Demand for Internet in the NUL Student Halls of Residence

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Abstract

The information society revolution brought about by the internet is one of the hallmarks of modernity. The role of the internet, particularly on the learning process, is the reason behind this investigation. The National University of Lesotho (NUL) is facing growing student numbers coupled with growing strain of facilities. In this paper a case is made that the strain of Information and Communications Technology (ICT) resources can be alleviated by making the internet accessible to students in their residences. In fact this is supported by the findings of this investigation. The direct tabulation of the survey data and the estimation of an ordered probit suggest that there is a predominantly strong demand for internet access in the study bedrooms as indicated by the students' willingness to pay (WTP).

1. Introduction

The internet has advanced more rapidly over the past few years than even the technology experts expected. It is changing the way people communicate with one another and learn in virtually every aspect of life. Internet access has revolutionized the education landscape for the better. Internet is important in the learning process because students can access web libraries, encyclopedias thus helping them to get information that their own school libraries do not have. They can also access articles and reports from different organizations and on different topics such that they are not limited to what is immediately around them. They can form cyber discussion groups with their peers from around the world and have convenient times at which they meet on the web. They can also access first hand information and clarifications on their reading materials because many textbooks have companion websites nowadays. In addition, authors of the many working papers that are available online are happy to receive inquiries about their work and are often more than ready to explain further what their work is all about. All these contribute to making the learning process easy, convenient and fun too, hence enhancing the academic performance of students.

Enrolment figures in standard universities are such that internet access for all students cannot be catered for by conventional Information and Communications Technology (ICT) computer laboratories as well as faculty or departmental computer laboratories. In response to this problem, many universities, at least in developed countries, have installed network ports in their student residence bedrooms. Individual students indicate whether they need the service by undertaking to pay for it and only then is the service activated.

This paper estimates the demand for internet by the National University of Lesotho (NUL) students residing in the halls of residence on campus. Willingness to pay (WTP) has been used as the indicator of demand and on the basis of that indicator demand for internet by NUL campus residents is categorized into no demand, weak demand, regular demand and strong demand. The survey and the resulting model estimation show that the majority of residents are in the strong demand category while the no demand category is the least subscribed to category. This revelation makes a case for the student accommodation rooms to be equipped with internet access ports.

Section two of the paper highlights the problem of internet access at NUL while showing that access to computers is not a problem. Some background theory and literature on demand elicitation methods is the subject of section three while section four outlines the framework of analysis. Results and their interpretations are reported in section five. Section six summarizes and concludes the paper.

2. Problem Overview at NUL

As of February 2005[1] the NUL had 5061 students (NUL Academic Records) with only 44 computers available to all students (this excludes those in computer science laboratories as those are specifically for computer science students). The student-computer ratio was 115 to 1. This clearly means that it is not possible for a typical student to have regular access to internet. Given the central role of the internet in the learning process, outlined above, this is not a healthy state for the environment of higher learning.

In fact one of the troublesome experiences that one of the authors is having relates to putting the teaching materials on the server for open access by students particularly in the light of tight budgetary requirements that the departments operate under. Among other reasons why the material eventually didn't end up being uploaded is the realization that the two classes (a class of 140 and that of 70) on average share about two computers from which to download the material.

[1] This is the time during whose the survey which results are reported herein was conducted.

Access to computers is not a problem. NUL students buy computers mainly as entertainment equipment from which to play movies and music. The current observed widespread purchase of computers is explained not by their need in school work but by the change in era from when students were buying hi-fi systems and few other students TVs and VCRs. Recent developments in computer technology enabling them to perform functions that were performed by hi-fis, TVs & VCR are the major reason. The secondary reason that can be advanced is the increasing student population which has rendered the ICT laboratories virtually inaccessible to a greater proportion of student population.

3. Some Background Theory and Literature

The first notion on the theory of demand is that demand is defined as the economic agent's willingness to pay on various, especially successive, quantities of some good or a service. This relationship can be illustrated through a demand schedule. However, of utmost importance in economic analysis is what is referred to as effective demand (Green, 1980; Weinrich, 1982). Effective demand, according to Green (1980), has two essential features:

- The ability to pay, which means that buyers should have the purchasing power
- The willingness to purchase

This means that when an individual strongly desires a commodity but cannot afford to pay for it, then that is not effective demand.

In a recent article Beckert (2005) modeled the strong internet demand exhibited by the University of California at Berkeley community using an econometric framework for both discrete and continuous consumer choices. The finding of the modeling exercise was that besides the interpersonal heterogeneous characteristics, there were some unobserved intrapersonal characteristics that also affected internet demand of the study sample. Kelly and Lewis (2001) examined the determinants of household internet demand in Western Australia. The major determinants were household income, demographic variables such as age, gender and other socioeconomic characteristics such as whether the resident community in the well serviced area or a relatively disadvantaged area (Kelly and Lewis, 2001).

Most valuation surveys use the contingent valuation method and solicited consumers' WTP for a hypothetical product. The more proper approach to contingent valuation is that the researcher creates a hypothetical market in a non-market or new good, invites a group of subjects to operate in that market, and records the results while in some instances directly asking the subjects their WTP is acceptable (Mitchell and Carson 1989). The latter approach is susceptible to false revelations. Choice experiments and experimental auctions are other valuation techniques used to solicit WTP. See Kimenju *et. al.* (2005) for an application and comparison of these techniques together with the contingent valuation method.

Discrete choice models with stated preferences are frequently applied in marketing to elicit the preferences for new products or product attributes (Lusk and Hudson 2004). Of the available discrete choice models an ordered probit has been widely used in modeling WTP (see Diamond and Hausman, 1994 and Portney, 1994).

4. Analytical Framework

4.1 Sampling Design

Primary data was collected via a survey from a sample of 200 students that were residing in the halls of residence during the survey period. Stratified sampling was used in which the sample was divided into four strata – the first years, the second years, the third years and the fourth years and above. This was out of recognition that the need for internet access is in all likelihood dependent on one's year of study. The sample was distributed across the strata according to the following proportions:

10% of the respondents were the first year students
15% of the respondents were the second year students

30% of the respondents were the third year students
45% of the respondents were the "fourth year & above" students

The authors observations and experience are that in the first and second years students' work is still largely based on lecture notes and prescribed textbooks while in the third year and above, students start submitting typed assignments, mini projects and dissertations, all which require extensive and external reading. It is in these years of study that the need for both computer and internet access are magnified. It is this rationale that informed the distribution of respondents across the strata.

4.2 Econometric Methodology

While the survey revelations above give a picture of what the situation is, the picture is what the single sample of 200 students reveals, nothing more nothing less. Extrapolating that picture to population generalizations requires further statistical analysis. The strength of statistical analysis lies in the power of inferences. For instance, typical statistical results reveal what could have been had one carried out one hundred (100) surveys. This is often termed statistical significance or lack thereof. It is the quest for robust revelations that compels us to proceed econometrically as well.

The methodological outline in this section fis adapted from Greene (2003) and Verbeek (2000). The general regression specification in which the dependant variable is some indicator of the phenomenon being investigated is:

$$y_i^* = \mathbf{x}_i^T \boldsymbol{\beta} + \varepsilon_i \quad where \quad y_i = j \text{ if } \tau_{j-1} < y_i^* \leq \tau_j \qquad (1)$$

in which **x** is a vector of explanatory variables and β is a vector of unknown parameters.

Since we are modeling demand, the first thing to recognize is the fact that demand is given by the respondents' WTP schedule. Instead of asking respondents for their intensity of internet demand in the halls of residence, the question was framed in terms of the amount of money they would be willing to pay for the service per semester. The demand variable was then constructed as a multiple response ordered discrete variable as:

$$y = \text{Demand} = \begin{cases} 1 \text{ if } WTP \in [0,500] \\ 2 \text{ if } WTP \in [501,1000] \\ 3 \text{ if } WTP \in [1001,1500] \\ 4 \text{ if } WTP \in [1501,\infty) \end{cases} \Rightarrow \begin{cases} \text{No demand} \\ \text{Weak demand} \\ \text{Regular demand} \\ \text{Strong demand} \end{cases}$$

where $y^* = \text{WTP}$, $\tau_0 = 0$, $\tau_1 = 500$, $\tau_2 = 1000$ and $\tau_3 = 1500$. The explanatory variables contained in $\mathbf{x}^T$ are the following:

$$\text{Gender} = \begin{cases} 1 \text{ if } male \\ 0 \text{ otherwise} \end{cases}$$

A passing observation in the ICT laboratories is such that there is a marked gender differential in the number of internet users at any point in time with males being the most observed.

$$\text{Age} = \begin{cases} 1 \text{ if } aged \text{ 16-19} \\ 2 \text{ if } aged \text{ 20 - 23} \\ 3 \text{ if } aged \text{ 24 - 27} \\ 4 \text{ if } aged \text{ 28 } \& \text{ } above \end{cases}$$

$$\text{Yr of Study} = \begin{cases} 1 \text{ if } 1^{st} \text{ } year \\ 2 \text{ if } 2^{nd} \text{ } year \\ 3 \text{ if } 3^{rd} \text{ } year \\ 4 \text{ if } 4^{th} \text{ } year \text{ } \& \text{ } beyond \end{cases}$$

These stem from the firm belief that the recognition of the importance of internet access differs across age groups as well as years of study. This is especially true when the issue of willingness to pay arises. Younger people in lower classes do not need it for essential needs such as assignments, current events, etc. Surfing for mere fun is what it is about to them so they see no need to set aside resources to pay for such access.

$$\text{Program} = \begin{cases} 1 \text{ if } quantitatively \text{ } biased \\ 0 \text{ otherwise} \end{cases}$$

The authors are of the belief that quantitatively biased degree programs are more tutorial – based and lecture notes, along with prescribed textbooks and exercise sheets are the major study materials. The opposite is true with non-quantitative programs in which reading widely and extensively is the order of the day. It is in these programs that the authors believe internet access is most likely to be in strong demand relative to the other group of quantitative programs.

Monthly income

Income is what facilitates the transition from WTP to ability to pay. It is one of the major determinants of demand of any good or service.

An ordered probit is the most appropriate model because the phenomenon being investigated comes in ordered responses – from *no demand* to *strong demand* (see variable description above). This is because unlike other models, such as the Lewbel's least squares estimator, it is easier to deal with yet the results are similarly good. The regression equation (1) above is transformed with a normal distribution function, $\Phi(\cdot)$, into a probit and takes the form:

$$y_i = \Phi(\mathbf{x}_i^T \boldsymbol{\beta}) + \varepsilon_i \qquad \text{where} \quad i = 1, ..., N(=200)$$

(2)

The ordered probit in (2) above is estimated using STATA 9. It becomes possible to compute probabilities of any respondent being in a particular demand category. Demand category probabilities are generated by:

$$\Pr(y_i = 1 \mid \mathbf{x}) = \Phi(\tau_1 - \mathbf{x}_i^T \boldsymbol{\beta})$$
$$\Pr(y_i = 2 \mid \mathbf{x}) = \Phi(\tau_2 - \mathbf{x}_i^T \boldsymbol{\beta}) - \Phi(\tau_1 - \mathbf{x}_i^T \boldsymbol{\beta})$$
$$\Pr(y_i = 3 \mid \mathbf{x}) = \Phi(\tau_3 - \mathbf{x}_i^T \boldsymbol{\beta}) - \Phi(\tau_2 - \mathbf{x}_i^T \boldsymbol{\beta})$$
$$\Pr(y_i = 4 \mid \mathbf{x}) = 1 - \Phi(\tau_3 - \mathbf{x}_i^T \boldsymbol{\beta})$$

(3)

STATA estimation of an ordered probit automatically produces the τ's which as shown in equation (3) above are crucial in the computation of probabilities. These $\tau's$ are such that $\tau_1 < \tau_2 < \tau_3$. The estimated $\tau's$ are different from the WTP cutoff points because data is entered not in terms of WTP but in terms of demand categories, $y_i = j$, where $j = 1,\ldots,4$.

5. Empirical Findings

5.1 Survey Findings: A Summary

In this section the findings from the survey exercise are reported. The first thing that was of interest to the authors was the demand variable, which is defined by the respondents' willingness to pay. Table 1 below reports the respondents' revelations of their internet demand. Categories are explained in the variable description in the preceding section.

Table 1: Internet demand direct revelations

Demand Category	Frequency	Percentage
No Demand	8	4
Weak Demand	24	12
Regular Demand	59	29.5
Strong Demand	109	54.5

Source: Authors compilations from survey

Of the 200 respondents, table 1 above shows that it is the willingness to pay of only eight (4% of the respondents) that reveals no internet demand in the halls of residence. The 192 respondents (96% of the sample) revealed internet demand by their willingness to pay albeit at varying intensities. Nearly 55% of the respondents revealed strong desire to have internet access in their study bedrooms while for nearly 30%, the desire is moderate. These direct revelations present a case for the University to seriously consider getting the halls of residence wired with internet ports. This option should be considered side by side with that of erecting general purpose ICT laboratories and equipping them with computer equipment to meet the demands of increasing student population. The cost effectiveness of the two alternatives is a separate mandate that is beyond the intention of the current paper.

The second point of interest was to collate the demand categories with the respondents' characteristics. Table 2 below reports the distribution of demand categories by respondents' characteristics such as age group, gender, year of study, type of degree program as per the variable description. The distributions are reported in terms of percentages.

Table 2: Demand for Internet by respondents characteristics

Demand Category	**Percentage distribution across demand category by:**			
	Gender M,F	**Program N,Q**	**Age16-19, 20-23, 24-27, 28+**	**Year of Study 4th +, 3rd, 2nd, 1st**
No Demand	37.5, 62.5	50,50	75,25, 0,0	0,12.5,37.5,50
Weak Demand	42,58	54,46	17,46,25,12	25,37.5,29,8.5
Regular Demand	53,47	61,39	29,41,22,8	46,27,20,7
Strong Demand	51,49	67,33	26,58,11,5	52,31,7,10
Total by Xristics	**98,102**	**126,74**	**55,100,31,14**	**90,60,30,20**

Source: Authors computation from survey

Of the eight respondents that revealed no internet demand three (= 37.5%) were males while five (= 62.5%) were females. This confirms the observation that led us to pick the gender variable, which is the fact that the frequent visitors in the ICT labs were largely males. This group is evenly distributed across program types. All respondents in this category are between the ages 16 and 23 with six occupying the 16-19 age bracket and the other two, the 20-23 age bracket. General observation and experience suffice to conclude that the former of the two brackets is predominantly made up of the 1st years and the 2nd years. In fact the year of study characteristic lends support to this general observation because 87.5% (50% and 37.5%) of the respondents in the *no demand* group are first years and second years. Only one of the eight was a third year student while none came from fourth year and beyond. This confirms the belief that the demand for internet is strongly influenced by year of study.

In the *strong demand* category there is no marked differential in the internet demand across gender. The distribution of 51% of males and 49% females is fairly even. Degree program reveals a marked skewness towards those in no quantitative degree programs as only 33% of respondents in this category are enrolled in quantitatively biased programs while the remaining 67% is in the non-quantitative degree programs. This is not surprising since the latter degree programs require extensive reading and access to the most current literature and case study material while with the former programs tutorials and exercises are the major learning modes. It is also not surprising that 83% (= 52% + 31%) of those who strongly demand internet access in the halls of residence are third years and above. There is some strong demand from the second years (7%) and the first years (10%) coming out as well.

The other two categories, *weak demand* and *regular demand*, reveal patterns that are similar with respect to the program type. In this characteristic the non-quantitative program type still edges the quantitatively biased program type and this is consistent with what is revealed in the strong demand category as discussed above. The gender characteristic is such that males (53%) edge the females

(47%) in the *regular demand* category while in the *weak demand* categories it is the females (58%) that edge the males (42%). Just like in the strong demand category the majority of respondents in the two categories under consideration are in the third year of study and beyond, 62.5% (= 25% + 37.5%) in the *weak demand* category and 73% (= 46% + 27%) in the *regular demand* category. The age characteristic is more reflective of the sample composition which in turn mirrors the population composition. The majority of residents in the halls of residence are in the age group 16-23 while one seldom finds residents aged 28 and above in the halls of residence.

5.2 Estimation Results

This sub-section reports findings from further analysis of the collected data. As stated in the preceding section an ordered probit was estimated and below some crucial estimates that are instrumental inputs in generating demand category probabilities using equation (3) are reported. The estimated regression parameter vector is:

$$\hat{\boldsymbol{\beta}} = \begin{pmatrix} \hat{\beta}_0 = 0.1173 \\ \hat{\beta}_{\text{Gen}} = 0.6209 \\ \hat{\beta}_{\text{Inc}} = 0.0020 \\ \hat{\beta}_{\text{Prog}} = 0.5364 \\ \hat{\beta}_{\text{Age}} = -0.1003 \\ \beta_{\text{YoS}} = -0.0859 \end{pmatrix}$$

Only two of these parameters are statistically insignificant at five percent (5%) level of significance and those are $\hat{\beta}_{\text{Inc}}$ and $\hat{\beta}_{\text{YoS}}$. The estimated cut-off points between demand categories are $\tau_1 = 0.2287,\ \tau_2 = 0.6729$ and $\tau_3 = 1.2314$. As it can be readily observed the condition $\tau_1 < \tau_2 < \tau_3$ is satisfied by these estimates. The next magnitude that is computed is $\mathbf{x}^{\mathrm{T}}\boldsymbol{\beta}$ which is done using

$\hat{\boldsymbol{\beta}}$ and the means of $\mathbf{x}$. The computed $\overline{\mathbf{x}}^{\mathrm{T}}\hat{\boldsymbol{\beta}}$ is 0.1553. The implementation of equation (3) using the just reported figures yields:

$$\Pr(y_i = 1 \mid \mathbf{x}) = 0.028$$
$$\Pr(y_i = 2 \mid \mathbf{x}) = 0.167$$
$$\Pr(y_i = 3 \mid \mathbf{x}) = 0.163$$
$$\Pr(y_i = 4 \mid \mathbf{x}) = 0.642$$

These results are not surprising, especially having observed the survey direct revelations. The overall picture is similar. It is observed from these results that if the 100 surveys similar to the current one were carried out then at least 99 (since the estimated model's p-value is less that 0.01) would indicate that 64.2% of NUL student halls of residence would reveal *strong demand* for internet connection in the study bedrooms. Furthermore, at least 99 out of 100 such surveys with respect to *regular demand* and *weak demand* categories would indicate the residents' proportions of 16.3% and 16.7 % respectively. Only 2.8% of the NUL campus student residents do not demand internet in the study bedrooms, at least 99 out of 100 surveys would reveal.

These statistical results, just like the survey direct revelations, make a strong case for the student halls of residence to be wired with internet ports. As stated above the cost effectiveness of this strategy can be pitted against that of erecting further ICT labs and buying hundreds of computers to go with them.

5.3 Analysis of Determinants [2]

In this sub-section the determination is made on how the changes in the respondents' characteristics affect the demand

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[2] This sub-section is merely for completeness sake so that we don't get in trouble with our fellow professionals – economists that is!! Otherwise what the survey set out do accomplish, which is the magnitude of demand for internet connection in the NUL student halls of residence is fully accomplished in the preceding sections.

category probabilities. Firstly, an example is used to demonstrate what is carried out in this sub-section. For instance the probability that any given respondent *i* who revealed a strong internet demand is a female who is between 20 and 23 years of age, enrolled in the quantitatively biased program, in the third year of study with a monthly income of about M800 is given by:

$$\begin{aligned} \Pr(y_i=4|\mathbf{x}) &= 1-\Phi[1.2314-(0.1173+0.6209\times0+0.002\times3+0.5364\times1-0.1003\times2-0.0859\times3)] \\ &= 1-\Phi[1.2314-(0.1173+0.006+0.5364-0.2006-0.2577)] \\ &= 1-\Phi[1.2314-0.2014] \\ &= 1-\Phi[1.03] \\ &= 0.6515 \end{aligned}$$

The probability of observing the students with similar characteristics except the program of study (that is enrolled in the non-quantitative program) is 0.6029. As a result the marginal effect of the change in the program of study in the probability that respondent *i* will reveal a strong demand for internet is given by [3]:

$$\begin{aligned} \Delta \Pr(y_i = 4 | \mathbf{x}_{\Leftarrow \Delta \text{Prog}}) &= \Pr(y_i = 4 | \mathbf{x}_{\Leftarrow \text{Prog}=1}) - \Pr(y_i = 4 | \mathbf{x}_{\Leftarrow \text{Prog}=0}) \\ &= 0.6515 - 0.6029 \\ &= 0.0486 \end{aligned}$$

The interpretation of this change in probability is as follows: Of the third year, female residents with an average income of about M700 per month who strongly demand internet access in the halls of residence, the probability of observing the one enrolled in a quantitatively biased program exceeds that of observing the one enrolled in the non-quantitative program by 0.0486 (or 4.86 percentage points).

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[3] This is the marginal effect for a discrete covariate. Nearly all the covariate of the estimated model are in this paper. However for continuous covariates the marginal effect is given by $\frac{\partial \Pr(y_i = j | \mathbf{x})}{\partial x_k} = \phi(\mathbf{x}\boldsymbol{\beta})\beta_k$ where $\phi(\cdot) = \Phi'(\cdot)$.

This determination of marginal effects on the demand category probabilities can be similarly done and interpreted for all other residents' characteristics. Obviously, one can think of many combinations of the residents' characteristics with which to do the exercise. In order to keep the task manageable, only one characteristic is varied while holding others constant at their average levels. Table 3 below is a summary of the marginal effects of all the characteristics across demand categories.

Table 3: Marginal effect of residents' characteristics within demand categories

Demand Category	Residents characteristics			
	Gender	**Program**	**Age**	**YoS**
No Demand	-0.243	-0.212	0.04 0.04 0.039	0.034 0.034 0.034
Weak Demand	0.029	0.02	-0.004 -0.006 -0.007	-0.002 -0.004 -0.005
Regular Demand	0.075	0.063	*0.028* *0.027* *0.026*	0.024 0.024 0.023
Strong Demand	-0.14	-0.129	-0.024 -0.021 -0.019	-0.022 -0.02 -0.219

Source: Authors' computations

Zooming in under the variable age in the regular demand category in Table 3 above, the following are the interpretation of the reported marginal effects: In that category if the respondent crosses over from the age bracket 16 – 19 to 20 -23 then the probability of revealing regular demand for internet increases by 0.028 (or 2.8%). An equivalent interpretation is that in the regular demand category the probability of observing a respondent in the age bracket 20 -23 is 2.8% more than that of observing a 16 – 19 year old resident. From 20 - 23 to 24 - 27 the probability of revelation of regular internet demand increases by 2.7%. The year of study variable has as many categories as the age variable while the other two variables have only two categories. The interpretation are however similar. All that is needed is to have in mind what the categories in each variable are.

6. Summary and Conclusion

The paper set out to determine the demand for internet in the NUL student halls of residence. Recognizing that simply seeking respondents views on the matter would not provide accurate information, the study proceeded by soliciting the respondents' WTP for internet connection per semester. This approach is credible because by definition demand is the persons WTP schedule over different quantities of a good or a service. Revealed demand was organized into bounds that were set up to define the demand categories by intensity ranging from *no demand* to *strong demand*, with categories *weak demand* and *regular demand* occupying the two middle positions.

The demand revelation is that demand for internet is predominantly strong in the NUL student halls of residence with about 64% of the residents are willing to pay in excess of M300 per month for access while the position of no demand is occupied by very few residents, about 3% of the residents. About 17% of the residents are willing to pay slightly more than M100 but not beyond M200 per month while the remaining 16% willingness to pay is between slightly above M200 but not more than M300 per month. The revealed demand for internet reported here is emphatic, particularly in the light of the average monthly income of M700.

In recommendation, the University should give some serious thought to "wiring up" the student hostels. There is no remarkable difference on internet demand across gender so all residences can be "wired up" regardless of the gender they accommodate. However, priority should be given to senior students' hostels as the year of study appeared to skew the distribution in favor of the third year students and above. Worrying about students' incomes is perhaps not quite relevant because the cost of the internet access can be augmented to the students' accommodation costs which in turn are treated differently in the loan bursary contracts between the students and the sponsors. Great care should be given to pricing the service if this blanket access which is paid for by the sponsor is used. The alternative is the pay – per – use in which the service is activated once paid for by willing residents.

All in all given the rising student population and the continued strain on resources such as the laboratories, particularly the general use ICT labs, coupled with the revealed demand for internet access in the students' halls of residence, the challenge facing the NUL is to ride on the ICT for development bandwagon through making accessible internet connection in the students' study bedrooms.

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