# 1 Results

## 1.1 Single-Minded

**Single-Minded, Uniform Reward, Over Demanded, 20 bidders, 8 goods**

|  | Welfare | Revenue | EF | EFLoss | MC | MCLoss | Time | Winners |
|---|---|---|---|---|---|---|---|---|
| Huang et. al. | 0.9715 | 0.9715 | 0.0835 | 0.4142 | 0.0000 | 0.0000 | 0.0000 | 0.9651 |
| Guruswami et. al. Unl. Supply | 0.7924 | 0.7924 | 0.0000 | 0.0000 | 0.3778 | 0.3778 | 0.0004 | 0.7527 |
| LP greedy utilitarian | 0.9843 | 0.9843 | 0.0033 | 0.0051 | 0.1044 | 0.1625 | 0.0000 | 0.9716 |
| LP greedy egalitarian | 0.6492 | 0.6492 | 0.1991 | 0.2303 | 0.1312 | 0.2831 | 0.0000 | 0.9717 |
| LP optimal utilitarian | 1.0002 | 1.0002 | 0.0017 | 0.0022 | 0.0905 | 0.1421 | 0.1605 | 0.9917 |
| LP optimal egalitarian | 0.6712 | 0.6712 | 0.2063 | 0.2352 | 0.1096 | 0.2478 | 0.0576 | 1.0001 |

**Single-Minded, Uniform Reward, Under Demanded, 8 bidders, 8 goods**

|  | Welfare | Revenue | EF | EFLoss | MC | MCLoss | Time | Winners |
|---|---|---|---|---|---|---|---|---|
| Huang et. al. | 0.9958 | 0.9958 | 0.0059 | 0.0194 | 0.0000 | 0.0000 | 0.0000 | 0.9932 |
| Guruswami et. al. Unl. Supply | 0.6215 | 0.6215 | 0.0000 | 0.0000 | 0.7567 | 0.7567 | 0.0001 | 0.5168 |
| LP greedy utilitarian | 0.9984 | 0.9984 | 0.0000 | 0.0000 | 0.0196 | 0.0407 | 0.0000 | 0.9951 |
| LP greedy egalitarian | 0.8995 | 0.8995 | 0.0764 | 0.1115 | 0.0287 | 0.0782 | 0.0000 | 0.9952 |
| LP optimal utilitarian | 1.0000 | 1.0000 | 0.0000 | 0.0000 | 0.0185 | 0.0377 | 0.0301 | 0.9988 |
| LP optimal egalitarian | 0.9004 | 0.9004 | 0.0776 | 0.1126 | 0.0257 | 0.0718 | 0.0171 | 1.0000 |

**Single-Minded, Elitist Reward, Over Demanded, 20 bidders, 8 goods**

|  | Welfare | Revenue | EF | EFLoss | MC | MCLoss | Time | Winners |
|---|---|---|---|---|---|---|---|---|
| Huang et. al. | 0.9556 | 0.9556 | 0.0843 | 0.4199 | 0.0000 | 0.0000 | 0.0000 | 0.9648 |
| Guruswami et. al. Unl. Supply | 0.8745 | 0.8745 | 0.0000 | 0.0000 | 0.3778 | 0.3778 | 0.0004 | 0.7520 |
| LP greedy utilitarian | 0.9928 | 0.9928 | 0.0020 | 0.0040 | 0.0904 | 0.0883 | 0.0000 | 0.9709 |
| LP greedy egalitarian | 0.4171 | 0.4171 | 0.2004 | 0.3778 | 0.1291 | 0.3520 | 0.0000 | 0.9709 |
| LP optimal utilitarian | 1.0002 | 1.0002 | 0.0011 | 0.0028 | 0.0817 | 0.0775 | 0.1253 | 0.9836 |
| LP optimal egalitarian | 0.4296 | 0.4296 | 0.2083 | 0.3936 | 0.1074 | 0.3148 | 0.0572 | 1.0001 |

**Single-Minded, Elitist Reward, Under Demanded, 8 bidders, 8 goods**

|  | Welfare | Revenue | EF | EFLoss | MC | MCLoss | Time | Winners |
|---|---|---|---|---|---|---|---|---|
| Huang et. al. | 0.9960 | 0.9960 | 0.0052 | 0.0171 | 0.0000 | 0.0000 | 0.0000 | 0.9938 |
| Guruswami et. al. Unl. Supply | 0.7117 | 0.7117 | 0.0000 | 0.0000 | 0.7567 | 0.7567 | 0.0001 | 0.5197 |
| LP greedy utilitarian | 0.9993 | 0.9993 | 0.0000 | 0.0000 | 0.0185 | 0.0329 | 0.0000 | 0.9961 |
| LP greedy egalitarian | 0.8541 | 0.8541 | 0.0820 | 0.1492 | 0.0277 | 0.0806 | 0.0000 | 0.9959 |
| LP optimal utilitarian | 1.0000 | 1.0000 | 0.0000 | 0.0000 | 0.0179 | 0.0313 | 0.0294 | 0.9983 |
| LP optimal egalitarian | 0.8596 | 0.8596 | 0.0828 | 0.1504 | 0.0242 | 0.0711 | 0.0175 | 1.0000 |

## 1.2 Singleton

**Singleton, Uniform Reward, Over Demanded, 20 bidders, 14 goods**

|  | Welfare | Revenue | EF | EFLoss | MC | MCLoss | Time | Winners |
|---|---|---|---|---|---|---|---|---|
| Guruswami Envy-Free Approx. | 0.9532 | 0.8139 | 0.0000 | 0.0000 | 0.0889 | 0.0871 | 0.0000 | 0.9205 |
| LP greedy utilitarian | 0.9226 | 0.8007 | 0.0118 | 0.0174 | 0.1173 | 0.1191 | 0.0065 | 0.8857 |
| LP greedy egalitarian | 0.8768 | 0.7451 | 0.0494 | 0.0841 | 0.1435 | 0.1405 | 0.0065 | 0.8638 |
| LP optimal utilitarian | 0.9500 | 0.8201 | 0.0000 | 0.0000 | 0.0878 | 0.0879 | 0.0953 | 0.9151 |
| LP optimal egalitarian | 0.9058 | 0.7670 | 0.0386 | 0.0611 | 0.1159 | 0.1123 | 0.1435 | 0.8917 |

**Singleton, Uniform Reward, Under Demanded, 8 bidders, 15 goods**

|  | Welfare | Revenue | EF | EFLoss | MC | MCLoss | Time | Winners |
|---|---|---|---|---|---|---|---|---|
| Guruswami Envy-Free Approx. | 0.8615 | 0.7062 | 0.0000 | 0.0000 | 0.5850 | 0.5793 | 0.0000 | 0.7239 |
| LP greedy utilitarian | 0.8740 | 0.7614 | 0.0012 | 0.0018 | 0.5199 | 0.5467 | 0.0054 | 0.7541 |
| LP greedy egalitarian | 0.8675 | 0.7475 | 0.0036 | 0.0064 | 0.5336 | 0.5521 | 0.0047 | 0.7441 |
| LP optimal utilitarian | 0.8770 | 0.7528 | 0.0000 | 0.0000 | 0.5228 | 0.5404 | 0.0806 | 0.7532 |
| LP optimal egalitarian | 0.8757 | 0.7511 | 0.0009 | 0.0013 | 0.5267 | 0.5429 | 0.0803 | 0.7518 |

**Singleton, Elitist Reward, Over Demanded, 20 bidders, 14 goods**

|  | Welfare | Revenue | EF | EFLoss | MC | MCLoss | Time | Winners |
|---|---|---|---|---|---|---|---|---|
| Guruswami Envy-Free Approx. | 0.8599 | 0.8224 | 0.0000 | 0.0000 | 0.4614 | 0.4586 | 0.0000 | 0.5471 |
| LP greedy utilitarian | 0.8643 | 0.8323 | 0.0042 | 0.0061 | 0.4260 | 0.4250 | 0.0064 | 0.5769 |
| LP greedy egalitarian | 0.8010 | 0.6667 | 0.0329 | 0.0914 | 0.3861 | 0.3674 | 0.0064 | 0.6201 |
| LP optimal utilitarian | 0.8718 | 0.8376 | 0.0000 | 0.0000 | 0.4256 | 0.4146 | 0.0954 | 0.5773 |
| LP optimal egalitarian | 0.8175 | 0.6770 | 0.0276 | 0.0753 | 0.3704 | 0.3520 | 0.1434 | 0.6360 |

**Singleton, Elitist Reward, Under Demanded, 8 bidders, 15 goods**

|  | Welfare | Revenue | EF | EFLoss | MC | MCLoss | Time | Winners |
|---|---|---|---|---|---|---|---|---|
| Guruswami Envy-Free Approx. | 0.8469 | 0.7644 | 0.0000 | 0.0000 | 0.7135 | 0.7044 | 0.0000 | 0.5358 |
| LP greedy utilitarian | 0.8729 | 0.8142 | 0.0007 | 0.0012 | 0.6214 | 0.6428 | 0.0054 | 0.6138 |
| LP greedy egalitarian | 0.8657 | 0.8006 | 0.0025 | 0.0042 | 0.6393 | 0.6474 | 0.0047 | 0.5970 |
| LP optimal utilitarian | 0.8704 | 0.8055 | 0.0000 | 0.0000 | 0.6338 | 0.6411 | 0.0805 | 0.5994 |
| LP optimal egalitarian | 0.8692 | 0.8039 | 0.0009 | 0.0013 | 0.6370 | 0.6428 | 0.0804 | 0.5980 |

## 1.3 Size-Interchangeable

**Size-Interchangeable, Uniform Reward, Over Demanded, 20 bidders, 3 goods**

|  | Welfare | Revenue | EF | EFLoss | MC | MCLoss | Time | Winners |
|---|---|---|---|---|---|---|---|---|
| Simple Pricing | 0.8476 | 0.5903 | 0.0028 | 0.0047 | 0.1827 | 0.1827 | 0.0007 | 0.7345 |
| LP greedy utilitarian | 0.8496 | 0.6220 | 0.0114 | 0.0240 | 0.0970 | 0.0889 | 0.0045 | 0.7353 |
| LP greedy egalitarian | 0.8476 | 0.6210 | 0.0041 | 0.0077 | 0.1020 | 0.0932 | 0.0039 | 0.7420 |
| LP optimal utilitarian | 0.8663 | 0.6323 | 0.0069 | 0.0153 | 0.1131 | 0.1055 | 0.2162 | 0.7559 |
| LP optimal egalitarian | 0.8581 | 0.6271 | 0.0027 | 0.0042 | 0.1189 | 0.1102 | 0.1430 | 0.7529 |

**Size-Interchangeable, Uniform Reward, Under Demanded, 3 bidders, 3 goods**

|  | Welfare | Revenue | EF | EFLoss | MC | MCLoss | Time | Winners |
|---|---|---|---|---|---|---|---|---|
| Simple Pricing | 0.9310 | 0.8621 | 0.0006 | 0.0005 | 0.4607 | 0.4607 | 0.0000 | 0.8804 |
| LP greedy utilitarian | 0.9457 | 0.8883 | 0.0110 | 0.0121 | 0.0906 | 0.0839 | 0.0008 | 0.8994 |
| LP greedy egalitarian | 0.9423 | 0.8845 | 0.0070 | 0.0067 | 0.0979 | 0.0898 | 0.0006 | 0.9038 |
| LP optimal utilitarian | 0.9526 | 0.8947 | 0.0087 | 0.0101 | 0.1433 | 0.1376 | 0.0774 | 0.9063 |
| LP optimal egalitarian | 0.9458 | 0.8876 | 0.0046 | 0.0040 | 0.1515 | 0.1445 | 0.0549 | 0.9064 |

**Size-Interchangeable, Elitist Reward, Over Demanded, 20 bidders, 3 goods**

|  | Welfare | Revenue | EF | EFLoss | MC | MCLoss | Time | Winners |
|---|---|---|---|---|---|---|---|---|
| Simple Pricing | 0.7969 | 0.6591 | 0.0012 | 0.0019 | 0.3857 | 0.3857 | 0.0007 | 0.4283 |
| LP greedy utilitarian | 0.8100 | 0.6934 | 0.0054 | 0.0112 | 0.2752 | 0.2330 | 0.0046 | 0.4594 |
| LP greedy egalitarian | 0.8107 | 0.6922 | 0.0022 | 0.0039 | 0.2754 | 0.2335 | 0.0039 | 0.4652 |
| LP optimal utilitarian | 0.8184 | 0.6977 | 0.0039 | 0.0088 | 0.2916 | 0.2503 | 0.2142 | 0.4715 |
| LP optimal egalitarian | 0.8149 | 0.6944 | 0.0016 | 0.0027 | 0.2954 | 0.2526 | 0.1428 | 0.4700 |

**Size-Interchangeable, Elitist Reward, Under Demanded, 3 bidders, 3 goods**

|  | Welfare | Revenue | EF | EFLoss | MC | MCLoss | Time | Winners |
|---|---|---|---|---|---|---|---|---|
| Simple Pricing | 0.9366 | 0.8834 | 0.0006 | 0.0003 | 0.4864 | 0.4864 | 0.0000 | 0.8407 |
| LP greedy utilitarian | 0.9516 | 0.9059 | 0.0089 | 0.0123 | 0.1153 | 0.1020 | 0.0008 | 0.8671 |
| LP greedy egalitarian | 0.9478 | 0.9019 | 0.0061 | 0.0065 | 0.1210 | 0.1057 | 0.0007 | 0.8689 |
| LP optimal utilitarian | 0.9555 | 0.9084 | 0.0080 | 0.0101 | 0.1676 | 0.1548 | 0.0789 | 0.8710 |
| LP optimal egalitarian | 0.9500 | 0.9028 | 0.0045 | 0.0044 | 0.1740 | 0.1597 | 0.0545 | 0.8710 |