# MAT116 Project 1 Chapter 2: Set Theory

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## Definitions

- A **Set** is a group of things.
- An **Element** is a member of a set.
- **Set Theory** is the study of sets.

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## Notation

- A set is usually represented by capital letter
- **Curly brackets { }** indicate a set. Inside the curly brackets is either a description of the set, or a list of the elements in the set.
- If a list of elements continues indefinitely, three dots … are used to indicate “and so on”
- The symbol Î means “is an element of”
- The symbol Ï means “not an element of”

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## Examples

- Z = {1,2,3,4,5,…} = the set of all integers
- P = {2,3,5,7,11) = the set of the first five prime numbers



## Combining Sets

- Sometimes we want to combine sets by joining or intersecting them together.



## More Notation

- $^{C}$ (compliment) means “not” or “not in”
  - Note that this is a superscript symbol
  - Example: $A^{C}$
- È (union symbol) means “or”.
- Ç (intersection symbol) means “and”.

## Examples

- Let A = {1,2,3,4,5,6,7}
- Let B = {2,4,6,8,10}

- Find $A \cup B$
- Find $A \cap B$
- Find $A^C \cap B$
- Find $A \cap B^C$



## 2-3 Empty and Universal Sets

- An **Empty Set** is a set with nothing in it. The notation is $\varnothing$.
- A **Universal Set** is a set with everything in it. The notation is *U*, or sometimes *S*.



## Disjoint Sets

- Sets *A* and *B* called **disjoint** if they have no elements in common.
- A more precise definition:
  - Sets *A* and *B* are **disjoint** if and only if $A \cap B = \varnothing$ .
- Let A = {1,2,3}; Let B = {4,5,6}
  - Then $A \cap B = \varnothing$

## Subsets

- Set *A* is a **subset** of set *B* if and only if every element of set *A* is also an element of set *B*.
- The notation for subset is Í .



## Examples

- Let A = {June, Janet, Jill, Jeffrey, Jello}
- Let B = {Janet, Jello, Justin}
- Let C = {Sally, Solly, Molly, Jolly, Jello}

- Find $A \cup B$
- Find $A \cup (B \cup C)$
- Find $A \cap \varnothing$



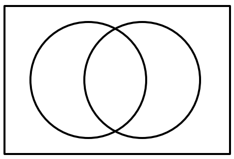
## Try It!!!

- Let A = {June, Janet, Jill, Jeffrey, Jello}
- Let B = {Janet, Jello, Justin}
- Let C = {Sally, Solly, Molly, Jolly, Jello}

- Find $(A \cap B) \cap C$
- Find $(A \cap B) \cup C$
- Find $A \cup (B \cap C)$

## 2-4 Venn Diagrams

- A diagram can often help visualize how sets are related.





## Venn Examples

- Let's look at previous examples
- $A \cap B$
- $A \cup B$



## Venn Examples

- Let U = {1, 2, 3, 4, 5, 6, 7, 8, 9, 10}.
- Let X = {1, 2, 3}, let Y = {2, 4, 6, 8, 10}, and
- Let Z = {4, 5, 6}.

- Find $X \cap Y$ and show it on a diagram
- Find $Z^C \cap Y^C$ and show it on a diagram

## Venn Examples

- I had a party and invited all my rich friends and all my famous friends. There were 18 rich friends, and 12 famous friends. Out of these people, 5 of them were rich *and* famous. Draw a Venn Diagram and place the appropriate number in each section. How many people were at my party?



## Venn Examples

- At my next party, I had 20 guests (all were rich and/or famous). 3 of them were rich *and* famous, 12 were famous but not rich. Draw a Venn Diagram and place the appropriate number in each section. How many rich but not famous?



## Venn Examples

- Shade the area $(A \cap B) \cup A^C$, given two sets, A and B.

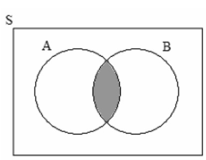
## Solution

- (**A** Ç **B**) ∪ **A**$^{C}$ means
  - "**It's in the intersection of A and B** OR **it's not in A**"



## Solution

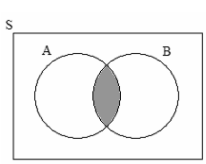
- The intersection of A and B

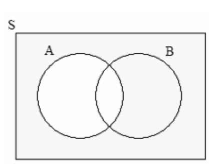





## Solution

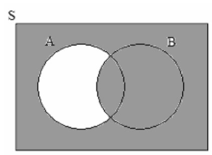
- Not in A



## Solution

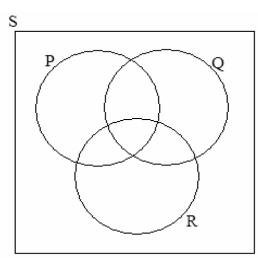
- The union of them: $(A \cap B) \cup A^C$






## Venn Example

- Shade $P \cup (Q \cap R)^C$






## Sections 2-6 & 2-7: Counting

- **Notation**
  - n(*A*) means the number of elements in set A.

- Example: Let A = {2,8,13,75.3,22}. Then n(A)=5

## Example

- Suppose that School A has 48 teachers, and School B has 65 teachers. There are 15 teachers that teach at both School A and School B. Make a Venn Diagram and put the appropriate numbers in each section.
  - n(A) = ?
  - n(B) = ?
  - $n(A \cap B)$ = ?
  - $n(A \cup B)$ = ?



## Example

- What can we say about $n(A \cup B)$?
  - Is it n(A) + n(B)
  - Why or why not?



## The Counting Formula

- **General Counting Formula**
- If *A* and *B* are sets, then
  - $n(A \cup B) = n(A) + n(B) - n(A \cap B)$

- Subtracting compensates for the double-counting error.

## Example

- Over the last 50 days there was either rain or high winds. There were 35 days of rain, and 20 days of high winds. Using the general counting formula, how many days had both high winds and rain?



## Section 2-8: DeMorgan's Laws

- **DeMorgan's Laws**
- If $A$ and $B$ are sets, then
  - $(A \cup B)^C = A^C \cap B^C$
  - and
  - $(A \cap B)^C = A^C \cup B^C$

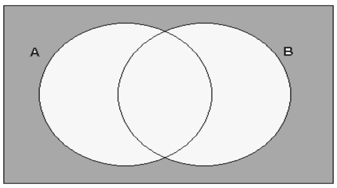


## Visual

- Let's check this with shading.

## DeMorgan's Laws

- Start with **(AÈ B)C**

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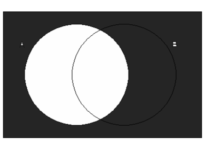
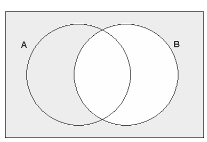
## DeMorgan's Laws

- Now we do $A^C \cap B^C$



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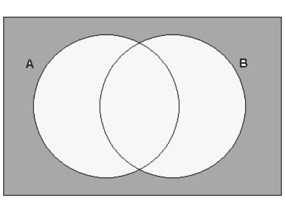
## DeMorgan's Laws

- Combining these gives $A^C \cap B^C$

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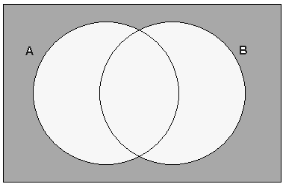
## DeMorgan's Laws

- Combining these gives $A^C \cap B^C$






## DeMorgan's Laws

- I'll leave it to you to check
  - $(A \cap B)^C = A^C \cup B^C$



## Examples

- A school has 500 students. 200 are enrolled in a math class, 400 are enrolled in an English class, and 150 are in both a math and English class. How many are not enrolled in either a math or an English class?
- Let M = students in Math, so $n(M) = 200$
- Let E = students in English, so $n(E) = 400$
- Since 150 are in both, then $n(M \cap E) = 150$
- What do we want to know?

## Section 2-9: DCOUNT

- We can use DCOUNT to find intersections and unions of sets. In general:
  - Intersections (AND) will require one line in the criteria range.
  - Unions (OR) will require two or more lines in the criteria range.



## Examples

- Using cars.xls find the following:
- The number of cars repaired that were Chevrolets and were repaired in Arizona
- The number of cars repaired that were Jeeps and were repaired in either Utah or New Mexico. Another way to think about this:
  - Cars that were Jeeps AND in Utah

    OR
  - Cars that were Jeeps AND in New Mexico
- The number of cars repaired that were Toyotas and cost more than $1000 and cost less than $2000.



## Focus on the Project

- We start by naming our sets:
- *S* = the set of all former workout clients who successfully paid back their loan
- *F* = the set of all former workout clients who failed to pay back the loan
- *Y* = the set of all former workout clients who have 7 years of experience
- *T* = the set of all former workout clients who have a Bachelor's Degree (Think of *T* for "training")
- *C* = the set of all former workout clients who operated during normal economic times (think of *C* for "condition" of the economy)

## Focus on the Project

- Recall our Class Project Data
- The following demographic and economic data characterize John Sanders' current situation.
  - John has seven years of experience in this kind of business. Y = 7
  - John has a Bachelor's degree in Business Administration. T = Bachelor's
  - The economy is currently in "normal times." C = Normal
- Full Loan Amount = $4M, Foreclosure Amount = $2.1M, Default Amount = $0.25M



## Focus on the Project

- Find the number of former workout clients who had 7 years of experience (like Sanders) and successfully paid back their loan in a workout.
- That is: What is $n(Y \cap S)$?
- How would we express the number of former workout clients who failed to pay back their loan in a workout and who have the same education level as Sanders?



## Focus on the Project

- Go to the section titled ***Project Specifics*** of the Text and do ***Part 1.***

## Focus on the Project

- Back up all your work and make sure your team designates one person to keep a working master and backups of all you files.
- Work TOGETHER on this in some way…get into the habit of doing this NOW.



## Focus on the Project

- Start a Word file that will eventually become your final written report. (You will use this to create your oral presentation) We will call this file your Progress Report.



## Focus on the Project

- Progress Report V1 should include:
- Introduction of your team and its task
- An introduction of your loan data…the borrower, etc.
- A useful summary of some of the DCOUNTS you did. Don't go overboard…think about what a typical reader might find interesting.
- Keep in mind this intro is subject to change as you learn more…don't think of this part as "done" until we get to the end of the project. The oral reports is a "work in progress."