GV300 - Quantitative Political Analysis

University of Essex - Department of Government

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Week 5 – 28 October, 2019

Your GTA

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Problem Set 1 – Answers provided by Dominik Duell

Start from problem number 5: Introduce ourselves

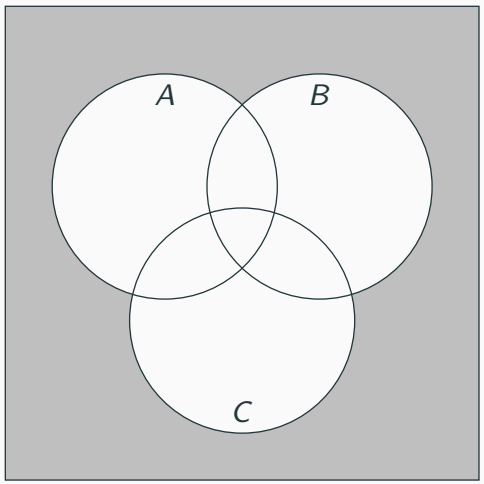
1. What topic you want to be working on?
2. Why this topic is relevant and important to do research on?
3. The research question you aim to answer?
4. How you would try to answer this question? (Refer to which kind of experiment you would try to run, data you would need to collect, and/or how you would analyze this data)
5. What you expect the answer to your research question might be?

Problem 1

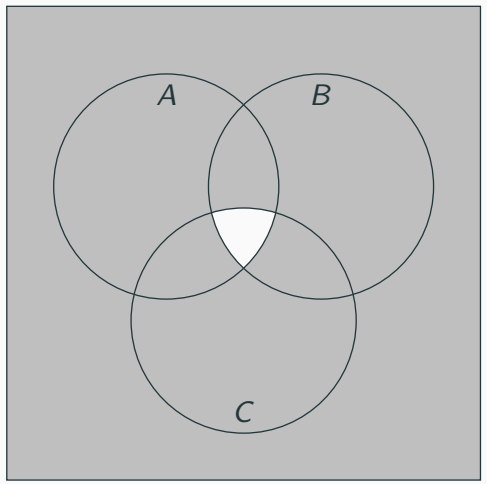
Use Venn Diagrams (or operations on sets) to determine which of the following is true (24 marks, 6 each):

(a) $(A + B + C)' = A' + B' + C'$ is not true.

$(A + B + C)' = (A \cup B \cup C)'$



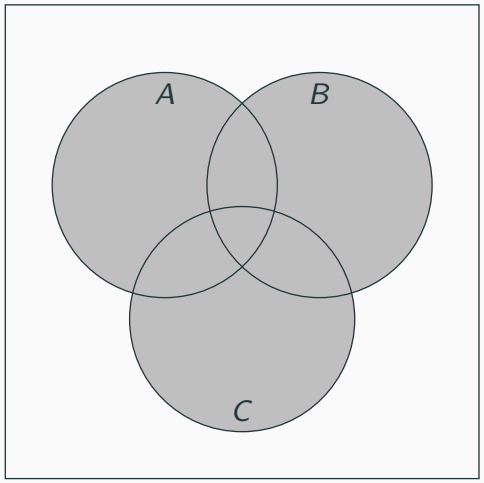
$A' + B' + C' = A' \cup B' \cup C'$



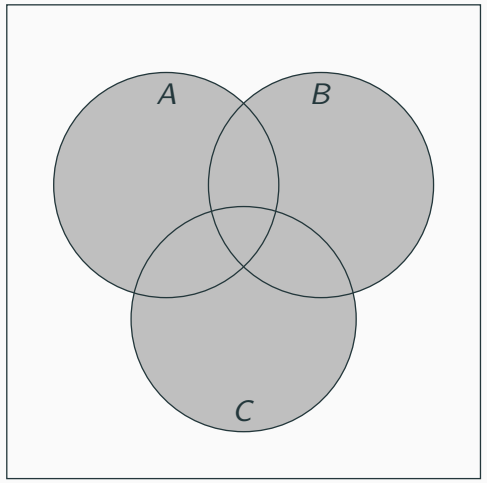
Problem 1

(b) $A + B + C = A + A'B + (A + A'B)'C$ is true.

$A + B + C = A \cup B \cup C$



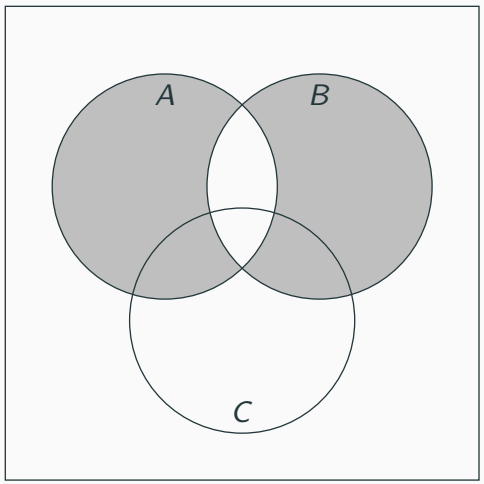
$A + A'B + (A + A'B)'C$



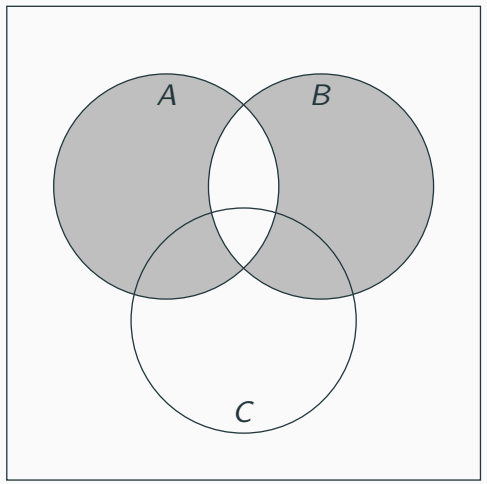
Problem 1

(c) $(A + B)(A' + B') = AB' + A'B + A'BC'$ is true.

$$(A + B)(A' + B') =$$
$$(A \cup B) \cap (A' \cup B')$$



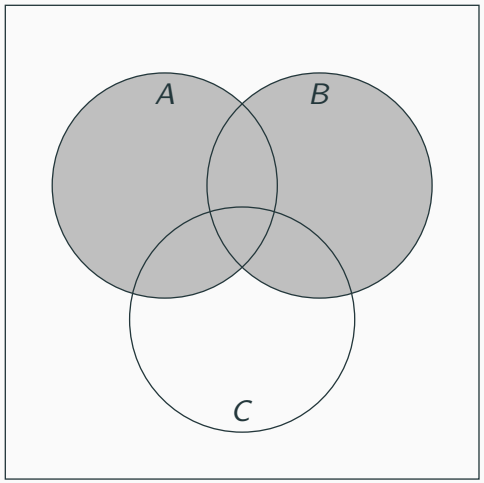
$$AB' + A'B + A'BC' =$$
$$(A \cap B') \cup (A' \cap B) \cup$$
$$(A' \cap B \cap C')$$



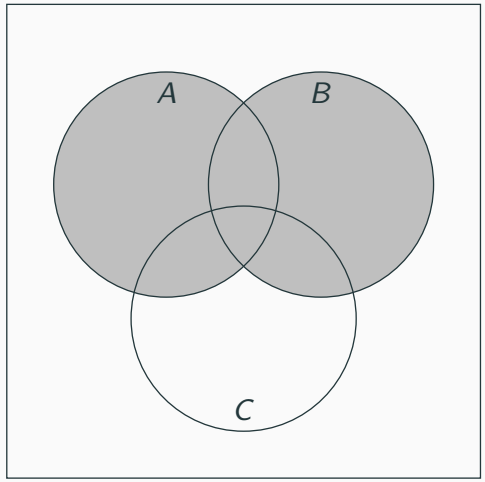
Problem 1

(d) $AB + AB' + A'B = (A'B')'$ is true.

$AB + AB' + A'B =$
$(A \cap B) \cup (A \cap B') \cup$
$(A' \cap B)$



$(A'B')' = (A' \cap B')'$



Problem 2

Consider an experiment where you throw two three-sided dice. Let F_n be the event "The first die rolls an n" and S_n be "The second die rolls an n." Determine whether each of the following are mutually exclusive, collectively exhaustive, a sample space or an event space. Which set of descriptors apply to each (24 marks, 6 each)?

Problem 2 – About the sample space

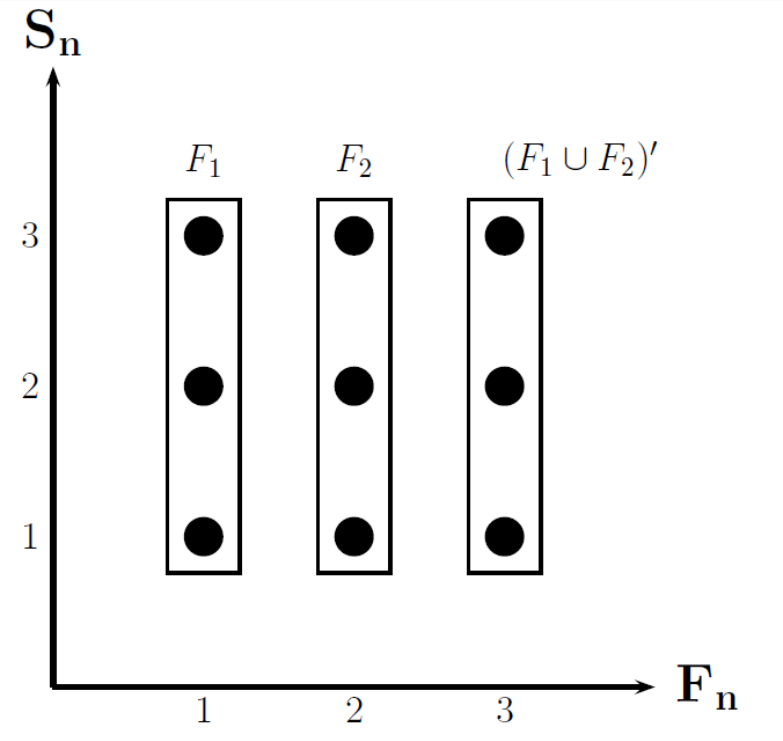
Who knows what a "sample space" is?

Problem 2 – About the sample space

- A "sample space" represents all possible outcomes.
- It is defined over outcomes, **not** events.
- Problem 2 presents collections of events. The concept of "sample space" does not apply to them
- The following statement can never be true: "This collection of **events** can be described as a sample space.
- Sample space: $\{F_1,S_1;\ F_1,S_2;\ F_1,S_3;\ F_2,S_1;\ F_2,S_2;\ F_2,S_3;\ F_3,S_1;\ F_3,S_2;\ F_3,S_3\}$

Problem 2

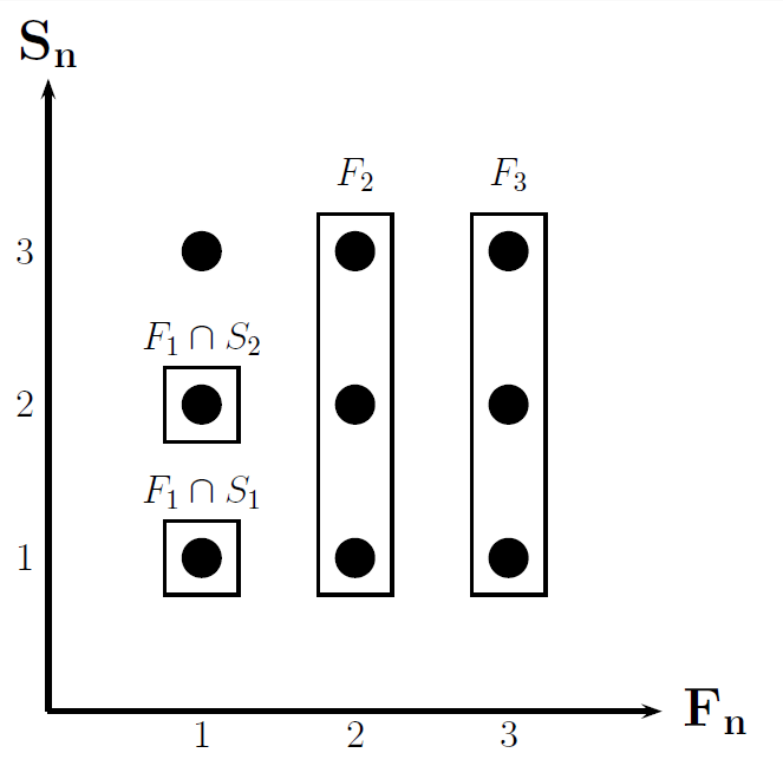
(a) F_1; F_2; $(F1 \cup F2)'$



- Mutually exclusive
- Collectively exhaustive
- Event space
- Not sample space

Problem 2

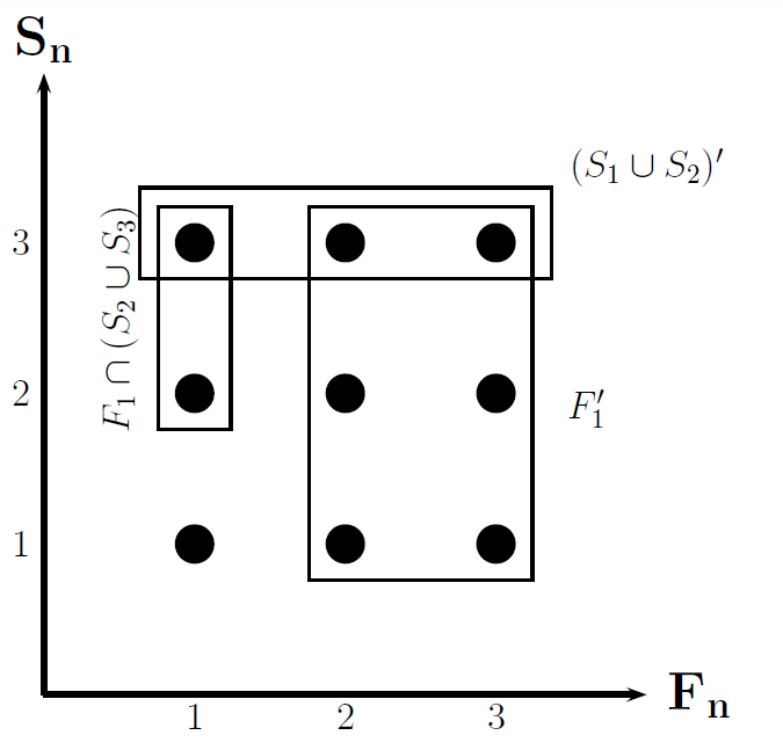
(b) $F_1 \cap S_1$; $F_1 \cap S_2$; F_2; F_3;



- Mutually exclusive
- Not collectively exhaustive
- Not event space
- Not sample space

Problem 2

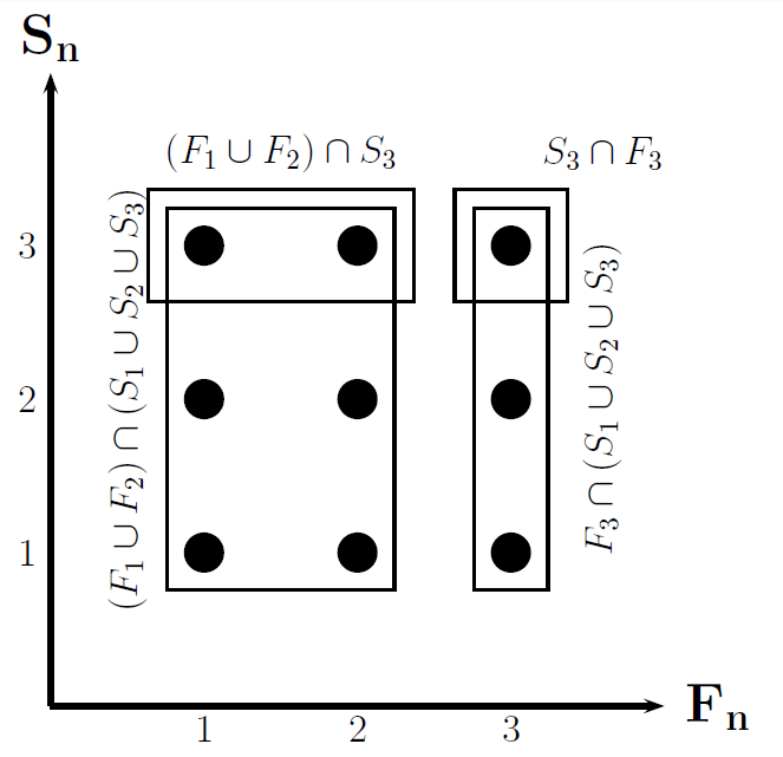
(c) $F_1 \cap (S_2 \cup S_3)$; $(F_1)'$; $(S_1 \cup S_2)'$



- Not mutually exclusive
- Not collectively exhaustive
- Not event space
- Not sample space

Problem 2

(d) $(F_1 \cup F_2) \cap (S_1 \cup S_2 \cup S_3)$; $(F_1 \cup F_2) \cap S_3$; $F_3 \cap (S_1 \cup S_2 \cup S_3)$; $S_3 \cap F_3$



- Not mutually exclusive
- Collectively exhaustive
- Not event space
- Not sample space

Problem 3

Answer and fully explain your answers to the following three questions (15 marks, 5 each):

(a) If events E and F are mutually exclusive but not collectively exhaustive, are E' and F' collectively exhaustive?
Yes. Say, $S = \{E, F, G\}$ *then* $E' = F + G$, $F' = E + G$, *it follows* $E' + F' = E + F + G$.

(b) If events E and F are mutually exclusive and collectively exhaustive, are E' and F' mutually exclusive?
Yes. Say, $S = \{E, F\}$ *then* $E' = F$ *and* $F' = E$.

(c) If events E and F are not mutually exclusive but are collectively exhaustive, are E' and F' collectively exhaustive?
No. Say, $S = \{E, F\}$ *where* $E = \{1, 2, 3\}$ *and* $F = \{3, 4, 5\}$ *then* $E' = \{4, 5\}$ *and* $F' = \{1, 2\}$.

Problem 4

Only three parties, Conservatives, Labour, and Liberal Democrats, face off in a parliamentary election (10 marks, 5 each).

(a) Ignoring the possibility of ties, what is the sample space of such an example of an election?

(b) A minority or coalition government must be formed if it is not the case that one party gained a majority of votes. What is the probability that the government can be formed without the need for a minority or coalition government?

Problem 4

Two possibilities for winning. Either by majority or by plurality.

(a) Sample space:

1. $\{C_m;\ L_m;\ LD_m;\ C_p;\ L_p;\ LD_p\}$ 6 outcomes
2. $\{C_m,L_2;\ C_m,LD_2;\ L_m,C_2;\ L_m,LD_2;\ LD_m,C_2;\ LD_m,L_2;$ $C_p,L_2;\ C_p,LD_2;\ L_p,C_2;\ L_p,LD_2;\ LD_p,C_2;\ LD_m,L_2\}$ 12 outcomes

(b) Probability of having a government with a majority (no plurality):

1. $\{C_m;\ L_m;\ LD_m\}$ 3 ways over 6 outcomes: $Prob = 0.5$
2. $\{C_m,L_2;\ C_m,LD_2;\ L_m,C_2;\ L_m,LD_2;\ LD_m,C_2;\ LD_m,L_2\}$ 6 ways over 12 outcomes: $Prob = 0.5$

Stata and R session

Loops, functions and programs in Stata and R

Math refresher (part 1)

1. Notation
   - 1.1 Variables and constants
   - 1.2 Sets
   - 1.3 Operators
2. Linear algebra
   - 2.1 Scalars
   - 2.2 Vectors
   - 2.3 Matrices
3. Functions
   - 3.1 Basic definitions
   - 3.2 Properties
   - 3.3 Important functions

Math refresher (part 2)

4. Calculus
    - 4.1 Basics
    - 4.2 Limits
    - 4.3 Derivative
    - 4.4 Rules of differentiation
    - 4.5 Extrema
5. Integrals
    - 5.1 Definite integral
    - 5.2 Indefinite integral
    - 5.3 Fundamental theorem of calculus
    - 5.4 Rules of operation

Conclusion

All clear? Questions?

Thanks and see you next week!