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Determining the factors affecting the happiness levels of divorced individuals by ordered logistics regression analysis

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ABSTRACT

In cases where the dependent variable is categorical and ordinal, the Ordinal Logistic Regression Model is used for model estimation. In order to predict the Ordinal Logistic Regression Model, it must provide the parallel lines assumption. In the study, the happiness levels of divorced individuals were estimated with the ordinal logistic regression model. The data set used in the analysis was obtained from the Life Satisfaction Survey implemented by the Turkish Statistical Institute in 2020. Brant's Wald Test and Likelihood Ratio Test were applied for the parallel lines assumption and the null hypothesis could not be rejected. In this context, the model ordinal logistic regression model was estimated. The statistically significant gender variable shows that divorced women are happier than divorced men. It has been determined that success and job variables tend to decrease happiness levels in divorced individuals compared to other factors. In general, when the education level is examined, it is seen that the level of happiness of divorced individuals increases as the education level increases. It has been concluded that divorced individuals who are satisfied with their health, education, income and social life are happier than divorced individuals who are not satisfied with their health, education, income and social life. It has been determined that divorced individuals are registered with the Social Security Institution and their happiness levels are higher than those who are not registered.

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1. Introduction

Some dependent variables encountered in data analysis can take categorical values. Many special statistical methods have been developed for the analysis of categorical data. Categorical data can be multi-class or ordered. The statistical method used when the dependent variable is categorical and ordinal is defined as the Ordered Logistic Regression Model.

The dependent variable, which is considered in many types of research and practices, can be in an ordinal structure. E.g.; There may be dependent variables in at least 3 categories such as life satisfaction level (dissatisfied, moderate, satisfied), happiness level (unhappy, moderate, happy), disease severity (mild, moderate) and in an ordered structure. In this case, the statistical method to be used should be determined as the Sequential Logistic Regression Model. In cases where the dependent variable is categorical and ordinal, using other regression models will result in erroneous results.

Sequential logistic regression models have been widely used in many fields such as medicine, economics, biology, zoology, education, and social sciences in recent years. In this study, the dependent variable was determined as the happiness levels of divorced individuals. In this context, some studies in the literature examining the factors that may affect the happiness or life satisfaction levels of individuals are as follows:

In Akın and Şentürk's studies; They used the 2007 European Quality of Life Survey dataset. They used happiness level as a dependent variable in the study, independent variables are Gender, Marital Status, Age, Educational Status, Occupational Status, Income, Work Sector, Lived Area/Settlement and Health. In the conclusion part of the study; it has been observed that as the income level increases, happiness also increases, students and retirees are generally happy, and individuals between the ages of 18-24 and 65 and over have a high level of happiness. In addition, the increase in the level of education caused a decrease in the level of happiness with the effect of not reaching the level of welfare that the individual expected after a certain level [3].

In the works of Boxwood and Generous; They used the 2010 Life Satisfaction Survey data set. They used happiness level as a dependent variable in the study, independent variables are Income level, Employment, Employment status, Sector, Gender, Age, Marital status, and Settlement status. In the conclusion part of the study; It has been determined that those with low-income levels are less happy than those with high income, men are less happy than women, and individuals aged 65 and over are happier than other age categories. It has been concluded that married individuals are happier than individuals living separately. It has been determined that those living in the city are less happy than those living in the countryside. It was concluded that employment, job status and industry variables did not affect happiness [18].

In Bee and Star studies; They used the 2014 Life Satisfaction Survey data set. The level of happiness was taken as the dependent variable in the study. Independent variables; gender, marital status, last completed school, employment status, health, education, residence, income, social life, relations with relatives, relations with friends, relations with neighbors, health services, public order services, legal services, education services, SGK services, transportation services determined as satisfaction. In the study, the Proportional Ratio Model, the Non-Proportional Ratio Model and Partial Proportional Ratio Model, which are sequential logistic models, were applied and these models were compared in terms of goodness of fit. As a result of the application, it was found significant in all three models. However, although the Proportional Ratio Model was found to be significant, the Parallel Lines Assumption required for the use of this model was not provided. When the Non-proportional Ratio Model and Partial Proportional Ratio Model were evaluated in terms of goodness of fit criteria, it was determined that the Partial Proportional Ratio Model was the most suitable model for the data set [5].

In his study, Servet used the 2004 and 2014 Life Satisfaction Survey datasets. He used happiness level as a dependent variable in the study, independent variables are household income, age, gender, education level, health satisfaction, welfare level, and need satisfaction. In the study, the years 2004 and 2014 were examined comparatively. As a result of the analysis, it was determined that the happiness levels of men increased in the intervening time. It has been concluded that individuals are happier as they get older. It has been determined that the happiness levels of married individuals decrease over time [15].

Sönmez and Altınsu Sönmez used the World Values Survey (WVS) Turkey data set in their studies. They used life satisfaction as a dependent variable in the study, independent variables are happiness, age, gender, being married, number of children, employment status, educational status, income status, skill, satisfaction with income, world citizen, social class, the importance of God, participation in religious services, destiny or control, cognitive task. In the study, individuals with high skills and higher income are less satisfied with life than individuals with no skills and low income. It has been determined that individuals with higher education levels, employed individuals and cognitively working individuals who believe that they shape their own destiny have higher life satisfaction. It has been determined that women have higher life satisfaction than men. It has been determined that individuals who participate in religious activities more frequently have higher life satisfaction than those who do not. In addition, it has been concluded that individuals with high social class are more satisfied with their lives than individuals with low social class. It is also among the results that the elderly people have higher life satisfaction than the young people [16].

Yılmazer used the 2018 Life Satisfaction Survey data set in his study. He used life satisfaction as a dependent variable in the study, and independent variables are happiness, employment status, marital status, and gender. In the study, it was concluded that individuals who are very happy and happy have higher life satisfaction than unhappy individuals. Another result obtained in the study is that working individuals have higher life satisfaction than non-working individuals [20].

Some studies in which life satisfaction or happiness levels were determined as dependent variables in the literature review and these dependent variables were estimated by ordinal logistic regression model are given above. The dependent variable in this study is the happiness levels of divorced individuals. No study has been found in the literature on the happiness levels of divorced individuals.

In the next part of the study, the ordinal logistic regression model, which is one of the logistic regression models and the analysis method of the study, is introduced in detail.

In the application part of this thesis, it is aimed to determine the factors affecting the happiness levels of divorced individuals. In the application section, the data set used in the analysis was introduced and descriptive statistics were given by the purpose. The results of the assumptions and estimation of the ordinal logistic regression model are also included in this section.

In the conclusion part of the study, a general evaluation was made and suggestions were made for future studies.

2. Materials and methods

2.1. Ordered logistic regression model

The ordinal logistic regression model is a logistic regression model used when the dependent variable has more than two categories and is sortable. Many examples such as satisfaction level (from dissatisfied to satisfied), happiness level (from unhappy to happy), disease severity (from least severe to most severe), and income level (from low to high) can be given to the dependent variable in the ordinal structure. Ordinal logistic regression is a logistic regression model used to model the relationship between categorical dependent variables in an ordinal structure and continuous or discrete independent variables. Assuming that the dependent variable in the ordinal structure has j categories, there are j-1 logistic model variations used to predict this model. This situation reveals whether the estimated regression coefficients and probability values differ according to the categories of the dependent variable of the model [10].

Since there is a hierarchy between the categories of the dependent variable in the ordinal logistic regression model, the model differs from the multinomial logistic regression model in this respect. Another difference between these two multi-category models concerns the selection of reference categories. In the multinomial logistic regression model, the reference category can be selected as any category of the dependent variable. However, since the ordinal logistic regression model uses the assumption that the categories of the dependent variable are parallel to each other, the reference category is usually determined as the reference category with the highest value [6].

Since non-linear models are used in models created with ordinal structure and categorical dependent variables, the Maximum Likelihood method is used when estimating the model. Odds (difference) ratios are generally used in the interpretation of the ordinal logistic regression model [14].

2.1.1. Hidden variable theory

In the ordinal logistic regression model, it is assumed that there is an unobserved latent variable y^*, which varies between -∞ and +∞, under the dependent variable y in the ordinal and categorical structure. The dependent variable y is shown in Eqn. 2.1 [13].

When $y_i = j$ then $\tau_{j-1} \le y_i^* < \tau_j \; j = 1,2,\dots,J$ (2.1)

"j" indicates the category number of the dependent variable. τ represents the breakpoints or thresholds. i and J represent extreme categories. In this context, it is defined as $\tau_{j-1} = \tau_0 = -\infty$ and $\tau_j = \tau_J = +\infty$ E.g.; Suppose that individuals' happiness levels are determined as an ordinal categorical variable. Suppose that happiness levels are divided into 5-point Likert-type categories as "1-Not at all happy", "2-Not happy", "3-Medium", "4-Happy" and "5-Very happy". This ordinal categorical dependent variable is assumed to be associated with a continuous latent variable y^*. The relationship between the observed y and the latent variable y^* is expressed as in Eq. 2.2 [13].

$$y_i^* = \begin{cases} 1 = Hiçmutludeğil\tau_0 = -\infty \le y_i^* < \tau_1 \\ 2 = Mutludeğil\tau_1 \le y_i^* < \tau_2 \\ 3 = Orta\tau_2 \le y_i^* < \tau_3 \\ 4 = Mutlu\tau_3 \le y_i^* < \tau_4 \\ 5 = Çokmutlu\tau_4 \le y_i^* < \tau_5 = +\infty \end{cases} \quad (2.2)$$

The relationship between the y categories observed from the y^* latent variable is shown in Figure 2.1 [13].

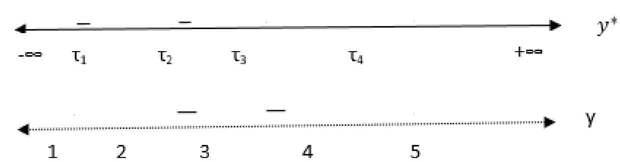

Figure 2.1 *Obtaining y observed categories from the hidden variable y^**

The τ_j values shown in Figure 2.1 are the breakpoints. In the example, since the dependent variable has 5 categories, 4 cut-off points are calculated while creating the model. The cut-off point varies depending on the category number of the dependent variable. The number of breakpoints is one less than the number of categories of the dependent variable [11].

2.1.2. Distribution assumptions

The Maximum Likelihood method is used to estimate the model established with the latent variable y^* [13]. To use the Maximum Likelihood method, the error term must have a certain distribution. The logit model is used when the error term has a logistic distribution. The ordered logit model shows a logistic distribution with ε error term mean zero and variance $\pi^2/3$ [13]. The probability density function is shown in Eqn. 2.3.

$$f(\varepsilon) = \frac{e^{\varepsilon}}{[1 + e^{\varepsilon}]^2} \quad (2.3)$$

The cumulative distribution function is shown in Eqn. 2.4.

$$F(\varepsilon) = \frac{e^{\varepsilon}}{1 + e^{\varepsilon}} \quad (2.4)$$

2.1.3. The probabilities of the observed categories

After determining the distribution of the errors, the probabilities of the observed values of the dependent variable y can be calculated for the given values of the independent variable x. The distribution of the latent variable for the three values of the independent variable x is shown in Figure 2.2.

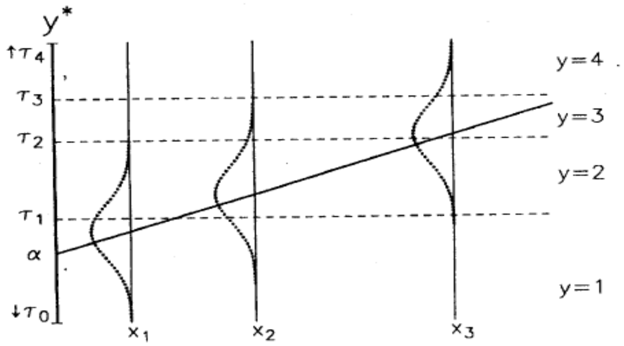

Figure 2. 2. *Scatter plot of Hidden Variable (y*) Given x Values for Ordinal Logistic Regression Model [13]*

The errors are either logistic or normally distributed around the regression line $E(y^*|x) = \alpha + \beta x$. The probability of m corresponds to the area between the cut-off points τ_{j-1} and τ_j. For the probability of the first category of the categorical dependent variable in the ordinal structure, it is expressed as $\tau_0 = -\infty \leq y_i^* < \tau_1$ as shown earlier in Eqn. 2.2 where variable $y^*$is between τ_0 and τ_1 while y=1.

Here, if one independent univariate $y^* = \beta x + \varepsilon$ is substituted, Eqn. 2.5 is obtained [13].

$$P(y = 1|x) = P(\tau_0 \leq \beta x + \varepsilon < \tau_1|x) \qquad (2.5)$$

Here, when βx is removed in the inequality, Eqn. 3.6 is obtained.

$$\mathrm{P}(y = 1|x) = P(\tau_0 - \beta x \leq \varepsilon < \tau_1 - \beta x|x) \qquad (2.6)$$

It is shown in Eqn. 2.7 that the probability of a random variable being between two values is equal to the difference between the cumulative distribution function evaluated at these values.

$$P\big((y = 1|x)\big) = P(\varepsilon_i < \tau_1 - \beta x|x) - P(\varepsilon_i < \tau_0 - \beta x|x)$$

$$F(\tau_1 - \beta x) - F(\tau_0 - \beta x) \qquad (2.7)$$

In this context, the probability of the observed y dependent variable being in m*th* categories is shown in Eqn. 2.8 [9].

$$P(y = j) = F\big(\tau_j - \beta x\big) - F\big(\tau_{j-1} - \beta x\big) \qquad (2.8)$$

The probability of the observed y dependent variable being in the last category is shown in Eqn. 3.9.

$$P(y = J) = F\big(\tau_J - \beta x\big) - F\big(\tau_{J-1} - \beta x\big) \qquad (2.9)$$

Since $\tau_J = +\infty$ is in the $F\big(\tau_J - \beta x\big)$ term in Eqn. 2.9, it is taken as $F(\infty - \beta x) = 1$ [1].

2.2. Parallel Lines Conjecture and Test

The parallel lines assumption assumes that the determining regression coefficients are equal in all categories of the ordinal and categorical dependent variable [7]. If the parallel lines assumption is met, the relationship between the independent variables and the dependent variable does not change according to the categories of the dependent variable. In order to explain the parallel lines assumption, the cumulative probability model of the category with a level equal to or lower than j, which is the number of categories of the dependent variable, is shown in Eqn. 2.10 [13].

$$P(y \leq j|x) = F\big(\tau_j - \beta x\big) \qquad (2.10)$$

The cumulative probability is the cumulative distribution function value in $\tau_j - \beta x$. Since β does not change according to the categories of the dependent variable, Eqn. 2.12 defines the models in which the dependent variable has two categories with different cut-off points. This situation is shown in Eqn. 2.11.

$$\tau_j - \beta x = \big(\tau_j - \beta_0\big) - \sum_{i=1}^{N} \beta_i x_i \; i = 1,2,\dots,Nj = 1,2,\dots,J \qquad (2.11)$$

In this case, the model for $y \leq 1$ is shown in Eqn. 2.12 and for $y \leq 2$ in Eqn. 2.13.

$$P(y \leq 1|x) = F\left((\tau_1 - \beta_0) - \sum_{i=1}^{N} \beta_i x_i\right) \qquad (2.12)$$

$$P(y \leq 2|x) = F\left((\tau_2 - \beta_0) - \sum_{i=1}^{N} \beta_i x_i\right) \qquad (2.13)$$

When Eqn. 2.12 is examined, the model for $y \leq 1$ is with $\tau_1 - \beta_0$ the cut-off point, when Eqn. 2.13 is examined, the model for $y \leq 2$ is with $\tau_2 - \beta_0$ cut-off point. When the Eqn. 2.12 and Eqn. 2.13 equations are examined, and it is seen that the regression coefficients for the variable x_i with different cut-off points remain the same. The graphical representation of the parallel lines assumption for the change in the breakpoints is given in Figure 2.3.

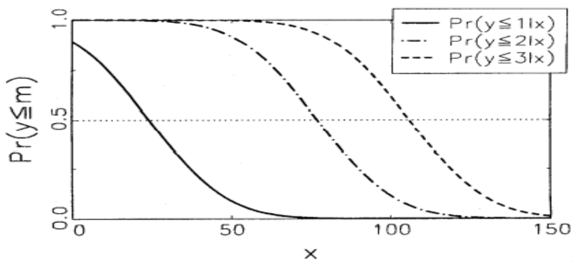

Figure 2. 3. *Graphical Representation of the Parallel Lines Conjecture*

As seen in Figure 2.3, the change in the cut-off points shifts the probability curve to the right or left, but does not change the shape of the curve [13]. When Figure 2.3 is examined, it is seen that cumulative probability lines are belonging to 3 categories. In this case, since it is known that 1 more of the correct number in the graph gives the category of the dependent variable, it is concluded that the dependent variable consists of 4 categories. In Figure 2.3, probability 0.5 is shown with a horizontal line as the midpoint. At this point, Eqn. 2.14 is obtained when 3 probability curves are determined [13].

$$\frac{\partial(y \leq 1|x)}{\partial x} = \frac{\partial(y \leq 2|x)}{\partial x} = \frac{\partial(y \leq 3|x)}{\partial x} \qquad (2.14)$$

Eq 2.14 shows that all regression lines are parallel.
The accuracy and reliability of the results obtained from the created model vary depending on whether the parallel lines assumption is provided or not. Therefore, the parallel lines assumption should be tested. To test this assumption, tests such as the Likelihood Ratio test and Brant's Wald Test are used. Under the assumption of parallel lines, hypotheses are established as shown in Eqn.. 2.15 [17].

$$H_0: \beta_1 = \beta_2 = \cdots = \beta_{J-1} = \beta$$
$$H_1: Enaz\ bir\ \beta\ farklıdır. \qquad (2.15)$$

While the null hypothesis (H_0) in Eqn. 2.15 states that the regression coefficients in the model are the same in all categories of the dependent variable, the alternative hypothesis (H_1) states that the regression coefficients in the model differ in at least one category of the dependent variable.

2.2.1. Likelihood ratio (lr) test

The likelihood ratio test, which is used to test the parallel lines assumption, makes a constrained model estimation and shows how the likelihood function changes when these constraints are removed [7]. In other words, the likelihood ratio test measures the performance of the unconstrained model compared to the constrained model [19]. The proportional ratio model with parallel lines assumption is the restricted version of the non-proportional ratio model. The likelihood of the proportional ratio model is expressed as LR, and the likelihood of the non-proportional ratio model is expressed as LUR. The likelihood ratio test statistic is shown in Eqn. 2.16.

$$LR = -2[lnL_R - lnL_{UR}] \qquad (2.16)$$

The log-likelihood function of the lnL_R the constrained model given in Eqn. 2.16 is the log-likelihood function of the lnL_{UR} unconstrained model. For the LR test statistic, logarithmic transformation and multiplying with the value of -2 is to provide an approximate χ^2 distribution [4]. The degrees of freedom for the χ^2 distribution is k(j-2). Here k represents the number of independent variables and j represents the category number of the dependent variable. The LR test statistic is compared with the χ^2 table value. If the LR test statistic is greater than the χ^2 table value, the H_0 hypothesis is rejected and it is concluded that at least one regression coefficient is different from the others. In this case, the assumption of parallel lines is not satisfied [4].

2.2.2. Brant's Wald test

With the Wald test developed by Brant, it is generally tested that the regression coefficients are equal in all categories of the dependent variable, and it is also shown which variable or variables break the parallel lines assumption [13]. Wald test statistics are obtained by the ratio of the coefficients of the predicted model to their standard errors [2]. The Wald test statistic fits the χ^2 distribution with 1 degree of freedom. The Wald test statistic is shown in Eqn. 2.17 [10].

$$W = \frac{\hat{\beta}_\iota - \beta_0}{sh(\hat{\beta}_\iota)} \qquad (2.17)$$

There is no definite information about which test should be used for the test of the parallel lines assumption, but it is stated that the Wald test proposed by Brant is slightly more powerful than the LR test [13].

2.3. Measuring goodness of fit in the ordered logistic regression model

The determination of how adequate and effective the model estimated in the regression analysis is in explaining the dependent variable can be measured by goodness-of-fit tests. By testing the goodness of fit of the model, it is aimed to obtain a statistical value representing all observation values. Measures such as the deviation measure and the so-called R^2 are used to test the goodness of fit of the model.

2.3.1. Deviance measure

One of the criteria used for the goodness of fit of the model is the measure of deviation. The deviation measure gives the magnitude of the deviation from the actual values. The deviation measure is expressed as shown in Eqn.. 2.18 [8].

$$D = -2(lnL_M - lnL_S) \quad (2.18)$$

The L_M is shown in Eqn. 2.18 represents the maximum likelihood value of any sub-model of the saturated model formed with the independent variables considered to be important, and L_s the maximum likelihood value of the saturated model. The small deviation measure is a condition that should be preferred for the goodness of fit of the model.

2.3.2. Pseudo R^2 value

The R^2 statistic is unsuitable for use with the logistic model. It may appear as a result of some logistic regression analysis but should be ignored. Because the R^2 value obtained in the logistic regression analysis does not give accurate information about the power of the independent variables to explain the dependent variable. Statisticians suggest pseudo-R^2 values suitable for logistic regression models. One of the so-called R^2 values developed for logistic regression models is the McFadden R^2 value developed by McFadden. Eqn. 2.19 is used to calculate the McFadden R^2 value [12].

$$R^2_{McFadden} = 1 - (lnL/lnL_0) \quad (2.19)$$

L_0 given in Eqn. 2.19 represents the maximum likelihood value of the model with only the constant term, and L represents the maximum likelihood value of the model with both the constant term and the independent variables.

3. Applicatıon

In this study, data from the Life Satisfaction Survey (YMA) implemented by the Turkish Statistical Institute (TUIK) in 2020 were used. In practice, it was aimed to determine the factors affecting the happiness levels of divorced individuals who participated in the survey. The Ordered Logistic Regression Model was used in the study due to the nature of the dependent variable. The Chi-Square Independence test was applied to 18 variables that could affect the happiness levels of divorced individuals, and 9 statistically significant variables were determined as independent variables (Table 3.1).

Table 3.1 *Chi-Square Test of Independence Results*

Variable Name	Chi-Square Value	Likelihood	Relationship Status
Gender	6.6873	0.035**	Yes
Educational status	32.7106	0.036**	Yes
Working status	0.8401	0.657	No
How Happy	34.7413	0.000***	Yes
Health Satisfaction	30.5174	0.000***	Yes
Housing Satisfaction	2.2339	0.973	No
Neighborhood Satisfaction	3.9597	0.861	No
Education Satisfaction	26.9324	0.000***	No
Income Satisfaction	39.5058	0.000***	No
Social Life Satisfaction	43.4395	0.000***	No
Job Satisfaction	9.6103	0.293	No
Relative Satisfaction	6.0829	0.638	No
Friend Satisfaction	11.3570	0.182	No
Neighbor Satisfaction	7.3039	0.504	No
Workplace relationship satisfaction	7.7943	0.454	No
Future Life	6.8316	0.337	No
SSI Registration	18.8296	0.000***	Yes
Hope	1.2171	0.544	No

In practice, it is "happiness" in adaptation. Independent abilities; age, war, education status, what makes you happy, health, education, income, social environment, Social Security Institution (SGK) registration requests.
Stata 15.0 statistical package program was used in the study. 10103 people participated in the 2020 Life Satisfaction Survey. By the purpose of the study, individuals who stated their marital status as divorced were selected from the individuals who participated in the survey. It has been determined that 364 divorced individuals participated in the survey.

3.1. Results

3.1.1. Descriptive Statistics

The frequency table of the variables used in the study is shown in Table 3.2.

Table 3. 2. *Frequency table of variables*

Variables	Number of Observations	Percentage (%)
Happiness		
1: Unhappy	98	26.92
2: Fair	159	43.68
3: Happy	107	29.40
Gender		
1: Male	134	36.81
2: Female	230	63.19
Education Status		
1: None	16	4.4
2: Primary School	119	32.69
3: Middle School	65	17.86
4: High School	88	24.18
5: College-	63	17.31
University	13	3.57
6: Postgraduate		
How Happy		
2: Success	23	6.32
3: Job	9	2.47
4: Health	252	69.23
5: Love	52	14.29
6: Money	25	6.87
98: Other	3	0.82
Health		
Satisfaction	206	56.59
1: Satisfied	109	29.95
2: Fair	49	13.46
3: Dissatisfied		
Education		
Satisfaction	192	53.78
1: Satisfied	79	22.13
2: Fair	86	24.09
3: Dissatisfied		
Income		
Satisfaction	100	27.47
1: Satisfied	93	25.55
2: Fair	171	46.98
3: Dissatisfied		
Social Life		
Satisfaction	123	33.79
1: Satisfied	107	29.40
2: Fair	134	36.81
3: Dissatisfied		
SSI Registration		
1: Yes	289	79.40
2: No	75	20.60

When Table 3.2 is examined, 26.92% of divorced individuals state that they are unhappy, 29.4% state that they are happy, and 43.68% state that they are moderately happy. It has been determined that 36.81% of divorced individuals participating in the Life Satisfaction Survey in 2020 are male and 63.19% are female. When the educational status of the divorced individuals participating in the survey was examined, it was determined that the individuals who did not complete a school were .4.4%, primary school graduates 32.69%, primary school graduates 17.86%, high school graduates 24.18%, college-faculty graduates 17.31% and postgraduate graduates 3.57%. In the question asked about what makes divorced individuals happy, 6.32% of divorced individuals state that they are a success, 2.47% work, 69.23% health, 14.29% love, 6.87% money and 0.82% other factors. While 56.59% of divorced individuals state that they are satisfied with their health, 13.46% state that they are not satisfied. While 53.78% of divorced individuals state that they are satisfied with the education they have received, 24.09% state that they are not satisfied. While 27.47% of divorced individuals state that they are satisfied with their monthly income, 46.98% state that they are not satisfied. While 33.79% of divorced individuals state that they are satisfied with their social life, 36.81% state that they are not satisfied. 79.4% of divorced individuals are registered with the Social Security Institution and 20.6% are individuals who are not registered with the Social Security Institution.

3.1.2. Ordinal logistic regression model prediction results

There are three assumptions to consider before using the ordinal logistic regression model. After the model estimation, there is no multicollinearity problem in the model, there is no specification error in the model, and the assumption of parallel lines is provided. First of all, there is no multicollinearity problem since there is no more than one continuous variable in the model created. After the created model was estimated with ordinal logistic regression, it was tested whether there was a specification error in the model with the link test, and the results are shown in Table 3.3.

H_0: The model has no specification errors.
H_1: The model has specification errors.

Table 3. 3. *Link Test result*

Variable	Test Statistics	Likelihood Value (p)
Hatsq	0.09	0.927

When Table 3.3 is examined, it is seen that the probability value of the Hatsq variable is 0.846. Since $p>0.01$, the coefficient of the Hatsq variable is not statistically significant and the null hypothesis cannot be rejected. In this case, there is no specification error in the model. Another and most important assumption of the ordinal logistic regression model is the parallel lines assumption. The parallel lines assumption was tested with Brant's Wald test and likelihood ratio test, and the results are shown in Table 3.4.

H_0: The regression coefficients of the model are the same in each category of the dependent variable.
H_1: The regression coefficients of the model are different in at least one category of the dependent variable.

Table 3. 4 Parallel lines assumption test results

Tests	**Test Statistics**	**Likelihood Value (p)**
Brant's Wald Test	14.07	0.170
Likelihood Ratio Test	15.55	0.113

When Table 3.4 is examined, it is seen that the probability values of all tests used to test the parallel lines assumption are p>0.01. In this case, the null hypothesis cannot be rejected. It was concluded that the regression coefficients of the model were the same in each category of the dependent variable. In this context, it can be said that the parallel lines assumption is provided and the ordinal logistic regression model can be used in the analysis.

The model created to determine the factors affecting the happiness levels of divorced individuals was estimated by ordinal logistic regression and the results are shown in Table 3.5.

Table 3. 5. *Sıralı Lojistik Regresyon Tahmin Sonuçları*

3

Independent Variables	**Coefficient**	**Odds Ratio**	**Likelihood Value (p)**	**Marginal Effects**
Age	.0100864	1.010137	0.337	.0015753
Gender (Basic Level: Male) 2: Female	.6937311	2.001168	0.003***	.102536
How Happy (Basic level: Other) 2: Success 3: Work 4: Health 5: Love 6: Money	-2.821646 -3.526317 -1.095435 -1.19982 -1.923653	.0595079 .029413 .3343941 .3012484 .1460724	0.018** 0.011** 0.319 0.289 0.103	-.4406809 -.5507355 -.1710836 -.1873863 -.3004335
Education Status (Basic Level: Ph.D.) 2:Primary 31:General Middle School 32:Vocational or Technical Secondary School 33:Middle School 41: General High School 42:Vocational or Technical High School 511:2 or 3-year college 512:4-year College or University 52: Master Degree 53: PhD	.5626191 .1898603 .8542974 .2199049 .6386383 .8276271 1.563182 .1824859 1.709674 .0816342	1.755264 1.209081 2.349723 1.245958 1.8939 2.287883 4.773987 1.200197 5.527161 1.085059	0.321 0.753 0.421 0.816 0.287 0.206 0.032** 0.772 0.080* 0.933	.0878691 .0296521 .133423 .0343445 .0997417 .1292577 .2441356 .0285004 .2670146 .0127495
Health Satisfaction (Basic Level: Dissatisfied) 1: Satisfied 2: Fair	1.144636 .386973	3.141297 1.472517	0.004*** 0.322	.1787677 .0604369
Education Satisfaction (Basic Level: Dissatisfied) 1: Satisfied 2: fair	1.023683 1.055584	2.783427 2.873653	0.001*** 0.002***	.1598774 .1648597
Income Satisfaction (Basic Level: Dissatisfied) 1: Satisfied 2: Fair	.949581 .235221	2.584627 1.265188	0.001*** 0.418	.1483043 .0367365
Social Life Satisfaction (Basic Level: Dissatisfied) 1: Satisfied 2: Fair	1.06721 .6959409	2.907257 2.005595	0.000*** 0.019**	.1666755 .1086911
SSI Registration (Basic Level: No) 1: Yes	1.189545	3.285587	0.000***	.1857816

A level of gender segregation is "Male" basic. 1% is significant as the point score of the "Woman" award.
It is the "Other" at the basic level as if to be divorced. In this regard, it has been evaluated as important at a level that can be evaluated within the scope of "Success" and "Work".
"He did not finish school" is expected at the basic level regarding the education level. In terms of education, 3-year college "5% point degree" and "master's degree" is important at 10% importance.

The baseline level of compliance with health is estimated as "Not satisfied". In this election, "Satisfied" is meaningful as a 1% point score.

Not very good as a basic level of expectation regarding adjustment from education. In this selection, "Satisfied" points and "Average" points are significant at 1% points.

The basic level of the income satisfaction variable was determined as the "Dissatisfied" category. In this variable, the "Satisfied" category is statistically significant at the 1% significance level.

The basic level of satisfaction with the social life variable was determined as the “Dissatisfied” category. In this variable, the "Satisfied" category is statistically significant at the 1% significance level and the "Medium" category at the 5% significance level.

The basic level of the SGK registry variable is the “No” category. In this variable, it was concluded that the "Yes" category was statistically significant at the 1% significance level.

The odds ratios of the model estimated by ordinal logistic regression are given in Table 3.5. Statistically, significant odds ratios are interpreted as follows:

- When the gender variable is examined, it is concluded that the happiness level of divorced individuals is 2.001168 times higher than that of men.
- When the variable about what makes divorced individuals happy is examined, it is concluded that the happiness level of the “success” factor is approximately 0.06 times less than the reference category “other” factors.
- It was concluded that the happiness level of the "work" factor, which is one of the factors that make divorced individuals happy, is approximately 0.03 times less than the reference category "other" factors.
- When the educational status variable was examined, it was concluded that the divorced individuals graduated from a "2 or 3-year college" and their happiness level was approximately 4.77 times higher than the divorced individuals who did not "complete a school".
- It has been concluded that the divorced individuals being a "master's degree" and their happiness level is 5.53 times higher than the divorced individuals who have not "finished a school".
- When the health satisfaction variable was examined, it was concluded that the happiness levels of the divorced individuals who were "satisfied" with their health were approximately 3.14 times higher than the divorced individuals who were "not satisfied" with their health.
- When the variable of satisfaction with education is examined, it has been concluded that the happiness level of divorced individuals who are "satisfied" with the education they have received so far is approximately 2.78 times higher than the "Dissatisfied" divorced individuals.
- It has been concluded that the happiness level of divorced individuals who are "moderately" satisfied with the education they have received so far is approximately 2.87 times higher than the "Dissatisfied" divorced individuals.
- When the income satisfaction variable is examined, it is concluded that the happiness level of divorced individuals who are "satisfied" with their monthly income is approximately 2.58 times higher than the divorced individuals who are "not satisfied" with their monthly income.
- When the variable of satisfaction with social life was examined, it was concluded that the happiness levels of divorced individuals who were "satisfied" with their social life were approximately 2.91 times higher than those of divorced individuals who were "not satisfied" with their social life.
- It has been concluded that the happiness level of divorced individuals who are "moderate" satisfied with their social life is approximately 2.01 times higher than those who are "Dissatisfied" with their social life.
- It has been concluded that the happiness level of divorced individuals who are "moderate" satisfied with their social life is approximately 2.01 times higher than those who are "Dissatisfied" with their social life.

4. Results

In the model estimated by ordinal logistic regression, it was determined that the "age" variable was not statistically significant. The statistically significant gender variable shows that divorced women are happier than divorced men. It has been determined that success and job variables tend to decrease happiness levels in divorced individuals compared to other factors. When the education level is examined in general, it has been concluded that as the education level of divorced individuals increases, their happiness levels also increase. It has been concluded that divorced individuals who are satisfied with their health are happier than divorced individuals who are not satisfied with their health. It has been determined that the divorced individuals are more satisfied with the education they have received so far and their happiness levels are higher than the dissatisfied individuals. It has been concluded that divorced individuals who are satisfied with their income and social life are happier than those who are not satisfied. It is one of the results obtained as a result of the analysis that divorced individuals are registered with the Social Security Institution and their happiness levels are higher than those who are not registered.

To our best knowledge, there is no research or application on the happiness of divorced individuals in the literature. In this context, it is thought that this thesis stud[y] can guide the studies on the factors affecting the happiness levels of divorced individuals.

References

[1]. Agresti, A. (2015). Foundations of Linear and Generalized Linear Models. New Jersey: John Wiley & Sons, Inc.

[2]. Agresti, A. (2019). An Introduction to Categorical Data Analysis (Thirht Edition b.). Hoboken, NJ: John Wiley & Sons, Inc.

[3]. Akın, H. B., & Şentürk, E. (2012). Bireylerin Mutluluk Düzeylerinin Ordinal Lojistik Regresyon ile İncelenmesi. Öneri Dergisi, 10(37), 183-193.

[4]. Arı, E. (2013). Sıralı Lojistik Regresyonda Paralel Doğrular Varsayımı ve Çözümleme Yaklaşımları. Doktora Tezi. Eskişehir: Eskişehir Osmangazi Üniversitesi, Fen Bilimleri Enstitüsü.

[5]. Arı, E., & Yıldız, Z. (2016). Bireylerin Yaşam Memnuniyetini Etkileyen Faktörlerin Sıralı Lojistik Regresyon Analizi ile İncelenmesi. Uluslararası Sosyal Araştırmalar Dergisi, 9(42), 1362-1374.

[6]. Aslan, H. (2006). Bireylerin Otomobil Seçiminin Çoklu Tercih Modelleri ile Analizi. Yüksek Lisans Tezi. İstanbul: Marmara Üniversitesi, Sosyal Bilimler Enstitüsü.

[7]. Ayhan, S. (2006). Sıralı Lojistik Regresyon Analiziyle Türkiye'deki Hemşirelerin İş Bırakma Niyetini Etkileyen Faktörlerin Belirlenmesi. Yüksek Lisans Tezi. Eskişehir: Osmangazi Üniveristesi, Fen Bilimleri Enstitüsü.

[8]. Barak, N. A. (2005). Sıralı (Ordinal) ve Multinomial Logit Modeller Üzerine Bir Uygulama. Yüksek Lisans Tezi. Ankara: Hacettepe Üniveristesi, Sağlık Bilimleri Enstitüsü.

[9]. Cramer, J. S. (2003). Logit Models from Economics and Other Fields. New York: Cambridge University Press.

[10]. Harrell, F. E. (2015). Regression Modeling Strategies with Applications to Linear Models, Logistic and Ordinal Regression, and Survival Analysis (Second Edition b.). Switzerland: Springer International Publishing.

[11]. Hayat, E., & Sözen Özden, A. (2021). Genelleştirilmiş Sıralı Lojistik Regresyon Analizi ile Bireylerin Mutluluk Düzeylerine Etki Eden Faktörlerin Belirlenmesi. OPUS Uluslararası Toplum Araştırmaları Dergisi, 18(40), 2288-2316.

[12]. Hilbe, J. M. (2009). Logistic Regression Models. Chapman & Hall .

[13]. Long, J. S. (1997). Regression Models for Categorical and Limited Depented Variables. California: Sage Publications, Inc.

[14]. O'Connell, A. A. (2006). Logistic Regression Models for Ordinal Response Variables . California: Sage Publications, Inc.

[15]. Servet, O. (2017). Mutluluğun Türkiye’deki Belirleyenlerinin Zaman İçinde Değişimi. Akdeniz İİBF Dergisi, 17(35), 16-42.

[16]. Sönmez, A., & Altınsu Sönmez, Ö. (2018). Life Satisfaction and Happiness with Regard Human Capital and Religiosity in Turkey. Bingöl Üniversitesi Sosyal Bilimler Enstitüsü Dergisi, 8(16), 217-234.

[17]. Şerbetçi, A. (2012). Sıralı Lojistik Regresyon Analizi ile İstatistik ve Ekonometri Derslerinde Başarıyı Etkileyen Faktörlerin Belirlenmesi: Atatürk Üniversitesi İktisadi ve İdari Bilimler Fakültesi Öğrencileri Üzerine Bir Uygulama . Yüksek Lisans Tezi. Erzurum: Atatürk Üniversitesi, Sosyal Bilimler Enstitüsü.

[18]. Şimşir Cömertler, N. (2013). Türkiye'de Mutluluk Ekonomisinin Belirleyicilerinin Ekonometrik Analizi. Finans Politik & Ekonomik Yorumlar, 50(579), 7-22.

[19]. Yerdelen Tatoğlu, F. (2020). Ekonometri Stata Uygulamalı. İstanbul: Beta Basım Yayım Dağtım A.Ş.

[20]. Yılmazer, A. (2020). Yaşam Memnuniyeti ve Yaşam Memnuniyetini Etkileyen Faktörlerin Sıralı Lojistik Analiziyle İncelenmesi. Yüksek Lisans Tezi. İstanbul: Marmara Üniversitesi, Sosyal Bilimler Enstitüsü..