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# *Helping Our Heroes: A Study of Hiring Hero Business and Logistics Data*


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## Summary

With the availability of logistical and business data from Hiring Heroes USA, we strive to provide insights to client services and new service initiatives such as spouse and volunteer services. Our machine learning model gives reasonably prediction on job placement date based on clients' demographic information. LinkedIn profiles help find job placements. The utilization of volunteer services helps clients obtain multiple offers and a generally higher salary; yet clients using volunteer services tend to wait longer before getting hired. Veteran spouses tend to be under-employed, but services to spouses are more effective.

## 1) Problem and Motivation

With the availability of logistical and business data from Hiring Heroes USA (HH), we strive to provide insights to improve the organization's business decisions on client services, as well as to shed light on new service initiatives such as spouse and volunteer services [1-3]. Answering these critical questions based on data analytics will assist HH in making sound business decisions and evaluating if more resources should be devoted to spouse and volunteer services. Some of our most important findings are as follows:

- Client services: We built a Linear SVM model to predict job placement date. Veterans with LinkedIn profiles are more likely to find job placements. Clients who spend longer in the military register quicker after separation, and HH is mostly used by veterans in Georgia & Colorado.
- Volunteer services: The utilization of volunteer services helps clients obtain multiple offers and a generally higher salary. Clients that use volunteer services tend to wait longer before getting hired. Therefore, with better management and promotion, clients may be able to utilize volunteer services more effectively.
- Spouse services: Veteran spouses with higher education levels are less likely to drop out in the initial assessment process. Comparing with veterans, their spouses tend to be more under-employed. However, spouses helped by HH can find jobs better than veterans helped by HH, while spouses tend to stay with our service more as well.

## 2) Tools and Data

We used Jupyter Notebook with Pandas to clean up the datasets provided by HH [3]. We removed null values when appropriate and extrapolated missing values, and converted data types. Tableau Prep was used partially to handle multi-entry data, especially for the analysis where clients may have multiple hiring records with numerous offers. When analyzing the data, we also joined multiple tables via inner joins. Visualizations and analysis were completed using seaborn and sklearn packages. We also used Tableau to visualize data.

In addition to using the datasets from Hiring Heroes USA, we also obtained demographic data on 2016 veteran population from the U.S. Department of Veteran Affairs [4].

## 3) Results

In this section, we will provide the motivations, analytics, and results for business questions related to client services, volunteer services, and spouse services, respectively.

### 3.1) Client Services

**Motivation**

As the core business of HH, client services are essential to the success of the HH organization. We analyzed past behaviors of the client base and applied Machine Learning to provide insights to HH based on each client's profile. Specifically, we isolated most beneficial features to job searches, provided a job placement time predictor for clients with different backgrounds, and evaluated HH's geographical coverage and program effectiveness.

**Results**

Our main goal is to build a machine learning model to predict how long it takes (in months) for each client to get hired from their account creation date. We experimented different models using

10-fold cross-validation using the 27,117 known hires after removing about 5% of the outliers. Our feature vector has 86 independent variables including 1) the client's demographic features: race, gender, highest level of education, military service rank, whether the spouse is employed, military service branch, and employment status 2) whether the client participated in the following services: virtual workshop, VCF, volunteer services, resume tailoring tips, federal services, value proposition, interview skills, and on job board; and 3) the time it takes for the client to complete resume and assessment.

The best-performing model is a regression with Linear SVM. The model predicts a job placement date based on the features of a client mentioned above. 47.4% of clients' job placement date are within two months from the predicted data and 75.4% within four (Fig. 2, Slide 2). Our model applies to all clients with detailed HH profiles. In terms of demographics, a client tends to be able to find job placement quicker if he or she has a 4-year degree or above, is white, is male, has a higher rank in the military, and has an employed spouse. In terms of preferred contact method, clients are more likely to find a job if they are active LinkedIn users, with a 49.15% hiring rate among all LinkedIn users in HH (Fig. 3, Slide 3). In terms of HH services, the most helpful one is the virtual workshop, which reduces clients' average time to get hired from 6 months to 5 (Fig. 4, Slide 3).

We also analyzed different clients' registration time for HH service among different demographic groups. We used the time between the military separation date and the account creation date as the registration time. Then, we computed the registration rate for each state by dividing the number of registered HH clients in that state by the state's total veteran population obtained from U.S. Department of Veteran Affairs. Generally, clients who spend longer in the military register quicker after separation, with two registration peaks at 4 and 20 years in the military (Fig. 5, Slide 4). The average time to register for males is 2.75 years, but those with a Doctor degree need more than 8.3 years. For females, the average time to register is three years, but African American and Caucasian females need more time to register, averaging 6.38 and 5.89 years respectively (Fig. 7, Slide 4). Geographically, the south-eastern regions have a higher registration rate than the west. HH is most popular in Georgia, and Colorado, with 2.32 and 2.12 veterans registered per 1000 veterans (Fig. 6, Slide 4).

## 3.2) Volunteer program

**Motivation**

Volunteer program gathers experienced employees from different companies and industries to help clients and their families. As one of the most accessible and personally suited services (compared with general campaign and workshops), the quality of volunteer program may affect how possible clients will choose to use HH as their job searching platform. If career counseling has a positive effect on job search, HH may also invest to expanding this program and helping more clients who are in need.

**Results**

When analyzing the provided dataset, we made the following assumptions: 1) time cost of job search is calculated as (*confirmed_hire_date – account_creation_date*); 2) the lower bound of an interval is chosen to represent a client's salary. For example, $50,000 will stand for the salary interval $50,000 - $59,999. And 3) clients are considered volunteer program users if the service program status is completed or in progress. Those with other status will be considered as not validly utilizing the volunteer program.

First, we analyzed if the volunteer program helps shorten the time spent on finding a job. Surprisingly, we observed that users of the volunteer programs are more likely to wait longer before hiring confirmation (2-sample t-test, p-value < 0.05). This may be because the clients who made use of the volunteer programs became more confident with themselves and tend to wait longer until a satisfying job (Fig. 8, Slide 5). On the other hand, clients using the volunteer program are

likely to find jobs with better quality. As shown in Fig. 8 in Slide 5, more volunteer program users earn salaries higher than $50,000.

We also observed that most effective service types are not the most popular services used by clients. Hired clients mostly requested for mock interview, industry specific and LinkedIn review. However, clients who use job search practices, LinkedIn review or resume feedback get hired the fastest. This discrepancy shows that clients may have a biased understanding of which volunteer requests may be the most effective. (Fig. 9, Slide 6)

Among the clients that submitted post hire requests, there are 39 clients who have new confirmed offers after their requests. Out of the 39 clients, 8 of those maintain the same salary level, 21 of those have a salary increase and 10 of those have a salary decrease. Thus, we can see that volunteer requests are helping some clients to get better offers compared to the initial offers. Among the clients who have salary decrease, we find out that most of them have a significant change in working location or position. Therefore, services are used to improve the working environment. Our results also show that clients who get multiple hires are more involved in volunteer programs (Fig. 12, Slide 7) with the Chi-Square critical value being 86.74 (p-value < 0.001).

To conclude, the analysis of the volunteer program shows how much it helps with clients to get jobs with higher quality. Meanwhile, this program does not seem to have achieved its full potential. If HH would invest more to manage the efficiency and promote the utilization among clients, the volunteer program could be highly potential in attracting and assisting more clients for veterans.

## 3.3) Serving Spouses Program

**Motivation**

As a new project that serves military spouses, a critical group related to core clients, Serving Spouses Program has the potential to make a significant impact on HH's business model. We analyzed the data for the spouses to answer: who tend to remain underemployed and underemployed; does education level affect the black rate for military spouses; and how underemployed spouses we helped have been employed vs. stop getting helped from HH without a confirm hire.

**Results**

To find the effect of education on the black rate of spouses (black: end the service before finishing the initial assessment), we calculated the proportion of spouses who turned black, separated by their education levels. The result shows that a higher education level means a lower black rate for spouses, a trend more strictly than veterans (Fig. 13, Slide 8). We recommend that more emphasis might be put on spouses who only have a high-school education.

To zoom into the spouses' employment status, we compared spouses by their status label to that of the veterans. Noticeably, the ratio of under-employed to unemployed for spouses is 0.17, higher than 0.12 for veterans. Moreover, spouses have undesirable statuses combined of 63.5%, while veterans only have 37% (Fig. 15, Slide 9). Thus, compared with veterans, spouses indeed are more underemployed than unemployed, as desirable employments are even fewer.

To find out the effectiveness of our spouse service, we separated spouses by their color-turning status and their work status, while comparing against veterans. Comparing to the veterans, spouses tend to get hired than to stop getting helped from HH without a hire (Fig. 16, Slide 9). With our service, under-employed spouses (the same trend with the unemployed) find jobs better than the general clients, instead of stop getting serviced.

In conclusion, spouses do struggle more with employment, and the lower the degree, the lower the motivation to get help; but our program seems to help spouses to get more jobs.

## References


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