**645 – Computational Economics**

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**HW1 – Part B**

**Question 1**

Indices

* s ∈ S: scenarios for permitting and construction outcomes (delay, overrun, abandonment), with probabilities πs​ and ∑𝑠𝜋𝑠 = 1
* t ∈ {1,…,T}: operating years after COD.

Parameters

* Cbase [$]: baseline EPC capital (include soft costs unless noted separately).
* ϕs [decimal]: cost overrun multiplier in scenario s (e.g., 0.25 means +25%).
* Δts [years]: time from FID to COD in scenario s.
* r [%]: risk-adjusted discount rate (WACC plus risk premium).
* pt [$/MWh]: expected real price in year t.
* Qt [MWh]: expected energy in year t (e.g., 8760 × Cap × CF, adjusted for outages if desired).
* T [years]: financial lifetime for operating cash flows.

Variables

* x ∈ {0,1}: binary build decision (1 = build, 0 = do not build)

Objective Function

The model minimizes the expected levelized cost of electricity (LCOE), as expressed in the objective function. The numerator represents the effective capitalized cost of construction, which increases with higher baseline costs (Cbase), cost overruns (ϕ), financing rates (r), and delays (Δt). The denominator reflects the present value of expected electricity revenues over the plant’s operating life, discounted by the same rate r. Permitting reform shifts the probability distributions of these uncertain parameters by shortening and stabilizing construction timelines, reducing cost overruns, and lowering financing risk. These changes decrease interest during construction (IDC), reduce the risk premium embedded in r, and cut soft costs through simpler regulatory processes. By improving predictability and reducing the likelihood of abandonment, reform lowers the expected LCOE and, equivalently, increases the project’s expected net present value (NPV).

Constraints

* *Scenario probabilities*

Each scenario s represents a possible realization of delay (Δts) and cost overrun (ϕs) outcomes. The probabilities πs weight each scenario in the expected value of the objective function.

* *Delay and cost overrun bounds*

Δtmin ​≤ Δts​ ≤ Δtmax​, ϕmin ​≤ ϕs ​≤ ϕmax​

These constraints ensure delays and overruns remain within realistic limits (e.g., truncating extreme values). Under reform, both the mean and variance of these parameters decrease.

* *Policy shift relationships*

Rreform ​< rbaseline​, E[Δts​]reform ​< E[Δts​]baseline​, E[ϕs​]reform ​< E[ϕs​]baseline​

These comparative conditions represent the effect of permitting reform, which shortens timelines, reduces uncertainty, and lowers financing risk. They are not strict optimization constraints but define how parameter inputs differ between policy cases.

* Feasibility condition for construction and operation

Both the capitalized cost (numerator) and the discounted revenue term (denominator) must be positive to ensure a valid LCOE value. These implicit constraints keep the model well-defined without binary build or completion variables.

Sample Code

*Refer to text file in repository*

**Question 2**

Data Sources

* *Portugal-Pereira et al. (2018), “Better Late Than Never, but Never Late is Better: Risk Assessment of Nuclear Power Construction Projects,” Energy Policy 120, 158–166*

This paper compiles global data on cost overruns and construction delays for 180 reactor projects. I will use the reported mean delay (approximately 7 years) and the estimated 20 percent cost escalation per additional year to calibrate the baseline delay and overrun distributions (Δts, ϕs) in the stochastic model. These data provide the foundation for modeling how permitting reform shortens delays and tightens uncertainty ranges.

* *Guaita, Spangler & Hansen (2025), “Parametric and Nonparametric Models of U.S. Cost Overruns for Nuclear Power Plants,” Idaho National Laboratory*

This forthcoming INL study provides updated U.S. parameters for cost growth, financing burden, and schedule risk after 2000. I will use its reported probability density functions for cost overruns to validate the Monte Carlo sampling and to benchmark U.S. project performance against international experience. The data help distinguish “status-quo” versus “reform” variance in project outcomes.

* *Jacobs, Jantarasami & Fishman (2024), Licensing and Permitting Reforms to Accelerate Nuclear Energy Deployment, Bipartisan Policy Center*

This policy report provides estimated reductions in permitting duration (25 to 40 percent) and administrative costs (10 to 15 percent) under proposed NRC process reforms. I will apply these values to define the “moderate” and “comprehensive reform” scenarios that shift the delay and soft-cost parameters in the model.

**Assumptions**

* *Construction Financing*: Interest during construction (IDC) compounds annually at the project WACC, consistent with IEA/NEA (2020) methods for levelized cost modeling.
* *Risk Premium Reduction*: Permitting reform lowers the project risk premium by 150 basis points, following the midpoint of estimates in Jacobs et al. (2024).
* *Abandonment Probability*: Projects with combined delay > 14 years or cost overrun > 80 percent are treated as abandoned, consistent with the historical tails reported in Portugal-Pereira et al. (2018).
* *Operating Life*: A 60-year lifetime is assumed for private projects and up to 80 years for public ownership scenarios, consistent with IEA (2023) Projected Costs of Generating Electricity.
* *Price and O&M Path*: Constant real wholesale price of $60 per MWh and O&M cost of $12 per MWh are used, reflecting median U.S. reactor data.
* *Elasticity Example (illustrative)*: For sensitivity testing of market response, I will assume an electricity demand elasticity of –0.5, consistent with Brown et al. (2024). This ensures that small price reductions from reform do not imply unrealistic demand growth.

These data and assumptions translate qualitative policy reforms into quantitative model inputs. Portugal-Pereira et al. (2018) and Guaita et al. (2025) provide statistical foundations for delay and cost distributions, while Jacobs et al. (2024) anchors plausible reform magnitudes. The listed assumptions allow the stochastic model to operate transparently with defensible parameter ranges while remaining tractable for a classroom-scale project.