Summary Descriptions of Core Curriculums

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Table of Contents

Graduate Courses: UBC

Course Title	Textbooks/References	Course Materials	Grades

DSCI 591: Capstone Project - NLP Product Knowledge Graph - UBC	Aumüller, Martin, Erik Bernhardsson, and Alexander Faithfull. 2018. "ANN-Benchmarks: A Benchmarking Tool for Approximate Nearest Neighbor Algorithms." https://arxiv.org/abs/1807.05614. Bernhardsson, Erik. 2017. "ANNOY Spotify Repository." GitHub repository. https://github.com/spotify/annoy.	• Named-entity Recognition • LLMs Fine-tuning (BERT, RoBERTa and T5) • Data Annotation • Inter-annotator Agreement • ANNOY Model for Similarity Search • Similarity Algorithms • neo4j Graph Local Database Deployment • Dashboard Deployment on Render • AWS Neptune Graph Database Deployment	A+
DSCI 575: Advanced Machine Learning - UBC	Bird, S., Klein, E., & Loper, E. (2009). *Natural Language Processing with Python.* O'Reilly Media, Inc. Eisenstein, J. (2018). *Natural Language Processing*. MIT Press. Goldberg, Y. (2017). *Neural Network Methods for Natural Language Processing* (Vol. 37). San Rafael, CA: Morgan & Claypool. Goodfellow, I., Bengio, Y., & Courville, A. (2016). *Deep Learning*. MIT Press. Jurafsky, D. and Martin, J.H. (2019) *Speech and Language Processing*. Pearson Education International.	• Markov Models (n-gram) • PageRank Algorithm • spaCy & nltk NLP libraries • Hidden Markov Models • Viterbi Algorithm • Automatic Speech Recognition (ASR) System • Noisy Channel Model • Part-of-speech Tag Sequence • Baum-Welch Algorithm • Advanced Topic Modeling • Latent Dirichlet Allocation • Topic2Vec Algorithm • BERTopic Algorithm • Recurrent Neural Networks (Stacked and Bidirectional) • Self-attention Networks & Positional Encodings • Advanced Transformers Block Architectures • GPT Models • Bidirectional Transformer Models (BERT, RoBERTa) • Next Sentence Prediction • Transfer Learning via Fine-Tuning • Sentiment Analysis • Zero-shot Classification via NLI Models	A+

DSCI 574: Spatial and Temporal Models - UBC	Hyndman, Rob J. & Athanasopoulos, George. & OTexts.com, issuing body. (2021). *Forecasting: principles and practice*. Hyndman, R. J., Koehler, A. B., Ord, J. K., & Snyder, R. D. (2008). *Forecasting with Exponential Smoothing: The State Space Approach*. Springer. John., R., Sergio. Arribas-Bel, Dani. Wolf, Levi. (2023). *Geographic Data Science With Python*. Routledge. Pebesma, E.; Bivand, R. (2023). *Spatial Data Science: With Applications in R*. Chapman and Hall/CRC. Shumway, R. H., Stoffer, D. S. (2017). *Time Series Analysis and Its Applications*. Springer.	• Time Series Seasonal Trend-cycle Decomposition • STL Decomposition • Holt-Winter's Model • Exponential Smoothing Algorithms • ETS (Error, Trend, Seasonal) Models • Correlograms ACF & PACF • SARIMAX Models • Forecasting with Machine Learning Models • Multivariate Time Series • Quantile Regression • Anomaly Detection • NA Imputation • Time Series with Deep Learning (2D CNNs, RNN, LSTM) • Spatial Analysis with Vector and Raster Data • Spatial Modelling with Spatial and Areal Interpolation • Dijkstra Algorithm	A+
DSCI 572: Supervised Learning II - UBC	Bishop, Christopher M. (2006). *Pattern recognition and machine learning*. New York: Springer. Goodfellow, I., Bengio, Y., & Courville, A. (2016). *Deep learning*. MIT Press. Poole, D., Mackworth, A. (2023). *Artificial Intelligence: Foundations of Computational Agents*. Cambridge, UK: Cambridge University Press. Russell, S., Norvig, P. (2020). *Artificial Intelligence: A Modern Approach*. Prentice Hall.	• Floating-point Numbers • Overflow & Underflow Errors • Loss Functions • Optimization and Gradient Descent Algorithms • Stochastic Gradient Descent and Mini-batch Gradient Descent Algorithms • Neural Networks • Convolutional Neural Networks (CNNs) • Hyperparameter Tuning • Transfer Learning • Siamese Networks for Few-Shot Learning • Generative Adversarial Networks (GANs)	A+

DSCI 563: Unsupervised Learning - UBC	Abu-Mostafa, Y. S., Magdon-Ismail, M., & Lin, H. (2012). *Learning from data: a short course.* [United States] :AMLBook.com Daume, H. III (2017) *A Course in Machine Learning*. The Perceptron. Russell, S., Norvig, P. (2020). *Artificial Intelligence: A Modern Approach*. Prentice Hall.	• K-Means Clustering • Gaussian Mixture Models • DBSCAN Clustering • Hierarchical Clustering • Principal Component Analysis (PCA) • Latent Semantic Analysis (LSA) • Non-negative Matrix Factorization (NMF) • Term-term Co-occurrence Matrix • word2vec Skip-gram Model • fastText algorithm • GloVe algorithm • t-SNE for Manifold Learning • Collaborative Filtering • Content-based Filtering	A+
DSCI 562: Regression II - UBC	Fahrmeir, L. (2013). *Regression Models, Methods and Aplications*. Springer Berlin Heidelberg. Faraway, Julian J. (2005). *Extending the Linear Model with R: Generalized Linear, Mixed Effects and Nonparametric Regression Models*, CRC Press LLC. Gelman, A. and Hill, J. (2007). *Data Analysis Using Regression and Multilevel/Hierarchical Models*. Analytical Methods for Social Research. Cambridge University Press. Kleinbaum, D. G. and Klein, M. (2005). *Survival analysis: A Self-Learning Text*. Springer. Rubin, D. B. (1987). *Multiple Imputation for Nonresponse in Surveys*. Wiley.	• Binary Logistic Regression for GLMs • Analysis of Deviance, AIC, and BIC • Poisson Regression • Quasi-Poisson Regression • Negative Binomial Regression • Multinomial Logistic Regression • Ordinal Logistic Regression • Linear Mixed-Effects Models • Kaplan-Meier Non-parametric Estimation for Survival Analysis • Parametric Estimation for Survival Analysis • Cox Proportional Hazards Model • Data Imputation for Various Missing Data • Quantile Regression • LOWESS Regression • Robust Regression	A+

DSCI 554: Experimentation and Causal Inference - UBC	Cetinkaya-Rundel, M., Diez, D., & Barr, C. (2019). *OpenIntro Statistics*. (Fourth Edition ed.) OpenIntro, Inc. Oehlert, G.W. (2010). *A First Course in Design and Analysis of Experiments*. Library of Congress Cataloging-in-Publication Data, USA. Seltman, H. J. (2015). *Experimental Design and Analysis*. Pittsburgh: Carnegie Mellon University.	• Bonferroni Correction • False Discovery Rate • Simpson's Paradox • Randomization • A/B/n Testing • Blocked Designs • Power Analysis • Early Stopping and Peeking • Confounding • Stratified Analysis for Causality • Sampling Schemes (Case-control, Cross-sectional and Cohort) • Simulations	A+
DSCI 553: Statistical Inference and Computation II - UBC	Downey, A. B. (2022). *Think Bayes*. Sebastopol, California: O'Reilly Media. Johnson, A.A., Ott, M.Q., & Dogucu, M. (2022). *Bayes Rules!: An Introduction to Applied Bayesian Modeling (1st ed.)*. Chapman and Hall/CRC.	• Bayesian Statistics • Maximum a Posteriori Estimation (MAP) • Beta-Binomial Model • Gamma-Poisson Model • Normal-Normal Model • Markov Chain Monte Carlo (MCMC) Algorithm • Metropolis-Hastings Algorithm • Bayesian Normal Linear Regression • Bayesian Binary Logistic Regression • Bayesian Hierarchical Models • Gelman-Rubin Diagnostic	A+
DSCI 542: Communication and Argumentation: - UBC	Levitin, D. J. (2020). *A Field Guide to Lies: Critical Thinking with Statistics and the Scientific Method*. Dutton. Savage, S. A. (2012). *The Flaw of Averages: Why We Underestimate Risk in the Face of Uncertainty*. John Wiley & Sons.	• P-hacking • Correlation and Causation • ML Fairness • Inverse Fallacy • Explanation with Analogy • Writing Technical Reports	A+

DSCI 541: Privacy, Ethics, and Security - UBC	DiResta, R. 2018, April 13. *How Do We Know What's True Anymore* [Video]. YouTube. https://www.youtube.com/ watch?v= vIkJoUeoY-o Murgia, M. 2017, May 23. *How data brokers sold my identity* [Video]. YouTube. https://www.youtube.com/ watch ?v=AU66C6HePfg&t=433s	• Disinformation • Goodhart's/Campbell's Law • Deepfakes • Metadata • Data K-anonymization • L-diversity • Differential Privacy • Types of Bias in DS • Confusion Matrix & Fairness Metrics	A+
DSCI 532: Data Visualization II - UBC	Wickham, H. (2021). *Mastering Shiny*. O'Reilly Media, Inc.	• Shiny App Development • Dash App Development • Interactive Visualization	A+
DSCI 525: Web and Cloud Computing - UBC	Amazon Web Services. (2023). AWS Documentation. Amazon Web Services. https://docs.aws.amazon.com/ index.html	• Big Data • Parquet Data • Serialization/Deserialization • Apache Arrow • DuckDB, Polars and Ibis • Amazon VPC • Amazon EC2 Instance • AWS Lambda • Amazon S3 Bucket • Amazon RDS • Amazon DynamoDB • Hadoop Framework • MapReduce and Spark • Amazon EMR	A+
DSCI 524: Collaborative Software Development - UBC	Beuzen, T., Timbers, T. (2022). *Python Packages*. Chapman & Hall/CRC. Wickham, H., Bryan, J. (2023). *R Packages*. O'Reilly Media, Inc.	• Cookiecutter and Poetry • Git Flow • pytest & testthat for Unit Testing, Integration Testing and Regression Testing • Code Coverage Metrics • Continuous Integration (CI) • Continuous Development (CD) • GitHub Actions • Deployment on CRAN and PyPI	A+

DSCI 573: Feature and Model Selection - UBC	Bishop, Christopher M. (2006). *Pattern recognition and machine learning*. New York: Springer. Goodfellow, I., Bengio, Y., & Courville, A. (2016). *Deep learning*. MIT Press. Poole, D., Mackworth, A. (2023). *Artificial Intelligence: Foundations of Computational Agents*. Cambridge, UK: Cambridge University Press. Russell, S., Norvig, P. (2020). *Artificial Intelligence: A Modern Approach*. Prentice Hall.	• Confusion Matrix • Precision-recall (PR) Curve and Receiver Operating Characteristic (ROC) Curve • Class Imbalance • Hyperparameter Tuning • MSE, RMSE, MAPE, R^2 • Linear and Non-linear Feature Engineering • Radial Basis Function(RBF) • nltk and spaCy • TF-IDF Term Weighting • Part-of-speech (POS) • Feature Importance • Recursive Feature Elimination Algorithm • Loss Functions • L0, L1, L2 Regularization • Sparsity • Collinearity • Ensembles • Random Forests (RF) • Gradient Boosted Trees • eli5 • SHapley Additive exPlanations (SHAP)	A+
DSCI 571: Supervised Learning I - UBC	Bishop, Christopher M. (2006). *Pattern recognition and machine learning*. New York: Springer. Goodfellow, I., Bengio, Y., & Courville, A. (2016). *Deep learning*. MIT Press. Poole, D., Mackworth, A. (2023). *Artificial Intelligence: Foundations of Computational Agents*. Cambridge, UK: Cambridge University Press. Russell, S., Norvig, P. (2020). *Artificial Intelligence: A Modern Approach*. Prentice Hall.	• Decision Trees • Cross Validations • Overfitting and Underfitting • k-Nearest Neighbors (KNN) • Support Vector Machines (SVMs) • Imputation and Scaling • One-hot encoding (OHE) • Bag of Words (BOW) • TF-IDF • Hyperparameter Optimization • Optimization Bias • Naive Bayes • Laplace Smoothing • Gaussian Naive Bayes • Linear Regression • Logistic Regression	A+

DSCI 561: Regression I - UBC	Faraway, J.J. (2014). *Linear Models with R.* Chapman and Hall/CRC. Irizarry, R. (2019). *Introduction to Data Science.* CRC Press.	• Linear Regression • F-test for nested models • Evaluation Metrics • Prediction Intervals VS Confidence Intervals • Multicollinearity • Confounding	A+
DSCI 552: Statistical Inference and Computation I - UBC	Ismay, C., & Kim, A.Y. (2019). *Statistical Inference via Data Science: A ModernDive into R and the Tidyverse*. Chapman and Hall/CRC.	• Sampling Distributions • Bootstrapping • Simulation • Randomization • Central Limit Theorem • Normal Distributions • t-Distributions • Hypothesis Testing • Pearson's Chi-squared Test • Type I and II Errors • p-value • Analysis of Variance (ANOVA) • Maximum Likelihood Estimation	A+
DSCI 551: Descriptive Statistics and Probability for Data Science - UBC	Blitzstein, J.K., & Hwang, J. (2019). *Introduction to Probability*. Chapman and Hall/CRC. Tsun, A. (2020). *Probability & Statistics with Applications to Computing*.	• Discrete Distributions • Joint Probability • Independence • Conditional Probability • Continuous Distributions • Contour Plots • Marginal Distributions • Simulation	A+
DSCI 531: Data Visualization I - UBC	Munzner, T. (2014). *Visualization Analysis and Design*. CRC Press. Wilke, C. (2019*). Fundamentals of Data Visualization*. O'Reilly Media Inc.	• ggplot2 • Altair • Exploratory Data Analysis • Color Theory • Interactive Plots • Pairwise Comparisons	A+

DSCI 523: Programming for Data Manipulation - UBC	Irizarry, R. (2019). *Introduction to Data Science.* CRC Press.	• R Programming • Data Wrangling • Packages (tidyverse, gapminder, purr and so on) • Factor Data • roxygen2 Documentation • Anonymous Functions in R • Mapping • Nested Data Frames • Tidy Evaluation	A+
DSCI 522: Data Science Workflows - UBC	Irizarry, R. (2019). *Introduction to Data Science.* CRC Press. Peng, R., Matsui, E. (2017). *The Art of Data Science*.	• Read-eval-print-loop (REPL) Framework • Shell Scripts • Advanced Reporting in R Markdown • Makefile for Pipelines • Docker	A+
DSCI 521: Computing Platforms for Data Science - UBC	Adhikari, A., DeNero, J., Wagner, D. (2022). *Computational and Inferential Thinking: The Foundations of Data Science.*	• LaTex • Bash Shell • Wildcards • Regular Expressions • Git and GitHub for Version Control • Merge Conflicts • Virtual Environments • Quarto Documents	A+
DSCI 513: Databases and Data Retrieval - UBC	Karwin, B. (2010). *SQL antipatterns: Avoiding the Pitfalls of Database Programming*. The Pragmatic Programmers, LLC. Ramakrishnan, R., & Gehrke, J. (2002). *Database Management Systems*. McGraw-Hill. Celko, J. (2011). *Joe celko's SQL for Smarties: Advanced SQL programming*. Morgan Kaufmann.	• Relational Databases • SQL • Data Retrieval • Data Manipulation • ACID Properties • Sub-queries • Non-relational Databases • MongoDB • Advanced Queries	A+

DSCI 512: Algorithms and Data Structures - UBC	Dasgupta, S., Papadimitriou, C., Vazirani, U. (2006). *Algorithms.* McGraw Hill. Goodrich, M. T., Tamassia, R., Goldwasser, M. H. (2013). *Data Structures and Algorithms in Python*. Wiley.	• Big O Time and Space Complexity • Binary Search Trees • Sorting Algorithms • Hash Tables & Functions • Recursion & Recursive Data Structures • Nearest Neighbors • k-d Trees • Amortization • Graphs • Graph Search: Recursive & Iterative Implementation • Stacks and Queues • Centrality and PageRank • Matrices • Sparsity • Discrete & Continuous Optimization • Linear Programming • Caching & Memorization • Dynamic Programming • Vectorization • Backtracking • Linked List	A+
DSCI 511: Programming for Data Science -UBC	McKinney, W. (2012). *Python for Data Analysis*. O'Reilly Media.	• Loops & Functions • Unit Tests & Classes • NumPy • Pandas • Advanced Data Wrangling	A+
# Undergraduate Courses: UCLA & UCSD			
ECON 171: Decisions Under Uncertainty - UCSD	Lindley, D. V. (1991). *Making Decisions.* Wiley.	• Game Theories • Decision Theories • Conditional Probability and Bayes' Law • Expected Utility Theories • Theory of Stochastic Dominance • Comparative Statics of Risk • Prospect Theory • Subjective Uncertainty	A

ECON 147: Economics of Education - UCSD	Assigned Journal Publications, Articles and Readings by Professor Julian Betts.	• Correlation & Causality • Omitted Variable Bias and Endogenous Regressors • Regression Discontinuity • Instrumental Variables • Difference-in-Difference Models • Human Capital Theory • Signaling Theory • School Choice • School Finance • Postsecondary Education	A+
ECON 135 / USP 102: Urban Economics - UCSD	O'Sullivan, A. (2009). *Urban Economics.* McGraw Hill.	• Suburbanization • Zoning • Urban Transportation • Segregation • Local Government	A-
ECON 130: Public Policy - UCSD	Miller, R. (2017). *The Economics of Public Issues.* Pearson.	• Pareto Efficiency • Taxes and Subsidies • Coase Theorem • Market Failure • Monopoly • Pigouvian Taxes • Tradeable Permits • Imperfect Information	A+
ECON 120C: Econometrics C - UCSD (with Stata coding)	Stock, J., Watson, M. (2007) *Introduction to Econometrics.* Pearson.	• Discrete Choice Model • Instrumental Variable Regression • Panel Data • Experiments and Quasi-Experiments • Time Series Data • Simultaneous Equations • Non-parametric Statistics	A+
ECON 120B: Econometrics B - UCSD (with Stata coding)	Stock, J., Watson, M. (2007) *Introduction to Econometrics.* Pearson.	• Ordinary Least Squares • Confidence Interval and Hypothesis Testing • Dummy Variables • Multiple Regression • Simultaneity • Sample Selection • Measurement Error • Non-linear Models	A+

ECON 120A: Econometrics A - UCSD	Stock, J., Watson, M. (2007) *Introduction to Econometrics.* Pearson.	• Descriptive Statistics • Probability Distributions • Sampling • Point Estimation • Interval Estimation • Hypothesis Tests	A+
ECON 110B: Macroeconomics B - UCSD	Jones, C. I. (2014). *Macroeconomics.*	• IS Curve • Monetary Policy & Philips Curve • AS/AD Model • The Great Recession • Short-Run Model • Exchange Rate and International Trading	A
ECON 102: Globalization - UCSD	Assigned Journal Publications, Articles, and readings by Professor Marc-Andreas Muendler.	• Comparative Advantage • Ricardo Model and HOS Model • Distribution of Gains • Heckscher-Ohlin Model • Production Possibility Frontier • Offshoring • Fischer model of International Capital Flows	A+
ECON 101: Microeconomic Theory - UCLA	Nicholson, W., Snyder, C. (2016) *Microeconomic Theory: Basic Principles and Extensions.* South-Western College.	• Game Theories • Mixed Strategies and Sequential Games • Monopoly • Oligopoly • Economics of Information	A+
ECON 100B: Microeconomics B - UCSD	Perloff, J. (2016). *Microeconomics: Theory and Applications with Calculus*. Pearson.	• Production Functions • Law of Diminishing Marginal Returns • Isoquants • Costs • Profit Maximization • Competitive Model • General Equilibrium	A+

ECON 100A: Microeconomics A - UCSD	Perloff, J. (2016). *Microeconomics: Theory and Applications with Calculus*. Pearson.	• Level Curves and Utility Functions • Optimization and Comparative Statics of Demand • Slutsky Equation and Elasticity • Decision Theories for Supply of Labor and Saving	A
ECON 3: Economics - Macro - Advanced Placement Credit - UCSD	Bernanke, B., Frank, R., Antonovics, K., Heffetz, O. (2015). *Principles of Economics*. McGraw-Hill Irwin.	• Long Run Growth • Savings & Investment • Money & Banking System • Short Run Business Cycles • Macroeconomic Models • Fiscal & Monetary Policy • Exchange Rates	AP 5
ECON 1: Economics - Micro - Advanced Placement Credit - UCSD	Bernanke, B., Frank, R., Antonovics, K., Heffetz, O. (2015). *Principles of Economics*. McGraw-Hill Irwin.	• Supply & Demand Curves • Elasticity • Production, Cost & Profit • Perfect Competition • Monopoly	AP 5

MATH 181A: Introduction to Mathematical Statistics I - UCSD (with statistical R coding)	Rice, J. (2006). *Mathematical Statistics and Data Analysis*. Duxbury Press. Wackerly, D., Mendenhall, W., Scheaffer, R. (2007). *Mathematical Statistics with Applications*. Duxbury Press.	• Method of Moments Estimator (MME) • Maximum Likelihood Estimator (MLE) • Interval Estimation • Unbiasedness & Efficiency • Monte Carlo Simulation • Parametric Bootstrap Algorithm • Cramer-Rao Lower Bound • Fisher Information • Convergence in Probability • Asymptotic Normality • Hypothesis Test & p-value • Exact Test & t -test • Type I and II errors • Wald Testing • Likelihood Ratio Test • Neyman-Pearson Lemma • Uniformly Most Powerful Test • Normal Distributions • Bayesian Inference	A
MATH 180A: Introduction to Probability - UCSD (with Python coding)	Adhikari, A. and Pitman, J. (2016). *Probability for Data Science.* Anderson, D., Seppäläinen, T. and Valkó, B. (2017). *Introduction to Probability*. Cambridge University Press.	• Conditional Probability & Bayes' Rule • Independence • Probability Distributions • Sampling • Normal and Poisson Approximation • Poisson Process • Moment Generating Function • Joint Distributions • Law of Large Numbers • Central Limit Theorem	A+
MATH 174E: Mathematics of Finance - UCLA	Hull, J. C. (2017). *Options, Futures and Other Derivatives.* Pearson.	• Options & Futures Markets • Binomial Trees • Wiener Processes • Ito’s lemma • Black-Scholes-Merton Model • Numerical Procedures • Volatility & Value at Risk	B

MATH 170B: Probability Theory - UCLA	Durrett, R. (2010). *Probability: Theory and Examples.* Cambridge University Press. Grimmett, G. R., & Welsh, D. J. (2014). *Probability: An Introduction.* Oxford: Oxford University Press.	• Multinomial Distributions • Hypergeometric Distribution • Negative Binomial Distribution • Conditional Distribution • Convergence in Distribution • Central Limit Theorem • Markov and Chebyshev Inequalities • Convergence in Probability • Weak and Strong Law of Large Numbers • Almost-sure Convergence • Bernoulli Process • Poisson Process • Random Walks	A-
MATH 170A: Introduction to Numerical Analysis - UCSD (with MATLAB coding)	Watkins, D. S. (2010). *Fundamentals of Matrix Computation.* Wiley.	• Floating-Point Numbers • Linear Systems of Equations • Triangular Systems of Equations • LU Decomposition • Gauss Elimination • Cholesky Factorization • Sensitivity of Linear Systems • Gram-Schmidt Process • QR Factorization • Iterative Methods	A+
MATH 164: Optimization - UCLA	Chong, E. K.P. and Zak, S. H. (2013). *An Introduction to Optimization.* Wiley.	• Convex Geometry • Lagrange Multipliers • Second Derivative Test • Gradient Ascent/Descent • Newton's Method • Conjugate Gradient Methods • Least Squares • Linear Programming (the Simplex, Ellipsoid and Interior Point Methods) • Dual Linear Program • Semidefinite Programming • Shortest Paths in 3D • Curves of Quickest Descent	A-

MATH 142B: Introduction to Analysis II - UCSD	Fitzpatrick, P. M. (2009). *Advanced Calculus*. American Mathematical Society. Ross, K. A. (2013). *Elementary Analysis: The Theory of Calculus.* Springer.	• Uniform Convergence • Cauchy Sequences • Power Series • Abel's Theorem • Weierstrass Approximation • Differentiability • Mean Value Theorem • L'Hopital's Rule • Taylor's Theorem • Riemann Integrals • Continuity • Fundamental Theorems of Calculus	A
MATH 142A: Introduction to Analysis I - UCSD	Ross, K. A. (2013). *Elementary Analysis: The Theory of Calculus.* Springer.	• Limit Theorems for Sequences • Monotone Sequences • Cauchy Sequences • Subsequences and Series • Uniform Continuity • Limits of Functions • Mean Value Theorem • L'Hopital's Rule • Taylor's Theorem	A
MATH 135: Ordinary Differential Equations - UCLA	Simmons, G. F. (2016). *Differential Equations with Applications and Historical Notes. Chapman and Hall/CRC.*	• Laplace Transforms • Existence and Uniqueness Theorems • Lipschitz Condition • Convolution Theorem • Heaviside Expansion Theorem • Dirac Distribution • Weierstrauss M-test • Picard Iteration • Fourier Series • Periodic Functions • Convergence Theorems • Heat Equations • Sturm-Liouville Theory • Euler's Differential Equation • Green’s Functions • Isoperimetric Problems • Separation of Variable Solutions to Partial Differential Equations	A

MATH 115A: Linear Algebra - UCLA	Friedberg, S., Insel, A. and Spence, L. (2018). *Linear Algebra*. Pearson.	• Vector Spaces & Span • Lagrange Interpolation • Linear Transformations • Matrix Multiplication • Invertibility& Isomorphisms • Eigenvalues & Eigenvectors • Diagonalization • Inner Products • Orthogonalization & Norms • Adjoints	A
MATH 109: Mathematical Reasoning - UCSD	Eccles, P. J. (1997). *An Introduction to Mathematical Reasoning.* Cambridge University Press.	• Boolean Algebra • Proof by Contradiction • Induction Principle • Set Theories • Limits of Sequences • Injections, Surjections and Bijections • Finite Sets • Division Algorithms • Euclidean Algorithm • Congruence Classes • Limits of Functions • Continuity & Derivatives	A+
MATH 61: Discrete Structures - UCLA	Johnsonaugh, R. (2017). *Discrete Mathematics.* Prentice-Hall.	• Mathematical Induction • Sets & Functions • Sequences & Strings • Matrices of Relations • Counting Principles • Generalized Permutations and Combinations • Pigeonhole Principle • Recurrence Relations • Graphs, Paths, and Cycles • Shortest-path Algorithm • Planar Graphs • Minimal Spanning Trees • Binary Trees and Sorting • Isomorphic Trees	A-

MATH 20F: Linear Algebra - UCSD (with MATLAB coding)	Lay, D. C. (2011). *Linear Algebra and Its Applications.* Pearson.	• Systems of Linear Equations • Vector Equations • Linear Independence • Linear Transformations • Invertible Matrices • Vector Spaces and Subspaces • Determinants • Cramer's Rule • Eigenvectors and Eigenvalues • Diagonalization • Orthogonality • Gram-Schmidt Process	A
MATH 20E: Vector Calculus - UCSD (with MATLAB coding)	Marsden, J. E. and Tromba, A. J. (2011). *Vector Calculus.* W. H. Freeman.	• Mean Value Inequality • Triple Integrals • Change of Variable Theorem • Vector Fields • Path and Line Integrals • Surface Integrals • Green's Theorem • Stokes' Theorem • Gauss Divergence Theorem • Gauss Law	A
MATH 20D: Introduction to Differential Equations - UCSD	Nagle, R., Saff, E. and Snider, A. (2017). *Fundamentals of Differential Equations.* Pearson.	• Homogeneous Linear Equations • Exact Equations • Undetermined Coefficients • Superposition Principle • Nonhomogeneous Equations • Variable-Coefficient Equations • Laplace Transforms • Power Series • Linear Systems	A+

MATH 20C: Calculus & Analytic Geometry for Science and Engineering - UCSD	Marsden, J. E. and Tromba, A. J. (2011). *Vector Calculus.* W. H. Freeman.	• Vectors • Inner Product and Cross Product • Differentiation • Paths and Curves • Gradients and Directional Derivatives • Iterated Partial Derivatives • Lagrange Multiplier • Acceleration & Arc Length • Double Integrals	A+
MATH 20B: Calculus for Science and Engineering - Advanced Placement Credit - UCSD	Rogawski, J., Adams, C. and Franzosa, R. (2018). *Calculus: Early Transcendentals.* W. H. Freeman.	• Integration • Polar Coordinates • Complex Exponential • Trigonometric and Hyperbolic Integrals • Power Series • Taylor Series	AP 5
MATH 20A: Calculus - Advanced Placement Credit - UCSD	Rogawski, J., Adams, C. and Franzosa, R. (2018). *Calculus: Early Transcendentals.* W. H. Freeman.	• Limits and Continuity • Squeeze Theorem • Intermediate Value Theorem • Mean Value Theorem • L'Hopital's Rule	AP 5
COMPTNG 10A: Introduction to Programming - UCLA (with C++ coding)	Horstmann, C. & Budd, T. (2008). *Big C++*. John Wiley & Sons.	• Fundamental Types • Casting • Overflow & Underflow • Loops • Functions • References • Vectors and Arrays in 2D • Classes • Points & Pointer Arithmetic • Array Pointer Duality Law • Memory Leak • File and String Streams	A

CSE 3: Fluency in Information Technology - UCSD (with C++, Java, HTML coding)	Lehnert, W. (2002). *The Web Wizard's Guide to HTML.* Addison-Wesley. Snyder, L. (2008). *Fluency with Information Technology.* Addison-Wesley.	• Path and Directory • ASCII • List and Strings • Loops • Functions • TCP/IP and Domain Names • Cookies • JavaScript Basics • HTML Basics • Relational Database & SQL • Data Queries • Adobe Photoshop • Bitmap & Vector Graphics • Encryption Schemes • Internet Security • Turing Test • NP-complete Problems	A
GEOG 7: Introduction to Geographic Information Systems (GIS) - UCLA (with QGIS coding)	Shin, M., Campbell, J. and Burkhart, N. (2015). *Essentials of Geographic Information Systems.* Washington, D.C. Flat World Knowledge.	• Reference Mapping • Cartographic Principles • Thematic Mapping • Coordinate Systems • Raster Data Analysis • Spatial Analysis • Map Projections • Data Queries • Vector Operations	P
PSYC 60: Introduction to Statistics in Psychology - UCSD (with statistical R coding)	Howell, D. (2016). *Fundamental Statistics for Behavioral Sciences.* Wadsworth Publishing.	• Normal Distribution • Z scores • Correlation • Regression • t-tests • ANOVA • Chi-squared Test	A-