Project Estimation and Risk

- practical software estimation
  - general principles of estimation
  - estimating size, complexity, test cases, bugs
  - estimating productivity
  - reasonable estimates and how to give them
- project risk
  - assessment
  - mitigation, monitoring, and management
  - common risk and management approaches

Project Estimation

"Predictions are tough,
particularly when they involve the future."
Yogi Berra

- project estimation involves imponderables
  - we aren't exactly sure what we will do
  - we don't know what problems will arise
  - we don't know what distractions we will have
- inaccurate estimates can be disastrous
  - projects fail because of bad estimates

estimates vs. schedules

- estimates
  - time and resources required for each task
  - usually prepared by engineering
- schedules
  - which tasks will be performed when
  - which resources will be used when
  - when will each task be completed
  - usually prepared by management
- schedules are based on estimates
  - but incorporate much additional information

Estimation Principles

- estimates are not guesses
  - good estimate = good data + good analysis
- estimates are not precise or deterministic
  - it is not a number, but a confidence range
  - estimates start out very "rough"
  - they are revised throughout life of project
- get estimates from multiple sources
  - ask different people to make the estimates
  - use multiple techniques to develop estimates

Estimation Principles - detail

- estimate at a low level of detail
  - for each component, or sub-component
  - for each activity, step, task, and sub-task
- low level estimates invite you to consider
  - the full range requirements to be satisfied
  - the design of the components to be built
  - the methodology to be used to build them
  - the kinds of problems that are likely to occur
- planning and estimating go hand-in-hand

Elements of an Estimate

- Program size
  - LOC, function points, routines, classes, …
- Program complexity
  - algorithmic, data-structures, interactions, …
- Programmer productivity
  - (ready-to-integrate) LOC / day
- Required test cases
  - test cases, LOC, time to get them working
- Bugs we will have to fix at each stage
  - with associated productivity rates

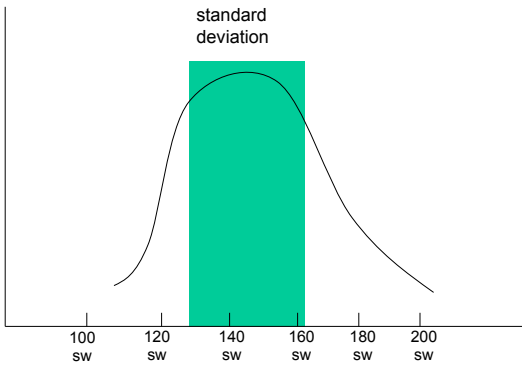
bugs, tests and project size

- simple logic & coding errors tend to be flat
  - for a particular person, problem, technology
- other errors scale with the problem
  - misunderstood specifications
  - misunderstood interfaces
  - unanticipated interactions
- test cases should scale with the risk
  - it will take more tests to find these problems
- interaction problems take longer to debug

Giving Estimates

- you are not allowed to say "I can't"
  - it is part of deciding if a project is viable
- don't just make up a number
  - it will be both wrong and indefensible
- **do what you've been trained to do:**
  - gather data, make assumptions, do analysis
    - put assumptions and analysis out for review
  - present results honestly (as confidence band)
    - be able to provide a basis for every number
    - have a plan for narrowing confidence bands

a reasonable estimate



a back-up slide

Requirements	Architecture	Integration	System test
8-12sw	12-15sw	8-12sw	12-20sw

Design		Coding			Testing			Debugging			total
	sw	LoC	rate /sw	cost (sw)	#	rate /sw	cost (sw)	#	rate /sw	cost (sw)	sw
U/I front end	3 4	1500 2000	150 180	8 13	150 200	20 25	6 10	25 35	8 10	3 5	20 32
Task Applets	2 3	1000 1200	100 150	6 12	150 240	40 50	3 6	15 25	5 6	3 5	14 26
Access Clients	2 3	500 700	120 150	3 6	75 140	40 50	2 4	5 10	4 5	1 2	6 15
Storage Server	4 5	900 1200	100 120	8 12	90 150	25 30	3 6	25 40	3 5	5 13	20 36
Content	1 2	6000 8000	600 900	7 13	N/A	1200	5 6	100 120	40 50	2 3	15 24

Grand Total: 115-192 sw = 25-43sm

Agile and Estimation

- agile methods are not date driven
  - they strive for customer satisfaction
  - flexible requirements demand flexible dates
- agile methods punt on big design probs
  - requirements and plans will change
  - refactor as need for change is recognized
- design and estimation are progressive
  - progressive requirement/task refinement
  - design the next few tasks on the list
  - estimates are based on detailed designs

Estimation: Agile vs. Planned

- they completely agree on basic principles
  - based on a detailed design
  - seek consensus from multiple sources
  - estimates are imprecise and inaccurate
  - be honest, rational, and clear
- they differ on prognostication
  - "Always in motion the future is"
  - "Do the best you can w/available information"
- these represent different project models

Different Models and Goals

- Agile … planning the next sprint
  - the team and sprint cadence are givens
  - how much can we accomplish in this sprint?
- Waterfall … product planning
  - how many people will we need?
  - when will the entire product be complete?
- Does project demand up-front planning?
  - even so, agile processes may still apply
    - continuous integration, regular customer feedback, focused small team sprints

On Risk

"If you're not managing risk, you're managing the wrong thing!"

Rear Admiral Bill Carlson

"Risk Management is Project Management for adults."

Tim Lister

Risks: poor technical planning

- incorrect or incomplete requirements
- designs that can't be built or won't work
- schedule based on inadequate analysis
- team lacks experience w/tools, techniques
- problems that prove harder than expected

Risks: poor management

- schedules imposed without commitment
- external dependencies with no back-ups
- failure to assign required resources
- doing unnecessary/less important work
- failure to monitor progress and problems
- delayed or ineffective problem response
- poor inter/intra-group communication

Risks: unexpected events

- requirements changes
  - customer changes his/her mind
  - evolving competitive landscape
- staffing problems
  - illness, resignations
  - hiring difficulties
- distractions
  - customer emergencies
  - legacy support work-load

risk assessment

- like software failure mode enumeration
  - enumerate all plausible sources of risk
    - unclear/unstable requirements
    - poorly understood technical problems
    - staff size, skills, experience, tools
    - complexities of the domain and platform
  - describe each in as much detail as possible
  - rate each for likelihood and impact
  - order them by risk exposure (likelihood * impact)
  - decide which warrant inclusion in the plan

risk management

- for each high exposure risk, formulate
  - proactive mitigation measures
    - what can we do to reduce its likelihood
    - what can we do to reduce its expected impact
  - reactive monitoring and management plan
    - what danger signs should we watch for
    - how will we respond when problem happens
- cost-benefit comparison of alternatives
  - determine the most cost-effective approach
- incorporate into plans and schedules

Wrap-up on Risk

- this entire course has been about *risk*
  - problems that cause projects to fail
    - their nature and causes
    - the elements of good (and bad) solutions
  - processes to mitigate these risks
    - to prevent them
    - to monitor and manage them
- this is only an introduction/overview
  - **you** must gain facility with the concepts
  - **you** must develop skill in the techniques
  - **you** must develop disciplined approaches

For Next Lecture

- McConnell section 34.7 (risk awareness)
- Wiegers: Successful Project Management
- Brooks: Mythical Man Month (digest)
- Kampe:
  - Project Management Concepts
  - Project Milestones
  - Putnam Norden Rayleigh curves
- Wiki: Earned Value Analysis
- Kampe: SCRUM points and velocity

Supplementary Slides

Estimation Principles - other stuff

- be sure to include other process activities
  - recruiting and training new personnel
  - participation in reviews
  - training for customers, sales and support
  - customer driven travel and meetings
  - hand-holding alpha customers
- be sure to include waiting time
  - for hires, feedback, turn-around time

other project risks

- business risk
  - our business strategy will change *(executive)*
  - the market will change *(inbound marketing)*
  - we won't be able to sell it *(sales)*
- project risk
  - failure to fund or staff *(executive)*
  - external dependencies *(program management)*
  - failure to monitor and manage *(project management))*
- these risks are assumed by other people
  - this is why there are project approval processes