Unemployment Benefits Calculation Using Knowledge Systems

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Abstract: The knowledge system is a more general type of expert system, but nowadays both terms are taken as synonyms. It is one of the most successful applications of artificial intelligence. They have flourished since the first demonstration in the 1980s and are now used in many areas where complex task decisions need to be simulated based on detailed and directly expressed expertise or judgment. The aim of our article is to create a knowledge system that will be able to insert, delete and edit individual knowledge and choose between different knowledge bases. The knowledge of this system will be applied to issues related to decisions on inclusion in the register of job seekers. In the event of an entitlement to unemployment benefits, the system calculates its amount in accordance with the Employment Act No. 435/2004 Coll. The system will make decisions based on the questions it asks.

Keywords: Knowledge system; unemployment benefits; decision making; labor market

JEL Classification: Z11; E27; D44

1. Introduction

Comparing Artificial intelligence (AI) is an area used in many disciplines, including neurology, philosophy, psychology, computer science, robotics, and linguistics. It focuses on imitating human behavior and thinking. Prior to interest in commercial applications, they were used only in research centers. Nowadays, popular areas of AI include mainly artificial neural networks, genetic algorithms, knowledge / expert systems and much more. (Provazník, 1999)

Knowledge systems (KS) work on the principle that the user provides various facts and receives expert advice in response to the system. The current KSs can explain the process of their own reasoning and thus the final statement. If the user is an expert, the system serves as a support that can help to find a solution to the problem more effectively. Decision-making, planning, classification, etc. are included in the evaluation. To define a problem in the KS language, it is not necessary to have knowledge of how to program in low-level languages. Only simple "what should happen under what conditions" rules are created. (Provazník, 1999)

The KS is divided into several parts. The most important parts are the knowledge base containing the knowledge and the inference mechanism that takes care of their processing.

It is further divided into an explanatory module, which describes and explains the reasoning process, the knowledge acquisition module, through which new knowledge is entered into the system, and the I / O interface, which is most often represented as a dialog mode where the user answers the system query. By separating knowledge from the mechanism of its use, KS differs from classical programs. The characteristic of KS is the possibility of decision-making under uncertainty and the ability to explain. (Berka, 1998; Dvořák, 2004)

The effect of unemployment benefits has been one of the key issues for most political parties in recent years. High levels of unemployment benefits affect work incentives, and people prefer voluntary unemployment and prefer free employment. Thus, the corresponding number of candidates cannot be found for low-paid jobs. This view is supported by a number of economic studies (Mikael Randrup & Raza, 2018). There is a substitution and pension effect. It can be deduced from this that a reduction in the compensation rate will lead to an increase in the labor supply and thus to a reduction in the unemployment rate (Mikael Randrup & Raza, 2018). Other authors' (Farber & Valletta, 2015) estimates suggest that the next month's extended benefits will increase the unemployment period by about 0.06 months, which is slightly below the lower limit of past estimates (Katz & Meyer, 1990). They found that a one-week increase in the potential duration of benefits increased the average duration of unemployment for AI recipients by 0.16 to 0.20 weeks (Katz & Meyer, 1990).

It is also necessary to monitor what external factors cause unemployment (e.g. trade, technology, recession, supply shocks, changing consumer preferences, economic cycles, etc.) (Guo & Johnston, 2021).

2. Methodology

2.1. Basic Idea

It is impossible without the law to calculate the amount of unemployment benefit or to verify whether a person has the right to be included in the register of job seekers. This application therefore provides expert decisions based on the potential candidate's answers to the questions asked. With each question, the user's answer is kept, as well as the paragraph to which it belongs. As a result, it is not only a decision, but also a list of labor laws for easier orientation or as supporting data for further user action. This application therefore serves every unemployed person who is not sure of the regulations and wants to verify whether in his case there is a possibility of entitlement to support or at least meets the conditions for inclusion in the register of job seekers and with it the payment of health insurance. On the other hand, it also serves for people who work very well in this sector or are familiar with employment laws and all implementing regulations. We will continue to talk about such people as experts. The expert can edit questions and constants for calculation in the knowledge base. Since such numbers change every year and the application would no longer have to be up to date, an editing mode is implemented here.

The proposed knowledge system is designed for a specific example with the possibility of easy extension and built on the calculation of support. If the legislation that changes the way the aid is calculated changes, adjustments must be made to the application. Other changes in legislation do not affect the application, only its knowledge base.

2.2. Implementation

The choice of ways to specifically implement the knowledge system was based on the fact that it will be designed to address the issue of inclusion in the register of job seekers and the granting or non-granting of unemployment benefits. The program's ability to be easily scalable includes the ability to be used for a completely different knowledge system. The program was based on a valid calculation from editable variables, where the last legislative change for the calculation of support is valid from 1 January 2011. The Java object-oriented programming language was chosen for implementation.

Knowledge retrieval was implemented as a binary search over the list. The time average complexity of this algorithm is in this case equal to O ($\log n$).

The user interface is created using JavaFX FXML, an XML-derived markup language. It is a platform based on the Java platform, which creates a graphical interface. The open-source application JavaFX Scene Builder 8.5.0 was used to create the design of the knowledge system. This application allows you to create a graphical interface using the operation "Drag and drop" or dragging components to the displayed window, without the need to write in the above-mentioned markup language.

The system is divided into two interfaces. For the part adapted for the expert and the part for the average user. The transition between these two separate modes is done through the menu in the menu. The menu also contains items such as load another knowledge base or help, which contains an item for a short description of the application and the display of the manual. Expert mode focuses on knowledge-based operations such as editing, deleting, or adding knowledge or variables. The expert sees a statement of the entire knowledge base and for detail he always chooses one knowledge or variable with which he can perform other tasks. The average user has a simpler environment, he only runs evaluation.

3. Data and Results

3.1. Actual Situation on Labour Market in the Czech Republic

The registered unemployment rate was 3.86% in 2021 and increased by 0.35% compared to 2020. The registered unemployment rate is lower than the natural unemployment rate. This situation on the labor market causes an excess of labor demand over labor supply. The increasing nominal wage is based on this. Average gross nominal wages rose to 6.1% in 2021 (Czech Statistical Office, 2022). In 2020, growth was only 3.1% (see Figure 1). However, this decline was caused by the Covid-19 pandemic. However, due to government measures, there has been no significant increase in the registered unemployment rate (Hedvicakova, 2018; Hedvičáková & Svobodová, 2017; Král, 2017).

In December 2021, expenditures related to unemployment benefits reached CZK 725.0 million (see Figure 2). A total of CZK 9,969.5 million was paid in unemployment benefits (approximately 98.9% of the state budget -– 10,080.7 million CZK) in 2021.

The share of unemployed persons in December 2021 increased by 0.2 pp compared to November 2021 to 3.5%, compared to December last year it decreased by 0.5 pp (December 2020 – 4.0%).
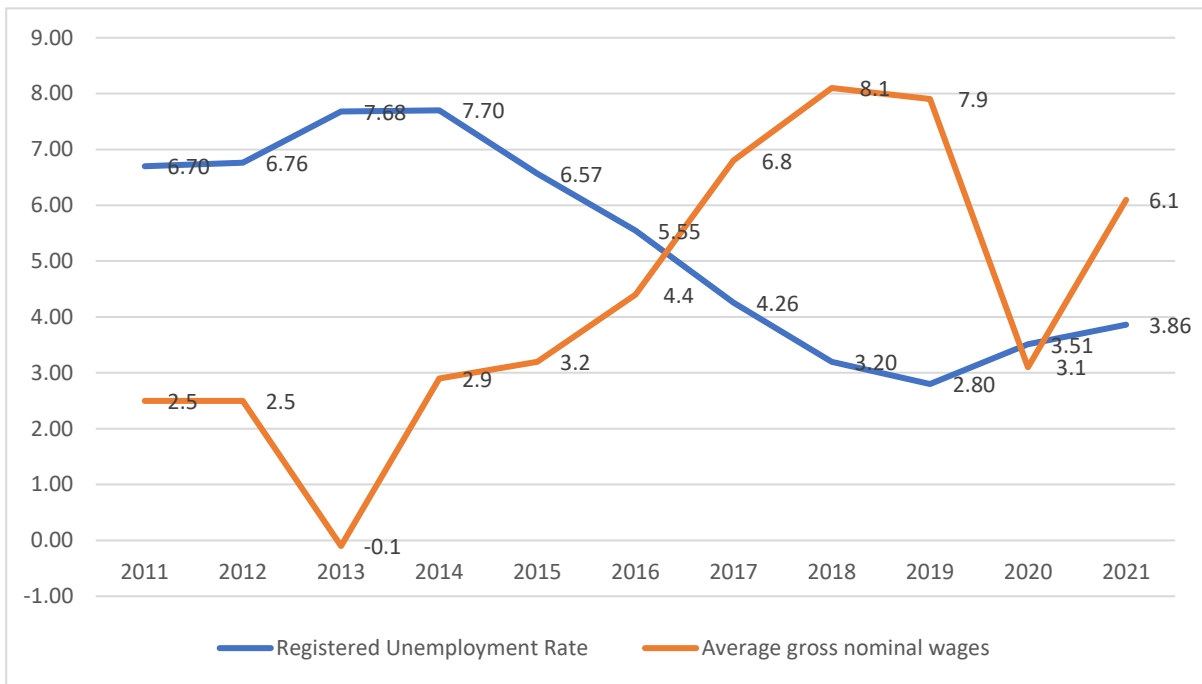
Figure 1. Registered unemployment rate and average gross nominal wages in % (Czech Statistical Office, 2020)

Number of jobseekers who were entitled to unemployment benefits at the end of December 2021 (an indicator that significantly affects the amount of unemployment), reached about 82.3 thousand, i.e. 31.9% of the total number of 258.2 thousand persons kept as of 31 December 2021 in the records of the Labor Office of the Czech Republic. (MPSV, 2022)
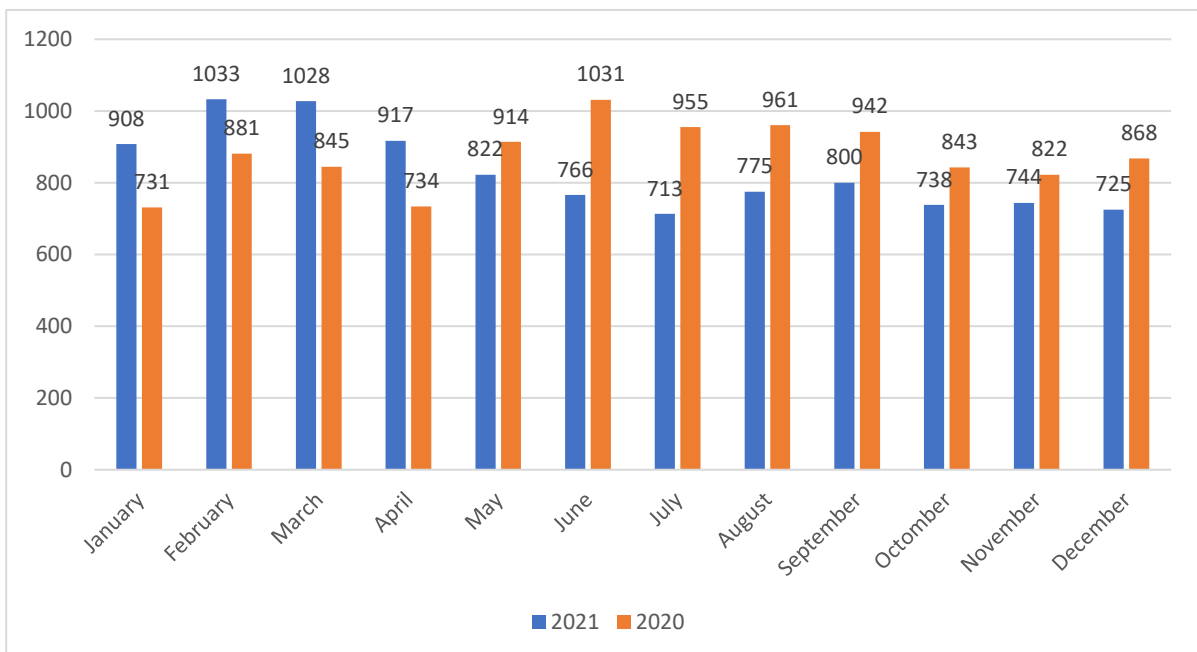

Figure 2. Development of expenditure on unemployment benefits in millions of CZK (MPSV, 2022)

3.2. Data

A user who is entitled to be registered must meet certain conditions. He is not a self-employed person and is not in an employment relationship or employment relationship. This condition does not apply to such an employment relationship, employment relationship or employment agreement, where this activity is not rewarded with a monthly salary higher than half of the minimum wage (we speak of so-called non-conflicting employment). Assuming that the earnings are lower, he is entitled to be included, but he is no longer entitled to unemployment benefits compared to the others (this also applies to zero earnings). For the year 2021, this amount is set at CZK 7,600. Furthermore, he may not perform the activities of a compulsory administrator, procurator or liquidator. He is not a member of the council of a territorial self-governing unit that receives remuneration as a dismissed member, a foster parent who is paid a foster parent's remuneration, a judge, a deputy or a senator. If the user is a full-time student, he / she must meet the condition that he / she has been employed or has had another gainful activity with participation in the pension insurance for at least 12 months in the last two years. A natural person who is recognized as temporarily unable to work, receives maternity allowance, is 6 weeks postpartum, is fully disabled in the third degree, is unable to work under completely extraordinary conditions, or is serving a custodial sentence cannot be included in the records, security detention or is in custody.

In order to fulfill the claim, the user must have, during the relevant period, which is set at two years, be employed or have another gainful activity with participation in the period of pension insurance. The spare time is also included in this time. The replacement period is the period during which the user cared for a child under the age of 4, cared for a natural person dependent on the help of others of at least grade II (moderate dependence) or received a full invalidity pension for third degree invalidity. At the same time, the user must not have ended up in his last job due to a breach of an obligation under the labor law applicable to his work or a breach of another duty in a particularly gross manner. (Labor law, 2019)

If the user has received support in the past and meets the requirements see above, then he is entitled to support under the following conditions. He was employed or had another gainful activity with a pension for at least 6 months after the support period. If the entire support period has not expired and he has been active in the pension insurance for at least 3 months after the end of his activity, he is again entitled to the entire support period, otherwise he is entitled to the remaining part of the support period which he did not use in the previous records or previous records. (Labor law, 2019)

The maximum amount of support is derived from the average wage in the national economy for the first to third quarters of the previous calendar year (hereinafter referred to as the "average wage"). For the year 2021, this amount corresponds to CZK 34,611. The maximum amount of support is 0.58 times. The support period, the so-called support period, is determined by the age of the user. It is set at 5 months until the age of 50, it is 8 months for the age between 50 and 55 and 11 months above the age of 55. In the first two months of this period, 65% are taken, the next two months 50% and the rest of the support period 45% of the average monthly net earnings of the last job. There is an exception when the user has

terminated the employment himself or in agreement with the employer, then it is 45% for the entire support period. If he is entitled to a retirement allowance, he is entitled to the difference between that allowance and the aid that would accrue to him. If this difference is inconsistent, he is not entitled to support. If the condition of previous employment is met by counting the replacement period and this period was the last activity performed, the support is 0.15 times in the first two months, 0.12 times for the next two months and 0.11 times the average wage for the remaining support period. The beginning of the payment of support is shifted by the number of times the average monthly earnings of the user from the paid severance pay.

3.3. Model Examples and Results

In this chapter we will show the results of the application on model examples. For the first example, we have a man aged 24 who is a full-time college student. The application for the given example evaluated that the student is not entitled to inclusion in the register of job seekers according to § 25 paragraph 1, letter r) of Act No. 435/2004 Coll., on employment.

In the second case, we have a woman aged 26, a full-time university student with a terminated employment agreement, participating in a pension insurance period of 13 months in the last two years, where she had an average monthly net income of CZK 4,500. She ended this activity by agreement. In this case, this student is entitled according to § 25 paragraph 4 of Act No. 435/2004 Coll., on employment.

For the third example, we have a man who is 56 years old. He worked for the company for 15 years and ended up for organizational reasons (his position was canceled). His average monthly net earnings were CZK 65,450. After leaving the job, he received a three-month severance pay, depending on the length of his employment. This man will receive the maximum possible support for a period of 11 months, which is postponed by 3 months due to the right to severance pay (see Figure 3).
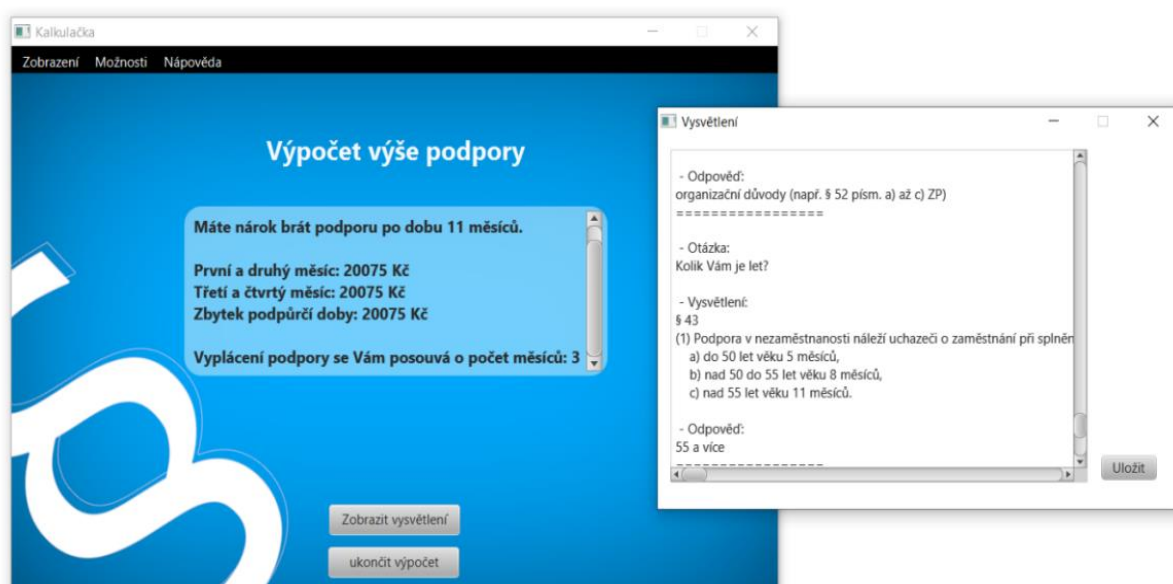

Figure 3. Calculation for 3 example (Letáček, 2021)

4. Discussion

Given the current situation, where there is high inflation in the market and there is a constant increase in the average and minimum wage, it is necessary to have a tool that quickly calculates the current amount of unemployment benefits or whether it is entitled to it at all and for how long. There are already several calculation tools on the market, but not all of them are user-friendly.

The economic literature states that increasing the labor supply does not automatically lead to an increase in employment. The level of employment is also affected by effective demand in the goods market. From this it can be deduced that unemployment is a demand-driven problem and not a function of high real wages or high unemployment benefits (Mikael Randrup & Raza, 2018). Okun's law and its effects on unemployment growth and GDP growth can also be applied. Another study (Marinescu et al., 2021) states that during the COVID-19 crisis, a 10% increase in unemployment benefits due to the Federal Unemployment Pandemic Assistance (FPUC) led to a 3.6% decline in Glassdoor job applications.

Another study (Doris et al., 2020) found that the reduction in unemployment benefits also affects very young people (18- and 19-year-olds), for whom the unemployment period has decreased significantly (especially for 18-year-olds). The knowledge system we have proposed could be beneficial for this age group as well.

The study (Rotar & Krsnik, 2020) analyzed the relationship between unemployment benefits and the length of unemployment with regard to different approaches to social policy between EU countries. The authors conclude that unemployment benefits have counter-effects and prolong unemployment. National governments should take effective action to ensure optimal unemployment benefits. Emphasis should be placed on an active unemployment policy rather than a passive one.

Last but not least, it is necessary to monitor what percentage unemployment benefits contribute to state budget expenditures and how they develop over time and with regard to the phases of the economic cycle.

5. Conclusions

Aim of the article was construction of a knowledge system that we created in the NetBeans environment, where it was programmed using the Java programming language. Once created, we began to fill this empty system with knowledge in collaboration with an expert on labor law. This raised 33 questions concerning the inclusion in the register of jobseekers and the calculation of unemployment benefits. All solved possibilities in the knowledge base are described in the third chapter, where they were subsequently tested with specific examples.

Unemployment benefits are a comprehensive and topical issue for most governments. Governments are trying to find an appropriate level of unemployment benefits that would serve as sufficient social support while stimulating active job search. An active employment policy is a better way than a passive unemployment policy. The proposed application would help job seekers to orientate themselves in this complex issue.

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