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COURSE SYLLABUS

SL 4G



COURSE SYLLABUS — SL 4G: OPERATIONS RESEARCH/SYSTEMS ANALYSIS (ORSA)

Maven Smart System (MSS) — USAREUR-AF

HEADQUARTERS
UNITED STATES ARMY EUROPE AND AFRICA
(USAREUR-AF)
Wiesbaden, Germany

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MAVEN SMART SYSTEM (MSS) — USAREUR-AF

Field	Detail
Level	SL 4G (ORSA Specialist Track)
Duration	5 days (40 hours)
Prerequisites	SL 1, SL 2, SL 3 (all Go evaluations on file — REQUIRED , not recommended); Data Literacy Technical Reference (recommended); graduate-level quantitative background (statistics, linear algebra, optimization); working proficiency in Python or R
Audience	FA49 Operations Research officers, quantitative analysts, ORSA-assigned Civilians
Format	Instructor-led lab + guided practice + commander brief practical
Location	MSS Training Environment (Code Workspace provisioned)

BLUF: SL 4G teaches ORSA analysts to translate operational questions into models inside Foundry — connecting to operational data, building quantitative models, and delivering products commanders can use to allocate resources and compare COAs. Course does not teach statistics from scratch; it applies existing quantitative skills to MSS data and USAREUR-AF ORSA product standards.

LEARNING OBJECTIVES

#	Objective
1	Configure a Python/R Code Workspace with required packages; verify Foundry dataset connectivity; write outputs back to Foundry curated datasets via transaction

#	Objective
2	Build and validate a regression model for a provided readiness or logistics dataset; document validation statistics and assumptions
3	Construct a time series forecast with documented model selection rationale, assumptions, and confidence bounds
4	Run a Monte Carlo simulation for a COA comparison scenario; quantify risk at defined probability thresholds
5	Formulate and solve a linear programming resource allocation problem with documented constraints and sensitivity analysis
6	Build analytical Quiver/Contour visualizations displaying model outputs with uncertainty bounds
7	Produce a commander brief presenting findings in operational language — every point estimate with a confidence range; explicitly stated assumptions and limitations
8	Apply USAREUR-AF ORSA product standards: documentation, validation, reproducibility (set seed), and uncertainty communication

PRE-COURSE CHECKLIST

Complete 7–10+ duty days before Day 1:

- Request **Code Workspace access** from C2DAO — standard unit MSS Administrator access is insufficient; allow 7–10 duty days
- Confirm the workspace runs a provided test script before Day 1 — if the test script fails, contact C2DAO before arriving
- Read TM-40G, Chapter 1 (Introduction, role, prerequisites self-check) — 30 min
- Read TM-40G, Chapter 2, Sections 2-1 and 2-2 (Code Workspace overview) — 20 min

DAILY SCHEDULE

Day 1 — Environment Setup and Foundry Data Access

Time	Block	Method	Content
0800–0900	1	Brief	ORSA role on MSS; analytical product standards; the Foundry data model and how ORSA connects to it

Time	Block	Method	Content
0900–1100	2	Lab	Code Workspace setup: Python/R environment, package installation, GPU/CPU allocation, environment reproducibility
1100–1115	—	Break	
1115–1200	3	Lab	Foundry dataset connectivity: accessing Ontology datasets from Code Workspace, reading via Spark/pandas, inspecting schema
1200–1300	—	Lunch	
1300–1500	4	Lab	Writing outputs to Foundry: transaction pattern for writing results back to curated datasets — test this on Day 1, not Day 4
1500–1515	—	Break	
1515–1700	5	Lab	Data profiling in Code Workspace: null distributions, outlier detection, feature distributions — building QC habits before modeling

Evening reading: TM-40G, Chapter 3 (Statistical Modeling) — review regression and validation procedures.

Day 2 — Statistical Modeling

Time	Block	Method	Content
0800–0830	—	Review	Day 1 questions; Foundry write transaction troubleshooting
0830–1030	6	Lab	Regression: linear regression for readiness forecasting — feature selection, assumption checking, training, validation statistics
1030–1045	—	Break	
1045–1200	7	Lab	Classification models: logistic regression, decision trees — feature selection, cross-validation, calibration check
1200–1300	—	Lunch	
1300–1500	8	Lab	Model validation standards: residual analysis, cross-validation, documenting assumptions; writing validated output to Foundry

Time	Block	Method	Content
1500– 1515	—	Break	
1515– 1700	9	Lab	Practice build: apply regression to a second provided dataset; document model, write output to Foundry, build a Quiver visualization

Evening reading: TM-40G, Chapter 4 (Time Series — ARIMA procedures and confidence bound requirements); Chapter 5 (Monte Carlo — simulation framework).

Day 3 — Time Series and Monte Carlo

Time	Block	Method	Content
0800– 0830	—	Review	Day 2 questions; model documentation standards check
0830– 1030	10	Lab	Time series: stationarity testing, ACF/PACF plot interpretation, ARIMA model identification — document why you chose (p,d,q)
1030– 1045	—	Break	
1045– 1200	11	Lab	ARIMA/SARIMA build: readiness trend forecast and logistics demand signal with 90% confidence bounds
1200– 1300	—	Lunch	
1300– 1500	12	Lab	Monte Carlo: COA comparison framework, distribution selection rationale, 1,000-trial simulation (minimum), seed for reproducibility
1500– 1515	—	Break	
1515– 1700	13	Lab	Sensitivity analysis; logistics stockage level risk modeling; quantifying probability at operationally meaningful thresholds

Evening reading: TM-40G, Chapter 6 (Optimization — Resource Allocation and Scheduling: formulation and constraint documentation); Chapter 9 (Communicating Uncertainty).

Day 4 — Optimization and Decision Support

Time	Block	Method	Content
0800–0830	—	Review	Day 3 questions; Monte Carlo output review — confirm 1,000 trials, seed set, probability at threshold documented
0830–1030	14	Lab	Linear programming: resource allocation formulation, constraint definition, scipy/lpSolve implementation
1030–1045	—	Break	
1045–1200	15	Lab	Scheduling optimization: maintenance scheduling against operational commitments; sensitivity analysis on constraints
1200–1300	—	Lunch	
1300–1500	16	Lab	Wargame/exercise data architecture: collection templates, aggregation pipelines, outcome measurement; post-exercise analysis pipeline build
1500–1515	—	Break	
1515–1700	17	Lab	Quiver/Contour for ORSA: readiness forecast dashboard, COA comparison visualization, uncertainty bound display

Evening reading: TM-40G, Chapter 9 (Communicating Uncertainty — briefing posture and what NOT to say). Review your full model output from this week — what would you brief to the G4?

Day 5 — Commander Brief Standards and Practical Exercise

Time	Block	Method	Content
0800–0900	18	Lecture	Communicating uncertainty: confidence intervals, prediction intervals, briefing posture, translating quantitative output to operational language
0900–1000	19	Discussions	Common ORSA brief failures: point estimates without bounds, unqualified predictions, methods-paper language at a commanders' brief
1000–1015	—	Break	
1015–1100	20	Brief	Practical exercise scenario brief; planning time; ORSA product standards checklist review

Time	Block	Method	Content
1100– 1200	—	Buffer	Questions / environment check
1200– 1300	—	Lunch	
1300– 1700	21	Eval	Practical exercise: build regression + time series forecast + commander brief from provided dataset

REQUIRED READING SUMMARY

When	Reading
Before Day 1	TM-40G, Ch 1 (Introduction/prereq self-check)
Before Day 1	TM-40G, Ch 2 Sec 2-1/2-2 (Code Workspace overview)
Day 1 evening	TM-40G, Ch 3 (Statistical Modeling — regression/validation)
Day 2 evening	TM-40G, Ch 4 (Time Series — ARIMA/confidence bounds)
Day 2 evening	TM-40G, Ch 5 (Monte Carlo — simulation framework)
Day 3 evening	TM-40G, Ch 6 (Optimization — Resource Allocation and Scheduling)
Day 3 evening	TM-40G, Ch 9 (Communicating Uncertainty)
Day 4 evening	TM-40G, Ch 9 (re-read briefing posture sections)

PRACTICAL EXERCISE

Scenario: The G4 requires a readiness forecast and risk analysis to support a theater sustainment planning session. Provided: a 12-month readiness dataset.

#	Task
1	Configure Code Workspace; connect to the provided dataset; verify write transaction works before building models
2	Build a linear regression to identify readiness predictors; document validation statistics and model assumptions

#	Task
3	Build an ARIMA time series forecast for the next 6 months with 90% confidence intervals; document model selection rationale (ACF/PACF analysis)
4	Run a Monte Carlo simulation comparing two sustainment COAs at D+30; produce probability distributions; set seed for reproducibility
5	Build a Quiver dashboard displaying the forecast with uncertainty bounds
6	Produce a commander brief presenting findings — every point estimate with confidence range; explicitly state model assumptions and limitations; present in operational language the G4 can use

Go standard: Pass 5 of 6 tasks. Commander brief reviewed by ORSA evaluator (FA49 or equivalent) against the ORSA product standards checklist. A brief that presents numbers without uncertainty characterization fails that element.

GO CRITERIA

Task	Hard Standard
Commander brief	Numbers without uncertainty characterization do not pass — "C2 probability of 78%" without confidence bounds fails that element
Model code	Must be readable and documented — variable names interpretable; non-obvious logic requires inline comments
Monte Carlo	1,000 trials minimum; seed set for reproducibility; evaluator will ask to re-run the simulation and it must produce the same output

KEY TIPS

Risk	Guidance
Foundry write transaction	Test the write transaction on Day 1 (Block 4), not Day 4. Trainees who skip this lose time during the evaluation when the write fails
ARIMA model selection	Check ACF/PACF plots — do not guess at (p,d,q). The evaluator will ask why you chose your parameters
Monte Carlo trial count	100-trial simulations produce unstable distributions that will not pass. Set seed for reproducibility before evaluation

Risk	Guidance
Commander brief language	The audience is a G4 or CG — they want "probability we run out of Class IX by D+30 under each COA," not ARIMA model specification. Translate methods into operational language
Sensitivity analysis	Consistently skipped due to time pressure — read TM-40G, Chapter 5 before Day 3; evaluator questions on brief assumptions draw directly from it

CONTINUATION

Graduates who remain in active ORSA roles and require theater-level analytical capability may pursue **SL 5G (Advanced ORSA)**. SL 5G covers Bayesian inference, agent-based simulation, multi-objective optimization, network analysis, and GO/SES-standard analytical products. Prerequisites: SL 4G Go evaluation on file; 18+ months active ORSA experience or concurrent graduate enrollment.

ASSOCIATED EXERCISES AND ASSESSMENTS

Item	Reference
Pre-course exam	EXAM_TM40G_PRE
Post-course exam	EXAM_TM40G_POST
Practical exercise	EX_40G (EXERCISE.md + ENVIRONMENT_SETUP.md)

RELATIONSHIP TO WFF TRACKS

WFF track analysts (SL 4A through SL 4F) are the operational consumers of ORSA products built in this course. ORSA practitioners should understand the analytical questions each WFF community brings to MSS: sustainment analysts (SL 4D) drive demand for logistics forecasts and resource allocation; intelligence analysts (SL 4A) consume risk and COA comparison products; movement and maneuver analysts (SL 4C) use optimization outputs for route and task organization analysis.

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