

Assessing Reasonableness of Activity-based Model: Example of Work Activity Generation and Workers' Travel Scheduling Models

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SCAG ABM Framework

1. Population Synthesis

2. Long-term Choices

2.0 Preschool Arrangement

2.1 Usual School Location

2.2 Work Arrangement

2.3 Usual Work Location

2.4 Work Scheduling Flexibility

3. Mobility Choices

3.1 Driver License

3.2 Auto Availability

4. Generation-Allocation

Mandatory Activity Generation

Child Mandatory Activities

4.1.1 Frequency

4.1.2 Start/ End Time

4.1.3 Trip Mode

Adult Mandatory Activities

4.2.1 Frequency

4.2.2 Start/ End Time

4.2.3 Allocation of Dropoff/Pickup

Non-Mandatory Activity-Tour Generation

4.3.1 Participation decision

4.3.2 Time budget

4.3.3 Non-Mandatory Time allocation

4.3.4 Serve Passenger Activity Generation

4.3.5 Tour Formation

5. Joint Activity Scheduling

5.1 Primary purpose

5.2 Start time

5.3 Location

5.4 Tour mode

5.5 Duration of intermediate stop

6. Tour Scheduling

6.1 Adult Mandatory Tour

6.1.1 Tour Mode

6.1.2 Stop purpose and duration

6.1.3 Distance to stop

6.1.4 Stop Location

6.1.5 Departure, Return time period

6.2 Non-Mandatory Tour: Worker

6.2.1 Tour window

6.2.2 Primary destination

6.2.3 Tour mode

6.2.4 Stop purpose and duration

6.2.5 Distance to stop

6.2.6 Stop Location

6.3 Non-Mandatory Tour: Non-worker

6.3.1 Tour window

6.3.2 Primary destination

6.3.3 Tour mode

6.3.4 Stop purpose and duration

6.3.5 Distance to stop

6.3.6 Stop Location

Population Synthesis
Long-Term Choice
Mobility Choice
Activity Generation & Allocation
Joint Activity Scheduling
Tour Scheduling

SCAG ABM Development Schedule

Stage 1: 2009-2013

- Framework Design
- Model Development

Stage 2: 2013-2015

- Model Enhancement
- Implementation
- Calibration & Validation

SCAG ABM Development Team

Academia
UT, UCSB,
ASU

Theory,
Design

Consultant
PB

Estimation,
Calibration,
Validation

**Software
Developer**
Caliper

Software,
Output
Analysis

SCAG
Modelers

Testing,
Operation

ABM Challenge to Planning Agency Modelers

- It's new
- Framework is complicated
- Many sub-models
- Estimated by advanced techniques
- Output analysis

Question:

Do we fully understand our new model?

Model Assessment & Presentation Purpose

Model assessment procedure:

- Carried out in-house
- A self-learning procedure
- Assisted by consultants

Purpose of this presentation

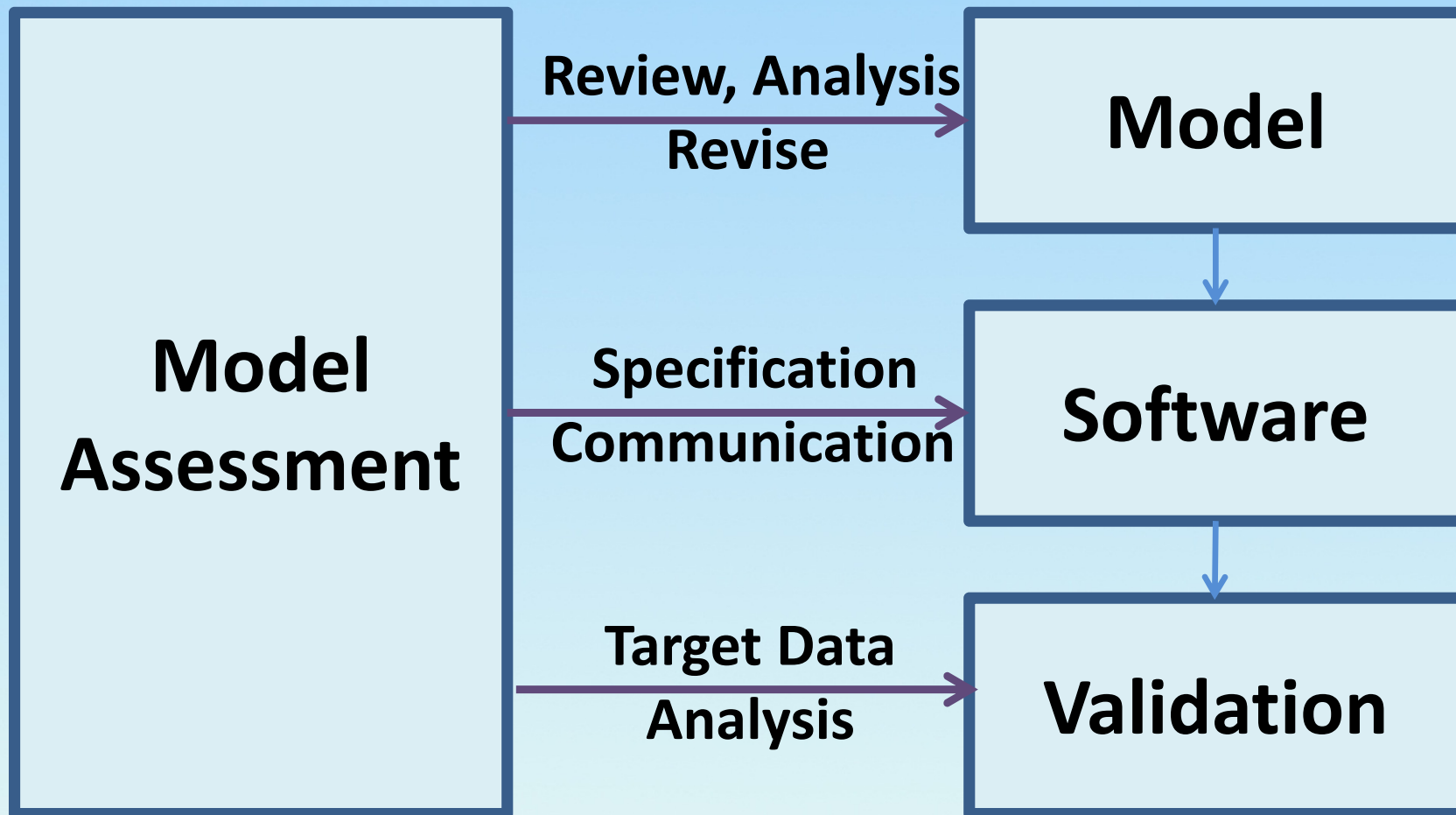
- Introduce SCAG's model assessment framework and procedure

Goals of Model Assessment

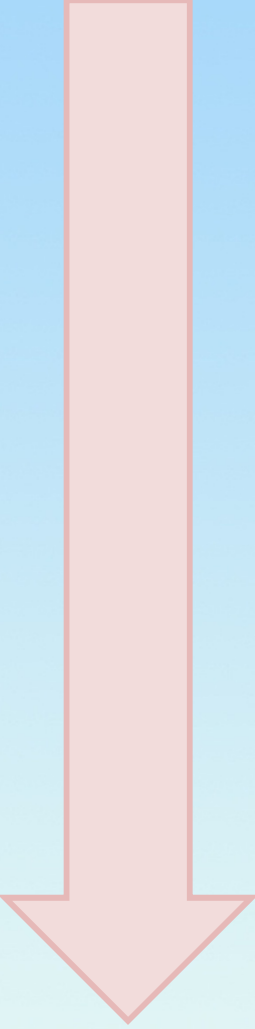
SCAG modelers should be able to:

- Fully understand each (sub)model,
- Analyze household survey,
- Re-estimate each model,
- Create model specification,
- Develop validation target, and
- Validate/Calibrate model

Model Assessment Procedure

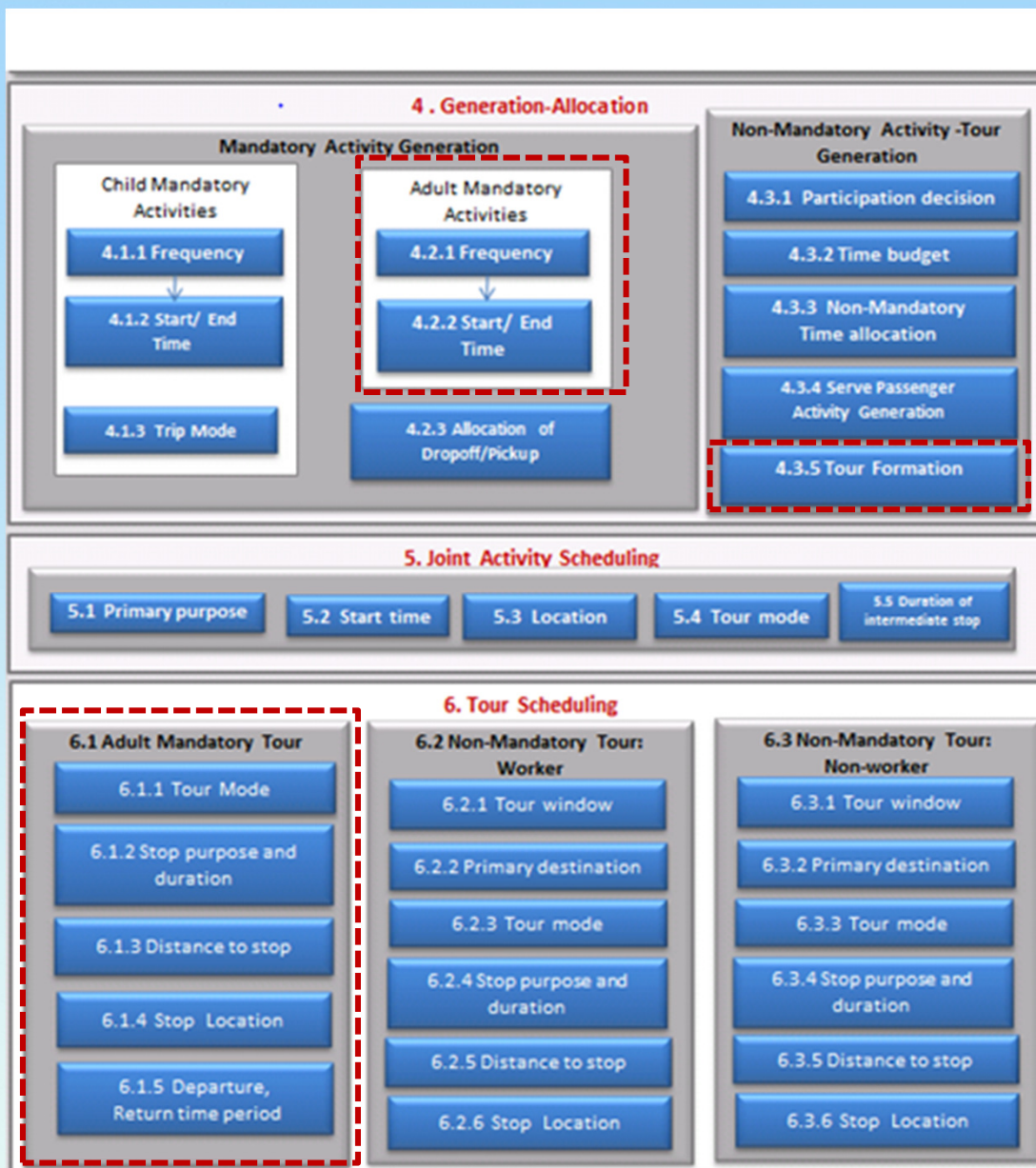


Model Assessment Tasks

- 
- Analyze Household Survey
 - Model Review
 - Model Re-estimate
 - Software Implementation
 - Model Output Analysis
 - Model Calibration & Validation
 - 1-2 meetings each week

Example of Model Assessment

Work Activity Generation & Travel Scheduling Models



- Frequency
- Start/ End time
- Tour duration
- Tour mode
- Stop purpose & duration
- Distance to stop
- Stop location
- Time period

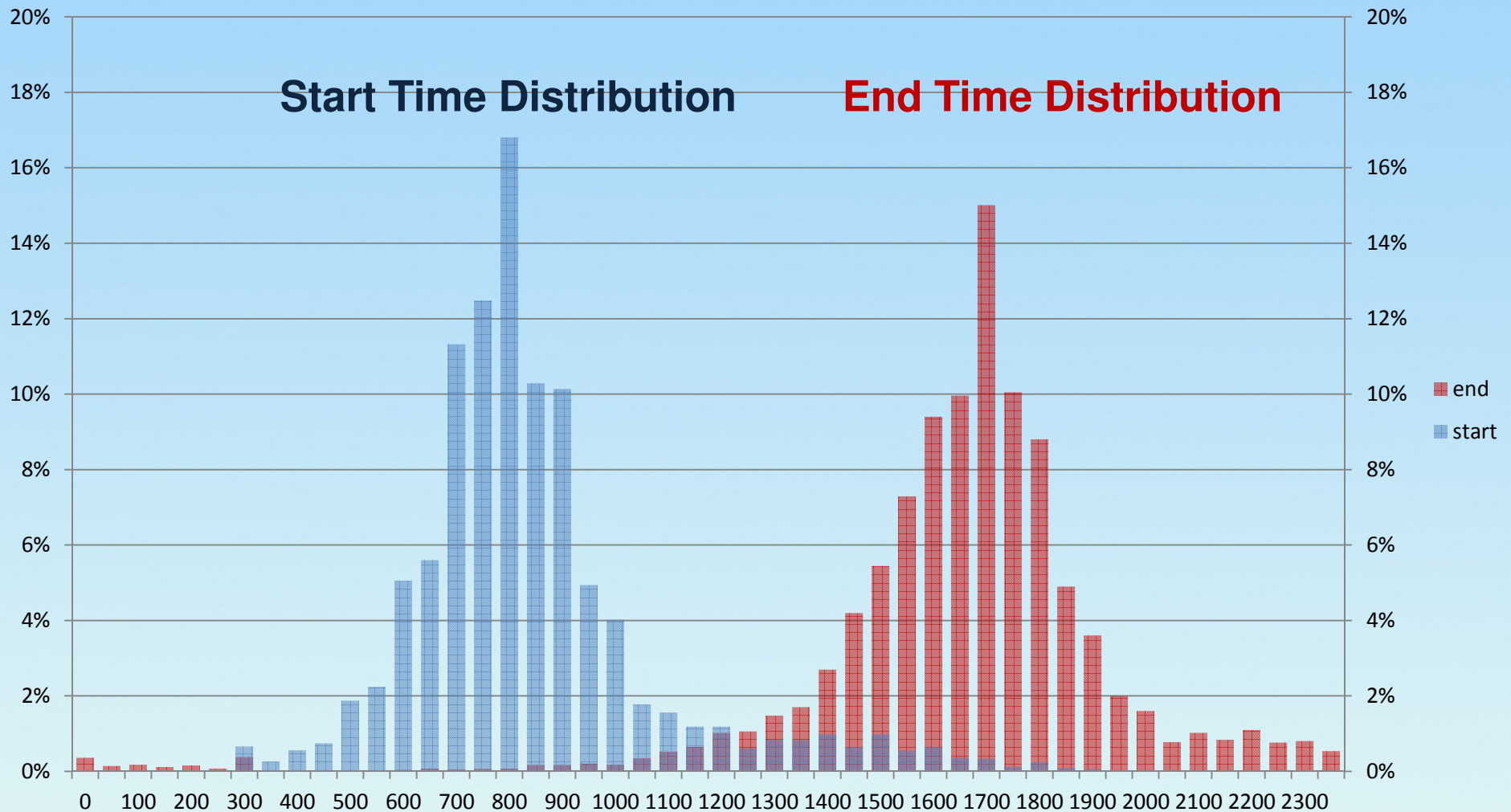
1. Analyze Household Survey

- Analyze variables related to the model:
 - Individual attributes
 - Household attributes
 - Work characteristics
 - Land use & built environment
 - Accessibility

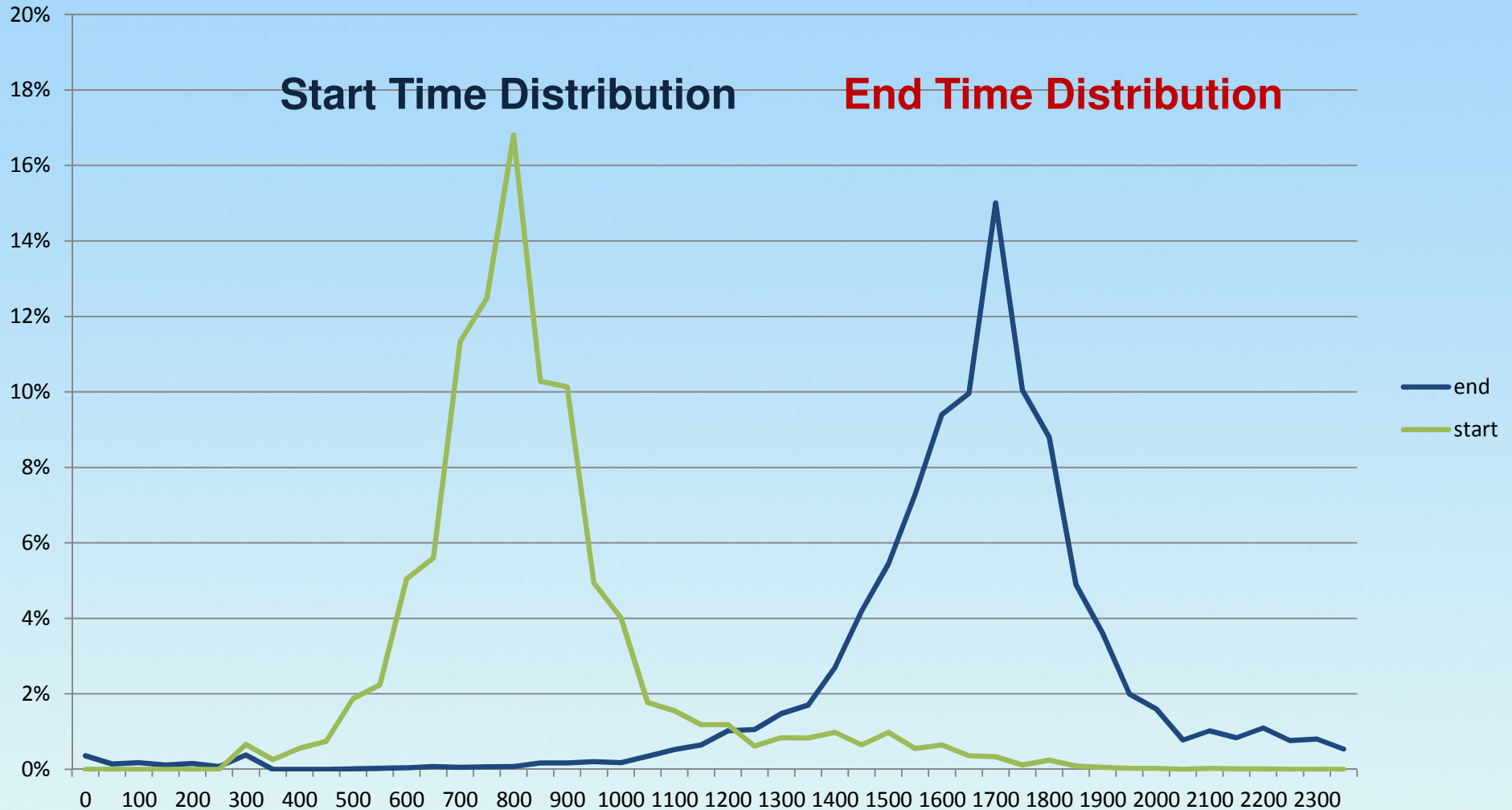
Example:

Workers' Work Start, End time, Duration

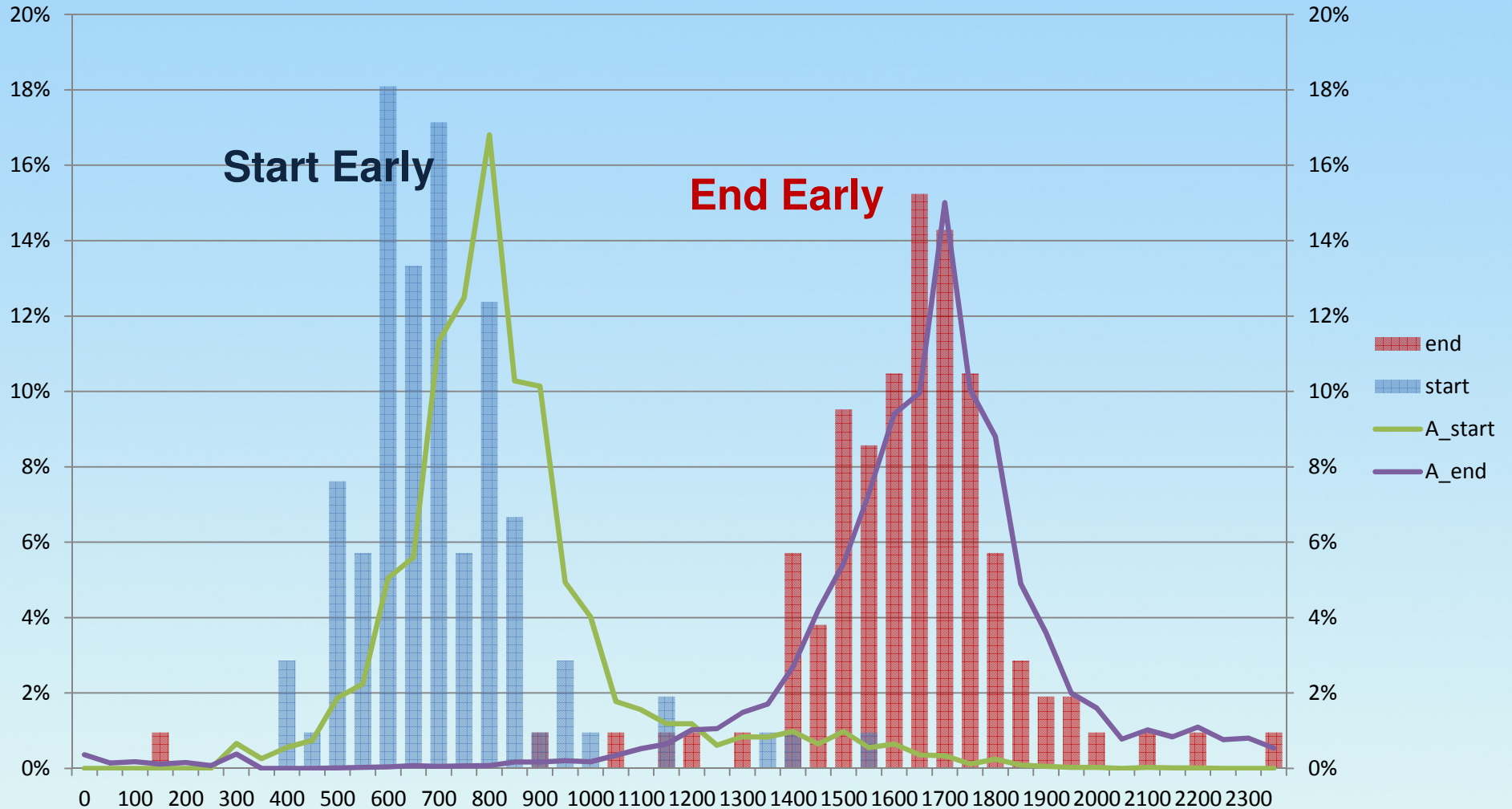
Overall Worker's Work Start Time and End Time by 30 Minutes



Overall Worker's Work Start Time and End Time by 30 Minutes

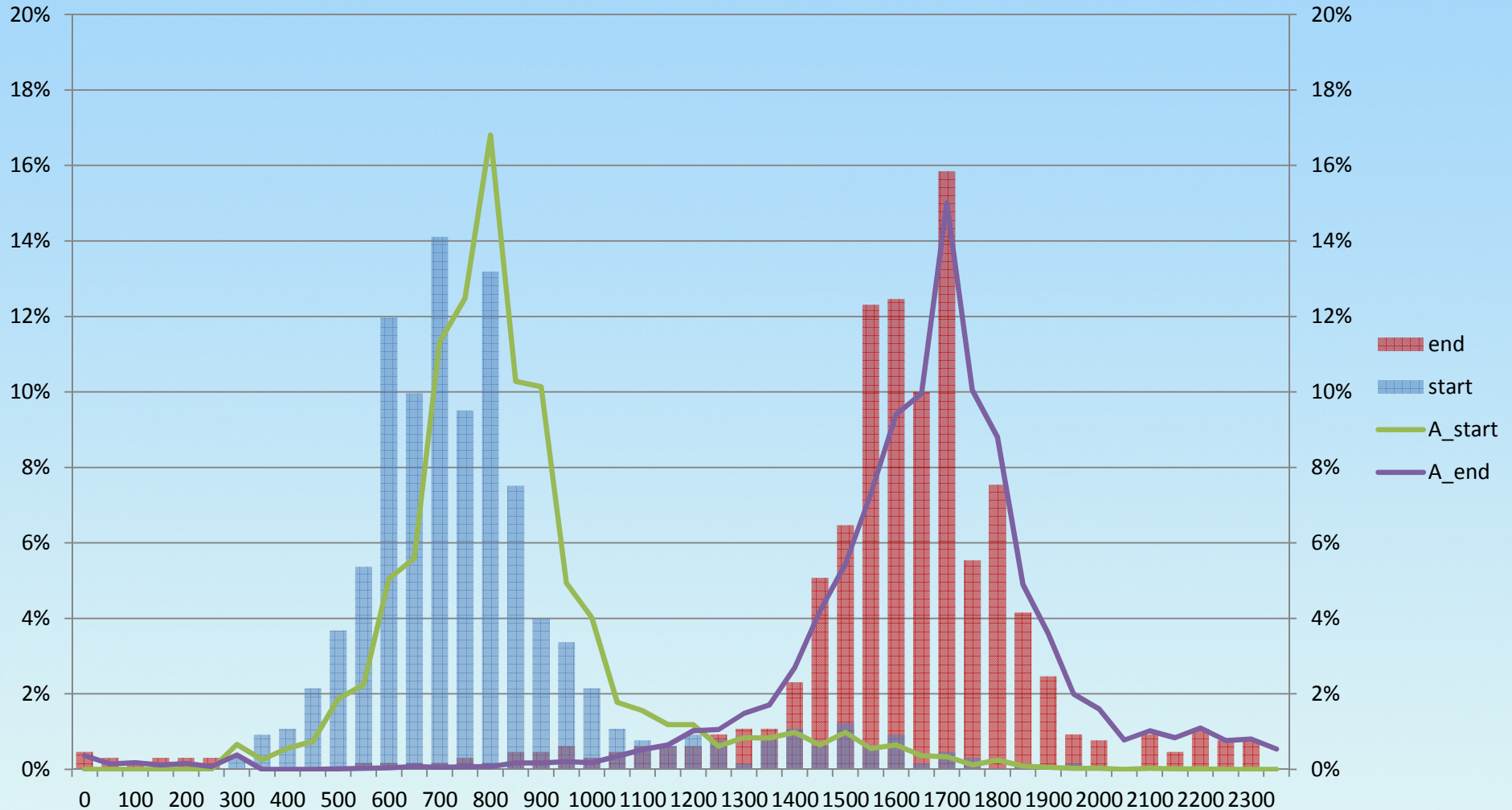


IND1 Agriculture & Mining (start/end early)

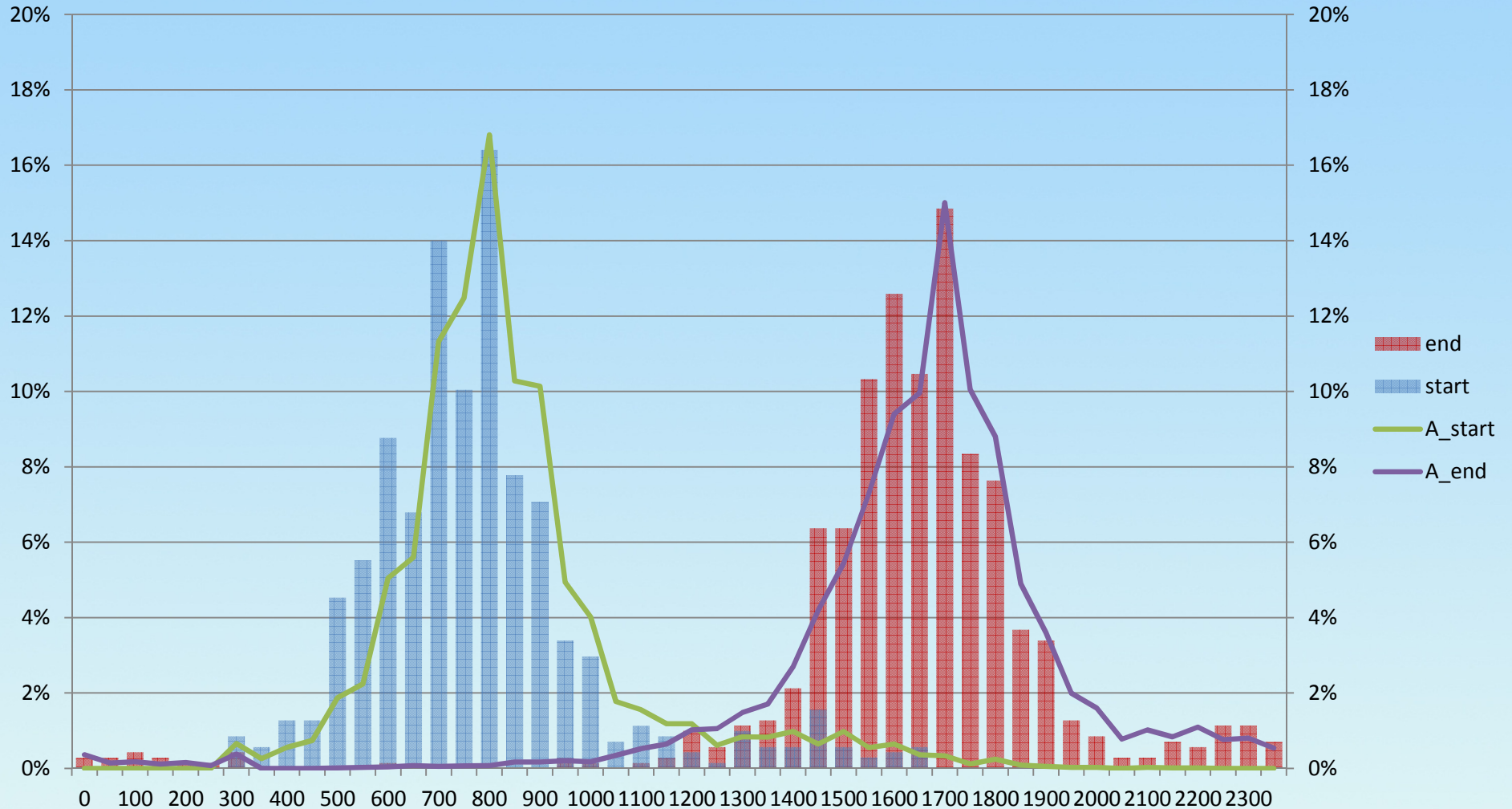


IND2 Construction & Utility

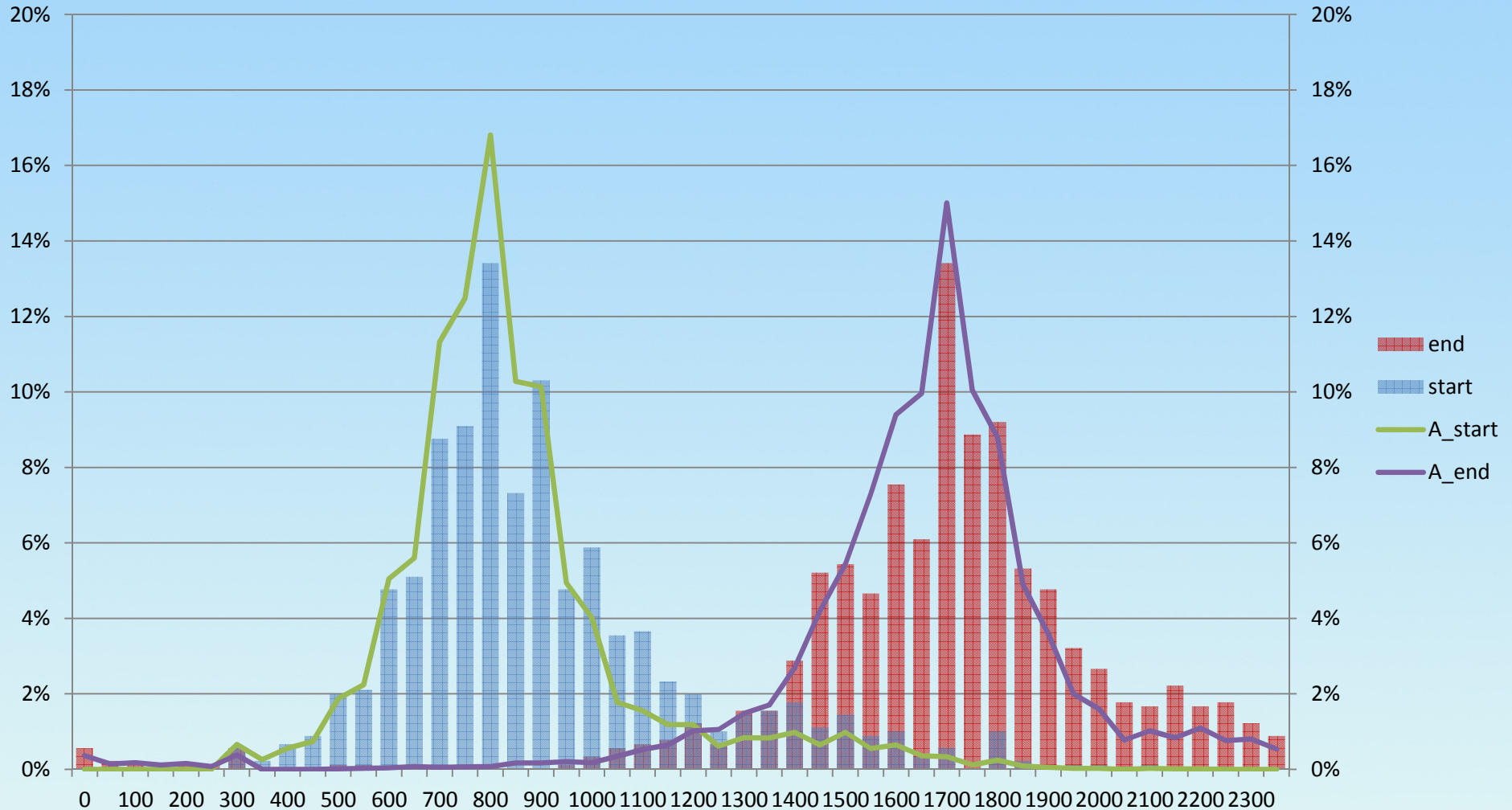
(start early, some workers end early)



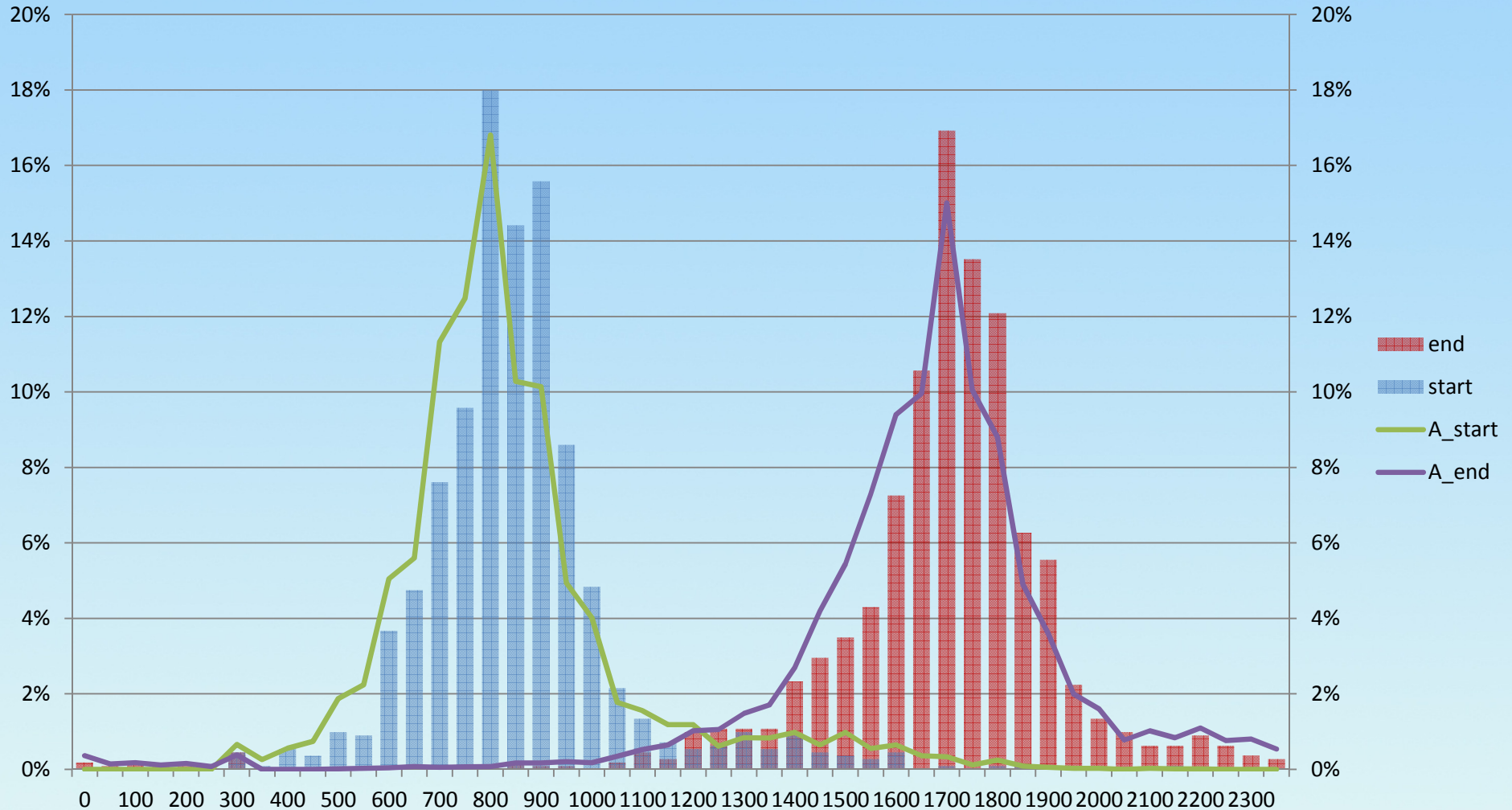
IND3 Manufacturing & Warehousing (some start/end early)



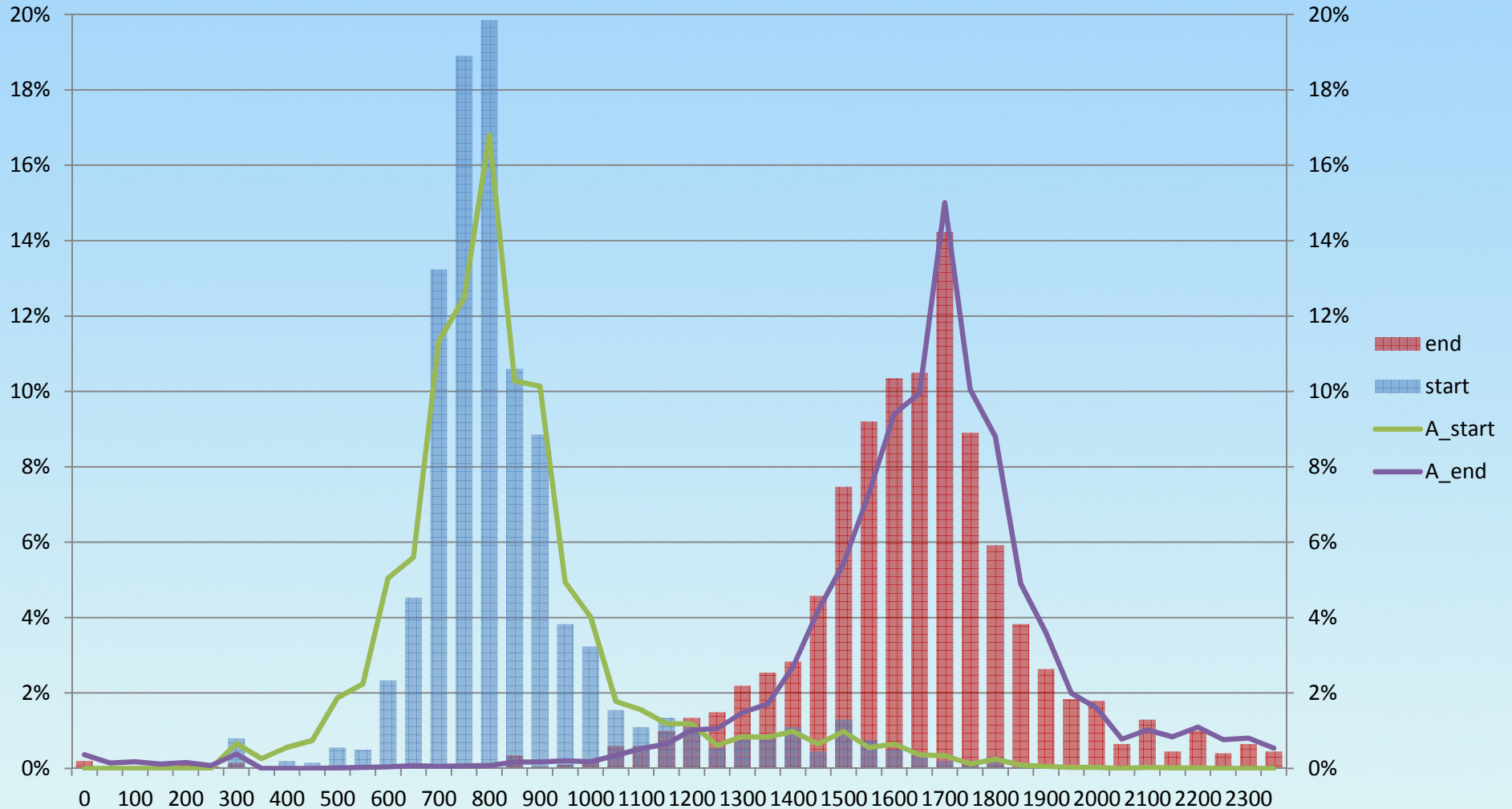
IND4 Retail & Other Service (some start/end late)



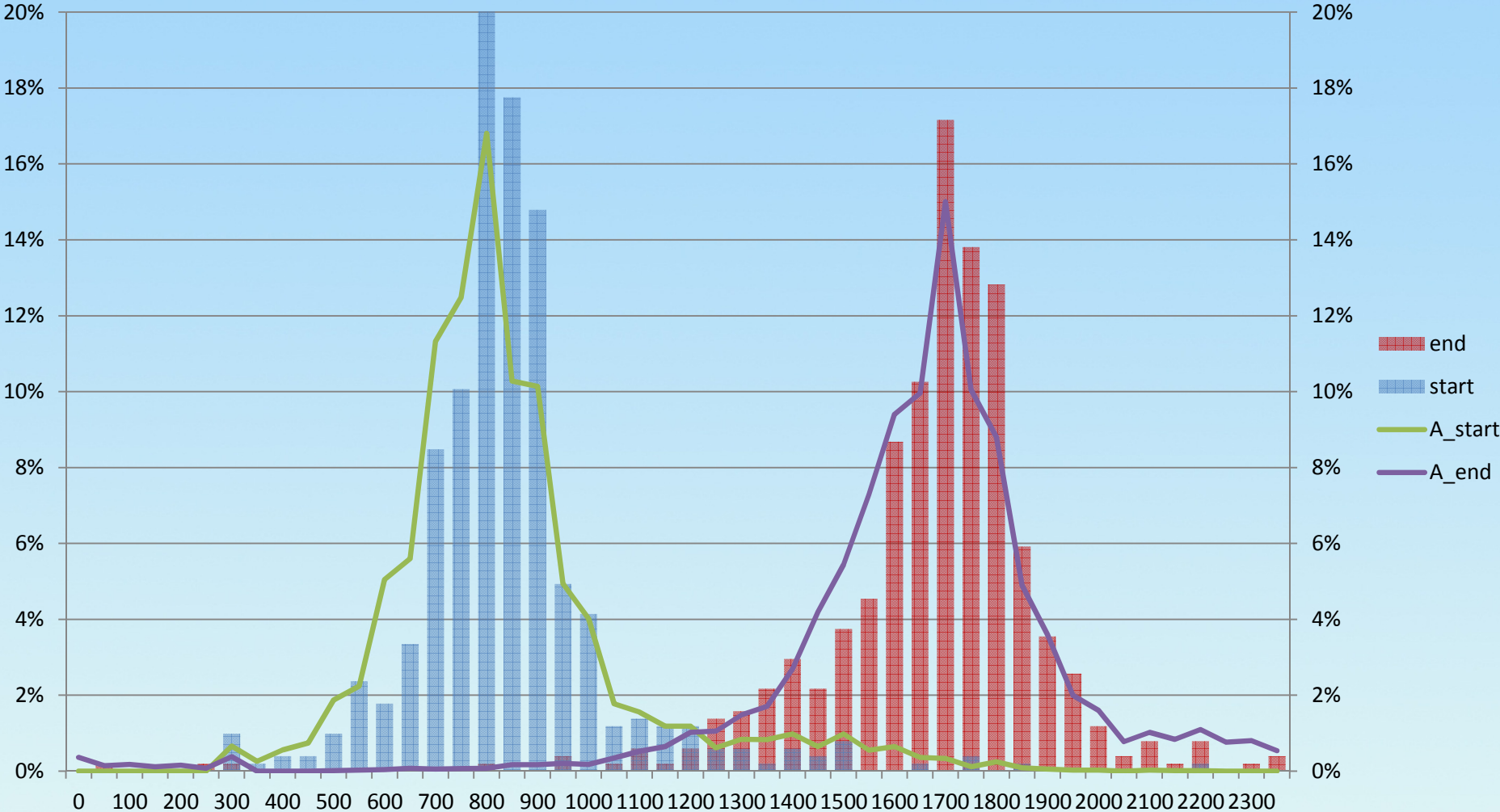
IND5 Information & Business Service (some start/end a little late)



IND6 Education & Health/Social Services (start/end a little early)

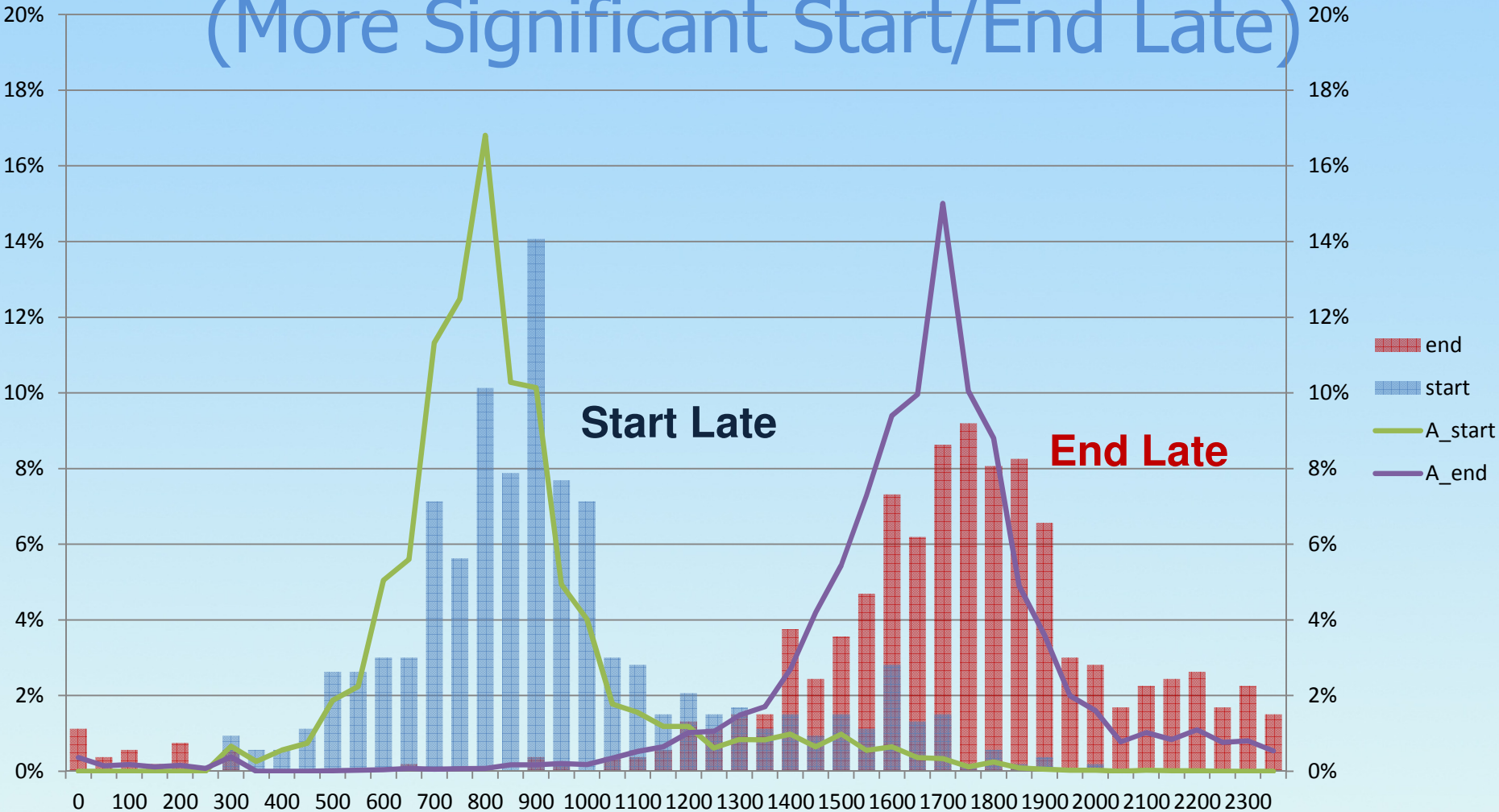


IND7 Finance, Insurance & Real Estate (start/end a little late)

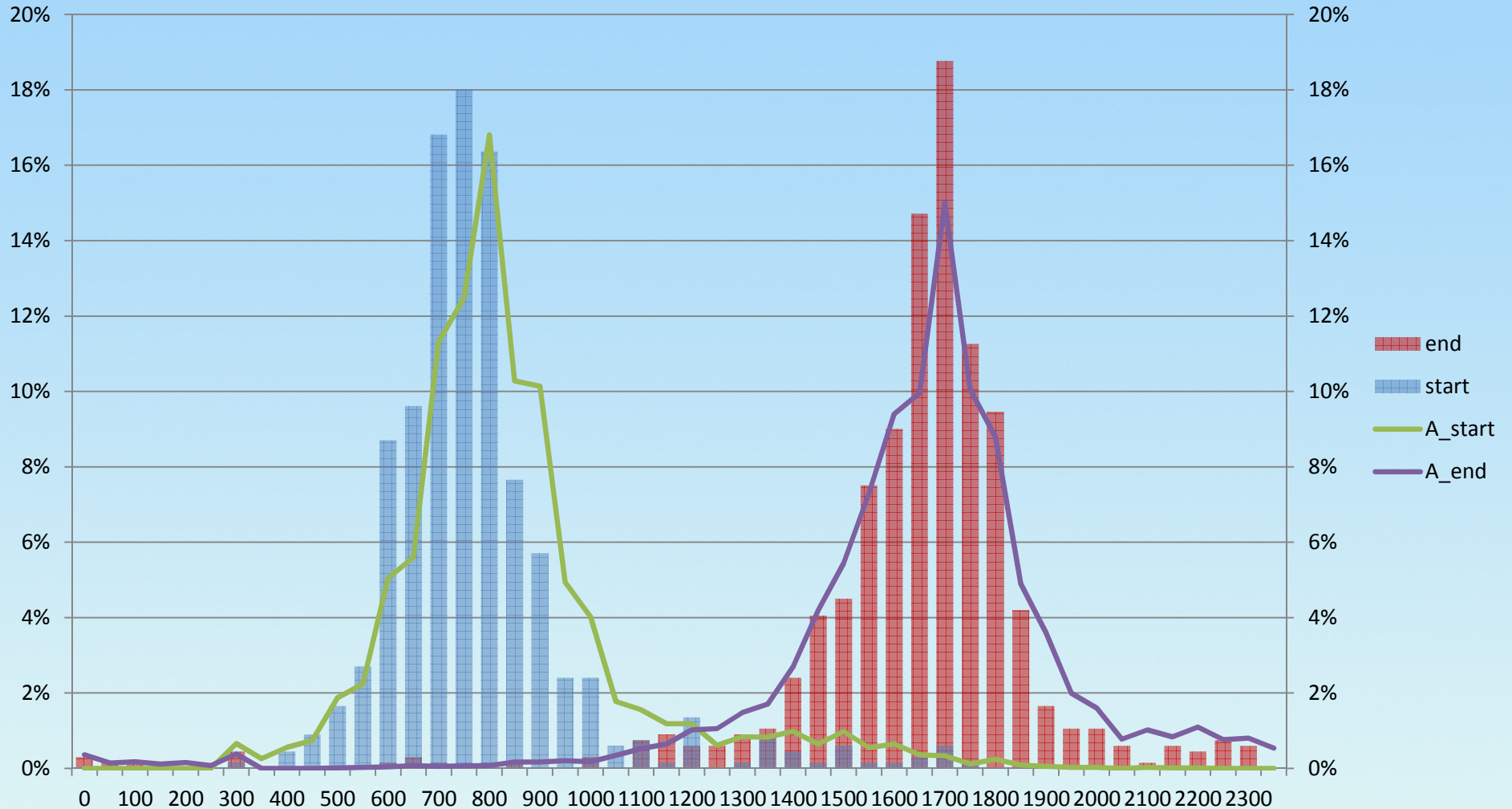


IND8 Arts/Entertainment, Food Service/Hospitality

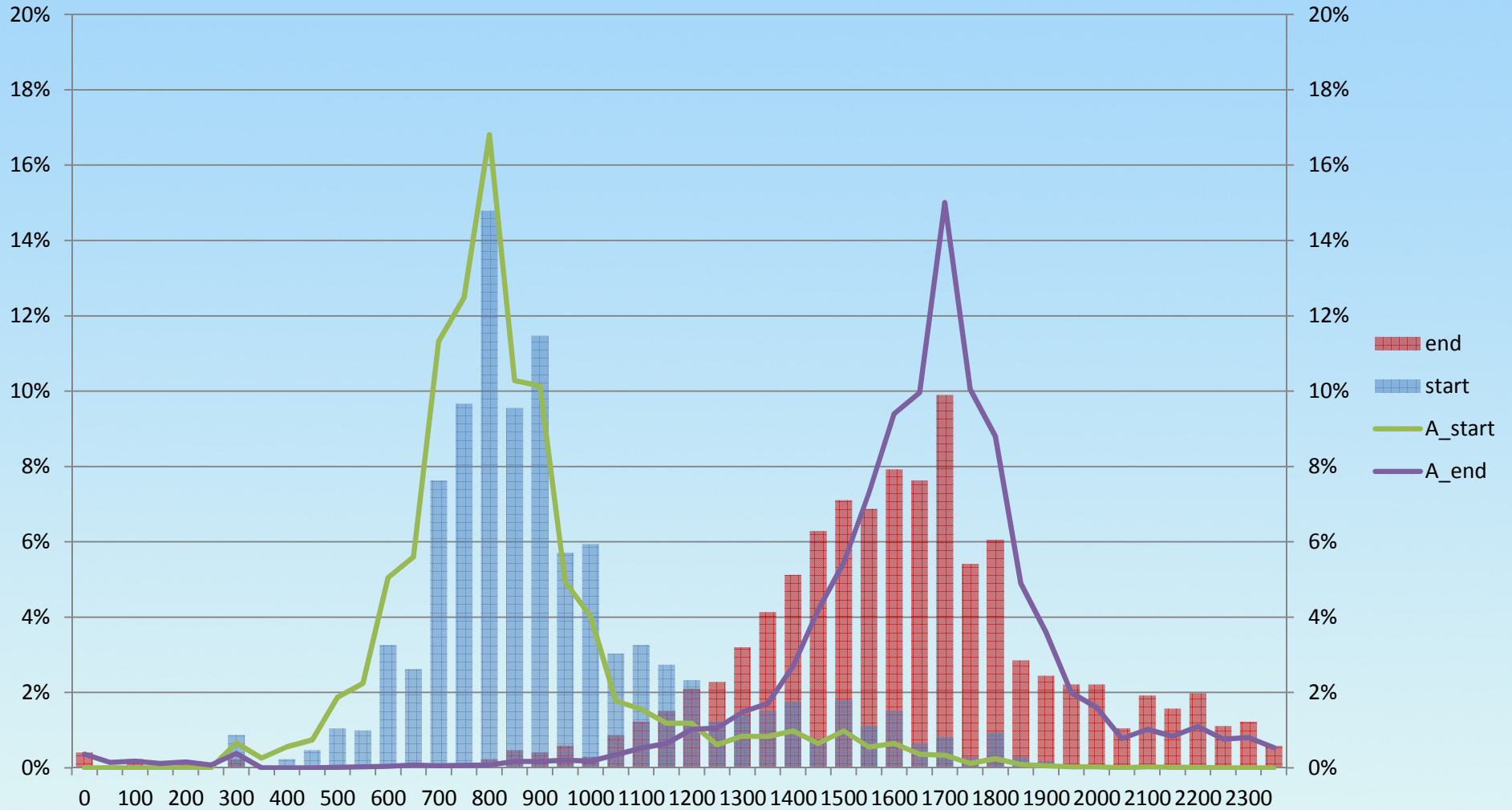
(More Significant Start/End Late)



IND9 Public Administration (Start/End a little early)

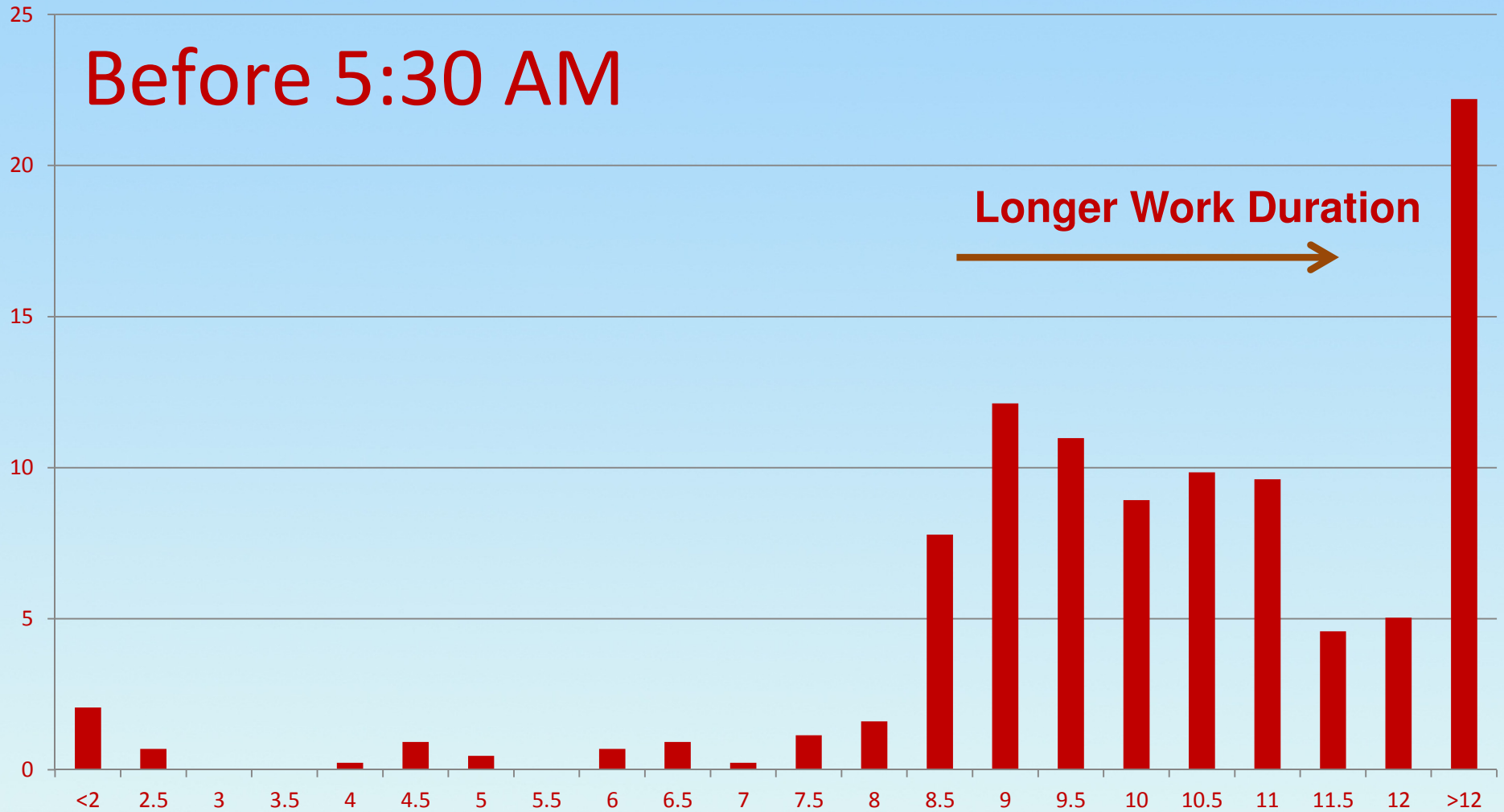


Part-Time Workers (Start late, end early)



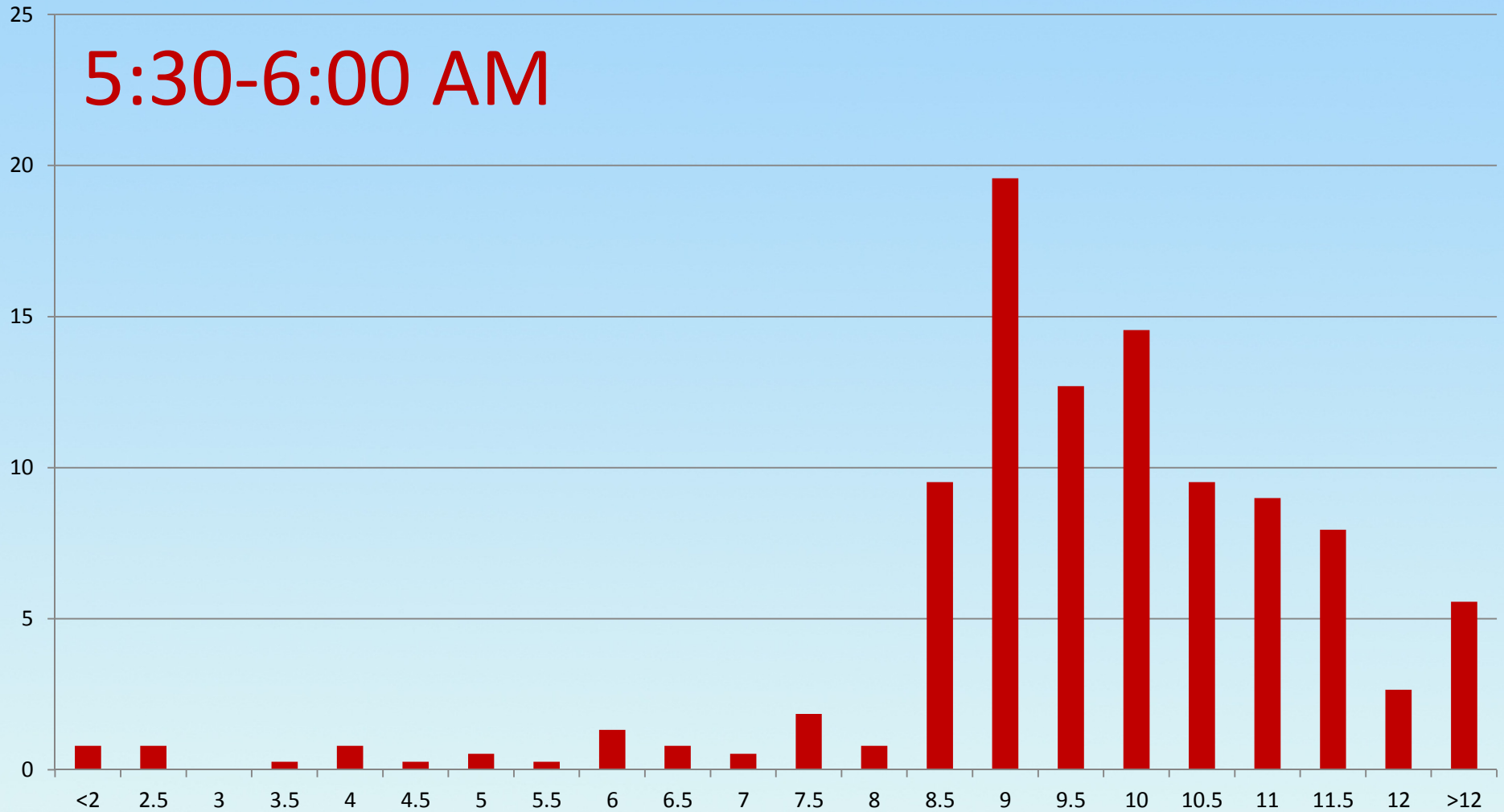
Work Duration by Start Time

(Start early, long hours)



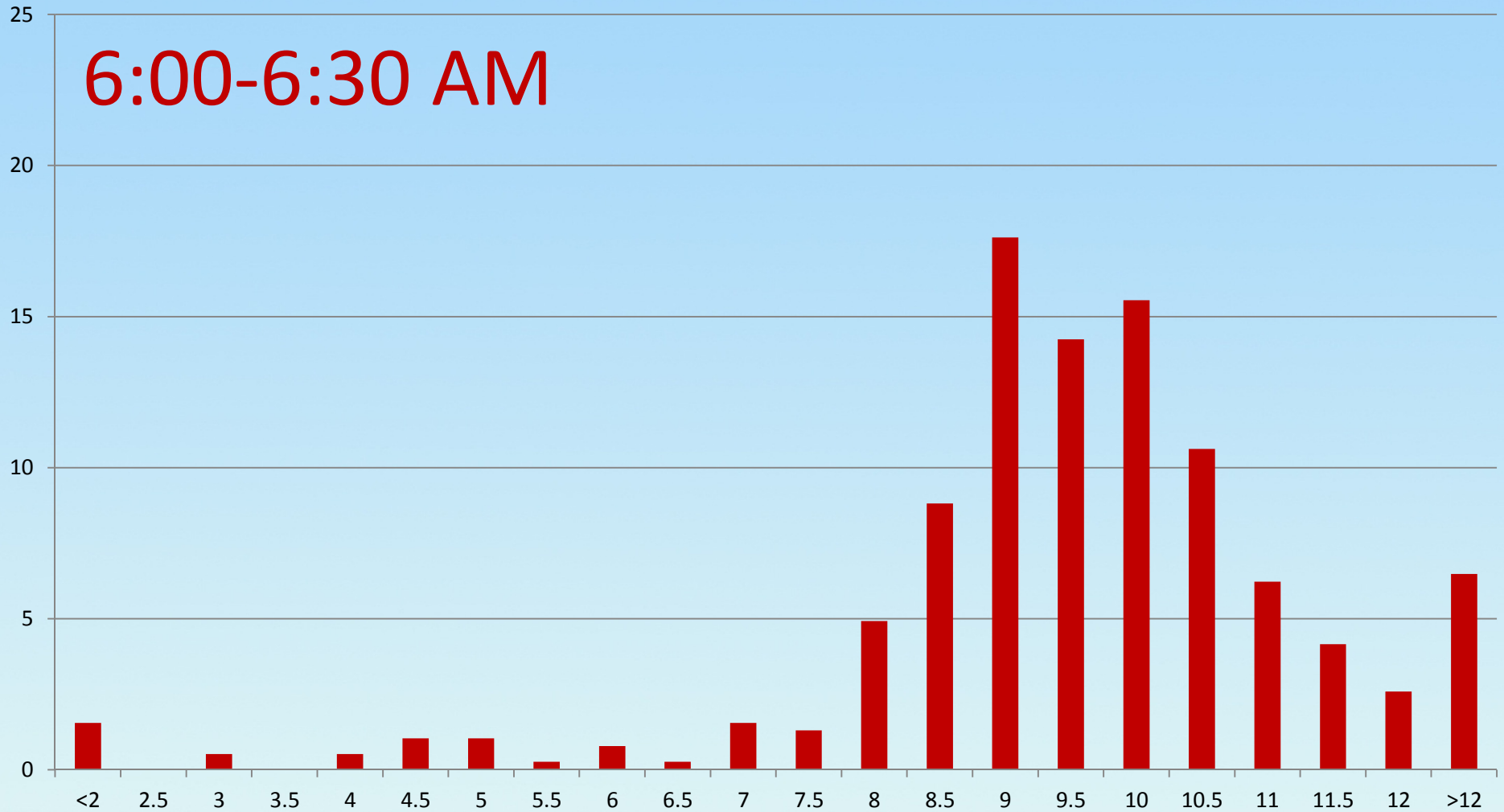
5:30-6:00

(long hours, but shorter than half hour ago)

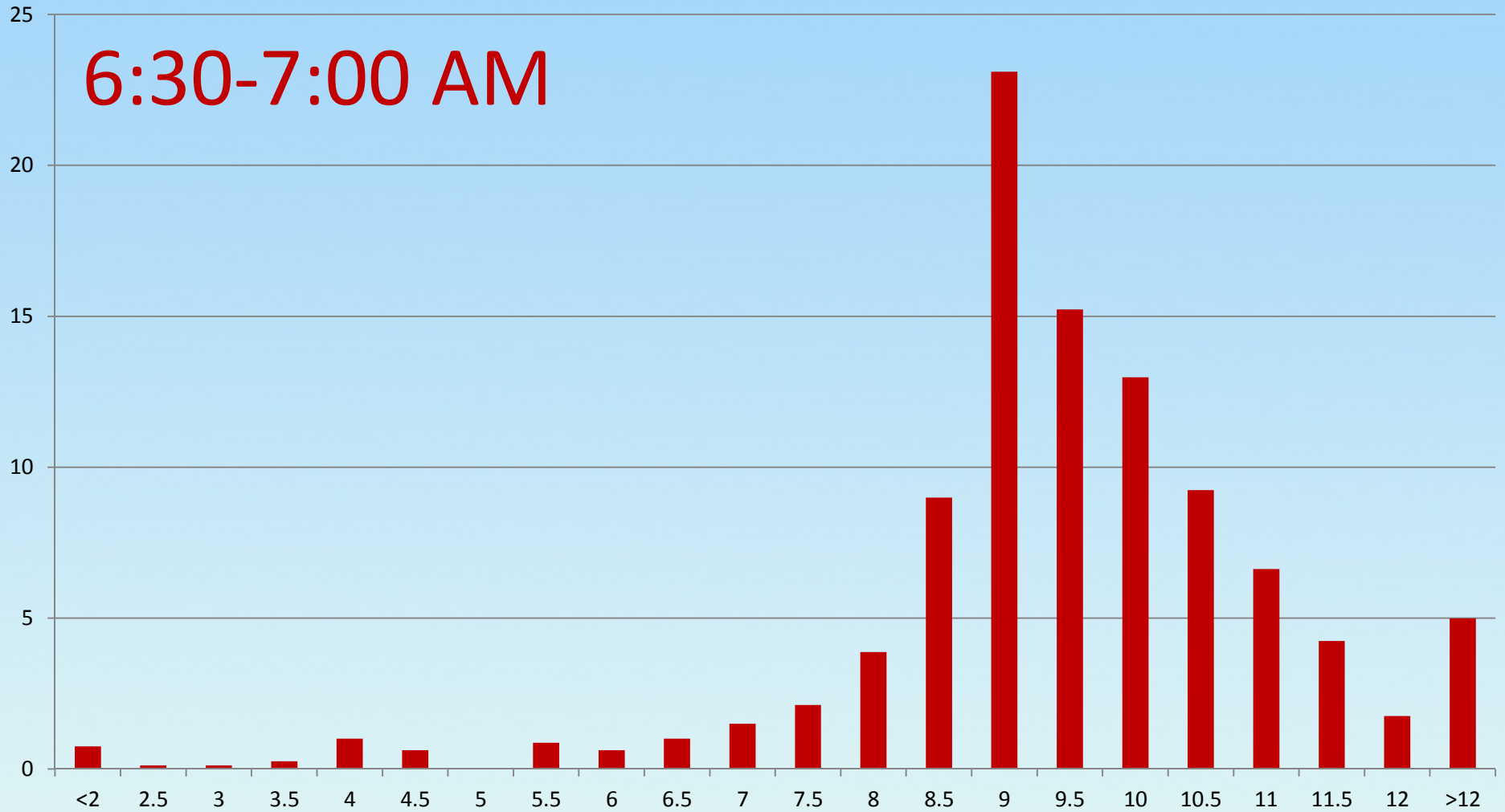


6:00-6:30

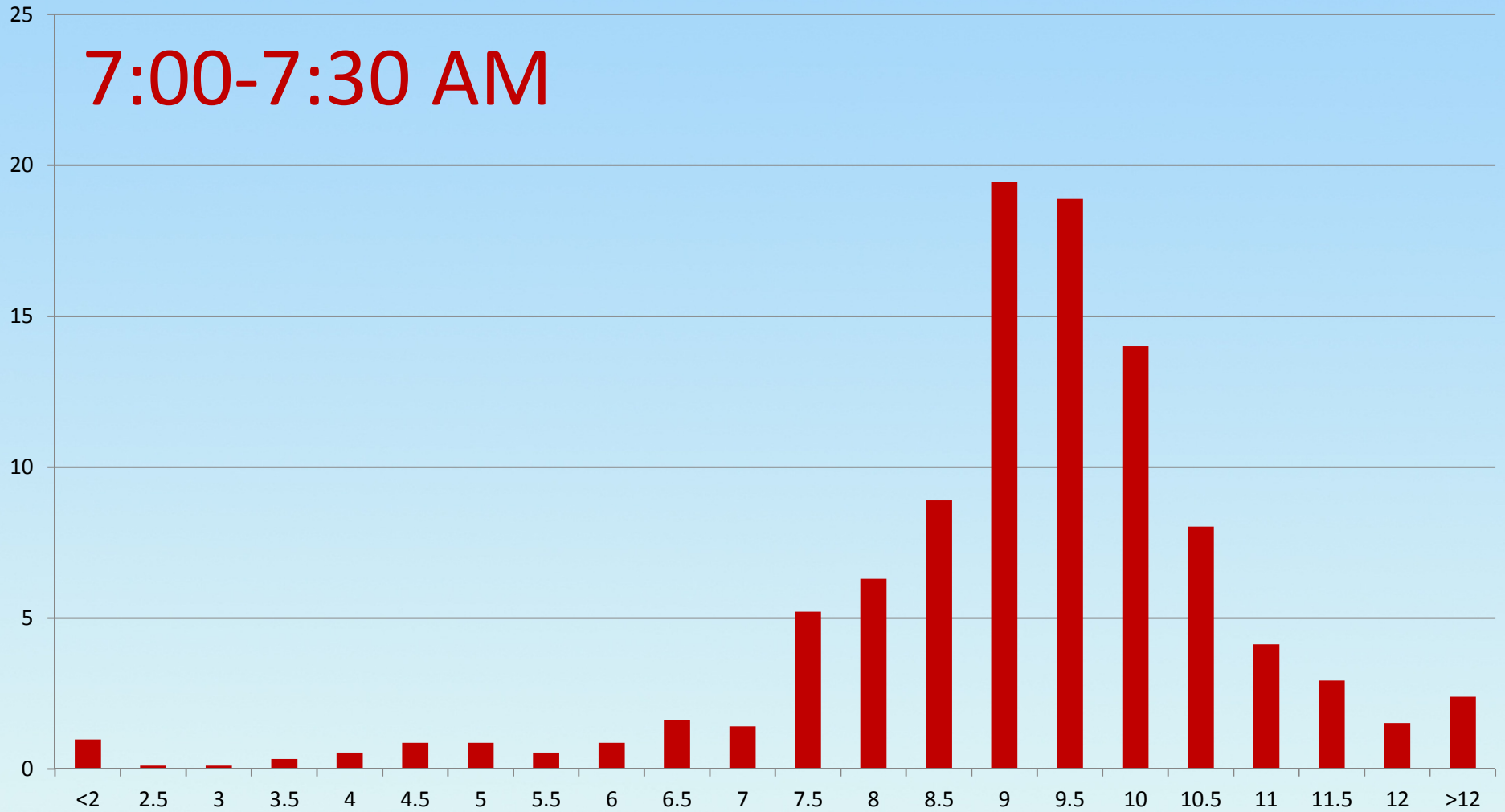
(long hours, but shorter than half hour ago)



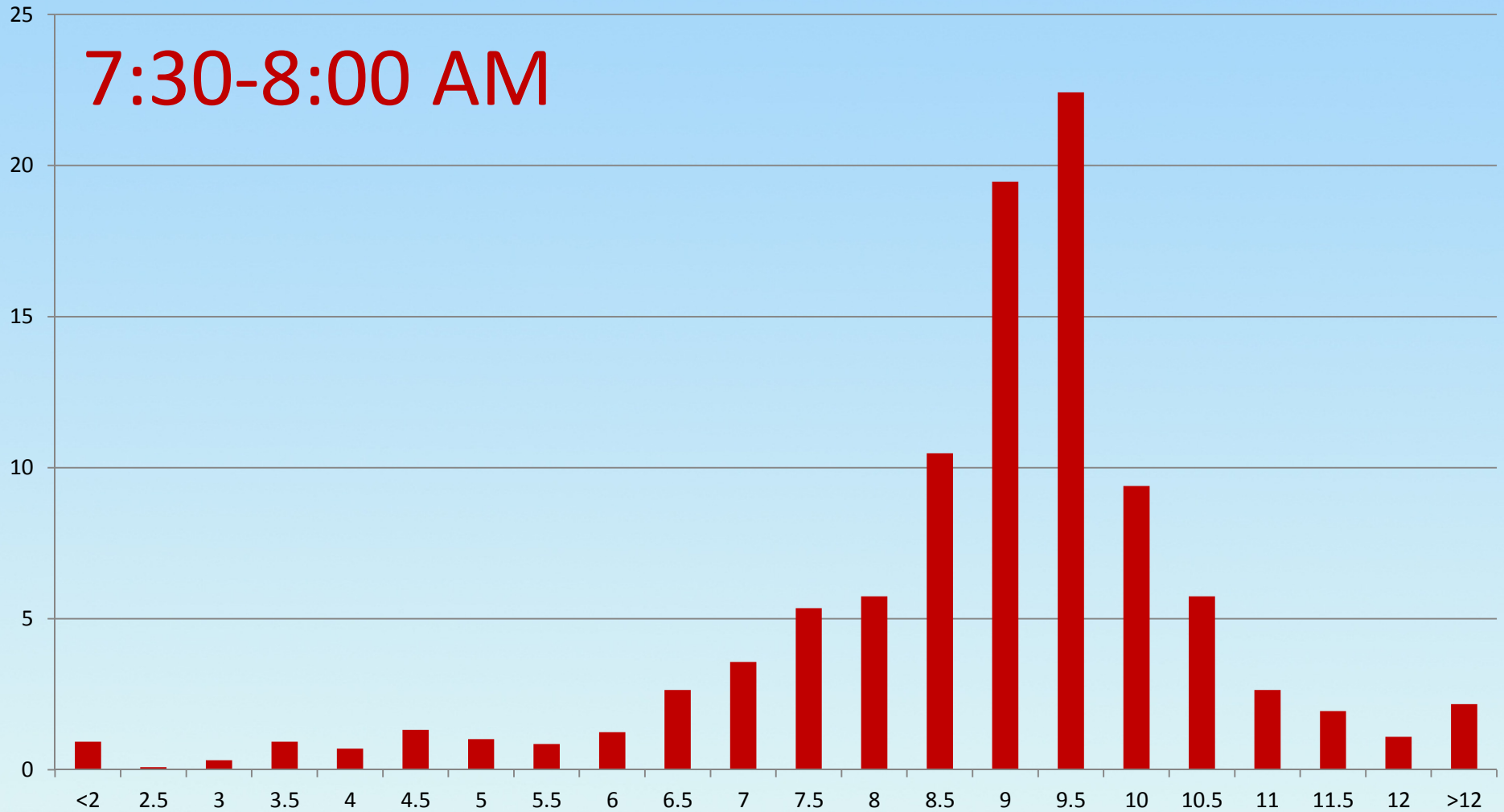
6:30 - 7:00



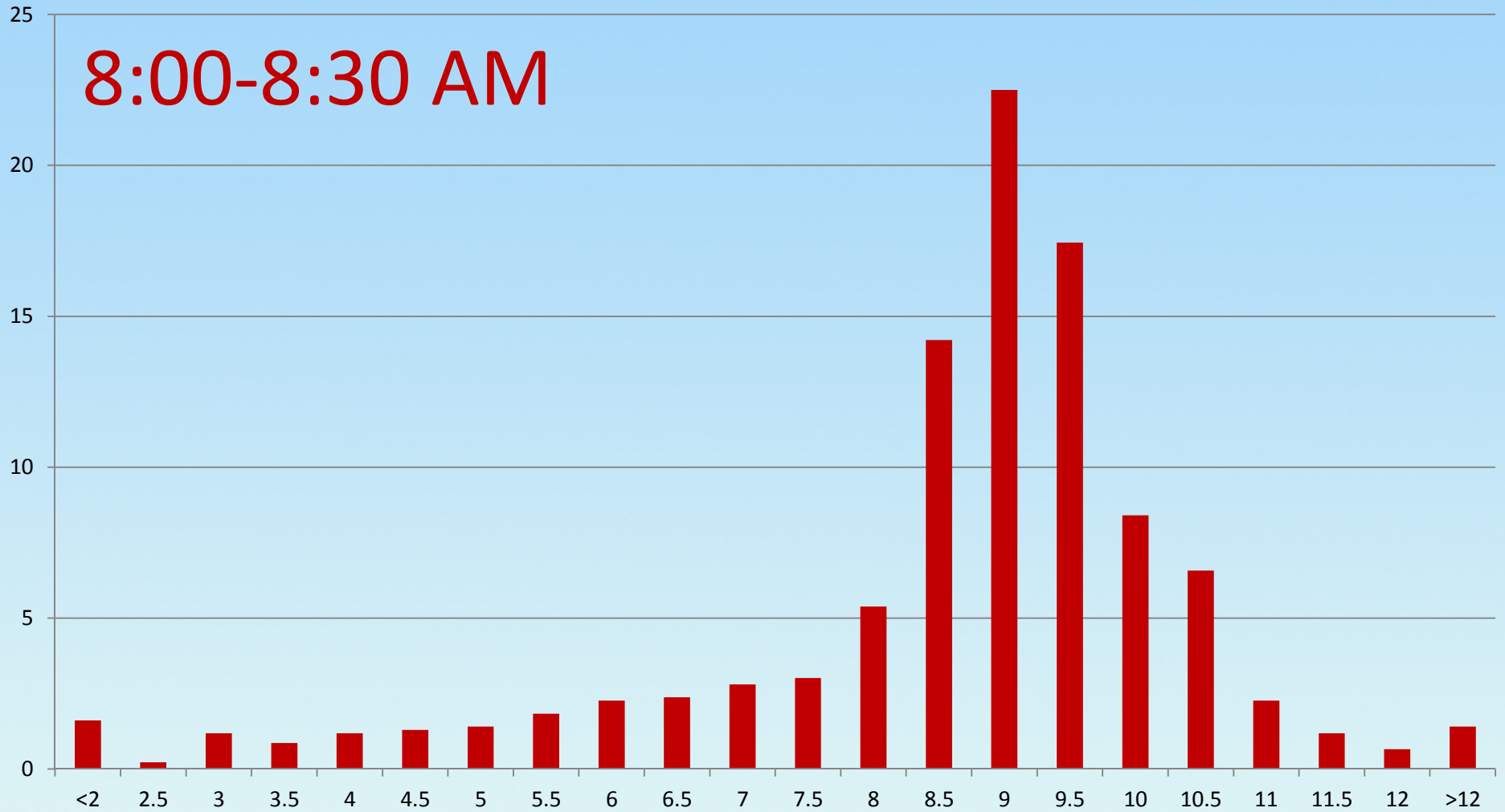
7:00 - 7:30



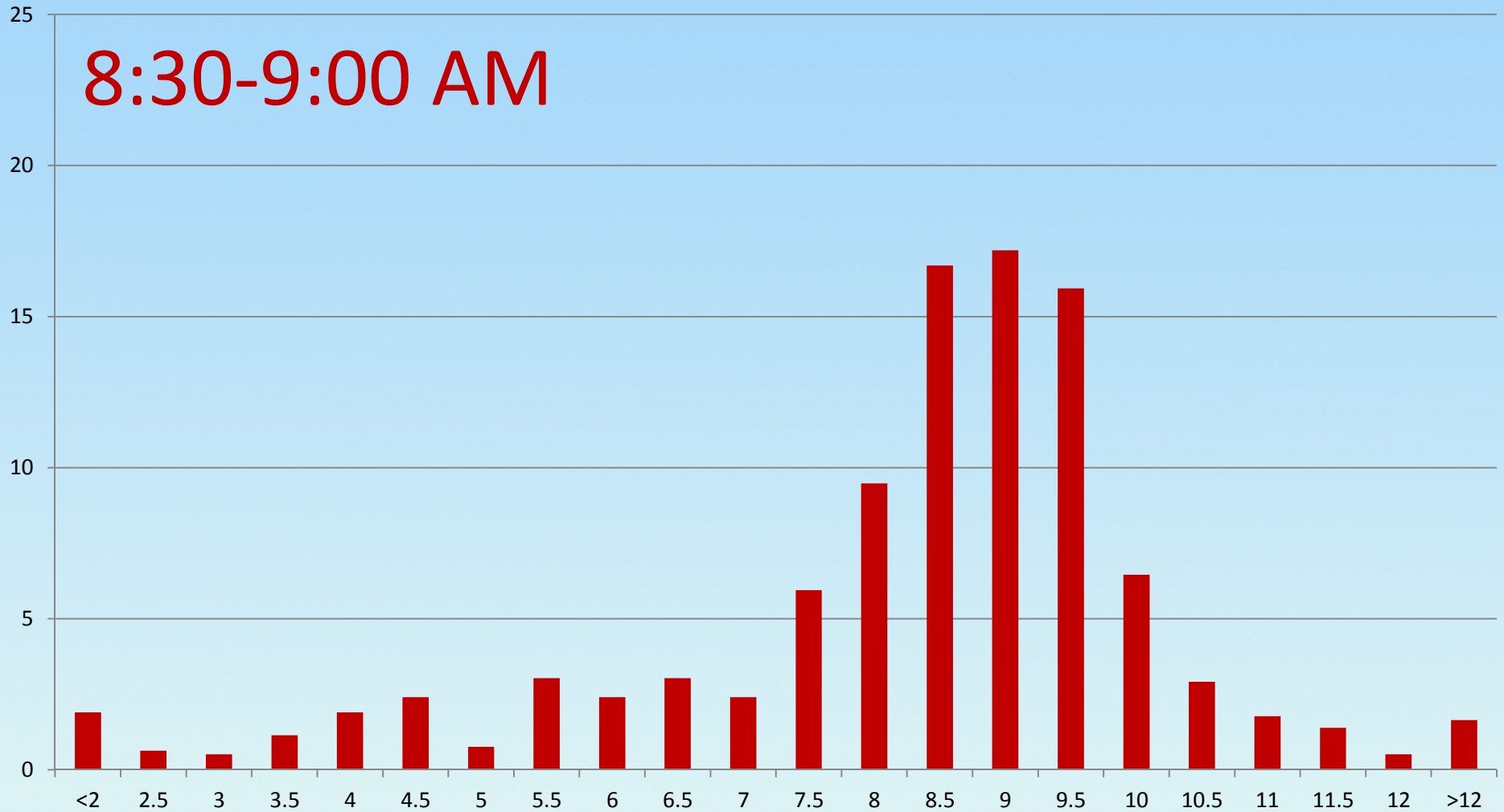
7:30 - 8:00 (Base)



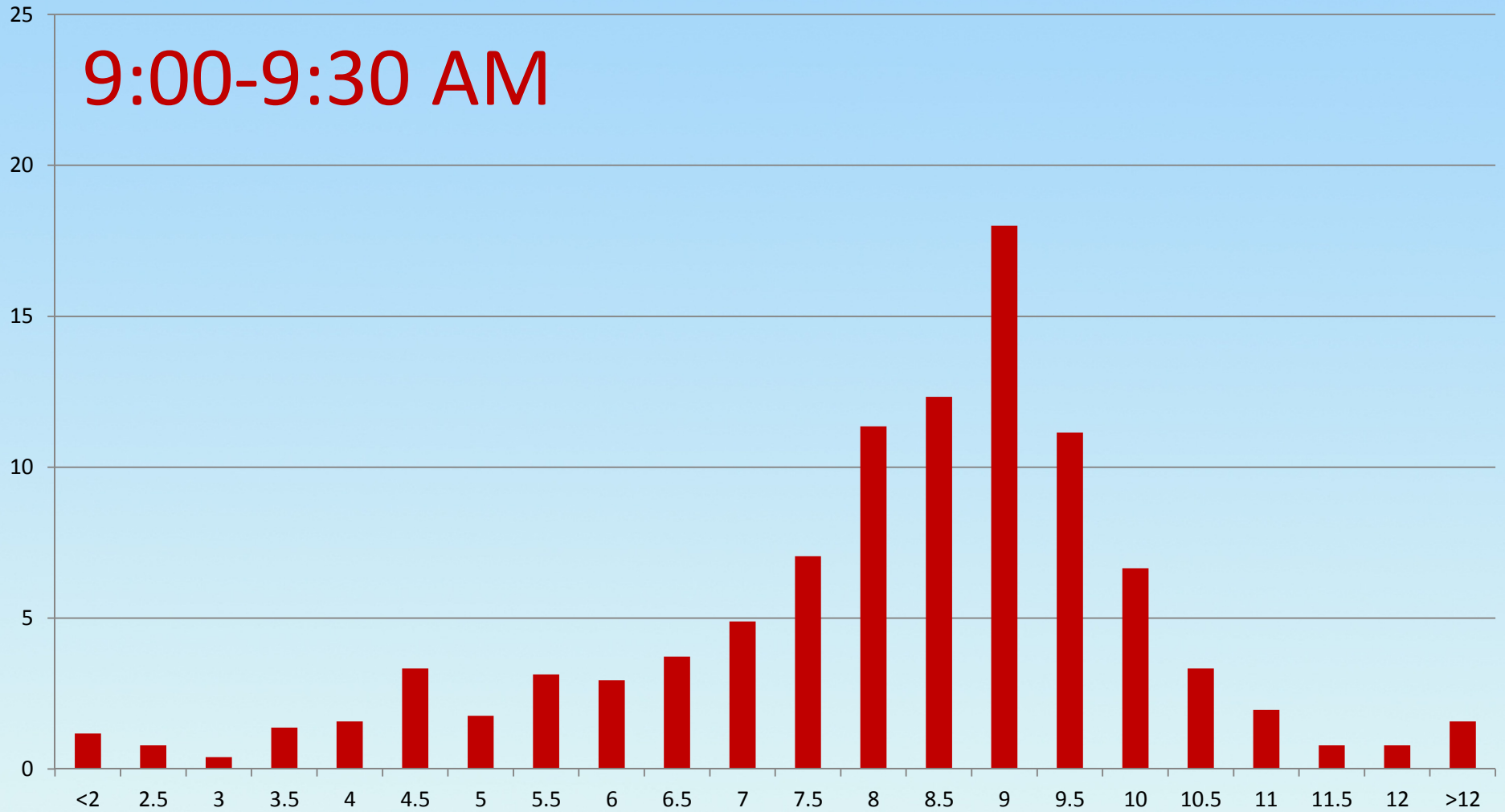
8:00 - 8:30



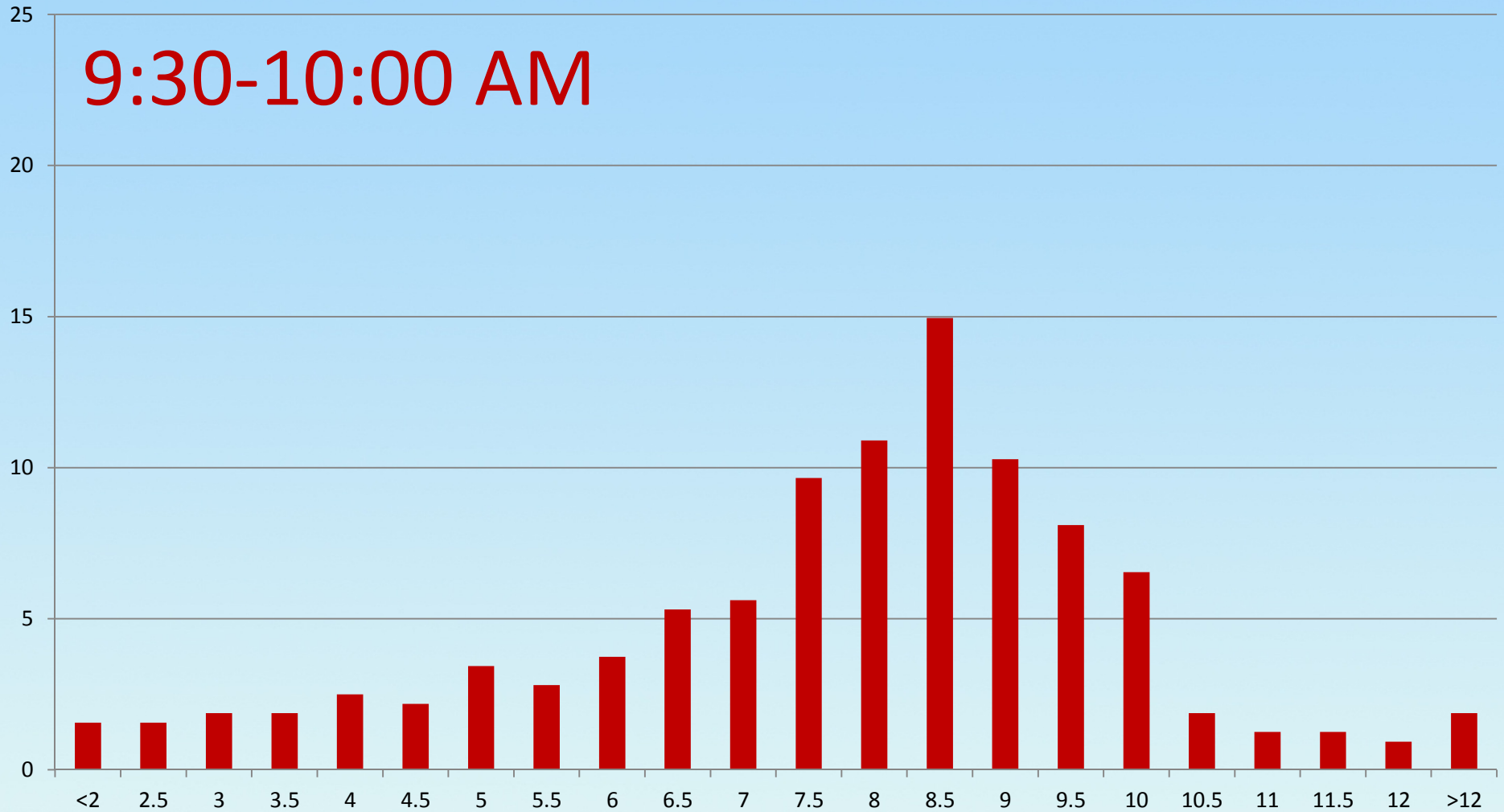
8:30 - 9:00 (moving to shorter hours)



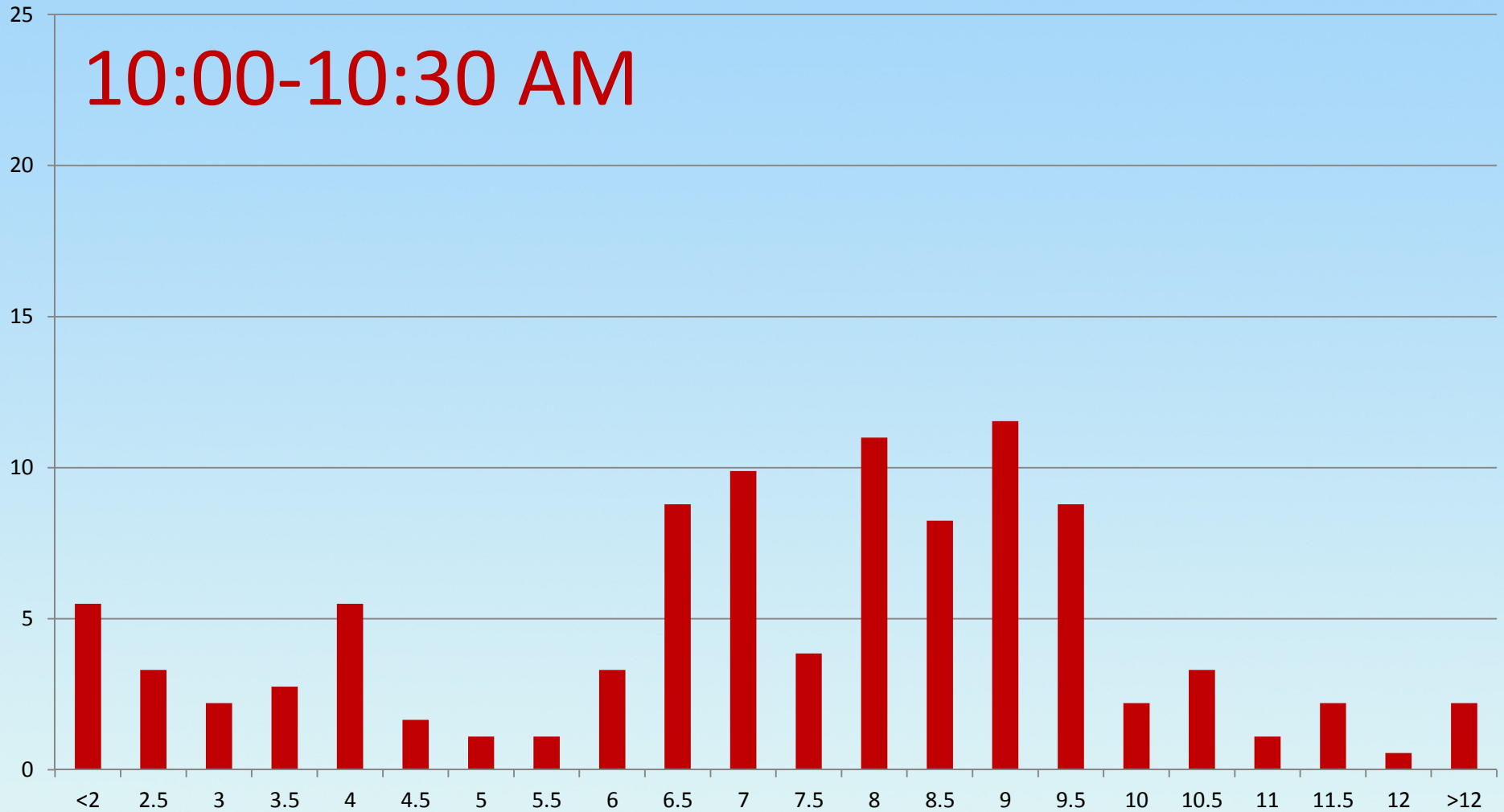
9:00 - 9:30



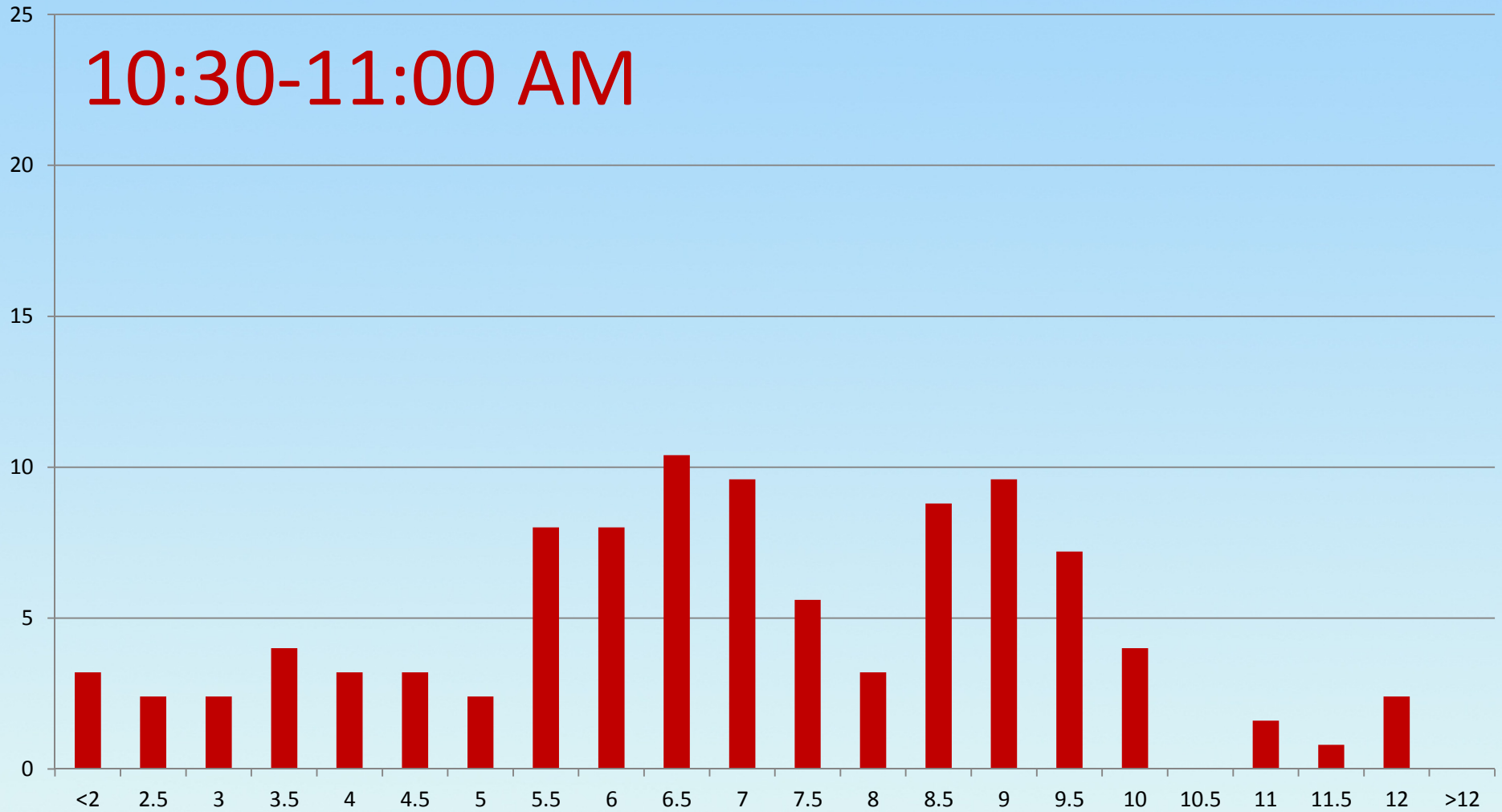
9:30 - 10:00 (shorter)



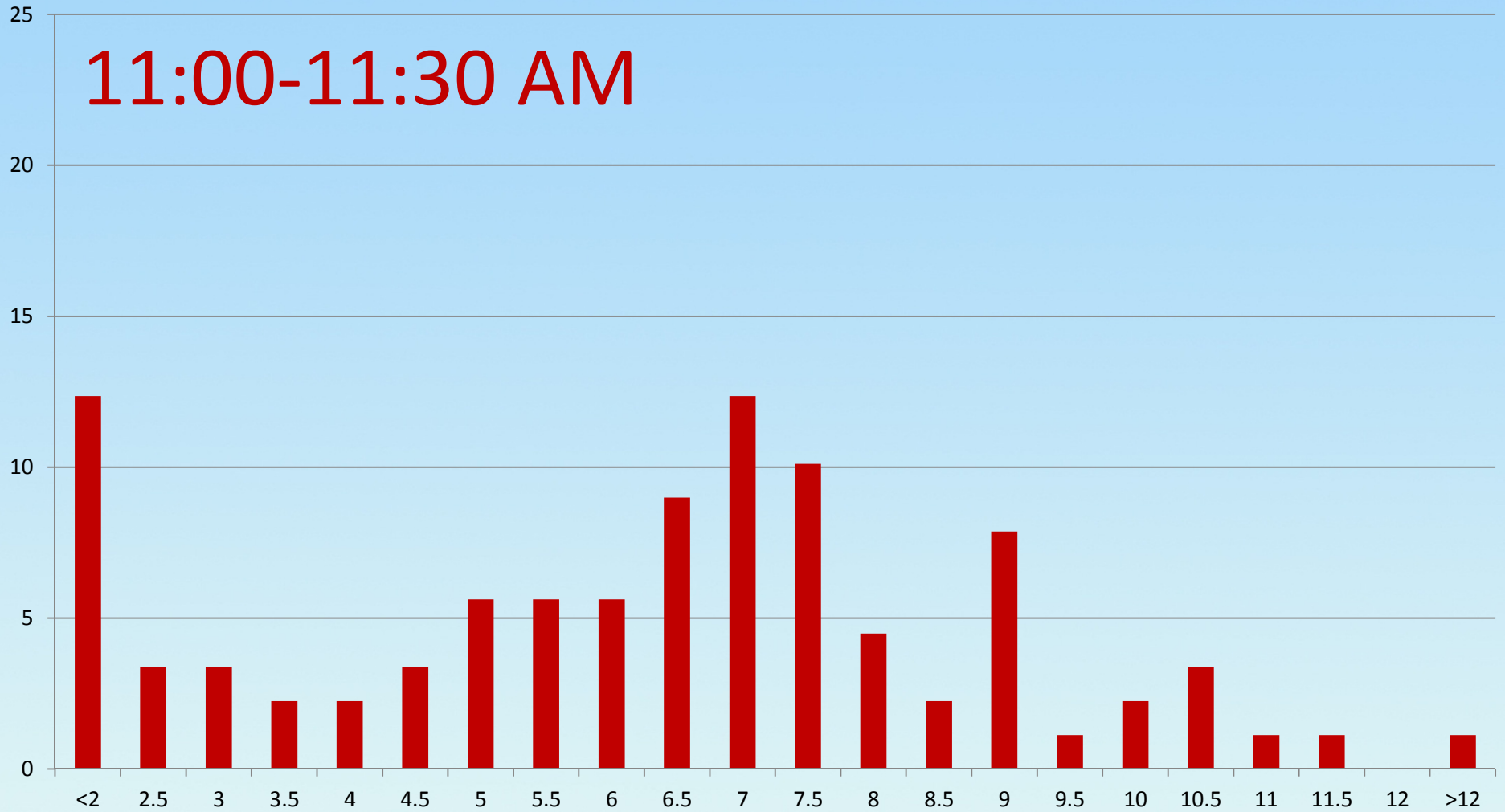
10:00 - 10:30 (uniform)



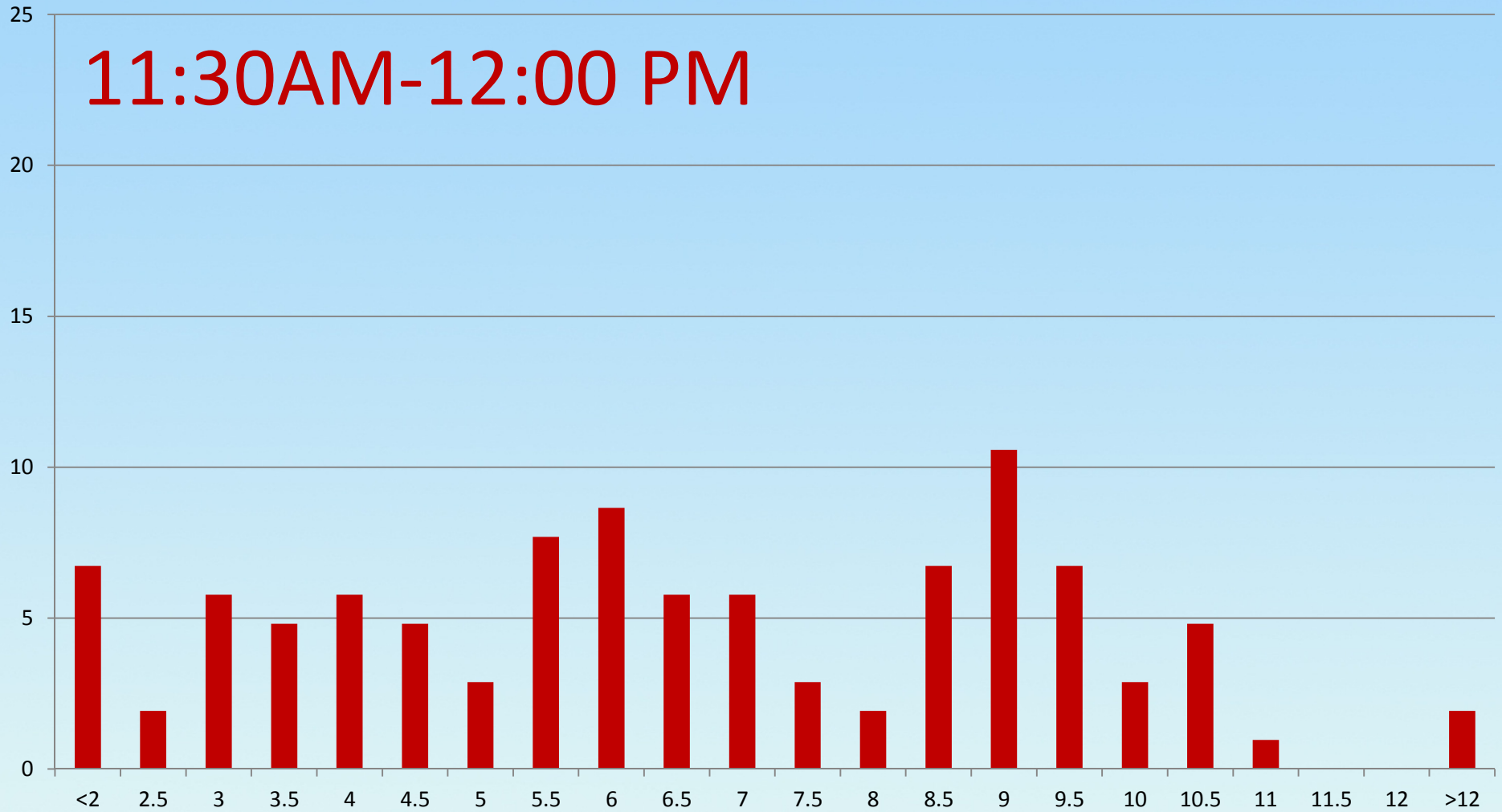
10:30 - 11:00



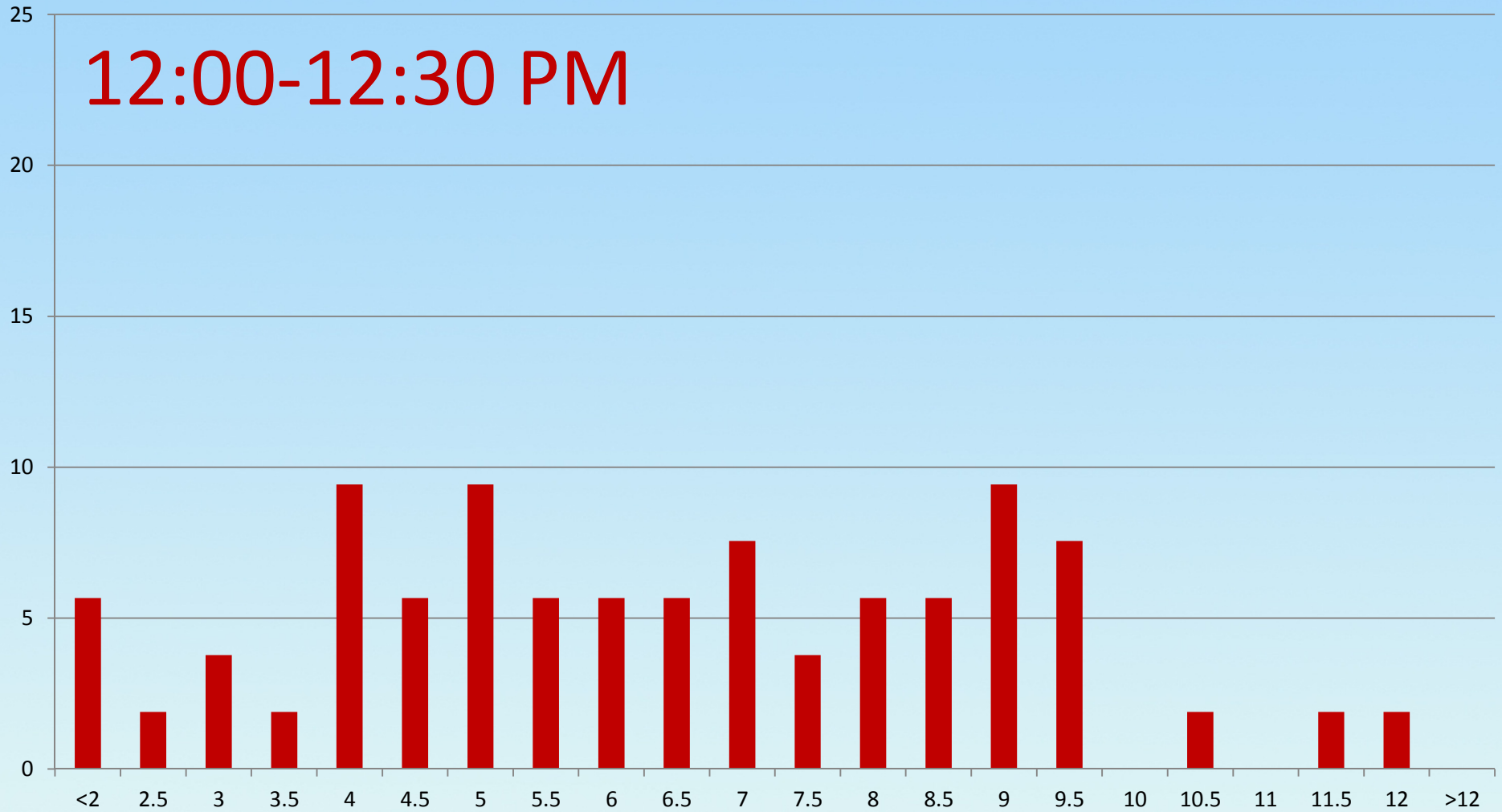
11:00 - 11:30



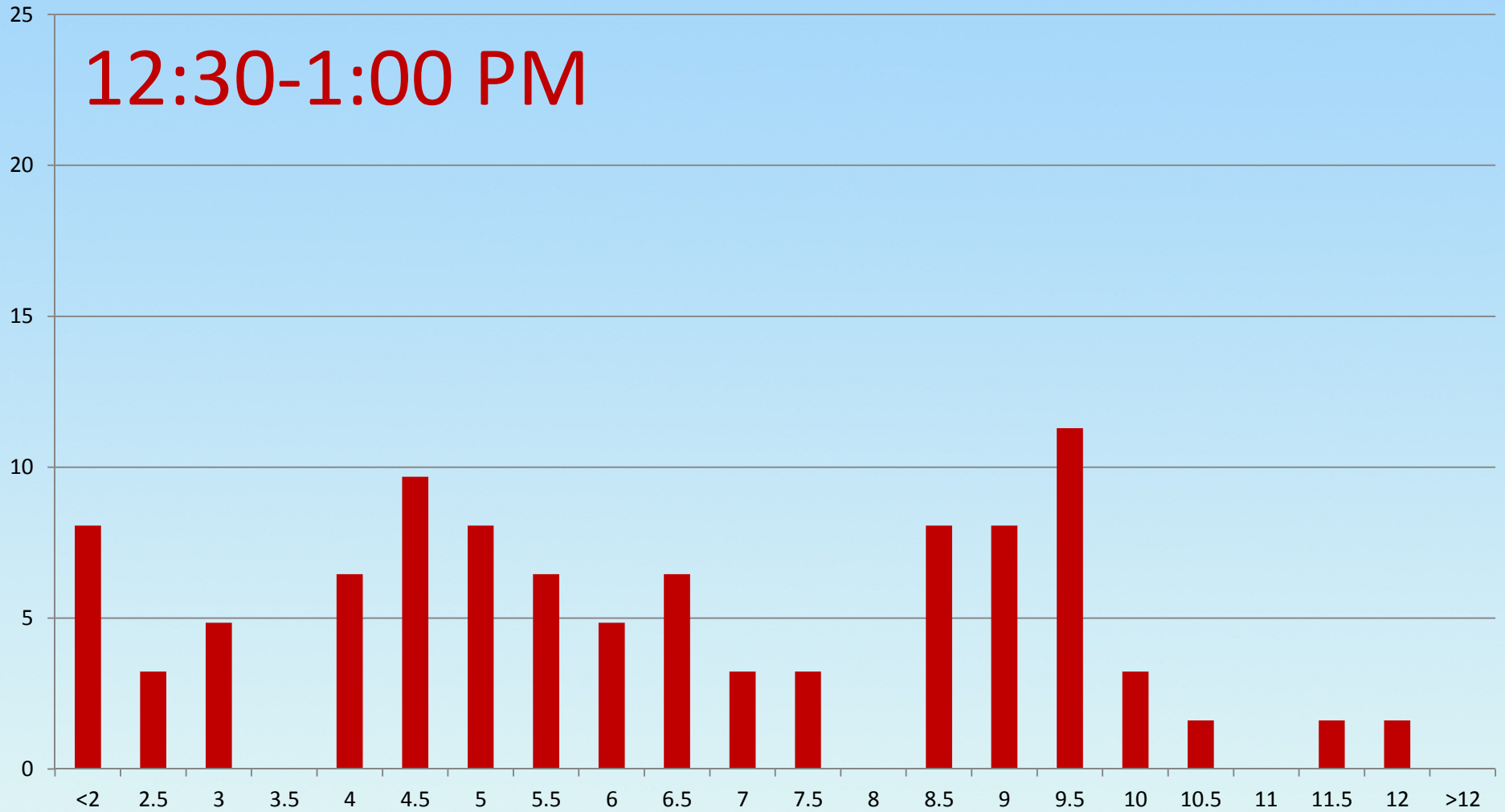
11:30 - 12:00



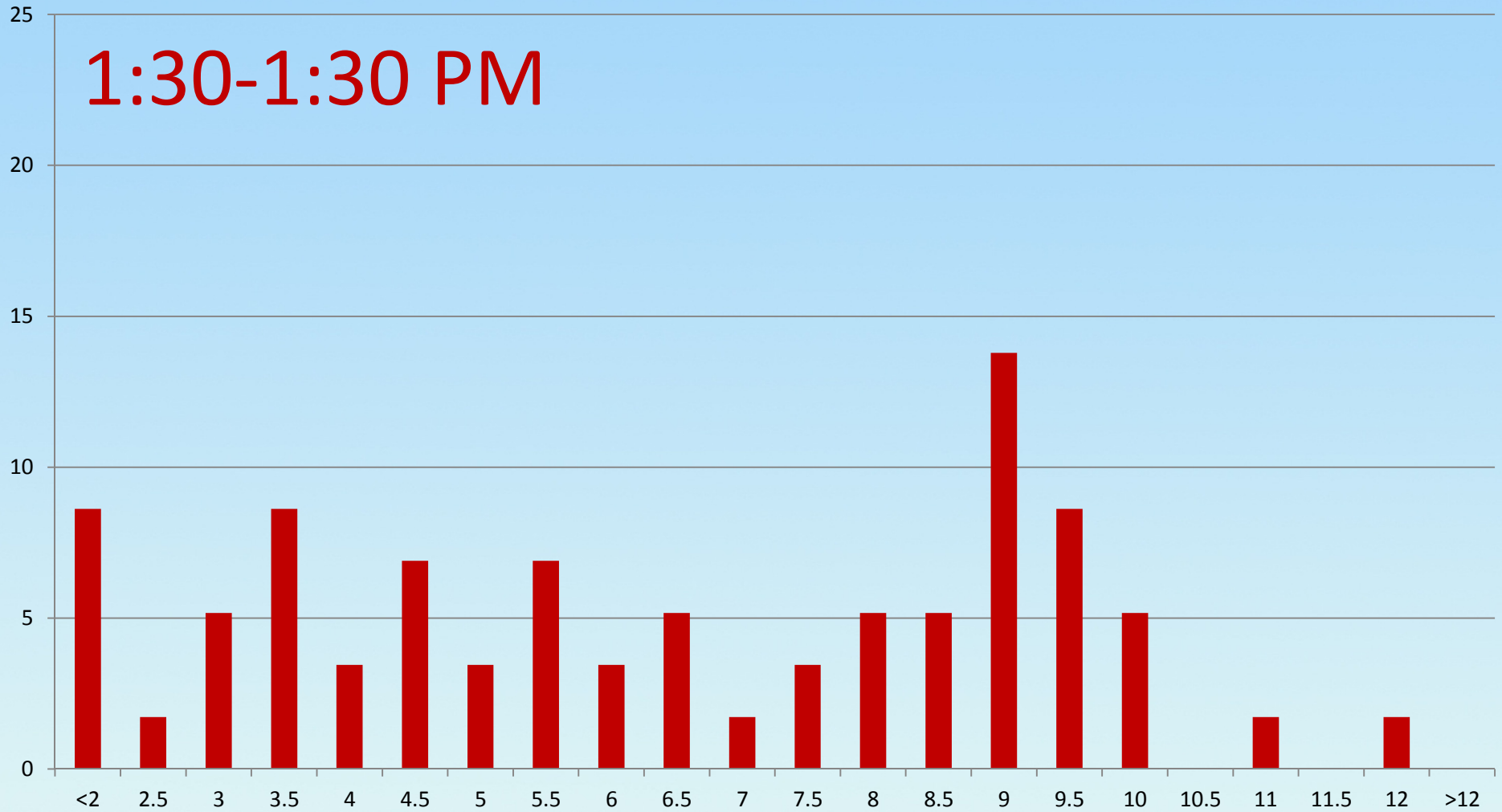
12:00 - 12:30



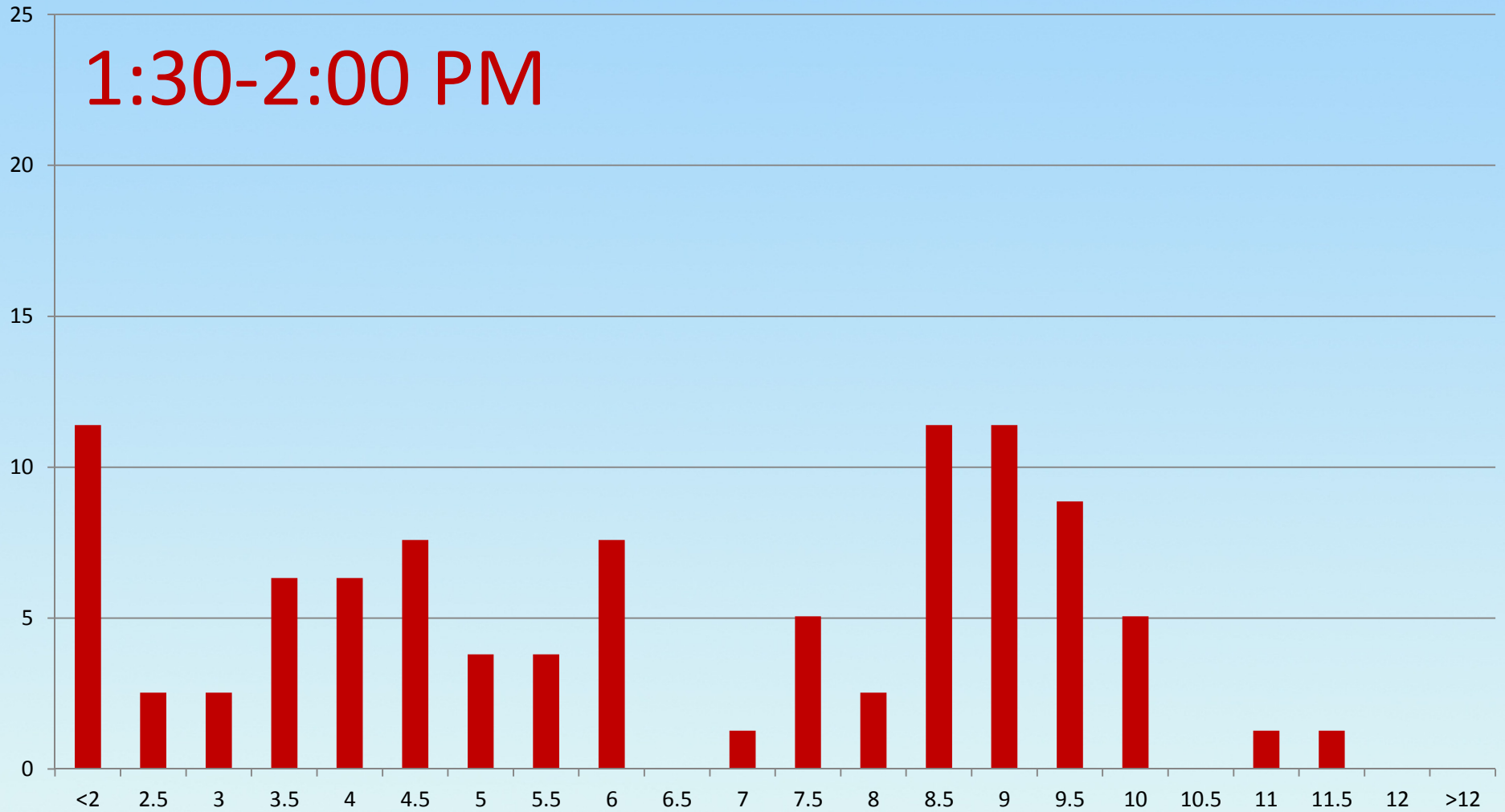
12:30 - 1:00 PM



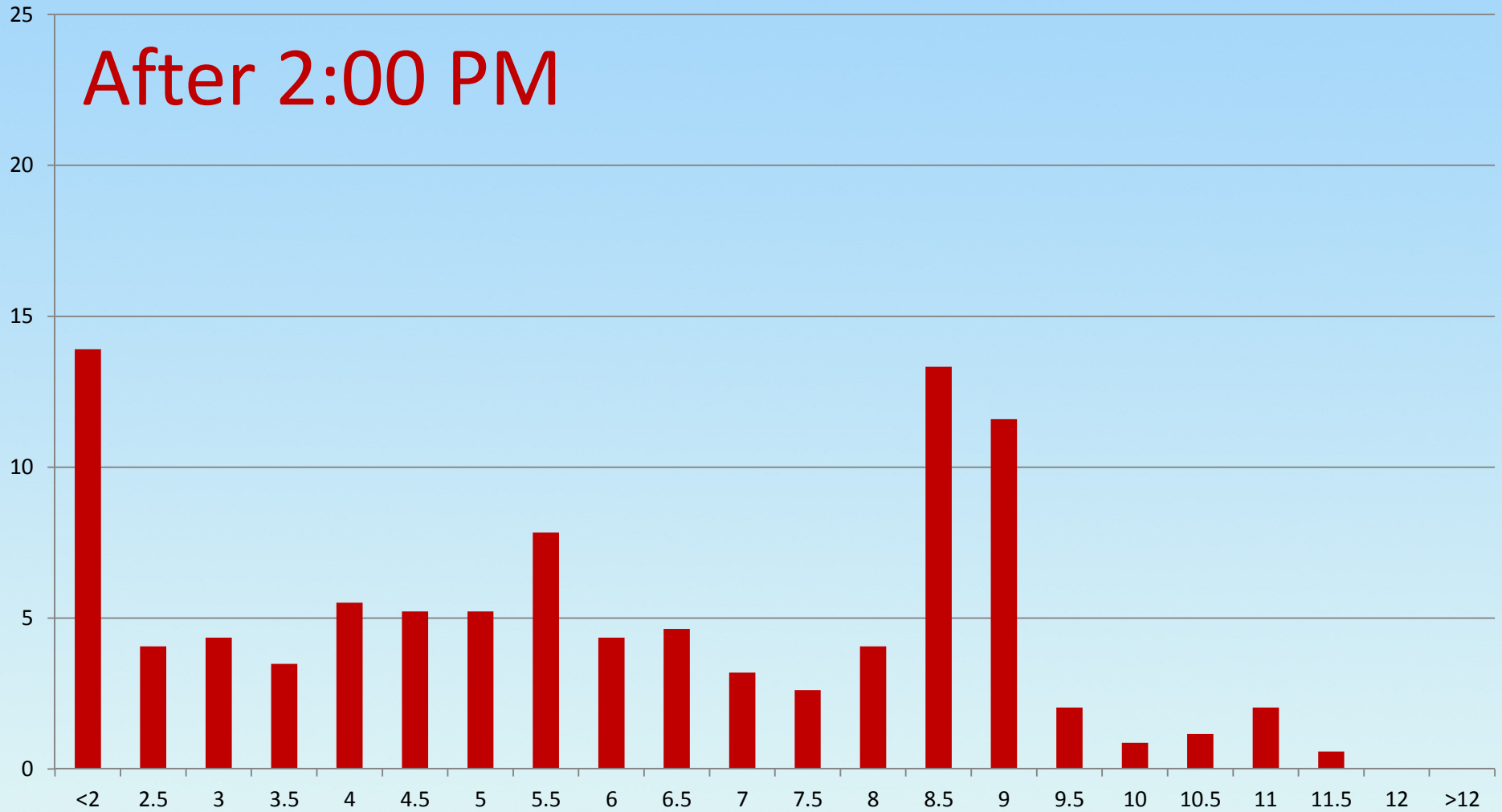
1:00 - 1:30 PM



1:30 - 2:00 PM

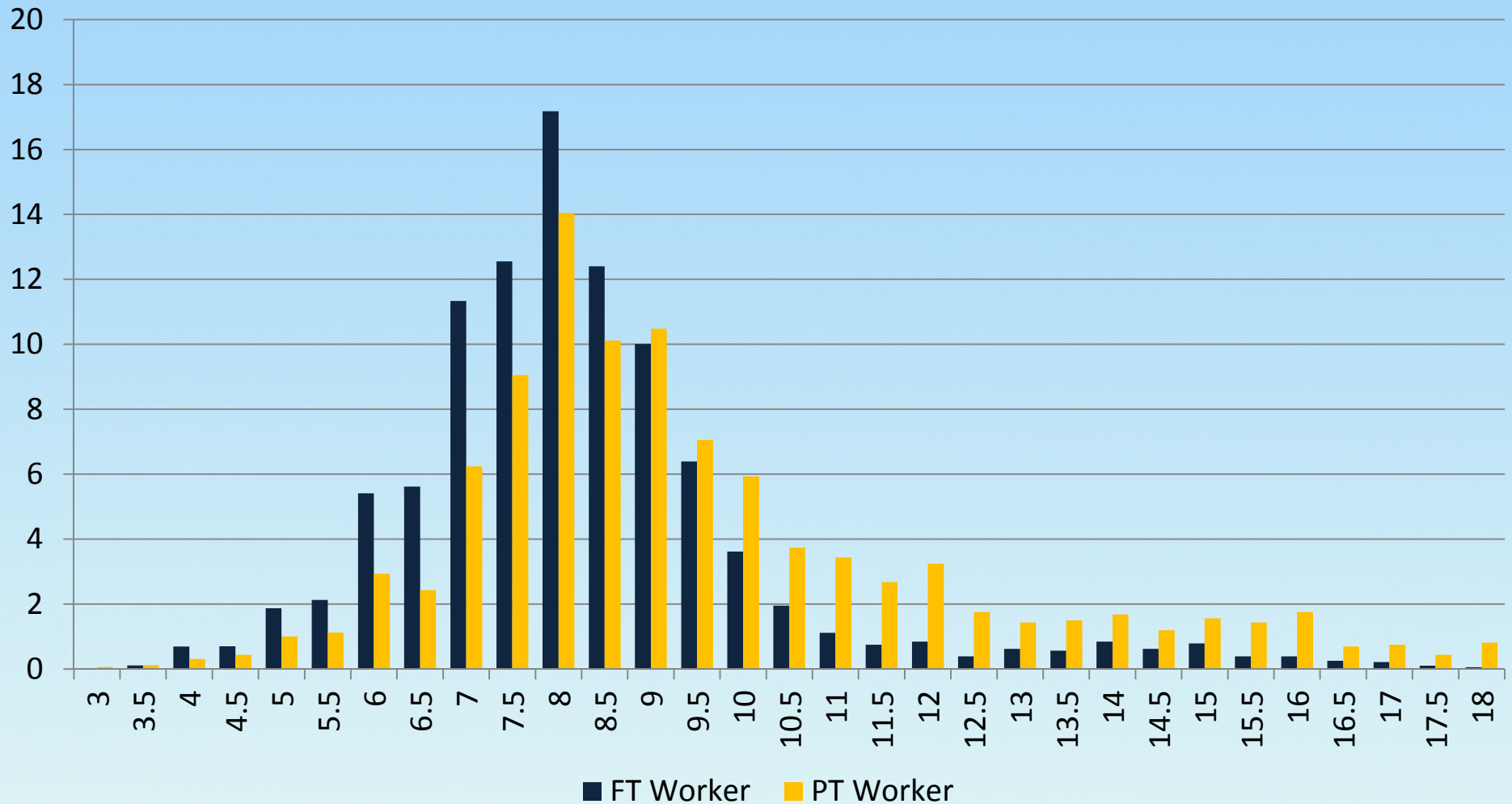


After 2:00 PM

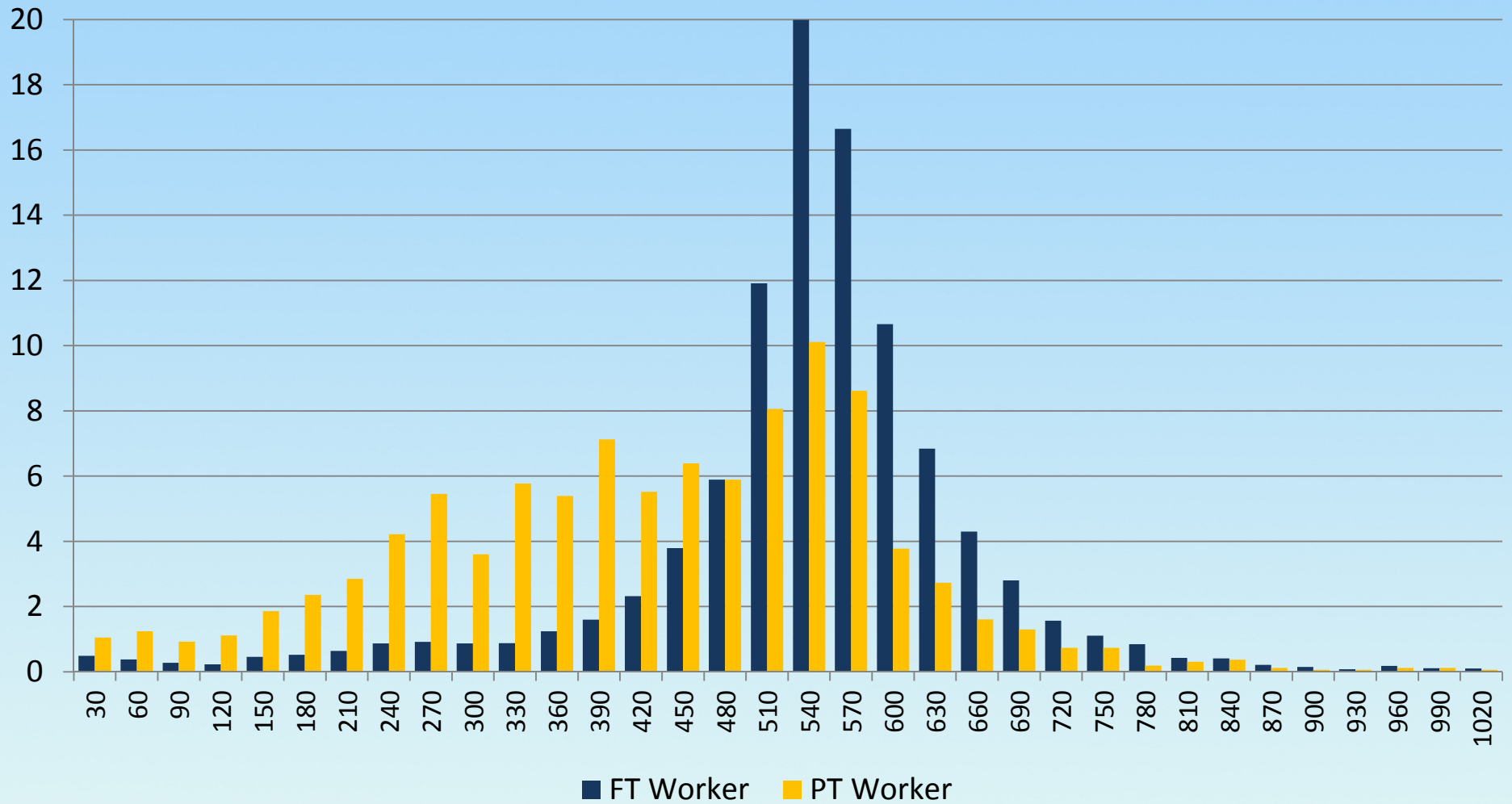


Start Time

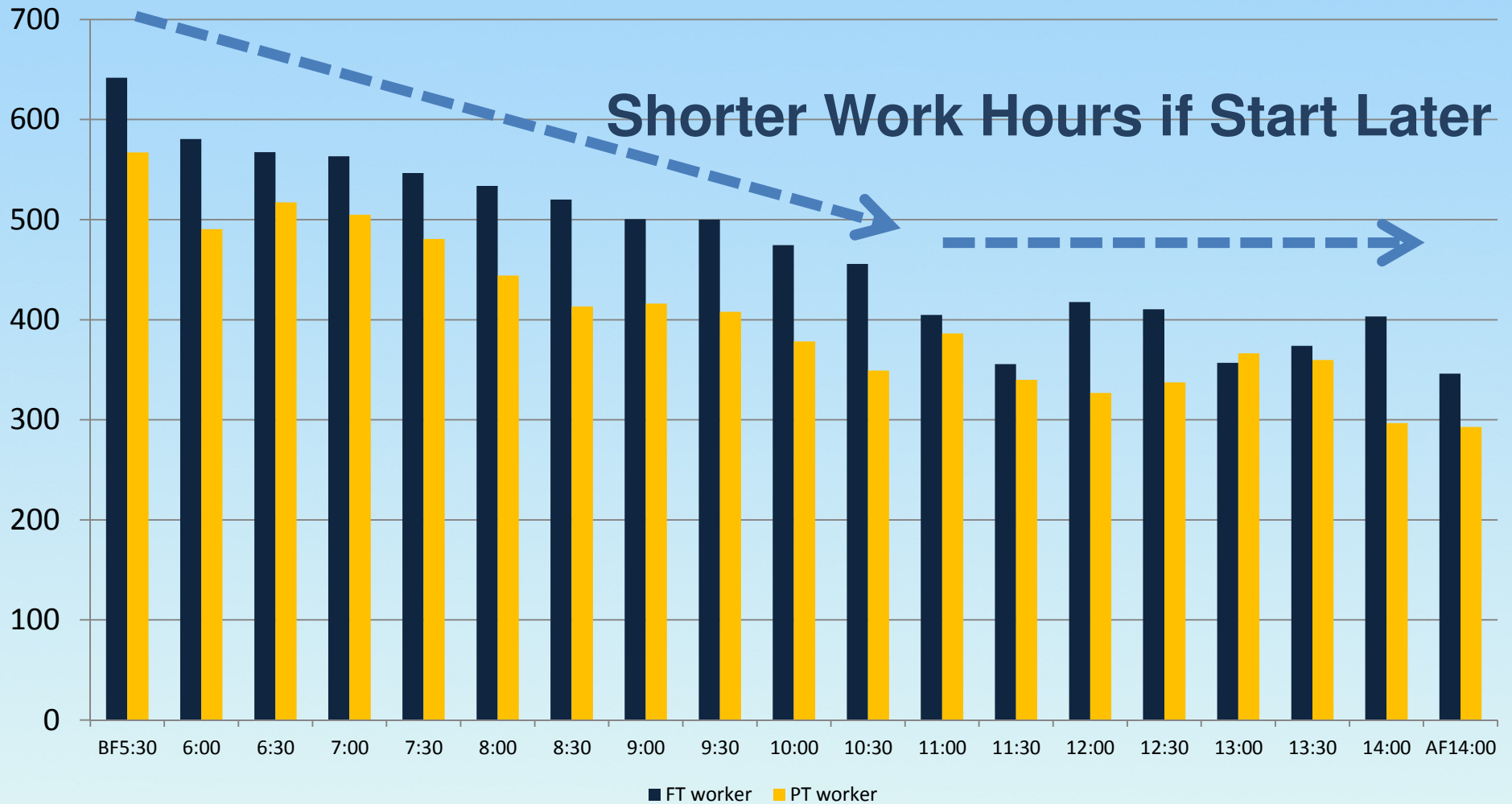
(PTW tends to starts later than FTW)



Work Duration

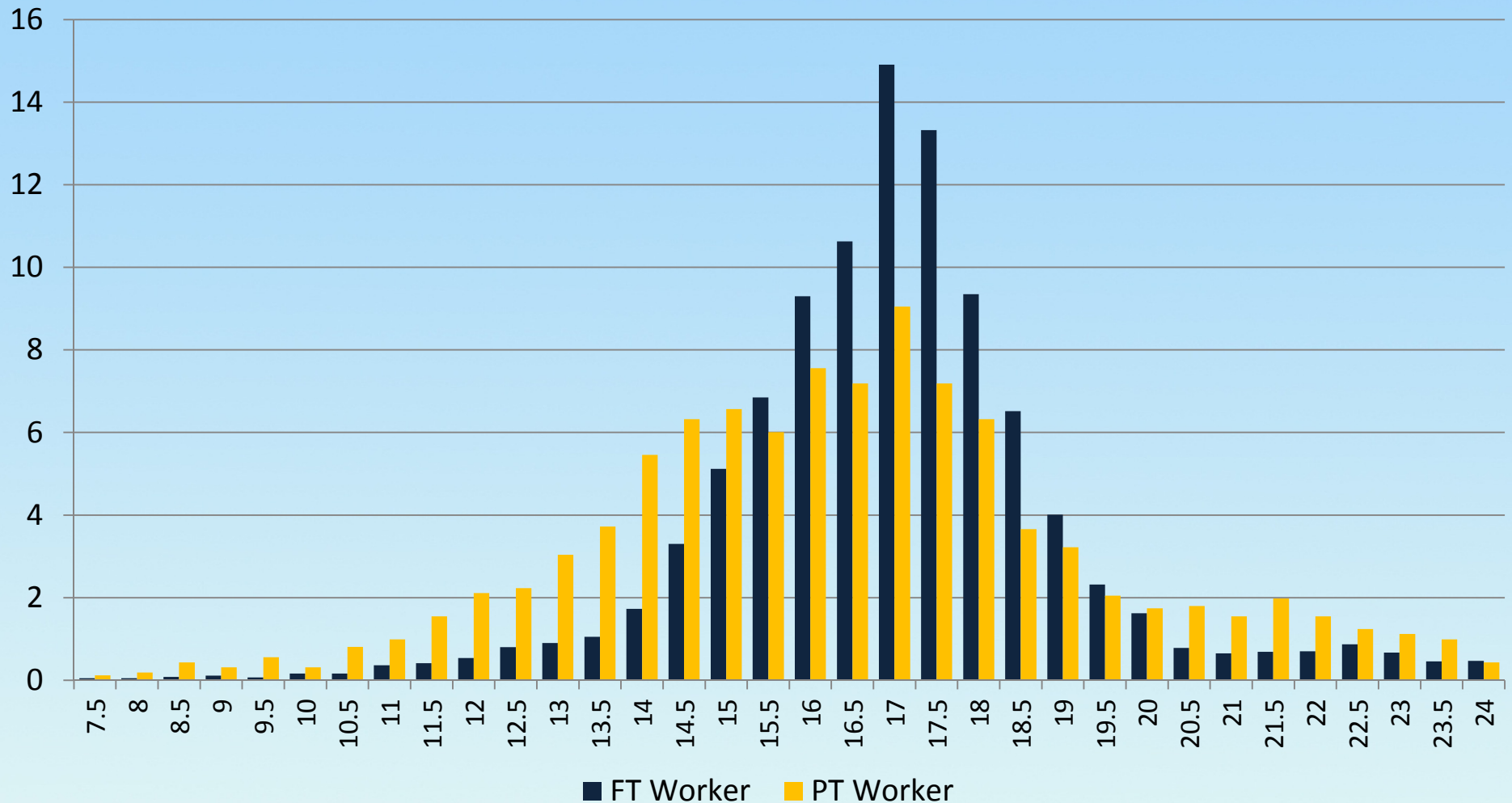


Work Duration by Start Time



End Time

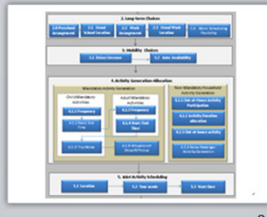
(similar distribution, STDEV is larger for PTW)



Other Examples Worker's Trip Scheduling

Model 6: Trips & Scheduling for Work Tour
HTS Data Analysis

Hsi-Hwa Hu
Feb, 6, 2015



Tour/Stop

- Outbound Tour for Primary Activity - Home to Prime Activity
- Inbound Tour for Primary Activity - Prime Activity to Home
- SubTour Outbound Tour - Home Based
- SubTour Inbound Tour - Home Based

Number of Stop for Tour

(SubTour is not included)

• Outbound (OB) tour: Home to Prime to Home (2 stops)
• Inbound (IB) tour: Prime to Home to Home (2 stops)
• Home based tour: Home to Prime to Home to Home (3 stops)

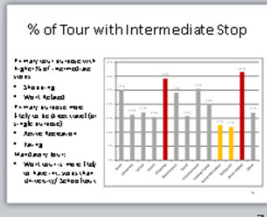
Tour Type	Stop 1	Stop 2	Stop 3	Stop 4	Stop 5	Stop 6	Stop 7	Stop 8	Stop 9	Stop 10	Stop 11	Stop 12	Stop 13	Stop 14	Stop 15	Stop 16	Stop 17	Stop 18	Stop 19	Stop 20	
OB	Home	Prime	Home																		
IB	Prime	Home	Home																		
Home Based	Home	Prime	Home	Home																	

Numr of Stop for SubTour

(work based)

- Outbound: 1 stop
- Inbound: 1 stop
- Home based: 1 stop

Stop	OB	IB	Home Based
1	1	1	1
2	1	1	1
3	1	1	1
4	1	1	1
5	1	1	1
6	1	1	1
7	1	1	1
8	1	1	1
9	1	1	1
10	1	1	1
11	1	1	1
12	1	1	1
13	1	1	1
14	1	1	1
15	1	1	1
16	1	1	1
17	1	1	1
18	1	1	1
19	1	1	1
20	1	1	1



Tour/Stop Analysis

- Will analyze each of 13 Tour Purposes
- % of tour with intermediate stops by outbound and inbound
- Stop activity types and duration

Tour/Stop Analysis (2)

Analyze both outbound and inbound data for each Tour Purpose.

Tour Purpose	OB	IB	Home Based
1. Home to Prime	100%	100%	100%
2. Prime to Home	100%	100%	100%
3. Home to Prime to Home	100%	100%	100%
4. Prime to Home to Home	100%	100%	100%
5. Home to Prime to Home to Home	100%	100%	100%
6. Prime to Home to Home to Home	100%	100%	100%
7. Home to Prime to Home to Home to Home	100%	100%	100%
8. Prime to Home to Home to Home to Home	100%	100%	100%
9. Home to Prime to Home to Home to Home to Home	100%	100%	100%
10. Prime to Home to Home to Home to Home to Home	100%	100%	100%
11. Home to Prime to Home to Home to Home to Home to Home	100%	100%	100%
12. Prime to Home to Home to Home to Home to Home to Home	100%	100%	100%
13. Home to Prime to Home to Home to Home to Home to Home to Home	100%	100%	100%

Tour Purpose = Work Outbound

• Outbound tours with intermediate stops are more likely to be work related (60% vs 40% for non-work related).

Tour Purpose	Work	Non-Work
1. Home to Prime	60%	40%
2. Prime to Home	60%	40%
3. Home to Prime to Home	60%	40%
4. Prime to Home to Home	60%	40%
5. Home to Prime to Home to Home	60%	40%
6. Prime to Home to Home to Home	60%	40%
7. Home to Prime to Home to Home to Home	60%	40%
8. Prime to Home to Home to Home to Home	60%	40%
9. Home to Prime to Home to Home to Home to Home	60%	40%
10. Prime to Home to Home to Home to Home to Home	60%	40%
11. Home to Prime to Home to Home to Home to Home to Home	60%	40%
12. Prime to Home to Home to Home to Home to Home to Home	60%	40%
13. Home to Prime to Home to Home to Home to Home to Home to Home	60%	40%

Tour Purpose = Work Inbound

- Similar observation to OB tour
- Half tour with int. stops is a little higher than OB (27%)
- Stop duration is a little shorter than OB.

Purpose for Intermediate Stops

• Outbound: about 7% is escort (30% 24% for intermediate)

• Inbound: about 22% each for escort, 3% intermediate

Stop	OB	IB
1. Escort	7%	22%
2. Intermediate	3%	3%
3. Home Based	90%	75%
4. Escort	7%	22%
5. Intermediate	3%	3%
6. Home Based	90%	75%
7. Escort	7%	22%
8. Intermediate	3%	3%
9. Home Based	90%	75%
10. Escort	7%	22%
11. Intermediate	3%	3%
12. Home Based	90%	75%
13. Escort	7%	22%
14. Intermediate	3%	3%
15. Home Based	90%	75%

Full-Time / Part-Time Workers Outbound

• Patterns are similar.

• FTW's spend much longer time than FTW on int. stops if have 2+ stops.

• Total budget time is maintained at similar level: less time on work, then more time for int. activities.

Stop	FTW	PTW
1	100%	100%
2	100%	100%
3	100%	100%
4	100%	100%
5	100%	100%
6	100%	100%
7	100%	100%
8	100%	100%
9	100%	100%
10	100%	100%
11	100%	100%
12	100%	100%
13	100%	100%
14	100%	100%
15	100%	100%
16	100%	100%
17	100%	100%
18	100%	100%
19	100%	100%
20	100%	100%

Full-Time / Part-Time Workers Inbound

• Similar patterns.

• Time for int. activities after work is less than 2 hours.

Stop	FTW	PTW
1	100%	100%
2	100%	100%
3	100%	100%
4	100%	100%
5	100%	100%
6	100%	100%
7	100%	100%
8	100%	100%
9	100%	100%
10	100%	100%
11	100%	100%
12	100%	100%
13	100%	100%
14	100%	100%
15	100%	100%
16	100%	100%
17	100%	100%
18	100%	100%
19	100%	100%
20	100%	100%

Arrive at Work before/after 8am

- Duration of int. stop activities for outbound

- If arrive at office before 8am, then less likely for intermediate stops. This may happen more likely for FTW due to longer work duration.
- If arrive after 8am, then more likely (or more time) for intermediate stops.

Arrive at Work before/after 8am

- % of int. stop activities for outbound

- Before 8am: less likely on escort, more on work related

Stop	Before 8am	After 8am
1. Escort	7%	22%
2. Intermediate	3%	3%
3. Home Based	90%	75%
4. Escort	7%	22%
5. Intermediate	3%	3%
6. Home Based	90%	75%
7. Escort	7%	22%
8. Intermediate	3%	3%
9. Home Based	90%	75%
10. Escort	7%	22%
11. Intermediate	3%	3%
12. Home Based	90%	75%
13. Escort	7%	22%
14. Intermediate	3%	3%
15. Home Based	90%	75%

Depart from Work before/after 6pm

- Duration of int. stop activities for inbound

- If leave office before 6pm, then more likely for intermediate stops. This may happen less likely for FTW due to shorter work duration.

Depart from Work before/after 6pm

- % of int. stop activities for inbound

- Leave before 6pm: more likely for escort

Stop	Before 6pm	After 6pm
1. Escort	27%	17%
2. Intermediate	27%	27%
3. Home Based	27%	27%
4. Escort	27%	17%
5. Intermediate	27%	27%
6. Home Based	27%	27%
7. Escort	27%	17%
8. Intermediate	27%	27%
9. Home Based	27%	27%
10. Escort	27%	17%
11. Intermediate	27%	27%
12. Home Based	27%	27%
13. Escort	27%	17%
14. Intermediate	27%	27%
15. Home Based	27%	27%

Intermediate Stop Purpose

- OB: Escort
- IB: OB: Shopping, Visiting, AF (Active Recreation), WF
- IB: OB: Maintenance, Social Entertainment, Int. Other
- 1 stop: Escort, AF

Stop	OB	IB
1. Escort	7%	22%
2. Intermediate	3%	3%
3. Home Based	90%	75%
4. Escort	7%	22%
5. Intermediate	3%	3%
6. Home Based	90%	75%
7. Escort	7%	22%
8. Intermediate	3%	3%
9. Home Based	90%	75%
10. Escort	7%	22%
11. Intermediate	3%	3%
12. Home Based	90%	75%
13. Escort	7%	22%
14. Intermediate	3%	3%
15. Home Based	90%	75%

Basic Data for Intermediate Stop/Trip Scheduling

- OB: Escort
- OB: Shopping, Visiting, AF (Active Recreation), WF
- IB: OB: Maintenance, Social Entertainment, Int. Other
- 1 stop: Escort, AF

Stop	OB	IB
1. Escort	7%	22%
2. Intermediate	3%	3%
3. Home Based	90%	75%
4. Escort	7%	22%
5. Intermediate	3%	3%
6. Home Based	90%	75%
7. Escort	7%	22%
8. Intermediate	3%	3%
9. Home Based	90%	75%
10. Escort	7%	22%
11. Intermediate	3%	3%
12. Home Based	90%	75%
13. Escort	7%	22%
14. Intermediate	3%	3%
15. Home Based	90%	75%

Data

Stop	OB	IB
1. Escort	7%	22%
2. Intermediate	3%	3%
3. Home Based	90%	75%
4. Escort	7%	22%
5. Intermediate	3%	3%
6. Home Based	90%	75%
7. Escort	7%	22%
8. Intermediate	3%	3%
9. Home Based	90%	75%
10. Escort	7%	22%
11. Intermediate	3%	3%
12. Home Based	90%	75%
13. Escort	7%	22%
14. Intermediate	3%	3%
15. Home Based	90%	75%

Stop Activity Duration

• Activity duration is more likely to be longer for FTW (30-40 min) than for PTW (15-20 min).

• Same activity for both FTW and PTW (e.g., 30 min, 40 min, 50 min).

• Duration for the same activity is more likely to be longer for FTW than for PTW.

Stop	FTW	PTW
1. Escort	30	15
2. Intermediate	30	15
3. Home Based	30	15
4. Escort	30	15
5. Intermediate	30	15
6. Home Based	30	15
7. Escort	30	15
8. Intermediate	30	15
9. Home Based	30	15
10. Escort	30	15
11. Intermediate	30	15
12. Home Based	30	15
13. Escort	30	15
14. Intermediate	30	15
15. Home Based	30	15

Stop Activity Arrival (Start) Time

- Escort has serious time constraint.
- OB: Intermediate and visiting is 10-12, probably for FTW and low for PTW. Others are between 2-9.
- IB: Average on 7pm.
- Average doesn't tell much. Need to check distribution.

Stop	OB	IB
1. Escort	10-12	7-9
2. Intermediate	10-12	7-9
3. Home Based	10-12	7-9
4. Escort	10-12	7-9
5. Intermediate	10-12	7-9
6. Home Based	10-12	7-9
7. Escort	10-12	7-9
8. Intermediate	10-12	7-9
9. Home Based	10-12	7-9
10. Escort	10-12	7-9
11. Intermediate	10-12	7-9
12. Home Based	10-12	7-9
13. Escort	10-12	7-9
14. Intermediate	10-12	7-9
15. Home Based	10-12	7-9

Stop Activity Departure (End) Time

- For OB departure time after 9 or 10 AM, more likely for FTW.
- IB: 10-12 for visit, 2-9 for work, 1-2 for home.
- IB: 10-12 for visit, 2-9 for work, 1-2 for home.

Stop	OB	IB
1. Escort	10-12	7-9
2. Intermediate	10-12	7-9
3. Home Based	10-12	7-9
4. Escort	10-12	7-9
5. Intermediate	10-12	7-9
6. Home Based	10-12	7-9
7. Escort	10-12	7-9
8. Intermediate	10-12	7-9
9. Home Based	10-12	7-9
10. Escort	10-12	7-9
11. Intermediate	10-12	7-9
12. Home Based	10-12	7-9
13. Escort	10-12	7-9
14. Intermediate	10-12	7-9
15. Home Based	10-12	7-9

Travel Time to Stop

- OB: Overall 10-12 min, more likely to be longer (20-30 min) for FTW.
- IB: 10-12 min, 20-30 min for visit, 1-2 min for home.
- IB: 10-12 min, 20-30 min for visit, 1-2 min for home.

Stop	OB	IB
1. Escort	10-12	7-9
2. Intermediate	10-12	7-9
3. Home Based	10-12	7-9
4. Escort	10-12	7-9
5. Intermediate	10-12	7-9
6. Home Based	10-12	7-9
7. Escort	10-12	7-9
8. Intermediate	10-12	7-9
9. Home Based	10-12	7-9
10. Escort	10-12	7-9
11. Intermediate	10-12	7-9
12. Home Based	10-12	7-9
13. Escort	10-12	7-9
14. Intermediate	10-12	7-9
15. Home Based	10-12	7-9

Summary

- The number of intermediate stops (trip chain) and their activity duration is closely related to time constraint of work, including work duration, work start time, work end time.
- Activities for intermediate stops are very different: some have very short activity duration (< 10 min), very long duration (2-4 hours), and in-between.
- Total activity time for different number of intermediate stops is maintained at the similar level.
- Escort is an important intermediate activity.

Summary

- The number of intermediate stops (trip chain) and their activity duration is closely related to time constraint of work, including work duration, work start time, work end time.
- Activities for intermediate stops are very

Examples

- Worker's Tour by Time Window

WORKERS' TRIPS AND SCHEDULING FOR MANDATORY TOURS (M6.1)

1. Work start time, end time
2. Total NM activity time for each purpose (MDCCV)
3. Joint activity time and purpose (M5)
4. Time budget for each NM activity = 2-3

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Already Known

1. Work start time, end time
2. Total NM activity time for each purpose (MDCCV)
3. Joint activity time and purpose (M5)
4. Time budget for each NM activity = 2-3

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Need to Know

- Number (frequency) of intermediate stops by outbound tour and inbound tour (half tour)
- Stop activity purpose and activity duration
- Order to stop. Not sure if it's important, but will check with HTS
- Distance

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Work Tour Intermediate Stops

- 13% OB tour has 1 int. stop and 3-4% has 2+ int. stops
- 15% IB tour has one int. stop and 9% has 2+ int. stops
- Move HBWD for OB tours IB.
- Suggest to have up to 2 int. stops for each (or 3+ stops for IB).

# Int. Stops	% OB	# Int. Stops	% IB
0	87	0	72
1	12	1	17
2+	1	2	6

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Outbound 1 Int. Stop

- Escort (62%)
- Maintenance (20%)
- Shopping (7%)

Activity	%
1 Escort	62
2 Shopping	7
3 Maintenance	20
4 Social	6
5 Entertainment	3
6 Other	2

- Not likely:
- Social, Entertainment, visiting, other
 - High activity duration, not for workers

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Outbound 2+ Int. Stop

- Escort (40%)
- Maintenance (20%)
- Work related (10%), shopping (8%)

Activity	%
1 Escort	40
2 Shopping	8
3 Maintenance	20
4 Social	7
5 Entertainment	3
6 Other	2

- Not likely:
- Social, Entertainment, visiting, other
 - Active recreation

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Outbound 1 Int. Stop - Duration

- Top 3
- Escort: 4-5 min drop-off;
 - Maintenance & shopping: 10 min (median seems more reasonable)
 - Travel access time: about 10 min

Activity	Min	Q1	Q2	Q3	Max
1 Escort	4	4	5	5	5
2 Shopping	10	10	10	10	10
3 Maintenance	10	10	10	10	10
4 Social	10	10	10	10	10
5 Entertainment	10	10	10	10	10
6 Other	10	10	10	10	10

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Outbound 2+ Int. Stop - Duration

- Top 4
- Escort: 3 min pick-up
 - Maintenance & shopping: about 10 min
 - Work related: 45 min
 - Travel access time: 10 min; 20 min for WR

Activity	Min	Q1	Q2	Q3	Max
1 Escort	3	3	3	3	3
2 Shopping	10	10	10	10	10
3 Maintenance	10	10	10	10	10
4 Social	10	10	10	10	10
5 Entertainment	10	10	10	10	10
6 Other	10	10	10	10	10

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Inbound 1 Int. Stop

- Escort & Shopping: each about 1/4
- Maintenance (18%)
- Work Related (14%)

Activity	%
1 Escort	25
2 Shopping	25
3 Maintenance	18
4 Social	7
5 Entertainment	2
6 Other	2

- Not likely:
- Social, Entertainment, Eating, other
 - Similar to OB, but less escort %

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Inbound 2 Int. Stop

- Escort, Shopping, maintenance: each about 20%
- Work Related (11%)

Activity	%
1 Escort	20
2 Shopping	20
3 Maintenance	20
4 Social	11
5 Entertainment	2
6 Other	2

- Not likely:
- Social, Entertainment, Other

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Inbound 3+ Int. Stop

- Similar to 2 stops
- Escort, Shopping, maintenance: each about 20%
- Work Related, Eating (each 11%)

Activity	%
1 Escort	20
2 Shopping	20
3 Maintenance	20
4 Social	11
5 Entertainment	2
6 Other	2

- Not likely:
- Social, Entertainment, All, Other

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Inbound 1 Int. Stop - Duration

- Top 3
- Escort: 5 min pick-up;
 - Maintenance & shopping: 20-30 min
 - Travel access time: about 20 min
 - Longer than OB, probably due to less constrained

Activity	Min	Q1	Q2	Q3	Max
1 Escort	5	5	5	5	5
2 Shopping	20	20	20	20	20
3 Maintenance	20	20	20	20	20
4 Social	20	20	20	20	20
5 Entertainment	20	20	20	20	20
6 Other	20	20	20	20	20

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Inbound 2 Int. Stop - Duration

- Escort: 5 min pick-up;
- Maintenance & shopping: 15-25 min
- Travel access time: about 15 min
- Activity and travel time of each stop is shorter than 1-stop tour

Activity	Min	Q1	Q2	Q3	Max
1 Escort	5	5	5	5	5
2 Shopping	15	15	15	15	15
3 Maintenance	15	15	15	15	15
4 Social	15	15	15	15	15
5 Entertainment	15	15	15	15	15
6 Other	15	15	15	15	15

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Inbound 3+ Int. Stop - Duration

- Escort: 5 min pick-up;
- Maintenance & shopping: 10-20 min
- Travel access time: about 10-15 min
- Activity and travel time of each stop is shorter than 2-stop tour

Activity	Min	Q1	Q2	Q3	Max
1 Escort	5	5	5	5	5
2 Shopping	10	10	10	10	10
3 Maintenance	10	10	10	10	10
4 Social	10	10	10	10	10
5 Entertainment	10	10	10	10	10
6 Other	10	10	10	10	10

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Comparison - Purpose

Activity	OB	IB	IB	IB	IB
1 Escort	62	25	20	20	20
2 Shopping	7	25	20	20	20
3 Maintenance	20	18	20	20	20
4 Social	6	11	11	11	11
5 Entertainment	3	2	2	2	2
6 Other	2	2	2	2	2

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Comparison - Activity Duration

Activity	OB	IB	IB	IB	IB
1 Escort	4	5	5	5	5
2 Shopping	10	20	20	20	20
3 Maintenance	10	15	15	15	15
4 Social	10	10	10	10	10
5 Entertainment	10	10	10	10	10
6 Other	10	10	10	10	10

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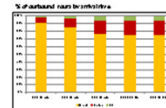
Comparison - Travel Access Time

Activity	OB	IB	IB	IB	IB
1 Escort	10	10	10	10	10
2 Shopping	10	10	10	10	10
3 Maintenance	10	10	10	10	10
4 Social	10	10	10	10	10
5 Entertainment	10	10	10	10	10
6 Other	10	10	10	10	10

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Outbound Tour by Work Arrival Time

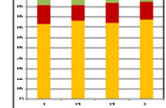
- People are more likely to have intermediate stops if arrive at office after 9:00AM.



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Outbound Tour by Work Duration

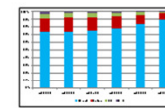
- Pattern is not clear.



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Inbound Tour by Work Departure Time

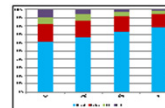
- Leave work place earlier, more intermediate stops for inbound tour



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Inbound Tour by Work Duration

- Longer work hours, less intermediate stops for inbound tour.



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Arrive at Work before/after 8am - % of int. stop activities for inbound

- Before 8am: less likely an escort, more on work related

Activity	Before 8am	After 8am
1 Escort	25	25
2 Shopping	25	25
3 Maintenance	20	20
4 Social	11	11
5 Entertainment	2	2
6 Other	2	2

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Depart from Work before/after 6pm - % of int. stop activities for inbound

- Leave before 6pm; more likely for escort

Activity	Before 6pm	After 6pm
1 Escort	25	25
2 Shopping	25	25
3 Maintenance	20	20
4 Social	11	11
5 Entertainment	2	2
6 Other	2	2

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Activity Duration vs NM Time Budget

- For those workers who participate in escort activity during outbound to work, average 50% of the workers available time budget on escort is used.
- The activity time/budget time proportion is higher for IB than OB.

Activity	OB	IB
1 Escort	25	25
2 Shopping	7	25
3 Maintenance	20	20
4 Social	6	11
5 Entertainment	3	2
6 Other	2	2

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Travel Distance

- Average Home-Work Distance = 13 miles
- With intermediate stops:
 - Outbound: add 10mi to 2.5 miles (travel time constraint); Not much difference with add/omit stop
 - Inbound: less constraints

Activity	OB	IB	IB	IB
1 Escort	13	13	13	13
2 Shopping	13	13	13	13
3 Maintenance	13	13	13	13
4 Social	13	13	13	13
5 Entertainment	13	13	13	13
6 Other	13	13	13	13

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Travel Time

- Average Home-Work Time = 26 minutes
- With intermediate stops:
 - Outbound: additional 52 minutes
 - Inbound: 4-50 minutes

Activity	OB	IB	IB	IB
1 Escort	26	26	26	26
2 Shopping	26	26	26	26
3 Maintenance	26	26	26	26
4 Social	26	26	26	26
5 Entertainment	26	26	26	26
6 Other	26	26	26	26

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Outbound Travel Distance/Time

- Travel distance increases marginally with longer home-work distance.
- Probably those intermediate stops are on the way to work.

Activity	OB	IB	IB	IB
1 Escort	13	13	13	13
2 Shopping	13	13	13	13
3 Maintenance	13	13	13	13
4 Social	13	13	13	13
5 Entertainment	13	13	13	13
6 Other	13	13	13	13

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Inbound Travel Distance/Time

- Travel distance increases dramatically with longer home-work distance.
- Same observation for travel time

Activity	OB	IB	IB	IB
1 Escort	13	13	13	13
2 Shopping	13	13	13	13
3 Maintenance	13	13	13	13
4 Social	13	13	13	13

Examples

- Worker's Non-Mandatory Tour

M6 Worker's Non-Mandatory Tour and Trip

Hsi-Hwa Hu
Feb. 20, 2015

A Worker's NM Activities

- Current framework separate worker's participation/engagement in non-mandatory activities by mandatory tour and non-mandatory tour
- Mandatory tour: engage in NM activities during the commuting from home to work, or from work back to home.
- Non-mandatory tour: before work, after work, work base

Current Approach

- Current approach is a sequential approach: First determine non-mandatory activities as intermediate stops for outbound/inbound commuting tours, then allocating remaining NM time budget to BW, AW, and WB tours.
- Thought: A worker should have had a comprehensive view when plan for a NM activities and schedule of a day. Not a sequential procedure.

Different Approach

- A worker's participation in non-mandatory activities is closely linked to his time constraint from work-work schedule.
- Works schedule: work start time and end time
 - Work starts early: less likely for Commuting outboard and BW tours
 - Work ends late: less likely for Commuting inbound and AW tour

Analysis Overview

- Number of Tours with NM Stops
- Work Schedule
- Distance to Work
- Chained or Separated Tour
- NM Activity Purpose
- Distance
- Travel Time and Activity Time
- Made Us

TOURS WITH NON-MANDATORY ACTIVITY

Daily Tours for NM Activities

- 44% of workers do not travel for any NM activities.
- 25% of workers have 1 tour with NM stops
- 18% has 2 tours, and
- 10% have 3+ tours

NMTour	Percent
0	44%
1	25%
2	12%
3	5%
4+	2%

Workers' NM Daily Tour % Stops

- For workers made NM travel, 38% of those workers have 1 tour/1 stop, 9.5% have 1 tour/2 stops.
- 1 tour: 1-2 stops
- 2 tours: 2-4 stops
- 3 tours: 3-4 stops

NMTour	1 Stop	2	3	4	5	6+
1	21%	4.4%	2.4%	0.6%	0.5%	11.5%
2	0	3.7%	2.7%	3.3%	1.4%	16.1%
3	0	0	5.5%	4.3%	3.7%	13.1%
4+	0	0	0	0	0	0
Sum	21%	7.7%	10.6%	8.3%	5.7%	26.4%

Tours with NM Activities

- 6% of total tours with NM stops are Before Work tours compared to 22% for After Work tours
- About 25% of NM tours are outboard / inbound tour, respectively.

NMTour	Percent
Before	24%
After	23%
Mid/After	27%
Other	27%

Number of NM Tours

- For workers who take After Work tours, 86% of those workers have one tour, 12% have 2 tours.
- Same % for before work tours.
- Only 1 tour for work based tour

Tour with Trip Chain

- Overall, about 25% of tours are chained.

Category	Chained (trip chain)	1 NM stop	2 NM stops	3+ NM stops
Outbound	25%	10%	5%	8%
Inbound	27%	10%	6%	7%

For Workers with 1 NM Tour per Day

- Ratio of Before Arrival Work to After Departure from Works 1:4

Tour	Before Work	Percent
Before Work	Before Work	17%
After Work	After Work	17%
Other	Other	17%
Mid/After	Mid/After	17%
Other	Other	17%

For 2 NM Tours per Day

- Ratio of AW:WB:IB:OB:Other = 1:1:4:1:6
- OB may include high proportion of stop off trip (with check)
- High combination: OB:WB:IB:OB:Other = 28%:18%:18%:18%:18%
- Observation: for 2 tours, less likely to have before work; at least one during commuting

3+ NM Tours

- Less likely: Before Work
- More likely: Outbound
- Likely: WB, IB, After Work (more with 2 tours)

Work Schedule

- Works schedule is related to availability of time for engaging in NM activities
- Work Arrival Time vs. Before Work Tour and Outbound Tour
- Work Departure Time vs. After Work Tour and Inbound Tour
- Work Duration

Work Arrival Time & Total NW Tour

- Number of tour with NM activity has no clear relation with work arrival time.
- About 5% of workers have arrival time after 12:00

Work Departure Time & Total NW Tour

- Workers who leave early from work are more likely to have at least one tour of a day for NM activity.
- More time for NM tour after work

Work Duration & Total NW Tour

- Workers who work for short duration (part-time worker) are more likely to have at least one tour of a day for NM activity.

Work Arrival Time & Outbound Tour with NM Stops

- Workers who leave home early are less likely to have NM stop for outbound tour.
- About 5% of workers have arrival time after 12:00

Work Arrival Time & Before Work Tour with NM Stops

- 6% of all workers have Before Work tour.
- There is no clear pattern between work arrival time and Before Work tour.

Work Departure Time & Inbound Tour with NM Stops

- Workers who leave work early are more likely to have NM stop for inbound tour.

Work Departure Time & After Work Tour with NM Stops

- Workers who leave work early are more likely to have NM stop for After Work tour
- Similar to Inbound tour

Work Base

- More likely to have WB tour if arrive later (before noon) or departure later (before 20:00)

Home-Work Distance

- Shorter distance to work, more likely to have After Work Tour. But the difference is marginal.

Tour Chain and Work Schedule

- Inbound travel are less likely to have chain if later departure time from work
- Outbound travel are less likely to have chain if earlier arrival time to work

Tour Chain and Work Schedule (2)

- After work travel are less likely to have chain if later departure time from work
- Before work travel are less likely to have chain if earlier arrival time to work

PURPOSE AND FREQUENCY OF NM ACTIVITY TRAVEL

Non-Mandatory Activity Participation

- Top 4 NM Activities for Workers: Is cart, Maintenance, Shopping, and Eating Out

Activity	Count	Percent	% of workers with this activity
1. Is cart	175	100%	100%
2. Maintenance	175	100%	100%
3. Shopping	175	100%	100%
4. Eating Out	175	100%	100%
5. Other	26	15%	15%
6. Drinking Water	26	15%	15%
7. Rest	26	15%	15%
8. Inbound/Outbound	26	15%	15%
9. Before/After Work	26	15%	15%
10. Other	26	15%	15%
11. Drinking Water	26	15%	15%
12. Rest	26	15%	15%
13. Inbound/Outbound	26	15%	15%
14. Other	26	15%	15%

Stops by Each NM Activity for

Average Number of Stops by

Activity

Activity

Activity

Activity

Activity

Examples - Worker's Intermediate Stops

M5 & 6 Non-Mandatory Stops for Workers, Students, & Non-Workers

Hi-Hwa Hu
March 7, 2015

Outline

- Review AllNM Travel for Workers, Students, and Non-Workers
- By three main groups:
 - Escort Travel
 - Joint Activity
 - Other NM Stops

WORKER

% of Total Trips

Interstop	Frequency	Percent	Per stop
1 To IntStop - Other (NM/Strategic)	67	66%	OB
2 To IntStop - IB (NM/Strategic)	15	15%	IB
3 To IntStop - Work to Work (Sub Tour)	11	11%	WB
4 To IntStop - Other (NM/Strategic)	228	22%	Other (NM/Strategic)
5 To IntStop - Other (NM/Strategic)	257	25%	Other (NM/Strategic)
6 To IntStop - Other (NM/Strategic)	154	15%	Other (NM/Strategic)
7 To IntStop - Other (NM/Strategic)	9	1%	Other (NM/Strategic)
8 To IntStop - Other (NM/Strategic)	65	6%	Other (NM/Strategic)
Total	301	301%	

% of Total NM Stops

Interstop	Frequency	Percent	Per stop
1 To IntStop - Other (NM/Strategic)	26	26%	OB
2 To IntStop - IB (NM/Strategic)	16	16%	IB
3 To IntStop - Work to Work (Sub Tour)	13	13%	WB
4 To IntStop - Other (NM/Strategic)	62	62%	Other (NM/Strategic)
5 To IntStop - Other (NM/Strategic)	26	26%	Other (NM/Strategic)

NM Stops by Purpose

- IBW (not many): escort, AF
- OB: escort, shopping
- WB: eating, WF
- IB: other (mostly): escort, shopping, maintenance
- AW: escort, shopping, maintenance, AF, eating

Interstop	SP	IB	WB	AW	OB	AF	Other
1	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0

% of Stops for Escort (To pick up/Drop off)

- 73% with Mandatory Tour during HW and W-H

Interstop	Frequency	Percent
1 To IntStop - OB (NM/Strategic)	39	39%
2 To IntStop - IB (NM/Strategic)	37	37%
3 To IntStop - Work to Work (Sub Tour)	21	21%
4 To IntStop - Other (NM/Strategic)	32	32%
5 To IntStop - Other (NM/Strategic)	14	14%
6 To IntStop - Other (NM/Strategic)	14	14%
7 To IntStop - Other (NM/Strategic)	14	14%
8 To IntStop - Other (NM/Strategic)	14	14%
Total	185	185%

% of Stops for Joint Activity (Intro HH JA)

- IB+ AW > 80%
- Main IB (33%), the work will go to JA location from work location.

Interstop	Frequency	Percent
1 To IntStop - OB (NM/Strategic)	114	114%
2 To IntStop - IB (NM/Strategic)	227	227%
3 To IntStop - Work to Work (Sub Tour)	25	25%
4 To IntStop - Other (NM/Strategic)	42	42%
5 To IntStop - Other (NM/Strategic)	42	42%

% of From/To Joint Activity

- 55% of JA departs from home
- Main JA for workers: Shopping, Maintenance, Eating from work location.

Interstop	From	To
1	114	114
2	227	227
3	25	25
4	42	42
5	42	42

Summary

- 20.4% of workers NM stops are to provide escort services, 14% are joint activity, and 65% for other independent NM activity.

Interstop	Frequency	Percent
SP	204	204%
IB	16	16%
NM	632	632%

% of Total NM Stops

- SP: IB, OB
- JA: IB, AW
- NM: IB

Interstop	Frequency	Percent	Per stop
1 To IntStop - Other (NM/Strategic)	15	15%	OB
2 To IntStop - IB (NM/Strategic)	15	15%	IB
3 To IntStop - Work to Work (Sub Tour)	13	13%	WB
4 To IntStop - Other (NM/Strategic)	62	62%	Other (NM/Strategic)
5 To IntStop - Other (NM/Strategic)	26	26%	Other (NM/Strategic)

% of Total NM Stops by Purpose

- JA: more on eating out, less on WR

Interstop	SP	IB	WB	AW	OB	AF	Other
1	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0

STUDENT

% of Total Trips

- Three grades: PS-8, 9-12, College/University
- Patterns are similar among grades.

Interstop	Frequency	Percent	Per stop
1 To IntStop - Other (NM/Strategic)	114	114%	OB
2 To IntStop - IB (NM/Strategic)	227	227%	IB
3 To IntStop - Work to Work (Sub Tour)	25	25%	WB
4 To IntStop - Other (NM/Strategic)	42	42%	Other (NM/Strategic)
5 To IntStop - Other (NM/Strategic)	42	42%	Other (NM/Strategic)

% of Total NM Stops

- Pattern for college students is different from PS-12 students.
- College students have higher % on BS (Before School) and less on AS.

Interstop	Frequency	Percent	Per stop
1 To IntStop - Other (NM/Strategic)	114	114%	OB
2 To IntStop - IB (NM/Strategic)	227	227%	IB
3 To IntStop - Work to Work (Sub Tour)	25	25%	WB
4 To IntStop - Other (NM/Strategic)	42	42%	Other (NM/Strategic)
5 To IntStop - Other (NM/Strategic)	42	42%	Other (NM/Strategic)

Total NM Stops by Activity

- Compared to PS-12, college students have higher % on escort and WR; lower % on AR.

Interstop	SP	IB	WB	AW	OB	AF	Other
1	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0

% NM by Activity/Period

Interstop	SP	IB	WB	AW	OB	AF	Other
1	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0

Mode Share of Joint Activity

- College students have higher % as drivers/DO
- Younger students rely on ride by HH adults.
- High school students have the highest % on biking.

Interstop	SP	IB	WB	AW	OB	AF	Other
1	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0

Joint Activity by Grade

- Main focus on IB (School-Home) and AS (After School).
- PS-12 have higher JA than non-JA than College students.

Interstop	SP	IB	WB	AW	OB	AF	Other
1	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0

Joint Activity by Type

- JA have higher % on shopping, maintenance, and eating out than non-JA for all students.
- PS-12 have higher % for Visiting AF on JA than non-JA.

Interstop	SP	IB	WB	AW	OB	AF	Other
1	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0

JA and non-JA by Mode

- PS-12 students tend to be escort recipient for their NM activities.
- For all NM stops, escort recipient (DOV passenger) is 75% for PS-12, 60% for 9-12, and 32% for college. (Data from NM state NM tour mode!)

Interstop	SP	IB	WB	AW	OB	AF	Other
1	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0

NON WORKER

By Activity Arrival (Start) Time

- There is no lecture/work/school for non workers, using TOD for NM activity stop arrival time for the analysis.
- Overall, half of NM start between 12 for nonworkers.

Time	Observed	Expected	Observed	Expected
0-5	0	0	0	0
5-10	0	0	0	0
10-15	0	0	0	0
15-20	0	0	0	0
20-25	0	0	0	0
25-30	0	0	0	0
30-35	0	0	0	0
35-40	0	0	0	0
40-45	0	0	0	0
45-50	0	0	0	0
50-55	0	0	0	0
55-60	0	0	0	0
60-65	0	0	0	0
65-70	0	0	0	0
70-75	0	0	0	0
75-80	0	0	0	0
80-85	0	0	0	0
85-90	0	0	0	0
90-95	0	0	0	0
95-100	0	0	0	0

By Purpose

- Half of NM stops are for escort, shopping, and maintenance. Most of escort are handled by NM adults.
- Elderly have higher % on shopping/maintenance; children have higher % on visiting and AF.

Interstop	SP	IB	WB	AW	OB	AF	Other
1	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0

Activity Start Time & Purpose

- In the morning, more NM starts for escort and AF, but in the afternoon, more NM starts for shopping and maintenance (stop at home, school, or work, or other locations and maintenance, also more on bus and on road).
- Shopping and maintenance are more common for nonworkers in all day (to be more relevant).</

Examples

- Household Activity Generation

M4.2.1 – M4.2.4 Non-Mandatory Household Activity Generation

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12/30/2014

ABM Flowchart

Models Included

- Model 4.2.1: Out-of-Home Non-Mandatory Activity Participation
- Model 4.2.2: Activity Duration Allocation
- Model 4.2.3: Out-of-Home Non-Mandatory Activity Generation
- Model 4.2.4: Serve Passenger Activity Generation

Model 4.2.1: Out-of-Home Non-Mandatory Activity Participation

Introduction

- This model predicts whether any person within a household participate in any out-of-home non-mandatory activities.
- It is a binary logic model with two choices: no one in the household participates in out-of-home non-mandatory activities, and at least one person participates in one or more non-mandatory activities.
- Households with at least one out-of-home activity participation are exposed to Model 4.2.2, the MDCEV model that generates out-of-home activities for each person in a household.

Data Analysis

- Using HTS data to analyze % of households that make at least one out-of-home trips for NM activities.
- Remove all households with problematic trip duration and activity duration data.
- Total 13,173 households.

Overall %

- 81.4% of household make at least one OH (out-of-home) NM (non-mandatory) activity.
- Calibration target processed by P8
- 78.6% from me (weighted and remove HH samples with "problematic" trips - trips without correct activity duration data)
- 82.3% (if not remove "problematic" trips)
- They are all consistent - I'm using unweighted data for following analysis.

Household Workers

- More workers, higher % for OH NM
- HH with 2 workers and 3 workers are about the same.

Household Size	OH NM %	OH NM %	OH NM %
1	12%	10%	12%
2	12%	10%	12%
3	12%	10%	12%

Household Non-Working Adults (not include retiree)

- If a household has no non-working adults, the household is less likely to engage NM activity during weekday due to time constraint for mandatory activity.

Person Type	OH NM %	OH NM %
0	10.3%	10.3%
1	12.3%	12.3%
2	12.3%	12.3%
3	12.3%	12.3%

Household Retiree

- Higher % for making OH NM trip if no retiree in a household

OH NM %	OH NM %	OH NM %
0	12.3%	12.3%
1	10.3%	10.3%
2	12.3%	12.3%

Household Child

- % for OH NM activity is higher if 1) more kids in household, or 2) kids are older (more NM activities)

OH NM %	OH NM %	OH NM %
0	12.3%	12.3%
1	10.3%	10.3%
2	12.3%	12.3%

Household Vehicles

- % is higher if more cars

OH NM %	OH NM %	OH NM %
0	10.3%	10.3%
1	12.3%	12.3%
2	12.3%	12.3%
3	12.3%	12.3%
4	12.3%	12.3%

Household Income

- Higher income → higher %

OH NM %	OH NM %	OH NM %
0	10.3%	10.3%
1	12.3%	12.3%
2	12.3%	12.3%
3	12.3%	12.3%
4	12.3%	12.3%

Household with Mandatory Activity

- Used by stage-1 model
- % is lower if no mandatory activity
- Pattern is not clear for mandatory activity duration; needs to include other variables.

OH NM %	OH NM %	OH NM %
0	10.3%	10.3%
1	12.3%	12.3%
2	12.3%	12.3%
3	12.3%	12.3%
4	12.3%	12.3%

Other Variables

- No significant pattern for employment density (total and local-service), household density (in 3 miles), and non-motorized mode accessibility to NM activity.

Model Test for Joint Effect - V1

OH NM %	OH NM %	OH NM %
0	10.3%	10.3%
1	12.3%	12.3%
2	12.3%	12.3%
3	12.3%	12.3%
4	12.3%	12.3%

Model Test for Joint Effect - V2

OH NM %	OH NM %	OH NM %
0	10.3%	10.3%
1	12.3%	12.3%
2	12.3%	12.3%
3	12.3%	12.3%
4	12.3%	12.3%

Model Test for Joint Effect - V3

OH NM %	OH NM %	OH NM %
0	10.3%	10.3%
1	12.3%	12.3%
2	12.3%	12.3%
3	12.3%	12.3%
4	12.3%	12.3%

Summary

- Household member composition tends to have significant effect on the activity making for OH NM activity. The model test is consistent with data analysis
- HH vehicles 2-4 has similar coeff - can be combined
- Local-employment density (3 miles) performs better than accessibility

Model 4.2.2: Activity Duration Allocation

Introduction

- This model predicts the total time that a household spends in out-of-home activities, exclusive of travel time and mandatory activity time.
- The model applies only to households that participate in out-of-home activities (outcome of M 4.2.1).
- It takes the form of a fractional split model that allocates the total available time among in-home activities, out-of-home non-mandatory activities, and travel time.
- Total available time is exclusive of time spent in mandatory activities, that is, for each person total available time is 24 hours minus time spent in work and school.

Basic Data

- On average, 72% of total household time staying at home; 11.5% for NM activity; 6% for travel, and 10.9% for Mandatory activity.

Activity Type	OH NM %	OH NM %	OH NM %
0	10.3%	10.3%	10.3%
1	12.3%	12.3%	12.3%
2	12.3%	12.3%	12.3%
3	12.3%	12.3%	12.3%
4	12.3%	12.3%	12.3%

By Household Size

- Overall, % in home is between 65% - 77%
- % non-mandatory time and travel time reduces with larger Hh size (shared duties)
- % Mandatory time increases with larger Hh size; should be examined with #workers.

OH NM %	OH NM %	OH NM %
0	10.3%	10.3%
1	12.3%	12.3%
2	12.3%	12.3%
3	12.3%	12.3%
4	12.3%	12.3%

Basic Data for This Model

- Total (100%) does not include activity duration for mandatory activity - (140k Hh size - Mandatory Time)
- On average, 80.7% of times staying at home; 12.6% for NM activity; 6.7% for travel.

OH NM %	OH NM %	OH NM %
0	10.3%	10.3%
1	12.3%	12.3%
2	12.3%	12.3%
3	12.3%	12.3%
4	12.3%	12.3%

Household Size

- With larger Hh size, % in home increases and % of for travel and NM activities decreases.

OH NM %	OH NM %	OH NM %
0	10.3%	10.3%
1	12.3%	12.3%
2	12.3%	12.3%
3	12.3%	12.3%
4	12.3%	12.3%

Household Vehicles

- Households without a car tend to spend more time on travel, while % time spent for NM activity is lower.

OH NM %	OH NM %	OH NM %
0	10.3%	10.3%
1	12.3%	12.3%
2	12.3%	12.3%
3	12.3%	12.3%
4	12.3%	12.3%

Household Income

- Household with higher income tend to have higher % NM activity time and travel time.

OH NM %	OH NM %	OH NM %
0	10.3%	10.3%
1	12.3%	12.3%
2	12.3%	12.3%
3	12.3%	12.3%
4	12.3%	12.3%

Analysis with Multiple Variables 1

- Using regression to examine how variables are associated with % Hh OH NM activity time.
- Larger hsize → lower %; Higher hh income → higher % (consistent with prior analysis)

OH NM %	OH NM %	OH NM %
0	10.3%	10.3%
1	12.3%	12.3%
2	12.3%	12.3%
3	12.3%	12.3%
4	12.3%	12.3%

2. Model Review

Review model estimated by consultants

Based on HTS analysis, examine the reasonableness of:

- Model assumption
- Variable definition
- Explanatory variables

3. Model Re-estimate

Based on model review, enhance/re-estimate a model if needed.

- Consultants:
 - Provide training
 - Provide estimation data and script
- Staff:
 - Revise estimation data
 - Re-estimate the model

4. Software Implementation

- Prepare model specification to software developer
- Feedback from software developer
- Staff learn software coding
- Model output analysis

5. Model Validation

- Staff create validation target
 - Household Survey
 - ACS
 - Other data – CTPP, ATUS, ...
- Model calibration / validation

SCAG Experience

- We started the assessment procedure in Aug, 2014.
- About 80% of models have been reviewed and re-estimated.
- All completed by SCAG staff.
- A painful procedure, but worth it.
- Understand the model much better.

Conclusion

- The model assessment is a useful procedure for agency staff for ABM development.
- Greatly enhance the understanding of this complicated model.

Thank you Question?

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