META

LLSE, Covariance, Conditional Expectation, and Markov Chains

1 General Comments

1. Focus on
   - LLSE: all parts
   - Covariance: 2.1 and 2.2.1
   - Conditional Expectation: all parts
2. Covariance: Make the connection between the covariance formula and the variance formula, and why it makes sense to define covariance this way.
3. LLSE
   - Make sure to do covariance and conditional expectation first because LLSE relies on it
   - Explain what LLSE is, and why the formula makes sense–intuitively, why. If there is time or interest, prove it.
4. Conditional Expectation
   - Make the connection between normal expectation and conditional expectation, and explain intuitively what conditional expectation means
   - Explain what LLSE is, and why the formula makes sense–intuitively, why. If there is time or interest, prove it.
5. Markov Chains
   - First order Markov property: probability of an object being in any state depends only on the state the object was in right before

- Homogeneity: Regardless of how many steps the chain has run, the transition matrix doesnt change (i.e. $P(X_{i+1} = a|X_i = b)$ is the same regardless of the value of i)
- Irreducibility: there is no sink
- A state x is periodic if by starting in x, all ways of returning to x have some GCD greater than 1. If any state is periodic, then the chain is periodic.
- Explain the intuition behind stationary/invariant distributions and irreducibility and aperiodicity

2 Questions

2.1 Covariance

1. **Roll 2 Dice**
   - This goes back to basic expectation and probability; students who can do 2.1 but get stuck here likely have some gaps in their understanding of previous topics.
2. **Fah Kat**
   - Back to basics; given the actual distribution, calculate expectation (and thus covariance) from scratch.

2.2 Conditional Expectation

1. **Expectation of Conditional Expectation**
   - Using many properties of summations, make sure students understand each step
2. **Take Out** h
   - Using many properties of summations, make sure students understand each step
3. **Given Probability Distribution**
   - Plug and chug, going back to basic distributions.

2.3 Markov Chains

1. **Life of Alex**
   - Basic uses of the formulas

- d: Do not forget that any distribution must add up to 1, and explain that using this method of finding the stationary distribution, two of the first-step equations will be linearly dependent.