



# Work Sampling

---

Sections:

1. How Work Sampling Works – **part 1**
2. Statistical Basis of Work Sampling – **part 2**
3. Application Issues in Work Sampling – **part 3**
  - 3.1 Defining the Activity Categories
  - 3.2 Work Sampling Forms
  - 3.3 Scheduling Observation Times
  - 3.4 Advantages and Disadvantages of Work Sampling



# Work Sampling

---

## ***3. Application Issues in Work Sampling***



## Application Issues in Work Sampling

---

- Work sampling must be custom-designed for specific problem it is intended to address
- But general steps summarized in Table 1 (*reading assignment # 2*)
- We will focus here on following WS steps/issues:
  1. defining the activity categories (Table 1 – 4)
  2. work sampling forms (Table 1 – 5.a)
  3. scheduling the observation times (Table 1 – 5.d)



## 3.1 Defining the Activity Categories

---

- Activity categories must be:
  - Consistent with objectives of study
  - Immediately recognizable by observer
  - Mutually exclusive (each category distinguishable from others)
- If output measures are included in study,
  - activity categories must correlate with those measures (e.g. 3 outputs  $\Rightarrow$  3 categories)
  - activity categories must be defined for specific study being conducted



## 3.1 Defining the Activity Categories

---

- Number of activity categories:
  - Helpful to limit number of categories to  $\leq 10$
  - Fewer categories,
    - $\Rightarrow$  higher average value:  $\hat{p}_k$
    - $\Rightarrow$  reduce variances and improve confidence levels
    - Also:  $\Rightarrow$  observer's task: easier (fewer choices about the state of subject)
    - $\Rightarrow$  less confusion and fewer mistakes in classifying observed state



## 3.1 Defining the Activity Categories

---

Examples of possible activity categories for various types of work

---

**TABLE 2** Possible Activity Categories for a Work Sampling Study on Machinists in a Small Lot Job Shop

---

Category	Description
1. Plan	Worker is studying engineering drawing in preparation for new job.
2. Setup	Worker is setting up machine tool for new job.
3. Run production	Worker is running machine tool in production of parts.
4. Cleanup	Worker is cleaning up machine tool and immediate work area.
5. Wait	Worker is waiting for materials, tools, instructions from foreman, etc.
6. Personal	Worker is taking personal time, rest break, or coffee break, conversing with coworker.
7. Away	Worker is not at machine, not in sight.

---



## 3.1 Defining the Activity Categories

Examples of possible activity categories for various types of work

**TABLE 3** Possible Activity Categories for a Work Sampling Study on Office Workers

Category	Description
1. Key punching at computer terminal	Each desk is equipped with a personal computer. Worker is involved with the operation of a computer.
2. Writing at desk	Worker is filling out paper forms, or engaged in similar paperwork.
3. Filing	Worker is at central file area, performing either storage or retrieval tasks.
4. Telephone	Worker is using telephone.
5. Walking	Worker is walking within office area.
6. Conversing	Worker is conversing with coworker, supervisor, or customer in office.
7. Personal	Worker is taking personal time, rest break, coffee break, etc.
8. Away	Worker is not at desk, not in office.



## 3.2 Work Sampling Observation Form

---

- Forms in WS study must be designed specifically for given study
- Each study is different from all others in
  - activity categories
  - subjects
  - total number of observations,
  - and time period
- Form must be:
  - easy and convenient to use
  - enable making snap readings of subject(s)
  - enable quick recording of data







## 3.3 Scheduling the Observation Times

---

- Total # of observations in WS study
  - usually large (several thousand)
  - # must be reduced to schedule of observations
  - randomizing observation times ⇒
    - improves statistical accuracy
    - reduces bias



## 3.3 Scheduling the Observation Times

---

- Method 1 of randomization:
  - randomize times throughout entire study period
  - e.g. 1
    - 10 subject machines
    - 500 observations
    - $\Rightarrow$  total of  $500/10 = 50$  rounds during one-week period
    - 50 rounds: randomized throughout 5 days
    - $\Rightarrow$  10 rounds per day (on average)
    - Note, some days can have more rounds, other days fewer



## 3.3 Scheduling the Observation Times

---

- Method 2 of randomization:
  - use principle of **sampling stratification\***:
    - total # of observations divided into specified # of time periods (e.g. days, 1/2-days, hrs)
    - equal # of samples taken in each period
  - In e.g. 1:
    - 5-day period
    - 10 randomized observation rounds/day
    - Further step : 5 randomized observations each 1/2-day (e.g., 5: morning, 5: afternoon)
      - $\Rightarrow$  reduce variance in WS study
      - Also: more convenient for observers



## 3.3 Scheduling the Observation Times

---

- Random numbers:
  - converted to clock times during time period of interest (e.g., shift)
  - e.g. use random number 248 as 2:48 p.m.
  - then re-sequenced into chronological order
- Random time devices
  - Determine random times during study period
  - Sampling times: automatically determined
  - Sampling time interval: several minutes to several hours
  - Beeper: provides audible beep at sampling time



## e.g. 5: Random Observation Times

---

### **Example 5** Generation of Random Observation Times for Work Sampling

For the machine utilization example, generate the schedule of 10 observation times for the first day. The shift hours are 8:00 A.M. to noon, then 1:00 P.M. to 5:00 P.M.

**Solution:** A set of three digit numbers were randomly generated from a uniform distribution between 1 and 999 using Excel (seed number = 193). The first 18 numbers generated were as follows: 021, 542, 865, 804, 023, 488, 587, 743, 570, 722, 308, 118, 431, 465, 337, 605, 229, 325. Conversion of these numbers into clock times is accomplished using the following rules: (1) numbers with first digits = 8, 9, 1, 2, 3, and 4 are read directly as the clock hour, (2) numbers with first digits = 0 and 6 are read as clock hours 10 and 11, respectively, (3) numbers with first digits = 5 and 7 are discarded, (4) numbers with second digits 6 through 9 are discarded. The results of the conversion are presented in Table 4. The converted times are then resequenced into chronological order to yield the following schedule of observation times for the first day: in the morning: 8:04, 10:21, 10:23, and 11:05; and in the afternoon: 1:18, 2:29, 3:08, 3:25, 3:37, and 4:31.





cont. e.g. 5:

**TABLE 4** Conversion of Random Numbers into Observation Times in Example 5

Random Number	Conversion to Clock Time	Random Number	Conversion to Clock Time	Random Number	Conversion to Clock Time
021	10:21	587	Discarded	431	4:31
542	Discarded	743	Discarded	465	Discarded
865	Discarded	570	Discarded	337	3:37
804	8:04	722	Discarded	605	11:05
023	10:23	308	3:08	229	2:29
488	Discarded	118	1:18	325	3:25



## 3.4 Advantages of Work Sampling

---

- Can be used to measure activities that are impractical to measure by direct observation
- Multiple subjects can be included
- Requires less time and lower cost than continuous direct observation
- Training requirements less than DTS or PMTS
- Less tiresome and tedious on observer than continuous observation
- Subject in WS: less demanding than being watched continuously for a long time





## 3.4 Disadvantages and Limitations

---

- Not as accurate for setting time standards as other work measurement techniques
- Usually not practical for studying single subject
- Work sampling provides less detailed information about work elements than DTS or PMTS
- Since work sampling deals with multiple subjects, individual differences will be missed
- Workers may be suspicious because they do not understand the statistical basis of work sampling
- Behavior of subjects may be influenced by the act of observing them