Public procurement evaluation

(model example)

You are a member of the evaluation committee choosing the company constructing a migration corridor over the highway. Assume that all applicants met all requirements like delivering complete documentation, references, qualifications, etc. and all bids were submitted on time. Evaluate bids.

Bid	Price (mil. CZK)	Delivery (months)	Guarantee (months)	Technical aspects (0-10 scale)
A	15.2	25	43	9
B	16	23	69	6
C	18.9	19	86	7
	50%	20%	15%	15%

Process of evaluating in public procurement is close to the WSA (weighted sum approach). Values of each variant are transformed into the normalized form and multiplied by given weights. The difference is in the different transformation formulae. Normalized values in this case do not necessarily acquire value 0 in case of the worst parameter – they acquire proportional value compared to the best parameter (maximizing criterion), or value calculated as inverse proportional (minimizing criterion). Normalized values are finally multiplied by weights and summed.

In case of maximizing criterion we calculate transformed values as a proportion of the best value. In case of minimizing criterion we calculate the value as inverse proportional using flipped fractions.

Solution steps: Normalized matrix of parameters (below) is multiplied by given weights:

Bid	Criterion 1	Criterion 2	Criterion 3	Criterion 4
A	1.00	0.76	0.50	0.90
B	0.95	0.83	0.80	0.60
C	0.80	1.00	1.00	0.70

Solution: Bid A acquired score of **86.20%**, bid B acquired **85.06%**, and bid C acquired **85.71%**. Bid A is victorious and applicant should be asked to deliver the realization of public procurement.

Hedonic method

(model example)

You are asked to evaluate benefits of an anti-flood dam that would reduce the probability of a flood in residential area of 80 houses. Use hedonic method for evaluation if you know that the price of houses in given area can be estimated using linear regression model:

$$p_i = \alpha + \beta(prob) + \gamma(x_i) + \varepsilon_i$$

where p_i means estimated price of the house, $prob$ probability of flood occurrence in some time horizon, and x_i some other parameters of house that we do not need to consider in this case.

Based on the survey of house prices the coefficient have values $\alpha = 75$, $\beta = -200$ and $\gamma = 1$. Dam construction is estimated to reduce the risk of flood in some time horizon from 0.4 to 0.05.

Hedonic method represents an approach used for estimating the values of certain measures, good or services that directly affect the market prices of some other goods. Usual application area is reality market, which reflects impacts of changes of local environmental attributes.

Hedonic method assumes that the price of a certain market good is directly influenced by its characteristics and our considered measure (resp. good, service). Steps of this method consist of collecting sufficient data regarding prices and characteristics of considered market goods and their subsequent statistical analysis. The result is then a price function of market good consisting of effects of individual characteristics. Based on the impact of changing individual parameters we estimate the social benefits of introducing evaluated measure (good, service).

When applying this method in project evaluation we examine the impact on the welfare (e.g. change in the prices of realities) when changing selected variables that we can influence (deciding whether to undergo the project). Final impact of the project realization (resp. measure introduction) is then calculated as a difference between the original state and the new state after the project realization.

Solution steps: In our case we calculate the difference the value of houses before and after the construction of the anti-flood dam. Specifically we compare the total value of houses using regression model using the original and new parameters. Numerically this is a difference between $p_i = 75 - 200 * (0.4) = -5$, and $p_i = 75 - 200 * (0.05) = 65$, resp. simplified into $\Delta p_i = -200 * (0.05 - 0.4) = 70$ for a single house. Other parameters than flood occurrence probability in this case do not change, therefore we do need to consider them in the calculation.

Change in value of a single house in this case is value increase by 70.

Solution: Total benefit of building an anti-flood dam for residential area has a value of **5600**.

Shadow pricing – variant of deriving prices from the demand curves

(model example)

Region plans to build a new bridge that would lower the travelling costs between two cities by 100 CZK/trip. This costs reduction includes shorter travelling time, lower vehicle depreciation and lower fuel consumption of 120 CZK/trip in total minus 20 CZK toll per bridge crossing – a Regions income. Before the bridge there was total of 1 million trips per year, estimates after the bridge is built are 1.5 million trips per year. Calculate annual benefits of the new bridge for drivers and for the Region.

Shadow pricing represents a way how to estimate the value of goods and services in situation where their real price does not exists or does not reflect the true value (often due to the regulations, temporary fluctuations, or other market failures). Shadow price can be perceived as a price that would be reached in a perfect competition market. Shadow price represents a *proxy* value of a good, usually considered as a value of what one has to sacrifice in order to get an additional unit.

With shadow prices there are two basic approaches how to estimate the value of evaluated goods – first one is a direct observation of subject's behavior (**revealed preferences**). Various methods can be used with this approach based on specific situations. One is the method of pilot projects, where we test in a lower scale, resp. demonstrate the impact of the future project. With this method we note all of the pilot project's impacts together with their quantification and monetization. Subsequently we estimate the shadow prices for the whole large project. Second method derives shadow prices from the demand curves. With this method we need to know the original state and state after the realization of the project, and based on that we derive the demand curve. After that we calculate the social surplus of the consumer resulting from the shift from original to the new state. Third method represents estimation of prices based on observing market behavior of the subjects, such as market analogy method (like "free" public schools and paid private schools), travel cost method (suitable for attractive location), defensive expenditures method (how much subjects sacrifice in order to avoid something), etc.

Second approach for estimation Shadow prices is based on declared preferences (see WTP method).

Solution steps: In our case we have data about demand before and after the project realization, thus we derive shadow prices from the relevant demand curve. We can start with benefits to the Region, which are basically number of trips times collected toll for the bridge crossing (*de facto* revenues).

In case of drivers we need to differentiate between the group that would travel regardless of the new bridge – they would enjoy benefits of the full cost saving, and the remaining group with decreasing benefits due to the slope of the demand curve. In other words, benefit for the driver no. 1,000,001 is almost the full costs savings, while the benefit for the driver no. 1,500,000 is basically zero – this is the very last driver that has decided to do the trip, as it was almost on par with the alternative of, for instance, staying at home or taking alternative route.

Solution: Benefit for the drivers is **125 mil. CZK/year**, benefit for the Region is **30 mil. CZK/year**.

TCM – Travel Cost Method

(model example)

A municipality owns a lookout tower. Annual maintenance costs including personnel are 300,000 CZK (material, repairs, etc.). Municipality wants to know what the social benefits of the tower are. Calculate them using TCM. Consider travel costs of 2 CZK/km, travel pace of 30 km/hour, average hourly wage 120 CZK, and entrance fee of 10 CZK/person. Further parameters are in the Table. Consider discontinuous changes in demand for visits (each zone has same demand level), and irrelevant visits from additional zones. Also consider that visits are not cumulative (only the tower).

Zone	Distance	Population	Probability of visit per year
0	1	200	50%
1	10	10,000	5%
2	30	100,000	2%

TCM represents a method of evaluating nonmarket goods based on **observing** the market behavior of subject as a part of the Shadow pricing. It is used mostly when appraising attractive locations or ecosystems, where it naturally difficult to set market value.

This method assumes that the value of evaluated goods is equal to loss (costs), that subjects are willing to accept by travelling to the destination with the good, specifically the costs for travelling (fuel, public transportation), value of lost time due to the travelling, and the entrance fees, if there are any. These costs are divided into the zones based on the distance.

Initially we identify the demand points in the form of amounts of visits and related total costs per visit for each considered zone. From these points we derive demand curve for visiting considered location or attraction. The value of attraction is then represented by the area under the curve.

Disadvantage of this method is, for instance, the necessity of sufficient data, as well as inaccuracies due to the combined visits to the multiple locations (costs are then shared between the visits), or the perceived benefits from the travelling itself.

Solution steps: We have data about three zones, we do not consider other. We also do not consider standard demand curve shape, but only three homogenous groups of visitors based on zones. We calculate costs/visit for each zone: 0) 100*(2CZK*2*1km+120CZK*2*1km/30+10CZK); 1) 500*(2CZK*2*10km+120CZK*2*10km/30+10CZK); 2) 2000*(2CZK*2*30km+120CZK*2*30km/30+10CZK).

Solution: Benefits of the lookout tower are 2200 CZK + 65000 CZK + 740000 CZK = **807,200 CZK/year**.

WTP – Willingness to Pay

(model example)

Municipality is considering introducing new waste collection system – instead of central container (fully paid by the municipality) use bins for individual households. Estimate social benefits of such new system using WTP. This could tell the municipality at what level should it set the fee for the new system in order to cover the additional expenditures.

Population (200 total) has been sorted based on their willingness to pay for the new system from the lowest fee to the highest and divided into the quartiles. Assume that the willingness to pay grows linearly within each quartile. First person is not willing to pay anything, person at the first quartile can pay 300 CZK, at the second quartile 380 CZK, at the third quartile 440 CZK, and last one 560 CZK.

WTP method represents the second approach how to estimate shadow prices and is based on **stated** (declared) **preferences.** It is a kind of Contingent Valuation Method (CVM) that uses questionnaires/surveys. In contrast with the first approach (revealed preferences), this approach estimates the values based on subjective opinions (theoretical preference), not from actual behavior.

The method itself consists of collecting data from a survey, in which a relevant sample of subjects state the maximum price they are willing to pay for some good or service. Survey can start with lower amounts and continue higher, or alternatively can directly ask about the highest price. Based on collected data we derive a pseud-demand curve for considered good.

The benefits estimated by WTP method is, as with other methods based on preferences, calculated as the consumer surplus – the area under the derived pseudo-demand curve.

Analogical method is WTA – Willingness to Accept, where you estimate the price, resp. equivalent that would make subject accept the presence of some negative factor.

Main problem of WTP method is in often observed difference between stated and reveled preferences (real, market) preferences, and the correct use of this method requires taking this into the consideration. Respondents in case of WTP and WTA often overstate their willingness to pay, resp. their minimal accepted equivalent for some negative effect. Another problem of this method is acquiring the data from a representative sample during the survey.

Solution steps: Based on the collected data we derive a pseudo-demand curve of the willingness to pay and calculate the area under it. Total willingness to pay in 4^{th} quartile is (50*440+(560-440)*50/2) = 25 000 CZK, in 3^{rd} quartile is (380*50+(440-380)*50/2) = 20 500 CZK, in 2^{nd} quartile is (50*300+(380-300)*50/2) = 17 000 CZK, and in the first quartile is (300*50/2) = 7 500 CZK.

Solution: Social benefit from new waste collection system using bins would be **70 000 CZK**.