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## Optimizing university enrollment confirmation timelines: A survival analysis of student decision-making in Mongolia

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### Abstract

This study investigates the optimal timeline for university enrollment confirmation using survival analysis, focusing on behavioral data from the National University of Mongolia (hereinafter NUM). As higher education institutions streamline operations and competition intensifies, the timing of student decisions becomes increasingly critical. Applying the Cox proportional hazards model to multi-year administrative data, we find that approximately 90% of confirmations occur within the first 600–700 minutes of the registration window. Factors such as program type, institutional affiliation, entrance scores, and regional origin significantly influence confirmation timing. These findings suggest that an 11-hour confirmation period balances logistical efficiency with student decision-making needs. The results align with theories of bounded rationality and decision overload, offering a novel empirical basis for policy reform in developing higher education systems.

**Keywords:** Enrollment confirmation deadlines, Higher education admissions strategyx, Student decision-making behavior, Survival analysis in education, University enrollment timing.

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**Transparency:** The authors confirm that the manuscript is an honest, accurate, and transparent account of the study; that no vital features of the study have been omitted; and that any discrepancies from the study as planned have been explained. This study followed all ethical practices during writing.

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### 1. Introduction

Over the past decade, Mongolia's labor market has experienced marked improvements, evidenced by a steady decline in the national unemployment rate—from 7.7% in the fourth quarter of 2014 to 3.9% in the same quarter of 2023. These shifts reflect a growing demand for a skilled workforce and place new pressures on the higher education sector to align

more closely with labor market dynamics. As a result, access to quality higher education has become increasingly consequential—not only for individual career trajectories but also for national economic competitiveness [1].

Parallel to these labor market trends, Mongolia's higher education landscape has undergone structural consolidation. Since 2005, the number of higher education institutions has declined significantly, from over 100 to just 64 by 2024. While this contraction has been largely driven by quality assurance reforms instituted by the Ministry of Education and Science, it has also intensified competition for university placements. In this context, the enrollment and registration confirmation processes have become critical decision points that shape students' access to academic pathways and long-term opportunities.

Despite the importance of admissions timelines, little empirical research has been conducted in Mongolia—or in many comparable developing contexts—on how institutional scheduling policies affect student behavior. Internationally, studies have highlighted the role of admissions deadlines and early decision schemes in influencing student choice, commitment, and institutional yield. Yet, most of this work has focused on U.S. or European systems, with limited application to more centralized or state-regulated systems like Mongolia's.

To address this gap, the present study draws on actual admissions data from the NUM to empirically estimate the optimal confirmation period. Specifically, the study applies survival analysis and Cox proportional hazards modeling to identify (a) the time range within which most students confirm their enrollment and (b) the factors that influence earlier or later confirmation decisions. This study makes several contributions.

- First, it provides the first survival-model-based estimate of registration behavior in a developing country higher education system.
- Second, it offers policy-relevant insights into how admission procedures can be redesigned to improve both equity and efficiency.
- Third, it introduces a replicable, data-driven approach for admissions optimization that can be extended to other universities in similar policy environments.

### *1.1. Literature Review*

The decision to enroll in a particular university and academic program is among the most consequential choices in a student's educational trajectory. A robust body of research has explored this process, highlighting its dependence on cognitive, psychological, and informational factors. As Gati and Asher [2] and Germeijs, et al. [3] argue, students' decision-making is not merely a rational matching process but a complex interplay of uncertainty, informational access, self-efficacy, and perceived academic fit [2, 3]. Decision-making profiles vary widely based on students' readiness, background, and the structure of opportunities presented to them. In competitive higher education environments, such as Mongolia's increasingly consolidated university sector, these dynamics are further intensified. While recent reforms have reduced the number of higher education institutions—from over 100 to 64 in less than two decades—there is limited understanding of how this structural tightening interacts with admissions-related behaviors, particularly the timing of enrollment confirmation.

Time constraints play a critical role in shaping enrollment outcomes. Studies conducted in North America and Europe have demonstrated that admission deadlines and early decision schemes can meaningfully affect when and whether students commit to an institution. Avery, et al. [4] for instance, found that early admissions policies allow universities to attract high-performing applicants by incentivizing quicker decision-making [4]. However, such mechanisms may also inadvertently disadvantage students who require more time to evaluate offers or secure financial aid. More broadly, research in behavioral economics has emphasized that while deadlines can enhance productivity, overly compressed timelines may impair decision quality. Ariely and Wertenbroch [5] noted that under time pressure, individuals often resort to heuristics or rushed choices, which can lead to suboptimal outcomes [5]. These concerns are particularly salient in post-secondary decision-making contexts, where students are often making high-stakes choices under conditions of incomplete information and varying levels of support.

Despite the theoretical richness of these behavioral insights, most higher education institutions in developing countries continue to design admissions procedures based on static administrative calendars, rather than student-centered evidence. The registration confirmation period—the window of time within which a student must finalize their intent to enroll—remains largely unexamined from an empirical perspective. In the case of Mongolia, registration windows vary significantly between universities, ranging from just over a week to nearly a month, often without any formal evaluation of whether these durations align with student decision-making patterns. This absence of data-driven guidance presents a missed opportunity for both policy improvement and institutional planning.

While traditional studies on admissions behavior tend to rely on cross-sectional surveys or retrospective interviews, more recent methodological advancements have opened up new possibilities for analyzing time-sensitive behaviors. Survival analysis, and particularly the Cox proportional hazards model, has been increasingly applied in higher education research to examine student dropout [6] time-to-degree completion, and persistence trends. These techniques allow for the modeling of event timing—such as the point at which a student confirms enrollment—while accounting for censoring and covariate effects. Despite their growing use in the study of retention and graduation, survival models have not yet been widely utilized to analyze the timing of initial enrollment confirmations, particularly in non-Western systems. This represents both a methodological gap and a substantive one.

Bringing together these strands of research, it becomes evident that enrollment confirmation behavior is shaped by an interaction of institutional structures—such as the duration and design of registration windows—and student-level characteristics, including program type, regional background, and entrance exam performance. However, few studies to

date have integrated behavioral theory with survival modeling to evaluate these processes in real-world admissions data. The present study addresses this critical gap by applying time-to-event analysis to identify the optimal confirmation window for university enrollment in Mongolia, providing not only empirical insights but also actionable implications for higher education policy and institutional design.

### 1.2. Research Methodology

This study adopts a quantitative research design, grounded in event history analysis, to examine the timing of university enrollment confirmation among newly admitted students. Specifically, the research applies survival analysis using the Cox proportional hazards model, which is well-suited for analyzing time-to-event data in the presence of censored observations. This method allows for a nuanced investigation of when students confirm their enrollment and the factors associated with earlier or delayed decisions [7].

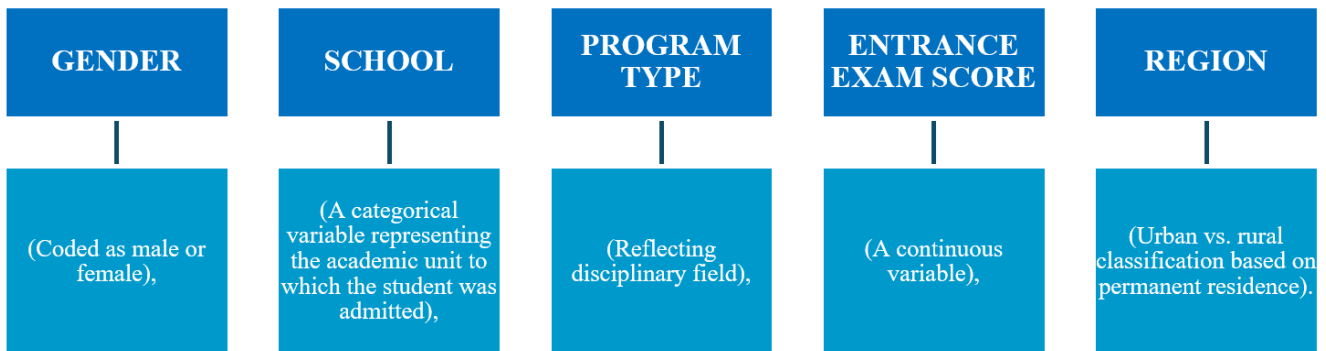
#### 1.2.1. Data Source and Context

The empirical data were obtained from the Admissions Office of the NUM and encompass multiple admission cycles over recent academic years. The dataset includes student-level records that reflect actual behavioral outcomes rather than self-reported intentions. For each admitted student, the data capture the timestamp of enrollment confirmation, the total duration of the registration window, and whether the student ultimately confirmed their admission. Additional demographic and institutional variables were also included, such as gender, region of origin (urban vs. rural), entrance exam score, academic program, and the school or faculty to which the student was admitted.

All data were anonymized and processed in compliance with NUM’s data-sharing agreement and ethical research protocols. Because the dataset involved administrative, non-intervention-based records and no personally identifiable information was used, formal IRB approval was not required under institutional guidelines. However, all analysis was conducted in a manner consistent with principles of responsible data use in higher education research.

#### 1.2.2. Variables and Operational Definitions

The primary outcome variable was the time to enrollment confirmation, defined as the number of minutes elapsed from the opening of the registration window until the student completed their confirmation. Students who did not confirm within the available time were treated as right-censored observations, a standard approach in survival analysis.



**Figure 1.**  
The key independent variables included.

These variables were selected based on their theoretical relevance in prior studies of enrollment behavior and institutional choice Figure 1.

#### 1.2.3. Analytical Strategy

The analysis proceeded in two stages. First, Kaplan-Meier survival curves were generated to visually explore the distribution of confirmation times across the student population. This non-parametric method provided initial insights into when most confirmations occurred and whether timing differed across key groups.

Second, the Cox proportional hazards model was estimated to examine the relationship between student/institutional characteristics and the hazard of confirming enrollment. The model does not require the specification of a baseline hazard function, making it flexible for application in settings where the underlying time distribution is unknown or not easily defined. The proportional hazards assumption was tested and satisfied for all covariates included.

The hazard ratios (HRs) produced by the Cox model were interpreted as the relative likelihood of earlier confirmation. For example, an HR greater than 1 indicated a higher likelihood of confirming sooner, while an HR less than 1 indicated a delay, controlling for other variables in the model. Statistical significance was assessed at the conventional 5% level ( $p < .05$ ), and 95% confidence intervals were reported for all estimates.

Together, this methodological approach enables a data-driven, behaviorally sensitive analysis of university registration timelines—offering actionable insights for institutional planning and policy design in the Mongolian higher education sector.

## 2. Empirical Results

The Cox proportional hazards model was employed to examine the timing of university enrollment confirmation and the influence of student- and institution-level characteristics. The model yielded several statistically significant predictors, summarized in Table 1.

The analysis revealed that gender had no statistically significant effect on the timing of enrollment confirmation ( $p = .417$ ), suggesting that male and female students completed the process at similar rates. In contrast, the school to which students were admitted was a significant predictor of confirmation timing ( $HR = 1.073$ ,  $p < .01$ ), indicating that institutional differences—such as administrative procedures, program structures, or communication practices—played a meaningful role in shaping when students confirmed their registration.

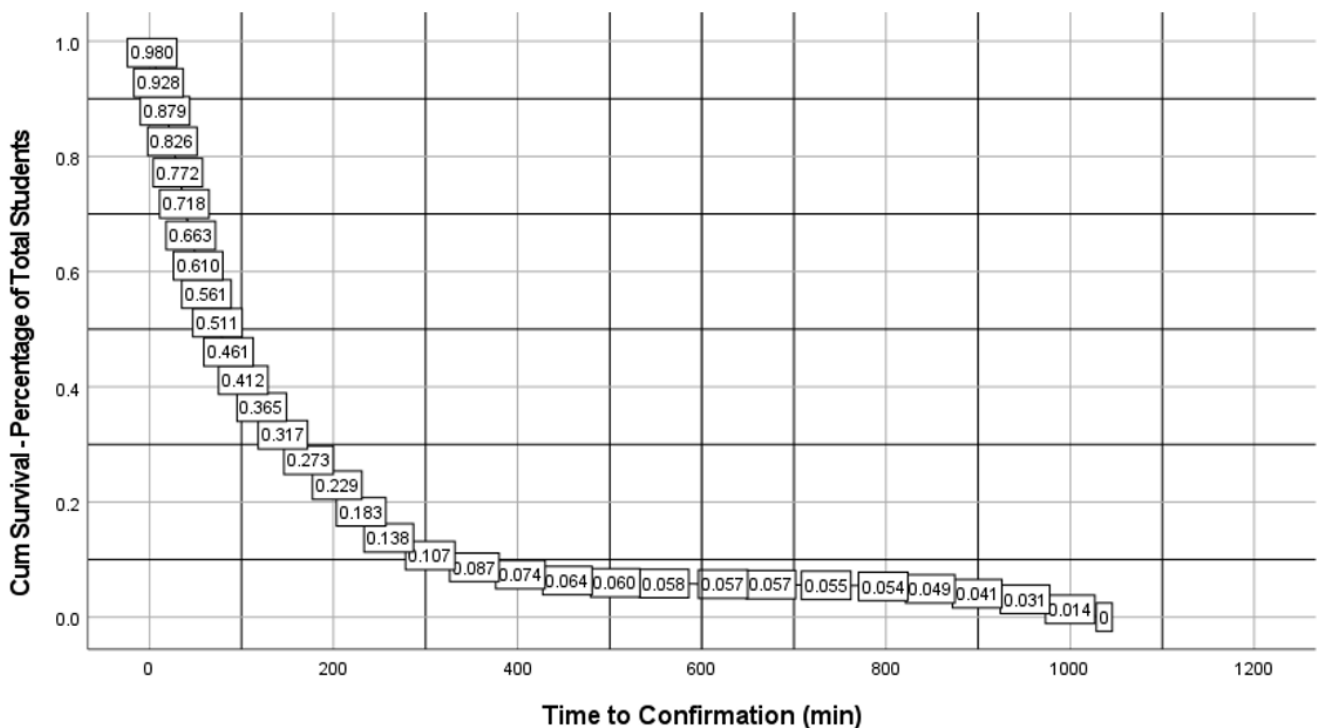
The academic program variable was also statistically significant ( $HR = 0.953$ ,  $p < .05$ ), suggesting that students in certain fields confirmed earlier than others. Entrance exam scores had a small but significant effect ( $HR = 1.002$ ,  $p < .05$ ), indicating that higher-scoring students were marginally more likely to confirm early. Finally, regional origin showed a notable effect, with urban students confirming more quickly than their rural counterparts ( $HR = 1.090$ ,  $p < .05$ ), highlighting geographic disparities in decision-making behaviors.

**Table 1.**  
Cox Proportional Hazards Regression Results.

Variable	beta	SE	Wald	p-value	HR	95% CI (Lower–Upper)
Gender	-0.034	0.042	0.658	0.417	0.967	0.891–1.051
School	0.071	0.027	6.913	0.009	1.073	1.018–1.130
Program	-0.048	0.019	6.137	0.013	0.953	0.918–0.989
Score	0.002	0.001	5.412	0.02	1.002	1.000–1.004
Region	0.086	0.034	6.463	0.011	1.09	1.020–1.165

To complement the Cox model, a Kaplan-Meier survival curve was generated to visualize the distribution of confirmation times. The curve shows that approximately 50% of students confirmed within the first 100 to 200 minutes. Confirmation activity intensified between 400 and 600 minutes, during which nearly 90% of students completed the process. After 800 minutes, fewer than 7% remained unconfirmed, and by 1,000 minutes, nearly all students had finalized their decisions Figure 2.

These results suggest that a registration confirmation window of 600 to 700 minutes (10–12 hours) effectively accommodates the majority of students, with little added benefit beyond this range.



**Figure 2.**  
Survival Function - Duration to Confirmation and Cumulative Percentage of Students.

The next section analyzes the 6,167 accesses to the NUM's admissions database based on the sample survey data. The distribution of access times and program confirmation times during the study period is shown in the following table, grouped in 60-minute or one-hour increments (Table 2).

**Table 2.**

The frequency of groups corresponding to each admission period and the average duration.

<b>Time Interval</b>	<b>Frequency</b>	<b>Avarage duration</b>
1-60	2655	29.90
61-120	1245	86.27
121-180	654	147.70
181-240	589	212.41
241-300	352	263.47
301-360	146	325.85
361-420	97	391.40
421-480	55	445.22
481-540	9	502.56
541-600	8	562.13
601-660	6	627.67
661-720	6	692.7
721-780	11	756.18
781-840	28	813.9285714
841-900	54	871.7037037
901-960	83	935.8192771
961-1020	149	994.2751678
1021-1080	20	1029.5
<b>Total</b>	<b>6167</b>	<b>154.5</b>

Since the verification time is likely to be exponentially distributed, a test was carried out to confirm this assumption (Figure 3 & 4).

```

data=scan(text=data.xlsx)

hist(data)

> hist(data,freq=F)

> curve(dexp(x,mean(data)),add=TRUE)

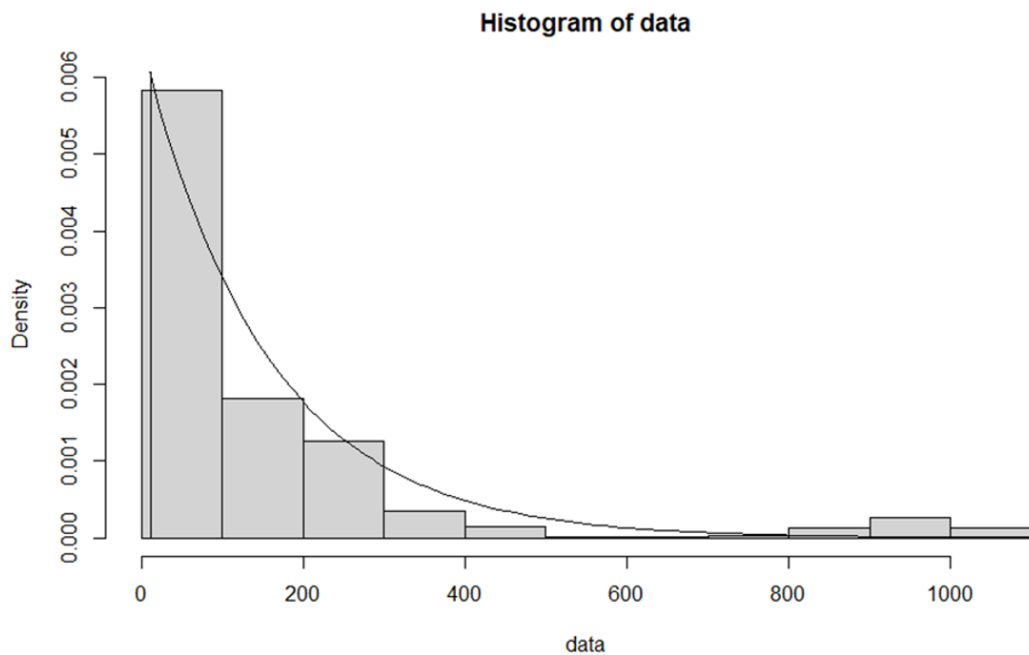
> curve(dexp(x,1/mean(data)),add=TRUE)

> sum(data >600)/length(data) data=scan(text=data.xlsx)
hist(data)
> hist(data,freq=F)
> curve(dexp(x,mean(data)),add=TRUE)
> curve(dexp(x,1/mean(data)),add=TRUE)
> sum(data >600)/length(data)

```

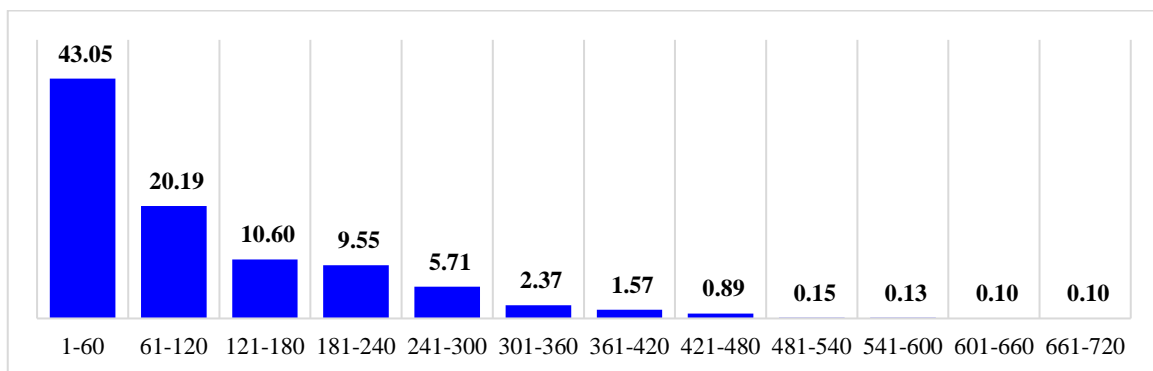
**Figure 3.**

The code written in R programming language (with Figure 4).



**Figure 4.**  
Distribution of admission confirmations for graduates registered at NUM.

The above distribution results show that 94.8 percent of the time it takes for enrollees in the study to confirm their registration is within 12 hours, or less than 720 minutes (Figure 4).



**Figure 5.**  
National University of Mongolia Admission Confirmation - Percentage of Students.

When analyzing the time taken by applicants to confirm their admission, which is 12 hours or 720 minutes, 43 percent of applicants spend 1-60 minutes confirming their admission, and 63.23 percent of applicants spend 1-120 minutes confirming their admission, indicating that most applicants confirm their admission within 2 hours (Figure 5).

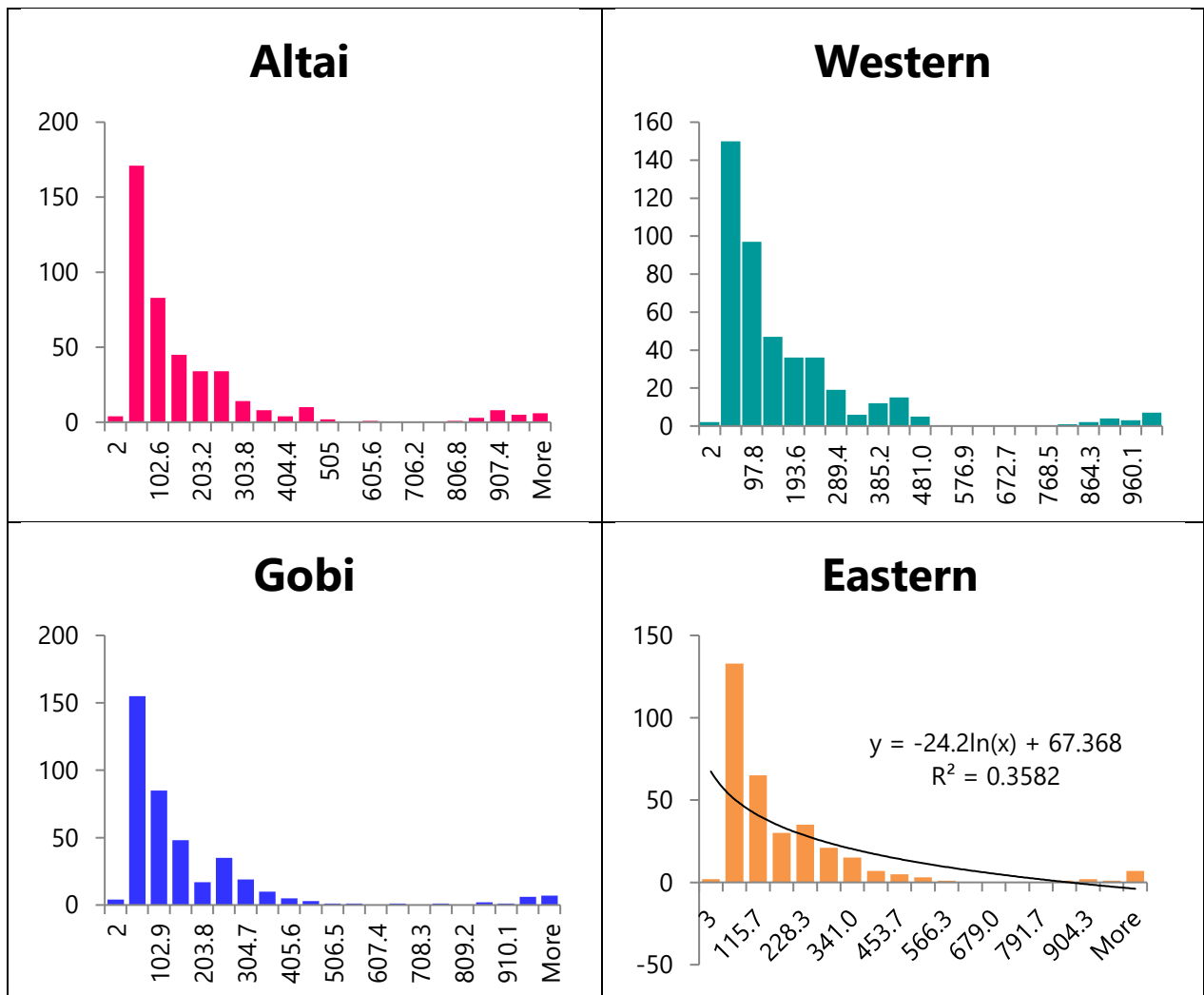
The tail of the exponential function, or the remaining 5 percent or 357 applicants, was influenced by other factors in some way. For example, double-registering for another school may have created a second choice and delayed the confirmation time. Therefore, it is possible to focus on these applicants and conduct a study to determine the reasons for their slow decision-making.

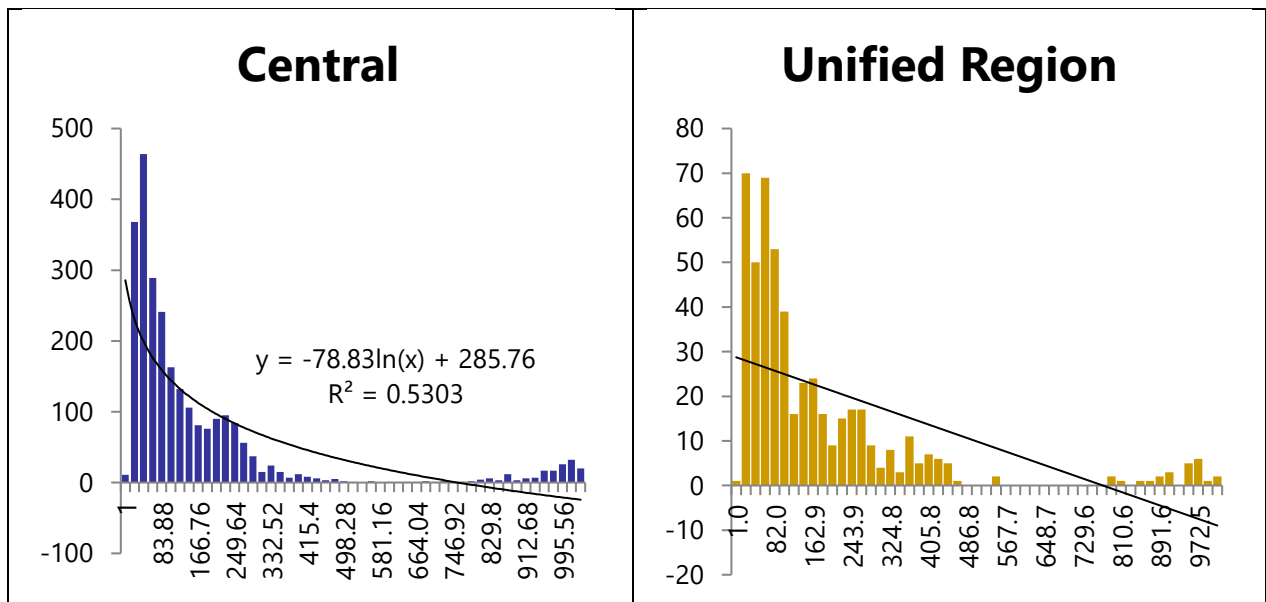
In accordance with Mongolia’s Long-Term Development Policy “Vision-2050”, the government introduced a redefined system of territorial development that groups provinces into new regional clusters, namely the Altai Region, Western Region, Gobi Region, Eastern Region, Central Region, and Khangai Region, along with a Unified Region that reflects broader integration objectives [8]. This restructuring aims to promote balanced socio-economic development, reduce disparities, and create region-specific opportunities.

Responding to this national policy shift, the NUM has revised its admission framework to align with the newly established regions. Since the reform, student admissions have been categorized according to these regional clusters, including the Unified Region for supplementary admissions. By doing so, NUM not only ensures that its enrollment policy reflects the country’s long-term development vision but also demonstrates its institutional commitment to advancing regional equity in access to higher education. This alignment reinforces the university’s role as a key partner in implementing the goals of Vision-2050, particularly in fostering human capital development across all regions of Mongolia. When the study is conducted regionally and combined for analysis, the following results are obtained (Table 3).

**Table 3.**  
Time until verification (across regions).

<b>TIME TO VERIFICATION (MIN)</b>					
<b>REGION</b>	<b>2022 Fall</b>	<b>2022 Spring</b>	<b>2023 Fall</b>	<b>2023 Spring</b>	<b>Total</b>
Altai Region	220		213		433
Western Region	273		169		442
Gobi Region	214		187		401
Eastern Region	158		170		328
Unified Region		61	333	110	504
Unified Region (Supplementary Admission)			221		221
Central Region	1265		1294		2559
Khangai Region	732		547		1279
<b>Total</b>	<b>2862</b>	<b>61</b>	<b>3134</b>	<b>110</b>	<b>6167</b>





**Figure 6.**  
Distribution of the Verification Time for Admissions by Region.

The distribution of enrollment confirmations across regions is similar, as can be seen from the figures above (Figure 6).

Therefore, in general, it is confirmed that about 95% of enrollees confirm their enrollment within the first 720 minutes or 12 hours. Also, 63.23% of enrollees spend 1-120 minutes, which means that most enrollees confirm their enrollment within 2 hours.

### 3. Discussion

While this study focuses on the National University of Mongolia (NUM), its implications are applicable to the broader landscape of public universities in Mongolia, which share similar administrative processes and student demographics. Moreover, the methodology used—survival analysis of behavioral confirmation data—offers a scalable approach that can be replicated across institutions to inform system-wide policy improvements.

The findings of this study align with key principles from decision-making theory, particularly bounded rationality and temporal discounting. Students operate under constraints of limited information and time, often resulting in satisficing rather than optimizing behaviors [9]. The observed early confirmations align with temporal discounting theory, where immediate action is favored over delayed decisions due to perceived value depreciation over time. Additionally, the variation in confirmation behavior across program types and regions reflects the influence of contextual decision load and access disparities, highlighting choice overload in densely competitive admissions scenarios [10].

This study set out to identify the optimal duration for university enrollment confirmation using a survival analysis approach, applied to real-time administrative data from the NUM. The results reveal that a registration confirmation window of approximately 600 to 700 minutes—or roughly 10 to 12 hours—is sufficient to accommodate the vast majority of student confirmations. Beyond this threshold, the confirmation rate plateaus, suggesting that extending the registration window further yields limited additional engagement.

These findings have both practical and theoretical implications. From a behavioral perspective, the clustering of confirmations within a specific time frame supports prior research on decision-making under temporal constraints [5]. The data suggest that most students tend to act promptly when given a clear window, particularly when the registration period is neither overly compressed nor excessively long. This aligns with literature emphasizing the importance of structured deadlines in reducing decision fatigue while still allowing for meaningful deliberation [11].

Moreover, the Cox regression analysis revealed significant variation in confirmation behavior based on school affiliation, academic program, entrance exam score, and region of origin. Students admitted to certain faculties confirmed significantly earlier than others, suggesting institutional or disciplinary differences in communication, orientation, or perceived program prestige. Similarly, higher entrance exam scores were modestly but positively associated with earlier confirmation, perhaps reflecting higher levels of certainty or institutional preference. These results echo earlier findings by Avery, et al. [4] who showed that high-achieving students are more likely to respond decisively to early admissions opportunities [4].

Importantly, students from rural areas were found to confirm later than their urban peers, highlighting a potential equity issue. While infrastructure limitations (e.g., internet access) may partly explain this lag, the finding also points to broader informational asymmetries that can disadvantage certain student populations during time-sensitive stages of the admissions process. Addressing this imbalance through targeted communication strategies or extended access windows for rural applicants could be an important policy consideration moving forward.

This research contributes to the existing literature in several ways. First, it demonstrates the value of applying survival analysis—commonly used in medical and engineering research—to student enrollment behavior, particularly in contexts where decision timing is central to system efficiency. Second, it offers the first empirical benchmark for admissions

confirmation timelines in the Mongolian higher education sector, where policy design has traditionally been guided more by administrative precedent than behavioral evidence. Finally, the use of administrative data rather than self-reported intentions enhances the validity and policy relevance of the findings.

Nonetheless, several limitations should be acknowledged. The analysis draws on data from a single institution, which, while large and representative, may not capture variations present across Mongolia's diverse higher education system. Additionally, the dataset does not account for psychological or socioeconomic variables (*e.g., family income, motivation, or advising support*), which could further explain heterogeneity in confirmation behavior. Future studies could incorporate mixed methods approaches, combining quantitative modeling with qualitative interviews, to more holistically understand the decision-making context.

In summary, the study offers compelling evidence that optimizing registration confirmation timelines is both feasible and impactful. By tailoring enrollment strategies based on empirical patterns of student behavior, institutions can enhance operational efficiency while also supporting more equitable student outcomes.

#### **4. Conclusion and Recommendations**

This study applied survival analysis techniques—including Cox proportional hazards modeling—to identify the optimal timeframe for confirming university enrollment at the NUM. Based on administrative data, the analysis found that the majority of students confirmed their registration within 600 to 700 minutes (approximately 10–12 hours) after the enrollment window opened. Extending this window beyond 12 hours produced minimal gains in registration rate, indicating diminishing returns on institutional time and resources.

The results further showed that factors such as institutional affiliation, academic program, exam performance, and regional origin significantly influenced the timing of confirmation. These findings provide compelling evidence to support data-informed admissions planning, particularly in settings where uniform registration timelines have been used without regard to student heterogeneity or behavioral patterns.

The policy implications are both immediate and practical. For NUM and comparable institutions, implementing a more targeted and strategically timed enrollment window can improve the efficiency of admissions operations while minimizing delays and drop-offs. Equally important, institutions should consider differentiated strategies to address structural disparities—for instance, by allowing early confirmation access for high-achieving students or offering extended support to applicants from rural areas.

##### *4.1. Policy Recommendations*

Based on the findings of this study, several practical recommendations can be proposed to enhance the efficiency, equity, and effectiveness of the university enrollment confirmation process.

First, the study strongly supports defining an optimal registration confirmation window of approximately 11 hours. This duration strikes a balance between institutional logistics and students' decision-making behaviors. It allows sufficient time for most students to complete confirmation without introducing administrative inefficiencies or decision fatigue associated with excessively long registration periods.

Second, the introduction of a differentiated approach—specifically, early confirmation access for high-achieving applicants—is recommended. Allocating the initial 1 to 2 hours of the registration window exclusively to top-scoring students could not only expedite decision-making but also serve as a competitive mechanism for attracting high-potential enrollees. This strategy aligns with previous research on early admissions systems and their positive influence on institutional selectivity and applicant engagement.

Third, the results highlight the need for targeted flexibility for specific student populations. In particular, students from rural areas or those enrolled in specialized programs may require extended access or support due to infrastructural limitations or unique admission prerequisites. Integrating this flexibility into centralized admission policies could mitigate disparities and promote inclusive access to higher education opportunities.

Fourth, the implementation of digital reminder systems is recommended. Evidence from behavioral economics suggests that low-cost interventions such as SMS nudges can significantly improve follow-through on time-sensitive educational decisions. As such, institutions should consider deploying automated, personalized notifications throughout the registration window to prompt action and reduce the likelihood of late or missed confirmations.

Finally, the findings underscore the necessity for the NUM to continuously align its admission policies with national development goals under Vision-2050, while at the same time ensuring equitable access and minimizing regional disparities in the admission verification process. By addressing the observed gaps, NUM can play a more active role in supporting balanced regional development and in fostering equal educational opportunities for all applicants. While this study was limited to a single institution, the methodology employed—specifically survival analysis using Cox regression—offers a replicable framework. Public universities across the higher education system are encouraged to apply similar data-driven approaches to evaluate and refine their own registration policies. Doing so could yield broader insights into student behavior and inform coordinated, system-level reforms in enrollment management.

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