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How Much Work Are You Really Doing?

Introduction

The published teaching schedule is often an embarrassment to both faculty and administration because it suggests that a full time faculty member is working eight or perhaps twelve hours each week and seven months a year. We try to sell the idea that the remaining time is spent on "preparation", but no one seems to be buying. This paper offers a method of determining workload based on evaluation of process time for all the activities associated with teaching. Analysis is based on classic methods of work measurement, specifically the use of a system of predetermined times. New methods are presented for analysis of common tasks such as grading. Using these methods, a statement of process time in the form of a distribution rather than a point estimate is developed. As an exercise, the impact on workload due to a change in course content and teaching methods is examined. As an example of the possible extension of these techniques, a method of determining student workload and its effect on student success is presented.

What is Work?

There is a motto that I have found to be particularly inspiring when I think about the Economics of everyday life. "Naked came I into the world and Naked shall I leave it, and nothing have I to barter my way but my attention and my time." The motto inspires me because, as an Industrial Engineer, I am in the business of appropriately placing people in the workplace. Sometimes I have an opportunity (rare) to design a workplace around the capabilities of the employees. I am employed because I have the ability to determine how long a job should take and what skills a person needs to do the job and a list of other things too long to include here. The one thing they all have in common is *time* and the ability to deliver somebody's *attention* to the job. The one thing they all have in common is work!

In the century and a quarter that we have been in business, Industrial Engineers have come to understand very well how to measure, allocate and manage work of certain types. We find ourselves less capable with work of other types because, perhaps, we lack the appropriate tools. But when it comes to "pure service work" like teaching, we seem to be "clueless". It's not that work isn't there. A day at teaching will leave anyone fatigued. The requirement to maintain a pace can cause a degree of tension that may limit the quality of the product. The need to engage in other time-consuming activities may cause an "operator" to reduce the amount of time that is voluntarily added to the production task. An employer will expect a certain level of productivity out of a teaching staff although with "productivity" we have yet another key concept that everyone understands but nevertheless seems to evade definition. Surely there is enough here to whet the engineer's appetite. Perhaps the biggest obstacle is that, for good reasons, we don't want to know how much work we're really doing.

Perhaps if we assemble the proper tools we can find a way. Three tools will be necessary to start, a good model, some comfortable ethical principles and a toolbox filled with the principles of good old fashioned work measurement. The first step is to develop a model

The Job Model

Academia changed about half a century ago from what I shall call the "Ancient" model to the Corporate model. During the age of the Ancient model, a faculty member lived close to the college and was on campus all the time. Students came to school to be enlightened through contact with the faculty. Faculty mentored and advanced exceptional students. The Administration provided the infrastructure to permit the Student-Faculty relationship to proceed efficiently. Faculty did research and published for recognition and because research identifies the profession. Most of the time, students went to graduate school because they wanted to teach college.

Under the Corporate Model Faculty members are more like day workers. Students come to school to get a diploma (the paper chase). Students are enlightened by studying for tests and writing papers. Contact (with the faculty) can be very light indeed! Faculty members "pay" students with grades for the privilege of contact! Students see grades as payment for time they spend on the course. They feel cheated if they don't get good grades regardless of how long they actually work at it and how much they have learned. Exceptional students receive A's. But students who get into college have been told they are exceptional since the first grade. This certainly warps the education plane. The administration is the sole provider of all good to both faculty and students. Faculty members do research to obtain grants to do more research. At first tenure and promotion may be strong motivators, but as motivators they are self-limiting. Students go to graduate school to get an advanced diploma that converts to more pay.

The one area where the ancient model is retained in the presence of the corporate model is in the area of supervision. The task of the supervisor is to assure that an employee works the time expected and at the speed expected and has enough work to do and enough resources to use the time allocated. The only job in industry that functions at the basic level without real supervision is a job on an assembly line and that's because the machine is the supervisor. On the assembly line, the person identified as supervisor becomes a combination of coach and water boy. The machine doesn't really need much help.

This brings us to the first fiat in the model. It is management's job to provide the work. An assembly line worker is paid to keep up with the line. A perfectly balanced line is impossible, and random delays happen in all processes. This means that everyone experiences some time when there is no work to do. Management accepts that this available time can be spent (wasted) as idle time. Occasionally someone tries to hand out brooms etc. but work rules usually prohibit working out of classification. Elsewhere in the corporate model, a supervisor finds work for the employees to do, but for assembly lines and Faculty there are no supervisors.

A faculty member has no official source for assignment of work beyond the assignment of a teaching schedule: a course and a meeting time and place. As a professional, the faculty member will recognize an ethical responsibility to find valuable work to do. The place, time and content of this self-assigned activity is usually at the option of the faculty member. It is in all respects a voluntary activity and I shall identify the time given to these activities as VAT for Voluntary Activity Time. The time required for work in support of required activities will be RAT for Required Activity Time.

I choose to define *Salary Time* as the total amount of time our employer expects that we will be available to perform our duties. In most industrial cases salary time is associated with a work schedule that encompasses all the time a worker is expected to be available. A production worker, for example will be expected, on specified days, to "punch in" by a certain time (and not much before) and punch out by a certain time (and not line up at the clock). A service worker will be expected to be available during "business hours" usually at a particular location. Usually absences or short days will be easily noticed. Supervisors pay particular notice to the amount of time a worker is available, often more notice than is paid to the nature or the quality of the work performed.

Teaching Faculty follow radically different general work rules from those used to control assembly line or standard white collar work. The demand for our work varies in the extreme as we pass through the different periods of the academic year for which we are paid to be present. There is also considerable variability among the different colleges in this respect. I would like to use, as a running example, the 2005-06 academic year at a hypothetical local institution which is, in many respects, similar to my own college, and offer a schedule like my current schedule as a case. Ole State is one of the State Colleges in a state-sponsored system that includes research universities, community colleges and privates with a number of different orientations. Regardless of the institution involved, the principles discussed are fundamental and I believe this means that the techniques discussed here are universally applicable.

The Structure of the Model

Ole (old) State is an industrial enterprise. The university strives to keep all our facilities in use throughout the year and to be paid for their use. Most faculty members are on a 10 month contract. The focus of the work is, of course, delivery of selected enlightenment to a number of selected students. For a thousand years or so, this has been done primarily by having one or more teachers meet with a number of students for a number of hours a few times each week. For nearly the same amount of time we have realized that successful enlightenment also happens when students teach themselves or teach each other. In order to make this work, faculty members must support organization and implementation of this out-of-class effort. Hence class assignments that require review, tests that must be graded and occasional small group tutoring or review that must be sponsored, and also office and advisement time all become part of the Faculty member's responsibilities: those specific things that bring a bi-weekly check. We must add to this an activity that supports both the student and society. Come hell or high water, we must develop a grade for each student!

Let's say that Ole State is an undergraduate-only comprehensive institution offering a number of ABET-accredited Engineering courses. Without support from graduate programs (there aren't any), the faculty assumes execution of all aspects of support for the teaching activity. A full teaching load at Ole State usually involves teaching three sections, each scheduled at three contact hours per week. Laboratory courses are independent and carry a different load allocation. Teaching Faculty members must allocate about two hours of office time per week. By union-inspired institution rules, faculty may be scheduled for a maximum of three preparations per semester. This once imposed a severe scheduling limitation on management, but with a structural change in the curriculum introduced several years ago, it is no longer an issue.

A Practical Time Demand Model

Under the Corporate Model, a faculty member contracts to provide service to the institution during a particular calendar period. Ole State is buying my time through the period from August 31 through June 29. In my case, my entire obligation is to perform work in the area of teaching undergraduates and supporting the infrastructure. We can capture the scope of a faculty member's obligation by settling on how much of the time within this period we owe to the University. Of course, the University does not own us 24-7 for the entire ten months. In order to find a basis for calculating work time available, I undertook a little research. After discussions with a number of faculty members, I was surprised to find broad support for the idea that a week's pay should be understood to be pay for 40 hours' availability. For my pay, Ole State is buying 1,704 hours of the total 5,112. Ethically, what I do with the remainder is my business.

To earn the 1704 hours of salary time, all the work I do that is not specifically assigned by management is voluntary. Ethically, I am compelled to make good use of this time on activities of interest to the Institution. Time that is being spent on work and has not been assigned by management as Required Activities must be considered to be work on Voluntary Activities. If voluntary activities are routinely channeled to the interests of the College and the Students, then the available Voluntary Activity Time (VAT) could be an indicator of institutional quality. The ratio of VAT to Required Activity Time (RAT) could become an index to excellence!

Figure 1 displays a breakdown of the contract year into four periods. Except for support of Infrastructure, Students provide all the demand for my contract services. For most of our faculty, RAT is generated only when students are present. Notably, even support of infrastructure is usually done when classes are in session. Faculty members are usually not present on campus when the campus is not needed to support their voluntary activities. When students are not present we are paid for VAT, and because there is no possible RAT demand I call this Invincible VAT. With Figure 1 we can identify the part of the contract year during which RAT demand is available.

				Full Load Contact Hrs
Fall Term:	Aug 31 – Dec 20	80 Days	28 Class Meetings	42.0
Inter Term:	Dec 21 – Jan 17	6 Days	VAT only	
Spring Term:	Jan 18 - May 5	78 Days	27 Class Meetings	40.5
Post Term:	May 8 – June 29	27 Days	VAT only	
		Total Salary Time	213 Days	1704 Hours
		Invincible VAT	33 Days	264 Hours

Figure 1: A Time Availability Breakdown for the Contract Period.

Ethical Considerations in Modeling Faculty Load

In Figure 1, we see that I have an obligation to be available to do 1,704 hours of work for my pay. The work that I am required to deliver is of two kinds. My primary effort is in teaching, but equally important is support of infrastructure. If I wish to have an activity count as RAT, it is important that the University sanction the performance of work. For example, if I am elected faculty representative to the University Board of Trustees, then the institution will expect me to attend all meetings of the board and my assigned committees. In planning I should count the time as RAT. But there is a legitimate standing rule that teaching comes first. This means that if in performing Board duties I strike a conflict with my teaching responsibilities, I must find a way to fulfill both. Also, the University acting through the Dean or the Provost should assist me in resolving the conflict. For workload accounting purposes, I should not "double dip" on any overlapping RAT. I am also a member of the board of a Symphony Orchestra not affiliated with the college. Since my work here is not of interest to the University, it should not be part of the budget. Also, during the contract period, schedule conflicts must be resolved in favor of the University RAT activities.

The issue of faculty research provides another area of ethical interest. If I am offered released time to conduct an activity, then I should use the contact time for a course equivalent to the released load as a basis. For example, if I am given one course equivalent of released time, I should apply 42 hours (28 * 1.5) per academic year to the RAT budget in the name of the activity. I should also expect to spend at least 42 hours on the job. Regardless of whether I receive released time for a sanctioned activity or not, I should use Work Measurement techniques to estimate the time commitment associated with the activity. This is especially important for project type activities because inappropriate allocation of time to perform (scheduling) can often lead to procrastination and ultimately inability to deliver by deadlines.

Budgeting Work Time

Figure 2 presents a load budget for my Fall 2005 schedule. Assume that I was assigned three sections of the same course. The course is fully developed in that it requires no preparation other than familiarization before each class meeting. There were 25 students assigned to each section. The classes met in daytime. Students were primarily Juniors and Seniors. The class is open to the entire campus and is very popular among Engineers.

Instructor Workload

Activity RAT	166	Sections	3
Contact RAT	126	Class Size	25
Total RAT	292	Cycles Total Students	75

Salary Time	640
VAT	348
VAT % of Salary Time	54
RAT/VAT	0.84

Activity (Student Support)	Units Are	Units	Min per Unit	Cycles	Time Required (HR)
Pop Quiz Type 1	Questions	35	0.071	75	3.11
Pop Quiz Type 1	Questions	35	0.071	75	3.11
Pop Quiz Type 1	Questions	35	0.071	75	3.11
Midterm Part 1	Questions	50	0.071	75	4.44
Midterm Part 2	Questions	5	1.5	75	9.38
Design Project Report	Pages	10	1	75	12.50
Design Project Item	Item Eval	1	5	75	6.25
Ethics Case Study	Pages	10	2.5	75	31.25
Short Report 1	Pages	4	2.5	75	12.50
Short Report 2	Pages	4	2.5	75	12.50
Final Exam Part 1	Questions	50	0.071	75	4.44
Final Exam Part 2	Questions	5	1.5	75	9.38
Office Hours	Occurrence	1	60	28	28.00
Class Preparation	Occurrence	1	30	28	14.00
Registration Support	Occurrence	1	15		
Other RAT Activity					
Department & School Meeting	Occurrence	1	120	3	6.00
Union Meeting	Occurrence	1	90	3	4.50
Honors and Awards Committee	Occurrence	1	60	2	2.00

Figure 2: Load Budget for Fall 2005

The Load Budget provides a comprehensive picture of the effect of various sources of demand on an instructor's load for an entire semester. A system of predetermined times currently under development is used to generate the values found in the *Min per Unit* column. The rest of the form is a very simple EXCEL worksheet model.

Figure 3 shows that Total RAT is 292 hours or 46% of Salary Time for the fall semester. This seems small, but because of the unevenness of demand, workload becomes unsustainable around midterm. Without a presentation schedule this will not be apparent, but during weeks 7 and 8 a number of grading activities come together. There is an understanding in my class that all graded materials will be returned within 3 class meetings from the date submitted. Clearly a RAT of 50 hours in one week cannot be supported, especially during a high social-demand period. The solution might be to simply apologize for being late by a week in returning the Design Project. Fortunately, the problem was revealed in the planning stage and the due date of the Design Project submittal was delayed by one week.

Date Issued	Activity	Load	Due Week
Week 7:	Pop Quiz 2	3.11	8
Week 7:	Midterm	13.82	8
Week 8	Design Project	18.75	7
8:	Union Meeting	2	8
8:	Committee	2	8
7, 8:	Office Hrs	2	8
7,8:	Class Prep	2	7, 8
7,8:	Contact	6	7, 8
	TOTAL RAT	~50	

Figure 3: Summary of a Demand Log Jam

The Load Budget can also be used to assess the effect of proposed changes in policy related to faculty load. For example, almost every semester, demand difficulties will cause the Registrar to cancel a number of sections after registration opens and try to redistribute students into sections of other courses that meet at the same time. Suppose I am asked to add five students each to the three sections I am teaching. Referring to the Load Budget, I find that at 25 students per section the RAT is 292 hours. At 30 students, the RAT becomes 315 hours, an increase of 24 hours or a little less than 2 hours per week. In other words, the addition of fifteen students will increase my weekly workload by about 2 hours. The RAT/VAT ratio does not exceed 1.0 and I feel assured that I can handle the increased load without difficulty. If we can find enough seats, the students are welcome. Of course, ethically I am obliged to offer all my VAT hours to the cause. The University is paying for them. Nevertheless, this is a no-notice change and I believe that, historically, I use my VAT very well. In more oppressive circumstances I might reduce my workload by dropping some of the assignments or change grading methods. The Load Budget could help me immensely in this but such an action could seriously diminish the course. That would produce a new type of Ethical problem.

Student Workload

Students have been bragging about how little they study for at least as long as the corporate model for higher education has been in existence. The younger they are, the more they brag. Faculty have been bragging about how much they load up a course with homework, and it seems the younger *they* are the more they brag. With the students there isn't much of a problem because, conforming to the Industrial model, they are grade and not enlightenment-driven and very prone to lie, and to brag about falsehoods. With faculty there *is* a problem! Faculty members often really do go overboard with assignments. How many times have we heard "She thinks her course is the only one I'm taking," spoken with a sense that this is an original thought, until the student realizes the four of the five instructors on stage this term are acting in exactly the same manner. Inevitably there is an 'interest collapse" on both sides and, for the students, the bragging becomes less and less a lie. We need to require an analysis of student workload with every syllabus and with the help of Figure 4, I propose to demonstrate how it can be done.

Student Workload

Available Hr	140
Committed Hr	137.0
Uncommitted Hr	3.0

Activity (Student Support)	Units Are	Units	Min per Unit	Cycles	Time Required (HR)
Monitor Films 1	Occurrence	20	30	1.2	12.0
Monitor Films 2	Occurrence	2	60	1	2.0
Reading Assignmts	Chapters	12	45	1	9.0
Computer Research	Occurrence	10	60	1	10.0
Other Research	Occurrence	10	60	1	10.0
Midterm					5.0
Design Project					10.0
Ethics Case Study					15.0
Short Report 1					6.0
Short Report 2					6.0
Final Exam					10.0
Contact	Class Mtg	28	90	1	42.0

Figure 4: Student Workload Analysis

As with assessment of faculty load, the process of assessing student workload should begin with an agreement on available hours. A popular rule of thumb is 3 hours for each semester hour outside the major and 5 hours inside the major. For an engineer carrying 16 semester hours of basic load with 2 in engineering, 1 in math and 1 in general education the time the student must make available for preparation is 64 hours per week. Add to this the 12 contact hours associated with 4 courses and the student is expected to devote 76 hours per week to education. If you are confused with some of these numbers, please note that we are still using Ole State to supply the data for our model and at Ole State, 4 credit hours relates to 3 contact hours.

There are at least two things wrong with this model. First, how does it make sense to call for more study for persons inside the major and less for those outside? A course is a course. Shouldn't the amount of study be tied to the amount of time necessary for a person to master the content and shouldn't that be less for a person with background in the major? The second problem is with the total time. We haven't been requiring a person to work 74 hours per week since the ten hour day-7 day work week of the 1880's and prior. In 1880 the job with these work rules was probably in the mines.

The workload analysis of Figure 4 is built on the model that holds all courses equal. It is based on the 40 hour work week, the same standard that we apply to a faculty. Predetermined Times analysis will apply as heavily in developing the Student Workload Analysis as it did for the Instructor Workload Analysis. *Films 1* refers to a set of 20 films that the student must view during the term. They run 27 minutes each and can be stopped and rewound if necessary. Hence the assignment of 1.2 cycles per view and a calculated 12 hours to view the series. The times assigned to items in the test and report series are based on estimates. The analysis necessary to provide these values as standard data has not yet been done. The Reading Assignment load data was based entirely on a time study performed as part of a new method being advanced by this author. Some details on the application of this new technique will be discussed in the next section of this report.

The Student Workload Analysis reveals that a student who performs the study function as expected will commit 137 hours to the mastery of the goals of the course. Under the 40 hour rule, the student has 14 weeks available through a commitment of 10 hours per week. This is based on a standard 4 course registration.

The Ideal Program of Study

The Instructor Load Budget and the Student Workload Analysis can be worthy tools in extending our effort from analysis of or design of a single course to development of the architecture of an entire program. Enlightenment in a particular field can be seen as a process sequence where the process is an element of a learning plan. Each of these learning elements brings the student from a less advanced to a more advanced level of knowledge on some topic. A single-semester course might be designed to exercise three or four learning elements.

Because the amount of time a student has available is always limited, Student Workload Analysis could be a key tool in designing the learning element. Courses and course sequences would be designed by cutting and trying the fit of learning elements. Designing an academic program could come to resemble balancing a transfer line where instructor load and student load are balanced simultaneously by changing content and noting the effect on process time.

As on-line education of various forms grows in sophistication, engineering program architecture will come more and more to depend on properly conceived learning elements. Two hours of "chalk and talk" followed by three hours of problem-solving in simulated reality will likely be adequately replaced by a lesson in which a student is machine-guided and grilled for about two hours. Learning elements could be made easily portable and whole academic programs could be reorganized or updated by changes in or replacement of individual learning elements.

A New Approach to Process Analysis

The analysis that yielded the predetermined time factors used in figures 2 and 4 makes use of a powerful new method for analyzing process time observations. A new distribution has been developed by the author for use in statistical analysis of process flow information.

The new FG distribution is defined in terms of its Cumulative Probability Function (CPF):

$$ {}_{FG}F(x) = e^{\left(-\left(\frac{M-X}{M-G}\right)^{k}\right)} \qquad \begin{array}{l} 0 \leq X < M \\ 0 \leq G < M \\ 0 < k \end{array} $$

Here, X is the random variable, M is the maximum value attainable (actually, the minimum value unattainable) G is the location parameter and k is the shape parameter. The Probability Density Function (PDF) is obtained by taking the derivative of the CPF (${}_{FG}$ f(x)). Observation data is processed using a complex procedure based on the Maximum Likelihood Estimator. The PDF form of the FG Distribution changes shape from what looks like a negative exponential form when $k < 1$ to the exponential when $k=1$ to form similar to that shown in Figure 5 for $k > 1$. As k increases in value the curve tightens horizontally. The form shown below represents a k of about 1.5. If k exceeds 10 the curve at the mode appears more like a spike. If you refer to the CPF form (${}_{FG}$ F(x) shown in the definition) you may notice that the value ${}_{FG}$ F(g) is always 0.3678~ regardless of the value of k.

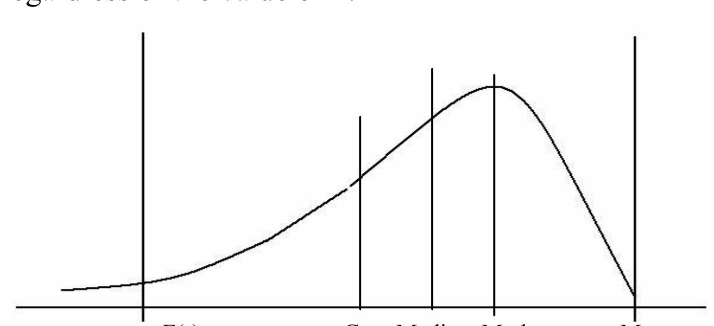

Figure 5: The PDF form of the FG Distribution ${}_{FG}$ f(x)

Work measurement data that is commonly output from time studies can be converted to rate of flow format by simply taking the reciprocal of the elapsed time data. That is, if the data is presented in the Time domain: 3 minutes per piece, it readily converts to the Frequency or Flow domain at: 20 pieces per hour.

Analysis of Reading Time

Sort by: Prime=Pace Rating

Par	Sec	Words	Pace		Second	Session	Calculated Rate (word/min) Reading
36	74	300	**C**		**2**	**C**	243.24
38	54	212	C		2	C	235.56
40	89	394	C		2	C	265.62
41	37	158	C		2	C	256.22
43	62	224	C		2	C	216.77
44	10	59	C		2	C	354.00
46	26	136	C		2	C	313.85
48	59	246	C		2	C	250.17
37	31	179	C			C	346.45
39	42	174	C			C	248.57
42	28	116	C			C	248.57
45	25	156	F	H	2	C	374.40
5	31	166	F	H		A	321.29
21	27	142	**F**	**H**		**B**	315.56
40	61	394	F	H		C	387.54
44	9	59	F	H		C	393.33

→ (row 36) Pace C: Read for Content. An entry of 2 under Second means that the paragraph was skimmed immediately before it was read for content or read for content before skimming. The entry indicates this piece was read during the third reading session (Morning)

→ (row 21) Entry indicates paragraph was skimmed at a high pace, the time value was for an unprepared reading and it was done during session B, in the evening (tired).

Figure 6: Analysis of Reading Times (Observation Data)

Figure 6 presents a segment of the data developed in conjunction with a time study exercise. An 1100 word printed article was read and the time required to read each paragraph was measured. The reader was instructed to use a variety of techniques that would be expected to affect speed such as skimming and reading for content. The reader timed himself and provided a coded remark which identified his impression of the pace actually used in reading the paragraph. The result of this analysis is shown in Figure 7.

Analysis of Reading Time

Entry	Pace		Second	Session	Max	k	G	$F(_0)$	Mode	Median	Values
1	C			C	500	7.40	249.21	0.00	244	261	6
2	F	H			500	4.04	353.10	0.00	329	366	6
3	F	L		A	500	9.64	253.10	0.00	250	262	8
4	F	L		C	500	6.43	275.77	0.00	269	288	9
5	F		2		500	3.26	374.18	0.00	334	388	4
6	F				500	5.66	278.14	0.00	269	292	38
7	F			C	500	5.49	283.15	0.00	273	297	5
8	M				500	31.40	244.47	0.00	244	247	5
9	C		2	C	500	7.56	250.49	0.00	246	262	8
					450	5.80	251.21	0.00	243	263	8
					400	3.94	252.75	0.00	235	266	8
					360	2.02	257.66	0.00	184	275	8
10	C Combined			C	500	7.49	249.93	0.00	245	262	14
11	F Combined				500	6.11	273.25	0.00	265	286	47

Figure 7: Analysis of Reading Time (Calculation of FG Parameters)

Figure 7 provides the information necessary to make use of the time study data. Entries 1 thru 9 provide results for the various work pace levels, 10 and 11 provide generalized results. Entries 10 and 11 were developed by combining the appropriate sets of data. In general Data can be combined when G or its equivalent, Median, are close. The range of the values for k is not important. It is possible to obtain very useful information from analysis of very small data sets. This is because k and G are calculated through the mathematics of the Maximum Likelihood Estimator. Parameters are not estimated by a secondary calculation. Data Average and Standard Deviation are not used at all in the calculation. The Median value, taken from the calculated FG curve, is used as the estimator for performance. The average value of the data set is not used for anything in the analysis. The parameter Max must be independently determined and not inferred from the data. For work measurement tasks Max means the *slowest* pace that can *never* be achieved in the work situation (from the definition formula: $X < Max$). An easier definition for reading and understanding is "A little more than the fastest pace attainable". The value 500 was used in all analyses except for the demonstration set in Entry 9. A number of reading systems claim reading speeds in the high 400's and there is one case our data where a reading speed of 430 words per minute is achieved.

Choice of Max is a serious activity. The entries in 9 reflect the result of analysis of the same data set. Max is the only parameter whose value is changed. The highest observed pace value in the data set chosen for demonstration is *342*. A major change can be seen in the calculated value of k as different values are chosen for Max. This will not be important for interpretation of the analysis unless we wish to evaluate the quality of the experiment design. In general, data that is consistent with a hypothesis can be expected to calculate to a high value of k. Much more important to a work measurement exercise is that *G*, and therefore *Median* change, but not enough to discredit the analysis. Whenever the analysis of related activities is performed, it is important to use the same value for Max to assure consistent results.

If tables of predetermined times are developed, the value of Median should be provided for use as a point estimate. The values of G and k should be provided to permit use in simulation, and the design of the table should relate the various controlling conditions in such a way that all would use the same value for Max. Of course these controlling conditions should be carefully explained and the value for Max should be reported. Note that significant variation in the value of Max between workplaces should be a prime indicator of significant difference in infrastructure.