Looking at Economic Analyses of Drugs and Economic Recession

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LEADER Project
Guidance document on estimating the social costs of illegal drugs

LEADER Project: Guidance document on estimating the social costs of illegal drugs

Deliverable 1.3, Work Package 1

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* denotes methods which go beyond the standard way of social cost estimation.

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Participant organisations in LEADER are:

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- *LEADER Project Deliverable 1.1 Systematic Review of Existing Publications on Social Costs of Illegal drugs, Alcohol and Tobacco*, led by the FCRB research team
- *LEADER Project Deliverable 1.2 Review of existing guidance documents in estimating the social costs of drugs*

The Guidance Pack outline was informed by comments both from the LEADER partners and external experts who were invited to contribute through a web-based consultation and email exchange, and then fine-tuned accordingly. In the next stage, the chapters of the Guidance Pack were fleshed out and sent for internal review following an iterative process, culminating in the first full draft of the Guidance Pack early 2016. External experts were then invited to provide comment on the methods and approach of the Guidance Pack through the second web-based consultation, which was followed by in-depth face-to-face review meeting, held in April 2016. In turn, a pilot test of the Guidance Pack was undertaken in order to explore the accessibility and usability of the Guidance Pack and the feasibility of undertaking such a social cost study. Based on the review meeting discussion and the findings of the pilot study, the lead authors further worked on the Guidance Pack, resulting in this PDF and the complementary EXCEL file: LEADER EXCEL Guidance.

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Abstract

The guidance document presents a set of practical recommendations for the estimation of the basic social costs of illegal drug use with the application of commonly available computer software MS EXCEL, including EXCEL templates.

The methods discussed include the methods of estimation of the attributable fraction and mortality related to drug use and the methods of estimation of certain premature mortality effects caused by the consequences of drug use.

The next part involves the presentation of the methods of estimation of other kinds of the social costs of illegal drug use and guidance on how to fill the gaps in statistical data concerning, among others, the estimation of the costs related to the criminal justice system.

Additionally, new solutions in the estimation of the social costs of drug use are also presented.

Finally, the conclusion outlines the proposal of the standard method for presenting estimates of the social costs of illegal drug use, aiming to assure better comparability among the countries.

The guidance document is complemented with three annexes discussing issues related to *Sampling Theory*, *the Regression* in EXCEL and techniques for creating basic charts in EXCEL.

PART 1: About the LEADER Guidance

How the Guidance Pack was developed and what it contains

1. Introduction

What are the social costs of illegal drugs use?

Illegal drug use causes many negative consequences for the whole society – referred to as the social costs of illegal drug use. The most important costs are: additional costs of health care services and relating to the criminal justice system, additional costs of social benefits, prevention costs, costs involved in education and research concerning drug use.

As illegal drug users often die earlier than non-users of similar age, the society loses these persons prematurely. The loss can be expressed as the number of years of their lives lost. It can be expected that if prematurely deceased drug users lived longer, they could work further to the benefit of the society; therefore, the number of years lost at the age of working activity of prematurely deceased drug users is, in turn, the basis for the estimation of productivity potentially lost by the society.

Beyond the kinds of the social costs of illegal drug use mentioned above are human harm, pain and suffering, which are only partly measureable, but still should be described and discussed.

Why do we need to estimate the social costs of illegal drug use?

As illegal drug use causes many negative consequences for users, their families and surrounding, as well as for society at large, policymakers consider it necessary to apply a variety of measures in order to prevent or at least attenuate the negative effects of illegal drug use. However, the resources that can be allocated for this purpose are limited; therefore, priorities for their use must be established. Decision makers are also interested in cost-effective allocations of funds, and their decisions should use the knowledge on the magnitude of the consequences of illegal drug use for different subjects as a basis – therefore, proper estimates of the social costs of illegal drug use are needed. Further, it is important to document the health and well-being footprint of illegal drug use as an accountability, monitoring and advocacy tool (see Anderson et al. 2016). Overall social cost estimates are a good way to do this.

Why is new guidance for estimating the social costs of illegal drug use needed?

Although there are several guidance documents for estimating the social costs in question [see LEADER Project *Deliverable 1.2 Review of existing guidance documents in estimating the social costs of drugs*], there are many misunderstandings and the lack of general consent on how to solve methodological and practical problems arising in such estimations. The existing guidance documents often provide a good theoretical background, but they tend to be too general, and even for an experienced researcher it is difficult to apply their instructions. In practice, everybody has to find his/her own way of dealing with the problem. As stated in LEADER Project *Deliverable 1.1. Systematic Review of Existing Publications on Social Costs of Illegal drugs, Alcohol and Tobacco* (p.3), "(…) *Given the high methodological heterogeneity that exists in the field, and in order to better assess this burden and to effectively develop adequate policies, methodological guidance is urgently needed."*

An additional problem is that the existing guidance only rarely shows how to measure the costs caused by drug use and incurred by people other than users (known as *harm to others*) and how to estimate the proportion of the social costs of illegal drug use that could be potentially avoided (known as *avoidable costs*).

Furthermore, the existing data needed for measuring this concept show gaps in most countries, with scarce guidance available advising on how to fill them in.

In turn, as estimates coming from different countries are obtained with the use of different methodologies, they are usually not comparable, a trait which would be especially desired within the EU.

Purpose and development of the new LEADER guidance

The purpose of this new guidance document is to introduce, for basic social cost components, a standard and internally coherent methodology for estimating the various consequences of illegal drug use, as well as to propose a standard way of presenting these results, which will enhance data comparison between time and space of these social costs.

Emphasis is put on the practical side of the estimation, so most of the methods presented could be applied within different theoretical frameworks. While describing the estimation methods, corresponding assumptions and any shortcomings are discussed, so the real meaning and significance of the results can be clearly understood.

The way-forward to estimate each of the different items of social costs is explained and shown step by step with the use of the commonly accessible computer program Microsoft EXCEL, including supporting EXCEL templates.

Practical examples are provided using the estimation results obtained mostly in the frame of the ALICE-RAP study on *Social costs of addictive substances and behaviours*, which uses Poland, Portugal and Catalonia (Spain) as case examples. The ALICE-RAP study was performed in the frame of the FP7 EU co-funded Addictions and Lifestyles in Contemporary Europe – Reframing Addictions Project (ALICE-RAP; www.alicerap.eu), (see Mielecka-Kubien, et al. 2014 and 2015), and is further referred to as "ALICE-RAP".

Therefore, the considerations below are not a coherent presentation of the estimation results of social costs for any country; it should also be taken into account that the specific data applied below (for instance *Relative Risk* estimates) only perform the supplementary role as the examples, and in the proper social cost estimation the ones most adequate to a country's specificity should be applied.

Who is the new LEADER guidance for?

The guidance is addressed to researchers who intend to estimate the social costs of illegal drugs in a given jurisdiction. The guidance may help to solve some problems arising during the cost estimation, and make it easier to perform calculations, but as the estimation of the social costs of illegal drugs is a complicated task, it requires multidisciplinary knowledge.

First of all, as social costs are essentially an economic category, economics knowledge is necessary to determine what data should be used and where to look for them in a country.

Such data are gathered by different institutions in different countries and they have different structure and meaning.

The estimation of the premature mortality of drug users and the number of years of live lost requires, in turn, some knowledge of vital statistics, since vital statistics methods are used there, as well as some understanding of epidemiology.

As estimation uses statistical methods, some basic statistics knowledge is also needed.

No calculation is possible without formulae, hence the ability to read, understand and calculate according to the formulae is also necessary.

To undertake a study to estimate the social costs of illegal drugs is no mean task – based on the experience of those who kindly piloted parts of the Guidance pack, it is estimated that the full process could take between three to six months, requiring the collaboration of several government departments and institutions such as the national statistics office, the ministry of Justice or the national health system, in the collection and provision of data.

→ HOW TO USE THIS GUIDANCE PACK

The LEADER Guidance Pack consists of two complementary tools:

- the **Guidance PDF document**, which introduces the reader to the topic and then presents the suggested methodology for estimating each of the social costs of illegal drug use, explaining and commenting the approach and then including practical examples illustrating each step of the estimation with the help of EXCEL screenshots.
- the **EXCEL file** containing examples of social cost estimations using real data, including ‘empty’ EXCEL templates, where own data can be introduced as to replicate the examples, obtaining results thanks to the automatic formulae included in each of the spreadsheets.

Both documents are publicly available on the LEADER project website.

TIP! We recommend having both documents at hand as it can be useful to skip back and forth from one to the other when looking into each of the chapters of this document.

2. Contents of the LEADER Guidance

Structure of the PDF document

The LEADER Guidance gives some theoretical background, but first of all it presents methods and examples of the estimation of different kinds of the social costs of illegal drug use.

The document is divided into four core parts:

1. **About the LEADER Guidance** (Chapters 1-3), containing introductory remarks, that is some theoretical considerations about different possible approaches to social costs of drug use estimation as well as the assumptions adopted in the practical examples.

2. **Cost estimation Guidance** (Chapters 4-10), which is the main part of the document. The following kinds of social costs are included:

   a. Basic social cost estimation which starts with estimation of premature mortality related to illegal drug use and its consequences, both direct (number of lives lost, number of years of life lost, life expectancy (e_0) and life potential loss) and indirect (productivity loss due to premature deaths). Then the way of estimation of morbidity and its consequences [additional health care service costs (inpatients costs, outpatients cost, emergency costs, pharmaceuticals costs, etc.)] is explained, as well as the way of estimation of productivity loss due to morbidity, followed by explaining the way of estimating crime, law enforcement and criminal justice costs; here some possible ways of filling gaps in statistical data are suggested.

   b. *Harm to others* costs, which are the extension of standard social costs, often traditionally treated as a separate cost category.

   c. Avoidable costs, which can be estimated once the total costs (standard + harm to others costs) are estimated.

   The estimates of all kinds of social costs of drug use, but particularly the estimation results for avoidable costs, can be used as a powerful advocacy tool.

   Each chapter of Part 2 follows the standard structure, where theory and methods are presented, then remarks/limitations (if any) are mentioned.

   The theoretical considerations are followed by a brief summary box and illustrative examples with full instructions provided throughout the document on how to undertake the estimations with the use of the computer program EXCEL.

   The methods which go beyond basic social cost estimation are marked with *.

3. **Using the cost estimates** (Chapter 11): a standard way of presenting the whole estimation results is proposed with the intention of providing more comparability among the results for different countries.

4. **Supporting info** (the three appendices):

   I. Considerations on *the Sampling Theory* (the meaning and importance of *randomness* and *representativeness* of the sample, the meaning of *the coverage rate*, more effective methods of questioning, for example the randomized response technique, simple random sampling, systematic sampling, stratified sampling).

   II. Basics of the estimation with a regression function in EXCEL and the interpretation of the results given in EXCEL *Summary Output* (R^2, basic tests).

   III. Guidance on graph construction in EXCEL (line and column charts, scatter plots, pie charts)

Recommendations for further research

The LEADER Guidance Pack is the result of the combined effort of the LEADER partners with valuable input from external experts, produced within the frame of a certain project, timing and resources. It hopes to constitute the first step in consolidating a standard way forward in performing studies on the social costs of illegal drug use.

The methods and examples presented cover the main aspects of the estimation of the social costs of illegal drugs, consistent with the findings presented in Table 1 of Deliverable 1.2 *Review of existing guidance documents in estimating the social costs of drugs* (p.18) referred to as “the Minimum framework”. The estimation of the social costs of drug use can be expanded in many ways.

The issues not covered in the Guidance Pack and requiring further research are:

- Private costs (covering consequences of drug use for the user himself),
- Costs to the user’s surroundings (family, workplace),
- Intangible costs, including the quality of life of illegal drug users and their families,
- Costs estimated according to the rules of the Incidence approach,
- Costs estimated according to the Demographic approach,
- Lifetime productivity costs estimated for the entire working life that prematurely deceased drug users could hypothetically live,
- Identifying the subjects of the costs (who bears the costs),
- Societal and environmental consequences of illegal drug use,
- Sensitivity analysis, taking into account the consequences of the approach chosen, assumptions adopted and the shortcomings of the data sets applied.

3. Position and assumptions of the LEADER Guidance

Social costs

As the main purpose of the guidance document is to show the practical aspect of estimating the social costs of illegal drugs and ensuring better comparability of estimation results among countries, common methodology concerning basic costs, acceptable in different countries, and including the standard way of presenting estimation results is suggested.

There are several theoretical approaches to the estimation of the social costs of illegal drug use, involving a lot of heterogeneity in the definitions of social costs themselves as well as in the definitions of their components. We are going to use these terms without getting into a discussion on different terms and their meaning, but in research into the social costs of illegal drug use the approach and definitions applied should be clearly specified and documented.

The detailed comparison of theoretical backgrounds and definitions used in practice and applied in the estimation of the social costs of illegal drugs is discussed in LEADER Project *Deliverable 1.2 Review of existing guidance documents in estimating the social costs of drugs*.

In general, the guidance applies the approach to and the definitions of social costs proposed by Rehm et al. (2002) as …*a cost-of-illness study presenting "aggregate costs", which are calculated by looking at all the external costs of substance abuse and comparing them with a hypothetical situation where no substance abuse exists* (p.2).

According to Single et al. (2001), the cost-of-illness (COI) study… *involves combining an epidemiological database with financial information to generate an amount valued in monetary terms which purports to say something about the costs to society of a particular disease* …. and *all relevant costs are opportunity costs, as it is the case when an activity (such as illness) prevents resources being used for some other purpose, and so an opportunity is foregone* (Chapter 2.2.1).

Social costs consist of *tangible costs* (further divided into *direct* and *indirect costs*), which can be directly expressed in numbers, and *intangible costs*.

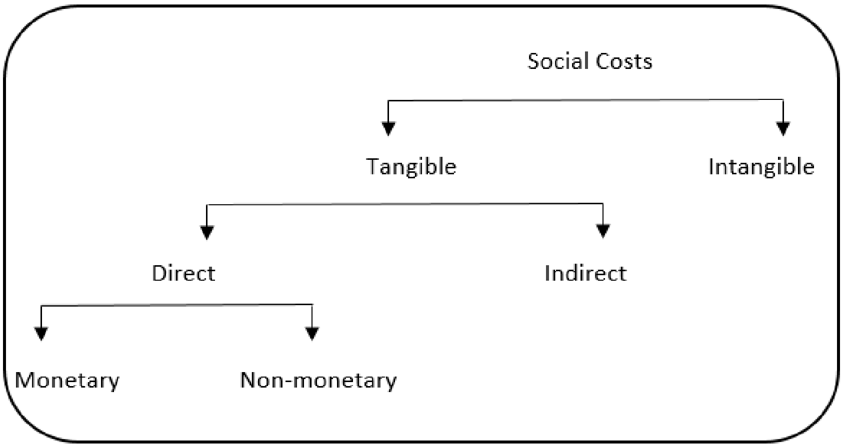
Direct costs express the value of goods and resources which are used to deal with illegal drug use and its consequences (expressed in monetary terms), and also premature mortality (expressed, in turn, in non-monetary terms, as the number of premature deaths and the number of years of life lost, especially of the years of working activity of prematurely deceased illegal drug users).

Indirect costs refer to lost productivity mainly due to premature deaths or the disability of drug users.

Intangible costs are human costs which are not related to money, are difficult to value and their measurement raises a lot of controversy [Sustein 2003], amongst others. The kind of intangible costs that is frequently estimated covers the loss of the quality of life, the measures of which are quality-adjusted life years (QALY).

The guidance recommends the structure of the social costs of illegal drug use according to their main components, presented in the following scheme:

Social Costs



Source: Authors' own.

Important theoretical issues which have to be decided while estimating the social costs of illegal drug use are which estimation approach should be used:

- Human Capital or Demographic approach?
- Incidence or Prevalence perspective?

Following the considerations presented in LEADER project Deliverable 1.2 *Review of existing guidance documents in estimating the social costs of drugs* (p.10-11), it can be stated that both approaches, that is the *Human Capital* as well as the *Demographic*, compare a real population with a hypothetical one.

In the *Human Capital* approach, the estimation of losses embraces both present and future ones, as it determines the hypothetical production which drug users could generate presently and in the future, if they … *had not suffered from the consequences of drug use* (Xie et al. 1999)….[quoted after Deliverable 1.2, p.10].

In the *Demographic Approach* the actual population output is considered, under the assumption that nobody in the population uses drugs [Godfrey et al. 2002].

As stated in Deliverable 1.2, according to [Kopp and Fenoglio 2002] these two approaches should be complementary rather than alternative.

Another important decision concerns choosing between the *Prevalence-based* or *Incidence* approaches. In the *Prevalence-based* approach, the cost estimation concerns all kinds of drug users: new, mature and former ones [Deliverable 1.2, p.11]. The *Incidence* approach looks only into new cases of drug use. The two approaches should be, as previously, complementary rather than alternative.

The methods presented below represent the *COI (Costs of Illness), Prevalence-based, Human Capital* approach, as the most popular in social cost estimation (see LEADER Project *Deliverable 1.1 Systematic Review of Existing Publications on Social Costs of Illegal drugs, Alcohol and Tobacco*, p.9, and LEADER Project *Deliverable 1.2 Systematic Review of Existing Publications on*

Social Costs of illegal drugs, Alcohol and Tobacco, p.9-13), and adequately the examples enclosed are composed according to their rules.

> ***This approach is suggested for the estimation of basic social costs of illegal drug use.***
>
> ***Most of the estimation methods presented in the EXCEL examples in Chapter 4 onwards may also be used when theoretical approaches other than the one applied in the Guidance are adopted.***

Statistical data

The way of estimating different kinds of social costs related to illegal drug use depends a great deal on the availability and quality of statistical data, which in many cases show gaps or are not presented according to the desired structure.

The following steps may be applied to obtain the set of data needed:

- Gathering the existing data (official statistical data, survey data),
- In the cases when such data are not available or they are not sufficiently precise, we may use:
  - proxies, such as the *instrumental* variables (*the key*),
  - special studies aiming to elicit the data,
  - surveys asking for expert opinions on the issues,
  - the results of other studies.

The application of the *instrumental* variables and the way of asking for expert opinions when adequate data are unavailable will be explained in the next chapters.

Sources of statistical data

There are large databases maintained by several international institutions, such as:

- WHO databases, especially the European Health for All Database: http://www.euro.who.int/en/data-and-evidence/databases/european-health-for-all-database-hfa-db,
- Eurostat database: http://ec.europa.eu/eurostat/data/database?p_p_id=NavTreeportletprod_WAR_NavTreeportletprod_INSTANCE_nPqeVbPXRmWQ&p_p_lifecycle=0&p_p_state=normal&p_p_mode=view&p_p_col_id=column-2&p_p_col_count=1,
- EMCDDA database: http://www.emcdda.europa.eu/,
- OECD databases: general https://data.oecd.org/ and health statistics http://www.oecd.org/els/health-systems/health-data.htm.

Although institutional data are covering an increasing number of problems and topics every year, in many cases they are still too general for social cost estimation, therefore, for the time being, national statistics remain the main source of data. Accordingly, the Examples presented in the guidance are based on national statistics data, and this source of data is recommended.

While researching the social costs of illegal drugs, the data sources applied should be clearly documented and described, including reliability, gaps and other potential shortcomings of the data.

PART 2: Cost estimation Guidance

Suggested methods for estimating the social costs of illegal drug use

4. Attributable fraction

4.1 Estimation of the attributable fraction

Content (with quicklinks):

- ***4.1 Estimation of the attributable fraction***
  - *Examples 4a - 4b*

Methodology

The attributable fraction is applied to estimate the premature mortality and morbidity of drug users in cases where the use of drugs is one of the causes of a disease.

Mortality related to illegal drug use can be either entirely caused by drug use[1] (meaning that if not for drug use, no death would occur) or partly caused by drug use – then, apart from illegal drug use, other factors contribute to the deaths of drug users, and also the persons who have never used drugs can die from such causes of death. In consequence, in the population of illegal drug users only the surplus number (above the population level) of such deaths should be attributed to illegal drug use.

For such estimation it is necessary to know the population attributable fraction, which is based on two factors: a prevalence rate of drug users in the population (a measure of exposure) and the risk of their mortality relative to the risk of mortality in the population, or better, to the remaining, not using drugs, part of population.

The concept of the population attributable fraction (attributable risk, etiologic fraction, excess fraction) was first proposed by Levin (1953). The population attributable fraction determines the proportion of disease risk in a population that can be attributed to a certain risk factor (or chosen risk factors) – here to illegal drug use – in the situation when the disease is caused by several factors.

The problem involved in the estimation of the population attributable fraction, essential in the estimation of mortality related to illegal drug use, is well documented in literature {see: [Walter 1976], [Rockhill, Newman and Weinberg 1998], [Eide, Heuch 2001], [Ezzatti, Lopez 2003], [Laaksonen 2010], amongst others}, but more attention should be paid to its meaning, interpretation and limitations.

Commonly used formulae applied to define the population attributable fraction are as follows.

Let the following denote:

λ – the population attributable fraction,
p – the prevalence rate of drug users in a population (a measure of exposure),
γ – the risk of their mortality in comparison to the population mortality.

$$\lambda = \frac{p(\gamma - 1)}{1 + p(\gamma - 1)} \tag{4.1}$$

---

[1] It should be stressed that death certificates and consequently mortality statistics usually specify only one, main, cause of death.

The population attributable fraction is usually estimated for one risk factor, but the formula (4.1) can be extended for use with multicategory exposures – under the assumption that there is no confounding of exposure-disease association [Rockhill, Newman, Weinberg 1998, p.16], as:

$$\lambda = \frac{\sum_{j=1}^{k} p_j(\gamma_j - 1)}{1 + \sum_{j=1}^{k} p_j(\gamma_j - 1)} \tag{4.2}$$

where $j = 1,2,\dots k$ refers here to the j^{th} exposure factor or level.

The population attributable fraction λ is usually estimated for each gender, and in age groups (i), so for each gender the formula (4.1) takes the following form:

$$\lambda_i = \frac{p_i(\gamma - 1)}{1 + p_i(\gamma - 1)} \tag{4.3}$$

where p_i denotes a prevalence rate, i.e. the share of illegal drug users in the population in age group *i*,

or, in the (rare) cases where coefficients of relative mortality risk are available in age groups, the form:

$$\lambda_i = \frac{p_i(\gamma_i - 1)}{1 + p_i(\gamma_i - 1)} \tag{4.4}$$

where γ_i denotes relative mortality risk of illegal drug users in comparisons to that in the population in age group *i.*

A confidence interval for the attributable fraction is presented in: [Natarajan, Lipsitz, Rimm 2007].

As indicated above, the value of the population attributable fraction λ depends on two elements:

- a measure of exposure (here – the prevalence rate of drug users in a population),
- the mortality risk of illegal drug users compared to the mortality risk in the population.

Prevalence rates of illegal drug users in a population, also according to gender and age, are from time to time estimated in surveys in most EU countries, therefore the best idea is to apply these estimates for determining the population attributable fraction in the country under study – the use of the attributable fraction estimated for another country would unnecessarily cause additional bias, especially in the situation of significant exposure differences.

The basic and difficult problem in estimating the prevalence rate of drug users results from the fact that the questions about the quantity or frequency of drug use are sensitive, so the prevalence rates estimated in surveys, even if questionnaires were anonymous or computer assisted, are very often underestimated; therefore, in Annex I the basics of sampling theory and the basics of one of the more effective methods of questioning called the randomized response technique are presented.

Here, the importance of using regression analysis should be stressed – the results coming from the surveys are often based on small samples, and they might be biased with the non-sampling errors (see Annex I); additionally, the results are not always presented in the target age groups.
The use of theoretical values of a well fitted regression function allows to construct the probable shape of the prevalence rate distribution in the population and to estimate the values needed in

any age group, and, therefore, it enables more precise estimation. The examples of such applications of regression analysis are presented as Examples 4a and 4b.

→ SEE HOW THE EXAMPLES WORK IN PRACTICE WITH THE GUIDANCE PACK EXCEL

On the other hand, the estimation of the relative risk of drug user mortality is difficult and time-consuming, so it is not performed very often and not in every country. In the estimation of the attributable fraction it is then necessary to apply the available estimates, even if they are obtained for another country and a different period of time. It is advisable to choose estimates from the country most similar to the one under study, especially with respect to drug use patterns.

There are several specific measures of the relation of illegal drug user mortality to the mortality in the whole population, which, in spite of different ways of their defining and estimation, could be applied to determine the population attributable fraction λ. These measures either describe the relative risk of total drug user mortality or the risk of mortality from specific diseases – the ones partly caused by illegal drug use. The most popular measures are:

- Relative Risk (RR),
- Odds Ratio (OR),
- Standardized Mortality Ratio (SMR).

Relative Risk and Odds Ratio

Both measures express the association between an exposure (here: illegal drug use) and an outcome (here: death) in one group (here: among illegal drug users) to that in the other (here: among the non-users), and are estimated within the case-control studies [Jewell 2004].

The *Relative Risk* is the ratio of probability of an event (death) in the two groups, while the *Odds Ratio* is the ratio of the odds of an event (death).

For both measures a value of 1 indicates that the effects are the same in both groups considered (i.e. among users and non-users of illegal drugs). If the value of the estimate of the *Relative Risk* or the *Odds Ratio* is higher than 1, it means that the risk is higher in the exposed group (here: among illegal drug users), if it is lower than 1 – the opposite, the risk is higher in the unexposed group (among non-users). The difference between the *Relative Risk* and the *Odds Ratio* is explained more precisely below.

The following table expresses the population structure with respect to the exposure and the outcome.

		Outcome	
		+	-
Exposure	+	a	b
	-	c	d

Where:

Exposure + denotes use of illegal drugs,
Exposure - denotes non-use of illegal drugs,
Outcome + denotes death,
Outcome - denotes non-death,
a – number of deaths among illegal drug users,
b – number of non-deaths among illegal drug users,
c – number of deaths among illegal drug non-users,
d – number of non-deaths among illegal drug non-users.

Using the above symbols, the *Relative Risk* can be defined as:

$$RR = \frac{a}{a+b} \div \frac{c}{c+d} \tag{4.5}$$

where $p_e = \frac{a}{a+b}$ and $p_{ne} = \frac{c}{c+d}$ are subsequently the proportions of deaths among exposed and unexposed persons, and in fact the estimates of the probability of death of illegal drug users and non-users.

Accordingly, the *Odds Ratio* can be expressed as:

$$OR = \frac{a/c}{b/d} = \frac{ad}{bc} \tag{4.6}$$

The *Odds Ratio* is usually calculated either on the basis of a table as above (formula 4.6) or as an outcome of logistic regression.

The *Odds Ratio* can be interpreted as an approximation of the *Relative Risk* if the number of outcomes in "+" among the exposed to the disease or condition under study (here: use of illegal drugs) is rare[2] in comparison to their outcome in "-", which means in this case that deaths among illegal drug users should be rare.

For both measures the confidence interval can be estimated {[Altman 1991], [Bland, Altman 2000], [Jewell 2004], [Szumilas 2010]}.

The quality of such studies depends greatly on the proper choice of controls in control studies, which in the case of illegal drugs is especially difficult; problems in research arise because …*of low prevalence of exposure in the general population, and likely under ascertainment of exposures histories even when they exist* [English et al. 1995, p.497].

Standardized Mortality Ratio

In epidemiology the *Standardized Mortality Ratio* (SMR) is the ratio of the number of observed deaths to the number of expected deaths according to a specific health outcome (here: illegal drug use) obtained during follow-up studies. In this case, the purpose of such studies is to compare the observed empirical number of deaths among illegal drug users to their hypothetical number of deaths, that is, to the number of deaths which would happen in their population, if they were not drug users.

In prospective mortality studies a chosen part of a population of living people, called *a cohort* (here: the chosen part of a population of illegal drug users) is observed for a certain period of time – from present to some point in the future[3] – and it is determined how many of them died during the period of observation. Then this number is compared to the hypothetical

---

[2] According to [Zhang, Kai 2009] when the percentage of the considered "plus" outcome does not exceed 10%.

[3] The alternative is the retrospective method, where the observation of the cohort takes place from some point in the past to the present.

number of deaths, that is to the number of deaths which would happen in the population of the same size, if the mortality rates of the whole population were applied[4]:

$$SMR = \frac{O}{E} \tag{4.7}$$

where O denotes the number of observed deaths and E the number of expected deaths among users of illegal drugs. The confidence interval for SMR can be found in [Silcocks 1994], [Ulm 1990], [Soe, Sullivan 2006].

As previously, the SMR value of 1 indicates that the mortality risk is the same among users and non-users of illegal drugs. If the value of SMR is higher than 1 it means that the risk is higher among illegal drug users, if it is lower than 1 – the opposite, the risk is higher among non-users.

The construction of SMR can be explained more precisely as follows.

If l_a stands for the number of illegal drug users followed up (*the cohort*), m_a – for mortality rates of those drug users, the observed number of deaths of illegal drug users in follow-up studies (d_a) is a product of the two:

$$O = d_a = l_a \cdot m_a \tag{4.8}$$

If, in turn, m_p denotes the mortality rates in the whole population, then the expected number of deaths in the followed-up cohort of illegal drug users (d_p) can be calculated as

$$E = d_p = l_a \cdot m_p \tag{4.9}$$

Such estimations are usually made for gender/age groups, so it is estimated how many deaths would happen in the population of the same size and gender/age structure as the cohort of the followed-up drug users, if gender/age specific mortality rates of the whole population were applied.

Though SMR is widely used for comparisons of mortality in the distinguished parts of a population to the mortality in the whole population, it has also been criticised {[Gaffey 1976], [Jones, Swerdiow 1998] and others]. The main shortcoming of this measure lies in the fact that in follow-up studies many persons cannot, for different reasons, be followed up, so the final SMR estimates are obtained only on the basis of a part of the initially chosen cohort – which means that there is no knowledge available about the mortality pattern in the unobserved part of the cohort.

Thus, SMR estimates can be seriously biased {[Kristman, Manno, Cote 2004], [Hogan, Roy, Korkontzeloe 2004], [Larsen et al. 2012], [Sordo et al. 2015], [Christensen et al. 2015]}.
The following literature describes the relation of illegal drug user mortality to population mortality, where the risk coefficients needed for estimation of the population attributable fraction can be found: [English et al. 1995], [Bargagli et al. 2001], [Antolini et al. 2006],

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[4] The appropriate approach would be to estimate the expected number of deaths in the drug user cohort with reference to non-drug user population mortality rates; in practice, the difference between the general population mortality rates and mortality rates of the non-drugs user population, as the population of drug users is relatively small, is usually also small, so the mortality rates of the whole population are often applied.

[Lejckova, Mravcik 2007], [Mathers et al. 2008], [Hall, Degenhardt 2009], [Degenhardt et al. 2011], [Nelson et al. 2011], [Mathers et al. 2013], amongst others.

After estimating the prevalence rate of illegal drug users in every gender/age group of the population (p_i) and deciding what measures of the relative risk of illegal drug user mortality will be used, formulae (4.1-4.4) should be applied so as to obtain the attributable fraction; Example 4c illustrates the whole procedure.

Considerations

Apart from mortality and morbidity, in the cases of other consequences of illegal drugs use – where the use of drugs is one of the causes (crimes or offences committed, car accidents caused under the influence of drugs) *the relative risk* and *the attributable fraction* should be estimated; the problem is analogous to the one of mortality or morbidity partly attributable to illegal drug use.

Taking, for instance, a robbery committed under the influence of drugs or in order to obtain money for drugs – a robbery can be committed by users as well as by non-users of drugs, so theoretically, if the population of drugs users did not use drugs, a number of robberies would be expected anyway, similarly as in the remaining part of the population.

So again only the surplus – above the average population level – should be considered as drug attributable. Unfortunately, nowadays such estimation is not possible, due to the lack of estimates of relevant *relative risks* coefficients.

Summary

To estimate the population attributable fraction for diseases partly caused by illegal drug use the following information is needed:

- Prevalence rate, i.e. a percentage (or share) of illegal drug users in the population, according to gender and age (obtained on a survey basis).
- Estimates of relative mortality risk of illegal drug users with reference to non-user or population mortality for diseases partly caused by illegal drug use, preferably, if such information is accessible, according to gender and age groups (available in literature).

Example 4a: Estimation of the theoretical values of prevalence rates

→ SEE HOW THE EXAMPLES WORK IN PRACTICE WITH THE GUIDANCE PACK EXCEL

As mentioned above, the need to estimate the theoretical values of prevalence rates[5] stems from the fact that the survey sample distributions of prevalence rates are often based on small samples and their shapes are, mostly due to some non-sampling errors (see Annex I), irregular; additionally, the results might be expressed in age groups other than needed. The application of the theoretical values of well fitted theoretical functions smoothes the distributions and enables the construction of the probable shape of a population distribution, so it becomes possible to:

1. estimate the percentage of drug users in every desired group of age,
2. eliminate the influence of some non-sampling errors which cause irregularities in the distribution of empirical survey data.

The procedure to estimate the theoretical values of a regression function will be shown for the prevalence rates of drug users in Catalonia (men). The data used in this example come from the work performed on estimating the social cost of addictions in the frame of the ALICE-RAP study (see Mielecka-Kubien, et al. 2014).

To estimate the theoretical values of a regression function, first of all, a proper theoretical function has to be fitted to empirical data; one has to know what the shape of a relationship is. In EXCEL it can be done with the help of a chart (see also Annex III). To construct a chart, basic data and their description (categories) are needed.

Original data:

Table 4.1 Percentage of drug users in Catalonia

Age	Percentage of drug users
15-24	31.4
25-34	23.8
35-44	17.4
45-54	3.3
55-64	0.9

Source: Program on Substance Abuse. Public Agency of Government of Catalonia, Data for Catalonia elaborated from the National Household EDADES Survey on Drugs from the National Drug Plan (2011) - 15 to 64 years of age.

First, the percentage should be substituted by a share, i.e. every number in the second column should be divided by 100, and the age groups should best have the length of 5 years, as in the table below.

If the data are given in columns, the first column contains the names of the categories which will appear on the X-axis.

One should select the whole table, then go to "INSERT" and select the chart. For „2-D Line” – a dotted line will appear (blue).

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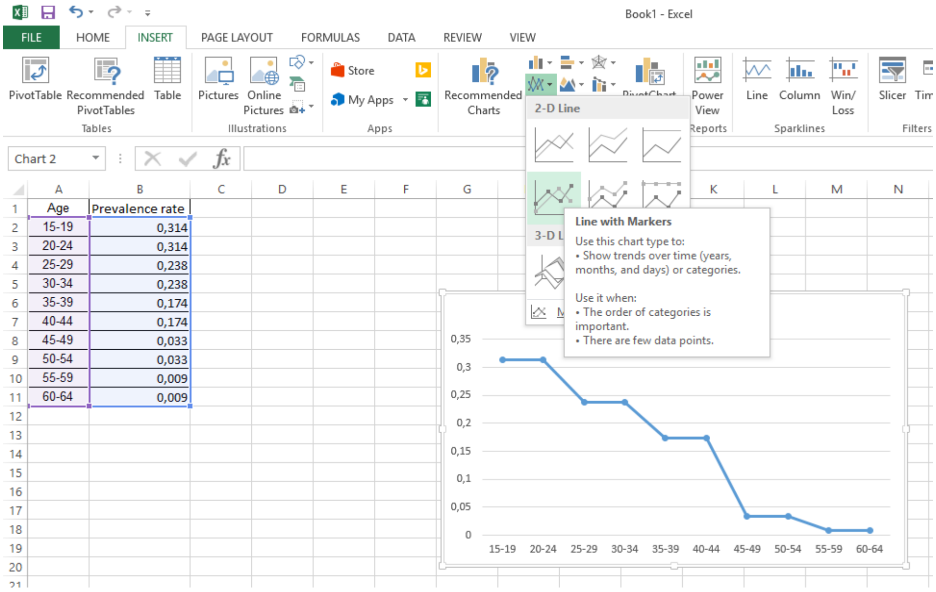
[5] The method can also be used for other data; sometimes it is not possible to find a theoretical function well fitted to empirical distribution.

Example 4a

Screenshot 4.1 Creating the graph



Age	Prevalence rate
15-19	0,314
20-24	0,314
25-29	0,238
30-34	0,238
35-39	0,174
40-44	0,174
45-49	0,033
50-54	0,033
55-59	0,009
60-64	0,009

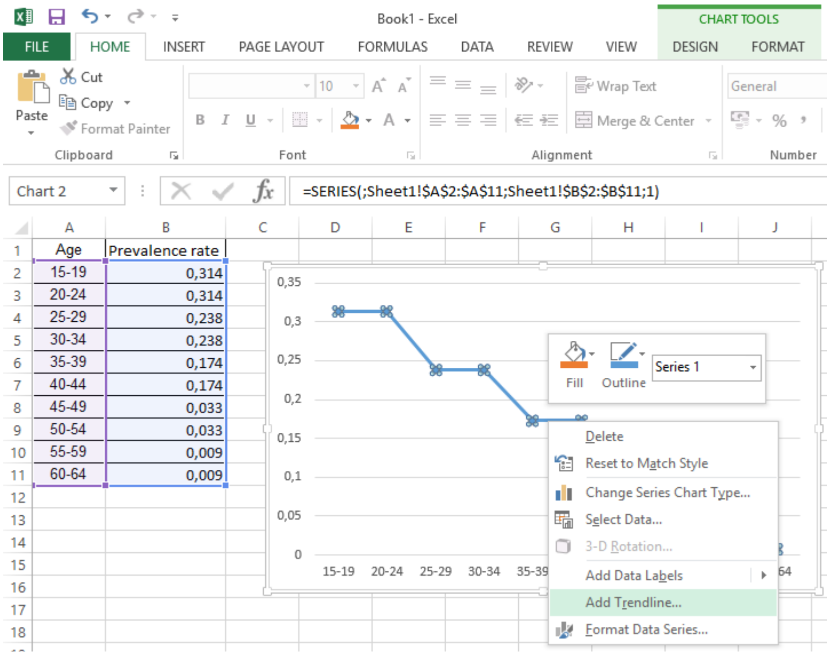
Line with Markers

Use this chart type to:
- Show trends over time (years, months, and days) or categories.

Use it when:
- The order of categories is important.
- There are few data points.

To find the best theoretical curve to describe the empirical data one should click on one point of the blue line and press the left mouse button, then choose „Add Trendline".

Screenshot 4.2 Fitting a theoretical function



=SERIES(;Sheet1!$A$2:$A$11;Sheet1!$B$2:$B$11;1)

Age	Prevalence rate
15-19	0,314
20-24	0,314
25-29	0,238
30-34	0,238
35-39	0,174
40-44	0,174
45-49	0,033
50-54	0,033
55-59	0,009
60-64	0,009

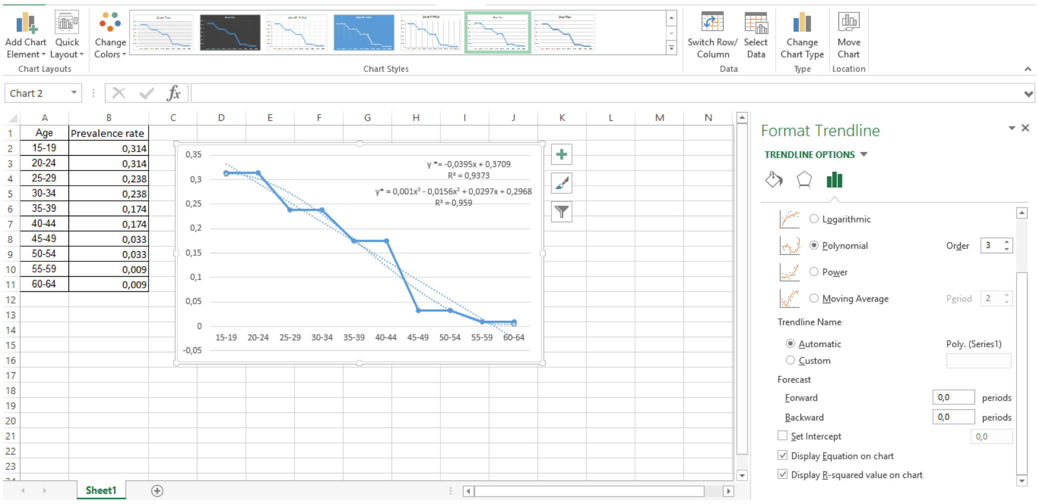
There are 5 possibilities available, called "TRENDLINE OPTIONS" in EXCEL.

The estimated equation and the R^2 value can be displayed, if one indicates it.

One should try several different options until the best fit is found – usually the best is the one with the highest R^2.

In the example, the two theoretical functions considered are well fitted: a linear function and a third degree polynomial. For the purpose of smoothing the distribution and calculating the theoretical values for different age groups, the third degree polynomial is a better choice than the linear function, not only because of a slightly higher R^2, but also due to better predictive possibilities, for instance in lower or higher age groups than presented in the chart.

Screenshot 4.3 Two possible theoretical functions fitted



	A	B
1	Age	Prevalence rate
2	15-19	0,314
3	20-24	0,314
4	25-29	0,238
5	30-34	0,238
6	35-39	0,174
7	40-44	0,174
8	45-49	0,033
9	50-54	0,033
10	55-59	0,009
11	60-64	0,009

y *= -0,0395x + 0,3709
R² = 0,9373

y* = 0,001x³ - 0,0156x² + 0,0297x + 0,2968
R² = 0,959

Format Trendline

TRENDLINE OPTIONS

○ Logarithmic
● Polynomial Order 3
○ Power
○ Moving Average Period 2

Trendline Name
● Automatic Poly. (Series1)
○ Custom

Forecast
Forward 0,0 periods
Backward 0,0 periods
☐ Set Intercept 0,0
☑ Display Equation on chart
☑ Display R-squared value on chart

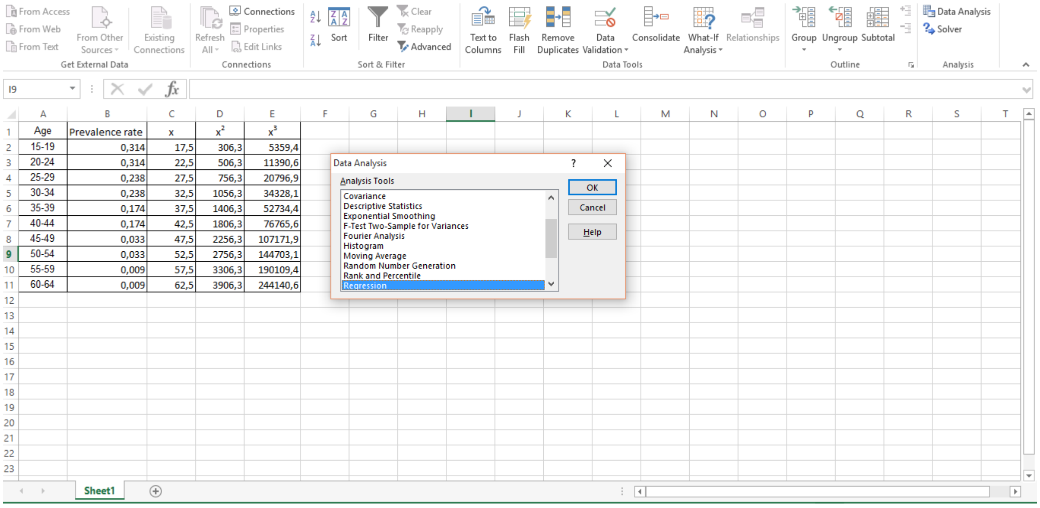
Once the theoretical form of the function is chosen, the proper estimation of the regression function parameters has to be performed in order to obtain the theoretical values. This can be achieved with EXCEL “Regression analysis”.

To find this option we choose: DATA ⟶ Data Analysis ⟶ Regression

The dependent variable in this case is the “Prevalence rate”. There are three independent variables: x, x^2, x^3, the values of which have to be calculated. The values of the first variable x are calculated as middle values of the age groups, i.e. for group [15-19) it is 17.5, for group [20-24) it is 22.5 etc.; x^2, x^3 are subsequently the values of x raised to the second and third power.

If we press “Regression”, more options appear. One should tick “Labels” and “Residuals”. Then as “Input Y Range” one should highlight “Prevalence rate” (the title and the numbers), as “Input X Range” one should highlight variables x, x^2, x^3 (the titles and the numbers), and press “OK”.

Screenshot 4.4 Introducing regression analysis



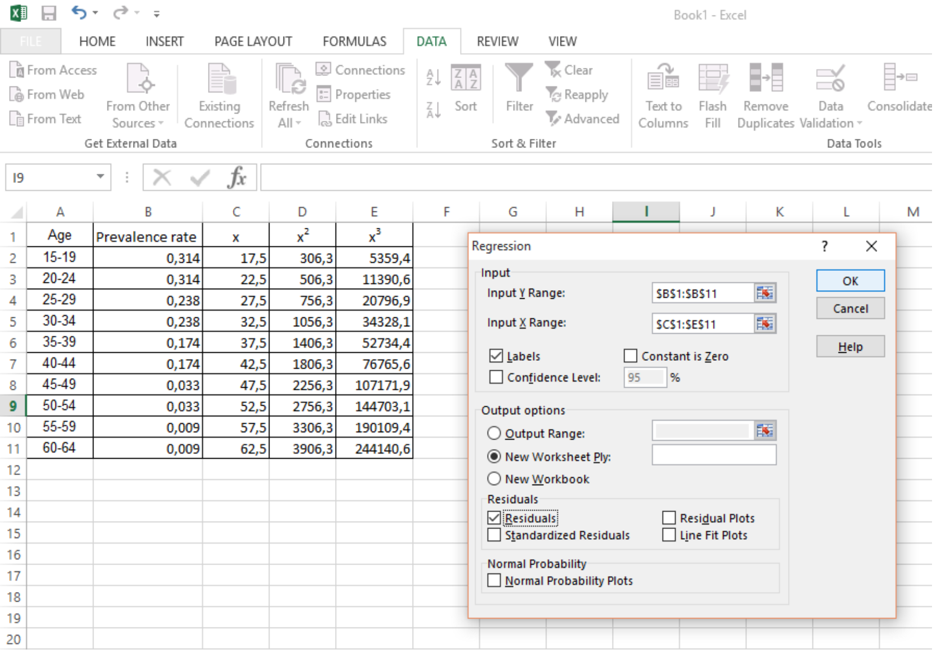
	A	B	C	D	E
1	Age	Prevalence rate	x	x^2	x^3
2	15-19	0,314	17,5	306,3	5359,4
3	20-24	0,314	22,5	506,3	11390,6
4	25-29	0,238	27,5	756,3	20796,9
5	30-34	0,238	32,5	1056,3	34328,1
6	35-39	0,174	37,5	1406,3	52734,4
7	40-44	0,174	42,5	1806,3	76765,6
8	45-49	0,033	47,5	2256,3	107171,9
9	50-54	0,033	52,5	2756,3	144703,1
10	55-59	0,009	57,5	3306,3	190109,4
11	60-64	0,009	62,5	3906,3	244140,6

Data Analysis

Analysis Tools
- Covariance
- Descriptive Statistics
- Exponential Smoothing
- F-Test Two-Sample for Variances
- Fourier Analysis
- Histogram
- Moving Average
- Random Number Generation
- Rank and Percentile
- Regression

Example 4a

Screenshot 4.5 Entering data



	A	B	C	D	E
1	Age	Prevalence rate	x	x^2	x^3
2	15-19	0,314	17,5	306,3	5359,4
3	20-24	0,314	22,5	506,3	11390,6
4	25-29	0,238	27,5	756,3	20796,9
5	30-34	0,238	32,5	1056,3	34328,1
6	35-39	0,174	37,5	1406,3	52734,4
7	40-44	0,174	42,5	1806,3	76765,6
8	45-49	0,033	47,5	2256,3	107171,9
9	50-54	0,033	52,5	2756,3	144703,1
10	55-59	0,009	57,5	3306,3	190109,4
11	60-64	0,009	62,5	3906,3	244140,6

Regression

Input

Input Y Range: $B$1:$B$11

Input X Range: $C$1:$E$11

☑ Labels ☐ Constant is Zero

☐ Confidence Level: 95 %

Output options

○ Output Range:

● New Worksheet Ply:

○ New Workbook

Residuals

☑ Residuals ☐ Residual Plots

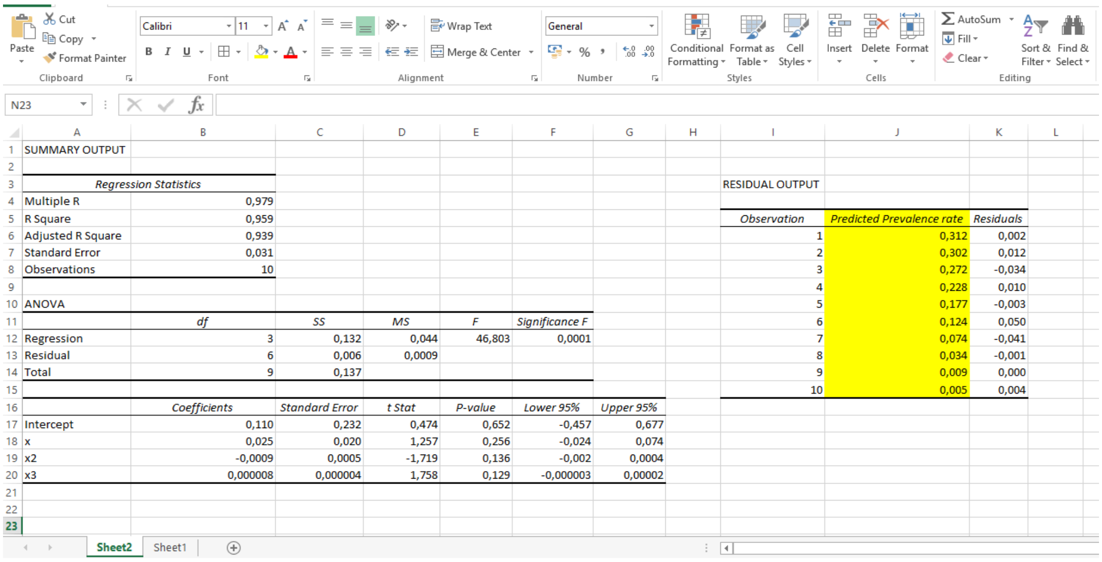
☐ Standardized Residuals ☐ Line Fit Plots

Normal Probability

☐ Normal Probability Plots

The results of estimation are presented below. The most important output here is “Predicted Prevalence rate” (in yellow). They are calculated for every age group taken into account.

Screenshot 4.6 The output



SUMMARY OUTPUT

Regression Statistics	
Multiple R	0,979
R Square	0,959
Adjusted R Square	0,939
Standard Error	0,031
Observations	10

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	3	0,132	0,044	46,803	0,0001
Residual	6	0,006	0,0009		
Total	9	0,137			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	0,110	0,232	0,474	0,652	-0,457	0,677
x	0,025	0,020	1,257	0,256	-0,024	0,074
x2	-0,0009	0,0005	-1,719	0,136	-0,002	0,0004
x3	0,000008	0,000004	1,758	0,129	-0,000003	0,00002

RESIDUAL OUTPUT

Observation	*Predicted Prevalence rate*	*Residuals*
1	0,312	0,002
2	0,302	0,012
3	0,272	-0,034
4	0,228	0,010
5	0,177	-0,003
6	0,124	0,050
7	0,074	-0,041
8	0,034	-0,001
9	0,009	0,000
10	0,005	0,004

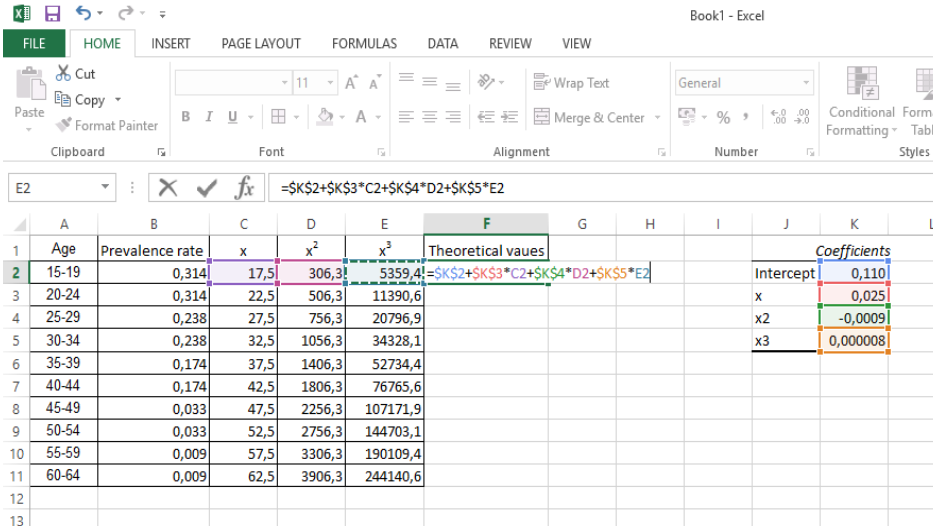
The theoretical values can also be obtained in another way which enables their calculation in differently defined age groups. Using the coefficients estimated previously we introduce the equation, starting with the sign “=” and blocking the values of the coefficients with the key “F4”, so the “$“ sign appears.

The sign “$” indicates that the cell content was blocked by the computer key “F4“, which enables multiplication (or other mathematical operations) of the subsequent numbers in a column (or verse) by the same cell content.

Then it is enough to copy and paste this equation to all the cells of column “F” (F3 to F11).

Example

Screenshot 4.7 Calculation of theoretical values



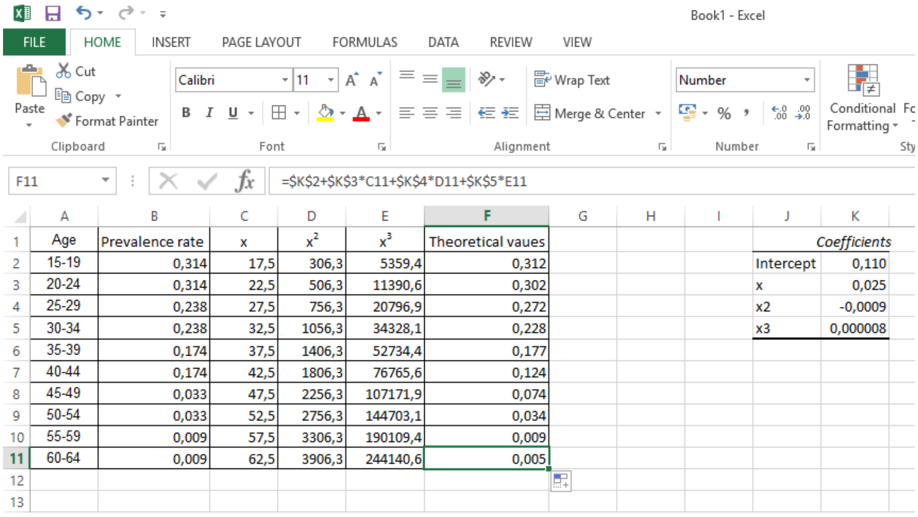
=$K$2+$K$3*C2+$K$4*D2+$K$5*E2

Age	Prevalence rate	x	x^2	x^3	Theoretical vaues
15-19	0,314	17,5	306,3	5359,4	=$K$2+$K$3*C2+$K$4*D2+$K$5*E2
20-24	0,314	22,5	506,3	11390,6	
25-29	0,238	27,5	756,3	20796,9	
30-34	0,238	32,5	1056,3	34328,1	
35-39	0,174	37,5	1406,3	52734,4	
40-44	0,174	42,5	1806,3	76765,6	
45-49	0,033	47,5	2256,3	107171,9	
50-54	0,033	52,5	2756,3	144703,1	
55-59	0,009	57,5	3306,3	190109,4	
60-64	0,009	62,5	3906,3	244140,6	

	Coefficients
Intercept	0,110
x	0,025
x2	-0,0009
x3	0,000008

The results are the same as previously:

Screenshot 4.8 The final result

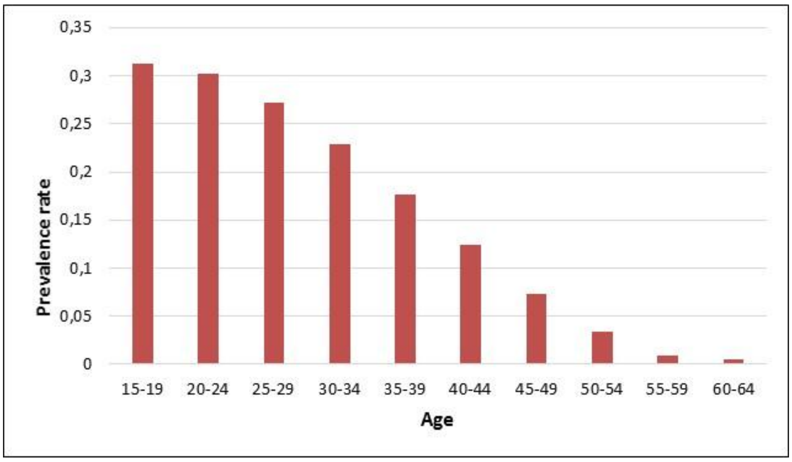


=$K$2+$K$3*C11+$K$4*D11+$K$5*E11

Age	Prevalence rate	x	x^2	x^3	Theoretical vaues
15-19	0,314	17,5	306,3	5359,4	0,312
20-24	0,314	22,5	506,3	11390,6	0,302
25-29	0,238	27,5	756,3	20796,9	0,272
30-34	0,238	32,5	1056,3	34328,1	0,228
35-39	0,174	37,5	1406,3	52734,4	0,177
40-44	0,174	42,5	1806,3	76765,6	0,124
45-49	0,033	47,5	2256,3	107171,9	0,074
50-54	0,033	52,5	2756,3	144703,1	0,034
55-59	0,009	57,5	3306,3	190109,4	0,009
60-64	0,009	62,5	3906,3	244140,6	0,005

	Coefficients
Intercept	0,110
x	0,025
x2	-0,0009
x3	0,000008

Figure 4.1 Estimated prevalence rates, Catalonia, males, final result



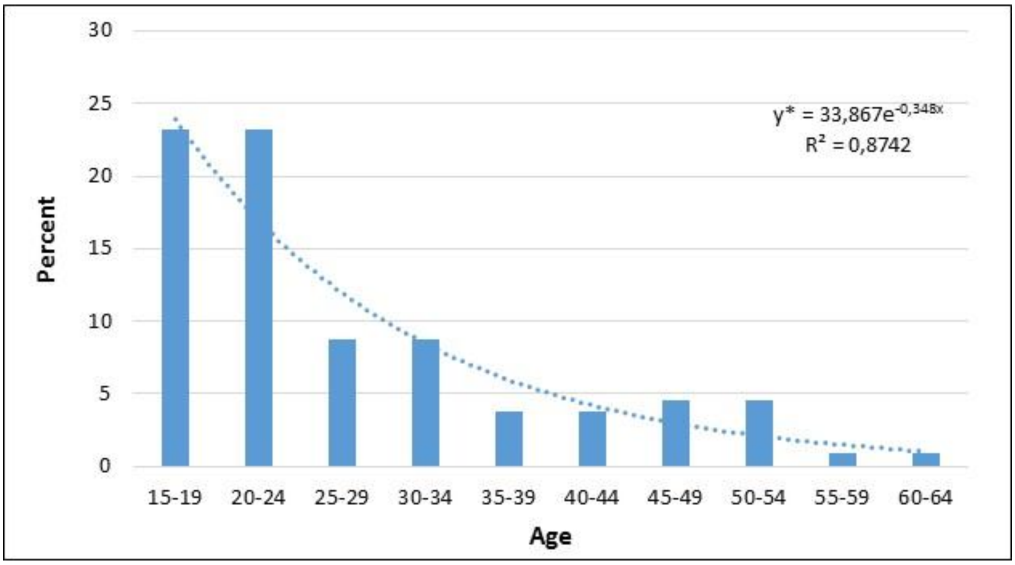
Source : [Mielecka-Kubien et al. 2014, p.69].

Example 4b

Example 4b Estimation of the theoretical values of prevalence rates using additional information

To fit the proper pattern of theoretical values, additional information should often be taken into account. For Catalonia, females, the prevalence rates are arranged as in Figure 4.2 (the example comes from the ALICE-RAP study).

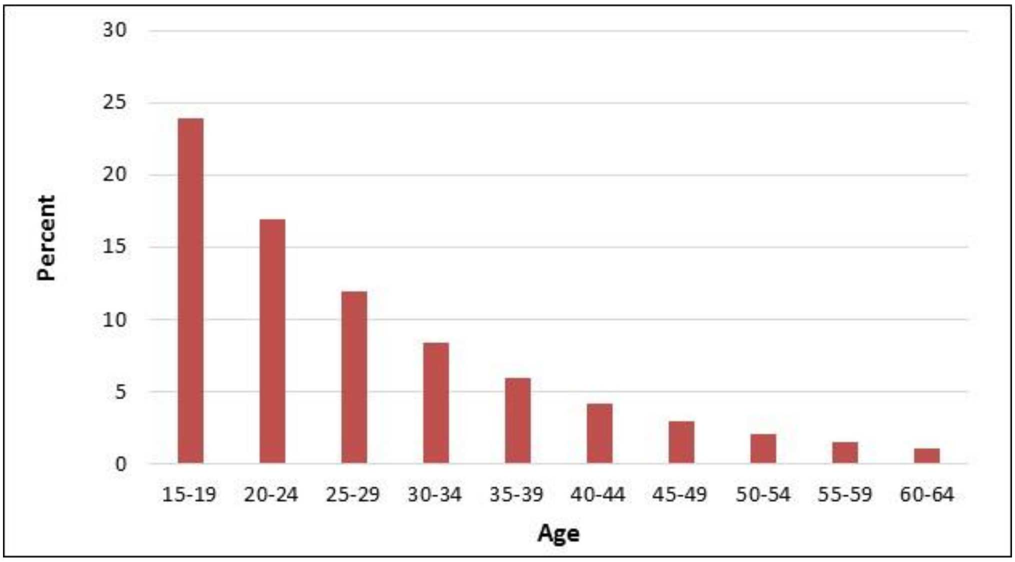
Figure 4.2 Prevalence rates and fitted exponential function



Source: Authors' own on the basis of data of the Program on Substance Abuse. Public Agency of Government of Catalonia, Data for Catalonia elaborated from the National Household EDADES Survey on Drugs from the National Drug Plan (2011) - 15 to 64 years of age.

It can be observed that at the age [15-44) the values decrease, but they increase at the age [45-54). Under the assumption that the increase is casual, due to the existence of some non-sampling errors in the survey, as a well-fitted theoretical function, an exponential function can be applied (as in figure 4.2) and the theoretical distribution of the prevalence rates looks as in figure 4.3.

Figure 4.3 Theoretical values of prevalence rates based on the exponential function

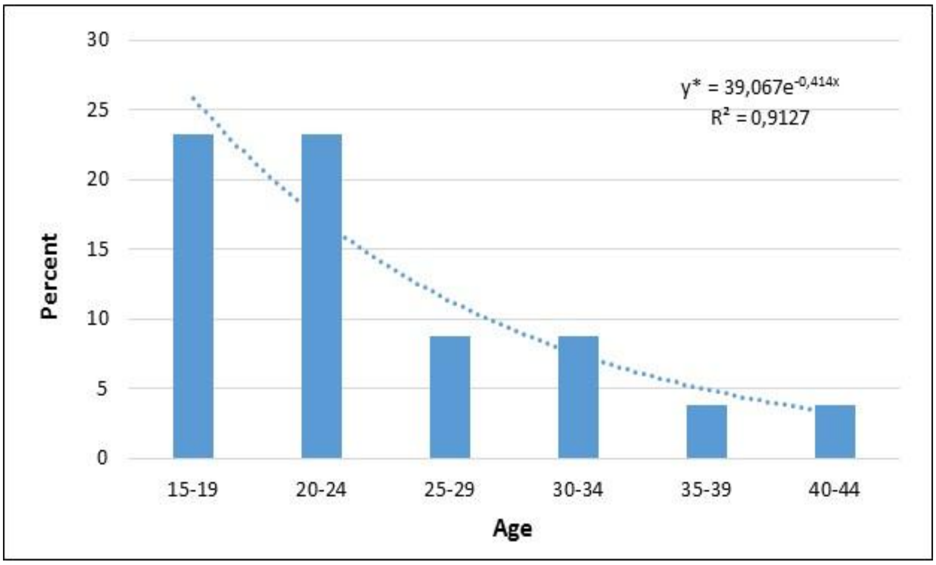


Source: Authors' own on the basis of data of the Program on Substance Abuse. Public Agency of Government of Catalonia, Data for Catalonia elaborated from the National Household EDADES Survey on Drugs from the National Drug Plan (2011) - 15 to 64 years of age.

Example 4b

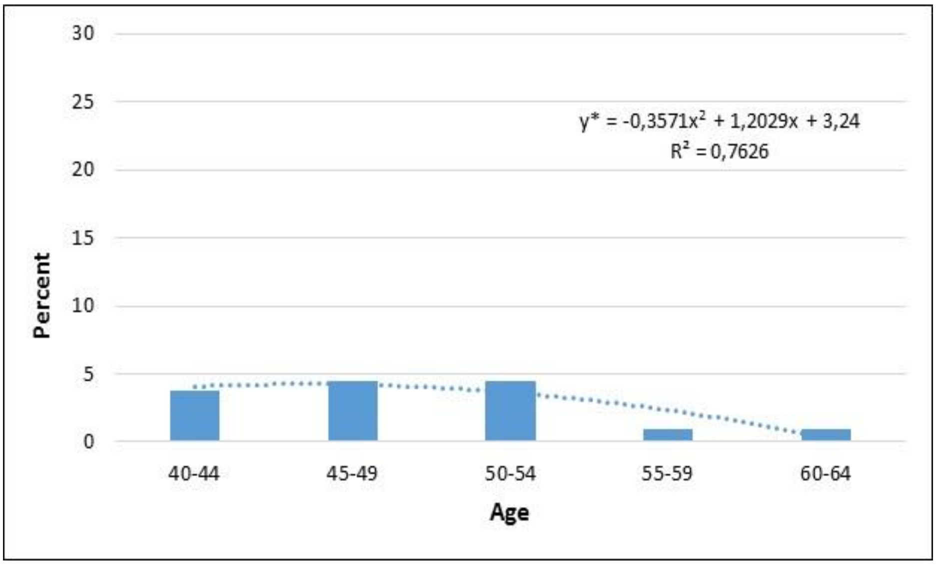
If the reason for the increase in the values of the prevalence rates at the age [45-54) is important, the increase should be taken into account. For instance, the original values of the prevalence rates can be divided into two parts, for age group [15-44) as in figure 4.4 and age group [40-64) as in figure 4.5. Then, two separate theoretical functions can be fitted, which will constitute the final distribution of the prevalence rates. The value for the class [40-44) will be the arithmetic mean of the values given by the two fitted theoretical functions (table 4.1). The results are presented in figure 4.6.

Figure 4.4 Prevalence rates and fitted exponential function for the age group [15-44)



Source: Authors’ own on the basis of data of the Program on Substance Abuse. Public Agency of Government of Catalonia, Data for Catalonia elaborated from the National Household EDADES Survey on Drugs from the National Drug Plan (2011) - 15 to 64 years of age.

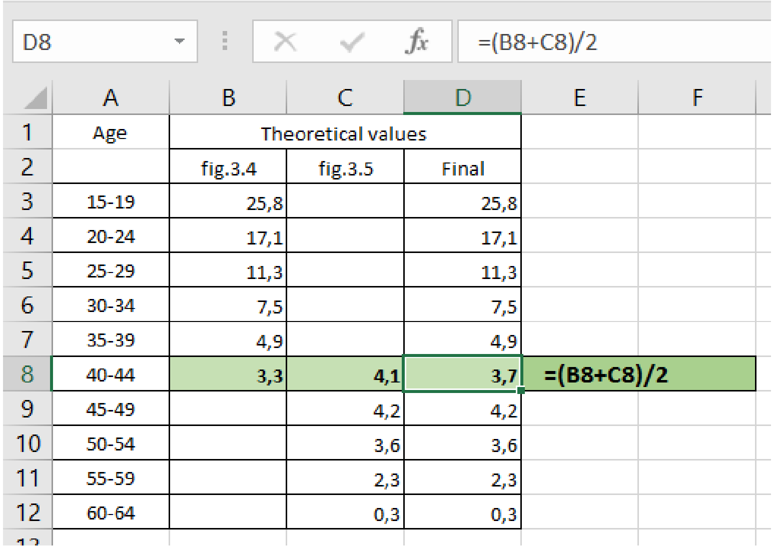
Figure 4.5 Prevalence rates and fitted polynomial function for the age group [40-64)



Source: Authors’ own on the basis of data of the Program on Substance Abuse. Public Agency of Government of Catalonia, Data for Catalonia elaborated from the National Household EDADES Survey on Drugs from the National Drug Plan (2011) - 15 to 64 years of age.

Example 4b

Screenshot 4.9 Theoretical values composed of the two functions

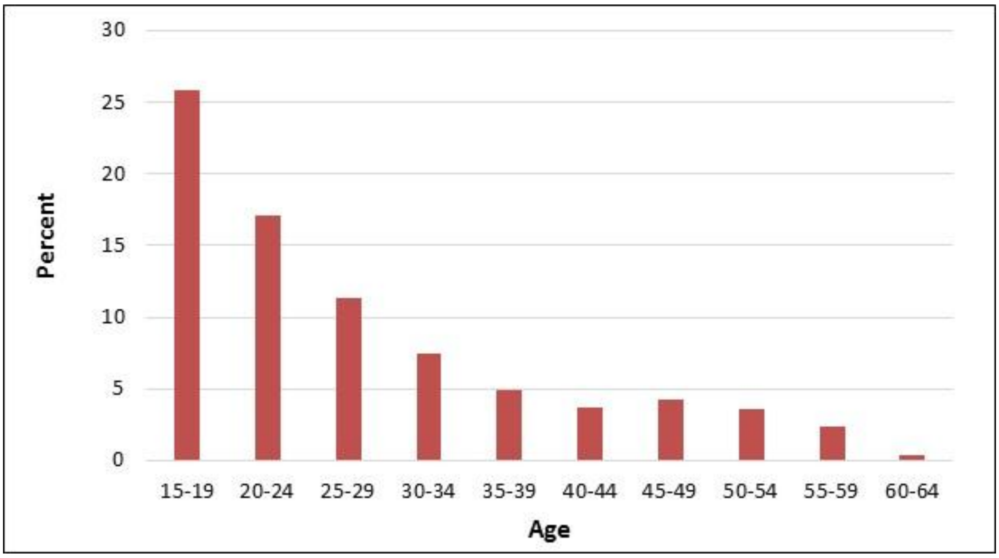


D8 =(B8+C8)/2

	A	B	C	D	E	F
1	Age	Theoretical values				
2		fig.3.4	fig.3.5	Final		
3	15-19	25,8		25,8		
4	20-24	17,1		17,1		
5	25-29	11,3		11,3		
6	30-34	7,5		7,5		
7	35-39	4,9		4,9		
8	40-44	3,3	4,1	3,7	**=(B8+C8)/2**	
9	45-49		4,2	4,2		
10	50-54		3,6	3,6		
11	55-59		2,3	2,3		
12	60-64		0,3	0,3		

Source: Authors' own on the basis of data of the Program on Substance Abuse. Public Agency of Government of Catalonia, Data for Catalonia elaborated from the National Household EDADES Survey on Drugs from the National Drug Plan (2011) - 15 to 64 years of agr.

Figure 4.6 Final distribution of the prevalence rates composed of the two functions



Source: Authors' own on the basis of data of the Program on Substance Abuse. Public Agency of Government of Catalonia, Data for Catalonia elaborated from the National Household EDADES Survey on Drugs from the National Drug Plan (2011) - 15 to 64 years of age.

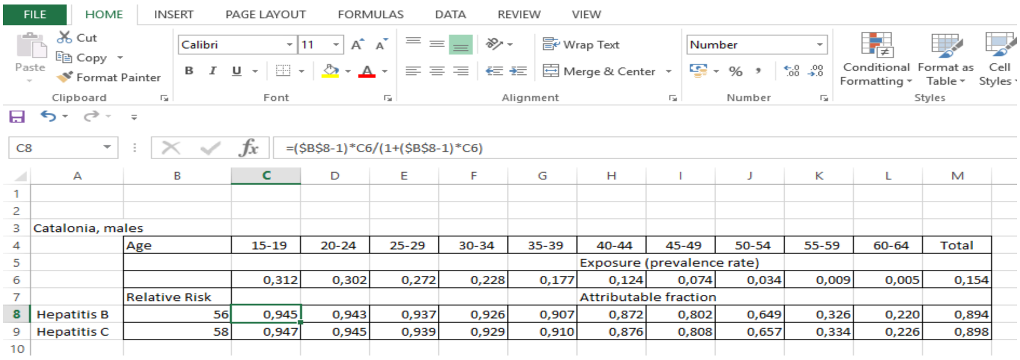
Example 4c

Example 4c: Estimation of the population attributable fraction

Once the prevalence rates are estimated and the measure of the relation of drug user mortality risk to population mortality risk is chosen, one of the formulae (4.1-4.4) should be applied in order to obtain the population attributable fraction values.

In the discussed case, it was possible to apply the formula (4.3), which is expressed in EXCEL in the highest row (marked with "*fx*"). One starts to write the equation with "=" and block with "F4" the value of the relative risk (cell B8). Then one should copy and paste the equation to the cells in row 8 (from C8 to L8). The similar calculation has to be done for Hepatitis C[6], but in this case one has to block cell B9 with key F4.

Screenshot 4.10 Estimation of the attributable fraction



C8

=($B$8-1)*C6/(1+($B$8-1)*C6)

	A	B	C	D	E	F	G	H	I	J	K	L	M
1													
2													
3	Catalonia, males												
4		Age	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	Total
5								Exposure (prevalence rate)					
6			0,312	0,302	0,272	0,228	0,177	0,124	0,074	0,034	0,009	0,005	0,154
7		Relative Risk						Attributable fraction					
8	Hepatitis B	56	0,945	0,943	0,937	0,926	0,907	0,872	0,802	0,649	0,326	0,220	0,894
9	Hepatitis C	58	0,947	0,945	0,939	0,929	0,910	0,876	0,808	0,657	0,334	0,226	0,898
10													

---

[6] Relative risk values for Hepatitis B and C quoted after [English et al. 1995].

5. Premature mortality and its consequences

Content **(with quicklinks)*:***

- ***5.1 Estimation of mortality attributable to illegal drug use***
    - *Examples 5a - 5b*
- ***5.2 Estimation of the number of lives and years of life lost***
    - *Example 5c*
- ***5.3 Estimation of productivity loss (labour costs) caused by premature mortality of illegal drug users***
    - *Examples 5d*
- ***5.4 Estimation of the loss of life expectancy (e_0) and life potential of illegal drug users****
    - *Examples 5e – 5f*

5.1 Estimation of mortality attributable to drug use

Methodology

As indicated above, mortality related to illegal drug use can be either entirely caused by illegal drug use (meaning that if not for drug use, no death would occur) or partly caused by drug use.

Data on the number of deaths entirely caused by drug use are usually accessible in a country's official mortality statistics. For instance, according to the Central Statistical Office of Poland, the following categories are considered drug-related deaths:[7]

- Mental and behavioural disorders due to psychoactive substance use (ICD-10 CODES: F11-F12, F14-F16, F19),
- Accidental poisoning by and exposure to noxious substances (ICD-10 CODES: X42, X44, X62, X64),
- Injury, undetermined whether accidental or purposely inflicted (ICD-10 CODES: Y12, Y14).

So the numbers of deaths entirely caused by drug use are in Poland, as well as in other European countries, usually easily available, also in gender and age groups.

If mortality data is not readily available from official sources in a given jurisdiction, it is suggested to check the WHO European Health For All database, which provides free and downloadable data.

Having the population attributable fraction for the considered causes of death estimated (preferably according to gender/age groups), in order to obtain the number of deaths partly caused by illegal drug use within the whole number of deaths from the considered causes of death in the population, it is enough to multiply the values of the attributable fractions by empirical numbers of deaths from those causes of deaths in the whole population (data available in the national mortality statistics). It should be stressed, however, that, as both

---

[7] There are slight differences in the causes of death of drug users included in this category among EU countries, see: http://www.emcdda.europa.eu/stats11/drd/methods

components of the population attributable fraction have certain shortcomings (see above), the results give only a rough approximation of mortality partly caused by illegal drug use, and have to be treated with adequate caution.

Among the causes of death partly attributable to illegal drug use, the following are most often specified: [8]

- Tuberculosis (ICD-10 CODES: A15-A19),
- Hepatitis B (ICD-10 CODES: B16, B18, B18.1),
- Hepatitis C (ICD-10 CODES: B17.1, B18.2),
- HIV/AIDS (ICD-10 CODES: B20-B24),
- Homicide or injury inflicted by another person with the intent to injure or kill, by any means (ICD-10 CODES: X85-Y09).

Sometimes no coefficient of the relation of illegal drug user mortality risk to that in the whole population can be found in literature. In such cases it might be possible to apply less precise information, for instance the percentage of cases of disease attributed to drug use in another study, as it was done in the ALICE-RAP project, where it was assumed[9] that 4.5 percent of cases of deaths from *Tuberculosis*, and 15.8 percent of cases of deaths from *Homicide or injury*...can be ascribed to illegal drug use.

In the case when statistical data on HIV/AIDS deaths attributed to drug use are not available, the situation is more advantageous – in most European countries information about the percentage of positive diagnoses for HIV/AIDS attributed to drug injections is available; this value can be taken as an approximate percentage of HIV/AIDS deaths attributable to illegal drug use (see Example 5a).

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Summing up the numbers of deaths entirely attributable to illegal drug use and estimated numbers of deaths partly attributable to illegal drug use, one obtains the estimate of the level of mortality related to illegal drug use – which, in fact, is premature mortality, meaning that if the deceased persons had not used drugs they could have lived further, similarly as other, non-drug user members of the population in their gender/age group.

The final results of the estimation of mortality attributable to illegal drug use are presented in Example 5b.

Summary

To estimate mortality attributable to illegal drug use, the following information is needed, preferably according to gender and age groups:

- Number of deaths entirely attributable to illegal drug use; possible source: national mortality statistics.
- Empirical numbers of deaths from the considered causes of deaths partly attributable to illegal drug use in the whole population; possible source: national mortality statistics.
- Previously estimated population attributable fractions for the considered diseases partly attributable to illegal drug use.

---

[8] List of causes of deaths and ICD-10 codes quoted after [Office of National Drug Control Policy…2004, B-11].

[9] See [Harwood, Fountain, Livermore 1998], quoted after [Office of National Drug Control Policy…2004, Appendix B].

Example 5a

Example 5a: Estimation of the percentage of HIV/AIDS deaths attributable to illegal drug use

On the basis of the data from *Centre d'Estudis Epidemiològics sobre les ITS/HIV/SIDA de Catalunya* (CEEISCAT), it can be calculated that in Catalonia in 2010 about 43.2% of AIDS deaths and 16.7% of HIV positive diagnosed deaths could be ascribed to injecting drugs by drug users, as the most probable way of infection, which gives an average (weighted with the total number of AIDS and HIV deaths in the same survey) equal to 32.8%.

The calculation proceeds as follows:

Total number of AIDS deaths = 37
Number of IDU deaths among AIDS deaths = 16
Calculated share of IDU deaths in total number of AIDS deaths: 16/37 = 0.432 (i.e. 43.2%)

Total number of HIV positive diagnosed deaths = 24
Number of IDU deaths among deaths with HIV positive diagnoses = 4
Calculated share of IDU deaths in total number of deaths with HIV positive diagnoses: 4/24 = 0.167 (i.e. 16.7%)

The weighted average is equal to:

$$\frac{0.432 \cdot 37 + 0.167 \cdot 24}{37 + 24} = 0.328$$

so about 32.8% of AIDS & HIV positive mortality can be attributed to illegal drug use.

In this case the data did not allow the separate estimation of the percentages either for each gender or according to age groups, so the value of 0.328 has to be applied to men as well as to women in every age group.

Based on official mortality statistics, it is known that in Catalonia in 2010, 122 men and 28 women who suffered from AIDS or were HIV positive died, so AIDS & HIV positive mortality attributable to illegal drug use in Catalonia in 2010 is:

$0.328 \cdot 122 + 0{,}328 \cdot 28 = 49.18 \approx 50$ persons.

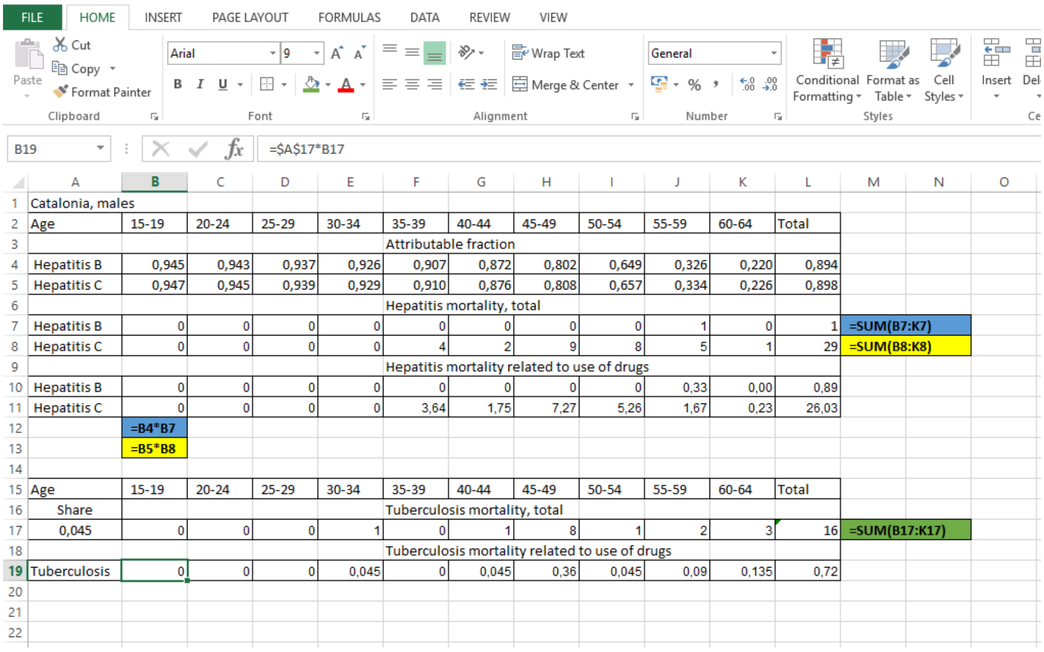
Example 5b

Example 5b: Estimation of mortality attributable to illegal drug use

To determine mortality partly attributable to illegal drug use, the number of deaths from the considered causes in general population is needed, according to gender/age groups. Then one has to multiply the values of the population attributable fraction by the numbers of deaths in every gender/age group.

If one has to use the share of deaths which can be attributed to drug use (as in the example considered in the case of Tuberculosis or HIV/AIDS), one has to multiply the numbers of deaths in every gender/age group (cells B17-K17) by this share (blocked with key "F4"). In the little frames, marked with different colours, EXCEL cell numbers and mathematical operations which have to be performed are indicated; they have to be preceded by the sign "=", as in the highest row.

Screenshot 5.1 Estimation of attributable mortality

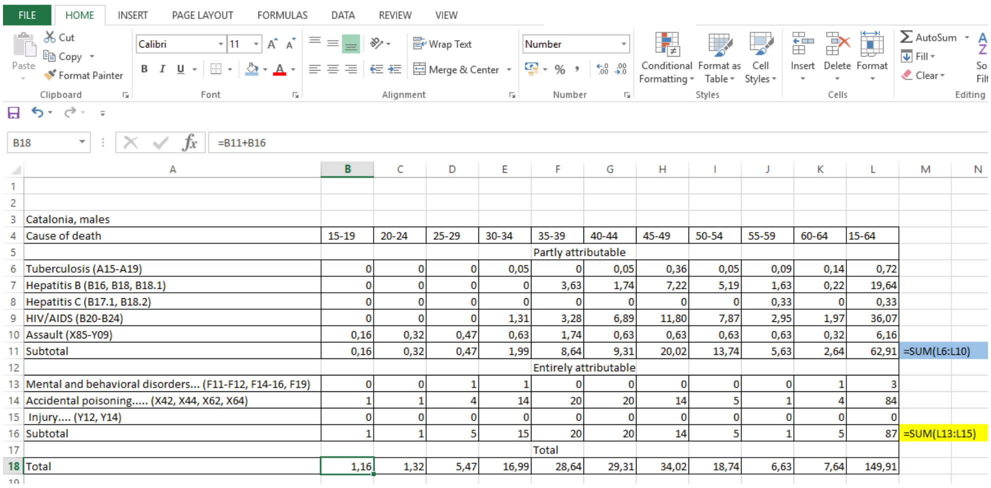


B19 =$A$17*B17

	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Catalonia, males												
2	Age	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	Total	
3						Attributable fraction							
4	Hepatitis B	0,945	0,943	0,937	0,926	0,907	0,872	0,802	0,649	0,326	0,220	0,894	
5	Hepatitis C	0,947	0,945	0,939	0,929	0,910	0,876	0,808	0,657	0,334	0,226	0,898	
6						Hepatitis mortality, total							
7	Hepatitis B	0	0	0	0	0	0	0	0	1	0	1	=SUM(B7:K7)
8	Hepatitis C	0	0	0	0	4	2	9	8	5	1	29	=SUM(B8:K8)
9						Hepatitis mortality related to use of drugs							
10	Hepatitis B	0	0	0	0	0	0	0	0	0,33	0,00	0,89	
11	Hepatitis C	0	0	0	0	3,64	1,75	7,27	5,26	1,67	0,23	26,03	
12		=B4*B7											
13		=B5*B8											
14													
15	Age	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	Total	
16	Share					Tuberculosis mortality, total							
17	0,045	0	0	0	1	0	1	8	1	2	3	16	=SUM(B17:K17)
18						Tuberculosis mortality related to use of drugs							
19	Tuberculosis	0	0	0	0,045	0	0,045	0,36	0,045	0,09	0,135	0,72	
20													
21													
22													

Finally, one has to sum up all the partial results:

Screenshot 5.2 Mortality attributable to drugs in Catalonia in 2010



B18 =B11+B16

	A	B	C	D	E	F	G	H	I	J	K	L	M
1													
2													
3	Catalonia, males												
4	Cause of death	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64	15-64	
5						Partly attributable							
6	Tuberculosis (A15-A19)	0	0	0	0,05	0	0,05	0,36	0,05	0,09	0,14	0,72	
7	Hepatitis B (B16, B18, B18.1)	0	0	0	0	3,63	1,74	7,22	5,19	1,63	0,22	19,64	
8	Hepatitis C (B17.1, B18.2)	0	0	0	0	0	0	0	0	0,33	0	0,33	
9	HIV/AIDS (B20-B24)	0	0	0	1,31	3,28	6,89	11,80	7,87	2,95	1,97	36,07	
10	Assault (X85-Y09)	0,16	0,32	0,47	0,63	1,74	0,63	0,63	0,63	0,63	0,32	6,16	
11	Subtotal	0,16	0,32	0,47	1,99	8,64	9,31	20,02	13,74	5,63	2,64	62,91	=SUM(L6:L10)
12						Entirely attributable							
13	Mental and behavioral disorders... (F11-F12, F14-16, F19)	0	0	1	1	0	0	0	0	0	1	3	
14	Accidental poisoning..... (X42, X44, X62, X64)	1	1	4	14	20	20	14	5	1	4	84	
15	Injury.... (Y12, Y14)	0	0	0	0	0	0	0	0	0	0	0	
16	Subtotal	1	1	5	15	20	20	14	5	1	5	87	=SUM(L13:L15)
17						Total							
18	Total	1,16	1,32	5,47	16,99	28,64	29,31	34,02	18,74	6,63	7,64	149,91	

Accordingly, in Catalonia in 2010 we estimate that 150 men died as a result of illegal drug use.

5.2 Estimation of the number of lives and years of life lost

Methodology

As the mortality risk coefficients (*RR, OR, SMR*) described above measure excess mortality (over the level of population mortality), so estimated with the methods presented in the previous chapter, the number of deaths attributable to illegal drug use also represents the number of lives lost because of the use of drugs in the year of the study (in one year).

On this basis, the number of years of life lost due to illegal drug use in the population can be estimated, and so can the number of years of life lost within the working age of illegal drug users. For this purpose, life expectancy (e_x) estimates for the country population in the considered gender/age groups are additionally needed. These data are available in national mortality statistics.

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To obtain the number of years of life lost, it is enough to multiply the numbers of deaths attributed to illegal drug use by the life expectancy values in the adequate gender/age group, and then to sum up the products.

If d_x stands for the number of deaths attributed to illegal drug use at the age x, and e_x for the life expectancy at this age, the number of years of life lost (YLL) because of illegal drug use for any gender can be calculated as follows[10] (see Example 5c):

$$YLL = \sum_{x=x_o}^{M-1} d_x \cdot e_x \qquad (5.1)$$

where x_0 denotes the lowest class of age included and M – the highest one.

If the age considered is restricted to the one of working activity in a country, the estimate of the number of 'working' years of life lost can be obtained as:

$$FYLL = \sum_{x=x_w}^{W-1} d_x \cdot e_x \qquad (5.2)$$

where x_w denotes the age of beginning working activity, and W – the retirement age in a country.

Summary

To estimate the number of years of life lost attributable to illegal drug use, the following information is needed:

- Previously estimated number of deaths attributable to illegal drug use according to gender/age groups.
- Life expectancy (e_x) estimates for a country's population in the gender/age groups considered; possible source: national mortality statistics.

---

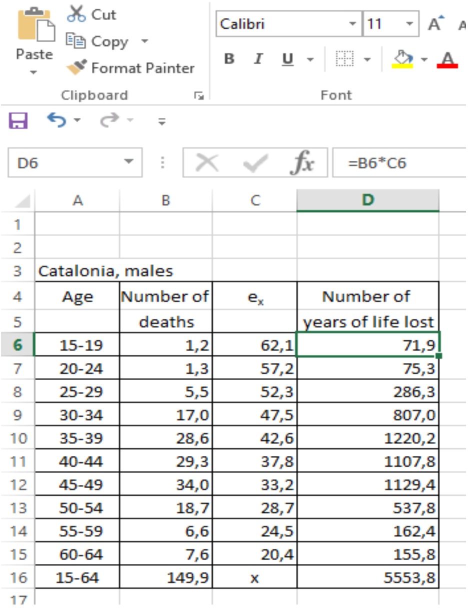
[10] There are several definitions of measures of the number of years of life lost (see for instance [Murray, Salomon 2002]), and it also happens that the same measure has a different name in different studies.

Example 5c

Example 5c: Estimation of the number of years of life lost

To estimate the number of years of life lost due to illegal drug use, one has to multiply the previously estimated number of deaths attributable to drug use at the age *x* by life expectancy at the age *x* and to sum up the results.

Screenshot 5.3 Estimation of the number of years of life lost



D6 =B6*C6

	A	B	C	D
1				
2				
3	Catalonia, males			
4	Age	Number of deaths	e_x	Number of years of life lost
6	15-19	1,2	62,1	71,9
7	20-24	1,3	57,2	75,3
8	25-29	5,5	52,3	286,3
9	30-34	17,0	47,5	807,0
10	35-39	28,6	42,6	1220,2
11	40-44	29,3	37,8	1107,8
12	45-49	34,0	33,2	1129,4
13	50-54	18,7	28,7	537,8
14	55-59	6,6	24,5	162,4
15	60-64	7,6	20,4	155,8
16	15-64	149,9	x	5553,8
17				

The equation has to be copied from cell D6 to cells D7 to D15, and the results have to be added up (cell D16).

5.3 Estimation of the productivity loss (labour costs) caused by premature mortality of illegal drug users

Methodology

The estimation of productivity loss (labour costs) caused by the premature mortality of illegal drug users is often performed in social costs studies {[Johanson et al. 2006], [Rehm et al. 2006], [Fenoglio et al., 2003], [García-Altés, Ollé, Antoñanzas, & Colom, 2002], amongst others, see also LEADER Project Deliverable 1.1. *Systematic Review of Existing Publications on Social Costs of Illegal drugs, Alcohol and Tobacco*, p.9-10}. It is, however, often reduced to forecasting the value of a country's GDP (or some other financial measures of productivity, such as wages[11]) that could be produced if there was no loss of lives attributed to illegal drug use (*Human Capital approach*).

---

[11] In the authors' opinion wages are the measure of the working value of an employee offered by an employer. If, for instance, two persons performing the same job but earning different wages die, according to the wages approach, productivity loss to society will be different in each case. What the society really loses is their output (assuming that these persons were not substituted), so the Guidance recommends the GDP approach over the wages approach.

Whilst many social cost estimates include productivity costs in their total value, others have stressed that productivity loss is potential [Anderson, Baumberg 2006, p.204].

As productivity costs are based on a different kind of data, and a different estimation method is applied, their significance is also different from the significance of direct costs expressed in monetary terms. Direct costs are the costs actually incurred by the society, while productivity costs are the costs which could be incurred only potentially.

Additionally, such estimation requires strong assumptions which are seldom specified and checked in studies on productivity costs.

Therefore, in the authors' opinion, estimated productivity costs should not be added to the 'hard' cost estimates that are obtained on the basis of real and not hypothetical data, and should be considered as a different category of social costs.

Strictly speaking, the estimation of productivity costs should account for two different situations:

- If prematurely diseased users of illegal drugs continued to live, they would remain users,
- If they continued to live, they would be non-users – such an assumption is consistent with the *Cost of Illness* philosophy (Chapter 2) and holds after conducting the productivity costs estimation in the way proposed beneath.

The Guidance proposes and recommends GDP-based estimation, so it has been assumed that:

- The employment rate[12] among the theoretically living persons within the period of working activity specific to a country would be the same as the employment rate in the whole (living) population at this age, i.e. it is assumed that the same percentage of theoretically living persons at the age of working activity would be employed,
- The hypothetically employed persons could have produced the same average value of GDP as the actually (living) employed people produced in the considered year.

It can be argued, however, that the hypothetical employment of prematurely deceased persons depends on: an unemployment rate, their qualifications, migration possibilities and trends, and many other, hardly predictable, factors, so it is uncertain, and hardly possible to check to what extent the above assumptions could be satisfied, if at all.

Productivity cost estimation allows for the evaluation of the losses that the society **could possibly** incur, and also allows for comparisons of these hypothetical values in different countries or in time – given the estimation was done under the same assumptions.

In some studies, the estimation of productivity loss caused by premature mortality is expanded to more than one year [Kopp, Fenoglio 2002], [Menzin et al. 2012], which requires the introduction of discount rates (usually of the value 3-6%). Because of the uncertainty of these estimates, in this guidance document productivity loss estimates have been limited to one year.

---

[12] Employment rates are defined as the ratio of the employed to the working age population, about [15-64) in most European countries. They are the measures of the extent to which people available to work are employed.

The procedure for estimating productivity loss caused by premature mortality of illegal drug users in one year is presented in Example 5d.

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Summary

To estimate productivity loss (labour costs) attributable to illegal drug use in one year, applying the GDP-based approach, the following information is needed:

- Number of lives lost due to illegal drug use at the age of working activity specific to a county [estimated as in Chapter 5.2].
- Employment rate in the considered population; possible source: national statistics.
- Value of GDP in a country expressed in current prices; possible source: national statistics
- Number of persons employed; possible source: national statistics

Example 5d

Example 5d: Estimation of productivity loss (labour costs) attributable to illegal drug use of in one year in Catalonia, males

The data:

- GDP value in 2010 in euro, current prices – EUR 204 285 million,
- Persons in employment in 2010 (IDESCAT data based on INE's Survey of active population) 3 269.1 thousand,
- Employment rate – 52.5%.

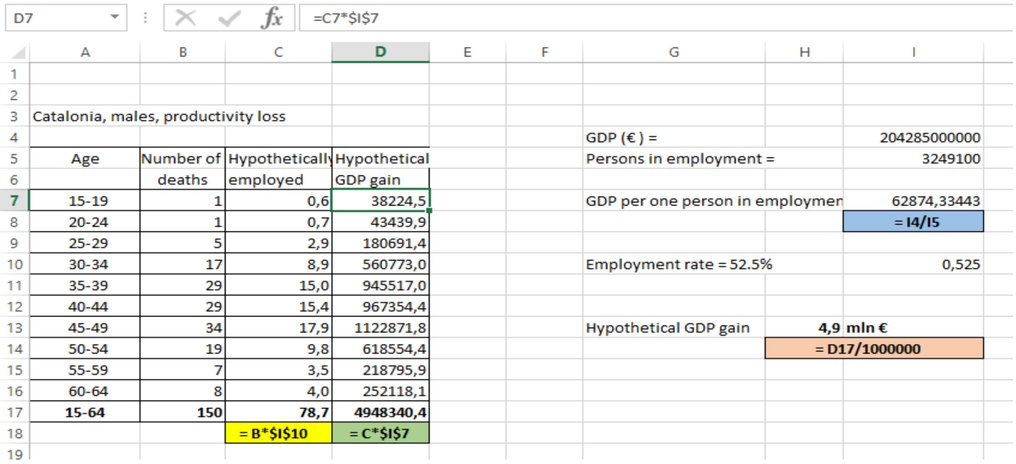
Source of data: *Generalitat de Catalunya Institut d'Estadistica de Catalonia.*

- Number of lives lost (estimated previously).

Important remark: the average GDP value has to be calculated with reference to the number of people employed, and not with reference to the whole population size.

The calculation proceeds as follows:

Screenshot 5.4 Estimation of productivity loss



=C7*$I$7

	A	B	C	D	E	F	G	H	I
1									
2									
3	Catalonia, males, productivity loss								
4							GDP (€) =		204285000000
5	Age	Number of	Hypothetically	Hypothetical			Persons in employment =		3249100
6		deaths	employed	GDP gain					
7	15-19	1	0,6	38224,5			GDP per one person in employmen		62874,33443
8	20-24	1	0,7	43439,9					= I4/I5
9	25-29	5	2,9	180691,4					
10	30-34	17	8,9	560773,0			Employment rate = 52.5%		0,525
11	35-39	29	15,0	945517,0					
12	40-44	29	15,4	967354,4					
13	45-49	34	17,9	1122871,8			Hypothetical GDP gain	**4,9 mln €**	
14	50-54	19	9,8	618554,4				**= D17/1000000**	
15	55-59	7	3,5	218795,9					
16	60-64	8	4,0	252118,1					
17	**15-64**	**150**	**78,7**	**4948340,4**					
18			**= B*$I$10**	**= C*$I$7**					
19									

In little frames, marked with different colours, EXCEL cell numbers and mathematical operations which have to be used are indicated; they have to be preceded by the sign " = ", as in the highest row.

As a result, it was estimated that, under accepted assumptions, in Catalonia in 2010 prematurely deceased male illegal drug users could have produced the additional GDP value equal to EUR 4.9m.

5.4 Loss of life expectancy (e_0) and life potential of illegal drug users*

Methodology

To underline a negative effect of drug use on premature user mortality, more methods can be applied. Three possible approaches are outlined below.[13] Under certain assumptions, one can estimate:

- Mortality rates for illegal drug users,
- Life tables and life expectancy at the age *x* for illegal drug users,
- Life potential of a population partly composed of illegal drug users.

Mortality rates for illegal drug users

In order to obtain mortality rates for illegal drug users, it is assumed that mortality rates in the lowest and the highest age groups are the same as in the general population; the estimates are calculated only for the age groups of drug users. It is also assumed that the population consists exclusively of drug users and non-users.

Let:

m_p – denote mortality rates in a population,
m_u – mortality rates for illegal drug users (unknown value),
m_n – mortality rates for illegal drugs non-users (unknown value),
p_u – prevalence rate (share) of drug users in the population,
p_n – prevalence rate (share) of drugs non-users in the population; so $p_u + p_n = 1$.

As mortality rates in a population are a weighted average of the mortality rates of illegal drug users and those of non-users, where the weights are the shares of these groups in the population, it can be written down that:

$$m_p = m_u \cdot p_u + m_n \cdot p_n \tag{5.3}$$

Taking into account the definitions of *RR* or *SMR* presented in Chapter 4, after some simple transformations, mortality rates for illegal drug users can be calculated as:

$$m_u = \frac{m_p \cdot \gamma}{p_u(\gamma - 1) + 1} \tag{5.4}$$

where γ is, as previously, the risk of drug user mortality in comparison to the risk of population mortality (*RR* or *SMR*), and mortality rates for illegal drugs non-users as:

$$m_n = \frac{m_p}{p_u(\gamma - 1) + 1} \tag{5.5}$$

---

[13] The methods were proposed by Z.Mielecka-Kubien and they are described in detail in: [Mielecka-Kubien 2006], [Mielecka-Kubien 2007], [Mielecka-Kubien 2012], where the formulae are also derived.

Formulae (5.3-5.5) can be applied for different gender/age groups. The calculation procedure and its results are presented in Example 5e.

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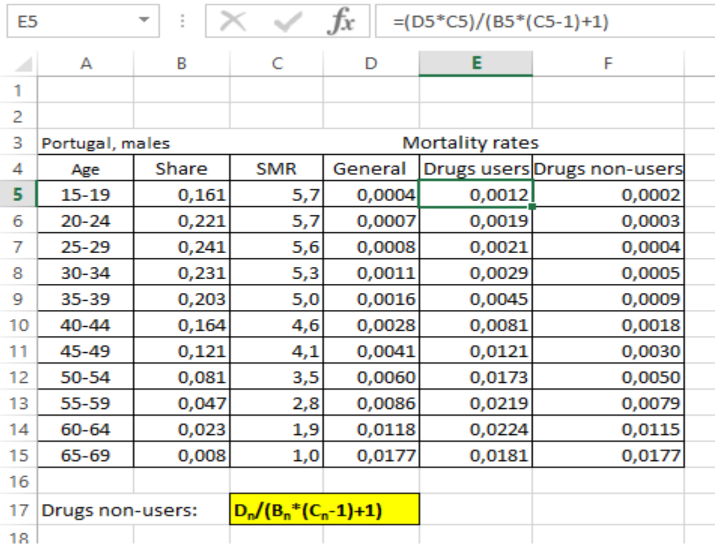
Example 5e

Example 5e: Estimation of mortality rates for illegal drug users and non-users

In order to obtain mortality rates for the drug users and non-users, general mortality rates in the corresponding gender/age groups are needed, as well as the prevalence rates in these classes and a measure of the relation of drug user mortality risk to mortality risk in the whole population. With this information it is possible to apply the formulae (5.4) and (5.5), which are presented below, with the use of EXCEL cell names. The calculation procedure and the comparison of the three kinds of mortality rates for Portugal, males, are presented below.

Screenshot 5.5 Estimation of mortality rates for drug users and non-users

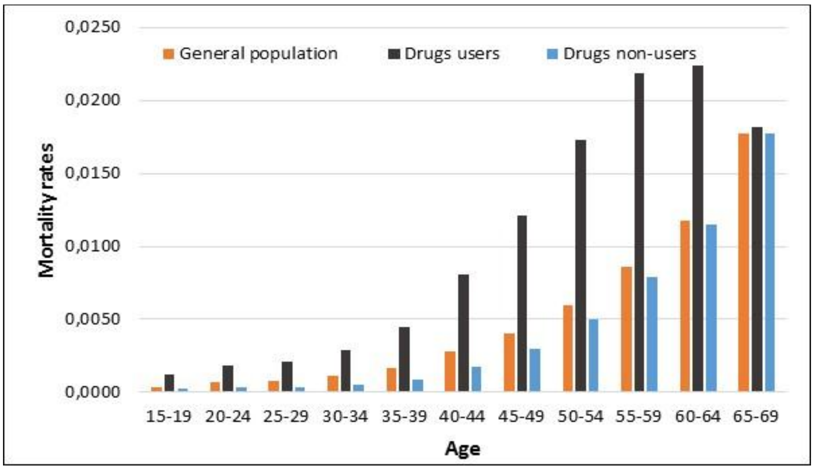


E5 =(D5*C5)/(B5*(C5-1)+1)

Portugal, males			Mortality rates		
Age	Share	SMR	General	Drugs users	Drugs non-users
15-19	0,161	5,7	0,0004	0,0012	0,0002
20-24	0,221	5,7	0,0007	0,0019	0,0003
25-29	0,241	5,6	0,0008	0,0021	0,0004
30-34	0,231	5,3	0,0011	0,0029	0,0005
35-39	0,203	5,0	0,0016	0,0045	0,0009
40-44	0,164	4,6	0,0028	0,0081	0,0018
45-49	0,121	4,1	0,0041	0,0121	0,0030
50-54	0,081	3,5	0,0060	0,0173	0,0050
55-59	0,047	2,8	0,0086	0,0219	0,0079
60-64	0,023	1,9	0,0118	0,0224	0,0115
65-69	0,008	1,0	0,0177	0,0181	0,0177

Drugs non-users: $D_n/(B_n*(C_n-1)+1)$

Figure 5.1 Mortality rates in general population and the populations of drug users and non-users



Source: Authors' own on the basis of [Sieroslawski 2014], data for Portugal: Balsa, C., Vital, C. & Urbano, C. (2013). "III Inquérito Nacional ao Consumo de Substâncias Psicoativas na População Portuguesa. Portugal 2013. Relatório Preliminar", and Instituto Nacional de Estatistica, Statistics Portugal.

It can be observed that drug user mortality rates are much higher than the ones of the general population and of non-users.

Life tables and life expectancy at the age 0 for illegal drug users

Life tables are theoretical models applied to the analyses and comparisons of population mortality. In these models a cohort of new-borns (usually 100,000 persons) is considered, and under the assumptions that there are no new births and no immigration or emigration, a hypothetical cohort is constructed with the use of the mortality parameters of the current, existing population. On this basis, a model of survival for this population is built, where the most important estimated parameter is the life expectancy of new-borns (e_0), informing about the average number of years a person at the age 0 is expected to live – under the assumption of the existing mortality pattern in the population. For the purpose of the analysis of the cause -specific mortality in a population, special cause-elimination life tables can be applied, but it is also possible to use another approach.

Once mortality rates for the three types of population (users, non-users, whole population) are available, one can estimate the life tables for every population.[14] Although it could be possible (but difficult) to perform calculations in EXCEL, it is advisable to use the United Nations commonly accessible software MORTPAK for this special purpose:

http://www.un.org/en/development/desa/population/publications/mortality/mortpak.shtml

The most important outcome here is the life expectancy of new-borns (e_0); the comparison of these values in the three kinds of populations enables the evaluation of life expectancy loss in the population of illegal drug users (see Example 5f):

$$\Delta e_0 = e_{0P} - e_{0u} \tag{5.6}$$

$$\Delta e_0 = e_{0n} - e_{0u} \tag{5.7}$$

where Δe_0 – denotes the change in e_0 values,
e_{0P} – life expectancy at the age 0 for the whole population,
e_{0u} – life expectancy at the age 0 for illegal drug users,
e_{0n} – life expectancy at the age 0 for non-users of illegal drugs.

Life potential of the population of illegal drug users

In traditional *Demography* a basic statistical unit is one person – this approach involves the hidden assumption that every person in the population has the same significance. But in fact, from the demographic point of view, people are not equal, because younger ones would probably live longer, while older ones – shorter. In other words, it can be considered that younger persons have higher life potential than older ones. In traditional *Demography* only the life potential of single persons is taken into account and its measure is life expectancy at the age *x*.

It is also possible to consider the life potential of a population,[15] which is understood as the number of years the whole population is expected to live. Such a measure is especially

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[14] For the same purpose probability of deaths can also be applied.

[15] Life potential measures (formula 5.8 and others) were proposed by L. Hersch (1940), here quoted after [Vielrose 1958], pp. 39-40. A similar idea is behind the years of life lost measures (5.1, 5.2), where the loss of the life potential of drug users is estimated – now it is estimated as the value of life potential of the whole population which partly consists of drug users, based on the life tables outcomes; application of L.Hersch's other formulae gives many possibilities of analysing the life potential of populations.

valuable from the social point of view, and in this case it enables the evaluation of life potential loss to the society caused by illegal drug use. The basic formula for the calculation of life potential (called *the seventh Hersch formula*) is:

$$V(0,\omega)=\sum_{0}^{\omega-1}P_x\cdot\frac{e_x+e_{x+1}}{2} \tag{5.8}$$

$V(0,\omega)$ – life potential of a population,
ω – highest, taken into account, age in the population,
P_x – number of persons in the population at the age *x* (available in the national statistics),
e_x, e_{x+1} – life expectancy of persons at the age *x* or *x*+1 years (the life tables outcome).

The differences between the values of life potential can be calculated as:

$$\varDelta V = V_P - V_u \tag{5.9}$$

$$\varDelta V = V_n - V_u \tag{5.10}$$

where $\varDelta V$ – denotes a change in *V* values,
V_P – life potential of the whole population,
V_u – life potential of the illegal drug users,
V_n – life potential of the non-users of illegal drugs.

The calculation procedure and the results are presented in Example 5f.

→ ***SEE HOW THE EXAMPLES WORK IN PRACTICE WITH THE GUIDANCE PACK EXCEL***

Considerations

The considered life potential of drug users is estimated on the basis of mortality rates for drug users (5.4), where it has been assumed that mortality rates in the lowest and the highest age groups are the same as in the general population.

If the MORTPACK software is used, age groups have to be specified as beneath.

Summary

To estimate the mortality rates of illegal drug users, their life expectancy and life potential, the following information is needed:

- Mortality rates in a population for each gender and 5-year groups of age, group [0-4) divided to: age 0 and group [1-4), (data available in national mortality statistics).
- Prevalence rate (share) of drug users and non-users in the population for each gender and 5-year groups of age (estimated on a survey basis).
- Population size according to gender and age for each gender and 5-year groups of age, group [0-4) divided to: age 0 and group [1-4), (available in national statistics).
- A measure of risk of the mortality of drug users in comparison to population mortality (RR or SMR, available in literature).

Example 5f

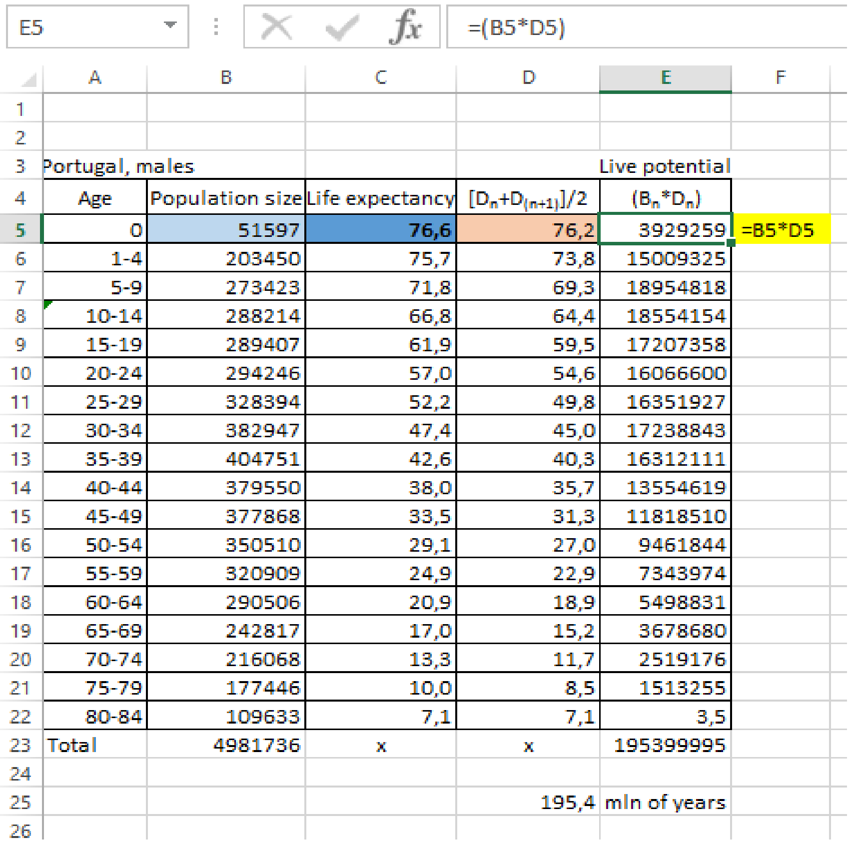
Example 5f: Estimation of the life expectancy loss and life potential loss of drug users

The calculation of life expectancy and potential loss will be presented for Portugal, males. Data on the population size come from *Instituto Nacional de Estatistica*, Statistics Portugal.

Estimated[16] life expectancy at the age 0 for the general population in 2010 was equal to 76.55 years, in the population of drug users – 69.72 years, and in the population of non-users – 77.63 years. Applying the formula (5.6), we can calculate that drug users lose, on average, about 6.83 years of their life in comparisons to the general population and 7.91 years in comparison to the population of non-drug users (formula 5.7).

The procedure for calculating the life potential of the population is presented below.

Screenshot 5.6 Estimation of life potential



E5

=(B5*D5)

	A	B	C	D	E	F
1						
2						
3	Portugal, males				Live potential	
4	Age	Population size	Life expectancy	$[D_n+D_{(n+1)}]/2$	(B_n*D_n)	
5	0	51597	76,6	76,2	3929259	=B5*D5
6	1-4	203450	75,7	73,8	15009325	
7	5-9	273423	71,8	69,3	18954818	
8	10-14	288214	66,8	64,4	18554154	
9	15-19	289407	61,9	59,5	17207358	
10	20-24	294246	57,0	54,6	16066600	
11	25-29	328394	52,2	49,8	16351927	
12	30-34	382947	47,4	45,0	17238843	
13	35-39	404751	42,6	40,3	16312111	
14	40-44	379550	38,0	35,7	13554619	
15	45-49	377868	33,5	31,3	11818510	
16	50-54	350510	29,1	27,0	9461844	
17	55-59	320909	24,9	22,9	7343974	
18	60-64	290506	20,9	18,9	5498831	
19	65-69	242817	17,0	15,2	3678680	
20	70-74	216068	13,3	11,7	2519176	
21	75-79	177446	10,0	8,5	1513255	
22	80-84	109633	7,1	7,1	3,5	
23	Total	4981736	x	x	195399995	
24						
25				195,4	mln of years	
26						

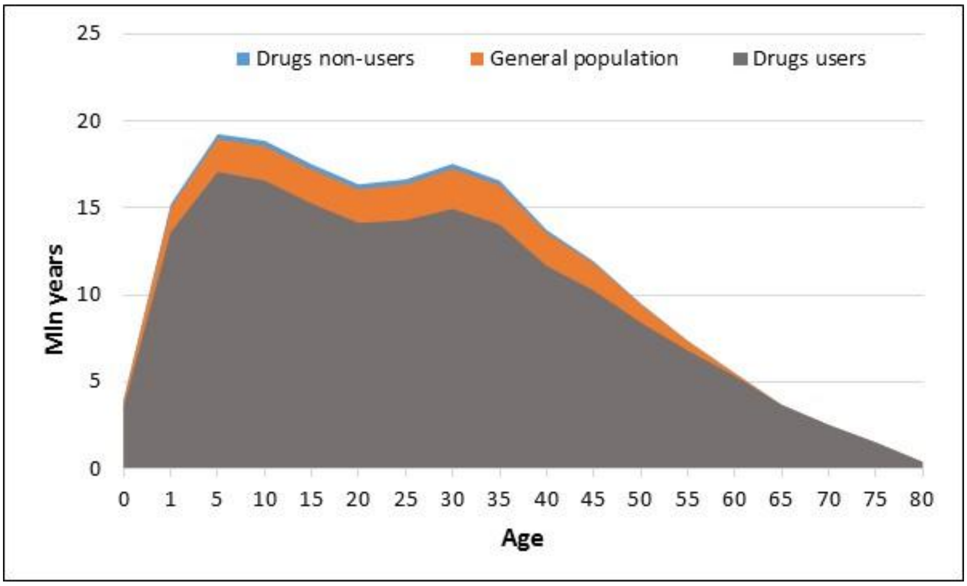
Figure 5.2 presents the comparison of estimated life potential in the general population and in the populations of drug users and non-users for Portugal, males.

---

[16] Life table parameters were estimated with software: MORTPACK for Windows, Version 4.3, United Nations, New York.

Example 5f

Figure 5.2 The life potential of the general population and the populations of drug users and non-users, Portugal, males



Source: Authors' own on the basis of [Sieroslawski 2014], data for Portugal: Balsa, C., Vital, C. & Urbano, C. (2013). "III Inquérito Nacional ao Consumo de Substâncias Psicoativas na População Portuguesa. Portugal 2013. Relatório Preliminar", and Instituto Nacional de Estatistica, Statistics Portugal.

The loss of the life potential of drug users can be seen clearly – it is presented as the orange area in comparison to the general population and as the orange + blue area in comparison to the non-user population.

6. Estimation of morbidity related to illegal drug use and its consequences

Content **(with quicklinks)*****:***

- ***6.1 Estimation of inpatient and outpatient costs of morbidity attributable to drug use, and cost of medicines***
    - *Example 6a*
- ***6.2 Estimation of ambulance and emergency services costs***
    - *Example 6b*
- ***6.3 Estimation of absenteeism costs***
    - *Example 6c*

6.1 Estimation of inpatient and outpatient costs of morbidity attributable to drug use and costs of medicines

6.1.1 The costs of inpatient services

Methodology

The estimation of the costs of inpatient services attributable to illegal drug use can usually be conducted with the similar method as the estimation of attributable mortality, but in such estimation a lot depends on the availability of statistical data. In some countries data enable performing more detailed analysis, whereas in others only rough estimates of certain types of morbidity costs can be obtained.

In the ALICE-RAP project more detailed cost estimation was possible for Poland, so the methods of estimation will be explained with the use of Polish data.

Hospital morbidity data in Poland are available for any disease according to ICD-10 codes, (though in many cases in rather broad groups of diseases), gender and age, and also according to the average length of hospital stay for each of the groups of diseases. Additionally, data on person-day costs of a stay in different types of hospitals (general hospitals, psychiatric hospitals) are also available.

It is particularly easy to calculate the costs attributable to diseases classified as entirely caused by drug use (the names of the diseases and their ICD-10 codes as in Chapter 5).

The number of patients hospitalized for a particular disease was multiplied by an average length of a hospital stay caused by the disease and then multiplied by the person-day cost of hospital stay.

For diseases partly attributable to illegal drug use, the population attributable fraction of morbidity should be estimated according to formulae (4.1-4.4). The previously estimated prevalence rates can be applied in this case and, preferably, the relative risk of drug user morbidity for the considered diseases in relation to morbidity risk for the diseases in the population.

The estimates of relative morbidity risk are becoming increasingly more frequent [Rehm et al. 2003]. If such estimates are not available, measures of relative mortality risk have to be applied. This procedure is justified because, with the exception of sudden deaths, any other death is preceded by a disease and seriously ill patients are often hospitalized.

Then, similarly as in the case of mortality estimation (Chapter 5), the values of the attributable fraction have to be multiplied by the number of all patients hospitalized for the considered diseases. The results should be then multiplied by an average length of a hospital stay for every type of disease and then multiplied by the person-day cost of hospital stay.

Depending on the way of funding a patient’s stay in hospital, other cost measures, such as patient costs per discharge, should be applied in estimation – in this case the information on the length of a hospital stay or the person-day cost of hospital stay are not needed anymore.

The availability of statistical data determines how detailed the calculation can be – according to broader or narrower groups of diseases, different types of hospitals, etc.

The calculation procedure for inpatient costs attributable to illegal drug use is presented in Example 6a.

→ SEE HOW THE EXAMPLES WORK IN PRACTICE WITH THE GUIDANCE PACK EXCEL

Summary

To estimate inpatient costs attributable to illegal drug use, the following information is needed, preferably according to gender and age groups:

- Number of patients hospitalized for diseases entirely attributable to illegal drug use; possible source: national health statistics.
- Number of all patients hospitalized for diseases partly attributable to illegal drug use; possible source: national health statistics.
- Estimated population attributable fractions of morbidity for the considered diseases partly attributable to illegal drug use.
- Average length of a hospital stay for the considered diseases; possible source: national health statistics.
- Person-day cost of a hospital stay; possible source: national health statistics.
- Other options (such as costs per discharge) alternative to an average length and a person-day cost of a hospital stay, depending on how hospitals are funded.

Example 6a

Example 6a: Estimation of inpatient costs attributable to illegal drug use

The example is taken from the ALICE-RAP project and concerns Polish women. Tables 6.1a and 6.1c present basic estimation data for HIV/AIDS patients.

Table 6.1a Number of general hospital HIV/AIDS patients according to age, women

DISEASE	ICD-10 CODES	Number of hospital patients							
		15-19	20-34	35-44	45-54	55-64	65+	Total	15-64
HIV/AIDS	B20-B24	51	286	255	73	26	0	691	691

Source: The National Institute of Public Health (National Institute of Hygiene) in Warsaw.

To obtain the number of general hospital HIV/AIDS women patients attributed to illegal drug use (table 6.1b), the numbers of all HIV/AIDS women patients (table 6.1a) have to be multiplied by an appropriate population attributable fraction or ascribed shares of such patients. In this case, mortality coefficients had to be applied, i.e. the previously estimated share of HIV/AIDS mortality attributed to illegal drug use, which in Poland was equal to 0.531.

Table 6.1b Number of general hospital HIV/AIDS patients attributed to illegal drug use according to age, women

DISEASE	ICD-10 CODES	Number of hospital patients							
		15-19	20-34	35-44	45-54	55-64	65+	Total	15-64
HIV/AIDS	B20-B24	27	152	135	39	14	0	367	367

Source: Authors' own based on the [Mielecka-Kubien et al. 2014] data and the National Institute of Public Health (National Institute of Hygiene) in Warsaw.

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Table 6.1c Average length of a hospital stay (days) of HIV/AIDS patients according to age, women

DISEASE	ICD-10 CODES	Average length of a hospital stay (days)							
		15-19	20-34	35-44	45-54	55-64	65+	Total	15-64
HIV/AIDS	B20-B24	3.8	9	10.5	16.5	13.8	0	x	X

Source: The National Institute of Public Health (National Institute of Hygiene) in Warsaw.

To estimate the number of person-days, attributed to illegal drug use, that HIV/AIDS women patients spent in general hospitals (table 6.1d), the numbers of table 6.1b were multiplied by adequate numbers in table 6.1c.

Table 6.1d Number of person-days, attributed to illegal drug use, that HIV/AIDS patients spent in hospitals – according to age, women

DISEASE	ICD-10 CODES	Number of hospital person-days							
		15-19	20-34	35-44	45-54	55-64	65+	Total	15-64
HIV/AIDS	B20-B24	103	1367	1422	640	191	0	3722	3722

Source: Authors' own based on the [Mielecka-Kubien et al. 2014] data and the National Institute of Public Health (National Institute of Hygiene) in Warsaw.

Taking into account that the average cost of one person-day in a general hospital in Poland in 2010 was approximately EUR 78.42, we obtain the general HIV/AIDS women patient hospital costs attributed to illegal drug use by multiplying the numbers of table 4.1d by 78.42 (table 4.1e).

Example 6a

Table 6.1e HIV/AIDS patient hospital costs attributed to illegal drug use according to age, women

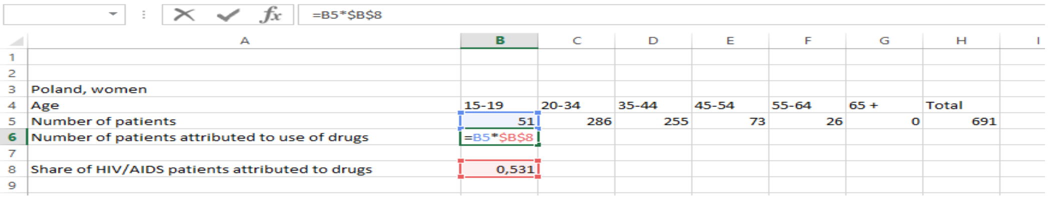
DISEASE	ICD-10 CODES	Costs (thousand euros)							
		15-19	20-34	35-44	45-54	55-64	65+	Total	15-64
HIV/AIDS	B20-B24	8.1	107.2	111.5	50.2	14.9	0.0	291.8	291.8

Source: Authors' own based on the [Mielecka-Kubien et al. 2014] data and the National Institute of Public Health (National Institute of Hygiene) in Warsaw.

Estimated inpatient costs for HIV/AIDS attributed to illegal drug use for women in Poland in 2010 were equal to EUR 291,800.00.

In EXCEL, using the names of EXCEL cells:

Screenshot 6.1 Estimation of the number of HIV/AIDS patients attributed to drug

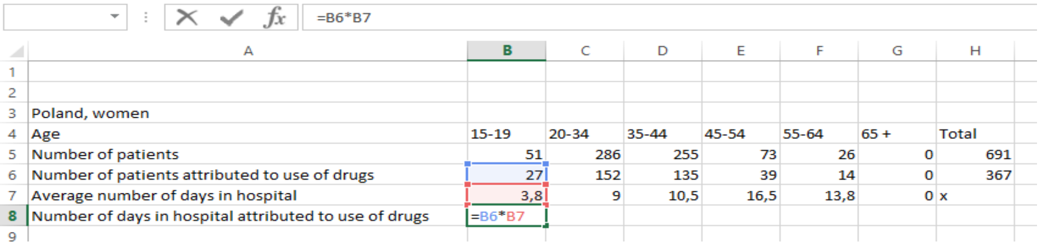


=B5*$B$8

	A	B	C	D	E	F	G	H	I
1									
2									
3	Poland, women								
4	Age	15-19	20-34	35-44	45-54	55-64	65 +	Total	
5	Number of patients	51	286	255	73	26	0	691	
6	Number of patients attributed to use of drugs	=B5*$B$8							
7									
8	Share of HIV/AIDS patients attributed to drugs	0,531							
9									

Cell B8 has to be blocked by key F4 and the equation has to be copied from cell B6 to cells C6 to H6.

Screenshot 6.2 Estimation of the number of person-days spent in hospitals by HIV/AIDS patients attributed to drug use

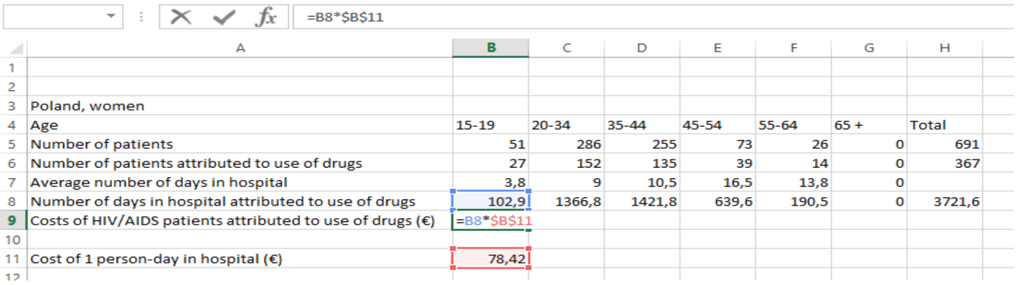


=B6*B7

	A	B	C	D	E	F	G	H
1								
2								
3	Poland, women							
4	Age	15-19	20-34	35-44	45-54	55-64	65 +	Total
5	Number of patients	51	286	255	73	26	0	691
6	Number of patients attributed to use of drugs	27	152	135	39	14	0	367
7	Average number of days in hospital	3,8	9	10,5	16,5	13,8	0	x
8	Number of days in hospital attributed to use of drugs	=B6*B7						
9								

The equation has to be copied from cell B8 to cells C8 to H8.

Screenshot 6.3 Estimation of hospital costs of HIV/AIDS patients attributed to drug use



=B8*$B$11

	A	B	C	D	E	F	G	H
1								
2								
3	Poland, women							
4	Age	15-19	20-34	35-44	45-54	55-64	65 +	Total
5	Number of patients	51	286	255	73	26	0	691
6	Number of patients attributed to use of drugs	27	152	135	39	14	0	367
7	Average number of days in hospital	3,8	9	10,5	16,5	13,8	0	
8	Number of days in hospital attributed to use of drugs	102,9	1366,8	1421,8	639,6	190,5	0	3721,6
9	Costs of HIV/AIDS patients attributed to use of drugs (€)	=B8*$B$11						
10								
11	Cost of 1 person-day in hospital (€)	78,42						
12								

Cell B11 has to be blocked by key F4 and the equation has to be copied from cell B9 to cells C9 to H9.

6.1

6.1.2. Outpatient costs, costs of medicines

Methodology

The estimation of outpatient costs is easier in the case of diseases entirely attributed to illegal drug use when patients are treated in special treatment centres, so the costs of their treatment, including substitution treatment or harm reduction costs, are available in health statistics. It is more difficult to estimate these costs in the case of diseases partly attributed to drug use and in the case of the costs of medicines.

First of all, available statistical data should be gathered. If detailed statistical data are available (including ICD-codes), estimation can be performed similarly as in the case of inpatients cost. Unfortunately, such data cannot usually be obtained, so another way, which gives only a rough approximation of the social costs of outpatient services and medicines, has to be applied.

One of the possible approaches is to use *a key*, that is to base estimation on the distribution of another variable (called *an instrumental variable* in statistics), possibly strongly correlated with the one in question.

The costs of outpatient services and medicines (not the ones that a patient pays himself, if we consider social costs), for example, can be estimated using the previously estimated structure of inpatient costs or even the structure of drug-related mortality, i.e. the percentage of drug use attributable inpatient costs in the costs of all hospitalized patients or, ultimately, the percentage of drug use attributable mortality in total population mortality, if possible separately for any of the diseases considered.

The same percentage can be applied to give a rough approximation of the number of outpatients attributed to illegal drug use and the costs of medicines. In this case the inpatient costs or mortality related to drug use perform the role of *the instrumental variable*, the distribution of which can be applied to find the approximate distribution of the other variables considered, that is the outpatient costs (or the costs of medicines).

The justification of the procedure is that before a patient is hospitalized he (she) is usually treated in an outpatient clinic and receives appropriate medicines.

For instance, in 2010 in Poland, 372 deaths could be attributed to illegal drug use (ALICE-RAP, p.78) and the total number of deaths was 378,478 (Central Statistical Office of Poland), so

$$\frac{372 \cdot 100}{378478} = 0.098\%$$

of all deaths can be attributed to drug use, and this percentage can be used in further estimation – as a very rough approximation – of the number of outpatients attributed to illegal drug use and the costs of medicines.

The next step is to multiply the estimated number of consultations in outpatients clinics attributed to drug use by the cost of one consultation. This information is usually available in the national health statistics.

Summary

First of all, available statistical data should be gathered.

In the case when detailed data for the purpose of rough cost estimation are not available, basic data needed are as follows:

- Number of consultations in outpatient clinics, preferably according to the type of a clinic (general or psychiatric); possible source: national health statistics.
- Average cost of a consultation, preferably according to the type of a clinic (general or psychiatric); possible source: national health statistics.
- Total costs of medicines (without costs paid by patients); possible source: national health statistics.
- The *key*, that is the distribution of the instrumental variable, for instance the previously estimated percentage of drug related inpatients in relation to all inpatients, or previously estimated percentage of drug related mortality in relation to total mortality from all causes.

6.2 Estimation of ambulance and emergency services costs

Methodology

The quality of the estimation of the costs of ambulance and emergency services attributable to drug use depends very strongly on statistical data available in the country, and in the first step available statistical data should be gathered. It is easier to obtain the data concerning services entirely attributed to drug use (for instance in the cases of drug intoxication).

It is very difficult, however, if not impossible, to obtain the data on cases where, for instance, a person was simultaneously under the influence of drugs and alcohol, or just one of the reasons of an accident was that the person was under the influence of drugs.

One of the ways of dealing with such situations is to approach those who can give any information about the matter at all, for example, ambulance and emergency service employees.

This method was applied in the ALICE-RAP project in the case of Poland, where an *ad hoc* survey (on a small scale) was conducted to elicit necessary information.

First of all, a representative sample of emergency service stations and ambulance service stations had to be drawn (see Annex I). Then a short questionnaire, the purpose of which was to determine the percentage of the costs of illegal drug use attributed services, was created. The basic questions in the questionnaire concerned the following issues:

1. Number of ambulance interventions related to illegal drug use in which a respondent took part in a specific period of time – respondent's opinion.
2. Number of all ambulance interventions in which a respondent took part in a specific period of time – respondent's opinion.

Alternatively

1. Percentage of ambulance interventions related to illegal drug use in which a respondent took part in a specific period of time – respondent's opinion.
2. Number of all ambulance interventions in which a respondent took part in a specific period of time – respondent's opinion.

The percentage or number of interventions attributable to illegal drug use can be calculated based on the data acquired from respondent stations. Then an average cost of one ambulance intervention had to be determined and this cost was multiplied by the estimated number of interventions attributed to drug use. The information about the average cost can be obtained either from official health statistics or a relevant question has to be added to the questionnaire.

If the information about the total costs of ambulance and emergency services in a country in the considered year is available, Question 4 can be skipped and the estimated average percentage of interventions which are attributed to illegal drug use for respondent stations should be multiplied by the total cost.

The content of the questions can be modified depending on a purpose (only drugs, drugs and alcohol, accidents under the influence of drugs, ambulance or emergency services, etc.).

Important remark: it seems to be a better idea to ask about the most recent events (last month, last quarter) and then, if need be, update the data according to the changed exposure to drugs in the population than to ask about the remote time – respondents may have difficulty recollecting earlier events.

If, for instance, the survey was conducted in 2012 but the results are used for 2010 estimation, in order to update the data on ambulance services, the relations of the number of ambulance calls in 2010 (in Poland, 185 thousand according to the Central Statistical Office) to the corresponding number in 2012 can be calculated (163 thousand):

$$I_a = \frac{185}{163} = 1.135 \tag{6.1}$$

and the survey results, as *the number of illegal drug use related ambulance interventions in which the respondent took part in* 2012, should be multiplied by 1.135.

The estimation procedure for ambulance or emergency services costs attributable to illegal drug use is presented in Example 6b.

→ SEE HOW THE EXAMPLES WORK IN PRACTICE WITH THE GUIDANCE PACK EXCEL

Summary

First of all, available statistical data should be gathered.

When we lack relevant statistical data:

- *Ad hoc* surveys (on a small scale) can be conducted in order to obtain the estimates of the proportion of ambulance interventions that were related to illegal drug use and the frequency of ambulance interventions in a given period.
- Additionally, information on the costs of one intervention or about the total costs of interventions is needed; it may be available in national health statistics or we may need to determine it with the use of a survey.

Example 6b

Example 6b: Estimation of ambulance or emergency services costs attributable to illegal drug use

The example is taken from the ALICE-RAP project and concerns Poland. The number of respondents in the survey concerning ambulance services was 39 persons. They took part in 11,944 ambulance interventions in the first half of 2012. The number of respondents in the survey concerning emergency services was 15 persons. They took part in 89,043 emergency interventions in the first half of 2012.

Table 6.2 Basic information for the estimation of drug attributable ambulance and emergency costs

SUBSTANCE	Ambulance service		Emergency service	
	Number of interventions	Share of interventions	Number of interventions	Share of interventions
Drugs	286	0.024	81	0.0009
Alcohol + drugs	707	0.059	697	0.0078

Source: [Mielecka-Kubien et al. 2014].

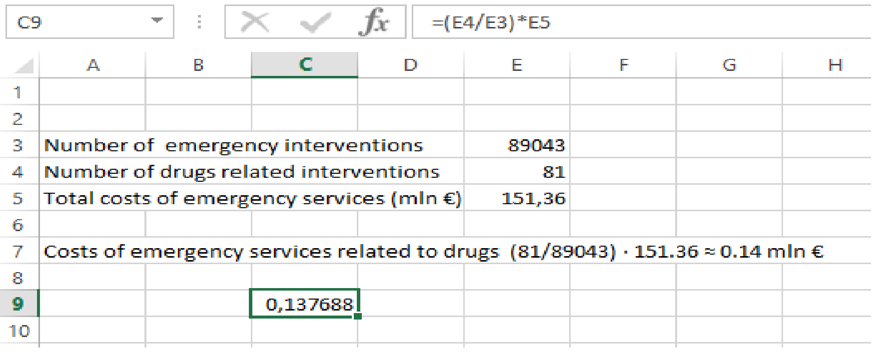
It is known from official statistics that the cost of ambulance services in Poland in 2010 was EUR 8.96 m and the cost of emergency services was EUR 151.36 m. Assuming that the percentage of ambulance and emergency services attributable to illegal drug use and drugs + alcohol in Poland in 2010 was the same as in the first half of 2012, it was estimated that the cost of ambulance services attributed to drug use was EUR 0.21 m, and for drugs + alcohol – EUR 0.53 m; the respective figures for emergency services are: EUR 0.14 m and EUR 1.2 m.

For instance, for drug related emergency services, the calculation proceeds as follows:

$$81/89\,043 \approx 0.0009$$
$$0.0009 \cdot 151.36 \approx 0.14 \text{ m EUR.}$$

In EXCEL, using the names of EXCEL cells:

Screenshot 6.4 Estimation of emergency services costs



=(E4/E3)*E5

	A	B	C	D	E	F	G	H
1								
2								
3	Number of emergency interventions				89043			
4	Number of drugs related interventions				81			
5	Total costs of emergency services (mln €)				151,36			
6								
7	Costs of emergency services related to drugs (81/89043) · 151.36 ≈ 0.14 mln €							
8								
9			0,137688					
10								

6.3 Estimation of productivity loss due to morbidity

Methodology

Labour costs of morbidity attributed to illegal drug use are here understood as absenteeism costs.

The aim is to estimate what value of GDP[17] working illegal drug users could hypothetically produce if they worked all the time (if they were not on sick-leaves) during the considered period of time.

The necessary assumption in this case is that absent persons could produce the same average (per capita) value of GDP as persons who actually worked at the time (they were present in their work all the time).

The main problem in this estimation is data on absenteeism – preferably according to gender, age, kind of disease and an average length of absence. Such data can be provided by insurance companies.

In the case of diseases entirely caused by drug use, the number of days of absence provided by insurance companies should be applied.

To estimate the share (percentage) of days of absence caused by diseases partly attributable to illegal drug use, the previously estimated population attributable fractions of morbidity should be applied – the total number of days of absence resulting from diseases partly caused by illegal drug use should be multiplied by the appropriate attributable fraction.

This result should be further multiplied by an average (per one working person) value of GDP in the country, divided additionally by the number of working days in the considered year, which gives a rough estimate of hypothetical absenteeism costs.

In more detailed analysis, the average value of GDP per one working person who is present at work at the relevant time can also be calculated.

In Poland detailed data on absenteeism (according to gender, age, ICD-10 codes, and number of sick-leave days) were provided by the Social Insurance Company (ZUS). In the ALICE-RAP project, it was estimated that in 2010, in Poland, about 114.0 thousand of days of absence can be attributed to illegal drug use. Adopting the above assumption, it can be stated that, if absent drug users worked all the time, they could hypothetically produce additional EUR 7.1 m in GDP (see Example 6c).

→ SEE HOW THE EXAMPLES WORK IN PRACTICE WITH THE GUIDANCE PACK EXCEL

As it was already indicated, in the authors' opinion, this hypothetical value should not be added to the other 'hard' social cost estimates, where estimation was based on real, as opposed to hypothetical, data, but should constitute a separate cost category.

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[17] See Chapter 5.

Example 6c: Estimation of the costs of absenteeism attributable to illegal drug use

The example is taken from the ALICE-RAP project and concerns Poland. The source of data: *Statistical Yearbook of Poland*, 2011, the *Social Insurance Statistics* (ZUS), 2010.

The basic data:

Number of people employed in 2010 – 15 961.0 thousand,

GDP in 2010 – EUR 354 159.24 m,

GDP per one person employed – EUR 354 159.24 m / EUR 15 961 thousand ≈ EUR 22.19 thousand,

GDP per one person employed per one working day – EUR 0.061 thousand,

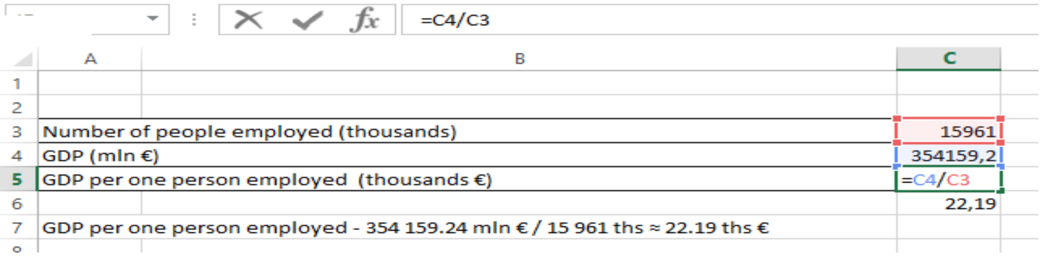
GDP per one person employed without the sick-leaves per one working day – EUR 0.062 thousand,

Previously estimated number of sick-leave days attributed to illegal drug use – 114.0 thousand,

Estimated absenteeism costs – 0.062 · 114.0 ≈ EUR 7124.4 thousand, that is about EUR 7.1m.

In EXCEL, using the names of EXCEL cells:

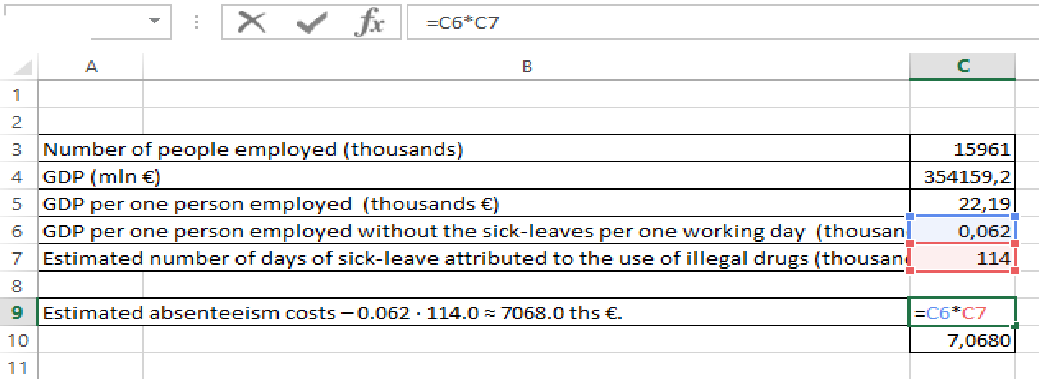
Screenshot 6.5 Estimation of the value of GDP per one person employed



=C4/C3

	A	B	C
1			
2			
3	Number of people employed (thousands)		15961
4	GDP (mln €)		354159,2
5	GDP per one person employed (thousands €)		=C4/C3
6			22,19
7	GDP per one person employed - 354 159.24 mln € / 15 961 ths ≈ 22.19 ths €		

Screenshot 6.6 Estimation of the absenteeism costs



=C6*C7

	A	B	C
1			
2			
3	Number of people employed (thousands)		15961
4	GDP (mln €)		354159,2
5	GDP per one person employed (thousands €)		22,19
6	GDP per one person employed without the sick-leaves per one working day (thousan		0,062
7	Estimated number of days of sick-leave attributed to the use of illegal drugs (thousan		114
8			
9	Estimated absenteeism costs – 0.062 · 114.0 ≈ 7068.0 ths €.		=C6*C7
10			7,0680
11			

Summary

To estimate the labour costs of morbidity attributed to illegal drug use based on the GDP approach, the following information is needed:

- Number of days of sick-leave (according to gender, age, ICD-10 codes, and an average length) for diseases entirely and partly attributable to illegal drug use; possible source: insurance statistics.
- Previously estimated population attributable fraction of morbidity for diseases partly attributable to illegal drug use, preferably according to gender and age.
- Average value of a country's GDP per one working person (or per one working person present at work at all time – without sick-leaves), and one working day, calculated on the basis of national statistical data.
- Number of working days in the considered year (without weekends, public holidays, an average length of annual holidays, etc.).

7. Estimation of crime, law enforcement and criminal justice costs

Methodology

Content **(with quicklinks)*:***
- ***Methodological remarks***
  - ○ *Examples 7a – 7b*

The estimation of the basic social costs of illegal drug use related to the criminal justice sector includes the costs of the police, public prosecutors, law courts, probation officers, custom service, border guards and incarceration. Such costs will depend on the legal status of drugs in each country.

The quality of the estimation of crime, law enforcement and criminal justice social costs attributable to illegal drug use, as in the case of morbidity, depends on the availability of statistical data. In the first step available statistical data should be gathered.

As previously, in some countries more detailed analysis is possible, in others only rough estimates of certain types of social costs of illegal drug use can be obtained. In practice, however, none of the EU countries is currently able to provide official statistical data sufficient for detailed social cost analysis in this area.

A special study can be conducted to determine the percentage of crimes or offences of a considered kind which could be attributed to the use of drugs (Jarl et al., 2008), (Bouchery et al., 2011).[18]

When necessary data are not available, one of the possible ways to obtain missing and necessary information is to conduct special surveys (on a small scale) and to interview persons who are likely to possess the information, even if respondents share only their expert opinions.

Such information combined with some official statistical data gives at least the approximate value of the social costs of crime, law enforcement and criminal justice costs attributable to illegal drug use in a country.

This method was proposed by Z. Mielecka-Kubien [Kuzmicz, Mielecka-Kubien, Wiszejko-Wierzbicka 2009, Chapter IV] and then applied in the ALICE-RAP study for Poland; the estimation concerned: the police, public prosecutors, law courts, probation officers, custom service, and border guards.

---

[18] Results were further applied in cost estimation for other countries (Lievens, D. et al., 2016) according to the formulae (in the case of the police costs): *Total budget of the police x percentage of cases linked to relevant offences x percentage of offences attributed to use of drugs*. The transfer of the results concerning crimes or offences obtained in one country to other countries or in time should be done very cautiously – the percentage of crimes or offences attributed to drugs depends not only on the level of drug use in a given country and kinds of drugs used, but also on a country's law and police activities, and differences among the countries are essential. This method of cost calculation involves the hidden assumption that every kind of crime or offence generates the same police (or other institutions) related costs, which is doubtful.

The cost estimation for the police, public prosecutors, law courts, probation officers, custom service, and border guards was restricted to the estimation of the wages of employees involved in drug-related cases and the costs of relevant expert evaluations.

It can be disputed whether other categories of costs, such as an annual public budget allocated to computerization (equipment, investments, maintenance), buildings (maintenance, operating costs), investments in new buildings, training and education etc., should be taken into account.

When appropriate data concerning the percentage of other illegal drug use attributable costs (apart from wages and expert evaluations) are not available, the percentage of wages attributed to illegal drug use in total wages paid to relevant officers can be subsequently used as *the key*, if expanded analysis is conducted.

The estimation presented below was restricted only to the costs of wages and expert evaluations attributed to the use of illegal drugs.

The surveys concerned crimes and offences directly related to drug use (i.e. against anti-drug laws) and those committed under the influence of drugs, such as health impairment, fight and battery, larceny, sexual offences, robbery, homicide, damages and other.

To question the police, public prosecutors, law courts and probation officers, a sample of 48 cities was selected. Three cities were selected in every province of Poland: a small one (up to 50 thousand inhabitants), a medium-sized one (50-100 thousand inhabitants), and a large one (over 100 thousand inhabitants).

Simple random sampling (see Annex I) was applied both to select the cities in each province and to choose a police station, a public prosecutor office, a law court, and probation officers in the selected cities[19]. Then, it was the interviewers' responsibility to find a person who dealt with drug-related cases in the selected institution.

The survey was conducted in 2012 and the whole study is based on 2010 data, so it was necessary to update some of the survey results using coefficients expressing the relation of the number of cases in the considered category in 2010 to the adequate number in 2012. For that purpose, the data from the Statistical Yearbooks of Poland 2011 and 2013 were applied.

The basic questions concerning the wages estimation were:

- Please estimate what percentage of your working time was devoted to drug related cases in the first half of 2012.
- Please estimate what number of drug related cases you examined in the first half of 2012.

The following questions were asked with regard to drug-related expert evaluations (the subject of an opinion specified in the questionnaire):

- Have you commissioned expert evaluations in drug-related cases?

---

[19] The described analysis can be expanded to several institutions in the area or several persons in the institutions, if needed. In such a case, average values should be applied.

- Please estimate the percentage of drug-related cases in which expert evaluations were commissioned.
- What is, in your opinion, the average cost of an expert evaluation?

These questions were modified depending on an institution and a particular provision in the law. Not every case required questions about expert evaluations.

This way of estimating the costs of dealing with crimes and offences committed under the influence of drugs required the assumption that those crimes and offences would not have been committed if the criminals had not been drug users.

As already indicated in Chapter 4, in such cases, as well as in the cases of many other consequences of illegal drugs use, *the relative risk* and *the attributable fraction* of committing a crime or offence where drugs were involved should be estimated, so only the surplus – over the average population level – would be considered as drug attributable.

As in the ALICE-RAP project the analysis was very detailed and covered several different legal acts,[20] the idea of the estimation of the costs of wages and expert evaluations of the police, public prosecutors, law courts and probation officers attributed to drug use based on survey results and available official statistical data will be explained on the example coming from another study [Kuzmicz, Mielecka-Kubien, Wiszejko-Wierzbicka 2009]. The study was conducted in Poland in 2009 and was restricted to only one legal act (no 62) of the *Offences Against the Law of Counteracting Drug Addiction*, which concerned the punishment for drug possession. The procedure for estimating the police costs is presented in Example 7a.

→ SEE HOW THE EXAMPLES WORK IN PRACTICE WITH THE GUIDANCE PACK EXCEL

Estimation proceeds similarly for public prosecutors, courts of law and probation officers; probation officers did not commission any expert evaluations.

Slightly different data are needed for the customs services and border guards (see *Summary*) and the examples coming from the ALICE-RAP project are presented (Example 7b).

---

[20] The following legal acts were taken into account: Law of Counteracting Drug Addiction, Health Impairment, Fight and Battery, Larceny, Sexual Offences, Robbery, Homicides, Damages, and Pretrial Detainees.

Summary

In order to estimate the wages of employees of the police, public prosecutors, law courts, probation officers involved in drug-related cases and the costs of relevant expert evaluations, if such statistical data are not available, the following information is needed:

1. Official statistical data; possible source: national statistics:
    - Number of committed crimes or offences against a particular legal act.
    - Average wages in a relevant institution.
    - Average cost of relevant expert evaluations, if available; if not, a corresponding question has to be added to the survey questionnaire.
2. Basic survey questions concerning:
    - Percentage of working time devoted to relevant cases (respondent's opinion).
    - The number of such cases that a respondent took part in (respondent's opinion).
    - Percentage of respondents who commissioned expert evaluations relating to relevant cases (respondent's opinion).
    - Percentage of cases for which expert evaluations were commissioned (respondent's opinion).
    - Average cost of an expert evaluation, if needed (respondent's opinion).

To estimate the wages of customs service and border guard employees, the following information is needed:

1. Official statistical data; possible source: national statistics:
    - Number of controls performed by the customs service.
    - Average salary of a customs service employee.
    - Number of cases investigated by the border guard.
    - Average salary of a border guard employee.
2. Survey questions concerning:
    - Average number of cases (controls) related to drugs.
    - Average percentage of such cases in all investigated cases.
    - Average percentage of time devoted to cases related to drugs.

Example 7a

Example 7a: Estimation of the costs of wages and expert evaluations related to Paragraph no 62 of the *Offences Against the Law of Counteracting Drug Addiction*, the Police

Wages

The data applied in the estimation:

1. Official statistical data

- Number of offences against Paragraph 62 in 2008 was 30 548,
- Average monthly wage of a policeman in 2008 was EUR 637.3.

2. Basic survey questions

- Please estimate what percentage of your working time was devoted to cases related to Paragraph no 62 of the *Offences against the Law of Counteracting Drug Addiction* from January to July 2009.
- Please estimate what number of such cases you examined from January to July 2009.

The survey revealed that in the first 7 months of 2009 the police, on average, were involved in 20.9 cases, and it took them, on average, 41.3% of their working time.

Accordingly, in one year (2009) the questioned policemen were involved, on average, in:

$$(12/7) \cdot 20.9 \approx 35.8 \text{ cases.}$$

The official data available at the time when the study was performed concerned the year 2008, so it was assumed that the same average number of cases was valid for the previous year (2008).

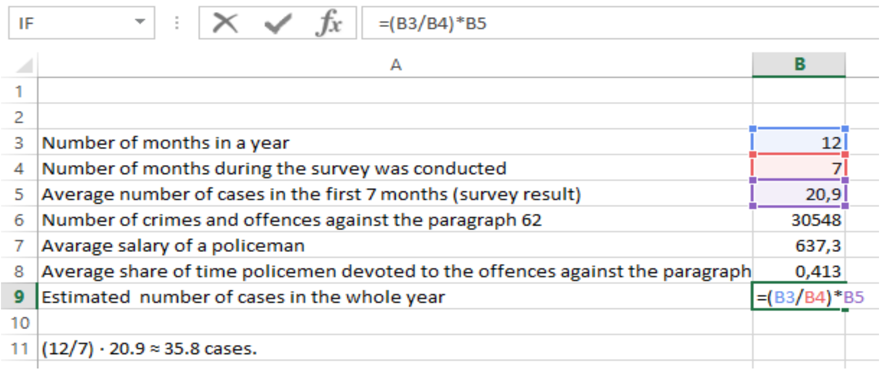
As the official police statistics indicate, in 2008 there were 30 548 crimes and offences against Paragraph 62, which means that, on average, one policeman dealt with 35.8 such cases, theoretically 30 548 / 35.8 ≈ 853 policemen were involved in crimes and offences against Paragraph 62.

Taking into account that an average monthly salary of a policeman in Poland in 2008 was EUR 637.3 and the involvement in the cases against Paragraph 62 took them about 41.3% of their working time, it could be calculated that the costs of the police wages attributed to crimes and offences against Paragraph 62 amounted to:

$$853 \cdot 637.3 \cdot 12 \cdot 0.413 \approx \text{EUR } 2\ 694\ 265.$$

In EXCEL, using the names of EXCEL cells:

Screenshot 7.1 Estimation of the number of cases in the whole year

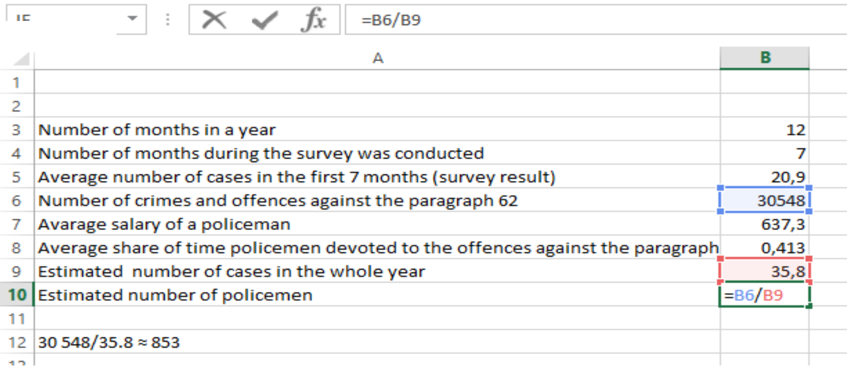


=(B3/B4)*B5

	A	B
1		
2		
3	Number of months in a year	12
4	Number of months during the survey was conducted	7
5	Average number of cases in the first 7 months (survey result)	20,9
6	Number of crimes and offences against the paragraph 62	30548
7	Avarage salary of a policeman	637,3
8	Average share of time policemen devoted to the offences against the paragraph	0,413
9	Estimated number of cases in the whole year	=(B3/B4)*B5
10		
11	(12/7) · 20.9 ≈ 35.8 cases.	

Example 7a

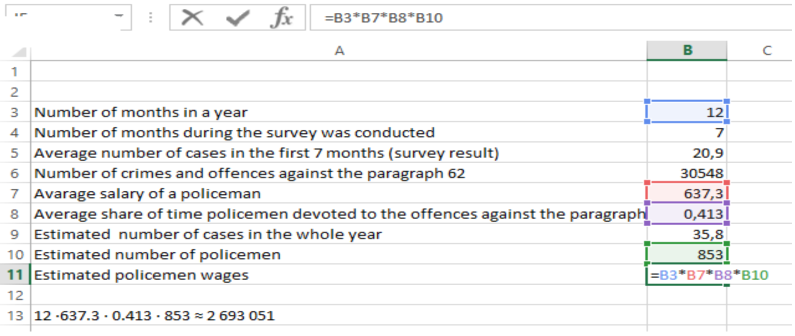
Screenshot 7.2 Estimation of the theoretical number of policemen dealing with relevant cases



=B6/B9

	A	B
1		
2		
3	Number of months in a year	12
4	Number of months during the survey was conducted	7
5	Average number of cases in the first 7 months (survey result)	20,9
6	Number of crimes and offences against the paragraph 62	30548
7	Avarage salary of a policeman	637,3
8	Average share of time policemen devoted to the offences against the paragraph	0,413
9	Estimated number of cases in the whole year	35,8
10	Estimated number of policemen	=B6/B9
11		
12	30 548/35.8 ≈ 853	

Screenshot 7.3 Estimation of the attributed police wages



=B3*B7*B8*B10

	A	B	C
1			
2			
3	Number of months in a year	12	
4	Number of months during the survey was conducted	7	
5	Average number of cases in the first 7 months (survey result)	20,9	
6	Number of crimes and offences against the paragraph 62	30548	
7	Avarage salary of a policeman	637,3	
8	Average share of time policemen devoted to the offences against the paragraph	0,413	
9	Estimated number of cases in the whole year	35,8	
10	Estimated number of policemen	853	
11	Estimated policemen wages	=B3*B7*B8*B10	
12			
13	12 ·637.3 · 0.413 · 853 ≈ 2 693 051		

The cost of expert evaluations

The data applied in the estimation concern the costs of physicochemical expert evaluations:

- Previously estimated number of policemen involved in dealing with offenses against Paragraph 62 (853),
- Previously estimated number of cases per one policeman (35.8),
- Percentage of policemen who commissioned expert evaluations – 75.6% (survey data),
- Percentage of cases for which expert evaluations were commissioned – 74.6% (survey data),
- Average cost of an expert evaluation at EUR 148.6 (survey data or official statistics, if available).

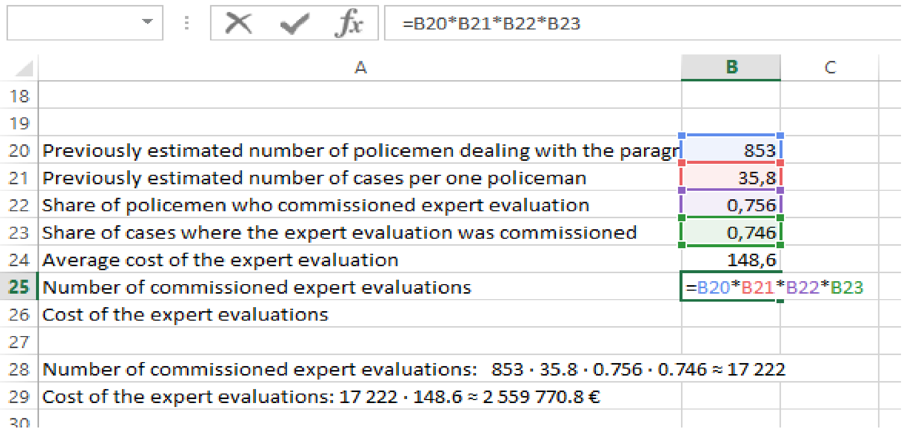
The costs of physicochemical expert evaluations were estimated as follows.

> Estimated number of commissioned expert evaluations: 853 · 35.8 · 0.756 · 0.746 ≈ 17 222
> Estimated cost of the expert evaluations: 17 222 · 148.6 ≈ EUR 2 559 770.8.

In EXCEL, using the names of EXCEL cells:

Example 7a

Screenshot 7.4 Estimation of the costs of expert evaluations



=B20*B21*B22*B23

	A	B	C
18			
19			
20	Previously estimated number of policemen dealing with the paragr	853	
21	Previously estimated number of cases per one policeman	35,8	
22	Share of policemen who commissioned expert evaluation	0,756	
23	Share of cases where the expert evaluation was commissioned	0,746	
24	Average cost of the expert evaluation	148,6	
25	Number of commissioned expert evaluations	=B20*B21*B22*B23	
26	Cost of the expert evaluations		
27			
28	Number of commissioned expert evaluations: 853 · 35.8 · 0.756 · 0.746 ≈ 17 222		
29	Cost of the expert evaluations: 17 222 · 148.6 ≈ 2 559 770.8 €		
30			

Example 7b

Example 7b: Estimation of the customs service and border guard costs

The survey results:

SUBSTANCE	Customs service			Border guards		
	Number of cases	Percentage of cases	Percentage of time	Number of cases	Percentage of cases	Percentage of time
Drugs	3.6	2.2	2.3	1.4	13.9	9.6

Customs service

1. Official statistical data

- Number of controls in the considered year (684 554),
- Average salaries per one employee in this year (18 445.1EUR).

2. Survey results

- Average number of cases (controls) related to drugs (3.6),
- Average share of such cases (0.022),
- Average share of time devoted to cases related to drugs (0.023).

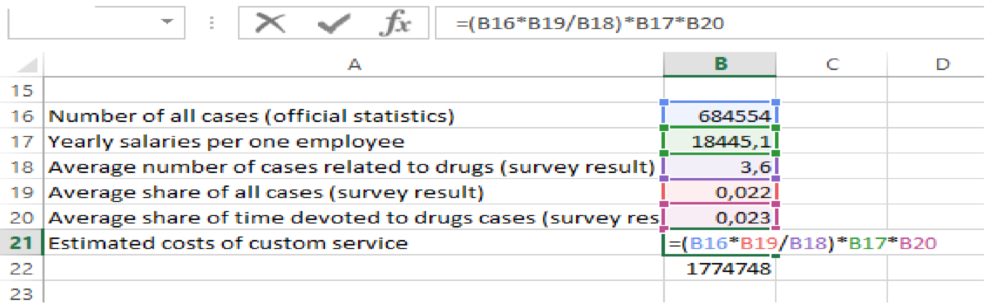
Estimated costs of customs service attributed to illegal drug use in Poland in 2010:

(684 554 · 0.022/3.6) · 18 445.1 · 0.023 ≈ EUR 1 774 751.6.

In EXCEL, using the names of EXCEL cells:

Example 7b

Screenshot 7.5 Estimation of customs service costs



=(B16*B19/B18)*B17*B20

	A	B	C	D
15				
16	Number of all cases (official statistics)	684554		
17	Yearly salaries per one employee	18445,1		
18	Average number of cases related to drugs (survey result)	3,6		
19	Average share of all cases (survey result)	0,022		
20	Average share of time devoted to drugs cases (survey res	0,023		
21	Estimated costs of custom service	=(B16*B19/B18)*B17*B20		
22		1774748		
23				

Border Guards

1. Official statistical data

- Number of cases in the considered year (8431),
- Average salaries per one employee in this year EUR 10476,1.

2. Survey results

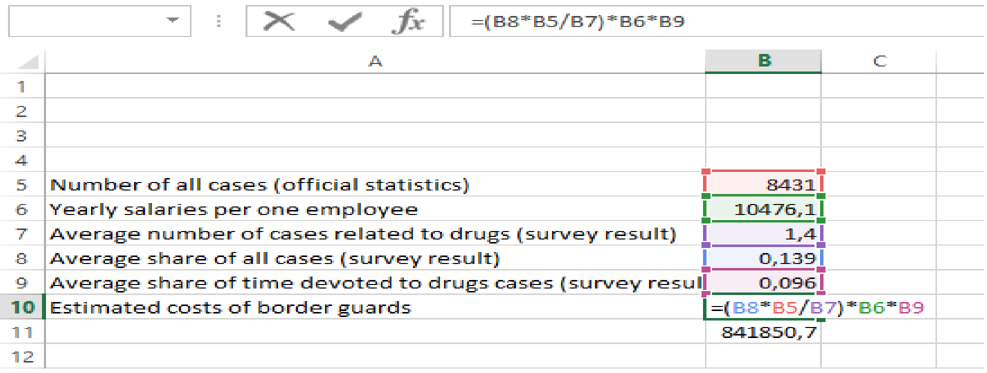
- Average number of cases (controls) related to drugs (1.4),
- Average share of such cases (0.139),
- Average share of time devoted to cases related to drugs (0.096).

Estimated costs of border guards attributed to illegal drug use in Poland in 2010:

$$(8431 \cdot 0.139/1.4) \cdot 10\,476.1 \cdot 0.096 \approx \text{EUR } 841\,850.7.$$

In EXCEL, using the names of EXCEL cells:

Screenshot 7.6 Estimation of the costs of border guards



=(B8*B5/B7)*B6*B9

	A	B	C
1			
2			
3			
4			
5	Number of all cases (official statistics)	8431	
6	Yearly salaries per one employee	10476,1	
7	Average number of cases related to drugs (survey result)	1,4	
8	Average share of all cases (survey result)	0,139	
9	Average share of time devoted to drugs cases (survey resul	0,096	
10	Estimated costs of border guards	=(B8*B5/B7)*B6*B9	
11		841850,7	
12			

8. Remarks on the estimation of other types of costs

Other costs most commonly estimated

Other types of costs should also be included in the basic social costs of illegal drug use, first of all:

- Prevention costs,
- Education costs,
- Research costs,
- Social assistance costs.

The way of estimating such costs may be based, as described above, on:

- The existing data (official statistical data, survey data),
- In cases when such data are not available, *a key* variable, special study, *ad hoc* surveys or results of other studies may be used.

As in different countries the costs specified above may be financed from different sources, in each country it should be considered whether the costs are not double counted.

Public Expenditure

Apart from the concept of social cost estimation, also a narrower scope of drug related costs can be considered, called *the Public Expenditure.* It comprises the public authorities' financial contribution to the drug policy, while social cost estimation covers the total costs that the society incurs because some of its members use illegal drugs. Special attention to *the Public Expenditure* is given by EMCDDA, where these costs are often estimated.

The EMCDDA publications on *the Public Expenditure* can contribute to better understanding of the nature of different types of costs and help to find international statistical data sources. Useful links are as follows:

http://www.drugs.ie/resourcesfiles/ResearchDocs/Europe/Research/2008/TDSI08001ENC_WEB.pdf

http://www.emcdda.europa.eu/attachements.cfm/att_143682_EN_TDSI11001ENC.pdf

http://www.emcdda.europa.eu/attachements.cfm/att_223772_EN_TDAU13007ENN.pdf

Non-medical use of prescription opioids

Sometimes there is a need to consider more detailed types of costs, for example the costs of non-medical use of prescription opioids. The problem with estimating these costs (not the ones paid by patients) lies in the fact that official statistics concerning the matter are not available.

One way of getting a rough approximation of the costs is to conduct a survey.

The questions can be addressed to the users of prescription opioids – in such a case it is advisable to apply a technique that is more effective than the anonymous questionnaire technique (for instance the randomized response technique, see Annex I) – or to other persons who are likely to provide relevant information (physicians who prescribe opioids or treat users, pharmacists, users' families or friends, etc.).

9. Remarks on the methods of evaluation of *harm to others* caused by illegal drug use*

Dealing with harm to others

The problem of the estimation of the *harm to others* range is more often discussed with reference to alcohol or smoking rather than illegal drug use. The most exhaustive study dealing with *harm to others* [Laslett et al. 2010] concerns alcohol, similarly to [Hope 2014], [Gell et al. 2015] and many others listed and discussed in [Navarro, Doran, Shakehaft 2010]. Among the studies concerning drugs, [Callinan, Room 2014] and [Melberg et al. 2011] can be mentioned. The issue of *harm to others* caused by drug use is sometimes discussed in the context of possible legalization of certain types of drugs [Husak 1992].

The *harm to others* costs are, as a matter of fact, part of the social costs of illegal drugs use. Their estimation requires special kinds of research and therefore, conventionally and traditionally, they are often considered separately.

What are harm to others *costs?*

Illegal drug use does not only hurt those taking the substances but may also impact those around them: families, children (including foetuses), the whole society. Illegal drug use also causes problems in the workplace. The society is harmed by additional costs generated by the health care system, institutions of law etc., which arise as a result of actions brought about by drug use, for instance judicial costs related to offences committed by persons under the influence of drugs – these financial means could be used for other purposes and benefit the whole society. Not only does illegal drug use create additional financial costs, but it also causes significant human harm {see: [Melberg et al. 2011]}, the description and evaluation of which should be included at least in the *harm to others* estimation.

So the questions which have to be answered are:

- *Who other than the user is affected by illegal drug use?*
- *In which domains does harm take place?*

As stated in [Laslett et al. 2010, p.13] with reference to alcohol use…..*First, costs accrue to the drinker him/herself due to the harms experienced from his/her own drinking; second, to the victims, due to the harms they experience; third, to the service providers such as police, courts, hospitals etc who are responding to the drinker and/or the victim because of the harm; and fourth, to those who eventually bear some of the costs faced by the first three groups, e.g. taxpayers, families, friends, government, businesses etc.*…Similarly, these subjects may be affected by the use of drugs, and with the exception of the user himself (herself) the others bear consequences of somebody else’s use of drugs, so the costs they incur can be regarded as *the harm to others* costs.

The estimation of the level of *harm to others* caused by illegal drug use requires:

1. Estimation of the direct and non-direct social costs attributed to illegal drug use (as in Chapters 5-8).
2. Estimation of the costs concerning persons affected by somebody else's use of drugs (victims of people committing crimes under the influence of drugs), direct and non-direct costs, as in Chapters 5-8.
3. Conducting a survey (surveys) to elicit information which cannot be obtained in other ways, mainly concerning human harm.

The way to estimate the main types of social costs caused by drug use has already been explained above, but some additional important information could be obtained from institutional sources. Such information may concern victims of crimes or offences committed under the influence of drugs, health care service costs relating to these victims etc.; detailed information about the matter is available in: [Laslett et al. 2010].

A questionnaire for estimating the harm to others *caused by illegal drug use*

To estimate the range of *harm to others* for families or in a workplace, a survey should be conducted, similarly as in [Hope 2014] with reference to alcohol. There were three sets of questions, which, adjusted to drug related problems, concerned:

1. Family problems, traffic accidents, financial difficulties, being a victim of someone *under the influence of drugs*.
2. Problems in the workplace because someone else was *a drug user*.
3. Harm to children because *of illegal drug use* by other persons.

The questionnaire adjusted to illegal drug use is presented beneath.

The* harm to others *questions on families, traffic accidents, financial problems, and being a victim of someone under influence of drugs are quoted after [Hope 2014. p.10-11] with the kind permission of Dr. Ann Hope from the Trinity College Dublin, Ireland.

The questions on a workplace and children are quoted with the kind permission of Professor Robin Room from the University of Melbourne, Australia, {see also: [Laslett et al. 2010]}.

Another very detailed and exhaustive questionnaire, which can be used for the estimation of *harm to others* caused by illegal drug use – if adjusted to illegal drug use – is presented in: [*A WHO/Thai Health International Collaborative Research project, 2013/2015*].

Yet one more questionnaire, directly concerning drugs, is available in: [Callinan, Room 2014].

The questionnaire

The following questions were asked to all respondents – **general population**.

> Because of someone else's use of illegal drugs, how many times in the past 12 months have you . . .
>
> a. Had family problems or relationship difficulties due to someone else's *using illegal drugs*?
> b. Been a passenger with a driver who *was under the influence of illegal drugs*?
> c. Been hit or assaulted by someone who *was under the influence of illegal drugs*?
> d. Had financial trouble because of someone else's *use of illegal drugs*?
> e. Had property vandalised by someone who *was under the influence of illegal drugs*?
> f. Been involved in a traffic accident because of someone else *was under the influence of illegal drugs*?

The possible responses were none, 1-3 times, 4 or more times.

The second set of questions related to the **workplace** where workers (paid workers or volunteers but with the exclusion of college students) were asked questions about co-workers whom the respondent considered to be *regular drug users* or someone who *uses drugs* sometimes.

> Because of your co-worker's illegal drug use, how many times in the last 12 months . . .
>
> a. Has your ability to do your job been negatively affected?
> b. Have you been involved in an accident or a close call at work?
> c. Have you had to work extra hours?

The third set of questions related to **children in families** and measured the exposure of children to neglect and abuse because of someone else's *illegal drug use* – harm to children.
The questions were asked of respondents who had parental/guardian responsibility, whether the child lived with them or not. The four questions were:

> Because of someone else's illegal drug use, how many times in the past 12 months. . .
>
> a. Have children been left in an unsupervised or unsafe situation because of someone else's *use of illegal drugs*?
> b. Have children been yelled at, criticised or otherwise verbally abused because of someone else's *use of illegal drugs*?
> c. Have children been physically hurt because of someone else's *use of illegal drugs*?
> d. Have children been witness to serious violence in the home because of someone else's *use of illegal drugs*?

The possible responses were; every day, 4-5 times a week, 2-3 times a week, once a week, 2-3 times a month, about once a month, one or a few times a year, never, don't know.

10. Estimation of avoidable costs

Why and how to estimate avoidable costs?

For the purpose of the social policy, apart from the magnitude of social costs attributed to illegal drug use, valuable information about part of the costs that can be potentially avoided – through appropriate social policy initiatives and behavioural changes of the population of illegal drug users or potential illegal drug users – is needed. Such estimation is usually conducted for *the burden of disease.*

Content **(with quicklinks)*****:***

- ***10.1 Feasible Minimum***
  - *Example 10a*
- ***10.2 Arcadian Normal***
  - *Example 10b*
- ***10.3 Z. Hellwig's method****

According to [Collins et al. 2006], the first step in the estimation of the avoidable part of social costs is to determine the magnitude of the entire social costs and … *based on the conceptualization of attributable burden, it is then possible to introduce the term avoidable burden of disease. The latter term denotes the proportion of disease burden that can be reduced by changing the current exposure distribution to an alternative, more favoured, exposure distribution* [ibid., p.21].

As a matter of fact, all drug use related costs estimated according to the COI approach can be considered as the costs which could be avoided if nobody in the society used drugs, as such an assumption is at the core of *the Cost of Illness* philosophy (Chapter 2).

In practice, two more realistic approaches to the estimation of avoidable costs are applied: t*he Feasible Minimum* and *the Arcadian Normal.*

As indicated in the Guidelines [ibid., p.22], in order to estimate *the Feasible Minimum,* researchers try to answer the question: *What would happen if risk factor distributions shifted to different counterfactual scenarios?* (Murray and Lopez, 1999, quoted after Collins et al. 2006, p.23), and in order to estimate *the Arcadian Normal*, instead of using epidemiological data from which the feasible minimum can be calculated, the lowest recorded rates of mortality from certain causes which were reported in a country are compared to the mortality rates from these causes reported in other countries. These methods were applied in the ALICE-RAP project (AR D6.2).

Another method that can prove useful in the estimation of the avoidable costs can be proposed. The method, drawing on the multidimensional theory, was proposed by the Polish statistician, Z. Hellwig[21], in 1968 and can be applied to the cases when many characteristics of a phenomenon have to be taken into account.

---

[21] [Hellwig 1968].

10.1 Feasible Minimum

Methodology

To evaluate the number of lives potentially saved, the following information is needed:

- Estimated attributable fraction under the assumption of lower prevalence rates.
- Estimated mortality level as in Chapter 5.

To apply the method of *the Feasible Minimum* in the ALICE-RAP project, it was assumed that illegal drug users may shift from category of *users* to that of *non-users.* It was also assumed that changes in mortality entirely attributable to illegal drug use were adequate to the ones in mortality partly attributable to drug use. The estimation was performed for drug related mortality.

Under these assumptions, it was estimated how the level of drug related mortality would change, if the population had 10%, 20% or 50% fewer users of illegal drugs than in reality.
To estimate mortality partly attributable to illegal drug use, the method described in Chapter 5.2 (Example 5b) should be applied, but the estimation should use reduced (by 10%, 20% or 50% or other values) prevalence rates, which leads to a decrease in the values of the attributable fraction. The procedure for estimating the lower attributable fraction is explained in Example 10a for Catalonia (Spain), men.

→ SEE HOW THE EXAMPLES WORK IN PRACTICE WITH THE GUIDANCE PACK EXCEL

10.2 Arcadian Normal

Methodology

In order to apply the Arcadian Normal method to calculate the number of lives potentially saved, the following information is needed:

- Estimated mortality rates for causes of deaths attributed to illegal drug use in every considered country.
- Estimated expected level of mortality in the considered countries under the assumption of the mortality rates, determined for causes of deaths attributed to use of illegal drugs, lowest in the whole set of countries.

The method of *the Arcadian Normal* is based on the comparison of the participating countries in terms of mortality rates for causes of deaths related to illegal drugs use. As in the ALICE RAP project, three countries [Poland, Portugal and Catalonia (Spain)] were included, so the use of *the Arcadian Normal* was limited to these three countries. The mortality rates for causes of deaths related to illegal drugs use were calculated, and then it was estimated how many lives could be saved if mortality rates in a given country were equal to the lowest ones among the compared countries. The way of proceeding is explained in Example 10b.

Example 10a

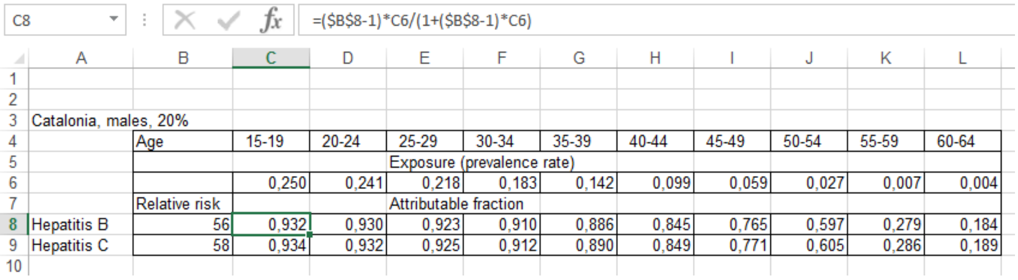
Example 10a: Estimation of the Feasible Minimum

It was assumed that the population of men in Catalonia had 20% fewer illegal drug users than in reality, so the prevalence rates were 20% lower in every age group.

For instance, for the age group [15-19), the number of drug users was in reality 53 970 persons and now it is 43 126 persons (that is 20% lower, 53 970 · 0.8 = 43 126) and the prevalence rate was previously 0.312 (see Example 4c) and now it is 0.250.

The attributable fraction for the same age group and Hepatitis B was previously 0.945 and now it is 0.932.

Screenshot 10.1 Estimation of the attributable fraction with decreased exposure



C8

=($B$8-1)*C6/(1+($B$8-1)*C6)

	A	B	C	D	E	F	G	H	I	J	K	L
1												
2												
3	Catalonia, males, 20%											
4		Age	15-19	20-24	25-29	30-34	35-39	40-44	45-49	50-54	55-59	60-64
5					Exposure (prevalence rate)							
6			0,250	0,241	0,218	0,183	0,142	0,099	0,059	0,027	0,007	0,004
7		Relative risk			Attributable fraction							
8	Hepatitis B	56	0,932	0,930	0,923	0,910	0,886	0,845	0,765	0,597	0,279	0,184
9	Hepatitis C	58	0,934	0,932	0,925	0,912	0,890	0,849	0,771	0,605	0,286	0,189
10												

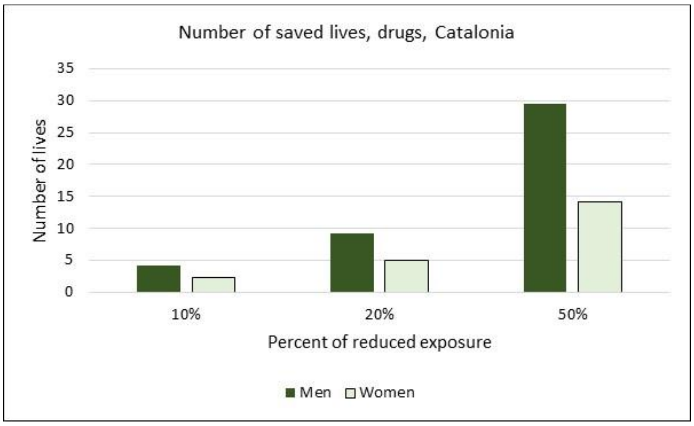
When the new, lower values of the attributable fractions are estimated, the next steps of calculation are the same as in the case of initial mortality estimation (Examples 5a-5c).

Next, the level of drug related mortality from these causes of deaths for which the attributable fraction was not calculated should also be diminished. For this purpose, *the key* was applied, that is the proportion of Hepatitis B and C deaths estimated with the lower attributable fractions to the number of deaths initially estimated, that is: 18.85/19.97 = 0. 939.

As the initially estimated number of deaths attributable to drug use for men in Catalonia was 150, and now it is 141, in this population 9 lives could be saved if exposure to drugs was reduced by 20%.

The final results of estimation of avoidable mortality in Catalonia under the listed assumptions are presented in figure 7.1.

Figure 7.1 Number of potentially saved lives according to reduced exposure to drug use, Catalonia, men



Source: [Mielecka-Kubien 2015, p.19].

Example 10b

Example 10b: Estimation of avoidable mortality with the use of the Arcadian Normal method

In table 10.1 the mortality rates for men in Poland, Portugal and Catalonia (Spain) attributed to illegal drug use are presented. The mortality rates are calculated as the relation of the number of deaths attributed to illegal drug use to the population size, age [15-64], and multiplied by 100 000.

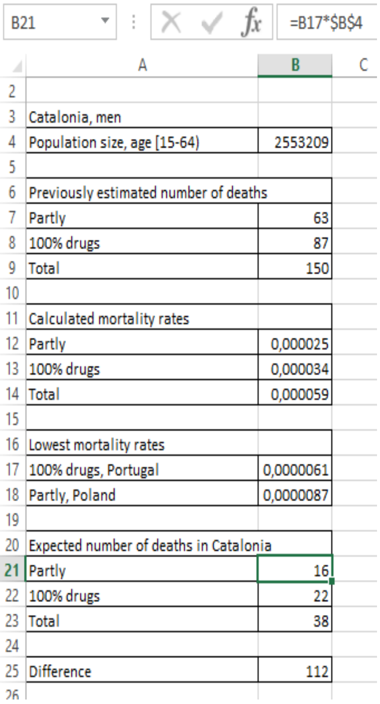
Table 10.1 Mortality rates related to use of illicit drugs for population age [15-64], per 100 000 of population, men

CAUSES OF DEATHS	Poland	Portugal	Catalonia (Spain)
	Men	Men	Men
Partly	0.9	2.2	2.5
100% drugs	1.1	0.6	3.4
Total	2.0	2.8	5.9

Source: [Mielecka-Kubien 2015, p.32].

The mortality rates for deaths partly attributable to illegal drug use were the highest in Catalonia (Spain) and the lowest in Poland; in the cases where deaths were entirely attributable to illegal drug use, they were the lowest in Portugal.

Screenshot 10.2 Estimation of the number of lives potentially saved



B21 =B17*$B$4

	A	B	C
2			
3	Catalonia, men		
4	Population size, age [15-64)	2553209	
5			
6	Previously estimated number of deaths		
7	Partly	63	
8	100% drugs	87	
9	Total	150	
10			
11	Calculated mortality rates		
12	Partly	0,000025	
13	100% drugs	0,000034	
14	Total	0,000059	
15			
16	Lowest mortality rates		
17	100% drugs, Portugal	0,0000061	
18	Partly, Poland	0,0000087	
19			
20	Expected number of deaths in Catalonia		
21	Partly	16	
22	100% drugs	22	
23	Total	38	
24			
25	Difference	112	

Then it was estimated what number of deaths attributed to illegal drug use would occur in Catalonia, if the mortality rates for the causes of deaths attributed to drug use were as low as in Poland (partly attributable) and in Portugal (entirely attributable).

It can be observed that if mortality rates for causes of deaths partly attributable to illegal drug use in Catalonia were as low as in Poland, only 16 (and not 63) men would have died, and if mortality rates for causes of deaths entirely attributable to illegal drug use were as low as in Portugal, 22 (and not 87) men would have died from these causes of deaths. So, theoretically, in the year 2010 in the population of Catalonia, 112 lives could have been saved.

Summary

To estimate the number of lives which could potentially be saved, the following information is needed:

- For the *Feasible Minimum* method – the same data as previously for the estimation of drug use related mortality and its consequences.
- For the *Arcadian Normal* method – the additional information on the population size and previously estimated numbers of deaths attributed to illegal drug use.

10.3 Z. Hellwig's method*

Methodology

The method[22] classifies objects (here: countries) characterized by several factors according to the chosen criterion. The purpose of such a study is to compare objects and determine which of them is in a better or worse situation from a given point of view.

Here one can compare the countries according to the level of mortality attributed to illegal drug use. As in the ALICE-RAP project three countries were compared (Poland, Portugal and Catalonia), the way the method works will be explained for these countries, though its advantages can be better seen when the number of objects is higher.

The underlying concept of the method involves constructing one variable, called *a synthetic variable*, based on several variables (in statistics referred to as *diagnostic variables*) characterizing the considered, directly unobservable, phenomena.

Diagnostic variables have to be comparable, which means that they have to operate in the same direction, for instance, the higher the level of diagnostic variables, the worse the situation of the object (as in the case of mortality rates), and their values have to be standardized.

Then a model consisting of the most favourable values of the diagnostic variables from the set of the countries under study is build, and every country is compared to this model. The model may be an abstract one, meaning that each of the most favourable values of the diagnostic variables comes from a different country or they all may come from one country.

Let x_{ij} be the values of a diagnostic variable X_j (j = 1,2,…,k) in a country i (i = 1, 2,…,m) and z_{ij} the values of this variable standardized according to the formulae:

$$z_{ij} = \frac{x_{ij} - \bar{x}_j}{s_j} \qquad (10.1)$$

---

[22] In Poland Z.Hellwig's method is called *the Measure of Economic Development*.

where $\bar{x}_j$ is the average value of variable X_j, and s_j its standard deviation.

The synthetic variable Z is constructed as follows:

$$z_i = 1 - \frac{d_{i0}}{d_0} \tag*{(10.2)}$$

where d_{i0} is the distance of the object (country) i from the model, calculated as:

$$d_{i0} = \left[\sum_{j=1}^{k}\left(z_{ij} - z_{0j}\right)^2\right]^{0.5} \tag*{10.3)}$$

and d_0 as:

$$d_0 = \bar{d}_0 + 2s_0 \tag*{(10.4)}$$

where $\bar{d}_0$ and s_0 are respectively its average and standard deviation defined as:

$$\bar{d}_0 = m^{-1}\sum_{i=1}^{m} d_{i0} \tag*{(10.5)}$$

The synthetic variable Z usually takes values (0, 1) and only exceptionally exceeds these limits. Its values rank the objects (here countries) from the 'worst' to the 'best' according to a selected criterion.

The method is presented in Example 10c.

→ SEE HOW THE EXAMPLES WORK IN PRACTICE WITH THE GUIDANCE PACK EXCEL

Example 10c

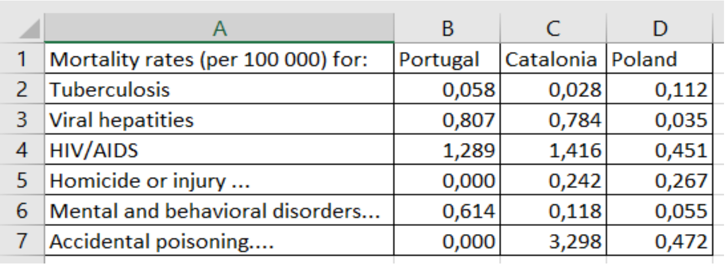
Example 10c: Estimation of the distance between the countries with the Hellwig's Method

There are three objects (i = 1,2,3): Poland, Portugal, Catalonia, and six diagnostic variables (j = 1,2,…,6), which are the mortality rates for:

Tuberculosis,
Viral Hepatities,
HIV/AIDS,
Homicide or injury inflicted by another person with the intent to injure or kill, by any means,
Mental and behavioural disorders due to psychoactive substance use,
Accidental poisoning by and exposure to noxious substances.

Injury, undetermined whether accidental or purposely inflicted had to be eliminated because the variable always took the value of zero.

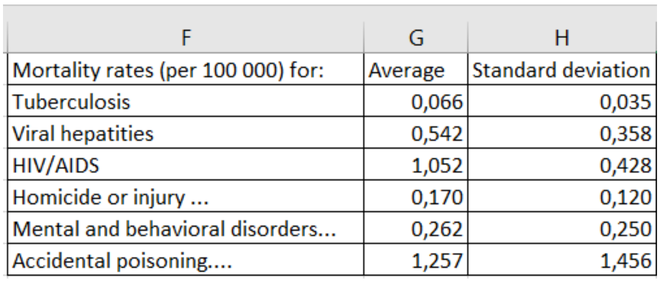
Screenshot 10.3 Estimation of the mortality rates



	A	B	C	D
1	Mortality rates (per 100 000) for:	Portugal	Catalonia	Poland
2	Tuberculosis	0,058	0,028	0,112
3	Viral hepatities	0,807	0,784	0,035
4	HIV/AIDS	1,289	1,416	0,451
5	Homicide or injury ...	0,000	0,242	0,267
6	Mental and behavioral disorders...	0,614	0,118	0,055
7	Accidental poisoning....	0,000	3,298	0,472

We calculate the average and the standard deviation of each diagnostic variable:

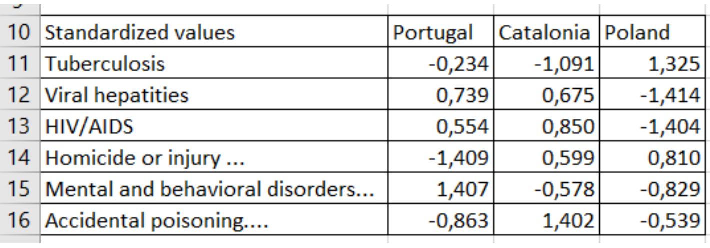
Screenshot 10.4 Calculation of the average and the standard deviation



F	G	H
Mortality rates (per 100 000) for:	Average	Standard deviation
Tuberculosis	0,066	0,035
Viral hepatities	0,542	0,358
HIV/AIDS	1,052	0,428
Homicide or injury ...	0,170	0,120
Mental and behavioral disorders...	0,262	0,250
Accidental poisoning....	1,257	1,456

and their standardized values according to the formulae (7.1):

Screenshot 10.5 Calculation of the standardized values

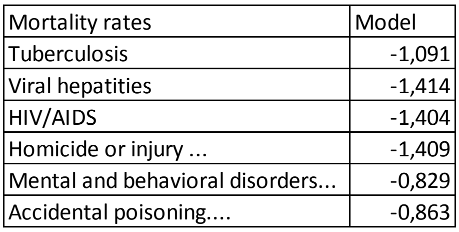


10	Standardized values	Portugal	Catalonia	Poland
11	Tuberculosis	-0,234	-1,091	1,325
12	Viral hepatities	0,739	0,675	-1,414
13	HIV/AIDS	0,554	0,850	-1,404
14	Homicide or injury ...	-1,409	0,599	0,810
15	Mental and behavioral disorders...	1,407	-0,578	-0,829
16	Accidental poisoning....	-0,863	1,402	-0,539

Then we construct the model:

Example 10c

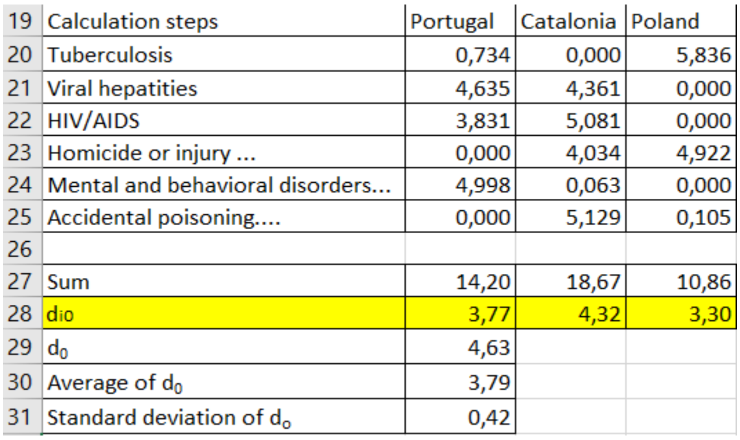
Screenshot 10.6 Formulating the model



Mortality rates	Model
Tuberculosis	-1,091
Viral hepatities	-1,414
HIV/AIDS	-1,404
Homicide or injury ...	-1,409
Mental and behavioral disorders...	-0,829
Accidental poisoning....	-0,863

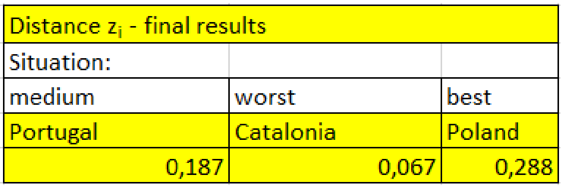
and calculate further according to formulae (7.2)-(7.6)

Screenshot 10.6 Further calculations



19	Calculation steps	Portugal	Catalonia	Poland
20	Tuberculosis	0,734	0,000	5,836
21	Viral hepatities	4,635	4,361	0,000
22	HIV/AIDS	3,831	5,081	0,000
23	Homicide or injury ...	0,000	4,034	4,922
24	Mental and behavioral disorders...	4,998	0,063	0,000
25	Accidental poisoning....	0,000	5,129	0,105
26				
27	Sum	14,20	18,67	10,86
28	d_{io}	3,77	4,32	3,30
29	d_0	4,63		
30	Average of d_0	3,79		
31	Standard deviation of d_o	0,42		

Screenshot 10.7 Final results



Distance z_i - final results		
Situation:		
medium	worst	best
Portugal	Catalonia	Poland
0,187	0,067	0,288

So, it can be observed that the worst situation with reference to mortality attributed to illegal drug use in the year 2010 was in Catalonia, while the best – in Poland. The distance between Poland and Catalonia was 0.221 and between Poland and Portugal less than half of it (0.102).

Summary

To determine the order of the objects (countries) according to the level of the researched phenomena, preferably many characteristics of the phenomena are needed for every country.

PART 3: Using the cost estimates

Suggestions for synthesising and presenting social cost estimates in a standard way

11. Standard presentation of the results of social cost estimates

Introduction

The standard presentation of the results of basic social cost estimates may help to make better comparisons of the costs among the countries. In Chapter 11 basic tables and figures for such a presentation are proposed; their description and comments should be added in the final presentation of the estimation results.

Proposed order of presenting social cost estimates **(with quicklinks)*:***

11.1 Prevalence of illegal drug use in time, space and according to the type of drugs

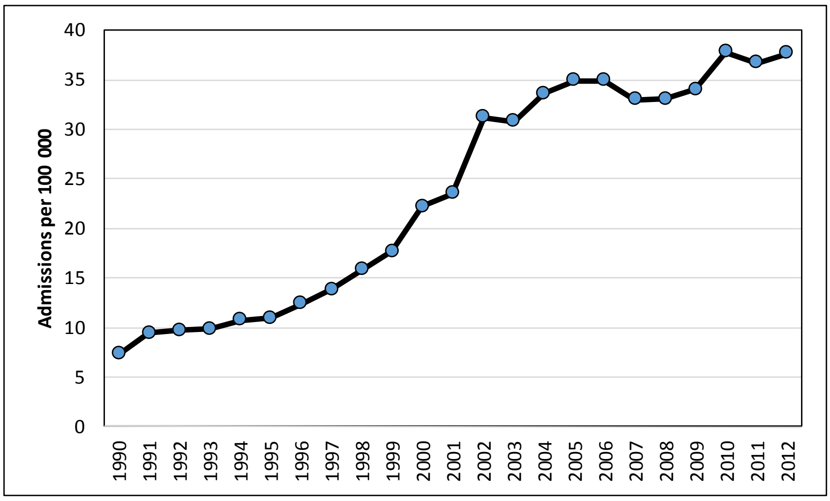
As drugs in question are illegal, official statistics concerning the prevalence of drugs are not available. To present how illegal drug use has changed in a certain period of time or how it is distributed within a country, *the diagnostic variables* can be applied. Such variables can be based on official statistics concerning, for instance, crimes or offences related to drug use or attributable mortality and morbidity.

The type of illegal drugs used in the population is usually the subject of surveys, so such data can be applied.

As the purpose of the presentation of the prevalence data is mainly illustrative, the results can be shown in graphs, for instance:

Prevalence in time

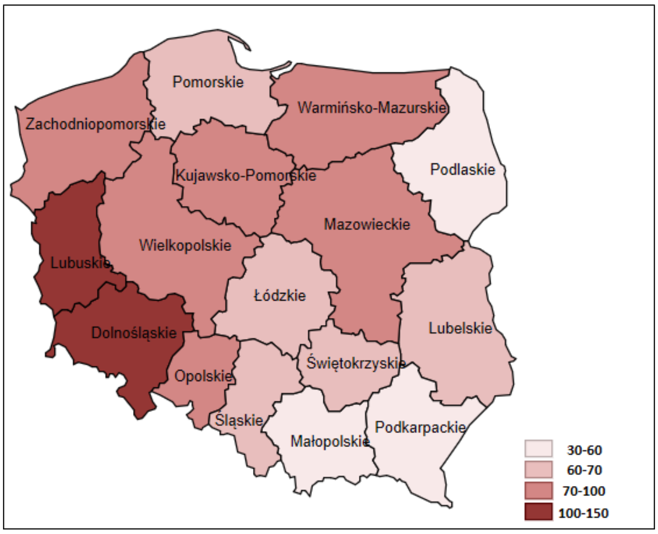
Figure 11.1 Admissions to residential drug treatment in Poland in 1990-2012 (per 100 thousand of population)



Source: Authors' own based on the data from the Institute of Psychiatry and Neurology in Warsaw.

Prevalence in space

Figure 11.2 Suspects under the Act on Counteracting Drug Addiction in Poland, according to provinces in 2013, per 100 thousand. population



Source: Authors' own based on the Police data.

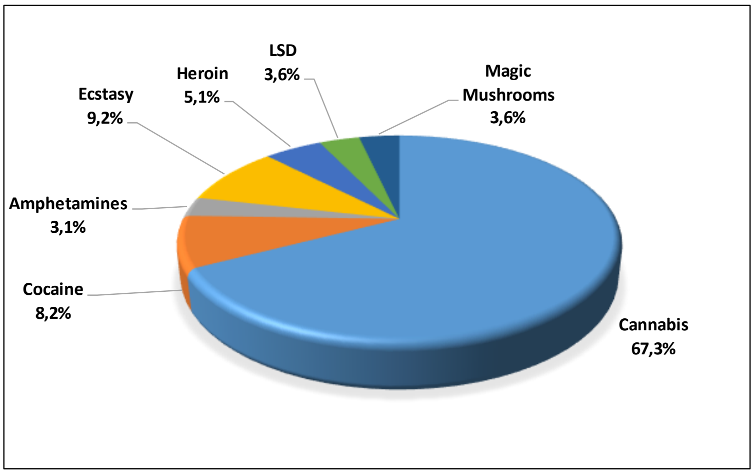
Table 11.1 Percentage of drug users in a country's adult population [15+], survey data

PERIOD OF TIME	Men	Women
Last 30 days		
Last 12 months		
Lifetime		

Source:……

Types of drugs used

Figure 11.3 Breakdown of lifetime drug users according to the type of drugs in Portugal in 2012



Source: Authors' own based on Balsa, C., Vital, C. & Urbano, C. (2013). "III Inquérito Nacional ao Consumo de Substâncias Psicoativas na População Portuguesa. Portugal 2013. Relatório Preliminar" .
http://www.idt.pt/PT/ComunicacaoSocial/ComunicadosImprensa/Paginas/IIIInquéritoNacionalaoConsumodeSubstânciasPsicoativasnaPopulação.aspx

11.2 Prevalence of drug use according to gender and age

Prevalence according to gender and age should be, for better clarity, expressed both as the original data and the estimated data (the theoretical values), which can be further used in mortality estimation – as in the following example.

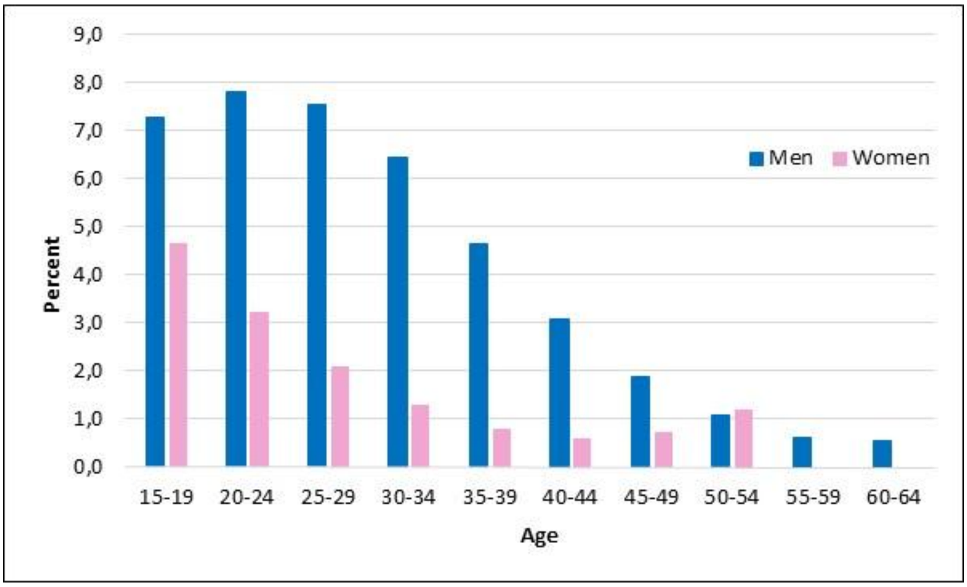
Table 11.2 Prevalence of the last 12 months' drug users in Portugal according to gender and age, original data

AGE	Men	Women
15-24	7.5	4.2
25-34	7.2	1.6
35-44	4.2	0.4
45-54	1.1	1.1
55-64	0.6	0.0

Source: Balsa, C., Vital, C. & Urbano, C. (2013). "III Inquérito Nacional ao Consumo de Substâncias Psicoativas na População Portuguesa. Portugal 2013. Relatório Preliminar" .

http://www.idt.pt/PT/ComunicacaoSocial/ComunicadosImprensa/Paginas/IIIInquéritoNacionalaoConsumodeSubstânciasPsicoativasnaPopulação.aspx

Figure 11.4 Prevalence of the last 12 months' drug users in Portugal according to gender and age, estimated values



Source : [Mielecka-Kubien et al. 2014, p.56].

11.3 Estimated attributable fraction of mortality related to illegal drug use according to gender and age

Next, the results of estimating the attributable fraction for causes of death partly attributable to the use of drugs are presented (see Chapter 4). As the use of drugs usually differs in the populations of men and women, the attributable fraction should be presented separately for each gender. In both populations the use of drugs depends on age, so these essential differences should be taken into account.

Table 11.3 Attributable fractions for causes of death partially attributable to drug use according to gender and age

CAUSES OF DEATH	ICD… CODES	15-19	20-24	25-29	30-34	35-39	40-44	45-49	…
Men									
……									
Women									
……									

Source: ……

11.4 Estimated mortality partly and entirely attributable to illegal drug use

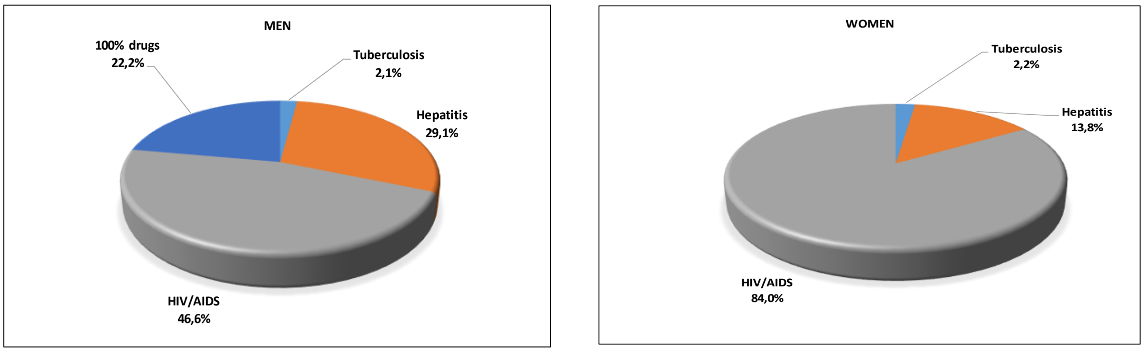
Table 11.4 presents the results of the estimation of mortality for causes of death entirely attributable to the use of drugs as well as for causes of death partly attributable to the use of drugs, estimated with the use of the attributable fraction (Chapter 5). As the use of drugs and, consequently, the attributable fraction vary according to gender and age, so does drug related mortality, therefore it is proposed to present data disaggregated by gender and age.

Table 11.4 Mortality attributable to illegal drug use according to gender and age

CAUSES OF DEATH	15-19	20-24	25-29	30-34	35-39	40-44	45-49	…	Total
					MEN				
100%									
PARTLY									
TOTAL									
					WOMEN				
100%									
PARTLY									
TOTAL									
					MEN+WOMEN				
TOTAL									

Source:…..

Figure 11.4 Structure of mortality attributable to illegal drug use in Portugal, 2010, according to gender and causes of death



Source: [Mielecka-Kubien et al. 2014, p.96].

11.5 Summary output of estimated social costs attributable to illegal drug use

Table 11.5 summarises the main results of cost estimation (Chapters 6, 7, and 9).

Following the results in Chapter 6, health service costs attributed to the use of drugs, with all subsequent items added up, are presented. This sum is then compared to total health service costs in the country and the percentage of drug use attributable costs in total health service costs is calculated.

Similarly, the results of the estimation of criminal justice system costs attributed to the use of drugs are shown, including the calculated percentage of criminal justice costs attributed to the use of drugs in total costs of criminal justice system in the country.

Subsequently, the results of the estimation of other costs attributed to the use of drugs are presented and added, so that finally the total sum of direct costs expressed in monetary terms is given.

To ensure better comparability of the results among countries, the final sum is also expressed as the percentage of a country's GDP.

The premature mortality level is expressed as the number of prematurely deceased drug users and the number of years of life lost is given in years. These two results are the basis for the estimation of productivity costs of mortality (Chapter 5.3); similarly, productivity costs of morbidity are obtained from the estimation of the period of 'sick leaves' as in Chapter 6.3 – both kinds of productivity costs are given in monetary terms.

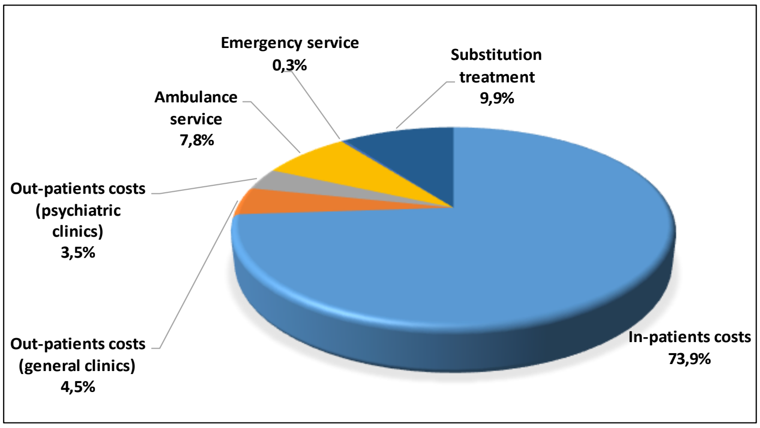
Finally, it is proposed to present 'harm to others' costs embracing both similar cost categories as direct and non-direct costs described above and results specific to 'harm to others' research (Chapter 10).

Table 11.5 Estimated social costs of illegal drug use in JURISDICTION in the year YYYY

SPECIFICATION	**COSTS (m EUR)**
DIRECT COSTS EXPRESSED IN MONETARY TERMS	
HEALTH SERVICE	
Inpatients costs (general hospitals)	
Inpatients costs (psychiatric hospitals)	
Outpatient costs (general clinics)	
Outpatient costs (psychiatric clinics)	
Harm reduction and substitution treatment costs	
Ambulance service	
Emergency service	
Payments for medicines (not paid by patients)	
…..	
TOTAL HEALTH SERVICE	
PERCENTAGE OF HEALTH SERVICE COSTS ATTRIBUTED TO DRUGS IN TOTAL HEALTH SERVICE COSTS	
CRIMINAL JUSTICE SYSTEM	
Police	
Prosecution System	
Courts of Law	
Prisons	
Probation Officers	
Custom Service	
Border Guard	
….	
TOTAL CRIMINAL JUSTICE SYSTEM	
PERCENTAGE OF CRIMINAL JUSTICE SYSTEM COSTS ATTRIBUTED TO DRUGS IN TOTAL CRIMINAL JUSTICE COSTS	
OTHER COSTS	
Prevention	
Education	
Research	
Social assistance	
…..	
TOTAL OTHER COSTS	
TOTAL DIRECT COSTS EXPRESSED IN MONETARY TERMS	
PERCENTAGE OF DIRECT COSTS EXPRESSED IN MONETARY TERMS IN A COUNTRY'S GDP	
DIRECT COSTS NOT EXPRESSED IN MONETARY TERMS	
PREMATURE MORTALITY (number of deaths)	
YEARS OF LIFE LOST (thousands)	
Years of life lost at the age of professional activity (thousands)	
INDIRECT COSTS (PRODUCTIVITY COSTS) EXPRESSED IN MONETARY TERMS	
Mortality	
Absenteeism	
TOTAL PRODUCTIVITY COSTS	
***HARM TO OTHERS* COSTS CONCERNING VICTIMS OF PERSONS UNDER THE INFLUENCE OF DRUGS**	
DIRECT COSTS	
INDIRECT COSTS	
SPECIFIC COSTS	

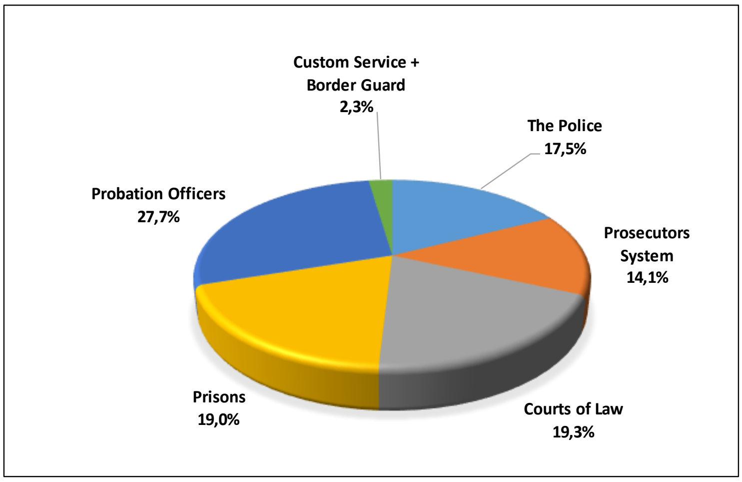
Source: Authors' own.

Figure 11.5 Breakdown of the estimated monetary direct costs of health care service attributable to illegal drug use in Poland in 2010



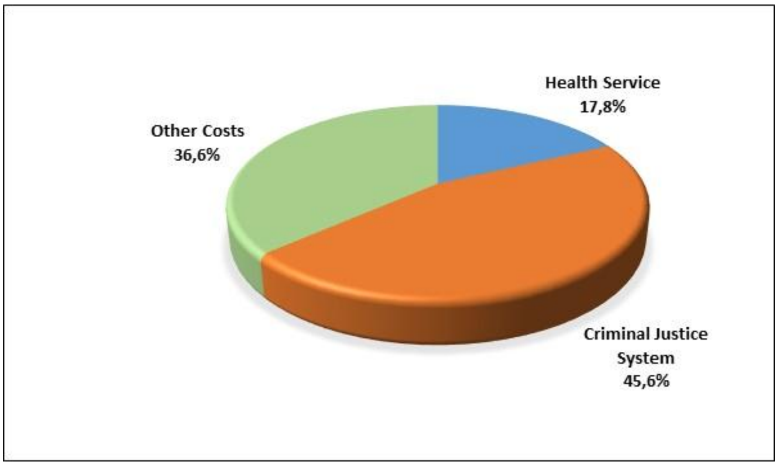
Source: Authors' own based on the [Mielecka-Kubien et al. 2014] data.

Figure 11.6 Breakdown of the estimated monetary direct costs of the criminal justice system attributable to illegal drug use in Poland in 2010



Source: Authors' own based on the [Mielecka-Kubien et al. 2014] data. data.

Figure 11.7 Breakdown of the estimated monetary direct costs of illegal drugs use in Poland in 2010



Source: Authors' own based on the [Mielecka-Kubien et al. 2014] data.

11.6 Estimation results for avoidable mortality

As avoidable mortality, as well as the avoidable part of the other kinds of social costs of drug use, cannot be calculated until basic costs are calculated, the results for avoidable mortality follow the presentation of the basic costs summary. It is proposed to present the results of the estimation of the 'Feasible Minimum' and the 'Arcadian Normal' (Chapter 10.1 and 10.2). The third method (Chapter 10.3) goes beyond basic costs estimation and, for the time being, is not included, but such results can be added if the method is applied.

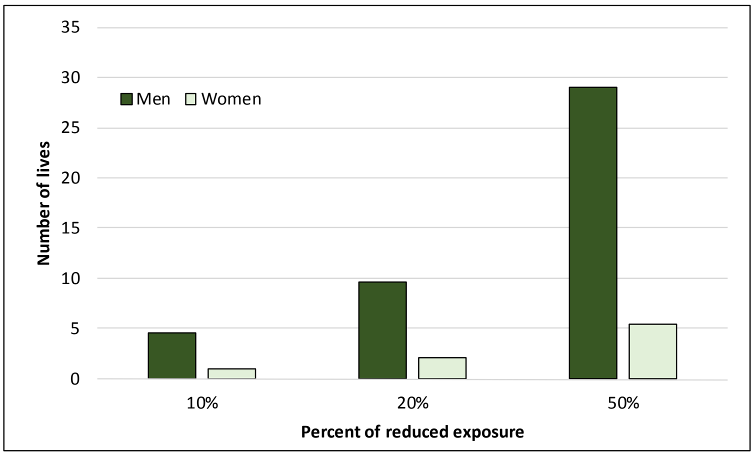
Feasible Minimum

Table 11.6 Potential changes in mortality from different causes related to illegal drug use according to gender and reduced exposure

CAUSES OF DEATHS	MEN, EXPOSURE REDUCED BY:				WOMEN, EXPOSURE REDUCED BY:			
	0%	10%	20%	…	0%	10%	20%	…
Partly								
100% Drugs								
Total								
Number of saved lives	x				x			
Percentage	x				x			

Source: ….

Figure 11.6 Number of potentially saved lives according to gender and reduced exposure to drug use in Portugal in 2010



Source: [Mielecka-Kubien 2015].

Arcadian Normal

Table 11.7 Expected number of lives saved in countries A, B and C….. under the assumption of the lowest mortality rates for causes of death attributed to illegal drug use

CAUSES OF DEATHS	NUMBER OF POTENTIALLY SAVED LIVES							
	Country A		Country B		Country C		…….	
	MEN	WOMEN	MEN	WOMEN	MEN	WOMEN	MEN	WOMEN
Partly								
100% drugs								
Total								

Source: ….

PART 4: Supporting information

Additional information to take into account when performing social cost estimates

I. Highlights on the Sampling Theory

I.1 Basic definitions

***Content** (with quicklinks):*
- ***I.1 Basic definitions***
  - *Example Ia*
- ***I.2 Errors in surveys (non-response, respondent's error)***
  - *Examples Ib - Ic*

The systematic reading on *the Sampling Theory* is available in literature {[Chaudhuri, Stenger 2005], [Benedetto**,** Ferreira 2005], [Sampath 2005], [Groves, 2009], amongst others}; the purpose of Annex I is to draw attention to some problems concerning surveys on addictive substances.

As the surveys concerning drugs are usually based on the part of the general population called a sample, the first important issue is to choose a proper sample. This choice determines the quality of survey results. The sample should be representative of the general population under study.

Representative sample

A representative sample is a scaled-down version of the population, capturing these characteristics that are under examination, so the structure of the sample according to the relevant variables should be possibly closest to their population structure.

For example, if the purpose of a study is to determine the structure of the population with regard to the prevalence of drug use in gender/age groups, the sample structure according to the prevalence of drug use in gender/age groups should be similar to such a structure of the population – but the problem is that the population structure is unknown prior to the survey, and this structure is exactly what we want to determine in the survey.

Accordingly, the question is: *How to choose a sample similar to the general population if we do not know what the population looks like?*

The possible solution to such a problem is explained by *the Laws of Large Numbers* stemming from *the Probability Theory*, which, expressed in simpler terms, argues that if the sample is a random one, the bigger the sample, the higher the probability that it will be similar to the (unknown) general population.

So one of the advantages of the randomness of the sample is that, being large enough, the sample will probably be representative of the population. The other advantage is that advanced statistical analysis based on the probability theory, including commonly applied statistical tests and confidence intervals, may be used only if the sample is a random one.

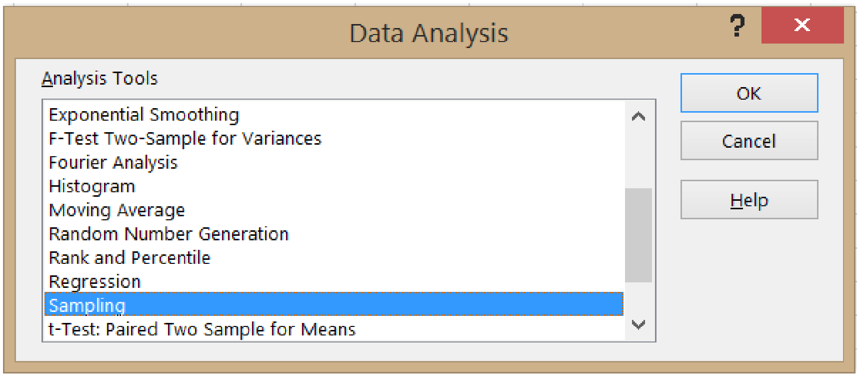
Random sample

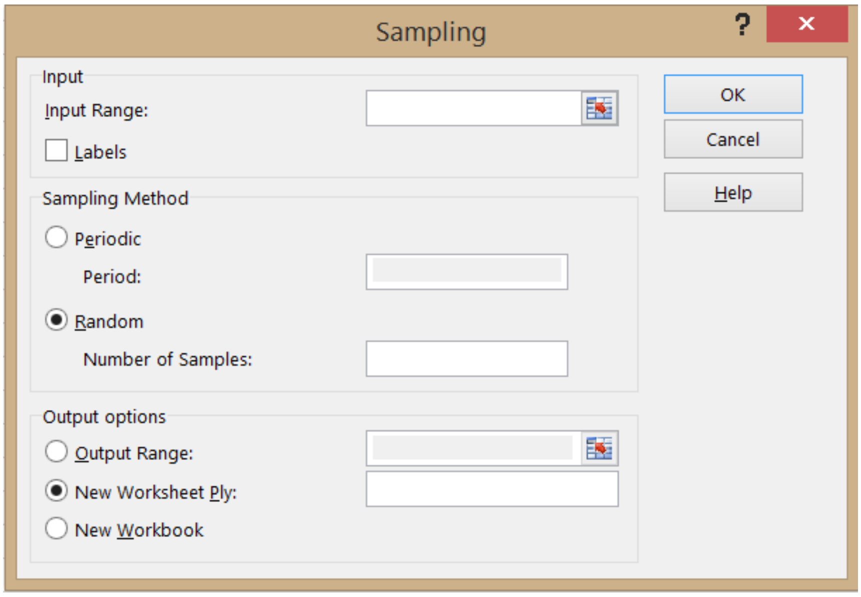
There are several sampling frameworks that enable drawing a random sample, described in details in *the Sampling Theory* literature. The basic and simplest ones are: *the simple random sampling, the systematic sampling, the stratified sampling.*

The simple random sampling allows the choice of a subset of a population in which each individual of the subset has the same probability of being chosen. Each individual is chosen randomly and entirely by chance.

In the systematic random sampling, the first individual is randomly picked from the population. Then, each *k'th* individual from the list is selected. The procedure is very easy and its results are representative of the population – unless certain characteristics of the population are repeated for *k'th* individual.

The simple random sampling and *the systematic random sampling* can be performed with EXCEL Data Analysis.





'Periodic' means the systematic sampling, and 'Period' is the distance *k* between each two neighbouring units included in the sample. 'Random' is the simple random sampling, and 'Number of samples' refers to the desired sample size.

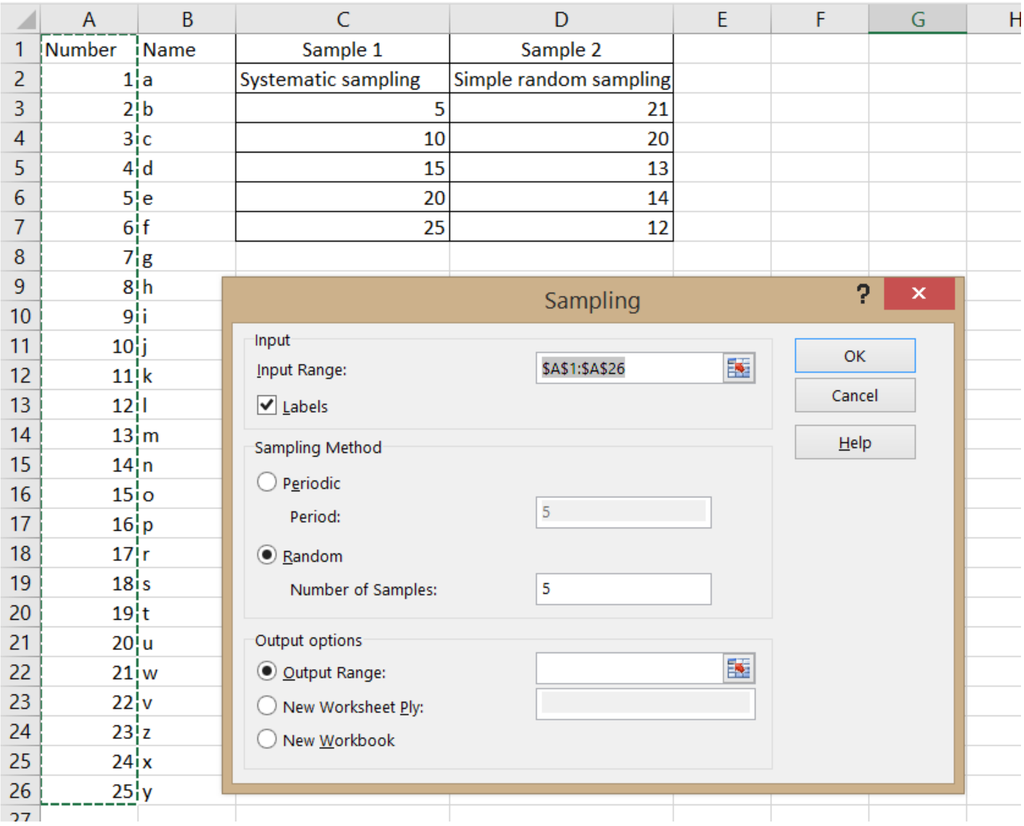
The stratified sampling is a probability sampling technique where the entire population is divided into possibly homogeneous strata and then the individuals are randomly selected from the different strata, for instance with the use of the simple random sampling.

The stratified sampling is particularly profitable if the values of the studied variable show big differences between the strata and small differences within the strata.

Example Ia

Example Ia: Drawing samples

Let us assume that the general population consists of 25 persons, who are subsequently numbered, and we want to draw a sample of 5 persons. It can be done either with the systematic sampling or with the simple random sampling, each of them yielding different random samples:



	A	B	C	D	E	F	G	H
1	Number	Name	Sample 1	Sample 2				
2	1	a	Systematic sampling	Simple random sampling				
3	2	b	5	21				
4	3	c	10	20				
5	4	d	15	13				
6	5	e	20	14				
7	6	f	25	12				
8	7	g						
9	8	h						
10	9	i						
11	10	j						
12	11	k						
13	12	l						
14	13	m						
15	14	n						
16	15	o						
17	16	p						
18	17	r						
19	18	s						
20	19	t						
21	20	u						
22	21	w						
23	22	v						
24	23	z						
25	24	x						
26	25	y						

Sampling

Input

Input Range: $A$1:$A$26

☑ Labels

Sampling Method

○ Periodic

Period: 5

● Random

Number of Samples: 5

Output options

● Output Range:

○ New Worksheet Ply:

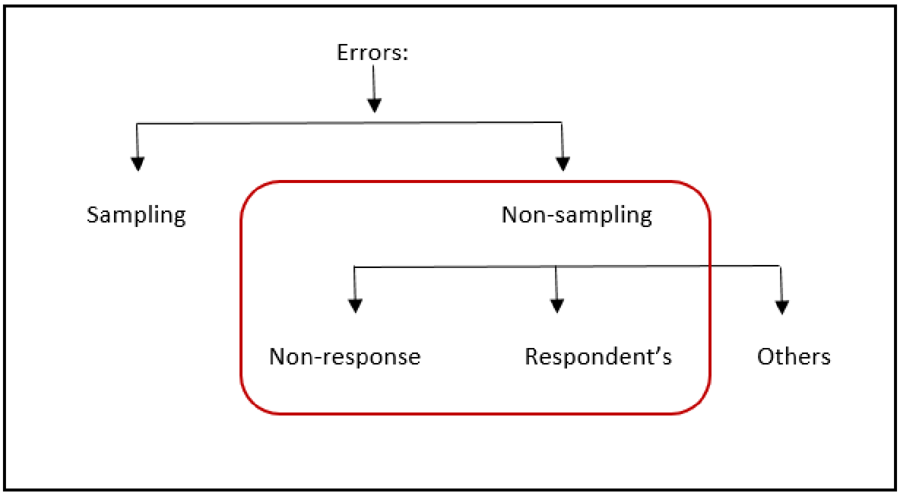
○ New Workbook

Sample 1 consists of persons: 5 (e),10 (j), 15(o), 20(u), 25(y), while sample 2 includes persons: 12(l), 13(m), 14(n), 20(u), 21(w).

I.2 Errors in surveys (non-response, respondent’s error)

The quality of survey results depends heavily on the presence of errors in the survey. The detailed and comprehensive description of possible errors appearing in surveys can be found for instance in: [Groves, 1989], [Groves, Couper, 1998]. The most characteristic errors in surveys on addictive substances are presented in the following, simplified, scheme.

Errors in surveys



The sampling error arises because only part of the population (the sample) is investigated. It depends (among others) on the sample size and can be reduced by an increase in the size of the sample.

Non-sampling errors may happen in every sample, regardless of its size, and they cannot be reduced by an increase in the sample size.

Surveys on addictive substances usually contain some non-sampling systematic errors (biases), which can negatively influence the quality of survey results. The most serious impact may be exerted by: the non-response and the respondent’s errors.

Non-response

The meaning of the non-response error is explained in Example Ib.

Example Ib: Non-response errors

Assumptions:

Let us consider a general population where 10% of population members are illegal drug users. In reality, this percentage is not known and it should be determined in the survey on the basis of a random sample.

The survey question was: *Have you used any kind of illegal drugs during the last 12 months?*
We assume that in each case a random sample of n = 100 persons is drawn and in every such sample there were 10 drug users and 90 drugs non-users.

We also assume that every respondent who answered the question told the truth.

Case 1

In the sample of n_1 = 100 persons, 10 persons answered that they were drug users, while 90 stated that they were drugs non-users. *The coverage rate*, understood as a percentage of responses in the drawn sample, was 100%.

As everybody told the truth, estimated on the basis of the actually examined sample, the percentage of drug users in the general population is equal to:

$$p_1 = \frac{10}{10+90} \cdot 100 = 10\%$$

so the estimation result is correct.

Case 2

A sample of n_2 = 100 persons was drawn, but 10 persons refused to take part in the survey, so there were 10 non-responses and 90 responses; the examined sample was smaller (90 persons).

a. Out of the 90 persons who responded to the question, 9 persons admitted that they were drug users, and 81 persons denied using drugs. In this case, the estimated percentage of drug users in the general population is:

$$p_2 = \frac{9}{9+81} \cdot 100 = 10\%$$

so the estimation result is also correct, but the estimate is less precise than the one presented in Case 1 because we examined a smaller sample than was initially drawn, so the sampling error increased. *The coverage rate* was 90%.

b. It may also happen that out 90 persons who took part in the survey only 5 persons admitted using drugs, while 85 stated that they were non-users. In this case, the estimated percentage of drug users in the general population is:

$$p_3 = \frac{5}{5+85} \cdot 100 = 5.5\%$$

As previously, *the coverage rate* was 90%, but the estimation result does not match the general population structure, and, apart from an increase in the sampling error, the result is biased because non-responses occurred in the survey.
Case 3

Let us assume that again a sample of n_3 = 100 persons was drawn, but 30 persons refused to take part in the survey, so there were 30 non-responses and 70 responses. The examined sample size was 70 persons.

a. Out of the 70 persons who responded to the questions, 7 persons admitted that they were drug users and 63 persons denied using drugs. The estimated percentage of drug users in the general population is:

$$p_4 = \frac{7}{7+63} \cdot 100 = 10\%$$

so the estimation result is again correct, but the result of the estimation is less precise than the one described in Case 1 because the sampling error increased. *The coverage rate* was 70%.

b. Let us assume that out 70 persons who took part in the survey only 2 persons admitted using drugs, while 68 stated that they were non-users. In this case, the estimated percentage of drug users in the general population is:

$$p_5 = \frac{2}{2+68} \cdot 100 = 2.8\%$$

As previously, *the coverage rate* was equal to 70%, but the estimation result is far from the general population structure, and, apart from the significant increase in the sampling error, the result is seriously biased because of the non-response error in the survey.

In Cases 2a and 3a the actually examined samples were, in spite of the non-response, representative of the general population, while in Cases 2b and 3b the actually examined samples were, due to the non-response error, not representative of the population – even if the initially drawn samples (the size of 100) were representative. Moreover, the situations presented in Cases 2b, and 3b are very probable, because drug users have more reasons to refuse to take part in the survey than non-users.

Summary

- Non-response in the survey may seriously bias the survey results.
- The most important issue in evaluating the meaning of the non-response in the survey is stating whether respondents and non-respondents differ according to relevance in the survey characteristics.
- The coverage rate, which is as a rule applied to characterize the quality of surveys, only shows that the investigated sample was smaller than the one initially drawn, so the only information the coverage rate gives concerns the sampling error.

Note! The coverage rate does not give any information about the correctness of survey results.

- It is not sufficient that the initially drawn sample is representative of the general population under study. The most important factor is whether the actually examined sample is representative of the population, so every effort should be undertaken to assure its representativeness.

Respondent's error

Respondents can be the source of several kinds of errors in surveys. The issue is described in detail in literature [Groves, 1989, pp. 407-445].

As the question about illegal drug use is a sensitive one, surveys on drugs, as well as on other addictive substances, often suffer from non-sampling errors due to the quality of the respondents' answers – respondents may not tell the truth about their drug use, even if the questionnaire is an anonymous one, so in effect some characteristics of drug use, for instance, the prevalence of drug use, might be underestimated [Dietz et al. 2013], [Fox 2015], [Franke et al. 2013].

In order to achieve more reliable results, more effective interviewing techniques can be used [Chaudhuri 2010]. One of them is *the Randomized Response Technique*, often applied in surveys if questions concern sensitive, socially disapproved, or incriminating behaviours. *The Randomized Response Technique* assures respondents of absolute anonymity through the procedure itself. It was developed by S.Warner (1965). As Warner's original proposal has nowadays mainly historical meaning, the idea of the procedure will be explained on the example based on R. Simmon's idea of introducing *an unrelated question* to a survey [Horvitz, Shah, Simmons 1967].

The basic principle of *the Randomized Response Technique* is that the respondent answers the sensitive question only with a certain probability, and the interviewers do not know, and have no possibility of discovering, whether the respondent answered the sensitive question or not.

The description of different randomized response techniques can be found in [Fox, Tracy 1986], [Liu, Chow 1971], [Goodstadt, Gruson 1975], [Ljungvist 1993], [Lensvelt-Mulders, Hox, Van Der Heijden 2005], [Lensvelt-Mulders et al. 2005], [Striegel, Ulrich, Simon 2009], [DeJong, Pieters, Fox 2010], [Chaudhuri 2010], [Blair, Imai, Zhou 2015a], [Blair, Zhou, Imai, 2015b], [Fox 2015], amongst others.

Summary

- Although it is to the advantage of a survey's quality to have as large a sample as possible, in the light of non-sampling errors, sometimes a better strategy is to limit the sample size and to put more attention and effort into reducing non-sampling errors in the survey.

- More effective survey methods, which may turn out to be more difficult, expensive and time-consuming, can be used only for part of the sample – to shed light on the possible underestimation level of some of the population characteristics.

Example Ic

Example Ic: Randomized response technique

Let us assume that the purpose of a study is to estimate the percentage of illegal drug users in the population.

In the survey two questions are asked:

1. The sensitive question: *Have you used any kind of illegal drugs during the last 12 months?*
2. The unrelated question: *Are you born in May?*

Then we need to introduce a randomizing device, for instance, the respondents are asked to toss a coin, but the result of the tossing is known only to the respondent.

The respondents who tossed a head answer the first, sensitive, question. The respondents who tossed the tail answer the second, unrelated, question.

The response of the respondents is only "yes" or "no". As the interviewers do not know the result of the toss of the coin, they do not know which of the two questions was answered, the sensitive one or the unrelated one.

If the sample consists of 100 persons and the randomizing device is the toss of a coin, the calculation proceeds as follows:

The probability of tossing the head of the coin is equal to the probability of tossing the tail, and they are both 0.5. So it can be assumed that out of 100 persons, 50 persons answered the first question and another 50 persons answered the second question.

As a result of the survey, 9 "yes" answers and 91 "no" answers were obtained.

As out of 50 persons, who answered the second question

$$\frac{1}{12} \cdot 50 \approx 4$$

were probably born in May, out of 9 "yes" answers 4 concerned persons born in May so
9 – 4 = 5 answers concerned drug use.

As the first question was answered by 50 persons, the estimated percentage of drug users in the population is equal to:

$$\frac{5}{50} \cdot 100 = 10\%$$

The Randomized Response Technique as well as other effective survey techniques may reduce both types of the non-sampling errors: the non-response and the respondent's error.

II. Regression in EXCEL

The detailed description of the principles of *Regression Analysis* can be found in literature [Draper, Smith 1998], [Serber, Lee 2003], [Mongomery 2012].

There may be different purposes of *the Regression Analysis*, such as:

- to explain relations among certain phenomena,
- forecasting,
- smoothing a distribution (as it was done in Chapter 3).

In regression analysis, two basic types of variables are applied:

- the dependant variable (Y), which represents the phenomena which should be explained by the analysis,
- the explanatory (independent) variables (X_j, j = 1,2,…,k), whose task is to explain the changes of Y.

Prior to proper regression analysis, two complementary operations should be performed:

- drawing scatterplots (see Chapter 3 and Annex III) for every explanatory variable versus the dependent one; the purpose is to determine the shape of relationships (linear, non-linear),
- estimating correlation coefficients for every explanatory variable and the dependent variable – to know the level and directions of relationships (positive, negative), as well as estimating correlation coefficients in the set of explanatory variables to know the level of their mutual correlation.

Some of the basics of regression analysis with the use of EXCEL Data Analysis have already been explained in Chapter 3. The purpose of Annex II is to explain the output of EXCEL regression analysis, as in Example IIa

Example IIa

Example IIa: Performing regression in EXCEL

Let us consider a linear regression equation, with one explanatory variable (*X*):

$$Y = \alpha_0 + \alpha_1 X + \varepsilon \qquad \text{(II.1)}$$

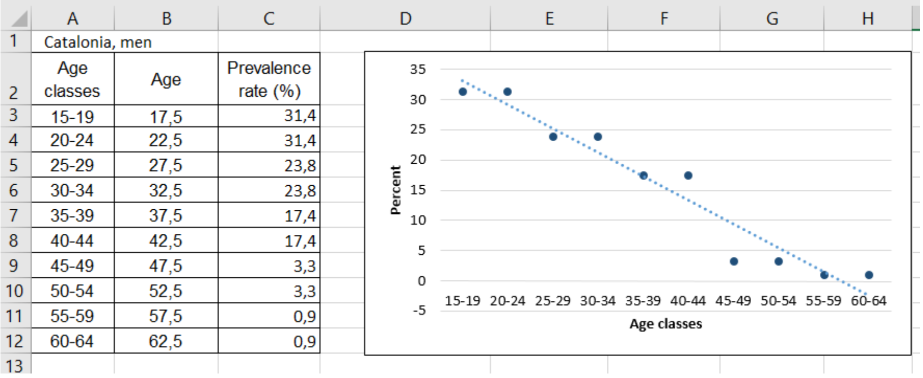
where *Y* represents the explained phenomena, α_0 and α_1 are the regression coefficients that should be estimated and ε is a random error term (stochastic disturbance).

In the following example the dependent variable (*Y*) is the *Prevalence rate* (%) of drug use in the population of Catalonian men.

The independent variable (*X*) is *Age*, measured in the middle of the age groups.

The purpose is to determine the relation between *Age* and *Prevalence rate* in the population of Catalonian men, i.e. to estimate the values of the regression coefficients α_0 and α_1 of equation II.1 and to verify whether regression results are of acceptable quality.

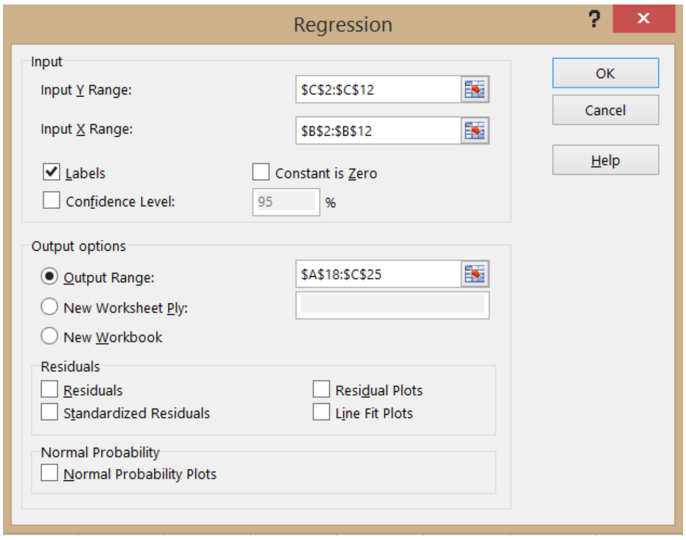
As the graph (a scatterplot) indicates the relation (*X, Y*) can be regarded as a linear one.



	A	B	C
1	Catalonia, men		
2	Age classes	Age	Prevalence rate (%)
3	15-19	17,5	31,4
4	20-24	22,5	31,4
5	25-29	27,5	23,8
6	30-34	32,5	23,8
7	35-39	37,5	17,4
8	40-44	42,5	17,4
9	45-49	47,5	3,3
10	50-54	52,5	3,3
11	55-59	57,5	0,9
12	60-64	62,5	0,9
13			

Source of data: Program on Substance Abuse. Public Agency of Government of Catalonia, Data for Catalonia elaborated from the National Household EDADES Survey on Drugs from the National Drug Plan (2011) - 15 a 64 years.

In the Data Analysis – Regression the proper cells are marked:



Regression

Input

Input Y Range: $C$2:$C$12

Input X Range: $B$2:$B$12

☑ Labels ☐ Constant is Zero

☐ Confidence Level: 95 %

Output options

● Output Range: $A$18:$C$25

○ New Worksheet Ply:

○ New Workbook

Residuals

☐ Residuals ☐ Residual Plots

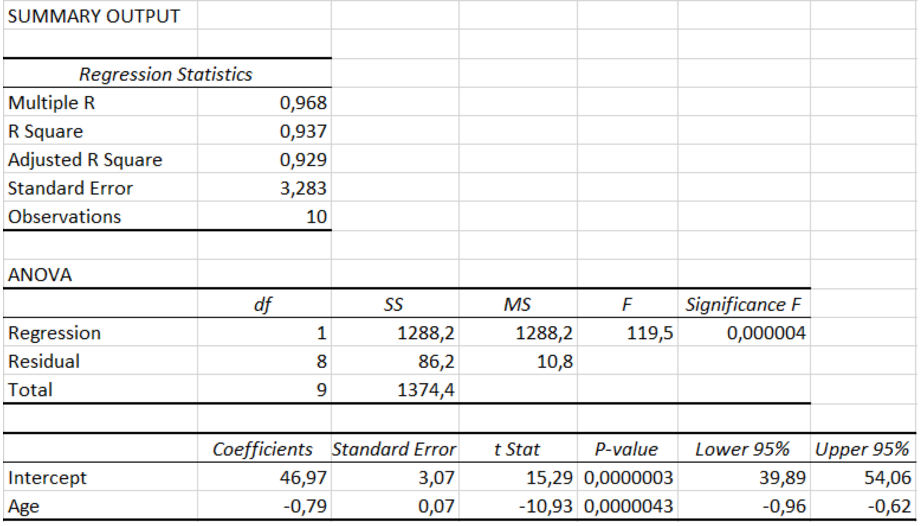
☐ Standardized Residuals ☐ Line Fit Plots

Normal Probability

☐ Normal Probability Plots

Example IIa

and the output is:



SUMMARY OUTPUT						
Regression Statistics						
Multiple R	0,968					
R Square	0,937					
Adjusted R Square	0,929					
Standard Error	3,283					
Observations	10					
ANOVA						
	df	*SS*	*MS*	*F*	*Significance F*	
Regression	1	1288,2	1288,2	119,5	0,000004	
Residual	8	86,2	10,8			
Total	9	1374,4				
	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*
Intercept	46,97	3,07	15,29	0,0000003	39,89	54,06
Age	-0,79	0,07	-10,93	0,0000043	-0,96	-0,62

Interpretation

Multiple R – it informs whether the relationship between the set of explanatory variables and the dependent one is either a weak or a strong one. In this case there is only one explanatory variable (*Age*) and the relationship between *Age* and *Prevalence rate* is very strong.

R Square – the *Coefficient of Determination* informs what percentage of the variance of the dependent variable is explained by the estimated regression equation. Here nearly 94% of *Prevalence rate* variation can be explained by changes in *Age*.

Adjusted R Square – it is interpreted as *the R Square*. The measure is used when a sample is small and there are many regression parameters to estimate.

Standard Error – it informs about the average distance of empirical observations to the regression line or to multi-dimensional shape. Here it can be stated that observations are on average 3.283% distant from the regression line. As the value of the *Standard Error* depends on the units of measurement of the dependant variable as well as on the distances, it does not say whether the average distance is a big or a small one.

Observations – it means the number of observations applied in the estimation.

In the second table (ANOVA) the most important information is in columns 5 and 6, where the hypothesis about the *Multiple R* (R_w) is tested with the use of test F.

As *the Coefficient of Determination* R^2 is a squared value of the *Multiple R* (R_w), the results of testing also indicate whether *the Coefficient of Determination* is statistically significant.

We verify the null hypothesis $H_0 : \mathrm{R_w} = 0$ against the hypothesis $H_1 : \mathrm{R_w} > 0$.

The test statistic *F* is defined as:

$$F = \frac{R_w^2}{1-R_w^2} \cdot \frac{n-k}{k-1} \qquad \text{(II.2)}$$

where *n* is the number of the observations and *k* – the number of estimated regression coefficients.

To state whether or not the null hypothesis should be rejected, we consider the probability called *the Significance F* in EXCEL (6th column).

This value is interpreted here as follows: if the null hypothesis $H_0: R_w = 0$ is true, the probability that the test statistic F is equal to 119.5 is 0.000004. This is a very low probability, so it is hardly probable that the null hypothesis H_0 is true. In effect, we reject the null hypothesis H_0, which means that neither R_w nor R^2 is equal to zero, and practically they are both statistically significant, so regression results with reference to these both measures can be accepted.

Practical advice

In practice, we choose a certain probability called *the level of significance* α, usually of values: 0.1, 0.05, 0.01, 0.005, 0.001.

With the chosen *level of significance* $\alpha = 0.05$, we reject the null hypothesis H_0 if *the Significance F* is equal to or smaller than 0.05, and do not reject the hypothesis if the probability, called in EXCEL *the Significance F*, is higher than 0.05.

In the third table, the second column gives the values of estimated regression coefficients. The most important is the estimate of α_1 called *Age* in the table.

The interpretation of the estimated value of the coefficient α_1 is in this case: if the value of variable *Age* increases by one unit (a year) the value of *Prevalence rate* will decrease, on average, by 0.79%.

In columns 4 and 5 of the third table, the hypothesis about the significance of the regression coefficients α_0 and α_1 is verified; Student's *t*-test is applied.

In general, we verify the null hypothesis $H_0 : \alpha_j = 0$ $(j = 1,2,\dots,k)$ against the hypothesis:
$H_1 : \alpha_j \neq 0$ or $H_1 : \alpha_j > 0$ or $H_1 : \alpha_j < 0$.

The test statistic t is defined as:

$$t = \frac{a_j}{d(a_j)} \tag{II.3}$$

where a_j is the estimated value of the regression coefficient a_j (column 2), and $d(a_j)$ is its standard error of estimation (column 3).

To decide whether the null hypothesis ($H_0 : \alpha_j = 0$) should be rejected or not, similarly, as in the case of test F, we consider the probability now called in EXCEL *P-value* (5th column).

The interpretation of the probability value in the case of the coefficient standing by the variable *Age* (α_1) is as follows: if the null hypothesis ($H_0 : \alpha_1 = 0$) is true, the probability that the test statistic t is equal to (-10.93) is 0.0000043. Again, it is a very small probability, so assuming *the level of significance* $\alpha = 0.05$ we reject the hypothesis that the coefficient $\alpha_1 = 0$. This means that the variable *Age* is statistically significant and can be accepted in the regression equation[23].

In columns 6 and 7, the confidence intervals for the regression coefficients, $\gamma = 0.95$ are presented.

The estimated regression equation II.1 should be written down as follows:

---

[3] Sometimes Student's *t*-test results may not be conclusive. It happens when multicollinearity of independent variables occurs, that is in the case when the independent variables are highly correlated, as in Example 4a. More about multicollinearity of independent variables can be found in [Maddala 2001, Chapter 7].

$$\hat{y} = 46.97 - 0.79x \qquad R^2 = 0.937 \qquad \text{(II.4)}$$

$$(-10.53)$$

so, apart from the estimated values of regression coefficients (46.97, -0.79), also the value of the coefficient of determination should be shown (0.937), and beneath the equation, in brackets, the value of the test *t* statistics for the explanatory variable *Age* (-10.53); the appropriate value for the Intercept can be omitted.

Summary

The estimated regression equation II.4 is well fitted to empirical data. The coefficient of determination R^2 has a high value and is statistically significant. The explanatory variable Age is also significant and can be accepted in the equation.

III. Creating charts in EXCEL

A proverb says: *A picture is worth a thousand words*.

Not only do charts attract attention of the reader, but they can also present the results of the study more clearly, therefore they should be added to the presentation of the results of the estimation of the social costs of illegal drug use. Beneath it is explained how to create charts that could be particularly useful for the purpose. The types recommended for time-series data are lines or columns. The relationship of two variables is best presented in scatterplots, while the structure is particularly well illustrated with pies or columns.

***Content* (with quicklinks):**

- ***Chart 1. Lines***
- ***Chart 2. Columns (diagrams)***
- ***Chart 3. Scatterplot***
- ***Chart 4. Pie***

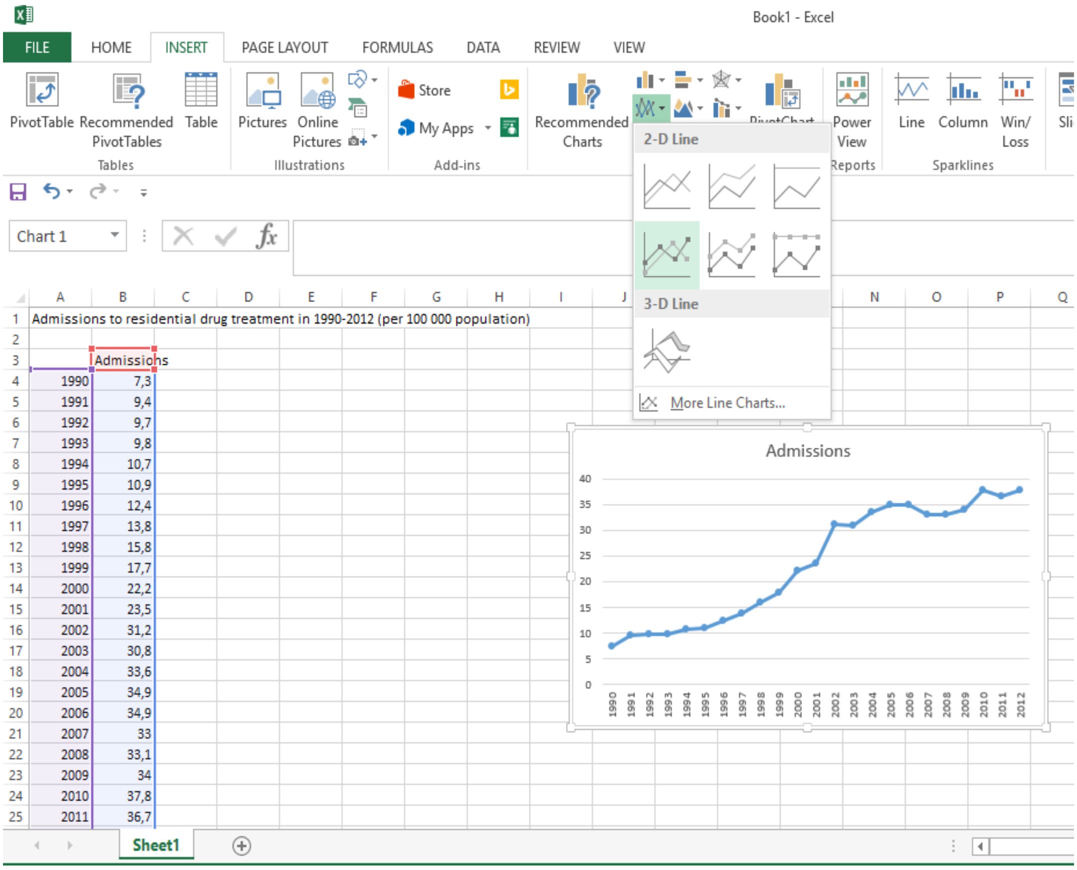
Chart 1. Lines

To create a line chart in Excel we need to select the data given in columns.

The first column is placed in a category name (horizontal axis).

When the data is marked, we go to the "insert" and select the chart.

Screenshot III.1 Choice of type of chart



Admissions to residential drug treatment in 1990-2012 (per 100 000 population)

	Admissions
1990	7,3
1991	9,4
1992	9,7
1993	9,8
1994	10,7
1995	10,9
1996	12,4
1997	13,8
1998	15,8
1999	17,7
2000	22,2
2001	23,5
2002	31,2
2003	30,8
2004	33,6
2005	34,9
2006	34,9
2007	33
2008	33,1
2009	34
2010	37,8
2011	36,7

There are 8 basic graphs to choose from with the cursor position.

The chart options can be changed by clicking the "+" button in the upper right-hand corner.

Screenshot III.2: Adding axis titles

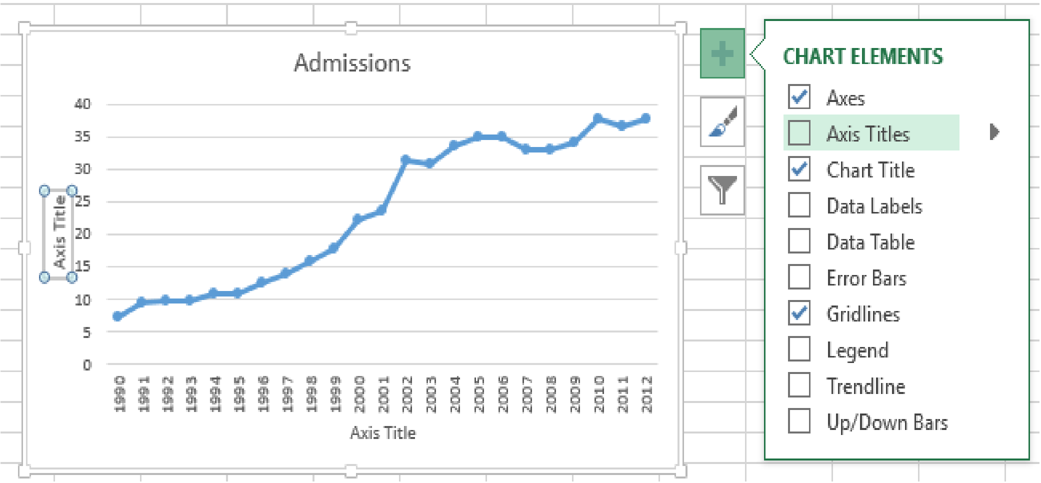


CHART ELEMENTS

☑ Axes
☐ Axis Titles
☑ Chart Title
☐ Data Labels
☐ Data Table
☐ Error Bars
☑ Gridlines
☐ Legend
☐ Trendline
☐ Up/Down Bars

To change the type of a chart you need to click the right mouse button and select: “Change Series Chart Type…”.

Screenshot III.3.Possibility of changing type of chart

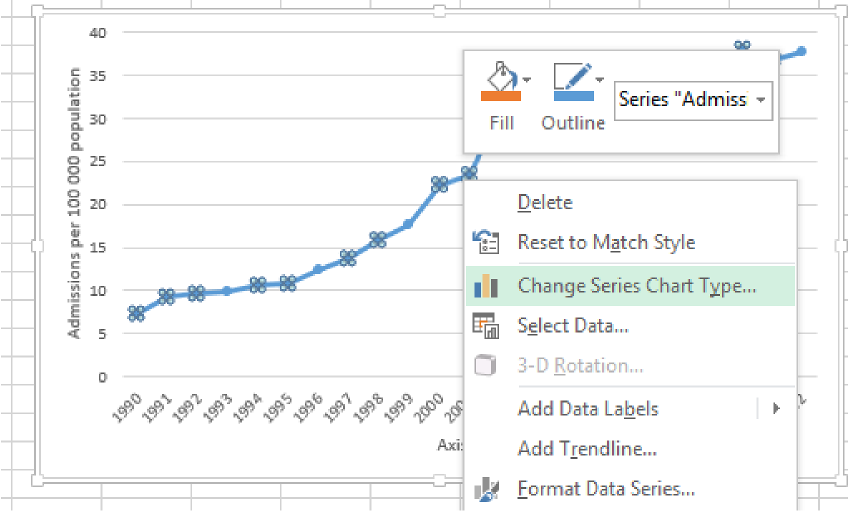
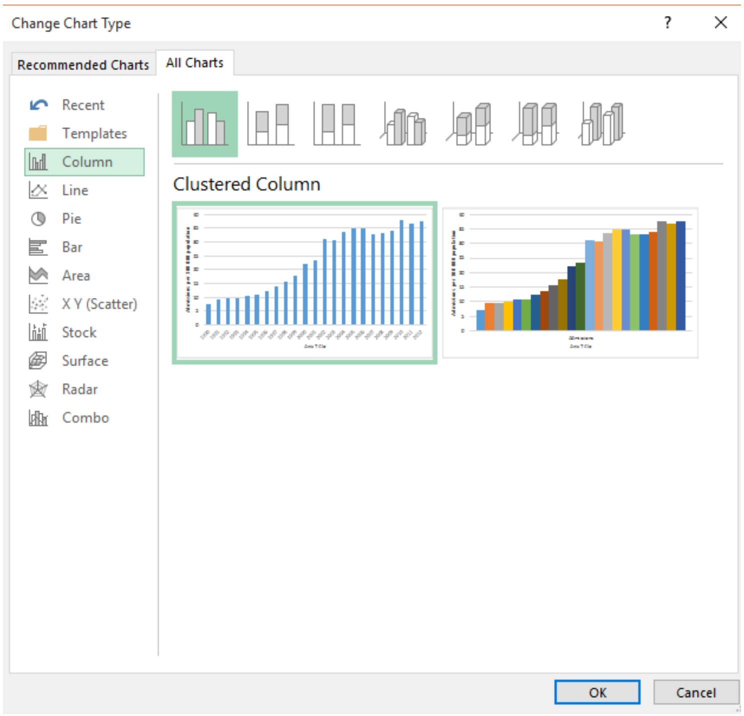


Chart 2. Columns (diagram)

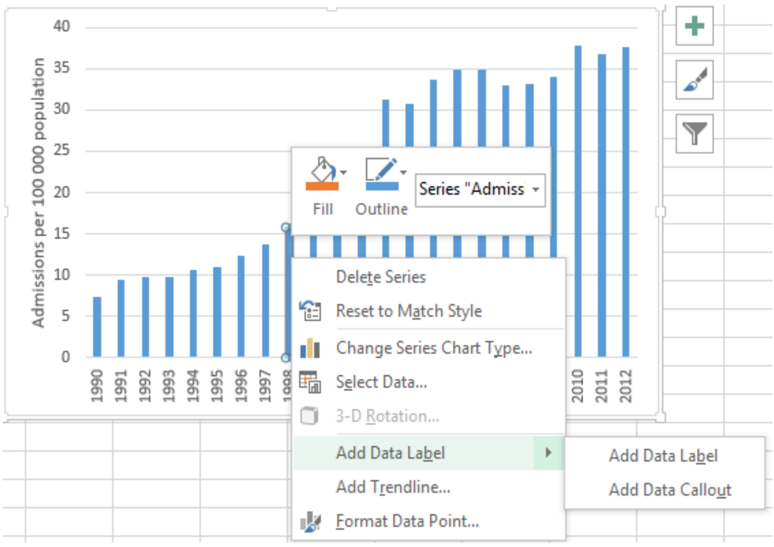
Based on the same data, a column chart can be created as follows:

Screenshot III.4: Choice of column chart

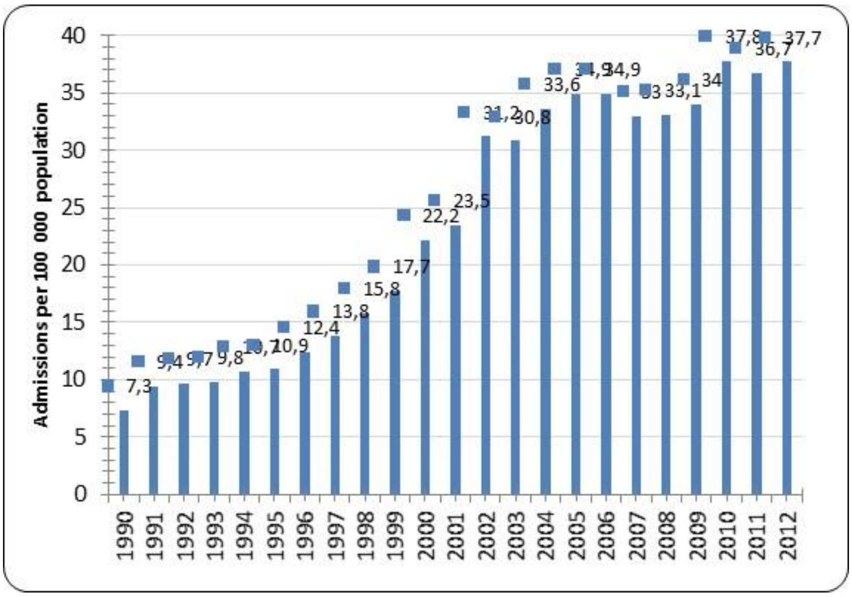


To add data labels into the diagram, we press the right mouse button and select: "Add Data Label"

Screenshot III.5: Introducing data labels

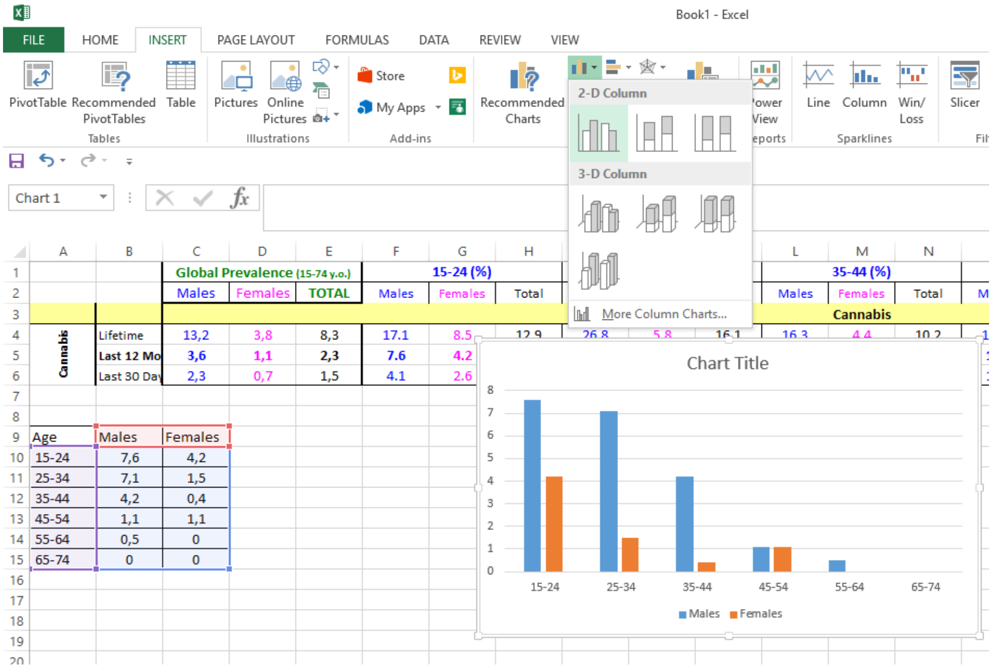


The result:



If we mark more than one data column we will receive the graph for more than one variable

Screenshot III.6: Creating graph for two variables



	A	B	C	D	E	F	G	H
1			Global Prevalence (15-74 y.o.)			15-24 (%)		
2			Males	Females	TOTAL	Males	Females	Total
3								
4	Cannabis	Lifetime	13,2	3,8	8,3	17.1	8.5	12.9
5		Last 12 Mo	3,6	1,1	2,3	7.6	4.2	
6		Last 30 Day	2,3	0,7	1,5	4.1	2.6	

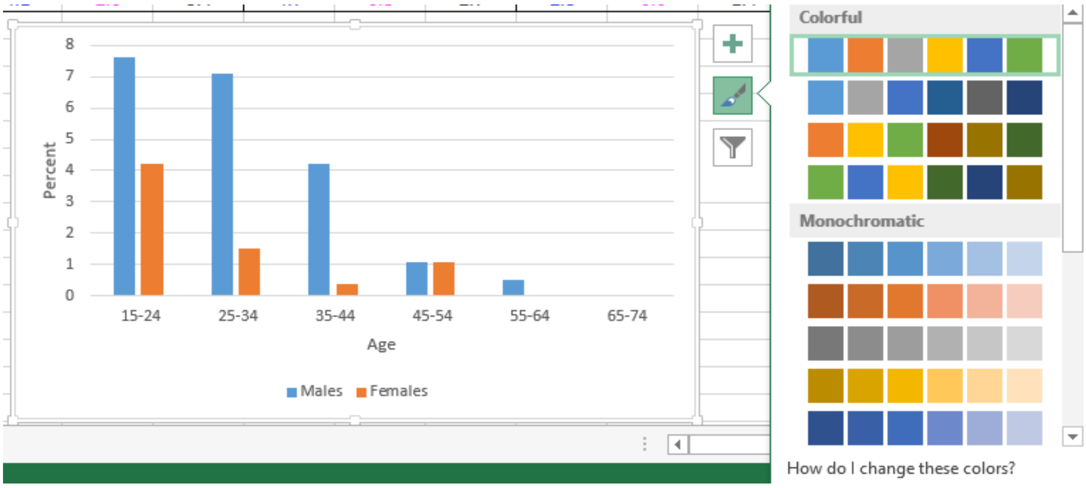
	L	M	N
1	35-44 (%)		
2	Males	Females	Total
3		Cannabis	
4	16.3	4.4	10.2

	A	B	C
9	Age	Males	Females
10	15-24	7,6	4,2
11	25-34	7,1	1,5
12	35-44	4,2	0,4
13	45-54	1,1	1,1
14	55-64	0,5	0
15	65-74	0	0

It is also possible to change the appearance of the graph and its colours by clicking on an appropriate icon in the top right-hand corner of the chart.

Some examples:

Screenshot III.7.Changing colors in graph



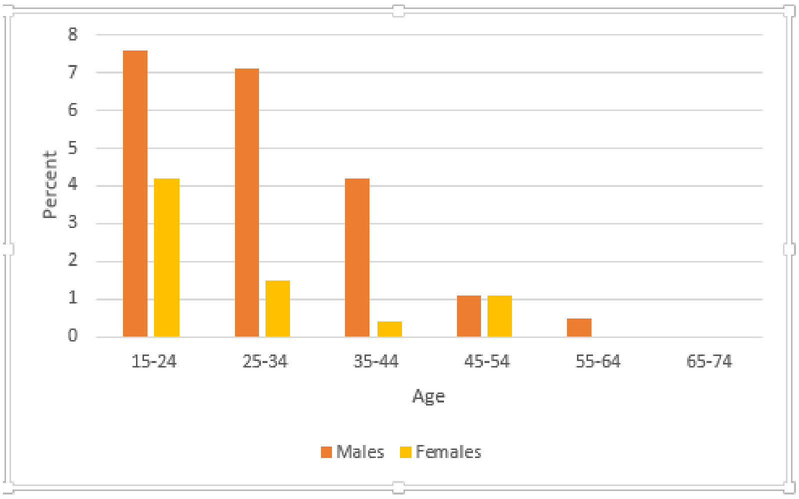
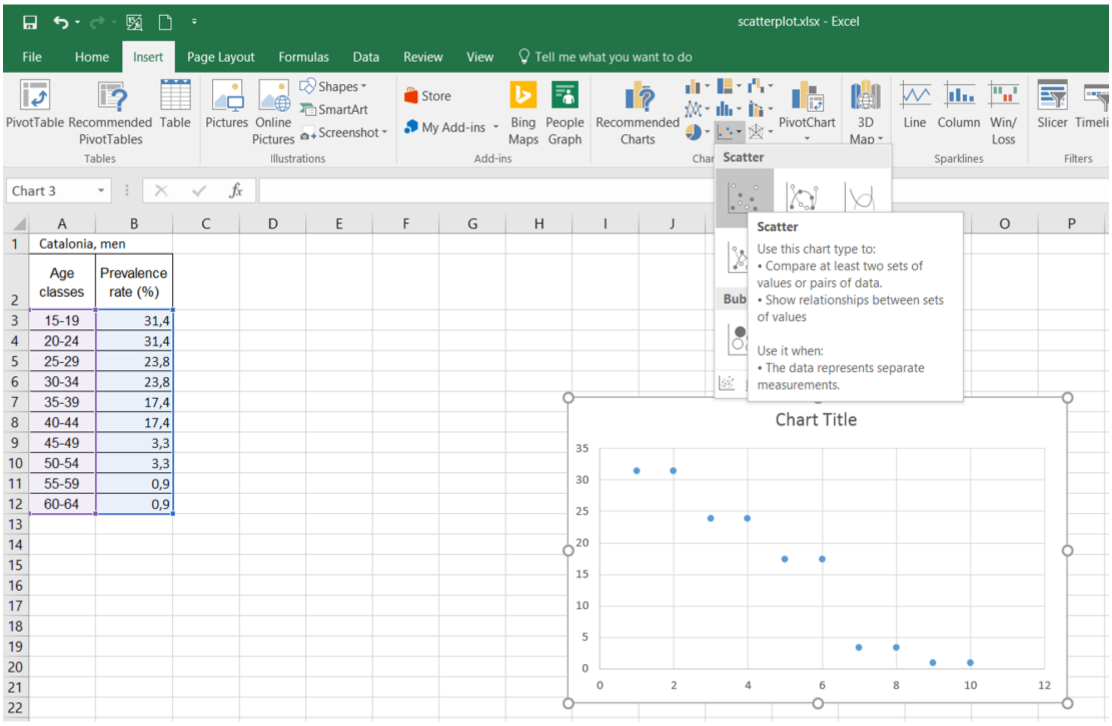


Chart 3. Scatterplot

Scatterplots are used to show the relationship between two variables, which is especially needed in *Regression Analysis*.

Additionally, a trend line can be inserted, to better illustrate the relationship. A trend line can also be added to other charts, such as a line chart or a column chart.

Screenshot III.8: Creating a scatterplot



Catalonia, men

Age classes	Prevalence rate (%)
15-19	31,4
20-24	31,4
25-29	23,8
30-34	23,8
35-39	17,4
40-44	17,4
45-49	3,3
50-54	3,3
55-59	0,9
60-64	0,9

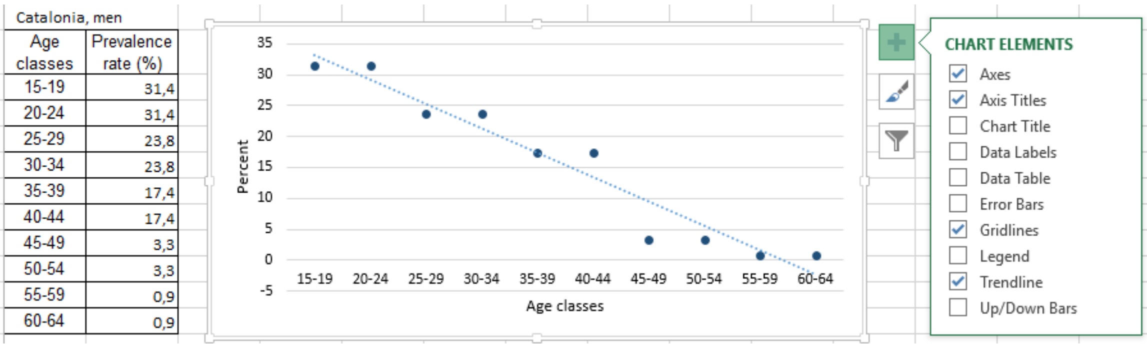
Scatter

Use this chart type to:
- Compare at least two sets of values or pairs of data.
- Show relationships between sets of values

Use it when:
- The data represents separate measurements.

The result:

Screenshot III.9 Adding a trend line



Catalonia, men

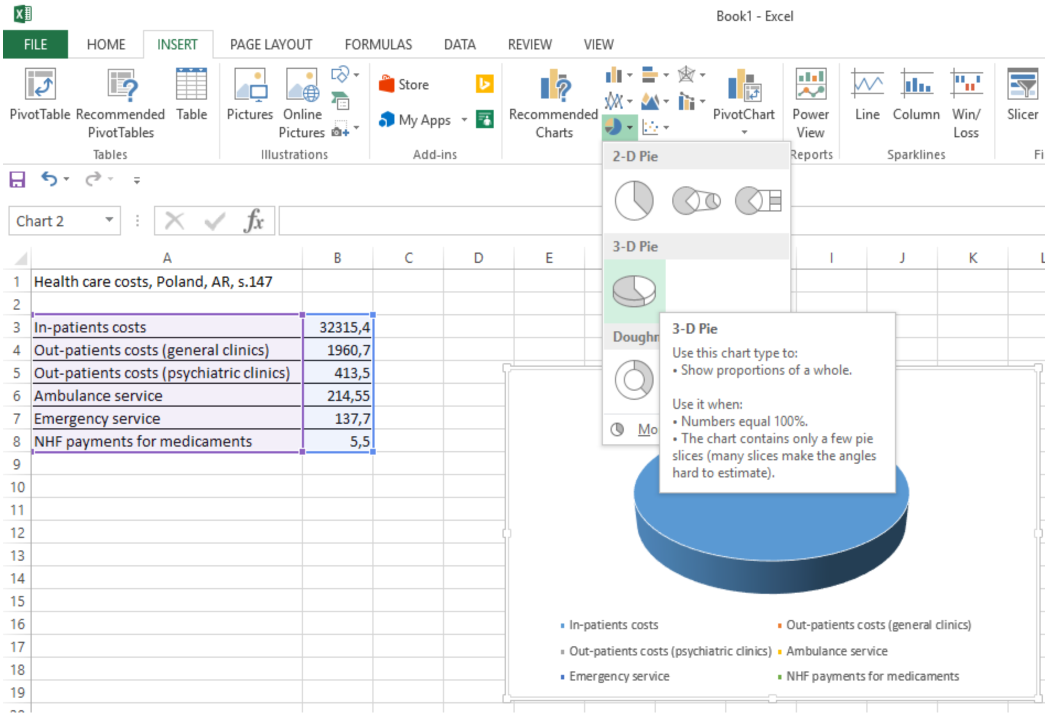
Age classes	Prevalence rate (%)
15-19	31,4
20-24	31,4
25-29	23,8
30-34	23,8
35-39	17,4
40-44	17,4
45-49	3,3
50-54	3,3
55-59	0,9
60-64	0,9

CHART ELEMENTS
- ☑ Axes
- ☑ Axis Titles
- ☐ Chart Title
- ☐ Data Labels
- ☐ Data Table
- ☐ Error Bars
- ☑ Gridlines
- ☐ Legend
- ☑ Trendline
- ☐ Up/Down Bars

Chart 4. Pie

If data sum up to 100%, the most appropriate chart to present them is a pie.

Screenshot III.10: Creating a pie chart



	A	B
1	Health care costs, Poland, AR, s.147	
2		
3	In-patients costs	32315,4
4	Out-patients costs (general clinics)	1960,7
5	Out-patients costs (psychiatric clinics)	413,5
6	Ambulance service	214,55
7	Emergency service	137,7
8	NHF payments for medicaments	5,5

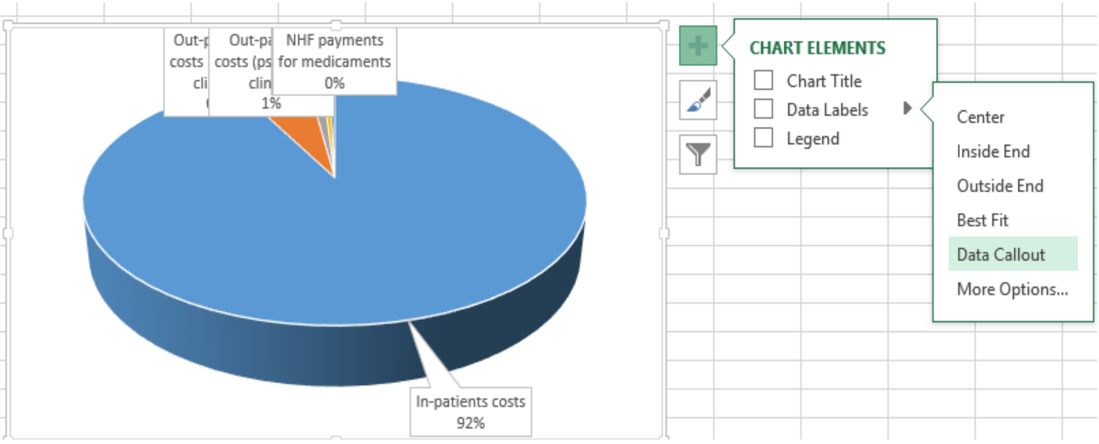
3-D Pie

Use this chart type to:
- Show proportions of a whole.

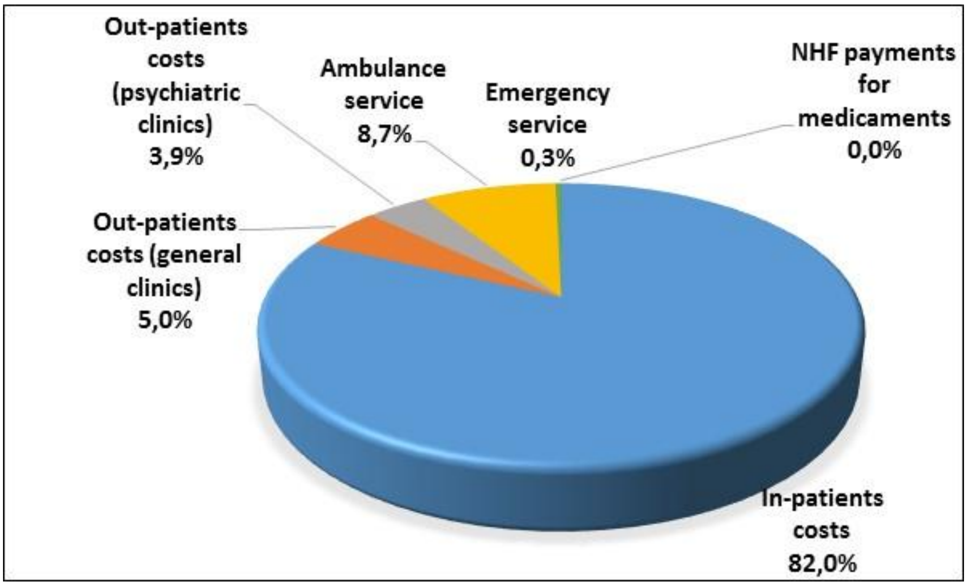
Use it when:
- Numbers equal 100%.
- The chart contains only a few pie slices (many slices make the angles hard to estimate).

As before, changes can be made by clicking the appropriate icon in the top right-hand corner of the chart.

Screenshot III.11: Adding data labels



The result:


Out-patients costs (psychiatric clinics) 3,9%
Ambulance service 8,7%
Emergency service 0,3%
NHF payments for medicaments 0,0%
Out-patients costs (general clinics) 5,0%
In-patients costs 82,0%

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References

Content (with quicklinks)_:_
- ***Scientific and grey literature***
- ***Websites and digital resources***

Scientific and grey literature

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http://www.drugs.ie/resourcesfiles/ResearchDocs/Europe/Research/2008/TDSI08001ENC_WEB.pdf

http://www.emcdda.europa.eu/stats11/drd/methods

http://www.emcdda.europa.eu/attachements.cfm/att_143682_EN_TDSI11001ENC.pdf

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