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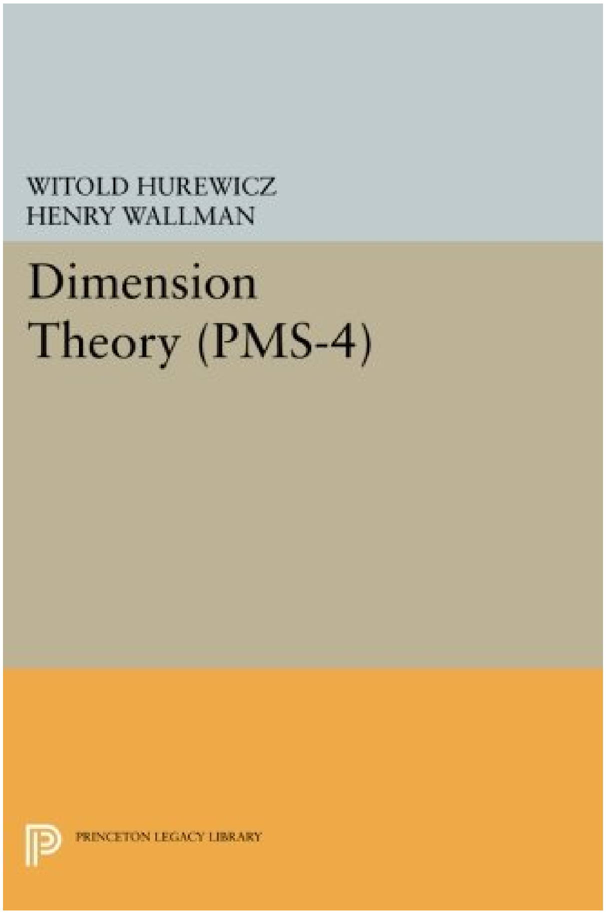

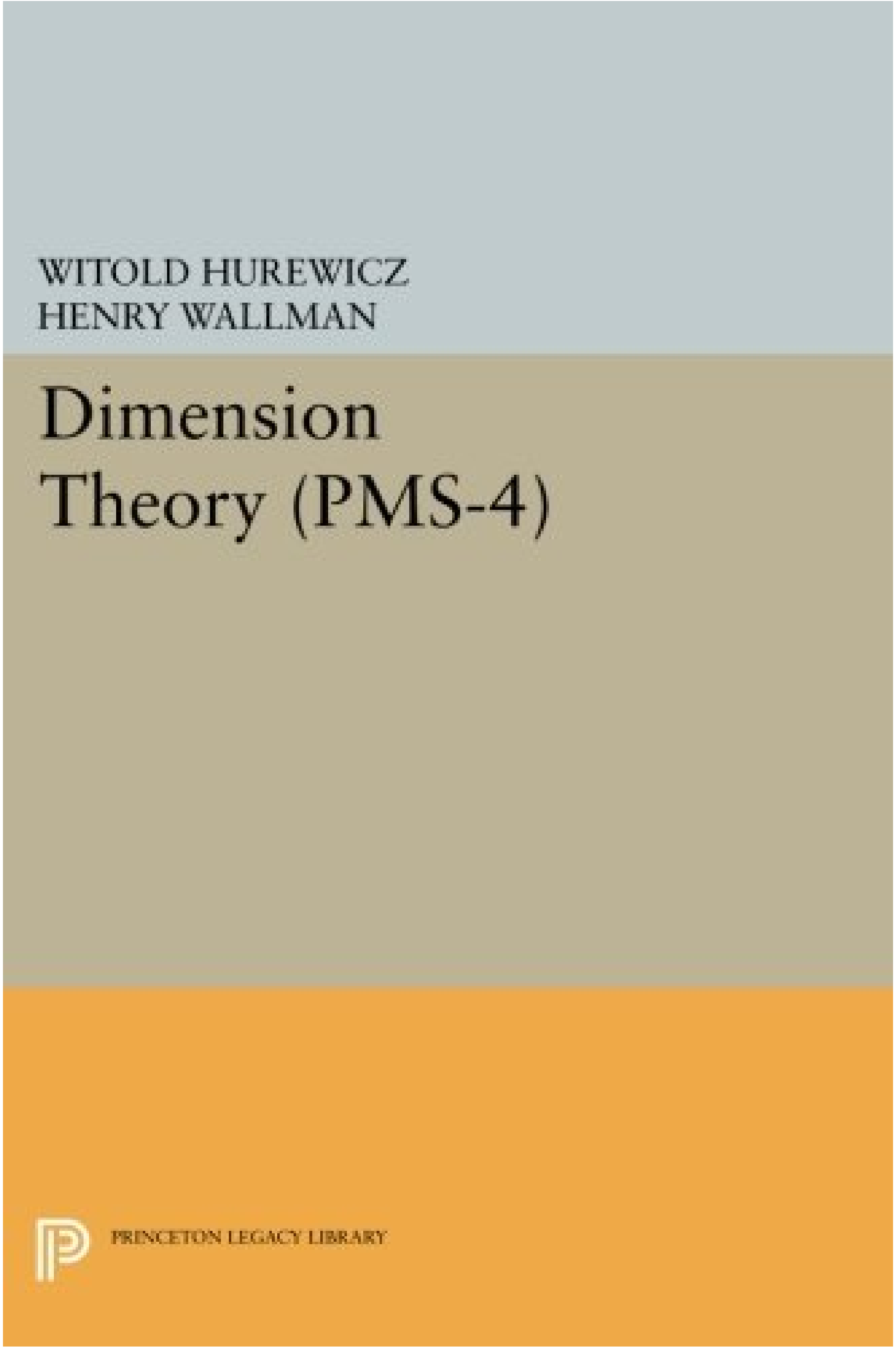
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- Sales Rank: #1955097 in Books
- Published on: 2015-12-08
- Released on: 2015-12-08
- Original language: English
- Number of items: 1
- Dimensions: 8.88" h x .40" w x 5.88" l, .0 pounds
- Binding: Paperback
- 174 pages

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15 of 15 people found the following review helpful.
Still an excellent book
By Dr. Lee D. Carlson
As an undergraduate senior, I took a course in dimension theory that used this book Although first published in 1941, the teacher explained that even though the book was "old", that everyone who has learned dimension theory learned it from this book. There are of course many other books on dimension theory that are more up-to-date than this one. But the advantage of this book is that it gives an historical introduction to dimension theory and develops the intuition of the reader in the conceptual foundations of the subject. The concept of dimension that the authors develop in the book is an inductive one, and is based on the work of the mathematicians Menger and Urysohn. In this formulation the empty set has dimension -1, and the dimension of a space is the least integer for which every point in the space has arbitrarily small neighborhoods with boundaries having dimension less than this integer. The authors restrict the topological spaces to being separable metric spaces, and so the reader who needs dimension theory in more general spaces will have to consult more modern treatments.
In chapter 2, the authors concern themselves with spaces having dimension 0. They first define dimension 0 at a point, which means that every point has arbitrarily small neighborhoods with empty boundaries. A 0-dimensional space is thus 0-dimensional at every one of its points. Several examples are given (which the

reader is to prove), such as the rational numbers and the Cantor set. It is shown, as expected intuitively, that a 0-dimensional space is totally disconnected. The authors also show that a space which is the countable sum of 0-dimensional closed subsets is 0-dimensional. The closed assumption is necessary here, as consideration of the rational and irrational subsets of the real line will bring out.

Chapter 3 considers spaces of dimension n, the notion of dimension n being defined inductively. Their definition of course allows the existence of spaces of infinite dimension, and the authors are quick to point out that dimension, although a topological invariant, is not an invariant under continuous transformations. The famous Peano dimension-raising function is given as an example. The authors prove an equivalent definition of dimension, by showing that a space has dimension less than or equal to n if every point in the space can be separated by a closed set of dimension less than or equal to n-1 from any closed set not containing the point. The `sum theorem' for dimension n is proven, which says that a space which is the countable union of closed sets of dimension less than or equal to n also has dimension less than or equal to n.

A successful theory of dimension would have to show that ordinary Euclidean n-space has dimension n, in terms of the inductive definition of dimension given. The authors show this in Chapter 4, with the proof boiling down to showing that the dimension of Euclidean n-space is greater than or equal to n. (The reverse inequality follows from chapter 3). The proof of this involves showing that the mappings of the n-sphere to itself which have different degree cannot be homotopic. The authors give an elementary proof of this fact. This chapter also introduces the study of infinite-dimensional spaces, and as expected, Hilbert spaces play a role here.

The Lebesgue covering theorem, which was also proved in chapter 4, is used in chapter 5 to formulate a covering definition of dimension. The author also proves in this chapter that every separable metric space of dimension less than or equal to n can be topologically imbedded in Euclidean space of dimension 2n + 1. The author quotes, but unfortunately does not prove, the counterexample due to Antonio Flores, showing that the number 2n + 1 is the best possible. These considerations motivate the concept of a universal n-dimensional space, into which every space of dimension less than or equal to n can be topologically imbedded. The author also proves a result of Alexandroff on the approximation of compact spaces by polytopes, and a consequent definition of dimension in terms of polytopes.

Chapter 6 has the flair of differential topology, wherein the author discusses mappings into spheres. This brings up of course the notion of a homotopy, and the author uses homotopy to discuss the nature of essential mappings into the n-sphere. The author motivates the idea of an essential mapping quite nicely, viewing them as mappings that cover a point so well that the point remains covered under small perturbations of the mapping. This chapter also introduces extensions of mappings and proves Tietze's extension theorem. This allows a characterization of dimension in terms of the extensions of mappings into spheres, namely that a space has dimension less than or equal to n if and only if for every closed set and mapping from this closed set into the n-sphere, there is an extension of this mapping to the whole space.

In chapter 7 the author relates dimension theory to measure theory, and proves that a space has dimension less than or equal to n if and only if it is homeomorphic to a subset of the (2n+1)-dimensional cube whose (n+1)-dimensional measure is zero. As a sign of the book's age, only a short paragraph is devoted to the concept of Hausdorff dimension. Hausdorff dimension is of enormous importance today due to the interest in fractal geometry.

Chapter 8 is the longest of the book, and is a study of dimension from the standpoint of algebraic topology. The treatment is relatively self-contained, which is why the chapter is so large, and the author treats both homology and cohomology. The author proves that a compact space has dimension less than or equal to n if and only if given any closed subset, the zero element of the n-th homology group of this subset is a boundary in the space. A similar (dual) result is proven using cohomology.

9 of 9 people found the following review helpful.
Complete survey of dimension theory up to 1940.
By Bernardo Vargas

This book includes the state of the art of (topological) dimension theory up to the year 1940 (more or less), but this doesn't mean that it's a totally dated book. Quite the opposite. If you read the most recent treatises on the subject you will find no signifficant difference on the exposition of the basic theory, and besides, this book contains a lot of interesting digressions and historical data not seen in more modern books. If you want to become an expert in this topic you must read Hurewicz.
Please read my other reviews in my member page (just click on my name above).

3 of 3 people found the following review helpful.
The standard treatise on classical dimension theory
By Malcolm
Dimension theory is that area of topology concerned with giving a precise mathematical meaning to the concept of the dimension of a space. An active area of research in the early 20th century, but one that has fallen into disuse in topology, dimension theory has experienced a revitalization due to connections with fractals and dynamical systems, but none of those developments are in this 1948 book. Instead, this book is primarily used as a reference today for its proof of Brouwer's Theorem on the Invariance of Domain.

Various definitions of dimension have been formulated, which should at minimum ideally posses the properties of being topologically invariant, monotone (a subset of X has dimension not larger than that of X), and having n as the dimension of Euclidean n-space. Unfortunately, no single satisfactory definition of dimension has been found for arbitrary topological spaces (as is demonstrated in the Appendix to this book), so one generally restricts to some particular family of topological spaces - here only separable metrizable spaces are considered, although the definition of dimension is metric independent. For these spaces, the particular choice of definition, also known as "small inductive dimension" and labeled d1 in the Appendix, is shown to be equivalent to that of the large inductive dimension (d2), Lebesgue covering dimension (d3), and the infimum of Hausdorff dimension over all spaces homeomorphic to a given space (Hausdorff dimension not being intrinsically topological), as well as to numerous other characterizations that could also conceivably be used to define "dimension."

The first 6 chapters are primarily point-set topological, and can be followed easily by anyone who has taken a first course in topology, using, for example, Munkres or Armstrong. (Alexandroff and Hopf was the main reference used here.) In them the core results are developed, namely, that the dimension of Euclidean n-space is n (and hence R^n is not homeomorphic to R^m and n-manifolds are not homeomorhpic to m-manifolds for n not equal to m), that arbitrary n-dimensional spaces can be embedded in a (2n+1)-dimensional cube (indeed even in an n-dimensional subset of it), and that mappings into the n-sphere of a closed subset of an n-dimensional space can be extended to the entire space. These are further used to prove, for example, the Jordan Separation Theorem and the aforementioned Invariance of Domain, which states that any subset of Euclidean n-space that is homeomorphic to an open subset of Euclidean n-space is also open. (This is not trivial since the homemorphism is not assumed to be ambient. Another way to phrase this theorem is that boundaries in R^n are intrinsic.) Almost every citation of this book in the topological literature is for this theorem.

Along the way, some concepts from algebraic topology, such as homotopy and simplices, are introduced, but the exposition is self-contained. Some other elementary topological theorems, not involving dimension theory, such as the Brouwer Fixed-Point Theorem, Tietze's Extension Theorem, Borsuk's Theorem, the Baire Category Theorem, and Brouwer's Reduction Theorem (the latter 2 being proved in the index!) are also proved.

Chapter 7 is concerned with connections between dimension theory and measure (in particular, Hausdorff p-measure and dimension). Some prior knowledge of measure theory is assumed here. As these were very new ideas at the time, the chapter is very brief - only about 6 pages - and the concept of a non-integral dimension, so important to modern chaos theory, is only mentioned in passing.

The final (and largest) chapter is concerned with connections between homology theory and dimension, in particular, Hopf's Extension Theorem. In it, more than 40 pages are used to develop (Cech) homology and cohomology theory from scratch, because at the time this was a rapidly evolving area of mathematics, but now it seems archaic and unnecessarily cumbersome, especially for such paltry results. It would be advisable to just skim through most of this chapter and then just read the final 2 sections, or just skip it entirely since it is not that closely related to the rest of the results in this book. Certainly there are much better expositions of Cech homology theory.

The first 6 chapters would make a nice supplement to an undergraduate course in topology - sort of an application of it. Chapter 7 could be added as well if measure theory were also covered (such as in a course in analysis). The proofs are very easy to follow; virtually every step and its justification is spelled out, even elementary and obvious ones. Only in Chapter 7 is any work left to the reader, and there are no exercises. The book also seems to be free from the typos and mathematical errors that plague more modern books.

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