

Written Exam Public Transport

Written Exam	Public Transport (195421200-1A)
Teacher	van Zuilekom
Course code	195421200
Date and time	20-1-2015, 13:45-16:45
Location	HB 2E
Remarks	Closed book, calculator allowed, English dictionary allowed Formulas and tables are, when necessary, part of the question.

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Calculation of the marks:

- The maximum number of points of this written exam, P_{max} , is 100
- The marks for the written exam, C , is calculated by the sum of points, P , times ten divided by the maximum number of points:

$$C = 10 \cdot \frac{P}{P_{max}}$$

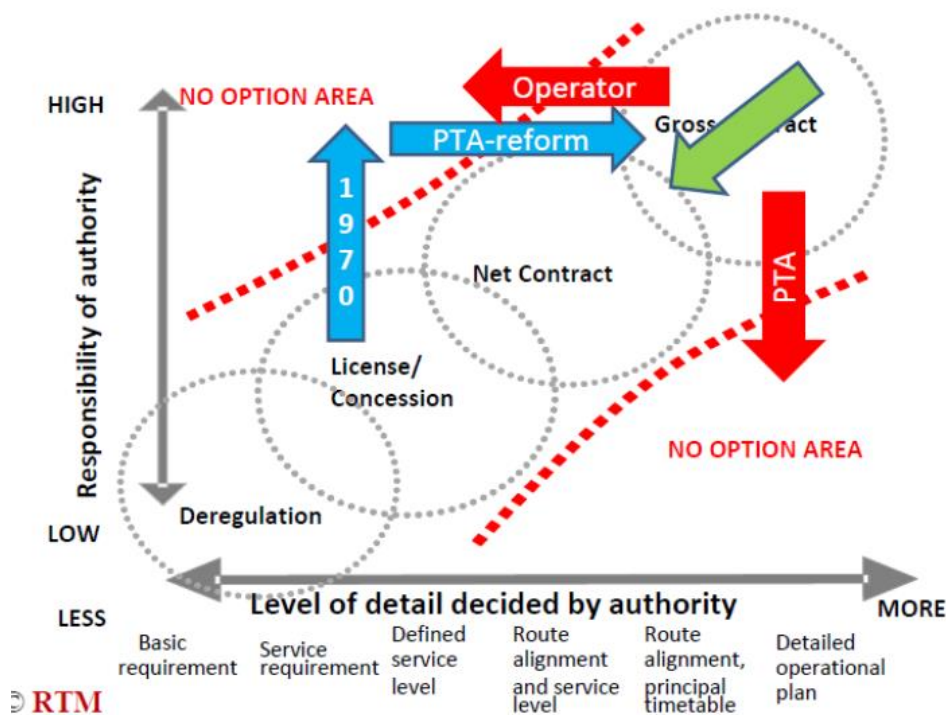
- Available time is 180 minutes (+ 25% for 'extra time students').

Question 1 (6 points) –The Swedish contract model

Beneath you will find a schematic picture of contract models and roles in PT (from the Swedish government).

- (2 points) Describe why the 'NO OPTION AREAS' are no option areas.
- (2 points) Describe where we are right now in the Dutch situation.

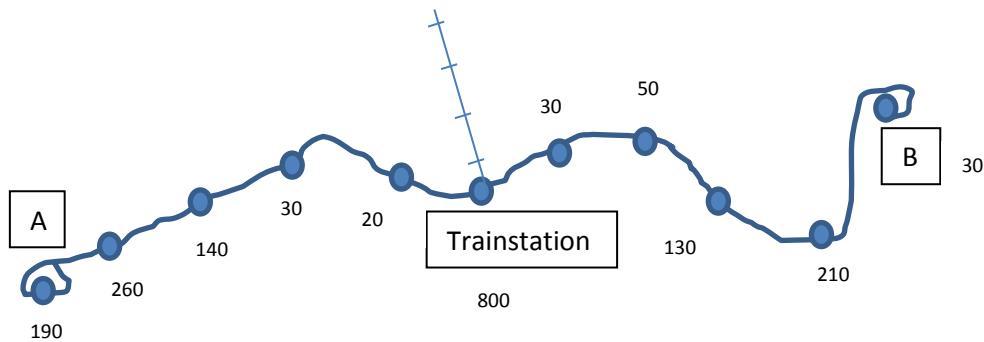
Contract models and roles



The Swedish government has recently (2012) developed a new Transport Act. One of the ideas is that besides granting regular concessions to the best PT-company, (other) PT companies are invited to deliver commercial (none subsidized) PT-services. This will bring deregulation closer. Suppose that this development to deregulation is considered in the Netherlands.

- (2 points) What kind of changes are necessary in the current laws and regulations to make this possible?

Question 2 (18 points) –Building a Timetable



The image above is the visualisation of a city bus line (A-B) with the number of boarding passengers during a standard working day.

Some facts:

Circulation time Station-A-Station: 45 minutes

Circulation time Station-B-Station: 31 minutes

Walking time between train and bus: 3 minutes

Trains arrive every hour at the station/terminus at .14 and .44 and leave at .20 and .50.

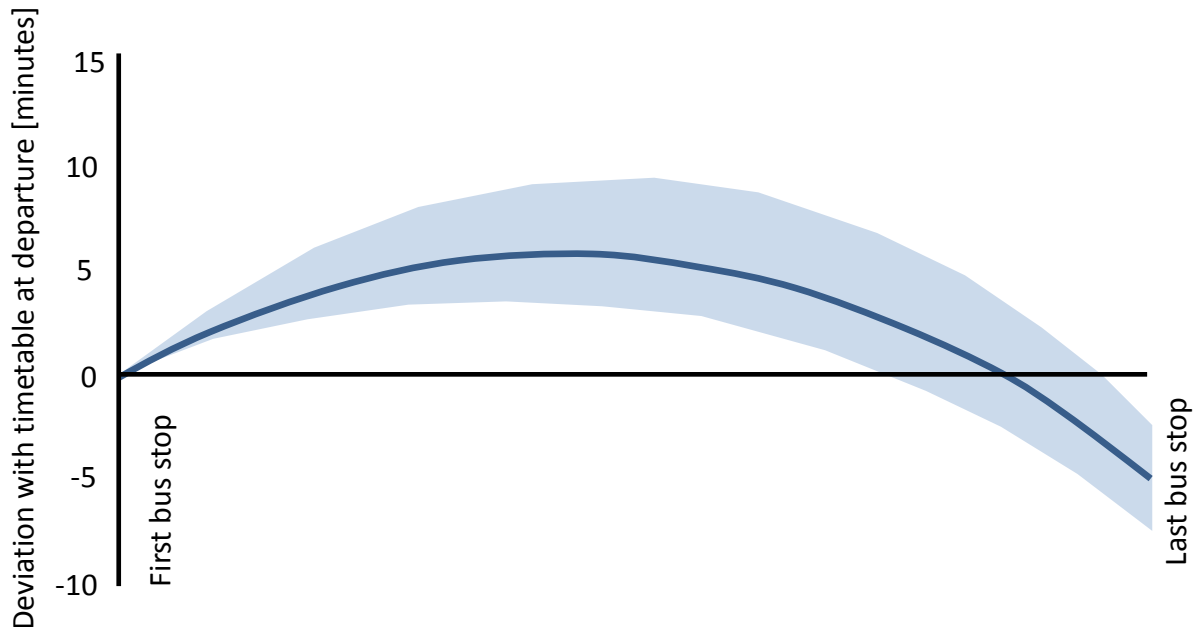
The standard frequency for line A-B on an working day is 2 busses/hour.

As a professional transport planner you will have to take the following steps:

- (4 points) make an effective connecting diagram for train and bus; this diagram shows the arrivals and departures
- (5 points) make a time – way diagram for line A-B, based on the connecting diagram in a)
- (4 points) calculate the number of busses needed for line A-B
- (5 points) make a proposal how to minimize the number of busses and make an estimation how it will affect the cost cover percentage

Question 3 (7 points) – Delay at bus stops

- a) (4 points) The publishing of the timetables by a bus company is the final result of a number of important steps to 'build the exploitation'. Name and explain the 7 steps prior to the publishing of the timetables.



The image above shows the average delay of busses in minutes (vertical axis) on the bus stops of a certain line (horizontal axis).

- b) (3 points) Explain why busses usually arrive too late at bus stops.

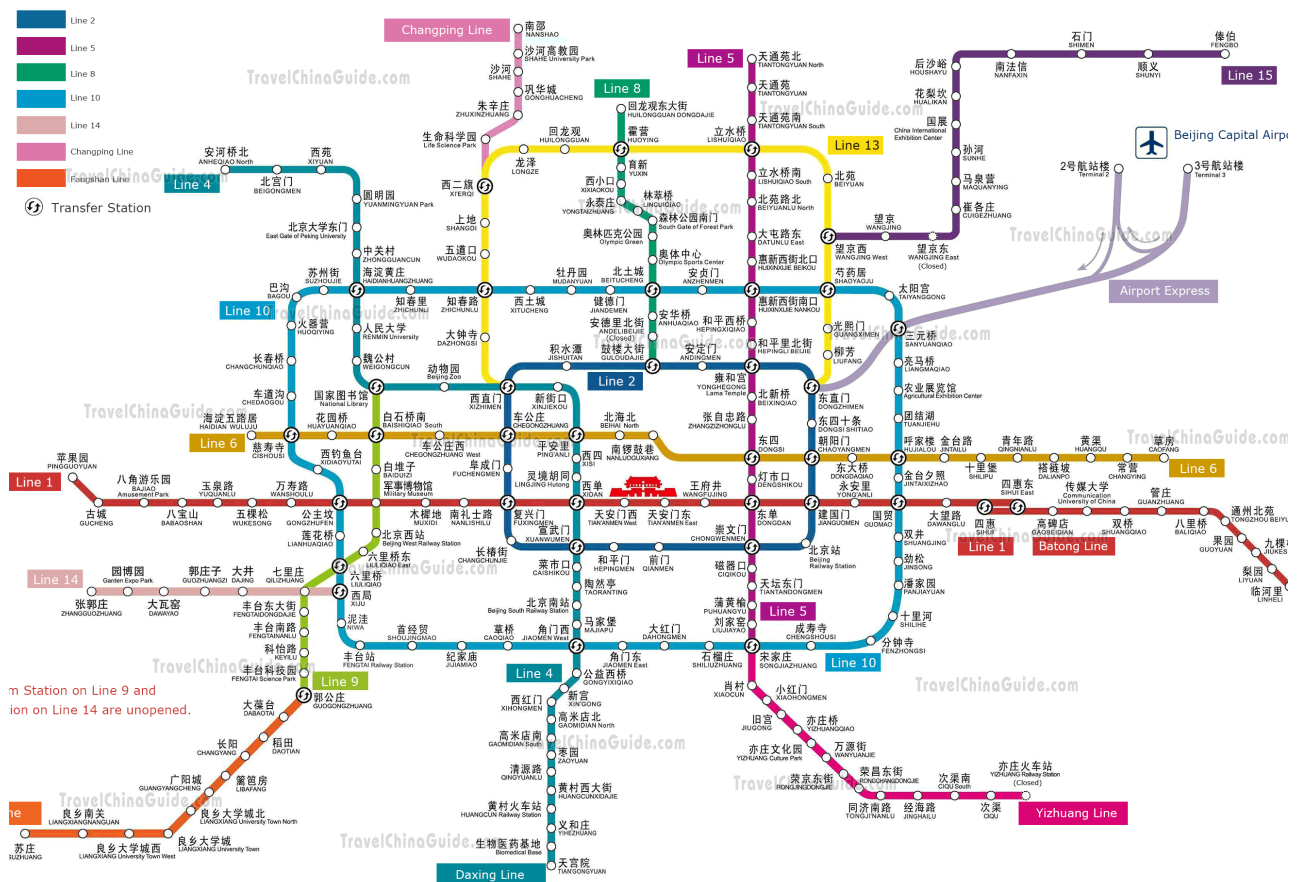
Question 4 (10 points) – Lines and networks

See the metro map of Beijing below.

a) (3 points) Name the types of the following lines:

- Line 6
- line 9
- line 10
- Yizhuang line.

b) (7 points) Calculate the number of different possible transfer movements (transfer permutations) at the intersection between line 2, line 4 and line 13.

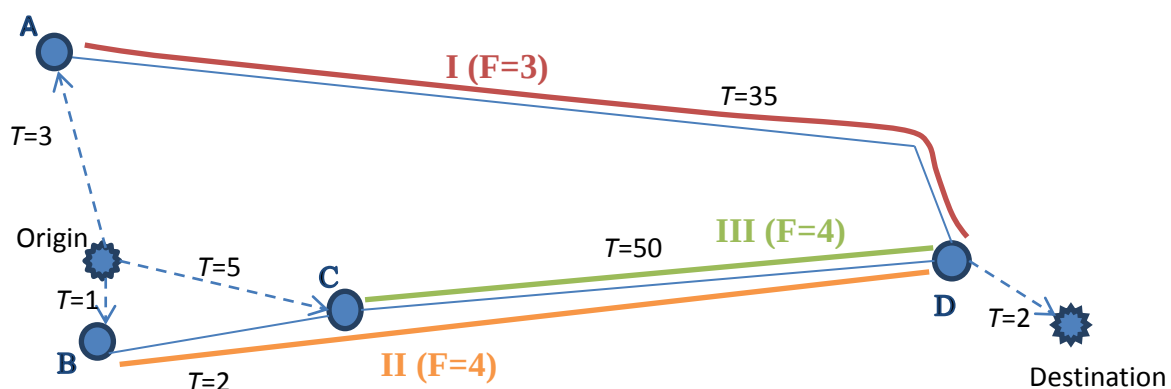


Note: Colour-blind are allowed to ask assistance in interpretation of the colours in the map.

Question 5 (24 points) – Public transport assignment

Consider the following PT network, consisting of 1 origin, 1 destination, 3 access links, 1 egress link, 4 nodes / stops (A, B, C and D), 3 transit links and 3 transit lines (I, II and III). Transit line I calls at stop A and D, has frequency (F) 3 per hour and a flat fare of €5.00. Transit line II calls at stop B, C and D and has frequency 4 per hour. Transit line III calls at stop C and D and has frequency 4 per hour. Line II and line III have a flat fare of €3.00.

The travel times T of (access, egress and transit) links are given in the network (in minutes). Assume the dwell time (for line II) at stop C to be equal to 0. Stops A, B and C are within the search radius from the origin. Assume that transferring from transit line II to transit line III at stop B involves such a high transfer penalty, that it is not a choice option for the traveler.



This transit network results in 4 routes being used by the travelers (if a different line is used this is considered as a separate route).

a) (20 points) Calculate the fractions for the use of each route for this OD pair. For that, take the following into account:

- Calculate the generalized costs in time units (minutes), assuming that waiting time has a 50% higher weight than in-vehicle travel time (factor 1.5). Access / egress travel time is equally weighted as in vehicle time. Other cost components (like distance or fare) are not considered in this question.
- Calculate the waiting time at stops by assuming that passengers arrive completely random at the stop and that the transit services run completely reliable with equal headways.
- Use the choice models within the Zenith algorithm: the formulas are given below. The stop choice parameter (θ) is 0.2 and the access service choice parameter (λ) is 0.1.

b) (4 points) Explain in words what would happen to the route fractions calculated in a) if fare is included in the generalized costs calculations.

All formulas necessary for this question you will find below.

Formula for stop choice:

$$P_s = \frac{e^{-\theta C_s}}{\sum_{x \in S} e^{-\theta C_x}}$$

Where:

P_s : fraction for stop s

C_s : generalized costs when using stop s

S : set of candidate stops at the origin

θ : stop choice parameter

Formula for service choice (= line choice):

$$P_l = \frac{F_l e^{-\lambda C_l}}{\sum_{x \in T} F_x e^{-\lambda C_x}}$$

Where:

P_l : fraction for line l

F_l : frequency of line l

C_l : generalized costs when using line l

T : set of candidate lines at the stop

λ : service choice parameter

Question 6 (10 points) – Data sources

Mention three different types of data sources that are used in PT related studies. Describe to what end these data are used or can be used.

Question 7 (10 points) – Changzhou China

In Changzhou China, Public Transport use is relatively large. Argue how the high PT share in the modal split can be sustained in Changzhou. Provide a credible “counter” argument to the claim PT share can be sustained at this level.

Question 8 (15 points) – Mass and energy

In ‘A systems approach to reduce urban rail energy consumption’ González-Gil et al. state:

‘The ratio of the traction energy saving percentage over the mass reduction percentage is estimated to be about 0.6–0.8 for urban rail’

- a) (7 points) What is meant with ‘*the mass reduction percentage is estimated to be about 0.6–0.8 for urban rail*’? Give a numerical example to illustrate your answer.
- b) (8 points) This estimated range of 0.6-0.8 of the mass reduction percentage is specific for urban rail. Will this mass reduction percentage be influenced by the average distance between stations? Explain why and (if applicable) in which direction the mass reduction percentage will change if the average distance between stations gets larger.