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1 Project Demand Evaluation Method

For the bubble chart, we need the projected demand data. The projected demand data can be collected from O*NET. The CIP taxonomy is organized on two levels: 1) the first two-digit series, 2) the four-digit series. We can look for the CIP code for a perticular progrom from IPEDS. The first two-digit series represent the most general groupings of related programs. The four-digit series represent intermediate groupings of programs that have comparable content and objectives. For example, the CIP code for the Computer Programmers is: 14.0901, where the digits '14' represents Engineering in general, the last four digits '0901', together with the first two digits, represents Computer Engineering. From IPEDS CIP code, we will have the program knowledge and current market demand of that program. From these information, we searched in O*NET for the demand data for that program. Based on the CIP code, the projected demand data for any program can be collected from O*NET. Say,

$$\begin{aligned} \text{the annual median/mean wages} &= W, \\ \text{the number of employments} &= N, \\ \text{the mean projected growth over the years in percentage} &= i. \end{aligned}$$

We need to put all the information into the projected demand formulation. Missing any of the values can be problematic in getting the true information for the projected demand. For that, we come up with the following formulation.

$$\begin{aligned} \text{The current demand}, CD &= W * N, \\ \text{The Current demand with the projected growth}, FD &= (1+i) * W * N \\ \text{The projected growth in demand}, PD &= FD - CD = i * W * N. \end{aligned}$$

In this evaluation metrics, we include all the needed details to form the proper demand criteria. For the illustration, lets assume the physics program's demand. From IPEDS, the CIP of the physics program 40.0801 tells us regarding the profession of physics program.From the O*NET , we get the following data for a physicist:

$$\begin{aligned} \text{the annual median/mean wages}, W &= \$122,850 \\ \text{the number of employments}, N &= \$19,200 \\ \text{the mean projected growth over the years in percentage}, i &= 8.5\%. \end{aligned}$$

From these data,

$$\text{the current demand}, CD = W * N = \$2.35872 \times 10^9$$
$$\text{the projected growth in demand}, PD = i * W * N = \$0.2 \times 10^9.$$

2 Programs with multiple opportunities

For some programs, there may be multiple opportunities in the market. For example, the computer science program has demand in software engineering, hardware engineering, database administrator, etc. For these cases, we are using a weighted average of all the avaiable opportunities to compute the overall demand for the program. The available opportunities for a program can be collected from the IPEDS. And the demand data can be collected from the O*NET for each opportunity. Let, for the t-th demand category,

$$\text{the annual median/mean wages} = W_t,$$
$$\text{the number of employments} = N_t,$$
$$\text{the mean projected growth over the year in percentage} = i_t.$$

Then,

$$\text{the overall annual salary}, W = \frac{\sum_{t=1}^{n} N_t * W_t}{\sum_{t=1}^{n} N_t}$$
$$\text{the overall projected growth over the years in percentage}, i = \frac{\sum_{t=1}^{n} N_t * i_t}{\sum_{t=1}^{n} N_t}$$
$$\text{the average number of employees}, \bar{N} = \frac{\sum_{t=1}^{n} N_t}{n}.$$
$$\text{The current demand}, CD = \bar{N} * W,$$
$$\text{The future demand}, FD = (1 + i) * \bar{N} * W$$
$$\text{The projected demand}, PD = FD - CD = i * \bar{N} * W,$$

where, $t = 1, 2, ..., n$ For example, we are considering the Computer science program for the weighted average demand calculation. From the IPEDS and O*NET we get the following categories of demand:

Opportunity	Annual median wage	Number of employees	Mean percentage of growth
Computer Hardware Engineers	117220	64400	5%
Software Developers	107510	421300	8.5%
Computer Programmers	86550	250300	-2%
Computer Network Architects	112690	159300	5%
Network and Computer Systems Administrators	83510	383900	5%
Computer and Information Systems Managers	146360	414400	11%

Table 1: Opportunities in Computer Science Program with demand data

From these data in Table 1, we get

$$\text{the current demand}, CD = W * N = \$30.86 \times 10^9$$
$$\text{the projected growth in demand}, PD = i * W * N = \$0.019 \times 10^9$$