Elektrotehnički fakultet univerziteta u Beogradu

Performanse računarskih sistema

Domaći zadatak jul 2019/2020

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1. **Uvod**

Domaći zadatak je realizovan u programskom jeziku C# u okruženju Microsoft Visual Studio Community 2019. Klase su smeštene u prostor imena PRSProjekatJun2020. Klase: Program.cs, GordonNewell.cs, Buzen.cs, ThreadedSimulation.cs. Main metoda se nalazi u klasi Program.cs. Korišćena je pomoćna biblioteka MathNet.Numerics.dll, koja može biti preuzeta preko NuGet packages manager-a, verzija 4.11.0.

Opis sistema: Sistem se sastoji od centralnog servera, procesora (CPU u daljem tekstu), 3 sistemska diska (SD1, SD2, SD3 u daljem tekstu) i K korisničkih diskova (UD1, UD2, ..., UDk). K uzima vrednosti iz skupa {2, 3, 4, 5, 6, 7, 8}. Stepen multiprogramiranja (n) uzima vrednosti iz skupa {10, 15, 20}. Treba obraditi sve kombinacije K i n, gde je to neophodno.

1. **Analitičko rešenje**

Analitičko rešavanje zadatog problema se sastoji iz 2 faze: primena Gordon-Newell-ove metode za određivanje potražnje servera i primene Bjuzenove metode za određivanje: potražnji resursa, iskorišćenja resursa, protoka kroz resurse, prosečan broj poslova na svakom resursu, vreme odziva sistema i kritičan resurs sistema. Kasnije će se svi ovi parametri dobiti i simulacijom i uporedićemo analitičke rezultate i rezultate simulacije.

* 1. **Gordon-Newell**: Cilj je rešiti sistem linearnih jednačina sa 4 + K nepoznatih, za zadate verovatnoće prelaza (pij) i prosečna vremena obrade poslova na svakom od resursa (sij). Normalizacija je rađena u odnosu na procesor, tako da je potražnja CPU postavljena na 1, samim tim sistem postaje sistem sa 3 + K nepoznatih. Za smeštanje podataka sam koristio tipove Matrix<double> i Vector<double> iz biblioteke MathNet.Numerics, a za rešavanje sistema jednačine metodu Solve klase Matrix. Time smo dobili potražnje svih resursa (xi) koje ćemo upotrebiti u sledećem koraku.
  2. **Buzen**: U ovom koraku računamo preostale navedene parametre, za početak vektor G[n], na osnovu čijih vrednosti, a po formulama sa vežbi, određujemo ostale parametre.

Vektor G:

Iskorišćenje resursa:

Protok kroz resurse:

Prosečan broj poslova na resursu:

Vreme odziva:

Nakon izračunavanja svih parametara, rezultati se upisuju u odgovarajuće datoteke (stavka 1.1. u potraznje\_analiticki.txt, Stavka 1.2. u rezultati\_analitički.txt) i prosleđuju instancama klase Simulation radi upoređivanja vrednosti dobijenih simulacijom i analitičkim metodama.

1. **Simulacija**

U okviru simulacije se simulira rad datog sistema sa 4 + K resursa. Simulacija se simulira za sve vrednosti parametara K = {2, 3, 4, 5, 6, 7, 8} i n = {10, 15, 20}, dodatno za svako n, simulacija se ponavlja 10, 25 ili 100 puta, respektivno, radi usrednjavanja rezultata.

Simulaciji se prosleđuju prosečna vremena obrade resursa (si), verovatnoće prelaza (pij) i vreme izvršavanja simulacije, podrazumevana vrednost 1 dan, u minutima.

Pri inicijalizaciji se u prioritetni red dodaje po element koji predstavlja početni i krajnji trenutak izvršavanja svakog posla i svakom od njih je dodeljen centralni server (CPU). Iz prioritetnog reda se redom uzima prvi element i u zavisnosti od toga da li predstavlja početni ili krajnji trenutak, izvršavaju se različite akcije. Ukoliko je dohvaćen element koji opisuje početni trenutak, ažurira se red čekanja, broj izvršenih poslova, prosečan broj poslova i početno vreme trenutnog posla koji se izvršava na odgovarajućem serveru. Ukoliko je element koji opisuje krajnji trenutak, ažurira se vreme koje je posao proveo na serveru, prosečan broj poslova na serveru i računa se na koji će server sledeće otići taj posao u odnosu na tabelu verovatnoća prelaza dobijenu Gordon-Newell metodom. Početni trenutak izvršavanja posla na sledećem serveru se računa kao 1ms nakon što se završi poslednji posao u redu za taj server ili ukoliko je red prazan, 1ms nakon kraja izvršavanja na prethodnom (trenutnom) serveru. Krajnji trenutak se računa tako što se na početni trenutak doda slučajna promenljiva sa eksponencijalnom raspodelom. Ujedno se ažurira i red čekanja za server na koji ide posao. Svaki put kada se ažurira red za čekanje bilo kog servera, poziva se metoda UpdateN() koja na prosečan broj poslova svakog servera doda broj poslova koji čekaju u redu za taj server po jedan put za svaki momenat nakon prethodnog pozivanja ove metode i podatak kada je poslednji put pozvana se čuva u promenljivoj lastUpdatedTime. Prioritetni red je implementiran tako da se gleda vremenski trenutak u kom je zabeležen početni ili krajnji trenutak jednog posla i uredjen je u rastucem poretku.

Kada istekne vreme simulacije, obrađuju se podaci u metodi PrepareForWriting() i upisuju u odgovarajuće datoteke (nakon prve simulacije u rezultati\_simulacije.txt, nakon ponovljenih simulacija u rezultati\_simulacije\_usrednjeno\_txt).

1. **Odstupanje analitičkih od simuliranih rezultata**

Kada se izvrše sve ponovljene simulacije i rezultati upišu u odgovarajuće datoteke, metodom PrepareForDiviation se upoređuju rezultati dobijeni simulacijom i analitičkim putem i upisuju u odgovarajuće datoteke (razlika pojedinačnih simulacija u odstupanje\_simulacija.txt, rezultati ponovljenih simulacija u odstupanje\_simulacija\_usrednjeno.txt). U metodi PrepareForDiviation() se izračunava relativno odstupanje po formuli

|  |  |  |
| --- | --- | --- |
| K | N | Kritican resurs |
| 2 | 10 | UserDisk |
| 15 | UserDisk |
| 20 | UserDisk |
| 3 | 10 | UserDisk |
| 15 | UserDisk |
| 20 | UserDisk |
| 4 | 10 | CPU |
| 15 | CPU |
| 20 | CPU |
| 5 | 10 | CPU |
| 15 | CPU |
| 20 | CPU |
| 6 | 10 | CPU |
| 15 | CPU |
| 20 | CPU |
| 7 | 10 | CPU |
| 15 | CPU |
| 20 | CPU |
| 8 | 10 | CPU |
| 15 | CPU |
| 20 | CPU |

Tabela kritičnih resursa za svaku kombinaciju broja korisničkih diskova i poslova

1. Rezultati jedne simulacije

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| K | Jobs |  | CPU | SD1 | SD2 | SD3 | UD1 | UD2 | SD3 | SD4 | SD5 | SD6 | SD7 | SD8 |
| 2 | 10 | U | 5.49% | 1.86% | 0.98% | 0.93% | 1.64% | 1.84% |  |  |  |  |  |  |
| X | 4.29% | 4.38% | 4.24% | 4.29% | 4.25% | 4.35% |  |  |  |  |  |  |
| N | 12.05% | 0.26% | 3.01% | 3.13% | 13.01% | 13.84% |  |  |  |  |  |  |
| Response | 4.11% | | | | | | | | | | | |
| 15 | U | 6.51% | 0.56% | 0.42% | 0.14% | 0.58% | 0.68% |  |  |  |  |  |  |
| X | 3.12% | 3.15% | 2.97% | 3.22% | 3.06% | 3.20% |  |  |  |  |  |  |
| N | 15.23% | 1.89% | 4.69% | 4.30% | 8.58% | 9.08% |  |  |  |  |  |  |
| Response | 3.03% | | | | | | | | | | | |
| 20 | U | 6.74% | 0.12% | 0.30% | 0.31% | 0.34% | 0.22% |  |  |  |  |  |  |
| X | 2.90% | 2.86% | 2.98% | 2.91% | 2.92% | 2.81% |  |  |  |  |  |  |
| N | 16.22% | 2.52% | 4.47% | 4.42% | 6.90% | 6.04% |  |  |  |  |  |  |
| Response | 2.82% | | | | | | | | | | | |
| 3 | 10 | U | 3.40% | 3.90% | 3.05% | 3.15% | 3.89% | 3.76% | 3.69% |  |  |  |  |  |
| X | 6.53% | 6.61% | 6.58% | 6.60% | 6.61% | 6.48% | 6.44% |  |  |  |  |  |
| N | 6.42% | 3.12% | 0.05% | 0.04% | 14.17% | 13.87% | 13.61% |  |  |  |  |  |
| Response | 6.13% | | | | | | | | | | | |
| 15 | U | 4.90% | 2.28% | 1.44% | 1.43% | 2.40% | 2.29% | 2.31% |  |  |  |  |  |
| X | 4.95% | 4.94% | 4.95% | 4.98% | 4.99% | 4.91% | 4.89% |  |  |  |  |  |
| N | 13.22% | 1.41% | 1.58% | 1.63% | 12.35% | 11.88% | 12.09% |  |  |  |  |  |
| Response | 4.72% | | | | | | | | | | | |
| 20 | U | 5.22% | 1.72% | 1.30% | 1.27% | 1.98% | 1.90% | 2.05% |  |  |  |  |  |
| X | 4.61% | 4.49% | 4.68% | 4.65% | 4.63% | 4.57% | 4.60% |  |  |  |  |  |
| N | 18.22% | 0.89% | 1.58% | 1.83% | 12.33% | 11.49% | 12.56% |  |  |  |  |  |
| Response | 4.40% | | | | | | | | | | | |
| 4 | 10 | U | 1.95% | 5.43% | 4.78% | 4.64% | 5.44% | 5.37% | 5.40% | 5.56% |  |  |  |  |
| X | 8.19% | 8.20% | 8.28% | 8.12% | 8.24% | 8.12% | 8.15% | 8.25% |  |  |  |  |
| N | 2.14% | 5.72% | 2.55% | 2.35% | 13.22% | 13.05% | 13.06% | 13.34% |  |  |  |  |
| Response | 7.57% | | | | | | | | | | | |
| 15 | U | 2.69% | 4.54% | 3.83% | 3.90% | 4.69% | 4.55% | 4.61% | 4.77% |  |  |  |  |
| X | 7.36% | 7.38% | 7.36% | 7.35% | 7.29% | 7.29% | 7.37% | 7.44% |  |  |  |  |
| N | 8.31% | 5.08% | 1.87% | 2.05% | 14.34% | 13.81% | 13.72% | 14.42% |  |  |  |  |
| Response | 6.86% | | | | | | | | | | | |
| 20 | U | 2.12% | 5.20% | 4.47% | 4.38% | 5.36% | 5.31% | 5.23% | 5.39% |  |  |  |  |
| X | 7.97% | 7.94% | 7.92% | 7.97% | 8.02% | 7.91% | 7.95% | 7.97% |  |  |  |  |
| N | 11.89% | 6.49% | 3.01% | 2.90% | 18.60% | 18.13% | 18.11% | 18.18% |  |  |  |  |
| Response | 7.38% | | | | | | | | | | | |
| 5 | 10 | U | 1.20% | 6.53% | 5.46% | 5.40% | 6.35% | 6.36% | 6.35% | 6.28% | 6.33% |  |  |  |
| X | 9.03% | 9.15% | 8.99% | 9.04% | 8.95% | 9.05% | 9.03% | 9.00% | 9.06% |  |  |  |
| N | 0.54% | 7.65% | 3.73% | 3.72% | 12.32% | 12.11% | 12.15% | 12.05% | 12.02% |  |  |  |
| Response | 8.28% | | | | | | | | | | | |
| 15 | U | 1.40% | 6.13% | 5.24% | 5.19% | 6.29% | 6.17% | 6.13% | 6.11% | 5.93% |  |  |  |
| X | 8.77% | 8.66% | 8.81% | 8.78% | 8.90% | 8.75% | 8.80% | 8.74% | 8.68% |  |  |  |
| N | 4.41% | 7.83% | 4.10% | 4.03% | 14.45% | 13.71% | 13.84% | 13.82% | 13.33% |  |  |  |
| Response | 8.06% | | | | | | | | | | | |
| 20 | U | 0.62% | 6.97% | 6.12% | 6.03% | 6.95% | 6.94% | 6.76% | 6.75% | 7.02% |  |  |  |
| X | 9.64% | 9.64% | 9.65% | 9.56% | 9.66% | 9.59% | 9.53% | 9.55% | 9.72% |  |  |  |
| N | 5.60% | 9.97% | 5.52% | 5.46% | 17.19% | 17.18% | 16.62% | 16.83% | 17.84% |  |  |  |
| Response | 8.79% | | | | | | | | | | | |
| 6 | 10 | U | 0.71% | 6.65% | 6.26% | 5.86% | 7.07% | 6.73% | 6.87% | 6.91% | 6.83% | 6.97% |  |  |
| X | 9.54% | 9.47% | 9.72% | 9.52% | 9.65% | 9.41% | 9.43% | 9.63% | 9.47% | 9.62% |  |  |
| N | 2.44% | 8.20% | 4.94% | 4.42% | 11.39% | 10.54% | 11.08% | 11.12% | 10.87% | 11.00% |  |  |
| Response | 8.71% | | | | | | | | | | | |
| 15 | U | 0.75% | 6.71% | 5.96% | 5.65% | 6.66% | 6.71% | 6.83% | 6.68% | 6.75% | 6.78% |  |  |
| X | 9.51% | 9.40% | 9.56% | 9.47% | 9.51% | 9.51% | 9.62% | 9.47% | 9.53% | 9.38% |  |  |
| N | 1.70% | 9.36% | 5.09% | 4.85% | 12.23% | 12.32% | 12.64% | 11.85% | 12.15% | 12.47% |  |  |
| Response | 8.68% | | | | | | | | | | | |
| 20 | U | 0.20% | 7.64% | 6.44% | 6.55% | 7.40% | 7.32% | 7.29% | 7.14% | 7.30% | 7.43% |  |  |
| X | 10.09% | 10.29% | 10.05% | 10.13% | 10.15% | 10.12% | 10.06% | 9.93% | 10.02% | 10.14% |  |  |
| N | 2.41% | 11.18% | 6.04% | 6.40% | 14.53% | 14.25% | 14.05% | 14.16% | 14.46% | 14.68% |  |  |
| Response | 9.17% | | | | | | | | | | | |
| 7 | 10 | U | 0.42% | 7.03% | 6.35% | 6.45% | 7.08% | 7.28% | 7.21% | 7.05% | 7.30% | 7.09% | 7.13% |  |
| X | 9.86% | 9.86% | 9.95% | 9.93% | 9.93% | 9.94% | 9.89% | 9.78% | 9.87% | 9.82% | 9.88% |  |
| N | 3.71% | 8.88% | 5.19% | 5.24% | 9.88% | 10.24% | 10.09% | 9.70% | 10.09% | 9.79% | 10.15% |  |
| Response | 8.98% | | | | | | | | | | | |
| 15 | U | 0.45% | 7.28% | 6.12% | 6.36% | 7.02% | 7.08% | 7.08% | 7.35% | 7.15% | 6.93% | 7.02% |  |
| X | 9.82% | 9.97% | 9.76% | 9.73% | 9.72% | 9.86% | 9.76% | 9.96% | 9.78% | 9.77% | 9.87% |  |
| N | 0.20% | 10.16% | 5.42% | 5.73% | 10.97% | 11.00% | 10.78% | 11.62% | 11.00% | 10.59% | 10.96% |  |
| Response | 8.94% | | | | | | | | | | | |
| 20 | U | 0.08% | 7.39% | 6.81% | 6.71% | 7.61% | 7.66% | 7.53% | 7.55% | 7.50% | 7.47% | 7.45% |  |
| X | 10.23% | 10.21% | 10.29% | 10.19% | 10.33% | 10.39% | 10.23% | 10.23% | 10.19% | 10.15% | 10.11% |  |
| N | 0.85% | 10.85% | 6.72% | 6.54% | 12.48% | 12.51% | 12.39% | 12.30% | 12.35% | 12.21% | 12.16% |  |
| Response | 9.28% | | | | | | | | | | | |
| 8 | 10 | U | 0.24% | 7.29% | 6.48% | 6.23% | 7.30% | 7.18% | 7.40% | 7.11% | 7.30% | 7.36% | 7.22% | 7.28% |
| X | 10.04% | 9.99% | 10.12% | 9.90% | 10.07% | 9.92% | 10.06% | 9.98% | 10.12% | 10.13% | 10.04% | 10.04% |
| N | 4.65% | 9.44% | 5.45% | 5.19% | 9.18% | 9.03% | 9.23% | 8.88% | 9.22% | 9.33% | 9.07% | 8.99% |
| Response | 9.13% | | | | | | | | | | | |
| 15 | U | 0.30% | 7.41% | 6.25% | 6.32% | 7.27% | 7.29% | 7.20% | 7.17% | 7.50% | 7.41% | 7.14% | 7.37% |
| X | 9.97% | 10.01% | 9.88% | 9.82% | 9.93% | 9.98% | 10.03% | 9.97% | 10.13% | 10.00% | 9.74% | 10.07% |
| N | 0.74% | 10.56% | 5.69% | 5.81% | 10.08% | 9.92% | 9.74% | 9.73% | 10.39% | 10.15% | 9.58% | 10.00% |
| Response | 9.07% | | | | | | | | | | | |
| 20 | U | 0.04% | 7.53% | 6.97% | 6.70% | 7.83% | 7.33% | 7.55% | 7.46% | 7.58% | 7.62% | 7.63% | 7.57% |
| X | 10.30% | 10.33% | 10.51% | 10.28% | 10.42% | 10.13% | 10.29% | 10.32% | 10.22% | 10.18% | 10.33% | 10.34% |
| N | 0.05% | 11.21% | 6.71% | 6.51% | 11.19% | 10.38% | 10.94% | 10.63% | 10.70% | 10.74% | 10.78% | 10.73% |
| Response | 9.33% | | | | | | | | | | | |

1. Rezultati usrednjenih simulacija

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| K | Jobs |  | CPU | SD1 | SD2 | SD3 | UD1 | UD2 | SD3 | SD4 | SD5 | SD6 | SD7 | SD8 |
| 2 | 10 | U | 5.46% | 1.81% | 0.85% | 0.93% | 1.71% | 1.75% |  |  |  |  |  |  |
| X | 4.29% | 4.33% | 4.25% | 4.33% | 4.27% | 4.31% |  |  |  |  |  |  |
| N | 12.00% | 0.39% | 3.22% | 3.13% | 13.35% | 13.51% |  |  |  |  |  |  |
| Response | 4.11% | | | | | | | | | | | |
| 15 | U | 6.51% | 0.60% | 0.25% | 0.21% | 0.62% | 0.64% |  |  |  |  |  |  |
| X | 3.15% | 3.12% | 3.12% | 3.16% | 3.15% | 3.17% |  |  |  |  |  |  |
| N | 15.17% | 1.88% | 4.41% | 4.36% | 8.74% | 8.89% |  |  |  |  |  |  |
| Response | 3.06% | | | | | | | | | | | |
| 20 | U | 6.81% | 0.27% | 0.56% | 0.51% | 0.27% | 0.29% |  |  |  |  |  |  |
| X | 2.82% | 2.82% | 2.82% | 2.83% | 2.81% | 2.82% |  |  |  |  |  |  |
| N | 16.39% | 2.25% | 4.72% | 4.66% | 6.41% | 6.58% |  |  |  |  |  |  |
| Response | 2.74% | | | | | | | | | | | |
| 3 | 10 | U | 3.48% | 3.87% | 3.00% | 3.05% | 3.87% | 3.87% | 3.86% |  |  |  |  |  |
| X | 6.49% | 6.50% | 6.54% | 6.50% | 6.49% | 6.51% | 6.49% |  |  |  |  |  |
| N | 6.67% | 3.04% | 0.07% | 0.02% | 14.03% | 14.02% | 13.97% |  |  |  |  |  |
| Response | 6.10% | | | | | | | | | | | |
| 15 | U | 4.84% | 2.40% | 1.57% | 1.61% | 2.40% | 2.40% | 2.38% |  |  |  |  |  |
| X | 4.99% | 4.98% | 5.02% | 5.01% | 4.99% | 5.00% | 4.99% |  |  |  |  |  |
| N | 13.16% | 1.41% | 1.48% | 1.44% | 12.11% | 12.04% | 12.05% |  |  |  |  |  |
| Response | 4.76% | | | | | | | | | | | |
| 20 | U | 5.25% | 1.94% | 1.11% | 1.10% | 1.96% | 1.95% | 1.94% |  |  |  |  |  |
| X | 4.53% | 4.52% | 4.54% | 4.53% | 4.54% | 4.53% | 4.52% |  |  |  |  |  |
| N | 18.46% | 1.02% | 1.87% | 1.86% | 12.32% | 12.26% | 12.18% |  |  |  |  |  |
| Response | 4.33% | | | | | | | | | | | |
| 4 | 10 | U | 2.03% | 5.38% | 4.56% | 4.61% | 5.46% | 5.41% | 5.41% | 5.44% |  |  |  |  |
| X | 8.10% | 8.06% | 8.11% | 8.09% | 8.11% | 8.09% | 8.09% | 8.12% |  |  |  |  |
| N | 2.32% | 5.67% | 2.25% | 2.31% | 13.39% | 13.26% | 13.22% | 13.35% |  |  |  |  |
| Response | 7.49% | | | | | | | | | | | |
| 15 | U | 2.71% | 4.66% | 3.76% | 3.86% | 4.68% | 4.66% | 4.68% | 4.66% |  |  |  |  |
| X | 7.34% | 7.34% | 7.31% | 7.34% | 7.34% | 7.33% | 7.34% | 7.32% |  |  |  |  |
| N | 8.37% | 5.30% | 1.82% | 1.93% | 14.28% | 14.07% | 14.11% | 14.01% |  |  |  |  |
| Response | 6.83% | | | | | | | | | | | |
| 20 | U | 2.14% | 5.32% | 4.45% | 4.46% | 5.32% | 5.32% | 5.31% | 5.32% |  |  |  |  |
| X | 7.97% | 7.98% | 7.97% | 7.98% | 7.98% | 7.99% | 7.97% | 7.97% |  |  |  |  |
| N | 12.03% | 6.76% | 3.00% | 3.06% | 18.50% | 18.42% | 18.40% | 18.35% |  |  |  |  |
| Response | 7.39% | | | | | | | | | | | |
| 5 | 10 | U | 1.20% | 6.33% | 5.46% | 5.40% | 6.37% | 6.35% | 6.35% | 6.31% | 6.30% |  |  |  |
| X | 9.01% | 9.01% | 9.03% | 8.98% | 9.00% | 9.03% | 9.04% | 9.01% | 9.02% |  |  |  |
| N | 0.55% | 7.40% | 3.69% | 3.67% | 12.23% | 12.14% | 12.19% | 12.13% | 12.04% |  |  |  |
| Response | 8.27% | | | | | | | | | | | |
| 15 | U | 1.39% | 6.08% | 5.20% | 5.21% | 6.11% | 6.11% | 6.10% | 6.12% | 6.06% |  |  |  |
| X | 8.78% | 8.78% | 8.76% | 8.78% | 8.81% | 8.79% | 8.79% | 8.78% | 8.76% |  |  |  |
| N | 4.32% | 7.84% | 3.97% | 4.02% | 13.85% | 13.68% | 13.67% | 13.75% | 13.61% |  |  |  |
| Response | 8.07% | | | | | | | | | | | |
| 20 | U | 0.63% | 6.96% | 6.10% | 6.09% | 6.96% | 6.96% | 6.94% | 6.93% | 6.93% |  |  |  |
| X | 9.65% | 9.66% | 9.66% | 9.65% | 9.65% | 9.65% | 9.64% | 9.62% | 9.64% |  |  |  |
| N | 5.71% | 9.80% | 5.51% | 5.53% | 17.44% | 17.37% | 17.38% | 17.39% | 17.32% |  |  |  |
| Response | 8.80% | | | | | | | | | | | |
| 6 | 10 | U | 0.71% | 6.77% | 5.99% | 6.08% | 6.89% | 6.82% | 6.73% | 6.96% | 6.82% | 6.86% |  |  |
| X | 9.55% | 9.50% | 9.56% | 9.60% | 9.57% | 9.53% | 9.48% | 9.64% | 9.54% | 9.55% |  |  |
| N | 2.47% | 8.32% | 4.53% | 4.66% | 11.03% | 10.98% | 10.80% | 11.14% | 10.90% | 10.97% |  |  |
| Response | 8.72% | | | | | | | | | | | |
| 15 | U | 0.75% | 6.81% | 5.89% | 5.90% | 6.77% | 6.77% | 6.77% | 6.79% | 6.78% | 6.80% |  |  |
| X | 9.49% | 9.49% | 9.49% | 9.48% | 9.48% | 9.48% | 9.48% | 9.49% | 9.50% | 9.49% |  |  |
| N | 1.76% | 9.22% | 5.06% | 5.14% | 12.44% | 12.29% | 12.36% | 12.37% | 12.36% | 12.40% |  |  |
| Response | 8.67% | | | | | | | | | | | |
| 20 | U | 0.20% | 7.42% | 6.54% | 6.56% | 7.41% | 7.39% | 7.42% | 7.38% | 7.40% | 7.40% |  |  |
| X | 10.11% | 10.13% | 10.13% | 10.14% | 10.13% | 10.10% | 10.12% | 10.09% | 10.09% | 10.10% |  |  |
| N | 2.48% | 10.76% | 6.24% | 6.29% | 14.64% | 14.53% | 14.62% | 14.50% | 14.59% | 14.51% |  |  |
| Response | 9.18% | | | | | | | | | | | |
| 7 | 10 | U | 0.43% | 7.13% | 6.30% | 6.25% | 7.16% | 7.14% | 7.16% | 7.15% | 7.16% | 7.20% | 7.14% |  |
| X | 9.87% | 9.86% | 9.89% | 9.85% | 9.90% | 9.83% | 9.90% | 9.86% | 9.84% | 9.91% | 9.88% |  |
| N | 3.71% | 9.03% | 5.08% | 5.01% | 10.04% | 9.94% | 10.02% | 9.92% | 10.00% | 10.05% | 10.02% |  |
| Response | 8.98% | | | | | | | | | | | |
| 15 | U | 0.45% | 7.13% | 6.23% | 6.28% | 7.12% | 7.11% | 7.09% | 7.11% | 7.14% | 7.12% | 7.10% |  |
| X | 9.82% | 9.83% | 9.82% | 9.83% | 9.81% | 9.82% | 9.81% | 9.81% | 9.84% | 9.84% | 9.84% |  |
| N | 0.22% | 9.91% | 5.62% | 5.75% | 11.12% | 11.02% | 10.96% | 11.01% | 11.05% | 11.04% | 11.04% |  |
| Response | 8.95% | | | | | | | | | | | |
| 20 | U | 0.08% | 7.57% | 6.67% | 6.69% | 7.54% | 7.53% | 7.51% | 7.51% | 7.50% | 7.52% | 7.54% |  |
| X | 10.25% | 10.28% | 10.25% | 10.27% | 10.25% | 10.25% | 10.23% | 10.22% | 10.23% | 10.22% | 10.26% |  |
| N | 0.84% | 11.09% | 6.49% | 6.53% | 12.33% | 12.32% | 12.25% | 12.28% | 12.26% | 12.34% | 12.33% |  |
| Response | 9.29% | | | | | | | | | | | |
| 8 | 10 | U | 0.26% | 7.32% | 6.46% | 6.44% | 7.27% | 7.30% | 7.36% | 7.32% | 7.35% | 7.35% | 7.35% | 7.27% |
| X | 10.04% | 10.05% | 10.02% | 10.04% | 9.97% | 10.05% | 10.06% | 10.05% | 10.09% | 10.07% | 10.05% | 10.01% |
| N | 4.60% | 9.46% | 5.41% | 5.37% | 9.06% | 9.13% | 9.19% | 9.09% | 9.15% | 9.25% | 9.26% | 9.08% |
| Response | 9.12% | | | | | | | | | | | |
| 15 | U | 0.30% | 7.31% | 6.42% | 6.39% | 7.28% | 7.31% | 7.28% | 7.31% | 7.32% | 7.30% | 7.29% | 7.25% |
| X | 10.00% | 10.01% | 10.02% | 9.97% | 10.00% | 10.01% | 10.01% | 10.04% | 10.01% | 9.97% | 9.98% | 9.99% |
| N | 0.76% | 10.33% | 5.95% | 5.95% | 9.97% | 9.95% | 9.86% | 9.90% | 9.93% | 9.92% | 9.89% | 9.92% |
| Response | 9.09% | | | | | | | | | | | |
| 20 | U | 0.04% | 7.64% | 6.73% | 6.72% | 7.59% | 7.59% | 7.57% | 7.56% | 7.56% | 7.54% | 7.58% | 7.60% |
| X | 10.29% | 10.34% | 10.31% | 10.31% | 10.30% | 10.29% | 10.29% | 10.27% | 10.27% | 10.26% | 10.29% | 10.30% |
| N | 0.06% | 11.24% | 6.58% | 6.61% | 10.77% | 10.76% | 10.70% | 10.69% | 10.68% | 10.68% | 10.73% | 10.73% |
| Response | 9.33% | | | | | | | | | | | |