🧭 THUMB RULES FOR PRELIMINARY ECONOMIC ANALYSIS (PEA) IN MINING PROJECTS

1. Project Definition & Scope

1. **PEA should define only "concept-level" details** — approximate mine plan, process route, and infrastructure layout.
2. **Accuracy range:** ±30% to ±50% on capital and operating cost estimates.
3. **Resource base:** Should be based primarily on *Inferred + Indicated* mineral resources (not Proven reserves).
4. **Target life of mine (LOM):** At least **10–15 years** for major metals, **5–10 years** for smaller commodities.

2. Capital Cost Estimation

1. **Capex Estimate Rule:**
   - Underground mines: **US$50,000–100,000 per tonne/day of mill throughput**
   - Open pit mines: **US$20,000–50,000 per tonne/day**
   - Heap leach operations: **US$10,000–25,000 per tonne/day**
2. **Breakdown of CAPEX:**
   - Mining: 25–35%
   - Processing: 35–45%
   - Infrastructure & Services: 10–20%
   - Contingency: 10–15%
3. **Contingency factor:**
   - Conceptual stage (PEA): **+25% to +40%**
   - Prefeasibility stage: **+15% to +25%**
4. **Working capital:** Usually **3–6 months** of operating cost.

3. Operating Cost Estimation

1. **OPEX Estimation Accuracy:** ±30%.
2. **Open pit total operating cost (mining + processing + G&A):**
   - Base metals: **US$20–50/t ore**
   - Precious metals: **US$25–70/t ore**
   - Bulk commodities (coal, iron ore): **US$10–25/t ore**
3. **Underground mining cost:** Typically **2.5× to 3×** the open pit cost per tonne of ore.
4. **Power cost:** Should not exceed **15–20%** of total OPEX.
5. **Labour + maintenance cost:** Together form **30–40%** of total OPEX.

4. Production & Recovery

1. **Mining recovery:** 90–95% (open pit), 85–90% (underground).
2. **Dilution:** 5–10% (open pit), 10–20% (underground).
3. **Plant recovery:** 85–95% for most base metals; 90–98% for gold leach circuits.
4. **Plant throughput:** Target steady-state operation within **2 years** of commissioning.

5. Economic Indicators

1. **Internal Rate of Return (IRR):**
   - Minimum acceptable: **>15% (after tax)**
   - Preferred: **>25% (robust project)**
2. **Net Present Value (NPV):**
   - Discount rate: 5–10% (depending on jurisdiction risk).
   - NPV should be **positive even under –10% price scenario**.
3. **Payback period:** Preferably **<4 years** from production start.
4. **Revenue-to-CAPEX ratio:** Should be **>1.5:1** to justify investment.

6. Sensitivity Analysis

1. **Price sensitivity:** Evaluate at ±20% price variation.
2. **Operating cost sensitivity:** ±15% variation.
3. **Grade sensitivity:** ±10% variation.
4. **Exchange rate sensitivity:** ±10% variation (for export-oriented projects).

7. Financial Structure

1. **Debt-to-equity ratio:** 60:40 or 70:30 is common for mining.
2. **Interest rate (post-tax WACC):** 6–10%.
3. **Tax & royalty burden:** Typically 25–35% of profit before tax.

8. Commodity Price Assumptions

1. **Use 3-year trailing average price** for PEA, unless market forecast is justified.
2. **Always perform sensitivity analysis with ±20% commodity price range.**

9. Environmental & Social

1. **Land acquisition + environmental cost:** Reserve **5–10%** of total CAPEX.
2. **Closure & reclamation cost:** Approx. **2–5%** of total life-of-mine cost.
3. **Community & CSR obligations:** Allocate **1–2%** of net profit or $1–2/t ore mined.

10. Decision Gate & Reporting

1. **PEA must establish "Go / No-Go" decision** based on IRR, NPV, payback.
2. **Avoid over-detailing:** Focus on demonstrating *economic viability and potential scale*.
3. **Peer benchmarking:** Compare with **similar mines (commodity, grade, scale, location)**.
4. **PEA → PFS trigger:** If IRR >25% and NPV positive under downside case.

11. Rule-of-Thumb Ratios for Screening

Parameter	Open Pit	Underground
Stripping Ratio	< 8:1	—
Cut-off Grade	0.3–0.6% Cu / 0.4–1 g/t Au	0.8–1.5% Cu / 2–4 g/t Au
Operating Cost (US$/t ore)	20–50	50–120
CAPEX/t Annual Throughput	10,000–50,000	50,000–100,000
Payback (years)	< 4	< 5
NPV/Capex Ratio	>1	>1.2

12. Documentation & Presentation

1. **Comply with NI 43-101 / JORC / UNFC guidelines** for resource classification and disclosure.
2. **Clearly state assumptions** (commodity price, recovery, cost base, discount rate).
3. **Summarize all data in key metrics table:** NPV, IRR, payback, LOM, cash flow, CAPEX, OPEX.

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