of losing your wallet. If you have stored the money in the form of digital currency on your phone or computer, you should remember your password and not lose those devices. Losing your coins means you won't be able to retrieve it.
- **Not Accepted Widely** – Not many websites and companies accept digital currencies yet. Very few countries have legalized the use of cryptocurrencies. It makes it impractical for everyday use.

## Decision Making:

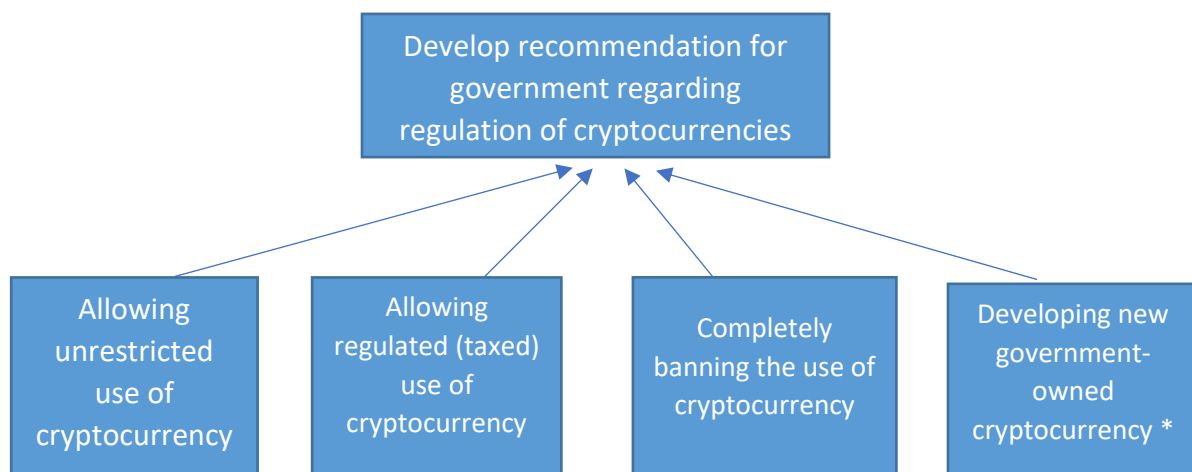
**Decision Context:** The aim of this study is to give a recommendation to the government of India regarding the regulation of cryptocurrencies. This will be done by developing a multi-attribute utility model.

## Fundamental Objectives:



\*We will not use the Minimize economic disruption objective due to lack of data and uncertainty.

## Means Objectives (Alternatives):



\*We will not use the Developing new government-owned cryptocurrency alternative due to lack of data and uncertainty.



### Consequence Table:

		Unrestricted Use	Regulated (Taxed) Use	Ban on Use
Attributes	Units	(Min, Mode, Max)	(Min, Mode, Max)	(Min, Mode, Max)
Minimize illegal transactions	Number	35,000 66,000 97,000	7,000 24,000 51,000	1,000 5,500 9,000
Maximize revenue from mining	Thousand USD (per day)	5,000 9,000 12,000	3,000 5,700 7,500	250 700 1,200
Maximize creation of jobs	Number	12,000 20,000 30,000	7,000 11,000 15,000	10 100 500

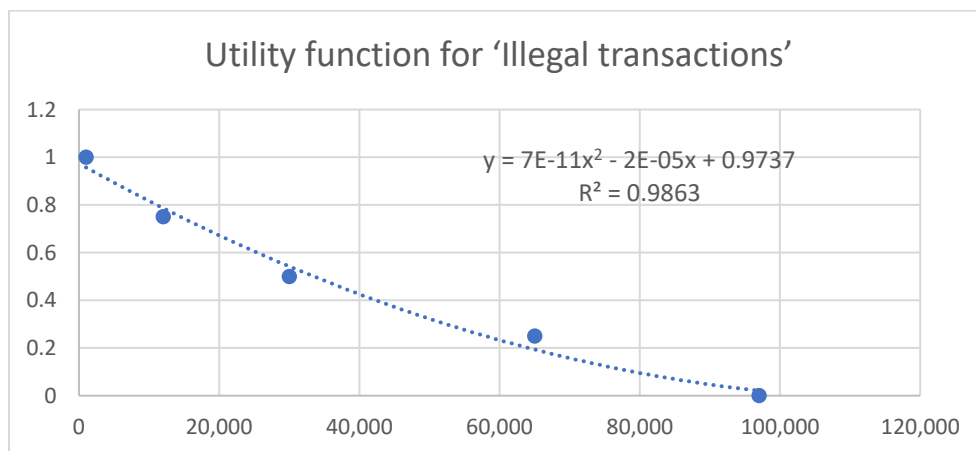
\*This data is obtained from websites investopedia.com and coindesk.com.

### Multi-Attribute Utility Model:

#### Utility function U(i) for 'Illegal transactions':

For U(i), we use the Certainty Equivalent method and assign 1 to the best and 0 to the worst.

Illegal transactions (number)	U(i)
97,000	0
65,000	0.25
30,000	0.5
12,000	0.75
1000	1



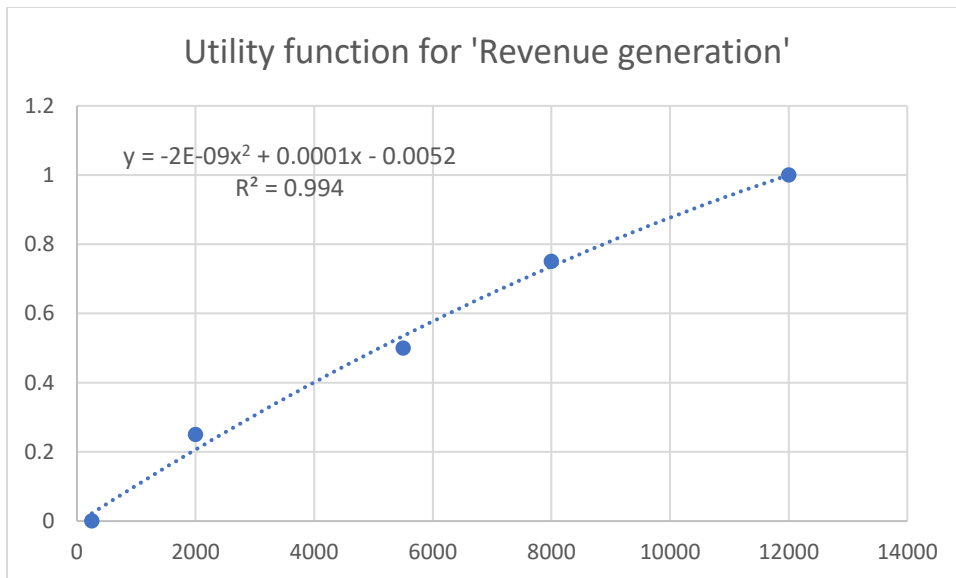
$$U(i) = 0.00000000007i^2 - 0.00002i + 0.9737$$



### Utility function for U(r) 'Revenue generation from cryptocurrency mining':

For U(r), we use the Certainty Equivalent method and assign 1 to the best and 0 to the worst.

Revenue generation (thousand USD per day)	U(r)
250	0
2,000	0.25
5,500	0.5
8,000	0.75
12,000	1

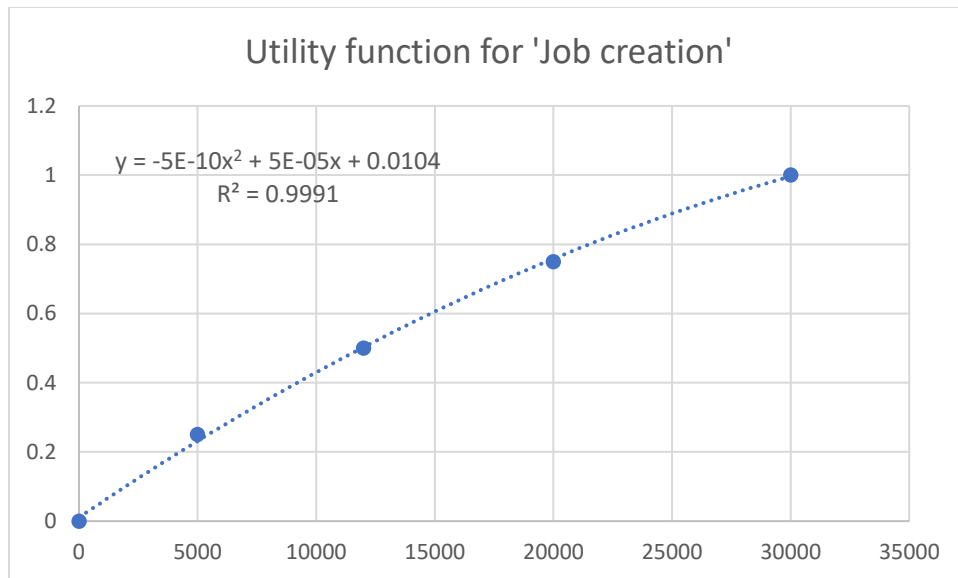


$$U(r) = -0.000000002r^2 + 0.0001r - 0.0052$$

### Utility function for U(c) 'Creation of new jobs':

For U(c), we use the Certainty Equivalent method and assign 1 to the best and 0 to the worst.

Creation of jobs (number)	U(c)
10	0
5,000	0.25
12,000	0.5
20,000	0.75
30,000	1



$$U(c) = -0.0000000005c^2 + 0.00005c + 0.0104$$

#### Assigning Swing Weights:

We using the swings weight method by creating a fictitious worst option and benchmark other attributes with it.

Attribute swung	Consequences	Rank	Rate	Weight
Benchmark	97000, 250, 10	4	0	0
Illegal transactions	1000, 250, 10	2	70	0.333
Revenue generation	97000, 12000, 10	1	100	0.476
Job creation	97000, 250, 30000	3	40	0.190

#### Additive Utility Function:

$$U(i, r, c) = w1*U(i) + w2*U(r) + w3*U(c)$$

Where,

$$U(i) = 0.00000000007i^2 - 0.00002i + 0.9737$$

$$U(r) = -0.0000000002r^2 + 0.0001r - 0.0052$$

$$U(c) = -0.0000000005c^2 + 0.00005c + 0.0104$$

$$w1 = 0.333, w2 = 0.476, w3 = 0.190$$

### Expected Utilities using Monte Carlo Simulation:

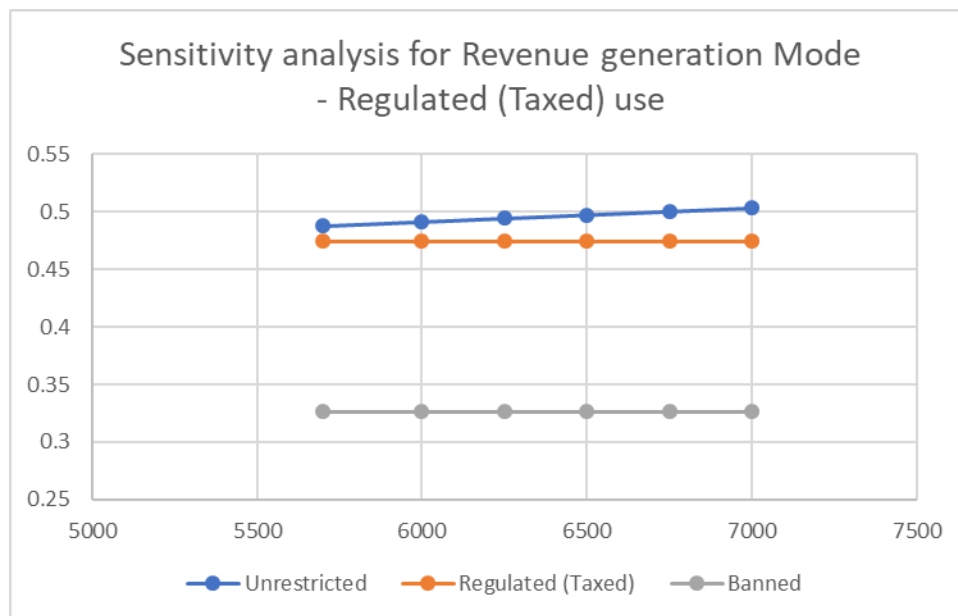
To assess the expected utility for each alternative, we perform a Monte Carlo simulation and averaged the resulting utilities.

Please refer the excel file “**Midterm (Monte Carlo).xlsx**” for Monte Carlo simulation.

	Unrestricted	Regulated (Taxed)	Banned
Expected Utility	0.47502867	0.487625442	0.327055642

We see that the Expected Utility is highest (0.487) for Alternative 2: Allowing regulated (taxed) use of cryptocurrency. Therefore, the government of India should implement alternative 2.

### Sensitivity Analysis:



As the mode of Revenue Generation for Regulated (Taxed) Use is increased from current 5700 to 7000, the expected utility for vector management increased from 0.487 to 0.503. This indicates that it would be further effective as compared to other alternatives. These results turn out to be fairly robust.

## **Final Recommendation:**

The government of India should implement the Alternative 2 i.e. Allow regulated (taxed) use of cryptocurrencies as this alternative has the highest Expected Utility of 0.487. This alternative will enable the government to increase Revenue generation, decrease illegal transactions and increase job creation.

## **References:**

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<https://coincenter.org>

<https://www.coindesk.com>

<https://bitcoinmagazine.com>

<https://blockgeeks.com>