CLASSROOM COURSE • SUBSURFACE DECISION ANALYSIS

Exploration Risk, Volumes and Decision Quality Under Uncertainty

From one prospect to a capital-constrained portfolio — a continuous, hands-on course in geological risking, probabilistic volumetrics, value of information and decision-quality practice, built around a single running case study.

10	9	1	15–19 hrs
Teaching notebooks + Capstone	Modules, one continuous arc	Running case study (Kestrel)	Instructor-led classroom time

Designed and taught by Kushwant Singh — petroleum geoscience, uncertainty quantification and exploration decision analysis.

COURSE AT A GLANCE

1. Course Setup & Kestrel Context
2. Decision Framing & Maturity
3. Geological Risking & Bayesian Networks
4. Expert Elicitation & Calibration
5. Advanced Probabilistic Volumetrics
6. Dependencies & Sensitivity
7. Economics, EMV & Decision Trees
8. Value of Information & Portfolio
9. Optimal Portfolio Under Budget

Capstone: From Kestrel to Portfolio

Why this course

Most exploration teams can build a Monte Carlo volumetric model. Far fewer can trace one prospect's assumptions cleanly from a first framing conversation through geological risking, calibrated expert judgement, dependency-aware volumetrics, economics, value of information, and a capital-constrained portfolio decision — without the story silently changing along the way.

This nine-module classroom course closes that gap. It is built for geoscientists and engineers who already know their subsurface data but want a rigorous, defensible language for chance, volumes and value — and the Python fluency to back it up.

One prospect, one continuous thread

> Every module works the same fictional offshore prospect — Kestrel. Its 60% working interest, USD 35mm drill cost, and USD 4mm seismic/fault-seal study option, introduced on day one, resurface as the exact inputs to the Bayesian risking network in Module 3, the calibration exercises in Module 4, the value-of-information calculation in Module 8, and the portfolio-scale comparison in Module 9. Participants see how a framing choice made early in the course changes a capital decision made at the end of it — not as an abstraction, but as one auditable number trail.

How the classroom sessions work

Each notebook is instructor-led and built to be paused on. Embedded Checkpoints test concepts before the class moves on, and Exercises put participants into the code or the decision itself — each with a model-answer discussion the instructor can reveal on screen. Instructor notes flag exactly where to pause, what question to ask, and which common misconception to pre-empt.

Notebooks run in Google Colab or any local Jupyter environment — no proprietary software, no licence cost, and every participant keeps the full set after the course ends.

What you'll be able to do

By the end of the course, participants can independently run — and defend — a full decision-quality analysis, from first framing to final capital allocation.

MODULES 1–4

Frame the decision and risk it honestly

- Separate facts, interpretations, assumptions and decisions before any modelling begins, and set a decision criterion and alternatives explicitly.
- Assess prospect maturity, build a traceable uncertainty register, and place a prospect within its play fairway and petroleum-system story.
- Build and defend an explicit geological chance-of-success model as a conditional Bayesian network — without double-counting dependent probabilities.
- Score expert forecasts for calibration (Brier scores, interval coverage) and apply outside-view, anchor-challenge, red-team and premortem techniques to reduce elicitation bias.

MODULES 5–6

Turn geology into a defensible volume range

- Calculate conditional recoverable volume from the volumetric equation and choose defensible input distributions (triangular, PERT, lognormal).
- Separate first-order input uncertainty from second-order parameter uncertainty, and know when the latter needs technical assurance.
- Preserve realistic dependence between volumetric inputs with a Gaussian copula, and validate a full correlation matrix.
- Distinguish a prospect's conditional (success-case) volumes from its unconditional, risked-volume distribution with an explicit zero-mass point.

MODULES 7–8

Convert volumes into value — and know what information is worth

- Translate volumetric and geological uncertainty into discounted cash flows and threshold-volume economics under fiscal, price and cost uncertainty.
- Build and read decision trees comparing drill-now, farm-down, defer/appraise and relinquish alternatives on one economic basis.
- Calculate EVPI as an upper bound on information value, then calculate imperfect EVI to decide whether a specific proposed study is actually worth funding.

MODULE 9 + CAPSTONE

Scale the decision from one prospect to a portfolio

- Explain why ranking prospects by standalone EMV alone produces a concentrated, correlated portfolio — and simulate shared play-level uncertainty across dozens of prospects.
- Formulate exploration capital allocation as a 0/1 capital-budgeting optimisation under a hard budget, and compare it against naive alternatives.
- Carry one transparent set of assumptions through every layer of the course — framing, chance, volumes, value, information and portfolio choice — and communicate the result in an executive-ready decision memo.

Course contents

Nine modules build in a fixed sequence, followed by a Capstone Project that requires every method taught along the way.

#	Module	What it covers	Time
1	Course Setup, Decision Context & Assessment Conventions	Establishes the Kestrel prospect, the decision frame, and the P90/P50/P10 reporting conventions used throughout.	75–90 min
2	Decision Framing & Maturity	Separates evidence from interpretation and assumption; builds the uncertainty register and maturity gate.	45–60 min
3	Geological Risking: CoS, Bayesian Networks & Play-Common Risk	Replaces a simple probability product with a conditional Bayesian network; models play-common risk across a small portfolio.	90–120 min
4	Expert Elicitation & Calibration	Seed questions, Brier scoring, interval coverage, debiasing techniques, and an auditable risk-review record.	75–90 min
5	Advanced Probabilistic Volumetrics	Distribution-family comparison, parameter-uncertainty propagation, scenario mixtures, and a validated Gaussian-copula dependence model.	90–120 min
6	Dependencies, Risked Volumes & Sensitivity	Builds the full risked-volume distribution, separates conditional from unconditional volumes, and drives an executive-ready summary.	90–120 min
7	From Volumes to Value: Economics, EMV & Decision Trees	Threshold-volume economics, fiscal and cost uncertainty, development-concept comparison, and a four-way decision tree.	75–90 min
8	Value of Information & Portfolio Decisions	EVPI, imperfect EVI, and a quantitative answer to whether Kestrel's deferred seismic study is worth funding.	75–90 min
9	Optimal Exploration Portfolio Under a Capital Budget	A 52-prospect synthetic portfolio across four play types; 0/1 capital-budgeting optimisation under a USD 300mm hard budget.	90–120 min

Capstone — From Kestrel to Portfolio. A multi-hour, end-to-end synthesis: participants carry one transparent set of Kestrel assumptions through framing, geological risking, calibrated challenge, conditional and risked volumetrics, economics, value of information, and a capital-constrained portfolio choice — then write the decision memo. 3–4 hours; splits cleanly across two classroom sessions or a take-home assignment.

Total instructor-led classroom time across all nine modules and the Capstone: approximately 15–19 hours.

Core deliverables

What every participant takes away from the course:

- 10 fully executable teaching notebooks (Google Colab / Jupyter-ready) covering Modules 1–9 plus the Capstone — yours to keep and reuse after the course.
- Embedded Checkpoints and Exercises with model-answer discussions at every key decision point, built to be paused on live in the classroom.
- Continuity instructor notes throughout, flagging exactly where to pause, what to ask, and which common misconception to pre-empt.
- Working Python models for conditional Bayesian-network geological risking, Gaussian-copula Monte Carlo volumetrics, EMV decision trees, EVPI/EVI value-of-information calculations, and 0/1 capital-budgeting portfolio optimisation across 52 synthetic prospects.
- One continuous case study (Kestrel) that carries every input forward from Module 1 through the Capstone, so the connections between modules are auditable, not asserted.
- A Capstone decision-memo template and worked reference solution, suitable as a portfolio piece for participants' own technical files.

Sample classroom agenda — 3-day intensive

The course also runs as a 9-week weekly seminar (one module per session, Capstone as a closing workshop). A sample 3-day intensive schedule:

Day	Focus	Modules	Session flow	Time
Day 1	Framing the Decision	Modules 1–4	Course setup & Kestrel context → Decision framing & maturity → Geological risking (Bayesian networks) → Expert elicitation & calibration	~4.5–6.5 hrs
Day 2	From Volumes to Value	Modules 5–7	Advanced probabilistic volumetrics → Dependencies, risked volumes & sensitivity → Economics, EMV & decision trees	~4.5–6 hrs
Day 3	Portfolios and Capstone	Modules 8–9 + Capstone	Value of information & portfolio decisions → Optimal portfolio under a capital budget → Capstone: From Kestrel to Portfolio (session 1 of 2, or take-home)	~6.75–8.75 hrs

Who should attend

- Exploration and development geoscientists, petrophysicists and reservoir engineers who build or review volumetric and geological-risking models.
- Technical and commercial analysts supporting portfolio, budget and capital-allocation decisions.
- Team leads and decision-review participants who need a shared, rigorous vocabulary for chance, volumes and value.
- Anyone preparing for — or teaching — SPE-style decision-quality or uncertainty-quantification training.

PREREQUISITES

Comfort with basic probability and Excel/Python-level numeracy. No prior Bayesian-network or Monte Carlo experience is required — every method is introduced from first principles and built up in code, live, in the classroom.

FORMAT

Delivered as a 3-day classroom intensive or a 9-week weekly seminar with a closing Capstone workshop. All notebooks run in Google Colab or local Jupyter — no proprietary software required, and every participant keeps the full notebook set.

ENROL OR ENQUIRE

Kushwant Singh — Course Instructor
Email: enquiries@apes-energyevolution.com

One prospect. Nine modules. One decision you can defend in the room.

Exploration Risk, Volumes and Decision Quality Under Uncertainty