# Manpower Planning for Demand Forecasting of Faculty Members using Trend Analysis and Regression

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**Abstract**

Employing adequate manpower is one of the major concerns of modern organizations. As Faculty members having specific characteristics, they are not available when necessary and this requires planning in order to predict their demand in time. In this research, using trend analysis as one of the quantitative method for estimation, first the predictive variables including BA,MA and PhD students also the published articles are predicted for five years, then by using regression equations models, the faculty members by rank, age and gender are forecasted. The findings showed that associate professors, aged 46 to 55 years are the most necessary manpower to be employed. Also the percentage of female faculty members shows significant growth.

**Keywords:** human resource planning, demand forecasting, regression analysis, trend analysis, faculty members.

**Introduction:**

Governments in second half of twentieth century care about analysis and forecasting manpower. This phenomenon following several interrelated transformational streams such as the changing and wide spreading training systems, increasing desire of households and firms for acquiring knowledge and skills, more division of works and specializing production processes, marketing of business activities and collapsing family business systems, self-employment in comparison with the past, the population growth and more desire of people specially women to enter the business markets, cause more communities facing workforce

supply surplus(Taee,2008). Hence considering a kind of workforce planning leading to editing training programs was conducted by human resources decision makers and policymakers.

The success and prosperity of the universities depend on their work force. If university officials, are unable to employ and retain qualified and motivated manpower, the universities can't do their responsibilities and duties well. The major role of higher education is training skilled manpower, so promoting and improving knowledge for the sake of national development. To reach its goal, the role of academic staff and their performance is one of the most critical issues. Faculty members' main task is transferring and creating new knowledge for the society (Foolaadvand et al, 2008), so paying attention to employ the best and most qualified ones is the duty of trustees.

**Literature Review**
Deciding about recruitment and development of personnel are strategic decisions and create long-term impacts. Therefore, the supply and demand of human resources as part of the organizational and practical planning processes should be predicted by the executives. Long term business requirements, promotion policies and employing opportunities (supply) should be compatible with each other so that the human resource needs and available estimates (from internal and external resources) are linked together effectively (Sutanto, 2000). Yet good candidates usually have different options and before having suggestions from the public sector, this talent can be seized by a more flexible organization(that is private sector) (Freyens, 2010.) In eastern countries which there is a tendency to operate in the private sector as having higher revenues, more freedom and existing complex employment processes in the public sector; planning in order to employ the best is hard but possible.

In universities and higher education institutions, human capital has an important role in furthering the organization's objectives and aligning with strategic objectives needs to invest in human capital and employing best graduates. The desired objectives and functions of the universities as a whole are as follows: Human- making, fostering critical and free thinking, training expertise in various fields of science, and providing research services to the community. University personnel, especially faculty members play a significant role in fulfilling these objectives. Farhangi and Hosseini (2000) state that "the first task and role of higher education is driving people toward common goals, interests, objectives, values, skills and aspirations that control people and governments voluntarily toward higher and bigger goals and that goal is humanity ".

**Manpower planning in practice**
Theoretical studies consider 'manpower planning' as Markov and semi-Markov operational research processes, but these methods are complicated and have little practical use for HR managers (Freyens, 2010). In the professional sector, workforce planning, often is followed by compartmental analysis where the rate of change in supply and demand for a particular task or skill is analyzed and anticipated over time (Mackay and Lee, 2005). Of studies and researches, it can be achieved that in practice, there is no such thing as a consistent model of workforce planning. There are a lot of workforce planning tools and processes adapted with different situations (Anderson, 2004), but researchers proposed two main models each including some planning models as follows: the interactive planning and rational planning. Rational models consider planning as some analytical tools to reach certain goals. This type put the programmer out of reality that is the purpose of planning and objective science styles are adapted to win over subjective issues (Adams, 2003). This model often is used by up-down

concentrated systems. Models such as linear, Comprehensive, single institute and social demand, human power planning, cost - benefit and mathematical models are in this group.

Interactive planning models unlike rational ones are less systematic. They are more participatory and need to match the environment. Since the planning is an attempt to form the future, so it is considered political. From this view, successful education planners should understand political issues by a high level and be skillful technically. Planning process should include various groups of beneficiaries and invite them to participate (Farrell, 2003). In planning literature, approaches such as political, exchanging, supportive and adaptive learning which pay attention more to the exchanging, monitoring and information are in this group (Mohammadi, 2008).

In choosing a forecasting technique, the following factors must be considered.

1. *Environment.* Jackson and Schuler (1990) observed that organizations operating in relatively stable environments may be able to quantify the expected values of the variables in their models so that they can use statistical forecasting models. On the contrary, for companies operating in unstable environments, quantitative predictions seems very tentative.

2. *Size.* Stone and Fiorito (1986) have also shown that large organizations in comparison with smaller ones tend more to have a slightly sophisticated techniques.

3. *Perceived uncertainty in the job market and economy.* Specifically, if the perceived uncertainty reach a point where other methods are not feasible or any other technique is required, more sophisticated techniques won't be used (Stone and Fiorito, 1986 ; Rowland and Summers, 1983).

4. *Competition.* Organizations in regulated industries are operating in expected product markets and gain resources to use similar prediction techniques (Doeringer et al, 1968; Fiorito et al, 1985; Moore and Reichert, 1983; Vatter, 1967).

Empirical studies have shown that the accuracy of forecasting techniques varies (Mahmoud, 1984). Selecting an appropriate forecasting technique to make reliable predictions is essential (Goh, 1998). Each forecast should emphasize on assumptions and restrictions to avoid misinterpretation. Although forecasts have certain value for economic, employment / education policies, they must not considered as just forecasting but they are a source of information for informed decision making. They provide early warning of what may happen in the future.

Therefore, in this study, according to the statistical society (one of the universities of Iran), for selecting an appropriate prediction method, the author tried to pay attention to the factors mentioned in the literature review. This university is one of the largest public universities located in the east of country and compete for the best personnel (exclusiveness), also it is operated in a relatively stable environment and have a centralized employing system from top to bottom. Therefore considering all aspects, trend and regression analysis techniques for forecasting the faculty members which are of mathematical and so rational models are considered to be the most appropriate method.

This research is going to predict the number of faculty members in one of the biggest and most important universities of Iran; considering the number of BA,MA and PhD students and published scientific papers ( ISI papers)by faculty members for coming 5 years(2014-2018). So the questions which are supposed to be answered in this study are as follows:

1. How many faculty members are required from 2014 to 2018 to be employed in this university?

2. How many faculty members are required based on their scientific rank from 2014 to 2018 to be employed?

3. How many faculty members are required based on their gender from 2014 to 2018 to be employed?

4. How many faculty members are required based on their age from 2014 to 2018 to be employed?

## Methods

Recent research is an applied one. It is descriptive in data gathering. Among descriptive researches, trend analysis and regression were chosen. In regression analysis, the future demand for manpower is estimated by the link between the employment level of the organization and its related variables such as interest rates, sales rates, and the amount of using the equipment.... (Dvlan and Scholes, 2000). Several factors affect the manpower demand of organization; in this study among factors affecting staffing levels (the faculty members), two key factors are considered the most important: number of students (bachelor, master's and doctoral) and the number of articles published by faculty members (including ISI And non- ISI ones) which exhibited profound solidarity with the number of faculty members. It should be noted that at the beginning, the other variables such as the number of held conferences and carried out research projects were also considered as predictor variables. But because there was no linear relationship between the number of faculty members in the study with them, were excluded from the regression equation.

## Results

*Phase 1:* At this stage, in order to predict the number of students and articles published by faculty members from 2014 to 2018 which have the role of predictor variables in final analysis, time series analysis was used. This method is studying past trends in the relationship between two variables to help predicting future trends. Precise data over a certain period of time is required; a maximum of twenty years- using past trends to predict future trends in the coming five years.

Given the number of students and articles published by faculty members in the last 20 years and setting a good model fit, the number of students and papers were predicted for next 5 years, and then this data was used (as the predictor variable) in regression analysis to predict the faculty members. In this study SPSS software was used. Required data collected over the past 20 years is as follows:

1. Data relating the number of students with different grades (BA, MA and PhD) from 1994-2013

2. Data on the number of published scientific papers (ISI, non- ISI) by faculty members from 1994-2013.

For example, to predict the number of doctoral students in the next 5 years, an appropriate forecasting model is Brown model time series. To determine fitting the model, namely the compatibility of the two parameters of the model with time series, R-Squared and Ljung-Box is considered.

Table 1.

**Model Statistics**

| Model | Number of Predictors | Model Fit statistics | Ljung-Box Q (18) | | | Number of Outliers |
|---|---|---|---|---|---|---|
| | | R-squared | Statistics | DF | Sig. | |
| PhD-Model_1 | 0 | . 952 | 7.002 | 17 | 0.984 | 0 |

$R^2$ or the determination coefficient, as can be seen in Table 1 is equal to 0.952, which means that the model is fitted with high accuracy. Ljung-Box Indicates whether the model is correctly specified or not. Significant amount which is less than 0.05 suggests that the observed structure in the series are calculated by the model (estimated). In this case sig = 0.984 which is not significant because 0.984> 0.05. So we can ensure that the model is correctly fitted. Actual and predicted values are shown in Figure 1. In this figure, the number of doctoral students by the year 2013 and forecasts numbers from 2014 to 2018 is displayed.
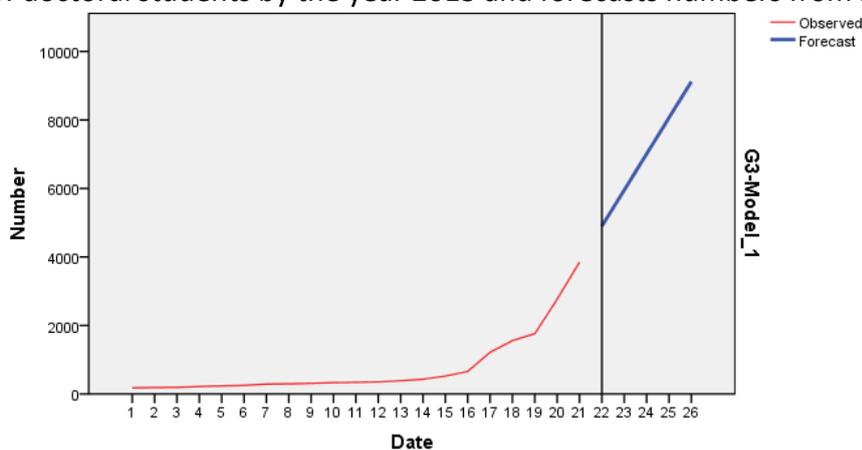


Figure 1. Forecasting the number of PhD students

To predict the number of students in other grades (bachelor and master), as well as the number of scientific articles, the above model is executed. Table 2 displays a summary of the predicted quantity.

Table 2: Forecasting the number of students and academic papers until 2018

| | Number of BA,BS Students | Number of MA,MS Students | Number of PhD Students | Number of Articles |
|---|---|---|---|---|
| **2014** | 12910 | 11485 | 4902 | 1009 |
| **2015** | 12039 | 13131 | 5956 | 1205 |
| **2016** | 11168 | 14776 | 7010 | 1754 |
| **2017** | 10298 | 16422 | 8064 | 2202 |
| **2018** | 9427 | 18067 | 9118 | 2500 |

*Phase 2*: In this phase to analyze the data, multiple regression analysis was applied; Enter regression method was used and all the calculations and analysis was done by SPSS software (Version 21). To answer the research questions, regression models were developed.

Regression model is a linear equation, in one side Y is placed which is faculty members and other related variables and in the other side the independent X variables which are the number of students and articles. So the regression equation is like this: y = a + b1x1 + b2x 2 + b3x3 + b4x4. In this model a is a fixed amount and b1 to b4 are Coefficients which are provided by the model based on past data and x1 to x4 forecasted values for the number of students and the amount of scientific papers during coming years. The detailed results of analysis regression for the first question is provided here and the other results are presented in Table 3.

The first question: How many faculty members are required from 2014 to 2018 to be employed?

The regression model is:

$$Y = 603.681 + 0.002 (x_1) + 0.01 (x_2) + .023 (x_3) \_ .046 (x_4)$$

As expressed before, in this equation, x1 is the number of bachelor students, x2 the number of master students, x3 the number of PhD students, x4 the number of scientific papers (ISI and non- ISI). Due to this, if the predicted number of variables according to the analysis performed in the previous step is entered into this model, the amount of y which is the number of required faculty members is to be calculated. The results of the regression analysis of first question are shown in Table 2.

Table 2 - The number of needed faculty members until 2018

| Years | The number of needed faculty members |
|-------|--------------------------------------|
| 2014 | **725** |
| 2015 | **747** |
| 2016 | **769** |
| 2017 | **791** |
| 2018 | **814** |

Other findings related to the three left questions (faculty members according to their academic rank, gender and age) are presented in Table 3.

Table 3:
Predicted faculty members in academic rank, gender and age category until 2018

| | 2014 | 2015 | 2016 | 2017 | 2018 |
|---|------|------|------|------|------|
| Coach | 54 | 45 | 36 | 27 | 18 |
| Assistant Professor | 332 | 334 | 335 | 336 | 337 |
| Associate Professor | 233 | 258 | 282 | 308 | 332 |
| Professor | 107 | 111 | 114 | 118 | 122 |
| Man | 645 | 662 | 680 | 698 | 715 |
| Woman | 115 | 128 | 141 | 154 | 167 |
| Under 35 years old | 114 | 133 | 152 | 171 | 191 |
| Between 36 and 45 years old | 162 | 145 | 128 | 111 | 95 |

| Between 46 and 55 years old | 321 | 340 | 359 | 379 | 399 |
| Between 56 and 60 years old | 82 | 89 | 96 | 103 | 110 |
| above 60 Years old | 36 | 28 | 20 | 12 | 4 |

**Discussion:**

Answering the first research question determined that 814 faculty members should be employed in this university until 2018 that due to the current state (712 member) there is needed to hire more than 102 people, an increase of 14.3%. This amount is dedicated to all faculties.

The second question is about the number of faculty members in academic rank. As indicated in Table 3, a drastic reduction in the number of coaches is shown. This phenomenon is consistent with the policies of higher education that newly is not to employ the people without PhD degree. A slight increase in the number of professor assistant is seen, which reflects the need to promote the current professor assistants to recruit the new personnel (as the new employed are professor assistant as first step). The greatest increase is of associate professors which shows that the policies of the mentioned university should orients toward the development and promotion of faculty members with the rank of assistant professors. Otherwise, along with the recruiting new personnel, assistant professor picks will emerge so the university would encounter problems in achieving future goals. Naturally, increasing the number of professors as we declared in our findings will be increased slightly since reaching this academic level requires passing several stages, such as scientific production and other indicators that require a lot of time, though the university shouldn't neglect motivating associate professors to improve themselves to reach this rank.

Answering the third question, the different gender of the faculty members is estimated. By the year 2018 the number of female faculty members shows an increase of 68 persons and male members 252 ones. The percentage of increasing female faculty members in the proportion of all faculty members has changed from 13% ($\frac{99}{712}$) in 2014 to 19% ($\frac{167}{865}$) in the year 2018. Obviously, strategies and action plans of the university should be in a way to attract a greater number of women.

In response to the fourth question, the number of faculty members according to age category is shown in Table 5. In age category under 35 years old, between 46 to 55 years old and between 56 to 60 years, an obvious increase is shown. Although two other categories which are between 36 to 45 years and above 60 years show extreme decrease. This phenomena may be due to the youth having doctoral degree in the community in comparison with the past; because nowadays college students often continuously study until having PhD degree for some reasons like recruiting without entrance test for talented ones or transferring students studying abroad to Iran which are usually from the rich families and so on. However the age category between 46 to 55 years old is the most required that shows the current faculty members and the second status belongs to the faculty members under 35 years old that are the new comers and newly-employed ones.

**Conclusions and recommendations:**

Three functions of a university or higher education system that UNESCO has emphasized are" the research or the production of knowledge ", " learning or knowledge transfer "and"services or dissemination and diffusion of knowledge ". Following the researches,

the second main function of higher education system is knowledge transfer to younger generations of educated and skilled manpower to train graduates for the society. Universities in modern industrial societies by educating graduates are the main factor in the formation of ideas and ideologies of the modern social and philosophical movements, as well as a good place to create thoughts conflicts. On the other hand, universities at the same time are a supplier of expertise for various social, economic, political and cultural sectors of the society (Haji Pour and Sultani, 2008).

Main elements in education are three: the teacher, student and educational environment. Therefore disorder in each of these three elements cause loss of education quantity. According to the systematic training design, the teacher is the most important pillar to create desired success in full filling education goals. The teacher can defects suitable books or deficiency of education facilities. Conversely, the best success and subject of teaching can be converted to an unattractive and passive environment by the lack of teacher's ability to create suitable emotional relationship. As the teacher is dealing with the students' spirit, mind and emotions, if wrong, he will leave irrecoverable damages. Indeed it is the teacher's performance and characteristics which leads to the achievement of goals of education and learning (Asghari and Mahjoob, 2010). The teacher is the most fundamental pillar to create success.

This study investigated required manpower planning during next 5 years in one of the public universities in Iran. Obviously, the number of faculty members needed regardless of their attributes and abilities will be imperfect. Nowadays there are this false belief that each knowledgeable person can be a good teacher. Such a claim is not always true and there are a lot of expertise that are not successful in teaching. Of course, the reverse can also be true and not all teachers are good researches (Maaroofi et al, 2007). Therefore a good teacher should have various characteristics to be able to increase the reputation of a learning institution. On the other hand having all good characteristics is not possible for a teacher and for the same reason, each institute has its own criteria for the competency of its teachers (Haji Agha-Jani, 2001). In this study, it is assumed that through the recruitment channels and multiple available filtering, nearly competent members will be employed. The other significant problem is the increasing number of university graduates that effect the supply of manpower in higher education. So the executives by suitable mechanisms can employ the best; as the basic and sustainable development in each community depends on transforming the education system and the main axis for its evolution and development is improving the quality of the teacher's performance and his/her characteristics (Hokm Abadi and Fallah, 2013 ).

Another significant issue associated with this estimation is the growth in female faculty members within next 5 years. Generally, participation rate of men and women over the past two decades suggests structural transformation of the distribution of gender in the workforce. One of the most important reasons for the increase in female participation rates can be justified by the educational level of women. Statistics show that the number of girls who were admitted in universities in recent years has increased dramatically, but whether this increase has led to their increased participation or not? Navazani and Yazdi believe that although women are overtaking men in higher education but aren't employed fairly in all over the world. Nowadays no one can deny the positive economic, social, hygienic, psychological and educational effect of women participation in different areas especially higher education which is the pathway to development (Samii et al, 2009). The rate and degree of human society development depends on fully participation and social

and civic learning of its people. Development of any society should enable all individuals to increase their abilities to the maximum possible extent (Navazani and Yazdi, 2010). In this way using women in social progress can accelerate the national development and progress and play a significant role in its prosperity(ibid).

Recently in Iran the number of female faculty members has grown a little but totally the proportion of them to the whole members has increased. The participation of women in scientific and administrative positions such as head of department, head of the university or college and so on are very low. The researches has demonstrated that the competencies and capabilities of women in science and management are high, but the talent is less appreciated in higher education and women aren't involved in decision making. The obstacles such as social and cultural problems, having other social roles such as being a mother and a wife (along with their responsibilities) and the special attitude toward women in the workplace caused problems for them in carrying out their duty (Aghapour et al. 2009). The participation of women in faculty research activities is still not desirable and despite the fact that women have shown their competencies in various fields, their recruiting in the universities still hasn't been facilitated. As there is not positive attitudes toward women's abilities in the universities, their competence hardy emerge. The women aren't contributed in educational and cultural planning and don't benefit from sabbatical, specialized courses and scholarships. To increase women's confidence and self-esteem in colleges a lot of work should be done (Aghapour et al. 2009).

It is suggested that women strengthen their abilities. If the full knowledge and creativity of women is going to take place, activities relating to education, opportunities in higher education and the development of their management skills shall be more in a macro level (Farasatkhah, 2004). At the same time, it is better when employing, gender differences are generally excluded and meritocracy as an important element of civil society be a priority.

Another important finding of this study that was implicitly referred to, is the inverse relationship between the number of faculty members and published scientific papers. The remarkable thing is that why by increasing the number of faculty members, scientific papers productivity that is one of the most obvious strengths and competencies required for this kind of employees decline? Researchers believe that the university should not just rely on scientific products from other countries. Teaching that is only upon memorizing the texts and journals of the developed world is no doubt ineffective in solving problems of developing countries (King, 2004). On the other hand, researchers who conduct research in developing countries and having sufficient experience and motivation (Roxburgh, 2006), financial support, free to choose his/her topic and research methods and having efficient manpower, equipment and funds are extremely rare (Zohoor and Fekri, 2003). Research approach at Iran universities is "research just to research" and motivations of most authors are promoting and getting academic ranks. Hence, more researches are theoretical and their findings have no practical use for the community. In the academic environment, there are facilities and tremendous potential staff to cause scientific stagnation and backwardness leave the universities; by projecting based on workforce knowledge, existing values and taking into account the economic, social, and cultural circumstances, science production and educating competent individuals will be impacted dramatically(King, 2004).

On the other hand, faculty members in different countries are trying to provide the highest quality of scientific products (Rezayian et al. 2013). The importance of this issue is to the

extent that European countries in 2003, sixteen billion euros have been allocated to this job (Vidulescu, 2003). Therefore it is better to consider research competency other than the ability of teaching when employing a faculty member; also providing financial and organizational support in order to motivate the production of articles, books, research projects, etc. Thus it can help educational institutions to achieve their goals that most notably among them is educating graduates seeking science and researching job. The presence of such people in community will help community development and its transition towards the prosperity and welfare of its citizens.

Also according to the study results, it is suggested that future studies use this model in segregated colleges. Furthermore, by using this method, a comprehensive model of demand forecasting plan for faculty members in higher education can be designed.

**Limitations**:
As the trend analysis method is based on past, technological developments and changing conditions in which changes are taking placed are ignored. In the meantime though, this study can be used as a basis for other studies but due to specific properties of universities, the results cannot be generalized to other organizations and institutions. Even in other universities different results may be obtained.

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