VECOM - vehicle communication Beacon on the route.

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Process Management and Operation Control of Public Transport → TRITAPT

http://vkk042.citg.tudelft.nl/hermes/ontime/19990609001o1.html

Theo H.J. Muller

June 1999

Quality on line 001 route 01 on 19990609 June 9, 1999 — Title

"On time" → Between -30 seconds and 90 seconds from the scheduled time

Public Transport Functions

- **Social Function**
  - Provide Transportation for transit captives with no viable alternative means of transport
- **Accessibility Function**
  - Provide Transit Capacity towards Activities
- **Substitution Function**
  - Provide an alternative for the car
- **Economic Function**
  - Invest in Most Cost-efficient Mode of Transport
  - Car Dependency
  - Provide for a Back-up System (oil crisis)

Operational Quality

- **Speed**
  - **Travel Time**
- **Reliability**
  - **Departure in time**
  - **Arrival in time**
- **Comfort**
  - **Travel circumstances**
  - **Certainty**

Speed Control

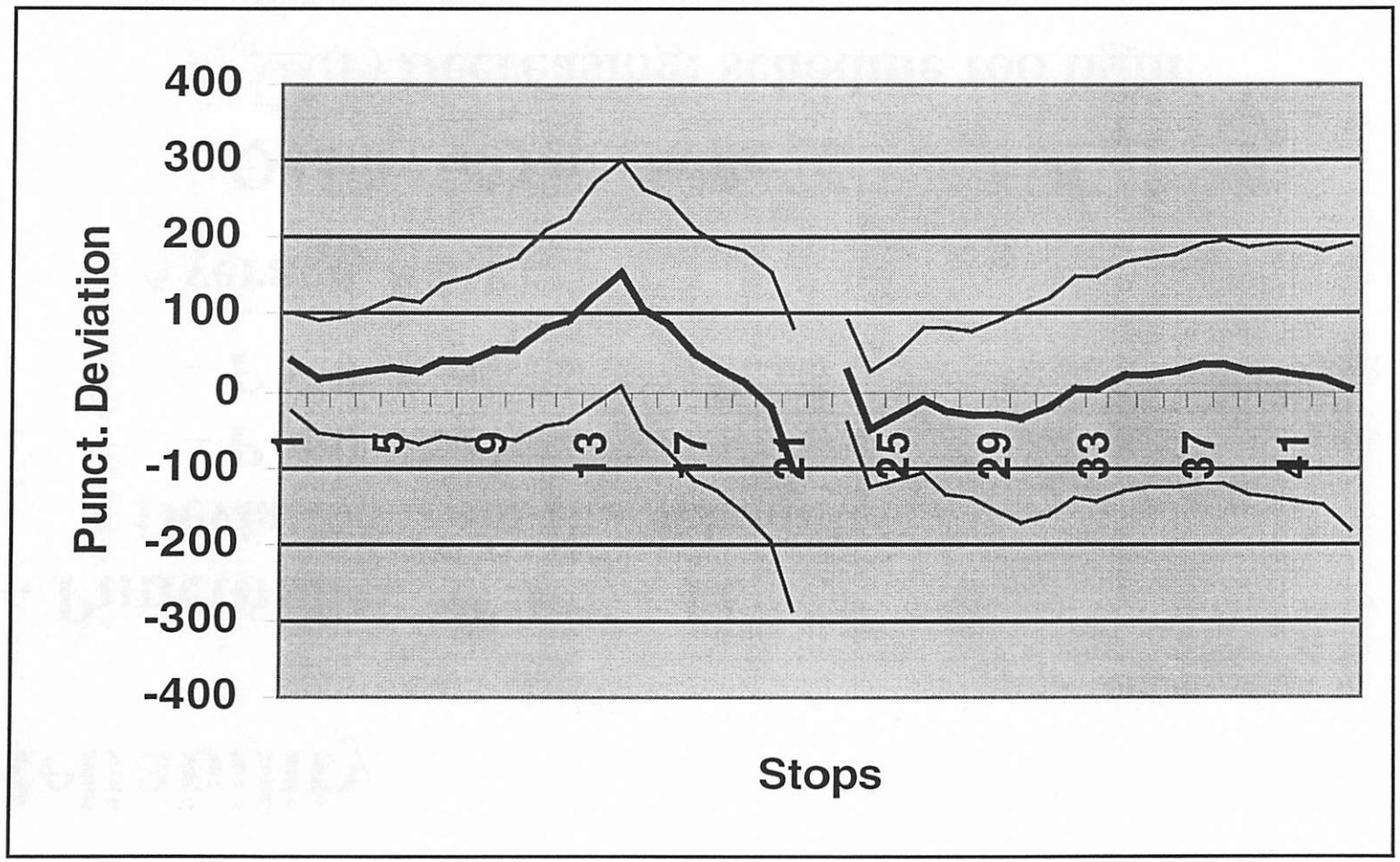
- **Increase Vehicle Speed**
  - **Bus Lanes**
  - **Priority Control at Intersections**
    - **General Priority**
      - **Adjust Flow rates**
    - **Absolute Priority**
      - **Multiple Realization of tram/bus phases**
      - **Truncation of conflicting Streams**
      - **Extension of Parallel Stream**
- **Decrease Waiting Time at stop**
  - **Punctual and Regular Operation**

Operational Quality

- **Reliability**
  - **Punctuality P = T - Tt**
    - **Deviation from the Schedule**
      - **P < 0 Early** — **0% < -1 min**
      - **P > 0 Late** — **85% < 2 min**
    - **Average**  **(P)** — **< 1**
      min
      - **Quality of Timetable**
      -  **(P) Decreasing: schedule too tight**
      -  **(P) Increasing: schedule too generous**
    - **Standard deviation**  **(P)** — **< 1.5**
      min
      - **Quality of operation (Waiting Time)**
      -  **(W) =**  *****  **(P)**

Punctuality

- **Radial Bus Line 25**
  - Positive : Late
  - Negative : Early



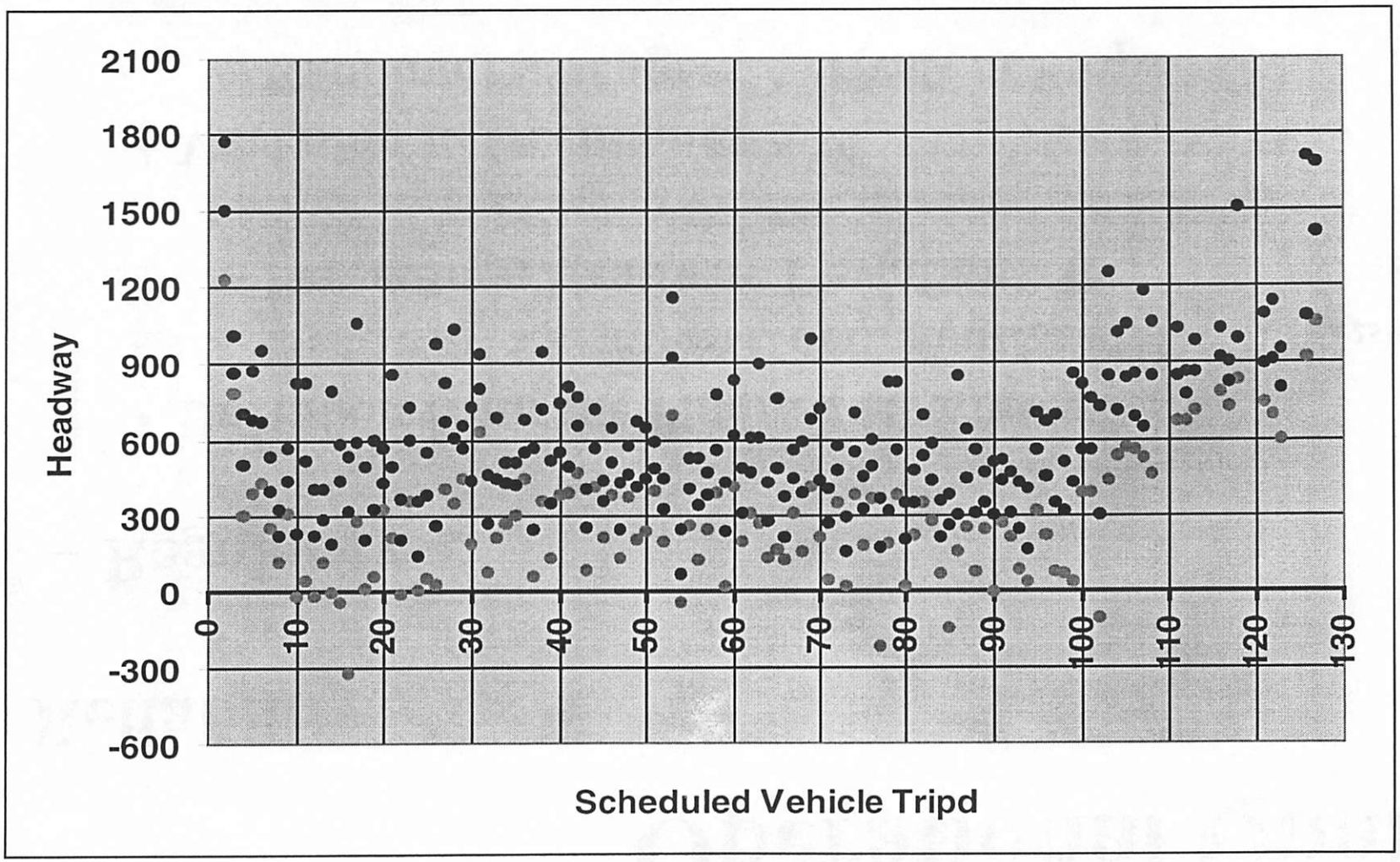
Operational Quality

- **Reliability**
  - **Regularity**
    - **Deviation from the Planned Headway**
      - **Headway Variation Coefficient: cv(H)** <25%
      - **Percentage Headway Deviation: R** <25%
    - **Variation in Occupancy**
      - **Random Passengers Arrivals at Stops**
    - **Increasing Waiting Time**
      - $\square(W) = \frac{1}{2} * \square(H) * (1 + cv(H)^2)$
      - $\square(W) = \frac{1}{2} * \square(H) * (1 + (\square(R))^2)$

???

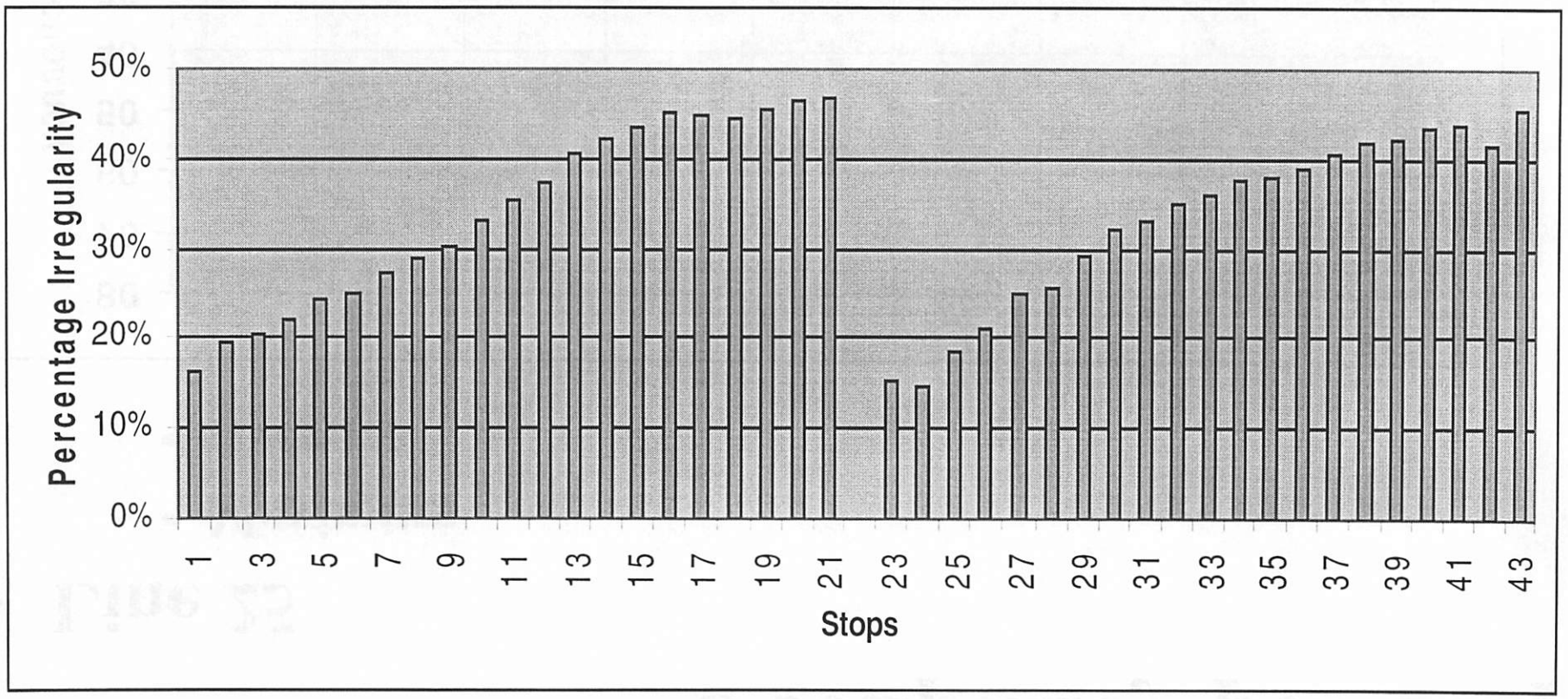
Headways

- **Radial Bus Line 25**
  - **Max. Min. and Average Headway per Vehicle Trip**



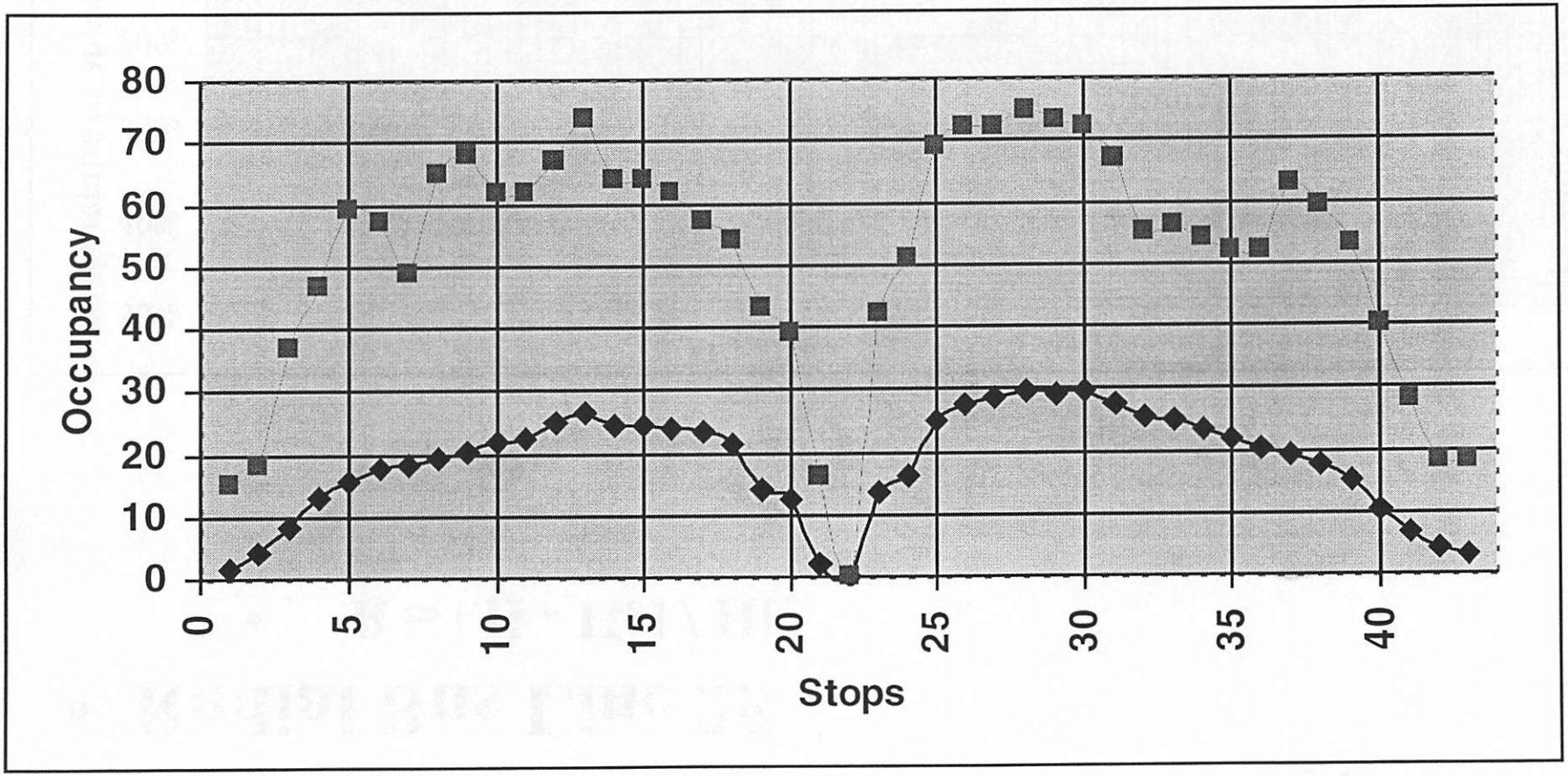
Regularity

- **Radial Bus Line 25**
  - **R = | H - Ht | / Ht**
  - **(R)**
  - **Var (H)**



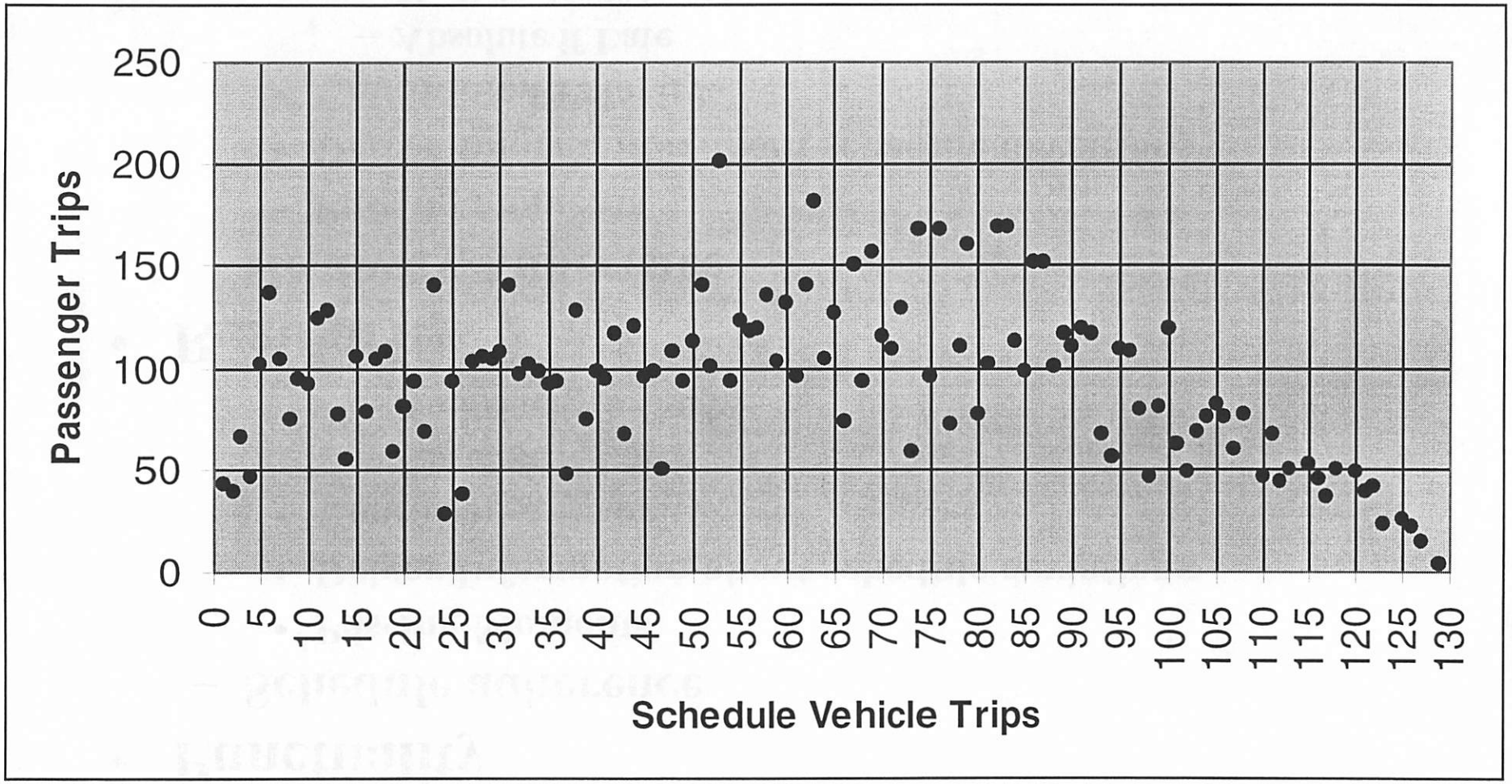
Occupancy per Stop

- **Line 25**
  - **Maximum**
  - **Average**



Unlinked Trips per Vehicle

- **Line 25, 129 Vehicle Trips**



Operational Control

- **Punctuality**
  - **Schedule adherence**
    - **Passing Moments**
    - **Driver Information about schedule deviations**
    - **Conditional Priority**
      - **Absolute if Late**
      - **No Priority if Early**
- **Regularity**
  - **Headway Adherence**
    - **Passing moments**
    - **Driver Information about schedule deviations**
    - **Conditional Priority**
      - **Absolute if Late**
      - **No Priority if Early**
- **Synchronism**
  - **Static attuning**
  - **Dynamic attuning**

Operational Quality

- Comfort
  - Occupancy (depends on time of day)
    - Probability of a seat
    - Probability of standing place
  - Convenience
    - System quality
      - Frequency
      - Policy headway
  - Information
    - Schedule deviations,
    - Skipped trips
    - Directions

Improving Operating Quality

- **Process Management**
  - Planning Time Tables
  - Involvement Personnel
  - Quality Control

- **Operational Control**
  - Speed (minimizing delay)
  - Punctuality (schedule adherence)
  - Regularity (headway adherence)
  - Synchronism (attuning services)

Process Management

- Route Schedule Planning
  - Data collection and Analysis
- Involvement personnel
  - Inform and listen to drivers, and dispatchers
- Implementation
  - Equipment and Procedures
- Quality Control
  - Data Collection and Analysis
  - Quality Information
    - Drivers, Planners, Maintenance, Management,
    - Subsidy providers
  - Responsibility
- Feed Back (adjust planning)

Planning Time Tables

- **Route Time**
  - **Feasibility Condition** 85%
    - **Average Route Time**
    - **Route time Standard Deviation**
  - **Homogeneous Periods of the Day**
    - **Feasible Route Time Deviation**
- **Passing Moments**
  - **Delay Early Vehicle**
  - **Decrease Punctuality Standard Deviation**

Involvement of personnel

- **Motivate**
  - **Inform / Consult / Promise**
- **Adjust Schedules**
  - **Explain / Consult / Attune**
- **Apply skills**
  - **Trust / Participation**
- **Sense of Ownership**
  - **Inform**
- **Control**
  - **Inform / Call to account**

Operational Control

- **Speed control**
  - **General Priority Control at Intersections**
  - **Absolute Priority control at Intersection**
- **Punctuality control**
  - **Passing Moments**
  - **Conditional Priority Control**
- **Regularity Control**
  - **Passing Moments**
  - **Conditional Priority Control**
- **Synchronization control**
  - **Passing Moments**
  - **Static Tuning (Off line: Transfer Scheduling)**
  - **Dynamic Tuning (On line: Schedule Adjustment)**

Quality Control

- *Travel Time*
  - *Access/Egress Time*
    - *Planning Quality*
  - *Waiting Time at boarding stop*
    - *Operation Quality (Punctuality/Regularity)*
  - *Trip Time*
    - *Infrastructure Quality (including Control)*
  - *Transfer Time*
    - *Operation quality (Synchronicity)*

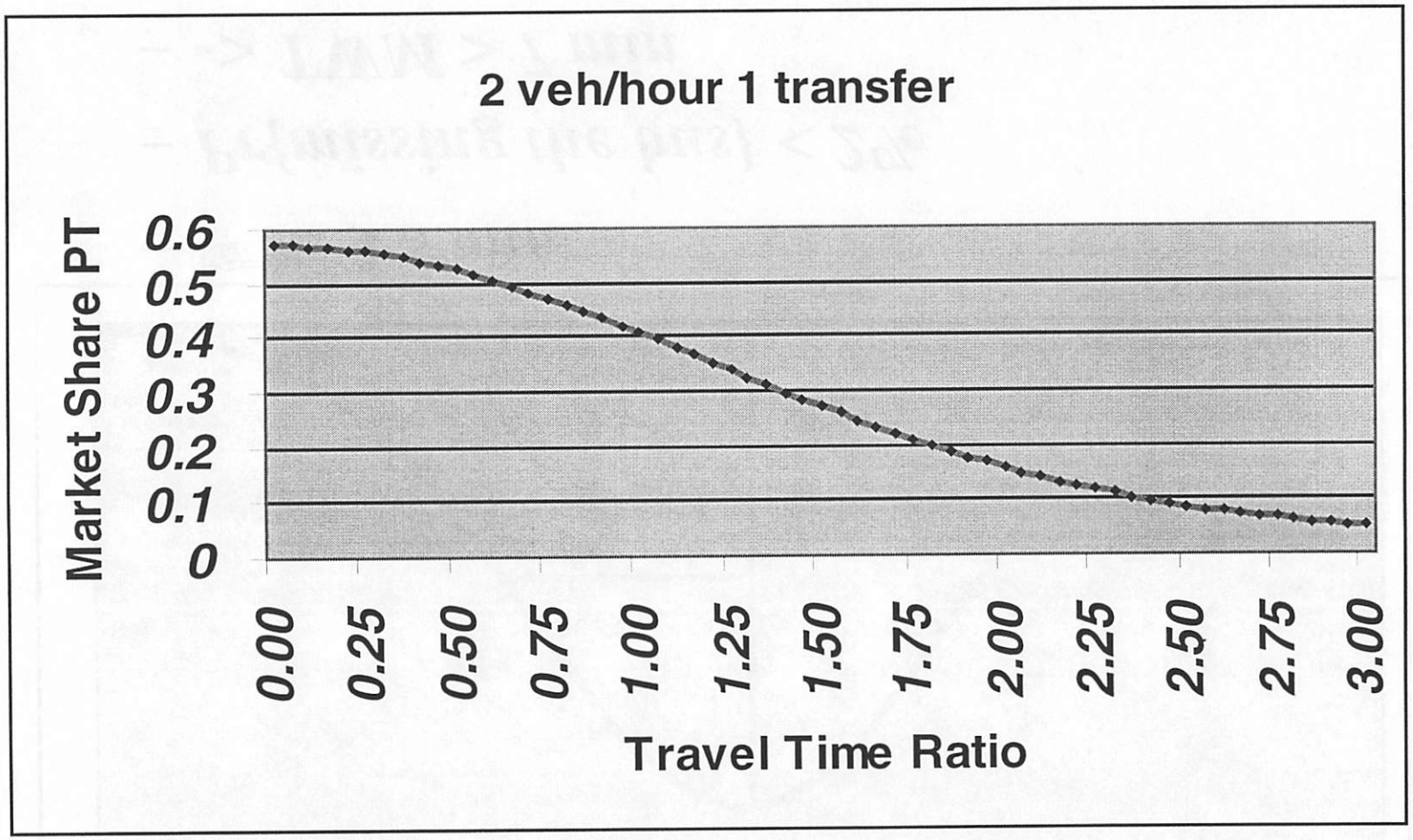
Travel Time Ratio

- ***Travel time by PT / Travel time by car***
  - ***Access time : 5 min 0 min***
  - ***Waiting time : 7 min 0 min***
  - ***Trip time : 35 min 21 min***
  - ***Egress time : 4 min 2 min***

  - ***Total : 51 min 23 min***

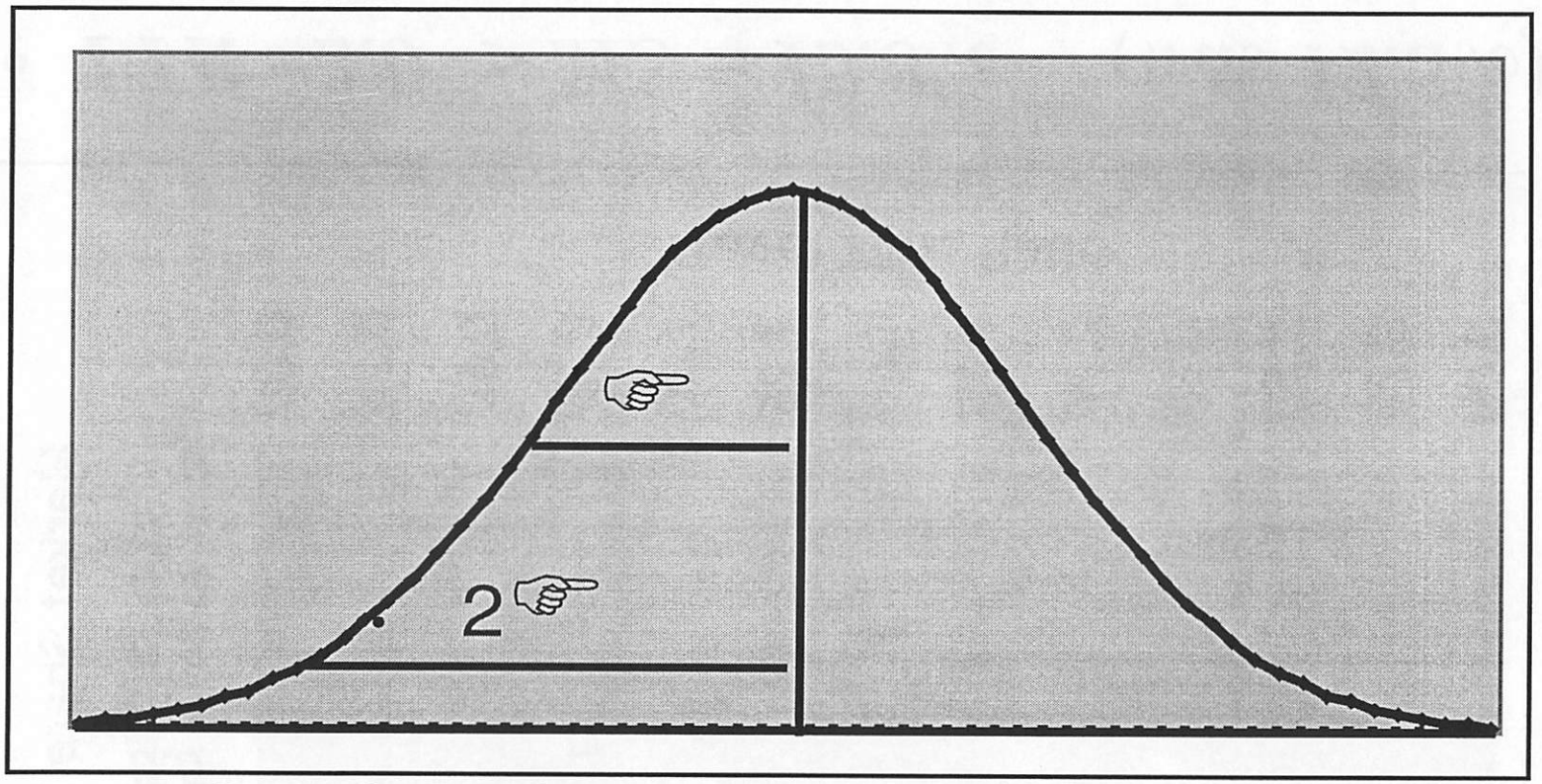
- ***Ratio TTR = 51/25 = 2.2***

Market Share PT



- *TTR =2.0 -> MS = 15.8% (was 12.5%)*
  - *> 27% Increase of Customers*

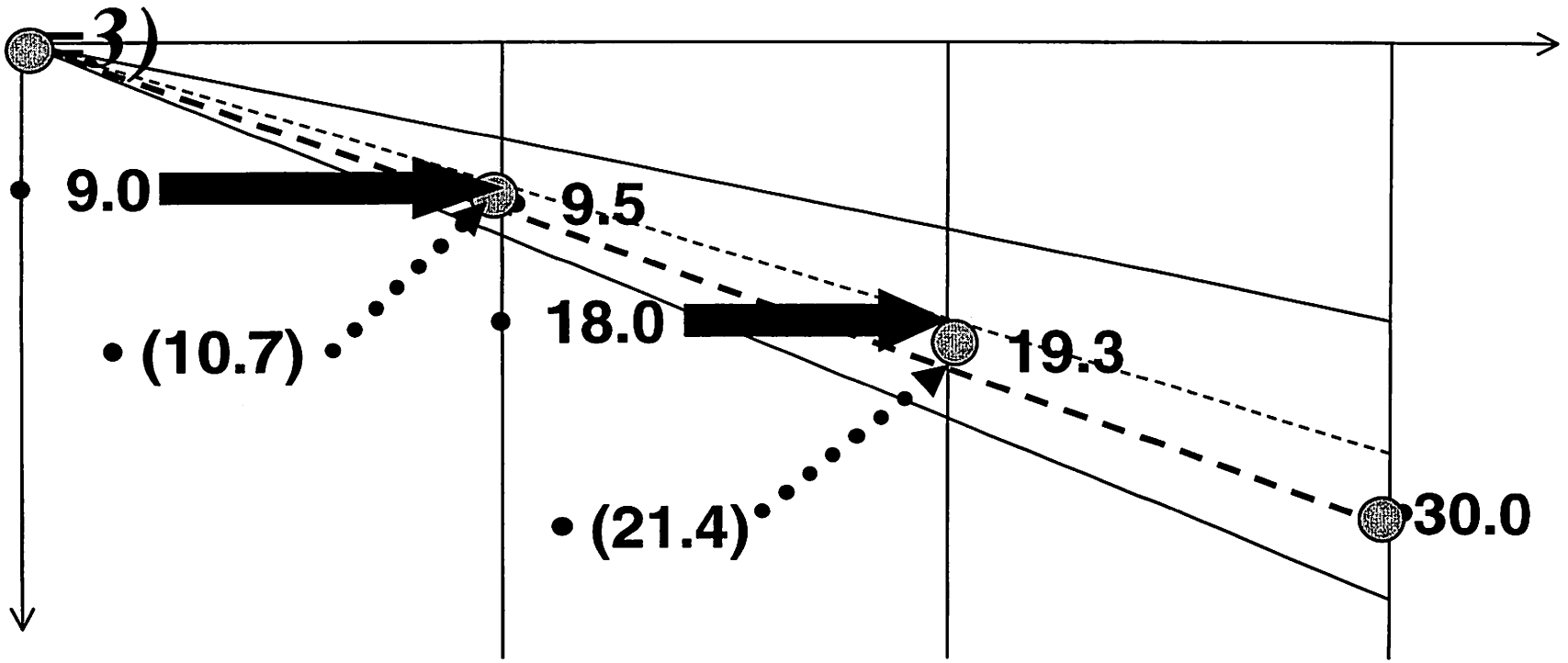
Passenger Arrival



- ☞ = 3.5 min
- Pr{missing the bus} < 2%
- -> TWM > 7 min
- Commuters

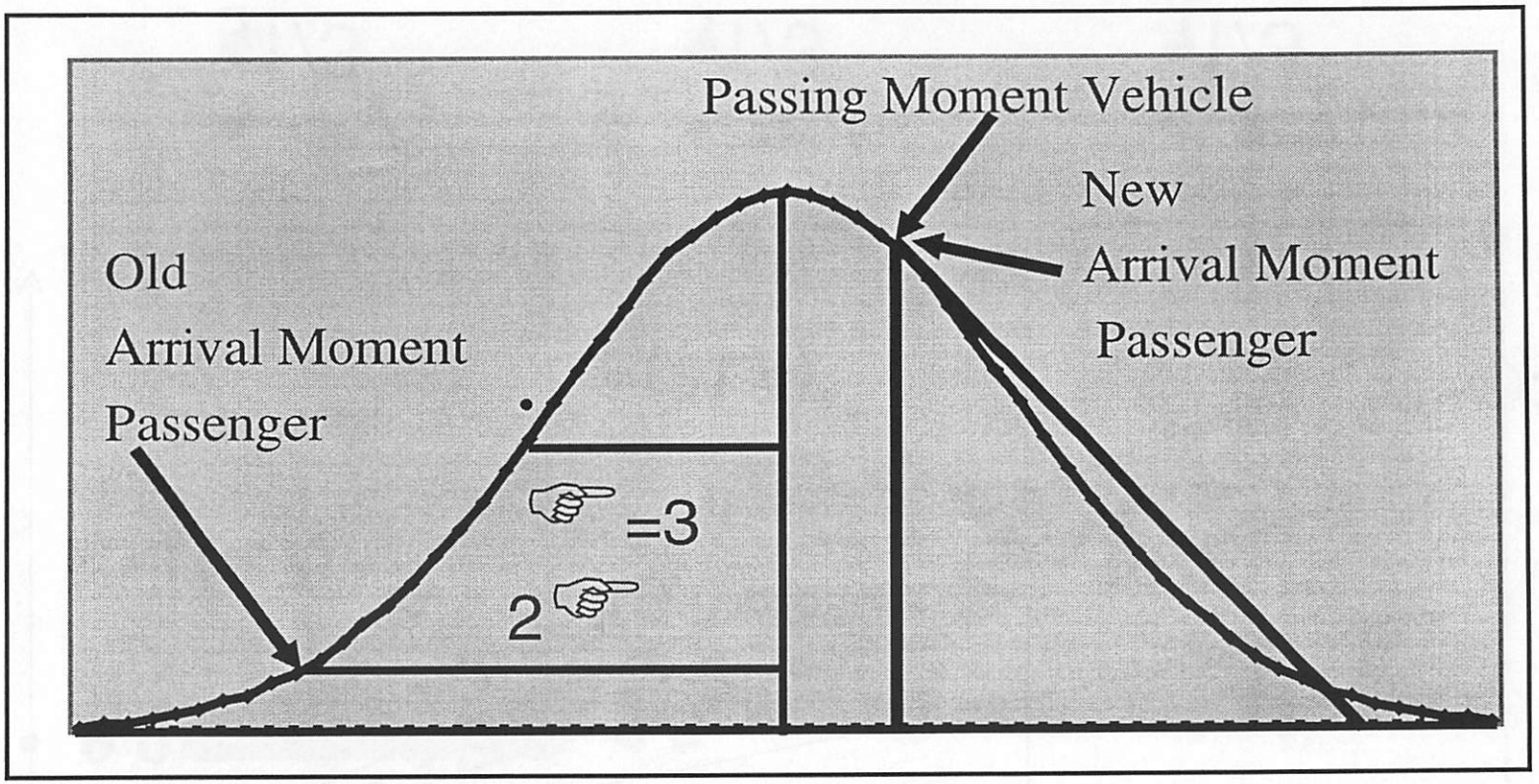
Route Times

- *TST85 = 💻 + 1.04 * ☞ (💻 =27, ☞ =3)*



- ☞ /√ 3 1/3 💻
- ☞ /√ 3 1/3 💻
- ☞ /√ 3 1/3 💻

Passenger Arrival

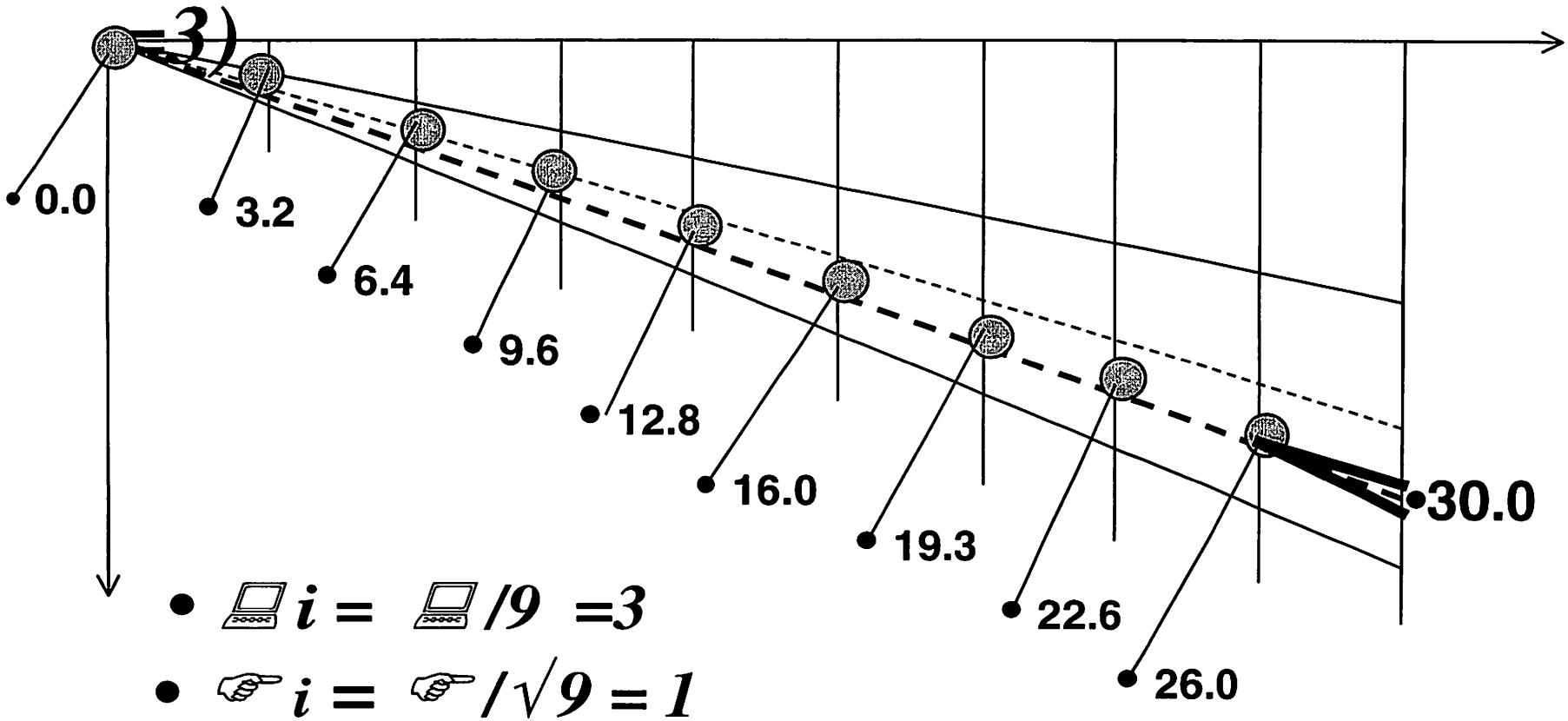


- *Commuters*
- ☞ *= 3 min*
- *Pr{missing the bus} < 2%*
- *-> W > 6 min*

*W = 60% * 0 +*
*40% * 1/3 * 6*
= 0.8 min

Passing Moments

- *TST =* 💻 *+ 1.04 * ☞ (💻 *=27,* ☞ *=3)*



- 💻*i =* 💻*/9 =3*
- ☞*i =* ☞*/√9 = 1*