

# MA162: Finite mathematics

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## SCHEDULE:

- Web Assign assignment (Chapter 6.4) due on Friday, November 8 by 6:00 pm.
- Web Assign assignment (Chapter 7.1, 7.2) due on Tuesday, November 12 by 6:00 pm.
- Exam 3 on Monday, November 25, 5:00 pm to 7:00 pm.

Today we introduce Probability Theory

## 7.1: Probability Theory Basics

- There is much overlap between Counting (Chapter 6) and Probability Theory (Chapter 7), but some terminology is different
- An **experiment** is an activity with observable results
- A **sample point** is an outcome of an experiment
- A **sample space** is the collection of all sample points of an experiment
- An **event** is a collection of some (possibly all, possibly none) sample points of an experiment
- A **simple event** is an event containing exactly one sample point

## 7.1: Counting to Probability Dictionary

### Counting

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element of a set

$\leftrightarrow$

### Probability

sample point

universal set

$\leftrightarrow$

sample space

subset of a set

$\leftrightarrow$

event





## 7.1: Probability Spaces

Students in MA 162 are asked the following questions:

- What year of college? Freshman, Sophomore, Junior, Senior
- Have you completed FIN 300? Already completed, Currently taking, Will take in future, No plans to take
- Describe a sample space for this experiment:
- Determine the event: Student is a Junior
- Determine the event: Student has not started FIN 300
- Determine the event: Student is Sophomore or Junior and has already completed FIN 300

## 7.1: Mutually Exclusive Events

- Two events are **Mutually Exclusive** if they cannot occur simultaneously
- In other words,  $E_1 \cap E_2 = \emptyset$
- Are the events: “Student is Junior” and “Student is Senior” mutually exclusive?
  
- Are the events: “Student is Junior” and “Student has already completed FIN 300” mutually exclusive?

## 7.2: Definition of Probability

- The **Probability** of an event is a number between 0 and 1
- The larger the probability, the more likely that outcome
- Probability of 0 means outcome will **NEVER** happen
- Probability of 1 means outcome will **ALWAYS** happen

## 7.2: Probability Measure

- Consider an experiment with sample space  $S = \{s_1, s_2, \dots, s_n\}$ .
- A probability function,  $P$ , assigns a number to each event between 0 and 1 according to the rules:
  - $0 \leq P(E) \leq 1$  for each event  $E$ .
  - $P(s_1) + P(s_2) + \dots + P(s_n) = 1$
  - If events  $E_1$  and  $E_2$  are mutually exclusive then

$$P(E_1 \cup E_2) = P(E_1) + P(E_2)$$

## 7.2: Empirical Distribution: Example

- 200 MA 162 students are polled and asked: “How many core business courses have you completed?”
- Sample space:  $\{\text{None, One, Two, } \dots\}$

Here are the results:

	None	One	Two	Three	At least Four
Number	5	23	42	63	67

- What is probability student selected at random has completed exactly one business course?
- What is probability student has completed no more than two business courses?

## 7.2: Another Empirical Distribution

University administrators polled a group of 500 students who had withdrawn from at least one course in the previous semester. Students were asked for the primary reason for withdrawing: “fell behind due to illness”, “fell behind due to being enrolled in too many course”, “fell behind due to being too busy at work”, “felt unprepared and withdrew to take a prereq”, “other reasons”

## 7.2: Another Empirical Distribution

Reason	Frequency	Probability
Illness	153	
Too many courses	268	
Too busy at work	42	
Unprepared	17	
Other		

- Fill in the rest of the table
- Given a random student who withdrew from a course last semester, what is the probability this student withdrew for a reason other than illness?
- Given a random student who withdrew from a course last semester, what is the probability this student withdrew due to being too busy, either with other courses or with work?