Math 751: Topics in Topology II
Fall 2019
POT 145
MWF 1-1:50

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This class is an introduction to stable homotopy theory through primary sources.

We often think of the stable homotopy category as *a place where topology acts more like algebra*. This slogan is more than a little vague and, making it more interesting, there are many of ways of making it rigorous. Over the course of the semester we will explore some of these perspectives, but there is one I think is a useful first example:

> Vector spaces have **duals** and if a vector space is finite dimensional it is isomorphic to its double dual.

We can translate the definition of dual to topological spaces, but the only space that has the property of being isomorphic to its double dual is a point - so this definition is not providing anything interesting.

> There is a modification of the definition of dual for spaces where closed smooth manifolds are (stably) homotopy equivalent to their double duals.

This is Atiyah duality and it provides an alternative approach to Poincare duality. This is a useful idea of duality for topological spaces and it is the result of using the definition of dual that comes from vector spaces in the stable homotopy category.

So one interpretation of the slogan above is: *We know duality is useful from experience in algebra. Topology doesn't automatically have it, but it can if we are willing to move to the stable homotopy category.* Many other interpretations of the slogan are given by replacing "duality" by other useful tools from algebra.

Prerequisites: We will freely use the topics covered in MA 551/651, 561/661, and 654/655.

Course Website: www.ms.uky.edu/~kate/teaching/f19_751.html.

Text: The following is a tentative list of books and papers we will read.

- Chapters 1 and 2 of Margolis, H. R. Spectra and the Steenrod algebra. Modules over the Steenrod algebra and the stable homotopy category. North-Holland Mathematical Library, 29. North-Holland Publishing Co., Amsterdam, 1983.
- Chapters 2-4 of Part III of Adams, J. F. Stable homotopy and generalised homology. Chicago Lectures in Mathematics. University of Chicago Press, Chicago, Ill.-London, 1974.
- Lewis, L. Gaunce, Jr. Is there a convenient category of spectra? J. Pure Appl. Algebra 73 (1991), no. 3, 233246.
- Mandell, M. A., May, J. P., Schwede, S., Shipley, B. Model categories of diagram spectra. Proc. London Math. Soc. (3) 82 (2001), no. 2, 441512.

They are available on the course canvas page.

Assignments: There will be no written assignments in this class. Instead, students will be responsible for explaining relevant concepts that are assumed by the references above.

Assignments will be posted on the course website. Students are free to exchange assignments.

Grades will be based on presentations and overall engagement with the class.

Classroom Demeanor: Turn off all cell phones or other electronic devices prior to entering the classroom. An attitude of respect for and civility towards other students in the class and the instructor is expected at all times.

Attendance: Class attendance is expected of all students.

Excused Absences: Students need to notify the professor of absences prior to class when possible. Senate Rules 5.2.4.2 defines the following as acceptable reasons for excused absences: (a) serious illness, (b) illness or death of family member, (c) University-related trips, (d) major religious holidays, and (e) other circumstances found to fit reasonable cause for nonattendance by the professor.

Students anticipating an absence for a major religious holiday are responsible for notifying the instructor in writing of anticipated absences due to their observance of such holidays no later than the last day in the semester to add a class. Information regarding major religious holidays may be obtained through the Ombud (859-257-3737, http://www.uky.edu/Ombud/ForStudents_ExcusedAbsences.php.)

Students are expected to withdraw from the class if more than 20% of the classes scheduled for the semester are missed (excused) per University policy.

Per Senate Rule 5.2.4.2, students missing any graded work due to an excused absence are responsible: for informing the Instructor of Record about their excused absence within one week following the period of the excused absence (except where prior notification is required); and for making up the missed work. The professor must give the student an opportunity to make up the work and/or the exams missed due to an excused absence, and shall do so, if feasible, during the semester in which the absence occurred.

Verification of Absences: Students may be asked to verify their absences in order for them to be considered excused. Senate Rule 5.2.4.2 states that faculty have the right to request "appropriate verification" when students claim an excused absence because of illness, or death in the family. Appropriate notification of absences due to University-related trips is required prior to the absence when feasible and in no case more than one week after the absence.

Academic Integrity: Per University policy, students shall not plagiarize, cheat, or falsify or misuse academic records. Students are expected to adhere to University policy on cheating and plagiarism in all courses. The minimum penalty for a first offense is a zero on the assignment on which the offense occurred. If the offense is considered severe or the student has other academic offenses on their record, more serious penalties, up to suspension from the University may be imposed.

Plagiarism and cheating are serious breaches of academic conduct. Each student is advised to become familiar with the various forms of academic dishonesty as explained in the Code of Student Rights and Responsibilities. Complete information can be found at the following website: http://www.uky.edu/Ombud. A plea of ignorance is not acceptable as a defense against the charge of academic dishonesty. It is important that you review this information as all ideas borrowed from others need to be properly credited.

Senate Rules 6.3.1 (see http://www.uky.edu/Faculty/Senate/ for the current set of Senate Rules) states that all academic work, written or otherwise, submitted by students to their instructors or other academic supervisors, is expected to be the result of their own thought, research, or self-expression. In cases where students feel unsure about a question of plagiarism involving their work, they are obliged to consult their instructors on the matter before submission.

When students submit work purporting to be their own, but which in any way borrows ideas, organization, wording, or content from another source without appropriate acknowledgment of the fact, the students are guilty of plagiarism.

Plagiarism includes reproducing someone else's work (including, but not limited to a published article, a book, a website, computer code, or a paper from a friend) without clear attribution. Plagiarism also includes the practice of employing or allowing another person to alter or revise the work, which a student submits as his/her own, whoever that other person may be. Students may discuss assignments among themselves or with an instructor or tutor, but when the actual work is done, it must be done by the student, and the student alone.

When a student's assignment involves research in outside sources or information, the student must carefully acknowledge exactly what, where and how he/she has employed them. If the words of someone else are used, the student must put quotation marks around the passage in question and add an appropriate indication of its origin. Making simple changes while leaving the organization, content, and phraseology intact is plagiaristic. However, nothing in these Rules shall apply to those ideas, which are so generally and freely circulated as to be a part of the public domain.

Accommodations due to disability: If you have a documented disability that requires academic accommodations, please see me as soon as possible during scheduled office hours. In order to receive accommodations in this course, you must provide me with a Letter of Accommodation from the Disability Resource Center (DRC). The DRC coordinates campus disability services available to students with disabilities. It is located on the corner of Rose Street and Huguelet Drive in the Multidisciplinary Science Building, Suite 407. You can reach them via phone at (859) 257-2754 and via email at drc@uky.edu. Their web address is http://www.uky.edu/StudentAffairs/DisabilityResourceCenter/.

Non-Discrimination Statement and Title IX Information: The University of Kentucky faculty are committed to supporting students and upholding the University's non-discrimination policy.

Discrimination is prohibited at UK. If you experience an incident of discrimination we encourage you to report it to Institutional Equity & Equal Opportunity (IEEO) Office, 13 Main Building, (859) 257-8927.

Acts of Sex- and Gender-Based Discrimination or Interpersonal Violence: If you experience an incident of sex- or gender-based discrimination or interpersonal violence, we encourage you to report it. While you may talk to a faculty member or TA/RA/GA, understand that as a "Responsible Employee" of the University these individuals MUST report any acts of violence (including verbal bullying and sexual harassment) to the University's Title IX Coordinator in the IEEO Office. If you would like to speak with someone who may be able to afford you confidentiality, the Violence Intervention and Prevention (VIP) program (Frazee Hall Lower Level; http://www.uky.edu/StudentAffairs/VIPCenter/), the Counseling Center (106 Frazee Hall, http://www.uky.edu/StudentAffairs/Counseling/), and the University Health Services (http://ukhealthcare.uky.edu/uhs/student-health/) are confidential resources on campus.

August 15, 2019