Fall 2016 Notes

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Contents

Chapter 1

Probability

We will devote this chapter to the material that is covered in MA 51900 (discrete probability) as it was covered in DasGupta's class. We will, for the most part, reference Feller's *An introduction to probability theory and its applications, Volume 1* [5] (especially for the discrete noncalculus portion of the class) and DasGupta's own book *Fundamentals of Probability: A First Course* [3].

1.1 Discrete Probability

The material in this section is pulled almost entirely from [5] with minor detours to [3]. We will not reference any particular pages in either book (unless we feel particularly lazy).

Background

We begin with axioms and terminology. We shall call the result of an experiment (which shall not be defined) as an *event*. Thus we shall speak of the event that of five coins tossed more than three fell heads. We also make a distinction between *compound* (or decomposable) and *simple* (or indecomposable) *events*. E.g., saying that two tosses of a coin resulted in one head and one tail amounts to saying that it resulted in (H, T) or (T, H) and this enumeration decomposes the event "two tosses of a coin resulted in one head and one tail" into two indecomposable events.

Now comes the rigor. If we want to speak about the outcome of experiments in a theoretical way with no ambiguity, we must first agree on the simple events representing the thinkable outcomes; *they define the idealized experiment*.

Chapter 2

Introduction to Partial Differential Equations

Here we summarize some important points about PDEs. The material is mostly taken from Evans's *Partial Differential Equations* [4].

Chapter 3

Algebraic Geometry

A summary to a course on an introduction to sheaf cohomology. We will mostly reference Donu's notes available here `https://www.math.purdue.edu/~dvb/classroom.html`, but also cite Ravi Vakil's *Fundamentals of Algebraic Geometry* [7] available here `https://math216.wordpress.com/`.

3.1 The de Rham Complex

Donu began his first lecture by talking about the de Rham complex and de Rham cohomology so let us also begin by on his lecture. For this section, we cite the first chapter of Bott and Tu's *Differential Forms in Algebraic Topology* [2].

Chapter 4

Algebraic Topology

From my meetings with Mark. We reference Hatcher's *Algebraic Topology* [6] freely available here `https://www.math.cornell.edu/~hatcher/#ATI`.

4.1 The de Rham Complex

Chapter 5

Classical Mechanics

This section is devoted to notes and problems from Владимир Арнольд's *Математические методы классической механики* [1].

5.1 Ньютонова Механика

Ньютонова механика изучает движение системы материальных точек в терхмерном евклидовом пространстве. В евклидовом пространстве действует шестимерная группа движений пространства. Основные понятия и теоремы ньютоновой механики (даже если они и формулируются в терминах декарвотых координат) инварианты относительно этой группы.

Ньютонова потенциальная механическая система задается массами точек и потенциальной энергией. Движениям пространства, оставляющим потенциальную энергию неизменной, соответствуют законы сохранения.

Уравнения Ньютона позволяют исследовать до конца ряд важных задач механики, например задачу о движении в центральном поле.

5.2 Экспериментальные фаткы

В этой главе описаны основые экспериментальные факты, лежащие в основе механики: принцип относительности Галилея

Bibliography

[1] V.I. Arnold, K. Vogtmann, and A. Weinstein. *Mathematical Methods of Classical Mechanics*. Graduate Texts in Mathematics. Springer New York, 2013.

[2] R. Bott and L.W. Tu. *Differential Forms in Algebraic Topology*. Graduate Texts in Mathematics. Springer New York, 2013.

[3] A. DasGupta. *Fundamentals of Probability: A First Course*. Springer Texts in Statistics. Springer New York, 2010.

[4] L.C. Evans. *Partial Differential Equations*. Graduate studies in mathematics. American Mathematical Society, 2010.

[5] W. Feller. *An introduction to probability theory and its applications*. Number v. 1 in Wiley mathematical statistics series. Wiley, 1950.

[6] A. Hatcher. *Algebraic Topology*. Cambridge University Press, 2002.

[7] R. Vakil. Math 216: Foundations of algebraic geometry, 2016.