ECON90033 Quantitative Analysis of Finance I

THE UNIVERSITY OF MELBOURNE · GRADUATE COURSEWORK · OPEN-BOOK EXAM SHEET

Full guide + ask Sia about ECON90033

0 · Exam Map

COURSE DATA · 2026

5	5	A1 15	A2 25	EXAM 50%

COMPONENT	WEIGHT · FORMAT
In class participation	5% · individual · Weeks 1–12
Quiz (weekly, 250 words)	5% · individual weekly activity
First Assignment	15% · individual or pair
Second Assignment	25% · individual or pair
2-hour end-of-semester exam	**50% · individual**

"It will be an open-book exam, so formula sheet and statistical tables will not be provided on the exam." *(ECON90033 Week 1 slides, 2026)*

1 · Universal Answer Spine

C1–C6

1. **Define the object:** level, return, excess return, residual, variance or vector.
2. **Specify:** write the model and information set; align dates, units and horizon.
3. **Calculate:** expose each substitution, sign and weight.
4. **Diagnose:** residuals, stability, stationarity or forecast error.
5. **Interpret:** state the supported financial meaning and its boundary.

EXAM MOVE → *Repair the first failed step; keep premises that still hold. A label earns marks only when it changes the calculation or conclusion.*

1b · First Classification

TOPIC MAPS

CLUE IN TASK	START WITH	CONTROL
Adjacent prices	return transformation	scale + dates
Asset vs market excess return	CAPM regression	residuals + stability
Weights/assets/factors	portfolio/factor exposure	benchmark + horizon
Lag dependence/forecast	ARMA process	stationarity + hold-out errors
Trending levels/high fit	unit-root diagnosis	spurious regression
Squared residual clustering	conditional variance	separate mean/variance
Several dynamic series	VAR	information set
Long-run level relation	cointegration	stationary combination

Do not jump from pattern to claim: transformations, diagnostics and forecast evaluation answer separate questions.

Boundary repair: Return conversion does not prove stationarity; high fit in persistent levels does not prove an economic relation. Diagnose the series before choosing the model.

2 · Prices → Returns

C1 · WEEK 1

SIMPLE RETURN

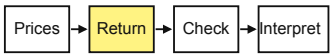
$R_t = P_t/P_{t-1} - 1$

LOG RETURN

$r_t = \ln(P_t) - \ln(P_{t-1}) = \ln(P_t/P_{t-1})$

Simple returns compound multiplicatively across periods. *Log returns* add because adjacent log-price differences telescope. Both require adjacent observations; neither transformation alone establishes stationarity or a forecast model.

NEED	USE	CHECK
one-period gain/loss	simple return	correct adjacent denominator
time aggregation	log return	sum matching intervals
holding-period result	compound simple returns or price ratio	same endpoints
description	scale, sign, distribution evidence	do not overstate stability



object → method → check → claim

Source C1 redrawn: price series, return transformation and distribution check do different jobs.

2b · Distribution Check

C1 BOUNDARY

Interpret **scale, sign and distributional evidence** after converting prices. The price level and its return are different objects; a high level need not imply a positive current return. Averages of percentages answer a different question from a compounded holding-period return.

WRITE BEFORE COMPUTING

`return date = (current price date, previous price date)`. Then record whether the prompt asks for a single-period return, a total holding-period return or an additive time decomposition.

EXAM TRAP → *Never average adjacent simple returns to recreate the endpoint return. Multiply growth factors or use the endpoint price ratio.*

2c · Return Audit

C1 WORKED + FAQ

AUDIT ITEM	QUESTION TO WRITE BESIDE IT
object	price level, simple return or log return?
dates	are P_t and P_{t-1} adjacent?
direction	does price up/down agree with return sign?
aggregation	multiply simple factors or add log differences?
endpoint	does the result match Pfinal/Pinitial?

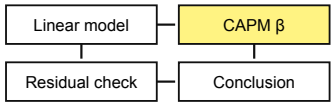
3 · Regression + CAPM

C2 · WEEK 2

CAPM REGRESSION

$R_{i,t} - Rf_t = \alpha_i + \beta_i(Rm_t - Rf_t) + \varepsilon_{i,t}$

PART	INTERPRETATION	DO NOT CLAIM
β_i	sample conditional slope on market excess return	causal effect or future constant
α_i	fitted excess return when market regressor = 0	guaranteed performance
$\varepsilon_{i,t}$	observed minus fitted component	irrelevant noise without checks
fit	sample variation accounted for	same thing as beta



Source C2 redrawn: coefficient meaning and model adequacy must be reported separately.

ANSWER SEQUENCE

1. Define both excess-return units and period.
2. Substitute or interpret α and β with direction and units.
3. Distinguish slope from goodness of fit.
4. Inspect residual structure and stability.
5. Limit the conclusion to the fitted sample/model.

3b · Residual Diagnostic

C2 FAQ

A plausible β may coexist with poor residual behaviour. Residual evidence can weaken the regression even when coefficients look economically familiar. Check whether unexplained structure remains and whether parameters are stable before forecasting or comparing risk.

EXAM SENTENCE → *"β describes the estimated sample relationship under the model; residual behaviour and stability determine how far that interpretation can travel."*

3c · Fit ≠ Meaning

C2

EVIDENCE	SUPPORTS	STILL NEEDED
slope	conditional association	units, uncertainty, stability
intercept	fitted value at zero regressor	economic setting
high fit	sample accounting	residual + time-series diagnosis
small residual	in-sample proximity	out-of-sample evidence

Transfer: If β changes from 1.2 to 0.7 while α stays fixed, estimated market sensitivity falls; fit, residual behaviour and setting must still be rechecked before comparing risk.

4 · Portfolio + Factors

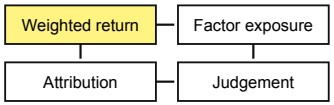
C3 · WEEK 3

PORTFOLIO RETURN

$R_{p,t} = \sum_{i=1}^{N} w_i R_{i,t}$ · first check $\sum w_i = 1$

The weighted return answers only the return arithmetic for aligned weights and returns. It does **not** by itself describe covariance, risk, benchmark-relative performance, factor exposure, transaction costs or changing weights.

QUESTION	OBJECT	REQUIRED EVIDENCE
What return did the mix earn?	portfolio return	weights + same-period returns
What risk source drove it?	factor exposure	chosen factor model
Why did portfolios differ?	performance attribution	components + benchmark
What mix lowers variance?	minimum-variance portfolio	variance/covariance information



Source C3 redrawn: return arithmetic precedes risk and performance attribution.

4b · Ranking Discipline

C3 FAQ

Rankings can disagree because benchmark, risk adjustment, horizon or factor model differs. Name the measure and all four conditions; changing one can change the result.

BEFORE MULTIPLYING

- Weights sum to one and refer to the stated portfolio.
- Weights and returns cover the same period.
- Percentage inputs are converted consistently.
- Any ranking is conditional on its benchmark and model.

EXAM TRAP → *A portfolio return is not a risk-adjusted performance measure. Do not infer covariance or factor exposure from the weighted mean alone.*

Attribution check: Performance measures depend on benchmark, horizon and risk model. Different benchmarks, risk adjustments, horizons or factor models reward different exposures, so rankings can disagree. Preserve the weighted return; without covariance and factor evidence do not infer risk, relative performance or its driver.

5 · Autocorrelation + ARMA

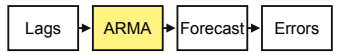
C4 · WEEKS 4–5

AR(1) PROCESS

$y_t = \varphi y_{t-1} + \varepsilon_t$

Use lag dependence to specify a **parsimonious** stationary ARMA process, then evaluate forecasts on observations not used to estimate or select it. The forecast origin controls what information is available; future observations cannot enter the estimate.

STAGE	QUESTION	FAILURE
identify	what lag dependence is visible?	treating pattern as proof
specify	what compact ARMA process fits?	unnecessary complexity
forecast	what is known at origin?	future-data leakage
evaluate	how large are hold-out errors?	using fit as forecast proof



identify → specify → predict → test

Source C4 redrawn: out-of-sample forecast error controls the final decision.

5b · AR(1) Boundary

C4 WORKED

In the standard AR(1) setting, $|\phi| < 1$ means shocks decay geometrically; $\phi = 1$ is the random-walk boundary. If ϕ changes to 1.02, the standard stationary interpretation fails: do not reuse the mean-reversion language or long-run variance result.

Autocorrelation identifies dependence with lags.

Forecast error tests the prediction against realised data. Small in-sample residuals may be purchased by complexity and need not improve forecasts.

WRITE BESIDE FORECAST → *origin, available information, horizon, parameter assumption, realised error.*

5c · Forecast Audit

C4 FAQ

CLAIM	NECESSARY CHECK
"pattern is stable"	parameter/stationarity evidence
"model predicts well"	unseen observations
"extra terms help"	hold-out error, not fit alone
"shock dies out"	AR coefficient magnitude

Model-selection boundary: Complexity can shrink in-sample residuals without improving forecasts. Estimate and select with information available at the forecast origin; evaluate on unused observations. Record horizon and realised error. Stationarity remains conditional on the specified process and a stable parameter.

6 · Trend or Unit Root?

C5 · WEEK 5

RANDOM WALK

$y_t = y_{t-1} + \varepsilon_t$

STRUCTURE	MEANING	RESPONSE
deterministic trend	movement around a specified trend	detrend; check residual stationarity
unit root	level shocks do not decay	difference; verify resulting properties
spurious regression	persistent unrelated levels look significant	check integration/long-run relation

Detrending and differencing solve different problems. The wrong transformation may remove signal or leave stochastic persistence intact. Before interpreting a test, state whether its null is stationarity or a unit root; direction differs across procedures.

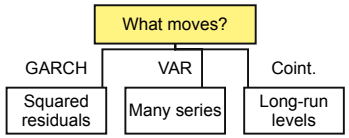
7 · GARCH · VAR · Cointegration

C6

GARCH(1,1) VARIANCE

$h_t = \omega + \alpha\varepsilon^2_{t-1} + \beta h_{t-1}$

EVIDENCE/TASK	METHOD	ANSWERS
clustered squared residuals	ARCH/GARCH	changing conditional variance
joint lagged dynamics	VAR	predictive interaction
response to a shock	impulse response	dynamic propagation
non-stationary levels move together	cointegration	stationary long-run combination



Source C6 redrawn: volatility, dynamic interaction and long-run equilibrium are separate questions.

7b · Interpretation Limits

C5–C6 FAQ

High R^2 or strong t statistics between unrelated random walks can be spurious. Check integration properties, cointegration and residual behaviour before economic interpretation. A VAR coefficient provides predictive content conditional on the information set; it is **not structural causation**.

Mean and variance equations must be written on separate lines. ARCH/GARCH, VAR and cointegration can coexist, but one model's significant coefficient is not evidence for another mechanism.

In the GARCH line, keep ω, lagged squared innovation $\alpha\varepsilon^2_{t-1}$ and lagged variance βh_{t-1} visibly separate before interpretation.

Forward this to your tutorial group

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v2 · 2026-10-16 · Semester 2 examination period, 2–20 November 2026.

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ECON90033 Quantitative Analysis of Finance I

THE UNIVERSITY OF MELBOURNE · WORKED DRILLS · TRAPS · FAST RECALL

Full guide + ask Sia about ECON90033

SIDE 2/2 FIVE GUIDE EXAMPLES → CHANGED CASES → MODEL CHOOSER → TRAPS → LAST-PASS TABLES

SHOW THE WORKING

Keep dates · units · information set · boundary

8 · Worked 1 – Returns

C1 WORKED · 100→104→101

Question: calculate the two simple returns and explain why their arithmetic mean does not reproduce the total holding-period return.

PERIOD 1

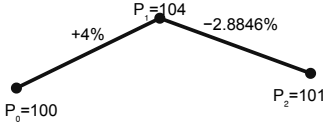
$R_1 = 104/100 - 1 = 0.04 = 4\%$

PERIOD 2

$R_2 = 101/104 - 1 \approx -0.028846 = -2.8846\%$

COMPOUND / ENDPOINT CHECK

$(1+R_1)(1+R_2) - 1$
$= 1.04 \times 0.971154 - 1 = 1\%$
$= 101/100 - 1$



Worked price path: multiply growth factors; the endpoint confirms a 1% total return.

Why the mean fails: adjacent percentage changes use different bases. The arithmetic mean answers the average one-period-return question; the holding-period return is multiplicative. The two price dates must be written under every return.

8b · Log-Return Transfer

C1 CHANGED CASE

Replace the simple returns by adjacent log-price differences. Add them:

$[\ln(104)-\ln(100)] + [\ln(101)-\ln(104)]$
$= \ln(101)-\ln(100) = \ln(101/100)$

The middle log price cancels, making temporal aggregation explicit. This does not remove the need to state scale or inspect the return distribution.

WRONG MOVE	REPAIR
average 4% and −2.8846%	compound factors
divide by wrong price	current/adjacent previous
call return stationary	run a separate diagnostic

FAST CHECK → *Compounded simple return and summed log return must describe the same endpoints on their respective scales.*

Scale bridge: Summed log returns give ln(101/100); compounded simple returns give 101/100−1 = 1%. They share endpoints but use different scales and values. Write adjacent dates under each return; add log differences or multiply simple growth factors. Neither result alone proves stationarity or supplies a forecast model.

9 · Worked 2 – CAPM

C2 WORKED · A=.001 · B=1.2

Given: an asset excess-return regression has intercept 0.001 and slope 1.2.

$R_{i,t}-Rf_{,t} = \mathbf{0.001} + \mathbf{1.2}(Rm_{,t}-Rf_{,t}) + \varepsilon_{i,t}$

1. **β = 1.2:** a one-unit increase in market excess return is associated with a 1.2-unit conditional change in asset excess return within the fitted sample.
2. **α = 0.001:** fitted asset excess return when the market excess-return regressor is zero.
3. **Qualify:** residual structure and parameter stability still require checking.



Worked CAPM reading: α and β describe the fitted line; ε keeps the diagnostic question open.

Units first. If returns are decimals, say "one-unit" carefully; never convert the slope itself to 120% sensitivity without matching the return scale. The fitted slope is neither causation nor a guaranteed future constant.

9b · Changed Slope

C2 TRANSFER · B=.7

Holding α fixed and changing β from 1.2 to 0.7 reduces the estimated market sensitivity. It does not by itself prove lower total risk or better performance: fit, residual behaviour, stability and the economic setting must be rechecked.

TEMPTATION	WHY INCOMPLETE
"β plausible, model good"	fit/residuals are separate
"β causes the return"	design does not support causality
"β stays .7"	stability is empirical
"small residual ⇒ forecast"	needs unseen data

SCORING LINE → *coefficient → units → conditional interpretation → residual/stability boundary.*

9c · Coefficient Drill

C2 WORKED LOGIC

PROMPT	REQUIRED MOVE	BOUNDARY
interpret β=1.2	conditional slope with both excess-return variables	fitted sample
interpret α=.001	fitted asset excess return at market excess=0	model setting

10 · Worked 3 – Portfolio

C3 WORKED · 60/40

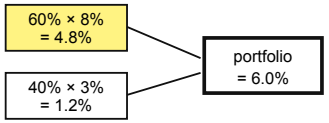
Given: 60% in an asset returning 8%; 40% in an asset returning 3%.

WEIGHT CHECK

$0.60 + 0.40 = \mathbf{1.00}$

WEIGHTED RETURN

$R_p = 0.60\times0.08 + 0.40\times0.03$
$= 0.048 + 0.012 = \mathbf{0.060 = 6\%}$



Worked weighted sum: component contributions 4.8% + 1.2% = 6.0%.

What 6% omits: covariance, benchmark-relative performance, factor exposure, transaction costs and whether weights changed. The answer must not smuggle these into a calculation that only combines returns.

10b · Changed Asset Return

C3 TRANSFER · 7%

If the second asset return rises to 7% while weights stay 60/40 and the first stays 8%:

$R_p = 0.60\times0.08 + 0.40\times0.07$
$= 0.048 + 0.028 = \mathbf{0.076 = 7.6\%}$

The weighted return changes, but the covariance, factor and attribution questions remain unresolved. A changed return does not authorise a new risk ranking.

CHECK	PASS CONDITION
weights	sum to one
period	weights/returns aligned
scale	decimals/percentages consistent
claim	no unsupported risk inference

10c · Ranking Trap

C3 FAQ

A ranking can reverse when benchmark, horizon, risk adjustment or factor model changes. State all four before calling one portfolio "better". Performance attribution names the driver under the chosen model; it is not model-free truth.

FAST REPAIR → *Keep the correct 6% or 7.6% arithmetic, then narrow only the unsupported interpretation.*

Attribution test: Weighted return combines aligned weights and returns. To rank portfolios, state benchmark, horizon, risk adjustment and factor model. Without covariance or factor evidence, keep the arithmetic and withhold risk or driver claims.

11 · Worked 4 – AR(1)

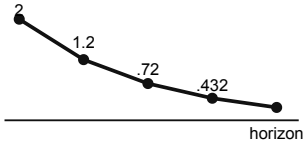
C4 WORKED · Φ=.6 · Y_t=2

Given: current demeaned value 2, AR(1) coefficient 0.6. At the forecast origin the innovation's conditional mean is zero.

ONE-STEP FORECAST

$\hat{y}_{t+1}|_t = \varphi y_t = 0.6\times2 = \mathbf{1.2}$

Because |0.6|<1, shocks decay geometrically in the standard stationary AR(1) setting. The conclusion assumes the specified process and stable parameter.



AR(1) intuition from the guide example: with |φ|<1, a shock shrinks by φ each step.

WRITE	REASON
forecast origin	fixes available information
horizon	distinguishes one/multi-step
parameter condition	supports shock-decay claim
forecast error	tests performance ex post

11b · Boundary Case

C4 TRANSFER · Φ=1.02

If φ changes to 1.02, the usual stationary AR(1) condition fails. Do not reuse the same mean-reversion interpretation or long-run variance formula. Reclassify the process, revisit transformation/specification, and keep future data outside the forecast information set.

Small in-sample residual? Insufficient. More complexity can improve fit without improving forecasts. Compare errors on observations excluded from estimation and model selection.

EXAM TRAP → *"Fits history" and "forecasts new observations" are different claims with different evidence.*

11c · ARMA Checklist

C4

1. Identify lag dependence.
2. Choose a parsimonious process.
3. Confirm the stationarity boundary.
4. Freeze the forecast information set.
5. Calculate forecast and realised error.
6. Compare out-of-sample performance.

11d · Multi-Step Consistency

DERIVED FROM C4 WORKED DATA

Continuing the same zero-mean-innovation forecast recursively:

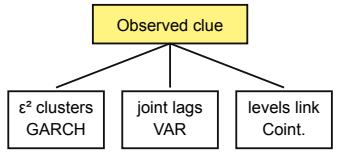
12 · Worked 5 – Route It

C5–C6 WORKED

Scenario A: two unrelated random walks generate high R^2. Persistent non-stationary levels can create impressive fit and t statistics even when innovations are unrelated. Diagnose integration; ask whether a defensible cointegrating relation and satisfactory residual behaviour exist before economic interpretation.

Scenario B: returns have clustered squared residuals while two price levels move together. Split the questions:

- **Changing variance:** conditional-variance model for squared-residual dependence.
- **Joint short-run dynamics:** VAR, conditional on the information set.
- **Long-run levels:** cointegration—a stationary combination of non-stationary levels.



Guide routing rule: variance, predictive interaction and long-run equilibrium require different models.

12b · Trend vs Difference

C5 CHANGED CASE

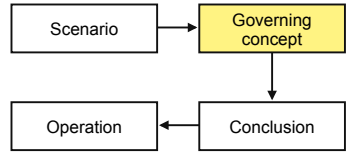
IF EVIDENCE SUGGESTS…	FIRST RESPONSE	THEN VERIFY
known deterministic trends	detrend	residual stationarity + breaks
unit-root persistence	difference	new series properties
two persistent levels	test long-run relation	stationary combination
apparently strong regression	withhold meaning	integration + residuals

Detrending a unit-root process can leave stochastic persistence. Differencing a trend-stationary process can remove useful structure. State the test null before reading the sign or rejection.

Interpretation firewall: ARCH/GARCH, VAR and cointegration answer different questions. Keep mean and variance separate. VAR models joint lags, but predictive causality depends on the information set; it is not structural causation. Cointegration asks whether non-stationary levels form a stationary combination; error correction can link them. Never use one model's coefficient to prove another mechanism.

13 · 20-Second Method Chooser

ALL TOPIC MAPS



Source front figure redrawn: scenario → governing concept → operation → conclusion.

PROMPT NOUN	DECISIVE FIRST LINE
price change	define adjacent return
market sensitivity	write CAPM excess-return equation
weighted performance	check Σw=1, then ΣwR
lag forecast	write process + origin
persistent level	classify trend/unit root
variance clustering	separate mean and h_t
several lagged series	VAR + conditional wording
long-run levels	cointegration question

13b · Formula Recall Grid

C1–C6 CHECKPOINTS

METHOD	CORE RELATION	BOUNDARY
simple return	$P_t/P_{t-1}-1$	adjacent prices
log return	$\ln P_t - \ln P_{t-1}$	add through time
CAPM	asset excess = α+β market excess+ε	sample/model
portfolio	$R_p=\Sigma w_i R_i$	Σw=1; same period
AR(1)	$y_t=\phi y_{t-1}+\varepsilon_t$	|φ|<1 for standard stationary case
random walk	$y_t=y_{t-1}+\varepsilon_t$	shock persists
GARCH	$h_t=\omega+\alpha\varepsilon^2_{t-1}+\beta h_{t-1}$	variance, not mean

14 · Common Errors

WORKED TIPS + FAQS

ERROR	REPAIR SENTENCE
wrong return denominator	label both dates first
average simple returns	compound growth factors
β = fit / causality	separate slope, fit, design
return = risk-adjusted rank	name benchmark/model/horizon
in-sample fit = forecast	use unseen observations
detrend = difference	match transformation to process
VAR = causation	say predictive and conditional
GARCH = cointegration	variance vs long-run levels

15 · Final 60-Second Audit

GUIDE STRATEGY

1. Object and horizon named?
2. Dates, units, signs and weights aligned?