



A Criterion-Referenced Equal-Interval Grading Model as an Alternative to the Linear Transformation Scale in Higher Education

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Abstract

Background and Aim: Grade transmutation continues to be practiced in some higher education institutions and has recently attracted renewed policy attention in the Philippines due to concerns regarding the accuracy and transparency of reported grades. When grades are systematically transformed beyond students' actual performance levels, they may obscure learning gaps, reduce the fidelity of assessment outcomes, and hinder meaningful comparisons across courses, programs, and institutions. To address these concerns, this study proposes a criterion-referenced equal-interval grading model for higher education as an alternative to the Linear Transformation Scale (LTS), a widely used transmutation-based approach that converts raw percentage scores into higher reported percentages.

Materials and Methods: The study employed an analytical-deductive design based on mathematical formalization and comparative modeling rather than empirical data analysis. A direct grading function was constructed using the official 5-point grading scale by dividing the passing raw-score interval from 50% to 100% into 21 equal-width intervals corresponding to official grades from 3.0 to 1.0. Scores below the passing threshold were assigned a grade of 5.0. The mathematical properties of the proposed model were examined and compared analytically with those of the LTS on the 100-point scale. A representative institutional equivalency schedule was used to illustrate differences in grading outcomes between the two approaches.

Results: The proposed model demonstrated several desirable properties, including a discrete official grade structure, equal-interval classification within the passing range, and monotonicity with respect to raw performance. Analytical comparisons showed that LTS-transmuted percentages are consistently greater than or equal to the cutoff-equivalent percentages generated by the proposed model, with a positive uplift observed for all non-perfect raw scores. Application of a sample institutional equivalency schedule further illustrated how this uplift can result in more favorable official transcript grades despite identical raw performance levels.

Conclusion: The proposed criterion-referenced equal-interval grading model provides a transparent, consistent, and mathematically explicit alternative to transmutation-based grading systems. The framework may assist higher education institutions, academic policymakers, registrars, and quality assurance offices in evaluating existing grading policies, conducting comparative grade simulations, and considering direct grading approaches that more accurately reflect students' demonstrated academic performance.

Keywords: Criterion-referenced grading; Equal-interval grading; Grade inflation; Grading policy; Higher education; Linear Transformation Scale (LTS).

Introduction

Grades are among the most consequential judgments made in higher education. They shape academic progression, retention, scholarship eligibility, graduation honors, and the credibility of institutional records. For that reason, a grading system is not merely a reporting device; it is an assessment policy that should communicate student achievement against defensible standards with clarity, consistency, and interpretive validity (Lok et al., 2016; Sadler, 2005).

Persistent concerns about grade inflation show, however, that reported grades can drift away from the level of performance they are meant to represent. In higher education, grade inflation has been associated with the awarding of increasingly favorable grades without commensurate gains in learning, thus weakening the comparability and meaning of grades across courses, cohorts, and institutions (Eiszler, 2002; Karadağ, 2021). The problem is not only technical but also ethical and distributive; that is, when grades become systematically more favorable than the underlying performance justifies, they can create unfair advantages in progression, distinction, and selection (Ciftci & Karadağ, 2024). The central problem addressed in this study is that transmutation-based grading may create a systematic gap between raw demonstrated performance and the official grade eventually recorded for institutional

decision-making.

In the Philippine context, this issue has renewed policy relevance. Department of Education (DepEd) classroom assessment policy formally includes grade transmutation in learner reporting, and subsequent issuances continued to reference the use of the transmutation in grade computation and reporting (DepEd, 2015, 2020, 2025). More recently, Education Secretary Sonny Angara publicly stated that DepEd would review and gradually discontinue grade transmutation and related practices because such rules may contribute to mass promotion and may prevent grades from accurately reflecting actual learner performance (Untalan, 2026). Although DepEd policies directly govern basic education rather than higher education, the policy debate is relevant to higher education because it raises a broader assessment principle: that is, grading rules should not systematically elevate reported outcomes beyond demonstrated achievement. Higher education institutions (HEIs) have greater autonomy in grading policies, yet the same concerns about grade integrity, transcript credibility, progression, retention, honors, and scholarship decisions apply when HEIs use transmutation or transmutation-like grading procedures.

This concern becomes sharper in institutional settings where a Linear Transformation Scale (LTS) is used to convert raw scores into reported grade equivalents. Such procedures may have been adopted for pragmatic or protective reasons, such as softening the effect of unusually difficult examinations, moderating very low raw-score distributions, reducing excessive failure rates, or making grade reporting more administratively manageable. These reasons are understandable in contexts where assessments may vary in difficulty across courses and instructors. However, the policy consequence of transmutation remains underexamined: once raw scores are systematically transformed upward before final grade reporting, the resulting grade may become less transparent as an indicator of actual performance. Prior scholarship strongly supports criterion-referenced assessment under outcomes-based education, while also warning that criteria-based systems lose clarity when the relationship among standards, cutoffs, and reported grades is not explicitly specified (Lok et al., 2016; Sadler, 2005). At the same time, the literature on grade inflation shows that grading outcomes can become systematically more favorable not only through instructor leniency but also through structural features embedded in the grading policy itself (Eiszler, 2002; Karadağ, 2021).

The present study is motivated by a more specific problem that has not been adequately formalized in the literature: how a linear transmutation rule behaves when compared with a criterion-referenced equal-interval cutoff model under a discrete official grade system. In the grading structure examined in this paper, the official grade set is not the full real interval from 1.0 to 5.0. Rather, the admissible official grades are $\{1.0, 1.1, 1.2, \dots, 3.0, 5.0\}$, where 1.0 denotes the highest level of achievement, 3.0 is the lowest passing grade, and all grades strictly worse than 3.0 are administratively collapsed into the single terminal grade 5.0, indicating failure and the need to retake the subject. Since the passing official grades run from 3.0 down to 1.0 in increments of 0.1, there are exactly 21 admissible passing grades. This structure provides the basis for partitioning the passing raw-score range into 21 equal-width intervals. Under such a system, the relevant question is not merely whether LTS raises reported percentages, but how that uplift should be interpreted relative to a grading model that assigns official grades directly from raw performance through fixed criterion-referenced cutoffs.

This study addresses that problem by developing a standardized equal-interval grading model that partitions the passing raw-score range from 50% to 100% into 21 equal-width intervals corresponding to official passing grades from 3.0 to 1.0. The study formalizes the grading function, establishes its key properties, and proves a universal comparative result on the 100-point scale: relative to the cutoff-equivalent percentage implied by the proposed model, the Linear Transformation Scale always yields an equal or higher transmuted percentage, with strict uplift for every non-perfect raw score. The paper then presents an institutional illustration showing how that percentage-scale uplift may translate into more favorable official grades when combined with a particular equivalency schedule. Comparative tabulations are included not as the paper's primary contribution, but as applied evidence clarifying the policy consequences of the competing systems.

Framed as a problem of grading-policy design rather than computational convenience, the study contributes to ongoing discussions on criterion-referenced assessment, grade integrity, and quality assurance in higher education. Specifically, the paper proceeds by defining the proposed model, proving its formal properties, comparing LTS with the cutoff-equivalent percentage implied by the model, illustrating possible official-grade distortion under one institutional equivalency scheme,



and discussing the policy implications of replacing transmutation-based grading with a direct criterion-referenced cutoff approach. In this sense, reforming grade computation is not merely a procedural adjustment; it is a matter of academic integrity, fairness, and policy coherence in higher education.

Objectives

This study aims to develop and analytically examine a criterion-referenced equal-interval grading model that assigns official grades directly from raw percentage performance and provides an adaptable framework for institutions using discrete passing-grade categories. Specifically, it seeks to: (1) Formulate a direct cutoff-based grading function that maps raw percentage performance to the official discrete grade set $\{1.0, 1.1, \dots, 3.0, 5.0\}$, using the assumed 50% minimum passing threshold and an equal-interval structure that may be recalibrated when institutions adopt different passing thresholds; (2) establish the formal properties of the proposed grading function, particularly its discrete grade image, equal-interval passing structure, collapsed failure region, and monotonicity with respect to raw performance; (3) Examine the behavior of the Linear Transformation Scale (LTS) deductively as a linear transmutation rule when compared with the cutoff-equivalent percentage implied by the proposed model on the 100-point scale; (4) establish whether and how LTS produces systematic percentage-scale uplift relative to the cutoff-equivalent percentage under the proposed criterion-referenced model; and (5) Illustrate, under a particular institutional equivalency schedule, how percentage-scale uplift under LTS may translate into official-grade distortion and identify the score zones where such distortion is most evident.

Literature Review

Criterion-referenced assessment is widely defended in higher education because it evaluates student work against declared standards rather than against the relative performance of a cohort. However, the literature also shows that criterion-based grading is frequently misunderstood in practice. Sadler (2005) argued that many so-called criteria-based systems fail to distinguish clearly between criteria and standards, thereby weakening the defensibility of grading decisions. Lok et al. (2016) further showed that criterion-referenced and norm-referenced judgments are not necessarily opposites, but that defensible grading still depends on clarity regarding what standards mean and how they are operationalized. This concern is reinforced by later work on grade integrity, which emphasizes that grades should represent academic achievement truthfully and preserve stable meaning across tasks, courses, and contexts (Sadler, 2009). Related studies likewise show that standards are not secured merely by publishing marking criteria, because grading judgments remain partly tacit, interpretive, and socially mediated within academic practice (Bearman & Ajawi, 2018; Bloxham & Boyd, 2012; Bloxham et al., 2011).

A second stream of scholarship focuses on the structure and resolution of grading scales themselves. This literature suggests that the design of the scale is not neutral, because the number of categories, the width of intervals, and the placement of cutoffs affect how performance distinctions are translated into official records. For example, studies of plus/minus grading found that finer-grained scales can improve differentiation among students and are often perceived as fairer, even when their effect on aggregate GPA is modest (Barnes & Buring, 2012; McClure & Spector, 2005). This issue is directly relevant to the present model because a discrete passing scale with grades from 3.0 to 1.0 in increments of 0.1 contains 21 admissible passing categories. The proposed equal-interval model, therefore treats grade-scale resolution as both a measurement and policy problem. This means that if official passing grades are already differentiated into 21 categories, then the raw-score passing interval should be partitioned transparently and consistently rather than indirectly reshaped through transmutation.

A third line of research addresses grade inflation and the institutional conditions that sustain it. Higher education studies have shown that favorable grades may be reinforced by systemic incentives, particularly when lenient grading aligns with positive student evaluations or related institutional pressures (Berezvai et al., 2021; Eiszler, 2002; Stroebe, 2016). In such cases, grades may rise without a corresponding increase in demonstrated learning, thereby weakening their validity as indicators of academic attainment. Recent longitudinal evidence confirms that grade inflation remains a continuing higher education concern. Ciftci and Karadag (2024), for example, analyzed graduation GPAs and high-honor classifications among 173,232 graduates from 32 teacher education institutions across 2003–2022 and reported increasing GPA and high-honor patterns over time. This literature is directly relevant to the critique developed in the present

study, because it suggests that grade inflation need not arise only from instructor leniency. It may also emerge from structural features embedded in the grading policy itself, including rules that systematically elevate reported outcomes above the level implied by raw performance.

A fourth body of work shows that grades and GPA are not automatically fair or interval-scaled representations of achievement. Johnson (1997) argued that traditional GPA inherits the limitations of ordinal grades and may therefore misrepresent student performance when treated as if it were naturally scaled. More recent quantitative studies have proposed mathematically adjusted approaches to account for course difficulty and grading disparity, demonstrating that observed GPA can be a biased measure of achievement and that alternative models can provide fairer academic comparisons (Tomkin & West, 2022; Vanderbei et al., 2014). Micha et al. (2024) model the conversion of numerical scores into letter-grade intervals and compare uniform letter-grading schemes with numerical scoring, showing that the design of grading categories can affect student incentives and subsequent performance. These studies are important for the present paper because they establish that grading systems are legitimate objects of formal mathematical and statistical analysis rather than merely administrative conventions.

This literature supports four conclusions. First, defensible grading should be criterion-referenced and anchored in explicit standards rather than relative rank (Lok et al., 2016; Sadler, 2005, 2009). Second, grade integrity depends not only on assessor judgment but also on the design of the grading scale and the transparency of its cutoffs, and the way institutional policy converts performance into official records (Barnes & Buring, 2012; Bearman & Ajjawi, 2018; Bloxham & Boyd, 2012; Bloxham et al., 2011; McClure & Spector, 2005). Third, grade inflation can arise from structural and institutional features of the grading system, not only from pedagogical leniency or student-evaluation pressures (Berezvai et al., 2021; Ciftci & Karadag, 2024; Eiszler, 2002; Stroebe, 2016). Fourth, mathematical models are appropriate tools for evaluating whether a grading rule preserves fairness, comparability, and interpretive validity (Johnson, 1997; Tomkin & West, 2022; Vanderbei et al., 2014).

Yet a specific gap remains. Existing studies have examined criterion-referenced assessment, grading-scale resolution, grade inflation, GPA comparability, and formal grading schemes, but they have not adequately formalized how an LTS-type transmutation rule behaves when official grades are reported on a discrete scale of $\{1.0, 1.1, 1.2, \dots, 3.0, 5.0\}$. Direct mathematical critiques of transmutation-based grading remain limited. This gap is especially important because transmutation may introduce a compounded distortion, that is, raw percentage performance is first transformed upward on the 100-point scale and may then be compressed again through a discrete official transcript-grade equivalency schedule. The present study addresses that gap by developing a criterion-referenced equal-interval cutoff model, proving its key mathematical properties, comparing it analytically with LTS on the 100-point scale, and illustrating how percentage-scale uplift may translate into official-grade distortion under a particular equivalency schedule.

Preliminaries and Model Definition

To formulate the proposed grading system rigorously, this study distinguishes among three analytically different quantities: the raw percentage score, the transmuted percentage produced by the Linear Transformation Scale (LTS), and the official grade assigned under the proposed criterion-referenced equal-interval model. These quantities are related, but they are not interchangeable. The raw percentage represents directly observed student performance; the LTS produces a transformed percentage on the 100-point scale; and the proposed model assigns an official transcript grade directly from raw performance through fixed criterion-referenced cutoffs. Let denote the student's raw percentage score.

$$P \in [0,100]$$

Definitions and Notation

The following definitions establish the mathematical objects used in the analysis. Definition 1 specifies the official grade set examined in the study. Definition 2 identifies the assumed passing threshold and the corresponding equal-width passing intervals. Definition 3 defines the LTS transformation. Definition 4 defines the proposed direct grading function. Definition 5 introduces the cutoff-equivalent percentage used only as an analytical benchmark for comparison on the 100-point scale.

Definition 1. Official Grade Set

The proposed grading model uses the discrete official grade set

$$\Omega = \{1.0, 1.1, 1.2, \dots, 3.0, 5.0\}.$$

Within this system, grades from 1.0 to 3.0 represent passing outcomes, with 1.0 denoting the highest level of performance and 3.0 the lowest passing grade. The grade 5.0 is the sole failing grade. No official grades exist in the open interval (3.0, 5.0); all such values are administratively collapsed to 5.0, indicating failure and the need to retake the course.

Accordingly, define the passing-grade subset

$$\Omega_{\text{pass}} = \{1.0, 1.1, \dots, 3.0\}, \quad \Omega_{\text{fail}} = \{5.0\}.$$

This definition fixes the admissible transcript-grade values considered in the model. It also clarifies that the proposed system does not treat the numerical interval from 3.0 to 5.0 as a continuous range of grades; rather, all nonpassing outcomes are represented by the terminal grade 5.0.

Definition 2. Passing Threshold and Equal-Interval Width

Let the minimum passing raw percentage be

$$\varepsilon = 50.$$

The value $\varepsilon = 50$ is used in this paper as the assumed minimum passing raw percentage for the model examined. This assumption is consistent with documented base-50 or 50%-passing practices in some higher-education settings, although it is not asserted as a universal standard (Cebu Technological University, 2018; Holy Cross College, 2020; UCSI College, n.d.). If an institution adopts a different passing threshold, the same construction remains applicable by replacing $\varepsilon = 50$ with the institution's chosen threshold and recalculating the interval width.

The passing interval $[50, 100]$ is partitioned into 21 equal-width subintervals corresponding to the 21 official passing grades from 3.0 to 1.0. The number 21 is determined by the discrete passing-grade structure examined in this study, namely $(3.0, 2.9, 2.8, \dots, 1.0)$. Such 0.1-increment 5-point grade structures, with 3.0 as the minimum passing grade and 5.0 as failure, are used in some higher-education settings (Father Saturnino Urios University, 2023). Thus, the 21-interval construction is grounded in an existing grade configuration, while remaining adaptable for institutions that use different grade sets.

The common interval width is therefore

$$\Delta = \frac{100 - \varepsilon}{21} = \frac{50}{21}.$$

For $k = 0, 1, \dots, 19$, define

$$I_k = [50 + k\Delta, 50 + (k + 1)\Delta),$$

and define the final interval by

$$I_{20} = [50 + 20\Delta, 100].$$

Thus, the 21 passing intervals are $I_0, I_1, \dots, I_{20}$, and the official passing grade associated with interval I_k is

$$g_k = 3.0 - 0.1k.$$

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In practical terms, each equal-width interval corresponds to one official passing grade. A student whose raw percentage falls within a given interval receives the official grade assigned to that interval.

Definition 3. Linear Transformation Scale

The Linear Transformation Scale (LTS) is the map defined by

$$\ell: [0,100] \rightarrow [50,100]$$

$$\ell(P) = 50 + \frac{1}{2}P.$$

This function converts a raw percentage score P into a transmuted percentage under the legacy grading rule. In particular, so, the entire raw-score range $[0, 100]$ is linearly mapped into the interval $[50, 100]$.

$$\ell(0) = 50$$

and

$$\ell(100) = 100,$$

This definition shows that LTS does not report raw performance directly. Instead, it shifts every raw score into the 50–100 scale before any further institutional interpretation or grade-equivalency conversion is applied.

Definition 4. Proposed Equal-Interval Official Grading Function

The proposed criterion-referenced equal-interval grading model is the function defined by Equivalently, on the passing interval $[50, 100]$, one may write

$$G: [0,100] \rightarrow \Omega$$

$$G(P) = \begin{cases} 5.0, & 0 \leq P < 50, \\ 3.0 - 0.1k, & P \in I_k, k = 0, 1, \dots, 20. \end{cases}$$

$$G(P) = 3.0 - 0.1 \min \left\{ \left\lfloor \frac{P - 50}{\Delta} \right\rfloor, 20 \right\}.$$

The use of the minimum operator ensures that the endpoint $P = 100$ is correctly assigned to the highest official grade 1.0, thus avoiding ambiguity at the upper boundary.

Thus, all raw scores below the passing threshold are assigned the official failing grade 5.0, while the passing interval is discretized into equal-width bands mapped to the official grades 3.0, 2.9, ..., 1.0. Unlike LTS, the proposed function $G(P)$ assigns the official grade directly from raw percentage performance.

Definition 5. Cutoff-Equivalent Percentage

After defining both the LTS transformation and the proposed direct grading function, it is useful to introduce a common-basis percentage benchmark for comparing the two systems on the 100-point scale. For this purpose, define the cutoff-equivalent percentage associated with the proposed model by where

$$C: [0,100] \rightarrow [0,100],$$

$$C(P) = \begin{cases} P, & 0 \leq P < 50, \\ 50 + \Delta \left\lfloor \frac{P - 50}{\Delta} \right\rfloor, & 50 \leq P < 100, \\ 100, & P = 100. \end{cases}$$

Thus, for passing scores, $C(P)$ is the lower-end percentage cutoff of the interval to which P belongs under the proposed grading model. For failing scores, $C(P)$ is defined to equal the raw score itself, since the proposed model assigns only the single failing grade 5.0 and does not impose further sub-classification below the passing threshold.

The function $C(P)$ is introduced only to permit a common-basis comparison on the 100-point scale between the LTS-transmuted percentage $\ell(P)$ and the performance-grounded percentage threshold implied by the proposed criterion-referenced model. It is not a new reported student grade, nor does it introduce another grading scale.

For convenience, the main notation used in the analysis is summarized as follows: P denotes the raw percentage score; $\ell(P)$ denotes the LTS-transmuted percentage; $G(P)$ denotes the official grade assigned by the proposed model; and $C(P)$ denotes the cutoff-equivalent percentage used only as an analytical comparison benchmark.

Remarks

The following remarks clarify several interpretive points that may otherwise cause confusion when moving from the definitions to the formal results.

Remark 1. Discreteness of the Official Grade Set

The proposed grading model is discrete rather than continuous. Although the numerical scale spans from 1.0 to 5.0, the admissible official grades are only.

$$\Omega = \{1.0, 1.1, 1.2, \dots, 3.0, 5.0\}.$$

Hence, the model does not assign every real value in the interval $[1.0, 5.0]$, but only a finite set of officially recognized grades.

Remark 2. Collapsed Failure Region

In the proposed model, the open interval $(3.0, 5.0)$ contains no admissible official grade. All raw performances below the minimum passing threshold of 50% are assigned the single failing grade 5.0. Thus, the grading structure consists of a discrete passing band, a Ω_{pass} and a collapsed failure state 5.0. Administratively, this means that the model distinguishes levels of passing performance but treats all nonpassing performance as requiring the same terminal academic consequence.

Remark 3. Direction of Grade Quality

Under the proposed grading model, smaller numerical grades correspond to better academic performance. In particular, 1.0 denotes the highest official grade, 3.0 the lowest passing grade, and 5.0 the failing grade. Consequently, when official grades are compared, a numerically smaller value represents a more favorable outcome.

Remark 4. Distinction Between Percentage-Scale and Official-Grade Comparisons

This study uses two analytically distinct scales. The first is the 100-point percentage scale, on which the raw score starts P , the LTS-transmuted percentage $\ell(P)$, and the cutoff-equivalent percentage $C(P)$ are

compared. The second is the official grade scale, on which the proposed grading function $G(P)$ is defined. Because higher percentages are better but lower official grades are better, the direction of inequalities differs across these two scales and should not be conflated.

Remark 5. Role of the Cutoff-Equivalent Percentage

The function $C(P)$ is introduced only as an analytic comparison device on the 100-point scale. It does not represent a new reported student grade. On the passing region, it identifies the lower-end cutoff of the equal-interval band to which the raw score belongs under the proposed model. On the failing region, it is defined as the raw score itself so that no artificial uplift is attributed to the proposed model below the passing threshold.

Remark 6. Scope of the Universal Comparison with LTS

In the main mathematical development of this paper, the Linear Transformation Scale is treated only through its fixed transmutation formula

$$\ell(P) = 50 + 0.5P.$$

Accordingly, the universal comparison established in this study is between the LTS-transmuted percentage $\ell(P)$ and the cutoff-equivalent percentage $C(P)$, not between institution-specific official grades derived from different equivalency tables. Any comparison involving a particular institutional conversion of transmuted grades into official grades belongs to a later applied or illustrative section, rather than to the core general theory.

Results and Comparative Analysis

The following results establish the formal properties of the proposed grading model before comparing it with the Linear Transformation Scale (LTS). Proposition 1 verifies that the proposed function produces only admissible official grades. Proposition 2 establishes the equal-interval structure of the passing region. Theorem 1 confirms that the function is monotone with respect to raw performance. Theorem 2 then provides the main comparative result by showing how the LTS-transmuted percentage relates to the cutoff-equivalent percentage implied by the proposed model.

Proposition 1. Image of the Grading Function and Collapsed Failure Region

Let be the proposed equal-interval official grading function defined in Definition 4. Then Equivalently,

$$G: [0,100] \rightarrow \Omega$$

$$\text{Im}(G) = \Omega = \{1.0, 1.1, 1.2, \dots, 3.0, 5.0\}.$$

$$\text{Im}(G) = \{5.0\} \cup \{3.0, 2.9, 2.8, \dots, 1.0\}.$$

In particular:

1. every passing grade produced by the G belongs to the discrete set Ω_{pass} ;
2. The only failing grade produced by the G is 5.0; and
3. No official grade in the open interval $(3.0, 5.0)$ is generated by the grading function.

Proof

We first show that

$$\text{Im}(G) \subseteq \{5.0\} \cup \{3.0, 2.9, \dots, 1.0\}.$$

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If $0 \leq P < 50$, then by Definition 4,

$$G(P) = 5.0.$$

Now suppose the $P \in [50, 100]$. By Definition 2, there exists a unique index

$$k \in \{0, 1, \dots, 20\}$$

such that

$$P \in I_k.$$

Hence, by Definition 4,

$$G(P) = 3.0 - 0.1k.$$

Since k ranges from 0 to 20, the set of possible passing values is exactly

$$\{3.0, 2.9, 2.8, \dots, 1.0\}.$$

Therefore,

$$\text{Im}(G) \subseteq \{5.0\} \cup \{3.0, 2.9, \dots, 1.0\}.$$

It remains to prove the reverse inclusion. First,

$$5.0 \in \text{Im}(G)$$

because, for example,

$$G(0) = 5.0.$$

Next, let $k \in \{0, 1, \dots, 20\}$, and define

$$P_k = 50 + k\Delta.$$

For $k = 0, 1, \dots, 19$, one has $P_k \in I_k$ by construction. For $k = 20$, one has

$$P_{20} = 50 + 20\Delta \in I_{20}.$$

Hence, for every $k \in \{0, 1, \dots, 20\}$,

$$G(P_k) = 3.0 - 0.1k.$$

Thus, every element of

$$\{3.0, 2.9, \dots, 1.0\}$$

is attained by G .

Therefore,

$$\{5.0\} \cup \{3.0, 2.9, \dots, 1.0\} \subseteq \text{Im}(G).$$

Combining both inclusions,

$$\text{Im}(G) = \{5.0\} \cup \{3.0, 2.9, \dots, 1.0\} = \Omega.$$

This proves the proposition. $\square$

Proposition 1 establishes the administrative validity of the proposed grading function. It shows that the function does not generate inadmissible transcript grades and that all possible outputs belong to the official grade set examined in this study. This is important because a grading model is not only a numerical transformation; it must also be compatible with the actual set of grades recognized for institutional reporting. The result further clarifies that the model distinguishes levels of passing performance while assigning all nonpassing outcomes to the single terminal grade of 5.0.

Proposition 2. Equal-Interval Characterization of the Passing Grades

Let

$$\Delta = \frac{50}{21},$$

and let the passing intervals $I_0, I_1, \dots, I_{20}$ be defined as in Definition 2. Then the family

$$\{I_k\}_{k=0}^{20}$$

forms a partition of the passing interval $[50, 100]$, and for each $k \in \{0, 1, \dots, 20\}$,

$$G(P) = 3.0 - 0.1k \text{ for all } P \in I_k.$$

Equivalently,

$$G^{-1}(3.0 - 0.1k) = I_k, \quad k = 0, 1, \dots, 20.$$

Hence, each official passing grade from 3.0 down to 1.0 corresponds to exactly one raw-score interval of common width $\Delta = \frac{50}{21}$.

Proof

By Definition 2, for $k = 0, 1, \dots, 19$,

$$I_k = [50 + k\Delta, 50 + (k + 1)\Delta),$$

and

$$I_{20} = [50 + 20\Delta, 100].$$

Since

$$50 + 21\Delta = 50 + 21 \cdot \frac{50}{21} = 100,$$

these intervals are contiguous and cover the entire passing interval $[50, 100]$. Also, the intervals are pairwise disjoint because each is left-closed and right-open, except the last interval, which is right-closed. Therefore,

$$[50, 100] = \bigcup_{k=0}^{20} I_k,$$

so $\{I_k\}_{k=0}^{20}$ is a partition of $[50, 100]$.

Now let $k \in \{0, 1, \dots, 20\}$, and let $P \in I_k$. By Definition 4,

$$G(P) = 3.0 - 0.1k.$$

Thus the grade assigned on each interval is constant and depends only on the index k .

To prove the preimage identity, first let $P \in I_k$. Then, as just shown,

$$G(P) = 3.0 - 0.1k,$$

so

$$I_k \subseteq G^{-1}(3.0 - 0.1k).$$

Conversely, suppose

$$G(P) = 3.0 - 0.1k.$$

If $P < 50$, then $G(P) = 5.0$, impossible. Hence $P \in [50, 100]$. Since the intervals $\{I_j\}_{j=0}^{20}$ partition $[50, 100]$, there exists a unique $j \in \{0, 1, \dots, 20\}$ such that $P \in I_j$. By Definition 4,

$$G(P) = 3.0 - 0.1j.$$

Therefore,

$$3.0 - 0.1j = 3.0 - 0.1k,$$

which implies $j = k$. Hence $P \in I_k$. So

$$G^{-1}(3.0 - 0.1k) \subseteq I_k.$$

Thus,

$$G^{-1}(3.0 - 0.1k) = I_k, k = 0, 1, \dots, 20.$$

This proves the proposition. $\square$

Proposition 2 establishes the measurement structure of the proposed model. Each official passing grade corresponds to exactly one raw-score interval of common width $\Delta = \frac{50}{21}$. Thus, the model avoids hidden widening or narrowing of selected grade bands within the passing region. In policy terms, each 0.1 step in the official passing-grade scale is supported by the same raw-score decision width. This makes the



assignment of official grades more transparent because the location and width of every passing cutoff interval are explicitly specified.

After establishing the image and interval structure of the proposed function, the next question is whether the model behaves consistently as raw performance increases. Since lower numerical grades represent better academic outcomes in the 5-point system examined here, consistency requires that a higher raw percentage should not result in a numerically worse official grade.

Theorem 1. Monotonicity of the Official Grading Function

Let

$$G: [0,100] \rightarrow \Omega$$

be the proposed equal-interval official grading function defined in Definition 4. Then G is monotone non-increasing on $[0, 100]$. That is, for any

$$P_1, P_2 \in [0,100], \\ P_1 \leq P_2 \Rightarrow G(P_1) \geq G(P_2).$$

Equivalently, if $P_1 < P_2$, then a student with a higher raw percentage score cannot receive a numerically worse official grade.

Proof

Let $P_1, P_2 \in [0,100]$ with $P_1 \leq P_2$. We show that

$$G(P_1) \geq G(P_2).$$

If $P_2 < 50$, then necessarily $P_1 < 50$ as well. Hence,

$$G(P_1) = G(P_2) = 5.0.$$

Now suppose $P_1 < 50 \leq P_2$. Then

$$G(P_1) = 5.0,$$

while $G(P_2) \in \Omega_{\text{pass}}$, so

$$G(P_2) \leq 3.0 < 5.0.$$

Therefore,

$$G(P_1) > G(P_2).$$

Finally, suppose $50 \leq P_1 \leq P_2 \leq 100$. Since the intervals

$$I_0, I_1, \dots, I_{20}$$

Partition $[50, 100]$, there exist unique indices

$$i, j \in \{0, 1, \dots, 20\}$$

such that

$$P_1 \in I_i, P_2 \in I_j.$$

Because the intervals are arranged from left to right and $P_1 \leq P_2$, one must have

$$i \leq j.$$

By Proposition 2,

$$G(P_1) = 3.0 - 0.1i, \quad G(P_2) = 3.0 - 0.1j.$$

Since $i \leq j$,

$$3.0 - 0.1i \geq 3.0 - 0.1j.$$

Hence,

$$G(P_1) \geq G(P_2).$$

All cases yield

$$P_1 \leq P_2 \Rightarrow G(P_1) \geq G(P_2).$$

Therefore, G is monotone non-increasing on $[0, 100]$. $\square$

Theorem 1 confirms that the proposed grading function is consistent with the direction of academic performance. A student with a higher raw percentage cannot receive a numerically worse official grade under the model. The theorem is stated as monotone non-increasing because lower numerical grades indicate better performance. The result is not strict because the model is interval-based which means that different raw scores within the same band legitimately receive the same official grade. This stepwise structure is expected in any discrete grading system and does not violate monotonicity.

The first three results establish the internal properties of the proposed grading model. The next result shifts the comparison to the 100-point percentage scale. Because LTS produces a transmuted percentage while the proposed model assigns an official grade, the comparison is made through the cutoff-equivalent percentage $C(P)$, which serves only as an analytical benchmark derived from the proposed equal-interval cutoff structure.

Theorem 2. Dominance of the Linear Transformation Scale over the Cutoff-Equivalent Percentage on the 100-Point Scale

Let

$$\ell(P) = 50 + 0.5P$$

be the Linear Transformation Scale defined in Definition 3 and let $C(P)$ be the cutoff-equivalent percentage defined in Definition 5. Then, for every

$$P \in [0, 100], \\ \ell(P) \geq C(P),$$

with equality if and only if

$$P = 100.$$

Equivalently, for every non-perfect raw percentage score $P < 100$,

[131]

$$\ell(P) > C(P).$$

Thus, on the 100-point scale, the Linear Transformation Scale always assigns a percentage that is at least as large as the cutoff-equivalent percentage under the proposed criterion-referenced model, and it assigns a strictly larger one for every non-perfect score.

Proof

Let $P \in [0,100]$. We first show that

$$C(P) \leq P.$$

If $0 \leq P < 50$, then by Definition 5,

$$C(P) = P.$$

If $50 \leq P < 100$, then

$$C(P) = 50 + \Delta \left\lfloor \frac{P - 50}{\Delta} \right\rfloor.$$

Since

$$\left\lfloor \frac{P - 50}{\Delta} \right\rfloor \leq \frac{P - 50}{\Delta},$$

it follows that

$$C(P) \leq 50 + \Delta \cdot \frac{P - 50}{\Delta} = P.$$

If $P = 100$, then by Definition 5,

$$C(100) = 100 = P.$$

Hence,

$$C(P) \leq P \text{ for all } P \in [0,100].$$

Next, by Definition 3,

$$\ell(P) = 50 + 0.5P,$$

so

$$\ell(P) - P = 50 + 0.5P - P = \frac{100 - P}{2}.$$

Therefore,

$$\ell(P) \geq P \text{ for all } P \in [0,100],$$

with equality if and only if $P = 100$. In particular,

$$P < 100 \Rightarrow \ell(P) > P.$$

Combining the two inequalities yields



$$\ell(P) - C(P) = (\ell(P) - P) + (P - C(P)) \geq 0,$$

and therefore

$$\ell(P) \geq C(P) \text{ for all } P \in [0,100].$$

Moreover, if $P < 100$, then $\ell(P) - P > 0$ and $P - C(P) \geq 0$, so

$$\ell(P) - C(P) > 0.$$

Hence,

$$\ell(P) > C(P) \text{ for all } P < 100.$$

Conversely, when $P = 100$,

$$\ell(100) = 100 = C(100).$$

Thus,

$$\ell(P) = C(P) \Leftrightarrow P = 100.$$

This proves the theorem. $\square$

Theorem 2 establishes the paper's main universal comparative result. The inequality $\ell(P) \geq C(P)$ means that the LTS-transmuted percentage is never lower than the cutoff-equivalent percentage implied by the proposed model. Moreover, the strict inequality for every $P < 100$ shows that the uplift is not accidental, sample-dependent, or limited to selected score ranges. It is a structural property of the LTS formula itself.

This result should be interpreted carefully. In some instructional contexts, grade adjustment or curving practices are used as compensatory responses to unexpectedly difficult assessments, problematic test items, or score distributions that appear inconsistent with intended assessment standards (Kulick & Wright, 2008; Mehvar, 2025). In that sense, LTS may appear pedagogically protective. However, Theorem 2 shows that LTS does not diagnose whether an assessment was too difficult or whether specific items were problematic; it systematically uplifts all non-perfect raw scores by construction. When used as a general grading rule, this structural uplift may weaken the transparency of the relationship between raw demonstrated performance and the reported percentage.

Thus Proposition 1, Proposition 2, and Theorem 1 establish the internal coherence of the proposed grading model which produces only admissible official grades, assigns passing grades through equal-width raw-score intervals, and preserves the correct direction of performance through monotonicity. Theorem 2 then supplies the main comparative result by showing that LTS systematically produces a transmuted percentage at least as large as the cutoff-equivalent benchmark, with strict uplift for every non-perfect score. Thus, the formal results move from internal model validity to external comparison with LTS, preparing the institutional illustration that follows.

The next section does not extend this result as a universal theorem on official transcript grades. Instead, it examines how the percentage-scale uplift established in Theorem 2 may translate into official-grade distortion under a particular institutional equivalency schedule.

Institutional Illustration of Official-Grade Distortion under an Existing LTS Equivalency Scheme

The preceding results establish the general mathematical framework of the proposed model and the paper's universal percentage-scale comparison with the Linear Transformation Scale (LTS). In particular, Theorem 2 shows that the LTS transmuted percentage is always at least as large as the cutoff-equivalent percentage under the proposed model, with strict inequality for every non-perfect raw score. That result, however, does not by itself determine the official transcript grade, because official grades under LTS-based systems depend on an additional institutional conversion rule.

In practice, institutions that use LTS do not stop at the transmuted percentage. After the transmuted score is obtained, an additional equivalency schedule is used to convert that score into the official 5-point transcript grade. Since such schedules may vary across institutions, any claim about official-grade distortion must be treated as institution-specific rather than universal. For this reason, the present subsection does not extend the core theory by another universal theorem. Instead, it provides an institutional illustration from a Philippine higher education context showing how the universal percentage-scale uplift established in Theorem 2 may be transmitted into official-grade outcomes under a particular equivalency schedule.

Let

$$\ell(P) = 50 + 0.5P$$

denote the LTS transmuted percentage corresponding to raw percentage score P . Let R denote the institutional rule used to convert the transmuted percentage into the integer value recognized by the official equivalency table, and let

$$\phi_{\text{inst}}$$

denote the institution's mapping from that integer transmuted value to the official 5-point grade. The official grade produced by the institutional LTS pathway may therefore be written as

$$H_{\text{inst}}(P) = \phi_{\text{inst}}(R(\ell(P))).$$

By contrast, the proposed model assigns official grade directly from raw percentage through the criterion-referenced cutoff function $G(P)$. The relevant institutional comparison in this subsection is therefore between $H_{\text{inst}}(P)$ and $G(P)$ over the same raw-score domain.

This distinction is important because the institutional equivalency table is not a consequence of linear interpolation itself. In the passing region, the integer LTS transmuted grades run from 75 to 100, yielding 26 distinct passing values. However, the official passing grades on the 5-point scale consist only of

$$3.0, 2.9, 2.8, \dots, 1.0,$$

which yields 21 admissible passing categories. Hence, a one-to-one correspondence between integer transmuted passing values and official passing grades is mathematically impossible: at least five transmuted values must be merged into already existing official grade categories. The exact locations of those merged categories are not dictated by the LTS formula itself, but by the institution's chosen equivalency schedule. Consequently, the official grade-equivalency scheme is better understood as a nonuniform discretization of the transmuted scale than as an equal-interval measurement scale.



Table 1 *A Particular Institutional Equivalency Schedule from Integer LTS Transmuted Grades to Official 5-Point Grades*

LTS Transmuted Grade	5-point Grade Equivalent
100	1.0
99	1.0
98	1.1
97	1.2
96	1.3
94-95	1.4
92-93	1.5
90-91	1.6
88-89	1.7
87	1.8
86	1.9
85	2.0
84	2.1
83	2.2
82	2.3
81	2.4
80	2.5
79	2.6
78	2.7
77	2.8
76	2.9
75	3.0
74 and below	5.0 (<i>Failed</i>)

Note. Table 1 presents a particular institutional equivalency schedule used in Philippine higher education setting. It is used here only for institutional illustration and does not form part of the paper's universal theory.

Table 1 records one such institutional equivalency schedule. As the table shows, some official grades correspond to a single integer transmuted value, whereas others correspond to two consecutive transmuted values. For example, the highest official grade 1.0 is assigned to both 99 and 100, while 1.4, 1.5, 1.6, and 1.7 each absorb two adjacent transmuted values. These merged categories occur because 26 integer transmuted passing values must be allocated across only 21 official passing grades. Thus, selected official grades necessarily absorb more than one adjacent transmuted value. This pattern is not a mathematical consequence of the linear transmutation formula; it is a feature of the institutional conversion schedule adopted after transmutation.

Under this institutional perspective, official-grade distortion arises from a double-mapping process, that is, raw performance is first uplifted through LTS on the 100-point scale and is then compressed through a nonuniform institutional equivalency table into the official 5-point scale. The proposed model avoids this double mapping by assigning official grades directly from raw performance through equal-width criterion-referenced cutoffs. The institutional comparison that follows therefore serves to illustrate how the universal uplift proved in Theorem 2 may, under an actual equivalency schedule, translate into more favorable official grades than those assigned by the direct cutoff model.

Comparative Pattern under the Institutional Illustration

Once the institutional map is fixed, the comparison between the existing LTS pathway and the proposed direct cutoff model can be evaluated pointwise over the admissible raw-score range. In this

institutional illustration, R denotes rounding to the nearest integer, with half-values rounded upward, before the equivalency table is applied. Thus,

$$H_{\text{inst}}(P) = \phi_{\text{inst}}(R(\ell(P)))$$

is compared with the direct cutoff grade $G(P)$ for each integer raw percentage P from 50 to 100. The difference

$$G(P) - H_{\text{inst}}(P)$$

is used to describe the direction and magnitude of official-grade distortion. Since smaller numerical grades are more favorable in the 5-point system, a positive value of $G(P) - H_{\text{inst}}(P)$ means that the institutional LTS pathway assigns a more favorable official grade than the proposed direct cutoff model.

Table 2 Summary of Pointwise Official-Grades Differences under the Institutional LTS Pathway and the Proposed Direct Cutoff Model

Difference $G(P) - H_{\text{inst}}(P)$	Raw Percentage (P)	Number of Cases	Interpretation
0.0	50, 86, 89–94, 96, 98–100	12	Same official grade under both systems
0.1	51–56, 58, 60, 62, 81–82, 84–85, 87–88, 95, 97	17	LTS pathway is more favorable by 0.1 grade point
0.2	57, 59, 61, 63–68, 70, 72, 74, 77–80, 83	17	LTS pathway is more favorable by 0.2 grade point
0.3	69, 71, 73, 75–76	5	LTS pathway is more favorable by 0.3 grade point

Note. The comparison covers all integer raw percentages from 50 to 100 under the equivalency schedule shown in Table 1 and the rounding rule R . Positive differences indicate that the institutional LTS pathway assigns a numerically lower, and therefore more favorable, official grade.

Table 2 summarizes the full pointwise comparison across the integer passing range. Across the 51 integer raw percentages from 50 to 100, the institutional LTS pathway yields the same official grade as the proposed model in 12 cases and a more favorable official grade in 39 cases. No case in this institutional illustration produces a less favorable official grade under the LTS pathway than under the proposed direct cutoff model. The favorable difference is 0.1 grade point in 17 cases, 0.2 grade point in 17 cases, and 0.3 grade point in 5 cases.

The maximum observed difference is 0.3 grade point, occurring at raw percentages $P = 69, 71, 73, 75$, and 76. These score points fall in the middle-to-lower portion of the passing range, where the upward shift created by LTS interacts with the nonuniform equivalency table in a way that moves the student into a more favorable official-grade category. This pattern shows that the distortion is not evenly distributed across the scale. It is absorbed at some score points, especially in the upper range where both systems already approach the best official grades, but it becomes more visible in selected middle and lower passing zones where transmutation and table compression reinforce one another.

The comparison also clarifies why the institutional LTS pathway can be more favorable even when the official equivalency table itself is not part of the LTS formula. The first layer of the pathway, $\ell(P) = 50 + 0.5P$, raises the raw percentage into the 50–100 scale. The second layer, $\phi_{\text{inst}}(R(\ell(P)))$, converts the rounded transmuted value into the official grade. Because the equivalency schedule is compressed and nonuniform, some raw-score locations receive a larger official-grade advantage than others. Thus, official-grade distortion arises from the interaction between percentage-scale uplift and policy-determined transcript-grade conversion.

The institutional consequences of this pattern are important. If the LTS pathway consistently assigns the same or more favorable grades than a direct cutoff model, then cumulative GPA, scholarship retention,



graduation honors, and academic progression decisions may be affected by the conversion rule, not only by raw academic performance. The pattern may also influence student motivation by making the final official grade less directly traceable to demonstrated achievement. These consequences are not claimed here as empirical outcomes across all institutions; rather, they indicate why institutions using LTS-based pathways should audit their equivalency schedules and examine whether final transcript grades remain faithful to raw performance standards.

Thus, this institutional illustration should not be read as proving a new universal theorem. What it demonstrates is that, under the particular equivalency schedule examined here, official-grade distortion arises not from linear transmutation alone but from the interaction between percentage-scale uplift and nonuniform transcript-grade conversion. This is precisely the double-mapping mechanism that the proposed direct cutoff model avoids by assigning official grades directly from raw performance through equal-width criterion-referenced intervals.

Conclusion and Policy Implications

This paper developed a standardized equal-interval criterion-referenced grading model that assigns official grades directly from raw percentage performance through fixed cutoff intervals on the institutional 5-point scale. Unlike transmutation-based approaches, the proposed model preserves a direct and transparent relationship between demonstrated performance and recorded official grade. The mathematical development established the model's key formal properties, namely, the discreteness of the official grade set, the equal-interval structure of the passing region, and the monotonicity of the grading function with respect to raw performance. The paper also proved a universal comparative result on the 100-point scale: relative to the cutoff-equivalent percentage implied by the proposed model, the Linear Transformation Scale (LTS) always yields an equal or higher transmuted percentage, with strict uplift for every non-perfect raw score. The institutional illustration then showed how this percentage-scale uplift may translate into more favorable official grades under a particular equivalency schedule, while remaining an institution-specific rather than universal result.

The analysis also clarifies that the difficulty with LTS-based reporting is not confined to the linear transmutation formula alone. In institutional settings where the transmuted percentage is subsequently converted into an official 5-point transcript grade, the final reported outcome is produced through a double-mapping process. Raw performance is first transformed upward through LTS on the 100-point scale and is then compressed through an institutional equivalency schedule into the official grade scale. Under such a system, the final transcript grade is shaped not only by student performance but also by the design of the intermediate transmutation rule and the structure of the institutional conversion table. The institutional illustration showed that this second layer is not a mathematical necessity of linear interpolation itself; rather, it is a policy choice governing how transmuted values are merged into discrete official grades.

From a policy perspective, the proposed model should not be treated simply as a replacement formula to be adopted without institutional review. Grading systems are embedded in historical records, faculty practices, student progression rules, scholarship requirements, and honors policies. For this reason, institutions considering a shift away from LTS may first conduct a grade-policy audit. Such an audit may include reviewing existing equivalency schedules, applying the proposed direct cutoff model to historical grade records, and comparing the resulting effects on pass rates, grade distributions, cumulative GPA, scholarship retention, and honors eligibility. A parallel run of the proposed model with the existing grading system over one semester or across archived datasets would allow registrars, academic councils, and quality assurance units to evaluate the practical consequences of the reform before formal implementation.

The removal of transmutation may also have consequences for student retention and institutional pass rates, especially in courses where assessments are unusually difficult, poorly calibrated, or inconsistently constructed. Therefore, a direct cutoff-based grading policy should be accompanied by faculty support in assessment design. This includes reviewing test difficulty, improving item quality, strengthening rubric construction, aligning assessment tasks with intended learning outcomes, and using moderation procedures where appropriate. In this way, the proposed model does not require institutions to ignore legitimate concerns about assessment difficulty. Rather, it shifts the response from post hoc score inflation to stronger assessment design and more transparent grading standards.



The proposed model is also relevant to quality assurance and accreditation. Since official grades are used as evidence of academic achievement, grading policies should be auditable, interpretable, and defensible. A direct equal-interval cutoff structure provides a clearer basis for explaining how raw performance becomes an official transcript grade. Quality assurance offices, curriculum committees, and accrediting bodies may therefore use the model as a framework for examining whether institutional grading systems preserve grade integrity, support comparability, and avoid unnecessary layers of transformation between student performance and official reporting.

The model is directly applicable to institutions using a comparable discrete 5-point scale, a 50% passing threshold, and 0.1-increment passing grades from 3.0 to 1.0. However, the general construction is not limited to this exact configuration. Institutions using different passing thresholds or official grade sets may recalibrate the interval width and grade categories while preserving the same principle: official grades should be assigned through explicit, criterion-referenced, and equal-interval cutoffs rather than through opaque transmutation pathways. The contribution of the paper, therefore, is not only the specific function developed here but also the broader analytic argument that grading policies should be formally examined before they are used to produce official academic records.

Hence, these results support the view that institutional grading systems should be evaluated not only for administrative convenience or historical familiarity but also for scale integrity, interpretability, and fidelity to raw academic performance. Reforming grade computation is therefore a matter of academic integrity and policy coherence. A grading model that assigns official grades directly from raw performance through explicit equal-width criterion-referenced cutoffs offers a more transparent and mathematically defensible alternative to transmutation-based grading systems.

Scope and Limitations

The theoretical results of this study apply universally only to the comparison between the proposed direct cutoff model and the Linear Transformation Scale on the 100-point percentage scale. In particular, Theorem 2 establishes a deductive result about the relationship between the LTS-transmuted percentage and the cutoff-equivalent percentage implied by the proposed model. By contrast, the official-grade comparison developed in the institutional illustration depends on a particular institutional equivalency schedule and on the rounding or integer-conversion rule applied before transcript-grade conversion. Accordingly, that part of the analysis should be interpreted as an applied institutional illustration rather than as a universal theorem about all 5-point grading systems.

Different institutions may adopt different official grade sets, equivalency schedules, cutoff structures, or rounding conventions. These policy choices may affect the exact pattern of official-grade outcomes under an LTS-based pathway. For this reason, the present paper does not claim that every institutional implementation of LTS will produce identical transcript-grade effects. Rather, it shows that once a percentage-scale uplift is combined with a nonuniform institutional conversion rule, official-grade distortion may arise in institution-specific ways.

The proposed model also assumes that a final raw percentage score has already been validly computed from the course assessment system. Thus, the model does not by itself determine the quality of test construction, the appropriateness of item difficulty, the reliability of scoring, or the alignment of assessment tasks with intended learning outcomes. If the raw percentage is weakly constructed, no grading conversion model can fully correct that weakness. The proposed model should therefore be understood as a grading-policy model applied after assessment evidence has already been scored and summarized, not as a substitute for sound assessment design.

The model likewise does not prescribe how institutions should weight quizzes, examinations, projects, performance tasks, laboratory work, or other course components. It also does not directly model partial-credit scoring or qualitative and rubric-based judgments before these are converted into a final raw percentage. These matters belong to course-level assessment design. Once those components are validly aggregated into a final raw percentage, however, the proposed model provides a transparent rule for assigning the official grade directly from that performance measure.

Because the proposed grading function is interval-based, students whose raw percentages fall within the same interval receive the same official grade even if their exact raw scores differ. This is not unique to the proposed model; it is a feature of any discrete grading system that reports achievement through a finite set of grade categories. The contribution of the proposed model is that the interval boundaries are explicit,



equal in width within the passing region, and tied directly to raw performance rather than being indirectly reshaped through a transmutation pathway.

The present study does not include empirical testing using individual student records because its primary contribution is formal and analytical: it defines the proposed grading function, proves its mathematical properties, and compares it deductively with LTS. The absence of student-record analysis does not weaken the deductive results, which follow from the definitions of the functions. However, empirical application using archived institutional grade records would be valuable as a subsequent policy-validation study, particularly for examining changes in GPA distributions, pass rates, scholarship eligibility, retention indicators, and honors classifications under actual institutional conditions.

Future work may extend the present analysis by examining multiple institutional equivalency schedules, comparing alternative rounding conventions, and testing the proposed model against actual institutional grading records. Such extensions would strengthen the comparative policy analysis, but they do not alter the paper's central conclusion: a grading model that assigns official grades directly from raw performance through explicit equal-width criterion-referenced cutoffs provides a more transparent and mathematically defensible alternative to transmutation-based grading systems.

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