

# Introduction To The Calculus Of Variations Hans Sagan

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Comprehending as skillfully as pact even more than other will manage to pay for each success. neighboring to, the proclamation as without difficulty as insight of this Introduction To The Calculus Of Variations Hans Sagan can be taken as with ease as picked to act.

## **The Calculus of Computation** Jun 26 2022

Written with graduate and advanced undergraduate students in mind, this textbook introduces computational logic from the foundations of first-order logic to state-of-the-art decision procedures for arithmetic, data structures, and combination theories. The textbook also presents a logical approach to engineering correct software. Verification exercises are given to develop the reader's facility in specifying and verifying software using logic. The treatment of verification concludes with an introduction to the static analysis of software, an important component of modern verification systems. The final chapter outlines courses of further study. [The Calculus of Change](#) Aug 05 2020 Worried about her struggling family and her best friend, Aden isn't looking for love. But when Tate walks into Calculus class wearing a yarmulke and a grin, Aden's heart is gone in an instant. This poignant debut novel explores unrequited love, grief, and finding comfort in one's own skin.

[Singularities in PDE and the Calculus of Variations](#) Jul 24 2019 This book contains papers presented at the "Workshop on Singularities in PDE and the Calculus of Variations" at the CRM in July 2006. The main theme of the meeting was the formation of geometrical singularities in PDE problems with a variational formulation. These equations typically arise in some applications (to physics, engineering, or biology, for example) and their resolution often requires a combination of methods coming from areas such as functional and harmonic analysis, differential geometry and geometric measure theory. Among the PDE problems discussed were: the Cahn-Hilliard model of phase transitions and domain walls; vortices in Ginzburg-Landau type models for superconductivity and superfluidity; the Ohno-Kawasaki model for di-block copolymers; models of image enhancement; and Monge-Ampere functions. The articles give a sampling of problems and methods in this diverse area of mathematics, which touches a large part of modern mathematics and its applications.

[Multiple Integrals in the Calculus of Variations](#) Apr 12 2021 From the reviews: "...the book contains a wealth of material essential to the

researcher concerned with multiple integral variational problems and with elliptic partial differential equations. The book not only reports the researches of the author but also the contributions of his contemporaries in the same and related fields. The book undoubtedly will become a standard reference for researchers in these areas. ...The book is addressed mainly to mature mathematical analysts. However, any student of analysis will be greatly rewarded by a careful study of this book." M. R. Hestenes in *Journal of Optimization Theory and Applications* "The work intertwines in masterly fashion results of classical analysis, topology, and the theory of manifolds and thus presents a comprehensive treatise of the theory of multiple integral variational problems." L. Schmetterer in *Monatshefte für Mathematik* "The book is very clearly exposed and contains the last modern theory in this domain. A comprehensive bibliography ends the book." M. Coroi-Nedeleu in *Revue Roumaine de Mathématiques Pures et Appliquées*

**The Calculus of Retirement Income** Feb 20 2022 This 2006 book introduces and develops the basic actuarial models and underlying pricing of life-contingent pension annuities and life insurance from a unique financial perspective. The ideas and techniques are then applied to the real-world problem of generating sustainable retirement income towards the end of the human life-cycle. The role of lifetime income, longevity insurance, and systematic withdrawal plans are investigated in a parsimonious framework. The underlying technology and terminology of the book are based on continuous-time financial economics by merging analytic laws of mortality with the dynamics of equity markets and interest rates. Nonetheless, the book requires a minimal background in mathematics and emphasizes applications and examples more than proofs and theorems. It can serve as an ideal textbook for an applied course on wealth management and retirement planning in addition to being a reference for quantitatively-inclined financial planners.

**The Calculus of Consent** May 26 2022

**The Calculus Lifesaver** Jan 10 2021 For many students, calculus can be the most mystifying and frustrating course they will ever take.

Based upon Adrian Banner's popular calculus review course at Princeton University, this book provides students with the essential tools they need not only to learn calculus, but also to excel at it.

[Calculus For Dummies](#) Feb 29 2020 Slay the calculus monster with this user-friendly guide [Calculus For Dummies](#), 2nd Edition makes calculus manageable—even if you're one of the many students who sweat at the thought of it. By breaking down differentiation and integration into digestible concepts, this guide helps you build a stronger foundation with a solid understanding of the big ideas at work. This user-friendly math book leads you step-by-step through each concept, operation, and solution, explaining the "how" and "why" in plain English instead of math-speak. Through relevant instruction and practical examples, you'll soon learn that real-life calculus isn't nearly the monster it's made out to be. Calculus is a required course for many college majors, and for students without a strong math foundation, it can be a real barrier to graduation. Breaking that barrier down means recognizing calculus for what it is—simply a tool for studying the ways in which variables interact. It's the logical extension of the algebra, geometry, and trigonometry you've already taken, and [Calculus For Dummies](#), 2nd Edition proves that if you can master those classes, you can tackle calculus and win. Includes foundations in algebra, trigonometry, and pre-calculus concepts Explores sequences, series, and graphing common functions Instructs you how to approximate area with integration Features things to remember, things to forget, and things you can't get away with Stop fearing calculus, and learn to embrace the challenge. With this comprehensive study guide, you'll gain the skills and confidence that make all the difference. [Calculus For Dummies](#), 2nd Edition provides a roadmap for success, and the backup you need to get there.

[Differential Equations and the Calculus of Variations](#) Aug 17 2021 Originally published in the Soviet Union, this text is meant for students of higher schools and deals with the most important sections of mathematics - differential equations and the calculus of variations. The first part describes the theory of differential

equations and reviews the methods for integrating these equations and investigating their solutions. The second part gives an idea of the calculus of variations and surveys the methods for solving variational problems. The book contains a large number of examples and problems with solutions involving applications of mathematics to physics and mechanics.

Apart from its main purpose the textbook is of interest to expert mathematicians. Lev Elsgolts (deceased) was a Doctor of Physico-Mathematical Sciences, Professor at the Patrice Lumumba University of Friendship of Peoples. His research work was dedicated to the calculus of variations and differential equations. He worked out the theory of differential equations with deviating arguments and supplied methods for their solution. Lev Elsgolts was the author of many printed works. Among others, he wrote the well-known books *Qualitative Methods in Mathematical Analysis* and *Introduction to the Theory of Differential Equations with Deviating Arguments*. In addition to his research work Lev Elsgolts taught at higher schools for over twenty years. *Direct Methods in the Calculus of Variations* Oct 19 2021 This book is developed for the study of vectorial problems in the calculus of variations. The subject is a very active one and almost half of the book consists of new material. This is a new edition of the earlier book published in 1989 and it is suitable for graduate students. The book has been updated with some new material and examples added. Applications are included.

*The Calculus of Friendship* Oct 31 2022 The Calculus of Friendship is the story of an extraordinary connection between a teacher and a student, as chronicled through more than thirty years of letters between them. What makes their relationship unique is that it is based almost entirely on a shared love of calculus. For them, calculus is more than a branch of mathematics; it is a game they love playing together, a constant when all else is in flux. The teacher goes from the prime of his career to retirement, competes in whitewater kayaking at the international level, and loses a son. The student matures from high school math whiz to Ivy League professor, suffers the sudden death of a parent, and blunders into a marriage destined to fail. Yet through it all they take refuge in the haven of calculus--until a day comes when calculus is no longer enough. Like calculus itself, *The Calculus of Friendship* is an exploration of change. It's about the transformation that takes place in a student's heart, as he and his teacher reverse roles, as they age, as they are buffeted by life itself. Written by a renowned teacher and communicator of mathematics, *The Calculus of Friendship* is warm, intimate, and deeply moving. The most inspiring ideas of calculus, differential equations, and chaos theory are explained through metaphors, images, and anecdotes in a way that all readers will find beautiful, and even poignant. Math enthusiasts, from high school students to professionals, will delight in the offbeat problems and lucid explanations in the letters. For anyone whose life has been changed by a mentor, *The Calculus of Friendship* will be an unforgettable journey.

**Modern Methods in the Calculus of Variations** Jul 16 2021 This is the first of two

books on methods and techniques in the calculus of variations. Contemporary arguments are used throughout the text to streamline and present in a unified way classical results, and to provide novel contributions at the forefront of the theory. This book addresses fundamental questions related to lower semicontinuity and relaxation of functionals within the unconstrained setting, mainly in  $L^p$  spaces. It prepares the ground for the second volume where the variational treatment of functionals involving fields and their derivatives will be undertaken within the framework of Sobolev spaces. This book is self-contained. All the statements are fully justified and proved, with the exception of basic results in measure theory, which may be found in any good textbook on the subject. It also contains several exercises. Therefore, it may be used both as a graduate textbook as well as a reference text for researchers in the field. Irene Fonseca is the Mellon College of Science Professor of Mathematics and is currently the Director of the Center for Nonlinear Analysis in the Department of Mathematical Sciences at Carnegie Mellon University. Her research interests lie in the areas of continuum mechanics, calculus of variations, geometric measure theory and partial differential equations. Giovanni Leoni is also a professor in the Department of Mathematical Sciences at Carnegie Mellon University. He focuses his research on calculus of variations, partial differential equations and geometric measure theory with special emphasis on applications to problems in continuum mechanics and in materials science.

*The Calculus of Consent* Jun 22 2019 A scientific study of the political and economic factors influencing democratic decision making *Introduction to the Calculus of Variations* Jan 22 2022 Provides a thorough understanding of calculus of variations and prepares readers for the study of modern optimal control theory. Selected variational problems and over 400 exercises. Bibliography. 1969 edition.

**Lectures on the Calculus of Variations and Optimal Control Theory** Sep 05 2020 This book is divided into two parts. The first addresses the simpler variational problems in parametric and nonparametric form. The second covers extensions to optimal control theory. The author opens with the study of three classical problems whose solutions led to the theory of calculus of variations. They are the problem of geodesics, the brachistochrone, and the minimal surface of revolution. He gives a detailed discussion of the Hamilton-Jacobi theory, both in the parametric and nonparametric forms. This leads to the development of sufficiency theories describing properties of minimizing extremal arcs. Next, the author addresses existence theorems. He first develops Hilbert's basic existence theorem for parametric problems and studies some of its consequences. Finally, he develops the theory of generalized curves and "automatic" existence theorems. In the second part of the book, the author discusses optimal control problems. He notes that originally these problems were formulated as problems of Lagrange and Mayer in terms of differential constraints. In the control formulation, these constraints are expressed in a more convenient form in terms of control functions. After pointing out the new

phenomenon that may arise, namely, the lack of controllability, the author develops the maximum principle and illustrates this principle by standard examples that show the switching phenomena that may occur. He extends the theory of geodesic coverings to optimal control problems. Finally, he extends the problem to generalized optimal control problems and obtains the corresponding existence theorems. *An Introduction to the Calculus of Variations* Nov 07 2020

*Lectures on the Calculus of Variations* Oct 07 2020

**Calculus of Variations** Dec 09 2020 Fresh, lively text serves as a modern introduction to the subject, with applications to the mechanics of systems with a finite number of degrees of freedom. Ideal for math and physics students. *Introduction to the Calculus of Variations* Nov 19 2021 The calculus of variations is one of the oldest subjects in mathematics, yet is very much alive and is still evolving. Besides its mathematical importance and its links to other branches of mathematics, such as geometry or differential equations, it is widely used in physics, engineering, economics and biology. This book serves both as a guide to the expansive existing literature and as an aid to the non-specialist? mathematicians, physicists, engineers, students or researchers? in discovering the subject's most important problems, results and techniques. Despite the aim of addressing non-specialists, mathematical rigor has not been sacrificed; most of the theorems are either fully proved or proved under more stringent conditions. In this new edition, the chapter on regularity has been significantly expanded and 27 new exercises have been added. The book, containing a total of 103 exercises with detailed solutions, is well designed for a course at both undergraduate and graduate levels.

**Calculus of Variations** Aug 24 2019 This textbook provides a comprehensive introduction to the classical and modern calculus of variations, serving as a useful reference to advanced undergraduate and graduate students as well as researchers in the field. Starting from ten motivational examples, the book begins with the most important aspects of the classical theory, including the Direct Method, the Euler-Lagrange equation, Lagrange multipliers, Noether's Theorem and some regularity theory. Based on the efficient Young measure approach, the author then discusses the vectorial theory of integral functionals, including quasiconvexity, polyconvexity, and relaxation. In the second part, more recent material such as rigidity in differential inclusions, microstructure, convex integration, singularities in measures, functionals defined on functions of bounded variation (BV), and  $\Gamma$ -convergence for phase transitions and homogenization are explored. While predominantly designed as a textbook for lecture courses on the calculus of variations, this book can also serve as the basis for a reading seminar or as a companion for self-study. The reader is assumed to be familiar with basic vector analysis, functional analysis, Sobolev spaces, and measure theory, though most of the preliminaries are also recalled in the appendix.

**A Treatise on the Calculus of Operations** Nov 27 2019

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**The Inverse Problem of the Calculus of Variations** Jul 04 2020 The aim of the present book is to give a systematic treatment of the inverse problem of the calculus of variations, i.e. how to recognize whether a system of differential equations can be treated as a system for extremals of a variational functional (the Euler-Lagrange equations), using contemporary geometric methods. Selected applications in geometry, physics, optimal control, and general relativity are also considered. The book includes the following chapters: - Helmholtz conditions and the method of controlled Lagrangians (Bloch, Krupka, Zenkov) - The Sonin-Douglas's problem (Krupka) - Inverse variational problem and symmetry in action: The Ostrogradskyj relativistic third order dynamics (Matsyuk.) - Source forms and their variational completion (Voicu) - First-order variational sequences and the inverse problem of the calculus of variations (Urban, Volna) - The inverse problem of the calculus of variations on Grassmann fibrations (Urban).

**An Introduction to the Calculus of Variations** Sep 17 2021 Clear, rigorous introductory treatment covers applications to geometry, dynamics, and physics. It focuses upon problems with one independent variable, connecting abstract theory with its use in concrete problems. 1962 edition.

Calculus of Variations Oct 26 2019 This text is basically divided into two parts. Chapters 1-4 include background material, basic theorems and isoperimetric problems. Chapters 5-12 are devoted to applications, geometrical optics, particle dynamics, the theory of elasticity, electrostatics, quantum mechanics, and other topics. Exercises in each chapter. 1952 edition.

**A First Course in the Calculus of Variations** Apr 24 2022 This book is intended for a first course in the calculus of variations, at the senior or beginning graduate level. The reader will learn methods for finding functions that maximize or minimize integrals. The text lays out important necessary and sufficient conditions for extrema in historical order, and it illustrates these conditions with numerous worked-out examples from mechanics, optics, geometry, and other fields. The exposition starts with simple integrals containing a single independent variable, a single dependent variable, and a single derivative, subject to weak variations, but steadily moves on to more advanced topics, including multivariate problems, constrained extrema, homogeneous problems, problems with variable endpoints, broken extremals, strong variations, and sufficiency conditions. Numerous line drawings clarify the mathematics. Each chapter ends with recommended readings that introduce the student to the relevant scientific literature and with exercises that consolidate understanding.

An Introduction to the Calculus of Variations Sep 29 2022 In this highly regarded text for advanced undergraduate and graduate students, the author develops the calculus of variations both for its intrinsic interest and for its powerful applications to modern mathematical physics. Topics include first and second variations of an integral, generalizations, isoperimetrical problems, least action, special relativity, elasticity, more. 1963 edition.

Calculus of Variations Feb 08 2021 First truly

up-to-date treatment offers a simple introduction to optimal control, linear-quadratic control design, and more. Broad perspective features numerous exercises, hints, outlines, and appendixes, including a practical discussion of MATLAB. 2005 edition.

**Lectures on the Calculus of Variations** May 02 2020 Pioneering modern treatise studies the development of the subject from Euler to Hilbert, addressing basic problems with sufficient generality and rigor to provide a sound introduction for serious study. 1904 edition.

**The Calculus of Variations** Aug 29 2022 Suitable for advanced undergraduate and graduate students of mathematics, physics, or engineering, this introduction to the calculus of variations focuses on variational problems involving one independent variable. It also discusses more advanced topics such as the inverse problem, eigenvalue problems, and Noether's theorem. The text includes numerous examples along with problems to help students consolidate the material.

**Introduction to Tensor Analysis and the Calculus of Moving Surfaces** Jun 14 2021

This textbook is distinguished from other texts on the subject by the depth of the presentation and the discussion of the calculus of moving surfaces, which is an extension of tensor calculus to deforming manifolds. Designed for advanced undergraduate and graduate students, this text invites its audience to take a fresh look at previously learned material through the prism of tensor calculus. Once the framework is mastered, the student is introduced to new material which includes differential geometry on manifolds, shape optimization, boundary perturbation and dynamic fluid film equations. The language of tensors, originally championed by Einstein, is as fundamental as the languages of calculus and linear algebra and is one that every technical scientist ought to speak. The tensor technique, invented at the turn of the 20th century, is now considered classical. Yet, as the author shows, it remains remarkably vital and relevant. The author's skilled lecturing capabilities are evident by the inclusion of insightful examples and a plethora of exercises. A great deal of material is devoted to the geometric fundamentals, the mechanics of change of variables, the proper use of the tensor notation and the discussion of the interplay between algebra and geometry. The early chapters have many words and few equations. The definition of a tensor comes only in Chapter 6 - when the reader is ready for it. While this text maintains a consistent level of rigor, it takes great care to avoid formalizing the subject. The last part of the textbook is devoted to the Calculus of Moving Surfaces. It is the first textbook exposition of this important technique and is one of the gems of this text. A number of exciting applications of the calculus are presented including shape optimization, boundary perturbation of boundary value problems and dynamic fluid film equations developed by the author in recent years. Furthermore, the moving surfaces framework is used to offer new derivations of classical results such as the geodesic equation and the celebrated Gauss-Bonnet theorem.

The Calculus of Happiness Mar 12 2021 How math holds the keys to improving one's health,

wealth, and love life? What's the best diet for overall health and weight management? How can we change our finances to retire earlier? How can we maximize our chances of finding our soul mate? In *The Calculus of Happiness*, Oscar Fernandez shows us that math yields powerful insights into health, wealth, and love. Using only high-school-level math (precalculus with a dash of calculus), Fernandez guides us through several of the surprising results, including an easy rule of thumb for choosing foods that lower our risk for developing diabetes (and that help us lose weight too), simple "all-weather" investment portfolios with great returns, and math-backed strategies for achieving financial independence and searching for our soul mate. Moreover, the important formulas are linked to a dozen free online interactive calculators on the book's website, allowing one to personalize the equations. Fernandez uses everyday experiences--such as visiting a coffee shop--to provide context for his mathematical insights, making the math discussed more accessible, real-world, and relevant to our daily lives. Every chapter ends with a summary of essential lessons and takeaways, and for advanced math fans, Fernandez includes the mathematical derivations in the appendices. A nutrition, personal finance, and relationship how-to guide all in one, *The Calculus of Happiness* invites you to discover how empowering mathematics can be.

*The Calculus of Friendship* Jul 28 2022 *The Calculus of Friendship* is the story of an extraordinary connection between a teacher and a student, as chronicled through more than thirty years of letters between them. What makes their relationship unique is that it is based almost entirely on a shared love of calculus. For them, calculus is more than a branch of mathematics; it is a game they love playing together, a constant when all else is in flux. The teacher goes from the prime of his career to retirement, competes in whitewater kayaking at the international level, and loses a son. The student matures from high school math whiz to Ivy League professor, suffers the sudden death of a parent, and blunders into a marriage destined to fail. Yet through it all they take refuge in the haven of calculus--until a day comes when calculus is no longer enough. Like calculus itself, *The Calculus of Friendship* is an exploration of change. It's about the transformation that takes place in a student's heart, as he and his teacher reverse roles, as they age, as they are buffeted by life itself. Written by a renowned teacher and communicator of mathematics, *The Calculus of Friendship* is warm, intimate, and deeply moving. The most inspiring ideas of calculus, differential equations, and chaos theory are explained through metaphors, images, and anecdotes in a way that all readers will find beautiful, and even poignant. Math enthusiasts, from high school students to professionals, will delight in the offbeat problems and lucid explanations in the letters. For anyone whose life has been changed by a mentor, *The Calculus of Friendship* will be an unforgettable journey.

**A Primer on the Calculus of Variations and Optimal Control Theory** Jun 02 2020 The calculus of variations is used to find functions that optimize quantities expressed in terms of

integrals. Optimal control theory seeks to find functions that minimize cost integrals for systems described by differential equations. This book is an introduction to both the classical theory of the calculus of variations and the more modern developments of optimal control theory from the perspective of an applied mathematician. It focuses on understanding concepts and how to apply them. The range of potential applications is broad: the calculus of variations and optimal control theory have been widely used in numerous ways in biology, criminology, economics, engineering, finance, management science, and physics. Applications described in this book include cancer chemotherapy, navigational control, and renewable resource harvesting. The prerequisites for the book are modest: the standard calculus sequence, a first course on ordinary differential equations, and some facility with the use of mathematical software. It is suitable for an undergraduate or beginning graduate course, or for self study. It provides excellent preparation for more advanced books and courses on the calculus of variations and optimal control theory.

**An Introduction to the Calculus of Variations** Dec 21 2021 Clear, rigorous introductory treatment covers applications to geometry, dynamics, and physics. It focuses upon problems with one independent variable,

connecting abstract theory with its use in concrete problems. 1962 edition.

*Calculus of Variations* May 14 2021 Fresh, lively text serves as a modern introduction to the subject, with applications to the mechanics of systems with a finite number of degrees of freedom. Ideal for math and physics students.

**Calculus in the First Three Dimensions** Sep 25 2019 Introduction to calculus for both undergraduate math majors and those pursuing other areas of science and engineering for whom calculus will be a vital tool. Solutions available as free downloads. 1967 edition.

*Calculus and Statistics* Mar 31 2020 Topics include applications of the derivative, sequences and series, the integral and continuous variates, discrete distributions, hypothesis testing, functions of several variables, and regression and correlation. 1970 edition. Includes 201 figures and 36 tables.

**The History of the Calculus and Its Conceptual Development** Mar 24 2022 Fluent description of the development of both the integral and differential calculus — its early beginnings in antiquity, medieval contributions, and a consideration of Newton and Leibniz.

*Calculus* Jan 28 2020 Gilbert Strang's clear, direct style and detailed, intensive explanations make this textbook ideal as both a course companion and for self-study. Single variable

and multivariable calculus are covered in depth. Key examples of the application of calculus to areas such as physics, engineering and economics are included in order to enhance students' understanding. New to the third edition is a chapter on the 'Highlights of calculus', which accompanies the popular video lectures by the author on MIT's OpenCourseWare. These can be accessed from [math.mit.edu/~gs](http://math.mit.edu/~gs).

**A Tour of the Calculus** Dec 29 2019 Were it not for the calculus, mathematicians would have no way to describe the acceleration of a motorcycle or the effect of gravity on thrown balls and distant planets, or to prove that a man could cross a room and eventually touch the opposite wall. Just how calculus makes these things possible and in doing so finds a correspondence between real numbers and the real world is the subject of this dazzling book by a writer of extraordinary clarity and stylistic brio. Even as he initiates us into the mysteries of real numbers, functions, and limits, Berlinski explores the furthest implications of his subject, revealing how the calculus reconciles the precision of numbers with the fluidity of the changing universe. "An odd and tantalizing book by a writer who takes immense pleasure in this great mathematical tool, and tries to create it in others."--New York Times Book Review