ECC3841 Network Economics

MONASH UNIVERSITY · SEMESTER 2 2026 · EXAM REVISION SHEET

Full guide + ask Sia about ECC3841

SIDE 1 · WHAT THE FINAL REWARDS — Represent → choose mechanism → solve → check → interpret — **PRIORITY RULES + FORMULAS**

1 · Exam map

COURSE DATA · BRIEF

Exercise 35%	15%	Examination 50%

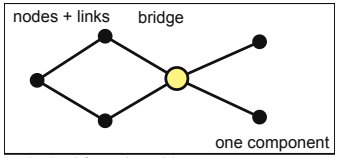
1 - Exercise 35% · 2 - Presentation 15% · 3 - Examination 50%

Permitted materials: not confirmed for this offering in the course materials we hold — check the exam instructions on the LMS.

The final is described as a traditional written final based on lecture notes and tutorial material. Historical papers recur around network games, social learning, education peer effects and financial contagion; practise question families, not predicted allocations.

2 · Representation first

C1 · STRATEGY



Read order: define nodes and direction → components → paths; a bridge can have modest degree and high betweenness.

BEFORE ARITHMETIC	CHECK
Node set; what one link means; directed/undirected; weighted/unweighted.	Does one adjacency row match the drawing?
Undirected graph	Σ degree = 2 × number of links.
After solving	Symmetric positions must give equal scores.

EXAM TIP *Never silently repair the graph later. The matrix convention controls every denominator and interpretation.*

3 · Centrality chooser

C1 · FAQ

PROMPT MECHANISM	USE / INTERPRET
Immediate contacts	**Degree**: local exposure.
Reach all nodes quickly	**Closeness**: short access.
Control shortest routes	**Betweenness**: brokerage.
Ties to important nodes	**Eigenvector**: recursive prestige.

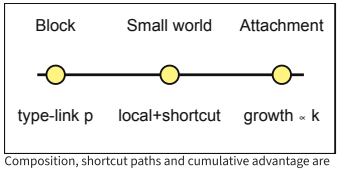
DENOMINATORS THAT EARN METHOD CREDIT

```
Density (undirected) = m ÷ [n(n-1)/2]
Normalised closeness_i = (n-1) ÷ Σ_j d_ij
Eigenvector score: high when linked neighbours also score high.
```

A ranking without its mechanism is incomplete. Same link count or degree distribution can hide different clustering, components and average path lengths; a large score is not causal influence.

4 · Formation fingerprints

C2 · TOPIC MAP



Composition, shortcut paths and cumulative advantage are different explanations; match the model to the statistic.

OBSERVED FEATURE	CANDIDATE STORY	DO NOT CLAIM
Type-dependent mixing	Block model	Preference proved
High clustering + short paths	Small-world rewiring	Strategic consent
Skewed degree in growth	Preferential attachment	Type mixing explained

Describe inputs, process and predicted statistic. An observed fit supports a story; it does not establish the data-generating process.

5 · Opportunity denominators

C2/C5 · STRATEGY

UNDIRECTED POSSIBLE PAIRS

```
within A = nA(nA-1)/2
within B = nB(nB-1)/2
cross A–B = nA × nB
link rate = observed links ÷ possible pairs
```

Use the denominator *before* interpreting mixing. Large groups mechanically have more possible same-type pairs. For directed nominations, state the ordered-pair convention instead.

ANSWER LAYER	REQUIRED SENTENCE
Description	Actual rate versus opportunity baseline.
Mechanism	Preference, geography, school or institution may generate it.
Consequence	Name what the tie carries: information, trust, support or sanctions.

6 · Pairwise stability

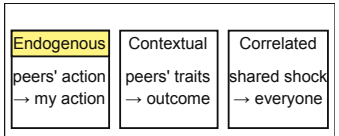
C2 · FAQ

LINK	TEST	PASS CONDITION
Existing ij	Each endpoint's payoff change from deleting it.	No endpoint wants unilateral deletion.
Absent ij	Each endpoint's payoff change from adding it.	Not both endpoints gain.
Efficiency asked	Recompute total welfare.	Include effects on non-endpoints.

Creation is bilateral; deletion is unilateral. Keep endpoint incentives separate from social welfare. Stable can be inefficient because endpoints ignore shorter paths, congestion or information benefits borne by others.

7 · Peer-effect channels

C3 · IDENTIFICATION



Similar outcomes are observationally consistent with three channels; name all before proposing causal identification.

THREAT	WHY CORRELATION FAILS	POSSIBLE RESPONSE
Reflection	My outcome and peers' outcomes are simultaneous.	Independent exposure variation.
Selection	Similar people choose one another.	Random assignment or defended instrument.
Shared inputs	Teacher, place or shock moves all.	Specified fixed effects / controls.

A leave-one-out mean removes the focal outcome from the peer average but does not solve reflection, selection or common inputs. State network boundary, link direction and when ties were measured.

8 · Network game spine

C3/C6 · METHOD

LOCAL-AGGREGATE BEST REPLY

```
x_i = a_i + βΣ_j g_ij x_j
Vector form: x = a + βGx
Equilibrium: (I-βG)x = a
x = (I-βG)^-1 a, when the equilibrium is unique.
```

B SIGN	MECHANISM	RESPONSE
β > 0	Strategic complements	Neighbour action raises my best reply; feedback amplifies.
β < 0	Strategic substitutes	Neighbour action lowers my best reply; responses offset.

Katz-Bonacich centrality matches complements because it sums direct and geometrically attenuated indirect exposure along walks. Do not use it without checking the model and uniqueness.

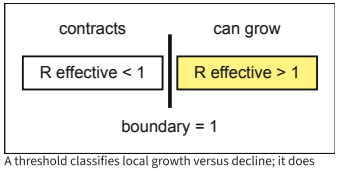
VISIBLE SOLUTION SEQUENCE

1. Derive each best reply from the payoff.
2. Check every row of G reproduces the neighbour sum.
3. Solve the simultaneous system.
4. Substitute into *every* original equation.
5. Interpret direct response plus network feedback.

EXAM TIP *Local aggregate uses friends' sum; local average normalises by degree. The policy logic can reverse.*

9 · Diffusion regime

C4 · THRESHOLDS



A threshold classifies local growth versus decline; it does not by itself give the peak, timing or final reach.

PROTECTION RULE

```
R_e = R_0(1-v)
Decline requires R_0(1-v) < 1
Therefore v > 1 - 1/R_0.
Equality is the boundary, not strict decline.
```

QUESTION CLUE	MODEL / IMPLICATION
Recovered leave susceptibility	**SIR**: S → I → R.
Recovery permits reinfection	**SIS**: S → I → S.
External information + imitation	**Bass**: adoption, not disease compartments.
One exposure may suffice	Simple contagion; bridges can matter.
Reinforcement required	Complex contagion; clustered seeds can win.

10 · State-update discipline

C4 · STRATEGY

1. Name states and draw flows.
2. Calculate new infections/adoptions and removals from beginning-of-period stocks.
3. Update all compartments only after both flows are known.
4. Check shares are non-negative and sum to one.
5. End with regime + assumption, not only a number.

POLICY	WHAT IT CHANGES	OBJECTIVE
Protection / distancing	Susceptibility or transmission	Reduce early growth / peak.
Faster recovery	Time infected	Shorten infectious exposure.
Advertising / seeding	External information / initial adopters	Accelerate useful adoption.

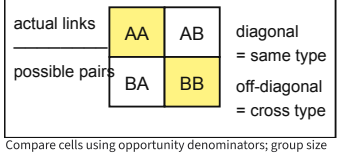
Reachability is potential, not realised transmission. A giant component supplies routes; behaviour, clustering and heterogeneous contact determine realised spread.

WHAT THE THRESHOLD DOES NOT ANSWER

NOT IDENTIFIED BY R_0 ALONE	WHAT ELSE IS NEEDED
Peak size / timing	Full state dynamics and initial stocks.
Final reach	Depletion, network placement and behaviour.
Best seed	Simple versus complex transmission rule.
Policy welfare	Costs, benefits and distribution.

11 · Homophily audit

C5 · METHOD



Compare cells using opportunity denominators; group size must not masquerade as preference.

RATE-FIRST METHOD

```
rAA = linksAA ÷ [nA(nA-1)/2]
rBB = linksBB ÷ [nB(nB-1)/2]
rAB = linksAB ÷ (nA nB)
```

FINDING	SAFE INTERPRETATION
Within rates > cross rate	Positive same-type mixing relative to opportunities.
Adjusted index > 0	More same-type ties than stated baseline.
Adjusted index = 0	Observed same-type share matches baseline.
Adjusted index < 0	More cross-type mixing than baseline.

Description is not cause. Choice homophily is preference conditional on opportunities; induced homophily is generated by schools, geography, occupations or institutional assignment.

12 · Consequence depends on flow

C5/C9

TIE CAN CARRY	POSSIBLE GAIN	POSSIBLE LIMIT
Trust / sanctions	Support, enforcement, insurance	Exclusion of outsiders
Information	Jobs, migration, learning	Redundancy inside clusters
Risk sharing	Smooth idiosyncratic shocks	Fails under correlated shocks
Technology evidence	Reduce uncertainty	Credit or skill may still bind

Weak ties often provide nonredundant reach; strong ties can make costly help or referrals credible. State the missing market, the tie's function and the condition under which the benefit fails.

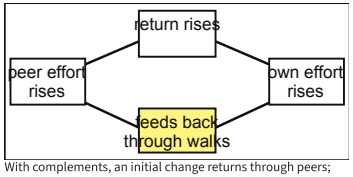
POLICY *Changing meeting opportunities is not the same as creating durable ties or changing downstream outcomes; measure all three stages.*

MECHANISM TEST

SURFACE PATTERN	RIVAL EXPLANATION	USEFUL VARIATION
Similar people link	Choice or constrained meetings	Change opportunities holding choice sets comparable.
Peers adopt together	Learning or common soil, prices, extension	Random seeding + recorded transmission.

13 · Key-player counterfactual

C6 · FAQ



With complements, an initial change returns through peers; stronger interaction makes the social multiplier larger.

Definition: the key player is the node whose removal causes the largest fall in *total equilibrium activity*. Highest degree is only a candidate.

REMOVAL ALGORITHM	WHY
1 Solve baseline x and Σx.	Establish comparison.
2 Delete candidate + incident links.	Topology changes.
3 Solve every survivor again.	Best replies adjust.
4 Compare baseline − reduced total.	Ranks equilibrium reduction.

Keep friendship and competition matrices separate if they enter different payoff terms. Then qualify policy with identification, missing ties, displacement, fairness and rewiring after intervention.

14 · Applied-method chooser

C7–C10

IF PROMPT SAYS...	DO THIS	DECISIVE CHECK
Peer coefficient	Threat → design → assumption → units → limitation.	Where does independent variation come from?
Bank shock / cascade	Assets − liabilities → direct loss → defaults → recovery rounds.	Debt direction; strict insolvency inequality.
Signals / herd	Enumerate private-signal histories, then public actions.	Do event probabilities sum to one?
Advertising target	Conversion × unique unaware reach − cost.	Overlap, margin loss, later-round rule.

FINANCIAL BOUNDARY

```
Equity E = assets - liabilities
Shocked equity E' = E - loss
Insolvent when E' < 0; E' = 0 is boundary.
```

SIGNAL-HISTORY CHECK

```
accuracy p: correct agreement p^2;
wrong agreement (1-p)^2; disagreement 2p(1-p). Sum = 1.
```

TARGETING SCREEN

```
Expected first-round value = purchase probability × (target + unique newly informed neighbours). Subtract campaign cost before profit.
```

ECC3841 Network Economics · Self-test drills

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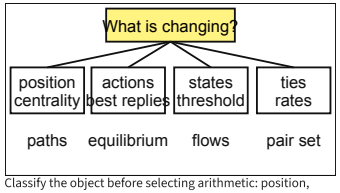
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SIDE 2 · DRILLS + TRAPS

Cover the answer path; say the decision before calculating

5 WORKED DRILLS

15 · Method chooser ALL CHAPTERS



Classify the object before selecting arithmetic: position, strategic action, dynamic state or tie pattern.

IF YOU SEE X	DO Y
"direct / fast / bridge / prestigious"	Degree / closeness / betweenness / eigenvector.
"best response / peer effort"	Write all equations; solve simultaneously; substitute back.
"protected share / early growth"	Write strict threshold inequality; label equality boundary.
"same-type links"	Count possible pairs before rates or preference language.
"remove a node"	Delete links and re-solve survivors; compare total equilibrium.
"bank owes bank"	Liability for debtor, asset for creditor; recompute rounds.
"target consumers"	Conversion × marginal unaware reach; deduct cost and overlap.

16 · Classic traps FAQ · STRATEGY

TEMPTING SHORTCUT	WHY IT LOSES MARKS
Highest degree = best target	Mechanism may value bridges, important neighbours, unique reach or equilibrium reduction.
Peer correlation = influence	Reflection, selection, contextual and correlated effects remain.
Stable = efficient	Endpoints ignore third-party externalities.
Dense network = safe / fast	Placement, exposure size, capital and recovery matter.
One threshold number = forecast	Peak, timing and final reach require dynamics and initial state.
Raw same-type count = homophily	Opportunity set and group composition are missing.

JUDGEMENT CARD *Every conclusion needs mechanism + denominator/equation + one assumption that could change it.*

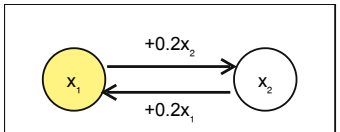
ANSWER SKELETON

Define → calculate → check → interpret → qualify.

Define nodes, links, states or balance-sheet direction; show the denominator/equation; perform visible steps; run symmetry, substitution, adding-up or boundary checks; interpret the economic channel; name the assumption most likely to move the result.

Counterfactual trap: Baseline centrality freezes behaviour. Change the graph or payoff, re-solve every survivor, then compare the stated outcome before naming the target.

17 · Worked 1: two-player game C3 WORKED



Each action enters the other's best reply: solve feedback, not two isolated choices.

Given: $x_1 = 2 + 0.2x_2$; $x_2 = 1 + 0.2x_1$.

1. Substitute x_2: $x_1 = 2 + 0.2(1 + 0.2x_1) = 2.2 + 0.04x_1$.
2. Collect own action: $0.96x_1 = 2.2$.
3. Solve: $x_1 = \mathbf{2.2917}$.
4. Back-substitute: $x_2 = 1 + 0.2(2.2917) = \mathbf{1.4583}$.
5. Check both original equations within rounding.

ANSWER

$(x_1, x_2) \approx (2.2917, 1.4583)$. Positive peer coefficients make actions strategic complements and transmit baseline returns through feedback.

METHOD CREDIT *Write every best reply and the check. Treating neighbours' actions as fixed hides the equilibrium method.*

18 · Game judgement cards C3/C6

IF YOU SEE...	SAY / DO...
β positive	Complements; shocks amplify along walks.
β negative	Substitutes; neighbours' actions offset.
Planner versus private	Circle the spillover term the individual ignores.
Key player	Compare solved reduced networks, not baseline centrality.
Crime policy	Separate model prediction, identification and recommendation.

Fixed-network caveat: removal estimates can overstate durable effects if survivors rewire or activity shifts to another person, place or offence.

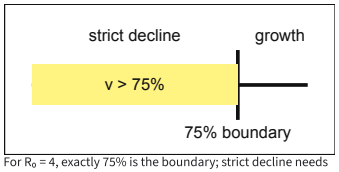
COUNTERFACTUAL AUDIT

Freeze nothing the model says should adjust. Record baseline total; state the intervention; change the graph or payoff; solve the new system; compare totals. A degree or Bonacich ranking is positional evidence, not the removal answer.

ANSWER CLAIM	MINIMUM EVIDENCE
"Influential"	Named interaction channel.
"Key player"	Largest solved equilibrium reduction.
"Policy works"	Identification plus displacement / rewiring caveat.

When friendship lowers detection but common-market activity creates competition, use separate matrices and read the sign of each payoff term. A continuous effort model explains the intensive margin unless an entry decision is separately modelled.

19 · Worked 2: protection C4 WORKED



For $R_0 = 4$, exactly 75% is the boundary; strict decline needs more than 75% fully protected.

Given: basic reproduction number $R_0 = 4$. Find the fully protected share v that makes effective R strictly below one.

1. Condition: $4(1-v) < 1$.
2. Divide by 4: $1-v < 1/4$.
3. Rearrange: $v > 3/4 = \mathbf{75\%}$.
4. Interpret: equality is the threshold; it is not strict decline.

ANSWER

More than 75% must be fully protected under the model assumptions.

20 · Diffusion judgement cards C4

IF YOU SEE...	DO / STATE...
Recovery gives lasting protection	SIR; R is removed from immediate susceptibility.
Recovery allows reinfection	SIS; return to S.
External channel + imitation	Bass; early innovation, later peer acceleration, then remaining market shrinks.
One exposure can transmit	Simple contagion; bridge seeding may create reach.
Multiple exposures required	Complex contagion; nearby reinforcing seeds may beat one hub.

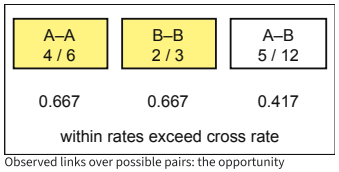
Update trap: compute all flows from beginning-of-period stocks, then update states together. Check non-negativity and that shares sum to one.

LIMIT *R below/above one describes local tendency near the stated state; heterogeneity, clustering and behavioural response can change realised diffusion.*

INTERVENTION DECODER

DESIRED CHANGE	LEVER	REPORT
Lower infection growth	Reduce transmission / susceptibility; speed recovery.	Which parameter or state moved.
Accelerate useful adoption	External information; credible seeds; remove adoption friction.	New awareness versus realised adoption.
Choose seeds	Match bridge or cluster to simple / complex rule.	Redundancy and initial conditions.

21 · Worked 3: mixing rates C5 WORKED



Observed links over possible pairs: the opportunity denominator changes across cells.

Given: four A nodes, three B nodes; four A–A links, two B–B links and five cross links.

1. A opportunities = 4×3/2 = 6; rate = 4/6 = **0.667**.
2. B opportunities = 3×2/2 = 3; rate = 2/3 = **0.667**.
3. Cross opportunities = 4×3 = 12; rate = 5/12 = **0.417**.
4. Both within-type rates exceed the cross rate.

ANSWER

The network displays same-type mixing relative to available pairs. The calculation does **not** identify preference as the cause.

22 · Homophily traps C5 FAQ

TRAP	REPAIR
Compare link counts	Compare rates using possible-pair denominators.
Call positive mixing prejudice	Separate choice from induced meeting opportunities.
Call homophily wholly bad	Name tie content: trust/support versus redundant information/exclusion.
Pool groups immediately	Report group-specific rates; majority and minority can face different opportunities.

For an adjusted index, state observed same-type share, baseline opportunity share, scaling denominator and sign. Keep raw counts beside it when a group is small.

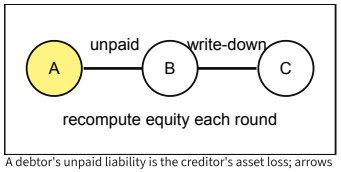
EDUCATION IDENTIFICATION CARD

THREAT	DESIGN RESPONSE	RESIDUAL CHECK
Friendship selection	Random assigned peers	Compliance and outside ties.
Shared teacher / school	Specified fixed effects	What variation remains?
Simultaneous outcomes	Defended instrument / timing	Exclusion restriction.
Mechanical own-outcome overlap	Leave-one-out mean	Still does not solve reflection.

State threat → design → assumption → coefficient units → limitation. Pre-treatment networks preserve timing; they can still reflect earlier selection.

Direction matters: a nominated friend and someone who nominates the focal student define different exposure measures. Also check isolated students, attrition and spillovers outside assigned groups.

23 · Worked 4: bank threshold C8 WORKED



A debtor's unpaid liability is the creditor's asset loss; arrows alone never determine failure.

Given: assets = 70, liabilities = 58; only a portfolio worth 50 is shocked. Find fractional fall s making equity negative.

1. Initial equity $E = 70 - 58 = \mathbf{12}$.
2. Portfolio loss = 50s.
3. Shocked equity $E' = 12 - 50s$.
4. Insolvency: $12 - 50s < 0 \Rightarrow s > 12/50 = \mathbf{0.24}$.
5. At 24%, equity equals zero: boundary, not strictly negative.

ANSWER

A fall strictly above 24% makes the bank insolvent under the stated balance sheet.

24 · Cascade algorithm C8 FAQ

ROUND	CALCULATION
0 Baseline	Outside assets + interbank assets − deposits − interbank liabilities = equity.
1 Direct shock	Apply percentage only to named asset category; mark all first defaults.
2 Recovery	Write down creditor claims under stated recovery / priority rule.
3 Repeat	Recompute each equity simultaneously until no new default.

Liquidity ≠ solvency: payment timing may fail despite adequate long-run value; fire-sale losses can convert a shortage into insolvency. Guarantees address runs, emergency lending bridges liquidity, recapitalisation repairs capital.

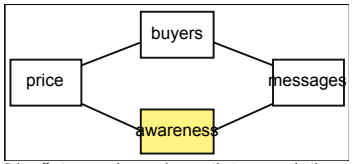
TRAP *Dense networks diversify exposure but add contagion routes. Position size, capital, concentration and recovery decide the net effect.*

STRESS-TEST CARD

VARY	ASK
Capital buffer	Which direct or counterparty loss crosses zero equity?
Recovery rate	How much of each creditor claim survives?
Exposure concentration	Does one default exhaust a creditor's buffer?
Common asset shock	Is distress correlated without a direct debt link?

Verify every interbank liability has a matching asset somewhere in the closed network. Reverse one debt arrow mentally: debtor and creditor roles switch.

25 · Worked 5: advertising C10 WORKED



Price affects conversion; purchases activate communication; communication expands awareness and future demand.

Given: count the target as one demand unit. A buys with probability 0.8 and informs three new neighbours; B buys with probability 0.5 and informs six.

1. A expected first-round value = $0.8 \times (1+3) = \mathbf{3.2}$.
2. B expected first-round value = $0.5 \times (1+6) = \mathbf{3.5}$.
3. B leads before overlap, cost and later-round effects.
4. Check contacts are unique and unaware.
5. Deduct advertising cost before the profit conclusion.

ANSWER

B has slightly larger expected first-round reach before costs and overlap.

26 · Pricing + learning traps C9/C10

PROMPT	CORRECT COMPARISON
Best advertising target	Purchase probability × marginal uninformed reach, not degree.
Several targets	Recompute overlap and awareness after each selected seed.
Price cut	Lost margin + added direct demand + diffusion demand.
Technology seed	Credible, nonredundant reach under actual learning mechanism.
Observed herd	Separate private signals from actions already responding to history.

Information cascades: early unlucky signals can create public evidence strong enough that later people rationally ignore private information. If eventual outcomes become visible, performance feedback can break the cascade.

27 · Exam-morning plan COURSE STRATEGY

1. Recite the four centrality mechanisms and three peer-effect channels.
2. Write pairwise-stability, protection-threshold and insolvency inequalities from memory.
3. Redo one simultaneous best-reply system and check by substitution.
4. Practise one opportunity denominator and one balance-sheet round.
5. Use an error ledger: representation → equation → arithmetic → interpretation.