

Risk analysis of major transport investment projects, co-financed with EU funds

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European
Investment
Bank



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for Reconstruction and Development

A. Introduction

- Definition of basic terms
- EU requirements regarding risk analysis
- JASPERS role in this respect

B. Methodological explanations

- Basic statistical concepts
- Sources of data
- Key elements of methodology
- Necessary tools

C. Application and interpretation

- Case study

INTRODUCTION

Basic terms

- Risk: the possibility of an event occurring that will have an impact on the achievement of objectives. The future is uncertain, so there is always a degree of risk. Risk is measured in terms of impact and likelihood.
- Risk analysis (our context): deals with probability with which the impact of given percentage changes in a variable may occur and its consequences for project's performance indicators. Risk analysis (RA) is one of the corner-stones of CBA; supplements deterministic calculation of NPV and IRR.
- Sensitivity analysis: % change in “critical” variables, but this change may not be consistent with the variables' potential variability (var. “switching values”).

INTRODUCTION

Basic terms

- Risk management: identification, assessment and handling of risks.
- This can include:
 - a) risk retention (accepting the risk),
 - b) risk reduction,
 - c) risk avoidance (not doing something risky),
 - d) risk transfer (e.g. PPP, insurance).
- RA most useful in early stages, when uncertainties are the largest but also the manoeuvring space or options to deal with the risk are still available.
- Impact of risks on our decisions:

INTRODUCTION

EU requirements – Formal

- Article 40 of EC Regulation No. 1083/2006:
The Member State or the managing authority shall provide the Commission with the following information on major projects:

...
a cost-benefit analysis, including a risk assessment and the foreseeable impact on the sector concerned and on the socio-economic situation ...

INTRODUCTION

EU requirements – Guide to CBA (2008)



- Definition: studying the probability of satisfying performance, as well as variability of the result, compared to the estimate made.
- Procedure: first sensitivity, then study probability distribution of the most critical variables, calculate the risk, assessment of acceptable risk and risk prevention.
- Methodological hints: Monte Carlo simulation for simultaneous treatment of multiple risks; data sources (statistical surveys, experimental studies, literature, the Delphi method; typically to facilitate the Delphi method a triangular probability distribution is used).

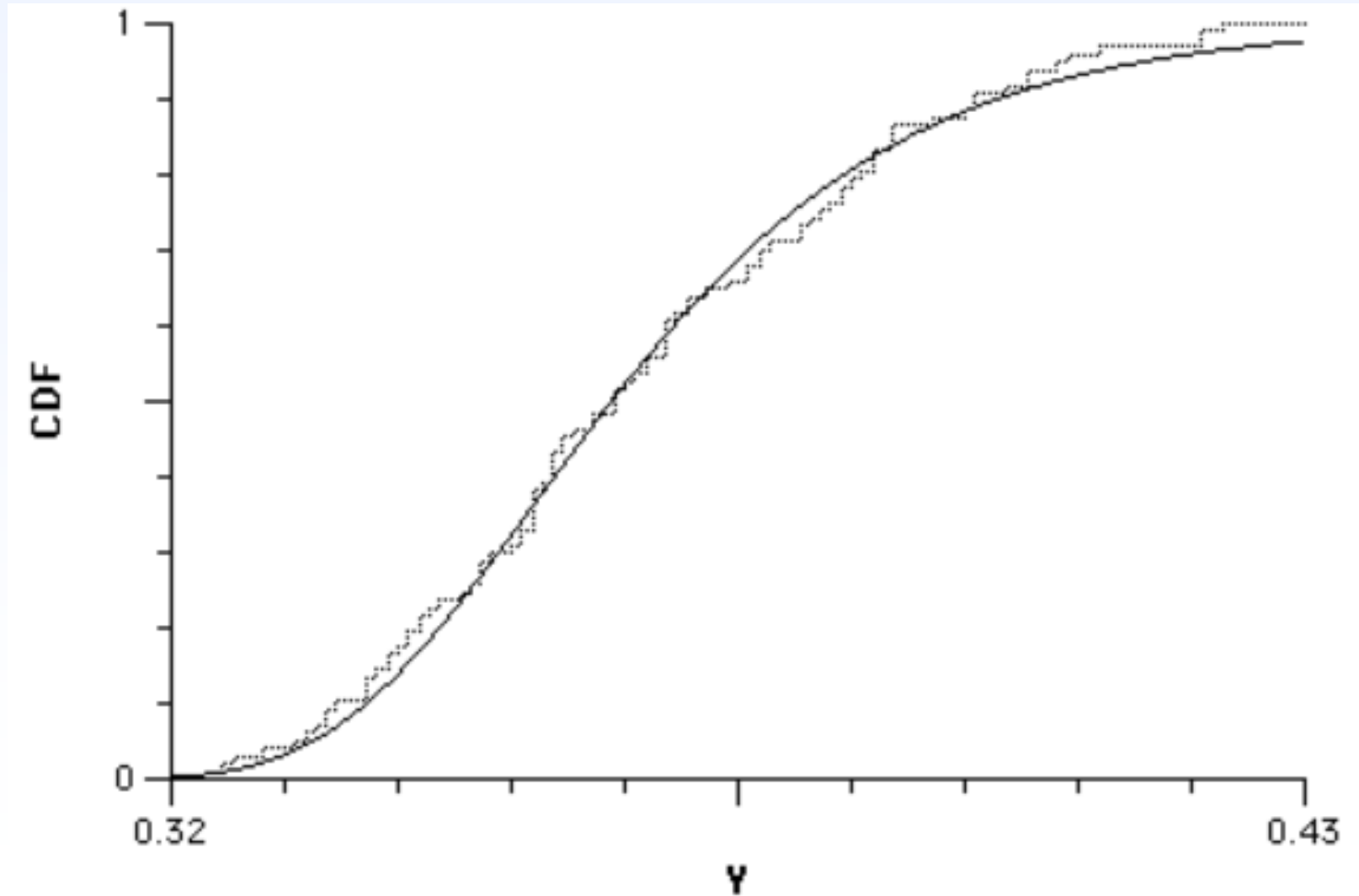
INTRODUCTION

EU requirements – WD 4 (2006)

- Definition: assessment of probability with which changes in variables may occur. By assigning appropriate probability distributions to the critical variables, probability distributions for the financial and economic performance indicators can be estimated.
- No new methodological suggestions.
- Links RA with eligibility of contingencies: those can only be included as eligible cost if the proposed project is supported by a detailed risk analysis.

METHODOLOGICAL EXPLANATIONS

Basic statistical concepts



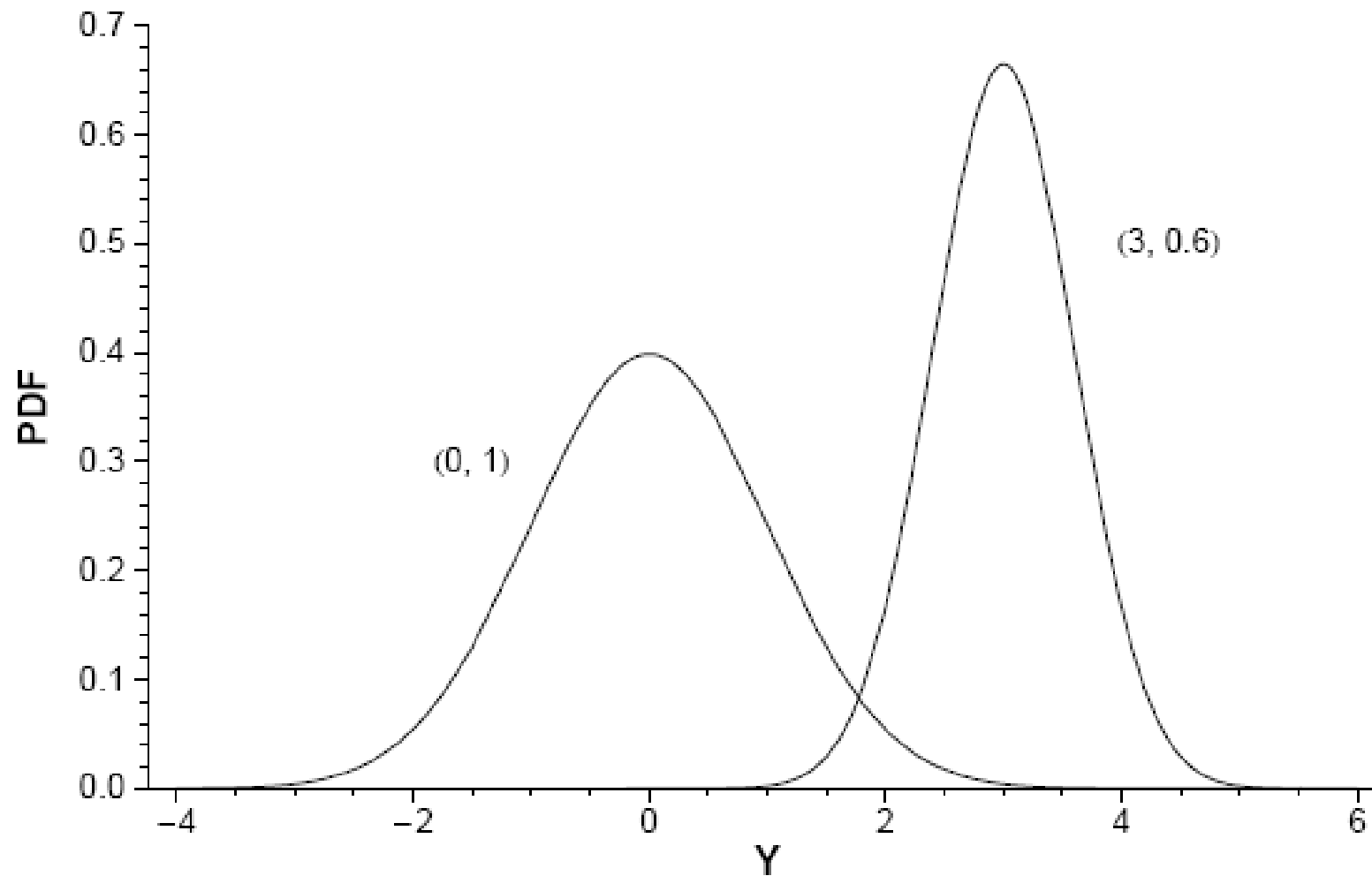
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METHODOLOGICAL EXPLANATIONS

Basic statistical concepts

Normal(A,B)

$B > 0$



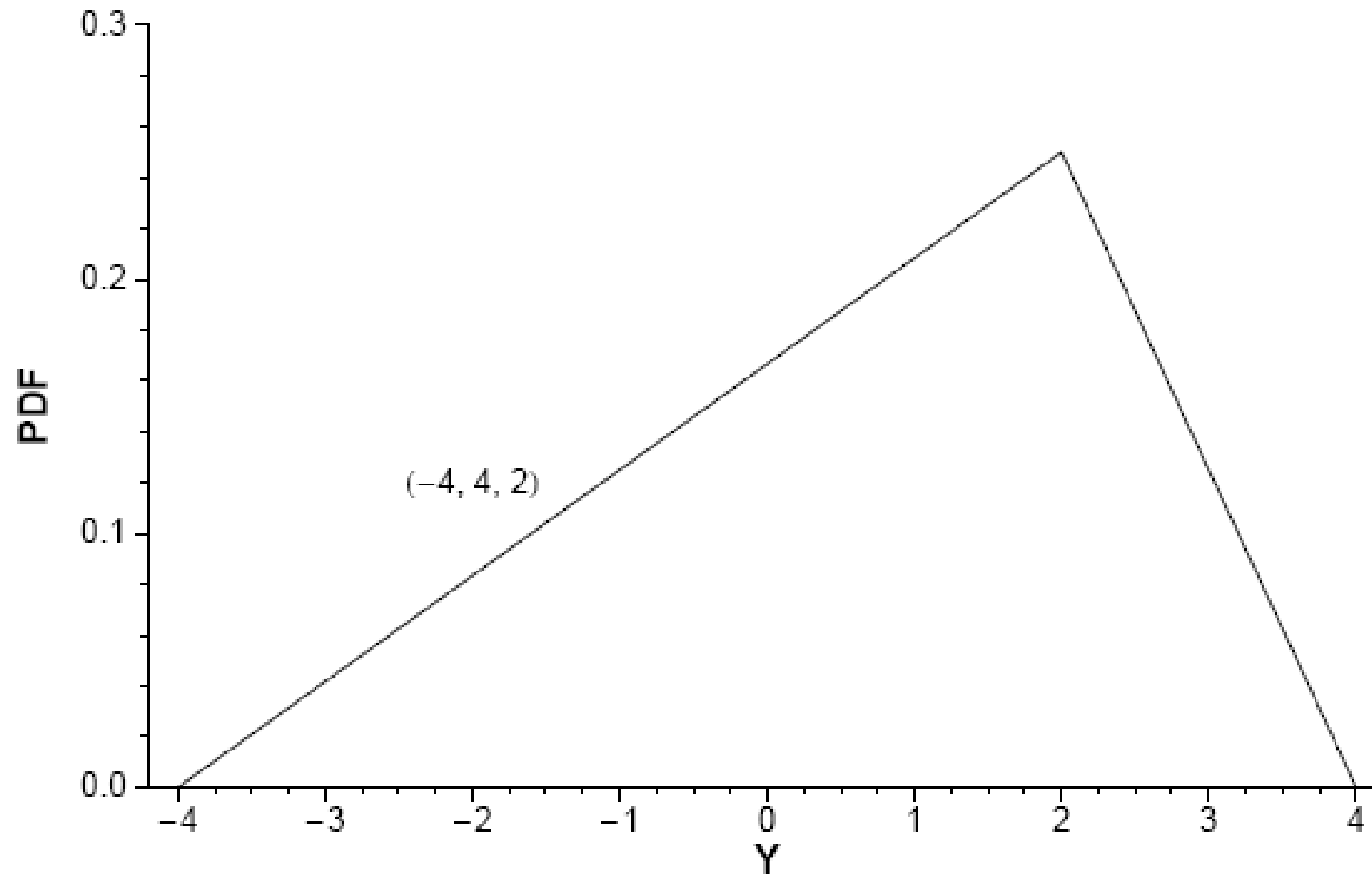
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METHODOLOGICAL EXPLANATIONS

Basic statistical concepts

Triangular(A,B,C)

$A < y, C < B$



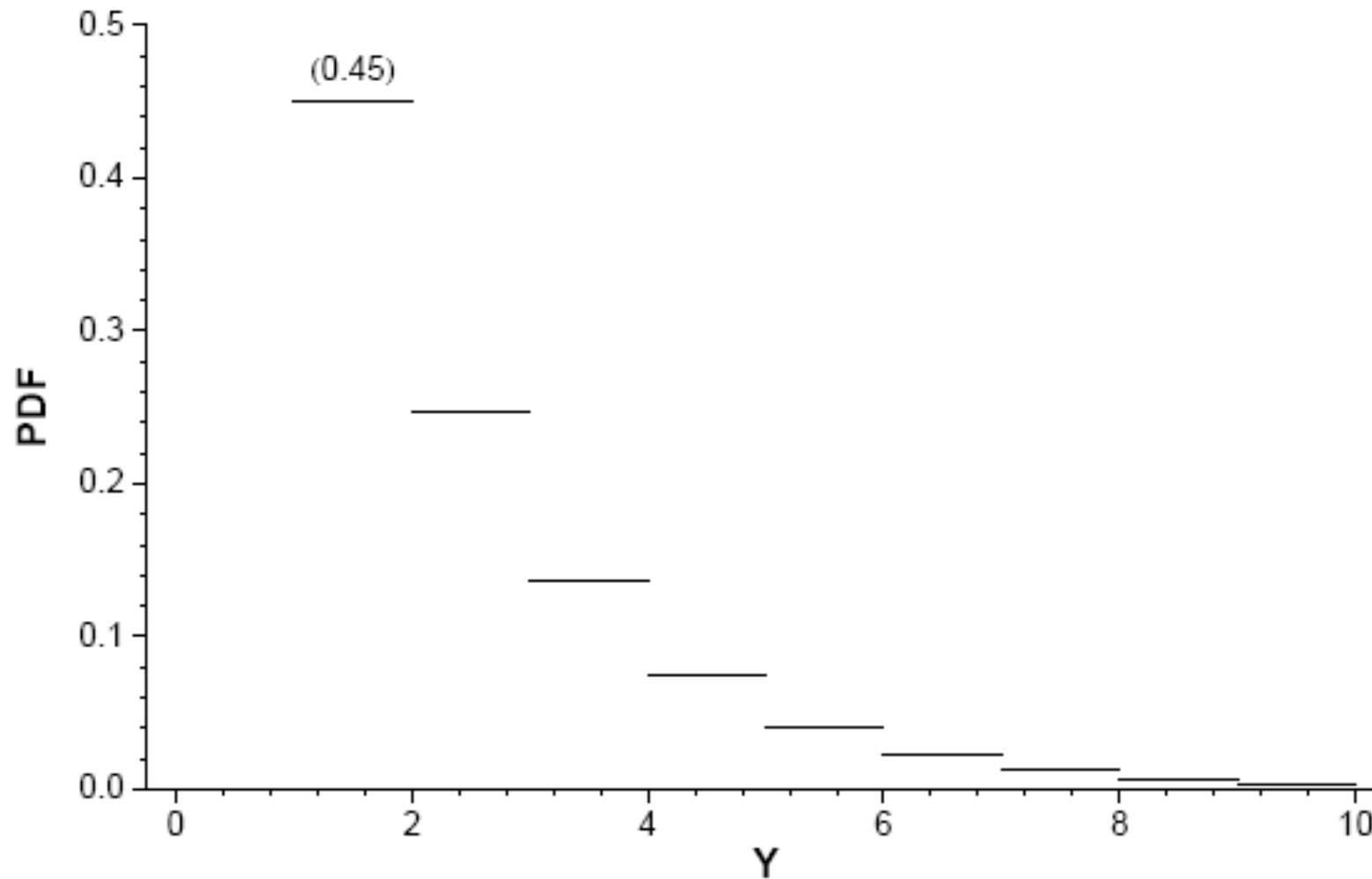
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METHODOLOGICAL EXPLANATIONS

Basic statistical concepts

Geometric(A)

$$y = 1, 2, 3, \dots, \quad 0 < A < 1$$



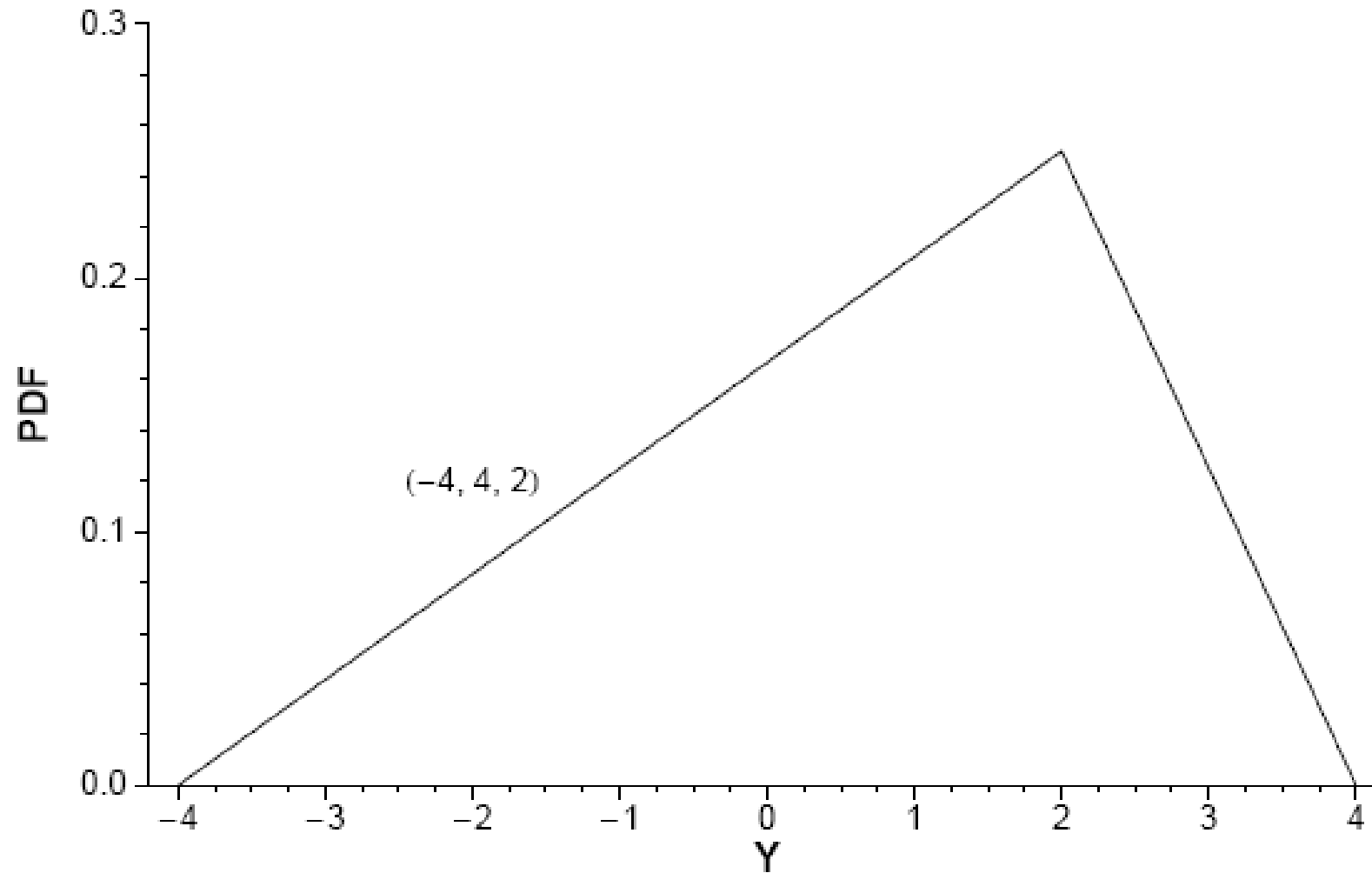
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METHODOLOGICAL EXPLANATIONS

Basic statistical concepts

Triangular(A,B,C)

$A < y, C < B$



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METHODOLOGICAL EXPLANATIONS

Sources of data

- Statistical surveys
- Experimental studies
- Literature (transfer from other countries or sectors)
- Delphi method
- Other

METHODOLOGICAL EXPLANATIONS

Monte Carlo

- Only in simplest cases (with 2 to 3 variables, which can assume up to 3 values) it is possible to use tabular analytical techniques.
- Monte Carlo: because it replicates the random occurrence of values for certain variable, under given probability distribution (as in gambling).
- Used in banks, production companies, marketing, etc.
- Computer tools (Excel, specialised software: Palisade @Risk, Decisioneering Crystal Ball, other).

METHODOLOGICAL EXPLANATIONS

Key elements

1. RA relates to impacts of risks on ENPV and FNPV.
2. Estimation of probability for risk occurrence and possible range of risk (expected, min, max) is carried out by a panel of experts. Value of risks is expressed in monetary terms (to assess impact on ENPV).
3. To facilitate this a non-symmetric triangular probability distribution is used.
4. A pre-defined list of risks is used.
5. Monte Carlo simulation (in Excel) for calculation.
6. Report.

APPLICATION

Risk inventory

1. Planning and administrative risks

| No. | Risk | Description/comments |
|-----|---------------------------------------|--|
| 1.1 | Building permit acquisition | Delay in building permit acquisition can lead to loss of expected benefits of the project. If partial building permits are issued missing permit can cause unnecessary overhead on the construction site. To be expressed in months of delays. |
| 1.2 | Utilities (and other) approvals | Electricity, gas, water, sewers, telephone. To be expressed in months of delays. |
| 1.3 | Changes in environmental requirements | E.g. additional noise protection (installation of sound proof windows in the affected area). To be expressed in monetary terms. |

2. Land acquisition risks

| No. | Risk | Description/comments |
|-----|---------------------------------------|--|
| 2.1 | Cost of land | Inaccurate cost estimates in the planning phase. To be expressed in monetary terms. |
| 2.2 | Delays of land purchasing | Unknown owners, incomplete cadastre, etc., disputes over price. To be expressed in months of delays. |
| 2.3 | Additional requirements | More land needed than initially planned. To be expressed in monetary terms. |
| 2.4 | Land for temporary access to the site | Land necessary to facilitate not adequately planned. To be expressed in monetary terms. |

APPLICATION

Risk inventory

3. Design risks

| No. | Risk | Description/comments |
|-----|---|---|
| 3.1 | Inadequate site surveys and investigation | Incorrect assumptions about ground material, groundwater conditions, etc. can lead to higher design cost due to necessary design improvements and updates. To be expressed in monetary terms. |
| 3.2 | Changes in the requirements | Profile, intersections, connections to existing roads, drainage. To be expressed in monetary terms. |
| 3.3 | Inadequate design cost estimates | Inaccurate cost estimates in the planning phase. To be expressed in monetary terms. |

APPLICATION

Risk inventory

4. Construction risks

| No. | Risk | Description/comments |
|------|---|--|
| 4.1 | Inadequate construction cost estimates | Inaccurate cost estimates in the planning phase (before tendering) due to inaccurate rates and/or quantities and inflation. To be expressed in monetary terms. |
| 4.2 | Cost overruns | More work, additional work needed. To be expressed in monetary terms. |
| 4.3 | Inadequate construction quality | Remedial works cost. To be expressed in monetary terms. |
| 4.4 | Flooding, land slides and similar | Causing delays and higher cost due to damage to works already carried out. To be expressed in monetary terms. |
| 4.5 | Archaeological findings | Causing delays, additional cost (e.g. six months of archaeological team engagement). To be expressed in monetary terms. |
| 4.6 | Inadequate supervision cost estimates | Inaccurate cost estimates in the planning phase. To be expressed in monetary terms. |
| 4.7 | Inadequate temporary works cost estimations | Inaccurate cost estimates in the planning phase due to inaccurate scope and scale of temporary works. To be expressed in monetary terms. |
| 4.8 | Contractor's bankruptcy | Can cause cost of delay. To be expressed in months of delays. |
| 4.9 | Contractor's resources | Contractor's inability to assure competent staff and materials can cause delay. To be expressed in months of delays. |
| 4.10 | Public procurement | Can cause delays due to appeals, repeated procedures etc. To be expressed in months of delays. |

APPLICATION

Risk inventory

5. Other risks

| No. | Risk | Description/comments |
|-----|--------------------------|--|
| 5.1 | Protester action | Can cause delays and damage. To be expressed in monetary terms. |
| 5.2 | Change of strategy | Can cause loss of already invested funds. To be expressed in monetary terms. |
| 5.3 | Introduction of tolls | Can cause toll evasion and thus lower the expected benefits. To be expressed in % of traffic. |
| 5.4 | Lack of national finance | Can cause delays. To be expressed in months of delays. |
| 5.5 | Traffic | Unexpected variation in traffic flows from those predicted can cause changes in expected benefits. To be expressed in % of traffic |

APPLICATION

Risk assessment sheet

Risk assessment sheet (example)

Evaluation date: dd.mm.yyy

Risk No.: 2.1

Risk:

Risk description:

Risk probability: _____ %

Minimum risk value (in LVL*): _____

Comments (optional):

Expected risk value (in LVL*): _____

Comments (optional):

Maximum risk value (in LVL*): _____

Comments (optional):

APPLICATION Spreadsheet



Microsoft Office
Excel Worksheet

APPLICATION

Interpretation

- What is probability for a FNPV or ENPV to become negative?
- If the expected NPV is below acceptable levels then some contingency plan is needed (risk management). This may include putting aside additional money (remember contingencies in the grant calculation!).