Cooperative games

1. A characteristic function game (N, v) assigns ...
   (a) to each coalition of players a worth v
   (b) to each player a single action
   (c) a probability to each outcome
   (d) to each player a payoff matrix
2. The Shapley value of a player is ...
   (a) their average marginal contribution over all orderings of the players
   (b) their payoff in the worst coalition
   (c) the worth of the grand coalition divided equally
   (d) the largest coalition they belong to
3. The efficiency property of the Shapley value says that ...
   (a) the players' payoffs sum to the worth of the grand coalition
   (b) every player receives the same amount
   (c) the strongest player gets everything
   (d) payoffs are always non-negative
4. A null player is one who ...
   (a) adds nothing to any coalition they join, and so receives a Shapley value of 0
   (b) has the highest marginal contribution
   (c) always receives the most
   (d) is in no coalition
5. The symmetry property says that two players who ...
   (a) join last always tie
   (b) have the same name receive equal payoffs
   (c) are both null players receive everything
   (d) contribute equally to every coalition receive equal Shapley values
6. The marginal contribution of player i to a coalition S is ...
   (a) $v(S)/|S|$
   (b) $v(\{i\})$
   (c) $v(S \cup \{i\}) - v(S)$
   (d) $v(S \cup \{i\})$

7. The grand coalition is ...
   (a) the coalition of all the players
   (b) the empty coalition
   (c) the strongest single player
   (d) any coalition of size two

8. A payoff vector must satisfy ...
   (a) $\sum_i \lambda_i = 0$
   (b) $\lambda_i = 1$ for all i
   (c) $\lambda_i = v(\{i\})$
   (d) $\sum_i \lambda_i = v(N)$, sharing out the grand coalition's worth

9. The additivity property of the Shapley value says that ...
   (a) marginal contributions are ignored
   (b) all players receive equal payoffs
   (c) the grand coalition gets nothing
   (d) the value of a sum of two games is the sum of the separate Shapley values

10. The Shapley value is given by the formula ...
    (a) $\phi_i = \frac{1}{N!} \sum_\pi \Delta_\pi(i)$
    (b) $\phi_i = v(N)/N$
    (c) $\phi_i = v(\{i\})$
    (d) $\phi_i = \max_S v(S)$

11. By convention, the worth of the empty coalition is ...
    (a) undefined
    (b) $v(\emptyset) = 0$
    (c) $v(\emptyset) = 1$
    (d) $v(\emptyset) = v(N)$

12. The number of orderings of N players, over which the Shapley value averages, is ...
    (a) N
    (b) N^2
    (c) 2^N
    (d) $N!$

13. Two players who contribute equally to every coalition ...

(a) split the whole worth between them

(b) receive nothing

(c) are both null players

(d) receive equal Shapley values (symmetry)

14. The Shapley value is the unique allocation satisfying ...

(a) no particular axioms

(b) efficiency alone

(c) symmetry alone

(d) efficiency, the null player property, symmetry and additivity

15. The characteristic function $v(S)$ gives ...

(a) the Shapley value of S

(b) the worth that coalition S can secure on its own

(c) the payoff to a single player

(d) the number of players in S

16. The set of predecessors $S_\pi(i)$ of player i in an ordering π is ...

(a) the grand coalition

(b) the players who appear before i in π

(c) all players other than i

(d) the players who appear after i in π

17. A characteristic function game is superadditive if, for disjoint coalitions S and T, ...

(a) $v(S \cup T) \geq v(S) + v(T)$

(b) $v(S \cup T) \leq v(S) + v(T)$

(c) $v(S) = v(T)$

(d) $v(S \cup T) = 0$

18. A characteristic function game is monotone if ...

(a) $v(S) = |S|$ for all S

(b) $v(S) \geq v(T)$ whenever $S \subseteq T$

(c) $v(\emptyset) = 1$

(d) $v(S) \leq v(T)$ whenever $S \subseteq T$

19. Written as a sum over coalitions, the Shapley value weights the marginal contribution of i over S by ...

(a) $\frac{|S|}{N}$

(b) $\frac{1}{N}$

(c) $\frac{|S|!\,(N-|S|-1)!}{N!}$

(d) $\frac{1}{N!}$

20. The Shapley value is the unique payoff vector satisfying efficiency, symmetry, additivity and ...

(a) superadditivity

(b) the null player property

(c) monotonicity

(d) individual rationality