Associate Professor EVA RUBLÍKOVÁ, Ph.D.
Department of Statistics FEI EU, Bratislava, Slovakia
Zavod za statistiku FEI EU, Bratislava, Slovačka

DEVELOPMENT OF EMPLOYMENT AND UNEMPLOYMENT IN HOTELS AND RESTAURANTS OF SLOVAKIA

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Preliminary report

This paper demonstrates Holt-Winters exponential smoothing method to create predictions for the number of employed and unemployed people in the economy of the Slovak Republic, for the quarters of the year 1997. Attention is devoted to the Hotels and Restaurants as the last main sections of economic activity in which persons are working or from which people have begun unemployed.

Key words: Seasonal indexes, exponential smoothing, Holt-Winnters model smoothing constants, forecasts error

1. INTRODUCTION

Since 1993 the Slovak Statistical Office provides quarterly sampling surveys as a permanent monitoring of labour force on the basis of a direct surveying in selected households. A base of the survey is a random selection of 10 250 apartments in all districts of the Slovak Republic, which is 0.6% of the total number of permanently occupied apartments. The survey covers all persons aged more than 15 who live in households of the selected apartments. Each selected household remains in the sample for 5 following quarters.

The method of the Labour Force Sample Survey in households is standard method recommended by international institutions under the co-ordination of the International Labour Office. The results of the Labour Force Sample Survey are carried out every quarter. They are designed one month earlier as calendar quarter i. e. quarters include following months:

1st quarter - December of the last year, January, February of the referenced year
2nd quarter - March, April, May of the referenced year and so on.

I would like to use the exponential soothing method to forecast aggregated employment and unemployment in Hotels and Restaurants of Slovakia by means of the time series data since Q1 1993 to Q4 1996 taken from [3].

Exponential smoothing is widely used to forecast the immediate future because of its simplicity, computational efficiency, the ease of adjusting its responsiveness to changes in the process being forecast and its accuracy. Another advantages of the method are that the method does not need a log time series (we have only sixteen observations) and that the exponential method can be used with wide availability of personal computers and their suitable statistical programs like Statgraphics Plus, Minitab, SPSS, SAS, Lotus 1, 2, 3 or Excel.

2. EXPONENTIAL SMOOTHING

Exponential smoothing is a forecasting method that weights each of the observated time series values unequally, with more recent observations being weighted more heavily than more remote observations. This unequal weighting is achieved through three smoothing constants, which determine how much weight is given to each observation. This procedure allows the forecaster to update the estimates of the model parameters so that changes in the values of these parameters can be detected and incorporated into forecasting system.

When a time series contains linear trend and seasonality, then Holt-Winters' model can be used. The number of employed or unemployed persons in Hotels and Restaurants is varying about the trend due to seasons. These seasonal deviations could be measured by the seasonal indexes, which are summarised in the Table 1.

Table 1 Seasonal indexes (%)

Quarter	Employment	Unemployment
1	98.90	105.07
2	98.26	99.83
3	103.11	95.70
4	99.73	99.40

Holt - Winters' Method

Holt - Winters' method assumes that the time series to be predicted can be adequately fitted by a linear trend with additive (constant) or multiplicative (proportional) variation. In economic time series usually multiplicative model is used, which could be written as

$$y_t = (A_0 + A_1 t).S_t + \varepsilon_t, \qquad (1)$$

where

y_t observed value of time series in time t
A_0, A_1 parameters of the linear trend
S_t seasonal effect in time t
ε_t random variable in time t
t = 1, 2, ..., T is time variable.

The estimates of the Winters' multiplicative model parameters

The updated estimates of the Winters' multiplicative model parameters for t = 1, 2, ..., T can be computed by means of following formula

$$a_{o,t} = \alpha y_t / s_{t-m} + (1-\alpha)(a_{o,t-1} + a_{1,t-1}) \qquad 0 < \alpha < 1 \qquad (2)$$

$$a_{1,t} = \beta(a_{0,t} - a_{0,t-1}) + (1-\beta)a_{1,t-1} \qquad 0 < \beta < 1 \qquad (3)$$

$$s_t = \gamma y_t / a_{o,t} + (1-\gamma)s_{t-m} \qquad 0 < \gamma < 1 \qquad (4)$$

where

α, β, γ are smoothing constants
m is the number of seasonal factors
$a_{o,t}$ is the updated estimate of the average level of the time series at time period t
$a_{1,t}$ is the updated estimate of the trend component at time period t
s_t is the updated estimate of the seasonal factor at time period t.

The smoothing constants controls the extant to which past realizations of the time series influence the forecast. Small values of the smoothing constants give significant weight to many prior observations and result is a slaw response of the forecasting system to changes in the parameters of the time series model. Larger values of the smoothing constants give the weight to only the more recent historical data and cause the forecasting system to respond more rapidly to parameter shifts. Smoothing constants can be chosen subjectively or objectively. If the evolution of the level of the time series appears smoother, the appropriate value for α becomes higher.

If the slope of the linear trend appears to change quite smoothly over time, this suggests a relatively high value for the smoothing constant β. Similarly, a high value for γ is desirable for a series with smoothly changing seasonal pattern, and a lower value would be preferable if seasonal pattern is more erratic.

In practice, for the user could be quite difficult to determine the values of α, β and γ of the smoothing constants from visual inspection of plotted time series. The smoothing constants can be chosen as those values minimizing the in-sample sum of squared forecasts errors - M.S.E. Grid searches for optimal in-sample values for smoothing constants are available as part of statistical programs packages as Statgraphics Plus and SPSS.

Point forecasts

Standing at time t, the forecast of y_{t+h} is obtained by projecting forward h periods the last slope estimate, with the latest level estimate as base, and then multiplying on the last available seasonal factor for the period of the year in which time t+h occurs. Thus, the forecast is

$$\hat{y}_t(h) = y_{t+h} = (a_{0,t} + ha_{1,t})s_{t+h-m} \qquad h = 1, 2, \ldots, m \qquad (5)$$
$$= (a_{0,t} + ha_{1,t})s_{t+h-2m} \qquad h = m+1, m+2, \ldots, 2m.$$

3. FORECASTS OF THE NUMBER OF EMPLOYED AND UNEMPLOYED IN HOTELS AND RESTAURANTS

The Holt-Winters' multiplicative method was used to calculate the point forecasts for the aggregated number of employed and unemployed in Hotels and Restaurants of the Slovak Republic for the year 1997 by support of statistical package Statgraphics Plus. The results are in Table 2.

The forecasts were chosen by the criterion of choosing smoothing constants, which minimize the in-sample sum of squared forecasts errors - M.S.E. and the smoothing constants are as follows:

The number of employed : $\alpha = 0.3944$, $\beta = 0.99$, $\gamma = 0.1187$ with
M.S.E = 6.733 and M.A.P.E = 2.9%.

The number of unemployed: $\alpha = 0.2519$, $\beta = 0.9999$, $\gamma = 0.5397$ with
M.S.E = 5.22 M.A.P.E = 12.251%.

Table 2 Point forecasts of the number of employed and unemployed in Hotels and Restaurants

Period	The number of Employed	The number of Unemployed
Q1 97	68 984	11 970
Q2 97	71 966	9 448
Q3 97	78 151	7 628
Q4 97	79 614	6 068

4. CONCLUSION

The Holt - Winters' method of forecasting time series of the number of employed and unemployed in Hotels and Restaurants is presented here as a possible alternative of calculating the short-term point forecasts.

REFERENCES

1. Montgomery, D.C., Johnson, L.A., Gardiner, J.S., (1990) Forecasting & Time Series
2. Analysis, Mc Graw-Hill, Inc., New York
3. Rublíková, E., Pacáková, V., (1997) Analysis and Forecasts of the Development of
4. Unemployment , Slovak Statistics and Demography, 7
5. Sample Survey Labour Force Investigation, (1996) Time Series of Employment and
6. Unemployment, Statistical Office SR
7. Statistical Yearbook of the Slovak Republic, (1996)

Sažetak

PREDVIĐANJE KRETANJA ZAPOSLENOSTI I NEZAPOSLENOSTI U HOTELIMA I RESTORANIMA SLOVAČKE

U radu je prikazana Holt-Winters metoda za eksponencijalno izglađivanje, korištena za predviđanje kretanja zaposlenosti i nezaposlenosti u ekonomiji Slovačke Republike, po godišnjim kvartalima za 1997 godinu. Posebna je pažnja posvećena hotelima i restoranima, koji su posljednja faza ekonomske aktivnosti ove djelatnosti u kojoj je stanovništvo zaposleno ili od koje započinje nezaposlenost.

Ključne riječi: sezonski indeksi, eksponencijalno izglađivanje, Holt- Winters model, konstante u modelu izglađivanja, greške u predviđanju