

MINERAL ECONOMICS AND BUSINESS

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Week 5

Lecture 21 : Purpose and Types of Valuation studies

Hello everybody, welcome to this lecture on the purpose and types of valuation studies. In this lecture, we will be dealing with mine valuation, but we will also talk about the different purposes of project valuation, how we conduct this kind of valuation, and the various approaches available for mining project valuation studies. Now, here the concepts we will cover again include market value and valuation, along with the definitions of these terms. And the types of valuation models available—the most important ones being cost, market, or income—and we have also added one more called option pricing. To start with, we will talk about market value and valuation.



The slide features a dark blue background. On the left, a white rounded rectangle contains the title 'CONCEPTS COVERED' in bold black text. Below the title is a list of six items, each preceded by a blue bullet point. On the right side of the slide, there is a vertical rectangular image showing an aerial view of a mining operation at sunset, with yellow excavators and trucks visible in the foreground.

CONCEPTS COVERED

- Market Value and Valuation
- Types of valuation model
- Cost approach
- Market approach
- Income approach
- Option pricing

So, from the word 'value,' we are trying to ask a simple question: What is the value of that mine? Because if you want to purchase or invest in it, then what is the value of that mine, and what is the mine worth? So, when we speak of market value, it means we want

to exchange this for money in monetary terms. It can be defined as the value established in the public market by exchanges between a willing buyer and a willing seller. When neither is under duress to complete the transaction, the degree of willingness of the buyer and seller, along with the market conditions for sale, will determine the market value fluctuations. So, before we talk about valuation, let us discuss the values associated with the project and the different parameters that can be judged in terms of value.

Market value and Valuation

- The broader question is "what is the value of the mine?" or "what is the mine worth?"
- We are speaking of *market value*
- **Market value is the value (price) established in a public market by exchanges between a willing buyer and a willing seller when neither is under duress to complete the transaction.**
- Market value fluctuates with the *degree of willingness of the buyer and seller* and with the conditions of the sale.



Mineral Economics and Business

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So, value is a term so basic to financial analysis that it can easily be confused. So, there are many types of value. How to measure these values. Some of the approaches differ based on different factors. It can be the salvage value of a machine, a plant, or even the salvage value of a mine when a project is over.

So, what is the salvage value? The replacement value approach capitalized value is also a valuation, book value, assessed value or say insured value. In the salvage value is the net sum over and above the cost of removal and sale realized for a property or asset when it is retired from service, when it has retired from service which is no more in service. So, what is the net value of that? So, it depends on many things like say if it is junk material you can just go by weight for equipment or so, but it can be even repaired and then put into service one second.

Types of value

- Value is a term so basic to financial analysis which cause, perhaps, the greatest amount of misunderstanding in mine valuation studies.
- There are many types of *value*. *Value* refers to a measure of the desirability of ownership of property.
- Some of the approaches are:
 - Salvage value
 - Replacement value
 - Capitalized value
 - Book value
 - Assessed value
 - Insured value



In that case the service value will be different. So, now the replacement value refers to the existing value of the property or asset as determined on the basis what it would cost to replace the property or its service with at least equally satisfactory or comparable property and service. If you want to replace to get one another what money I have to spend to get the similar or satisfactory comparable property and service. Then comes the book value like the book value is the original investment in the property or asset as carried on the corporate book less any cumulative allowance or depreciation amortization these things.

So, there was an original value minus the balances for depreciation and amortization. If you deduct that you get the book value at the end of that year. Again some depreciation is loaded and the book value changes once again. Assessed value is the value entered on the official assessor records as the value of the property, because this is mostly used for the your tax calculations with tax asset tax like that.

And the insured value is at which the property has been insured against loss, if there is a loss or disaster how much we are going to get from the insurance agency. So, that value has to be declared on a rational basis. The capital value otherwise is a property ah the sum of a discounted future annual or net earnings. by the property.

So, the capitalized value concept is synonymous with the income approach value estimation for properties which we will discuss later. Now, we will have the cash flow. So, any project involved involves a certain set of payments cash movements. Some of them are made by the company in order to run the project that means, we are talking about cash outflow and some of them are payments made by the project to the company. So, it is a cash inflow cash inflow.

Salvage Value:

- Salvage is the net sum, over and above the cost of removal and sale, realized for a property or asset when it is retired from service.

Replacement Value:

- Replacement value refers to the existing value of a property or asset as determined on the basis of what it would cost to replace the property or its service with at least equally satisfactory and comparable property and service.
- **Book Value:** Book value is the original investment in the property or asset as carried on the corporate books *less* any cumulative allowance for depreciation or amortization entered on the books.



So, this need net results of the payment in a given time period may lead to cash inflows and cash outflows. which would again sum up and indicate either a positive or negative sign right. Because if the if the positive amount is less and the negative is more so naturally the net flow will be negative. It has been shown like this the cash flow equals to annual cash flow inflow minus annual cash outflow it can be positive or say negative. So, some of the cash inflows which is a very important technique ah the cash inflows and cash outflows.

Assessed Value:

- The assessed value of a property is the value entered on the official assessor's records as the value of the property applicable in determining the amount of ad valorem taxes to be paid by the property.

Insured Value:

- The insured value of a property refers to that value at which the property has been insured against loss or disaster.

Capitalized Value:

- The capitalized value of a property is the sum of discounted future annual net earnings generated by the property. The capitalized value concept is synonymous with the income approach to value estimation for properties.



So, the example is like revenue from the sales. So, sales revenue from ore or metal that is cash inflow, salvage realized from the sale of equipment that has been that has retired from service to get the salvage realization cash inflow. Tax credits you pay tax you get some tax refund you get the tax credit. and then return of working capital at the end of mine productive life. So, the money comes back to you, it is a cash inflow.

And some of the cash outflow similarly, exploration expenditure, capital expenditure for development, expansion, equipment, operating costs are regular cash outflow, royalty is a cash outflow, mining tax payment, transportation and further processing charges are also cash outflow. Now, here the cash flow ah will be negative in the beginning, because in the beginning for mining ah projects the expenditure will be much more, the investment will be much more and the return will be in the beginning 0. So, gradually it ah picks up with the start of production phase, it gradually starts becoming positive from very low

Cash flow

- Any project involves a certain set of payments (cash movements). Some of the payments are made by the company in order to run the project; these are called **cash outflow**. Similarly, there are payments made by the project, and these are called **cash inflow**.
- The net result of payment in a given time period (a year) may lead to cash inflows and cash outflows, which would sum up and indicate either a **positive or negative** sign. A series of such outcomes for a given number of years will lead to the cash flow of the project.
- $\text{Cash flow} = \text{Annual cash inflow} - \text{Annual cash outflow}$



and then goes to the full capacity. So, as a convenience for economic analysis we do this cash flow this annual cash flow is assumed to occur at a particular point in time and that is usually the end of the year end of the year.

Some of the cash inflows may include:

- (i) Revenue from sale of ore or metal
- (ii) Salvage realized from sale of equipment
- (iii) Tax credits
- (iv) Return of working capital at the end of mine productive life

Some of the cash outflows may include:

- (i) Exploration expenditure
- (ii) Capital expenditure for development, expansion, equipment
- (iii) Operating cost
- (iv) Royalty
- (v) Mining tax payments
- (vi) Transportation and further processing charges



- A cash-flow analysis is involved with any investment in which income and expenditure are associated.
For a mining-related investment, cash flow will be negative in the beginning, owing to the large capital required for investment. **With the start of production phase, it gradually starts becoming positive.**
- As a convenience for economic analysis, each **annual cash flow is assumed to occur at a particular point in time.** Normally, an end-of-year convention is adopted, whereby future cash flows are assumed to occur at the **end of each year.**
- Cash flows are determined by subtracting the annual outflows from the annual inflows that result from the investment.



For example, for a financial year we take we assume that everything has taken place in the month of March of that financial year finally, and then again start from April to March. So, whatever is happening between April to March cash outflow cash inflow all these things will be determined at the end. So, everything has occurred at that time. So, as I said earlier that the cash flows will be finally, determined by subtracting the outflows from the annual cash inflows. For example, here say the annual cash flows if you are calculating profit:

$$\text{Profits} = \text{Gross income} - \text{Operating cost} - \text{Insurance charges} - \text{Interest on loan capital} - \text{Extraction taxes} - \text{Depreciation}$$

Calculation model for determining annual cash flow:

- $\text{Profits} = \text{Gross income} - \text{Operating cost} - \text{Insurance charges} - \text{Interest on loan capital} - \text{Extraction taxes} - \text{Depreciation}$
- $\text{Cash flow (positive or negative)} = \text{Gross income} - \text{Taxes} + \text{Depreciation} - \text{Repayment of loan capital} - \text{Investment costs}$

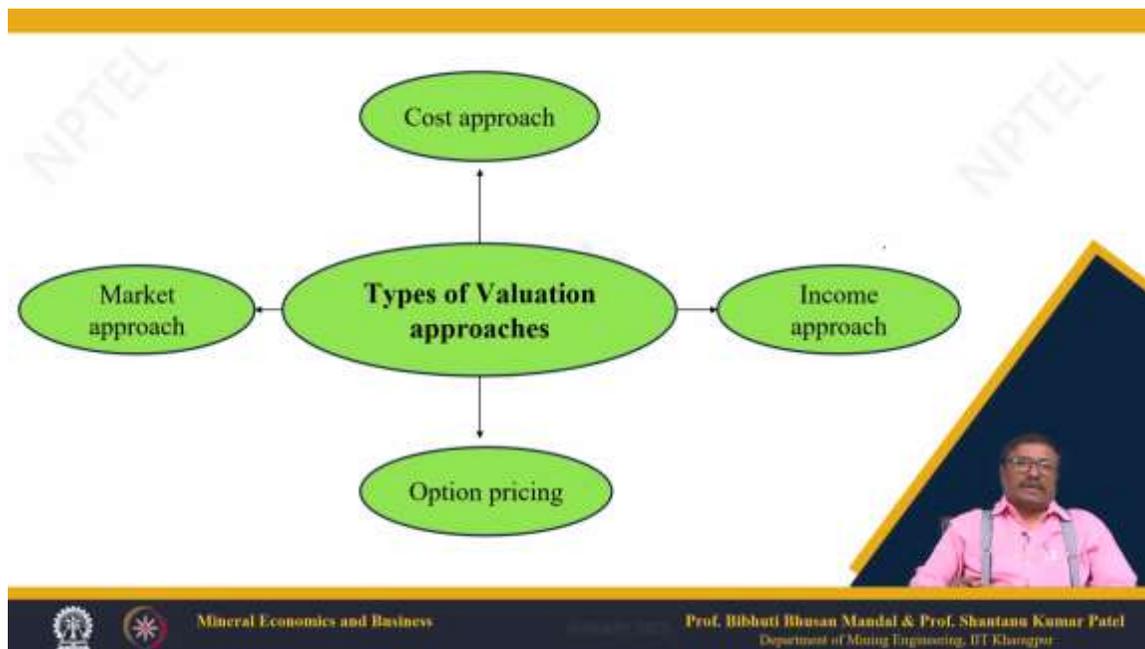
So, the gross income will be the cash inflow. Operating costs will be negative, like outflow, and these are all outflows. Now, here in the cash flow:

$$\text{Cash flow (positive or negative)} = \text{Gross income} - \text{Taxes} + \text{Depreciation} - \text{Repayment of loan capital} - \text{Investment costs}$$

So, these are negative. Like, you have to determine which are rather coming to you—your cash coming back from the project to the company. So, those will be inflows, and which are going from the company towards expenditure of running that project—those will be outflows. The different values we talked about—what and the cash flow, outflow, inflow—because of the purpose that whatever we are going to talk now, these terms will be very often used.

So, the types of valuation approaches. Can be broadly categorized into four: one, two, three, and four. Out of these, these three—the first three—are major. Option pricing is a very special case, but I have added it here for discussion with some examples. But these are the fair value approaches; these are standard practices.

Option pricing is a very, very special case. In the cost approach, to determine the depreciated replacement cost for the asset is taken as the cost approach. That means what it would cost to reproduce the asset with another of identical quality or the state of repair is a replacement type. So, the fundamental concept with this approach is that the purchaser would not be justified in paying more for a property. Than it would cost to acquire the land and construct improvements having comparable quality, assuming no undue delay.



That means, that you are if you are not if you are trying to do the valuation of a property same thing whether it cannot be done somewhere else with the land property and everything is built up. This is rarely applicable in mining because the correlation between construction cost and the value of the property is very very imperfect in case of mining. If one were to build two 100 TPT mines, one in a very rich deposit and one on the economically marginal low grade ore. Then the construction cost might be the same, but the fair market value of the two mines

clearly different. So, this cannot be a standard approach for the mining valuations. Similarly, the value of a concentrator when the ore is getting depleted that time the value or real value of that the concentrator plant lying over there will be very low, but when you are have a good reserve and which is running plant running company in that case the concentrator will be having very high value. Secondly, another problem arises when you try to apply the cost cost approach is for newly discovered mineral properties, which having no surface improvement or equipment of any kind green field you can say. The very nature of mineral exploration and mining dictates that the discovery value of an any ore deposit is generally greater than the cost incurred in making that discovery.



Cost Approach

- To determine the depreciated replacement cost for the asset. *What would it cost to reproduce the asset with another of identical quality and state of repair?*
- The fundamental concept with this approach is that a purchaser would not be justified in paying more for a property than it would cost him to acquire land and construct improvements having comparable utility, assuming no undue delay.
- The cost approach is rarely applicable in mining because the correlation between construction costs and the value of the property is very imperfect. If one were to build two 100 tpd mines- one on a very rich ore deposit and one on an economically marginal deposit- construction costs might be very similar, but fair market values of the two mines would clearly be substantially different.



Mineral Economics and Business

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So, it cannot be directly Cost approach is not a good approach for mining because of specific locations will definitely and it is it will differ from place to place. Now if we have if you go for the next one is for the market approach this assumes that the purchaser would not be justified in paying more of a property than it would cost him to acquire an equally desirable substitute property. It has a problem that I will discuss later on that is a that means, I am not buying this one, but I am paying another one. So, this method studies sales and purchase the market for similar assets, the market for similar asset in attempting to determine the market value of that item.

Cost Approach

- Similarly, the value of a concentrator when the ore deposit is depleted, or nearly depleted, is very limited regardless of the reproduction cost of the structure.
- Another problem arises with this approach when applied to newly discovered mineral properties having no surface improvements or equipment of any kind. The very nature of mineral exploration and mining dictates that the discovery value of an ore deposit is generally greater than the cost incurred in making that discovery.



Now, the concept of market value also presumes conditions of an open market where selling and buying occur for a reasonable time. So, you can make your decision based on data from many years, 1 year, or 2 years of knowledge. So, the knowledgeable buyers and sellers So, what will happen is they will make a decision based on a sufficient number of transactions occurring in an open and stable market. So, this is extensively used for residential and agricultural property, but practical problems will definitely arise when you try to apply it to mining transactions, as there are very few sales occurring at a given point in time.

So, the data available is insufficient for you to make a decision. So, if I am purchasing a manganese mine, it does not mean that I will have the data on which to base a decision. So, how many manganese mines are being sold and bought at a given period of time? That is very rare. So, what will happen is you have to look at 30, 40, or 50 years of data

Market (comparable sales) approach

- The market approach assumes a purchaser would not be justified in paying more for a property than it would cost him to acquire an equally desirable substitute property.
- This method studies sales and purchases-the market-for similar assets in attempting to determine the market value for the item in question. **The concept of market value also presumes conditions of an open market, exposure for a reasonable time, knowledgeable buyers and sellers, absence of pressure on either the seller to sell or the buyer to buy, and a sufficient number of transactions to create a stable market.**
- Used extensively for estimating residential and agricultural property values.
- Practical problems when applied to mining transactions:
 - *There are very few sales of mining properties and therefore few comparative data are available.*
 - *Since each mineral deposit is unique in quality, size, geographical location, degree of development, and many other parameters, any market data are of modest value at best.*



from different places, times, countries, and economic and social conditions. So, it is very difficult to compare those things.

So, that is why there are very few sales of mining properties, as we say here, and the comparative data will be unavailable. So, since each mineral deposit is unique in quality, size, and geographical location, as I was saying, the data cannot be compared so easily. So, the market data must not only be from a similar asset but also from a similar point in time—meaning, similar assets at similar points in time can be somewhat compared, and you can make some decisions; otherwise, it will be difficult. So, what will happen in that case is there has to be a judgmental trade-off rather than strict numerical calculations to make valuations. So, the judgmental trade-off will predominate in the market approach.

Market (comparable sales) approach

- To be applicable, the market data must not only be for **similar assets but also for a similar point in time**. In the absence of real or relevant data, the appraiser may estimate value using this approach by developing a model with supporting detailed calculations.
- This method typically involves **judgmental trade-offs rather than strict numerical relationships**. As might be expected, many of the procedures incorporated throughout the model are judgmental in nature, even though the procedures can be explicitly documented.



Now, we are coming to the income or earning approach. With the income approach, the value of an asset or say investment type properties estimated by calculating future annual net earnings generated from the producing property or asset and then discounting this earning stream to the present time using an appropriate interest rate. So, this is very important and you have already studied by this time the time value of money. estimating the value what we do that we try to project the output of this mining project return that is coming every year over say for example, for a period of 30 years.

And then you are using that discounted cash flow technique and bringing those value to the present value, calculating back the future values in terms of present values now. The present value of all future returns are calculated and bringing to one place for the purpose of calculating the net present value. Because of this procedure, many analysts refer to this approach as capitalized income approach. the present value of the income stream is to be derived from the property or estimated from the property. So, when I try to purchase I will not pay more than that I will not pay more than that.

Income (Earnings) approach

- With the income approach, the value of an asset or investment-type property is estimated by calculating future annual net earnings generated from the producing property or asset and then discounting this earnings stream to the present time using an appropriate interest rate.
- Because of this procedure, many analysts refer to this approach as the **capitalized income approach**. The approach assumes that a purchaser would not be justified in paying more to acquire an income-producing property than the **present value of the income stream to be derived from the property.**
- It is possible to arrive at a value estimate by combining the selling price of the commodity *produced* with the associated costs of producing the commodity from the property in question.



So, the present value can be net present value can be estimated and then a decision can be taken. So, it is as I said it is possible to arrive at a value estimate by combining the selling price of the commodity produced with the associated cost of producing the commodity. Of course, the selling price of the commodity also need to be forecast otherwise what happens that the time value again there cannot be applied. So, by properly incorporating this data in the DCF analysis or discounted flow analysis cash flow analysis, it is possible to arrive at the estimate of the property value when there is no ah no actual production. So, you can estimate that having the knowledge of that deposit and the engineering technical feasibility that can be studied a detailed feasibility study can be or even a pre feasibility study can be done through which we can understand what could be the value of this property.

So, it is not a direct estimate of the or computation of the value, but rather it is the estimate of the potential this is very important. It is estimate of the potential income that can be generated from the mining the commodity and selling the product. Now the mines as are having limited horizons operating horizons and they are well established, there are well established markets for mineral commodities. So, the income approach is widely used in valuation of mineral properties. Not only that most taxing authorities employ some variation of this approach for determining the mine value for the purpose of calculating the taxes.



Income (Earnings) approach

- By properly incorporating this data into a **discounted cash flow analysis**, it is possible to arrive at an estimate of property value even in the **absence of actual production**.
- The analyst must remember, however, that the value estimate thus obtained is **not a direct estimate of the market value of a commodity in place, but rather it is an estimate of potential income generated from mining the commodity and selling the product**.
- Because mines have limited operating horizons and because there are well-established markets for mineral commodities, **the income approach is used widely in valuing mineral properties**. The approach is used commonly by the mining industry in assessing investment rates of return and determining appropriate purchase prices for mines or mineral prospects.
- Also, most taxing authorities employ some variation of the income approach when determining mine values for the purpose of ad valorem taxation.



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From a practical standpoint, the income approach has the capability of incorporating more obtainable and realistic data for analysis. That is why we take this as a preferred approach. This income approach is consistent with the generally accepted definition of the value of a mineral property. This value is an estimated value of its potential to give you the return. So, the value of a mining or mineral property as a specific point of time is simply the present value of all anticipated future net annual proceeds occurring from the ownership.

accruing from now, if you are the owner what net annual proceeds will get. So, when you add all those things that gives you the value of the project. By the very nature of this income approach one is necessarily projecting the future cost and prices both. So, the

preferred method we can say so far property valuation and that can be used for commercial practice is the income approach. Now comes an additional ah very special type of valuation where ah we have the option pricing is like a stock must have heard about these are we will also discuss these things later on when you talk about the shares, equities and all these things.

Income (Earnings) approach

- From a practical standpoint, the income approach has the capability of incorporating more obtainable, realistic data for analysis and, therefore, is the preferred approach. In addition, the income approach is consistent with the generally accepted definition for the value of a mineral property.
- That is, the value of a mining or mineral property, at a specific point in time, is simply the present value of all anticipated future net annual proceeds accruing from ownership.
- By the very nature of the income approach, one is necessarily projecting future costs and prices.
- The preferred method for mining property valuation and the one unanimously used in commercial practice is the **income approach**.



The principle of this approach is that a mine is analogous to a stock. This is an assumption here—a very special case—to estimate its market value. It becomes only rather helpful when the output prices are uncertain, and it is possible to open and close a mine in response to variations in output price. That means if the output price goes up, you can operate. There is a tendency that it will continue. You can operate if there is a rise, and you can stop if there is a fall, which is very difficult for a mine. In certain cases, it is possible; in most cases, it is difficult. So, just to say that stopping it here for 2 months, 6 months, or 8 months is difficult for mining.

Even then, we will discuss cases where this can happen—where it is possible to employ outsourced manpower for a certain period and then say, 'You go unless I give you a call; do not come back,' like that. So, the assumption is that it is possible to open and close the mine in response to a significant variation in the output price. If it is not in your favor, then you do not operate; if it is promising and in your favor, you operate it. The conventional income approach does not recognize the value of this option to shut down; it is a continuous process. The option to shut down exists when it is possible to open a mine

in response to changes, as I said. The value of the option depends on the production cost, current product prices, and the volatility of the market or product in the market.

Option pricing

- The principle of this approach is that a mine is analogous to a stock in order to estimate its market value. This approach is very helpful when output prices are uncertain, and it is possible to open and close a mine in response to variation in output price.
- The conventional income approach does not recognize the value of the option to shut down. The option to shut down exists when it is possible to open a mine in response to changes in product prices. The value of the option depends on production cost, current product prices, and the volatility of product prices.
- It is claimed that valuation procedure related to option pricing theory provides an alternative to discounted cash-flow analysis. This procedure is advantageous because it does not require explicit cash-flow forecasts or risk-adjusted discount rates.



So, it is claimed that the valuation procedure relates to option pricing. It provides an alternative to DCF analysis, but this is in a very special case. This procedure is advantageous because it does not require explicit cash flow forecasts or risk-adjusted discount rates. We will just give you an example. So, for the option value, for the given data—for example, the current iron ore price is 7,500 rupees per ton.

The strike price for the cost of opening the mine per ton of ore extracted, for example, is equal to 6000. The time to expiration is 3 years. The risk-free interest is 6 percent, and the volatility of the iron ore prices, plus or minus, say, 25 percent, goes up and down. The most well-known formula for using the option pricing method is the Black-Scholes formula for a call option, where we have two important terms: d_1 and d_2 . d_1 is calculated as:

$$d_1 = \frac{\ln(S/K) + (r + 0.5 \times \sigma^2) \times T}{\sigma \times (T)^{0.5}}$$

Now, d_2 is:

$$d_2 = d_1 - \sigma \times (T)^{0.5}$$

From there, the call option is represented by a value C , which can be calculated as:

- $C = S \times N(d_1) - K \times e^{-rT} \times N(d_2)$, where N is normal distribution

Option pricing: Example

Find the appropriate option value for the given data.

- Current iron ore price (S) = ₹7,500 per ton ✓
- Strike price (K) (cost of opening the mine per ton of iron ore extracted) = ₹6,000 ✓
- Time to expiration (T) = 3 years ✓
- Risk-free interest rate (r) = 6% (0.06)
- Volatility of iron ore prices (σ) = 25% (0.25)

Sol: The Black-Scholes formula for a call option is:

- $d_1 = \frac{\ln(S/K) + (r + 0.5 \times \sigma^2) \times T}{\sigma \times (T)^{0.5}}$
- $d_2 = d_1 - \sigma \times (T)^{0.5}$
- $C = S \times N(d_1) - K \times e^{-rT} \times N(d_2)$, where N is normal distribution.



Let us calculate using the values that we have given in the previous slide. Simply by substituting the values here, we get that D1 is 1.177, and from D1, using this part and putting the value of D1 here, along with sigma and t, we get D2 to be 0.7147. Now, using the standard normal table, we can get the values of the distribution as 0.8742 and 0.7624, respectively, for N(D1) and N(D2). Now, we are determining the value of C using the formula that we have, the equation that we have given in the previous slide.

So, by replacing the N(D1) and N(D2) values and K values here, we know the value of D also. So, from there, we get the option value, which is given as C is 2736 rupees. The option value, 2736 per ton of iron ore, represents the premium. for waiting before committing to mining operations.

$$d_1 = \frac{\ln(S/K) + (r + 0.5 \times \sigma^2) \times T}{\sigma \times (T)^{0.5}}$$

$$d_1 = (\ln(7500/6000) + (0.06 + 0.5 \times (0.25)^2) \times 3) / (0.25 \times 3^{0.5})$$

$$d_1 = (0.2231 + 0.27375) / (0.433)$$

$$d_1 = 1.1477$$

$$d_2 = d_1 - \sigma \times (T)^{0.5}$$

$$d_2 = 1.1477 - 0.25 \times (3)^{0.5}$$

$$d_2 = 0.7147$$

Using standard normal tables:

$$N(1.1477) \approx 0.8742$$

$$N(0.7147) \approx 0.7624$$



That means, when this comes you can say that now we can go open the mining operations. If I do not know prices are highly volatile the option value will increase making the option approach more beneficial. Because here the if you change the those values that we have given in the previous equation and the fluctuations is more then the option value approach if applicable will be more beneficial than the existing discounted cash flow techniques. As I have told several times during this lecture is that the option pricing like applicability of that in gold mining in certain the applicability of the option pricing

in gold mining has been successfully done in many commodities also, but for general application of this particular ah this particular technique is not always possible right very special case. So, we can say that overall depending on whatever we have discussed so far, we can say that we should go for the income approach using the cash flow and the discounted cash flow techniques to find out the ah all the present values and the net present values as the ah preferred valuation mine valuation technique for the mining project. The others have their special special application area, specially the option pricing General applicability regarding the general applicability I would rather I must say that the income approach is the most popular and appropriate technique for a mining project valuation.

$$C = S \times N(d_1) - K \times e^{-rt} \times N(d_2)$$

$$C = (7500 \times 0.8742) - (6000 \times e^{-(0.06)(3)} \times 0.7642)$$

$$C = 6556.5 - 3820.1$$

$$C = 2736.55$$

$$\text{Option Value} = ₹2,736.55$$

- The **option value (₹2,736.55 per ton of iron ore)** represents the **premium for waiting** before committing to mining operations.
- If iron ore prices are highly volatile, the **option value increases**, making the option approach more beneficial.



We have certain references you can use the mine mineral project valuation book by Jones, Lilford and Chan also the Professor Ray, Professor Sinha's book. You can see this

one also and there is a good amount of material in option pricing models and volatility using excel. This is a practical demonstration by F.D. Rouah This is also good reference.



The slide features a dark blue background. At the top left, a light grey rounded rectangle contains the word 'REFERENCES' in bold, black, uppercase letters. Below this, a larger light grey rounded rectangle contains a bulleted list of three references. To the right of the text is a square photograph with rounded corners showing several large, clear, faceted diamonds resting on a dark, textured surface.

REFERENCES

- *Mineral Project Valuation Hardcover* by O Jones, E Lilford and F Chun
- *Mine and Mineral Economics* by Subhash C Ray and Indra N Sinha
- *Option Pricing Models and Volatility Using Excel- VBA: 361* by F D Rouah

So far, we have discussed different valuation approaches and techniques, and there are very special techniques also, like option pricing, that I have discussed. From here, we can say that the income approach or the cash flow technique is the most appropriate technique. This will be discussed extensively in the following lectures, and you can understand the utility of these particular ideas of cash flow and the income approach. Thank you very much.