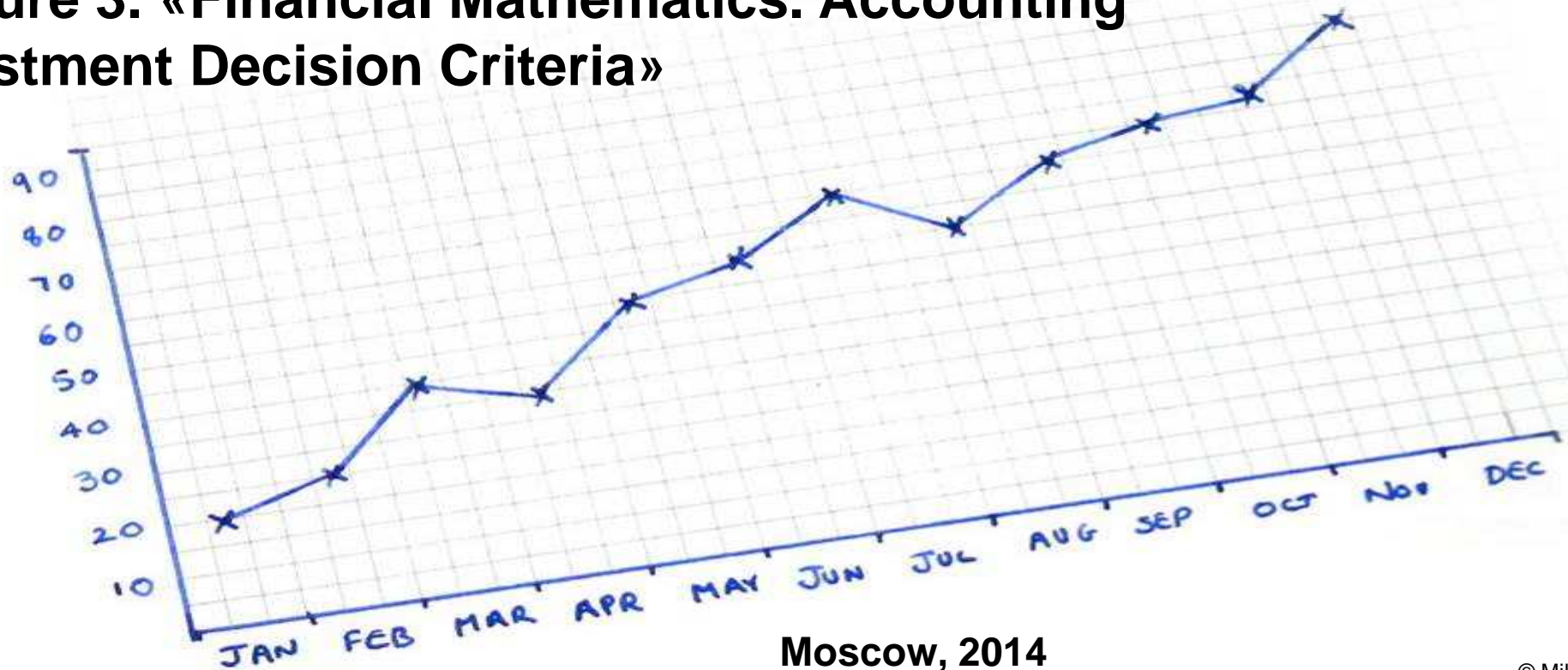


Investment Project Management

Lecture 3. «Financial Mathematics. Accounting Investment Decision Criteria»



Accounting Investment Decision Criteria

Alongside with economically-based investment decision criterion there are accounting-based criterion which are extremely important and are used together with ratios mentioned before. It's perfectly impossible to consider the Project's profitability without having observed: Amortization/Depreciation, Working Capital demands, Average worth of fixed assets, etc. Following instruments facilitate to finally select the best project:

- **Depreciation**/Amortization (4 methods)
- **AAR** (Average Accounting Rate of Return)
- **DSCR** (Debt Service Coverage Ratio)
- **Working Capital requirements** based on assets and liabilities turnovers



Accounting Rate of Return

The **Accounting Rate of Return (AAR)** or Simple Rate of Return reflects the ratio of estimated accounting profit of a project to the average accounting investment amount made in the project.

The formula for calculation of the Accounting Rate of Return (**AAR**) is:

$$\text{Accounting Rate of Return (ARR)} = \frac{\text{Average Accounting Profit}}{\text{Average Investment}}$$

or

$$\text{ARR} = \frac{\text{Net Income}}{\frac{1}{2} \times (\text{Investment Cost} - \text{Salvage Value})}$$

Accounting Rate of Return

The **Accounting Rate of Return (AAR)** calculation:

Average Accounting Rate of Return	Y0	Y1	Y2	Y3	Y4	Y5	Average for the period
Total value of purchased/constructed assets (depreciated & amortized)	5 000	6 775	10 750	9 149	7 695	6 309	7 613
Average net income	0	3 060	-2 096	4 860	6 936	9 157	3 653
							47,98%

The **AAR** model does not include the **Time Value of Money** concept but it looks very pictorial for initial understanding of the Project profitability.

Debt Coverage Ratio

The **Debt Service Coverage Ratio** (Debt Coverage Ratio, **DCR**) reflects the cash available for debt servicing to interest, principal and lease payments or the Project's ability to produce enough cash to cover its debt service total payments. The Total Cash Accrual which is adjusted from the Net Income plus all non-cash impairments plus Paid Interest should be larger than all debt repayments for the period.

The formula for calculation of the Debt Service Coverage Ratio (**DCR**) is:

$$\text{DCR} = \frac{\text{Annual Net Operating Income} + \text{Amortization/Depreciation} + \text{Interest Expense} + \text{other non-cash and discretionary items (similar as varying management bonuses)}}{\text{Principal Repayment} + \text{Interest payments} + \text{Lease payments}}$$

Debt Coverage Ratio

The **Debt Service Coverage Ratio** calculation:

Debt Service Coverage Ratio	Y0	Y1	Y2	Y3	Y4	Y5	Average for the period
Total Cash Accrued		3 985	-231	7 441	9 511	11 802	
Total Debt Service Requirements		5 700	6 840	7 980	9 120	10 260	
Debt Coverage Ratio (DCR)		0,70	-0,03	0,93	1,04	1,15	0,76

The **Debt Service Coverage Ratio** shows the sufficiency of borrowing policy to Project's cash generating capability.

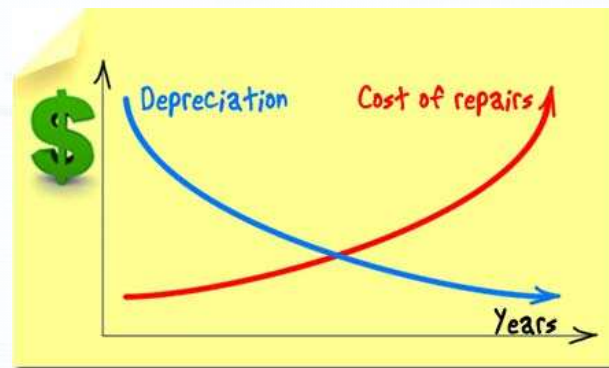
If DCR lays between

- 1,5 and 2,0** – the Project has perfectly **sufficient** borrowings;
- If DCR **< 1,5** - the loans maturities should be **extended**;
- If DCR **> 2,0** - the loans maturities can be **shortened**.

Depreciation & Amortization

The **Depreciation** (for material, tangible, fixed assets) and **Amortization** (for intangible assets) reflects the accounting decrease of assets' value with its allocation to certain reporting period which gives tax savings (on income tax). The concept of depreciation/amortization includes the acquisition cost, useful life term, Salvage (Residual) Value and the method of depreciation expense calculation (approved by tax authorities).

The **Salvage Value** reflects the amount of depreciated/amortized asset value when it can be written-off. The Useful Life can be measured either in produced units or in years (according to established tax limitations).



Depreciation. Straight-line method

The **Straight-line** method considers that within Asset Useful Life period annual depreciation expense is equal to proportional even part of the difference between Acquisition cost and Residual value.

The formula for calculation of the Annual Straight-line depreciation expense is:

$$\text{Annual Straight – line Expense} = \frac{\text{Acquisition Cost – Salvage Value}}{\text{Useful Life}}$$

Amount (USD, thous)	5 000	5 000	4 775	4 550	4 325	4 100	3 875
Year of going into operations (beginning of year)	Y1						
Depreciation method	Straight-line	The most neutral and conservative method					
Estimated useful life (years)	20						
Salvage (Residual) Value, (USD, thous.)	500						
Depreciable Cost (USD, thous.)	4 500						
Yearly depreciation rate (%)	5,00%						
Yearly depreciation expense (USD, thous)	225		225	225	225	225	225

Depreciation. Declining-balance method

The **Declining-balance** method considers that the expense at the beginning is extremely larger than later. The salvage value is not considered in determining the annual depreciation. Depreciation ceases when either the salvage value or the end of the asset's useful life is reached.

The last year expense as a difference between the last year depreciated value and the salvage value.

The formula for calculation of the Annual Declining-balance depreciation expense is:

Annual Declining – balance expense

= Double Straight

– line annual expense rate applied to the Remaining Value of asset

Depreciation. Declining-balance method

The **Declining-balance** calculation:

Amount (USD, thous)	2 000		2 000	1 200	720	432	259
Year of going into operations	Y2						
Depreciation method	Declining balance	More aggressive method than Straight-line Depreciation/Amortization					
Estimated useful life (years)	5						
Salvage (Residual) Value, (USD, thous.)	200						
Depreciable Cost (USD, thous.)	1 800						
Nominal Yearly depreciation rate (% of FA value of previous year)	40,00%			800	480	288	173
Yearly depreciation equivalent of annual rate (%)	36,90%			360	360	360	360

The formula for calculation of the Annual Declining-balance depreciation expense is:

Re – calculated to Straight Decl – Bal Depreciation Rate

$$= 1 - \sqrt[n]{\frac{\text{Salvage Value}}{\text{Fixed Asset Cost}}}$$

Depreciation. Sum-of-year-digits method

The **Sum-of-year-digits** method. Under this method the annual depreciation is determined by multiplying the depreciable cost by a schedule of fractions.

The formula for calculation of the Sum-of-year-digits depreciation expense is:

$$\begin{aligned} \text{Sum - of - year - digit Depreciation Rate for period } i &= r_i \\ &= \frac{n - i + 1}{\left(\frac{n^2 + n}{2}\right)}, \text{ where } n - \text{ number of periods} \end{aligned}$$

Depreciation. Sum-of-year-digits method

The **Sum-of-year-digits** method expense calculation:

Amount (USD, thous)	1 000		Y0	Y1	Y2	Y3	Y4	Y5
Year of going into operations	Y3		1 000	667	400	200	67	0
Amortization method	Sum-of-year-digits		Less aggressive method than Declining-Balance Depreciation/Amortization					
Estimated useful life (years)	5							
Salvage (Residual) Value, (USD, thous.)	0							
Amortizable Cost (USD, thous.)	1 000							
Number of period	i			1	2	3	4	5
Amortization rate for the period	Ri			1/3	4/15	1/5	2/15	1/15
Yearly amortization expense (USD, thous)	$R_i = (n-i+1)/((n^2+n)/2)$			333	267	200	133	67

Depreciation. Units-of-production method

The **Units-of-production** method expense is based on the share of total quantity of units (Useful Life) produced in the current period.

The formula for calculation of the Units-of-Production depreciation expense is:

$$\text{Annual Units – of – Production Depreciation Expense} = \frac{\text{FA Cost – Salvage}}{\text{Estimated Total Production}} \times \text{Actually Produced Units}$$

Amount (USD, thous)	4 000	Y0	Y1	Y2	Y3	Y4	Y5
Year of going into operations	Y3	4 000	3 438	2 763	1 975	900	
Depreciation method	<i>Units-of-production</i>	The aggressiveness of the method lays in defining of Estimated Total Production number					
Estimated useful life (total number of produced units)	800						
Salvage (Residual) Value, (USD, thous.)	400						
Depreciable Cost (USD, thous.)	3 600						
Actually Produced Units (units)			125	150	175	200	
Cumulative production of units		105	230	380	555	755	
Yearly depreciation expense (USD, thous)			563	675	788	900	

Working capital. Receivables planning

The **Working capital** represents the difference between current assets and liabilities which reflects the rate of Project's assets conversion to cash.

Accounts receivable		Y0	Y1	Y2	Y3	Y4	Y5					
Total Yearly sales, USD thous.		0	15 000	6 300	27 431	34 234	41 537					
Share of monthly sales on Cash-against-documents basis, USD thous.	30%	0	4 500	1 890	8 229	10 270	12 461	No receivables appear				
Share of monthly sales on 60-days Credit (Open account) basis, USD thous.	20%	0	3 000	1 260	5 486	6 847	8 307	3-months turnover or 1/4 year turnover is in receivables				
Share of monthly sales on regular 30-days basis, USD thous.	20%	0	3 000	1 260	5 486	6 847	8 307	1-month turnover or 1/12 year turnover is in receivables				
Accounts receivable on 60-days Credit (Open account) sales, USD thous.	60	0	493	207	902	1 126	1 366					
Accounts receivable on regular 30-days sales, USD thous.	30	0	247	104	451	563	683					
Total stable amount of trade receivables, USD thous.		0	740	311	1 353	1 688	2 048					

Each part of **Working capital** (accounts receivable, advances paid, advances received, inventories and goods for resale) should be re-calculated for each period in 2 angles: the turnover and the balance.

Working capital

The **Working capital** represents how much cash received as revenues and borrowings are frozen in the current assets.

Working Capital	Y0	Y1	Y2	Y3	Y4	Y5
Inventories, USD thous.	0	271	116	513	646	788
Goods for resale, USD thous.	0	337	215	617	756	902
Advances paid, USD thous.	0	688	294	1 300	1 638	1 996
Accounts receivable, USD thous.	0	740	311	1 353	1 688	2 048
Accounts payable, USD thous.	0	462	293	822	997	1 184
Total Working Capital	0	1 574	643	2 960	3 730	4 551
<i>Changes in Working Capital, USD thous.</i>		<i>1 574</i>	<i>-931</i>	<i>2 317</i>	<i>770</i>	<i>820</i>

The net changes of **Working capital** are to be added to cash position. Increase in Working capital means decrease of cash balance at the end of period.

Key Appraisal Ratios

Average Accounting Rate of Return (ARR) and the **Debt Service Coverage Ratio (DCR)** are used along with **NPV**, **IRR**, **PP**, **DPP**, **ANPV** and **DPI** as the key ratios for the initial selection and the current control of the Projects.

The net changes of **Working capital**, calculated depreciation/amortization, calculated balance of all current assets and liabilities allow to finalize Company's/Project's balance sheet and Cash flow statement.

BALANCE SHEET	
ASSETS	LIABILITIES
What the bank owns (Branch buildings, computers, cash in their tills, government bonds, other financial assets etc) + What people owe to the bank (Loans, mortgages, overdrafts etc)	Everything the bank owes to other people (or other banks) + Whatever's left for the shareholders (Shareholder equity)