



Use of Cost Models in Risk Management

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Agenda (Part 1 only)

- • Risk Management Context
- Cost Model Usage Overview
- Risk Identification
 - Expert COCOMO example
- Risk Analysis
 - tradeoff and sensitivity analyses
 - probabilistic estimation
- Tool Examples
- Summary and References



Agenda (Part 2)

- Risk Control tutorial by Dr. Dick Stutzke, SAIC

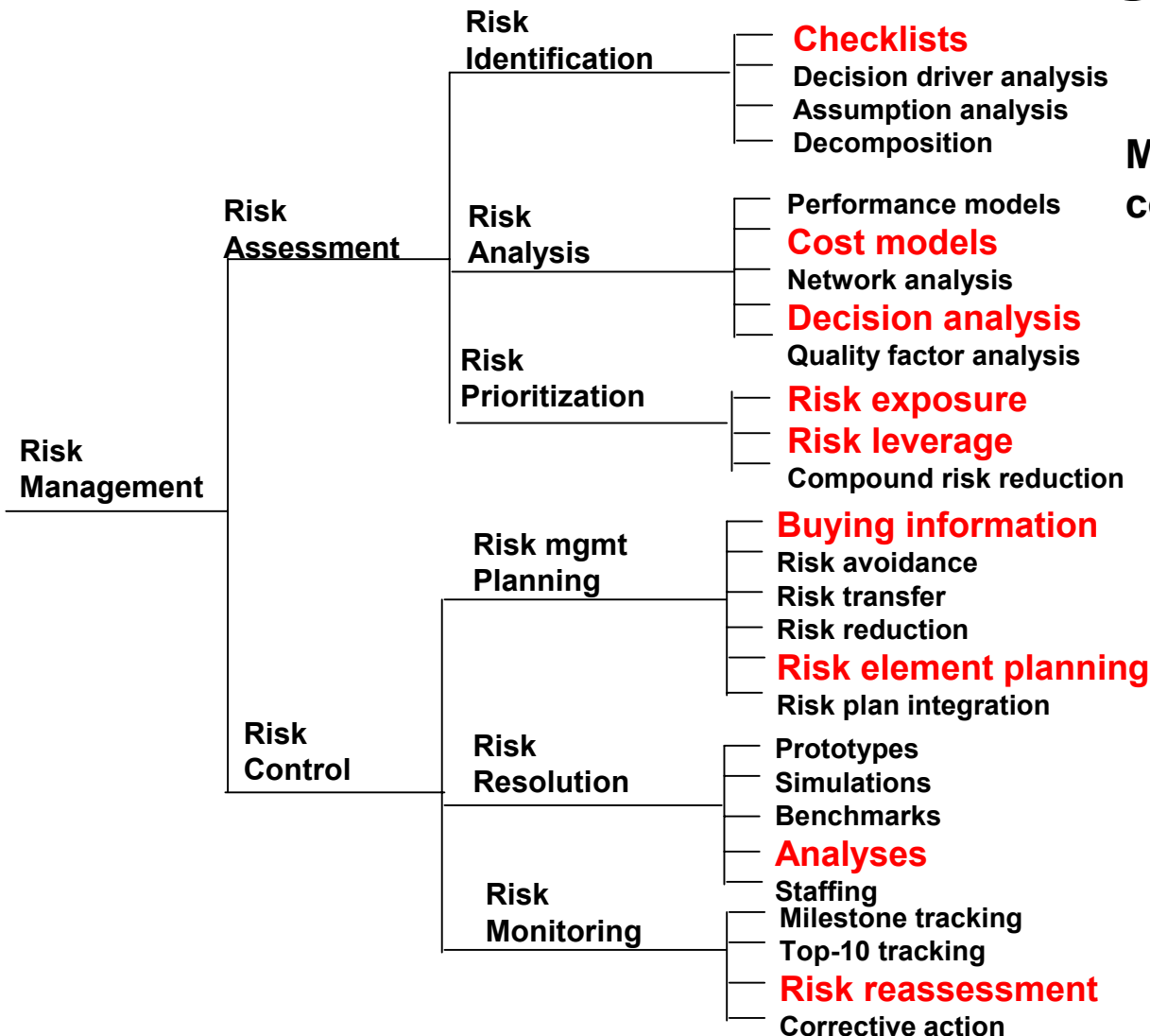
Risk Overview

- Risk is the possibility of an undesirable outcome
 - exceed budget
 - schedule overrun
 - deliver unsuitable product
- Risk impact = (probability of undesirable outcome) * (cost of undesirable outcome)

Risk Overview (cont.)

- Risk management involves several activities:
 - Risk assessment
 - Risk identification
 - Risk analysis
 - Risk prioritization
 - Risk control
 - Risk management planning
 - Risk resolution
 - Risk monitoring

Software Risk Management



Most direct applications for cost models are shown in red

Cost Estimation and Risk Management Alliance

- Cost estimates are used to evaluate risk and perform risk tradeoffs.
- Risk analysis methods such as Monte Carlo simulation can be applied to cost models.
- The likelihood of meeting cost estimates depends on risk management.

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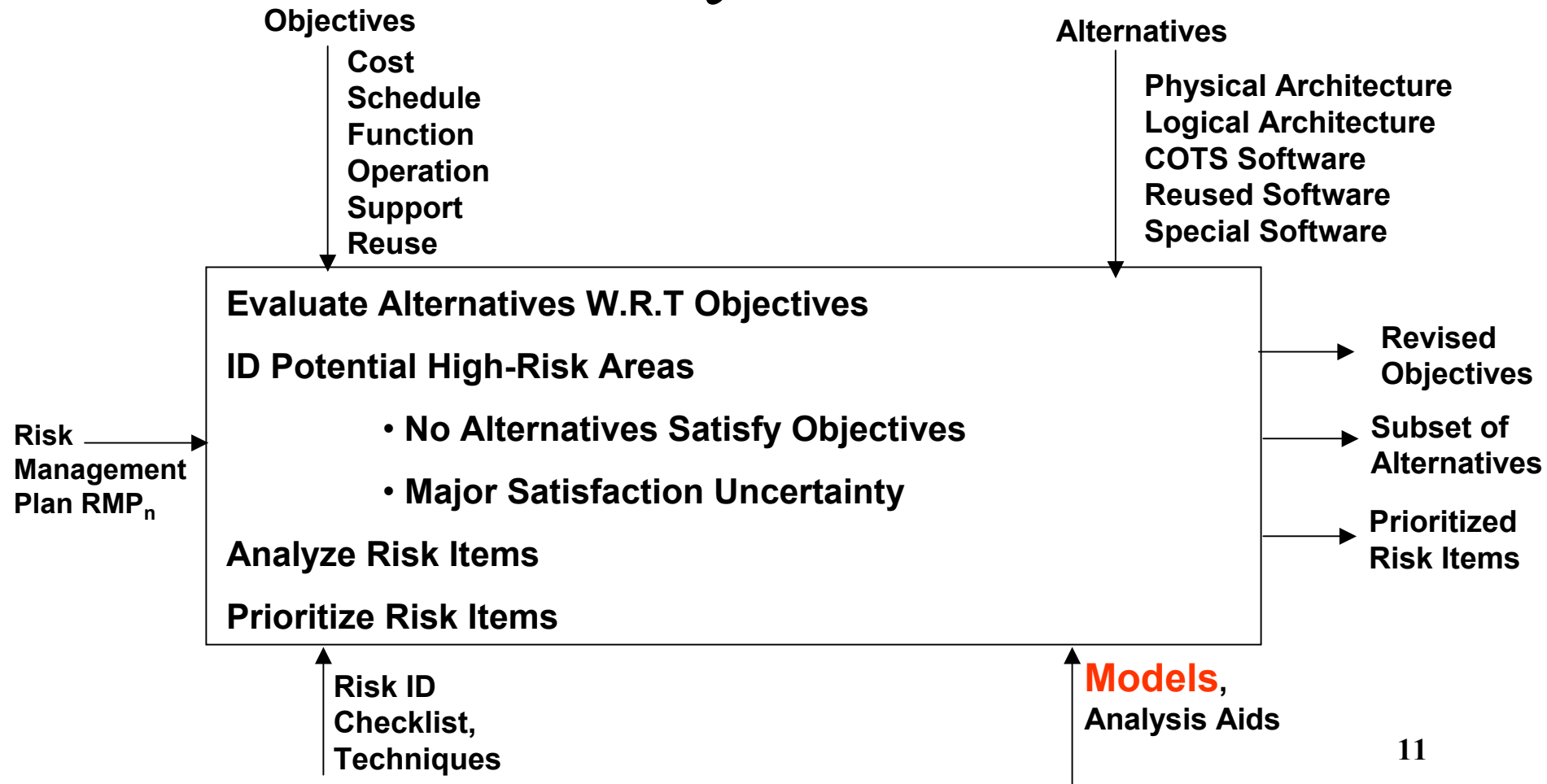
Specific Uses of Cost Models

- Use cost models as risk identification checklists
 - cost factors serve as checklist of risk items that correlate to cost/schedule overruns
- Support cost and schedule risk analyses
 - calculate risk consequence component of risk exposure
 - quantitative analysis of potential overruns
 - help in risk prioritization
 - decision option evaluation

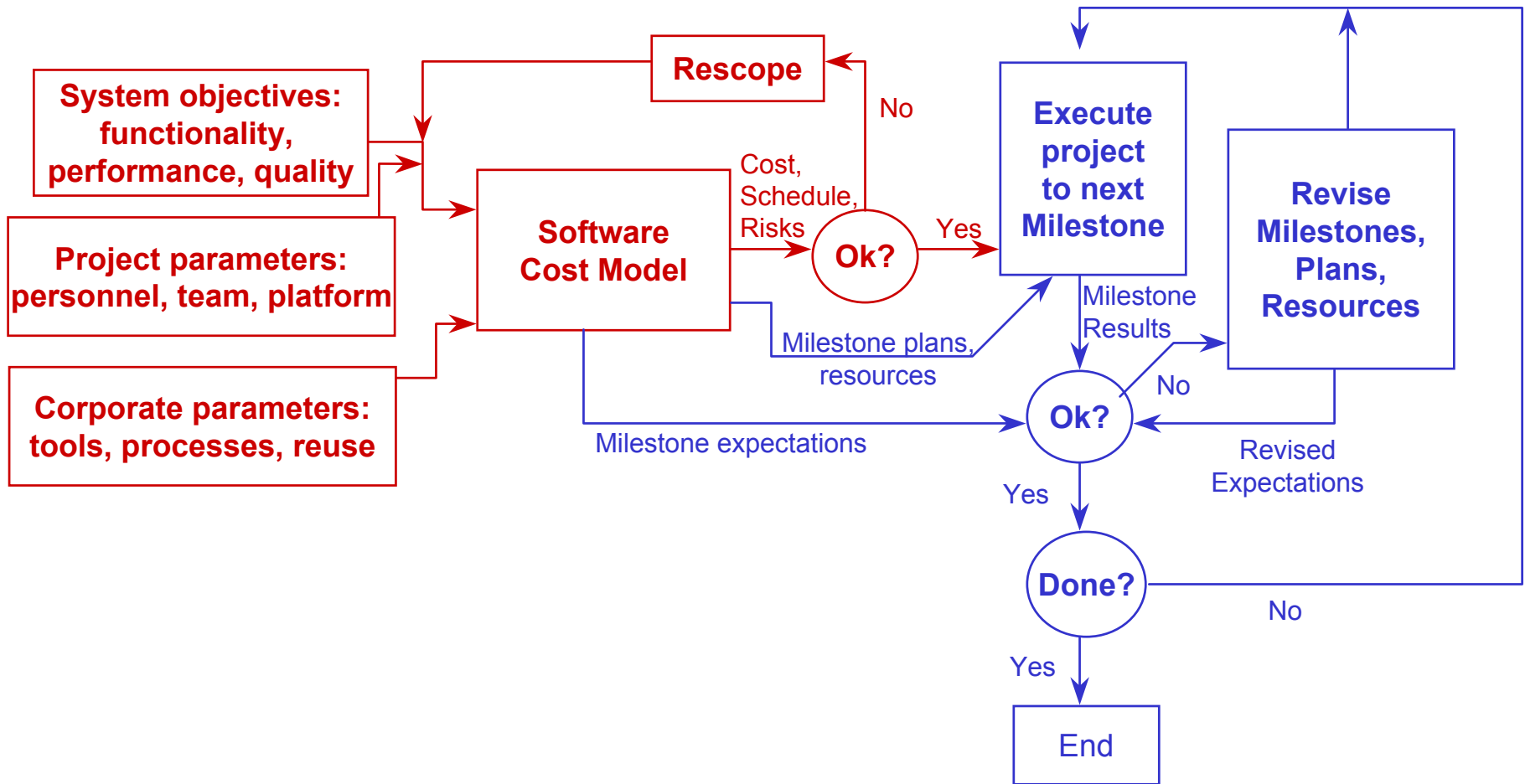
Specific Uses of Cost Models (cont.)

- Analyze uncertainties in cost or schedule estimate (uncertainty = risk)
 - determine confidence level of meeting plans and targets
- Support risk management planning
 - analyze cost/schedule impact of risk mitigation options
- Component of risk monitoring and control feedback loop during project execution
 - reassess risks continuously
 - support replanning efforts

Risk Assessment Role in Each Life-Cycle Phase



Cost Model Project Feedback



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Expert COCOMO Introduction

- An automated, heuristic technique to identify project risks in conjunction with cost estimation.
 - risks are further categorized, quantified and prioritized
- Risk situations are characterized by combinations of cost driver values indicating increased effort with a potential for more problems.
- It also detects cost estimate input anomalies in addition to conventional COCOMO cost/schedule calculations.

Knowledge Engineering

- COCOMO cost factor combinations used as abstractions for formulating risk heuristics
- Iterative elicitation of knowledge from domain experts and written sources
- Devised knowledge representation scheme and risk quantification algorithm
- Statistical testing performed

Risk Rule Example

**IF ((required development schedule < nominal)
AND (applications experience < nominal))
THEN there is a project risk**

Rule Base

- Includes 94 rules / over 600 risk conditions.
 - risk situations
 - multiple categories of risk
 - input anomalies/consistency checks
 - risk mitigation advice
 - project attribute rating

Rule Taxonomy

Overall Project Risk

Schedule risk SCED

sced_cplx
sced_rely
sced_time
sced_pvol
sced_tool
sced_acap
sced_aexp
sced_pcap
sced_vexp
sced_ltex
sced_pmat
sced_docu
sced_pcon
sced_site
sced_prec
sced_flex
sced_resl
sced_team
rely_data_sced
rely_stor_sced
cplx_time_sced
cplx_stor_sced
.

Product risk RELY

rely_acap
rely_pcap
rely_pmat
sced_rely
rely_data_sced
rely_stor_sced
rely_acap_pcap
prec_rely
resl_rely
ruse_rely
DATA
rely_data_sced
SIZE
size_pcap
CPLX
cplx_acap
cplx_acap_pcap
cplx_pcap
cplx_stor_sced
cplx_time_sced
cplx_tool
prec_cplx
.

Platform risk TIME

sced_time
time_pcap
time_acap
cplx_time_sced
time_stor_sced
time_pvol_sced
ruse_time
time_tool
prec_time
flex_time
resl_time
STOR
stor_acap
stor_pcap
ruse_stor
cplx_stor_sced
time_stor_sced
prec_stor
flex_store
resl_stor
PVOL
sced_pvol
.

Personnel risk ACAP

acap_risk
cplx_acap
cplx_acap_pcap
pmat_acap
rely_acap
rely_acap_pcap
ruse_acap
sced_acap
stor_acap
time_acap
tool_acap
pcon_acap
prec_acap
resl_acap
AEXP
ltex_aexp_sced
ruse_aexp
sced_aexp
pcon_aexp
resl_aexp
team_aexp
LTEX
.

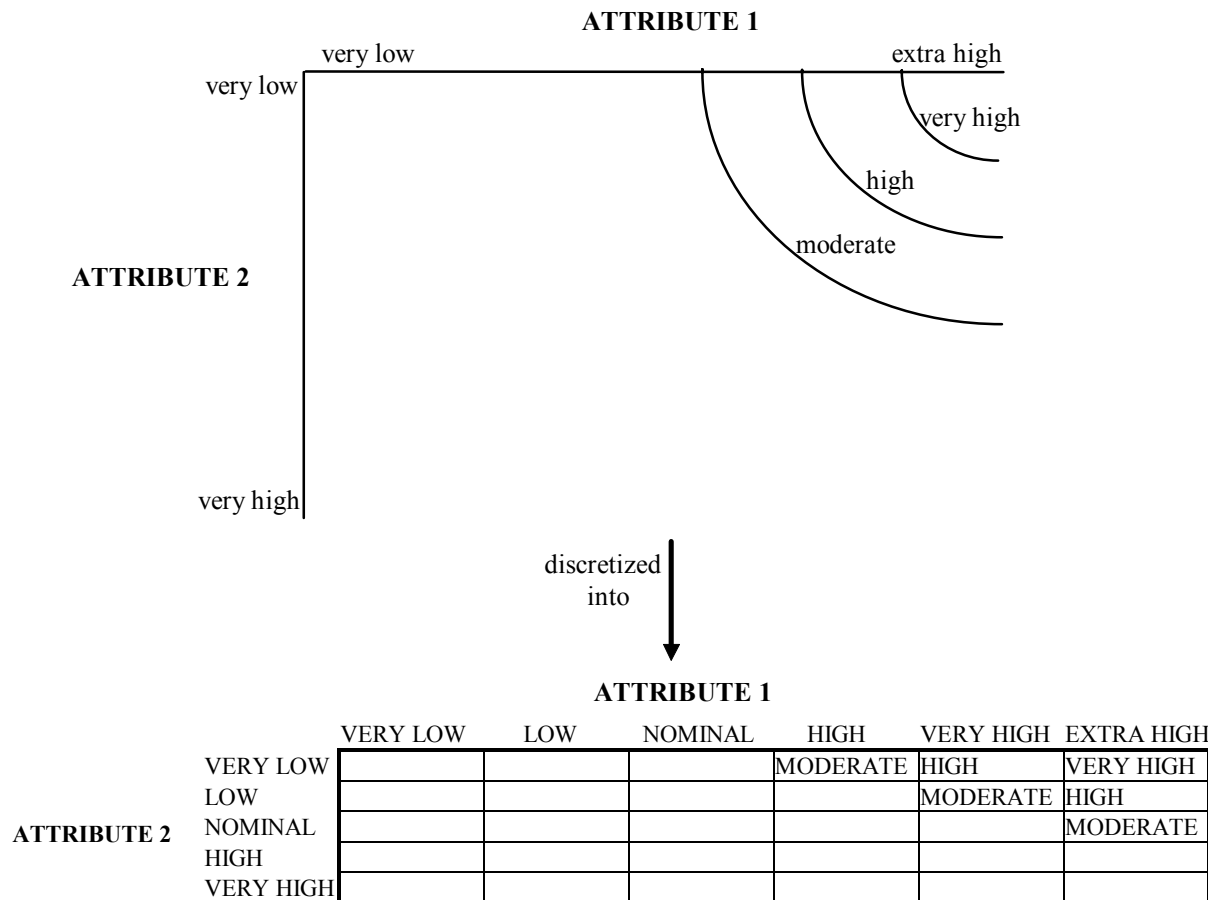
Process risk TOOL

sced_tool
tool_acap
tool_pcap
cplx_tool
time_tool
tool_pmat
pcon_tool
site_tool
resl_tool
SITE
site_docu
site_tool
pcon_site
sced_site
prec_site
team_site
PREC
prec_flex
prec_rely
prec_cplx
prec_ruse
prec_docu
.

Reuse risk RUSE

ruse_rely
ruse_aexp
ruse_ltex
ruse_acap
ruse_time
ruse_stor
ruse_docu
prec_ruse
resl_ruse

Typical Assignment of Risk Levels



Risk Weighting

$$\text{project risk} = \sum_{j=1}^{\#categories} \sum_{i=1}^{\#category risks} \text{risk level}_{i,j} * \text{effort multiplier product}_{i,j}$$

where risk level =

1	moderate
2	high
4	very high

effort multiplier product=
 (driver #1 effort multiplier) * (driver #2 effort multiplier) ... * (driver #n effort multiplier).

If the risk involves a schedule constraint (SCED), then

effort multiplier product=
 (SCED effort multiplier)/(relative schedule) * (driver #2 effort multiplier)... * (driver #n effort multiplier).

In the cases where a risk involves a scale driver, then the effective effort multiplier for the scale driver is of the form:

$$\text{scale driver multiplier} = \text{SIZE}^{.01 * W_i} / \text{SIZE}^{.01 * 3}$$

Expert COCOMO Input Screen (1/2)

USC Expert COCOMO II - Microsoft Internet Explorer

Address http://sunset.usc.edu/research/COCOMOII/expert_cocomo/expert_cocomo2000.ht Go File

COCOMO II with Heuristic Risk Assessment

Model: Post-architecture
Calibration: COCOMOII.2000
[Current rule base implementation](#)

Size

	SLOC	% Design Modified	% Code Modified	% Integration Required	Assessment and Assimilation (0% - 8%)	Software Understanding (0% - 50%)	Unfamiliarity (0-1)
New	30000						
Reused	20000	0	0	40	.4		
Modified	10000	20	35	70	2	39	5

Rate each cost driver below from Very Low (VL) to Extra High (EH). For **HELP** on each cost driver, select its name.

Very Low (VL) Low (L) Nominal (N) High (H) Very High (VH) Extra High (EH)

Scale Drivers

Expert COCOMO Input Screen (2/2)

	Very Low (VL)	Low (L)	Nominal (N)	High (H)	Very High (VH)	Extra High (EH)
Scale Drivers						
Precedentedness	<input type="radio"/> VL	<input type="radio"/> L	<input type="radio"/> N	<input checked="" type="radio"/> H	<input type="radio"/> VH	<input type="radio"/> XH
Development Flexibility	<input type="radio"/> VL	<input type="radio"/> L	<input checked="" type="radio"/> N	<input type="radio"/> H	<input type="radio"/> VH	<input type="radio"/> XH
Architecture/Risk Resolution	<input type="radio"/> VL	<input type="radio"/> L	<input checked="" type="radio"/> N	<input type="radio"/> H	<input type="radio"/> VH	<input type="radio"/> XH
Team Cohesion	<input type="radio"/> VL	<input checked="" type="radio"/> L	<input type="radio"/> N	<input type="radio"/> H	<input type="radio"/> VH	<input type="radio"/> XH
Process Maturity	<input type="radio"/> VL	<input checked="" type="radio"/> L	<input type="radio"/> N	<input type="radio"/> H	<input type="radio"/> VH	<input type="radio"/> XH
Product Attributes						
Required Reliability	<input type="radio"/> VL	<input type="radio"/> L	<input type="radio"/> N	<input type="radio"/> H	<input checked="" type="radio"/> VH	
Database Size		<input type="radio"/> L	<input checked="" type="radio"/> N	<input type="radio"/> H	<input type="radio"/> VH	
Product Complexity	<input type="radio"/> VL	<input type="radio"/> L	<input type="radio"/> N	<input type="radio"/> H	<input checked="" type="radio"/> VH	<input type="radio"/> EH
Required Reuse		<input type="radio"/> L	<input checked="" type="radio"/> N	<input type="radio"/> H	<input type="radio"/> VH	<input type="radio"/> EH
Documentation	<input type="radio"/> VL	<input type="radio"/> L	<input type="radio"/> N	<input checked="" type="radio"/> H	<input type="radio"/> VH	
Platform Attributes						
Execution Time Constraint			<input type="radio"/> N	<input checked="" type="radio"/> H	<input type="radio"/> VH	<input type="radio"/> EH
Main Storage Constraint			<input checked="" type="radio"/> N	<input type="radio"/> H	<input type="radio"/> VH	<input type="radio"/> EH
Platform Volatility		<input type="radio"/> L	<input type="radio"/> N	<input checked="" type="radio"/> H	<input type="radio"/> VH	

Expert COCOMO Output Screen (1/2)

http://sunset.usc.edu/cgi-bin/expert_cocomo2000 - Microsoft Internet Explorer

Address http://sunset.usc.edu/cgi-bin/expert_cocomo2000

Outputs

Top-level Estimate for Elaboration and Construction

Effort	1273.5 Person-months
Schedule	24.3 Months

MBASE Phase Distribution

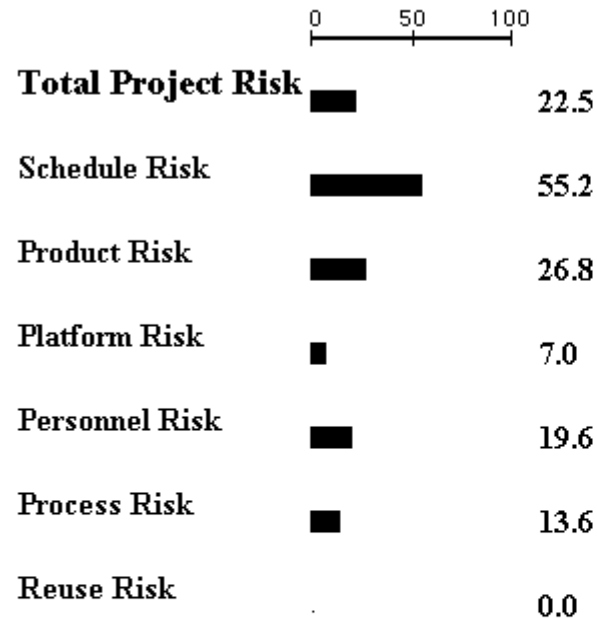
	Effort (Person-months)	Schedule (Months)
Inception	76.4	3.0
Elaboration	305.6	9.1
Construction	955.2	15.2
Transition	152.8	3.0

MBASE Activities (effort in person-months)

	Inception	Elaboration	Construction	Transition	Total
Management	10.7	36.7	95.5	21.4	164.3
Environment/CM	7.6	24.5	47.8	7.6	87.5
Requirements	29.0	55.0	76.4	6.1	166.6

Expert COCOMO Output Screen (2/2)

Risk Assessment Summary (0-100)



***** This project is a high risk. Try to mitigate the top individual risk items. *****

Individual Risk Items (non-normalized)

```
sced_cplx_risk= 3.83
sced_rely_risk= 3.60
sced_time_risk= 1.59
sced_pvol_risk= 1.64
```

Emerging COCOMO Extensions for Heuristic Risk Assessment

- COQUALMO (COConstructive QUALity Model)
- COCOTS (COConstructive COTS model)

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Tradeoff Analyses

- Cost drivers can be used to analyze their effects on effort and schedule
- Enables tradeoff analysis between different scenarios
 - e.g. evaluate impact of software packages, different tools, personnel decisions, etc.

Example Tradeoff Analysis

- Team A: low hourly rates, low personnel capability and experience

VS.

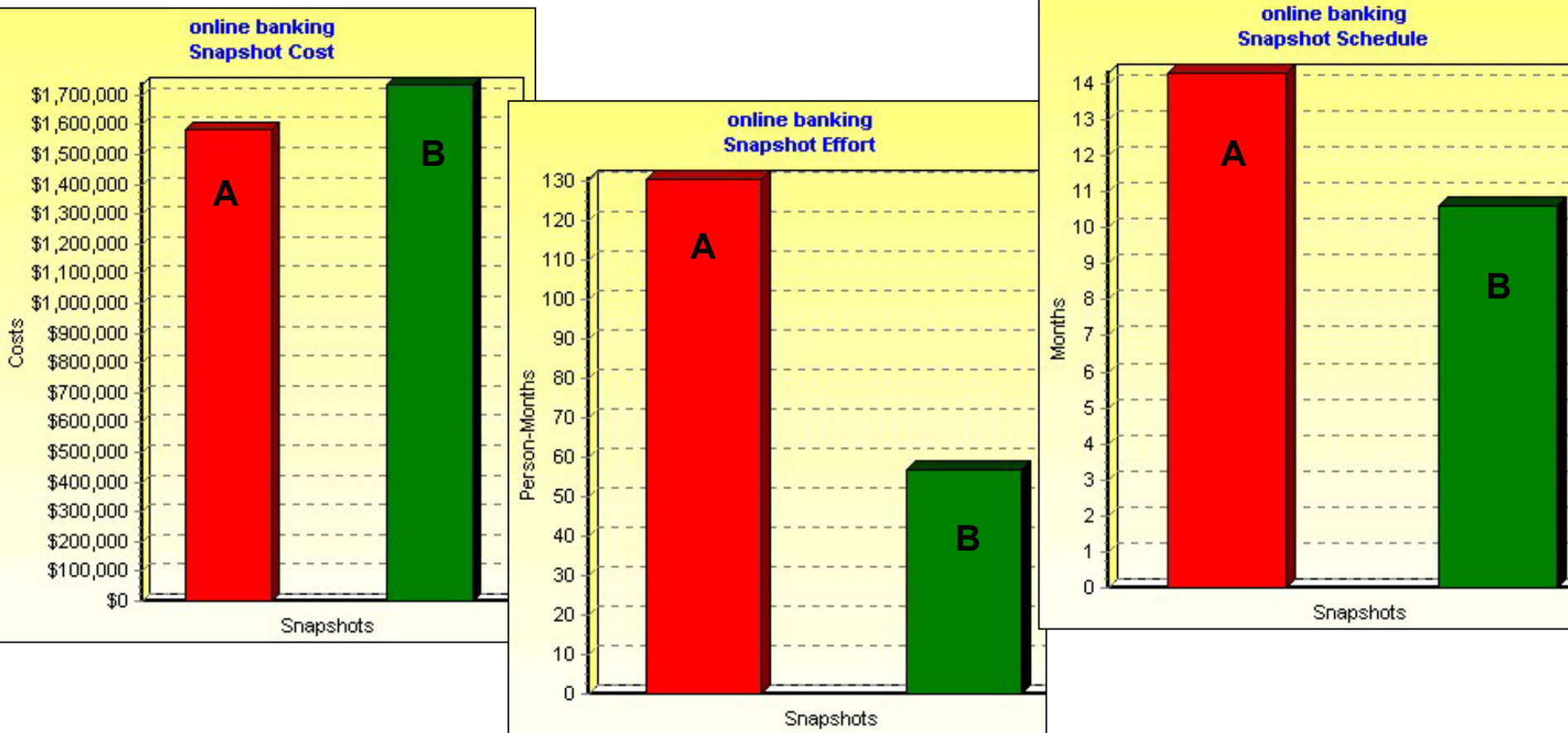
- Team B: high hourly rates, high personnel capability and experience
- Use cost model to analyze cost, effort and schedule tradeoffs

Tradeoff Parameters

Size = 30 KSLOC

	Team A	Team B
Analyst Capability	Low	High
Applications Experience	Low	High
Programmer Capability	Low	High
Hourly Labor Rate	\$80	\$200

Tradeoff Results



Which team would you choose?

Performing a Sensitivity Analysis

- Sensitivity analysis involves adjusting model input values to determine the impact on the cost estimate from varying the project factors.
- You attempt to identify factors with a high uncertainty and a high impact. These aspects can be quantified to help calculate the range of your estimates.

Performing a Sensitivity Analysis (cont.)

- Factors where changes reduce cost or schedule are candidates for organizational changes by management. Cost models allow a quantitative cost/benefit analysis to be made to find high leverage opportunities.
- Significant factors that are outside of your control constitute project risk.

A Sensitivity Analysis Method

- Determine the relative impacts by applying the software effort equation with changed factors:

$$\text{Effort} = A * \text{SIZE}^B * \text{Effort Adjustment Factor}$$

- Calculate the effort ratio between cases
 - all terms will cancel out except for those being changed
 - e.g., the impact of changing a cost driver is the ratio of its effort multiplier at the different ratings
- Same general method for schedule impact via the schedule formula

Sensitivity Analysis Examples

- Risk of size growth (from 100K to 130K)
 - $130^{1.2} / 100^{1.2} = 1.37$
 - relative effort increase = 37%
- Risk of more complex algorithms (Product Complexity (CPLX) from High to Very High)
 - $1.34 / 1.17 = 1.15$
 - relative effort increase = 15%
- Risk of not having good analysts (Analyst Capability (ACAP) from High to Nominal)
 - $1.00 / .85 = 1.18$
 - relative effort increase = 18%

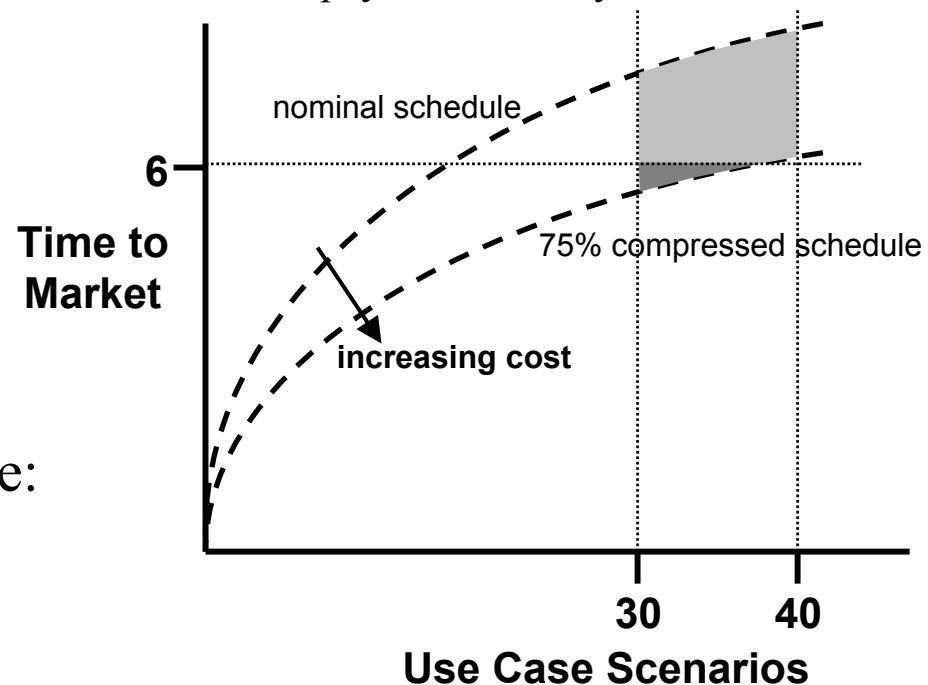
Timeboxing Decision Analysis Example

- Management wants you to plan a 6 month market-driven project consisting of 40 use case scenarios (assume equal effort for each). This project cannot overrun.
 - Can all scenarios be completed in the timeframe without schedule compression? If not, how many can?
- Your initial estimate results*:
 - 40 scenarios will take 8.3 months (29 Person-months effort)
 - 25 scenarios can be completed in 5.9 months (17.7 Person-months effort)
- After hearing your initial estimate, management says 25 scenarios won't constitute a core capability to attain ROI. Nearly all 40 use cases are crucial (30 minimum) and they are willing to pay extra for schedule compression. Can this be done?

* estimates using Cost Xpert version 3.2

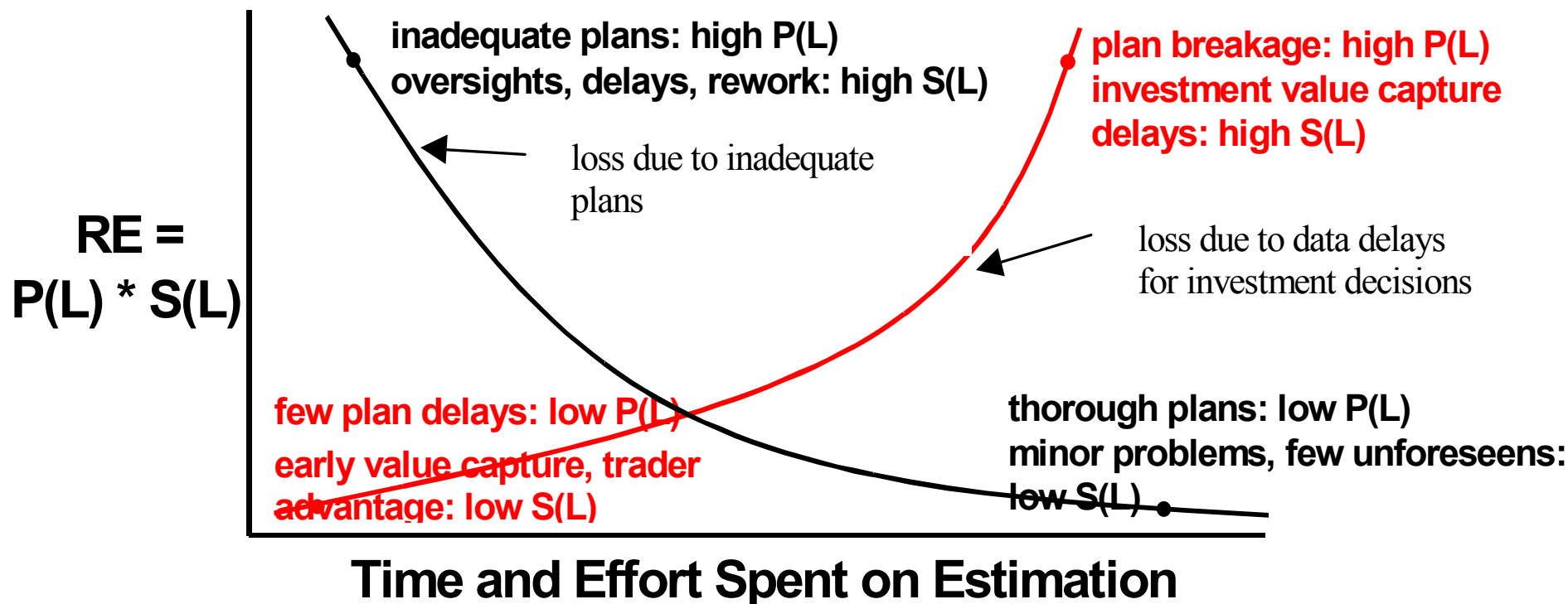
Timeboxing Decision Analysis Example (cont.)

- Next estimate:
 - 6.3 months is the shortest possible schedule (36.1 Person-months of effort)
 - you suggest identifying 37 scenarios that will payoff since they can be done in 6 months.
- The team defines a set of usage features that can be developed in the timeframe.
- The resulting tradespace:

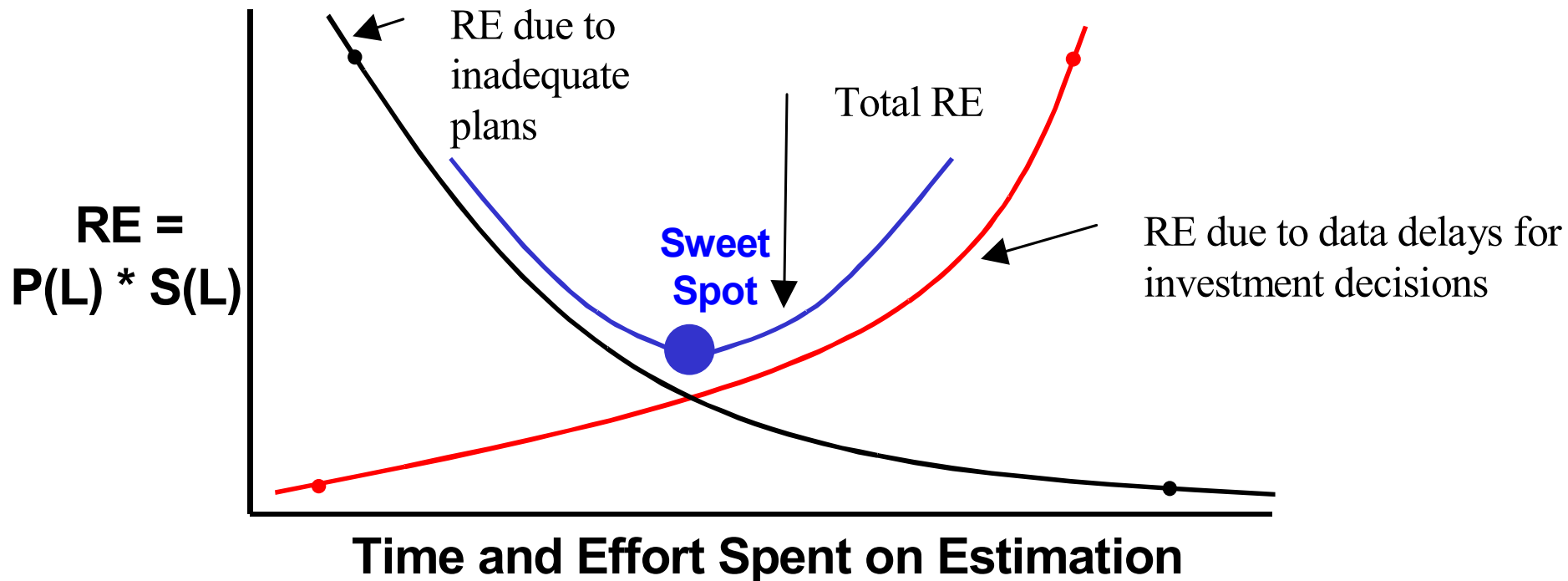


Estimation Process Risk Considerations

Example: financial services application for fund trading



Finding the Estimation Sweet Spot (How much is enough?)



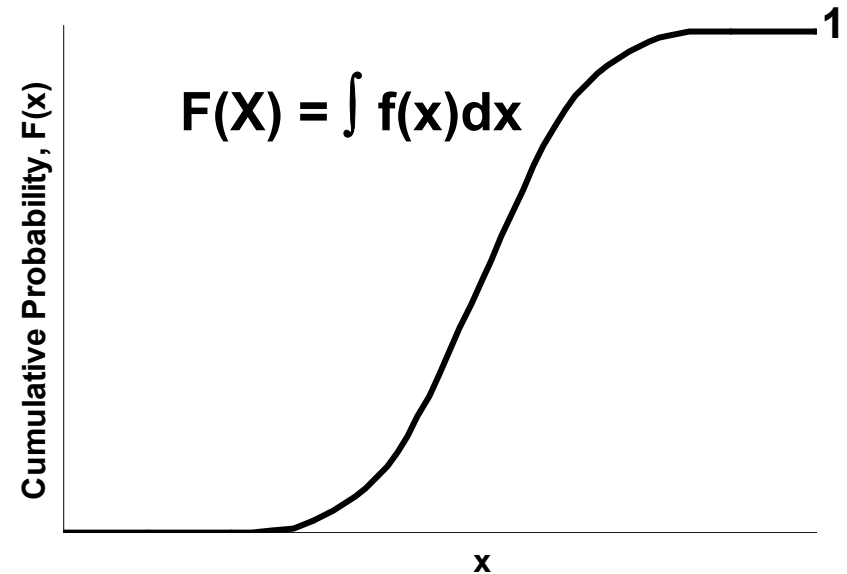
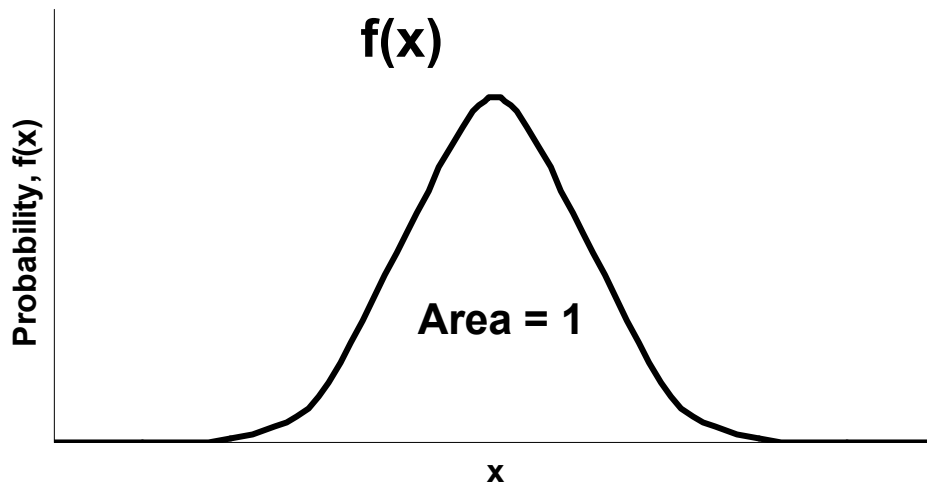
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Probabilistic Estimation

- A point estimate is only one of an infinite number of possibilities; hence the probability of achievement is zero. One should evaluate the uncertainty range.
- Risk analysis using probabilistic methods (e.g. Monte Carlo simulation, PERT) uses input probability distributions and computes corresponding output probability distributions.
- Confidence level risk charts are based on the resulting output distribution.
 - Confidence level refers to the probability of not exceeding a given value (e.g. a conservative 90% confidence level cost means a 10% chance of exceeding the cost based on the probabilistic inputs)
- A point estimate should be reported with its associated confidence level.

Probability Density Function and Cumulative Distribution



$0 \leq F(x) \leq 1$ for all x

$F(x)$ is nondecreasing

PERT Probability Distribution

- PERT distribution used in several models is a form of a Beta distribution
 - a rounded version of the triangular distribution that can be skewed
 - specified by three parameters: a minimum value, most likely and a maximum value
 - the minimum and maximum represent 5% and 95% cumulative probabilities respectively (each value will be exceeded only 1/20 times at the extreme ends)

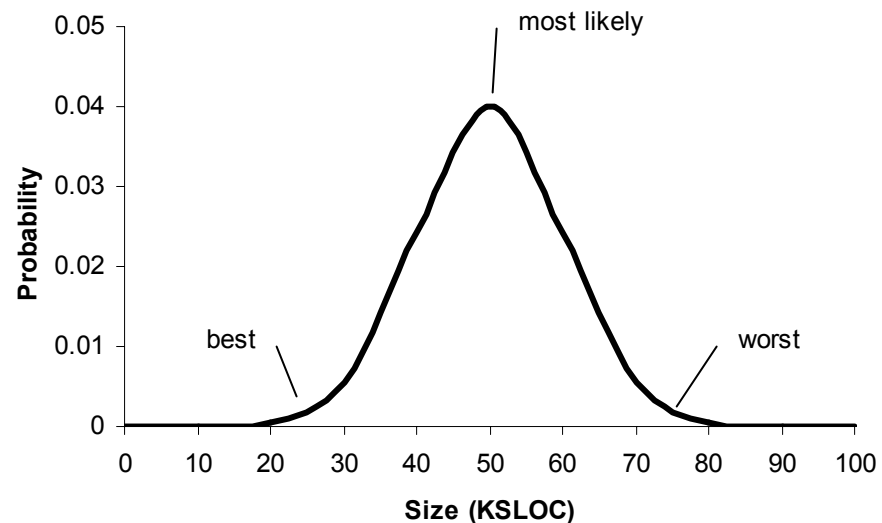
PERT Based Risk Analysis

- Base estimates on a distribution specified by best (minimum), most likely and worst (maximum) size values.

Mean:
$$\frac{(\text{best} + 4 * \text{most likely} + \text{worst})}{6}$$

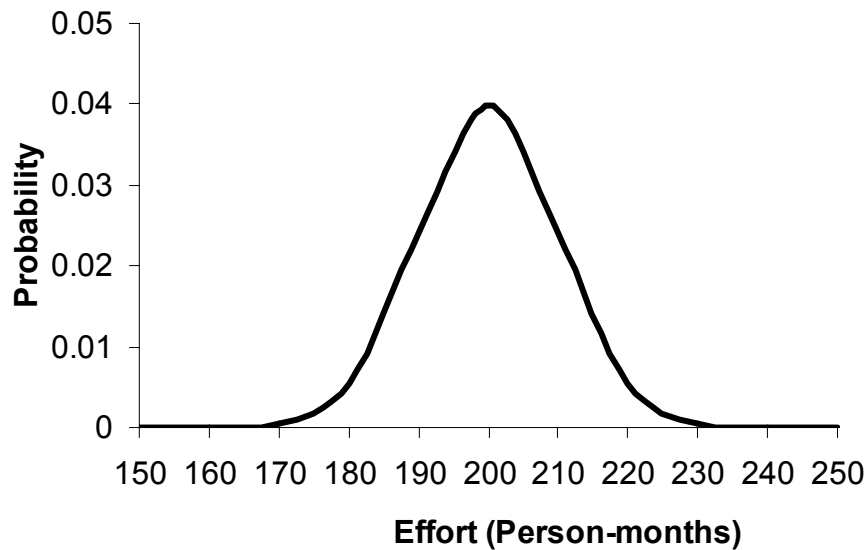
Standard deviation (SD):
$$\frac{(\text{worst} - \text{best})}{6}$$

- Sample input for a software component

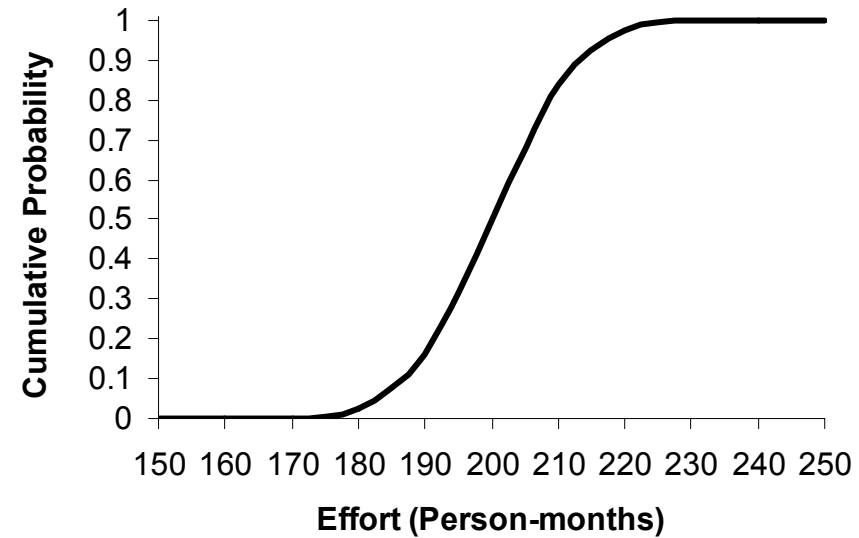


Sample Output Distributions

Effort Distribution

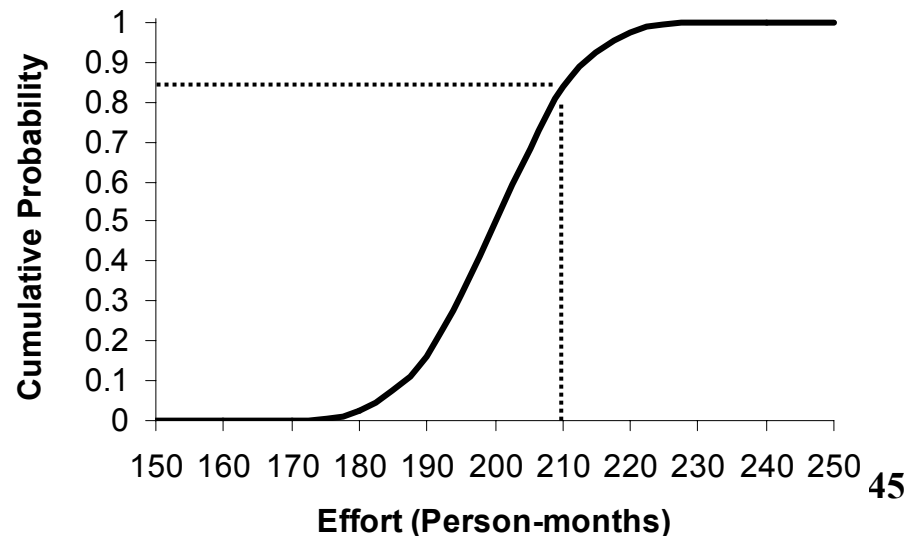
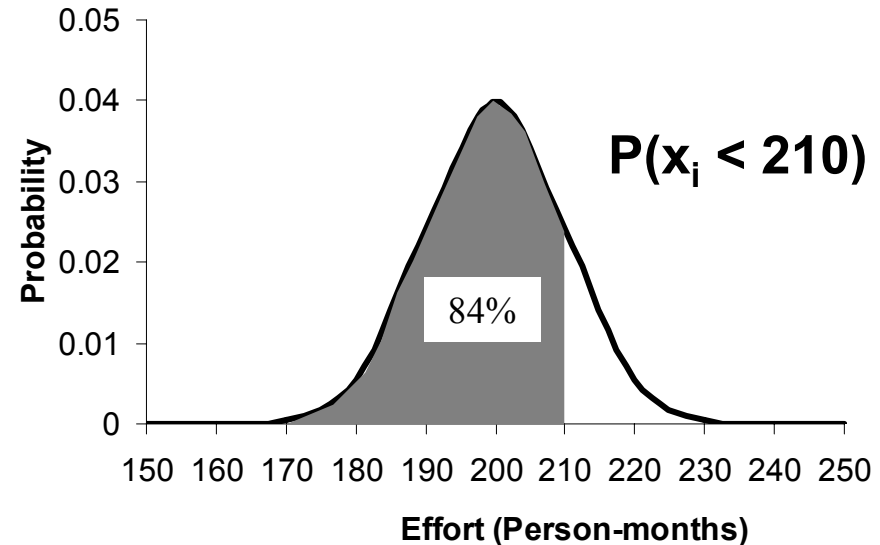


Confidence Level



Risk Tolerance Control


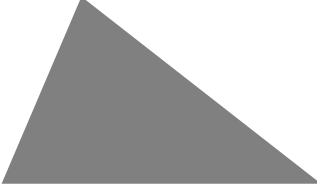

- User adjusts risk profile by specifying a point on the output distribution
- Example: 84% of possible outcomes are less than + one standard deviation
 - or 210 PM is the 84% confidence level



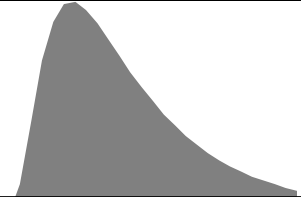
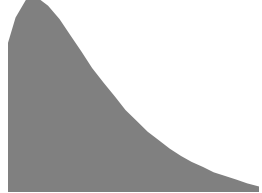
Practical Uses of the Results

- Estimating costs
 - You may want to budget contingency funds to cover a comfortable part of the range. For fixed price jobs this can be especially important.
- Setting expectations
 - Express size/cost/schedule estimates in terms of ranges rather than fixed numbers (point estimates).
 - Stakeholders should discuss project in terms of it's probability of completion.
 - E.g., there is an 84% chance that effort will be less than 210 Person-months.

Common Distributions for Cost Models

Distribution	Shape	Typical Applications
uniform		<ul style="list-style-type: none"> • used in the absence of distribution data • used to represent equally likely outcomes (e.g. decision choices) • software cost drivers
triangle		<ul style="list-style-type: none"> • a rough model when the minimum, most likely and maximum are known but no other distribution shape data • software cost drivers including size
Normal (or PERT)		<ul style="list-style-type: none"> • size, effort, complexity, other project characteristics • personnel factors representing a normal spread of capability • PERT available in many cost modeling tools; can be used to approximate this and other distributions

Common Distributions for Cost Models (cont.)

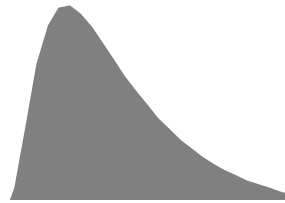
Distribution	Shape	Typical Applications
lognormal		<ul style="list-style-type: none"> • system size, effort, complexity • accounts for typical underestimation of scope and system-wide effects
truncated lognormal		<ul style="list-style-type: none"> • to prevent negative values or other inconsistent values from a standard lognormal (e.g. when the mean is close enough to zero that the spread goes negative)

Monte Carlo Analysis

- Monte Carlo analysis is a "game of chance" technique used to solve many types of problems by applying random sampling methods.
- It uses random numbers to sample from known input probability distributions to determine specific outcomes.
- It estimates the likely range of outcomes from a random process by simulating the process a large number of times.
- In our context, a software cost model is used for the simulation.

Monte Carlo Analysis with Multiple Input Factors

Input
Distributions



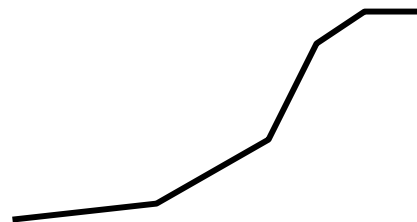
Size

Complexity

...

Output
Distributions

Effort



Effort

cumulative effort distribution

Monte Carlo Steps

1. For each random variable, take a sample from its probability distribution function and calculate its value.
2. Run a simulation using the random input samples and compute the corresponding simulation outputs.
3. Repeat the above steps until n simulation runs are performed.
4. Determine the output probability distributions of selected dependent variables using the n values from the runs.

Inverse Transform Technique

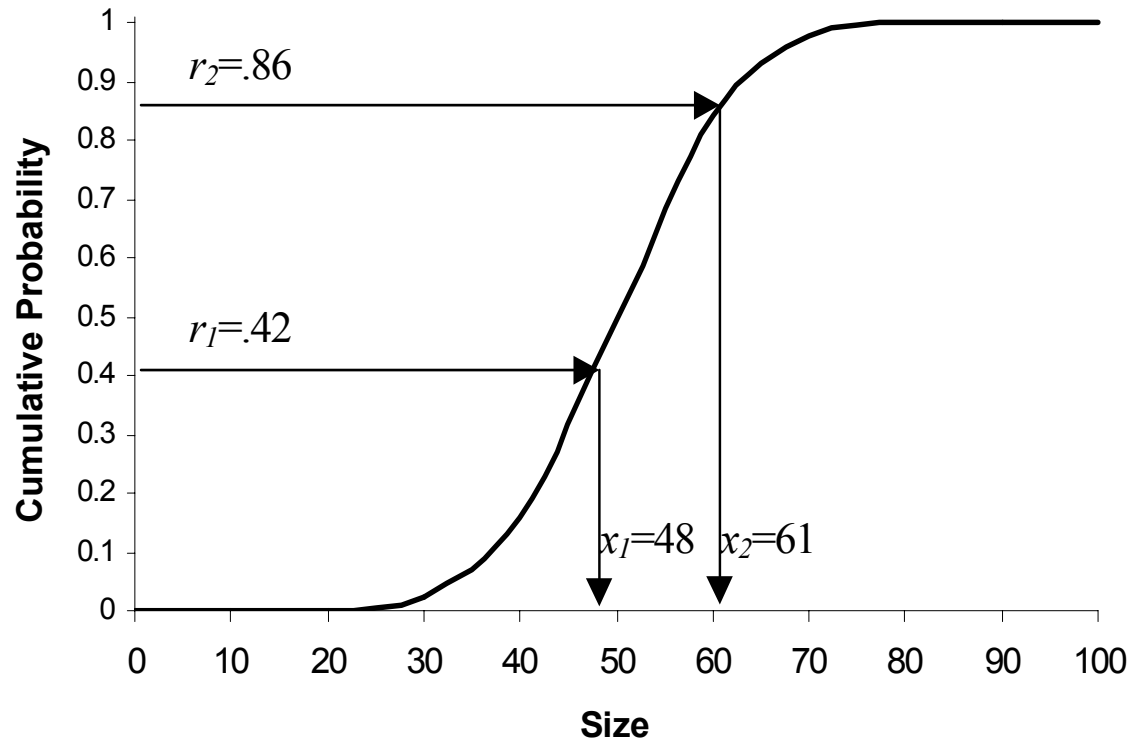
- The inverse transform is used to generate random variates for simulation input.
- First a random number r is chosen that is uniformly distributed between 0 and 1. It is set equal to the cumulative distribution to solve for x :

$$F(x) = r$$

- A particular value r_0 gives a value x_0 , which is a particular sample value of X . It can be expressed as

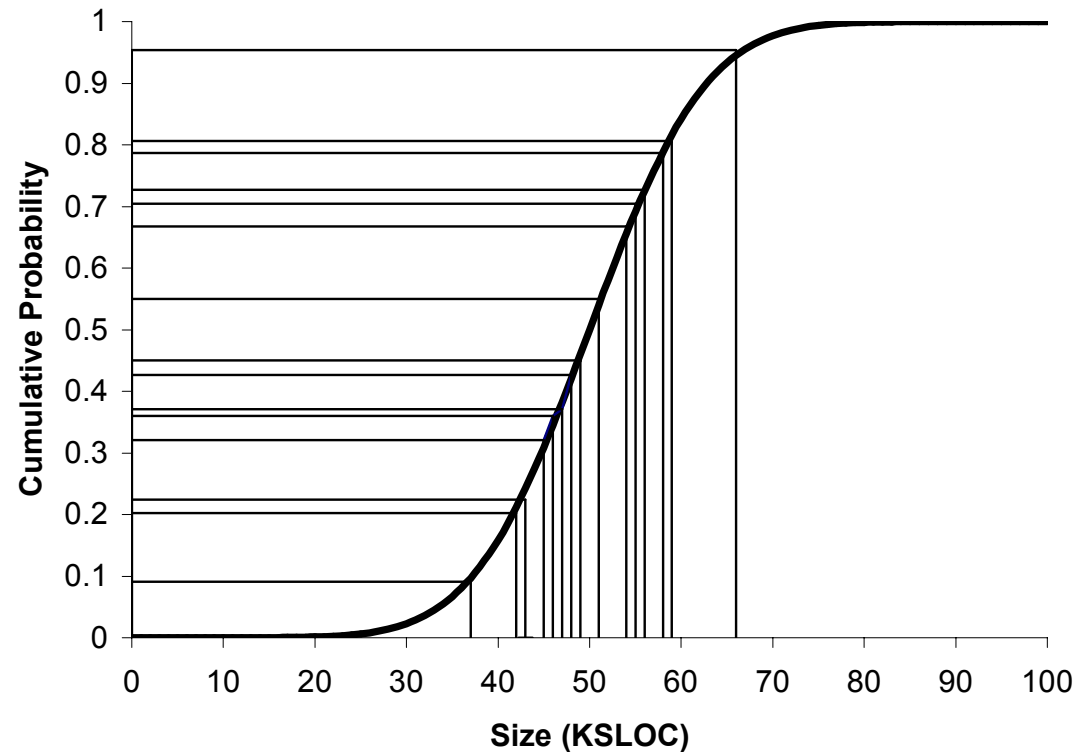
$$x_0 = F^{-1}(r_0)$$

Illustration of Inverse Transform



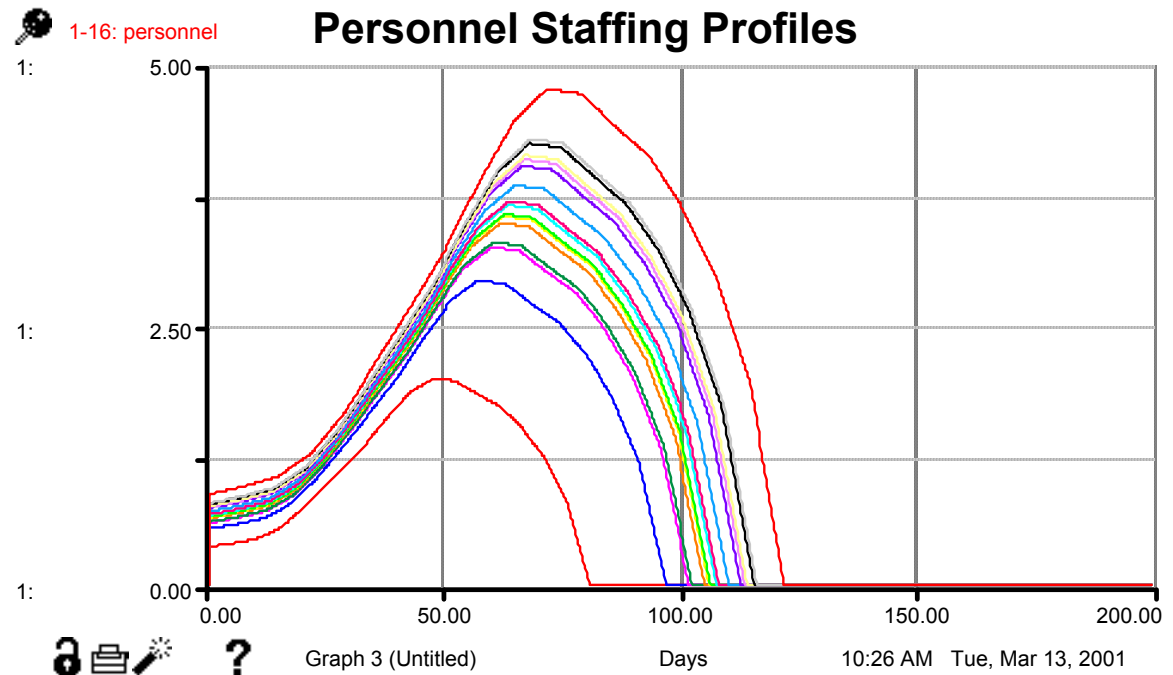
Monte Carlo Sampling for 16 COCOMO Runs

Iteration	Random Number (0-1)	Size (KSLOC)
1	0.321	45.4
2	0.550	51.3
3	0.091	36.6
4	0.807	58.7
5	0.427	48.1
6	0.667	54.3
7	0.451	48.8
8	0.003	22.7
9	0.727	56.0
10	0.360	46.4
11	0.954	66.8
12	0.371	46.7
13	0.224	42.4
14	0.704	55.4
15	0.787	57.9
16	0.202	41.7

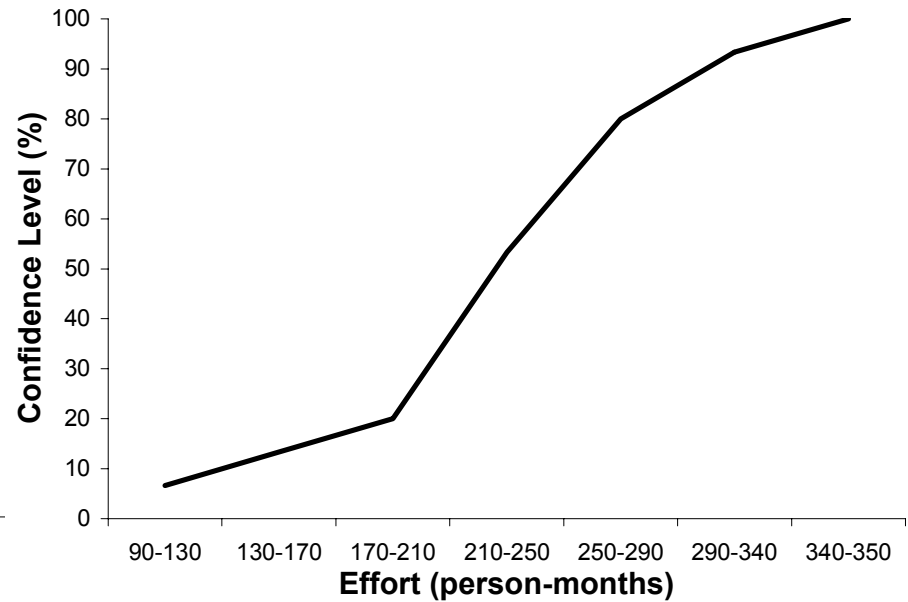
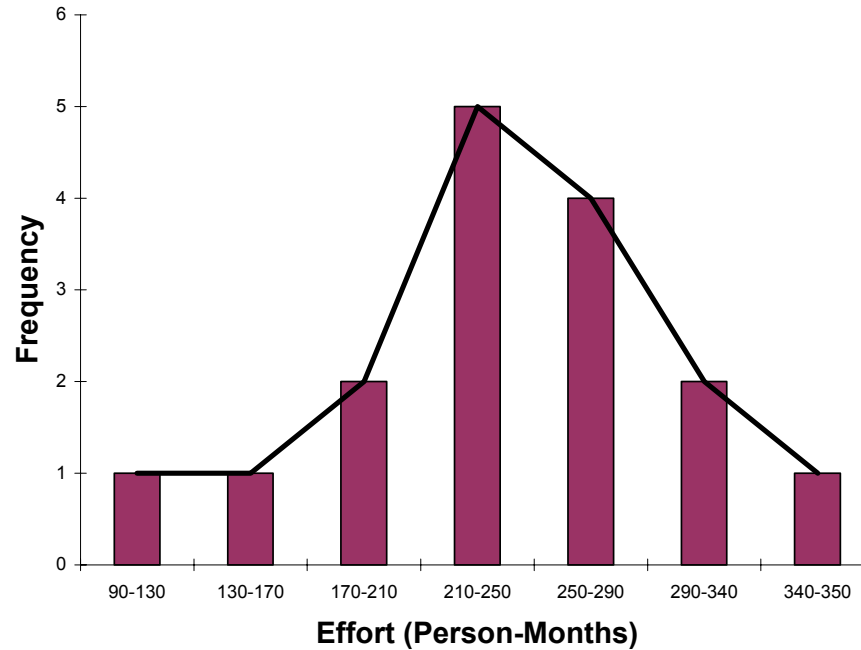


Monte Carlo Model Runs

Iteration	Effort (Person-months)
1	217.7
2	252.2
3	168.6
4	296.5
5	234.0
6	270.4
7	237.5
8	94.9
9	280.7
10	223.9
11	346.7
12	225.6
13	200.9
14	276.6
15	292.2
16	196.6



Monte Carlo Output Summary



Agenda

- Risk Management Context
- Cost Model Usage Overview
- Risk Identification
 - Expert COCOMO example
- Risk Analysis
 - tradeoff and sensitivity analyses
 - probabilistic estimation
- • Tool Examples
- Summary and References

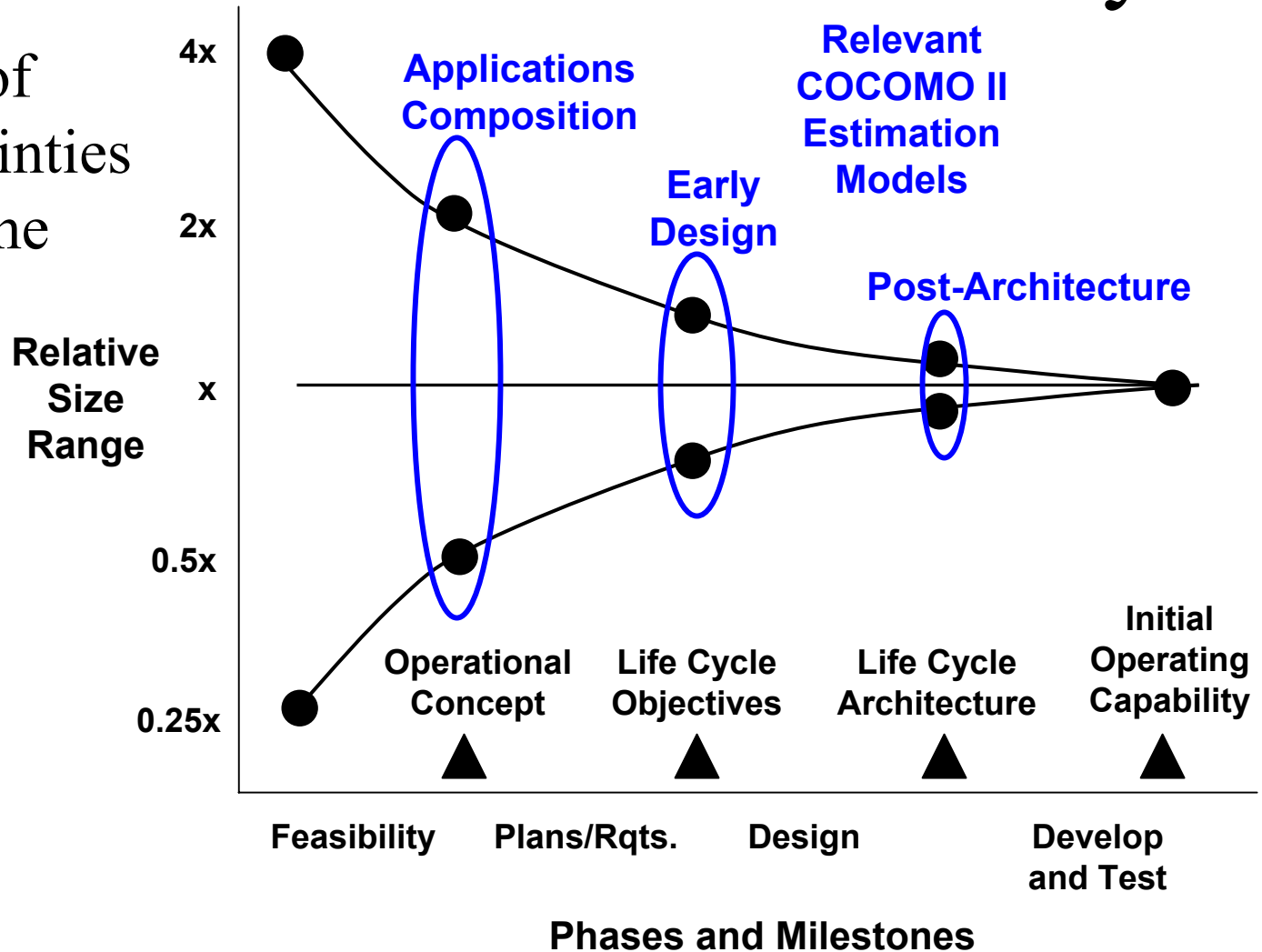
COCOMO II Output Ranges

- COCOMO II provides one standard deviation optimistic and pessimistic estimates.
- Reflect sources of input uncertainties per funnel chart.
- Apply to effort or schedule for all of the stage models.
- Represent 80% confidence limits: below optimistic or pessimistic estimates 10% of the time.

Stage	Optimistic Estimate	Pessimistic Estimate
1	0.50 E	2.0 E
2	0.67 E	1.5 E
3	0.80 E	1.25 E

Software Estimation Accuracy

- Effect of uncertainties over time



USC COCOMO Outputs

D:\cocomo\book\ars detailed.est - COCOMOII.1998.0

File View Edit Parameters Calibrate Phase Maintenance Help

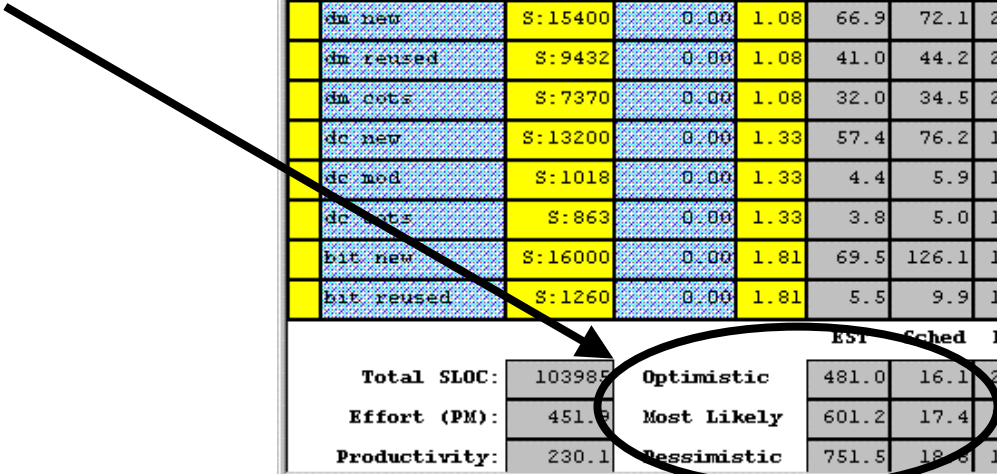
Project Name: **ARS detailed** Scale Factor Schedule

X	Module Name	Module Size	LABOR Rate (\$/month)	EAF	NOM PM DEV	EST PM DEV	PROD	COST	INST COST	FSWP	RISK
	ruc new	S:3215	0.00	1.08	14.0	15.1	213.5	0.00	0.0	0.9	5.1
	ruc mod	S:351	0.00	1.08	1.5	1.6	213.5	0.00	0.0	0.1	5.1
	ruc reused	S:1721	0.00	1.08	7.5	8.1	213.5	0.00	0.0	0.5	5.1
	tp new	S:13715	0.00	1.26	59.6	75.0	182.8	0.00	0.0	4.3	5.5
	tp mod	S:5392	0.00	1.26	23.4	29.5	182.8	0.00	0.0	1.7	5.5
	rd new	S:12200	0.00	1.50	53.0	79.5	153.5	0.00	0.0	4.6	5.1
	rd reused	S:2848	0.00	1.50	12.4	18.5	153.5	0.00	0.0	1.1	5.1
	dm new	S:15400	0.00	1.08	66.9	72.1	213.5	0.00	0.0	4.1	5.1
	dm reused	S:9432	0.00	1.08	41.0	44.2	213.5	0.00	0.0	2.5	5.1
	dm cots	S:7370	0.00	1.08	32.0	34.5	213.5	0.00	0.0	2.0	5.1
	dc new	S:13200	0.00	1.33	57.4	76.2	173.3	0.00	0.0	4.4	4.3
	dc mod	S:1018	0.00	1.33	4.4	5.9	173.3	0.00	0.0	0.3	4.3
	dc cots	S:863	0.00	1.33	3.8	5.0	173.3	0.00	0.0	0.3	4.3
	bit new	S:16000	0.00	1.81	69.5	126.1	126.9	0.00	0.0	7.2	9.3
	bit reused	S:1260	0.00	1.81	5.5	9.9	126.9	0.00	0.0	0.6	9.3

	EST	Sched	PROD	COST	INST	FSWP	RISK	
Total SLOC:	103985	Optimistic	481.0	16.1	216.2	0.00	0.0	29.9
Effort (PM):	451.8	Most Likely	601.2	17.4	173.0	0.00	0.0	34.5
Productivity:	230.1	Pessimistic	751.5	18.8	138.4	0.00	0.0	39.9

Project File : D:\cocomo\book\ars detailed.est is Loaded

uncertainty range depends on estimation model



Cost Xpert PERT Inputs

Cost Xpert 3.2 Personal Edition

File Edit Reports Maintain Wizards Tools Help

Project Volume Environment Constraints Results

New Reused COTS Mean SLOC: 55167

Module Name	Best	Expected	Worst	Mean	Std. Dev.
database interface	30,000	37,500	40,000	36,666.67	1,666.67
▶ transaction processing	14,000	18,000	25,000	18,500	1,833.33

+ Add - Remove Save Undo

Description

Hint

Break the project into modules. For each module, estimate the best case, expected, and worst case number of source lines of code. Source lines of code should include header declarations, job control language, and code lines. Do not include blank lines, comment lines, or standard headers provided with the compiler or commercial libraries. Do not

SLOC 1-Function Points 2-Internet Points 3-Domino Points 4-UML Use-Case Pts 5-UML Class Method
6-MK II Function Pts 7-Object Metrics 8-GUI Metrics 9-Feature Points Bottom Up Top Down

online banking Effort: 213.8 Pers-Mth Schedule: 17.1 Months Cost: \$3,216,819.35

Cost Xpert Risk Subtab

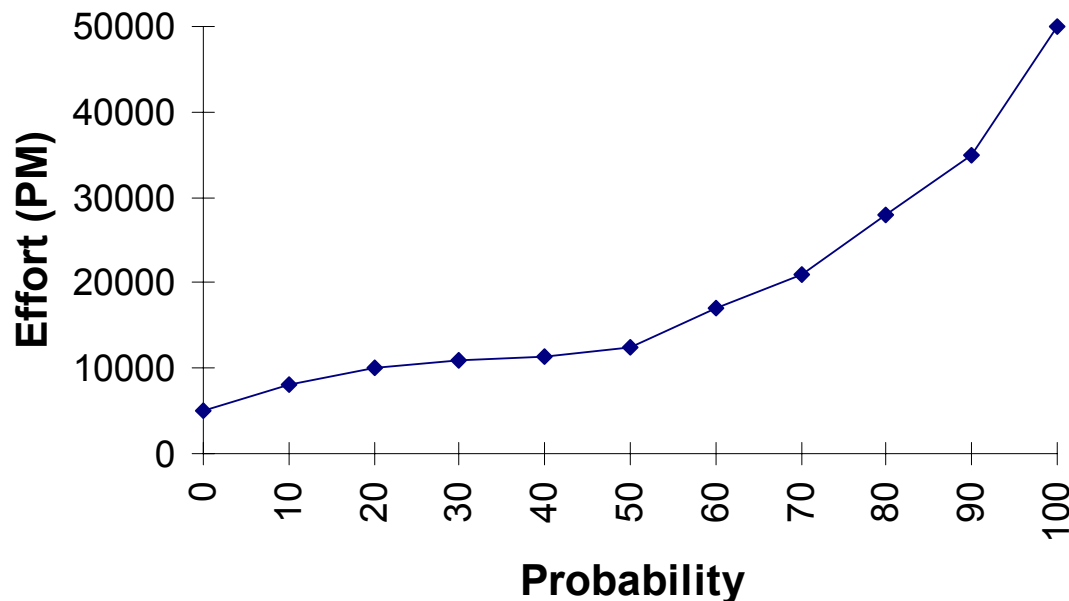
Likely risks for project type

Factor sensitivities

Range depends on PERT size inputs

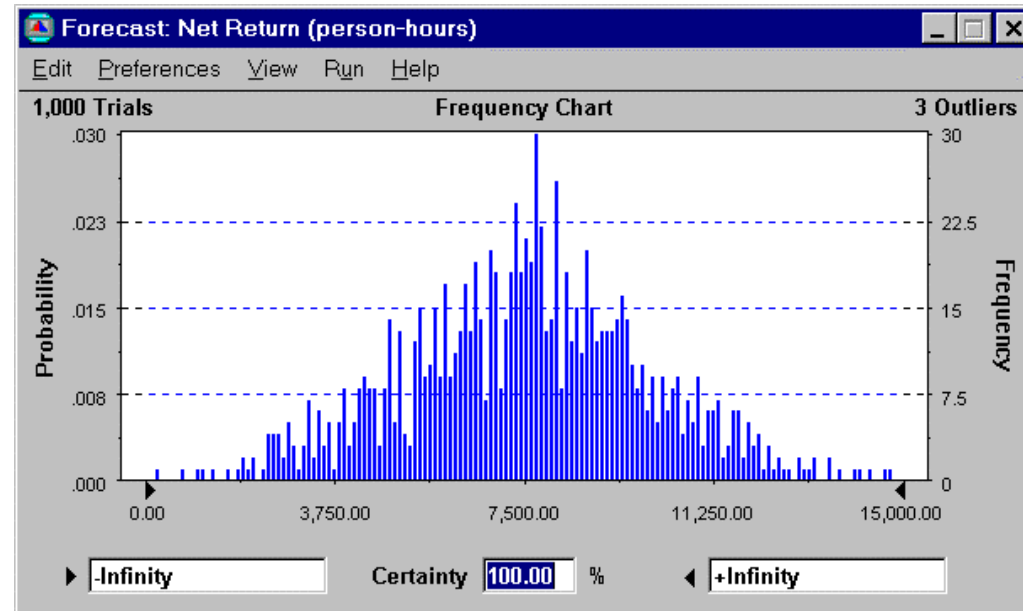
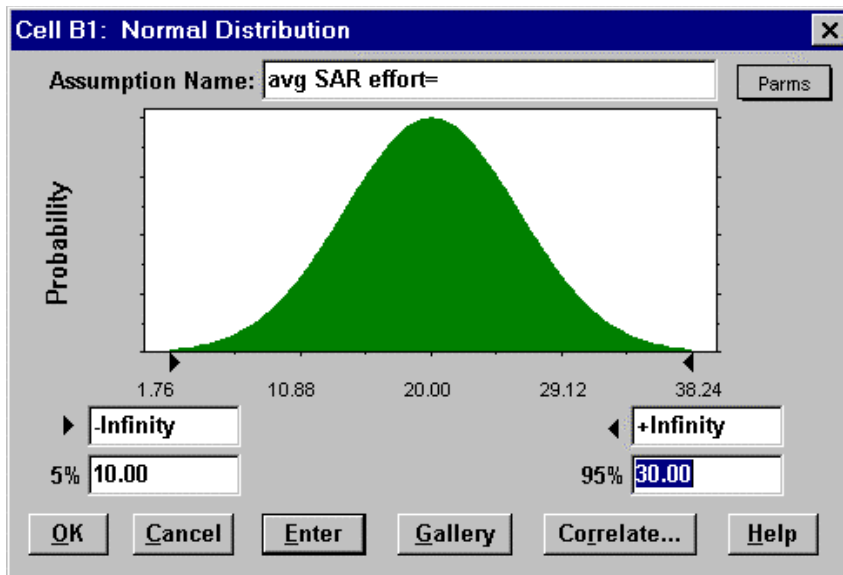
Handling Uncertainty in Other Cost Modeling Tools

- Other tools (e.g. SEER) allow PERT distributions for size and cost driver ranges
- Sample confidence level chart output:



Monte Carlo Tool Example

- Crystal Ball works with spreadsheets to define parameter distributions and run Monte Carlo.
- This software process analysis used an activity-based cost model.



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Summary and Conclusions

- Cost drivers provide a powerful mechanism to identify risks in union with cost estimation.
- Models support risk management by analyzing cost and schedule impacts, tradeoffs and sensitivities.
- Risk exposure is a convenient framework for software decision analysis.
- It's prudent to look at the range of possible results from a cost model rather than use a deterministic point estimate.
- Risk assessment is a continuous process throughout a project lifecycle

Further Information and References

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