TAUBER INSTITUTE
FOR GLOBAL OPERATIONS
UNIVERSITY OF MICHIGAN

WDI PUBLISHING

note 1-429-242
July 2, 2012

Note on Waiting Lines: Variability, Utilization, and Inventory

Introduction

All real-life service systems exhibit some degree of variability in both input process (inter-arrival times) and service process (service times). We observe those processes and describe them statistically in terms of their means (***a***, ***p***) and standard deviations (σ_a, σ_p). With this information, and the number of service channels (***m***), we can predict the expected steady-state wait time for service, T_q – the average ***T***ime spent by an item in ***q***ueue waiting to be served. Using this information, and applying Little's Law which states that Inventory = Rate * Time, we can compute other system performance measures for use in making system design and improvement decisions. So, by measuring and computing just 5 basic system values, we can predict with a high level of accuracy how the service system will perform in its base state, and how that performance will change in response to managerial actions.

"Waiting Lines: Variability, Utilization, and Inventory: Spreadsheet" (ID: 1-429-243) accompanies this note and can be used to learn more about the VUT equation, and to experiment with applying it to real-life service systems.

Variability-Utilization-Service Time (VUT) Equation

In words:

Average wait time for service endured by customers (or items) is determined by the product of three terms:

- A variability term computed from the squared coefficients of variation (standard deviation divided by the mean) of inter-arrival and service times
- A utilization term computed from inter-arrival and service times and the number of service channels
- And the average service time.

Published by WDI Publishing, a division of the William Davidson Institute (WDI) at the University of Michigan.