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MA 412-601 Summer 2026

Long-Term Actuarial Models Course Syllabus

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Course Information

- **Instructor:** Anzhelika Vasilyeva
- **Email:** [Email me at avasily2@ncsu.edu](mailto:avasily2@ncsu.edu)
- **Office:** SAS 3201
- **Office Hours:** Office hours on Zoom. Tuesday 8:30 AM - 9:30 AM, Thursday 1:00 - 3:00 PM
- **Course Modality:** This course is an online, asynchronous Distance Education course.
- **Course Website:** Find our course on [NC State Wolfware](#).

Course Description

Actuarial science is the discipline that applies mathematical and statistical methods to assess risk in insurance, finance, and other industries and professions. To become an actuary, one must pass a series of specialized exams on actuarial mathematics. This course covers (some of) the material for SOA Exam MLC: Models for Life Contingencies and SOA Exam FM: Financial Mathematics. Specifically, the course covers survival models, life tables, selection,

insurance benefits, annuities, premium calculation, and time permitting, multiple state models. We will also introduce and review key concepts from probability theory and interest theory, as needed. The material for this class will cover chapters 1-6 and 8 of the textbook, with extra material from other texts as needed.

Prerequisite: MA 241 or MA 231. (*Specifically, computing integrals and working with finite and infinite series.*)

Corequisite: One of MA 421, BUS[ST] 350, ST 301, ST 305, ST 311, ST 361, ST 370, ST 371, ST 380 (specifically, material on random variables).

GEP Mathematical Sciences.

Learning Objectives

By the end of this course, students should be able to:

1. **Describe** the main concepts, assumptions, and notation used in actuarial mathematics for life contingencies.
 2. **Interpret and use** actuarial notation, and **translate** between actuarial notation and related notation from probability and statistics.
 3. **Compute and interpret** probabilities and expectations associated with survival models, life tables, and future lifetime random variables.
 4. **Apply** the tools of interest theory to calculate present values, accumulated values, and annuity values.
 5. **Calculate** the values of insurance benefits, life contingent annuities, and premiums in a variety of actuarial models.
 6. **Analyze and solve** unfamiliar actuarial problems by choosing appropriate formulas, notation, and modeling assumptions.
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Course Structure

Lecture Materials

The material for this class is covered in 21 lectures, recorded specifically for this online course by Dr. Seth Sullivant. Each week you will watch video lectures and work to complete a quiz and a homework assignment. Each unit will have a quiz and written homework, and I encourage you to work on each of these problem-by-problem as you move through the unit.

In this online asynchronous course, the video content is designed to approximate the 150 minutes of weekly contact time typical of a regular semester course. Asynchronously recorded lectures often cover content faster than in-person, so you should expect to pause and review the videos as you watch them.

You may shift your viewing schedule each week to accommodate your own schedule. However, please keep in mind that this online, distance-education course is fast-paced, and it may become difficult to catch up if you fall behind.

Live sessions

N/A

Communication and Getting Help

Forum

We will use **Piazza** for class discussion and homework questions. You are encouraged to use Piazza to discuss concepts and homework with discretion-hints and suggestions are okay, but full solutions will be deleted. You can post under your name or you may be anonymous to your classmates; however, the instructor will be able to see who you are. Please be respectful of your fellow classmates' ideas and attempts. If you have a math question you are not sure should be a public post, it is better to send me a direct message as a private post on Piazza.

Enroll in this class Piazza through the Piazza link near the top of Moodle.

Request: when asking a question about a specific item (like an item in Moodle), please include a direct link to that item (e.g. the Moodle url). It helps everyone answer your question a lot faster.

Email

Contact me for confidential and private discussions about grades, scheduling office hours, etc. Please include MA 412 in the subject line. In general, I may not respond to messages outside of business hours (M-F, 9am-5pm), and it may take 24-72 hours for me to respond to an message. Math questions are generally best asked in office hours or on our forum, not by email.

Textbook

We will use the following text:

Dickson, Hardy, and Waters, *Actuarial Mathematics for Life Contingent Risks*,
Cambridge University Press, 2nd Edition. ISBN-13: 978-1107044074.

You may also use the online version available through the NC State library:

[NC State Library catalog entry for *Actuarial Mathematics for Life Contingent Risks*](#)

Optional Supplemental Texts

- Dickson, Hardy, and Waters, *Solution Manual for Actuarial Mathematics for Life Contingent Risks*, Cambridge University Press, 2nd Edition.
- Kellison, *The Theory of Interest*. I will provide scans of the first three chapters on the Moodle site, which is all that is needed for this course. However, this book is used for the SOA Exam FM: Financial Mathematics and would be useful to have if you plan to take the actuarial exams to become an actuary.

Please visit [Course Reserves](#).

LaTeX Resources

LaTeX resources

The links below provide learning materials and software for LaTeX. Additional resources are located in Moodle.

- [Learning LaTeX — Griffiths & Higham \(NCSU library\)](#) — Library record for the book "Learning LaTeX".
- [LaTeX Project — software and documentation](#) — Official LaTeX distribution and documentation.
- [LaTeX Wikibook — comprehensive guide](#) — Community-maintained LaTeX reference and examples.
- [Getting started with LaTeX — primer \(Trinity College Dublin\)](#) — Introductory tutorial and examples.
- [MiKTeX — easy-to-install LaTeX for Windows](#) — Windows installer and documentation for MiKTeX.
- [Using TeX notation in Moodle forums](#) — Moodle documentation for inserting math with TeX.

Homework

There are two types of homework in this class: written assignments in Gradescope and computer-based assignments in Moodle. The links to all homework assignments are available in Moodle and grades will appear in the Moodle Gradebook.

No homework scores will be dropped, so be sure to follow the Course Calendar carefully.

Moodle Quizzes

Each unit will contain a Moodle quiz; typically due at 11:00 PM on the listed day (see course schedule on Moodle for dates). You should think of the Moodle quiz as another form of homework. The problems are generally multiple choice. There is no time limit so you can start

and stop working on problems, discuss problems with other students, consult the book or lecture notes as you work, etc. Moodle quiz problems will tend to be numerical and somewhat shorter than the homework problems. There are two attempts per quiz.

Written Homework

Homework will be assigned on Moodle weekly and is typically due at 11:00 PM on the listed day (see course schedule on Moodle for dates). Homework will be submitted as a PDF through Gradescope. See Homework Preparation Guidelines on Moodle for information on how to prepare your homework.

Test Information

Test Dates

- Midterm: 6/8-6/9
- Final Exam: 6/25-6/26

Proctors

All examinations will be proctored through DELTA. You will either take your exam with DELTA, or coordinate remote proctoring with DELTA, according to which situation best describes you:

- If you live less than 50 miles away from Raleigh, NC, then you will take your tests on our campus through the Distance Education Testing Centers. Students should be mindful of closing hours for both Testing Centers, and give themselves plenty of time to complete their exams. For information, please visit [DELTA on-campus testing services](#).
- Those students who live more than 50 miles away from Raleigh, NC do not have to take their tests on NCSU campus. They may use a proctor in their town for testing. The proctor must be approved in advance through DELTA (not the instructor). It can take up to 1 week to verify a proctor and set up all needed contact info, so please do this early! Please visit the remote proctor website at [DELTA remote proctoring](#).

I encourage you to look through DELTA Testing Service's website, especially their [frequently asked questions \(FAQs\)](#). Please note that if you are taking a paper exam at DELTA, it will be administered on an iPad.

Note: the word *remote* in this context means that you are using a professional testing site (for example, a testing center, a local library, a college, etc.) other than DELTA. Remote testing does not mean testing at home.

Quick Links

Please sign up your preferred time and date as soon as possible. Time slots fill up fast:

DELTA and exam links

- [Your Final Exam Schedule](#)
- [On-Campus Testing \(DELTA\)](#)
- [Off-Campus Proctoring](#)
- [Reschedule with DELTA](#)

You may reschedule an exam appointment directly with DELTA using the link above. You do not need to contact the instructor for permission, provided that your new appointment is scheduled within the exam's posted date range.

Calculators

There are 6 calculator models that are permitted for the Society of Actuaries actuarial exams, all Texas Instruments, in the following models: BA-35, BA II Plus, BA II Plus Professional, TI-30Xa, TI-30X II (IIS solar or IIB battery), TI-30XS MultiView (or XB battery). If you are serious about becoming an actuary, purchase one of these calculators now and plan to use them on our exams and homework. They are all inexpensive and have a relatively limited functionality (e.g., no integrals). You will need a calculator of some sort and should plan to use it as you watch the lectures, work on homework and quizzes, and for exam days.

Test Format

Each exam will be taken as a Moodle quiz. If you select a remote proctor, your proctor must be able to administer this type of exam. You may not bring your own laptop to the testing center to take the exam.

Classroom Expectations

1. **Course Structure:** This is an online class; you are responsible for your own learning and for pacing yourself within course guidelines.
 - Watch the video lectures scheduled each week and follow the Course Calendar.
 - Track all due dates in Moodle and on the Course Calendar.
 - Complete all assignments in a timely fashion.
 - Post your math questions in the course forum for discussions and Q&A.
 - Optional: attend live sessions.
2. **Communication and announcements:** Please check your email, the course forum, and the Moodle site regularly. All announcements sent by email will also be saved under Announcements on Moodle. You are responsible for knowing the content of course emails.
3. **Respect and professionalism:** Treat everyone in class (students and instructor) with respect and courtesy. Be active and prepared in any live sessions. Come to office hours ready to ask questions and communicate with others.

4. **Accountability:** You are responsible for resolving any confusion about assignments, due dates, exams, accommodations, etc., in a prompt manner.
5. **Academic integrity:** Do not submit work that is not yours. It is understood that your name on any assignment indicates your adherence to the NC State Honor Pledge: "I have neither given nor received unauthorized aid on this test or assignment."
6. **Exam device policy:** Review the permitted items before each exam. Keep phones and other forbidden devices powered off and stored away during exams to avoid accidental use.

Student Success

Student well-being is important to success at NC State. Every student, faculty member, and staff member enriches the community through varied perspectives, knowledge, and experience. Our classroom should be a space where every student is respected and heard.

In an effort to affirm and respect the identities of all students in the classroom and beyond, please contact me if you wish to be referred to using a name and/or pronouns other than those listed in the student directory.

I welcome any suggestions you have for making our classroom more welcoming.

Grading

Grade Weighting and Numerical Conversion

Your grade will be determined by the following breakdown:

- Homework: 20%
- Quizzes: 10%
- Midterm: 35%
- Final Exam: 35%

Grades are tracked in real-time in the Moodle **Gradebook**.

Conversion from Numerical Grade to Letter Grade

A student's numerical average will be converted to a letter grade as follows (do not expect any additional rounding, extra credit, or curves):

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Standard Conversion Table

Grade	Range
A+	97-100
A	93-96.99
A-	90-92.99
B+	87-89.99
B	83-86.99
B-	80-82.99
C+	77-79.99
C	73-76.99
C-	70-72.99
D+	67-69.99
D	63-66.99
D-	60-62.99
F	0-59

Requirements for Credit-Only (S/U) Grading

In order to receive a grade of S, students are required to take all exams, complete all assignments, and earn a grade of C- or better. Conversion from letter grading to credit only (S/U) grading is subject to university deadlines. Refer to the Registration and Records calendar for deadlines related to grading. For more details refer to [REG 02.20.15 - Credit-Only Courses](#).

It is the student's responsibility to check if an S grade gives progress towards their degree(s).

Requirements for Auditors (AU)

Information about and requirements for auditing a course can be found at [REG 02.20.04 - Audits](#).

Policies on Incomplete Grades

NC State Policy

At the discretion of the instructor, students may be given an IN grade for work not completed because of a serious interruption in their work not caused by their own negligence. An IN must not be used, however, as a substitute for an F when the student's performance in the course is deserving of failing. An IN is only appropriate when the student's record in the

course is such that the successful completion of particular assignments, projects, or tests missed as a result of a documented serious event would enable that student to pass the course.

If an extended deadline is not authorized by the instructor or department, an unfinished incomplete grade will automatically change to an F after either (a) the end of the next regular semester in which the student is enrolled (not including summer sessions), or (b) the end of 12 months if the student is not enrolled, whichever is shorter. Incompletes that change to F will count as an attempted course on transcripts. The burden of fulfilling an incomplete grade is the responsibility of the student. See the university policy on incomplete grades: [REG 02.50.03 - Grades and Grade Point Average](#).

Course Schedule

The course schedule is tentative and subject to change. Adjustments may be made to accommodate the pace of the class and unforeseen circumstances. All major changes will be announced in class and posted on Moodle.

- Course Calendar: [HTML](#)

Important Dates

For holidays and other university closures, please consult [the general NC State Academic Calendar](#).

Your final exam schedule is already determined; find it here: [NC State Final Exam Calendar](#). You are responsible for reviewing your final exam sessions to arrange a suitable time for this course.

List of Topics

Here are the major topics of MA 412, with the approximate regular-semester time allocated to each:

- **Unit 1: Probability Review (~1.5 weeks)**. Major topics include continuous and discrete random variables, probability density function, cumulative distribution function, expected value, variance, and conditional probability.
- **Unit 2: Survival Models (~1.5 weeks)**. Major topics include the future lifetime random variable, force of mortality, Gompertz' law, complete and curtate expected future lifetimes, and actuarial notation.
- **Unit 3: Life Tables (~2 weeks)**. Major topics include the interpretation of life tables, fractional age assumptions (uniform distribution of deaths, constant force of mortality), life insurance underwriting, select and ultimate survival models.

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- **Unit 4: Interest Theory (~1.5 weeks).** Major topics include simple and compound interest, discount factor, nominal and effective rates of interest and discount, basic annuities, present value, and accumulated value.
- **Unit 5: Insurance Benefits (~2.5 weeks).** Major topics include the valuation of insurance benefits, whole life insurance, term insurance, pure endowment, and endowment insurance (continuous case, annual case, 1/mthly case), deferred insurance benefits, and approximation assumptions (uniform distribution of deaths, claims acceleration assumption).
- **Unit 6: Life Contingent Annuities (~2 weeks).** Major topics include (whole life and term) annual life annuities (immediate and -due), annuities payable continuously, annuities payable m times per year, deferred annuities, and guaranteed annuities.
- **Unit 7: Premium Calculation (~2 weeks).** Major topics include the present value of future loss random variable, the equivalence principle and portfolio percentile premium principle, net premium and gross premium calculations.

Course Continuity

To ensure course continuity, changes made to the method of instructional delivery, course structure, course schedule, number of assignments, grading or other aspects of the course after the start of the term will be communicated to all students in written form (e.g., by an instructor announcement) when course changes are implemented.

Additional Information

Student Expenses

Late Assignments

Generally no late assignments are accepted in this course. Please plan your work carefully and submit assignments by their stated deadlines. Extensions may be occasionally granted by the instructor for extenuating circumstances, which are best documented with [NC State Absence Verification](#).

For longer-term, recurring, or more serious illness or other interruptions to your participation in this class, you should reach out to your instructor as soon as you can.

Late Examinations

Excused absence. If an exam is missed with an excused absence (that is, for a university-approved reason with supporting documentation), then a make-up test will be scheduled individually. The make-up test may contain different questions and be assessed differently than the regular test. Documentation for an excused absence must be provided within 1 week of the missed class. All absences that require a make-up exam or other special

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accommodations must go through the NC State University absence verification process. Here is the link to that office: [NC State Absence Verification](#).

Failure to schedule. You must schedule exams in a timely fashion to guarantee that you will be able to take them. It is the instructor's discretion whether a make-up exam will be allowed if you are not able to schedule an exam appointment within the selected time frame. If the instructor approves a make-up exam, there may be a 10% penalty on that exam. The make-up test may contain different questions and be assessed differently than the regular test.

Other absences. If an exam is missed for an unexcused absence, that exam will be given a score of 0.

Attendance

Since this course is an asynchronous online course, there is no daily attendance. Instead, each student's participation in Moodle is tracked to check for regular activity. For complete attendance and excused absence policies, please see Attendance Regulations ([NCSU REG 02.20.03](#)).

Academic Integrity

Students are required to comply with the university policy on academic integrity found in the Code of Student Conduct ([NCSU POL 11.35.01](#)). Your submission of any exam indicates "I have neither given nor received unauthorized aid on this test or assignment." Violations of academic integrity will be handled in accordance with the Student Discipline Procedures ([NCSU REG 11.35.02](#)).

Posting any course material to websites like Chegg, ChatGPT, and Course Hero is a violation of copyright law and course policy and is strictly prohibited. Violations of this policy will be reported to the [Office of Student Conduct](#).

- Tests: Proctored tests are closed book assessments. You may not consult any internet resources nor receive help from anyone else. Do not share information about the content on the exams with anyone else in the class. See the calculator policy in the Test Information section of this syllabus.
- Homework: You may consult your notes, the textbook, each other, or online resources.
- Forum discussion boards: You are encouraged to discuss mathematical concepts and problems with your classmates. However, you must arrive at your own solutions with your own work. Do not seek nor state final answers on the forum; focus on understanding the concepts.

Disability Resources

Reasonable accommodations will be made for students with verifiable disabilities. In order to take advantage of available accommodations, students must register with the Disability

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Resource Office at Holmes Hall, Suite 304, 2751 Cates Avenue, Campus Box 7509, 919-515-7653. For more information on NC State's policy on working with students with disabilities, please see the Academic Accommodations for Students with Disabilities Regulation ([NCSU REG 02.20.01](#)).

Students who receive accommodations are responsible for filing those accommodations officially with DRO before the tests occur. It is not appropriate to tell the instructor that you should receive accommodations without going through the official channels. The instructor will only adjust test conditions after receiving the official Accommodation Letter Notification from DRO. Adjustments are never made retroactively to past examinations.

Digital Course Components

Because of the way our course is structured, students need internet connectivity in order to read course materials and complete assignments. NC State's Office of Information Technology (OIT) provides [technology guidance](#), including requirements and recommendations for computer hardware.

For access to computing hardware, please see the NC State University Libraries [Technology Lending](#) and the general [Library Computing resources](#). There are several computers available for use around campus, including in the [Mathematics Tutoring Center](#).

Digitally hosted course components will include but are not limited to Moodle and Zoom.

Software

There are several resources available to assist students with technical or computer issues. For technology help, please consult the [Office of Information Technology](#) at NC State University.

Here are some of the primary applications commonly used in online mathematics courses:

- [Moodle and Wolfware](#): Our course is hosted online on Moodle, where you can find the course content, a link to this syllabus, and the gradebook.
 - [Moodle Accessibility Statement](#)
 - [Moodle Privacy Notice](#)
 - [NC State WolfWare Privacy Statement](#)
- [Panopto](#): NC State uses Panopto for video hosting.
 - [Panopto Accessibility Features](#)
 - [Panopto Privacy Policy](#)
 - [Panopto Support](#)
- [Piazza](#): this site hosts our class forum. You will use **Piazza** to ask questions regarding the lecture or homework.
 - [Piazza Accessibility Statement](#)
 - [Piazza Privacy Policy](#)

- [Piazza Support Center](#)
- [Google Meet](#): when needed.
 - [Google Meet Accessibility features](#)
 - [Google Meet Security and Privacy](#)
 - [Google Meet Help](#)
- [Zoom](#): when needed.
 - [Zoom Accessibility Statement](#)
 - [Zoom Privacy Policy](#)
 - [Zoom Support](#)
- [Gradescope](#): We will use Gradescope for collecting and returning written work.
 - [Gradescope Accessibility Information](#)
 - [Gradescope Privacy Policy](#)
 - [Gradescope Help Center](#)

You must address the accessibility of these websites for yourself during the course drop/add period.

The instructor is not responsible for ensuring privacy or accessibility of electronic materials that are not required components of the course (e.g., links to supplemental information that is not part of the required reading list). However, the instructor will judiciously consider the privacy, copyright, and accessibility of supplemental links provided to students and warn them of any known issues or concerns in this regard. See Online Course Material Host Requirements ([NCSU REG 08.00.11](#)).

Electronically Hosted Components

Please be advised that live meetings for this course may be recorded for current and potential future educational purposes. By your continued participation in this recorded course, you are providing your permission to be recorded. If you would like for your likeness to be edited out of a recorded video, please contact me and I will edit the video accordingly.

Required Statement

Students may be required to disclose personally identifiable information to other students in the course, via digital tools, such as email or web-postings, where relevant to the course. Examples include online discussions of class topics, and posting of student coursework. All students are expected to respect the privacy of each other by not sharing or using such information outside the course.

Additional NC State Rules and Regulations

Your rights and responsibilities

Students are responsible for reviewing the NC State University Policies, Rules, and Regulations (PRRs), which pertain to their course rights and responsibilities, including, but not limited to:

- [POL 04.25.05](#) Opportunity and Non-Discrimination Policy Statement
 - [REG 02.20.01](#) Academic Accommodations for Students with Disabilities
- [POL 11.35.01](#) Student Conduct
 - [REG 11.35.05](#) Code of Student Conduct
 - [REG 11.35.02](#) Student Discipline Procedures
- [REG 02.20.03](#) Attendance Regulations
- [REG 02.50.03](#) Grades and Grade Point Average
- [REG 02.20.15](#) Credit-Only Courses
- [REG 02.20.04](#) Audits
- [REG 08.00.11](#) Online Course Material Host Requirements

You may also find additional references at [NC State Office of Equal Opportunity](#).

Non-Discrimination Policy

NC State University provides equality of opportunity in education and employment for all students and employees. Accordingly, NC State affirms its commitment to maintain a work environment for all employees and an academic environment for all students that is free from all forms of discrimination. Discrimination based on race, color, religion, creed, sex, national origin, age, disability, veteran status, or sexual orientation is a violation of state and federal law and/or NC State University policy and will not be tolerated. Harassment of any person (either in the form of quid pro quo or creation of a hostile environment) based on race, color, religion, creed, sex, national origin, age, disability, veteran status, or sexual orientation also is a violation of state and federal law and/or NC State University policy and will not be tolerated. Retaliation against any person who complains about discrimination is also prohibited. NC State's policies and regulations covering discrimination, harassment, and retaliation may be accessed at

[POL 04.25.05 - Equal Opportunity and Nondiscrimination Policy](#) or [the Office of Equal Opportunity](#)

Any person who feels that he or she has been the subject of prohibited discrimination, harassment, or retaliation should contact the Office for Equal Opportunity (OEO) at 919-515-3148.

Support

Everyone is encouraged to take care of themselves and their peers. If you need additional support, there are many resources on campus to help you:

1. [Counseling Center](#)
2. [Health Center](#)
3. [Share a Concern](#)
4. [Pack Essentials](#)

Course Evaluations

ClassEval is the end-of-semester survey for students to evaluate instruction of all university classes. The current survey is administered online and includes 12 closed-ended questions and 3 open-ended questions. Deans, department heads, and instructors may add a limited number of their own questions to these 15 common-core questions.

Each semester students' responses are compiled into a ClassEval report for every instructor and class. Instructors use the evaluations to improve instruction and include them in their promotion and tenure dossiers, while department heads use them in annual reviews. The reports are included in instructors' personnel files and are considered confidential.

Online class evaluations will be available for students to complete during the last two weeks of the semester for full semester courses and the last week of shorter sessions. Students will receive an email directing them to a website to complete class evaluations. These become unavailable at 8am on the first day of finals.

- [Contact ClassEval Help Desk](#)
- [ClassEval website](#)
- [Information about ClassEval and how the information is used](#)

Required statement

This course engages diverse scholarly perspectives to develop critical thinking, analysis, and debate and inclusion of a reading does not imply endorsement. *This statement is required per [UNC Policy Manual 400.1.6](#), adopted 12/19/2025.*

Syllabus Modification Statement

Our syllabus represents a flexible agreement. It outlines the topics we will cover and the order we will cover them in. Minor changes in the syllabus can occur if we need to slow down or speed up the pace of instruction.

Per [REG 02.20.07 – Course Syllabus](#), syllabi do **not** constitute an express or implied contract among the student, faculty, or institution. Rather, syllabi serve as a guide for the course.

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This syllabus was designed by Bevin Maultsby to meet the NC State University standards [REG 02.20.07 - Course Syllabus](#) (according to the February 3, 2026 revision) and to be WCAG 2.1 AA compliant.