Simulation

Regression analysis

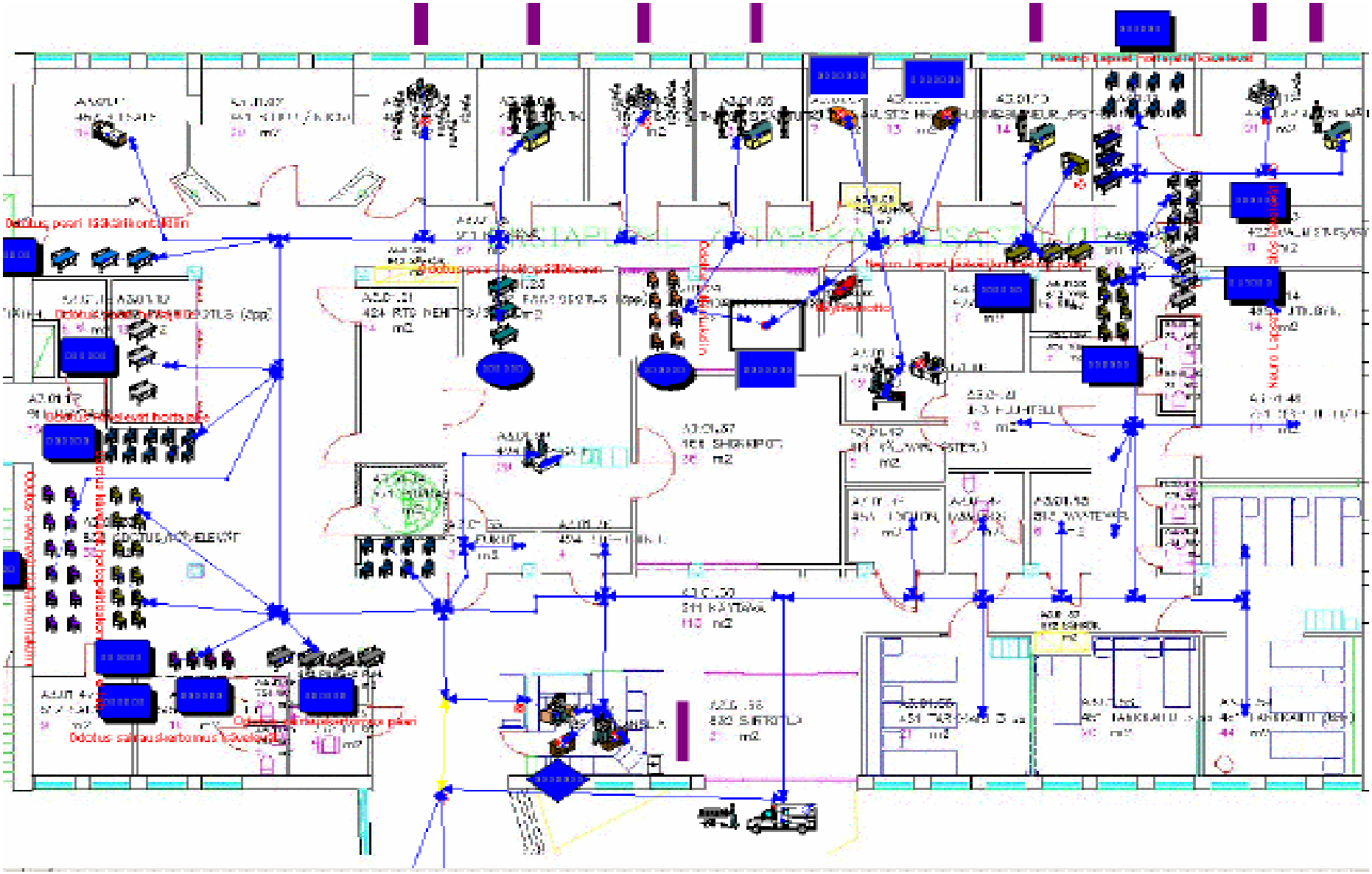
Example

Example of regression analysis

- Considers the emergency unit of the local central hospital (so called NOVA)
- PhD Thesis of Toni Ruohonen 2007
- Goal is to simulate the effect of different operating models to the average client response time

Simulation model

- Detailled simulation model was created of the unit (waiting rooms, consultation rooms, laboratories, distances)
- Patient data was recorded (different diagnoses, durations of operations)
- Commercial MedModel –simulation software was used



Model data

- Real operation was observed to get data to the model
- Total of 6 weeks (24/7), over 4000 patient cases
- Arrival times of the patients, problem types (urgency, needed expertice)

Model data

- Durations of different activities were measured or estimated
  - Time used by doctors, nurses, typists, etc in different operations
  - Time to move objects from one place to another (patient, bed patient, nurse, lab specimens)
  - Physical layout and distances were utilized

Model validation

- Model was simulated with observed parameters
- Simulated and observed sejourn times were compared
- Good match in averages, fair in variances
  - Good fit despite some lacking observation on true durations of activities

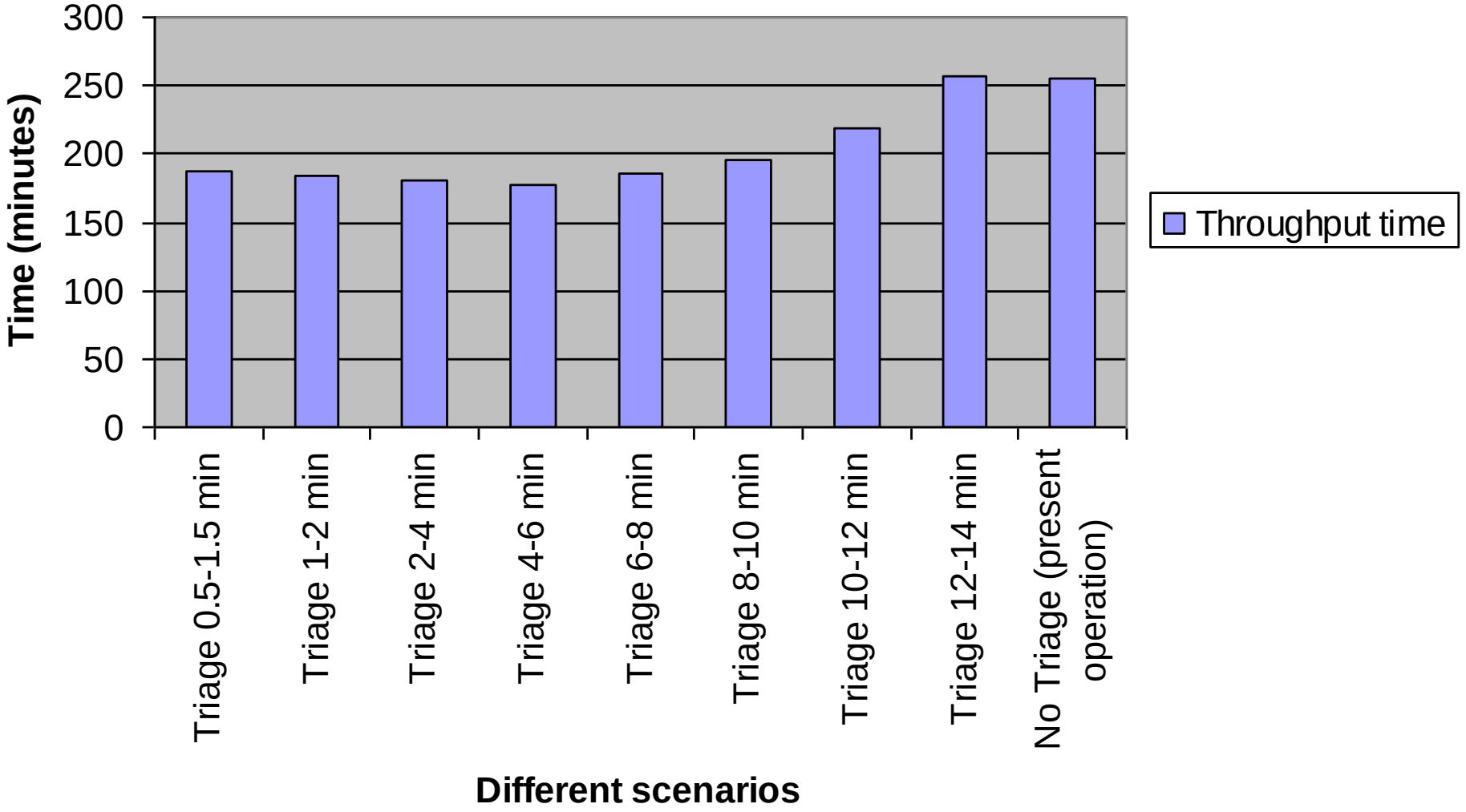
Experimenting with the model

- Goal was to simulate the effect of three functional changes to the sojourn times
  1. Triage (urgency evaluation by a doctor on arrival)
  2. Use of speech recognition to replace typing of dictated reports
  3. Internal tube mail for lab specimens

Experimenting with the model

- Each variant was implemented to the model
- Several levels for durations of the new activities (factors)
- First simulations one factor at time
  - Goal to find maximum allowable times for new operations that would not increase the sojourn times

The effects of different Triage-team scenarios on the average throughput time for the patients



REPLICATION ANALYSIS (Sample size 30)

Statistic	Statistic	Avg	Median	Min	Max	Std Dev	Std Err
Length of stay - Average Value	Triage 1-2min	183.39	187.53	127.01	260.66	35.79	6.53
Length of stay - Average Value	Triage 0.5-1.5	187.31	174.76	120.37	285.60	43.83	8.00
Length of stay - Average Value	Triage 2-4	181.00	180.94	123.38	229.29	26.89	4.91
Length of stay - Average Value	Triage 4-6	178.15	169.85	117.09	322.70	43.91	8.01
Length of stay - Average Value	Triage 6-8	185.63	179.01	117.49	274.54	40.48	7.39
Length of stay - Average Value	Triage 8-10	195.93	194.99	109.73	292.23	40.94	7.47
Length of stay - Average Value	Triage 10-12	218.23	212.42	166.80	295.95	35.92	6.55
Length of stay - Average Value	Triage 12-14	256.93	255.52	184.07	339.98	41.80	7.63

Regression analysis

- Best variant from each factor was selected for further study
- Full 2^3 –experiment to find all joint effects
- All trials fully independent (no covariance analysis needed)

test	x__0	x_1	x_2	x_3	x_12	x_13	x_23	x_123	y
1	1	-1	-1	-1	1	1	1	-1	255,07
2	1	1	-1	-1	-1	-1	1	1	178,15
3	1	-1	1	-1	-1	1	-1	1	234,07
4	1	-1	-1	1	1	-1	-1	1	221,31
5	1	-1	1	1	-1	-1	1	-1	196,13
6	1	1	1	-1	1	-1	-1	-1	164,57
7	1	1	-1	1	-1	1	-1	-1	167,1
8	1	1	1	1	1	1	1	1	144,32
	195,09	-31,56	-10,32	-12,88	1,23	**5,05**	**-1,67**	-0,63	

Confidence interval 4,62, so only main effects and X_13 significant. I.e. all options improve but 1 and 3 partly contradict each other.

Regression analysis

- Observing the tests closer one can find that factor at a time experiment would not give significance to factor 2 (with used amount of replications, 30)
- Partial (2^3-1) experiment would not help as factor 2 and joint effect of 1 and 3 are aliased